DM

DIAGNOSIS MANUAL
COMMON RAIL SYSTEM

V2607-CR-E4B,V2607-CR-TE4B,
V2607-CR-TIE4B (DOC only),
V3307-CR-TE4B,
V3307-CR-TIE4B (DOC only)

Kubota

KiSC issued 03, 2015 A

Record of Revisions

For pdf, use search function {Search word} to find the all revised locations.

Last digit of the Code No.	Issue month	Main Revised Point and Corrective Measures {Search word}	Reference Page
1	2015.03	Added the information of V2607-CR-TIE4 / V3307-CR-TIE4 (DOC only)	

I INFORMATION

INFORMATION

CONTENTS

1. SAFETY FIRST I-1

1. SAFETY FIRST

⚠ SAFETY FIRST

- **This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and on labels on the machine itself to warn of the possibility of personal injury. Read these instructions carefully.**
- **It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.**

⚠ DANGER
- **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

⚠ WARNING
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

⚠ CAUTION
- **Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

■ IMPORTANT
- **Indicates that equipment or property damage could result if instructions are not followed.**

■ NOTE
- **Gives helpful information.**

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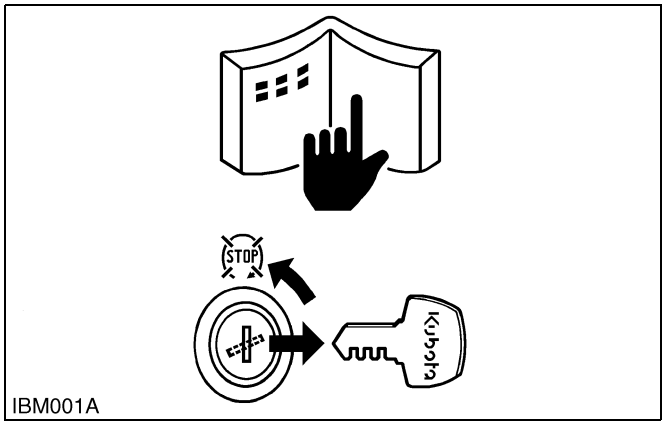
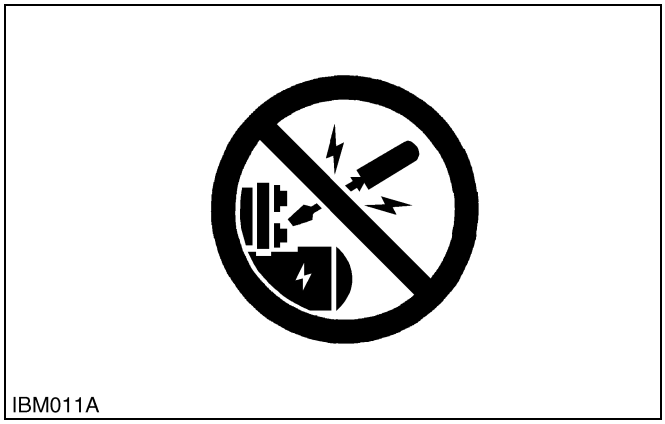


IBM001A


IBM011A

BEFORE SERVICING AND REPAIRING

- Read all instructions and safety instructions in this manual and on your machine safety decals.
- Clean the work area and machine.
- Park the machine on a firm and level ground.
- Allow the engine to cool before proceeding.
- Stop the engine, and remove the key.
- Disconnect the battery negative cable.
- Hang a **"DO NOT OPERATE"**tag in operator station.

9Y1200174INI0002US0

SAFETY STARTING

- Do not start the engine by shorting across starter terminals or bypassing the safety start switch.
- Unauthorized modifications to the engine may impair the function and / or safety and affect engine life.

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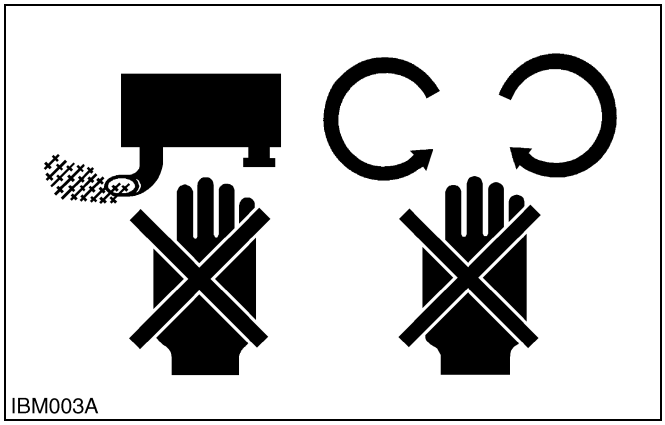
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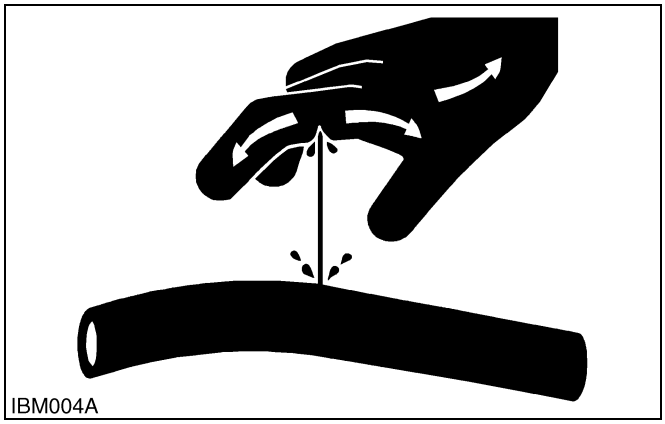
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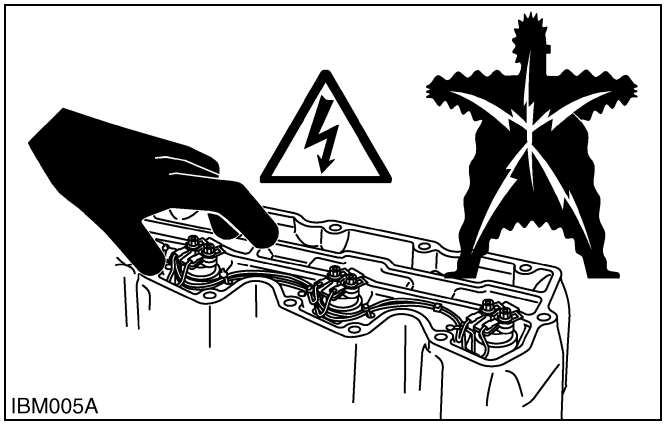
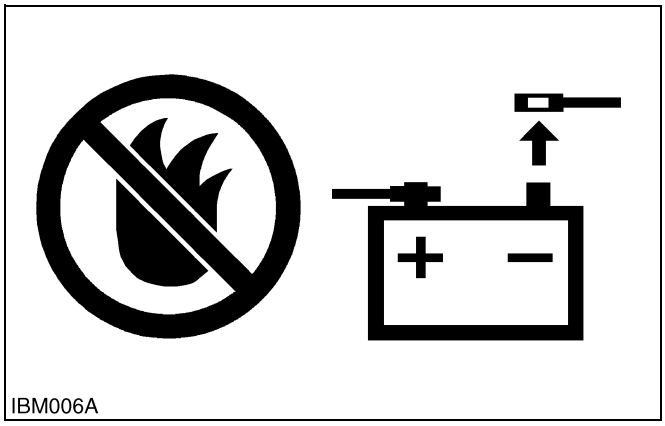

IBM005A


IBM006A

SAFETY WORKING

- Do not work on the machine while under the influence of alcohol, medication, or other substances or while fatigued.
- Wear close fitting clothing and safety equipment appropriate to the job.
- Use tools appropriate to the work. Makeshift tools, parts, and procedures are not recommended.
- When servicing is performed together by two or more persons, take care to perform all work safely.
- Do not touch the rotating or hot parts while the engine is running.
- Never remove the radiator cap while the engine is running, or immediately after stopping. Otherwise, hot water will spout out from radiator. Only remove radiator cap when cool enough to touch with bare hands. Slowly loosen the cap to first stop to relieve pressure before removing completely.
- Escaping fluid (fuel or hydraulic oil) under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or fuel lines. Tighten all connections before applying pressure.
- Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.
- Do not open high-pressure fuel system.
  High-pressure fluid remaining in fuel lines can cause serious injury. Do not disconnect or attempt to repair fuel lines, sensors, or any other components between the high-pressure fuel pump and injectors on engines with high pressure common rail fuel system.
- High voltage exceeding 100 V is generated in the ECU and injector.
  Pay sufficient caution to electric shock when performing work activities.

9Y1200174INI0004US0

AVOID FIRES

- Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- To avoid sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- Battery gas can explode. Keep sparks and open flame away from the top of battery, especially when charging the battery.
- Make sure that no fuel has been spilled on the engine.

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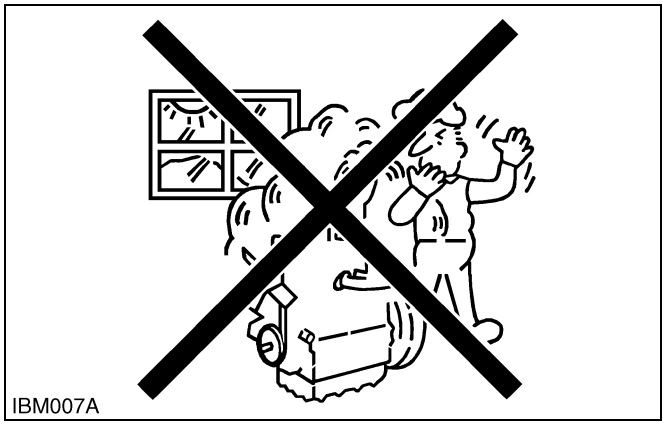
IBM007A

VENTILATE WORK AREA

- If the engine must be running to do some work, make sure the area is well ventilated. Never run the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.

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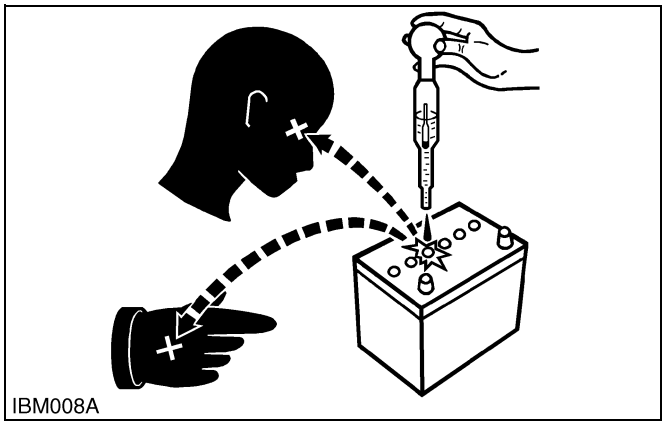
IBM008A

PREVENT ACID BURNS

- Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, clothing and cause blindness if splashed into eyes. Keep electrolyte away from eyes, hands and clothing. If you spill electrolyte on yourself, flush with water, and get medical attention immediately.

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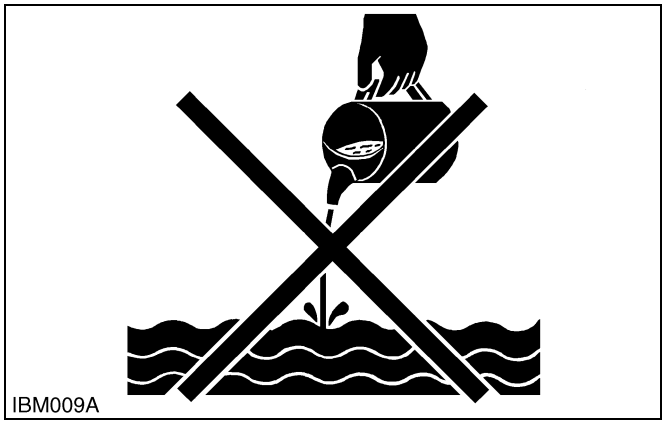
IBM009A

DISPOSE OF FLUIDS PROPERLY

- Do not pour fluids into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, electrolyte and other harmful waste.

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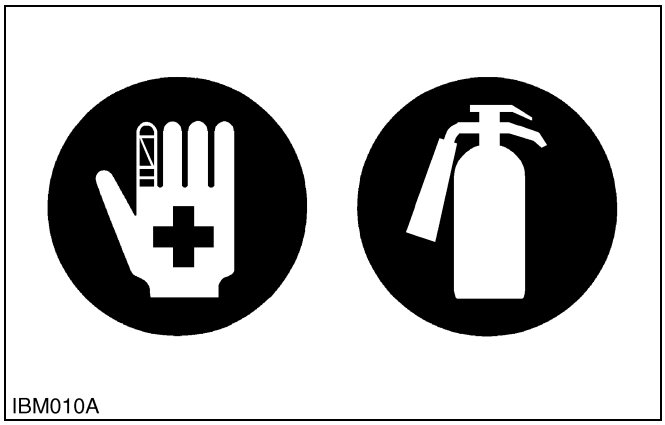

IBM010A

PREPARE FOR EMERGENCIES

- Keep a first aid kit and fire extinguisher handy at all times.
- Keep emergency numbers for doctors, ambulance service, hospital and fire department near your telephone.

9Y1200174INI0009US0

1 COMMON RAIL SYSTEM

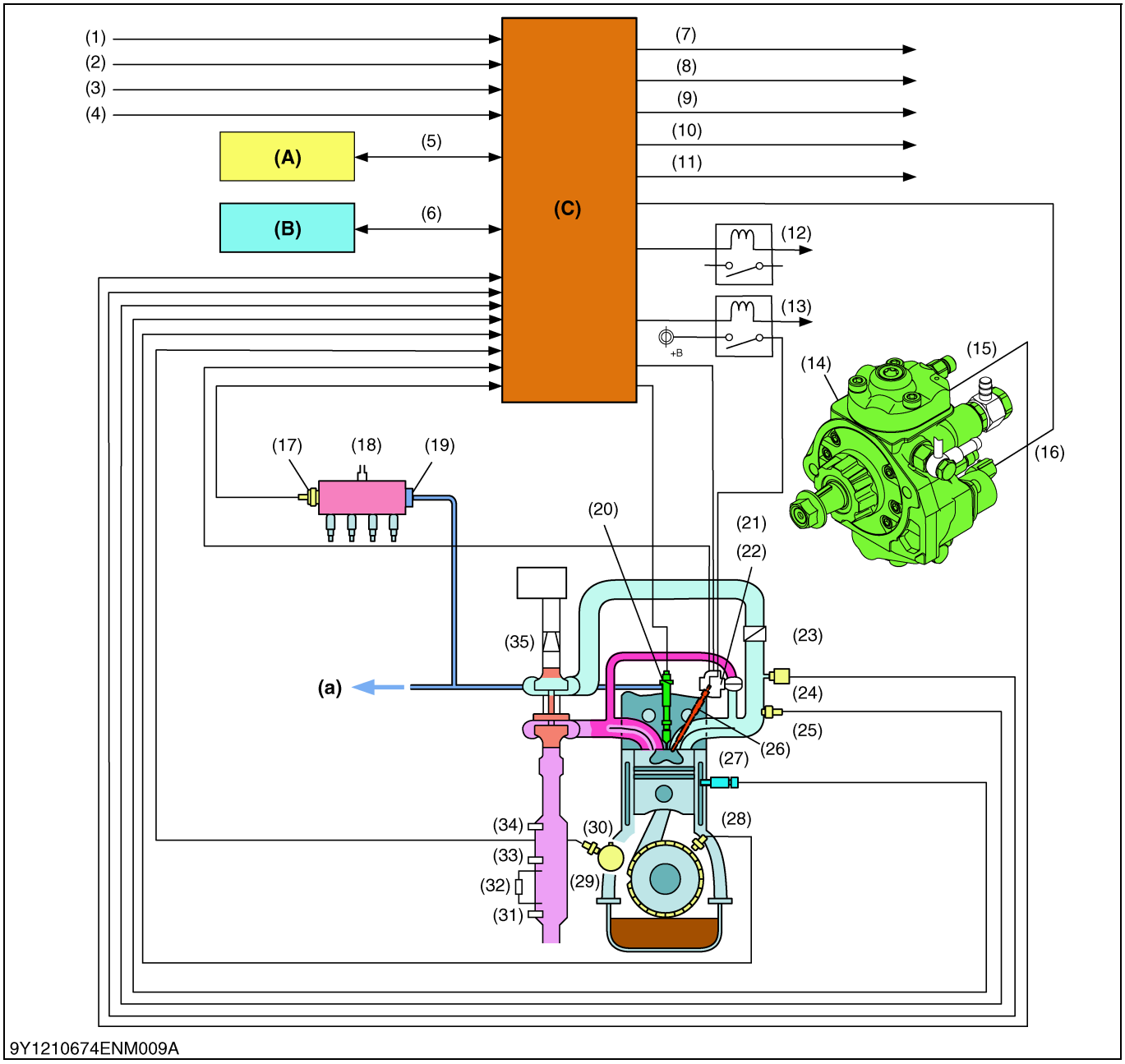
MECHANISM

CONTENTS

1. BASIC SYSTEM INFORMATION 1-M1
   [1] SYSTEM CONFIGURATION 1-M1
   [2] FUEL SYSTEM 1-M2
   [3] INTAKE AND EXHAUST SYSTEM 1-M3
   [4] WIRING DIAGRAM 1-M4
      (1) Engine Intermediate Harness (Engine Side Harness) 1-M4
      (2) Injector Intermediate Harness (Engine Side Harness) 1-M6
      (3) ECU Intermediate Harness (OEM Side Harness) 1-M7
      (4) System Wiring Diagram 1-M12
   [5] AVAILABLE DATA MONITOR SIGNALS (LEVEL 1) 1-M14
      (1) Monitor Items 1-M14
      (2) Normal Value 1-M17
   [6] ECU TERMINAL LAYOUT 1-M20
      (1) ECU Terminal Layout 1 (Engine Side) 1-M20
      (2) ECU Terminal Layout 2 (Machine Side) 1-M23

1. BASIC SYSTEM INFORMATION

[1] SYSTEM CONFIGURATION



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(1) Key Switch ON Signal
(2) Starter Switch Signal
(3) Emergency Stop Switch
(4) Oil Pressure Switch
(5) CAN Communication for OEM Machine (*Accelerator Position Signal, *Neutral Switch, *Machine Travel Speed Signal)
(6) CAN Communication for Service
(7) Engine Warning Light Signal
(8) Stop Lamp Signal
(9) Oil Pressure Warning Lamp Signal
(10) Overheat Lamp Signal
(11) Glow (Air Heater) Lamp Signal
(12) Starter Relay
(13) Glow Relay
(14) Supply Pump
(15) Fuel Temperature Sensor
(16) SCV (Suction Control Valve)
(17) Rail Pressure Sensor
(18) Rail
(19) Pressure Limiter
(20) Injector
(21) EGR DC Motor
(22) EGR Lift Sensor
(23) **Intake Throttle Valve
(24) Intake Air Pressure Sensor
(25) Intake Air Temperature Sensor
(26) Glow Plug
(27) Coolant Temperature Sensor
(28) Crankshaft Position Sensor
(29) Diesel Particulate Filter (Hereinafter Referred To As The "DPF") Muffler
(30) Camshaft Position Sensor
(31) **Temperature Sensor (DPF Outlet Exhaust Temperature) (T_2)
(32) **Differential Pressure Sensor (DPF Differential Pressure) (ΔP)
(33) **Temperature Sensor (DPF Inlet Exhaust Temperature) (T_1)
(34) **Temperature Sensor (DOC Inlet Exhaust Temperature) (T_0)
(35) Air Flow Sensor

(A) CAN2 Connector (For OEM Machine)
(B) CAN1 Connector (For Service)
(C) Engine ECU
(a) To Fuel Tank

(To be continued)

(Continued)

■ **NOTE**
- **The signals marked with * are CAN communication.**
- **The parts marked with ** are only for -E4B, -TE4B. (TIE4B do not equip the parts).**

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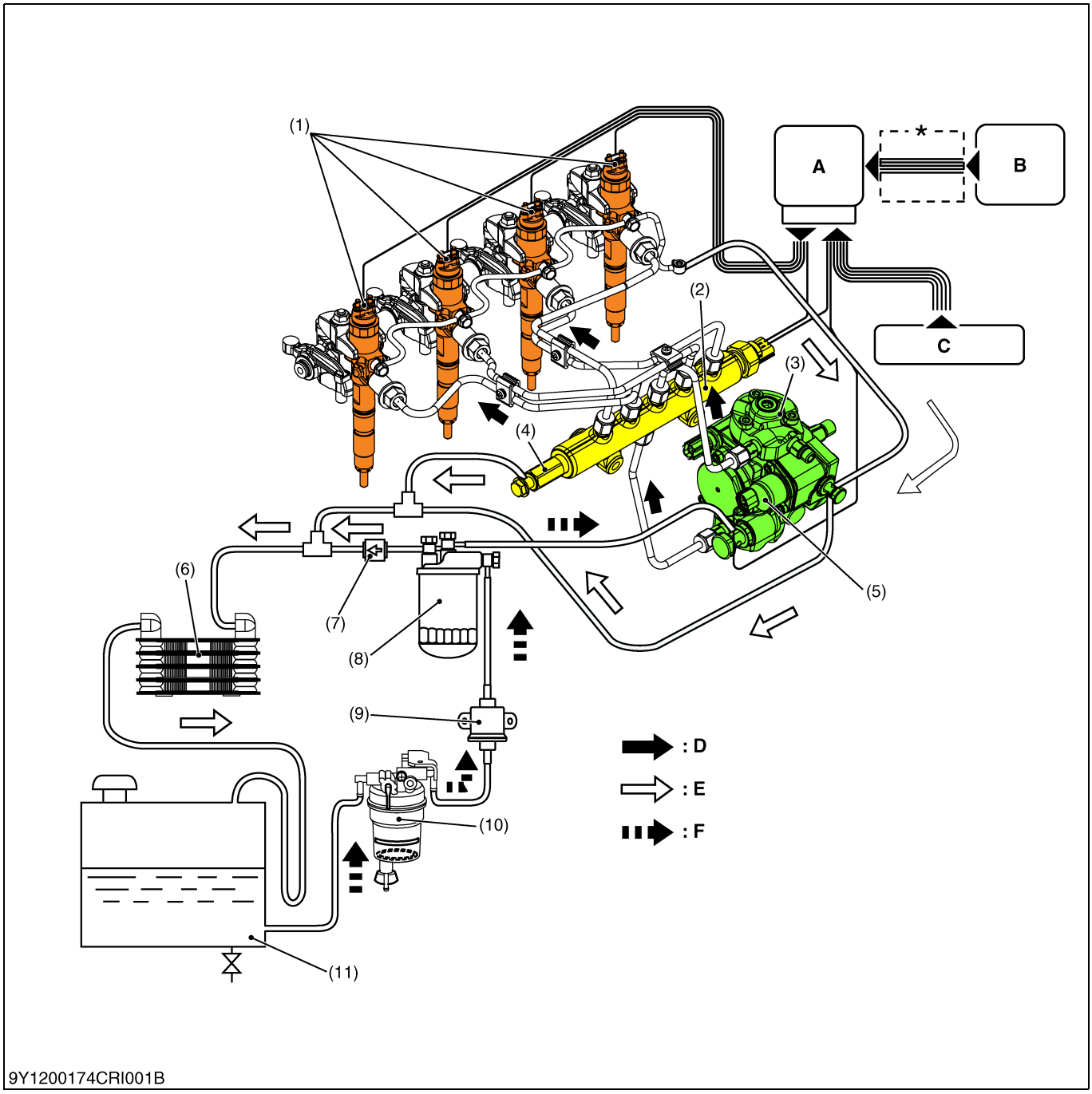
[2] FUEL SYSTEM



9Y1200174CRI001B

(1) Injector
(2) Rail
(3) Supply Pump
(4) Pressure Limiter
(5) SCV (Suction Control Valve)
(6) Fuel Cooler
(7) Check Valve
(8) Fuel Filter
(9) Fuel Feed Pump
(10) Water Separator
(11) Fuel Tank

A: ECU for Engine
B: ECU for Machine
C: Sensors
D: Injected Fuel Flow
E: Returned Fuel Flow
F: Feed Fuel Flow

■ **NOTE**
- **The signals marked with * are CAN communication.**

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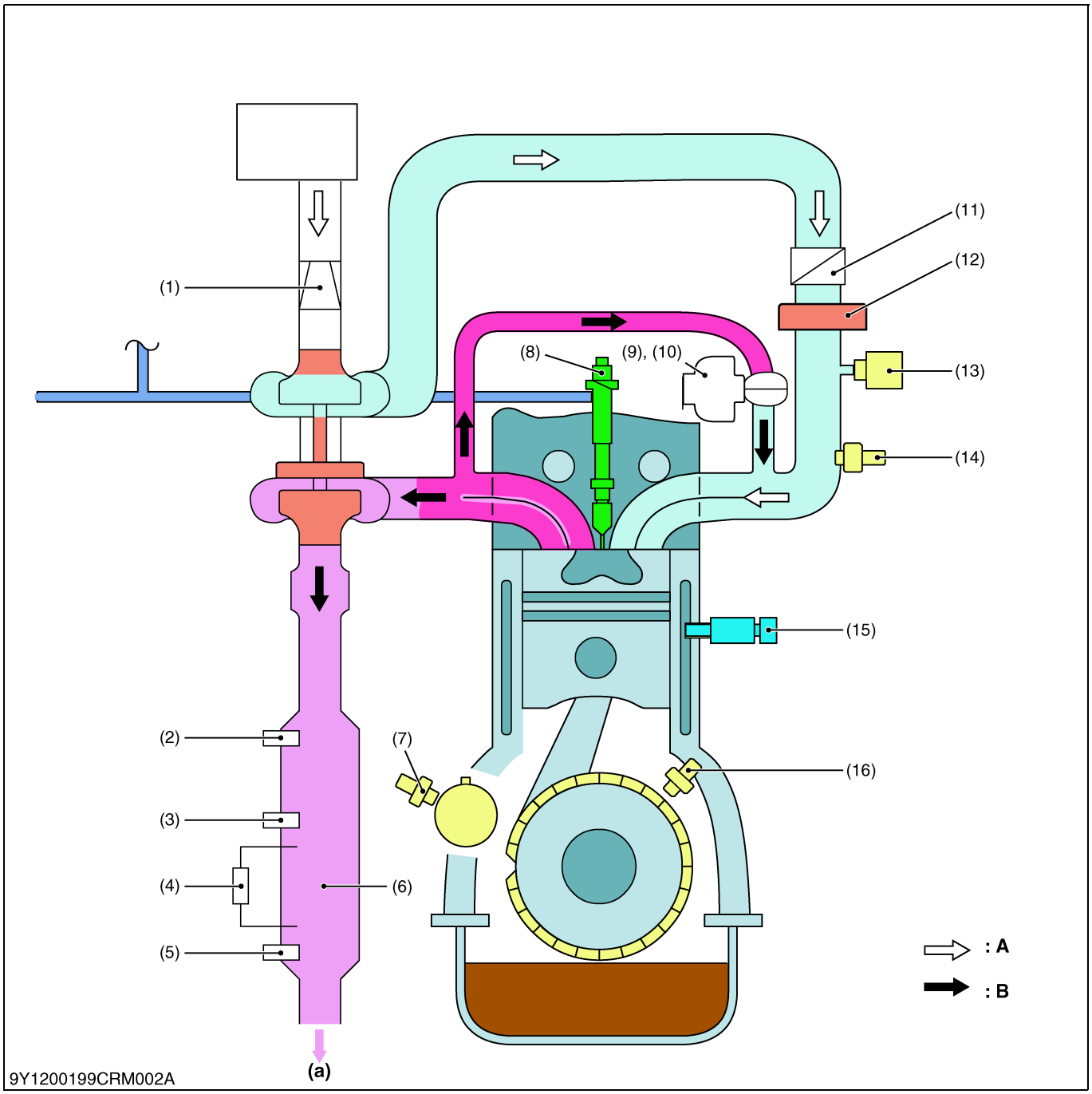
[3] INTAKE AND EXHAUST SYSTEM



(1) Mass Air Flow Sensor
(2) *Exhaust Gas Temperature Sensor0 (T0) (DOC Inlet Exhaust Gas Temperature)
(3) *Exhaust Gas Temperature Sensor1 (T1) (DPF Inlet Exhaust Gas Temperature)
(4) *Differential Pressure Sensor (DPF Differential Pressure) (ΔP)
(5) *Exhaust Gas Temperature Sensor2 (T2) (DPF Outlet Exhaust Gas Temperature)
(6) Diesel Particulate Filter (Hereinafter Referred To As The "DPF") Muffler
(7) Camshaft Position Sensor
(8) Injector
(9) EGR DC Motor
(10) EGR Lift Sensor
(11) *Intake Throttle Valve
(12) Glow Heater
(13) Boost Pressure Sensor
(14) Intake Air Temperature Sensor
(15) Coolant Temperature Sensor
(16) Crankshaft Position Sensor

A: Intake Air Flow
B: Exhaust Gas Flow

(a) To Muffler

■ **NOTE**

- **The parts marked with * are only for -E4B, -TE4B. (TIE4B do not equip the parts).**

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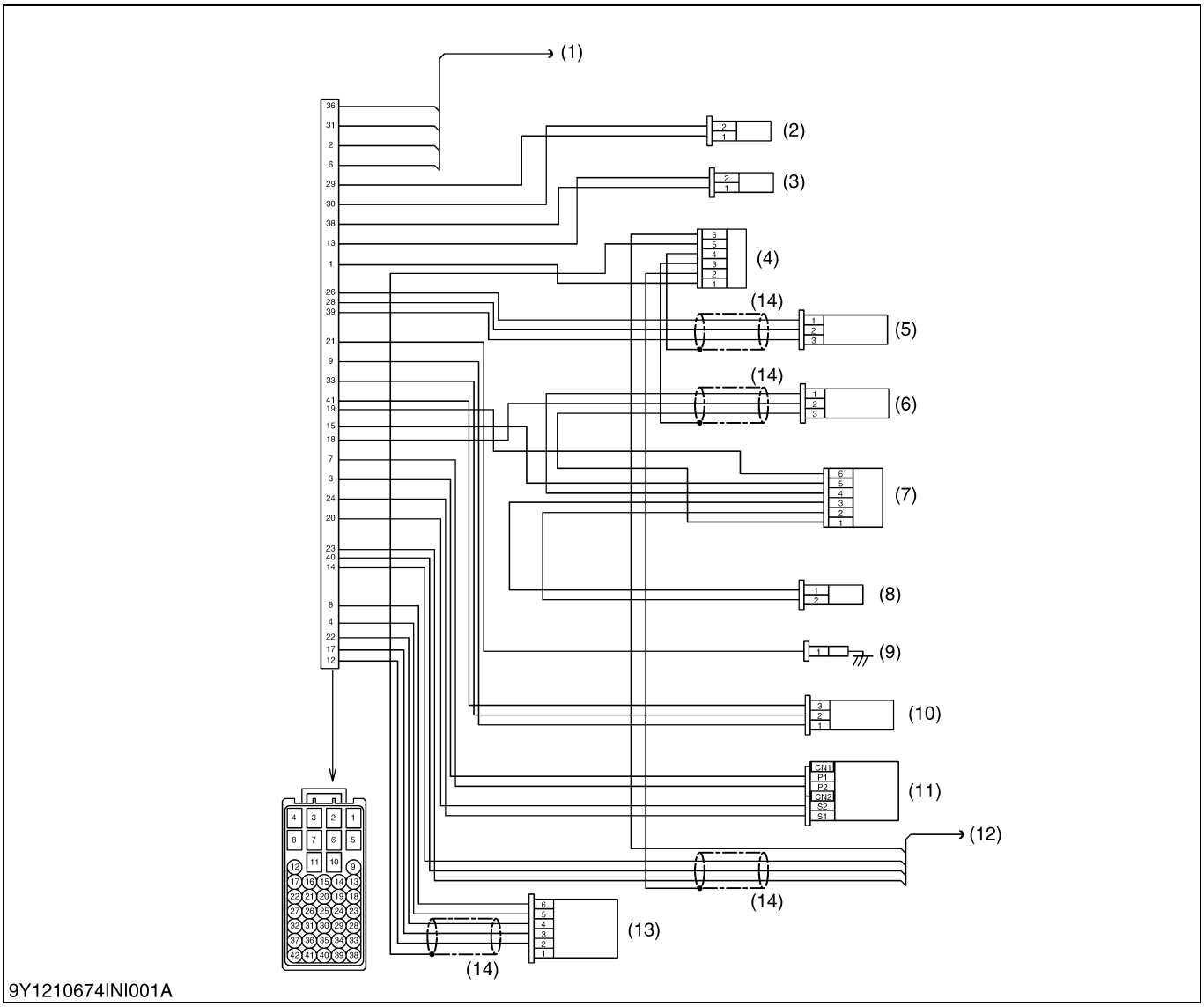
[4] WIRING DIAGRAM

(1) Engine Intermediate Harness (Engine Side Harness)



9Y1210674INI001A

(1)	–	CAN and EGR
(2)	CN202	Intake Air Temperature Sensor
(3)	CN203	Coolant Temperature Sensor
(4)	CN215	Engine Joint Connector 1
(5)	CN204	Rail Pressure Sensor
(6)	CN205	Crankshaft Position Sensor
(7)	CN216	Engine Joint Connector 2
(8)	CN206	Resistance Connector (1.1 kΩ)
(9)	CN207	Oil Pressure Switch
(10)	CN208	Boost Pressure Sensor
(11)	CN209 / 210	Supply Pump
(12)	–	Camshaft Position Sensor
(13)	CN212	Intake Throttle Valve (V2607-CR-E4 / V2607-CR-TE4 / V3307-CR-TE4)
(14)	–	Shield Cable

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

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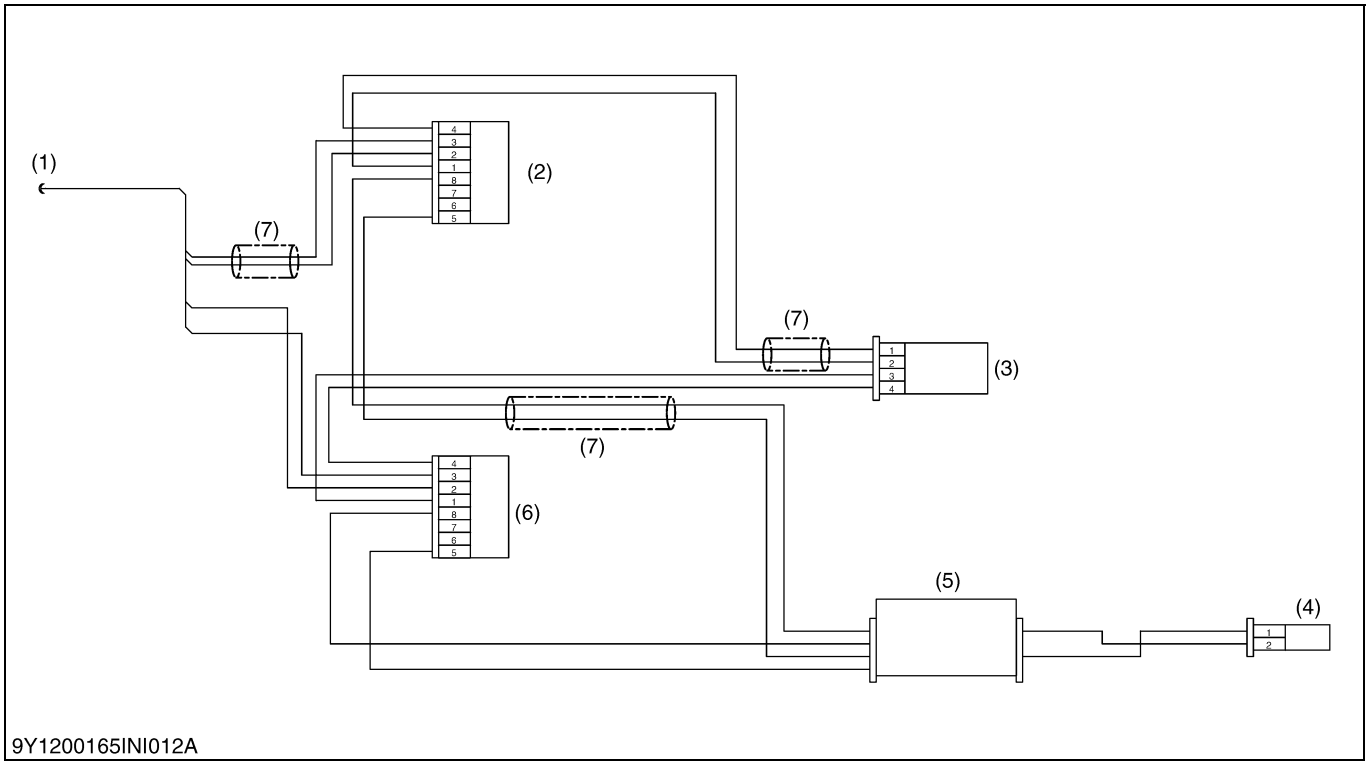

(1)	–	CAN and EGR
(2)	CN221	Engine Joint Connector 3
(3)	CN223	EGR Value
(4)	CN226	Resistance Connector (120 Ω)
(5)	CN224/225	Can Tool
(6)	CN222	Engine Joint Connector 4
(7)	–	Shield Cable

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

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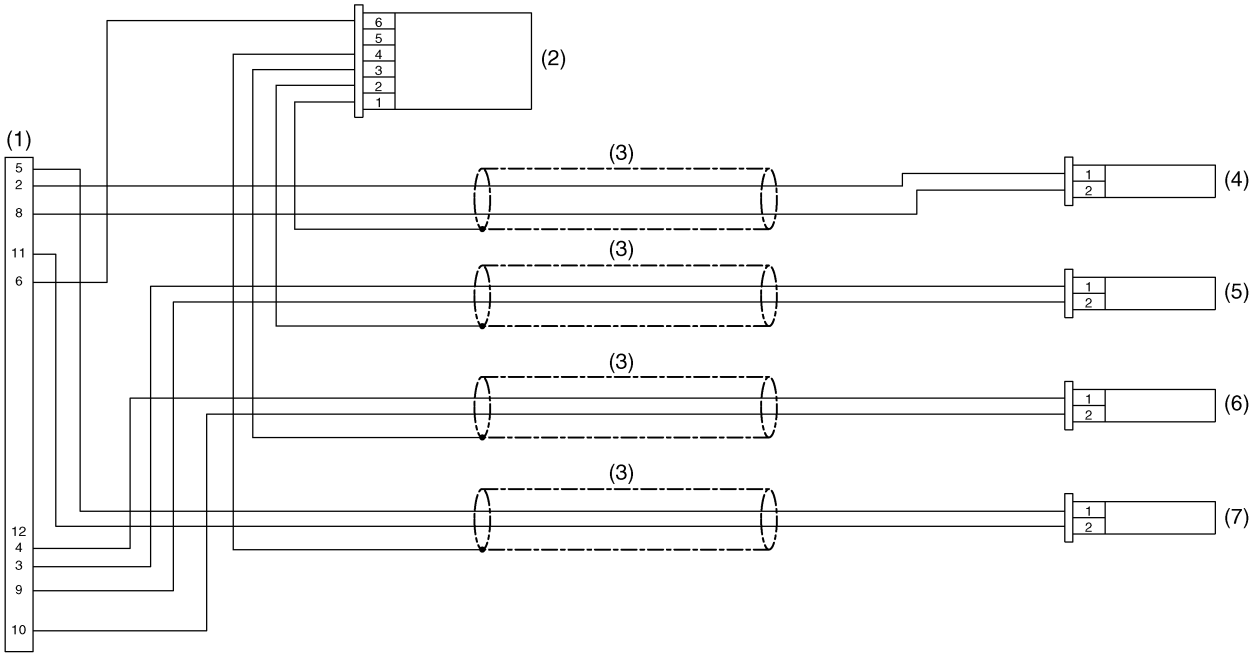
(2) Injector Intermediate Harness (Engine Side Harness)



9Y1210674INI003A

(1)	CN306	Injector Intermediate Connector
(2)	CN305	Injector Joint Connector 1
(3)	–	Shield Cable
(4)	CN301	Injector #1
(5)	CN302	Injector #2
(6)	CN303	Injector #3
(7)	CN304	Injector #4

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

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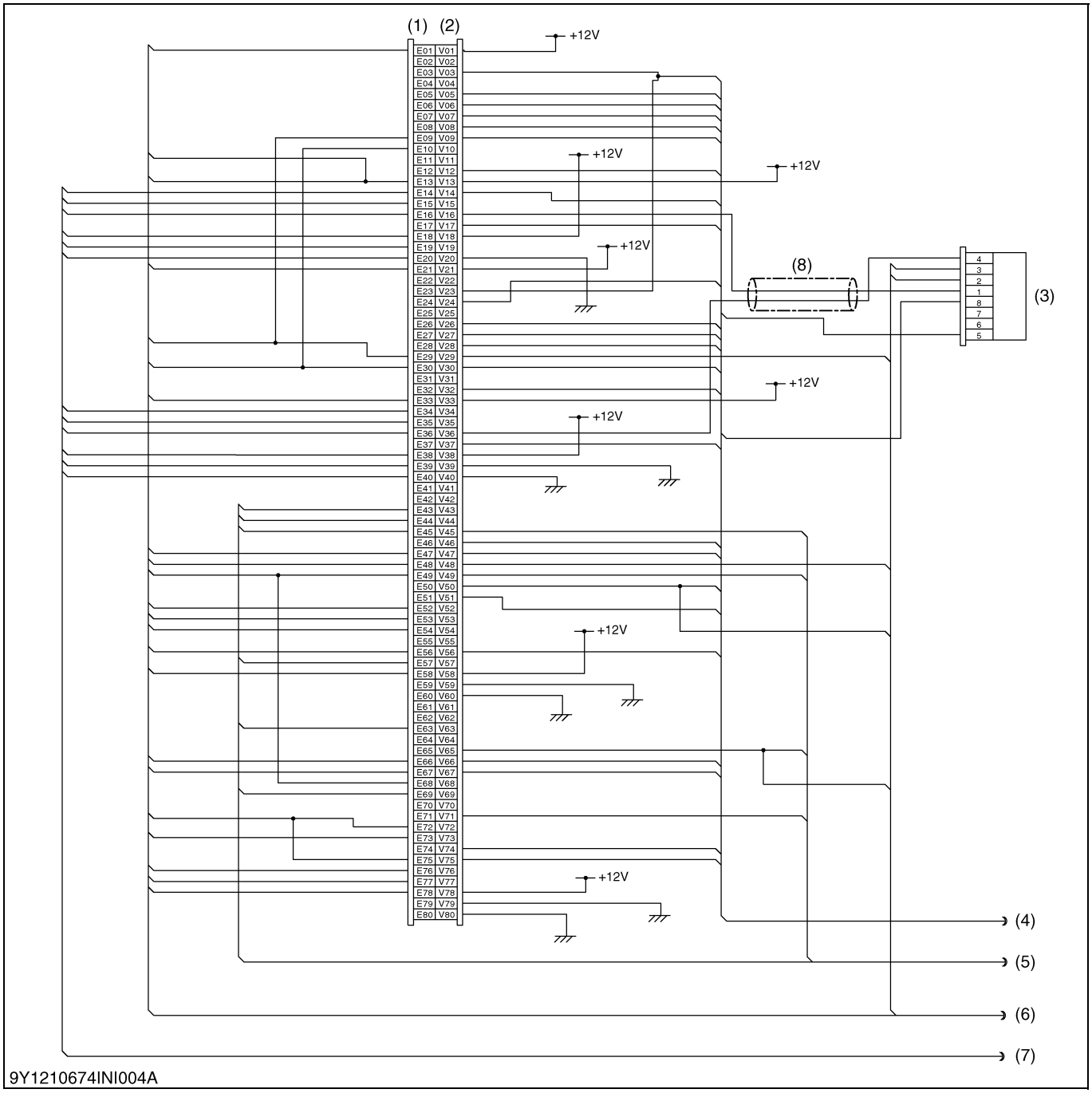
(3) ECU Intermediate Harness (OEM Side Harness)

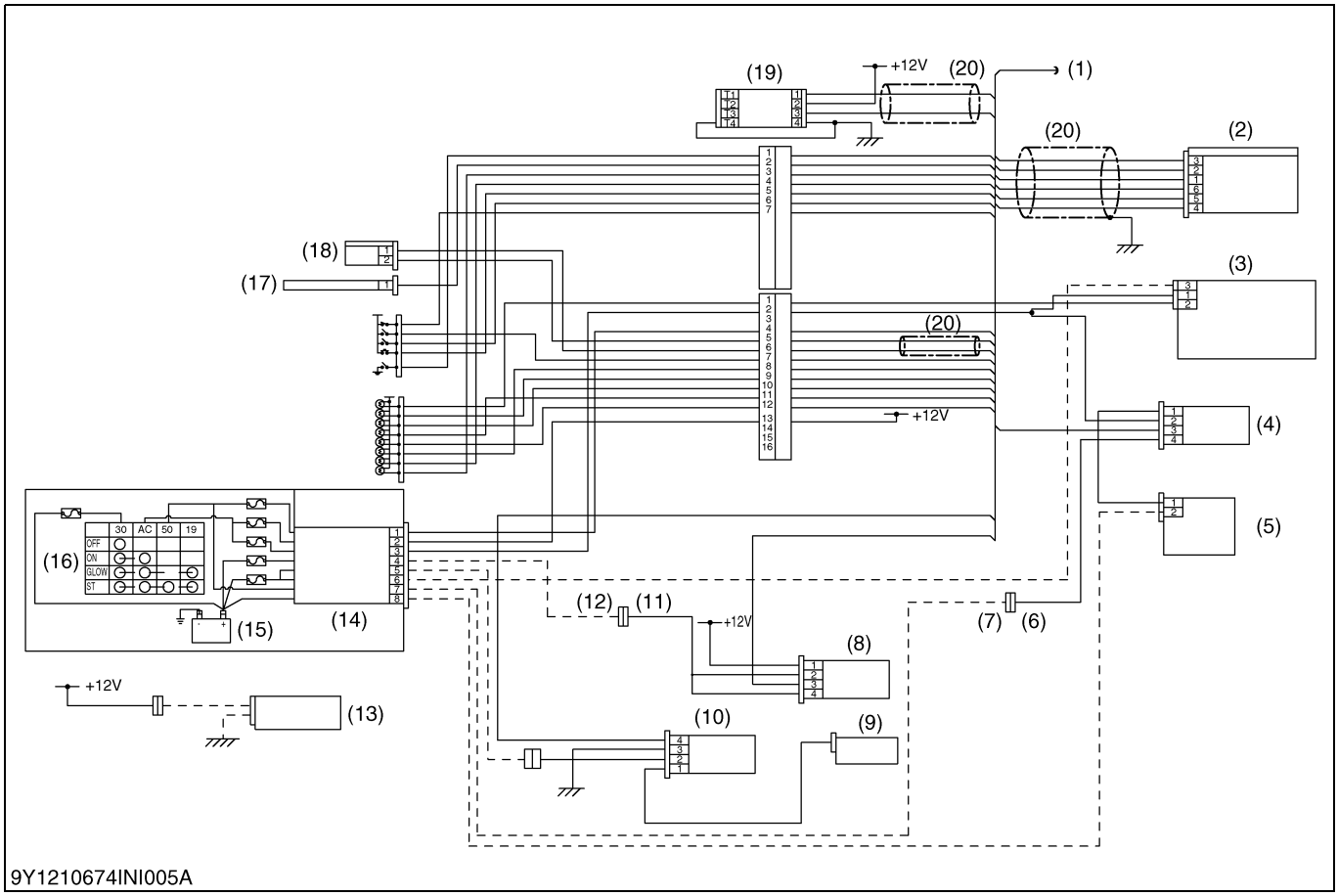


(1)	CN501	ECU (1)
(2)	CN502	ECU (2)
(3)	CN503	ECU Joint Connector 1
(4)	–	Power Unit
(5)	–	Diesel Particulate Filter (hereinafter referred to as the "DPF")
(6)	–	Engine
(7)	–	Injector
(8)	–	Shield Cable

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

9Y1200199CRM0045US0



9Y1210674INI005A

(1)	–	Power Unit
(2)	CN401	Accel Sensor
(3)	CN402	Alternator
(4)	CN403	Starter Relay
(5)	CN404	Starter
(6)	CN405	Connector
(7)	CN406	Connector
(8)	CN413	Main Relay
(9)	–	Glow Plug
(10)	CN416	Glow Relay
(11)	CN414	Connector
(12)	CN415	Connector
(13)	–	Fuel Feed Pump
(14)	–	Battery Unit
(15)	–	Battery
(16)	–	Key Switch
(17)	–	Speed Sensor
(18)	–	CAN for Vehicle
(19)	CN407 / 408	CAN Tool
(20)	–	Shield Cable

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

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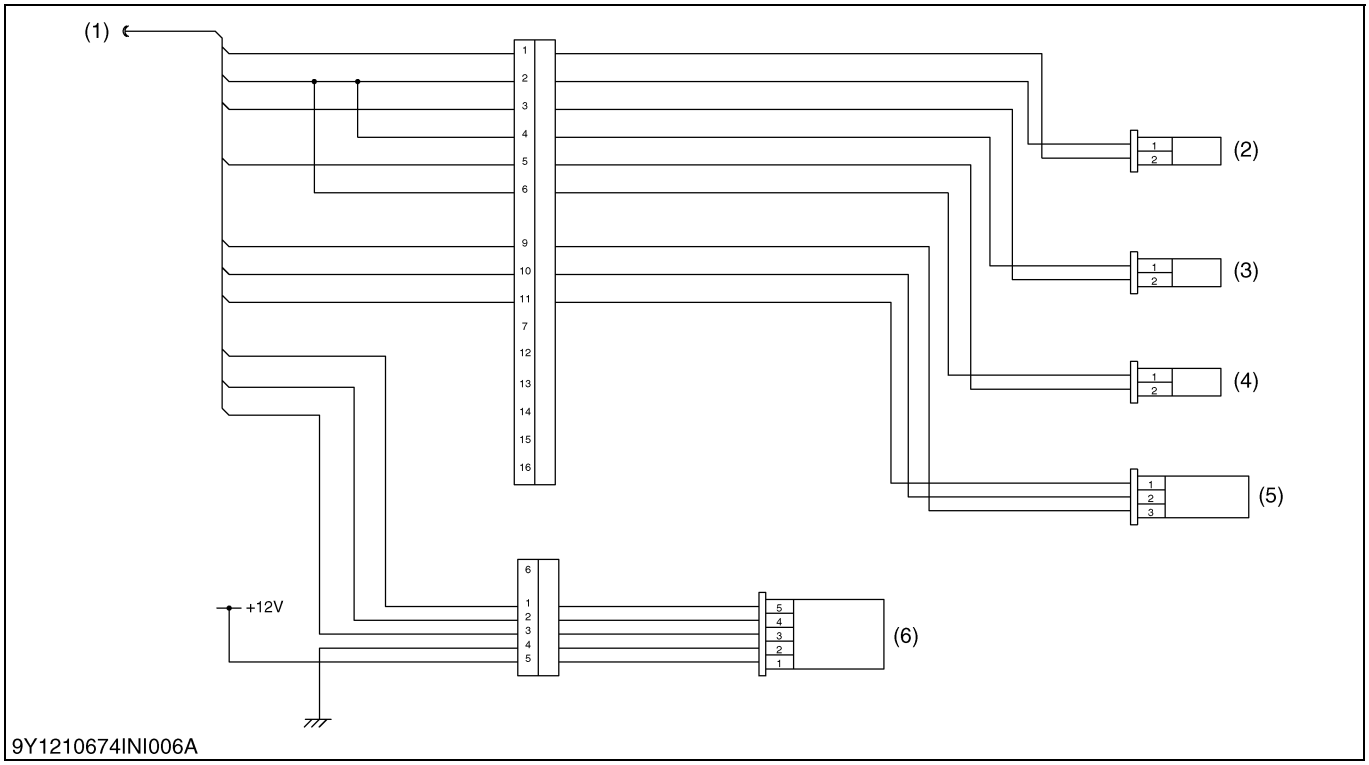

(1)	–	Diesel Particulate Filter (DPF)
(2)	CN101	DPF Temperature Sensor (T_2) (V2607-CR-E4B / V2607-CR-TE4B / V3307-CR-TE4B)
(3)	CN102	DPF Temperature Sensor (T_1) (V2607-CR-E4B / V2607-CR-TE4B / V3307-CR-TE4B)
(4)	CN103	DPF Temperature Sensor (T_0) (V2607-CR-E4B / V2607-CR-TE4B / V3307-CR-TE4B)
(5)	CN104	DPF Differential Pressure Sensor (ΔP) (V2607-CR-E4B / V2607-CR-TE4B / V3307-CR-TE4B)
(6)	CN105	Air Flow Sensor

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

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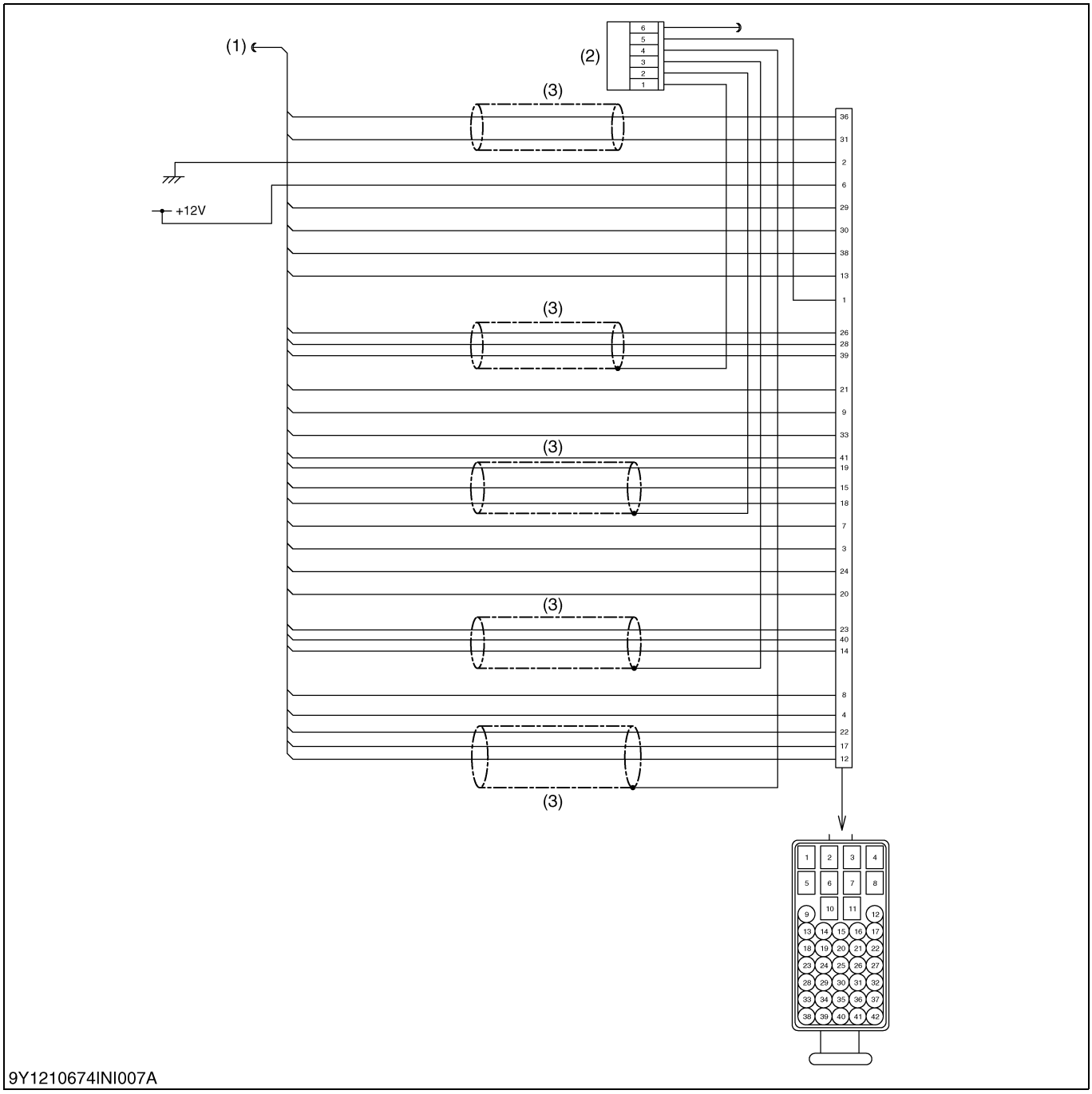

(1)	–	Engine
(2)	CN217	ECU Joint Connector 2
(3)	–	Shield Cable

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

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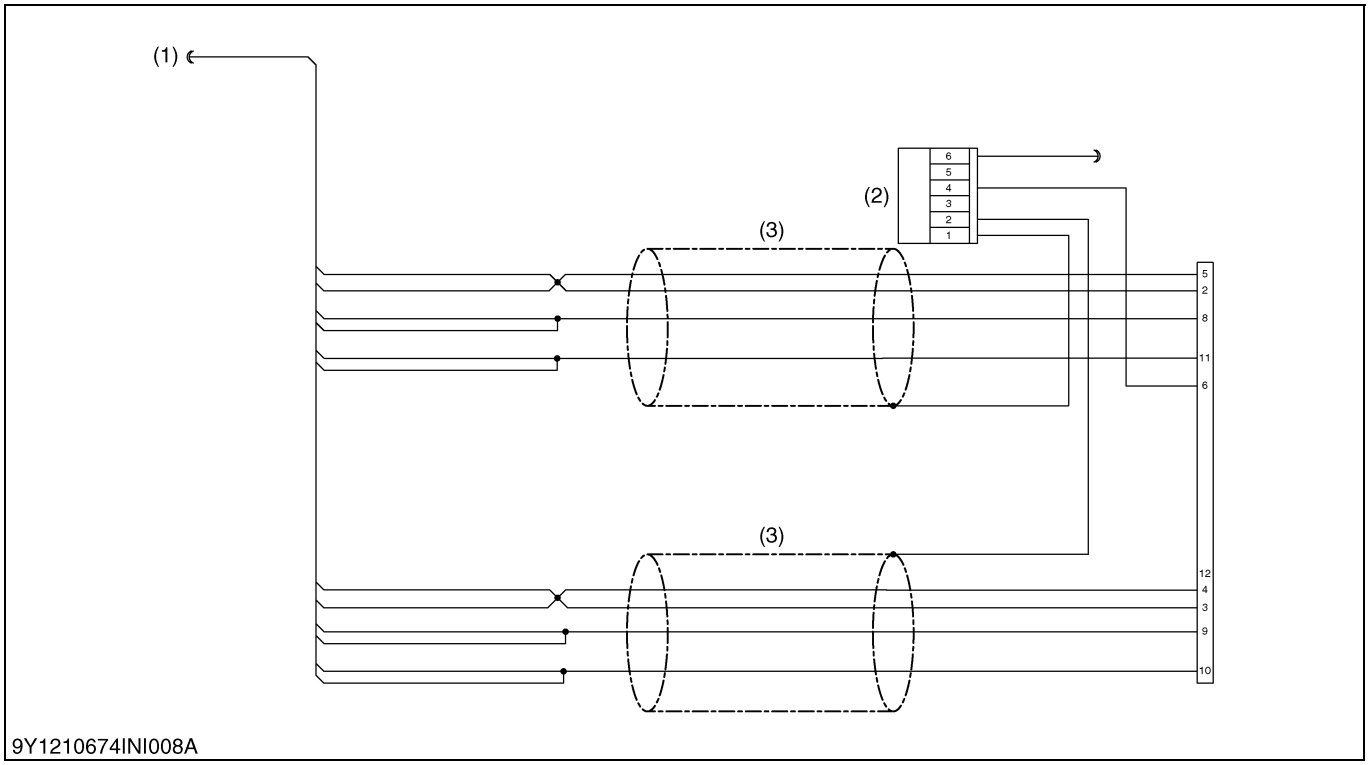

9Y1210674INI008A

(1)	–	Injector
(2)	CN308	ECU Joint Connector 3
(3)	–	Shield Cable

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from wire side, not mating side.**

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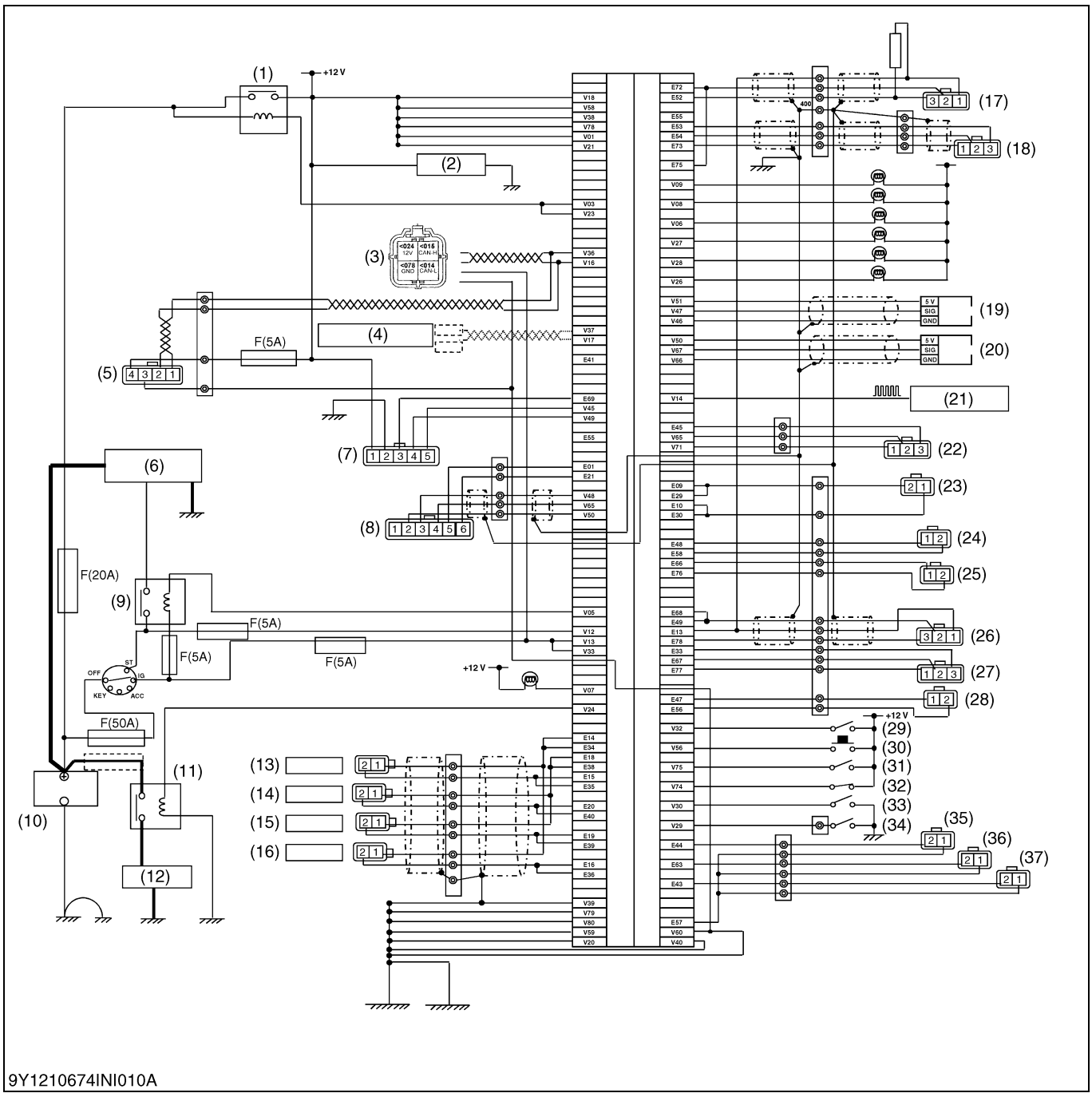
(4) System Wiring Diagram

V2607-CR-E4B, V2607-CR-TE4B, V3307-CR-TE4B



(1) Main Relay
(2) Fuel Feed Pump
(3) CAN1 Connector (For Service)
(4) CAN2 Connector (For OEM Machine)
(5) EGR Valve
(6) Starter
(7) Air Flow Sensor
(8) Intake Throttle Valve
(9) Starter Relay
(10) Battery
(11) Glow Relay
(12) Glow Plug
(13) Injector 1
(14) Injector 2
(15) Injector 3
(16) Injector 4
(17) Crankshaft Position Sensor
(18) Camshaft Position Sensor
(19) Accel Sensor 1
(20) Accel Sensor 2
(21) Vehicle Speed Sensor
(22) DPF Differential Pressure Sensor (ΔP)
(23) SCV (Suction Control Valve)
(24) Fuel Temperature Sensor
(25) Coolant Temperature Sensor
(26) Rail Pressure Sensor
(27) Boost Sensor
(28) Intake Air Temperature Sensor
(29) Stop Switch
(30) Parked Regeneration Switch
(31) Parking Switch
(32) Regeneration Inhibit Switch
(33) Neutral Switch
(34) Oil Switch
(35) DPF Temperature Sensor (T_0)
(36) DPF Temperature Sensor (T_1)
(37) DPF Temperature Sensor (T_2)

DPF: Diesel Particulate Filter

■ **NOTE**

- **Terminal names and terminal numbers marked with * have become invalid.**

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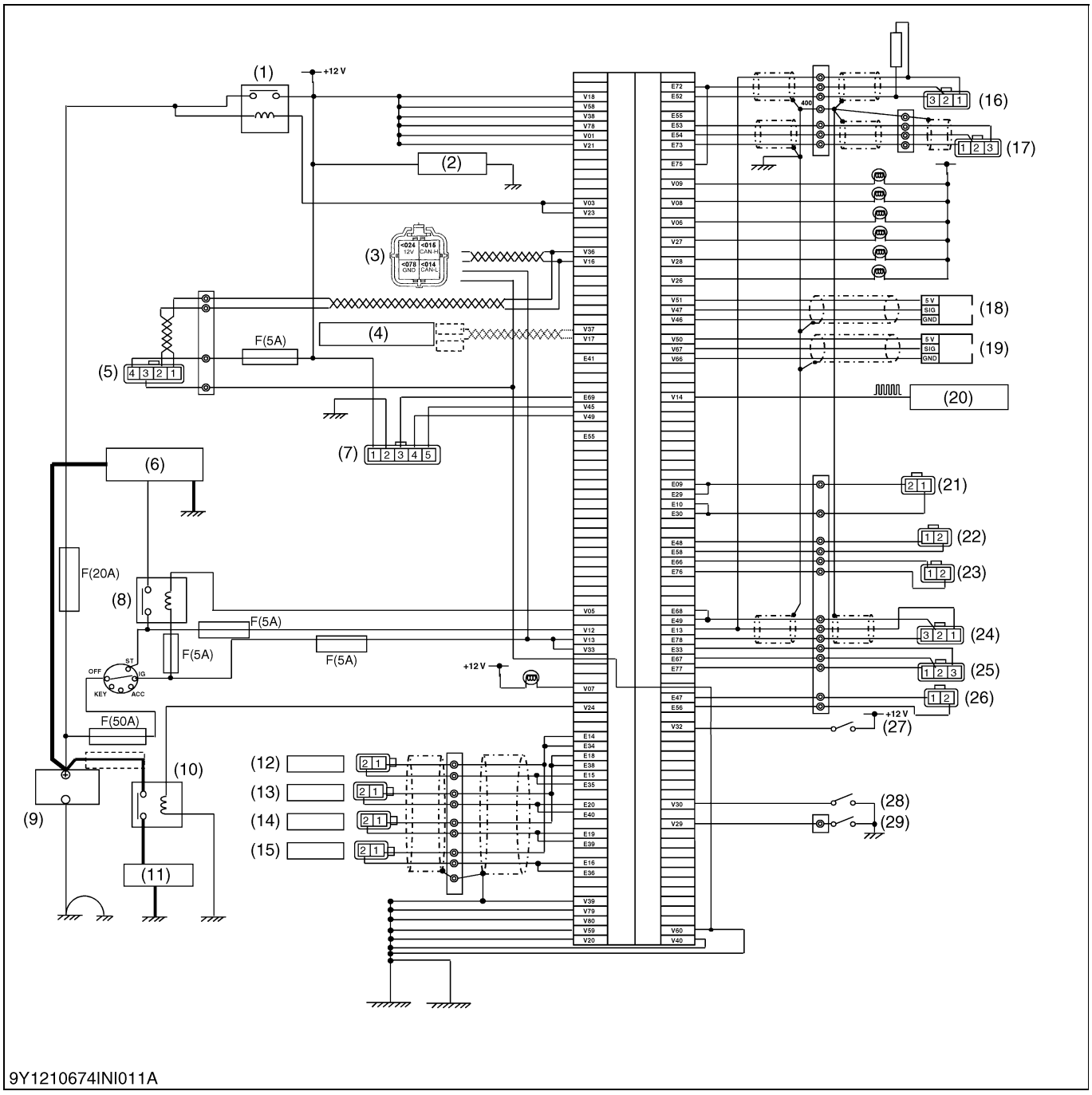
V2607-CR-TIE4B, V3307-CR-TIE4B



9Y1210674INI011A

(1) Main Relay
(2) Fuel Feed Pump
(3) CAN1 Connector (For Service)
(4) CAN2 Connector (For OEM Machine)
(5) EGR Valve
(6) Starter
(7) Air Flow Sensor
(8) Starter Relay
(9) Battery
(10) Glow Relay
(11) Glow Plug
(12) Injector 1
(13) Injector 2
(14) Injector 3
(15) Injector 4
(16) Crankshaft Position Sensor
(17) Camshaft Position Sensor
(18) Accel Sensor 1
(19) Accel Sensor 2
(20) Vehicle Speed Sensor
(21) SCV (Suction Control Valve)
(22) Fuel Temperature Sensor
(23) Coolant Temperature Sensor
(24) Rail Pressure Sensor
(25) Boost Sensor
(26) Intake Air Temperature Sensor
(27) Stop Switch
(28) Neutral Switch
(29) Oil Switch

■ **NOTE**

- **Terminal names and terminal numbers marked with * have become invalid.**

9Y1200199CRM0051US0

[5] AVAILABLE DATA MONITOR SIGNALS (LEVEL 1)

(1) Monitor Items

Classification		Signal Name	Unit	Terminal Name	Terminal No.
Input	Pulse / Rotary signal	Engine speed active flag	–	–	–
		Cam speed active flag	–	–	–
		Engine speed	min^{-1} (rpm)	NE + / −	E52 / E72
		Machine speed *	km/h	SPD	V14
	Analog signal	Accelerator pedal position	%	–	–
		Accelerator pedal position sensor 1 output voltage *	V	APS1	V47
		Accelerator pedal position sensor 2 output voltage *	V	APS2	V67
		Boost pressure	kPa	–	–
		Boost pressure sensor output voltage	V	PIM	E67
		Fuel temperature	°C	–	–
		Fuel temperature sensor output voltage	V	THF	E48
		Coolant temperature	°C	–	–
		Coolant temperature sensor output voltage	V	THW	E66
		Intake air temperature	°C	–	–
		Intake air temperature sensor output voltage	V	THA	E47
		Atmospheric pressure	kPa	–	–
		Atmospheric pressure sensor output voltage	V	PATM	–
		Battery voltage	V	+BP	V18, V38, V58, V78
	Digital signal	Key switch	–	IG-SW	V13, V33
		Starter switch	–	STA-SW	V12
		Neutral switch *	–	N-SW	V30

■ **NOTE**

- **The signals marked with * are inputs from ECU for machine through CAN. Terminal names and terminal numbers have become invalid.**

9Y1200199CRM0034US0

Classification		Signal Name	Unit	Terminal Name	Terminal No.
Output	Basic control signal	Final fuel injection quantity	mm^3/st	–	–
		Target rail pressure	MPa	–	–
		Actual rail pressure MPa	MPa	–	–
		Rail pressure sensor output voltage	V	PFUEL 1/2	E68 / E49
		Target suction control valve (SCV) current	mA	–	–
		Actual suction control valve (SCV) current	mA	SCV+ / −	E09, E29 / E10, E30
		Pump learning condition	–	–	–
		Pump difference learning correction value	mA	–	–
		Pressure feedback integral guard flag	–	–	–
		Engine stop flag	–	–	–
		Low temperature start mode flag	–	–	–
		Registration history (#1 cylinder)	–	–	–
		Registration history (#2 cylinder)	–	–	–
		Registration history (#3 cylinder)	–	–	–
		Registration history (#4 cylinder)	–	–	–
		Number of registrations (#1 cylinder)	–	–	–
		Number of registrations (#2 cylinder)	–	–	–
		Number of registrations (#3 cylinder)	–	–	–
		Number of registrations (#4 cylinder)	–	–	–
	Actuator	Exhaust gas recirculation (EGR) valve target position	%	–	–
		Exhaust gas recirculation (EGR) valve actual position	%	–	–
		Exhaust gas recirculation (EGR) position sensor output	–	–	(CAN)
		Glow (air heater) relay	–	GRLY	V24

9Y1200199CRM0035US0

Classification		Signal Name	Unit	Terminal Name	Terminal No.
Output	DPF data	Differential pressure 1 output voltage	V	DPS	E45
		Exhaust gas temperature 0 output voltage	V	IDOC	E44
		Exhaust gas temperature 1 output voltage	V	ODOC	E63
		Exhaust gas temperature 2 output voltage	V	ODPF	E43
		Intake air temperature built-in MAF output voltage	V	IATS	V49
		Intake throttle valve lift output voltage	V	ITS	V48
		Differential pressure 1	kPa	–	–
		Exhaust gas temperature 0	°C	–	–
		Exhaust gas temperature 1	°C	–	–
		Exhaust gas temperature 2	°C	–	–
		Mass air flow for intake throttle	kg/h	–	–
		Intake air temperature built-in MAF	°C	–	–
		Target intake throttle valve opening	%	–	–
		Intake throttle final duty control quantity	%	–	–
		Intake throttle valve lift	%	–	–
		PM sedimentation quantity 1	mg	–	–
		PM sedimentation quantity 2	mg	–	–
		Final fuel injection quantity multiplication quantity	L	–	–
		Target mass air flow	kg/h	–	–
		Pump learning end time	h	–	–
		Hour meter	h	–	–
		DPF auto regeneration last active time	sec	–	–
		Regeneration running time	min	–	–
		Source address of TSC1	–	–	–
		Parking SW	–	–	–
		Neutral SW	–	–	–
		DPF auto regeneration inhibit SW	–	–	–
		DPF manual regeneration force SW	–	–	–
		Oil pressure SW	–	–	–
		Target speed of isochronous control	min^{-1} (rpm)	–	–
		DPF regeneration control level	–	–	–
		DPF regeneration control status	–	–	–

9Y1200199CRM0036US0

(2) Normal Value

Classification		Signal Name	Unit	Engine Stops	During Start-Up	Idling	During Acceleration	During No-load Maximum Speed
Input	Pulse / Rotary signal	Engine speed	min^{-1} (rpm)	0	0 → 800 (Ordinary temperature)	Approx. 800 (After warm-up)	Approx. 800 → 2700	Approx. 2700 (After warm-up)
		Engine speed active flag	–	OFF	ON	ON	ON	ON
		Cam speed active flag	–	OFF	ON	ON	ON	ON
		Machine speed	km/h	When the machine stopped: 0				
	Analog signal	Final accelerator pedal position opening	%	0	0	0	0 → 100	100
		Accelerator pedal position sensor 1 output voltage	V	Sensor unused by CAN input				
		Accelerator pedal position sensor 2 output voltage	V					
		Boost pressure	kPa	Approx. 100	Approx. 100	Approx. 100	–	–
		Boost pressure sensor output voltage	V	Approx. 1.0	Approx. 1.0	Approx. 1.0	–	–
		Fuel temperature	°C	Representative value: Approx. 20 °C (68 °F) → Approx. 2.4 V Representative value: Approx. 40 °C (104 °F) → Approx. 1.5 V				
		Fuel temperature sensor output voltage	V					
		Coolant temperature	°C	Representative value: Approx. 20 °C (68 °F) → Approx. 2.4 V Representative value: Approx. 80 °C (176°F) → Approx. 0.5 V				
		Coolant temperature sensor voltage output	V					
		Intake air temperature	°C	Representative value: Approx. 20 °C (68 °F) → Approx. 2.4 V Representative value: Approx. 40 °C (104 °F) → Approx. 1.5 V				
		Intake air temperature sensor output voltage	V					
		Atmospheric pressure	kPa	Representative value: Approx. 100 kPa → 3.7 V (Depending on the atmospheric pressure)				
		Atmospheric pressure sensor output voltage	V					
		Battery voltage	V	When stopped: Approx. 12.5 V When operating: Approx. 14 V (Depends on the battery charging condition, whether or not there is a load voltage, rotation speed)				
	Digital signal	Key Switch	–	ON	ON	ON	ON	ON
		Start switch	–	OFF	ON	OFF	OFF	OFF
		Neutral switch	–	During neutral: ON				

9Y1200199CRM0037US0

Classification		Signal Name	Unit	Engine Stops	During Start-Up	Idling	During Acceleration	During No-load Maximum Speed
Output	Basic control signal	Final fuel injection quantity	mm^3 /st	0 (Indication value - 50)	0 → 80 (Ordinary temperature)	Approx. 12 (After warm-up)	Approx. 12→75 (After warm-up)	Approx. 30 (After warm-up)
		Target rail pressure	MPa	Depends on the rotation speed, load (After warm-up) When idling: Approx. 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) During no-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 116600 psi) During acceleration : 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi)				
		Actual rail pressure Mpa	MPa	–	Approx. the same as the target value (Follow to the target value)			
		Rail pressure sensor output voltage	V	Depends on the rotation speed, load (After warm-up) When stopped: Approx. 1.0 V When idling: 1.65 to 1.80 V During no-load maximum speed: 2.50 to 2.85 V During acceleration: 2.5 to 3.3 V				
		Target suction control valve (SCV) current	mA	–	1700 to 2000	Approx. 1800	Approx. 1400	Approx. 1600
		Actual suction control valve (SCV) current	mA	Approx. the same as the target value (Follow to the target value)				
		Pump learning condition	–	Normally 2 or 3*1 Indicates the following depending on the learning status: 255 (Default value), 1 (Provisional learning completion), 0 (Actual learning), 2 (Actual learning completion), 3 (Relearning)				
		Pump deviation learning correction value	mA	±200 mA (Guideline *2)				
		Pressure feedback integral guard flag	–	Normally OFF				
		Engine stop flag	–	ON	OFF	OFF	OFF	OFF
		Low temperature start mode flag	–	OFF	ON	OFF	OFF	OFF

■ **NOTE**

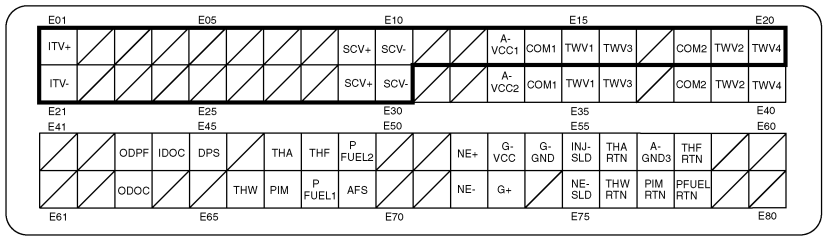
- ***1: Very occasionally, it does not shift from 3 to 2. If there is an engine malfunction on the status above, perform the forced-relearning.**
- ***2: As the following value of A varies depending on pump, the table above is for guideline. If the value of A has a wider gap than the initial learning value, there may be out of the range of the above table.**
  A net normal value is the value that provided by the forced-learning several times: Compared with A
  12 V spec: A - 100 ≤ normal value ≤ A + 50
  The current shall be used as a reference (guideline) only as this value varies depending on the pump used.

Classification		Signal Name	Unit	Engine Stops	During Start-Up	Idling	During Acceleration	During No-load Maximum Speed
Output	Actuator	Exhaust gas recirculation (EGR) valve target position	%	Depends on the rotation speed, load and temperature				
		Exhaust gas recirculation (EGR) valve actual position	%	Approx. the same as the target EGR position (Follow to the target value)				
		Exhaust gas recirculation (EGR) position sensor output	–	16 to 106 (CAN communication data) (Valve lift : 0 to 10 mm)				
		Glow (air heater) relay	–	Only during cold start-up (before-and-after): ON				
	DPF data	Differential pressure 1	kPa	Input range : –1.7 to 34.5 kPa Output range : 0.5 to 4.5 V				
		Differential pressure 1 sensor output voltage	V					
		Exhaust gas temperature 0	°C	Representative value: Approx. 100 °C (212 °F) → Approx. 4.4 V Representative value : Approx. 250 °C (482 °F) → Approx. 2.3 V				
		Exhaust gas temperature 0 sensor output voltage	V					
		Exhaust gas temperature 1	°C	Representative value : Approx. 100 °C (212 °F) → Approx. 4.4 V Representative value : Approx. 250 °C (482 °F) → Approx. 2.3 V				
		Exhaust gas temperature 1 sensor output voltage	V					
		Exhaust gas temperature 2	°C	Representative value : Approx. 100 °C (212 °F) → Approx. 4.4 V Representative value : Approx. 250 °C (482 °F) → Approx. 2.3 V				
		Exhaust gas temperature 2 sensor output voltage	V					
		Intake air temperature built-in MAF	°C	Representative value : Approx. 20 °C (68 °F) →Approx. 3.1 V Representative value : Approx. 80 °C (176 °F) → Approx. 0.9 V				
		Intake air temperature built-in MAF sensor output voltage	V					
		Mass air flow for intake throttle	kg/h	12.96 to 698.4 (1.239 to 4.598 V)				
		Intake throttle valve lift	%	100 (Full open)	100 (Full open)	100 to 0		
		Intake throttle valve lift output voltage	V	Approx. 0.5 V	Approx. 0.5 V	0.5 to 4.375 V		

9Y1200199CRM0038US0

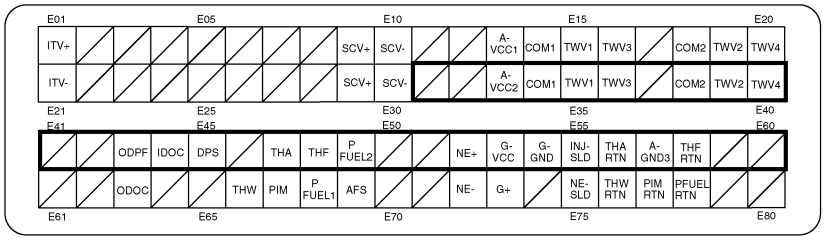
[6] ECU TERMINAL LAYOUT

(1) ECU Terminal Layout 1 (Engine Side)



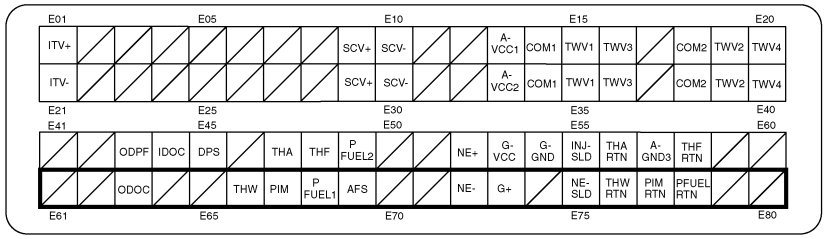
9Y1200144CRM005A

No.	Terminal Name	Signal Name
E01	ITV+	INTAKE THROTTLE VALVE MOTOR (+)
E02	–	–
E03	–	–
E04	–	–
E05	–	–
E06	–	–
E07	–	–
E08	–	–
E09	SCV+	SCV (SUCTION CONTROL VALVE) (+)
E10	SCV−	SCV (SUCTION CONTROL VALVE) (−)
E11	–	–
E12	–	–
E13	A-VCC1	SENSOR (POWER SUPPLY)
E14	COM1	INJECTION COMMON 1
E15	TWV1	INJECTION DRIVE1 (No.1 CYLINDER)
E16	TWV3	INJECTION DRIVE3 (No.4 CYLINDER)
E17	–	–
E18	COM2	INJECTION COMMON 2
E19	TWV2	INJECTION DRIVE2 (No.3 CYLINDER)
E20	TWV4	INJECTION DRIVE4 (No.2 CYLINDER)
E21	ITV−	INTAKE THROTTLE VALVE MOTOR (−)
E22	–	–
E23	–	–
E24	–	–
E25	–	–
E26	–	–
E27	–	–
E28	–	–
E29	SCV+	SCV (SUCTION CONTROL VALVE) (+)
E30	SCV−	SCV (SUCTION CONTROL VALVE) (−)



9Y1200144CRM005B

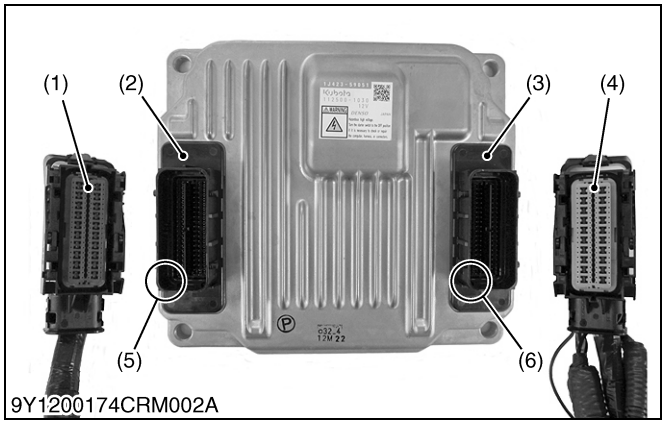
No.	Terminal Name	Signal Name
E31	–	–
E32	–	–
E33	A-VCC2	SENSOR (POWER SUPPLY)
E34	COM1	INJECTION COMMON 1
E35	TWV1	INJECTION DRIVE1 (No.1 CYLINDER)
E36	TWV3	INJECTION DRIVE3 (No.4 CYLINDER)
E37	–	–
E38	COM2	INJECTION COMMON 2
E39	TWV2	INJECTION DRIVE2 (No.3 CYLINDER)
E40	TWV4	INJECTION DRIVE4 (No.2 CYLINDER)
E41	–	–
E42	–	–
E43	ODPF	OUTLET DPF (DPF Exhaust Gas Temperature SENSOR T2)
E44	IDOC	INLET DOC (DPF Exhaust Gas Temperature SENSOR T0)
E45	DPS	DIFFERENTIAL PRESSURE SENSOR
E46	–	–
E47	THA	INTAKE AIR TEMPERATURE SENSOR
E48	THF	FUEL TEMPERATURE SENSOR
E49	PFUEL2	RAIL PRESSURE SENSOR 2
E50	–	–
E51	–	–
E52	NE+	CRANKSHAFT POSITION SENSOR (+)
E53	G-VCC	CAMSHAFT POSITION SENSOR (POWER SUPPLY)
E54	G-GND	CAMSHAFT POSITION SENSOR (GROUND)
E55	INJ-SLD	SHIELD GROUND
E56	THA RTN	INTAKE AIR TEMPERATURE SENSOR RTN
E57	A-GND3	DPF Exhaust Gas Temperature SENSOR T0, T1, T2 GROUND
E58	THF RTN	FUEL TEMPERATURE SENSOR RTN
E59	–	–
E60	–	–



9Y1200144CRM005C

No.	Terminal Name	Signal Name
E61	–	–
E62	–	–
E63	ODOC	OUTLET DOC (DPF EXHAUST GAS TEMPERATURE SENSOR T1)
E64	–	–
E65	–	–
E66	THW	COOLANT TEMPERATURE SENSOR
E67	PIM	BOOST PRESSURE SENSOR
E68	PFUEL1	RAIL PRESSURE SENSOR 1
E69	AFS	MASS AIR FLOW SENSOR
E70	–	–
E71	–	–
E72	NE-	CRANKSHAFT POSITION SENSOR (−)
E73	G+	CAMSHAFT POSITION SENSOR (+)
E74	–	–
E75	NE-SLD	CRANKSHAFT POSITION SENSOR SHIELD GROUND
E76	THW RTN	COOLANT TEMPERATURE SENSOR RTN
E77	PIM RTN	BOOST PRESSURE SENSOR RTN
E78	PFUEL RTN	RAIL PRESSURE SENSOR RTN
E79	–	–
E80	–	–

9Y1200199CRM0039US0

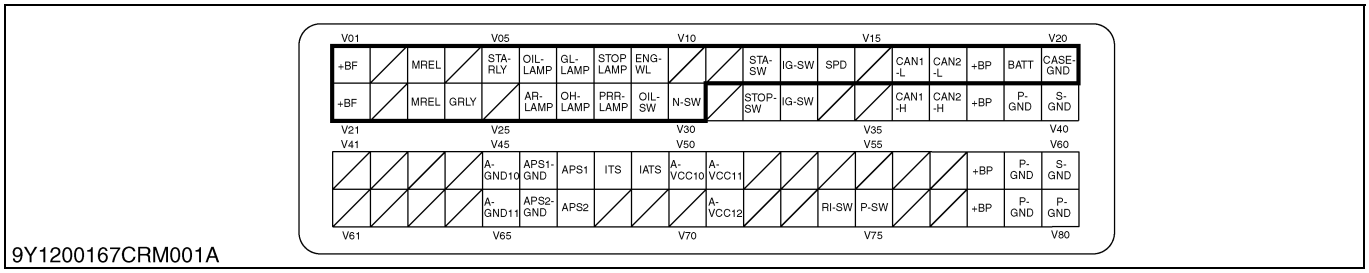


9Y1200174CRM002A

(1) ECU Wiring Harness Connector 1 (Engine Side)
(2) ECU Connector 1 (Engine Side)
(3) ECU Connector 2 (Machine Side)
(4) ECU Wiring Harness Connector 2 (Machine Side)
(5) E01 Pin Position
(6) V01 Pin Position

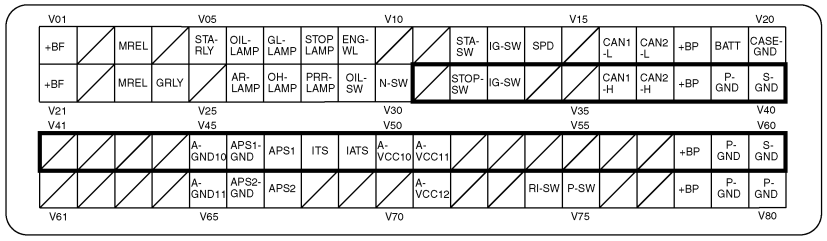
9Y1200199CRM0040US0

(2) ECU Terminal Layout 2 (Machine Side)



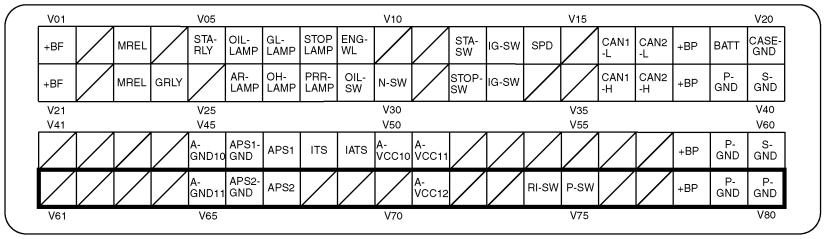
9Y1200167CRM001A

No.	Terminal Name	Signal Name
V01	+BF	BATTERY+ (MAIN RELAY)
V02	–	–
V03	MREL	MAIN RELAY
V04	–	–
V05	STA-RLY	STARTER RELAY
V06	OIL-LAMP	OUTPUT FOR OIL PRESSURE DECREASE LAMP SIGNAL
V07	GL-LAMP	OUTPUT FOR GLOW (AIR HEATER) LAMP SIGNAL
V08	STOP-LAMP	OUTPUT FOR ENGINE STOP LAMP SIGNAL
V09	ENG-WL	OUTPUT FOR ENGINE WARNING LIGHT SIGNAL
V10	–	–
V11	–	–
V12	STA-SW	STARTER SWITCH
V13	IG-SW	KEY SWITCH ON
V14	SPD	MACHINE TRAVEL SPEED SIGNAL
V15	–	–
V16	CAN1-L	CAN1-L (FOR SERVICE)
V17	CAN2-L	CAN2-L (FOR MACHINE)
V18	+BP	BATTERY+ (MAIN RELAY)
V19	BATT	BATTERY+
V20	CASE-GND	CASE GROUND
V21	+BF	BATTERY+ (MAIN RELAY)
V22	–	–
V23	MREL	MAIN RELAY
V24	GRLY	GLOW (AIR HEATER) RELAY
V25	–	–
V26	AR-LAMP	ACTIVE REGENERATION LAMP
V27	OH-LAMP	OUTOUT FOR OVERHEAT LAMP SIGNAL
V28	PRR-LAMP	PARKED REGENERATION REQUEST LAMP
V29	OIL-SW	OIL PRESSURE DECREASE SWITCH
V30	N-SW	NEUTRAL SWITCH



9Y1200167CRM001B

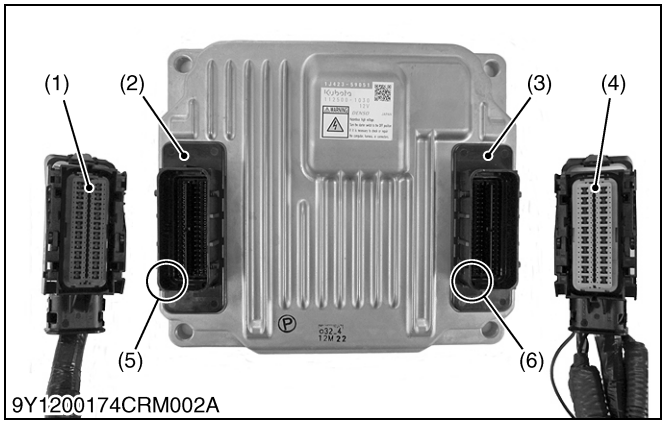
No.	Terminal Name	Signal Name
V31	–	–
V32	STOP-SW	EMERGENCY STOP SWITCH
V33	IG-SW	KEY SWITCH ON
V34	–	–
V35	–	–
V36	CAN1-H	CAN1-H (FOR SERVICE)
V37	CAN2-H	CAN2-H (FOR MACHINE)
V38	+BP	BATTERY+ (MAIN RELAY)
V39	P-GND	POWER GROUND
V40	S-GND	SIGNAL GROUND
V41	–	–
V42	–	–
V43	–	–
V44	–	–
V45	A-GND10	MASS AIR FOLW SENSOR GROUND
V46	APS1-GND	ACCELERATOR POSITION SENSOR1 (GROUND)
V47	APS1	ACCELERATOR POSITION SENSOR1
V48	ITS	INTAKE THROTTLE POSITION SENSOR
V49	IATS	INTAKE AIR TEMPERATURE SENSOR (IN MASS AIR FLOW SENSOR)
V50	A-VCC10	ACCELERATOR POSITION SENSOR2 (POWER SUPPLY)
V51	A-VCC11	ACCELERATOR POSITION SENSOR1 (POWER SUPPLY)
V52	–	–
V53	–	–
V54	–	–
V55	–	–
V56	–	–
V57	–	–
V58	+BP	BATTERY+ (MAIN RELAY)
V59	P-GND	POWER GROUND
V60	S-GND	SIGNAL GROUND



9Y1200167CRM001C

No.	Terminal Name	Signal Name
V61	–	–
V62	–	–
V63	–	–
V64	–	–
V65	A-GND11	DIFFERENTIAL PRESSURE SENSOR GROUND / INTAKE THROTTLE POSITION SENSOR GROUND
V66	APS2-GND	ACCELERATOR POSITION SENSOR2 (GROUND)
V67	APS2	ACCELERATOR POSITION SENSOR2
V68	–	–
V69	–	–
V70	–	–
V71	A-VCC12	DIFFERENTIAL PRESSURE SENSOR (POWER SUPPLY)
V72	–	–
V73	–	–
V74	R1-SW	REGENERATION INHIBIT SWITCH
V75	P-SW	PARKING SWITCH
V76	–	–
V77	–	–
V78	+BP	BATTERY+ (MAIN RELAY)
V79	P-GND	POWER GROUND
V80	P-GND	POWER GROUND

9Y1200199CRM0041US0



9Y1200174CRM002A

(1) ECU Wiring Harness Connector 1 (Engine Side)
(2) ECU Connector 1 (Engine Side)
(3) ECU Connector 2 (Machine Side)
(4) ECU Wiring Harness Connector 2 (Machine Side)
(5) E01 Pin Position
(6) V01 Pin Position

9Y1200199CRM0040US0

SERVICING

CONTENTS

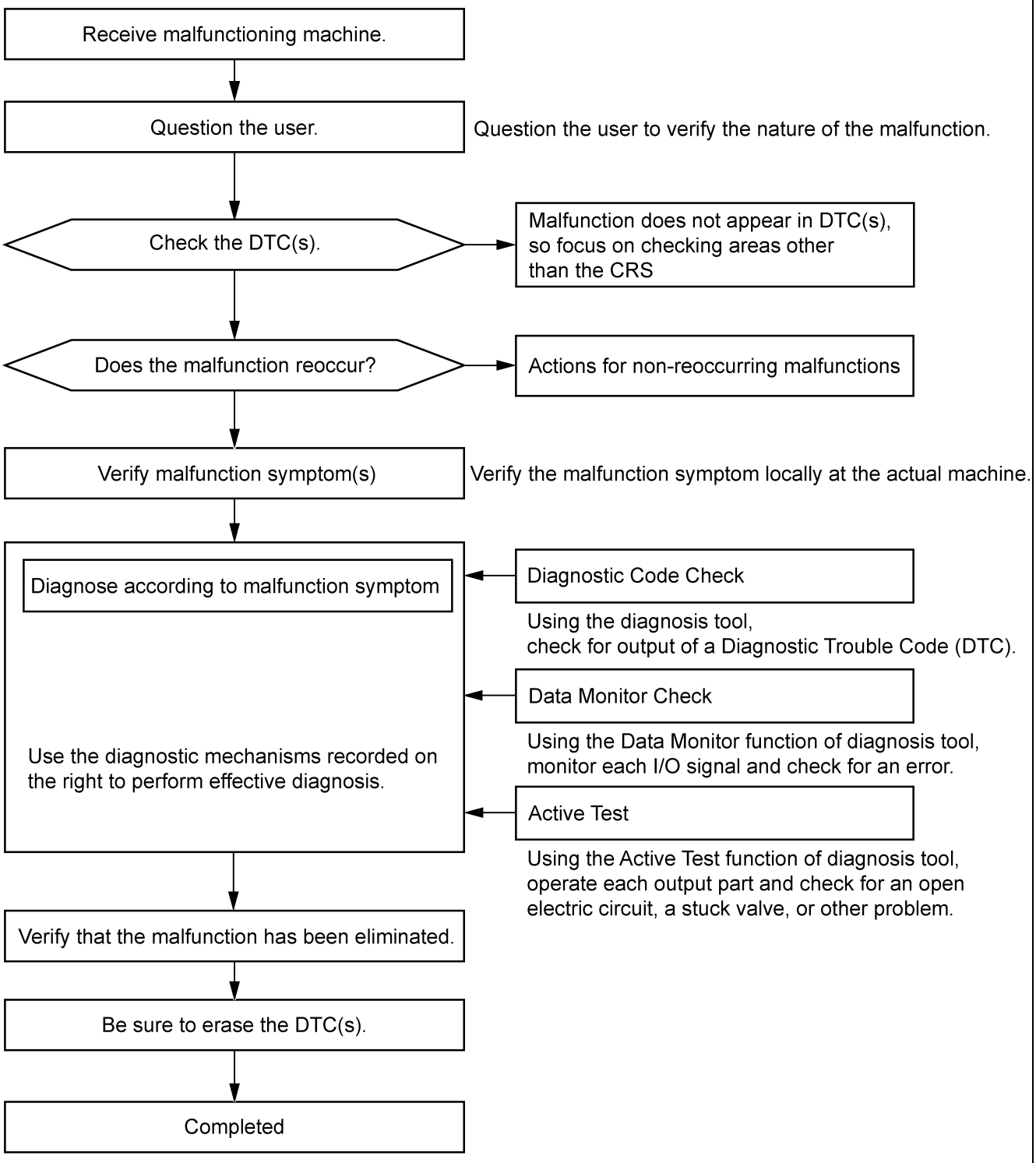
1. GENERAL....1-S1
   [1] OVERALL DIAGNOSTIC PROCEDURE....1-S1
   [2] QUESTIONING....1-S2
   [3] LIST OF MALFUNCTION SYMPTOM....1-S5
   [4] ACTIONS FOR NON-REOCCURRING MALFUNCTIONS....1-S6
2. DIAGNOSTIC TOOL CONNECTION PROCEDURE....1-S8
   [1] DIAGNOSTIC CONNECTOR POSITIONS....1-S8
   [2] DIAGNOSTIC TOOL CONNECTION PROCEDURE....1-S8
   [3] CHECKING THE COMMUNICATION OPERATION OF THE INTERFACE (DST-i)....1-S9
   [4] CHECKING THE OPERATION OF THE ECU....1-S10
      (1) Starting Diagmaster....1-S10
      (2) DST-i Communication Settings....1-S11
3. ACTIVE TEST AND SUPPLY PUMP DIFFERENCE LEARNING....1-S15
4. DIAGNOSIS BY MALFUNCTION SYMPTOM....1-S17
   [1] LIST OF MALFUNCTION CAUSES BY SYMPTOM....1-S17
   [2] DIAGNOSIS BY MALFUNCTION SYMPTOM....1-S21
      (1) Engine Warning Light Comes On....1-S21
      (2) Engine Does Not Start....1-S21
      (3) Takes A Long Time Before Engine Starts....1-S25
      (4) Idle Failure....1-S29
      (5) Engine Noise....1-S32
      (6) High fuel consumption....1-S34
      (7) Poor Acceleration (Insufficient Output)....1-S39
      (8) Abnormal Black Smoke Emitted....1-S44
      (9) Abnormal White Smoke Emitted....1-S48
      (10)Engine Stalls On Deceleration....1-S53
5. DIAGNOSTIC PROCEDURE BY DTC....1-S57
   [1] DTC LIST....1-S57
   [2] DIAGNOSTIC PROCEDURE BY DTC....1-S120
      (1) NE - G Phase Shift (DTC P0016 / 636-7)....1-S123
      (2) Intake Air Temperature Built-in MAF Sensor: Abnormality (DTC P0072 / 171-4, DTC P0073 / 171-3)....1-S124
      (3) Pressure Limiter Emergency Open (DTC P0087 / 633-7)....1-S127
      (4) High Rail Pressure (DTC P0088 / 157-0)....1-S132
      (5) SCV Stuck (DTC P0089 / 1347-7)....1-S137
      (6) Fuel Leak (in High Pressured Fuel System) (DTC P0093 / 1239-1)....1-S142
      (7) Intake Air Volume: Low (DTC P0101 / 132-1)....1-S147
      (8) MAF Sensor Abnormality (DTC P0102 / 132-4, P0103 / 132-3)....1-S148
      (9) Intake Air Temperature: High (Inter Cooler Model Only) (DTC P0111 / 172-0)....1-S150
      (10)Intake Air Temperature Error (DTC P0112 / 172-4, P0113 / 172-3)....1-S151
      (11)Coolant Temperature Sensor Abnormality (DTC P0117 / 110-4, P0118 / 110-3)....1-S154
      (12)Fuel High Temperature (DTC P0181 / 174-0)....1-S157
      (13)Fuel Temperature Sensor Abnormality (DTC P0182 / 174-4, P0183 / 174-3)....1-S158
      (14)Rail Pressure Sensor Abnormality (DTC P0192 / 157-4, P0193 / 157-3)....1-S161
      (15)Injector Charge Voltage: High (DTC P0200 / 523535-0)....1-S165
      (16)Open Circuit of Harness/Coil (DTC P0201 / 651-3, P0202 / 653-3, P0203 / 654-3, P0204 / 652-3)....1-S167
      (17)Engine Overheat (DTC P0217 / 110-0)....1-S170
      (18)Engine Overrun (DTC P0219 / 190-0)....1-S172

(19)Boost Pressure Sensor Abnormality (DTC P0237 / 102-4, P0238 / 102-3) 1-S173
(20)Crankshaft Position Sensor (NE Sensor) Abnormality (DTC P0335 / 636-8, P0336 / 636-2) 1-S177
(21)Camshaft Position Sensor (G Sensor) Abnormality (DTC P0340 / 723-8, P0341 / 723-2) 1-S182
(22)Air Heater Relay Driving Circuit Abnormality (DTC P0380 / 523544-3 / 523544-4) ...1-S186
(23)EGR Actuator Abnormality (DTC P0403 / 523574-3, DTC P0404 / 523574-4, P0409 / 523572-4).....1-S190
(24)Oil Pressure Error (P0524 / 100-1).....1-S193
(25)Exhaust Gas Temperature Sensor 1 (T1) Abnormality (DTC P0543 / 3242-4, P0544 / 3242-3).....1-S195
(26)Exhaust Gas Temperature Sensor 0 (T0) Abnormality (DTC P0546 / 4765-4, P0547 / 4765-3).....1-S198
(27)Battery Voltage Abnormality (DTC P0562 / 168-4, P0563 / 168-3).....1-S201
(28)QR Data Abnormality (DTC P0602/523538-2, P0602/523538-7) 1-S204
(29)ECU Flash-ROM and CPU Abnormality (DTC P0605 / 628-2, P0606 / 1077-2, P0606/ 523527-2).....1-S205
(30)Injector Charge Voltage Abnormality (DTC P0611 / 523525-1) 1-S207
(31)SCV Drive System Abnormality (DTC P0628 / 1347-4, P0629 / 1347-3).....1-S209
(32)Sensor Supply Voltage 1 Abnormality (DTC P0642 / 3509-4, P0643 / 3509-3).....1-S213
(33)Sensor Supply Voltage 2 Abnormality (DTC P0652 / 3510-4, P0653 / 3510-3).....1-S215
(34)Main Relay is Locked in Closed Position (DTC P0687 / 1485-2) 1-S217
(35)Pump Seizing (DTC P1274 / 523539-2, P1275 / 523540-2) 1-S220
(36)EEPROM Check Sum Error (DTC P1990 / 523700-13, P1991 / 523701-13, P1992 / 523702-13) 1-S225
(37)Intake Throttle Feedback Error (DTC P2108 / 523580-2) 1-S227
(38)Accelerator Position Sensor 1 Abnormality (DTC P2122 / 91-4, P2123 / 91-3).....1-S229
(39)Accelerator Position Sensor 2 Abnormality (DTC P2127 / 29-4, P2128 / 29-3).....1-S233
(40)Accelerator Position Sensor Error (CAN) (DTC P2131 / 523543-2).....1-S237
(41)Accelerator Position Sensor Correlation Error (DTC P2135 / 91-2) 1-S239
(42)Common 1 System Injector Drive Circuit Open (DTC P2146 / 523523-2) 1-S240
(43)Common 1 TWV Actuation System Short (DTC P2147 / 523523-4, P2148 / 523523-3) 1-S243
(44)Common 2 System Injector Drive Circuit Open (DTC P2149 / 523524-2) 1-S247
(45)Common 2 TWV Actuation System Short (DTC P2150 / 523524-4, P2151 / 523524-3) 1-S250
(46)Barometric Pressure Sensor Error (DTC P2228 / 108-4, P2229 / 108-3) 1-S254
(47)EGR (DC Motor) Abnormality (DTC P2413 / 523575-7, P2414 / 523576-2, P2415 / 523577-2) 1-S256
(48)Exhaust Gas Temperature Sensor 2 (T2) Abnormality (DTC P242C / 3246-4, P242D / 3246-3) 1-S259
(49)Differential Pressure Sensor 1 Abnormality (DTC P2454 / 3251-4, P2455 / 3251-3) ...1-S262
(50)Intake Throttle Lift Sensor Abnormality (DTC P2621 / 523583-4, P2622 / 523582-3) 1-S266
(51)Emission Deterioration (DTC P3001 / 3252-0).....1-S268
(52)Exhaust Gas Temperature Sensor 0: Emergency High (DTC P3002 / 4765-0).....1-S270
(53)Exhaust Gas Temperature Sensor 1: Emergency High (DTC P3003 / 3242-0).....1-S272
(54)Exhaust Gas Temperature Sensor 2: Emergency High (DTC P3004 / 3246-0).....1-S274
(55)Excessive PM3 (DTC P3006 / 3701-15) 1-S276
(56)Excessive PM4 (DTC P3007 / 3701-16) 1-S277
(57)Excessive PM5 (DTC P3008 / 3701-0) 1-S278
(58)Boost Pressure Low (DTC P3011 / 132-15).....1-S279
(59)Low Coolant Temperature in Parked Regeneration (DTC P3012 / 523589-17).....1-S281
(60)Parked Regeneration Time Out (DTC P3013 / 523590-16) 1-S282
(61)All Exhaust Gas Temperature Sensor Failure (DTC P3018 / 523599-0) 1-S284
(62)Initial Pump-calibration Incomplete (DTC P3019 / 523600-0).....1-S285
(63)High Exhaust Gas Temperature After Emergency High Temperature DTC (DTC P3023 / 523601-0).....1-S286
(64)High Frequency of Regeneration (DTC P3024 / 523602-0) 1-S287

(65)Over Heat Pre-caution (DTC P3025 / 523603-15) 1-S288
(66)CAN2 Bus Off (DTC U0075 / 523547-2) 1-S289
(67)No Communication with EGR (DTC U0076 / 523578-2) 1-S291
(68)CAN1 Bus Off (DTC U0077 / 523604-2) 1-S293
(69)CAN2 Frame Error (DTC U0081 / 523548-2, U0082 / 523591-2, U0083 / 523592-2, U0084 / 523593-2, U0085 / 523594-2, U0086 / 523595-2, U0087 / 523596-2, U0089 / 523598-2) 1-S294
6. INSPECTION PROCEDURE FOR EACH SYSTEM 1-S298
[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE 1-S298
[2] FUEL SYSTEM INSPECTION PROCEDURE 1-S299
[3] ELECTRIC SYSTEM INSPECTION PROCEDURE 1-S304
(1) Basics Of Checking Electrical / Electronic Circuit Systems 1-S304
(2) Connector Connection Fault Verification Method 1-S307
(3) Checking The Power And Ground System (Main Relay, ECU Circuit) 1-S308

1. GENERAL

[1] OVERALL DIAGNOSTIC PROCEDURE



9Y1200125CRS001C

9Y1200199CRS0608US0

[2] QUESTIONING

- Use the trouble check sheet to ensure that the customer's explanation is fully understood.
- Accurately judge information concerning the malfunction.
  Grasp the situation firmly, using five 5W1H (Who, What, When, Where, Why, How) as a basis.
  Ex: Low ambient temperature, starting, normal conditions, proximity to engine, metallic noise, etc.

(Reference)

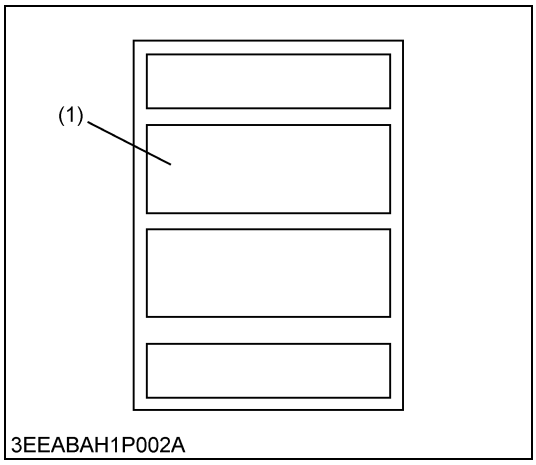
Do not ask random questions. Ask questions that will aid in narrowing down the possible malfunctioning system while making educated guesses based on the malfunction symptoms.

9Y1200199CRS0609US0

Questioning Points

What?	Malfunction symptom
When?	Date, time, frequency of occurrence.
Where?	Field conditions
What were conditions like at the time of malfunction?	Driving conditions, operating conditions, weather.
What happened?	Type of malfunction.

9Y1200199CRS0610US0



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Trouble Check Sheet for KUBOTA Common Rail System

When the machine is received from the customer, it is necessary to verify the "malfunction symptoms" and the "generated malfunction data" with the customer. This is performed based on the trouble check sheet.

(1) Trouble Check Sheet

Because:

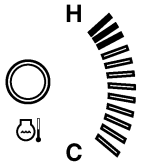
- The malfunction symptom may not be reproduced at the workshop.
- The customer's complaint does not always match the malfunction.
- If the person performing repairs is not working from the correct malfunction symptoms, man-hours will be wasted.

The question chart can aid the service person in diagnosing, repairing and verifying repair work.

9Y1200199CRS0611US0

Trouble Check Sheet					
Machine details					
Customer name					
Customer address					
Machine model			Machine serial number		
Engine serial number			Purchase date		
Repair date			Hourmeter indicator	hours	
Warranty					
Warranty Judgment	☐ Yes		☐ No		
Defective parts	☐ Injector		☐ Supply Pump		
	☐ Common rail		☐ Fuel Filter		
	☐ Others ( )				
Replace parts details					
Supply Pump	Quantity	Units	Part number		
	Serial number				
Injector	Quantity	Units	Part number		
	Serial number		Cylinder 1 ( )	Cylinder 2 ( )	
			Cylinder 3 ( )	Cylinder 4 ( )	
	Defective injector		☐ Injector 1	☐ Injector 2	
			☐ Injector 3	☐ Injector 4	
Actual part replacement	☐ Injector		☐ Supply Pump		
	☐ Common rail		☐ Fuel Filter		
	☐ ECU		☐ Others ( )		
Customer complaint					
☐ 1. Engine no start	☐ a. No initial combustion		☐ b. No complete combustion		
	☐ c. No cranking				
☐ 2. Difficult to start	☐ a. Engine crank slowly				
	☐ b. Others ( )				
☐ 3. Poor idling	☐ a. Incorrect first idle		☐ b. Noise		
	☐ c. Hunting idle from ( ) to ( ) min^{-1} (rpm)				
	☐ d. High idling ( ) min^{-1} (rpm)				
	☐ e. Low idling ( ) min^{-1} (rpm)				
	☐ f. Rough				
	☐ g. Others ( )				
☐ 4. Poor driveability	☐ a. Hesitation		☐ b. Surging		
	☐ c. Knocking		☐ d. Lack of power		
	☐ e. Others ( )				
☐ 5. Abnormal smoke	☐ a. Black		☐ b. White		
	☐ c. Others ( )				
☐ 6. Fuel leakage	☐ a. Large quantity		☐ b. Blurred		
	Leaking from:		☐ Injector	☐ Supply Pump	
			☐ Others ( )		
☐ 7. Engine not stop					
☐ 8. Engine stall					
☐ 9. Others					

9Y1200199CRS0612US0

Condition when problem occurs (Duplicated answers can be possible)		
1. Weather	☐ a. Fine	☐ b. Cloudy
	☐ c. Rainy	☐ d. Snow
	☐ e. Flood	
	☐ f. Others ( )	
2. Outdoor temperature	Approx. °C (°F)	
3. Altitude	Approx. m	
4. Engine coolant	☐ a. Cold	Write the position of the indicator on coolant temperature gauge.  9Y1200058ENI031A
	☐ b. Warming up	
	☐ c. After warming up	
	☐ d. Any temperature	
	☐ e. Others ( )	
5. Engine operation	☐ a. Starting	☐ b. Just after starting
	☐ c. Idling	☐ d. Racing
	☐ e. Acceleration	☐ f. Deceleration
	☐ g. While at work	
	☐ h. Others ( )	
6. Problem frequency	☐ a. Constant	☐ b. Once only
	☐ c. Sometime (Time per day/month)	
7. Engine warning light	☐ Turn on a light	☐ Turn off a light
8. Optional parts	Fill the parts in if you use optional parts or non-genuine parts for electrical, intake/exhaust and fuel system. ( )	
Dealer check		
1. Duplicate the problem	☐ a. Yes (Duplicate)	☐ b. No (Not occur)
2. Diagnosis trouble code	☐ a. Abnormal (What is code)	
	☐ b. Normal (No code)	
3. Appearance	☐ a. Normal	☐ b. Cracked
	☐ c. Discolored	
	☐ d. Others ( )	
4. Fuel condition	☐ a. Normal	
	☐ b. Abnormal ( )	

9Y1200199CRS0613US0

[3] LIST OF MALFUNCTION SYMPTOM

Malfunctions and corresponding symptoms resulting from the CRS may also be generated from other sources, such as the engine (mechanical parts), the fuel system, etc. When performing CRS troubleshooting, the aim is not to quickly determine that the CRS is the cause of a malfunction. Rather, the cause should be exhaustively considered while verifying the causes listed below.

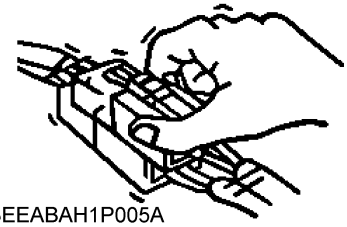
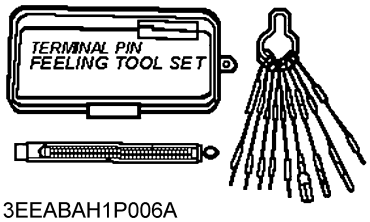
Malfunction symptom	Area of Fault	Cause	Action
Engine overheat	Fuel system	Poor fuel	Switch to the correct fuel (No.2-D diesel fuel).
	Lubrication system	Engine oil deterioration.	Change engine oil.
		Inappropriate engine oil.	Replace with the appropriate engine oil (API Service Classification CF grade or higher).
		Faulty oil pump.	Replace oil pump.
		Insufficient engine oil level	Add engine oil.
Insufficient output	Intake system	Clogged air cleaner element.	Clean or replace air cleaner element.
	Fuel system	Air mixed with the fuel system.	Perform fuel system air bleeding.
		Faulty fuel filter.	Replace fuel filter.
		Poor or inappropriate fuel.	Switch to the correct fuel (No.2-D diesel fuel).
	Engine	Worn cylinder liner and the piston ring of the piston. (Low compression pressure)	Overhaul engine.
	Other	Overheat	Refer to "Engine Overheat" items.
Faulty starting	Intake system	Clogged air cleaner element.	Clean or replace air cleaner element.
	Fuel system	Insufficient fuel.	Add fuel and perform fuel system air bleeding.
		Fuel system clogged.	Clean the fuel system.
		Large amount of intermixing water to the water separator, element clogging and deformation.	Clean or replace.
		Air being introduced through fuel system connection points.	Tighten connections.
		Clogged fuel filter	Replace fuel filter.
		Fuel feed pump operation fault.	Replace fuel feed pump.
		Injection pipe connection loose.	Tighten connecting nut.
	Electrical system	Battery fault	Inspect battery.
		Faulty starter wiring.	Replace starter wiring.
		Loose battery cable.	Tighten battery terminal connections, or replace cables.
		Faulty starter operation.	Replace starter assembly.
		Starting assist device (glow heater) fault.	Replace starting assist device (glow heater).
	Lubrication system	Excessive engine oil viscosity.	Replace with oil of appropriate viscosity.
	Engine	Burnt pistons.	Replace piston, piston ring and cylinder block.
		Burnt main bearing.	Replace main bearing and crankshaft.
		Low compression pressure.	Overhaul engine.
	Other	Ring gear damage.	Flywheel / starter replacement.
Idle fault	Engine	Poor valve clearance	Adjust valve clearance.
		Poor valve seat contact.	Break in valve and valve seat, or replace.
		Low coolant temperature.	Perform warm-up operation.
		Large difference in cylinder-to cylinder compression pressure.	Overhaul engine.

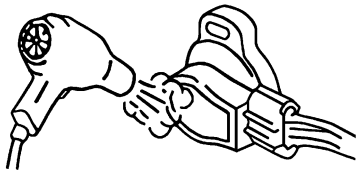
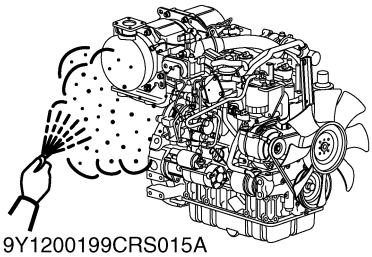
9Y1200199CRS0614US0

[4] ACTIONS FOR NON-REOCCURRING MALFUNCTIONS

- In cases where the malfunction does not reoccur, perform the actions below to determine the cause of the malfunction.
- In cases where the malfunction does not reoccur at the dealer, sales company or workshop, perform the work that actually caused the malfunction.
- Check the fuel pipe system [including the fuel feed pump (electromagnetic pump) and tank], intake system and exhaust system.
- If the malfunction does not reoccur, there may be an ECU malfunction. For diagnostic purposes only, temporarily replace the ECU with a unit that functions normally to perform the check procedure. At the same time, be sure to perform difference learning for the supply pump and input QR Code for injectors. If there would be no change, ECU should not be replaced.

9Y1200199CRS0615US0

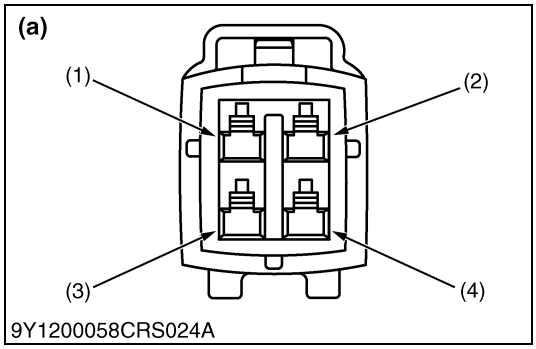
Action	Malfunction symptom		
	Dead battery	Engine will not start	Idle speed abnormal engine stall sluggish poor acceleration
Verify that there is no Diagnostic Trouble Code (DTC) stored in the memory.	–	❍	❍
Using the trouble check sheet as a base, perform a reoccurrence test in "Reoccurrence" mode. Use this data (engine ECU (PCM) voltage value, etc.) to determine the cause of the malfunction.	❍	❍	❍
Assume that an electrical system wiring harness or connector is the cause of the malfunction and vibrate these components by hand to verify whether or not a malfunction occurs and a DTC is generated.  3EEABAH1P005A	–	❍	❍
Assume that an electrical system female connector terminal is the cause of the malfunction and verify that the connection points are not defective. **Recommended Tools: KOWA Precision Handling** Feeling Tool Set (KLM-10- 20) Depending on the terminal, a matching size may not be available.  3EEABAH1P006A Insert the male terminal that matches the shape of the female terminal and check for looseness.  3EEABAH1P007A	–	❍	❍

Action	Malfunction symptom		
	Dead battery	Engine will not start	Idle speed abnormal engine stall sluggish poor acceleration
Heat the accelerator sensor and other electrical components with a hair dryer. Verify whether or not the voltage value (resistance value) changes. ■ **NOTE** • **Do not exceed 60 °C (140 °F) (still touchable by hand) when heating.** • **Do not remove the component case and add heat directly to electronic parts.**  3EEABAH1P008A	–	–	❍
Verify whether or not malfunction symptoms occur under heavy engine loads (headlights, A/C, wiper, etc. switches ON).	❍	–	❍
If any commercial electrical products have been installed, remove them and verify whether or not the malfunction symptoms occur.	❍	❍	❍
If it is thought that the malfunction occurs in rainy or high temperature weather, spray the machine with water and verify whether or not the malfunction occurs. ■ **NOTE** • **Do not spray water directly onto the engine. Spray water mist on the entire surface of the radiator to indirectly change the temperature and humidity of the engine compartment.** • **Do not spray water directly on electrical parts.**  9Y1200199CRS015A		❍	❍

9Y1200199CRS0616US0

2. DIAGNOSTIC TOOL CONNECTION PROCEDURE

[1] DIAGNOSTIC CONNECTOR POSITIONS



9Y1200058CRS024A

1. Refer to the operator's manual for this machine to check the position for connecting the diagnosis tool.

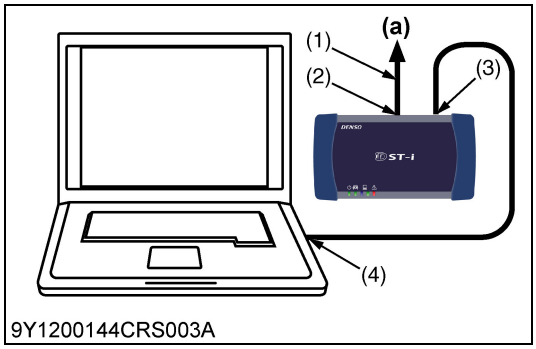
(1) Terminal IG-SW (V13, V33)
(2) Terminal CAN1-H (V36)
(3) Terminal S-GND (V60)
(4) Terminal CAN1-L (V16)
(a) CAN1 Connector

9Y1200199CRS0617US0

[2] DIAGNOSTIC TOOL CONNECTION PROCEDURE

■ **IMPORTANT**
- **At first time usage, it is necessary to do "Communication Setting" with administrator user account.**
- **Prepare a PC on which the diagnostic software has already been installed.**
- **When connecting the diagnosis cable, ensure that the key switch on the machine side is OFF.**

9Y1200199CRS0618US0



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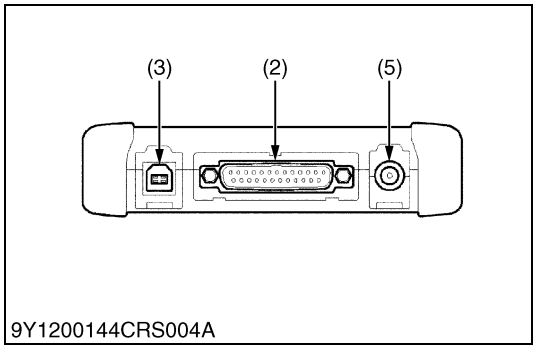


9Y1200144CRS004A

1. Start up a PC on which the diagnostic software has been installed with administrator user account.
2. Connect the machine-side CAN1 connector **(a)** to the interface connector (To Machine) (2) with the cable (To Machine) (1).
3. Connect the cable (USB) (4) to the USB connector (To PC) (3) and then connect the USB cable to the USB port on PC.
4. Start the diagnostic software.
5. Select "Communication Setting" from "System Setting" in the menu and execute. (Only when performing the initial settings.)

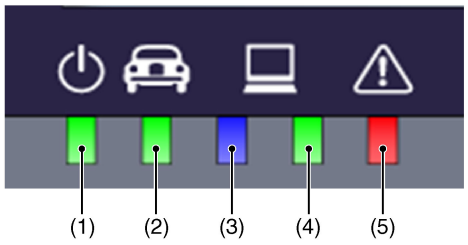
■ **NOTE**
- **The USB port used while the "Communication Setting" process, should always be used.**

(1) Cable (To Machine)
(2) Interface Connector (To Machine)
(3) USB Connector (To PC)*
(4) Cable (USB)
(5) DC Jack (Reserved)*
(a) CAN1 Connector

* Rubber cap is attached to USB connector and DC jack each

9Y1200199CRS0619US0

[3] CHECKING THE COMMUNICATION OPERATION OF THE INTERFACE (DST-i)



9Y1200144CRS005A

The communication operation can be checked with the illuminating condition of the five indicators on the DST-i unit.

If a communication error occurs, check the illuminating condition of each indicator and repair or replace the malfunction (including cable open circuits).

(1) Power Indicator
(2) Machine Communication Indicator
(3) PC Communication (Bluetooth) Indicator
(4) PC Communication (USB) Indicator
(5) Error Detection Indicator

No.	Type of LED	Color	LED Status	Details
(1)	Power Indicator	Green	Light OFF	Power OFF
			Light ON	Power is supplied from machine cable or USB cable
(2)	Machine Communication Indicator	Green	Light OFF	Stand-by for communication
			Light Flashing (synchronized with communication)	Communication in progress
(3)	PC Communication (Bluetooth) Indicator	Blue	Reserved	Bluetooth communication status (Bluetooth is option)
(4)	PC Communication (USB) Indicator	Green	Light OFF	USB cable has not connected to PC or USB driver has not installed to PC
			Light ON	Stand-by for communication
			Light Flashing	Stand-by for establishment of communication
			Light Flashing (synchronized with communication)	Communication in progress
(5)	Error Detection Indicator	Red	Light OFF	Normal conditions
			Light Flashing	Error occurs

9Y1200199CRS0620US0

DST-i operation Status and Display Specification

■ Light Operation During Normal Conditions

DST-i Status	LED Status			
	Power	Machine	USB	Error
Power OFF	□	□	□	□
Power ON	■	□	□	□
USB stand-by status	■	□	●	□
USB cable has not connected to PC or USB driver has not installed to PC	■	□	□	□
Machine stand-by for communication	■	□	■	□
Machine / USB communication in progress	■	★	★	□

■ Light Operation During Abnormal Operation

DST-i Status	LED Status			
	Power	Machine	USB	Error
System Error	■	●	●	●
	■	■	■	●

□: Light OFF ■: Light ON ●: Light Flashing ★: Light Flashing (Synchronized with communication)

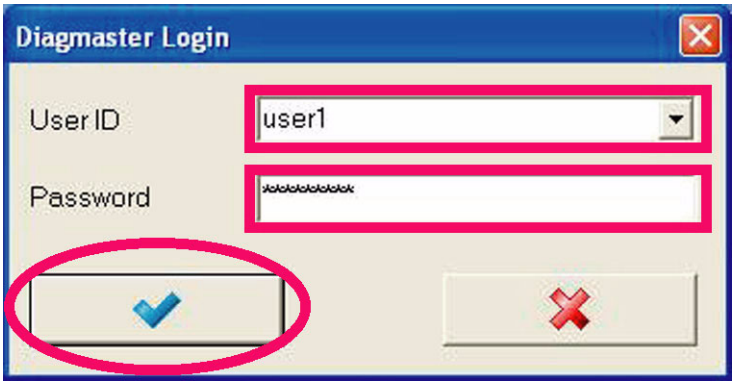
9Y1200199CRS0621US0

[4] CHECKING THE OPERATION OF THE ECU

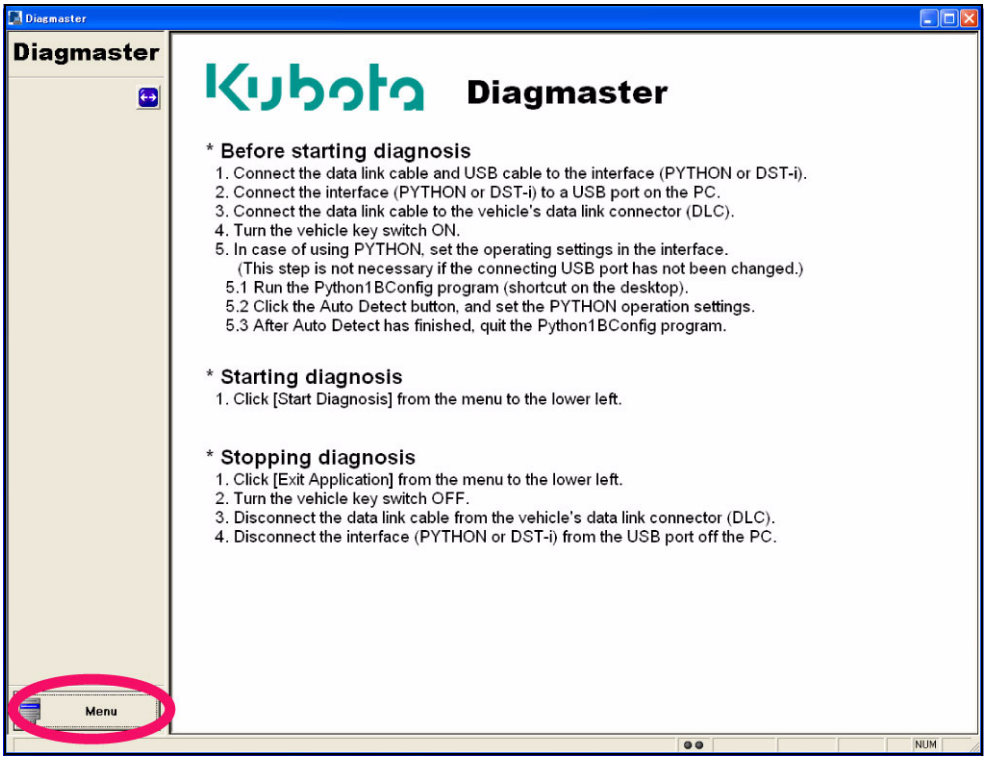
(1) Starting Diagmaster

1. Double-click the Diagmaster icon on your computer desktop

2. Enter your "User ID" and "Password", and then click the  button.



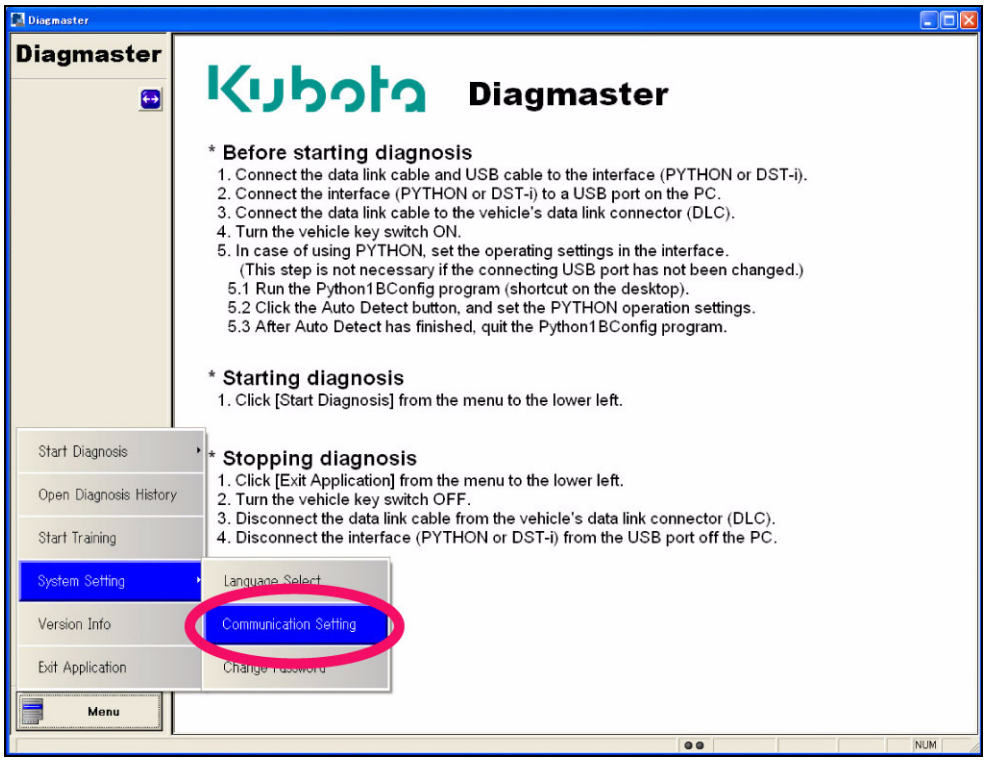
3. The Diagmaster initial screen appears.



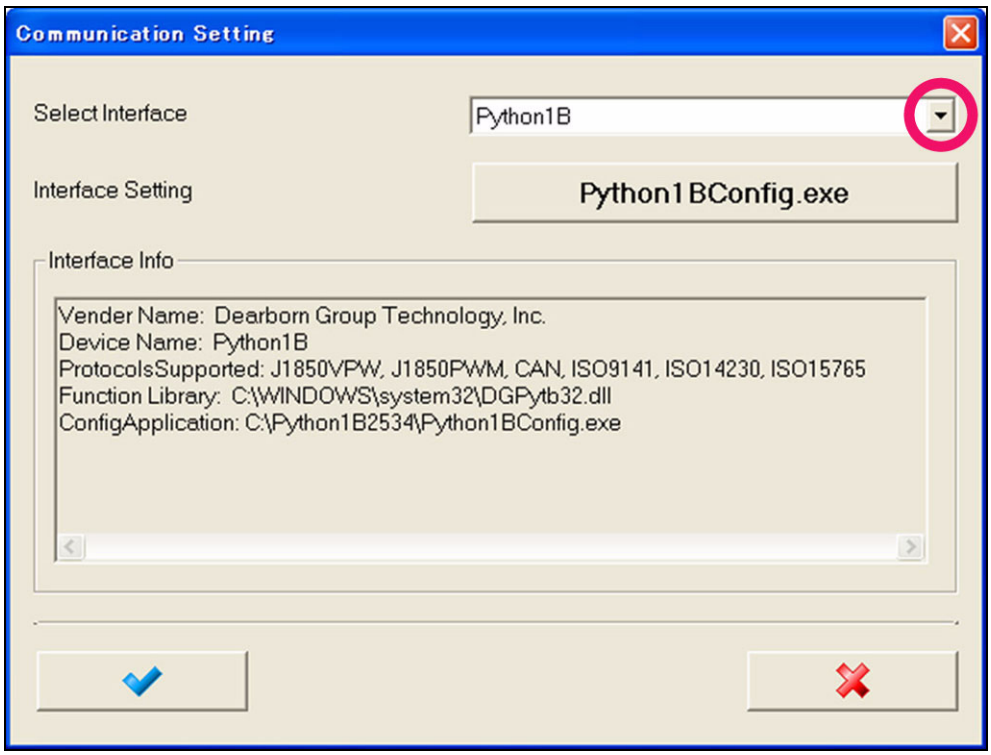
9Y1200199CRS0622US0

(2) DST-i Communication Settings

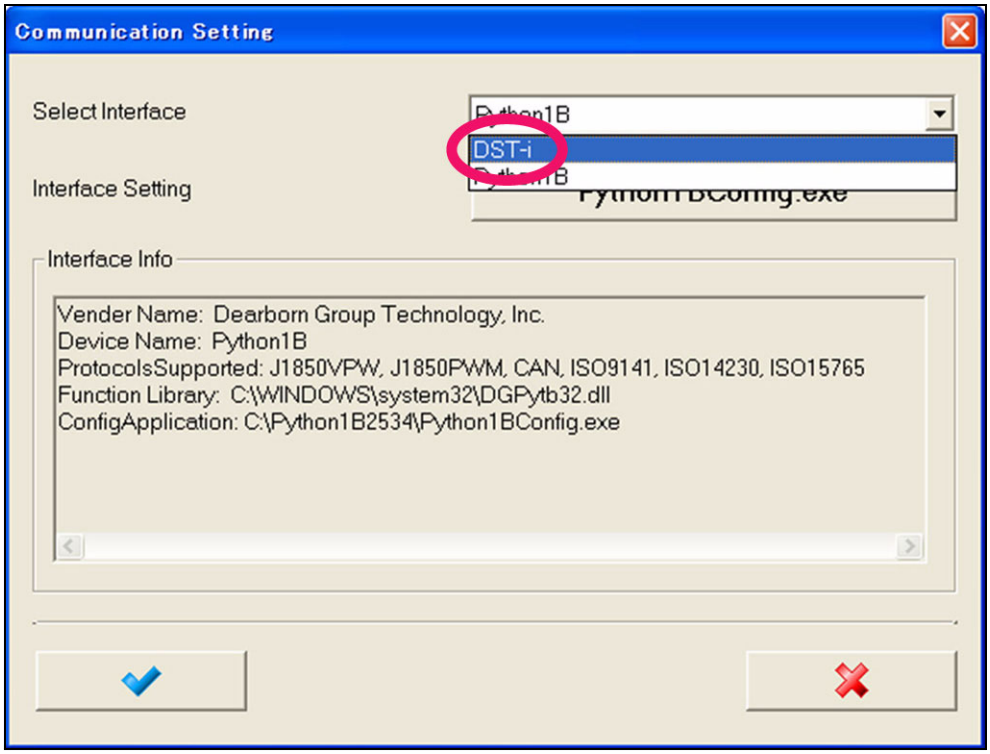
1. From the "Menu", select "System Setting", and then "Communication Setting"



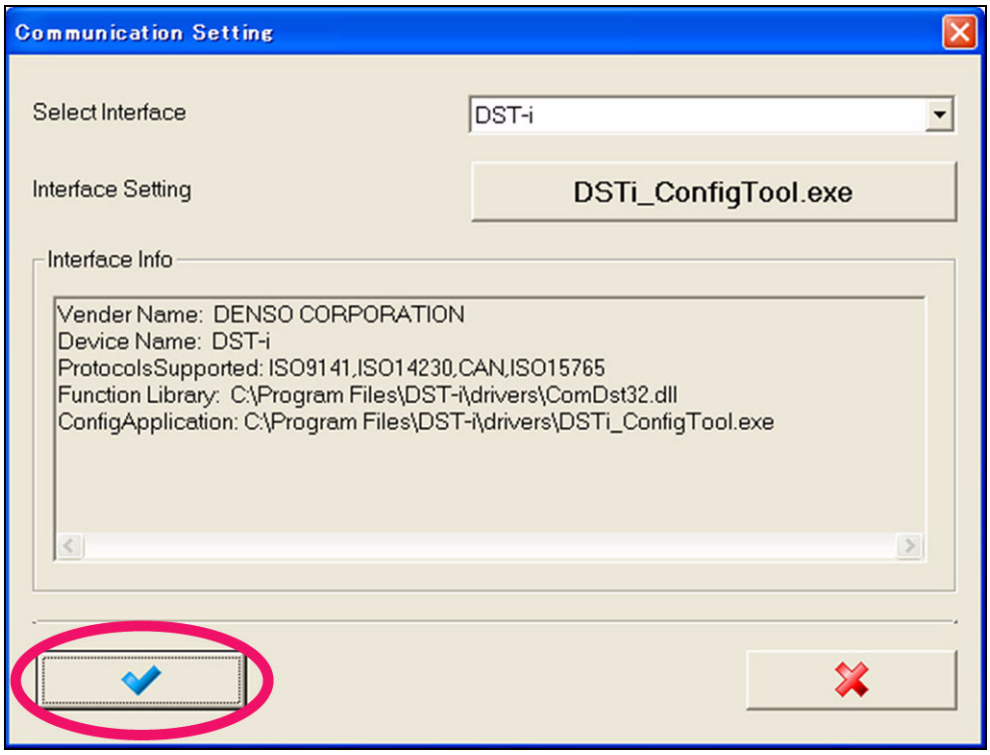
2. Click the interface select button.



3. Select "DST-i", and then click the mouse button.



4. Click the  button.

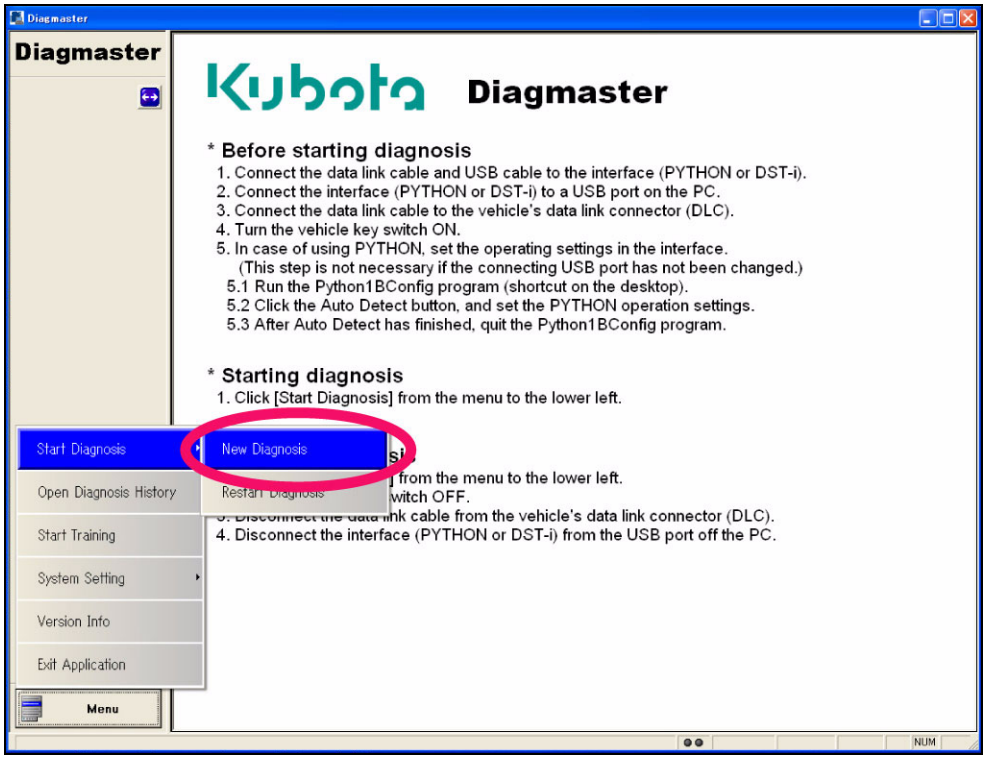


■ **NOTE**

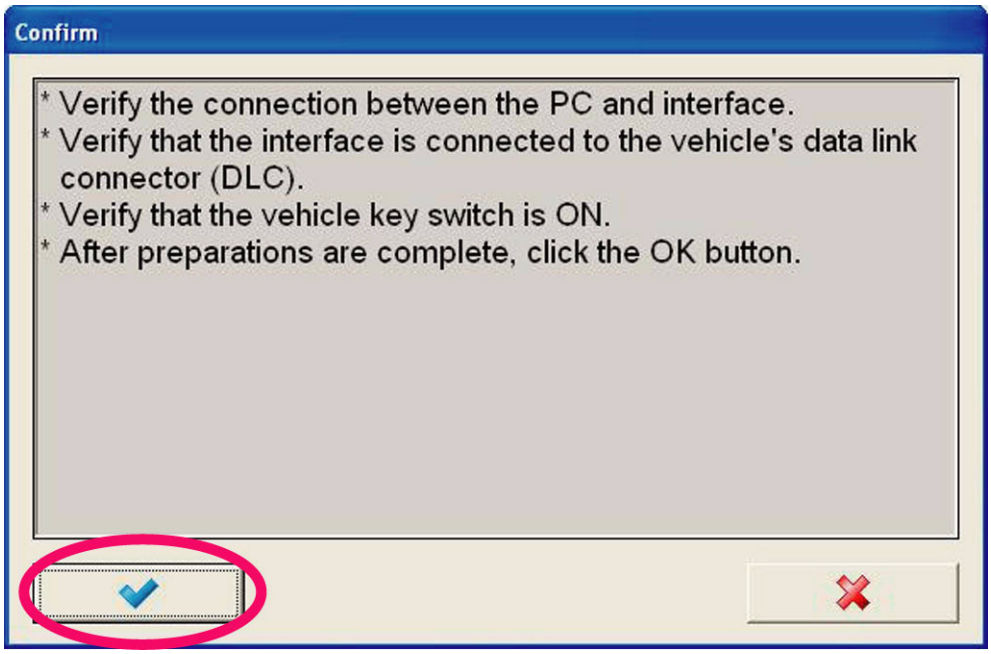
- **If you failed in the setting, confirm the connection and start again from procedure 1. to 4..**

9Y1200199CRS0623US0

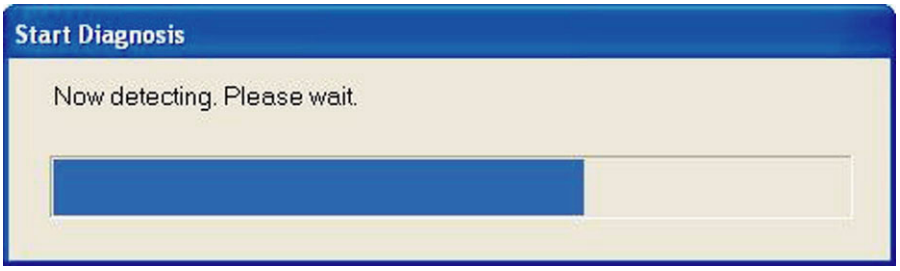
5. From "Menu", select "Start Diagnosis", and then "New Diagnosis".



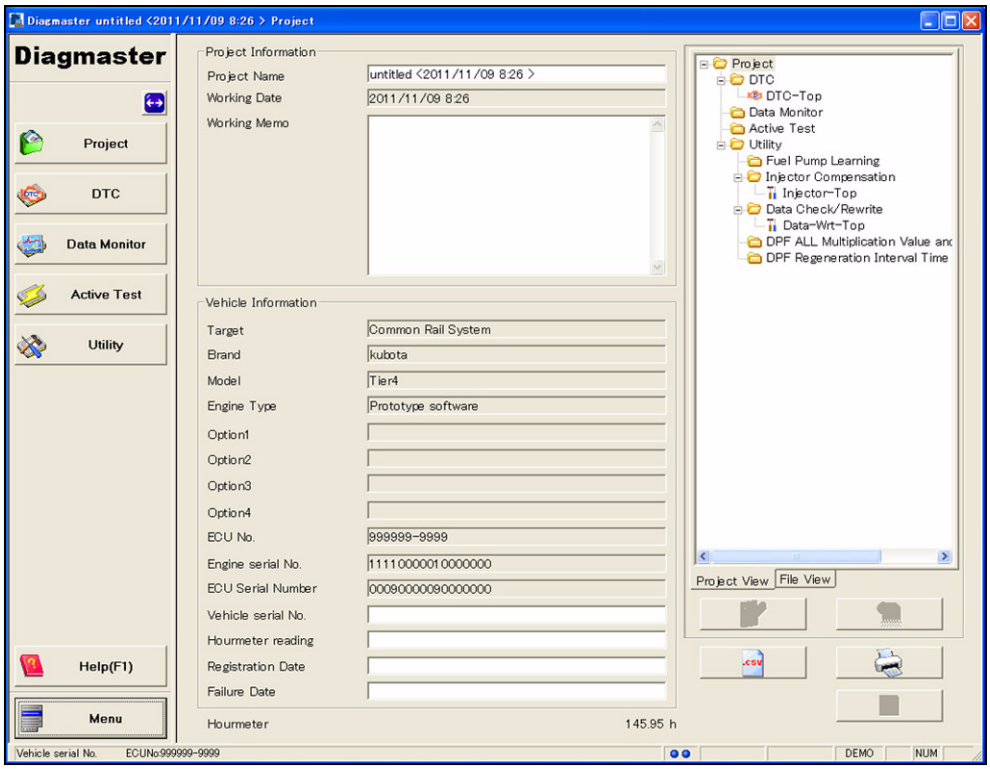
6. Click the  button.



7. The transmitting to ECU progress indicator appears.



8. The "Project" screen appears.



■ **NOTE**

- **If you failed in the setting, confirm the content of procedure 6. and start again from procedure 5. to 8..**

9Y1200199CRS0624US0

3. ACTIVE TEST AND SUPPLY PUMP DIFFERENCE LEARNING

The four items below are used (including the supply pump difference learning).

1	Injector non-injection instruction	From the active test screen
2	EGR actuation test	
3	Air heater relay actuation test	
4	Supply pump difference learning (clear the learning value)	From the utility screen

9Y1200199CRS0625US0

(Operating conditions → specified tool conditions)

1. The conditions below are required for 1. Injector non-injection instruction and 4. Supply pump difference learning:
   - Machine is stopped (KWPSPD = 0)
   - Neutral switch is ON (XNEU = 1 or ON)

9Y1200199CRS0626US0

[Operation details]

1. Injector non-injection instruction
   - Stop the injection for each cylinder injector in accordance with the requests from the tool.

Factory specification	Engine vibration and noise are increased when the injection for the corresponding cylinder is stopped. The same results must be attained from all the cylinders.

■ **NOTE**

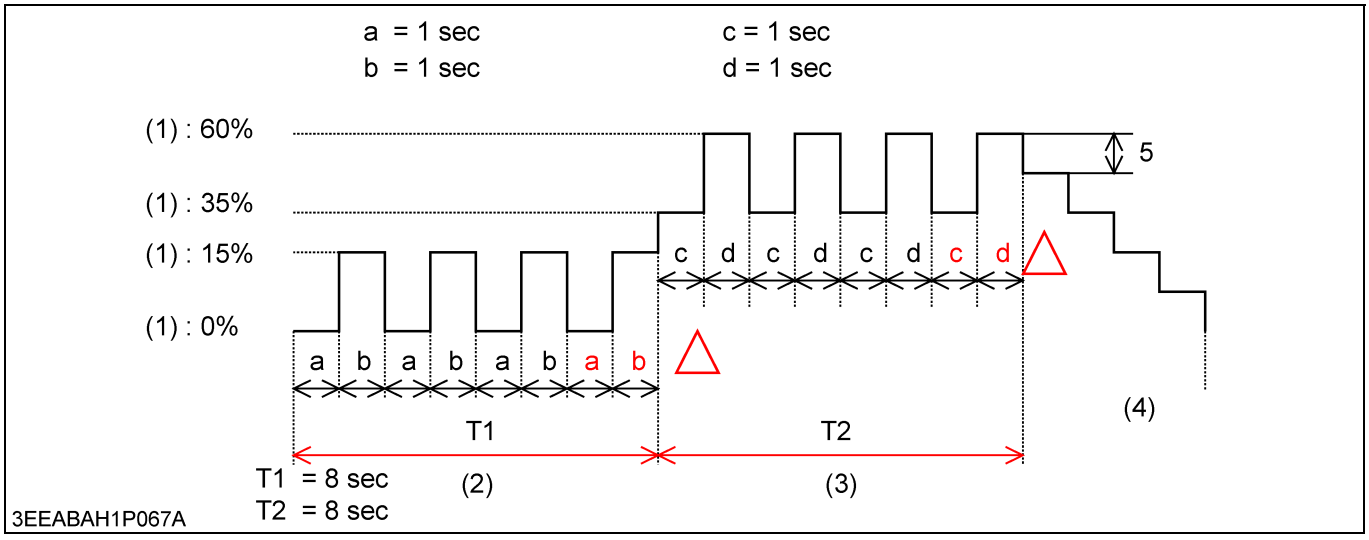
- **Do not judge with the corresponding cylinder only: also compare with the symptoms in the other cylinders.**

2. EGR actuation test
   - Operate as shown in the diagram below and in accordance with the requests from the tool.

Factory specification	Low side: When target EGR valve openings of 0 % and 15 % are given alternately, there must not be disparity in the actual EGR valve opening. High side: When target EGR valve openings of 35 % and 60 % are given alternately, there must not be disparity in the actual EGR valve opening.

■ **NOTE**

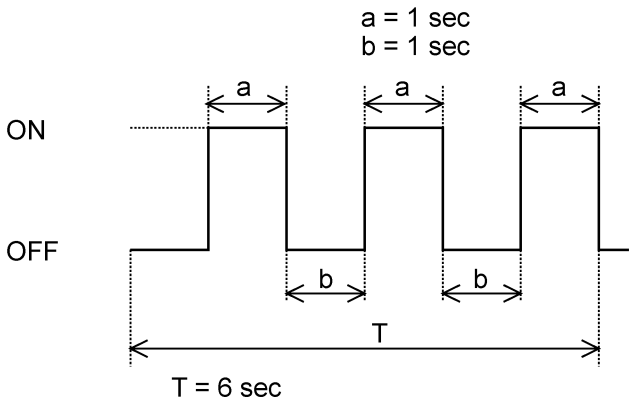
- **In some cases the actual opening may be different from the target opening.**
  The reason for this is because the learning value is always reflected for 0 lift, after being used for a long time 0 points are shifted.
  As such, the factory spec. is a relative evaluation and not an absolute evaluation.



(1) Opening
(2) Operation check on the fully closed valve side
(3) Operation check on the fully open valve side
(4) Fully open → impact dampening when fully closed

3. Air heater relay actuation test
   - Operate as shown in the diagram below and in accordance with the requests from the tool.

Factory specification	Operates repeatedly between ON and OFF in accordance with the specified cycle.



3EEABAH1P068A

4. Supply pump difference learning (clear the learning value)

■ **IMPORTANT**
- **Must be performed after replacing the supply pump or ECU.**
- **Clear the learning completion flag in accordance with the requests from the tool. (Initialize)**

Factory specification	A difference learning completion message comes from the tool. In addition, when the "Pump difference learning status" is checked with the monitor function, the status is 2 or 3.

■ **NOTE**
- **When the diagnosis related pressure is detected, or when the actual rail pressure can not follow the target pressure properly, perform pump difference learning and see what happens. (As there are some cases that can not complete the relearning (status 2) from status 3.)**
- **This major symptom is extreme air in fuel line or filter clogged etc., and it normally occurred when operating with the extreme vacuum pressure. Perform pump difference learning particularly when the replacement of the filter (too much dirt) has not performed or the engine stalls by air in fuel line etc.**

(The conditions of pump difference learning)
- Condition of the pump difference learning is ; After the engine has warmed up (after the thermostat is opened) and the machine is stopped + the neutral switch is ON (neutral status) + the engine is idling (accelerator open position 0 %).

9Y1200199CRS0627US0

4. DIAGNOSIS BY MALFUNCTION SYMPTOM

[1] LIST OF MALFUNCTION CAUSES BY SYMPTOM

- Verify the malfunction symptom, and perform diagnosis according to the appropriate number.
- Many diagnostic procedures include check and verification of malfunction symptom while it occurs. Be sure to perform work while verifying the malfunction symptom.

No.	Malfunction Symptom	Detail
1	Engine Warning Light Comes On.	–
2	Engine Does Not Start.	Engine does not crank (starter motor does not rotate).
		Engine stops when the key switch returns to the ON position from the ST position (engine does not rotate under its own power).
3	Takes A Long Time Before Engine Starts.	Takes a long time before engine starts.
		May accompany idle failure.
4	Idle Failure	Idle speed is lower than the standard value or unstable.
		Engine may stall.
5	Engine Noise	Abnormal noises come from inside the engine.
		Engine sound is loud.
6	High Fuel Consumption	Fuel consumption has increased significantly.
7	Poor Acceleration (Insufficient Output)	Acceleration is slower than before when depressing the accelerator pedal.
		Power feels insufficient compared with previously. Large amount of rotation drop.
8	Black Smoke Emitted.	The amount of black smoke in the exhaust gas has increased abnormally compared with previously.
9	White Smoke Emitted.	The amount of white smoke in the exhaust gas has increased abnormally compared with previously.
10	Engine Stalls On Deceleration.	Engine speed drops when releasing the accelerator pedal.
		Engine stalls on deceleration with the accelerator pedal fully closed.
		Engine stalls immediately after the machine stops when decelerating with the accelerator pedal fully closed.

9Y1200199CRS0628US0

Malfunction Cause		Malfunction Cause																	
		Control System											Engine						
		Crankshaft position sesor			Camshaft position sensor			Accelerator position sensor			Coolant temperature sensor								
		No signal output	Damaged sensor pulsar gear	Air gap size is too large	No signal output	Damaged sensor pulsar gear	Air gap size is too large	No signal output	False signal output	Misadjustment	No signal output	False signal output	Low compression pressure	Engine internal fault	Valve clearance fault	Valve timing fault	Low engine oil viscosity	Insufficient engine oil level
1	Engine Warning Light Comes On	❍	❍	❍	❍	❍	❍	❍	❍		❍		❍ *1	❍ *1		❍ *2		
2	Engine Does Not Start	❍	❍	❍	❍	❍						❍	❍	❍		❍		
3	Takes A Long Time Before Engine Starts		❍	❍	❍	❍					❍	❍	❍	❍		❍		
4	Idle Failure		❍	❍				❍	❍	❍		❍	❍	❍		❍		
5	Engine Noise		❍	❍								❍	❍	❍	❍	❍		
6	High Fuel Consumption		❍	❍								❍	❍	❍	❍	❍	❍	
7	Poor Acceleration (Insufficient Output)		❍	❍				❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	
8	Black Smoke Emitted		❍	❍									❍	❍	❍	❍	❍	
9	White Smoke Emitted		❍	❍									❍	❍	❍	❍		
10	Engine Stalls On Deceleration		❍	❍									❍	❍		❍		

*1: When the engine rotation change is large, it lights.
*2: It lights for a timing positional wrong gear.

9Y1200199CRS0629US0

		Malfunction Cause																	
		Control System									Engine Electrical System					Intake System			
		Boost pressure sensor		Rail pressure sensor		Fuel temperature sensor		SCV malfunction	Main relay malfunction	EGR valve fault	Battery		Charging system malfunction	Air cleaner clogging	Starter relay malfunction	Intake system components	Glow (intake air heater) system		Turbocharge malfunction
Malfunction Cause		No signal output	False signal output	No signal output	False signal output	No signal output	False signal output				Does not charge	Does not discharge				Leak	Faulty relay	Intake air heater fault	
1	Engine Warning Light Comes On	❍	❍	❍		❍		❍	❍		❍		❍			❍ *1	❍		
2	Engine Does Not Start			❍	❍			❍	❍		❍	❍	❍		❍		❍	❍	
3	Takes A Long Time Before Engine Starts			❍	❍			❍				❍			❍		❍	❍	
4	Idle Failure			❍	❍			❍											
5	Engine Noise			❍	❍			❍								❍			❍
6	High Fuel Consumption			❍	❍			❍						❍		❍			❍
7	Poor Acceleration (Insufficient Output)	❍	❍	❍	❍			❍						❍		❍			❍
8	Black Smoke Emitted			❍	❍			❍		❍				❍		❍			❍
9	White Smoke Emitted		❍	❍	❍			❍		❍				❍		❍	❍		❍
10	Engine Stalls On Deceleration							❍						❍					

*1: When pressure doesn't hang to the boost pressure sensor, it is likely to light.

9Y1200199CRS0630US0

Malfunction Cause		Malfunction Cause														
		Fuel System								Cooling System			Others			
		Supply pump learning failure	Fuel quality	Injectors: Blockage, leake, malfunction	Supply pump malfunction	Clogged fuel filter	Faulty fuel pressure limiter	SCV malfunction: Blockage	SCV malfunction: Leak	Cooling system failure (radiator, hoses, thermostat, cooling fan, etc.)	Damaged fan belt or misadjusted belt tension	Improper concentration of antifreeze	Power transmission malfunction (including clutch slipping) *1	Large dragging (including brake) *1	Loose fit parts	Defective CAN communication
1	Engine Warning Light Comes On			❍	❍	❍	❍	❍		❍						
2	Engine Does Not Start		❍	❍	❍	❍	❍	❍	❍					❍		
3	Takes A Long Time Before Engine Starts		❍	❍	❍	❍	❍	❍	❍					❍		
4	Idle Failure	❍	❍	❍	❍	❍	❍	❍	❍					❍		
5	Engine Noise	❍	❍	❍	❍						❍			❍	❍	
6	High Fuel Consumption	❍	❍	❍	❍	❍	❍	❍	❍				❍	❍		
7	Poor Acceleration (Insufficient Output)	❍	❍	❍	❍	❍	❍	❍	❍				❍	❍		❍
8	Black Smoke Emitted	❍	❍	❍			❍	❍	❍							
9	White Smoke Emitted	❍	❍	❍	❍	❍	❍	❍	❍							
10	Engine Stalls On Deceleration		❍	❍	❍	❍		❍	❍							

*1: It emphatically searches for the machine side.

9Y1200199CRS0631US0

[2] DIAGNOSIS BY MALFUNCTION SYMPTOM

(1) Engine Warning Light Comes On

1. Turn the key switch ON and check that the fuel feed pump is operating. If it is not operating, check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump".(Refer to page 1-S302)
2. Connect diagnosis tool and read DTC. Refer to pertinent DTC diagnosis guidelines and implement diagnosis.

9Y1200199CRS0632US0

(2) Engine Does Not Start

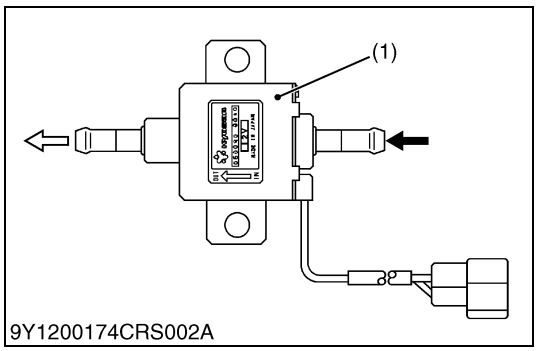
Possible causes:

1. Fuel feed pump operation fault.
2. Starting assist device (intake air heater)
   - Applicable only when the temperature is low: −10 °C (14 °F) or less
   - Refer to the workshop manual for the machine and check the air heater, relay and related wiring harness.

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

3. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve timing fault
4. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - Damage to the pulsar gear of the camshaft position sensor
   - SCV operation fault
   - Main relay malfunction
5. Engine electrical system
   - Battery fault
   - Charging system malfunction
   - Starter relay malfunction
6. Intake system
   - Glow (intake air heater) relay fault
   - Intake air heater fault
7. Fuel system
   - Fuel quality
   - Fuel filter clogging
   - Fuel pressure limiter fault
   - Fuel line clogging, leak
8. CRS (including the wiring harness)
   - Power supply system
   - Output system (supply pump, injector and common rail)
   - Input system (sensors and switches)
   - ECU
9. Others
   - Large amount of drag (including the brakes, etc.)

9Y1200199CRS0633US0



9Y1200174CRS002A

1. Check the Fuel Feed Pump Operation

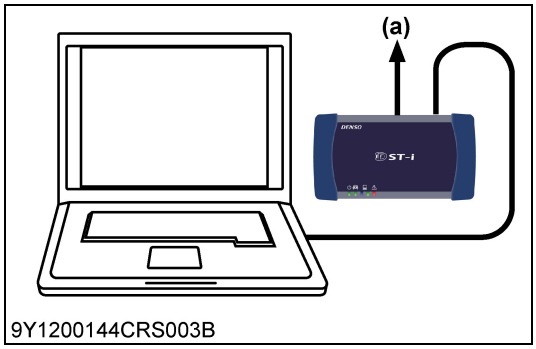
1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0



9Y1200144CRS003B

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

Communication error

OK	Go to "3. Check the Starting Assist Device".
NG	Go to "6. Check the ECU Power Supply and Grounding".

DTC presently existing

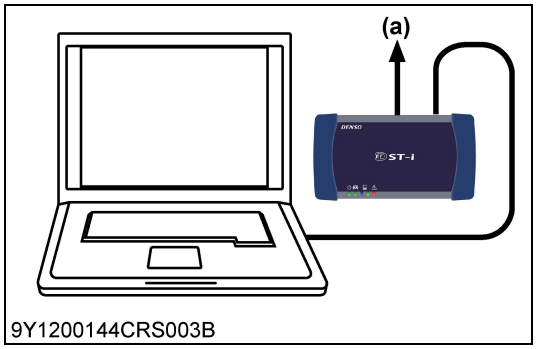
OK	Go to "3. Check the Starting Assist Device".
NG	Check in accordance with the troubleshooting procedures for each DTC.

Past DTC only

OK	Go to "3. Check the Starting Assist Device".
NG	Reproduce defect by referring to the freeze frame data, etc.

(a) CAN1 Connector

9Y1200199CRS0635US0



9Y1200144CRS003B

3. Check the Starting Assist Device

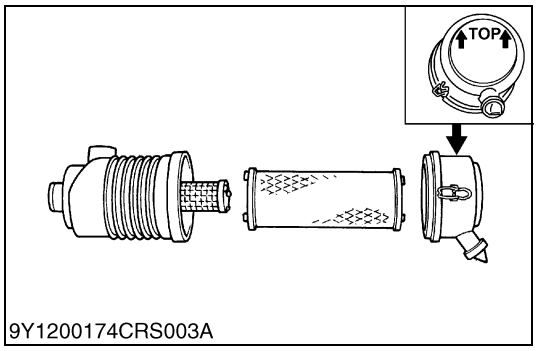
1. Refer to the workshop manual for the machine and check the air heater, relay and related wiring harness.
2. In case the engine can not start when it is new or after the maintenance, make sure to connect the injector harness connector of the head cover position.
3. If the starter relay is used, neutral condition is required depending on the model. Use the monitor function to check whether the neutral switch (signal) is ON.
4. Perform an active test for models that have relay control in the ECU on the engine side.

Factory specification	Operates repeatedly between ON and OFF in accordance with the specified cycle.

OK	Go to "4. Check the Intake System".
NG	Checking and repair of starting assist device (intake air heater).

(a) CAN1 Connector

9Y1200199CRS0636US0



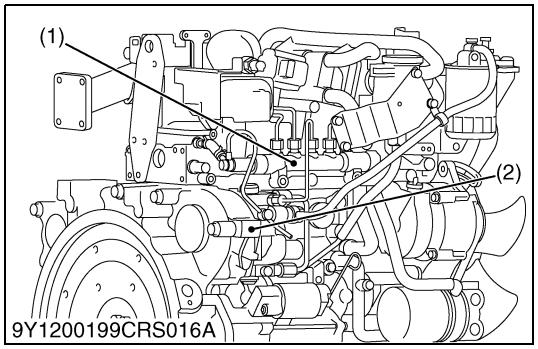
9Y1200174CRS003A

4. Check the Intake System

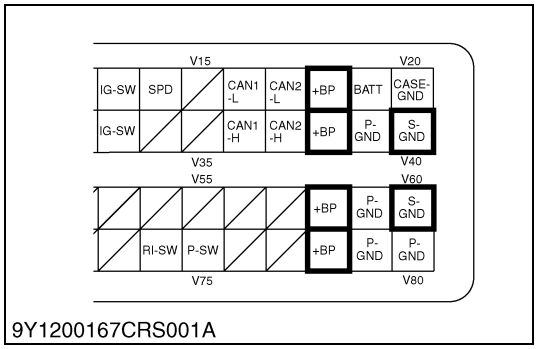
1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

OK	Go to "5. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

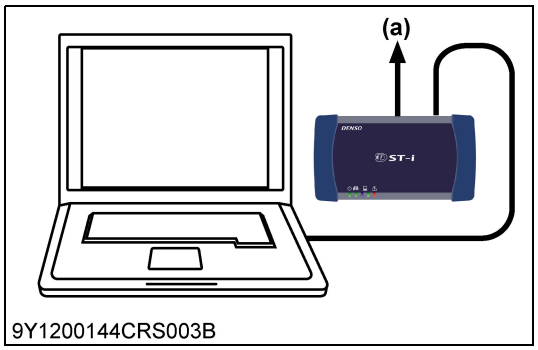
9Y1200199CRS0637US0



9Y1200199CRS016A



9Y1200167CRS001A



9Y1200144CRS003B

5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "6. Check the ECU Power Supply and Grounding".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail (2) Supply Pump

9Y1200199CRS0638US0

6. Check the ECU Power Supply and Grounding

1. Turn the key switch ON and measure the voltage between the ECU +BP terminals (V18 / V38 / V58 / V78) and ground (body / battery terminal) and ECU S-GND terminal (V40 / V60) and ground (body / battery terminal).

Factory specification	+BP terminal - ground: 10 V or higher S-GND terminal - ground: 0.5 V or lower

OK	Go to "7. Check the Crankshaft Position Sensor and Camshaft Position Sensor Signal".
NG	Diagnose by referring to "6.[3]. ELECTRIC SYSTEM INSPECTION PROCEDURE - (3) Checking The Power And Ground System (Main Relay ECU Circuit)". (Refer to page 1-S308)

9Y1200199CRS0639US0

7. Check the Crankshaft Position Sensor and Camshaft Position Sensor Signals

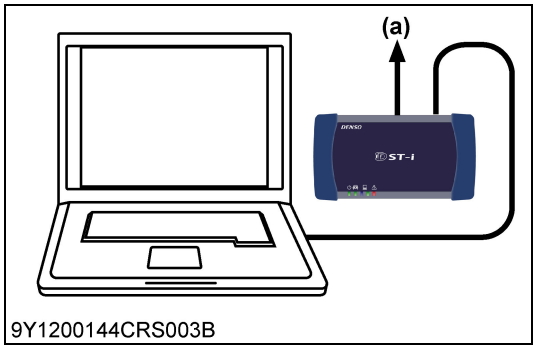
1. Set the key switch to START position and crank the engine. Check the "Engine speed active flag" and "Cam speed active flag" using the diagnosis tool data monitor function.

Factory specification	Both sides ON and constant

OK	Normal.
NG	Go to "8. Supply Pump Difference Learning and Checking the Monitor".
Both flags are unsatisfactory.	Cause of the engine starting failure has been determined. Determine the malfunction area by referring to sections in P0335, P0336 (Refer to page 1-S177) and P0340, P0341 (Refer to page 1-S182) in "5.[2] DIAGNOSIS BY DTC".
Only one side of the flag is unsatisfactory.	Care should be taken as this does not cause engine starting failure. Since the sensor signal is abnormal, determine the malfunction area by referring to sections in P0335, P0336 (Refer to page 1-S177) and P0340, P0341 (Refer to page 1-S182) in "5.[2] DIAGNOSIS BY DTC" as was the case in the above.

(a) CAN1 Connector

9Y1200199CRS0640US0



9Y1200144CRS003B

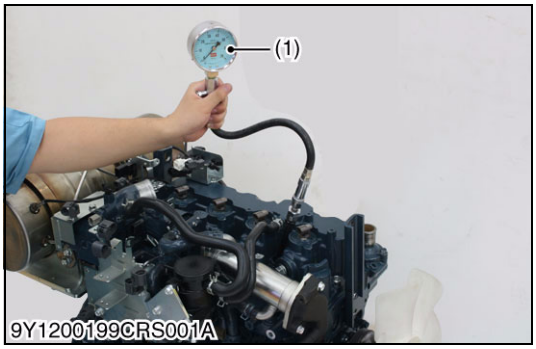
8. Supply Pump Difference Learning and Checking the Monitor

1. Perform difference learning for the supply pump in accordance with "3. ACTIVE TEST AND SUPPLY PUMP DIFFERENCE LEARNING". (Refer to page 1-S15)
2. In accordance with the previous "List of malfunction causes by symptom", use the diagnosis tool for a monitor check of the mode flags during start-up, such as the coolant temperature, rail pressure, SCV current value and battery voltage. (Refer to page 1-S17)

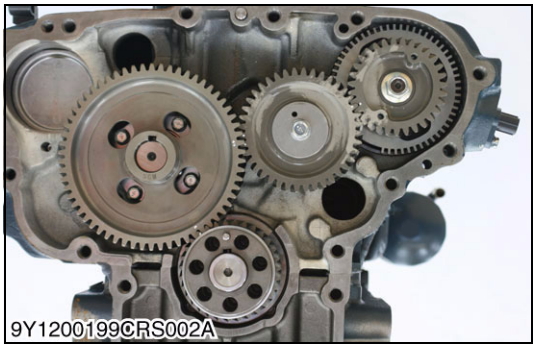
OK	Go to "9. Check the Engine".
NG	Repair the malfunction.

(a) CAN1 Connector

9Y1200199CRS0641US0



9Y1200199CRS001A


9Y1200199CRS002A

9. Check the Engine

1. Check the compression pressure, valve timing and the inside of the engine.

OK	Normal.
NG	Repair the malfunction.

(1) Compression Tester

9Y1200199CRS0642US0

(3) Takes A Long Time Before Engine Starts

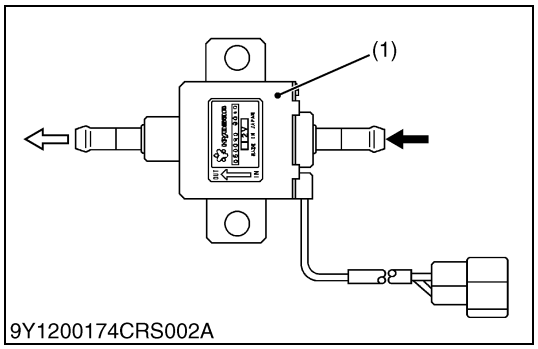
Possible causes:

1. Fuel feed pump operation fault.

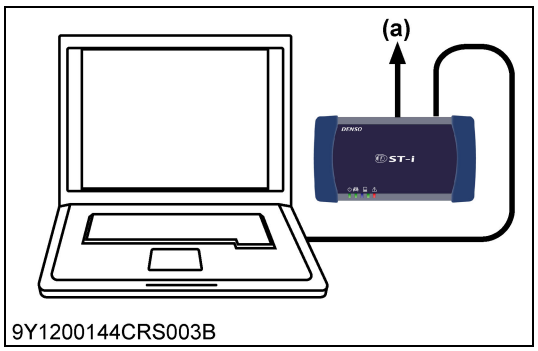
***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

2. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve timing fault
3. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - Damage to the pulsar gear of the camshaft position sensor
   - SCV operation fault
4. Engine electrical system
   - Battery fault
5. Intake system
   - Glow (intake air heater) relay fault
   - Intake air heater fault
6. Fuel system
   - Fuel quality
   - Fuel filter clogging
   - Fuel pressure limiter fault
   - Fuel line clogging, leak
7. CRS (Including the wiring harness)
   - Output system (Supply pump, injector and common rail)
   - Input system (Sensors and switches)
   - ECU
8. Others
   - Large amount of drag (Including the brakes, etc.)

9Y1200199CRS0643US0



9Y1200174CRS002A



9Y1200144CRS003B

1. Check the Fuel Feed Pump Operation

1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

DTC presently existing

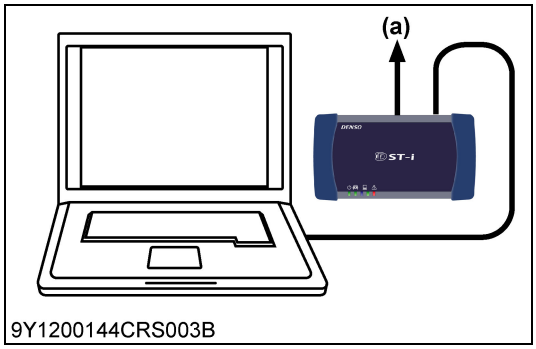
OK	Go to "3. Check the Starting Assist Device".
NG	Check in accordance with the troubleshooting procedures for each DTC.

Past DTC only

OK	Go to "3. Check the Starting Assist Device".
NG	Reproduce defect by referring to the freeze frame data, etc.

(a) CAN1 Connector

9Y1200199CRS0645US0



9Y1200144CRS003B

3. Check the Starting Assist Device

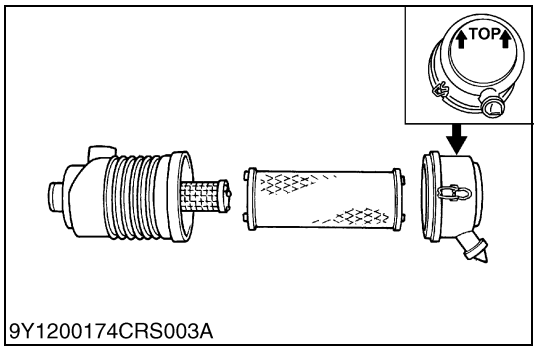
1. Refer to the workshop manual for the machine and check the air heater, relay and related wiring harness.
2. In case the engine can not start when it is new or after the maintenance, make sure to connect the injector harness connector of the head cover position.
3. If the starter relay is used, neutral condition is required depending on the model. Use the monitor function to check whether the neutral switch (signal) is ON.
4. Perform an active test for models that have relay control in the ECU on the engine side.

Factory specification	Operates repeatedly between ON and OFF in accordance with the specified cycle.

OK	Go to "4. Check the Intake System".
NG	Checking and repair of starting assist device (intake air heater).

(a) CAN1 Connector

9Y1200199CRS0636US0



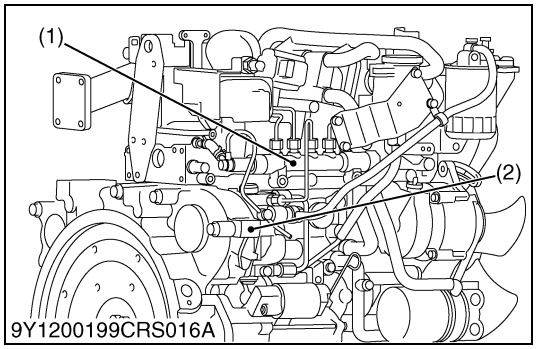
9Y1200174CRS003A

4. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

OK	Go to "5. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

9Y1200199CRS0637US0



9Y1200199CRS016A

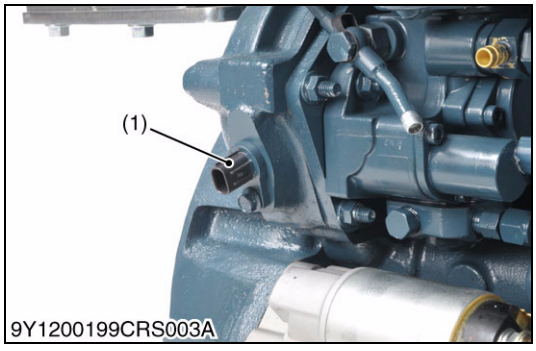
5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "6. Check the Crankshaft Position Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail (2) Supply Pump

9Y1200199CRS0648US0



9Y1200199CRS003A

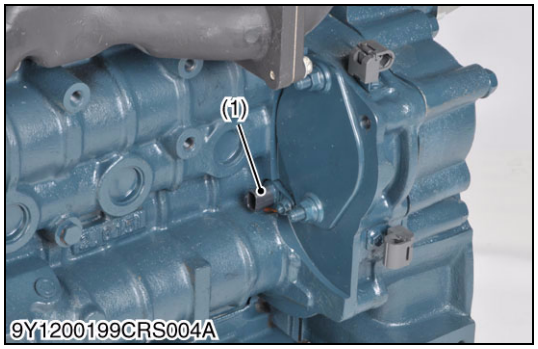
6. Check the Crankshaft Position Sensor

1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "7. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor (NE Sensor)

9Y1200199CRS0649US0



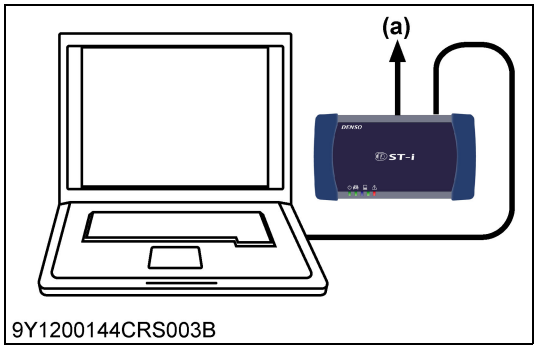
7. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "8. Check the Rail Pressure Sensor and Supply Pump".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor (G Sensor)

9Y1200199CRS0650US0



8. Check the Data Related to Pressure Control

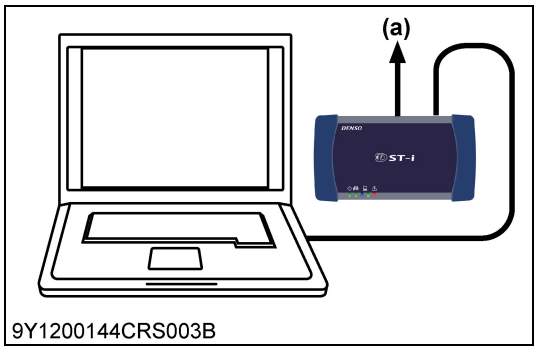
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Go to "9. Check the Injector (Including the Pipes, etc.)"
NG	**(Check the trouble related to pressure)** Refer to the pressure system items (P0087, P0088, P0089 and P0093 (Refer to page 1-S127)) and SCV abnormality items (P0628 and P0629 (Refer to 1-S209)) in "5.[2] DIAGNOSTIC PROCEDURE BY DTC", perform diagnosis for the ECU, wiring harness and sensor, and repair or replace the required parts. ■ **NOTE** • **Some diagnosis items above may be mentioned twice.**

(a) CAN1 Connector

9Y1200199CRS0651US0



9. Check the Injector (Including the Pipes, etc.)

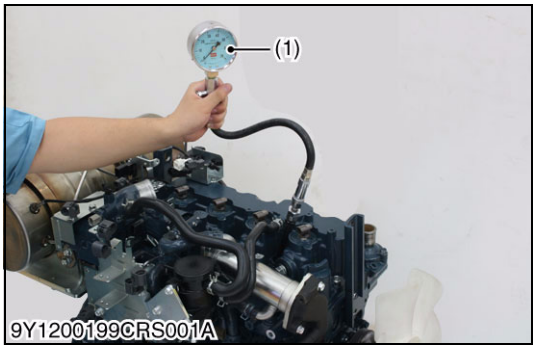
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

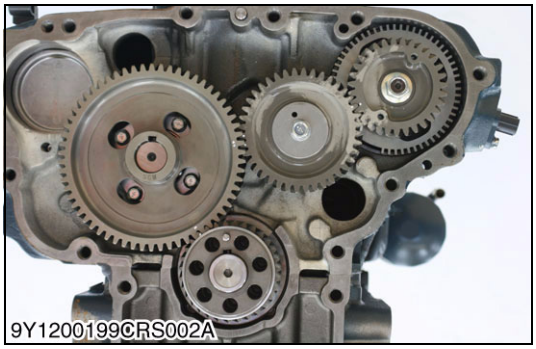
Factory specification	Engine vibration and noise are increased and the rotation rate is reduced when the injection for the corresponding cylinder is stopped. The same results must be attained from all the cylinders.

OK	Go to "10. Check the Engine".
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0652US0





10. Check the Engine

1. Check the compression pressure, valve timing and the inside of the engine.

OK	Normal.
NG	Repair the malfunction.

(1) Compression Tester

9Y1200199CRS0653US0

(4) Idle Failure

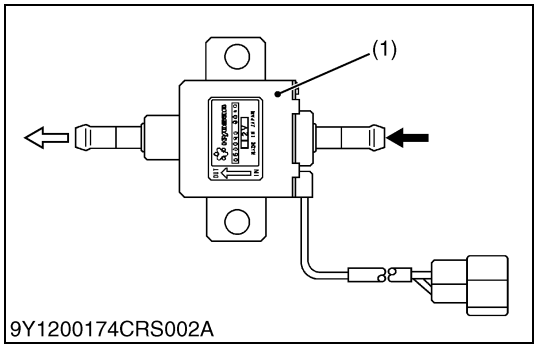
Possible causes:

1. Fuel feed pump operation fault.

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

2. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve timing fault
3. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - SCV operation fault
4. Fuel system
   - Supply pump learning has not been performed
   - Fuel quality
   - Fuel filter clogging
   - Fuel pressure limiter fault
   - Fuel line clogging, leak
5. CRS (including the wiring harness)
   - Output system (supply pump, injector and common rail)
   - Input system (sensors and switches)
   - ECU
6. Others
   - Large amount of drag (including the brakes, etc.)

9Y1200199CRS0654US0



9Y1200174CRS002A

1. Check the Fuel Feed Pump Operation

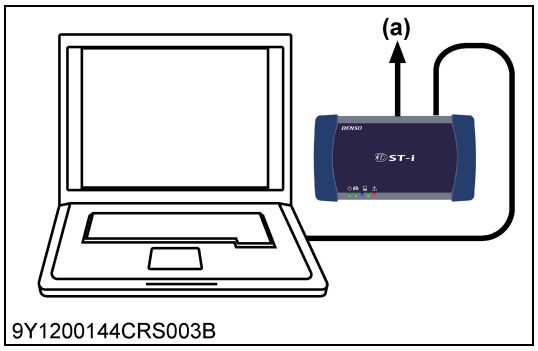
1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0



9Y1200144CRS003B

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

DTC presently existing

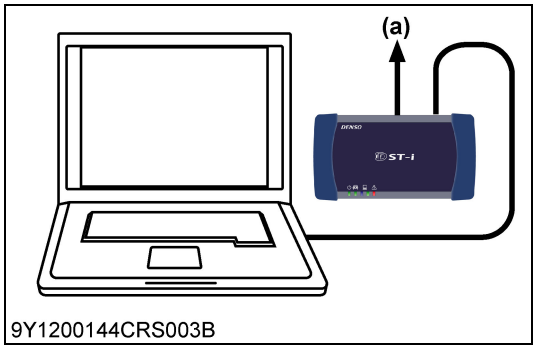
OK	Go to "3. Check the Injector (Including the Pipes, etc.)".
NG	Check in accordance with the troubleshooting procedures for each DTC.

Past DTC only

OK	Go to "3. Check the Injector (Including the Pipes, etc.)".
NG	Reproduce defect by referring to the freeze frame data, etc.

(a) CAN1 Connector

9Y1200199CRS0656US0



9Y1200144CRS003B

3. Check the Injector (Including the Pipes, etc.)

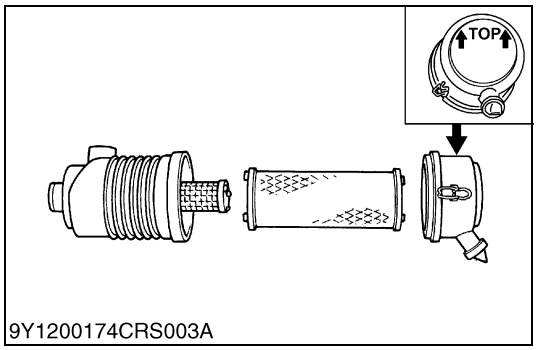
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

Factory specification	Engine vibration and noise are increased and the rotation rate is reduced when the injection for the corresponding cylinder is stopped. The same results must be attained from all the cylinders.

OK	Go to "4. Check the Intake System".
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0657US0



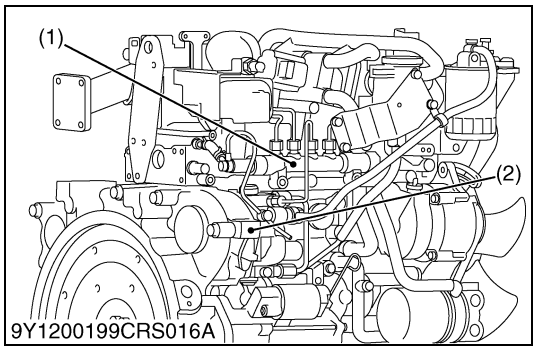
9Y1200174CRS003A

4. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

OK	Go to "5. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

9Y1200199CRS0637US0



9Y1200199CRS016A

5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "6. Check the Accelerator Position Sensor.
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail (2) Supply Pump

9Y1200199CRS0659US0

6. Check the Accelerator Position Sensor

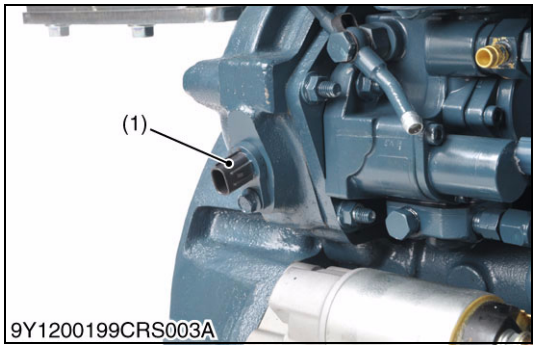
CAUTION

- **When checking, pay attention to the angle of mounting instead of the output signal quality.**

1. Inspect in accordance with the operator's manual.

OK	Go to "7. Check the Crankshaft Position Sensor".
NG	Replacement of accelerator position sensor.

9Y1200199CRS0660US0



9Y1200199CRS003A

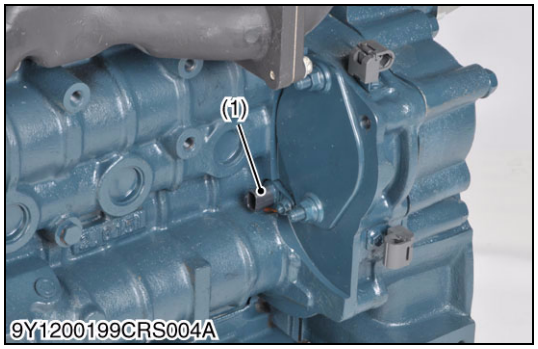
7. Check the Crankshaft Position Sensor

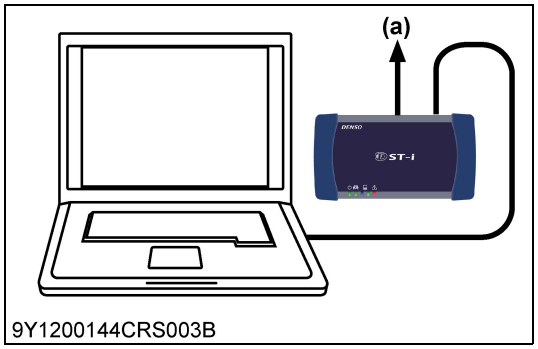
1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "8. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor (NE Sensor)

9Y1200199CRS0661US0





8. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "9. Check the Rail Pressure Sensor and Supply Pump".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor (G Sensor)

9Y1200199CRS0662US0

9. Check the Data Related to Pressure Control

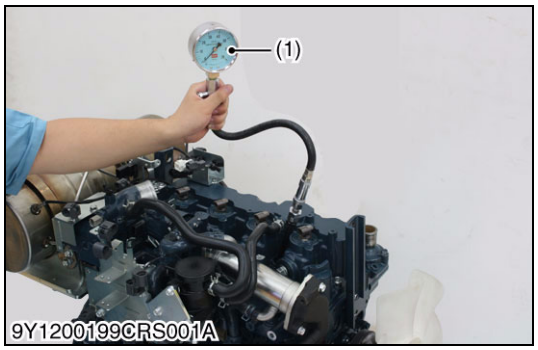
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

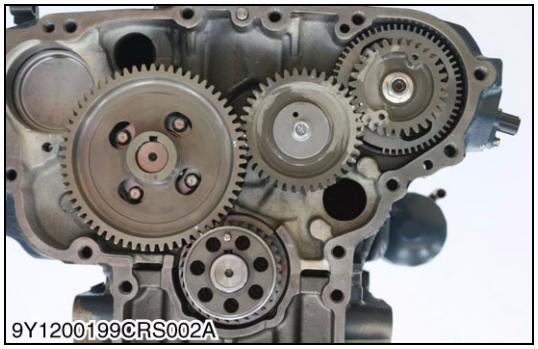
Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Go to "10. Check the Engine"
NG	**(Check the trouble related to pressure** Refer to the pressure system items (P0087, P0088, P0089 and P0093 (Refer to page 1-S127)) and SCV abnormality items (P0628 and P0629 (Refer to 1-S209)) in "5.[2] DIAGNOSTIC PROCEDURE BY DTC", perform diagnosis for the ECU, wiring harness and sensor, and repair or replace the required parts. ■ **NOTE** • **Some diagnosis items above may be mentioned twice.**

(a) CAN1 Connector

9Y1200199CRS0663US0





10. Check the Engine

1. Check the compression pressure, valve timing and the inside of the engine.

OK	Normal.
NG	Repair the malfunction.

(1) Compression Tester

9Y1200199CRS0653US0

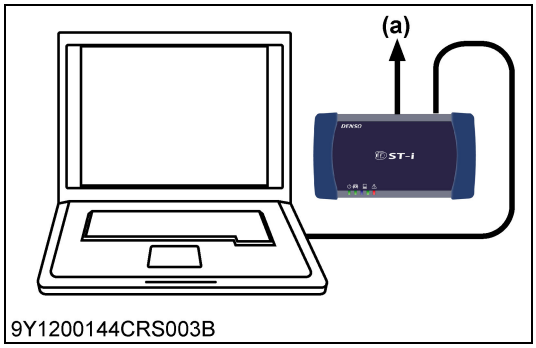
(5) Engine Noise

Possible causes:

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

1. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve clearance fault
   - Valve timing fault
2. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - SCV operation fault
3. Intake system
   - Leak from the intake system parts
4. Fuel system
   - Supply pump learning has not been performed
   - Fuel quality
5. Cooling system
   - Fan belt damage or tension misadjustment
6. CRS (including related fuel line)
   - Output system (supply pump, injector and common rail)
   - Input system (sensors)
   - ECU
7. Others
   - Large amount of drag (including the brakes, etc.)
   - Loose parts (including part interference sound)

9Y1200199CRS0665US0



9Y1200144CRS003B

1. Check the DTC

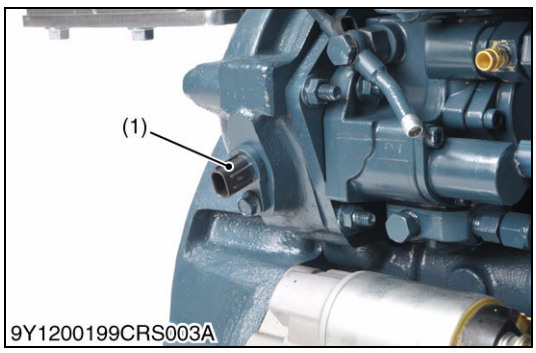
1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

OK	Go to "2. Check the Crankshaft Position Sensor"
NG	Check in accordance with the troubleshooting procedures for each DTC.

(a) CAN1 Connector

9Y1200199CRS0666US0



9Y1200199CRS003A

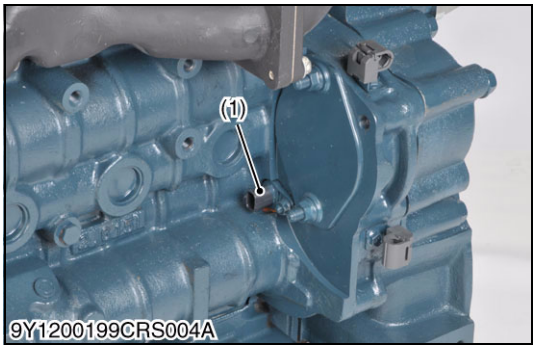
2. Check the Crankshaft Position Sensor

1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "3. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor
(NE Sensor)

9Y1200199CRS0667US0



9Y1200199CRS004A

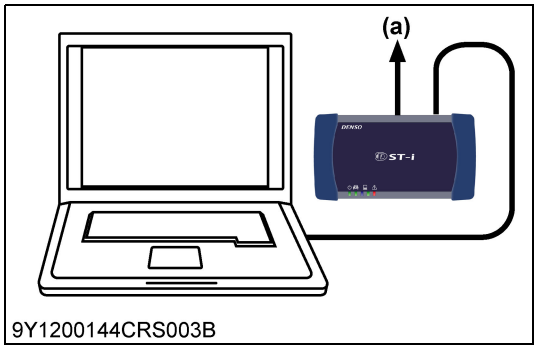
3. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "4. Check the Injector (Including the Pipes, etc.)".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor
(G Sensor)

9Y1200199CRS0668US0



4. Check the Injector (Including the Pipes, etc.)

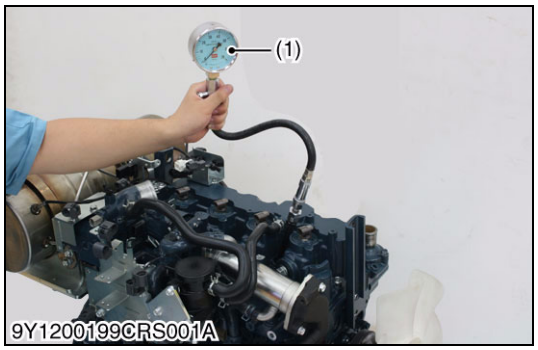
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

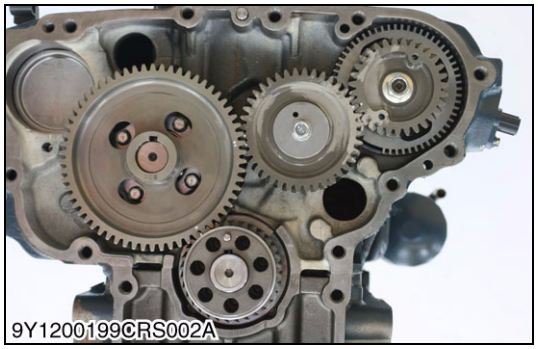
Factory specification	1. Engine vibration and noise are increased and the rotation speed is reduced when the injection for the corresponding cylinder is stopped. 2. The same results must be attained from all the cylinders.

OK	Go to "5. Check the Engine and Machine Body".
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0669US0





5. Check the Engine and Machine Body

1. Check the compression pressure, valve clearance, valve timing and the inside of the engine.

OK	Normal.
NG	Repair the malfunction.

2. Check for loose parts in the engine and on the machine body (including part interference sound).
3. Check for a large amount of drag (including the brakes, etc.).

OK	Normal.
NG	Repair the malfunction.

(1) Compression Tester

9Y1200199CRS0670US0

(6) High fuel consumption

Possible causes:

Reduced engine performance is detected and the fuel consumption is higher for this reason.

1. The engine performance is reduced and the fuel consumption is higher for this reason

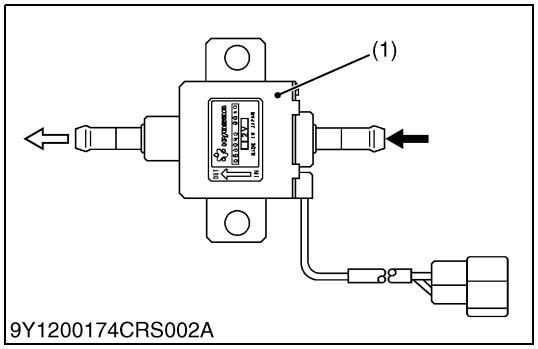
Reduced engine performance is not detected but the fuel consumption is higher.

1. Usage habits of the user or use of non-standard parts
   - Not the standard specification
     - Tires, wheels
     - Intake / exhaust system parts
   - Used for a long time under poor fuel consumption conditions
     - Engine used for a long time under a high load
     - Long idling time
   - Frequently used under driving conditions with a large injection quantity
     - Low mileage for each drive (frequently used before the engine has warmed up)
   - Faulty maintenance
     - Engine oil (dirt)
     - Air filter, fuel filter (dirt, clogging)
     - Radiator clogging
2. Powertrain malfunctions not involving the engine
   - Large driving resistance
     - Large resistance for actuation
     - Tire air pressure
     - Brake drag
   - Clutch slipping
3. Fuel feed pump operation fault.

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

4. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve clearance fault
   - Valve timing fault
   - Engine oil viscosity fault
5. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - SCV operation fault
6. Intake system
   - Air cleaner clogging
   - Leak from the intake system parts
   - Turbocharger operation fault
7. Fuel system
   - Supply pump learning has not been performed
   - Fuel quality
   - Fuel pressure limiter fault
   - Fuel line clogging, leak
8. CRS (including related parts)
   - Output system (supply pump and injector)
   - Input system (sensors) *A cause for larger injection quantity

9Y1200199CRS0671US0



9Y1200174CRS002A

1. Check the Fuel Feed Pump Operation

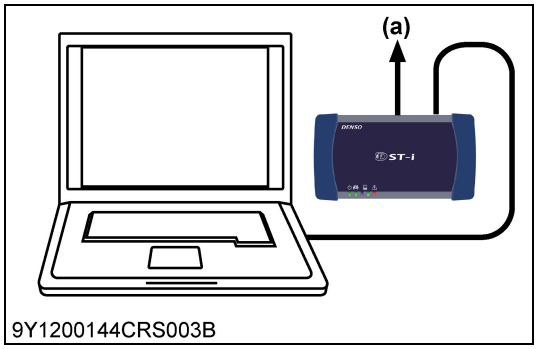
1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0



9Y1200144CRS003B

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

OK	Go to "3. Comparison of Fuel Economy".
NG	Check in accordance with the troubleshooting procedures for each DTC.

(a) CAN1 Connector

9Y1200199CRS0673US0

3. Comparison of Fuel Economy

1. Compare with a normal device working under the same operating conditions and measure the amount of consumed fuel (amount left in the tank).

OK	Use a specific example to explain and make the user understand that under some operating conditions the fuel consumption will increase and that the machine is not malfunctioning.
NG	Go to "4. Check the Engine and Machine Condition".

9Y1200199CRS0674US0


9Y1200199CRS005A

4. Check the Engine and Machine Condition

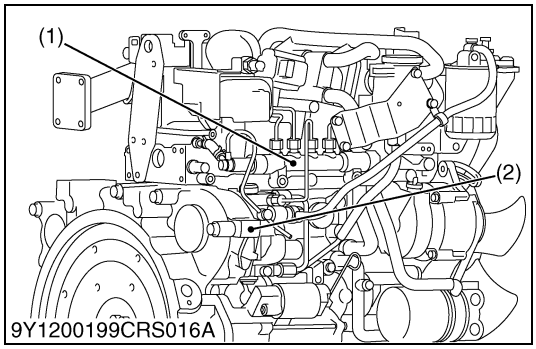
1. Check for the usage habits of the user or use of non-standard parts.
   - Use of non-standard parts such as tires, wheels and intake / exhaust system parts
   - Used under poor fuel consumption conditions
     - Engine used for a long time under a high load
     - Long idling time
   - Faulty maintenance
     - Engine oil level and dirt
     - Air filter, fuel filter dirt and clogging
     - Radiator clogging

OK	Go to "Check for malfunctions in the powertrain".
NG	Give guidance to the user.

2. Check for malfunctions in the powertrain.
   - Check the driving resistance
     - Is a large resistance required for actuation?
     - Is the tire air pressure correct?
     - Is there brake drag?

OK	Go to "5. Check the Fuel System".
NG	Adjust or repair the malfunction.

9Y1200199CRS0675US0



5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(Reference)

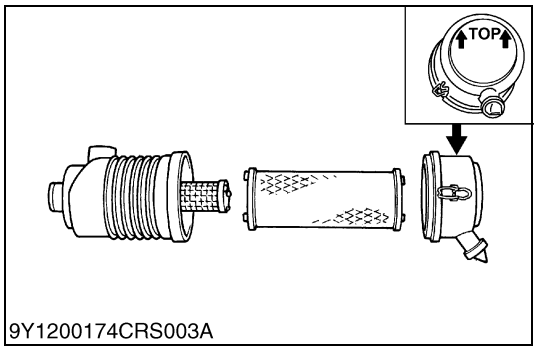
Pay attention particularly to the following two points:

- Service fuel (for summer / winter seasons, and cold region)
- Fuel leak from the fuel line

OK	Go to "6. Check the Intake System".
NG	Repair or replace the malfunctioning component.

(1) Rail (2) Supply Pump

9Y1200199CRS0676US0



6. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

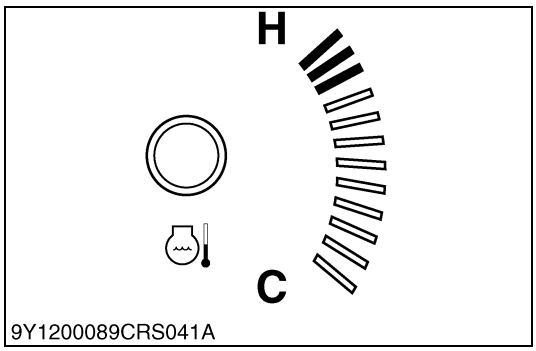
(Reference)

Pay attention particularly to the following point:

- Intake air leak

OK	Go to "7. Check the Coolant Temperature Increase Rate".
NG	Repair or replace the malfunctioning component.

9Y1200199CRS0677US0

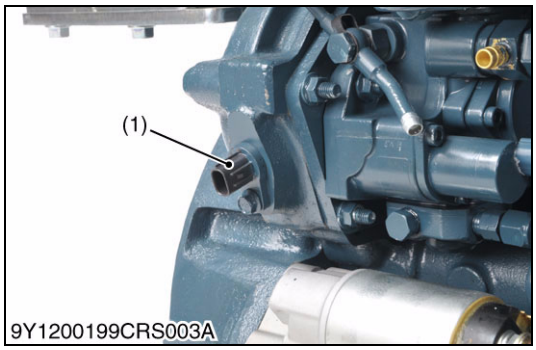


7. Check the Coolant Temperature Increase Rate

1. Check the speed of the coolant temperature increase on the coolant temperature gauge in the instrument panel (compared with a normal device).

OK	Go to "8. Check the Crankshaft Position Sensor".
NG	Check and repair the cooling system.

9Y1200199CRS0678US0



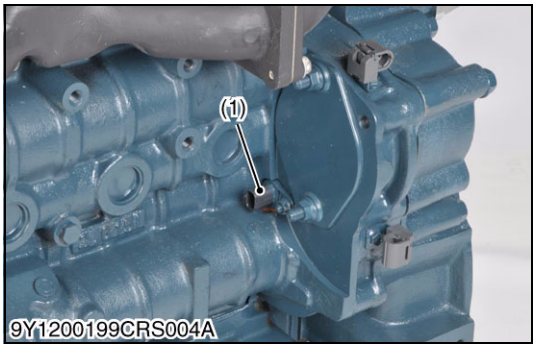
8. Check the Crankshaft Position Sensor

1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "9. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor (NE Sensor)

9Y1200199CRS0679US0



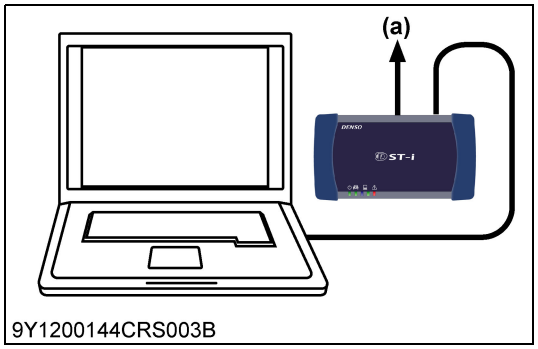
9. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "10. Check the Rail Pressure Sensor And Supply Pump".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor (G Sensor)

9Y1200199CRS0680US0



9Y1200144CRS003B

10. Check the Data Related to Pressure Control

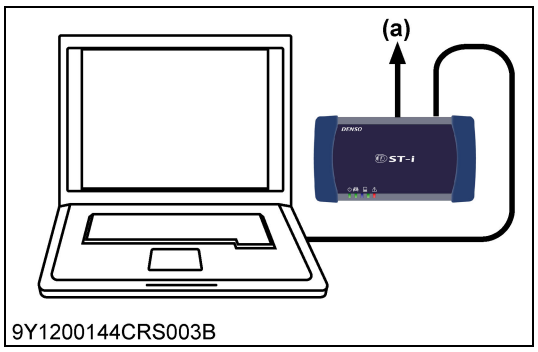
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Go to "11. Check the Injector (Including the Pipes, etc.)"
NG	**(Check the trouble related to pressure** Refer to the pressure system items (P0087, P0088, P0089 and P0093 (Refer to page 1-S127)) and SCV abnormality items (P0628 and P0629 (Refer to 1-S209)) in "5.[2] DIAGNOSTIC PROCEDURE BY DTC", perform diagnosis for the ECU, wiring harness and sensor, and repair or replace the required parts. ■ **NOTE** • **Some diagnosis items above may be mentioned twice.**

(a) CAN1 Connector

9Y1200199CRS0681US0



9Y1200144CRS003B

11. Check the Injector (Including the Pipes, etc.)

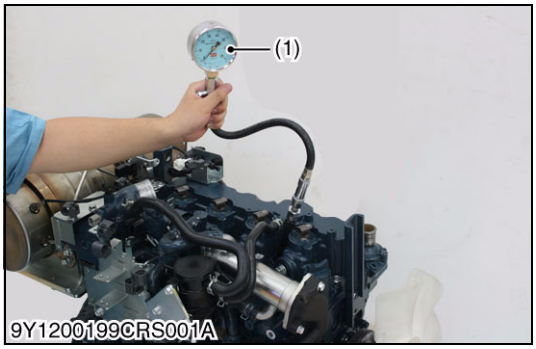
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

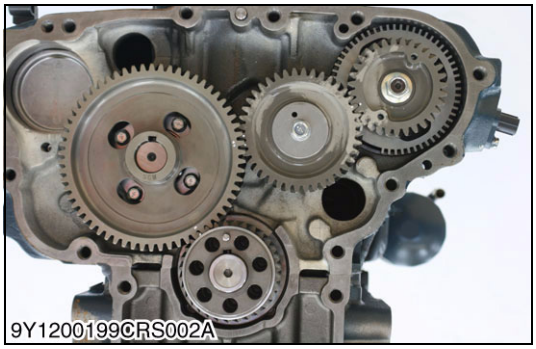
Factory specification	Engine vibration and noise are increased and the rotation speed is reduced when the injection for the corresponding cylinder is stopped. The same results must be attained from all the cylinders.

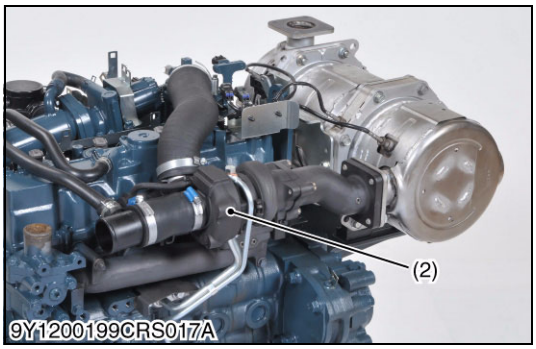
OK	Go to "12. Check the Engine".
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0682US0







12. Check the Engine

1. Check the compression pressure, valve clearance, valve timing, the inside of the engine and engine oil viscosity.
2. Check the timing gear.
3. Check the turbocharger.

OK	Normal.
NG	Repair or replace the related parts.

(1) Compression Tester
(2) Turbocharger

9Y1200199CRS0683US0

(7) Poor Acceleration (Insufficient Output)

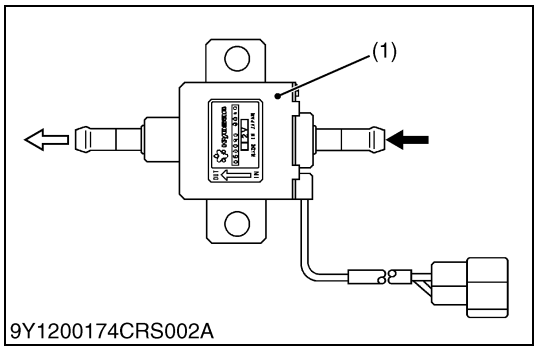
Possible causes:

1. Fuel feed pump operation fault.
2. Large driving resistance due to problems in the machine itself that do not involve the engine
   - Large resistance for actuation
   - Tire air pressure
   - Power transmission fault
   - Brake drag

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

3. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve clearance fault
   - Valve timing fault
   - Engine oil viscosity fault
4. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - Accelerator position sensor misadjustment
   - SCV operation fault
5. Intake system
   - Air cleaner clogging
   - Leak from the intake system parts
   - Turbocharger operation fault
6. Fuel system
   - Supply pump learning has not been performed
   - Fuel quality
   - Fuel pressure limiter fault
   - Fuel line clogging, leak
7. CRS (including related parts)
   - Output system (supply pump, injector and common rail)
   - Input system (sensors) *A cause for larger injection quantity
   - ECU
8. Others
   - Power transmission fault
   - Large amount of drag (including the brakes, etc.)
   - Defective CAN communication

9Y1200199CRS0684US0



9Y1200174CRS002A

1. Check the Fuel Feed Pump Operation

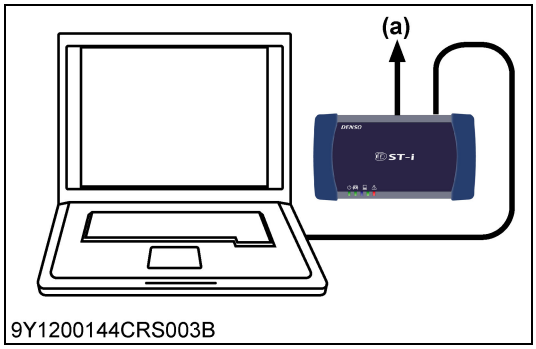
1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0



9Y1200144CRS003B

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

DTC presently existing

OK	Go to "3. Check the Accelerator Position Sensor.
NG	Check in accordance with the troubleshooting procedures for each DTC.

Past DTC only

OK	Go to "3. Check the Accelerator Position Sensor.
NG	Reproduce defect by referring to the freeze frame data, etc.

(a) CAN1 Connector

9Y1200199CRS0686US0

3. Check the Accelerator Position Sensor

CAUTION

- **When checking, pay attention to the angle of mounting instead of the output signal quality.**

1. Inspect in accordance with the operator's manual.

OK	Go to "4. Check the Idle Condition".
NG	Replacement of accelerator position sensor.

9Y1200199CRS0687US0


9Y1200199CRS005A

4. Check the Idle Condition

1. Check if idling is normal.

Factory specification	Stable at specified speed.

OK	Go to "5. Malfunction Verification - 1".
NG	Refer to "(4) Idle Failure", and implement checking and repair.(Refer to page 1-S29)

9Y1200199CRS0688US0

5. Malfunction Verification - 1

1. Reproduce running conditions (engine speed, machine speed, gear shift, etc.) as pointed out by the driver. Compare with another machine of the same model and check whether poor acceleration and power shortage can be sensed.

Factory specification	No malfunction should be detected.

OK	Explain to the driver that the machine is in a normal condition. **(Reference)** • Give appropriate advice to the driver about matters concerning anything noticed that is related to his driving manner (such as selection of shift, etc.).
NG	Go to "6. Malfunction Verification - 2".

9Y1200199CRS0689US0

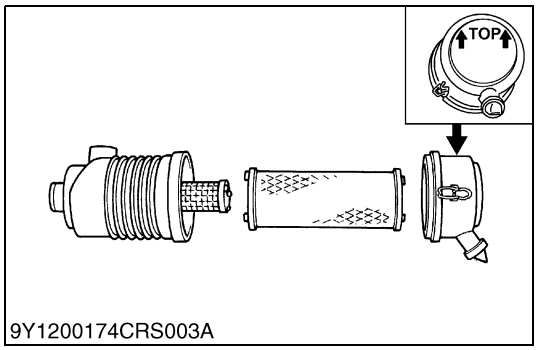

9Y1200199CRS005A

6. Malfunction Verification - 2

1. Check for a large driving resistance due to problems in the machine itself that do not involve the engine.
   - Large resistance for actuation
   - Tire air pressure
   - Power transmission fault
   - Brake drag

OK	Go to "7. Check the Intake System".
NG	Repair or adjust the malfunction.

9Y1200199CRS0690US0



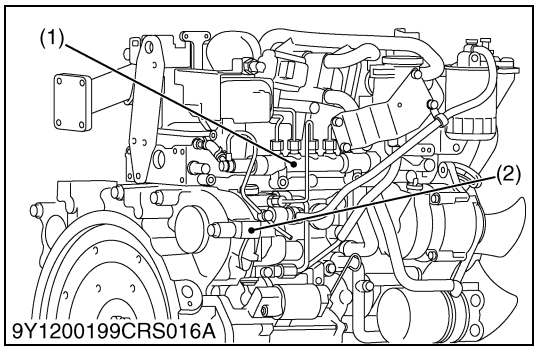
9Y1200174CRS003A

7. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

OK	Go to "8. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

9Y1200199CRS0691US0



9Y1200199CRS016A

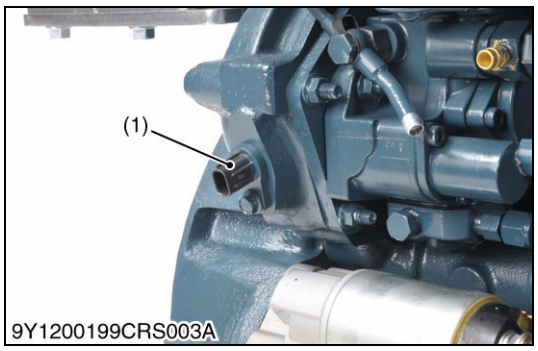
8. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "9. Check the Crankshaft Position Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail (2) Supply Pump

9Y1200199CRS0692US0



9Y1200199CRS003A

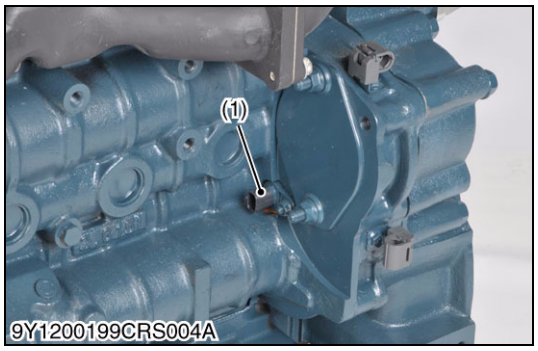
9. Check the Crankshaft Position Sensor

1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "10. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor
(NE Sensor)

9Y1200199CRS0693US0



9Y1200199CRS004A

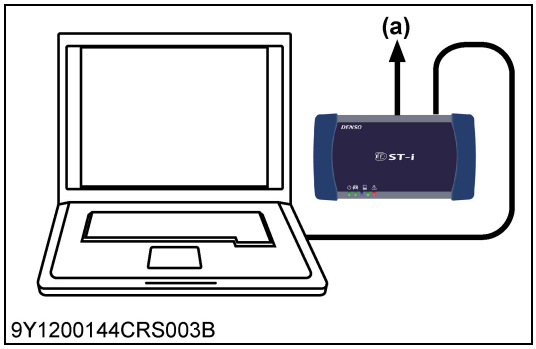
10. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "11. Check the Rail Pressure Sensor and Supply Pump".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor
(G Sensor)

9Y1200199CRS0694US0



9Y1200144CRS003B

11. Check the Data Related to Pressure Control

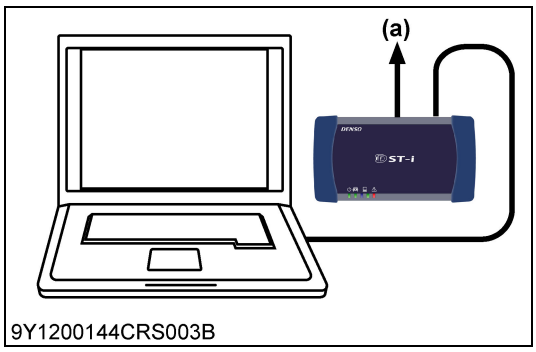
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Go to "12. Check the Injector (Including the Pipes, etc.)"
NG	**(Check the trouble related to pressure** Refer to the pressure system items (P0087, P0088, P0089 and P0093 (Refer to page 1-S127)) and SCV abnormality items (P0628 and P0629 (Refer to 1-S209)) in "5.[2] DIAGNOSTIC PROCEDURE BY DTC", perform diagnosis for the ECU, wiring harness and sensor, and repair or replace the required parts. ■ **NOTE** • **Some diagnosis items above may be mentioned twice.**

(a) CAN1 Connector

9Y1200199CRS0695US0



9Y1200144CRS003B

12. Check the Injector (Including the Pipes, etc.)

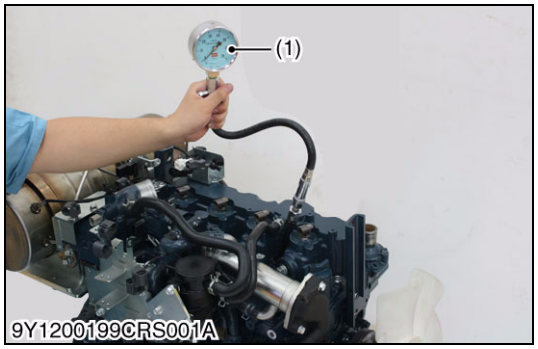
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

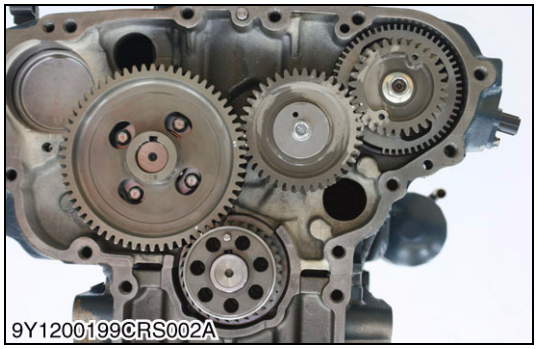
Factory specification	1. Engine vibration and noise are increased and the rotation speed is reduced when the injection for the corresponding cylinder is stopped. 2. The same results must be attained from all the cylinders.

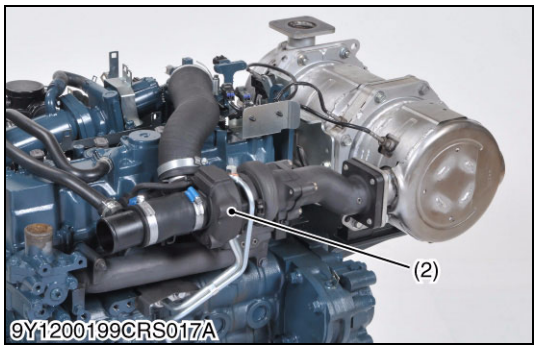
OK	Go to "13. Check the Engine"
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0696US0







13. Check the Engine

1. Check the compression pressure, valve clearance, valve timing, the inside of the engine and engine oil viscosity.
2. Check the timing gear.
3. Check the turbocharger.

OK	Normal.
NG	Repair or replace the related parts.

(1) Compression Tester (2) Turbocharger

9Y1200199CRS0697US0

(8) Abnormal Black Smoke Emitted

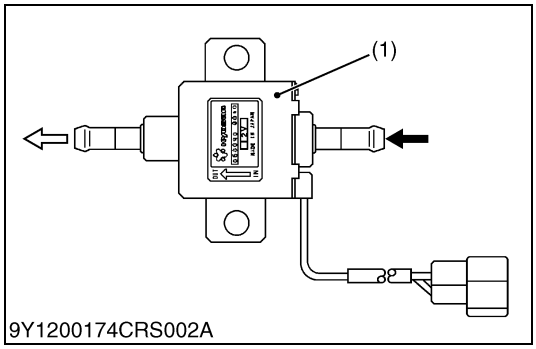
Possible causes:

1. Fuel feed pump operation fault.

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

2. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve clearance fault
   - Valve timing fault
   - Engine oil viscosity fault
3. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - SCV operation fault
   - EGR valve fault
4. Intake system
   - Air cleaner clogging
   - Leak from the intake system parts
   - Turbocharger operation fault
5. Fuel system
   - Supply pump learning has not been performed
   - Fuel quality
   - Fuel pressure limiter fault
   - Fuel line clogging, leak
6. CRS (including the wiring harness)
   - Output system (supply pump, injector and common rail)
   - Input system (sensors and switches)
   - ECU

9Y1200199CRS0698US0



9Y1200174CRS002A

1. Check the Fuel Feed Pump Operation

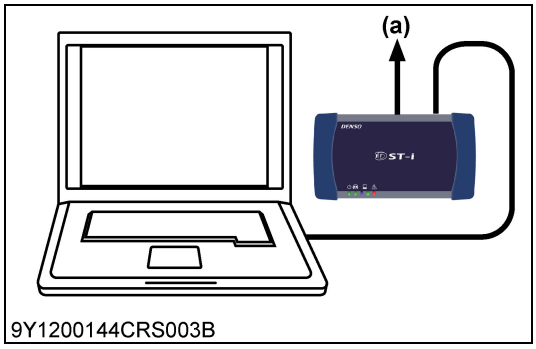
1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0



9Y1200144CRS003B

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

DTC presently existing

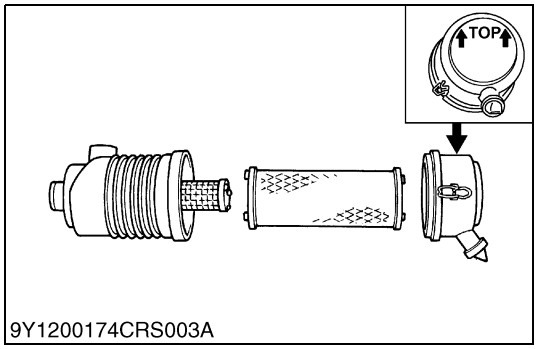
OK	Go to "3. Check the Intake System".
NG	Check in accordance with the troubleshooting procedures for each DTC.

Past DTC only

OK	Go to "3. Check the Intake System".
NG	Reproduce defect by referring to the freeze frame data, etc.

(a) CAN1 Connector

9Y1200199CRS0700US0

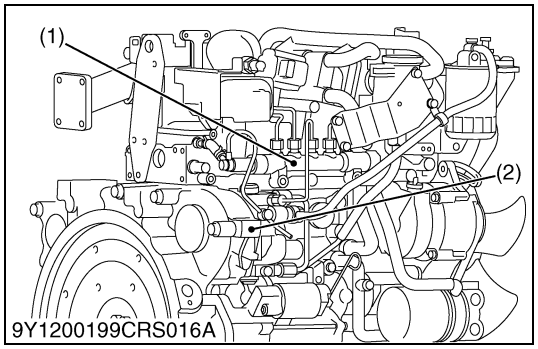


3. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

OK	Go to "4. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

9Y1200199CRS0701US0



4. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "5. Check the Accelerator Position Sensor.
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail (2) Supply Pump

9Y1200199CRS0702US0

5. Check the Accelerator Position Sensor

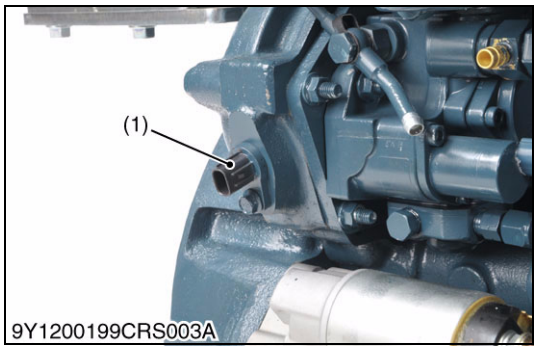
CAUTION

- **When checking, pay attention to the angle of mounting instead of the output signal quality.**

1. Inspect in accordance with the operator's manual.

OK	Go to "6. Check the Crankshaft Position Sensor".
NG	Replacement of accelerator position sensor.

9Y1200199CRS0703US0



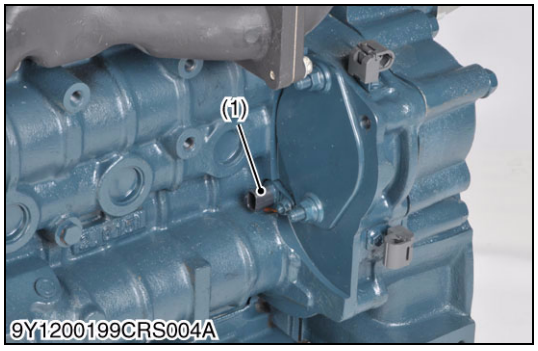
6. Check the Crankshaft Position Sensor

1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "7. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor
(NE Sensor)

9Y1200199CRS0649US0



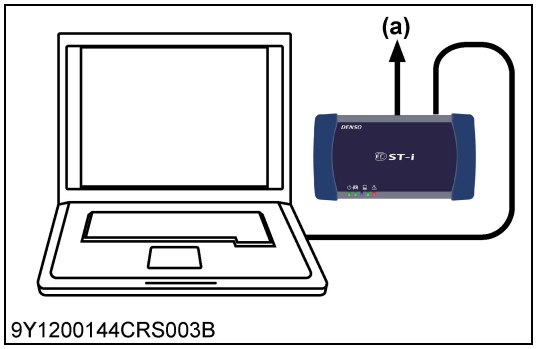
7. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "8. Check the EGR Valve".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor
(G Sensor)

9Y1200199CRS0705US0



9Y1200144CRS003B

8. Check the EGR Valve

Refer to "5.[2] DIAGNOSTIC PROCEDURE BY DTC" for the detailed EGR-related check. A simplified version is shown below. (Refer to page 1-S120)

CAUTION

- **Check that the EGR valve does not open before the engine has warmed up [coolant temperature: 65 °C (149 °F)].**

1. Use the monitor function to check whether the actual opening meets the target opening.

Factory specification	Refer to "1.[5].(2) Normal Value". (Refer to page 1-M17) In addition, for the check procedures refer to "5.[2] DIAGNOSTIC PROCEDURE BY DTC". (Refer to page 1-S120)

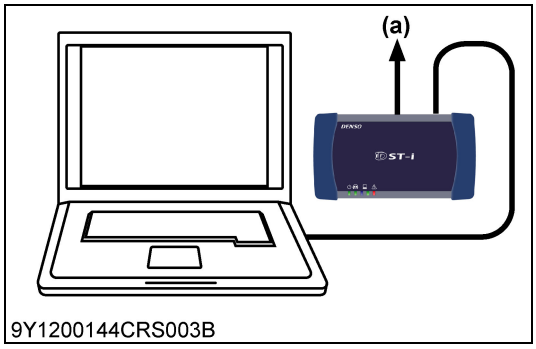
2. Perform an active test (EGR actuation test).

Factory specification	(Low side) When target EGR valve openings of 0 % and 15 % are given alternately, there must not be disparity in the actual EGR valve opening. (High side) When target EGR valve openings of 35 % and 60 % are given alternately, there must not be disparity in the actual EGR valve opening.

OK	Go to "9. Check the Rail Pressure Sensor and Supply Pump".
NG	Replace the EGR valve.

(a) CAN1 Connector

9Y1200199CRS0706US0



9Y1200144CRS003B

9. Check the Data Related to Pressure Control

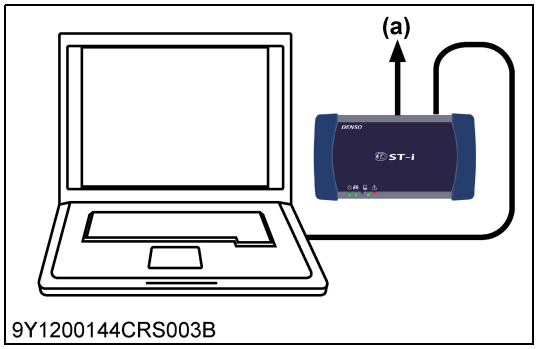
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Go to "10. Check the Injector (Including the Pipes, etc.)".
NG	**(Check the trouble related to pressure** Refer to the pressure system items (P0087, P0088, P0089 and P0093 (Refer to page 1-S127)) and SCV abnormality items (P0628 and P0629 (Refer to 1-S209)) in "5.[2] DIAGNOSTIC PROCEDURE BY DTC", perform diagnosis for the ECU, wiring harness and sensor, and repair or replace the required parts. ■ **NOTE** • **Some diagnosis items above may be mentioned twice.**

(a) CAN1 Connector

9Y1200199CRS0707US0



10. Check the Injector (Including the Pipes, etc.)

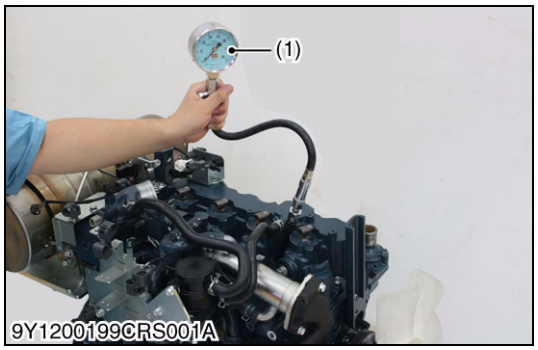
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

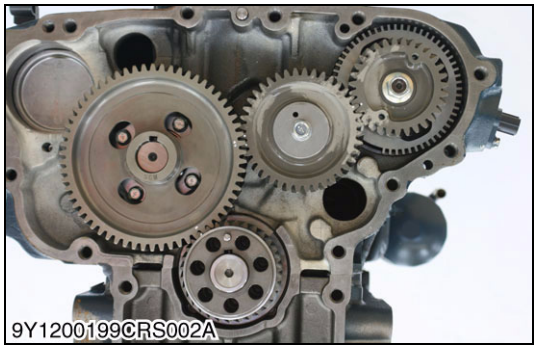
Factory specification	1. Engine vibration and noise are increased and the rotation speed is reduced when the injection for the corresponding cylinder is stopped. 2. The same results must be attained from all the cylinders.

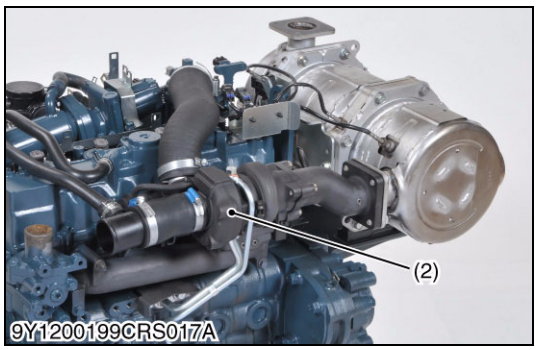
OK	Go to "11. Check the Engine".
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0708US0







11. Check the Engine

1. Check the compression pressure, valve clearance, valve timing, the inside of the engine and engine oil viscosity.
2. Check the timing gear.
3. Check the turbocharger.

OK	Normal.
NG	Repair or replace the related parts.

(1) Compression Tester (2) Turbocharger

9Y1200199CRS0709US0

(9) Abnormal White Smoke Emitted

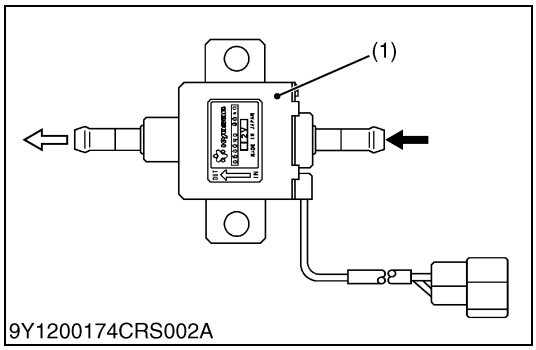
Possible causes:

1. Fuel feed pump operation fault.
2. Starting assist device fault (air heater and glow (air heater) relay do not operate)

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

3. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve clearance fault
   - Valve timing fault
4. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - SCV operation fault
   - EGR valve fault
5. Intake system
   - Air cleaner clogging
   - Leak from the intake system parts
   - Glow (intake air heater) relay fault
   - Turbocharger operation fault
6. Fuel system
   - Supply pump learning has not been performed
   - Fuel quality
   - Fuel filter clogging
   - Fuel pressure limiter fault
   - Fuel line clogging, leak
7. CRS (including the wiring harness)
   - Output system (supply pump, injector and common rail)
   - Input system (sensors and switches)
   - ECU

9Y1200199CRS0710US0



9Y1200174CRS002A

1. Check the Fuel Feed Pump Operation

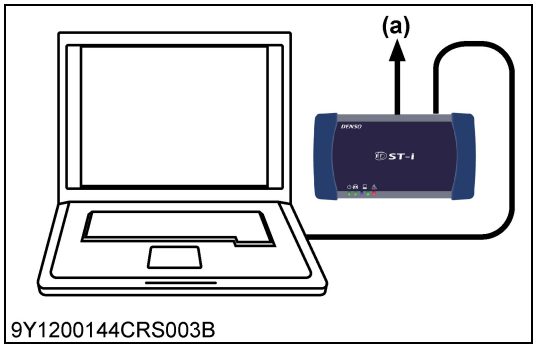
1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0



9Y1200144CRS003B

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

DTC presently existing

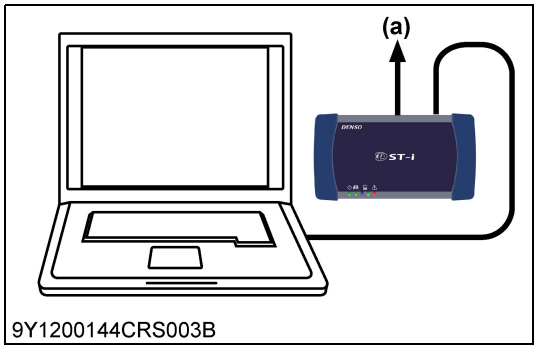
OK	Go to "3. Check the Starting Assist Device".
NG	Check in accordance with the troubleshooting procedures for each DTC.

Past DTC only

OK	Go to "3. Check the Starting Assist Device".
NG	Reproduce defect by referring to the freeze frame data, etc.

(a) CAN1 Connector

9Y1200199CRS0645US0



9Y1200144CRS003B

3. Check the Starting Assist Device

1. Refer to the workshop manual for the machine and check the air heater, relay and related wiring harness.
2. Perform an active test for models that have relay control in the ECU on the engine side.

Factory specification	Operates repeatedly between ON and OFF in accordance with the specified cycle.

OK	Go to "4. Check the Idle Condition".
NG	Checking and repair of starting assist device (intake air heater).

(a) CAN1 Connector

9Y1200199CRS0713US0


9Y1200199CRS005A

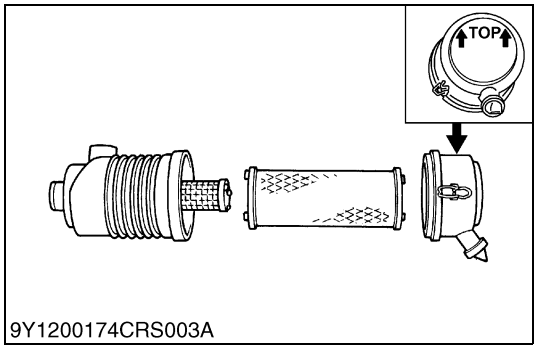
4. Check the Idle Condition

1. Check if idling is normal.

Factory specification	Stable at specified speed.

OK	Go to "5. Check the Intake System".
NG	Refer to "(4) Idle Failure", and implement checking and repair.(Refer to page 1-S29)

9Y1200199CRS0714US0



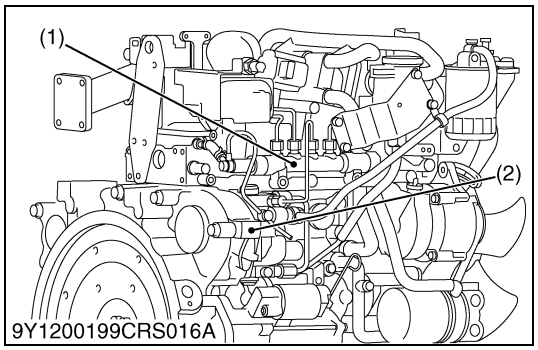
9Y1200174CRS003A

5. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

OK	Go to "6. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

9Y1200199CRS0715US0



9Y1200199CRS016A

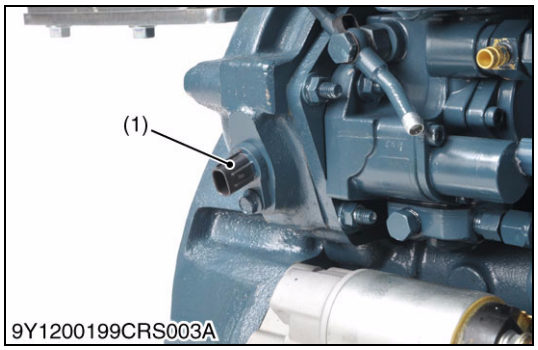
6. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "7. Check the Crankshaft Position Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail (2) Supply Pump

9Y1200199CRS0716US0



9Y1200199CRS003A

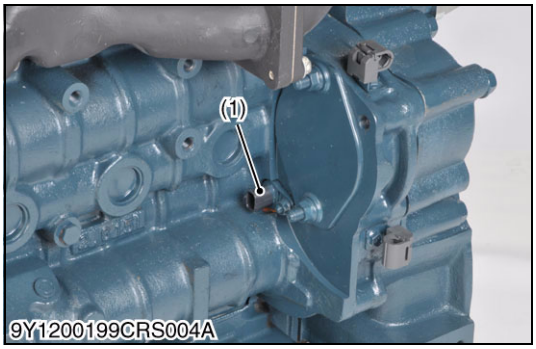
7. Check the Crankshaft Position Sensor

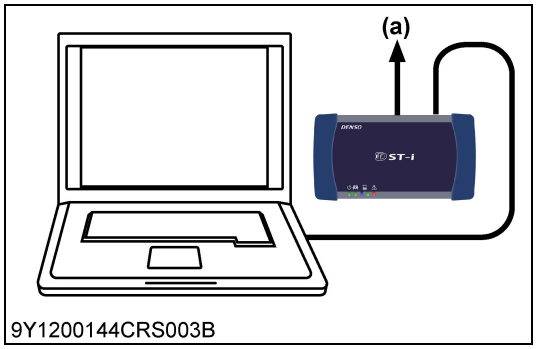
1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "8. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor (NE Sensor)

9Y1200199CRS0661US0





8. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "9. Check the EGR Valve".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor
(G Sensor)

9Y1200199CRS0718US0

9. Check the EGR Valve

Refer to "5.[2] DIAGNOSTIC PROCEDURE BY DTC" for the detailed EGR-related check. A simplified version is shown below. (Refer to page 1-S120)

CAUTION

- **Check that the EGR valve does not open before the engine has warmed up [coolant temperature: 65 °C (149 °F)].**

1. Use the monitor function to check whether the actual opening meets the target opening.

Factory specification	Refer to "1.[5].(2) Normal Value". (Refer to page 1-M17) In addition, for the check procedures refer to "5.[2] DIAGNOSTIC PROCEDURE BY DTC". (Refer to page 1-S120)

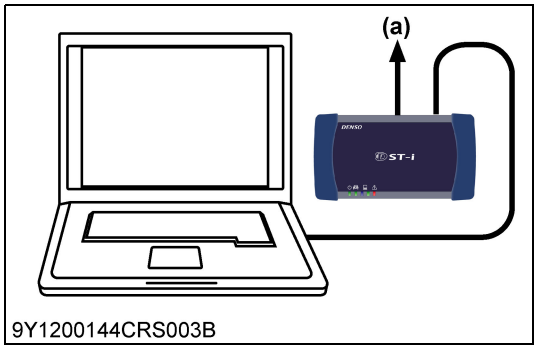
2. Perform an active test (EGR actuation test).

Factory specification	(Low side) When target EGR valve openings of 0 % and 15 % are given alternately, there must not be disparity in the actual EGR valve opening. (High side) When target EGR valve openings of 35 % and 60 % are given alternately, there must not be disparity in the actual EGR valve opening.

OK	Go to "10. Check the Rail Pressure Sensor and Supply Pump".
NG	Replace the EGR valve.

(a) CAN1 Connector

9Y1200199CRS0719US0



9Y1200144CRS003B

10. Check the Data Related to Pressure Control

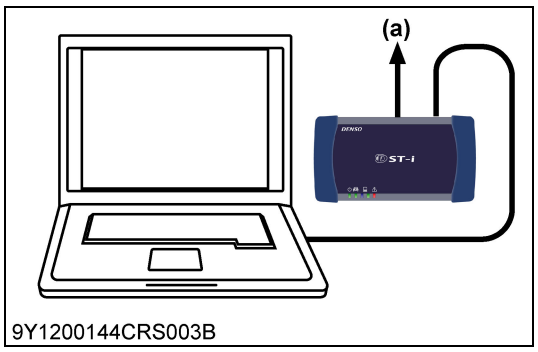
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Go to "11. Check the Injector (Including the Pipes, etc.)"
NG	**(Check the trouble related to pressure** Refer to the pressure system items (P0087, P0088, P0089 and P0093 (Refer to page 1-S127)) and SCV abnormality items (P0628 and P0629 (Refer to 1-S209)) in "5.[2] DIAGNOSTIC PROCEDURE BY DTC", perform diagnosis for the ECU, wiring harness and sensor, and repair or replace the required parts. ■ **NOTE** • **Some diagnosis items above may be mentioned twice.**

(a) CAN1 Connector

9Y1200199CRS0681US0



9Y1200144CRS003B

11. Check the Injector (Including the Pipes, etc.)

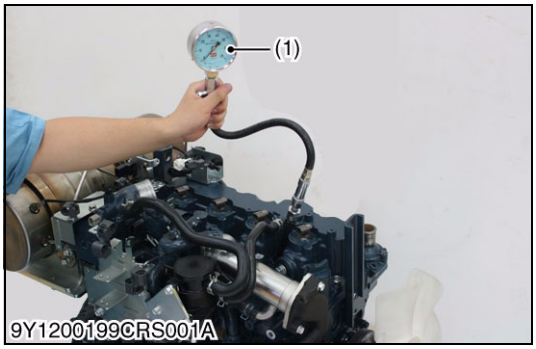
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

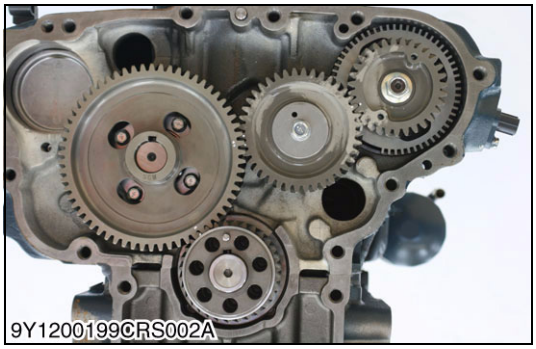
Factory specification	Engine vibration and noise are increased and the rotation speed is reduced when the injection for the corresponding cylinder is stopped. The same results must be attained from all the cylinders.

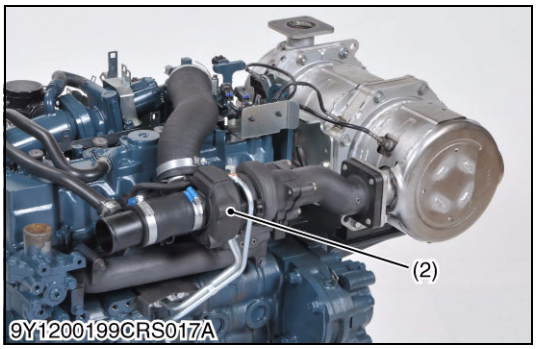
OK	Go to "12. Check the Engine".
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0682US0







12. Check the Engine

1. Check the compression pressure, valve clearance, valve timing and the inside of the engine.
2. Check the timing gear.
3. Check the turbocharger.

OK	Normal.
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(1) Compression Tester
(2) Turbocharger

9Y1200199CRS0722US0

(10) Engine Stalls On Deceleration

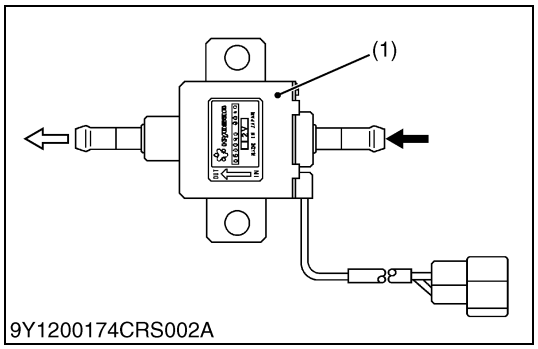
Possible causes:

1. Fuel feed pump operation fault.

***Refer to the previous "List of malfunction causes by symptom" for the subsequent details.**

2. Engine fault
   - Low compression pressure.
   - Engine internal fault
   - Valve timing fault
3. Control system
   - Damage to the pulsar gear of the crankshaft position sensor
   - Air gap of the crankshaft position sensor is large
   - SCV operation fault
4. Intake system
   - Air cleaner clogging
5. Fuel system
   - Fuel quality
   - Fuel filter clogging
   - Fuel line clogging, leak
6. CRS (including the wiring harness)
   - Output system (supply pump, injector and common rail)
   - Input system (sensors and switches)
   - ECU

9Y1200199CRS0723US0



9Y1200174CRS002A

1. Check the Fuel Feed Pump Operation

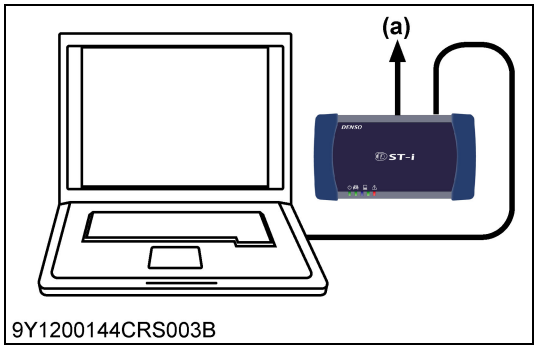
1. Turn the key switch ON and check that the fuel feed pump is operating.

Factory specification	Operates when the key switch is turned ON.

OK	Go to "2. Check the DTC".
NG	Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE - 5. Check the Fuel Feed Pump". (Refer to page 1-S302)

(1) Fuel Feed Pump

9Y1200199CRS0634US0



9Y1200144CRS003B

2. Check the DTC

1. Turn the key switch ON and check the DTC.

Factory specification	No DTC is output.

DTC presently existing

OK	Go to "3. Check the idle condition".
NG	Check in accordance with the troubleshooting procedures for each DTC.

Past DTC only

OK	Go to "3. Check the idle condition".
NG	Reproduce defect by referring to the freeze frame data, etc.

(a) CAN1 Connector

9Y1200199CRS0725US0


9Y1200199CRS005A

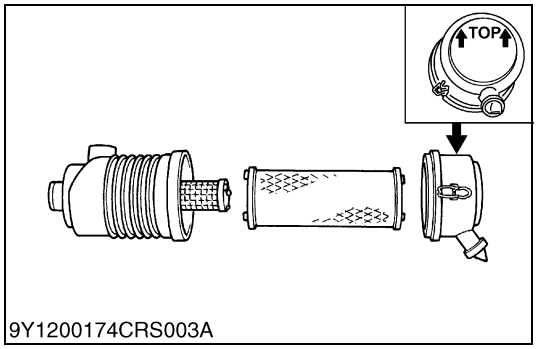
3. Check the Idle Condition

1. Check if idling is normal.

Factory specification	Stable at specified speed.

OK	Go to "4. Check the Intake System".
NG	Refer to "(4) Idle Failure", and implement checking and repair. (Refer to page 1-S29)

9Y1200199CRS0726US0



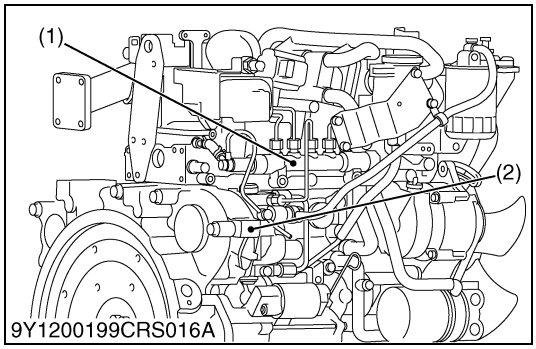
9Y1200174CRS003A

4. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

OK	Go to "5. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

9Y1200199CRS0637US0



9Y1200199CRS016A

5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "6. Check the Accelerator Position Sensor.
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail
(2) Supply Pump

9Y1200199CRS0659US0

6. Check the Accelerator Position Sensor

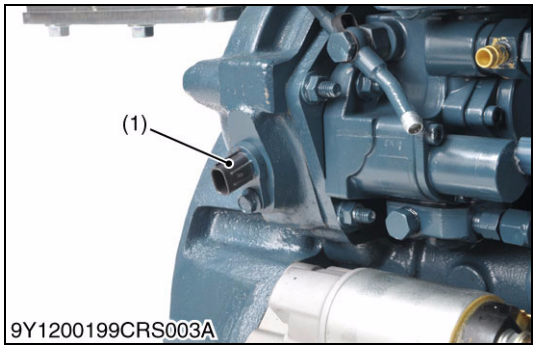
CAUTION

- **When checking, pay attention to the angle of mounting instead of the output signal quality.**

1. Inspect in accordance with the operator's manual.

OK	Go to "7. Check the Crankshaft Position Sensor".
NG	Replacement of accelerator position sensor.

9Y1200199CRS0660US0



9Y1200199CRS003A

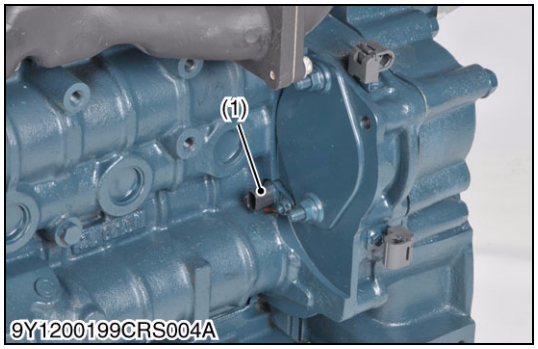
7. Check the Crankshaft Position Sensor

1. Refer to DTC P0335 and P0336, and implement checking of the crankshaft position sensor.

OK	Go to "8. Check the Camshaft Position Sensor".
NG	Repair and replacement of the crankshaft position sensor-related parts.

(1) Crankshaft Position Sensor (NE Sensor)

9Y1200199CRS0661US0



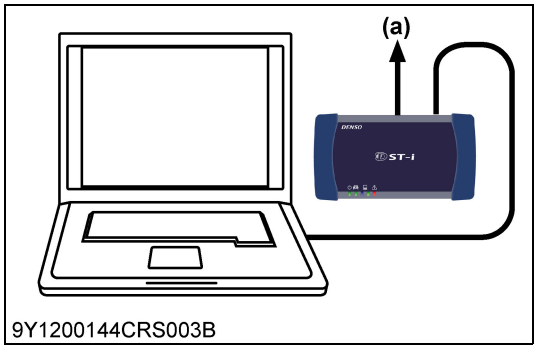
8. Check the Camshaft Position Sensor

1. Refer to DTC P0340 and P0341, and implement checking of the camshaft position sensor.

OK	Go to "9. Check the Rail Pressure Sensor and Supply Pump".
NG	Repair and replacement of camshaft position sensor-related parts.

(1) Camshaft Position Sensor
(G Sensor)

9Y1200199CRS0662US0



9. Check the Data Related to Pressure Control

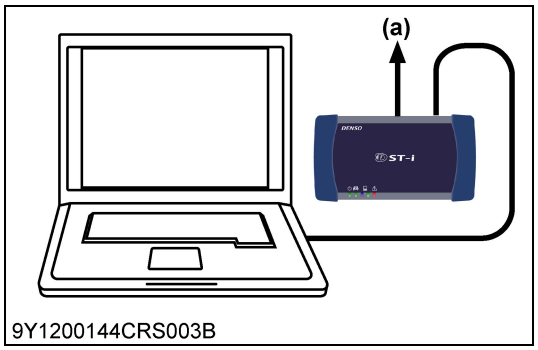
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Go to "10. Check the Injector (Including the Pipes, etc.)".
NG	**(Check the trouble related to pressure** Refer to the pressure system items (P0087, P0088, P0089 and P0093 (Refer to page 1-S127)) and SCV abnormality items (P0628 and P0629 (Refer to 1-S209)) in "5.[2] DIAGNOSTIC PROCEDURE BY DTC", perform diagnosis for the ECU, wiring harness and sensor, and repair or replace the required parts. ■ **NOTE** • **Some diagnosis items above may be mentioned twice.**

(a) CAN1 Connector

9Y1200199CRS0707US0



10. Check the Injector (Including the Pipes, etc.)

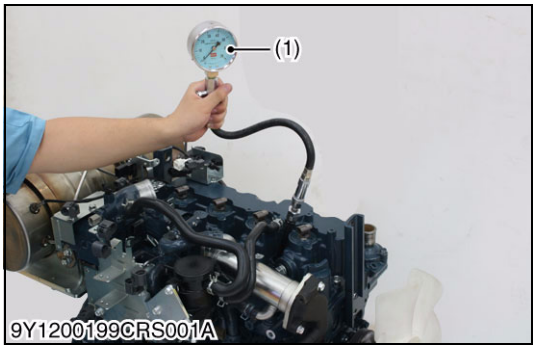
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

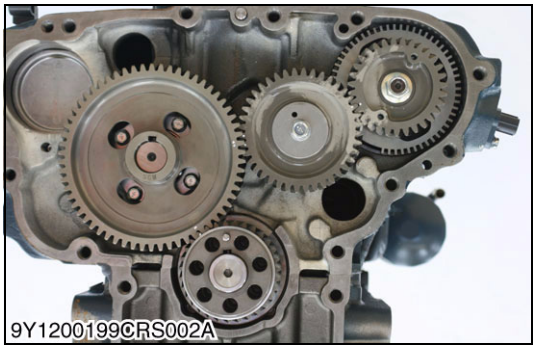
Factory specification	1. Engine vibration and noise are increased and the rotation speed is reduced when the injection for the corresponding cylinder is stopped. 2. The same results must be attained from all the cylinders.

OK	Go to "11. Check the Engine".
NG	Check and repair faulty parts including the high pressure line of the defective cylinder.

(a) CAN1 Connector

9Y1200199CRS0708US0





11. Check the Engine

1. Check the compression pressure, valve clearance, valve timing and the inside of the engine.
2. Check the timing gear.

OK	Normal.
NG	Repair the malfunction.

(1) Compression Tester

9Y1200199CRS0734US0

5. DIAGNOSTIC PROCEDURE BY DTC

[1] DTC LIST

Name		NE-G phase shift
ISO 14229 P-Code		P0016
J1939-73	SPN	636
	FMI	7
SPN Name SAE J1939 Table C1		Engine Position Sensor
DTC Name		NE-G phase shift
Management Unit for Detected Part		NEGUM
Detection item		• Large phase shift between NE (crankshaft position sensor) pulse and G (camshaft position sensor) pulse
DTC Set Preconditions		• Engine is operating above low idle speed • Battery voltage is normal • Sensor supply voltage VCC# is normal • NE signal is normal • G signal is normal • Coolant temperature is 10 °C (50 °F) or higher
DTC set parameter		(Approximate) • Phase difference between NE pulse and G pulse is within ±0.26 rad (±15 °)
Time to action or number of error detection		• 10 times or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		(Invalid G signal) • Engine hesitates at start-up
Engine Warning Light		• ON
Recovery from error		• Diagnostic counter =zero
Delay time for recovery		• Delay time varies with engine speed in proportional relation. • If it is set 30 sec at 800 min^{-1} (rpm), it is shorten to 15 sec at 1600 min^{-1} (rpm) operation.
Remark		• Engine hesitates at start-up • NE: Crankshaft position sensor • G: Camshaft position sensor

9Y1200199CRS0735US0

Name		Intake air temperature built-in MAF sensor abnormality	
ISO 14229 P-Code		P0072	P0073
J1939-73	SPN	171	171
	FMI	4	3
SPN Name SAE J1939 Table C1		Ambient Air Temperature	Ambient Air Temperature
DTC Name		Intake air temperature built-in MAF sensor: Low	Intake air temperature built-in MAF sensor: High
Management Unit for Detected Part		THAIL	THAIH
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness.
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal
DTC set parameter		• Intake air temperature built-in MAF sensor voltage: 0.1 V or less	• Intake air temperature built-in MAF sensor voltage: 4.9 V or more
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• 25 °C (77 °F) [default value]	• 25 °C (77 °F) [default value]
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• Immediately	• Immediately
Remark			

9Y1200199CRS0736US0

Name		Pressure limiter emergency open
ISO 14229 P-Code		P0087
J1939-73	SPN	633
	FMI	7
SPN Name SAE J1939 Table C1		Engine Fuel Actuator 1 Control Command
DTC Name		Pressure limiter emergency open
Management Unit for Detected Part		PLACT
Detection item		• Pressure limiter emergency open
DTC Set Preconditions		• Rail pressure sensor is normal • Sensor supply voltage VCC# is normal
DTC set parameter		• Combination of below A and B A: Fuel leak (P0093) is detected B: Condition (1) or (2) is fulfilled; (1) Rail pressure exceeds 191 MPa (1950 kgf/cm^2, 27700 psi) (2) Within 1 sec, after the rail pressure goes below 191 MPa (1950 kgf/cm^2, 27700 psi) [Before the pressure decrease, the rail pressure is above 191 MPa (1950 kgf/cm^2, 27700 psi)]
Time to action or number of error detection		• 1 time or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• To minimize PM emission to Diesel Particulate Filter (hereinafter referred to as the "DPF") • Engine speed may go down due to lack of fuel pressure, regardless limp home de-rating

9Y1200199CRS0737US0

Name		High rail pressure
ISO 14229 P-Code		P0088
J1939-73	SPN	157
	FMI	0
SPN Name SAE J1939 Table C1		Engine Injector Metering Rail 1 Pressure
DTC Name		High rail pressure
Management Unit for Detected Part		PCEX
Detection item		• Actual pressure exceeds the command pressure
DTC Set Preconditions		• Rail pressure sensor is normal • Sensor supply voltage VCC# is normal
DTC set parameter		• Actual pressure ≥ 197 MPa (2010 kgf/cm^2, 28600 psi)
Time to action or number of error detection		• 1 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON
Recovery from error		• Diagnostic counter = zero
Delay time for recovery		• 30 sec.
Remark		• To minimize PM emission

9Y1200199CRS0738US0

Name		SCV stuck
ISO 14229 P-Code		P0089
J1939-73	SPN	1347
	FMI	7
SPN Name SAE J1939 Table C1		Engine Fuel Feed Pump Pressurizing Assembly #1
DTC Name		SCV stuck
Management Unit for Detected Part		SCVS
Detection item		• SCV stuck at open position (Actual rail pressure continuously exceeds the command rail pressure)
DTC Set Preconditions		• Supply pump is normal and pump calibration has been executed • Engine is operating (Q: 4 mm^3/st or higher) • Injector is normal • Battery voltage is normal • Sensor supply voltage VCC# is normal • Rail pressure sensor is normal
DTC set parameter		• Discharge request of supply pump goes below 0 mm^3/st and the actual rail pressure is 10 MPa (100 kgf/cm^2, 1400 psi) higher than command pressure • Above state continues for 26 seconds or more
Time to action or number of error detection		• 1 time or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• To minimize PM emission • Engine stops in some case

9Y1200199CRS0739US0

Name		Fuel leak (in high pressured fuel system)
ISO 14229 P-Code		P0093
J1939-73	SPN	1239
	FMI	1
SPN Name SAE J1939 Table C1		Engine Fuel Leakage 1
DTC Name		Fuel leak (in high pressured fuel system)
Management Unit for Detected Part		FLEAK
Detection item		• Fuel leak from high pressured fuel system (Fuel consumption is calculated from the difference of fuel pressure of before and after the injection, and the error will be detected when excess fuel consumption is found)
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC# is normal • Rail pressure sensor is normal • Supply pump (SCV) is normal • Injector and injector drive circuit are normal • NE signal is active [Engine is operating (700 min^{-1} (rpm) or higher)] • No DTC of P0087, P0088, P0089
DTC set parameter		(a): the flow volume which is calculated from the difference of rail pressure (decrease) (b): total volume of injection and leakage Fuel leak is judged with following conditions: • In case, engine speed is more than 1200 min^{-1} (rpm): When the difference of (a) and (b) is 120 mm^3/st or above, (a) is higher than (b), and fuel leak is not from opening pressure limiter • In case, engine speed is 1200 min^{-1} (rpm) or less: When the difference of (a) and (b) is 400 mm^3/st or above, (a) is higher than (b), and fuel leak is not from opening pressure limiter
Time to action or number of error detection		• 1 time or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• To minimize PM emission • Engine stops in some case

9Y1200199CRS0740US0

Name		Intake air volume: Low
ISO 14229 P-Code		P0101
J1939-73	SPN	132
	FMI	1
SPN Name SAE J1939 Table C1		Engine Inlet Air Mass Flow Rate
DTC Name		Intake air volume: Low
Management Unit for Detected Part		GA
Detection item		• Engine inlet air mass flow rate lacking (Disconnect turbo blower intake hose)
DTC Set Preconditions		• Engine is operating [1000 min^{-1} (rpm) or higher] • Coolant temperature is 15 °C (59 °F) or higher (Coolant temperature sensor is normal) • MAF sensor is normal • EGR valve is normal • Intake throttle valve is normal • Battery voltage is normal
DTC set parameter		• Engine Inlet Air Mass Flow Rate: less than half of target value
Time to action or number of error detection		• 10.0 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		

9Y1200199CRS0741US0

Name		MAF sensor abnormality	
ISO 14229 P-Code		P0102	P0103
J1939-73	SPN	132	132
	FMI	4	3
SPN Name SAE J1939 Table C1		Engine Inlet Air Mass Flow Rate	Engine Inlet Air Mass Flow Rate
DTC Name		MAF sensor: Low	MAF sensor: High
Management Unit for Detected Part		MAFL	MAFH
Detection item		• Open circuit or ground short circuit of sensor / harness.	• +B short circuit of sensor / harness
DTC Set Preconditions		• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated • Sensor supply voltage is normal	• Battery voltage is normal • 700 min^{-1} (rpm) ≤ engine speed ≤ 2800 min^{-1} (rpm) • Target intake mass air flow is 460 or less and it continues for 3 secs • Sensor supply voltage is normal
DTC set parameter		• Mass air flow sensor voltage: 0.1 V or less	• Mass air flow sensor voltage: 4.9 V or more in certain operation condition
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• Sensor output: 0.7 times of target value at normal condition [default value] • Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• Sensor output: 0.7 times of target value at normal condition [default value] • Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance	• Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• Engine is not stopped forcibly by ECU. However KUBOTA strongly recommends operator to stop engine as soon as possible.	• Engine is not stopped forcibly by ECU. However KUBOTA strongly recommends operator to stop engine as soon as possible.

9Y1200199CRS0742US0

Name		Intake air temperature: high (Inter cooler model only)
ISO 14229 P-Code		P0111
J1939-73	SPN	172
	FMI	0
SPN Name SAE J1939 Table C1		Air Inlet Temperature
DTC Name		Intake air temperature: high Inter cooler model only
Management Unit for Detected Part		THAABH
Detection item		• Intake air temperature too high
DTC Set Preconditions		• Battery voltage is normal • Key switch is ON
DTC set parameter		• Intake air temperature higher than ambient temperature +60 °C (+140 °F)
Time to action or number of error detection		• 10 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• Inter cooler model only

9Y1200199CRS0743US0

Name		Intake air temperature error	
ISO 14229 P-Code		P0112	P0113
J1939-73	SPN	172	172
	FMI	4	3
SPN Name SAE J1939 Table C1		Engine Air Inlet Temperature	Engine Air Inlet Temperature
DTC Name		Intake air temperature error: Low	Intake air temperature error: High
Management Unit for Detected Part		THAL	THAH
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal
DTC set parameter		• Voltage of intake air temperature sensor is 0.05 V or less	• Voltage of intake air temperature sensor is 4.9 V or above
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 40 °C (104 °F) [default value]	• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 40 °C (104 °F) [default value]
Behaviour During Malfunction		• Amount of white smoke increases at low temperatures	• Amount of white smoke increases at low temperatures
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• 30 sec.	• 30 sec.
Remark		• White smoke increases at low temperature	• White smoke increases at low temperature

9Y1200199CRS0744US0

Name		Coolant temperature sensor abnormality	
ISO 14229 P-Code		P0117	P0118
J1939-73	SPN	110	110
	FMI	4	3
SPN Name SAE J1939 Table C1		Engine Coolant Temperature	Engine Coolant Temperature
DTC Name		Coolant temperature sensor: Low	Coolant temperature sensor: High
Management Unit for Detected Part		THWL	THWH
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal
DTC set parameter		• Voltage of coolant temperature sensor is 0.1 V or less	• Voltage of coolant temperature sensor is 4.9 V or above
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• During start-up = −25 °C (−13 °F) [default value] • Under other conditions = 80 °C (176 °F) [default value] • Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• During start-up = −25 °C (−13 °F) [default value] • Under other conditions = 80 °C (176 °F) [default value] • Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Amount of white smoke increases at low temperatures • Insufficient output • Worsening exhaust gas performance	• Amount of white smoke increases at low temperatures • Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• White smoke increases at low temperature	• White smoke increases at low temperature

9Y1200199CRS0745US0

Name		Fuel high temperature
ISO 14229 P-Code		P0181
J1939-73	SPN	174
	FMI	0
SPN Name SAE J1939 Table C1		Fuel Temperature
DTC Name		Fuel high temperature
Management Unit for Detected Part		THFABH
Detection item		• Fuel temperature high
DTC Set Preconditions		• Passed 300 sec after cranking • Engine speed is 800 min^{-1} (rpm) or more • Fuel temperature sensor is normal
DTC set parameter		• Fuel temperature higher than 90 °C (194 °F)
Time to action or number of error detection		• 10 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None
Engine Warning Light		• ON
Recovery from error		• Diagnostic counter = zero
Delay time for recovery		• 30 sec.
Remark		

9Y1200199CRS0746US0

Name		Fuel temperature sensor abnormality	
ISO 14229 P-Code		P0182	P0183
J1939-73	SPN	174	174
	FMI	4	3
SPN Name SAE J1939 Table C1		Engine Fuel Temperature 1	Engine Fuel Temperature 1
DTC Name		Fuel temperature sensor: Low	Fuel temperature sensor: High
Management Unit for Detected Part		THFL	THFH
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal
DTC set parameter		• Voltage of temperature sensor in supply pump is 0.1 V or less	• Voltage of temperature sensor in supply pump is 4.9 V or above
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 45 °C (113 °F) [default value] • Output limitation: Approximately 75 % of normal condition	• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 45 °C (113 °F) [default value] • Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• 30 sec.	• 30 sec.
Remark			

9Y1200199CRS0747US0

Name		Rail pressure sensor abnormality	
ISO 14229 P-Code		P0192	P0193
J1939-73	SPN	157	157
	FMI	4	3
SPN Name SAE J1939 Table C1		Engine Injector Metering Rail 1 Pressure	Engine Injector Metering Rail 1 Pressure
DTC Name		Rail pressure sensor: Low	Rail pressure sensor: High
Management Unit for Detected Part		PCL	PCH
Detection item		• Ground short circuit of sensor / harness • Failure of sensor	• Open circuit or +B short circuit of sensor / harness. • Failure of sensor
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC# is normal	• Battery voltage is normal • Sensor supply voltage VCC# is normal
DTC set parameter		• Voltage of rail pressure sensor is 0.7 V or less	• Voltage of rail pressure sensor is 4.9 V or above
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model) • Engine forcibly stopped 60 sec. later	• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model) • Engine forcibly stopped 60 sec. later
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance • Worsening running noise • Increase in white smoke • Engine stops	• Insufficient output • Worsening exhaust gas performance • Worsening running noise • Increase in white smoke • Engine stops
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• To minimize PM emission • Engine running noise increases. • White smoke increases.	• To minimize PM emission • Engine running noise increases. • White smoke increases.

9Y1200199CRS0748US0

Name		Injector charge voltage: High
ISO 14229 P-Code		P0200
J1939-73	SPN	523535
	FMI	0
SPN Name SAE J1939 Table C1		proprietary
DTC Name		Injector charge voltage: High
Management Unit for Detected Part		OCHG
Detection item		• Injector charge voltage: High
DTC Set Preconditions		• Battery voltage is normal • CPU is normal
DTC set parameter		• Injector charge voltage: High
Time to action or number of error detection		• 10 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model) • Engine forcibly stopped 60 sec. later
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance • Engine stops
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		

9Y1200199CRS0749US0

Name		Open circuit of harness/coil	
ISO 14229 P-Code		P0201	P0202
J1939-73	SPN	651	653
	FMI	3	3
SPN Name SAE J1939 Table C1		Engine Injector Cylinder #01	Engine Injector Cylinder #03
DTC Name		Open circuit of harness/coil in 1st cylinder injector	Open circuit of harness/coil in 3rd cylinder injector
Management Unit for Detected Part		NCTWV1	NCTWV2
Detection item		• Open circuit of harness • Open circuit of injector coil	• Open circuit of harness • Open circuit of injector coil
DTC Set Preconditions		• Engine is operating • Battery voltage is normal • During injection • CPU is normal	• Engine is operating • Battery voltage is normal • During injection • CPU is normal
DTC set parameter		• Open circuit of harness or open circuit of injector coil	• Open circuit of harness or open circuit of injector coil
Time to action or number of error detection		• 8 times or more	• 8 times or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Large vibration • Worsening exhaust gas performance	• Insufficient output • Large vibration • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• To minimize PM emission • Injectors which have no error are operated. • Engine vibration increases.	• To minimize PM emission • Injectors which have no error are operated. • Engine vibration increases.

9Y1200199CRS0750US0

Name		Open circuit of harness/coil	
ISO 14229 P-Code		P0203	P0204
J1939-73	SPN	654	652
	FMI	3	3
SPN Name SAE J1939 Table C1		Engine Injector Cylinder #04	Engine Injector Cylinder #02
DTC Name		Open circuit of harness/coil in 4th cylinder injector	Open circuit of harness/coil in 2nd cylinder injector
Management Unit for Detected Part		NCTWV3	NCTWV4
Detection item		• Open circuit of harness • Open circuit of injector coil	• Open circuit of harness • Open circuit of injector coil
DTC Set Preconditions		• Engine is operating • Battery voltage is normal • During injection • CPU is normal	• Engine is operating • Battery voltage is normal • During injection • CPU is normal
DTC set parameter		• Open circuit of harness or open circuit of injector coil	• Open circuit of harness or open circuit of injector coil
Time to action or number of error detection		• 8 times or more	• 8 times or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Large vibration • Worsening exhaust gas performance	• Insufficient output • Large vibration • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• To minimize PM emission • Injectors which have no error are operated. • Engine vibration increases.	• To minimize PM emission • Injectors which have no error are operated. • Engine vibration increases.

9Y1200199CRS0751US0

Name		Engine overheat	Engine overrun
ISO 14229 P-Code		P0217	P0219
J1939-73	SPN	110	190
	FMI	0	0
SPN Name SAE J1939 Table C1		Engine Coolant Temperature	Engine Speed
DTC Name		Engine overheat	Engine overrun
Management Unit for Detected Part		THWOT	NEOR
Detection item		• Overheat of engine coolant temperature	• Engine speed exceeds threshold speed
DTC Set Preconditions		• Coolant temperature sensor is normal	• Key switch is ON
DTC set parameter		• Engine coolant temperature ≥ 120 °C (248 °F)	• Engine speed ≥ 3500 min^{-1} (rpm)
Time to action or number of error detection		• 5 sec. or more	• 3 revolutions or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• Stop injection (Q = 0 mm^3/st)
Behaviour During Malfunction		• Insufficient output • Overheat	• Overrun
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• 30 sec.	• Immediately
Remark			

9Y1200199CRS0752US0

Name		Boost pressure sensor abnormality	
ISO 14229 P-Code		P0237	P0238
J1939-73	SPN	102	102
	FMI	4	3
SPN Name SAE J1939 Table C1		Engine Intake Manifold #1 Pressure	Engine Intake Manifold #1 Pressure
DTC Name		Boost pressure sensor: Low	Boost pressure sensor: High
Management Unit for Detected Part		PIML	PIMH
Detection item		• Ground short circuit of sensor / harness • Failure of sensor	• Open circuit or +B short circuit of sensor / harness • Failure of sensor
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC# is normal	• Battery voltage is normal • Sensor supply voltage VCC# is normal
DTC set parameter		• Voltage of boost pressure sensor is 0.2 V or below	• Voltage of boost pressure sensor is 4.9 V or above
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• 65kPa (0.66 kgf/cm^2, 9.4 psi) [default value]	• 65 kPa (0.66 kgf/cm^2, 9.4 psi) [default value]
Behaviour During Malfunction		• Insufficient output	• Insufficient output
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• Default value is changed in consideration with high altitude usage • Engine power drops.	• Default value is changed in consideration with high altitude usage • Engine power drops.

9Y1200199CRS0753US0

Name		Crankshaft position sensor (NE sensor) abnormality	
ISO 14229 P-Code		P0335	P0336
J1939-73	SPN	636	636
	FMI	8	2
SPN Name SAE J1939 Table C1		Engine Position Sensor	Engine Position Sensor
DTC Name		No input of NE sensor (Crankshaft position sensor) pulse	NE sensor (Crankshaft position sensor) pulse number error
Management Unit for Detected Part		NENOP	NEPUM
Detection item		• Open circuit or short circuit of sensor / harness • Failure of sensor	• Open circuit or short circuit of sensor / harness • Failure of sensor
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC# is normal • Engine is not stalled	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Engine speed is 350 min^{-1} (rpm) or higher
DTC set parameter		• No recognition of Ne sensor pulse	• Pulse count per rotation is not 56 teeth
Time to action or number of error detection		• 10 times or more	• 10 times or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition	• Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		(Running only with G signal) • Faulty starting • Vibration is slightly large • Insufficinet output	(Running only with G signal) • Faulty starting • Vibration is slightly large • Insufficinet output
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• Delay time varies with engine speed in proportional relation • If it is set 30 sec. at 800 min^{-1} (rpm), it is shorten to 15 sec. at 1600 min^{-1} (rpm) operation	• Delay time varies with engine speed in proportional relation • If it is set 30 sec. at 800 min^{-1} (rpm), it is shorten to 15 sec. at 1600 min^{-1} (rpm) operation
Remark		• Faulty starting. • Engine vibration increases slightly.	• Faulty starting. • Engine vibration increases slightly.

9Y1200199CRS0754US0

Name		Camshaft position sensor (G sensor) abnormality	
ISO 14229 P-Code		P0340	P0341
J1939-73	SPN	723	723
	FMI	8	2
SPN Name SAE J1939 Table C1		Engine Speed 2	Engine Speed 2
DTC Name		No input of G sensor (Camshaft position sensor) pulse	G sensor (Camshaft position sensor) pulse number error
Management Unit for Detected Part		GNOP	GPUM
Detection item		• Open circuit or short circuit of sensor / harness • Failure of sensor	• Open circuit or short circuit of sensor / harness • Failure of sensor
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC# is normal • Engine is not stalled	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Engine speed is 350 min^{-1} (rpm) or higher
DTC set parameter		• No recognition of G sensor pulse	• Pulse count per rotation is not 5 teeth
Time to action or number of error detection		• 10 times or more	• 10 times or more
Limp Home Action by engine ECU (system action)		• None	• None
Behaviour During Malfunction		(Invalid G signal) • Engine hesitates at start-up	(Invalid G signal) • Engine hesitates at start-up
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• Delay time varies with engine speed in proportional relation • If it is set 30 sec. at 800 min^{-1} (rpm), it is shorten to 15 sec. at 1600 min^{-1} (rpm) operation	• Delay time varies with engine speed in proportional relation • If it is set 30 sec. at 800 min^{-1} (rpm), it is shorten to 15 sec. at 1600 min^{-1} (rpm) operation
Remark		• Engine hesitates at start-up	• Engine hesitates at start-up

9Y1200199CRS0755US0

Name		Air heater relay driving circuit abnormality	
ISO 14229 P-Code		P0380	P0380
J1939-73	SPN	523544	523544
	FMI	3	4
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		+B short of air heater relay driving circuit	Ground short of air heater relay driving circuit
Management Unit for Detected Part		GRELBT	GRELGD
Detection item		• +B short of air heater relay driving circuit	• Ground short or open circuit of air heater relay driving circuit
DTC Set Preconditions		• Battery voltage is normal • During air heater relay drive command is activated	• Battery voltage is normal • Other than during air heater relay drive command is activated
DTC set parameter		• +B short circuit of harness	• Open circuit of harness, Ground short circuit
Time to action or number of error detection		• 1 sec. or more	• 1 sec. or more
Limp Home Action by engine ECU (system action)		• None	• None
Behaviour During Malfunction		(At low temperature) • Faulty starting • Increase in white smoke	(At low temperature) • Faulty starting • Increase in white smoke
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		(At low temperature) • Faulty starting • White smoke increases.	

9Y1200199CRS0756US0

Name		EGR actuator abnormality		
ISO 14229 P-Code		P0403	P0404	P0409
J1939-73	SPN	523574	523574	523572
	FMI	3	4	4
SPN Name SAE J1939 Table C1		proprietary	proprietary	proprietary
DTC Name		EGR actuator open circuit	EGR actuator coil short	EGR position sensor failure
Management Unit for Detected Part		DCMEGROPC	DCMEGROCC	LEGRC
Detection item		• EGR actuator open circuit	• EGR actuator coil short	• EGR position sensor failure
DTC Set Preconditions		• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal
DTC set parameter		• EGR actuator open error signal received via CAN	• EGR actuator coil short error signal received via CAN	• EGR position sensor error signal received via CAN
Time to action or number of error detection		• 2.8 sec or more	• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop	• Output limitation: Approximately 75 % of normal condition • EGR stop	• Output limitation: Approximately 75 % of normal condition • EGR stop
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance	• Insufficient output • Worsening exhaust gas performance	• Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–	–
Remark				

9Y1200199CRS0757US0

Name		Oil pressure error
ISO 14229 P-Code		P0524
J1939-73	SPN	100
	FMI	1
SPN Name SAE J1939 Table C1		Engine Oil Pressure
DTC Name		Oil pressure error
Management Unit for Detected Part		POILDN
Detection item		• Oil pressure switch
DTC Set Preconditions		• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: V12 terminal) is not activated • 10 sec or more after engine start [700 min^{-1} (rpm) or higher]
DTC set parameter		• Oil pressure switch ON: continues one sec or more
Time to action or number of error detection		• Transient
Limp Home Action by engine ECU (system action)		• None
Behaviour During Malfunction		• Engine stops
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		

9Y1200199CRS0758US0

Name		Exhaust gas temperature sensor 1 (T1) abnormality	
ISO 14229 P-Code		P0543	P0544
J1939-73	SPN	3242	3242
	FMI	4	3
SPN Name SAE J1939 Table C1		After treatment 1 Diesel Particulate Filter Intake Gas Temperature	After treatment 1 Diesel Particulate Filter Intake Gas Temperature
DTC Name		Exhaust gas temperature sensor 1: Low	Exhaust gas temperature sensor 1: High
Management Unit for Detected Part		THAEX1L	THAEX1H
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness.
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal • Coolant temperature is 65 °C (149 °F) or more: continues longer than 10 min. after engine starting • 100 °C (212 °F) ≤ T0 ≤ 800 °C (1472 °F): continues longer than 10 sec. or 100 °C (212°F) ≤ T2 ≤ 800 °C (1472 °F): continues longer than 10sec.
DTC set parameter		• Diesel Particulate Filter (hereinafter referred to as the "DPF") inlet temperature sensor (T1) voltage: 0.08 V or less	• DPF inlet temperature sensor (T1) voltage: 4.92 V or more
Time to action or number of error detection		• 5 sec. or more	• 120 sec. or more
Limp Home Action by engine ECU (system action)		• 0 °C (32 °F) [default value] • Output limitation: Approximately 75 % of normal condition	• 0 °C (32 °F) [default value] • Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark			

9Y1200199CRS0759US0

Name		Exhaust gas temperature sensor 0 (T0) abnormality	
ISO 14229 P-Code		P0546	P0547
J1939-73	SPN	4765	4765
	FMI	4	3
SPN Name SAE J1939 Table C1		After treatment 1 Diesel Oxidation Catalyst Intake Gas Temperature	After treatment 1 Diesel Oxidation Catalyst Intake Gas Temperature
DTC Name		Exhaust gas temperature sensor 0: Low	Exhaust gas temperature sensor 0: High
Management Unit for Detected Part		THAEX0L	THAEX0H
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness.
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal • Coolant temperature is 65 °C (149 °F) or more: continues longer than 5 min. after engine starting • 100 °C (212 °F) ≤ T1 ≤ 800 °C (1472 °F): continues longer than 10 sec. or 100 °C (212°F) ≤ T2 ≤ 800 °C (1472 °F): continues longer than 10 sec.
DTC set parameter		• DOC inlet temperature sensor (T0) voltage: 0.08 V or less	• DOC inlet temperature sensor (T0) voltage: 4.92 V or more
Time to action or number of error detection		• 5 sec. or more	• 120 sec. or more
Limp Home Action by engine ECU (system action)		• 0 °C (32 °F) [default value] • Output limitation: Approximately 75 % of normal condition	• 0 °C (32 °F) [default value] • Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark			

9Y1200199CRS0760US0

Name		Battery voltage abnormality	
ISO 14229 P-Code		P0562	P0563
J1939-73	SPN	168	168
	FMI	4	3
SPN Name SAE J1939 Table C1		Battery Potential / Power Input 1	Battery Potential / Power Input 1
DTC Name		Battery voltage: Low	Battery voltage: High
Management Unit for Detected Part		VBBL	VBBH
Detection item		• Open circuit, short circuit or damage of harness • Failure of battery	• Open circuit, short circuit or damage of harness • Failure of battery
DTC Set Preconditions		• Key switch is ON • Starter Switch signal (ECU: V12 terminal) is not activated	• Key switch is ON • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• ECU recognition of battery voltage is below 8 V in 12 V system • Not monitored during cranking	• ECU recognition of battery voltage is above 16 V in 12 V system
Time to action or number of error detection		• 1 sec. or more	• 1 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Faulty starting • Insufficient output • Worsening exhaust gas performance • Engine stops in some case	• Faulty starting • Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Key switch turn OFF
Delay time for recovery		• 30 sec.	–
Remark		• Faulty starting. • Engine stops in some case	• Faulty starting.

9Y1200199CRS0761US0

Name		QR data abnormality	
ISO 14229 P-Code		P0602	P0602
J1939-73	SPN	523538	523538
	FMI	2	7
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		QR data error	No QR data
Management Unit for Detected Part		QRERR	QRNOT
Detection item		• QR data read error from EEPROM	• Area of QR data on EEPROM is vacant
DTC Set Preconditions		• Key switch is ON	• Key switch is ON
DTC set parameter		• QR data read error from EEPROM	• Area of QR data on EEPROM is vacant.
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Nozzle caribration is not executed • Output limitation: Approximately 75 % of normal condition	• Nozzle correction factor = 0 [default value] • Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• Insufficient output	• Insufficient output
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• To cover each injector dispersion	

9Y1200199CRS0762US0

Name		ECU FLASH ROM and CPU abnormality		
ISO 14229 P-Code		P0605	P0606	P0606
J1939-73	SPN	628	1077	523527
	FMI	2	2	2
SPN Name SAE J1939 Table C1		Program Memory	Engine Fuel Injection Pump Controller	Proprietary
DTC Name		ECU FLASH ROM error	ECU CPU (Main IC) error	ECU CPU (Monitoring IC) error
Management Unit for Detected Part		FROM	MCPU	SCPU
Detection item		• FLASH ROM error	• Failure of CPU	• Failure of monitoring IC of CPU
DTC Set Preconditions		• Key switch is ON	• Key switch is ON • Battery voltage is 10 V or more • Starter Switch signal (ECU: V12 terminal) is not activated	• Key switch is ON • Battery voltage is 10 V or more • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• Check-sum error	• CPU fatal error	• Failure of monitoring IC of CPU
Time to action or number of error detection		• 1 time or more	• 1 time or more	• 1 time or more
Limp Home Action by engine ECU (system action)		• Engine stopped without delay	• Engine Stop	• Engine Stop
Behaviour During Malfunction		• Engine stops	• Engine stops	• Engine stops
Engine Warning Light		• ON	• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–	–
Remark				

9Y1200199CRS0763US0

Name		Injector charge voltage abnormality
ISO 14229 P-Code		**P0611**
J1939-73	**SPN**	523525
	FMI	1
SPN Name SAE J1939 Table C1		proprietary
DTC Name		Injector charge voltage: Low
Management Unit for Detected Part		LCHG
Detection item		• Injector charge voltage: Low • Failure of charge circuit of ECU
DTC Set Preconditions		• Battery voltage is normal • CPU is normal
DTC set parameter		• Injector charge voltage: Low • Failure of charge circuit of ECU
Time to action or number of error detection		• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficinet output • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• To minimize PM emission • Engine stops in some case

9Y1200199CRS0764US0

Name		SCV drive system abnormality	
ISO 14229 P-Code		P0628	P0629
J1939-73	SPN	1347	1347
	FMI	4	3
SPN Name SAE J1939 Table C1		Engine Fuel Feed Pump Pressurizing Assembly #1	Engine Fuel Feed Pump Pressurizing Assembly #1
DTC Name		SCV drive system error	+B short circuit of SCV
Management Unit for Detected Part		DRSCV	BSSCV
Detection item		• Open circuit or ground short circuit of SCV	• +B short circuit of SCV
DTC Set Preconditions		• Battery voltage is normal • Key switch is ON • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Key switch is ON • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• Open circuit or ground short of SCV	• +B short circuit of SCV
Time to action or number of error detection		• 2.6 sec. or more	• 2.6 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model) • Engine forcibly stopped 60 sec later	• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model) • Engine forcibly stopped 60 sec later
Behaviour During Malfunction		• Insufficinet output • Worsening exhaust gas performance	• Insufficinet output • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark			• Engine speed may go down due to low fuel pressure regardless limp home de-rating • Engine may stop automatically before stopped forcibly by ECU

9Y1200199CRS0765US0

Name		Sensor supply voltage 1 abnormality	
ISO 14229 P-Code		P0642	P0643
J1939-73	SPN	3509	3509
	FMI	4	3
SPN Name SAE J1939 Table C1		Sensor supply voltage 1	Sensor supply voltage 1
DTC Name		Sensor supply voltage 1: Low	Sensor supply voltage 1: High
Management Unit for Detected Part		VCC1L	VCC1H
Detection item		• Sensor supply voltage 1 error or recognition error	• Sensor supply voltage 1 error or recognition error
DTC Set Preconditions		• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• Voltage to sensor is below 4.375 V	• Voltage to sensor is above 5.625 V
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)	• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Faulty starting • Insufficient output • Worsening exhaust gas performance • Engine stops in some case	• Faulty starting • Insufficient output • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• Emission related • Faulty starting. • Engine stops in some case.	• Emission related • Faulty starting. • Engine stops in some case.

9Y1200199CRS0766US0

Name		Sensor supply voltage 2 abnormality	
ISO 14229 P-Code		P0652	P0653
J1939-73	SPN	3510	3510
	FMI	4	3
SPN Name SAE J1939 Table C1		Sensor supply voltage 2	Sensor supply voltage 2
DTC Name		Sensor supply voltage 2: Low	Sensor supply voltage 2: High
Management Unit for Detected Part		VCC2L	VCC2H
Detection item		• Sensor supply voltage 2 error or recognition error	• Sensor supply voltage 2 error or recognition error
DTC Set Preconditions		• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• Voltage to sensor is below 4.375 V	• Voltage to sensor is above 5.625 V
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition	• Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• Faulty starting • Insufficient output • Worsening exhaust gas performance	• Faulty starting • Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• Emission related • Faulty starting.	• Emission related • Faulty starting.

9Y1200199CRS0767US0

Name		Main relay is locked in closed position
ISO 14229 P-Code		P0687
J1939-73	SPN	1485
	FMI	2
SPN Name SAE J1939 Table C1		ECM Main Relay
DTC Name		Main relay is locked in closed position
Management Unit for Detected Part		MRYCS
Detection item		• Failure of main relay
DTC Set Preconditions		• Key switch is OFF • Engine stops
DTC set parameter		• Main relay stays active longer than 1 sec. without command
Time to action or number of error detection		• 2 times or more
Limp Home Action by engine ECU (system action)		• None
Behaviour During Malfunction		• Dead battery
Engine Warning Light		• OFF
Recovery from error		• Diagnostic counter = zero
Delay time for recovery		• 5.3 sec.
Remark		• Battery goes dead

9Y1200199CRS0768US0

Name		Pump seizing
ISO 14229 P-Code		P1274
J1939-73	SPN	523539
	FMI	2
SPN Name SAE J1939 Table C1		proprietary
DTC Name		Pump seizing 1
Management Unit for Detected Part		PMPPR
Detection item		• High pressure 1 error
DTC Set Preconditions		• Sensor supply voltage VCC# is normal • Rail pressure sensor is normal
DTC set parameter		(Approximate parameter) • Rail pressure of 230 MPa (2350 kgf/cm^2, 33400 psi) or more continues 1 second under the condition of above 800 min^{-1} (rpm) • Rail pressure of 220 MPa (2250 kgf/cm^2, 31900 psi) or more continues 1 second under the condition of below 800 min^{-1} (rpm) [Threshold changes depending on the engine speed. 700 min^{-1} (rpm) should be used as a reference]
Time to action or number of error detection		• 1 time or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• To minimize PM emission • To avoid extremely high pressure in injection system

9Y1200199CRS0769US0

Name		Pump seizing
ISO 14229 P-Code		**P1275**
J1939-73	**SPN**	523540
	FMI	2
SPN Name SAE J1939 Table C1		proprietary
DTC Name		Pump seizing 2
Management Unit for Detected Part		PMPEX
Detection item		• High pressure 2 error
DTC Set Preconditions		• Sensor supply voltage VCC# is normal • Rail pressure sensor is normal
DTC set parameter		(Approximate parameter) • Rail pressure of above 197 MPa (2010 kgf/cm^2, 28600 psi), and below 230 MPa (2350 kgf/cm^2, 33400 psi) continues total time for 35 seconds under condition of above 800 min^{-1} (rpm) [Threshold changes depending on the engine speed. 2000 min^{-1} (rpm) should be used as a reference] • Or, rail pressure of above 220 MPa (2250 kgf/cm^2, 31900 psi) continues total time for 1.7 second under condition of below 800 min^{-1} (rpm) [Threshold changes depending on the engine speed. 700 min^{-1} (rpm) should be used as a reference]
Time to action or number of error detection		• 1 time or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• To minimize PM emission • To avoid extremely high pressure in injection system

9Y1200199CRS0770US0

Name		EEPROM check sum error		
ISO 14229 P-Code		P1990	P1991	P1992
J1939-73	SPN	523700	523701	523702
	FMI	13	13	13
SPN Name SAE J1939 Table C1		proprietary	proprietary	proprietary
DTC Name		EEPROM check sum error	EEPROM check sum error (DST1)	EEPROM check sum error (DST2)
Management Unit for Detected Part		EEPKB	EEPDST1	EEPDST2
Detection item		• KBT-EEPROM check sum error	• DST1-EEPROM check sum error	• DST2-EEPROM check sum error
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal	• Battery voltage is normal
DTC set parameter		• EEPROM check sum error	• EEPROM check sum error (DST1)	• EEPROM check sum error (DST2)
Time to action or number of error detection		• Transient	• Transient	• Transient
Limp Home Action by engine ECU (system action)		• None	• None	• None
Behaviour During Malfunction		• None	• None	• None
Engine Warning Light		• ON	• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–	–
Remark				

9Y1200199CRS0771US0

Name		Intake throttle feedback error	Accelerator position sensor 1 abnormality	
ISO 14229 P-Code		P2108	P2122	P2123
J1939-73	SPN	523580	91	91
	FMI	2	4	3
SPN Name SAE J1939 Table C1		proprietary	Accelerator Pedal Position 1	Accelerator Pedal Position 1
DTC Name		Intake throttle feedback error	Accelerator position sensor 1: Low	Accelerator position sensor 1: High
Management Unit for Detected Part		DCMIFB	ACCP1L	ACCP1H
Detection item		• Intake throttle feedback error	• Ground short circuit or open circuit of sensor / harness	• Battery short circuit out of sensor / harness
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal • Sensor supply voltage VCC2 is normal	• Battery voltage is normal • Sensor supply voltage VCC2 is normal
DTC set parameter		(Approximate parameter) • Deviation of throttle position is not corrected in 20 times	• Voltage of accelerator position sensor 1 is 0.3 V or less	• Voltage of accelerator position sensor 1 is 4.8 V or less
Time to action or number of error detection		• 5 sec. or more	• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • Intake throttle 100 % open	• Forced Idle (Accelerator = 0 %)	• Forced Idle (Accelerator = 0 %)
Behaviour During Malfunction		• None	• Insufficient output	• Insufficient output
Engine Warning Light		• ON	• ON	• ON
Recovery from error		• Key switch turn OFF	• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		–	• 3 sec.	• 3 sec.
Remark				

9Y1200199CRS0772US0

Name		Accelerator position sensor 2 abnormality	
ISO 14229 P-Code		P2127	P2128
J1939-73	SPN	29	29
	FMI	4	3
SPN Name SAE J1939 Table C1		Accelerator Pedal Position 2	Accelerator Pedal Position 2
DTC Name		Accelerator position sensor 2: Low	Accelerator position sensor 2: High
Management Unit for Detected Part		ACCP2L	ACCP2H
Detection item		• Ground short circuit or open circuit of sensor / harness	• Battery short circuit out of sensor / harness
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC1 is normal	• Battery voltage is normal • Sensor supply voltage VCC1 is normal
DTC set parameter		• Voltage of accelerator position sensor 2 is 0.3 V or less	• Voltage of accelerator position sensor 2 is 4.8 V or less
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Forced Idle (Accelerator = 0 %)	• Forced Idle (Accelerator = 0 %)
Behaviour During Malfunction		• Insufficient output	• Insufficient output
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• 3 sec.	• 3 sec.
Remark			

9Y1200199CRS0773US0

Name		Accelerator position sensor error (CAN)	Accelerator position sensor corelation error
ISO 14229 P-Code		P2131	P2135
J1939-73	SPN	523543	91
	FMI	2	2
SPN Name SAE J1939 Table C1		proprietary	Accel Pedal Sensor 1
DTC Name		Accelerator position sensor error (CAN)	Accelerator position sensor corelation error
Management Unit for Detected Part		ACCPCAN	ACCPP
Detection item		• Accelerator position sensor signal error (sensor / harness open circuit, ground short circuit etc)	• Deviation from designed correlation in two sensors
DTC Set Preconditions		• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Accelerator position sensor1 is normal • Accelerator position sensor2 is normal
DTC set parameter		• Accelerator position sensor error signal received by CAN	• Deviation from designed corelation in two sensors • It depends on engine application
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Not applicable	• Forced Idle (Accelerator = 0 %)
Behaviour During Malfunction		• Insufficient output	• Insufficient output
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero (CAN signal recovers)	• Diagnostic counter = zero
Delay time for recovery		• Immediately	• 3 sec.
Remark			

9Y1200199CRS0774US0

Name		Common 1 system injector drive circuit open
ISO 14229 P-Code		P2146
J1939-73	SPN	523523
	FMI	2
SPN Name SAE J1939 Table C1		proprietary
DTC Name		Injector drive circuit open in No.1 and 4 Cylinder simultaneously
Management Unit for Detected Part		NCCOM1
Detection item		• Wiring harness open circuit
DTC Set Preconditions		• Engine is operating • Battery voltage is normal • During injection • CPU is normal
DTC set parameter		• When wiring harness open circuit
Time to action or number of error detection		• 8 times or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• Injectors which have no DTC are operated • To minimize PM emission • Engine vibration increases. • Engine stops in some case.

9Y1200199CRS0775US0

Name		Common 1 TWV actuation system short	
ISO 14229 P-Code		P2147	P2148
J1939-73	SPN	523523	523523
	FMI	4	3
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		1 & 4 cylinder injector short to ground at power supply side, or all cylinder injector short to ground	1 & 4 cylinder injector short to +B at power supply side, or all cylinder injector short to +B
Management Unit for Detected Part		GSTWV1	BSTWV1
Detection item		• Wiring harness short to ground	• Wiring harness short to +B
DTC Set Preconditions		• Engine is operating • Battery voltage is normal	• Engine is operating • Battery voltage is normal
DTC set parameter		• When wiring harness short to ground occurs	• When wiring harness short to +B occurs
Time to action or number of error detection		• 8 times or more	• 8 times or more
Limp Home Action by engine ECU (system action)		• Injectors which have DTC stop injection • Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• Injectors which have error stop injection • Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• Injectors which have no DTC are operated • To minimize PM emission • Engine vibration increases. • Engine stops in some case.	• Injectors which have no DTC are operated • To minimize PM emission • Engine vibration increases. • Engine stops in some case.

9Y1200199CRS0776US0

Name		Common 2 system injector drive circuit open
ISO 14229 P-Code		P2149
J1939-73	SPN	523524
	FMI	2
SPN Name SAE J1939 Table C1		proprietary
DTC Name		Injector drive circuit open in No.2 and 3 Cylinder simultaneously
Management Unit for Detected Part		NCCOM2
Detection item		• Wiring harness open circuit
DTC Set Preconditions		• Engine is operating • Battery voltage is normal • During injection • CPU is normal
DTC set parameter		• When wiring harness open circuit
Time to action or number of error detection		• 8 times or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• Injectors which have no DTC are operated • To minimize PM emission • Engine vibration increases. • Engine stops in some case.

9Y1200199CRS0777US0

Name		Common 2 TWV actuation system short	
ISO 14229 P-Code		P2150	P2151
J1939-73	SPN	523524	523524
	FMI	4	3
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		2 & 3 cylinder injector short to ground at power supply side, or all cylinder injector short to ground	2 & 3 cylinder injector short to +B at power supply side, or all cylinder injector short to +B
Management Unit for Detected Part		GSTWV2	BSTWV2
Detection item		• Wiring harness short to ground	• Wiring harness short to +B
DTC Set Preconditions		• Engine is operating • Battery voltage is normal	• Engine is operating • Battery voltage is normal
DTC set parameter		• When wiring harness short to ground occurs	• When wiring harness short to +B occurs
Time to action or number of error detection		• 8 times or more	• 8 times or more
Limp Home Action by engine ECU (system action)		• Injectors which have error stop injection • Output limitation: Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)	• Injectors which have error stop injection • Output limitation Approximately 75 % of normal condition • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark		• Injectors which have no DTC are operated • To minimize PM emission • Engine vibration increases. • Engine stops in some case.	• Injectors which have no DTC are operated • To minimize PM emission • Engine vibration increases. • Engine stops in some case.

9Y1200199CRS0778US0

Name		Barometric pressure sensor error	
ISO 14229 P-Code		P2228	P2229
J1939-73	SPN	108	108
	FMI	4	3
SPN Name SAE J1939 Table C1		Barometric Pressure	Barometric Pressure
DTC Name		Barometric pressure sensor error (Low side)	Barometric pressure sensor error (High side)
Management Unit for Detected Part		PATML	PATMH
Detection item		• Sensor / ECU internal circuit short to ground	• Sensor / ECU internal circuit short to +B
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal
DTC set parameter		• Barometric pressure sensor voltage: 1.6 V or less	• Barometric pressure sensor voltage: 4.4 V or more
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• 65 kPa (0.66 kgf/cm^2, 9.4 psi) [default value]	• 65 kPa (0.66 kgf/cm^2, 9.4 psi) [default value]
Behaviour During Malfunction		• Insufficient output	• Insufficient output
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• Immediately	• Immediately
Remark		• Default value is changed in consideration with high altitude usage • Engine power drops.	• Default value is changed in consideration with high altitude usage • Engine power drops.

9Y1200199CRS0779US0

Name		EGR (DC motor) abnormality		
ISO 14229 P-Code		P2413	P2414	P2415
J1939-73	SPN	523575	523576	523577
	FMI	7	2	2
SPN Name SAE J1939 Table C1		proprietary	proprietary	proprietary
DTC Name		EGR actuator valve stuck	EGR (DC motor) overheat	EGR (DC motor) temperature sensor failure
Management Unit for Detected Part		EGRVSC	EGRAMBTMPC	EGRTHC
Detection item		• EGR actuator valve stuck	• EGR (DC motor) overheat	• EGR (DC motor) temperature sensor failure
DTC Set Preconditions		• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal
DTC set parameter		• EGR actuator valve stuck error signal received via CAN	• EGR (DC motor) temperature error signal (thermistor: 125 °C (257 °F) or more) received via CAN	• EGR (DC motor) temperature sensor error signal received via CAN
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop	• Output limitation: Approximately 75 % of normal condition • EGR stop	• Output limitation: Approximately 75 % of normal condition • EGR stop
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance	• Insufficient output • Worsening exhaust gas performance	• Insufficient output • Worsening exhaust gas performance
Engine Warning Light		• ON	• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–	–
Remark				

9Y1200199CRS0780US0

Name		Exhaust gas temperature sensor 2 (T2) abnormality	
ISO 14229 P-Code		P242C	P242D
J1939-73	SPN	3246	3246
	FMI	4	3
SPN Name SAE J1939 Table C1		After treatment 1 Diesel Particulate Filter Outlet Gas Temperature	After treatment 1 Diesel Particulate Filter Outlet Gas Temperature
DTC Name		Exhaust gas temperature sensor 2: Low	Exhaust gas temperature sensor 2: High
Management Unit for Detected Part		THAEX2L	THAEX2H
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness.
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal • Coolant temperature is 65 °C (149 °F) or more: continues longer than 10 min. after engine starting • 100 °C (212 °F) ≤ T0 ≤ 800 °C (1472 °F): continues longer than 10 sec. or 100 °C (212°F) ≤ T1 ≤ 800 °C (1472 °F): continues longer than 10 sec.
DTC set parameter		• DPF outlet temperature sensor (T2) voltage: 0.08 V or less	• DPF outlet temperature sensor (T2) voltage: 4.92 V or more
Time to action or number of error detection		• 5 sec. or more	• 120 sec. or more
Limp Home Action by engine ECU (system action)		• 0 °C (32 °F) [default value] • Output limitation: Approximately 75 % of normal condition	• 0 °C (32 °F) [default value] • Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark			

9Y1200199CRS0781US0

Name		Differential pressure sensor 1 abnormality	
ISO 14229 P-Code		P2454	P2455
J1939-73	SPN	3251	3251
	FMI	4	3
SPN Name SAE J1939 Table C1		After treatment 1 Diesel Particulate Filter Differential Pressure	After treatment 1 Diesel Particulate Filter Differential Pressure
DTC Name		Differential pressure sensor 1: Low	Differential pressure sensor 1: High
Management Unit for Detected Part		PEX1L	PEX1H
Detection item		• Ground short circuit of sensor / harness	• Open circuit or +B short circuit of sensor / harness.
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC# is normal • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• DPF differential pressure sensor voltage: 0.21 V or less	• DPF differential pressure sensor voltage: 4.7 V or more
Time to action or number of error detection		• 2.8 sec. or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• 0 kPa (0.0 kgf/cm^2, 0.0 psi) [default value] • Output limitation: Approximately 75 % of normal condition	• 0 kPa (0.0 kgf/cm^2, 0.0 psi) [default value] • Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark			

9Y1200199CRS0782US0

Name		Intake throttle lift sensor abnormality	
ISO 14229 P-Code		P2621	P2622
J1939-73	SPN	523582	523582
	FMI	4	3
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		Intake throttle lift sensor: Low	Intake throttle lift sensor: High
Management Unit for Detected Part		ITHRPREL	ITHRPREH
Detection item		• Intake throttle lift sensor low	• Intake throttle lift sensor high
DTC Set Preconditions		• Battery voltage is normal • Sensor supply voltage VCC# is normal	• Battery voltage is normal • Sensor supply voltage VCC# is normal
DTC set parameter		• Intake throttle lift sensor voltage: 0.1 V or less	• Intake throttle lift sensor voltage: 4.89 V or more
Time to action or number of error detection		• 2.8 sec or more	• 2.8 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • Intake throttle 100 % open	• Output limitation: Approximately 75 % of normal condition • Intake throttle 100 % open
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark			

9Y1200199CRS0783US0

Name		Emission deterioration
ISO 14229 P-Code		**P3001**
J1939-73	**SPN**	3252
	FMI	0
SPN Name SAE J1939 Table C1		After treatment 1 Exhaust Gas Temperature 2 Preliminary FMI
DTC Name		Emission deterioration
Management Unit for Detected Part		DOCDTHEX
Detection item		• DOC is heated up due to unburned fuel
DTC Set Preconditions		• Other than during regeneration mode • Coolant temperature is 65 °C (149 °F) or more: continues longer than 5 min after engine starting
DTC set parameter		• T1 − T0 ≥ 250 °C (482 °F)
Time to action or number of error detection		• 60 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open
Behaviour During Malfunction		• Insufficient output
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• To minimize PM emission to DPF

9Y1200199CRS0784US0

Name		Exhaust gas temperature sensor 0: Emergency high	Exhaust gas temperature sensor 1: Emergency high
ISO 14229 P-Code		P3002	P3003
J1939-73	SPN	4765	3242
	FMI	0	0
SPN Name SAE J1939 Table C1		After treatment 1 Exhaust Gas Temperature 1 Preliminary FMI	After treatment 1 Exhaust Gas Temperature 2 Preliminary FMI
DTC Name		Emergency Exhaust gas temperature sensor 0: High	Emergency Exhaust gas temperature sensor 1: High
Management Unit for Detected Part		EXTEMPT0	EXTEMPT1
Detection item		• DOC inlet temperature (T0) high	• DPF inlet temperature (T1) high
DTC Set Preconditions		• Exhaust gas temperature sensor T0,T1 and T2 are normal • Battery voltage is normal	• Exhaust gas temperature sensor T0,T1 and T2 are normal • Battery voltage is normal
DTC set parameter		• DOC inlet temperature (T0): 700 °C (1292 °F) or more	• DPF inlet temperature (T1): 715 °C (1319 °F) or more
Time to action or number of error detection		• 2.0 sec. or more	• 9.0 min. or more
Limp Home Action by engine ECU (system action)		• Stop injection (Q = 0 mm^3/st) • Engine stop • Inhibit starter relay activation until exhaust gas temperature reduces down to 300 °C (572 °F)	• Stop injection (Q = 0 mm^3/st) • Engine stop • Inhibit starter relay activation until exhaust gas temperature reduces down to 300 °C (572 °F)
Behaviour During Malfunction		• Engine stops • Inhibitef cranking until down to 300 °C (572 °F)	• Engine stops • Inhibitef cranking until down to 300 °C (572 °F)
Engine Warning Light		• ON	• ON
Recovery from error		• Under 300 °C (572 °F) & key switch turn OFF	• Under 300 °C (572 °F) & key switch turn OFF
Delay time for recovery		–	–
Remark		• In case engine ECU is not involved to drive starter, starter activation should be inhibited by other way until exhaust gas temperature reduces down to 300 °C (572 °F)	• In case engine ECU is not involved to drive starter, starter activation should be inhibited by other way until exhaust gas temperature reduces down to 300 °C (572 °F)

9Y1200199CRS0785US0

Name		Exhaust gas temperature sensor 2: Emergency high
ISO 14229 P-Code		P3004
J1939-73	SPN	3246
	FMI	0
SPN Name SAE J1939 Table C1		After treatment 1 Exhaust Gas Temperature 3 Preliminary FMI
DTC Name		Emergency Exhaust gas temperature sensor 2: High
Management Unit for Detected Part		EXTEMPT2
Detection item		• DPF outlet temperature (T2) high
DTC Set Preconditions		• Exhaust gas temperature sensor T0,T1 and T2 are normal • Battery voltage is normal
DTC set parameter		• DPF outlet temperature (T2): 820 °C (1508 °F) or more
Time to action or number of error detection		• 2.0 sec. or more
Limp Home Action by engine ECU (system action)		• Stop injection (Q = 0 mm^3/st) • Engine stop • EGR stop • Intake throttle 0 % open (Close) • Inhibit starter relay activation until exhaust gas temperature reduces down to 300 °C (572 °F)
Behaviour During Malfunction		• Engine stops • Inhibitef cranking until down to 300 °C (572 °F)
Engine Warning Light		• ON
Recovery from error		• Under 300 °C (572 °F) & key switch turn OFF
Delay time for recovery		–
Remark		• In case engine ECU is not involved to drive starter, starter activation should be inhibited by other way until exhaust gas temperature reduces down to 300 °C (572 °F)

9Y1200199CRS0786US0

Name		Excessive PM3
ISO 14229 P-Code		P3006
J1939-73	SPN	3701
	FMI	15
SPN Name SAE J1939 Table C1		Diesel Particulate Filter Status
DTC Name		Excessive PM3
Management Unit for Detected Part		DPFPMEX2
Detection item		• PM accumulation level3
DTC Set Preconditions		• Battery voltage is normal
DTC set parameter		• PM accumulation more than trigger level • Regeneration level = 3
Time to action or number of error detection		• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition
Behaviour During Malfunction		• Insufficient output
Engine Warning Light		• ON
Recovery from error		• Diagnostic counter = zero
Delay time for recovery		• Immediately
Remark		• To minimize PM out put

9Y1200199CRS0787US0

Name		Excessive PM4	Excessive PM5
ISO 14229 P-Code		P3007	P3008
J1939-73	SPN	3701	3701
	FMI	16	0
SPN Name SAE J1939 Table C1		Diesel Particulate Filter Status	Diesel Particulate Filter Status
DTC Name		Excessive PM4	Excessive PM5
Management Unit for Detected Part		DPFPMEX3	DPFPMEX4
Detection item		• PM accumulation level4	• PM accumulation level5
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal
DTC set parameter		• PM accumulation more than trigger level • Regeneration level = 4	• PM accumulation more than trigger level • Regeneration level = 5
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition	• Output limitation: Approximately 50 % of normal condition
Behaviour During Malfunction		• Insufficient output	• Insufficient output
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Key switch turn OFF
Delay time for recovery		• Immediately	–
Remark		• To minimize PM out put	• To minimize PM out put • Engine is not stopped forcibly by ECU However KUBOTA strongly recommends operator to stop engine as soon as possible.

9Y1200199CRS0788US0

Name		Boost pressure low
ISO 14229 P-Code		P3011
J1939-73	SPN	132
	FMI	15
SPN Name SAE J1939 Table C1		Engine Inlet Air Mass Flow Rate
DTC Name		Boost pressure low
Management Unit for Detected Part		GA2
Detection item		• Disconnect the hose between the turbo blower out and intake flange
DTC Set Preconditions		• Other than during regeneration mode • Engine speed is 1600 min^{-1} (rpm) or more • Target intake air flow value is 950 mg/cyl or more • MAF sensor is normal • EGR valve is normal • Intake throttle valve is normal • Boost pressure sensor is normal • Barometric pressure sensor is normal • Coolant temperature sensor is normal
DTC set parameter		• Boost pressure sensor output is below target level in high air flow operating condition
Time to action or number of error detection		• 10 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 50 % of normal condition • Speed limitation (Accelerator limitation: 50 %) • EGR stop • Intake throttle 100 % open (except DOC model)
Behaviour During Malfunction		• Insufficient output
Engine Warning Light		• ON
Recovery from error		• Key switch turn OFF
Delay time for recovery		–
Remark		• Engine power is restricted by boost pressure signal accordingly • To minimize PM emission to DPF

9Y1200199CRS0789US0

Name		Low coolant temperature in parked regeneration	Parked regeneration time out
ISO 14229 P-Code		P3012	P3013
J1939-73	SPN	523589	523590
	FMI	17	16
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		Low coolant temperature in parked regeneration	Parked regeneration time out
Management Unit for Detected Part		ST5TIMEUP	MNRGNTIMEUP
Detection item		• During regeneration mode, engine warm-up condition is not satisfied (coolant temperature is low)	• Time out error: regeneration incomplete due to low temperature of DPF
DTC Set Preconditions		• During parked active regeneration mode	• During parked active regeneration mode • Coolant temperature is 65 °C (149 °F) or more
DTC set parameter		• Engine coolant temperature stays below 65 °C (149 °F) for 1500 seconds or more under parked regeneration process.	• Regeneration process is not completed within 2700 sec
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• None	• None
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero (Leaving from parked active regeneration status)	• Diagnostic counter = zero (Leaving from parked active regeneration status)
Delay time for recovery		• Immediately	• Immediately
Remark			

9Y1200199CRS0790US0

Name		All exhaust gas temperature sensor failure	Initial pump-calibration incomplete
ISO 14229 P-Code		P3018	P3019
J1939-73	SPN	523599	523600
	FMI	0	0
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		All exhaust gas temperature sensor failure	Initial pump-calibration incomplete
Management Unit for Detected Part		THAEXALL	IPMPSTDYNOT
Detection item		• All exhaust gas temperature sensor failure simultaneously	• Pump-calibration history
DTC Set Preconditions		• Engine speed is 1400 min^{-1} (rpm) or more • Quantity of injection is 30 mm^3/st or more • Coolant temperature is 65 °C (149 °F) or more: continues longer than 300 sec. • Intake air temperature is 0 °C (32 °F) or more • Passed 100sec after cranking	• Battery voltage is normal
DTC set parameter		• All exhaust gas temperature sensor failure (sensor low) simultaneously	• Initial pump calibration incomplete
Time to action or number of error detection		• 100 sec. or more	• Transient
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition	• None
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• Immediately	• Immediately
Remark			

9Y1200199CRS0791US0

Name		High exhaust gas temperature after emergency high temperature DTC	High frequency of regeneration
ISO 14229 P-Code		P3023	P3024
J1939-73	SPN	523601	523602
	FMI	0	0
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		High exhaust gas temperature after emergency high temperature DTC	High frequency of regeneration
Management Unit for Detected Part		STAINHIBIT	RGNINTWRN
Detection item		• Exhaust gas temperature sensor 0, 1, 2 output	• Time interval from the end time to the start time of the regeneration
DTC Set Preconditions		• Battery voltage is normal	• Battery voltage is normal • Key switch is ON
DTC set parameter		• All exhaust gas temperature (T0, T1 and T2) reduces down to 300 °C (572°F)	• Regeneration time interval within 30 min. occurs three times continuously
Time to action or number of error detection		• Transient	• Transient
Limp Home Action by engine ECU (system action)		• Engine stop • Inhibit starter relay activation until all exhaust gas temperature (T0, T1 and T2) reduces down to 300 °C (572 °F)	• Output limitation: Approximately 50 % of normal condition • EGR stop
Behaviour During Malfunction		• None	• Worsening exhaust gas performance (NOx)
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Key switch turn OFF
Delay time for recovery		• Immediately	–
Remark			

9Y1200199CRS0792US0

Name		Over heat pre-caution	CAN2 Bus off
ISO 14229 P-Code		P3025	U0075
J1939-73	SPN	523603	523547
	FMI	15	2
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		Over heat pre-caution	CAN2 Bus off
Management Unit for Detected Part		THWOT2	CANB2
Detection item		• Coolant temperature	• CAN2 +B / GND short circuit or high traffic error
DTC Set Preconditions		• Coolant temperature sensor is normal	• Battery voltage is normal • Key switch is ON
DTC set parameter		• Engine coolant temperature ≥ 110 °C (230 °F)	• CAN2 Bus off
Time to action or number of error detection		• Transient	• 2 sec. or more
Limp Home Action by engine ECU (system action)		• None	• Forced Idle (Accelerator = 0 %)
Behaviour During Malfunction		• Worsening exhaust gas performance (NOx)	• Insufficient output • Transmitted data is invalid
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Key switch turn OFF
Delay time for recovery		• Immediately	–
Remark			• Transmitted CAN data are invalid.

9Y1200199CRS0793US0

Name		No communication with EGR	CAN1 Bus off
ISO 14229 P-Code		U0076	U0077
J1939-73	SPN	523578	523604
	FMI	2	2
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		No communication with EGR	CAN1 Bus off
Management Unit for Detected Part		CANOPENEGR	CANB1
Detection item		• No communication with EGR	• CAN1 +B / GND short circuit or high traffic error
DTC Set Preconditions		• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Key switch is ON
DTC set parameter		• Interruption of CAN	• CAN1 Bus off
Time to action or number of error detection		• 1.3 sec. or more	• 2 sec. or more
Limp Home Action by engine ECU (system action)		• Output limitation: Approximately 75 % of normal condition • EGR stop	• Output limitation: Approximately 75 % of normal condition • EGR stop
Behaviour During Malfunction		• Insufficient output • Worsening exhaust gas performance	• Insufficient output • Transmitted data is invalid
Engine Warning Light		• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–
Remark			• Transmitted CAN data are invalid.

9Y1200199CRS0794US0

Name		CAN2 frame error		
ISO 14229 P-Code		U0081	U0082	U0083
J1939-73	SPN	523548	523591	523592
	FMI	2	2	2
SPN Name SAE J1939 Table C1		proprietary	proprietary	proprietary
DTC Name		CAN-KBT frame error	CAN CCVS (Parking SW and Vehicle Speed) frame error	CAN CM1 (Regen SW) frame error
Management Unit for Detected Part		CANOPENGENU	CANOPENCCVS	CANOPENCM1
Detection item		• CAN-KBT original frame open circuit error	• CAN_CCVS communication stopping	• CAN_CM1 communication stopping
DTC Set Preconditions		• Battery voltage is normal • Key switch turn OFF to ON • Starter Switch signal (ECU: V12 terminal) is not activated • No error of "CAN2 Bus off"	• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• CAN2 KBT frame open circuit error	• CAN CCVS frame time out error	• CAN CM1 frame time out error
Time to action or number of error detection		• Transient	• 0.5 sec. or more	• 2.0 sec. or more
Limp Home Action by engine ECU (system action)		• Forced Idle (Accelerator = 0 %)	• Parking SW = OFF, Vehicle speed = 0 [default value]	• Regeneration inhibit = ON, Parked regeneration SW = OFF [default value]
Behaviour During Malfunction		• Insufficient output	• None	• None
Engine Warning Light		• ON	• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–	–
Remark				

9Y1200199CRS0795US0

Name		CAN2 frame error		
ISO 14229 P-Code		U0084	U0085	U0086
J1939-73	SPN	523593	523594	523595
	FMI	2	2	2
SPN Name SAE J1939 Table C1		proprietary	proprietary	proprietary
DTC Name		CAN DDC1 (Transmission) frame error	CAN ETC2 (Neutral SW) frame error	CAN ETC5 (Neutral SW) frame error
Management Unit for Detected Part		CANOPENDDC	CANOPENETC2	CANOPENETC5
Detection item		• CAN_DDC1 communication stopping	• CAN_ETC2 communication stopping	• CAN_ETC5 communication stopping
DTC Set Preconditions		• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• CAN DDC1 frame time out error	• CAN ETC2 frame time out error	• CAN ETC5 frame time out error
Time to action or number of error detection		• 0.5 sec. or more	• 0.5 sec. or more	• 0.5 sec. or more
Limp Home Action by engine ECU (system action)		• Accelerator non-linear processing flag = 0 [default value] • Accelerator non-linear processing invalid	• Neutral SW = OFF [default value]	• Neutral SW = OFF [default value]
Behaviour During Malfunction		• None	• None	• None
Engine Warning Light		• ON	• ON	• ON
Recovery from error		• Key switch turn OFF	• Key switch turn OFF	• Key switch turn OFF
Delay time for recovery		–	–	–
Remark				

9Y1200199CRS0796US0

Name		CAN2 frame error	
ISO 14229 P-Code		U0087	U0089
J1939-73	SPN	523596	523598
	FMI	2	2
SPN Name SAE J1939 Table C1		proprietary	proprietary
DTC Name		CAN TSC1 frame error	CAN EBC1 frame error
Management Unit for Detected Part		CANOPENTSC1TM	CANOPENABS
Detection item		• CAN_TSC1 communication stopping	• CAN_EBC1 communication stopping
DTC Set Preconditions		• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated	• Battery voltage is normal • Starter Switch signal (ECU: V12 terminal) is not activated
DTC set parameter		• No request to "TSC1 buffer" continues 3 times after over-ride control request (other than 0x00)	• CAN EBC1 frame time out error
Time to action or number of error detection		• 60 msec. or more	• 0.5 sec. or more
Limp Home Action by engine ECU (system action)		• Override control mode = Normal mode [default value]	• Non shutdown [default value] • Output limitation: Approximately 75 % of normal condition
Behaviour During Malfunction		• None	• None
Engine Warning Light		• ON	• ON
Recovery from error		• Diagnostic counter = zero	• Diagnostic counter = zero
Delay time for recovery		• Immediately	• Immediately
Remark			

9Y1200199CRS0797US0

■ **NOTE**
- **If any DTC occurred, automatic active regeneration is inhibited.**
- **In case, "Excessive PM3", "Excessive PM4" and "High frequency of regeneration", parked active regeneration function is allowed.**

9Y1200199CRS0798US0

[2] DIAGNOSTIC PROCEDURE BY DTC

If a DTC output indicates a malfunction, locate the malfunction by following the diagnostic procedure in the following pages.

Follow the instructions of the diagnostic procedure when required to refer to other items.

In this manual, the diagnostic procedures are listed according to the Diagnostic Trouble Code (DTC) numbers as shown. (In exceptional cases, some procedures are given in different positions.)

ISO 14229 P-Code	J1939-73		Name	Reference Page
	SPN	FMI		
P0016	636	7	NE-G phase shift	1-S123
P0072	171	4	Intake air temperature built-in MAF sensor abnormality	1-S124
P0073	171	3		
P0087	633	7	Pressure limiter emergency open	1-S127
P0088	157	0	High rail pressure	1-S132
P0089	1347	7	SCV stuck	1-S137
P0093	1239	1	Fuel leak (in high pressured fuel system)	1-S142
P0101	132	1	Intake air volume: Low	1-S147
P0102	132	4	MAF sensor abnormality	1-S148
P0103	132	3		
P0111	172	0	Intake air temperature: high (Inter cooler model only)	1-S150
P0112	172	4	Intake air temperature error	1-S151
P0113	172	3		
P0117	110	4	Coolant temperature sensor abnormality	1-S154
P0118	110	3		
P0181	174	0	Fuel high temperature	1-S157
P0182	174	4	Fuel temperature sensor abnormality	1-S158
P0183	174	3		
P0192	157	4	Rail pressure sensor abnormality	1-S161
P0193	157	3		
P0200	523535	0	Injector charge voltage: High	1-S165
P0201	651	3	Open circuit of harness/coil	1-S167
P0202	653	3		
P0203	654	3		
P0204	652	3		
P0217	110	0	Engine overheat	1-S170
P0219	190	0	Engine overrun	1-S172
P0237	102	4	Boost pressure sensor abnormality	1-S173
P0238	102	3		
P0335	636	8	Crankshaft position sensor (NE sensor) abnormality	1-S177
P0336	636	2		
P0340	723	8	Camshaft position sensor (G sensor) abnormality	1-S182
P0341	723	2		
P0380	523544	3	Air heater relay driving circuit abnormality	1-S186
P0380	523544	4		

ISO 14229 P-Code	J1939-73		Name	Reference Page
	SPN	FMI		
P0403	523574	3	EGR actuator abnormality	1-S190
P0404	523574	4		
P0409	523572	4		
P0524	100	1	Oil pressure error	1-S193
P0543	3242	4	Exhaust gas temperature sensor 1 (T1) abnormality	1-S195
P0544	3242	3		
P0546	4765	4	Exhaust gas temperature sensor 0 (T0) abnormality	1-S198
P0547	4765	3		
P0562	168	4	Battery voltage abnormality	1-S201
P0563	168	3		
P0602	523538	2	QR data abnormality	1-S204
P0602	523538	7		
P0605	628	2	ECU FLASH ROM and CPU abnormality	1-S205
P0606	1077	2		
P0606	523527	2		
P0611	523525	1	Injector charge voltage abnormality	1-S207
P0628	1347	4	SCV drive system abnormality	1-S209
P0629	1347	3		
P0642	3509	4	Sensor supply voltage 1 abnormality	1-S213
P0643	3509	3		
P0652	3510	4	Sensor supply voltage 2 abnormality	1-S215
P0653	3510	3		
P0687	1485	2	Main relay is locked in closed position	1-S217
P1274	523539	2	Pump seizing	1-S220
P1275	523540	2		
P1990	523700	13	EEPROM check sum error	1-S225
P1991	523701	13		
P1992	523702	13		
P2108	523580	2	Intake throttle feedback error	1-S227
P2122	91	4	Accelerator position sensor 1 abnormality	1-S229
P2123	91	3		
P2127	29	4	Accelerator position sensor 2 abnormality	1-S233
P2128	29	3		
P2131	523543	2	Accelerator position sensor error (CAN)	1-S237
P2135	91	2	Accelerator position sensor corelation error	1-S239
P2146	523523	2	Common 1 system injector drive circuit open	1-S240
P2147	523523	4	Common 1 TWV actuation system short	1-S243
P2148	523523	3		
P2149	523524	2	Common 2 system injector drive circuit open	1-S247
P2150	523524	4	Common 2 TWV actuation system short	1-S250
P2151	523524	3		

ISO 14229 P-Code	J1939-73		Name	Reference Page
	SPN	FMI		
P2228	108	4	Barometric pressure sensor error	1-S254
P2229	108	3		
P2413	523575	7	EGR (DC motor) abnormality	1-S256
P2414	523576	2		
P2415	523577	2		
P242C	3246	4	Exhaust gas temperature sensor 2 (T2) abnormality	1-S259
P242D	3246	3		
P2454	3251	4	Differential pressure sensor 1 abnormality	1-S262
P2455	3251	3		
P2621	523582	4	Intake throttle lift sensor abnormality	1-S266
P2622	523582	3		
P3001	3252	0	Emission deterioration	1-S268
P3002	4765	0	Exhaust gas temperature sensor 0: Emergency high	1-S270
P3003	3242	0	Exhaust gas temperature sensor 1: Emergency high	1-S272
P3004	3246	0	Exhaust gas temperature sensor 2: Emergency high	1-S274
P3006	3701	15	Excessive PM3	1-S276
P3007	3701	16	Excessive PM4	1-S277
P3008	3701	0	Excessive PM5	1-S278
P3011	132	15	Boost pressure low	1-S279
P3012	523589	17	Low coolant temperature in parked regeneration	1-S281
P3013	523590	16	Parked regeneration time out	1-S282
P3018	523599	0	All exhaust gas temperature sensor failure	1-S284
P3019	523600	0	Initial pump-calibration incomplete	1-S285
P3023	523601	0	High exhaust gas temperature after emergency high temperature DTC	1-S286
P3024	523602	0	High frequency of regeneration	1-S287
P3025	523603	15	Over heat pre-caution	1-S288
U0075	523547	2	CAN2 Bus off	1-S289
U0076	523578	2	No communication with EGR	1-S291
U0077	523604	2	CAN1 Bus off	1-S293
U0081	523548	2	CAN2 frame error	1-S294
U0082	523591	2		
U0083	523592	2		
U0084	523594	2		
U0085	523593	2		
U0086	523595	2		
U0087	523596	2		
U0089	523598	2		

9Y1200199CRS0799US0

(1) NE - G Phase Shift (DTC P0016 / 636-7)

Behaviour during malfunction: (Invalid G signal)
- Engine hesitates at start-up

Detection item:
- Large phase shift between NE (crankshaft position sensor) pulse and G (camshaft position sensor) pulse

DTC set preconditions:
- Engine is operating above low idle speed
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- NE signal is normal
- G signal is normal
- Coolant temperature is 10 °C (50 °F) or higher

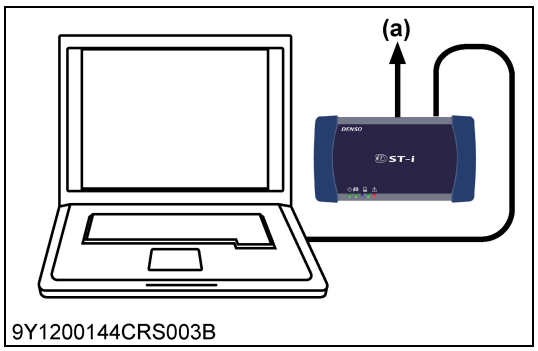
DTC set parameter: (Approximate)
- Phase difference between NE pulse and G pulse within ±0.26 rad (±15 °)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0800US0



9Y1200144CRS003B

1. Check the Crankshaft Position Sensor and Camshaft Position Sensor Signals

1. Run the engine and check the values of the "Engine speed active flag" and "Cam speed active flag" with the data monitor function.

Factory specification	Constantly ON

OK	Check the DTC (speed signal phase shift) again.	
	OK	Normal.
	NG	Check each pulsar for damage and deviation, and correct.
NG	Refer to "Crankshaft Position Sensor (NE sensor) Abnormality" (page 1-S177) and "Camshaft Position Sensor (G sensor) Abnormality" (page 1-S182).	

■ **NOTE**

(Crankshaft position sensor side)
- **The NE pulsar has deviated.**
- **A large magnetic substance has adhered to the pulsar, hardened and rotates together with it, or the teeth have been ground down.**

(Camshaft position sensor side)
- **The G pulsar plate is disconnected.**
- **The cam gear unit is disconnected, etc. (large side clearance).**
- **A large magnetic substance has adhered to the pulsar, hardened and rotates together with it, or the teeth have been ground down.**

(a) CAN1 Connector

9Y1200199CRS0801US0

(2) Intake Air Temperature Built-in MAF Sensor: Abnormality (DTC P0072 / 171-4, DTC P0073 / 171-3)

P0072 / 172-4: Intake air temperature built-in MAF sensor abnormality (Low side)
Behaviour during malfunction:
- None

Detection item:
- Ground short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- Intake air temperature built-in MAF sensor voltage: 0.1 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 25 °C (77 °F) [default value]

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0802US0

P0073 / 171-3: Intake air temperature built-in MAF sensor abnormality (High side)
Behaviour during malfunction:
- None

Detection item:
- Sensor / Harness short to +B

DTC set preconditions:
- Battery voltage is normal

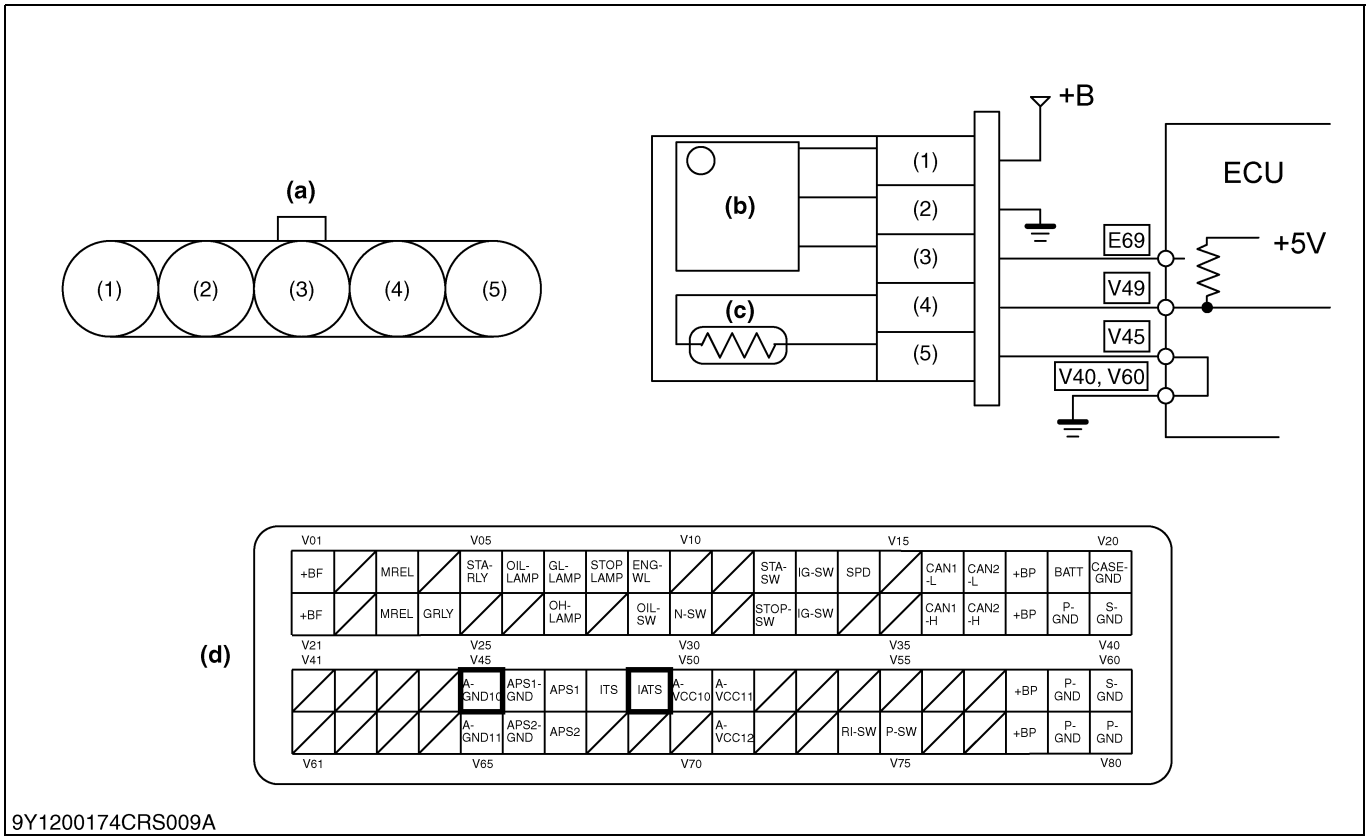
DTC set parameter:
- Intake air temperature built-in MAF sensor voltage: 4.9 V or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 25 °C (77 °F) [default value]

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0803US0

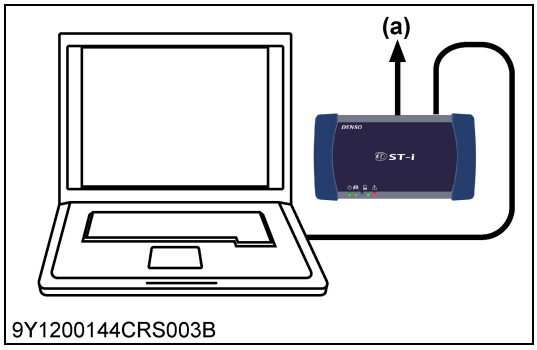


9Y1200174CRS009A

(1) Terminal Power (+12 V)
(2) Terminal Ground
(3) Terminal AFS
(4) Terminal IATS
(5) Terminal A-GND 10

(a) Terminal Layout
(b) Mass Air Flow (MAF) Sensor
(c) Intake Air Temperature (Built-in MAF)
(d) ECU Connector 1 (Engine Side)

9Y1200199CRS0804US0



9Y1200144CRS003B

1. Check the Intake Air Temperature Sensor Signals

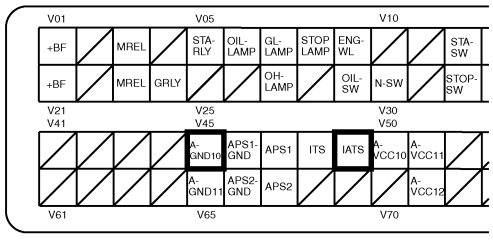
1. Place the key switch in the ON position, and check the "Intake air temperature" and "Intake air temperature sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual intake air temperature	Intake air temperature	Output voltage
20 °C (68 °F)	20 °C (68 °F)	Approx. 3.1 V
40 °C (104 °F)	40 °C (104 °F)	Approx. 2.2 V
60 °C (140 °F)	60 °C (140 °F)	Approx. 1.4 V
80 °C (176 °F)	80 °C (176 °F)	Approx. 0.9 V

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0805US0



9Y1200174CRS010A

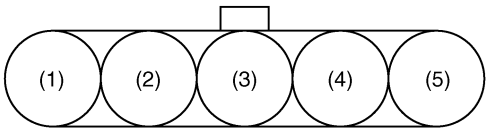
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals V45 and V49 of the connector.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.43 kΩ
40 °C (104 °F)	Approx. 1.15 kΩ
60 °C (140 °F)	Approx. 0.587 kΩ
80 °C (176 °F)	Approx. 0.321 kΩ

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the sensor".

9Y1200199CRS0806US0



9Y1200174CRS011A

3. Check the Sensor

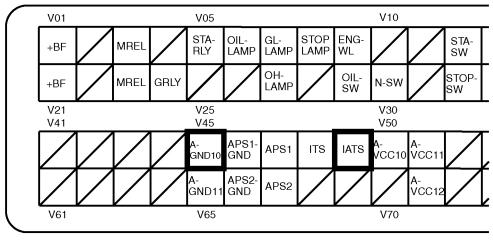
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.43 kΩ
40 °C (104 °F)	Approx. 1.15 kΩ
60 °C (140 °F)	Approx. 0.587 kΩ
80 °C (176 °F)	Approx. 0.321 kΩ

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Intake air temperature sensor fault → Replace the mass air flow sensor.

(1) Terminal Power (+12 V)
(2) Terminal Ground
(3) Terminal AFS
(4) Terminal IATS
(5) Terminal A-GND 10

9Y1200199CRS0807US0



9Y1200174CRS010A

4. Measure the ECU Terminal Voltage

1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals V45 and V49 at the ECU side.

Factory specification	Approx. 5 V

OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

9Y1200199CRS0808US0

(3) Pressure Limiter Emergency Open (DTC P0087 / 633-7)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Open circuit or +B short circuit of sensor / harness.

DTC set preconditions:
- Rail pressure sensor is normal
- Sensor supply voltage VCC# is normal

DTC set parameter:
- Combination of below A and B
  A: Fuel leak (P0093) is detected
  B: Condition (1) or (2) is fulfilled;
  (1) Rail pressure exceeds 191 MPa (1950 kgf/cm^2, 27700 psi)
  (2) Within 1 sec, after the rail pressure goes below 191 MPa (1950 kgf/cm^2, 27700 psi)
  [Before the pressure decrease, the rail pressure is above 191 MPa (1950 kgf/cm^2, 27700 psi)]

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0809US0

Diagnostic Procedure for Pressure System DTCs

Checking of fault conditions and actions taken

If DTCs of non-pressure system are detected (*Refer to the pressure system DTCs given below.)

First locate the non-pressure system problem indicated by DTCs, and repair the affected parts. After the repair has been carried out, check for an output of pressure system DTCs. If so, begin the diagnosis of the affected pressure system.

If only pressure system DTCs are detected (*Refer to the pressure system DTCs given below.)

Diagnose the affected pressure system indicated by DTCs.

If a DTC currently exists

Begin diagnosis without returning the key switch to the OFF position. However, carefully make satisfactory / unsatisfactory judgments as the injection amount and rail pressure are limited by system actions.

If only a past DTC exists

Log the freeze-frame data, clear the DTCs, and stop the engine. Then, try to reproduce the problem using the freeze-frame data and the trouble check sheet.

***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[Low pressure abnormality]
1. P0087: Pressure limiter emergency open
2. P0093: Fuel leak

[Abnormal pressure]
1. P0089: SCV stuck
2. P1274: Pump seizing 1
3. P1275: Pump seizing 2

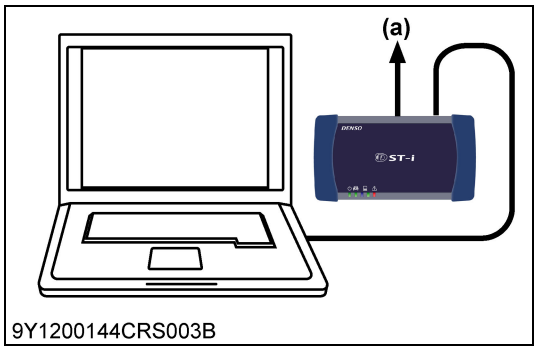
■ **IMPORTANT**
- **Multiple pressure system DTCs may be output simultaneously. Also, both abnormal high pressure and abnormal low pressure may be reported simultaneously under certain malfunction conditions.**

9Y1200199CRS0810US0

■ **NOTE**

- **If the pressure limiter is opened, it will be kept open until the engine stops running. Therefore, the rail pressure is kept at 40 to 60 MPa (410 to 610 kgf/cm^2, 5800 to 8700 psi) regardless of its target rail pressure. This point must be considered when measuring the rail pressure.**
  However, when the engine is stopped and the rail pressure reduces enough, the pressure limiter is closed and the rail pressure will start to increase again.
- **Even when the problem indicated by this DTC cannot be reproduced, the high pressure will have occurred for certain reasons. Therefore, the cause of the high pressure must be identified.**

9Y1200199CRS0811US0



9Y1200144CRS003B

1. Check the Data Related to the Rail Pressure

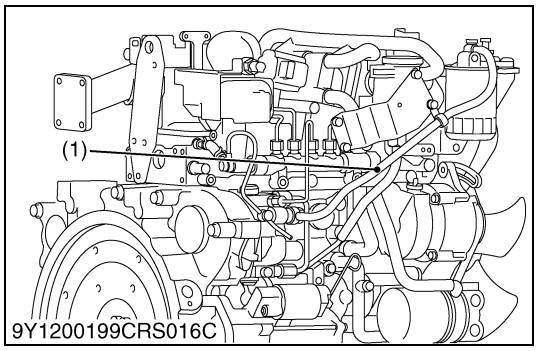
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.
NG	Go to "2. Check the Fuel System for the Existence of Air".

(a) CAN1 Connector

9Y1200199CRS0812US0



9Y1200199CRS016C

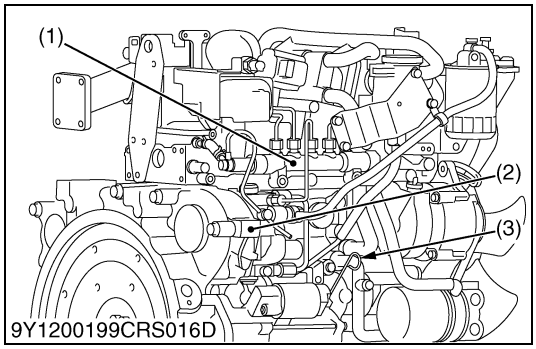
2. Check the Fuel System for the Existence of Air

1. Check each joint of the fuel system for the existence of air.
   To detect the existence of air effectively, replace the fuel hose with a transparent one.

OK	Go to "3. Check the Fuel System".
NG	Locate the position of the fuel leakage in the piping and repair it.

(1) Fuel Hose

9Y1200199CRS0813US0



3. Check the Fuel System

CAUTION

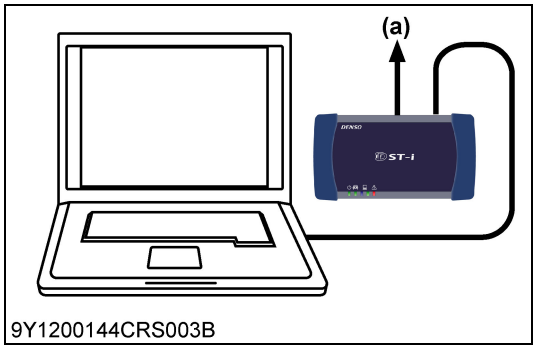
- **Visually check there is no leak in the high pressure fuel pipe system.**
- **A visual check is not possible if a leak (high pressure system) occurs inside the head cover, so check that the oil level has not increased.**

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail
(2) Supply Pump
(3) Dipstick

9Y1200199CRS0814US0



4. Check the Rail Pressure Sensor (*Refer to Items P0192 and P0193)

1. Check the rail pressure sensor.

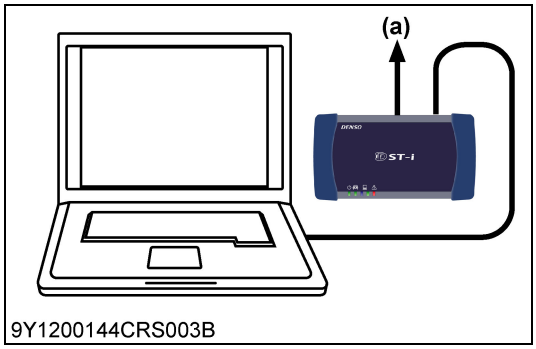
NOTE

- **Closely check sensor signals for a noise component and an abnormality that exists for a short time.**

OK	Go to "5. Check the DTC Again".
NG	Repair or replace the rail pressure sensor or its related parts. (Follow the diagnostic procedure of items P0192 and P0193.) (Refer to page 1-S161)

(a) CAN1 Connector

9Y1200199CRS0815US0



5. Check the DTC Again

1. Clear the past malfunction data, and make sure that the same DTC is output again in the reproduction test.

Factory specification	Normal (No DTC is output.)

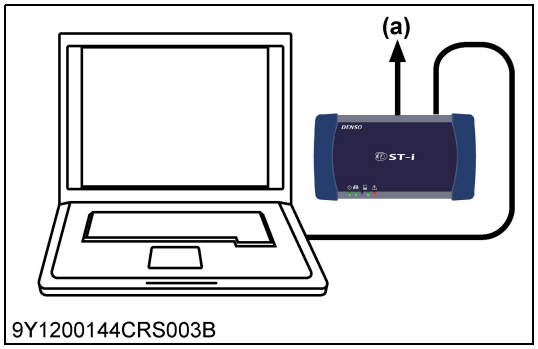
NOTE

- **Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.**

OK	Normal.
NG	Go to "6. Check the SCV-related Data".

(a) CAN1 Connector

9Y1200199CRS0816US0



9Y1200144CRS003B


9Y1200199CRS005A

6. Check the SCV-related Data

1. Check the "Target rail pressure", "Actual rail pressure", "Target SCV current", "Actual SCV current", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	1. The "Actual SCV current value" always follow to the "Target SCV current value". • When idling: Approx. 1800 mA • Accelerator opening: 0→100 % (During acceleration): Approx. 1400 mA minimum • During no-load maximum speed: Approx. 1600 mA • The numerical value is stable under normal operating and the target value corresponds with actual pressure value. *** The current shall be used as a reference only as this value varies depending on the pump used.** 2. The "Pressure feedback integral guard executing flag" must be OFF. 3. The "Pump deviation learning correction value" must be within ±200 mA. ■ **NOTE** • **As the following value of A varies depending on pump, the table above is for guideline. If the value of A has a wider shift than the initial learning value, there may be out of the range of the above table.** **A net normal value is the value that provided by the forced-learning several times.: Compared with A** **12 V spec.: A-100 ≤ normal value ≤ A+50** **Therefore, if the value is out of the range above, perform the forced-learning.**

■ **NOTE**

- **"Pump difference learning status"**
  It must be "2" (Learning completed) or "3" (During relearning). If not, keep idling the engine after warming up and when the learning status becomes "2" or "3", make the judgment. Occasionally, it does not shift from 3 to 2. Perform pump difference learning to take into account the above status, then compare with the status before learning.

OK	After confirming that an intermittent malfunction (such as power supply system or noise generation) does not occur in relation to the ECU, replace the ECU.
NG	Replace the supply pump.

(a) CAN1 Connector

9Y1200199CRS0817US0

(4) High Rail Pressure (DTC P0088 / 157-0)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Actual pressure exceeds the command pressure

DTC set preconditions:
- Rail pressure sensor is normal
- Sensor supply voltage VCC# is normal

DTC set parameter:
- Actual pressure ≥ 197 MPa (2010 kgf/cm^2, 28600 psi)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0818US0

Diagnostic Procedure for Pressure System DTCs

Checking of fault conditions and actions taken

If DTCs of non-pressure system are detected (*Refer to the pressure system DTCs given below.)

First locate the non-pressure system problem indicated by DTCs, and repair the affected parts. After the repair has been carried out, check for an output of pressure system DTCs. If so, begin the diagnosis of the affected pressure system.

If only pressure system DTCs are detected (*Refer to the pressure system DTCs given below.)

Diagnose the affected pressure system indicated by DTCs.

If a DTC currently exists

Begin diagnosis without returning the key switch to the OFF position. However, carefully make satisfactory / unsatisfactory judgments as the injection amount and rail pressure are limited by system actions.

If only a past DTC exists

Log the freeze-frame data, clear the DTCs, and stop the engine. Then, try to reproduce the problem using the freeze-frame data and the trouble check sheet.

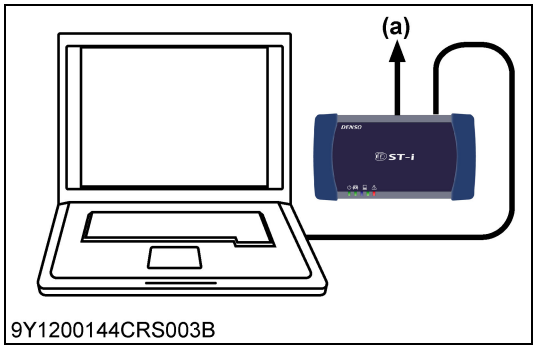
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[Low pressure abnormality]
1. P0087: Pressure limiter emergency open
2. P0093: Fuel leak

[Abnormal pressure]
1. P0089: SCV stuck
2. P1274: Pump seizing 1
3. P1275: Pump seizing 2

■ **IMPORTANT**
- **Multiple pressure system DTCs may be output simultaneously. Also, both abnormal high pressure and abnormal low pressure may be reported simultaneously under certain malfunction conditions.**

9Y1200199CRS0810US0



9Y1200144CRS003B

1. Check the Data Related to the Rail Pressure

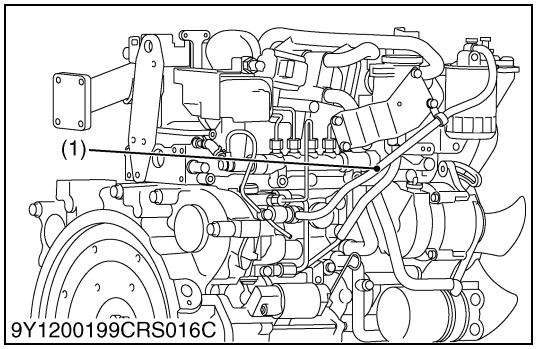
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.
NG	Go to "2. Check the Fuel System for the Existence of Air".

(a) CAN1 Connector

9Y1200199CRS0812US0



9Y1200199CRS016C

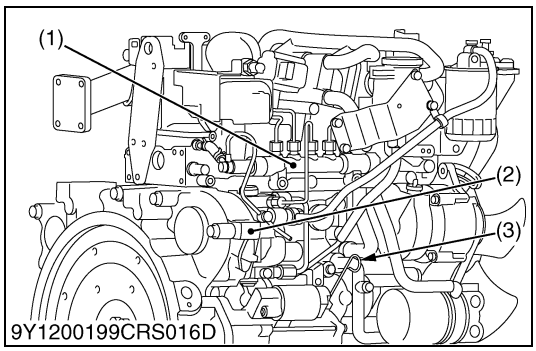
2. Check the Fuel System for the Existence of Air

1. Check each joint of the fuel system for the existence of air. To detect the existence of air effectively, replace the fuel hose with a transparent one.

OK	Go to "3. Check the Fuel System".
NG	Locate the position of the fuel leakage in the piping and repair it.

(1) Fuel Hose

9Y1200199CRS0813US0



9Y1200199CRS016D

3. Check the Fuel System

CAUTION

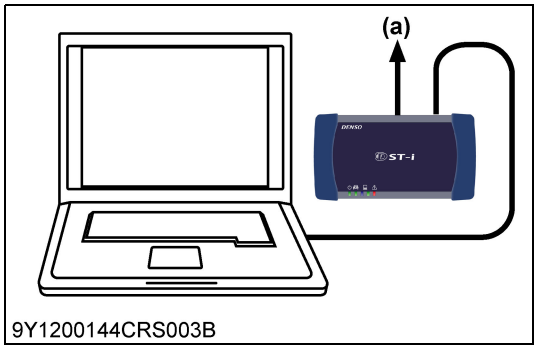
- **Visually check there is no leak in the high pressure fuel pipe system.**
- **A visual check is not possible if a leak (high pressure system) occurs inside the head cover, so check that the oil level has not increased.**

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail
(2) Supply Pump
(3) Dipstick

9Y1200199CRS0814US0



4. Check the Rail Pressure Sensor (*Refer to Items P0192 and P0193)

1. Check the rail pressure sensor.

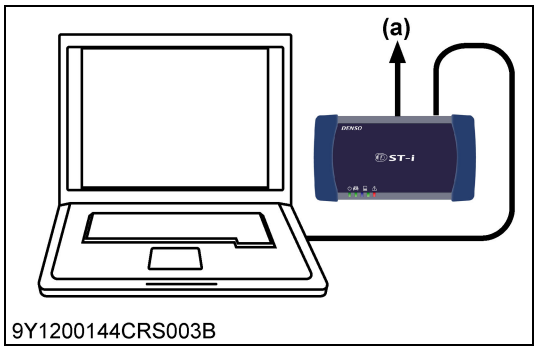
■ **NOTE**

- **Closely check sensor signals for a noise component and an abnormality that exists for a short time.**

OK	Go to "5. Check the DTC Again".
NG	Repair or replace the rail pressure sensor or its related parts. (Follow the diagnostic procedure of items P0192 and P0193.) (Refer to page 1-S161)

(a) CAN1 Connector

9Y1200199CRS0815US0



5. Check the DTC Again

1. Clear the past malfunction data, and make sure that the same DTC is output again in the reproduction test.

Factory specification	Normal (No DTC is output.)

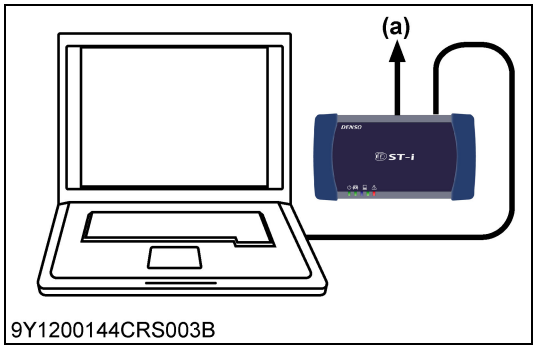
■ **NOTE**

- **Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.**

OK	Normal.
NG	Go to "6. Check the SCV-related Data".

(a) CAN1 Connector

9Y1200199CRS0816US0



9Y1200144CRS003B


9Y1200199CRS005A

6. Check the SCV-related Data

1. Check the "Target rail pressure", "Actual rail pressure", "Target SCV current", "Actual SCV current", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	1. The "Actual SCV current value" always follow to the "Target SCV current value". • When idling: Approx. 1800 mA • Accelerator opening: 0→100 % (During acceleration): Approx. 1400 mA minimum • During no-load maximum speed: Approx. 1600 mA • The numerical value is stable under normal operating and the target value corresponds with actual pressure value. *** The current shall be used as a reference only as this value varies depending on the pump used.** 2. The "Pressure feedback integral guard executing flag" must be OFF. 3. The "Pump deviation learning correction value" must be within ±200 mA. ■ **NOTE** • **As the following value of A varies depending on pump, the table above is for guideline. If the value of A has a wider shift than the initial learning value, there may be out of the range of the above table.** **A net normal value is the value that provided by the forced-learning several times.: Compared with A** **12 V spec.: A-100 ≤ normal value ≤ A+50** **Therefore, if the value is out of the range above, perform the forced-learning.**

■ **NOTE**

- **"Pump difference learning status"**
  It must be "2" (Learning completed) or "3" (During relearning). If not, keep idling the engine after warming up and when the learning status becomes "2" or "3", make the judgment. Occasionally, it does not shift from 3 to 2. Perform pump difference learning to take into account the above status, then compare with the status before learning.

OK	After confirming that an intermittent malfunction (such as power supply system or noise generation) does not occur in relation to the ECU, replace the ECU.
NG	Replace the supply pump.

(a) CAN1 Connector

9Y1200199CRS0817US0

(5) SCV Stuck (DTC P0089 / 1347-7)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- SCV stuck at open position (Actual rail pressure continuously exceeds the command rail pressure)

DTC set preconditions:
- Supply pump is normal and pump calibration has been executed
- Engine is operating (Q: 4 mm^3/st or higher)
- Injector is normal
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- Rail pressure sensor is normal

DTC set parameter:
- Discharge request of supply pump goes below 0 mm^3/st and the actual rail pressure is 10 MPa (100 kgf/cm^2, 1400 psi) higher than command pressure
- Above state continues for 26 seconds or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0826US0

Diagnostic Procedure for Pressure System DTCs

Checking of fault conditions and actions taken

If DTCs of non-pressure system are detected (*Refer to the pressure system DTCs given below.)

First locate the non-pressure system problem indicated by DTCs, and repair the affected parts. After the repair has been carried out, check for an output of pressure system DTCs. If so, begin the diagnosis of the affected pressure system.

If only pressure system DTCs are detected (*Refer to the pressure system DTCs given below.)

Diagnose the affected pressure system indicated by DTCs.

If a DTC currently exists

Begin diagnosis without returning the key switch to the OFF position. However, carefully make satisfactory / unsatisfactory judgments as the injection amount and rail pressure are limited by system actions.

If only a past DTC exists

Log the freeze-frame data, clear the DTCs, and stop the engine. Then, try to reproduce the problem using the freeze-frame data and the trouble check sheet.

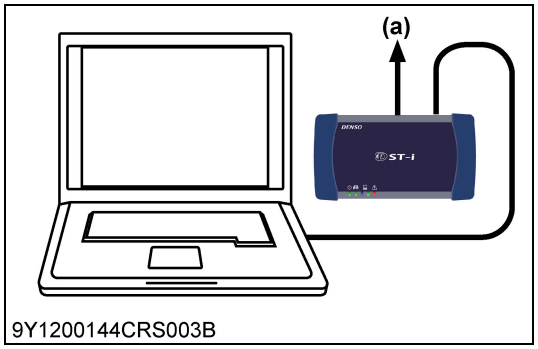
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[Low pressure abnormality]
1. P0087: Pressure limiter emergency open
2. P0093: Fuel leak

[Abnormal pressure]
1. P0089: SCV stuck
2. P1274: Pump seizing 1
3. P1275: Pump seizing 2

■ **IMPORTANT**
- **Multiple pressure system DTCs may be output simultaneously. Also, both abnormal high pressure and abnormal low pressure may be reported simultaneously under certain malfunction conditions.**

9Y1200199CRS0810US0



1. Check the Data Related to the Rail Pressure

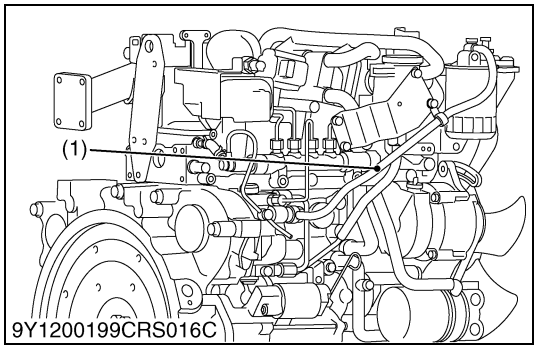
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.
NG	Go to "2. Check the Fuel System for the Existence of Air".

(a) CAN1 Connector

9Y1200199CRS0812US0



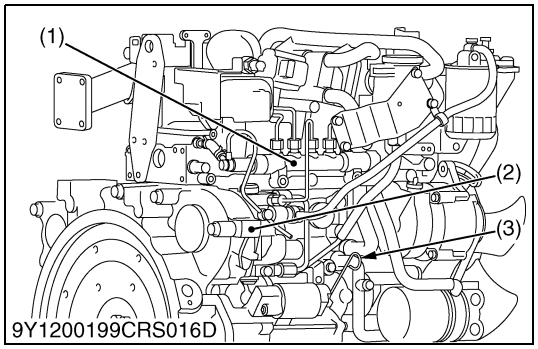
2. Check the Fuel System for the Existence of Air

1. Check each joint of the fuel system for the existence of air.
   To detect the existence of air effectively, replace the fuel hose with a transparent one.

OK	Go to "3. Check the Fuel System".
NG	Rotate the fuel feed pump sufficiently and bleed the air. Locate the position of the fuel leakage in the piping and repair it.

(1) Fuel Hose

9Y1200199CRS0829US0



3. Check the Fuel System

CAUTION

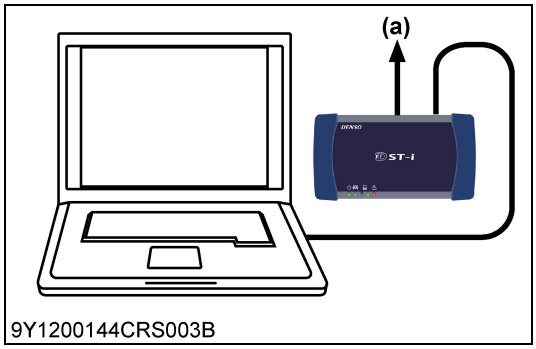
- **Visually check there is no leak in the high pressure fuel pipe system.**
- **A visual check is not possible if a leak (high pressure system) occurs inside the head cover, so check that the oil level has not increased.**

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail
(2) Supply Pump
(3) Dipstick

9Y1200199CRS0814US0



9Y1200144CRS003B

4. Check the Rail Pressure Sensor (*Refer to Items P0192 and P0193)

1. Check the rail pressure sensor.

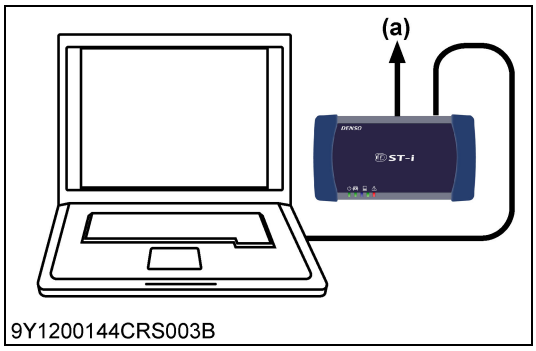
■ **NOTE**

- **Closely check sensor signals for a noise component and an abnormality that exists for a short time.**

OK	Go to "5. Check the DTC Again".
NG	Repair or replace the rail pressure sensor or its related parts. (Follow the diagnostic procedure of items P0192 and P0193.) (Refer to page 1-S161)

(a) CAN1 Connector

9Y1200199CRS0815US0



9Y1200144CRS003B

5. Check the DTC Again

1. Clear the past malfunction data, and make sure that the same DTC is output again in the reproduction test.

Factory specification	Normal (No DTC is output.)

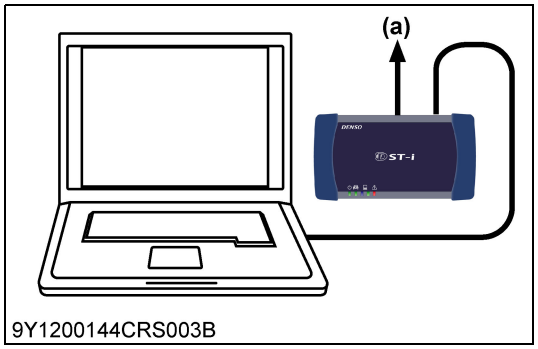
■ **NOTE**

- **Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.**

OK	Normal.
NG	Go to "6. Check the SCV-related Data".

(a) CAN1 Connector

9Y1200199CRS0816US0



9Y1200144CRS003B


9Y1200199CRS005A

6. Check the SCV-related Data

CAUTION

- **"Pump difference learning status"**
  It must be "2" (Learning completed) or "3" (During relearning). For cases other than those above, perform pump difference learning and judge after status 2 or 3 is entered. Occasionally, it does not shift from 3 to 2. Perform pump difference learning to take into account the above status, then compare with the status before learning.

1. Check the "Target rail pressure", "Actual rail pressure", "Target SCV current", "Actual SCV current", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	1. The "Actual SCV current value" always follow to the "Target SCV current value". • When idling: Approx. 1800 mA • Accelerator opening: 0→100 % (During acceleration): Approx. 1400 mA minimum • During no-load maximum speed: Approx.1600 mA • The numerical value is stable under normal operating and the target value corresponds with actual pressure value. *** The current shall be used as a reference only as this value varies depending on the pump used.** 2. The "Pressure feedback integral guard executing flag" must be OFF. 3. The "Pump deviation learning correction value" must be within ±200 mA. ■ **NOTE** • **As the following value of A varies depending on pump, the table above is for guideline. If the value of A has a wider shift than the initial learning value, there may be out of the range of the above table.** **A net normal value is the value that provided by the forced-learning several times.: Compared with A** **12 V spec.: A-100 ≤ normal value ≤ A+50** **Therefore, if the value is out of the range above, perform the forced-learning.**

3. Perform repeated sudden accelerations and decelerations, and check that the target rail pressure and actual rail pressure converge to approximately the same value.

Factory specification	Converge to within 10 MPa (100 kgf/cm^2, 1400 psi) within 20 seconds or less.

4. In addition, suddenly release the accelerator while driving at maximum speed to test the temporary non-injection condition without applying the brake (engine brake only) and check that the target rail pressure and actual rail pressure converge to approximately the same value.

Factory specification	Converge to within 10 MPa (100 kgf/cm^2, 1400 psi) within 20 seconds or less.

OK	After confirming that an intermittent malfunction (such as power supply system or noise generation) does not occur in relation to the ECU, replace the ECU.
NG	Replace the supply pump.

(a) CAN1 Connector

9Y1200199CRS1214US0

(6) Fuel Leak (in High Pressured Fuel System) (DTC P0093 / 1239-1)

Behaviour during malfunction:

- Insufficient output
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:

- Fuel leak from high pressured fuel system (Fuel consumption is calculated from the difference of fuel pressure of before and after the injection, and the error will be detected when excess fuel consumption is found)

DTC set preconditions:

- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- Rail pressure sensor is normal
- Supply pump (SCV) is normal
- Injector and injector drive circuit are normal
- NE signal is active [Engine is operating (700 min^{-1} (rpm) or higher)]
- No DTC of P0087, P0088, P0089

DTC set parameter:

(a): the flow volume which is calculated from the difference of rail pressure (decrease)
(b): total volume of injection and leakage
Fuel leak is judged with following conditions:

- In case, engine speed is more than 1200 min^{-1} (rpm):
  When the difference of (a) and (b) is 120 mm^3/st or above, (a) is higher than (b), and fuel leak is not from opening pressure limiter
- In case, engine speed is 1200 min^{-1} (rpm) or less:
  When the difference of (a) and (b) is 400 mm^3/st or above, (a) is higher than (b), and fuel leak is not from opening pressure limiter

Engine warning light:

- ON

Limp home action by engine ECU (system action):

- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:

- Key switch turn OFF

9Y1200199CRS0834US0

Diagnostic Procedure for Pressure System DTCs

Checking of fault conditions and actions taken

If DTCs of non-pressure system are detected (*Refer to the pressure system DTCs given below.)

First locate the non-pressure system problem indicated by DTCs, and repair the affected parts. After the repair has been carried out, check for an output of pressure system DTCs. If so, begin the diagnosis of the affected pressure system.

If only pressure system DTCs are detected (*Refer to the pressure system DTCs given below.)

Diagnose the affected pressure system indicated by DTCs.

If a DTC currently exists

Begin diagnosis without returning the key switch to the OFF position. However, carefully make satisfactory / unsatisfactory judgments as the injection amount and rail pressure are limited by system actions.

If only a past DTC exists

Log the freeze-frame data, clear the DTCs, and stop the engine. Then, try to reproduce the problem using the freeze-frame data and the trouble check sheet.

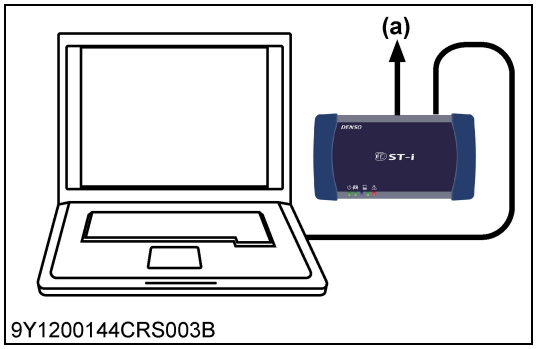
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[Low pressure abnormality]
1. P0087: Pressure limiter emergency open
2. P0093: Fuel leak

[Abnormal pressure]
1. P0089: SCV stuck
2. P1274: Pump seizing 1
3. P1275: Pump seizing 2

■ **IMPORTANT**
- **Multiple pressure system DTCs may be output simultaneously. Also, both abnormal high pressure and abnormal low pressure may be reported simultaneously under certain malfunction conditions.**

9Y1200199CRS0810US0



9Y1200144CRS003B

1. Check the Data Related to the Rail Pressure

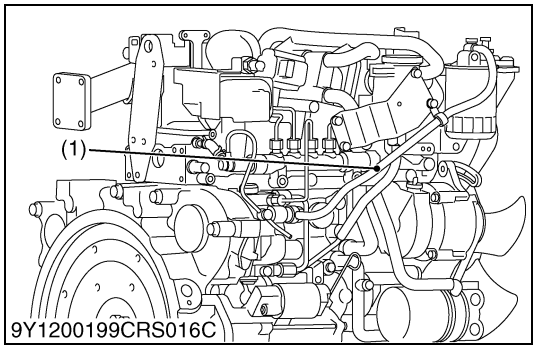
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.
NG	Go to "2. Check the Fuel System for the Existence of Air".

(a) CAN1 Connector

9Y1200199CRS0812US0



9Y1200199CRS016C

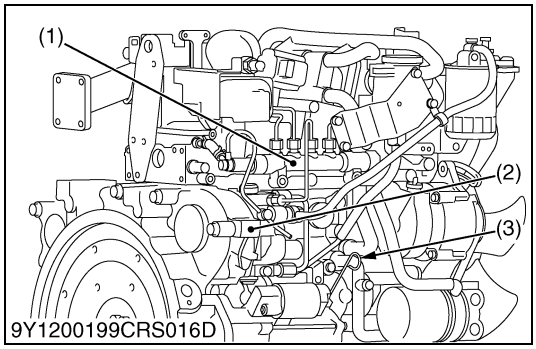
2. Check the Fuel System for the Existence of Air

1. Check each joint of the fuel system for the existence of air. To detect the existence of air effectively, replace the fuel hose with a transparent one.

OK	Go to "3. Check the Fuel System".
NG	Rotate the fuel feed pump sufficiently and bleed the air. Locate the position of the fuel leakage in the piping and repair it.

(1) Fuel Hose

9Y1200199CRS0829US0



9Y1200199CRS016D

3. Check the Fuel System

⚠ CAUTION

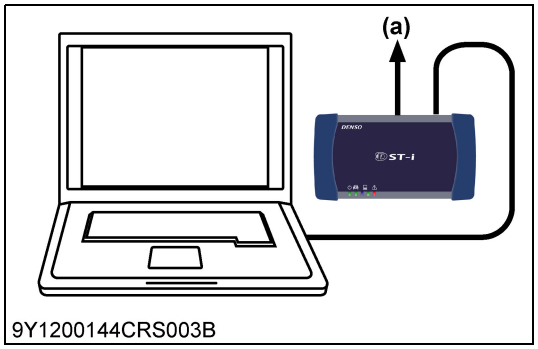
- **Visually check there is no leak in the high pressure fuel pipe system.**
- **A visual check is not possible if a leak (high pressure system) occurs inside the head cover, so check that the oil level has not increased.**

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail
(2) Supply Pump
(3) Dipstick

9Y1200199CRS0814US0



4. Check the Rail Pressure Sensor (*Refer to Items P0192 and P0193)

1. Check the rail pressure sensor.

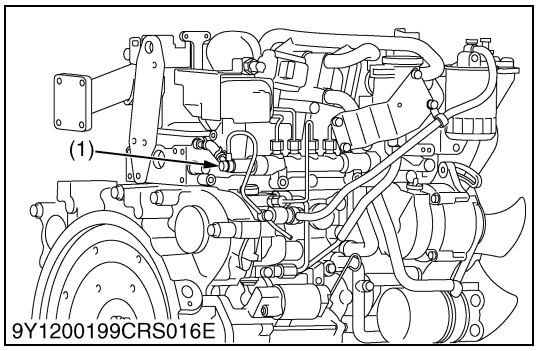
■ **NOTE**

- **Closely check sensor signals for a noise component and an abnormality that exists for a short time.**

OK	Go to "5. Check the Pressure Limiter for a Fuel Leakage".
NG	Repair or replace the rail pressure sensor or its related parts. (Follow the diagnostic procedure of items P0192 and P0193.) (Refer to page 1-S161)

(a) CAN1 Connector

9Y1200199CRS0839US0



5. Check the Pressure Limiter for a Fuel Leakage

1. Check the temperature of the pressure limiter return pipe by touching it.

Factory specification	Almost the same as the ambient temperature.

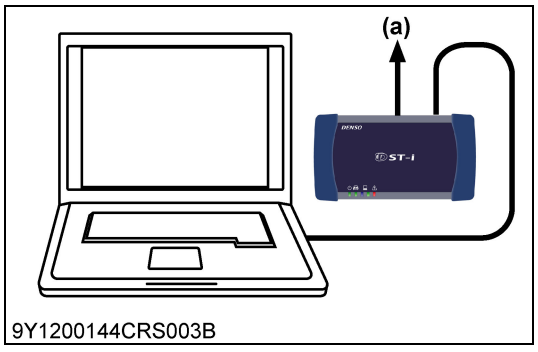
(Reference)

- If the fuel leaks from the pressure limiter, the high temperature and high pressure fuel flows through the return pipe and the pipe becomes very hot.

OK	Go to "6. Check for a Fuel Leakage".
NG	Replace the common rail (pressure limiter).

(1) Pressure Limiter

9Y1200199CRS0840US0



6. Check for a Fuel Leakage

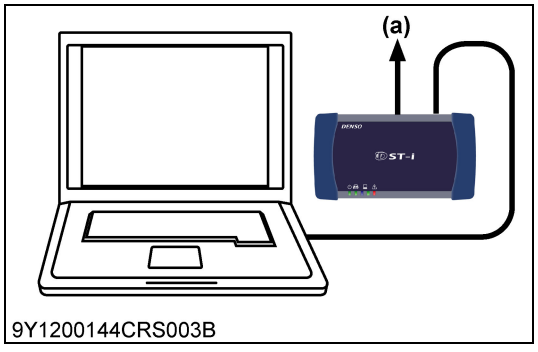
1. Increase the rail pressure by operating the accelerator pedal or accelerator lever, and check for a fuel leakage.

Factory specification	No fuel leaks.

OK	Go to "7. Check the DTC Again".
NG	Locate the leakage position and repair it.

(a) CAN1 Connector

9Y1200199CRS0841US0



7. Check the DTC Again

1. Clear the past malfunction data, and make sure that the same DTC is output again in the reproduction test.

Factory specification	Normal (No DTC is output.)

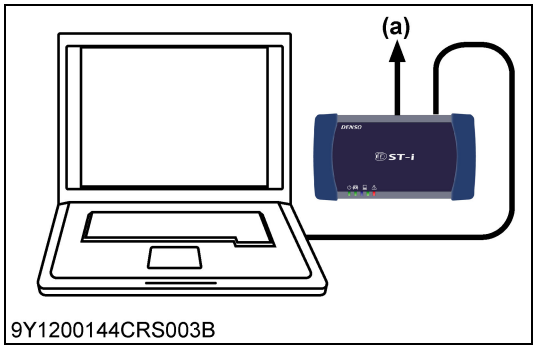
■ **NOTE**

- **Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.**

OK	Normal.
NG	Go to "8. Check the SCV-related Data".

(a) CAN1 Connector

9Y1200199CRS0842US0



9Y1200144CRS003B


9Y1200199CRS005A

8. Check the SCV-related Data

1. Check the "Target rail pressure", "Actual rail pressure", "Target SCV current", "Actual SCV current", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	1. The "Actual SCV current value" always follow to the "Target SCV current value". • When idling: Approx. 1800 mA • Accelerator opening: 0→100 % (During acceleration): Approx. 1400 mA minimum • During no-load maximum speed: Approx. 1600 mA • The numerical value is stable under normal operating and the target value corresponds with actual pressure value. *** The current shall be used as a reference only as this value varies depending on the pump used.** 2. The "Pressure feedback integral guard executing flag" must be OFF. 3. The "Pump deviation learning correction value" must be within ±200 mA. ■ **NOTE** • **As the following value of A varies depending on pump, the table above is for guideline. If the value of A has a wider shift than the initial learning value, there may be out of the range of the above table.** **A net normal value is the value that provided by the forced-learning several times.: Compared with A** **12 V spec.: A-100 ≤ normal value ≤ A+50** **Therefore, if the value is out of the range above, perform the forced-learning.**

■ **NOTE**

- **"Pump difference learning status"**
  It must be "2" (Learning completed) or "3" (During relearning). For cases other than those above, perform pump difference learning and judge after status 2 or 3 is entered. Occasionally, it does not shift from 3 to 2. Perform pump difference learning to take into account the above status, then compare with the status before learning.

OK	After confirming that an intermittent malfunction (such as power supply system or noise generation) does not occur in relation to the ECU, replace the ECU.
NG	Replace the supply pump.

(a) CAN1 Connector

9Y1200199CRS0843US0

(7) Intake Air Volume: Low (DTC P0101 / 132-1)

Behaviour during malfunction:
- Insufficient output

Detection item:
- Engine inlet air mass flow rate lacking (Disconnect turbo blower intake hose)

DTC set preconditions:
- Engine is operating [1000 min^{-1} (rpm) or higher]
- Coolant temperature is 15 °C (59 °F) or higher (Coolant temperature sensor is normal)
- MAF sensor is normal
- EGR valve is normal
- Intake throttle valve is normal
- Battery voltage is normal

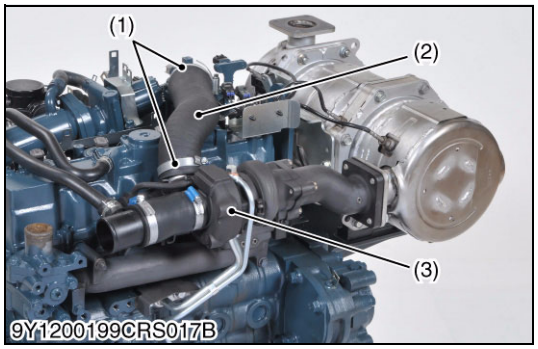
DTC set parameter:
- Engine Inlet Air Mass Flow Rate: less than half of target value

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0844US0



1. Check the Air Intake System

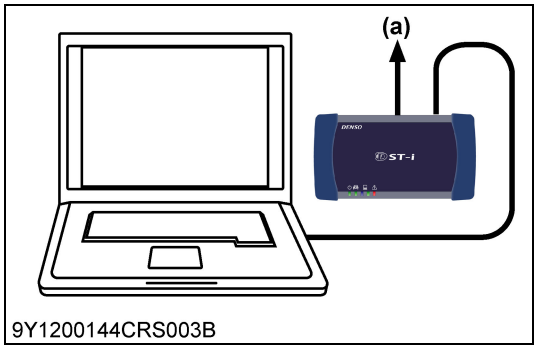
1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

■ **NOTE**
- **Check if the suction hose of the turbo blower does not come off. If the hose comes off, install it.**
- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**

OK	Go to "2. DTC Judgment".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS0845US0



2. DTC Judgment

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Operate the engine for 2 to 3 minutes with the engine in the idle status.
3. Check whether the DTC is output or not.

Factory specification	Either DTC is output.

OK	Normal.
NG	Replace the MAF Sensor or replace the ECU.

(a) CAN1 Connector

9Y1200199CRS0846US0

(8) MAF Sensor Abnormality (DTC P0102 / 132-4, P0103 / 132-3)

P0102 / 132-4: MAF sensor abnormality (Low side)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Open circuit or ground short circuit of sensor / harness.

DTC set preconditions:
- Battery voltage is normal
- Starter Switch signal (ECU: V12 terminal) is not activated
- Sensor supply voltage is normal

DTC set parameter:
- Mass air flow sensor voltage: 0.1 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Sensor output: 0.7 times of target value at normal condition [default value]
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0847US0

P0103 / 132-3: MAF sensor abnormality (High side)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- +B short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal
- 700 min^{-1} (rpm) ≤ engine speed ≤ 2800 min^{-1} (rpm)
- Target intake mass air flow is 460 or less and it continues for 3 secs
- Sensor supply voltage is normal

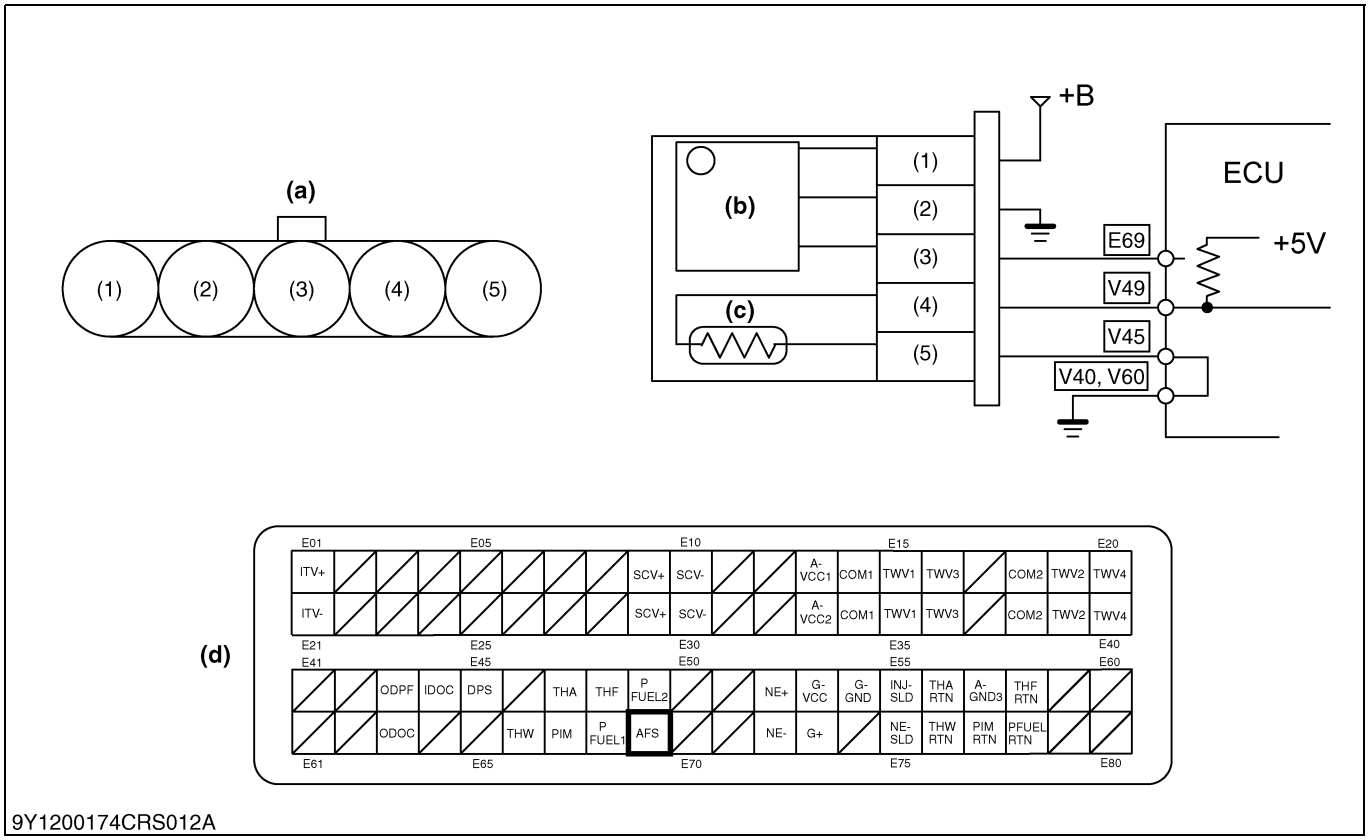
DTC set parameter:
- Mass air flow sensor voltage: 4.9 V or more in certain operation condition

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Sensor output: 0.7 times of target value at normal condition [default value]
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0848US0

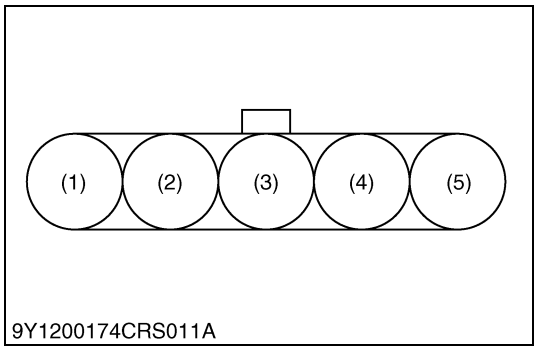


9Y1200174CRS012A

(1) Terminal Power (+12 V)
(2) Terminal Ground
(3) Terminal AFS
(4) Terminal IATS
(5) Terminal A-GND10

(a) Terminal Layout
(b) Mass Air Flow (MAF) Sensor
(c) Intake Air Temperature Sensor (Built-in MAF)
(d) ECU Connector 1 (Engine Side)

9Y1200199CRS0849US0



9Y1200174CRS011A

1. Measure the Sensor Terminal Voltage

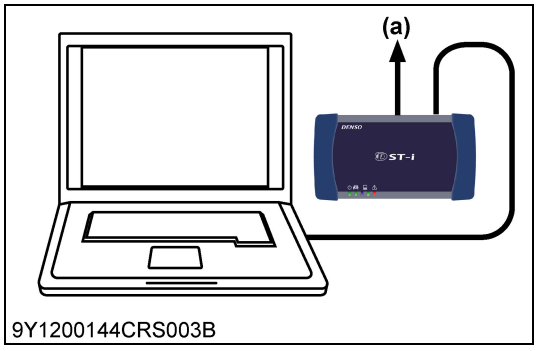
1. Move the key switch from the OFF to the ON position, and measure the voltage between sensor terminals 1 and 2.

Factory specification	Approx. 10 to 16 V

OK	Go to "2. DTC Judgment".
NG	Repair or replace the wiring harness, or replace the sensor

(1) Terminal Power (+12 V)
(2) Terminal Ground
(3) Terminal AFS
(4) Terminal IATS
(5) Terminal A-GND10

9Y1200199CRS0850US0



9Y1200144CRS003B

2. DTC Judgment

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Operate the engine for 2 to 3 minutes with the engine in the idle status.
3. Check whether the DTC is output or not.

Factory specification	Either DTC is output.

OK	Normal.
NG	Replace the MAF Sensor or replace the ECU.

(a) CAN1 Connector

9Y1200199CRS0846US0

(9) Intake Air Temperature: High (Inter Cooler Model Only) (DTC P0111 / 172-0)

Behaviour during malfunction:
- None

Detection item:
- Intake air temperature too high

DTC set preconditions:
- Battery voltage is normal
- Key switch is ON

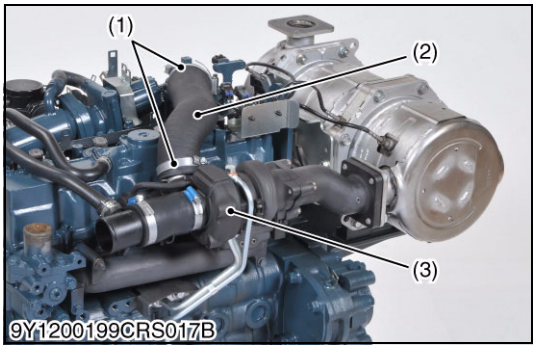
DTC set parameter:
- Intake air temperature higher than ambient temperature +60 °C (+140 °F)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0852US0



1. Check the Air Intake System

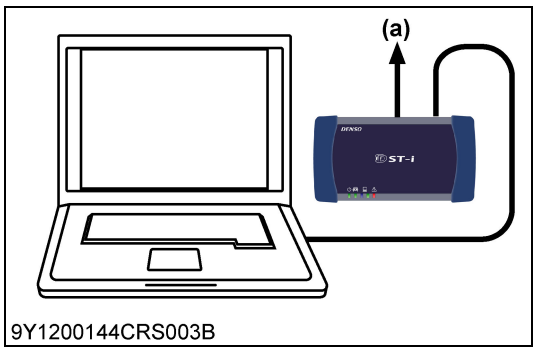
1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

■ **NOTE**
- **Check the clogging condition of the inter cooler. (Check whether the inter cooler functions properly. If the inter cooler has an electric fan, check whether it operates properly.)**
- **Check whether the connection pipe of the inter cooler does not come off.**

OK	Go to "2. Check the Intake Air Temperature (Refer to items P0072 and P0073)".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS0853US0



2. Check the Intake Air Temperature Sensor (*Refer to Items P0072 and P0073)

1. Check the intake air temperature sensor. (Refer to psge 1-S124)

OK	Normal.
NG	Repair or replace the intake air temperature sensor or its related parts. (Follow the diagnostic procedure of items P0072 and P0073.) (Refer to page 1-S124)

(a) CAN1 Connector

9Y1200199CRS0854US0

(10) Intake Air Temperature Error (DTC P0112 / 172-4, P0113 / 172-3)

P0112 / 172-4: Intake air temperature error (Low side)
Behaviour during malfunction:
- Amount of white smoke increases at low temperatures

Detection item:
- Ground short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- Voltage of intake air temperature sensor is 0.05 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- During start-up = −20 °C (−4 °F) [default value]
- Under other conditions = 40 °C (104 °F) [default value]

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0855US0

P0113 / 172-3: Intake air temperature error (High side)
Behaviour during malfunction:
- Amount of white smoke increases at low temperatures

Detection item:
- Open circuit or +B short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

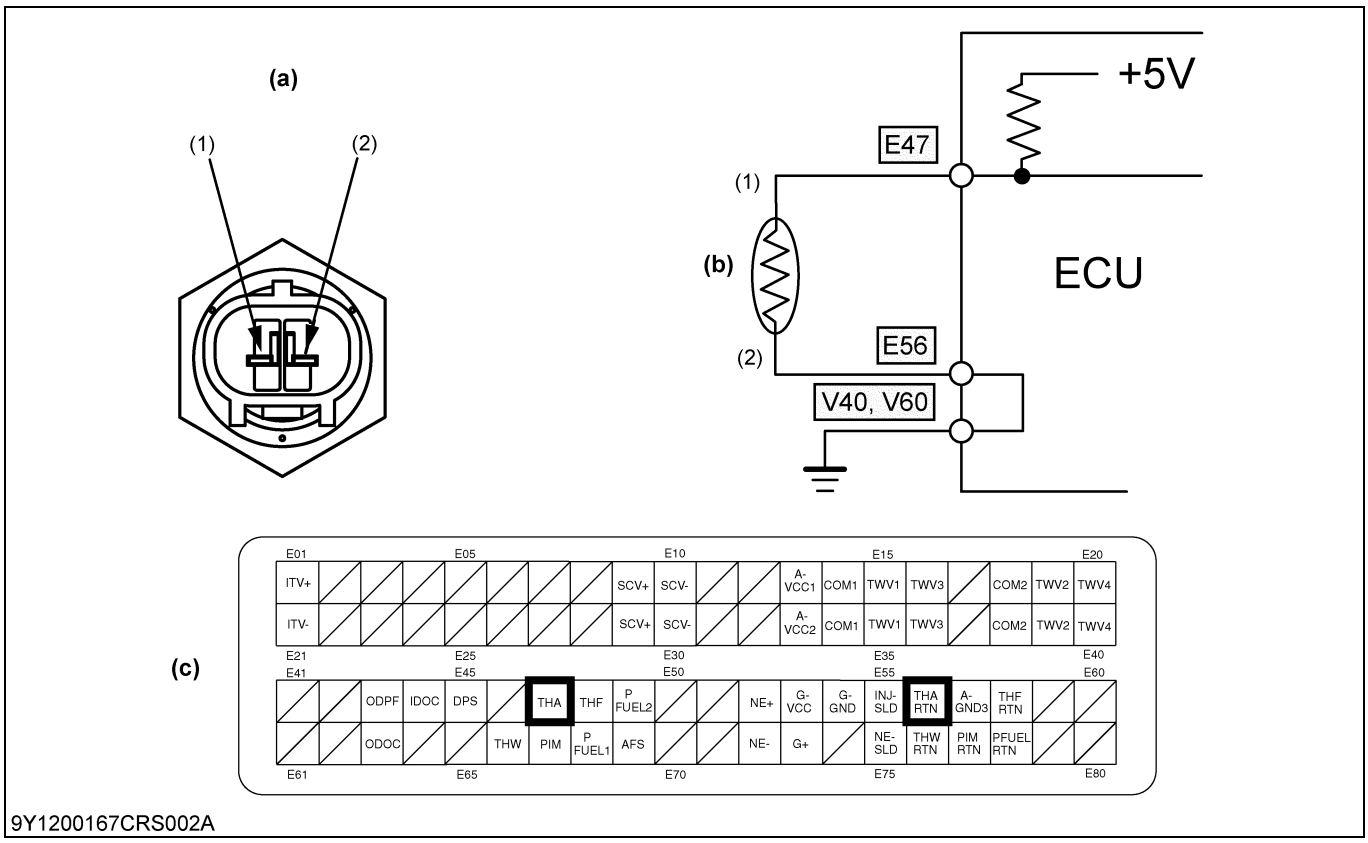
DTC set parameter:
- Voltage of intake air temperature sensor is 4.9 V or above

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- During start-up = −20 °C (−4 °F) [default value]
- Under other conditions = 40 °C (104 °F) [default value]

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0856US0



9Y1200167CRS002A

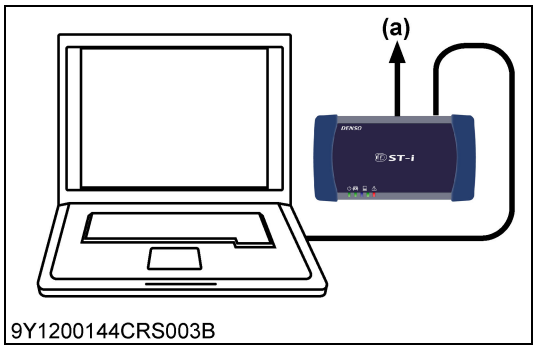
(1) Terminal THA

(2) Terminal THA RTN

(a) Terminal Layout
(b) Intake Air Temperature Sensor

(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0857US0



9Y1200144CRS003B

1. Check the Intake Air Temperature Sensor Signals

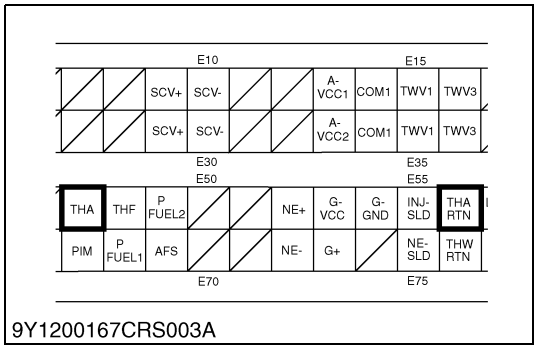
1. Place the key switch in the ON position, and check the "Intake air temperature" and "Intake air temperature sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual intake air temperature	Intake air temperature	Output voltage
20 °C (68 °F)	20 °C (68 °F)	Approx. 2.4 V
40 °C (104 °F)	40 °C (104 °F)	Approx. 1.5 V
60 °C (140 °F)	60 °C (140 °F)	Approx. 0.9 V
80 °C (176 °F)	80 °C (176 °F)	Approx. 0.5 V

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0858US0



9Y1200167CRS003A

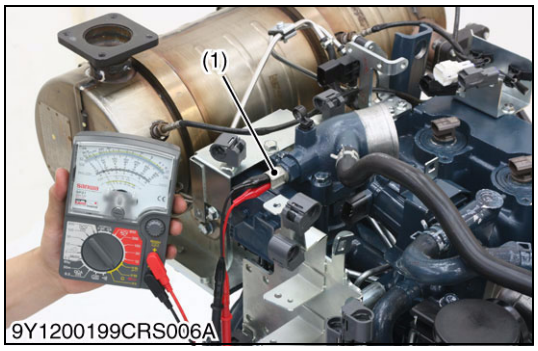
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E47 and E56 of the connector.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.4 kΩ
60 °C (140 °F)	Approx. 0.58 kΩ
100 °C (212 °F)	Approx. 0.18 kΩ

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the Sensor".

9Y1200199CRS0859US0



9Y1200199CRS006A

3. Check the Intake Air Temperature Sensor

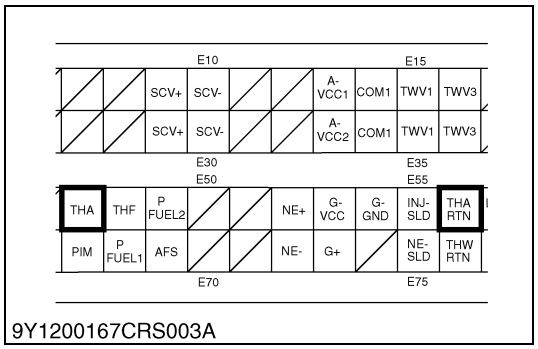
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.4 kΩ
60 °C (140 °F)	Approx. 0.58 kΩ
100 °C (212 °F)	Approx. 0.18 kΩ

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Intake air temperature sensor fault → Replace the intake air temperature sensor.

(1) Intake Air Temperature Sensor

9Y1200199CRS0860US0



9Y1200167CRS003A

4. Measure the ECU Terminal Voltage

1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals E47 and E56 at the ECU side.

Factory specification	Approx. 5 V

OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

9Y1200199CRS0861US0

(11) Coolant Temperature Sensor Abnormality (DTC P0117 / 110-4, P0118 / 110-3)

P0117 / 110-4: Coolant temperature sensor abnormality (Low side)

Behaviour during malfunction:
- Amount of white smoke increases at low temperatures
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Ground short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- Voltage of coolant temperature sensor is 0.1 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- During start-up = −25 °C (−13 °F) [default value]
- Under other conditions = 80 °C (176 °F) [default value]
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0862US0

P0118 / 110-3: Coolant temperature sensor abnormality (High side)

Behaviour during malfunction:
- Amount of white smoke increases at low temperatures
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Open circuit or +B short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

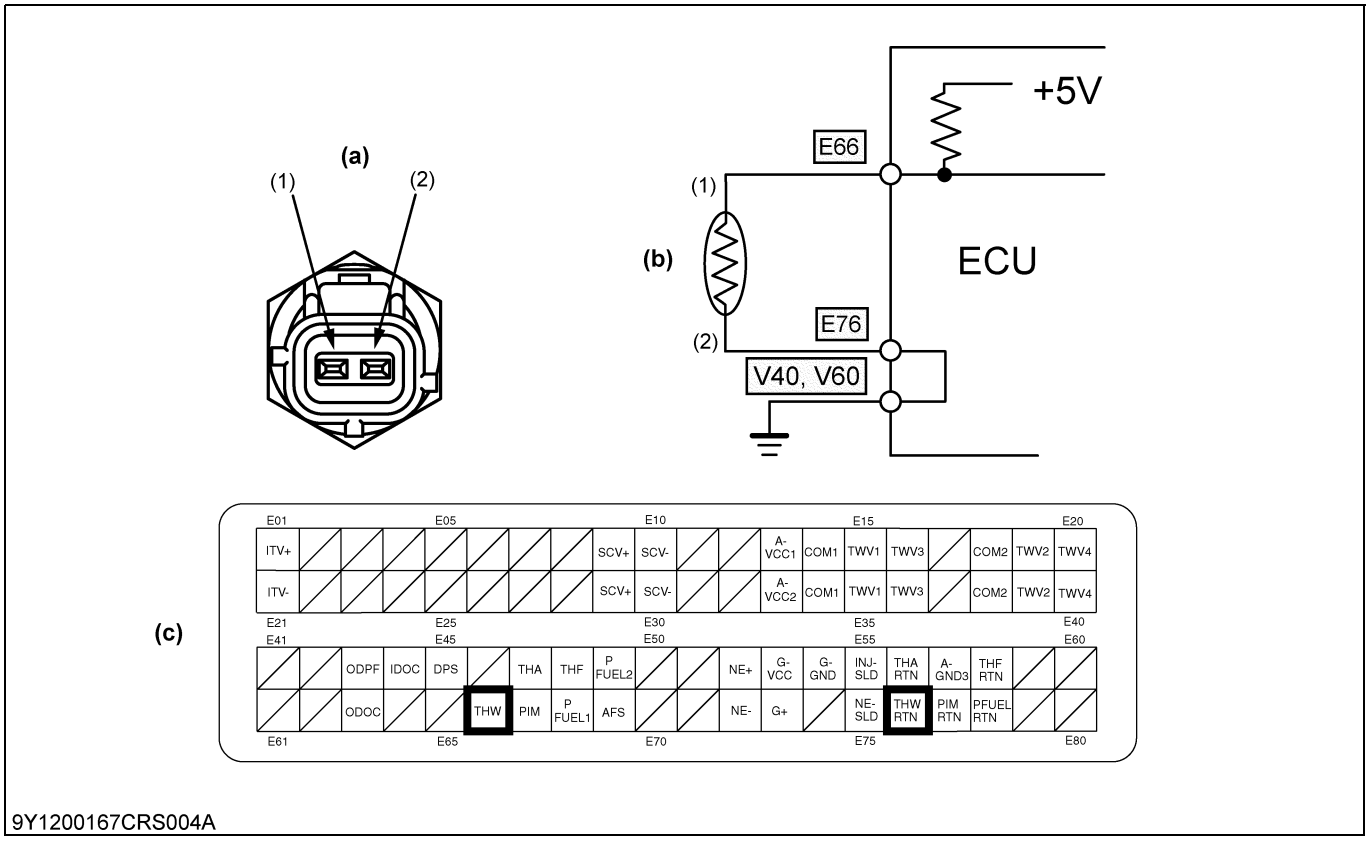
DTC set parameter:
- Voltage of coolant temperature sensor is 4.9 V or above

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- During start-up = −25 °C (−13 °F) [default value]
- Under other conditions = 80 °C (176 °F) [default value]
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

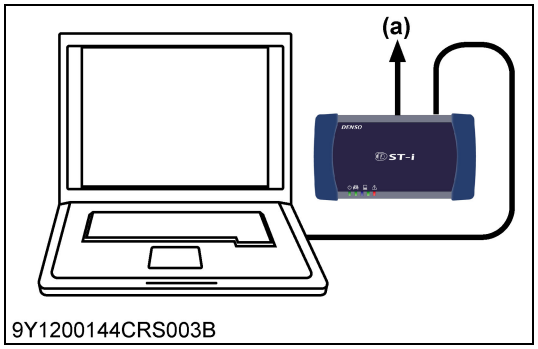
9Y1200199CRS0863US0



9Y1200167CRS004A

(1) Terminal THW
(2) Terminal THW RTN
(a) Terminal Layout
(b) Coolant Temperature Sensor
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0864US0



9Y1200144CRS003B

1. Check the Coolant Temperature Sensor Signals

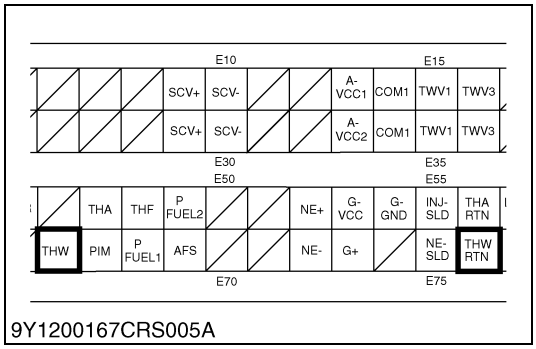
1. Place the key switch in the ON position, and check the "Coolant temperature" and "Coolant temperature sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual coolant temperature	Coolant temperature	Output voltage
20 °C (68 °F)	20 °C (68 °F)	Approx. 2.4 V
40 °C (104 °F)	40 °C (104 °F)	Approx. 1.5 V
60 °C (140 °F)	60 °C (140 °F)	Approx. 0.9 V
80 °C (176 °F)	80 °C (176 °F)	Approx. 0.5 V
100 °C (212 °F)	100 °C (212 °F)	Approx. 0.3 V

OK	Clear the DTC and check whether it is output again or not. ▼	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0865US0



9Y1200167CRS005A

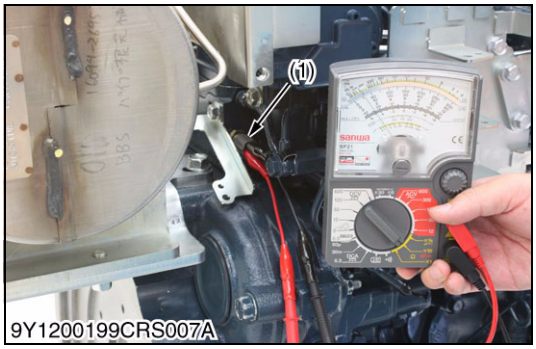
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E66 and E76 of the connector.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.5 kΩ
40 °C (104 °F)	Approx. 1.2 kΩ
60 °C (140 °F)	Approx. 0.58 kΩ
80 °C (176 °F)	Approx. 0.32 kΩ
100 °C (212 °F)	Approx. 0.18 kΩ

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the sensor".

9Y1200199CRS0866US0



9Y1200199CRS007A

3. Check the Coolant Temperature Sensor

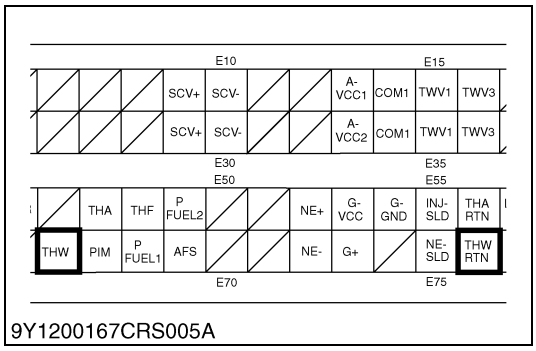
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.5 kΩ
40 °C (104 °F)	Approx. 1.2 kΩ
60 °C (140 °F)	Approx. 0.58 kΩ
80 °C (176 °F)	Approx. 0.32 kΩ
100 °C (212 °F)	Approx. 0.18 kΩ

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Coolant temperature sensor fault → Replace the coolant temperature sensor.

(1) Coolant Temperature Sensor

9Y1200199CRS0867US0



9Y1200167CRS005A

4. Measure the ECU Terminal Voltage

1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals E66 and E76 at the ECU side.

Factory specification	Approx. 5 V

OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

9Y1200199CRS0868US0

(12) Fuel High Temperature (DTC P0181 / 174-0)

Behaviour during malfunction:
- None

Detection item:
- Fuel temperature high

DTC set preconditions:
- Passed 300 sec after cranking
- Engine speed is 800 min^{-1} (rpm) or more
- Fuel temperature sensor is normal

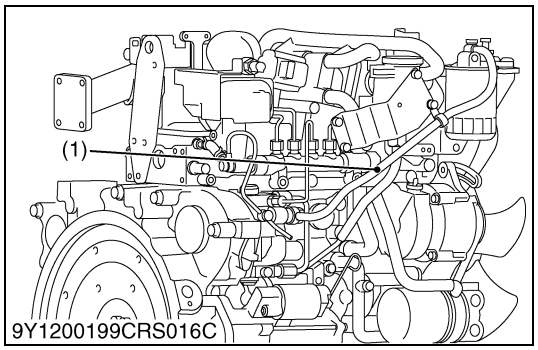
DTC set parameter:
- Fuel temperature higher than 90 °C (194 °F)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0869US0



1. Check the Fuel System

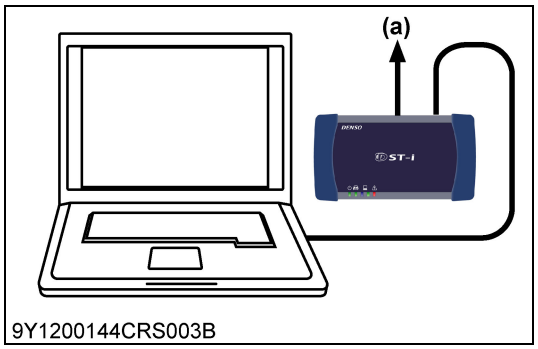
1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

■ **NOTE**
- **If the machine has a fuel fooler, check whether the fuel cooler is installed to the proper position.**
- **Check whether the cooling performance does not decrease due to dust.**
- **Check whether the fuel pipe is appropriate.**
- **Check the clogging condition of the fuel filter. If it is very dirty, replace the new one.**

OK	Go to "2. Check the Fuel Temperature sensor (Refer to items P0182 and P0183)".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Fuel Hose

9Y1200199CRS0870US0



2. Check the Fuel Temperature Sensor (*Refer to Items P0182 and P0183)

1. Check the fuel temperature sensor. (Refer to page 1-S158)

OK	Normal.
NG	Repair or replace the supply pump or its related parts. (Follow the diagnostic procedure of items P0182 and P0183.) (Refer to page 1-S158)

(a) CAN1 Connector

9Y1200199CRS0871US0

(13) Fuel Temperature Sensor Abnormality (DTC P0182 / 174-4, P0183 / 174-3)

P0182 / 174-4: Fuel temperature sensor abnormality (Low side)

Behaviour during malfunction:
- None

Detection item:
- Ground short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- Voltage of temperature sensor in supply pump is 0.1 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- During start-up = −20 °C (−4 °F) [default value]
- Under other conditions = 45 °C (113 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0872US0

P0183 / 174-3: Fuel temperature sensor abnormality (High side)

Behaviour during malfunction:
- None

Detection item:
- Open circuit or +B short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

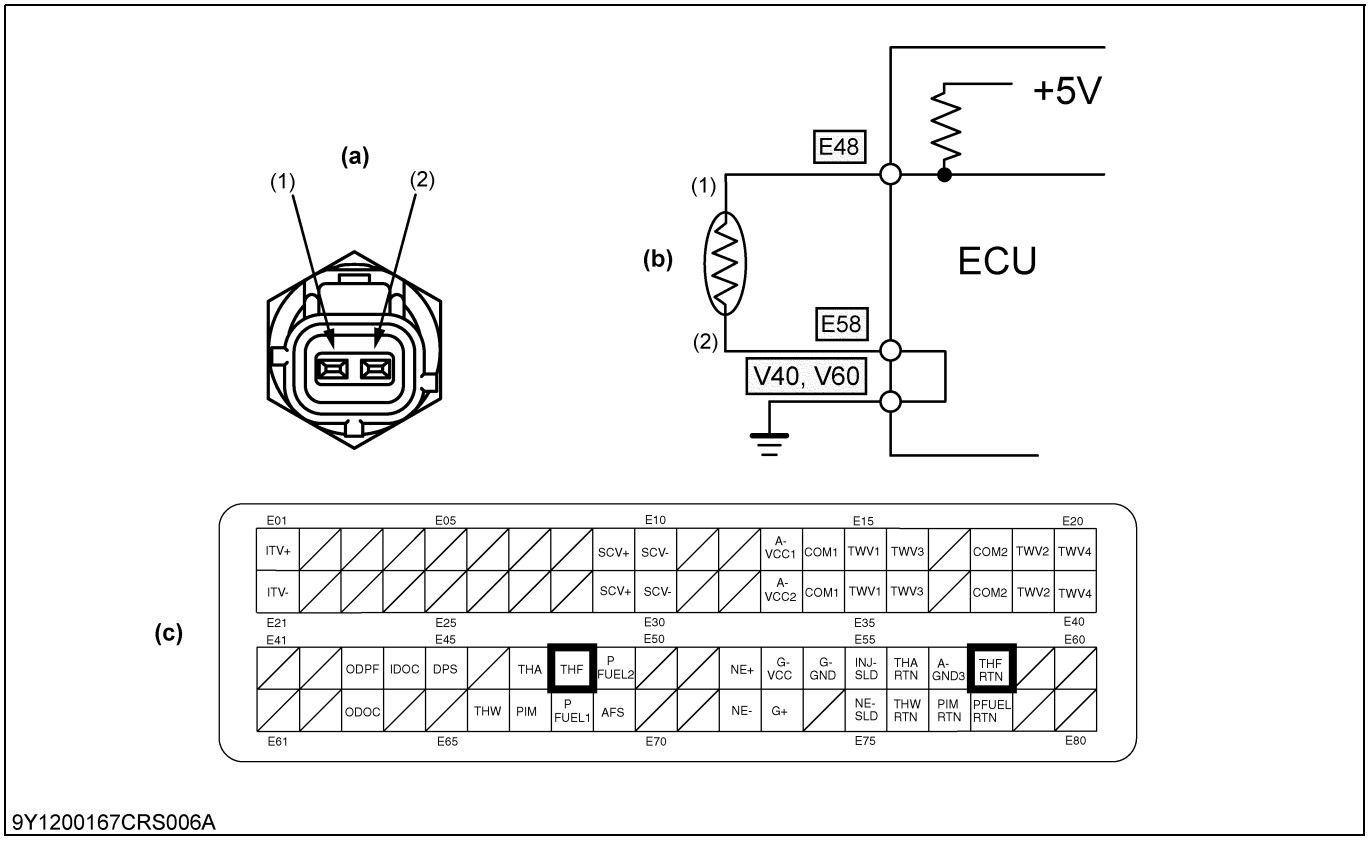
DTC set parameter:
- Voltage of temperature sensor in supply pump is 4.9 V or above

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- During start-up = −20 °C (−4 °F) [default value]
- Under other conditions = 45 °C (113 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Diagnostic counter = zero

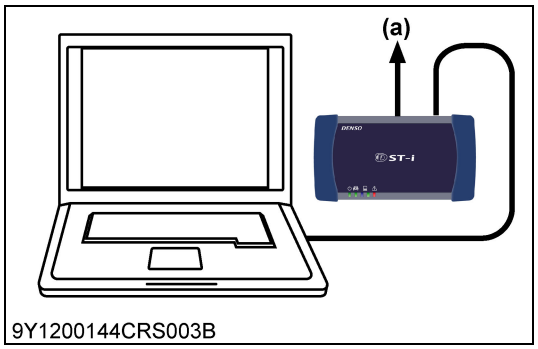
9Y1200199CRS0873US0



9Y1200167CRS006A

(1) Terminal THF
(2) Terminal THF RTN
(a) Terminal Layout
(b) Fuel Temperature Sensor
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0874US0



9Y1200144CRS003B

1. Check the Fuel Temperature Sensor Signals

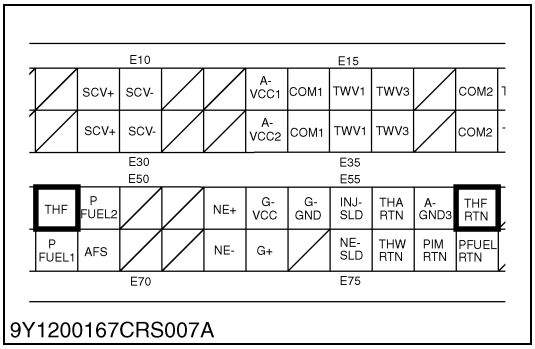
1. Place the key switch in the ON position, and check the "Fuel temperature" and "Fuel temperature sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual fuel temperature	Fuel temperature	Output voltage
20 °C (68 °F)	20 °C (68 °F)	Approx. 2.4 V
40 °C (104 °F)	40 °C (104 °F)	Approx. 1.5 V
60 °C (140 °F)	60 °C (140 °F)	Approx. 0.9 V
80 °C (176 °F)	80 °C (176 °F)	Approx. 0.5 V

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0875US0



9Y1200167CRS007A

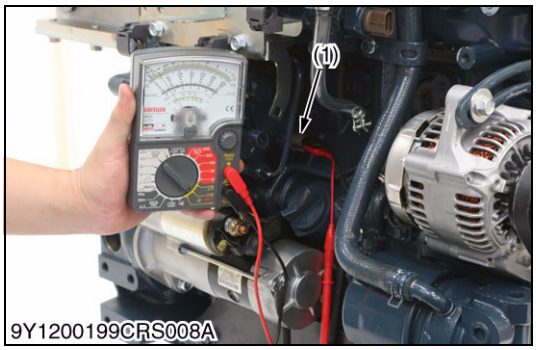
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E48 and E58 of the connector.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.5 kΩ
40 °C (104 °F)	Approx. 1.2 kΩ
60 °C (140 °F)	Approx. 0.58 kΩ
80 °C (176 °F)	Approx. 0.32 kΩ

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the Sensor".

9Y1200199CRS0876US0



9Y1200199CRS008A

3. Check the Fuel Temperature Sensor

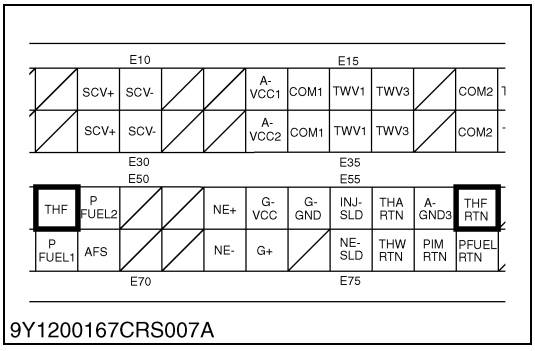
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.5 kΩ
40 °C (104 °F)	Approx. 1.2 kΩ
60 °C (140 °F)	Approx. 0.58 kΩ
80 °C (176 °F)	Approx. 0.32 kΩ

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Fuel temperature sensor fault → Replace the supply pump.

(1) Fuel Temperature Sensor

9Y1200199CRS0877US0



9Y1200167CRS007A

4. Measure the ECU Terminal Voltage

1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals E48 and E58 at the ECU side.

Factory specification	Approx. 5 V

OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

9Y1200199CRS0878US0

(14) Rail Pressure Sensor Abnormality (DTC P0192 / 157-4, P0193 / 157-3)

P0192 / 157-4: Rail pressure sensor abnormality (Low side)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance
- Worsening running noise
- Increase in white smoke
- Engine stops

Detection item:
- Ground short circuit of sensor / harness
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal

DTC set parameter:
- Voltage of rail pressure sensor is 0.7 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)
- Engine forcibly stopped 60 sec. later

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0879US0

P0193 / 157-3: Rail pressure sensor abnormality (High side)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance
- Worsening running noise
- Increase in white smoke
- Engine stops

Detection item:
- Open circuit or +B short circuit of sensor / harness.
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal

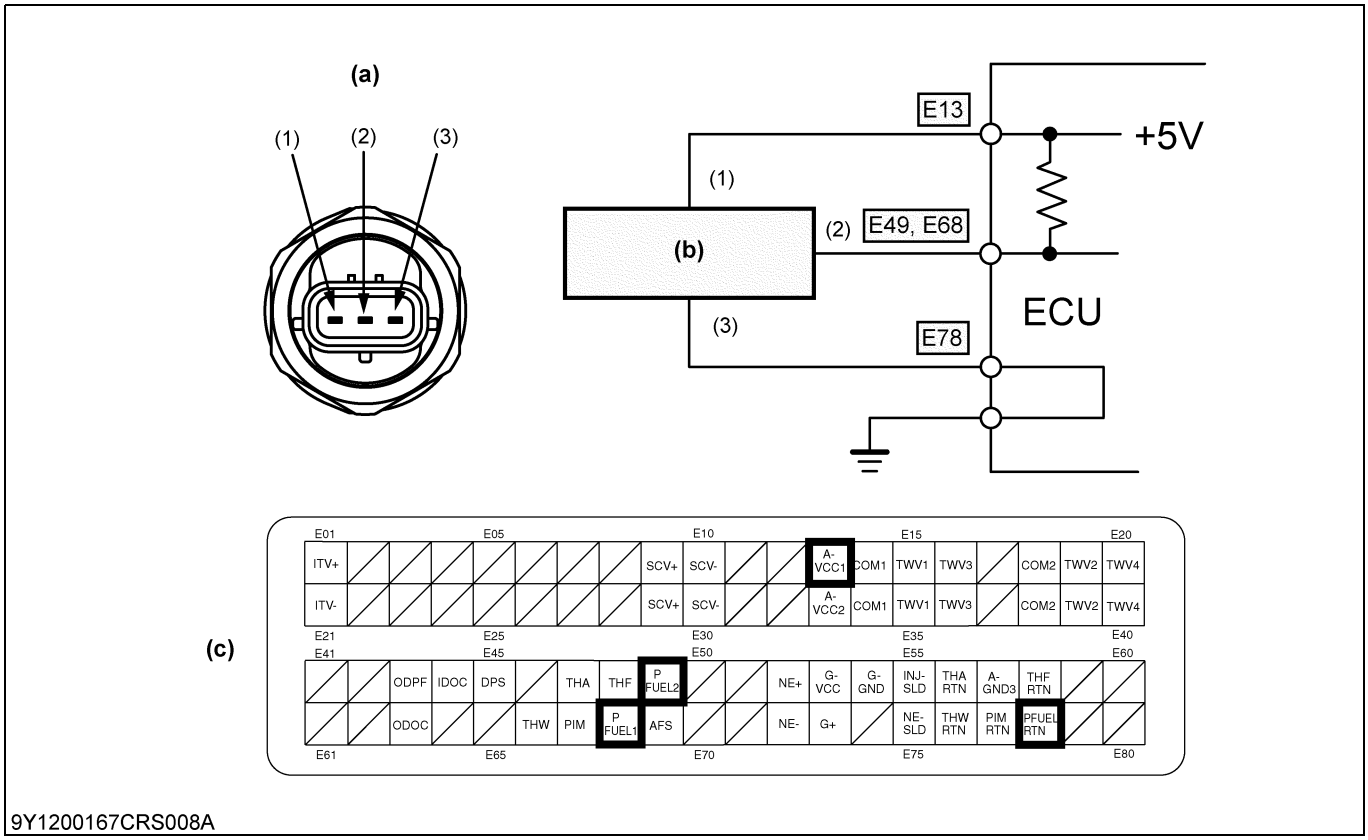
DTC set parameter:
- Voltage of rail pressure sensor is 4.9 V or above

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)
- Engine forcibly stopped 60 sec. later

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0880US0

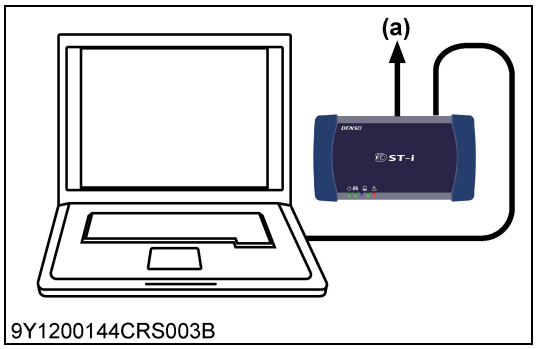


9Y1200167CRS008A

(1) Terminal A-VCC1
(2) Terminal PFUEL
(3) Terminal PFUEL RTN

(a) Terminal Layout
(b) Rail pressure sensor
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0881US0



9Y1200144CRS003B

1. Check the Rail Pressure Sensor Signals

1. Place the key switch in the ON position, and check the "Actual rail pressure" and "Rail pressure sensor output voltage" on the diagnosis tool data monitor.
2. Next, start the engine, change the depressed amount of the accelerator pedal, and check the same items again.

Factory specification	Depends on the rotation speed, load (After warm-up) 1. When stopped: Approx. 1.0 V 2. When idling: 1.65 to 1.80 V 3. During no-load maximum speed: 2.50 to 2.85 V 4. During acceleration: 2.5 to 3.3 V

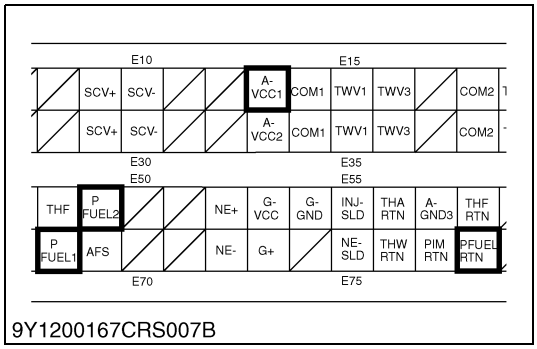
■ **NOTE**

- **When idling: Approx. 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi)**
  During no-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi)
- **Reference value (Factory spec.) has complete linearity.**

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the ECU terminal voltage".	

(a) CAN1 Connector

9Y1200199CRS0882US0



9Y1200167CRS007B

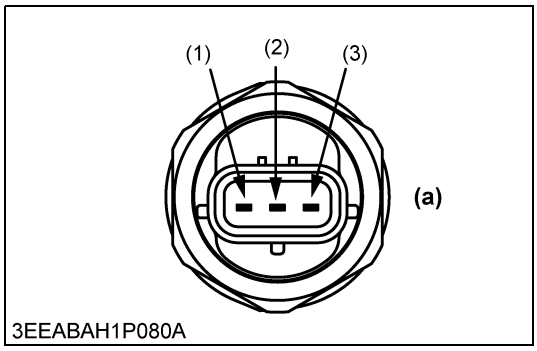
2. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals E68 and E78 and between terminals E49 and E78.
2. Next, start the engine, change the depressed amount of the accelerator pedal, and check the same items again.

Factory specification	Depends on the rotation speed, load (After warm-up) 1. When stopped: Approx. 1.0 V 2. When idling: 1.65 to 1.80 V 3. During no-load maximum speed: 2.50 to 2.85 V 4. During acceleration: 2.5 to 3.3 V

OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Go to "3. Measure the voltage between rail pressure sensor terminals - 1".	

9Y1200199CRS0883US0



3EEABAH1P080A

3. Measure the Voltage Between Rail Pressure Sensor Terminals - 1

1. Place the key switch in the ON position, and measure the voltage between terminals (2) and (3) of the rail pressure sensor at the wiring harness side.
2. Next, start the engine, change the depressed amount of the accelerator pedal, and check the same items again.

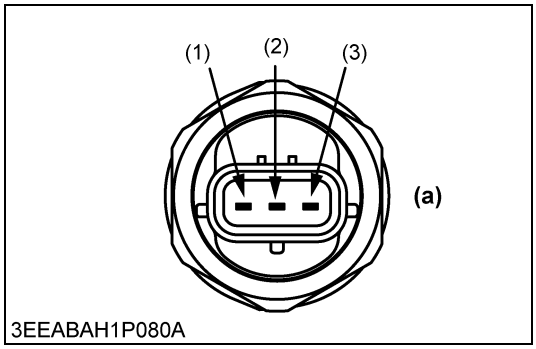
Factory specification	Depends on the rotation speed, load (After warm-up) 1. When stopped: Approx. 1.0 V 2. When idling: 1.65 to 1.80 V 3. During no-load maximum speed: 2.50 to 2.85 V 4. During acceleration: 2.5 to 3.3 V

OK	Check the wiring harness (between ECU terminals E49 / E68 and sensor terminal (2)). → Repair the faulty area.
NG	Go to "4. Measure the voltage between rail pressure sensor terminals - 2".

(1) Terminal A-VCC1
(2) Terminal PFUEL
(3) Terminal PFUEL RTN

(a) Terminal Layout

9Y1200199CRS0884US0



3EEABAH1P080A

4. Measure the Voltage Between Rail Pressure Sensor Terminals - 2

1. Set the key switch to the OFF position, and unplug the rail pressure sensor connector from the socket.
2. Place the key switch in the ON position, and measure the voltage between terminals (1) and (3) of the rail pressure sensor connector (at the wiring harness side).

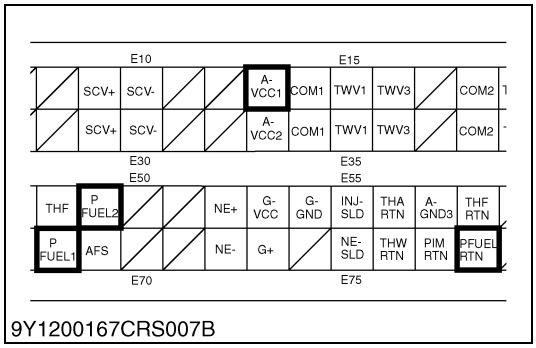
Factory specification	Approx. 5 V

OK	Check the wiring harness connector and sensor pins.	
	OK	Faulty rail pressure sensor → Replace.
	NG	1. Repair or replace the wiring harness. 2. Replace the rail assembly.
NG	Go to "5. Measure the ECU Terminal Voltage".	

(1) Terminal A-VCC1
(2) Terminal PFUEL
(3) Terminal PFUEL RTN

(a) Terminal Layout

9Y1200199CRS0885US0



9Y1200167CRS007B

5. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals E13 and E78.

Factory specification	Approx. 5 V

OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Check the wiring harness (between ECU terminal E13 and sensor terminal (1) and between ECU terminal E78 and sensor terminal (3)). → Repair the faulty area.	

9Y1200199CRS0886US0

(15) Injector Charge Voltage: High (DTC P0200 / 523535-0)

■ **NOTE**

- **This DTC is detected when the charge voltage in the injector actuation circuit is too high.**

Behaviour during malfunction:

- Insufficient output
- Worsening exhaust gas performance
- Engine stops

Detection item:

- Injector charge voltage: High

DTC set preconditions:

- Battery voltage is normal
- CPU is normal

DTC set parameter:

- Injector charge voltage: High

Engine warning light:

- ON

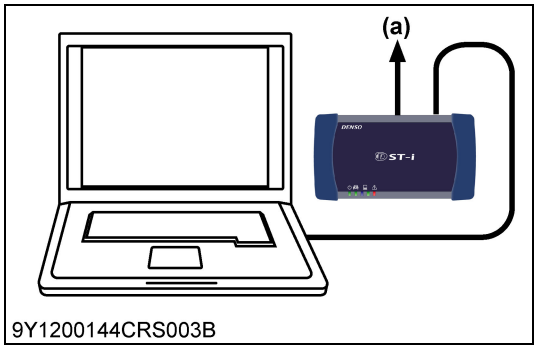
Limp home action by engine ECU (system action):

- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)
- Engine forcibly stopped 60 sec. later

Recovery from error:

- Key switch turn OFF

9Y1200199CRS0887US0



9Y1200144CRS003B

1. Checking Whether the DTC is Detected Again

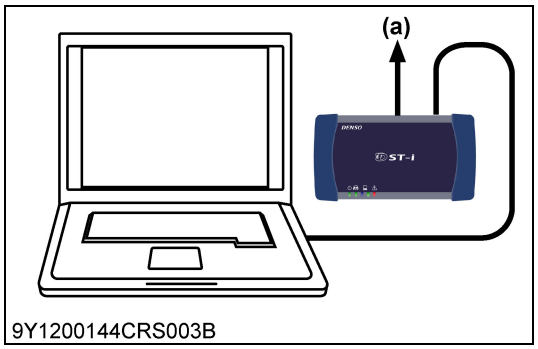
1. Turn the key switch OFF and then ON again.
2. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
3. Check whether or not the same DTC (P0200) is detected.

Factory specification	DTC is not detected.

OK	It could be a temporary malfunction caused by obstructions to the radio waves, so as long as it recovers to normal operation there is no problem.
NG	Go to "2. Replacing the Injector and Checking Whether the DTC Is Detected Again".

(a) CAN1 Connector

9Y1200199CRS0888US0



9Y1200144CRS003B

2. Replacing the Injector and Checking Whether the DTC Is Detected Again

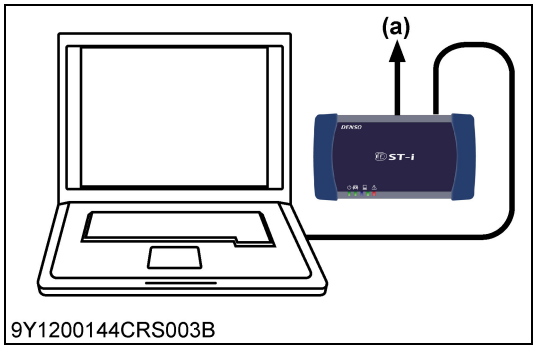
1. Replace the injector.
2. Turn the key switch OFF and then ON again.
3. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
4. Check whether or not the same DTC (P0200) is detected.

Factory specification	DTC is not detected.

OK	Injector fault → Replace the injector.
NG	Go to "3. Replacing the ECU and Checking Whether the DTC Is Detected Again".

(a) CAN1 Connector

9Y1200199CRS0889US0



9Y1200144CRS003B

3. Replacing the ECU and Checking Whether the DTC Is Detected Again

1. Replace the ECU.
2. Turn the key switch OFF and then ON again.
3. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
4. Check whether or not the same DTC (P0200) is detected.

Factory specification	DTC is not detected.

OK	ECU fault → Replace the ECU.

(a) CAN1 Connector

9Y1200199CRS0890US0

(16) Open Circuit of Harness/Coil (DTC P0201 / 651-3, P0202 / 653-3, P0203 / 654-3, P0204 / 652-3)

P0201 / 651-3: Engine No. 1 cylinder injector (TWV1) wiring harness open circuit, coil open circuit
P0202 / 653-3: Engine No. 3 cylinder injector (TWV2) wiring harness open circuit, coil open circuit
P0203 / 654-3: Engine No. 4 cylinder injector (TWV3) wiring harness open circuit, coil open circuit
P0204 / 652-3: Engine No. 2 cylinder injector (TWV4) wiring harness open circuit, coil open circuit

Behaviour during malfunction:
- Insufficient output
- Large vibration
- Worsening exhaust gas performance

Detection item:
- Open circuit of harness
- Open circuit of injector coil

DTC set preconditions:
- Engine is operating
- Battery voltage is normal
- During injection
- CPU is normal

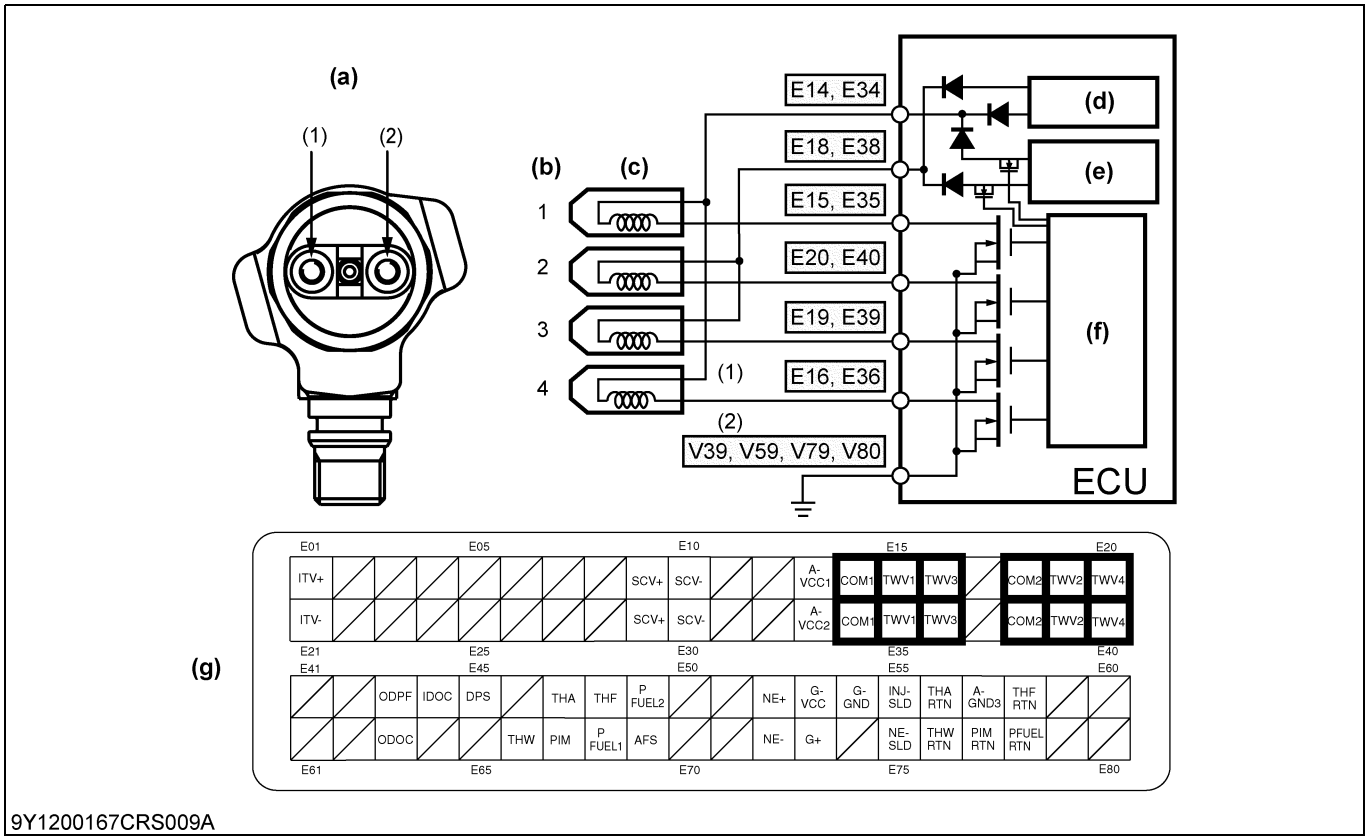
DTC set parameter:
- Open circuit of harness or open circuit of injector coil

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0891US0

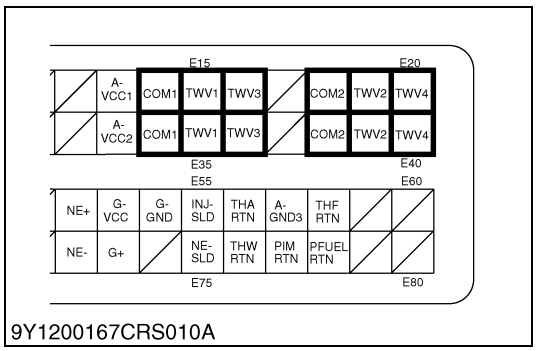


9Y1200167CRS009A

(1) Terminal COMMON
(2) Terminal TWV

(a) Terminal Layout
(b) Engine Cylinder No.
(c) Injectors
(d) Constant Amperage Circuit
(e) High Voltage Generation Circuit
(f) Control Circuit
(g) ECU Connector 1 (Engine Side)

9Y1200199CRS0892US0



9Y1200167CRS010A

1. Measure the Resistance Between ECU Terminals

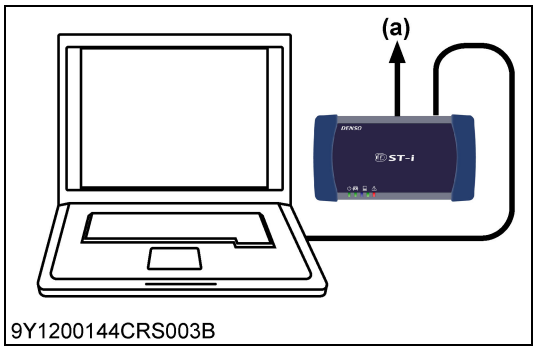
1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance each terminal of the connector.

Engine cylinder / TWV number	Measurement terminal
No. 1 cylinder / TWV1	E14, E34 ←→ E15, E35
No. 3 cylinder / TWV2	E18, E38 ←→ E19, E39
No. 4 cylinder / TWV3	E14, E34 ←→ E16, E36
No. 2 cylinder / TWV4	E18, E38 ←→ E20, E40

Factory specification	1.5 Ω or lower

OK	Go to "2. Check the DTC".
NG	Go to "4. Measure the Resistance Between Injector Terminals".

9Y1200199CRS0893US0



9Y1200144CRS003B

2. Check the DTC

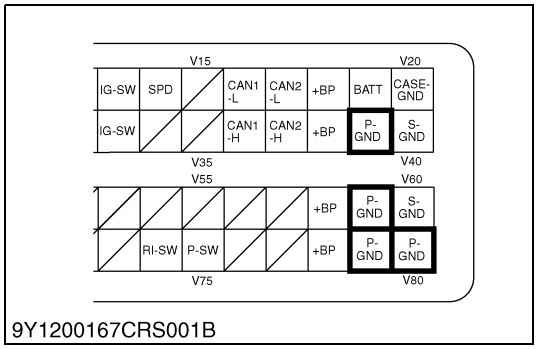
1. Plug the ECU connector into socket, and start the engine.
2. Clear the DTCs that occurred previously, and check the currently existing trouble.

Factory specification	No DTC is output.

OK	Go to "3. Check the Connector and Wiring Harnesses for Poor Contact".
NG	Faulty ECU → Replace.

(a) CAN1 Connector

9Y1200199CRS0894US0



9Y1200167CRS001B

3. Check the Connector and Wiring Harnesses for Poor Contact

1. Set the key switch to the OFF position, and check the wiring harness connectors and ECU pins for incorrect connection, deformation, poor contact or other defects.

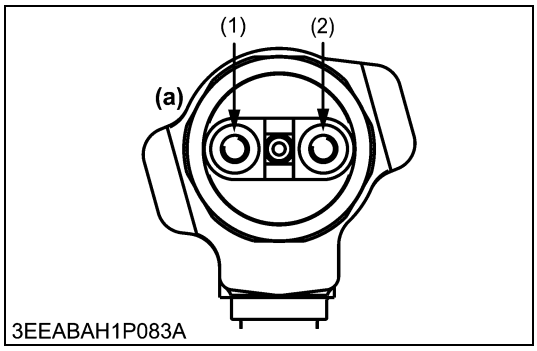
Factory specification	Must be free from faulty connection, deformation, poor contact or other defects.

■ **NOTE**

- **Intermediate connector and wiring harness in head cover should be checked, they are possible cause.**

OK	Check the wiring harness and connector of P- GND terminal (ECU terminals V39, V59, V79 and V80). → Repair.
NG	Check the injector wiring harnesses and connectors. → Repair.

9Y1200199CRS0895US0



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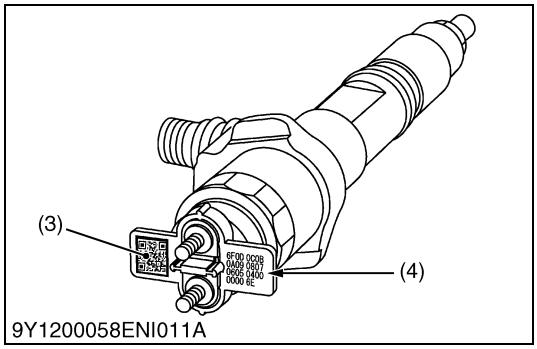
4. Measure the Resistance Between Injector Terminals

1. Unplug the injector cable connector of the cylinder indicated by the DTC, and measure the resistance between injector terminals (1) and (2).

Factory specification	0.35 to 0.55 Ω

OK	Check the wiring harnesses and connectors for a poor contact. → Repair.
NG	Faulty injector → Replace (Using the diagnosis tool, write the ID (QR) code of replaced injector in the ECU.)



9Y1200058ENI011A

(1) Terminal COMMON
(2) Terminal TWV
(3) QR Code
(4) ID Code

(a) Injector

9Y1200199CRS0896US0

(17) Engine Overheat (DTC P0217 / 110-0)

Behaviour during malfunction:
- Insufficient output
- Overheat

Detection item:
- Overheat of engine coolant temperature

DTC set preconditions:
- Coolant temperature sensor is normal

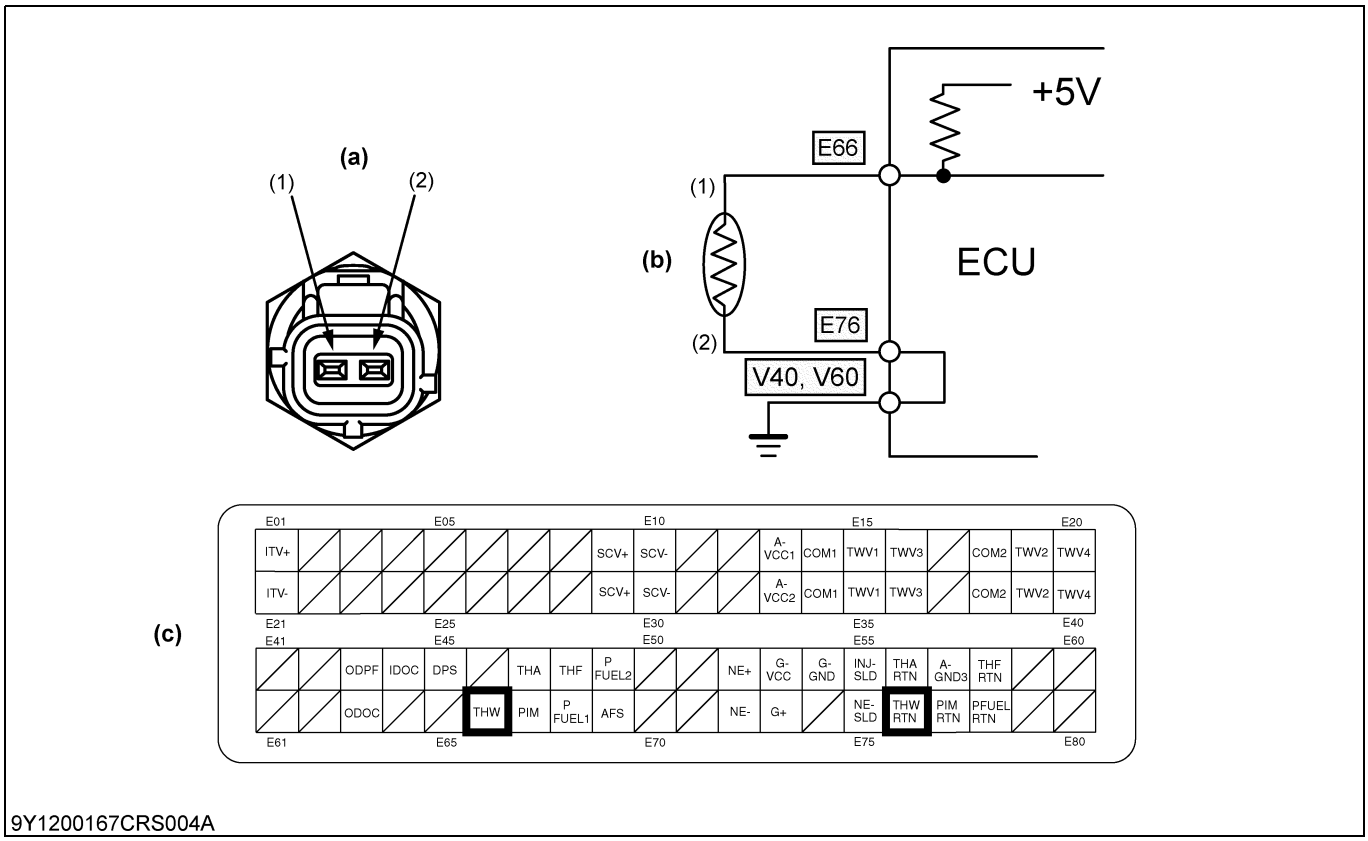
DTC set parameter:
- Engine coolant temperature ≥ 120 °C (248 °F)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Diagnostic counter = zero

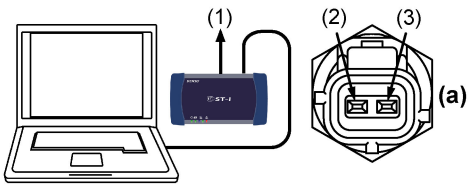
9Y1200199CRS0897US0



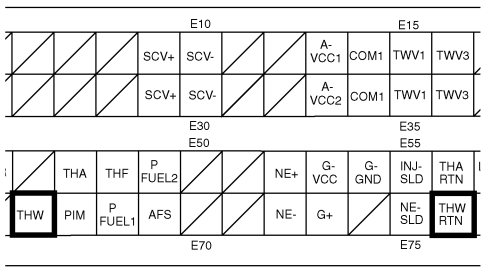
9Y1200167CRS004A

(1) Terminal THW
(2) Terminal THW RTN
(a) Terminal Layout
(b) Coolant Temperature Sensor
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0898US0



9Y1200144CRS006A



9Y1200167CRS005A

1. Check the Coolant Temperature Sensor Characteristics for An Error

1. Refer to DTC P0117, P0118, and check the ECU, wiring harness and sensor for an error.

OK	Check the cooling system. → Repair the faulty area. If the cooling system is operating normally, ask the user about malfunction occurrence based on the freeze-frame data to determine whether or not the system was used improperly.
NG	Check and repair or replace the faulty parts.

(1) CAN1 Connector
(2) Terminal THW
(3) Terminal THW RTN

(a) Terminal Layout

9Y1200199CRS0899US0

(18) Engine Overrun (DTC P0219 / 190-0)

Behaviour during malfunction:
- Overrun

Detection item:
- Engine speed exceeds threshold speed

DTC set preconditions:
- Key switch is ON

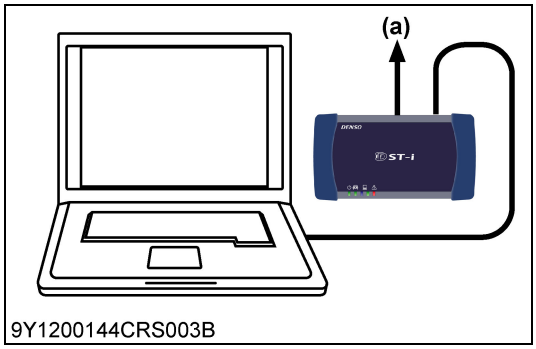
DTC set parameter:
- Engine speed ≥ 3500 min^{-1} (rpm)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Stop injection (Q = 0 mm^3/st)

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0900US0



9Y1200144CRS003B

1. Checking Whether the DTC Is Detected Again

1. Turn the key switch OFF and then ON again.
2. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
3. Check whether or not the same DTC (P0219) is detected.

Factory specification	DTC is not detected.

OK	Go to "2. Checking with the User".
NG	It could be a temporary malfunction caused by obstructions to the radio waves, so as long as it recovers to normal operation there is no problem.

(a) CAN1 Connector

9Y1200199CRS0901US0

2. Checking with the User

1. The following actions may have caused the overrun.
   - Towing heavy objects
   - Drag phenomenon when driving downhill
   - Mistaken operation when making a sudden shift change

   Question the user in detail about the items above and give guidance.

9Y1200199CRS0902US0

(19) Boost Pressure Sensor Abnormality (DTC P0237 / 102-4, P0238 / 102-3)

P0237 / 102-4: Boost temperature sensor abnormality (Low side)

Behaviour during malfunction:
- Insufficient output

Detection item:
- Ground short circuit of sensor / harness
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal

DTC set parameter:
- Voltage of boost pressure sensor is 0.2 V or below

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 65 kPa (0.66 kgf/cm^2, 9.4 psi) [default value]

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0903US0

P0238 / 102-3: Boost temperature sensor abnormality (High side)

Behaviour during malfunction:
- Insufficient output

Detection item:
- Open circuit or +B short circuit of sensor / harness
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal

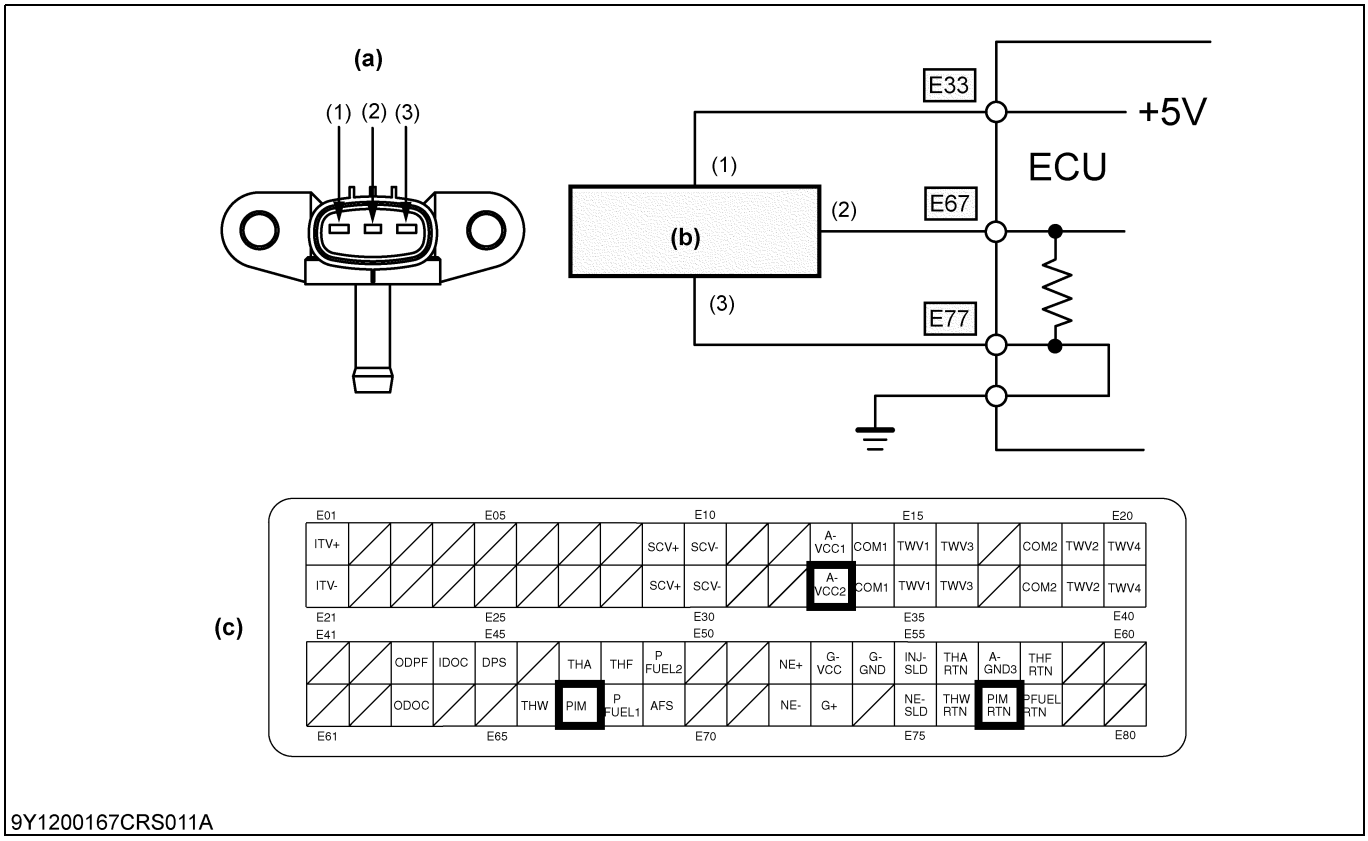
DTC set parameter:
- Voltage of boost pressure sensor is 4.9 V or above

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 65 kPa (0.66 kgf/cm^2, 9.4 psi) [default value]

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0904US0

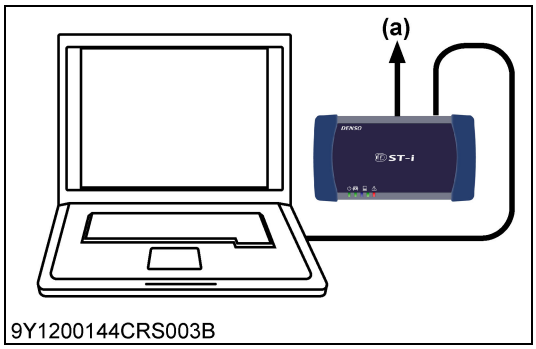


9Y1200167CRS011A

(1) Terminal A-VCC2
(2) Terminal PIM
(3) Terminal PIM RTN

(a) Terminal Layout
(b) Boost Pressure Sensor
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0905US0



9Y1200144CRS003B

1. Check the Boost Pressure Signals

1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again. Then, check the "Boost pressure" and "Boost pressure sensor output voltage" on the diagnosis tool data monitor.
2. Next, start the engine, change the depressed amount of the accelerator pedal, and check the same items again.

Factory specification		
Engine state	Actual boost pressure	Output voltage
Key switch is ON	Approx. 100 kPa (1.02 kgf/cm^2, 14.5 psi)	Approx. 1.0 V
After engine start-up	100 to 180 kPa (1.02 to 1.83 kgf/cm^2, 14.5 to 26.1 psi)	1.0 to 2.2 V

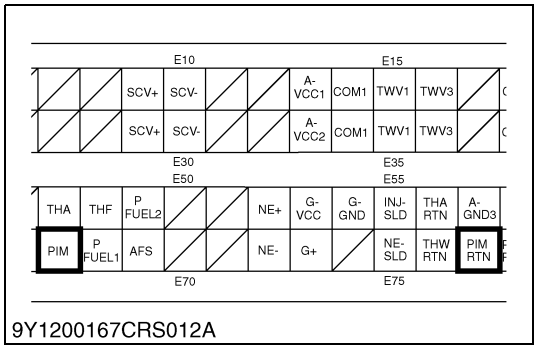
■ **NOTE**

- **Reference value (Factory specification) has complete linearity.**

OK	Clear the DTC and check whether it is output again or not. ▼	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the ECU Terminal Voltage".	

(a) CAN1 Connector

9Y1200199CRS0906US0



9Y1200167CRS012A

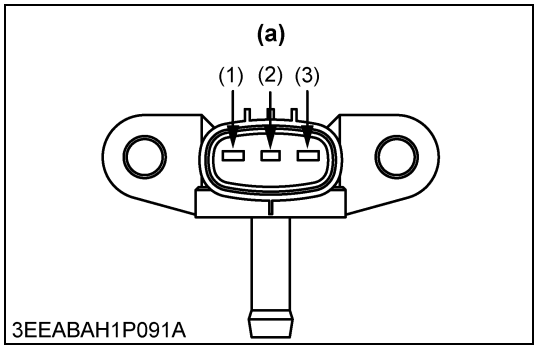
2. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals E67 and E77.
2. Next, start the engine, change the depressed amount of the accelerator pedal, and check the same items again.

Factory specification	
Engine state	Output voltage
Key switch ON	Approx. 1.0 V
After engine start-up	1.0 to 2.2 V

OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Go to "3. Measure the Voltage Between Boost Pressure Sensor Terminals".	

9Y1200199CRS0907US0



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3. Measure the Voltage Between Boost Pressure Sensor Terminals

1. Place the key switch in the ON position, and measure the voltage between terminals (2) and (3) of the boost pressure sensor at the wiring harness side.
2. Next, start the engine, change the depressed amount of the accelerator pedal, and check the same items again.

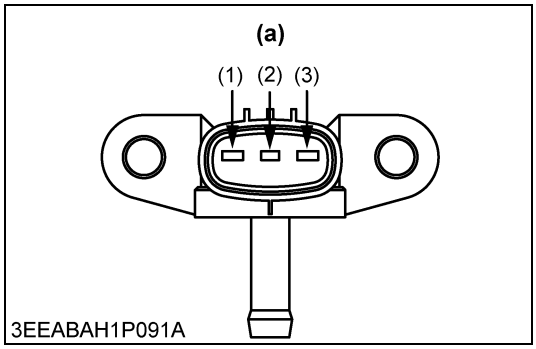
Factory specification	
Engine state	Output voltage
Key switch ON	Approx. 1.0 V
After engine start-up	1.0 to 2.2 V

OK	Check the wiring harness (between ECU terminal E67 and sensor terminal (2)). → Repair the faulty area.
NG	Go to "4. Measure the Voltage Between Boost Pressure Sensor Terminals".

(1) Terminal A-VCC2
(2) Terminal PIM
(3) Terminal PIM RTN

(a) Terminal Layout

9Y1200199CRS0908US0



4. Measure the Voltage Between Boost Pressure Sensor Terminals

1. Set the key switch to the OFF position, and unplug the boost pressure sensor connector from the socket.
2. Place the key switch in the ON position, and measure the voltage between terminals (1) and (3) of the boost pressure sensor connector (at the wiring harness side).

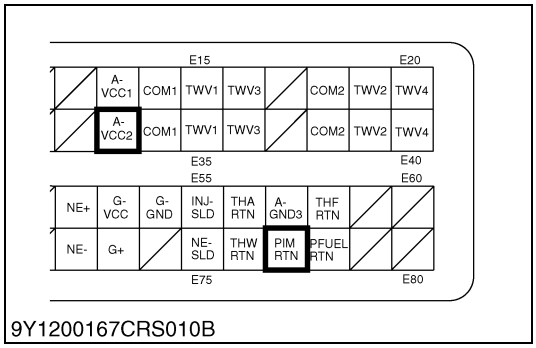
Factory specification	Approx. 5 V

OK	Check the wiring harness connector and sensor pins.	
	OK	Faulty boost pressure sensor → Replace.
	NG	1. Repair or replace the wiring harness. 2. Replace the boost pressure sensor.
NG	Go to "5. Measure the ECU Terminal Voltage".	

(1) Terminal A-VCC2
(2) Terminal PIM
(3) Terminal PIM RTN

(a) Terminal Layout

9Y1200199CRS0909US0



5. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals E33 and E77.

Factory specification	Approx. 5 V

OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Check the wiring harness (between ECU terminal E33 and sensor terminal (1) and between ECU terminal E77 and sensor terminal (3)). → Repair the faulty area.	

■ **NOTE**

- **Check the hose between intake manifold and sensor, When it is damaged, the boost pressure can not reach the sensor.**

9Y1200199CRS0910US0

(20) Crankshaft Position Sensor (NE Sensor) Abnormality (DTC P0335 / 636-8, P0336 / 636-2)

P0335 / 636-8: No input of NE sensor pulse

Behaviour during malfunction (Running only with G signal):
- Faulty starting
- Vibration is slightly large
- Insufficinet output

Detection item:
- Open circuit or short circuit of sensor / harness
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- Engine is not stalled

DTC set parameter:
- No recognition of Ne sensor pulse

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

■ **NOTE**
- **Engine will stop if both NE and G fail**

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0911US0

P0336 / 636-2: NE sensor pulse number error

Behaviour during malfunction (Running only with G signal):
- Faulty starting
- Vibration is slightly large
- Insufficinet output

Detection item:
- Open circuit or short circuit of sensor / harness
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- 350 min^{-1} (rpm) or higher

DTC set parameter:
- Pulse count per rotation is not 56 teeth

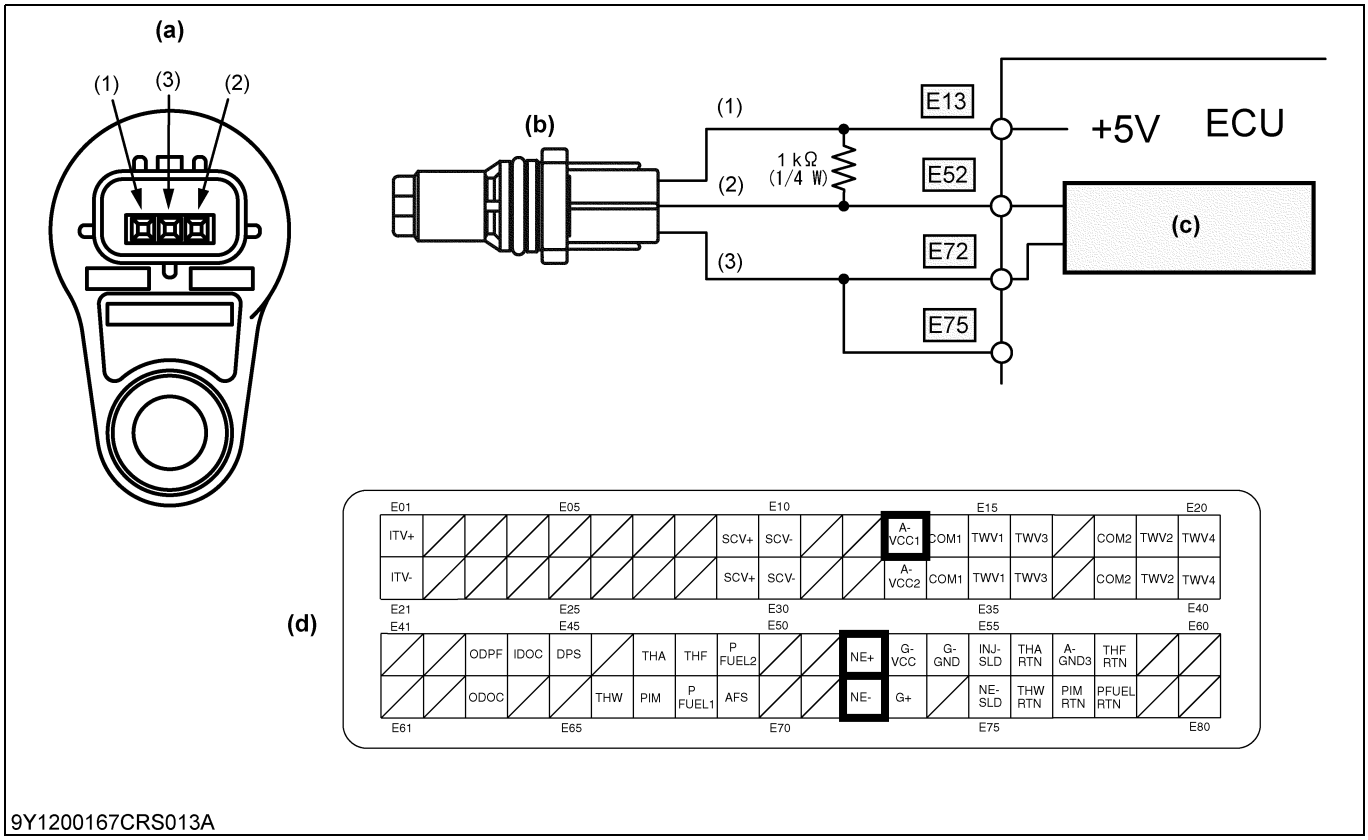
Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

■ **NOTE**
- **Engine will stop if both NE and G fail**

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0912US0

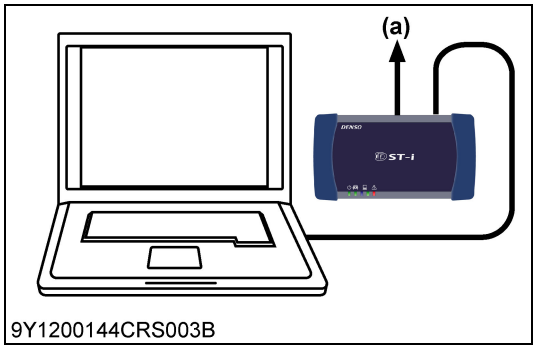


9Y1200167CRS013A

(1) Terminal A-VCC1
(2) Terminal NE+
(3) Terminal NE−

(a) Terminal Layout
(b) Crankshaft Position Sensor (NE Sensor)
(c) NE Sensor Input Circuit
(d) ECU Connector 1 (Engine Side)

9Y1200199CRS0913US0



9Y1200144CRS003B

1. Check the Crankshaft Position Sensor Signals

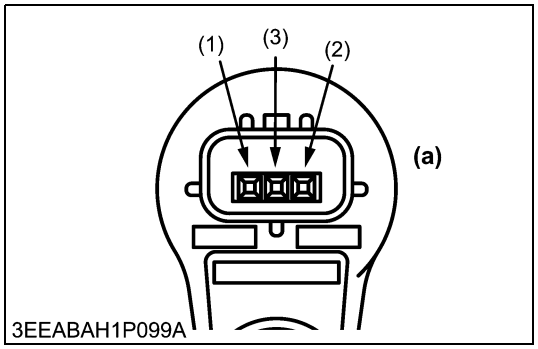
1. Rotate the engine, and check the "Engine speed active flag" value on the diagnosis tool data monitor.

Factory specification	Always ON

OK	It should be confirmed two or more times while changing the accelerator. ⬇	
	OK	Normal.
	NG	Go to "2. Check the Voltage Between Crankshaft Position Sensor Terminals".
NG	Go to "2. Check the Voltage Between Crankshaft Position Sensor Terminals".	

(a) CAN1 Connector

9Y1200199CRS0914US0



2. Check the Voltage Between Crankshaft Position Sensor Terminals

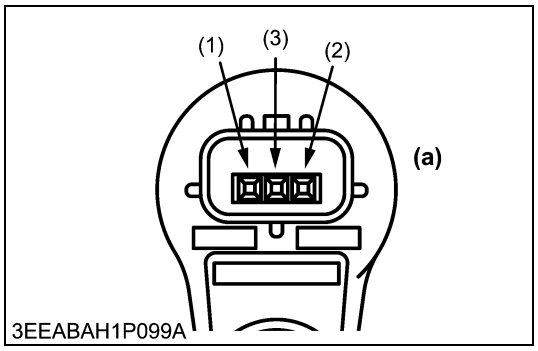
1. Place the key switch in the OFF position, and unplug the crankshaft position sensor connector from the socket.
2. Place the key switch in the ON position, and measure the voltage between A-VCC1 terminal and NE− terminal at the wiring harness side.

Factory specification	Approx. 5 V

OK	Go to "3. Check the Connectors".
NG	Go to "5. Measure the ECU Terminal Voltage".

(1) Terminal A-VCC1
(2) Terminal NE+
(3) Terminal NE−
(a) Terminal Layout

9Y1200199CRS0915US0



3. Check the Connectors

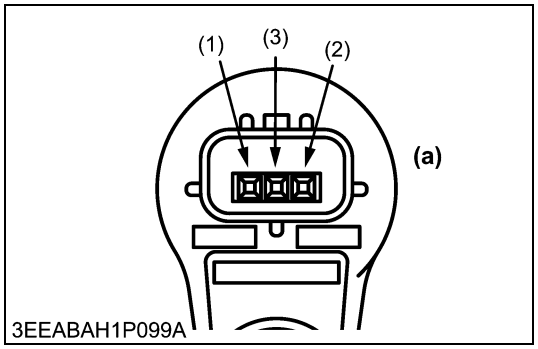
1. Check the sensor and wiring harness connectors for incorrect connection, inappropriate fitting, poor contact or other faulty areas.

Factory specification	Must be free from incorrect connection, inappropriate fitting, poor contact.

OK	Go to "4. Check the Wiring Harness".
NG	Repair or replace.

(1) Terminal A-VCC1
(2) Terminal NE+
(3) Terminal NE−
(a) Terminal Layout

9Y1200199CRS0916US0



4. Check the Wiring Harness

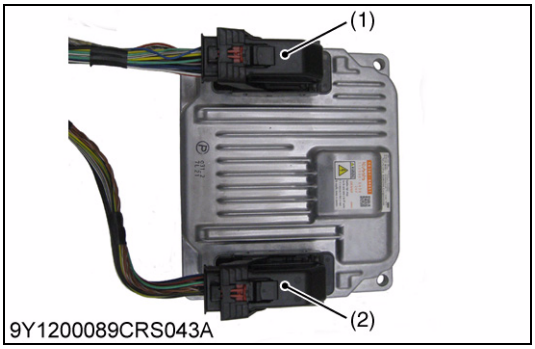
1. Check the wiring harness between NE+ terminal of sensor and ECU for a short or an open circuit.

Factory specification	Must be free from shorts and open circuit.

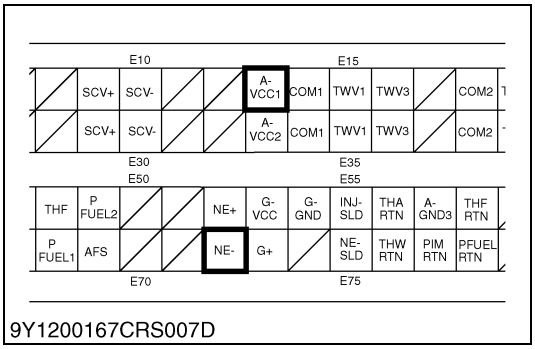
OK	The sensor has abnormality. → Replace.
NG	Repair.

(1) Terminal A-VCC1
(2) Terminal NE+
(3) Terminal NE−
(a) Terminal Layout

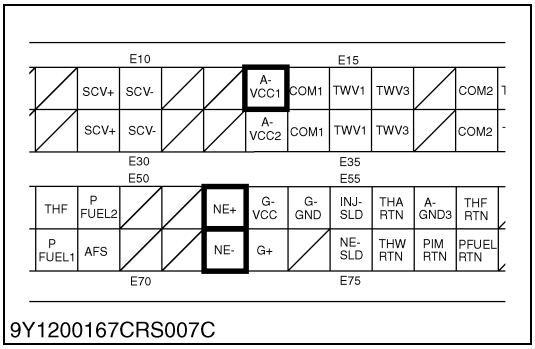
9Y1200199CRS0917US0



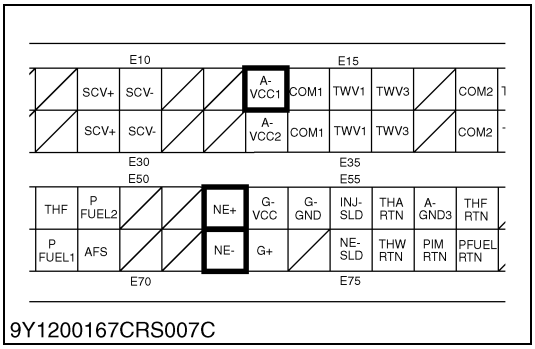
9Y1200089CRS043A



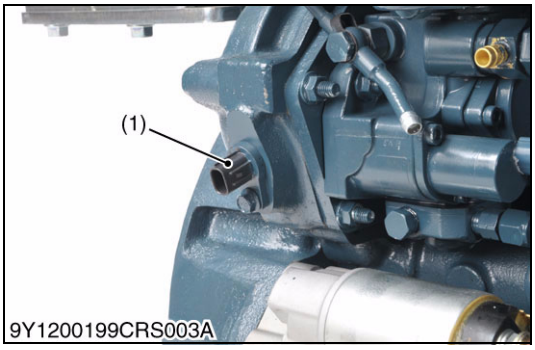
9Y1200167CRS007D



9Y1200167CRS007C



9Y1200167CRS007C



9Y1200199CRS003A

5. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector 1 (1) from the socket.
2. Place the key switch in the ON position, and measure the voltage between ECU terminals E13 and E72.

Factory specification	Approx. 5 V

OK	Go to "6. Check the connectors".
NG	Replace the ECU.

(1) ECU Wiring Harness Connector 1 (Engine Side)
(2) ECU Wiring Harness Connector 2 (Machine Side)

9Y1200199CRS0918US0

6. Check the Connectors

1. Check ECU terminals E13, E52 and E72 (at the ECU side) and the connectors (at the wiring harness side) for incorrect connection, inappropriate fitting, poor contact.

Factory specification	Must be free from incorrect connection, inappropriate fitting, poor contact.

OK	Go to "7. Check the wiring harness".
NG	Repair or replace.

9Y1200199CRS0919US0

7. Check the Wiring Harness

1. Check the wiring harness being connected to ECU terminals E13, E52 and E72 for a short or an open circuit.

Factory specification	Must be free from shorts and open circuit.

OK	Go to "8. Check the Sensor".
NG	Repair.

9Y1200199CRS0920US0

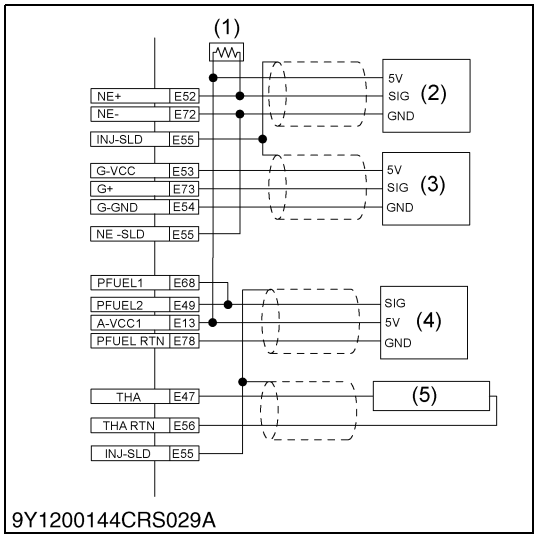
8. Check the Crankshaft Position Sensor

1. Disconnect the sensor and check the following items.
   - Is there a large amount of magnetic foreign material adhering to the sensor surface?
   - Are there interference marks of the pulsar and the sensor?
   - Are there any pulsar gear abnormalities?

OK	Replace the ECU and test.
NG	Repair or replace the sensor.

(1) Crankshaft Position Sensor (NE Sensor)

9Y1200199CRS0921US0



9Y1200144CRS029A

9. Check NE sensor pull-up resister

1. Remove the pull-up resister (1 kΩ) which is connected to harness, then check next item.
   - Check if there is improper connection of 1 kΩ resistive element and connector.
   - Check if there is damage of 1 kΩ resistive element. (measure the resistance of resistive element with tester.)

OK	Replace the ECU and test.
NG	Replace 1 kΩ resistive element, or improve improper connection.

(1) Resister 1 kΩ 1/4 W
(2) Crankshaft Position Sensor
(3) Camshaft Position Sensor
(4) Rail Pressure Sensor
(5) Intake Air Temperature Sensor

9Y1200199CRS0922US0

(21) Camshaft Position Sensor (G Sensor) Abnormality (DTC P0340 / 723-8, P0341 / 723-2)

P0340 / 723-8: No input of G sensor pulse
Behaviour during malfunction (Invalid G signal):
- Engine hesitates at start-up

Detection item:
- Open circuit or short circuit of sensor / harness
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- Engine is not stalled

DTC set parameter:
- No recognition of G sensor pulse

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

■ **NOTE**
- **Engine will stop if both NE and G fail**

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0923US0

P0341 / 723-2: G sensor pulse number error
Behaviour during malfunction (Invalid G signal):
- Engine hesitates at start-up

Detection item:
- Open circuit or short circuit of sensor / harness
- Failure of sensor

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- Engine speed is 350 min^{-1} (rpm) or higher

DTC set parameter:
- Pulse count per rotation is not 5 teeth

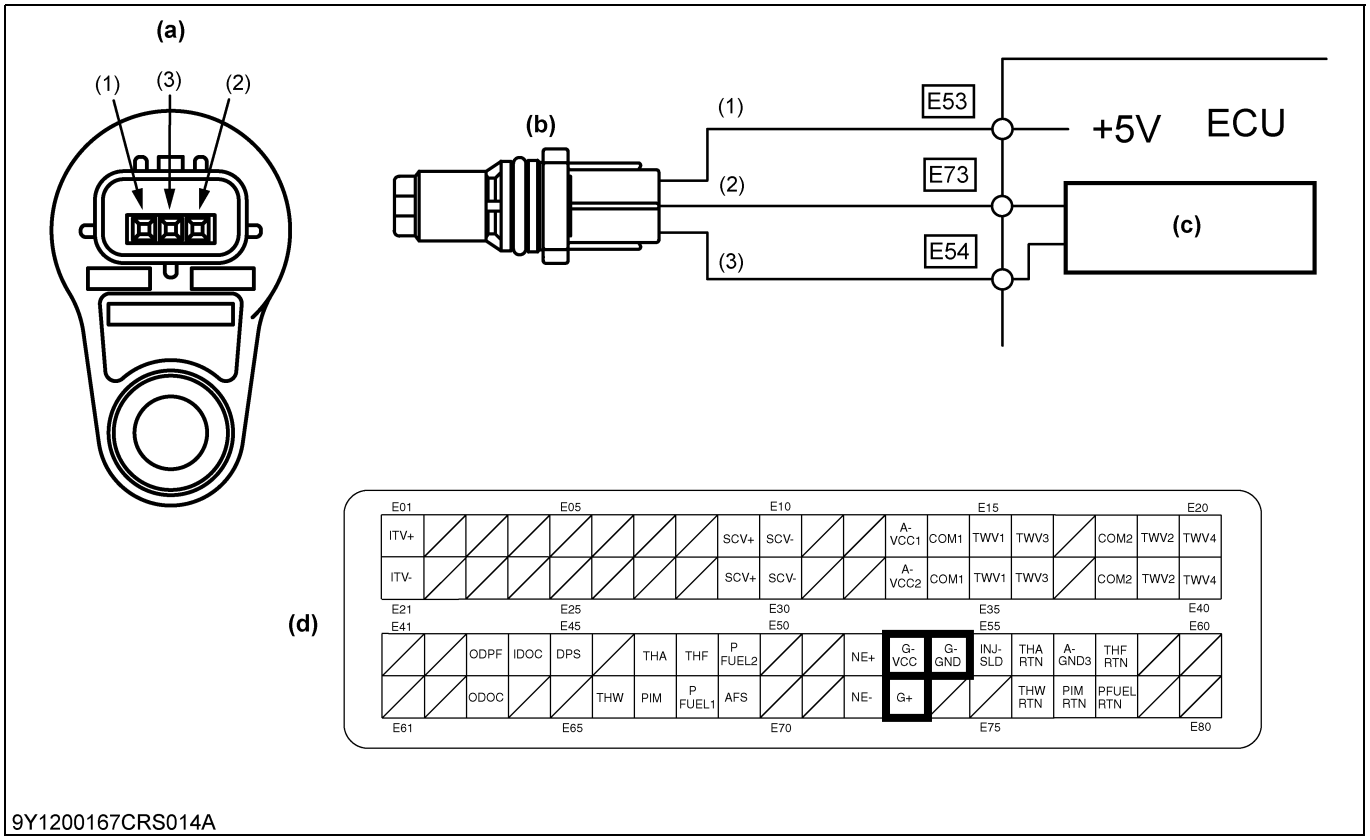
Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

■ **NOTE**
- **Engine will stop if both NE and G fail**

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0924US0

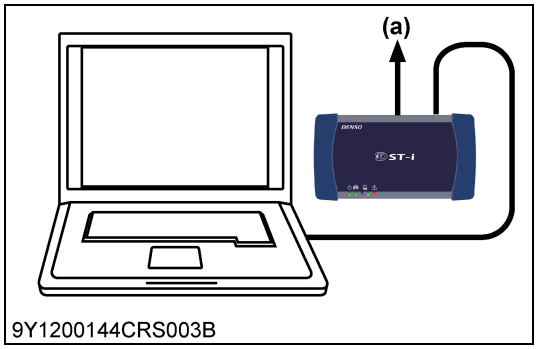


9Y1200167CRS014A

(1) Terminal G-VCC
(2) Terminal G+
(3) Terminal G-GND

(a) Terminal Layout
(b) Camshaft Position Sensor (G Sensor)
(c) G Sensor Input Circuit
(d) ECU Connector 1 (Engine Side)

9Y1200199CRS0925US0



9Y1200144CRS003B

1. Check the Camshaft Position Sensor Signals

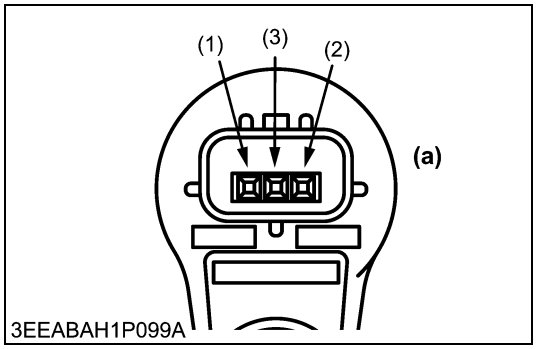
1. Rotate the engine, and check the "Cam speed active flag" value on the diagnosis tool data monitor.

Factory specification	Always ON

OK	It should be confirmed two or more times while changing the accelerator.	
	OK	Normal.
	NG	Go to "2. Check the Voltage Between Camshaft Position Sensor Terminals".
NG	Go to "2. Check the Voltage Between Camshaft Position Sensor Terminals".	

(a) CAN1 Connector

9Y1200199CRS0926US0



2. Check the Voltage Between Camshaft Position Sensor Terminals

1. Place the key switch in the OFF position, and unplug the camshaft position sensor connector from the socket.
2. Place the key switch in the ON position, and measure the voltage between G-VCC and G-GND terminals at the wiring harness side.

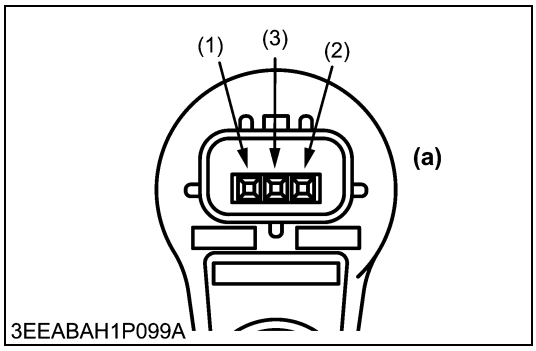
Factory specification	Approx. 5 V

OK	Go to "3. Check the Connectors".
NG	Go to "5. Measure the ECU Terminal Voltage".

(1) Terminal G-VCC
(2) Terminal G+
(3) Terminal G-GND

(a) Terminal Layout

9Y1200199CRS0927US0



3. Check the Connectors

1. Check the sensor and wiring harness connectors for incorrect connection, inappropriate fitting, poor contact or other faulty areas.

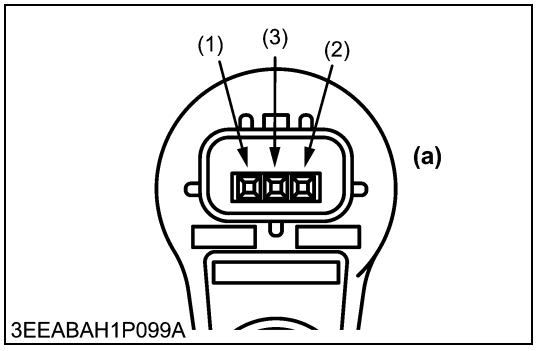
Factory specification	Must be free from incorrect connection, inappropriate fitting, poor contact.

OK	Go to "4. Check the Wiring Harness".
NG	Repair or replace.

(1) Terminal G-VCC
(2) Terminal G+
(3) Terminal G-GND

(a) Terminal Layout

9Y1200199CRS0928US0



4. Check the Wiring Harness

1. Check the wiring harness between G+ terminal of sensor and ECU for a short or an open circuit.

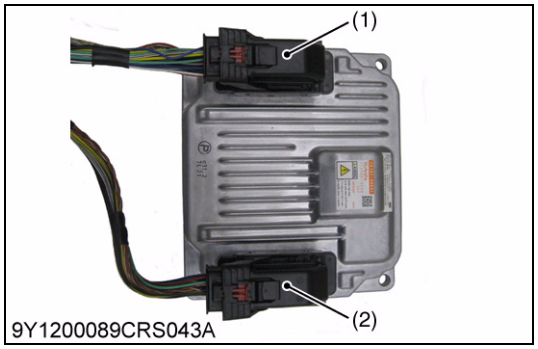
Factory specification	Must be free from shorts and open circuit.

OK	The sensor has abnormality. → Replace.
NG	Repair.

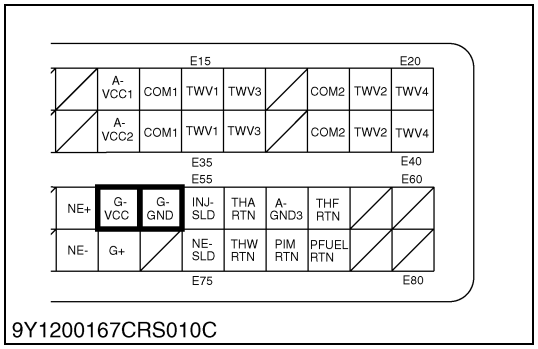
(1) Terminal G-VCC
(2) Terminal G+
(3) Terminal G-GND

(a) Terminal Layout

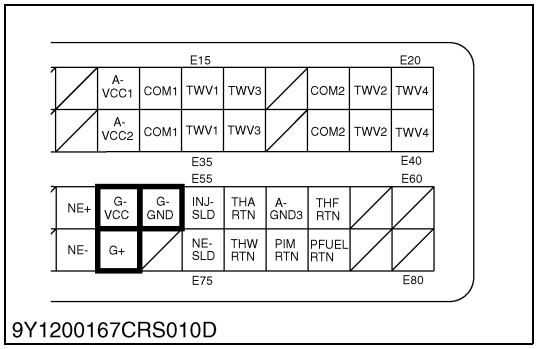
9Y1200199CRS0929US0



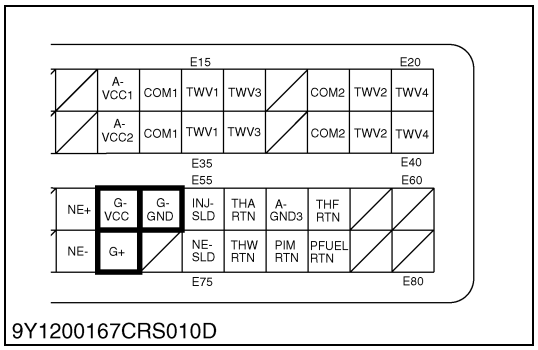
9Y1200089CRS043A



9Y1200167CRS010C



9Y1200167CRS010D



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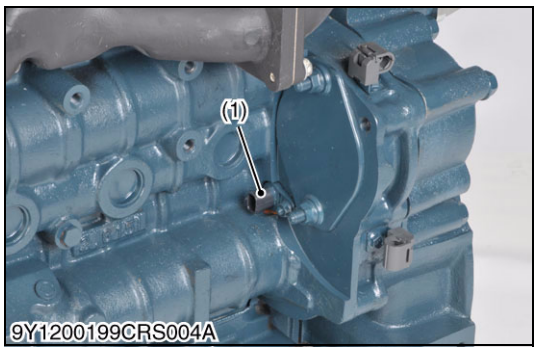


9Y1200199CRS004A

5. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector 1 (1) from the socket.
2. Place the key switch in the ON position, and measure the voltage between ECU terminals E53 and E54.

Factory specification	Approx. 5 V

OK	Go to "6. Check the Connectors".
NG	Replace the ECU.

(1) ECU Wiring Harness Connector 1 (Engine Side)
(1) ECU Wiring Harness Connector 2 (Machine Side)

9Y1200199CRS0930US0

6. Check the Connectors

1. Check ECU terminals E53, E73 and, E54 (at the ECU side) and the connectors (at the wiring harness side) for incorrect connection, inappropriate fitting, poor contact.

Factory specification	Must be free from incorrect connection, inappropriate fitting, poor contact.

OK	Go to "7. Check the Wiring Harness".
NG	Repair or replace.

9Y1200199CRS0931US0

7. Check the Wiring Harness

1. Check the wiring harness being connected to ECU terminals E53, E73 and E54 for a short or an open circuit.

Factory specification	Must be free from shorts and open circuit.

OK	Go to "8. Check the Sensor".
NG	Repair.

9Y1200199CRS0932US0

8. Check the Camshaft Position Sensor

1. Disconnect the sensor and check the following items.
   - Is there a large amount of magnetic foreign material adhering to the sensor surface?
   - Are there interference marks of the pulsar and the sensor?
   - Are there any pulsar gear abnormalities?

OK	Replace the ECU and test.
NG	Repair or replace the sensor.

(1) Camshaft Position Sensor (G Sensor)

9Y1200199CRS0933US0

(22) Air Heater Relay Driving Circuit Abnormality (DTC P0380 / 523544-3 / 523544-4)

■ **NOTE**
- **This item is a check related to the air heater (pre) relay control. Even if it is normal, air heating may not work. If this happens, look for the malfunction in accordance with the following procedure.**

P0380 / 523544-3: +B short of air heater relay driving circuit
Behaviour during malfunction (At low temperature):
- Faulty starting
- Increase in white smoke

Detection item:
- +B short of air heater relay driving circuit

DTC set preconditions:
- Battery voltage is normal
- During air heater relay drive command is activated

DTC set parameter:
- +B short circuit of harness

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0934US0

P0380 / 523544-4: Ground short of air heater relay driving circuit
Behaviour during malfunction (At low temperature):
- Faulty starting
- Increase in white smoke

Detection item:
- Ground short or open circuit of air heater relay driving circuit

DTC set preconditions:
- Battery voltage is normal
- Other than during air heater relay drive command is activated

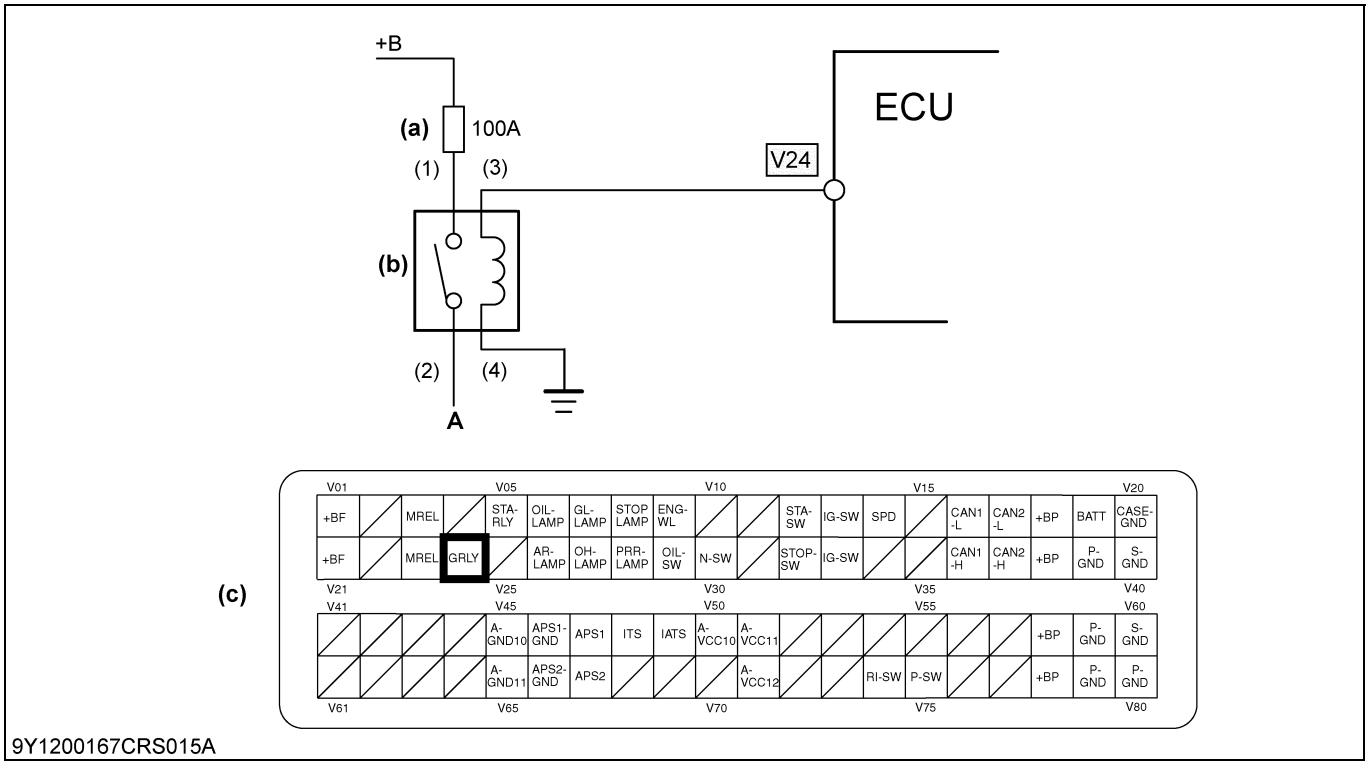
DTC set parameter:
- Open circuit of harness, Ground short circuit

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0935US0



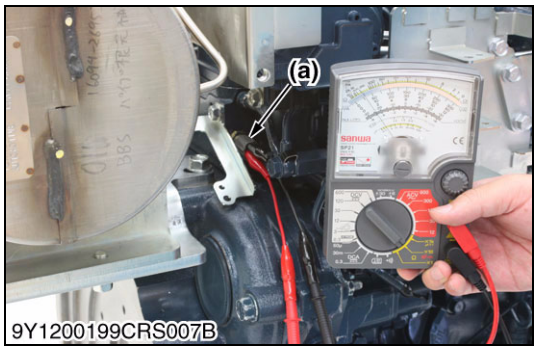
9Y1200167CRS015A

(1) Terminal +B
(2) Terminal MAHR
(3) Terminal GRLY
(4) Terminal GND

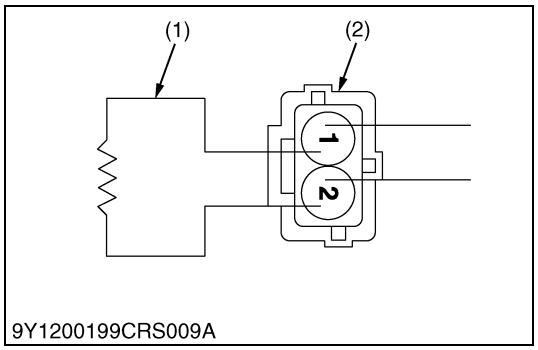
(a) Fuse
(b) Air heater relay
(c) ECU Connector 2 (Machine Side)

A: To Main Air Heater Relay

9Y1200199CRS0936US0



9Y1200199CRS007B



9Y1200199CRS009A

1. Check the GLRY Signal

1. Run the engine until the coolant temperature is 10 °C (50 °F) or higher.
2. Check the "Glow relay" data with the data monitor.

Factory specification	OFF

3. After disconnecting the connector (2) of coolant temperature sensor and connect the dummy resistor (1) as shown in the left figure, and turn the key switch ON.
   Dummy Resistor: 15 to 25 kΩ [Comparable to Approx. –30 to –20 °C (Approx. –22 to –5 °F)]
4. Check the "Glow relay" data with the data monitor.

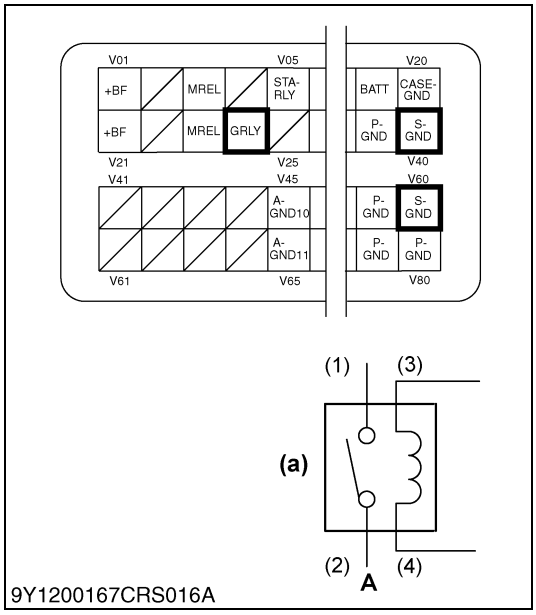
Factory specification	ON

OK	Normal.
NG	Go to "2. Check the Wiring Harness / Connector".

(1) Dummy Resistor
(2) Connector

(a) Coolant Temperature Sensor

9Y1200199CRS0937US0



2. Check the Wiring Harness / Connector

1. Remove the connector from the ECU side and check the state of the continuity between terminal V24 and (3).
2. Next, check the state of the continuity between terminal V40 / V60 and (4).

Factory specification	Both have continuity

3. Check the connector for poor connection, engagement and contact.

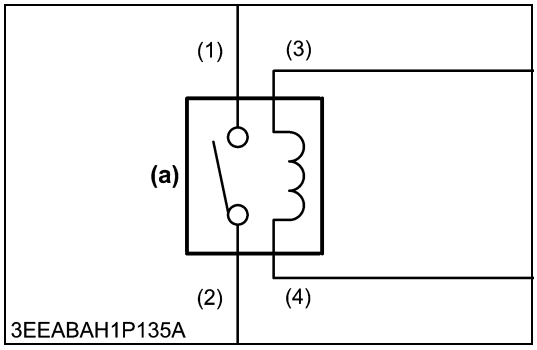
Factory specification	No poor connection, engagement or contact.

OK	Go to "3. Check the Relay".
NG	Repair or replace the faulty areas.

(1) Terminal +B
(2) Terminal MAHR
(3) Terminal GRLY
(4) Terminal GND

(a) Air Heater Relay
A: To Main Air Heater Relay

9Y1200199CRS0938US0



3. Check the Relay

1. After disconnecting the connector of coolant temperature sensor and connect the dummy resistor (5) as shown in the left figure, and turn the key switch ON.
   Dummy Resistor: 15 to 25 kΩ [Comparable to Approx. −30 to −20 °C (Approx. −22 to −5 °F)]
2. Measure the voltage between (3) and (4).

Factory specification	When relay is ON: Battery voltage value When relay is OFF: Approx. 0 V

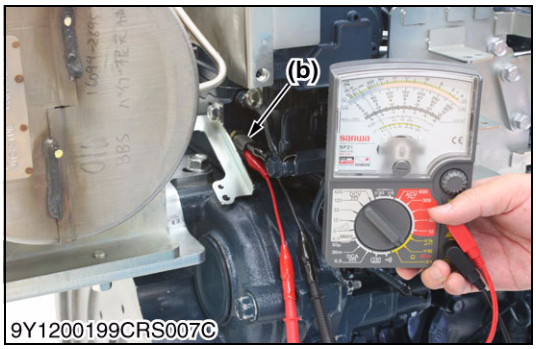
3. Check the state of the continuity between (1) and (2).

Factory specification	When relay is ON: Continuity When relay is OFF: No continuity

4. Measure the resistance in the relay unit (between (3) and (4)).

Factory specification	Coil resistance value of relay to use

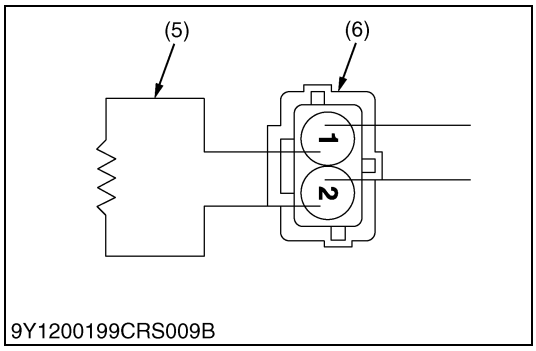
OK	Go to "4. ECU replacement check".
NG	Relay fault → Replace.

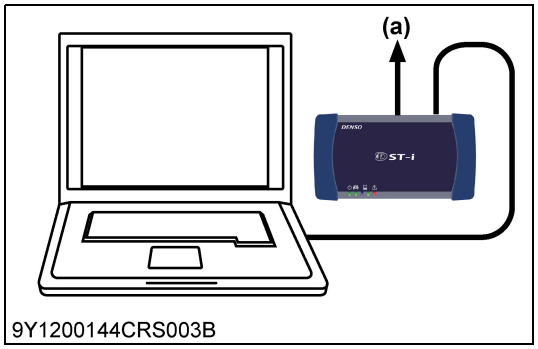


(1) Terminal +B
(2) Terminal MAHR
(3) Terminal GRLY
(4) Terminal GND
(5) Dummy Resistor
(6) Connector

(a) Air Heater Relay
(b) Coolant Temperature Sensor

9Y1200199CRS0939US0





9Y1200144CRS003B

4. ECU Replacement Check

1. Replace the ECU and perform the previous "Check the GLRY signal".

OK	ECU fault → Replace the ECU.

(a) CAN1 Connector

9Y1200199CRS0940US0

(23) EGR Actuator Abnormality (DTC P0403 / 523574-3, DTC P0404 / 523574-4, P0409 / 523572-4)

P0403 / 523574-3: EGR actuator open circuit

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- EGR actuator open circuit

DTC set preconditions:
- Battery voltage is normal
- No DTC of U0077 "CAN1 Bus off"
- EGR control line is normal

DTC set parameter:
- EGR actuator open error signal received via CAN

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0941US0

P0404 / 523574-4: EGR actuator coil short

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- EGR actuator coil short

DTC set preconditions:
- Battery voltage is normal
- No DTC of U0077 "CAN1 Bus off"
- EGR control line is normal

DTC set parameter:
- EGR actuator coil short error signal received via CAN

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0942US0

P0409 / 523572-4: EGR position sensor failure

Behaviour during malfunction:

- Insufficient output
- Worsening exhaust gas performance

Detection item:

- EGR position sensor failure

DTC set preconditions:

- Battery voltage is normal
- No DTC of U0077 "CAN1 Bus off"
- EGR control line is normal

DTC set parameter:

- EGR position sensor error signal received via CAN

Engine warning light:

- ON

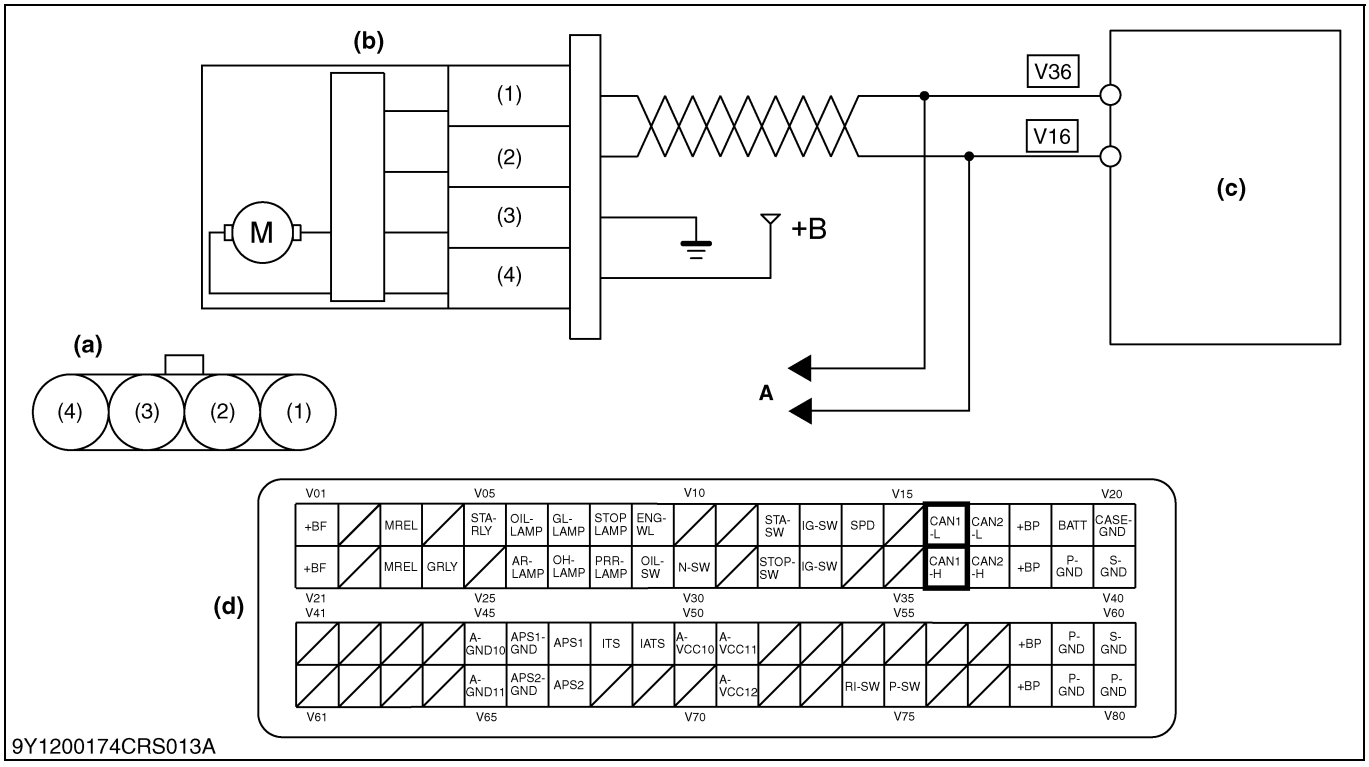
Limp home action by engine ECU (system action):

- Output limitation: Approximately 75 % of normal condition
- EGR stop

Recovery from error:

- Key switch turn OFF

9Y1200199CRS0943US0

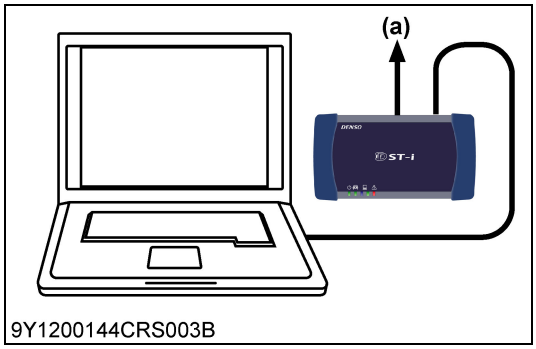


9Y1200174CRS013A

(1) Terminal CAN-H
(2) Terminal CAN-L
(3) Terminal Ground
(4) Terminal Power (+12 V)

(a) Terminal Layout
(b) EGR Valve Assembly
(c) Engine ECU
(d) ECU Connector 2 (Machine Side)
A: To Diagnosis Tool

9Y1200199CRS0944US0



9Y1200144CRS003B

1. DTC Judgment

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Place the key switch in the ON position, check whether the DTC is output or not.
3. Check the DTC again after starting up the engine with the coolant temperature over 65 °C (149 °F).

Factory specification	DTC must not be output.

OK	Normal.
NG	Replace the EGR assembly.

(a) CAN1 Connector

9Y1200199CRS0945US0

(24) Oil Pressure Error (P0524 / 100-1)

Behaviour during malfunction:
- Engine stops

Detection item:
- Oil pressure switch

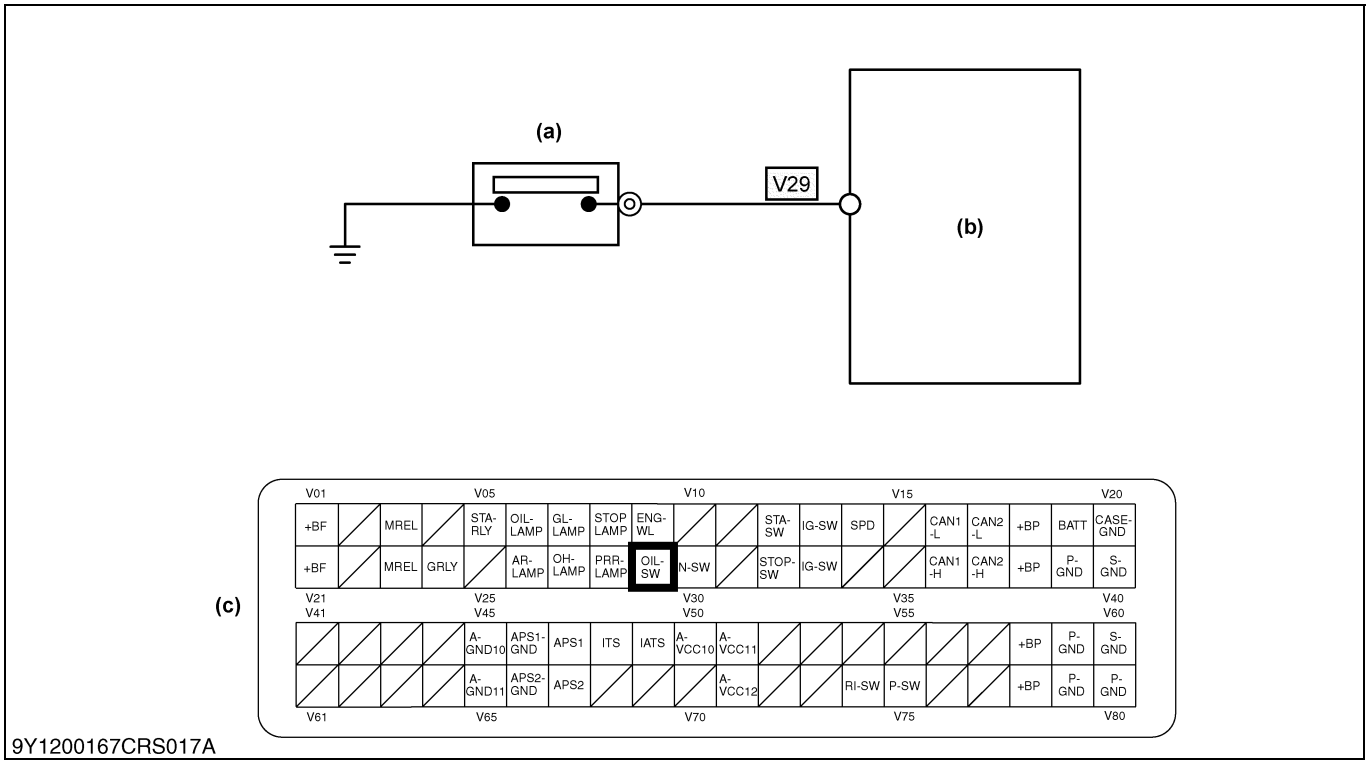
DTC set preconditions:
- Battery voltage is normal
- Key switch turn ON
- Starter Switch signal (ECU: V12 terminal) is not activated
- 10 sec or more after engine start [700 min^{-1} (rpm) or higher]

DTC set parameter:
- Oil pressure switch ON: continues one sec or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

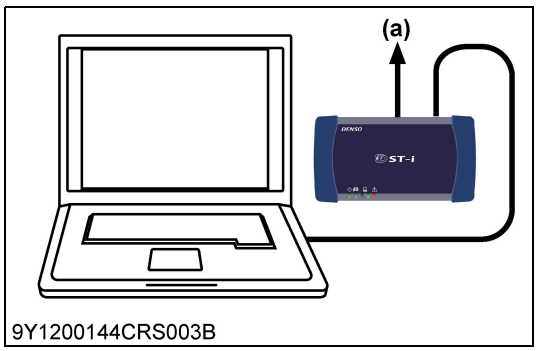
Recovery from error:
- Key switch turn OFF



9Y1200167CRS017A

(a) Oil Pressure Switch **(b) Engine ECU** **(c) ECU Connector 2 (Machine Side)**

9Y1200199CRS0946US0



9Y1200144CRS003B

1. DTC Judgment

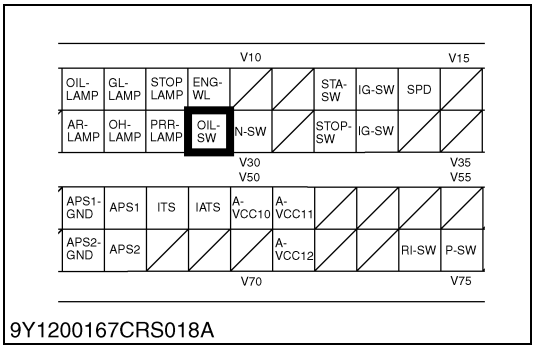
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Place the key switch in the ON position, check whether the DTC (P0524) is output or not.

Factory specification	DTC (P0524) must not be output.

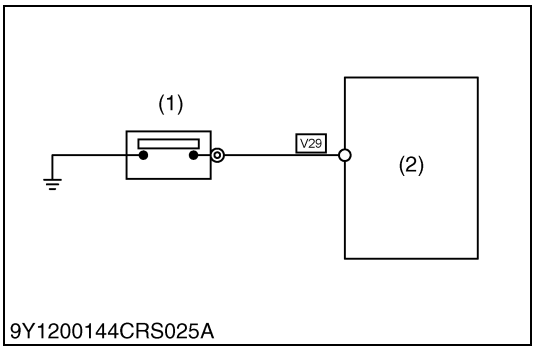
OK	Normal.
NG	Go to "2. Check the Wiring Related to the Oil Pressure Switch".

(a) CAN1 Connector

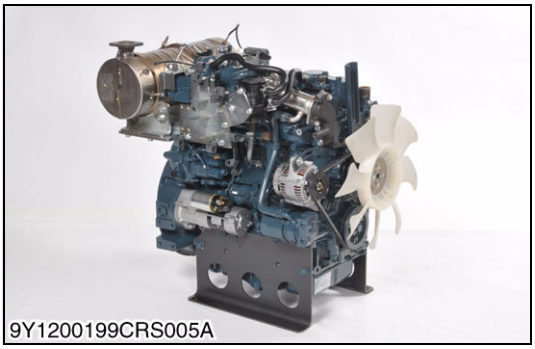
9Y1200199CRS0947US0

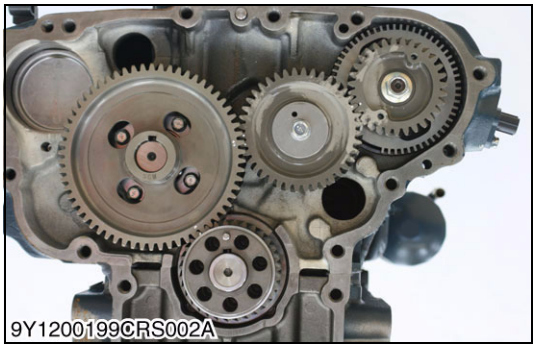


9Y1200167CRS018A



9Y1200144CRS025A


9Y1200199CRS005A


9Y1200199CRS002A

2. Check the Wiring Related to the Oil Pressure Switch

1. Check the connector and the wiring harness being connected to ECU terminal V29 for a short or an open circuit.

■ **IMPORTANT**

- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit System". (Refer to page 1-S304)**

OK	Go to "3. Check the Oil Pressure Switch".
NG	Repair or replace the faulty areas.

9Y1200199CRS0948US0

3. Check the Oil Pressure Switch

1. Replace the oil pressure switch and reconfirms it with the service tool.
   If the oil pressure can be measured, perform the oil pressure measurement.

Factory specification	Operating pressure of the oil pressure switch: 0.5 kgf/cm^2

OK	Oil pressure switch fault → Replace
NG	Go to "4. Check the Oil and Oil Filter".

(1) 1 Oil Pressure Switch (2) Engine ECU

9Y1200199CRS0949US0

4. Check the Oil and Oil Filter

1. Replace specified oil and the oil filter and reconfirms it with the service tool.

OK	Deterioration of the oil and oil filter → Change
NG	Go to "5. Check the Engine"

9Y1200199CRS0950US0

5. Check the Engine

1. Check the inside of the engine (oil passage).

OK	Normal.
NG	Repair the malfunction.

9Y1200199CRS0951US0

(25) Exhaust Gas Temperature Sensor 1 (T1) Abnormality (DTC P0543 / 3242-4, P0544 / 3242-3)

P0543 / 3242-4: Exhaust gas temperature sensor 1 (T1) abnormality (Low side)

Behaviour during malfunction:
- None

Detection item:
- Ground short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- Diesel Particulate Filter (hereinafter referred to as the "DPF") inlet temperature sensor (T1) voltage: 0.08 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 °C (32 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0952US0

P0544 / 3242-3: Exhaust gas temperature sensor 1 (T1) abnormality (High side)

Behaviour during malfunction:
- None

Detection item:
- Open circuit or +B short circuit of sensor / harness.

DTC set preconditions:
- Battery voltage is normal
- Coolant temperature is 65 °C (149 °F) or more: continues longer than 10 min. after engine starting
- 100 °C (212 °F) ≤ T0 ≤ 800 °C (1472 °F): continues longer than 10 sec. or 100 °C (212°F) ≤ T2 ≤ 800 °C (1472 °F): continues longer than 10 sec.

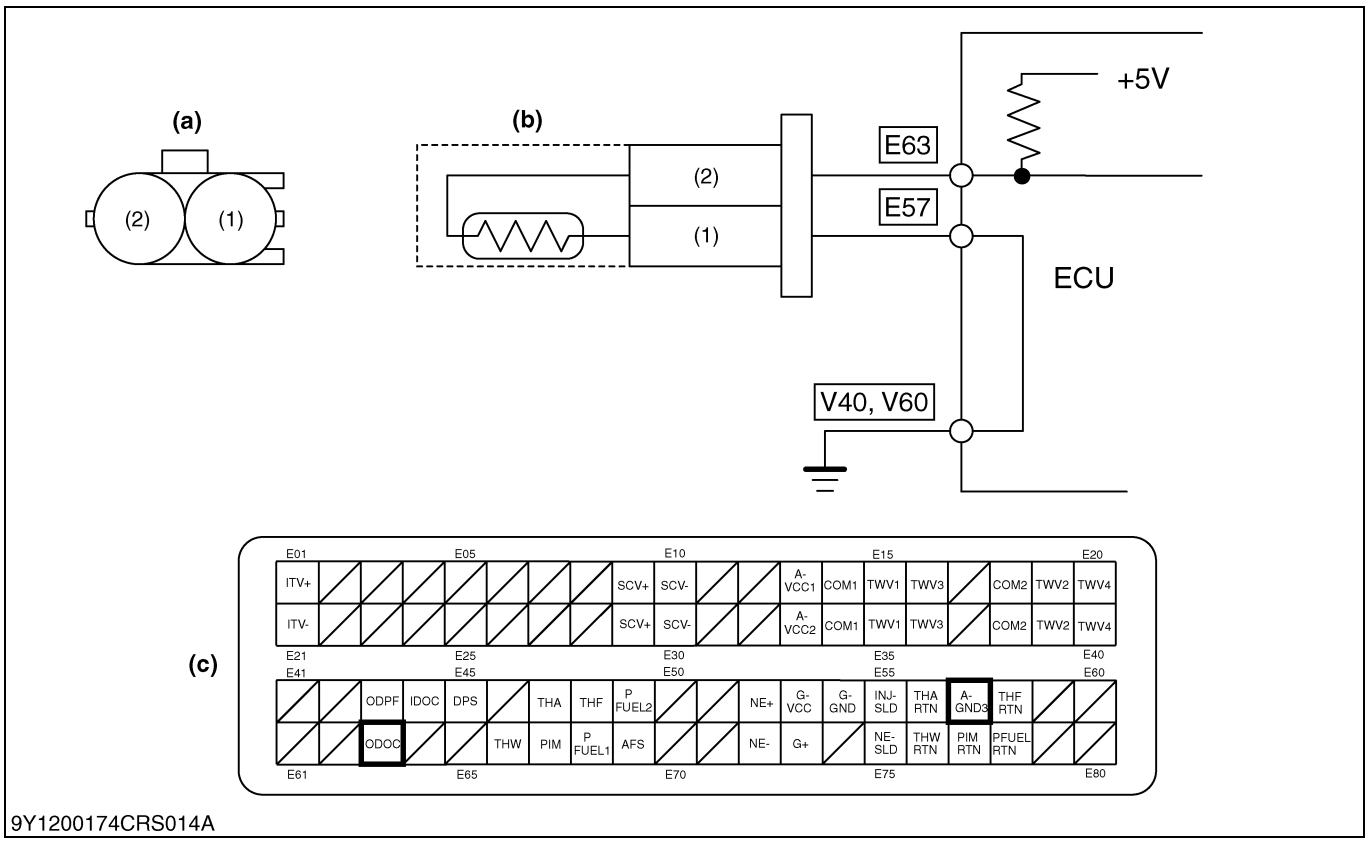
DTC set parameter:
- DPF inlet temperature sensor (T1) voltage: 4.92 V or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 °C (32 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

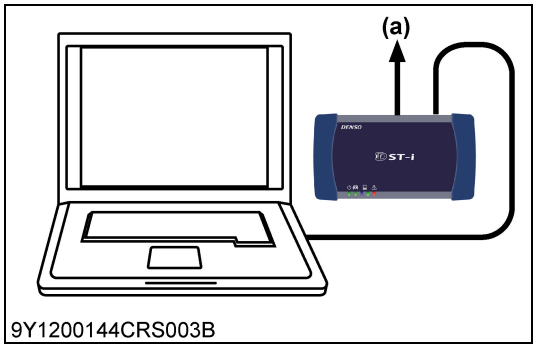
9Y1200199CRS0953US0



9Y1200174CRS014A

(1) Terminal A-GND3
(2) Terminal ODOC
(a) Terminal Layout
(b) Exhaust Gas Temperature Sensor 1 (T1)
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0954US0



9Y1200144CRS003B

1. Check the Exhaust Gas Temperature Sensor Signals

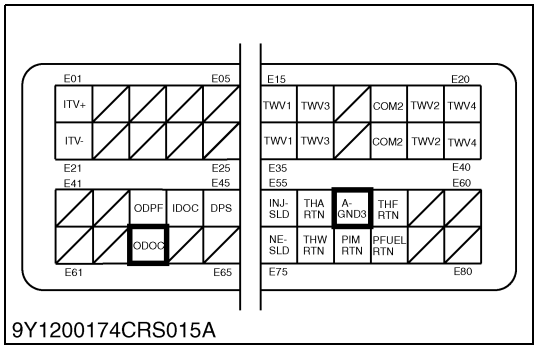
1. Place the key switch in the ON position, and check the "Exhaust gas temperature" and "Exhaust gas temperature sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual exhaust gas temperature	Exhaust gas temperature	Output voltage
100 °C (212 °F)	100 °C (212 °F)	Approx. 4.4 V
150 °C (302 °F)	150 °C (302 °F)	Approx. 3.7 V
200 °C (392 °F)	200 °C (392 °F)	Approx. 3.0 V
250 °C (482 °F)	250 °C (482 °F)	Approx. 2.3 V

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0955US0



9Y1200174CRS015A

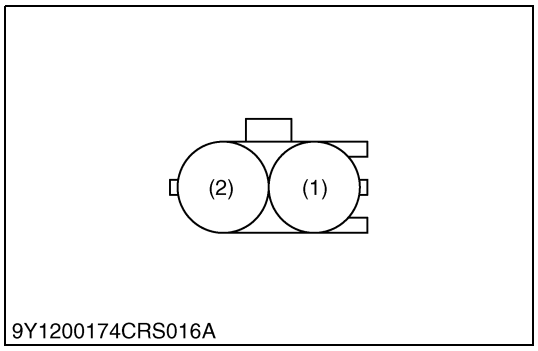
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E57 and E63 of the connector.

Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the Sensor".

9Y1200199CRS0956US0



9Y1200174CRS016A

3. Check the Sensor

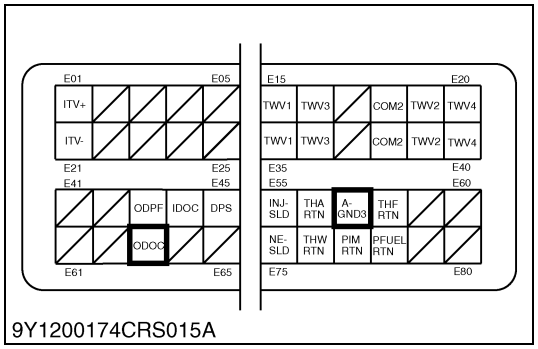
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Exhaust gas temperature sensor fault → Replace the exhaust gas temperature sensor 1 (T1).

(1) Terminal A-GND3 (2) Terminal ODOC

9Y1200199CRS0957US0



9Y1200174CRS015A

4. Measure the ECU Terminal Voltage

1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals E57 and E63 at the ECU side.

Factory specification	Approx. 5 V

OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

9Y1200199CRS0958US0

(26) Exhaust Gas Temperature Sensor 0 (T0) Abnormality (DTC P0546 / 4765-4, P0547 / 4765-3)

P0546 / 4765-4: Exhaust gas temperature sensor 0 (T0) abnormality (Low side)

Behaviour during malfunction:
- None

Detection item:
- Ground short circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- DOC inlet temperature sensor (T0) voltage: 0.08 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 °C (32 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0959US0

P0547 / 4765-3: Exhaust gas temperature sensor 0 (T0) abnormality (Low side)

Behaviour during malfunction:
- None

Detection item:
- Open circuit or +B short circuit of sensor / harness.

DTC set preconditions:
- Battery voltage is normal
- Coolant temperature is 65 °C (149 °F) or more: continues longer than 5 min. after engine starting
- 100 °C (212 °F) ≤ T1 ≤ 800 °C (1472 °F): continues longer than 10 sec. or 100 °C (212 °F) ≤ T2 ≤ 800 °C (1472 °F): continues longer than 10 sec.

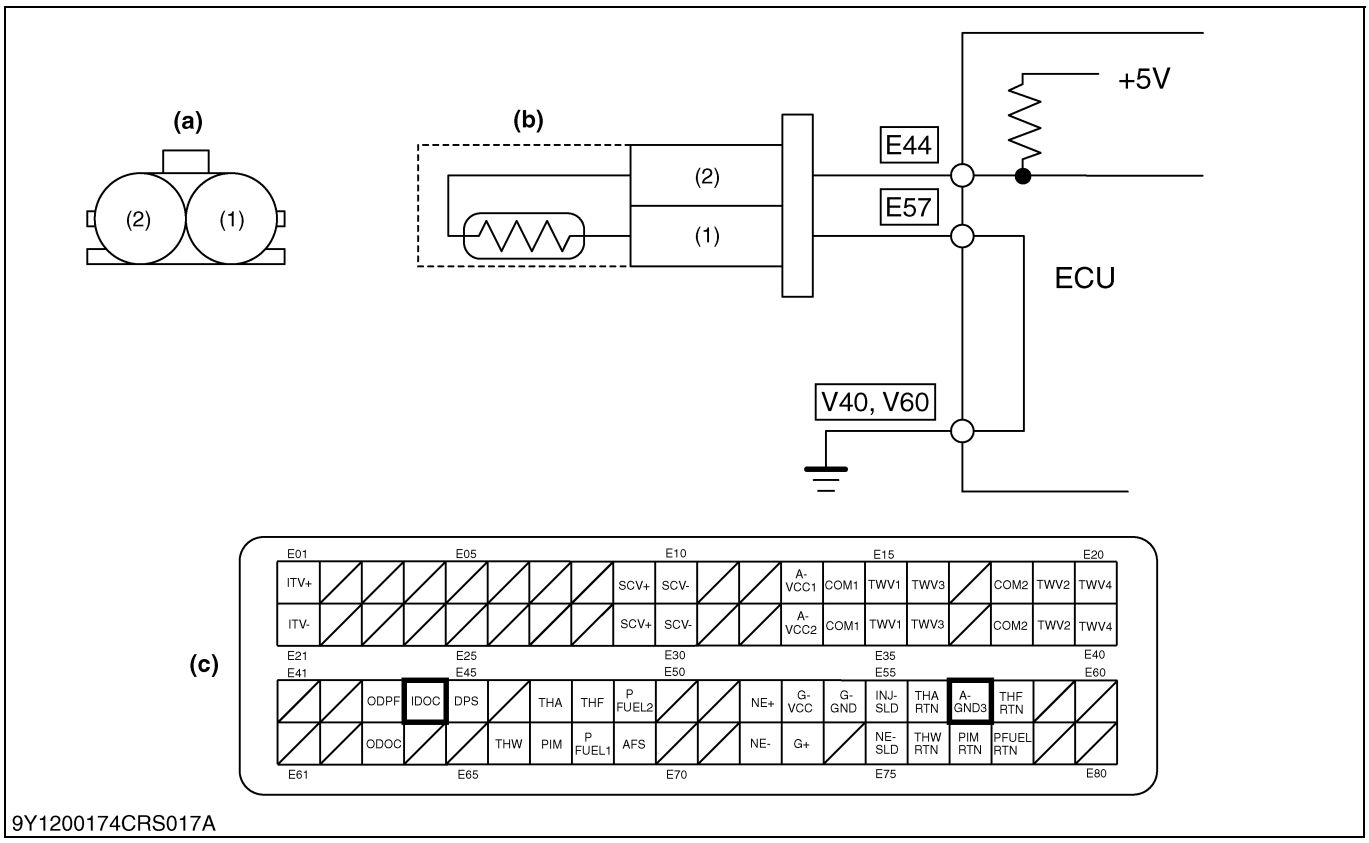
DTC set parameter:
- DOC inlet temperature sensor (T0) voltage: 4.92 V or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 °C (32 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

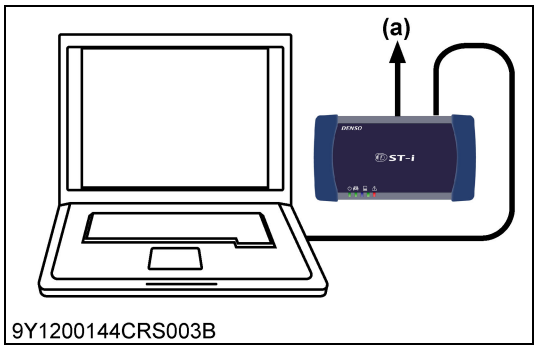
9Y1200199CRS0960US0



9Y1200174CRS017A

(1) Terminal A-GND3
(2) Terminal IDOC
(a) Terminal Layout
(b) Exhaust Gas Temperature Sensor 0 (T0)
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0961US0



9Y1200144CRS003B

1. Check the Exhaust Gas Temperature Sensor Signals

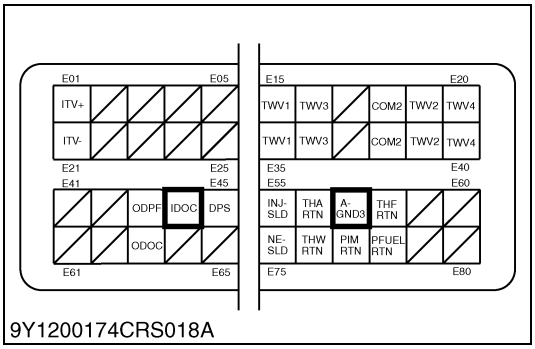
1. Place the key switch in the ON position, and check the "Exhaust gas temperature" and "Exhaust gas temperature sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual exhaust gas temperature	Exhaust gas temperature	Output voltage
100 °C (212 °F)	100 °C (212 °F)	Approx. 4.4 V
150 °C (302 °F)	150 °C (302 °F)	Approx. 3.7 V
200 °C (392 °F)	200 °C (392 °F)	Approx. 3.0 V
250 °C (482 °F)	250 °C (482 °F)	Approx. 2.3 V

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0962US0



9Y1200174CRS018A

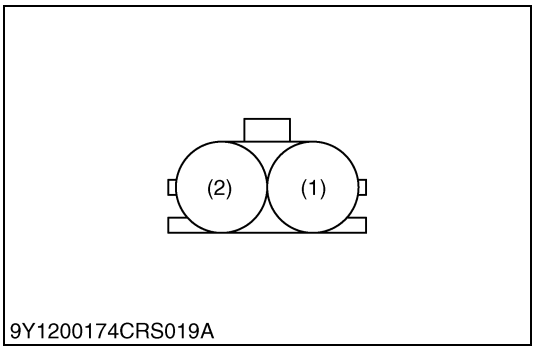
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E44 and E57 of the connector.

Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the Sensor".

9Y1200199CRS0963US0



9Y1200174CRS019A

3. Check the Sensor

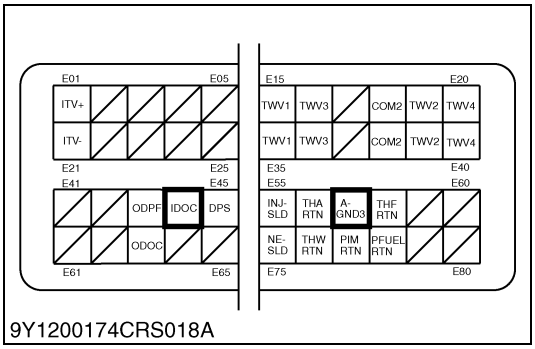
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Exhaust gas temperature sensor fault → Replace the exhaust gas temperature sensor 0 (T0).

(1) Terminal A-GND3 (2) Terminal IDOC

9Y1200199CRS0964US0



9Y1200174CRS018A

4. Measure the ECU Terminal Voltage

1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals E44 and E57 at the ECU side.

Factory specification	Approx. 5 V

OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

9Y1200199CRS0965US0

(27) Battery Voltage Abnormality (DTC P0562 / 168-4, P0563 / 168-3)

P0562 / 168-4: Battery voltage abnormality (Low side)

Behaviour during malfunction:
- Faulty starting
- Insufficient output
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Open circuit, short circuit or damage of harness
- Failure of battery

DTC set preconditions:
- Key switch is ON
- Starter Switch signal (ECU: V12 terminal) is not activated

DTC set parameter:
- ECU recognition of battery voltage is below 8 V in 12 V system
- Not monitored during cranking

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0966US0

P0563 / 168-3: Battery voltage abnormality (High side)

Behaviour during malfunction:
- Faulty starting
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Open circuit, short circuit or damage of harness
- Failure of battery

DTC set preconditions:
- Key switch is ON
- Starter Switch signal (ECU: V12 terminal) is not activated

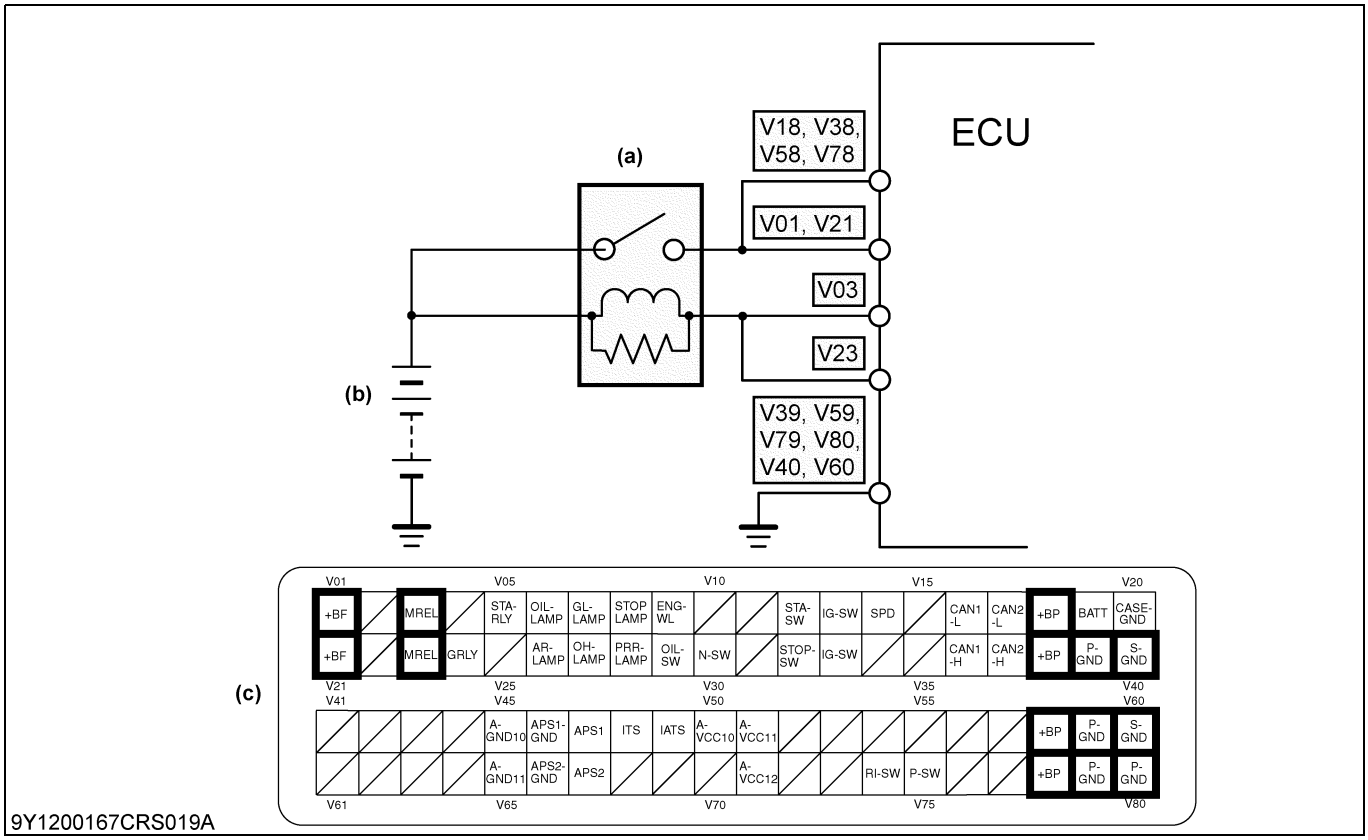
DTC set parameter:
- ECU recognition of battery voltage is above 16 V in 12 V system

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

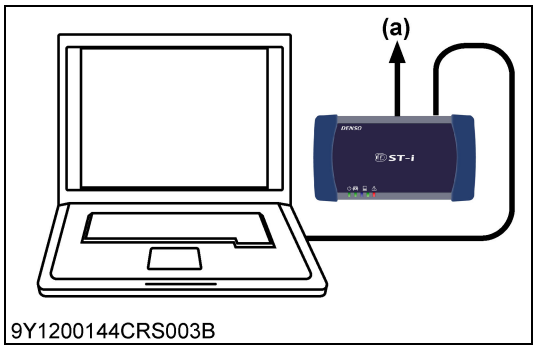
9Y1200199CRS0967US0



9Y1200167CRS019A

(a) Main Relay **(b) Battery** **(c) ECU Connector 2 (Machine Side)**

9Y1200199CRS0968US0



9Y1200144CRS003B

1. Check the ECU Data

1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again. Then, check the "Battery voltage" status on the data monitor.
2. Change the engine operation status, and check the "Battery voltage".

Factory specification	8 V or higher, 15 V or lower (except intense cold temperature)

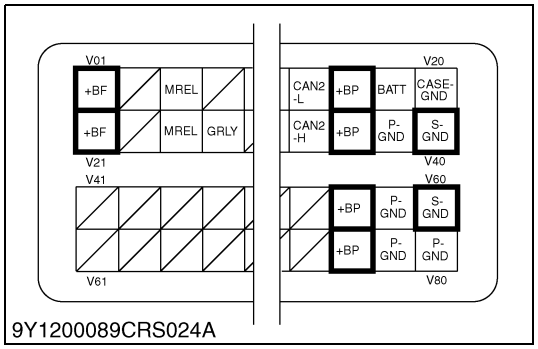
■ **NOTE**

- **Try to change the engine speed as the generated voltage changes accordingly.**

OK	Clear the DTC and check whether it is output again or not. ⇓	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Check the ECU Terminal Voltage (Part 1)".	

(a) CAN1 Connector

9Y1200199CRS0969US0



9Y1200089CRS024A

2. Check the ECU Terminal Voltage (Part 1)

1. Change the engine operation status, and measure the voltage between ECU terminals V18 / V38 / V58 / V78 and V40 / V60 and between terminals V01 / V02 and V40 / V60.

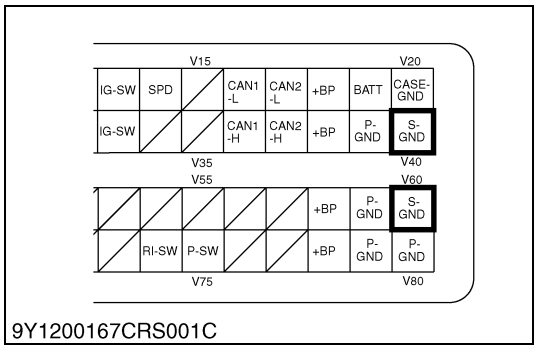
Factory specification	8 V or higher, 15 V or lower (except intense cold temperature)

■ **NOTE**

- **Try to change the engine speed as the generated voltage changes accordingly.**

OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Go to "3. Check the ECU Terminal Voltage (Part 2)".	

9Y1200199CRS0970US0



9Y1200167CRS001C

3. Check the ECU Terminal Voltage (Part 2)

1. Change the engine operation status, and measure the voltage between ECU terminal V40 / V60 and chassis ground terminal.

Factory specification	Always 0.5 V or lower

■ **NOTE**

- **Try to change the engine speed as the generated voltage changes accordingly.**

OK	1. Check the charging system, the battery itself, wiring harness and cables. → Repair the faulty area. 2. Locate the cause of excessively high or low voltage.
NG	Check the wiring harness between ECU terminal and the body ground terminal. → Repair the defects.

9Y1200199CRS0971US0

(28) QR Data Abnormality (DTC P0602/523538-2, P0602/523538-7)

P0602 / 523538-2: QR data error

Behaviour during malfunction:
- Insufficient output

Detection item:
- QR data read error from EEPROM

DTC set preconditions:
- Key switch is ON

DTC set parameter:
- QR correction data exceeds threshold value
- Multiple check error (QR correction data for each injector has been stored in three locations. When this data is read and compared, an error is determined if there is difference in all three values.)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Nozzle calibration is not executed
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0972US0

P0602 / 523538-7: No QR data

Behaviour during malfunction:
- Insufficient output

Detection item:
- Area of QR data on EEPROM is vacant.

DTC set preconditions:
- Key switch is ON

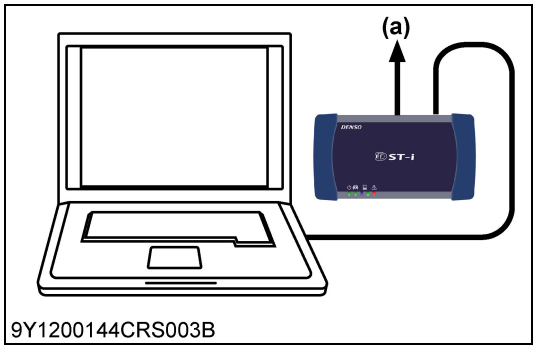
DTC set parameter:
- When QR correction data fails to write to the EEPROM (When the initial ECU value is "0", an error that QR data is not written to the disc at the time of vehicle shipment is detected.)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Nozzle correction factor = 0 [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0973US0



9Y1200144CRS003B

1. Write the QR Codes and Read the DTC Again

1. Using the diagnosis tool, write the correct QR codes in the ECU.
2. Clear the DTC and check whether the same DTC is output again or not.

Factory specification	OK

OK	An electromagnetic interference (EMI) may have caused the temporary malfunction. There is no problem if the system has recovered.
NG	Faulty Engine ECU.

(a) CAN1 Connector

9Y1200199CRS0974US0

(29) ECU Flash-ROM and CPU Abnormality (DTC P0605 / 628-2, P0606 / 1077-2, P0606/ 523527-2)

P0605 / 628-2: ECU Flash-ROM error

Behaviour during malfunction:
- Engine stops

Detection item:
- FLASH ROM error

DTC set preconditions:
- Key switch is ON

DTC set parameter:
- 3 times or more consecutive inconsistencies in checksum

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Engine stopped without delay

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0975US0

P0606 / 1077-2: ECU CPU (Main IC) error

Behaviour during malfunction:
- Engine stops

Detection item:
- Failure of CPU

DTC set preconditions:
- Key switch is ON
- Battery voltage is 10 V or more
- Starter Switch signal (ECU: V12 terminal) is not activated

DTC set parameter:
- CPU abnormality counter ≥ 5 times (RUN pulse abnormality occurs 5 times or more)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Engine Stop

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0976US0

P0606 / 523527-2: ECU CPU (Monitoring IC) error

Behaviour during malfunction:
- Engine stops

Detection item:
- Failure of monitoring IC of CPU

DTC set preconditions:
- Key switch is ON
- Battery voltage is 10 V or more
- Starter Switch signal (ECU: V12 terminal) is not activated

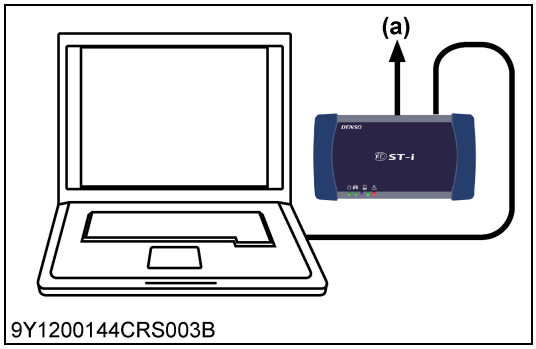
DTC set parameter:
- Abnormality continues for 2000 msec or more after the ECU is turned ON
- RUN pulse abnormality
- Above conditions occur continuously for 700 msec or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Engine Stop

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0977US0



9Y1200144CRS003B

1. Check the DTC

1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again.
2. Clear the DTC, and check whether the same DTC (P0605 or P0606) is output again or not.

Factory specification	No DTC is output.

OK	An electromagnetic interference (EMI) may have caused the temporary malfunction. There is no problem if the system has recovered.
NG	Faulty Engine ECU → Replace.

(a) CAN1 Connector

9Y1200199CRS0978US0

(30) Injector Charge Voltage Abnormality (DTC P0611 / 523525-1)

■ **NOTE**

- **This DTC is detected when the charge voltage in the injector actuation circuit is too low.**

Behaviour during malfunction:

- Insufficinet output
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:

- Injector charge voltage: Low
- Failure of charge circuit of ECU

DTC set preconditions:

- Battery voltage is normal
- CPU is normal

DTC set parameter:

- Injector charge voltage: Low
- Failure of charge circuit of ECU

Engine warning light:

- ON

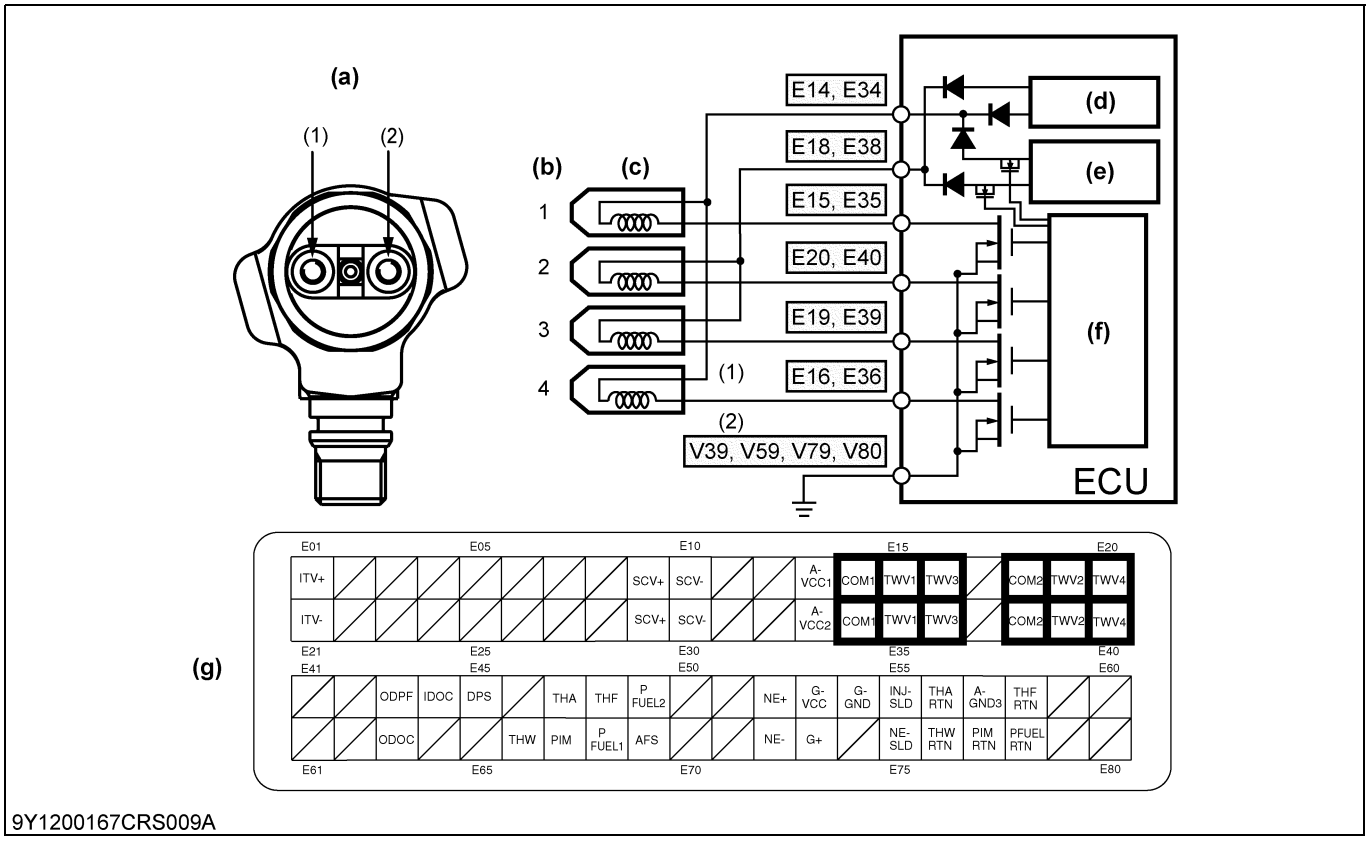
Limp home action by engine ECU (system action):

- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:

- Key switch turn OFF

9Y1200199CRS0979US0

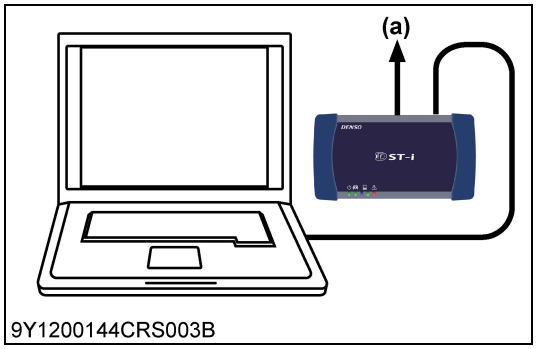


9Y1200167CRS009A

(1) Terminal COMMON
(2) Terminal TWV

(a) Terminal Layout
(b) Engine Cylinder No.
(c) Injector
(d) Constant Amperage Circuit
(e) High Voltage Generation Circuit
(f) Control Circuit
(g) ECU Connector 1 (Engine Side)

9Y1200199CRS0980US0



9Y1200144CRS003B

1. Checking Whether the DTC Is Detected Again

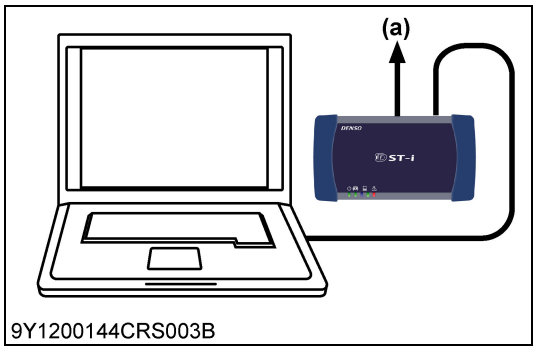
1. Turn the key switch OFF and then ON again.
2. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
3. Check whether or not the same DTC (P0611) is detected.

Factory specification	DTC is not detected.

OK	It could be a temporary malfunction caused by obstructions to the radio waves, so as long as it recovers to normal operation there is no problem.
NG	Go to "2. Replacing the Injector and Checking Whether the DTC Is Detected Again".

(a) CAN1 Connector

9Y1200199CRS0981US0



9Y1200144CRS003B

2. Replacing the Injector and Checking Whether the DTC Is Detected Again

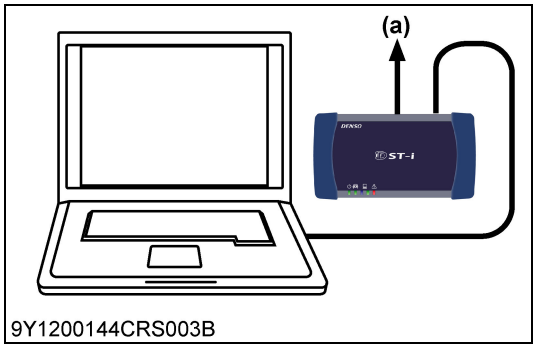
1. Replace the injector.
2. Turn the key switch OFF and then ON again.
3. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
4. Check whether or not the same DTC (P0611) is detected.

Factory specification	DTC is not detected.

OK	Injector fault → Replace the injector.
NG	Go to "3. Replacing the ECU and Checking Whether the DTC Is Detected Again".

(a) CAN1 Connector

9Y1200199CRS0982US0



9Y1200144CRS003B

3. Replacing the ECU and Checking Whether the DTC Is Detected Again

1. Replace the ECU.
2. Turn the key switch OFF and then ON again.
3. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
4. Check whether or not the same DTC (P0611) is detected.

Factory specification	DTC is not detected.

OK	ECU fault → Replace the ECU.

(a) CAN1 Connector

9Y1200199CRS0983US0

(31) SCV Drive System Abnormality (DTC P0628 / 1347-4, P0629 / 1347-3)

P0628 / 1347-4: SCV drive system error

Behaviour during malfunction:
- Insufficinet output
- Worsening exhaust gas performance

Detection item:
- Open circuit or ground short circuit of SCV

DTC set preconditions:
- Battery voltage is normal
- Key switch is ON
- Starter Switch signal (ECU: V12 terminal) is not activated

DTC set parameter:
- Open circuit or ground short of SCV

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)
- Engine forcibly stopped 60 sec later

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0984US0

P0629 / 1347-3: +B short circuit of SCV

Behaviour during malfunction:
- Insufficinet output
- Worsening exhaust gas performance

Detection item:
- +B+B short circuit of SCV

DTC set preconditions:
- Battery voltage is normal
- Key switch is ON
- Starter Switch signal (ECU: V12 terminal) is not activated

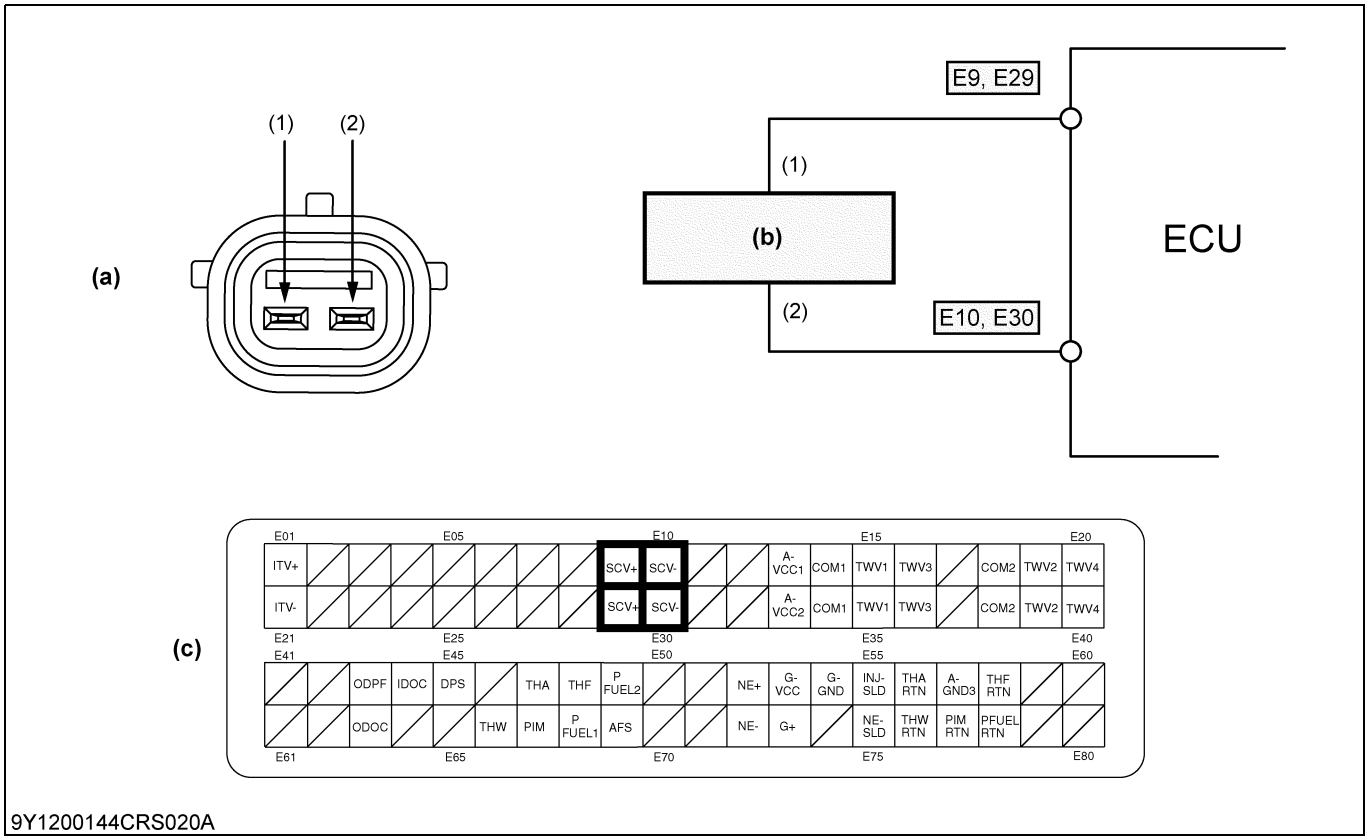
DTC set parameter:
- +B short circuit of SCV

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)
- Engine forcibly stopped 60 sec later

Recovery from error:
- Key switch turn OFF

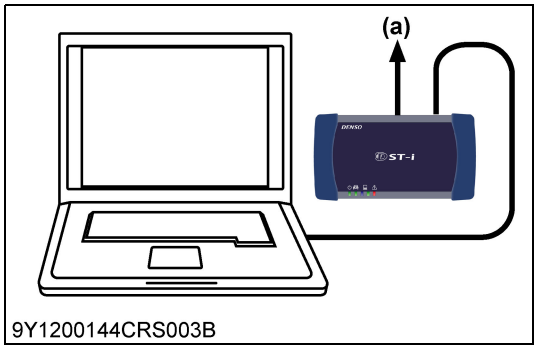
9Y1200199CRS0985US0



9Y1200144CRS020A

(1) Terminal SCV+
(2) Terminal SCV-
(a) Terminal Layout
(b) SCV (Suction Control Valve)
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS0986US0



9Y1200144CRS003B

1. Check the SCV Current

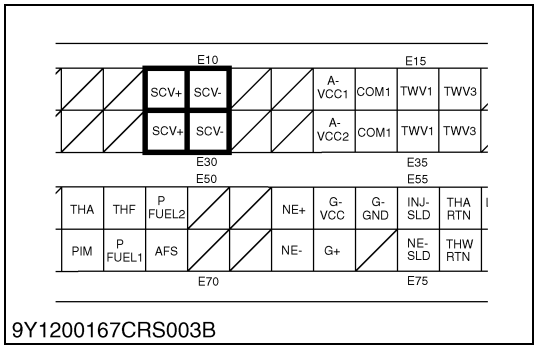
1. Place the key switch in the ON position, and check the "Target SCV current" and "Actual SCV current" on the diagnosis tool data monitor.

Factory specification	1. The "Actual SCV current value" always follow to the "Target SCV current value". • When idling: Approx. 1800 mA • Accelerator opening: 0→100 % (During acceleration): Approx. 1400 mA minimum • During no-load maximum speed: Approx.1600 mA The numerical value is stable under normal operating and the target value corresponds with actual pressure value. *** The current shall be used as a reference only as this value varies depending on the pump used.** 2. The "Pressure feedback integral guard executing flag" must be OFF. 3. The "Pump deviation learning correction value" must be within ±200 mA. ■ **NOTE** • **As the following value of A varies depending on pump, the table above is for guideline. If the value of A has a wider shift than the initial learning value, there may be out of the range of the above table.** **A net normal value is the value that provided by the forced-learning several times.: Compared with A** **12 V spec.: A-100 ≤ normal value ≤ A+50** **Therefore, if the value is out of the range above, perform the forced-learning.**

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0987US0



9Y1200167CRS003B

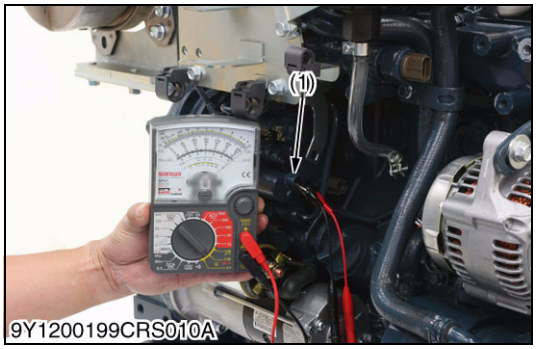
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E09 / E29 and E10 / E30 of the connector.

Factory specification		
Item	Temperature	Resistance
Resistance	20 °C (68 °F)	Approx. 2.1 Ω
Insulation resistance (between terminal valves)	20 °C (68 °F)	100 MΩ or higher

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the SCV".

9Y1200199CRS0988US0



3. Check the SCV

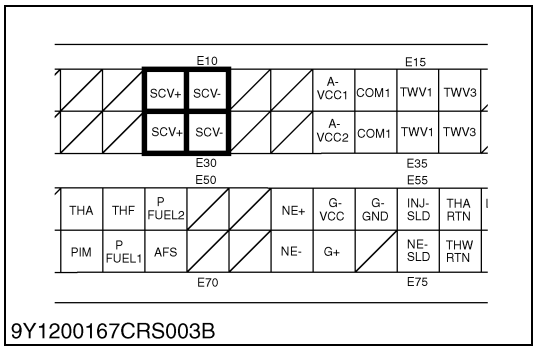
1. Turn the key switch OFF, remove the connector from the SCV side and measure the resistance between the terminals on the SCV side.

Factory specification		
Item	Temperature	Resistance
Resistance	20 °C (68 °F)	Approx. 2.1 Ω
Insulation resistance (between terminal valves)	20 °C (68 °F)	100 MΩ or higher

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	SCV fault → Replace the supply pump.

(1) SCV (Suction Control Valve)

9Y1200199CRS0989US0



4. Measure the ECU Terminal Voltage

1. Unplug the ECU wiring harness connector 1 from socket, and measure the voltage between ECU terminals E09 / E29 and E10 / E30 and the ground (at the wiring harness side).

Factory specification	Both must be approx. 0 V.

OK	Normal.
NG	Repair the wiring harness.

9Y1200199CRS0990US0

(32) Sensor Supply Voltage 1 Abnormality (DTC P0642 / 3509-4, P0643 / 3509-3)

P0642 / 3509-4: Sensor supply voltage 1 abnormality (Low side)

Behaviour during malfunction:
- Faulty starting
- Insufficient output
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Sensor supply voltage 1 error or recognition error

DTC set preconditions:
- Battery voltage is normal
- Key switch turn ON
- Starter Switch signal (ECU: V12 terminal) is not activated

DTC set parameter:
- Voltage to sensor is below 4.375 V

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0991US0

P0643 / 3509-3: Sensor supply voltage 1 abnormality (High side)

Behaviour during malfunction:
- Faulty starting
- Insufficient output
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Sensor supply voltage 1 error or recognition error

DTC set preconditions:
- Battery voltage is normal
- Key switch turn ON
- Starter Switch signal (ECU: V12 terminal) is not activated

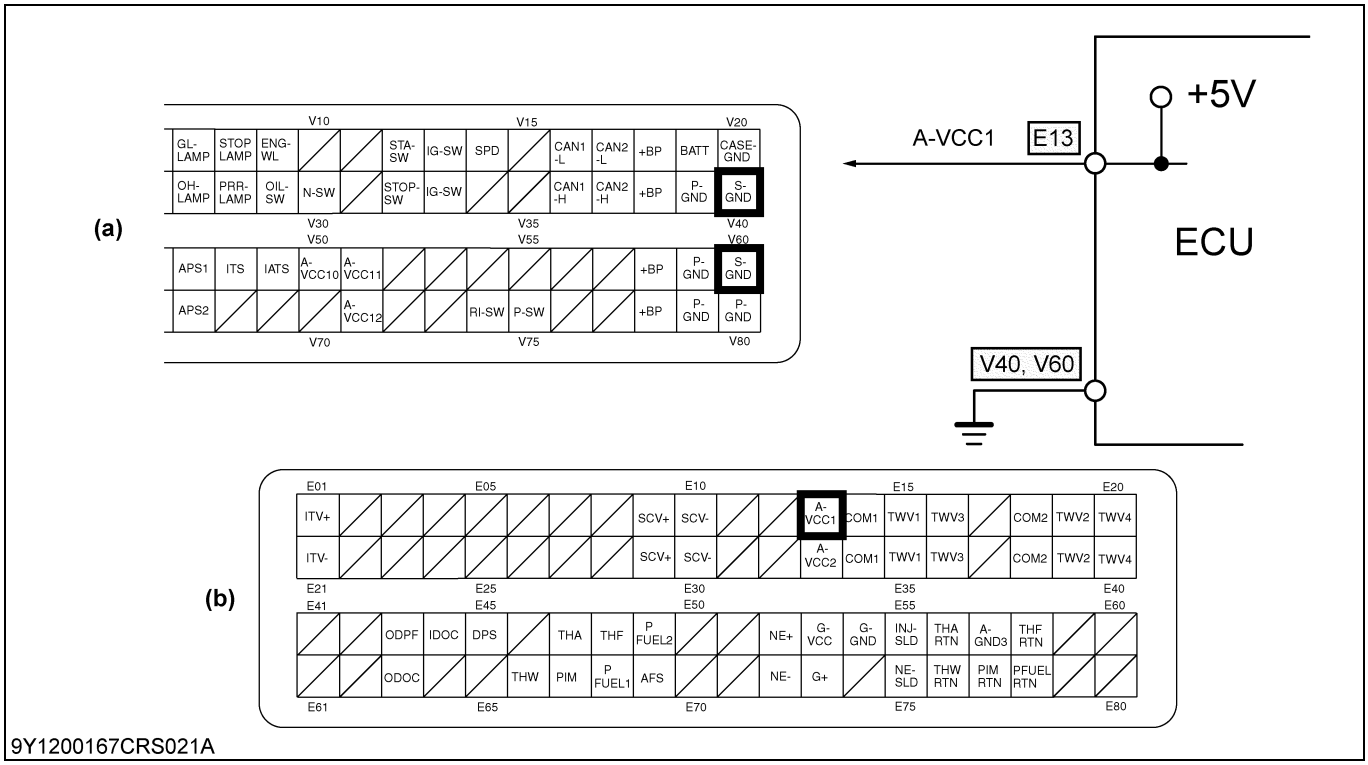
DTC set parameter:
- Voltage to sensor is above 5.625 V

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0992US0

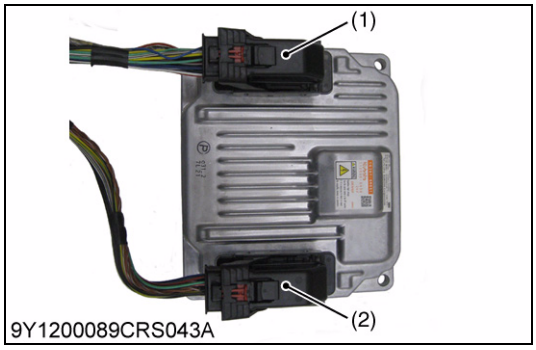


9Y1200167CRS021A

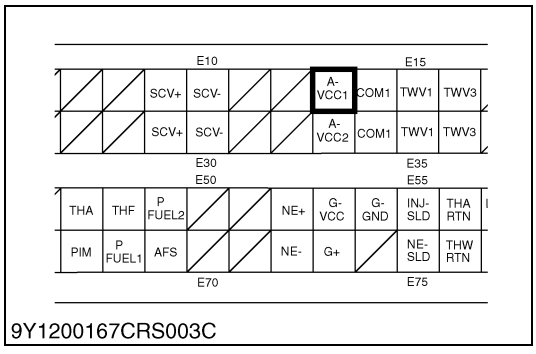
(a) ECU Connector 2 (Machine Side)

(b) ECU Connector 1 (Engine Side)

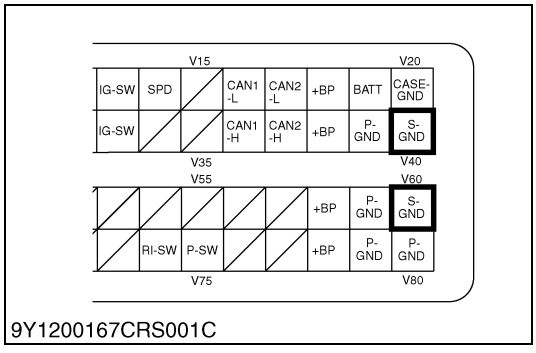
9Y1200199CRS0993US0



9Y1200089CRS043A



9Y1200167CRS003C



9Y1200167CRS001C

1. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector 1 (1) from the socket.
2. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals E13 and V40 / V60.

Factory specification	Approx. 5 V

OK	Check the wiring harness (ECU terminal E13) for a short. → Repair the faulty area.	
NG	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.

(1) ECU Wiring Harness Connector 1 (Engine Side)

(2) ECU Wiring Harness Connector 2 (Machine Side)

9Y1200199CRS0994US0

(33) Sensor Supply Voltage 2 Abnormality (DTC P0652 / 3510-4, P0653 / 3510-3)

P0652 / 3510-4: Sensor supply voltage 2 abnormality (Low side)
Behaviour during malfunction:
- Faulty starting
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Sensor supply voltage 2 error or recognition error

DTC set preconditions:
- Battery voltage is normal
- Key switch turn ON
- Starter Switch signal (ECU: V12 terminal) is not activated

DTC set parameter:
- Voltage to sensor is below 4.375 V

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0995US0

P0653 / 3510-3: Sensor supply voltage 2 abnormality (High side)
Behaviour during malfunction:
- Faulty starting
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- Sensor supply voltage 2 error or recognition error

DTC set preconditions:
- Battery voltage is normal
- Key switch turn ON
- Starter Switch signal (ECU: V12 terminal) is not activated

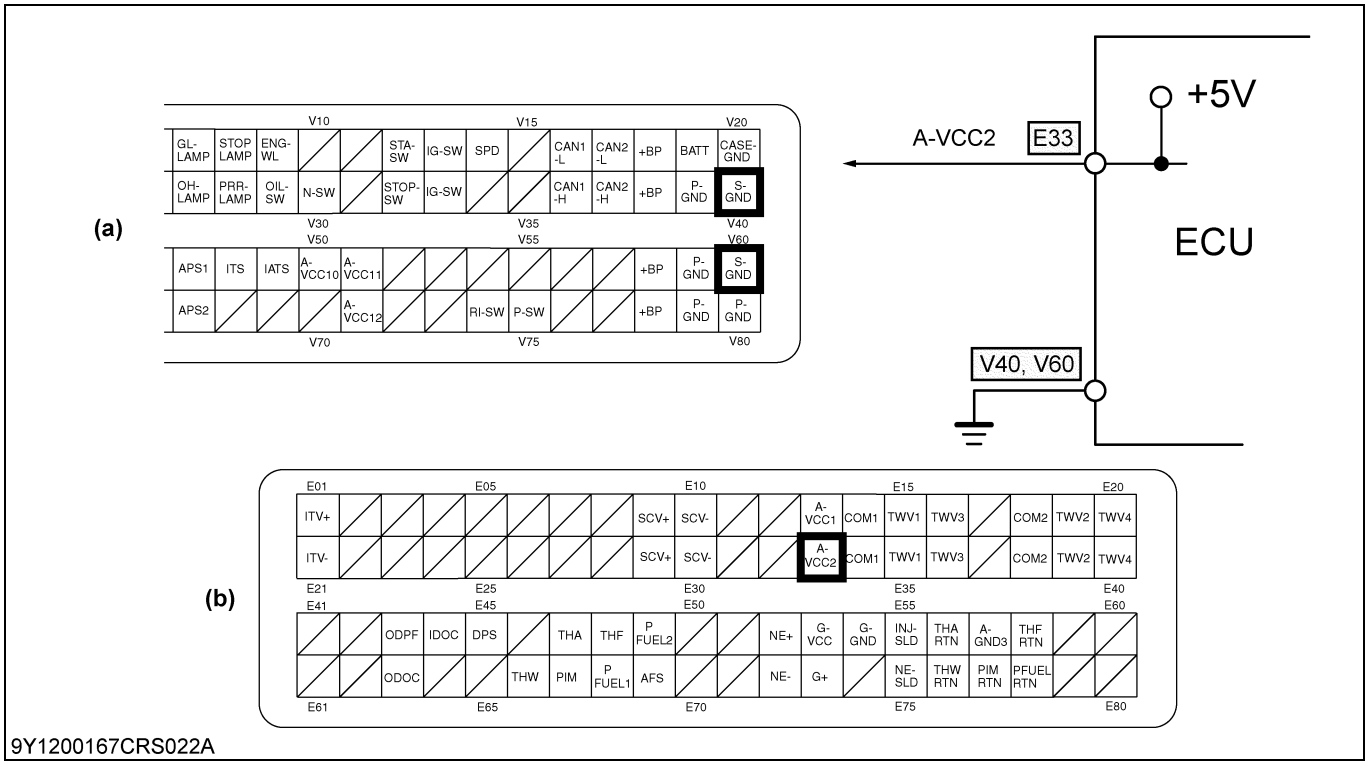
DTC set parameter:
- Voltage to sensor is above 5.625 V

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS0996US0

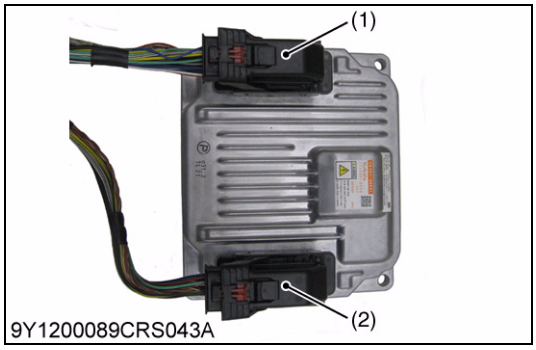


9Y1200167CRS022A

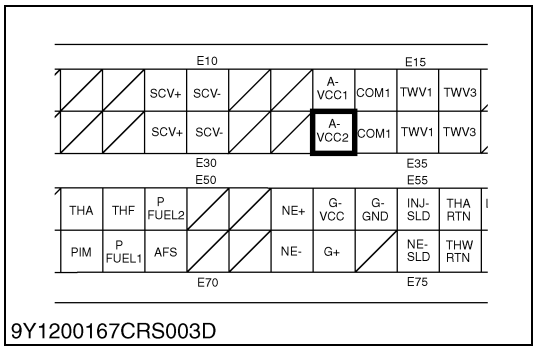
(a) ECU Connector 2 (Machine Side)

(b) ECU Connector 1 (Engine Side)

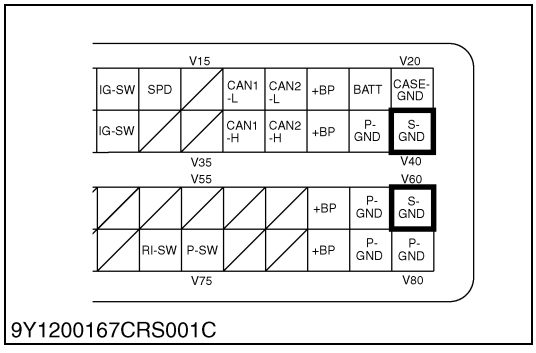
9Y1200199CRS0997US0



9Y1200089CRS043A



9Y1200167CRS003D



9Y1200167CRS001C

1. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector 1 (1) from the socket.
2. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals E33 and V40 / V60.

Factory specification	Approx. 5 V

OK	Check the wiring harness (ECU terminal E33) for a short. → Repair the faulty area.	
NG	Check the harness connectors and ECU pins. ▼	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.

(1) ECU Wiring Harness Connector 1 (Engine Side)

(2) ECU Wiring Harness Connector 2 (Machine Side)

9Y1200199CRS0998US0

(34) Main Relay is Locked in Closed Position (DTC P0687 / 1485-2)

Behaviour during malfunction:
- Dead battery

Detection item:
- Failure of main relay

DTC set preconditions:
- Key switch is OFF
- Engine stops

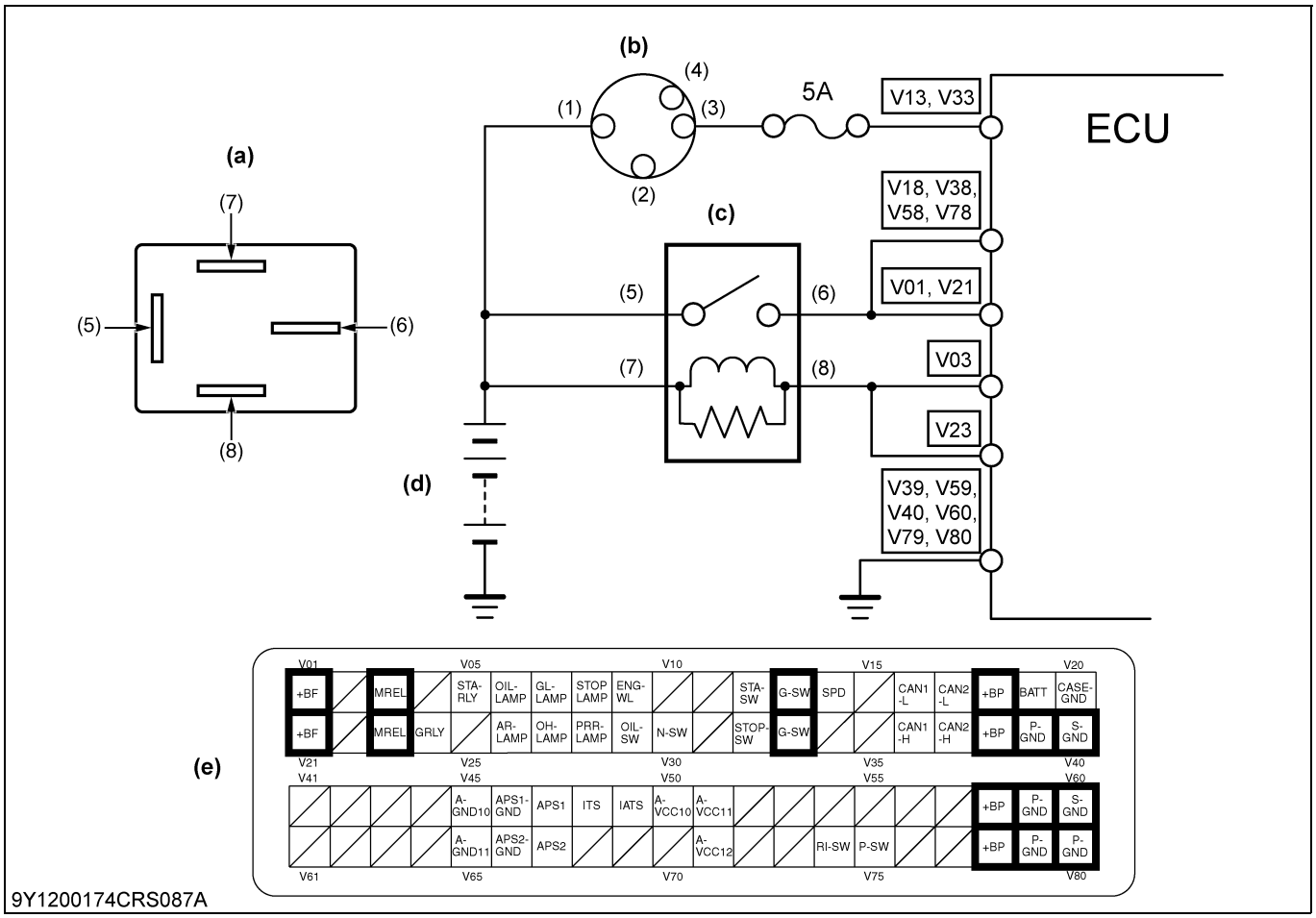
DTC set parameter:
- Main relay stays active longer than 1 sec. without command

Engine warning light:
- OFF

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS0999US0

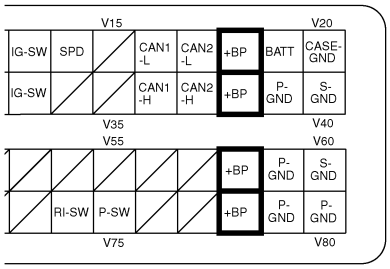


9Y1200174CRS087A

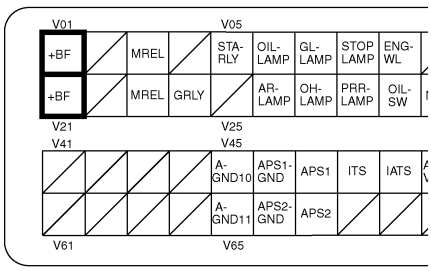
(1) Input Terminal
(2) ACC
(3) Output Terminal
(4) START
(5) Terminal 1
(6) Terminal 2
(7) Terminal 3
(8) Terminal 4

(a) Main Relay Terminal Layout
(b) Key Switch
(c) Main Relay
(d) Battery
(e) ECU Connector 2 (Machine Side)

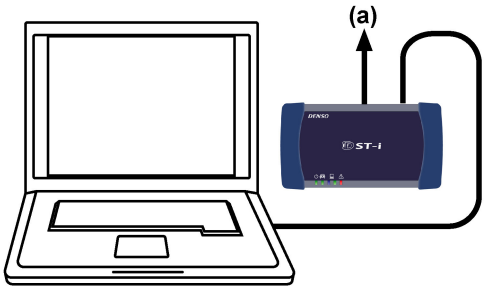
9Y1200199CRS1000US0



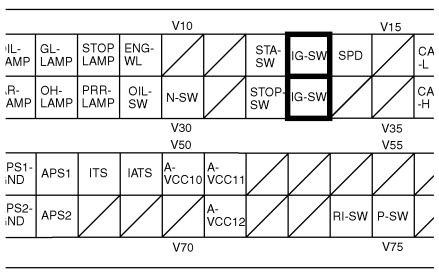
9Y1200167CRS001D



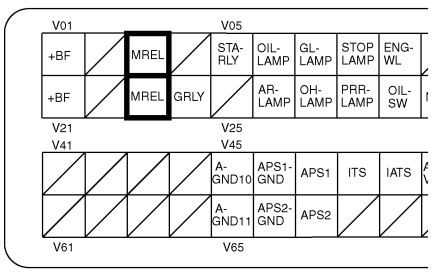
9Y1200167CRS024A



9Y1200144CRS003B



9Y1200167CRS025A



9Y1200167CRS024B

1. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and measure the voltage between ECU terminals V18 / V38 / V58 / V78 and V01 / V21 and the chassis ground.

Factory specification	0 V

OK	Clear the DTC and check whether it is detected again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Check the Key Switch Signal".	

9Y1200199CRS1001US0

2. Check the Key Switch Signal

1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again.
2. Using the data monitor function of diagnosis tool, check the "Key switch" data when the key switch is placed in the OFF position.

Factory specification	OFF

OK	Go to "4. Check the ECU Terminal Voltage".
NG	Go to "3. Check the IG-SW Signal".

(a) CAN1 Connector

9Y1200199CRS1002US0

3. Check the IG-SW Signal

1. Place the key switch in the OFF position, and measure the voltage at ECU terminal V13 / V33.

Factory specification	0 V

OK	Go to "4. Check the ECU Terminal Voltage".
NG	1. Check the wiring harness and the key switch. → Repair. 2. Locate the cause of constant voltage supply to the wiring harness.

9Y1200199CRS1003US0

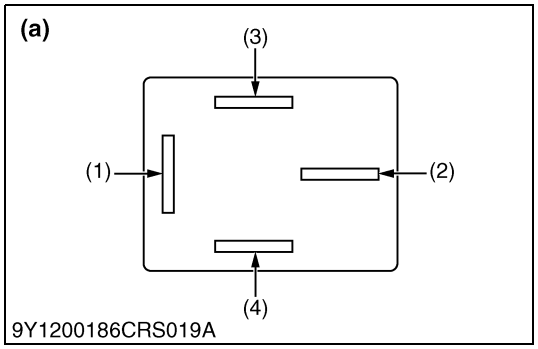
4. Check the ECU Terminal Voltage

1. Keep the key switch in the OFF position, and measure the voltage at ECU main relay terminals V03 and V23.

Factory specification	10 V or higher

OK	Go to "5. Measure the Resistance Between Relay Terminals (for Confirmation)".
NG	1. Check the wiring harness between relay and ECU and connectors. → Repair. 2. Locate the cause of constant shorted wiring harness to the ground.

9Y1200199CRS1004US0



5. Measure the Resistance Between Relay Terminals (for Confirmation)

1. Remove the main relay, and measure the resistance between each relay terminal.

Example of main relay terminal layout

Factory specification	Between terminals (3) and (4): Coil resistance value of relay to use Between terminals (1) and (2): Infinity

NG	Faulty main relay → Replace.

(1) Terminal 1 (Contact Terminal)
(2) Terminal 2 (Contact Terminal)
(3) Terminal 3 (Coil Operating Terminal)
(4) Terminal 4 (Coil Operating Terminal)

(a) Terminal Layout

9Y1200199CRS1005US0

(35) Pump Seizing (DTC P1274 / 523539-2, P1275 / 523540-2)

P1274 / 523539-2: Pump seizing 1

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- High pressure 1 error

DTC set preconditions:
- Sensor supply voltage VCC# is normal
- Rail pressure sensor is normal

DTC set parameter (Approximate parameter):
- Rail pressure of 230 MPa (2350 kgf/cm^2, 33400 psi) or more continues 1 second under the condition of above 800 min^{-1} (rpm)
- Rail pressure of 220 MPa (2250 kgf/cm^2, 31900 psi) or more continues 1 second under the condition of below 800 min^{-1} (rpm) [Threshold changes depending on the engine speed. 700 min^{-1} (rpm) should be used as a reference]

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1006US0

P1275 / 523540-2: Pump seizing 2

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- High pressure 2 error

DTC set preconditions:
- Sensor supply voltage VCC# is normal
- Rail pressure sensor is normal

DTC set parameter (Approximate parameter):
- Rail pressure of above 197 MPa (2010 kgf/cm^2, 28600 psi), and below 230 MPa (2350 kgf/cm^2, 33400 psi) continues total time for 35 seconds under condition of above 800 min^{-1} (rpm) [Threshold changes depending on the engine speed. 2000 min^{-1} (rpm) should be used as a reference]
- Or, rail pressure of above 220 MPa (2250 kgf/cm^2, 31900 psi) continues total time for 1.7 second under condition of below 800 min^{-1} (rpm) [Threshold changes depending on the engine speed. 700 min^{-1} (rpm) should be used as a reference]

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1007US0

Diagnostic Procedure for Pressure System DTCs

Checking of fault conditions and actions taken

If DTCs of non-pressure system are detected (*Refer to the pressure system DTCs given below.)

First locate the non-pressure system problem indicated by DTCs, and repair the affected parts. After the repair has been carried out, check for an output of pressure system DTCs. If so, begin the diagnosis of the affected pressure system.

If only pressure system DTCs are detected (*Refer to the pressure system DTCs given below.)

Diagnose the affected pressure system indicated by DTCs.

If a DTC currently exists

Begin diagnosis without returning the key switch to the OFF position. However, carefully make satisfactory / unsatisfactory judgments as the injection amount and rail pressure are limited by system actions.

If only a past DTC exists

Log the freeze-frame data, clear the DTCs, and stop the engine. Then, try to reproduce the problem using the freeze-frame data and the trouble check sheet.

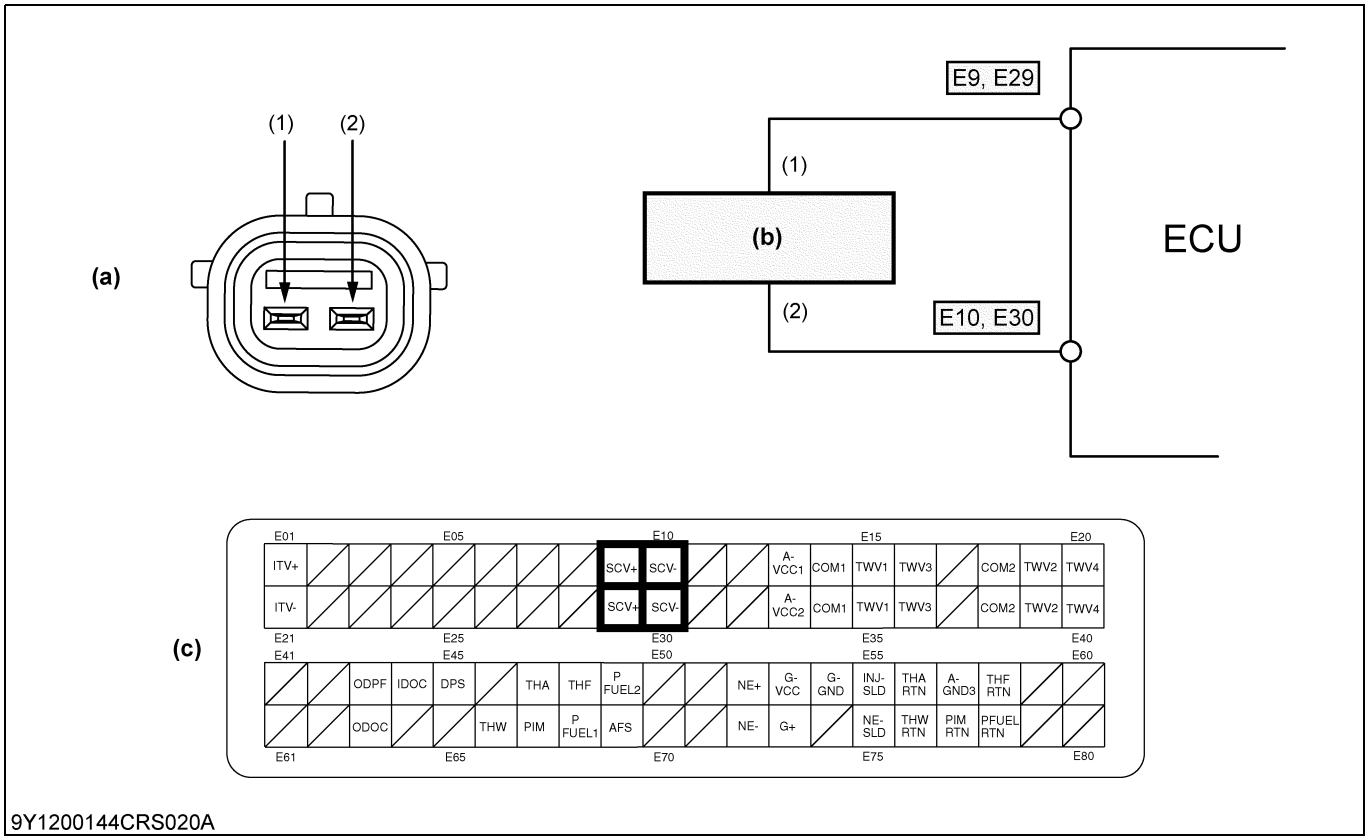
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[Low pressure abnormality]
1. P0087: Pressure limiter emergency open
2. P0093: Fuel leak

[Abnormal pressure]
1. P0089: SCV stuck
2. P1274: Pump seizing 1
3. P1275: Pump seizing 2

■ **IMPORTANT**
- **Multiple pressure system DTCs may be output simultaneously. Also, both abnormal high pressure and abnormal low pressure may be reported simultaneously under certain malfunction conditions.**

9Y1200199CRS0810US0

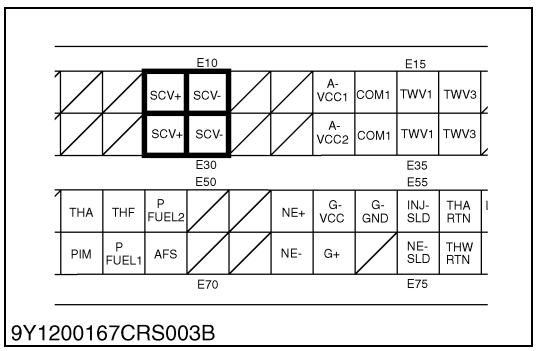


9Y1200144CRS020A

(1) Terminal SCV+ (2) Terminal SCV-

(a) Terminal Layout
(b) SCV (Suction Control Valve)
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS1009US0



9Y1200167CRS003B

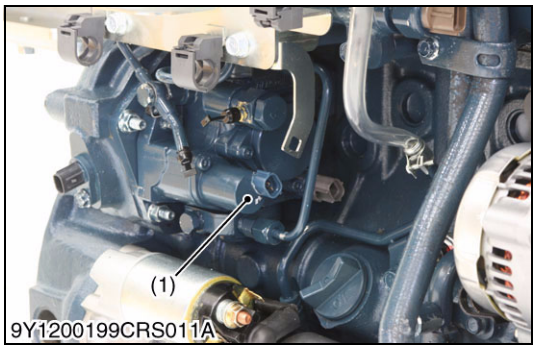
1. Measure the Resistance Between SCV Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E09 / E29 and E10 / E30 of the connector.

Factory specification		
Item	Temperature	Resistance
Resistance	20 °C (68 °F)	Approx. 2.1 Ω
Insulation resistance (between terminal and valve)	20 °C (68 °F)	100 MΩ or higher

OK	Go to "3. Check the Fuel System for the Existence of Air".
NG	Go to "2. Measure the Resistance Between Terminals of SCV Unit".

9Y1200199CRS1010US0



9Y1200199CRS011A

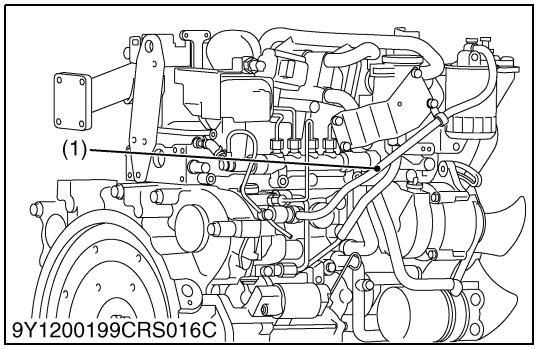
2. Measure the Resistance Between Terminals of SCV Unit

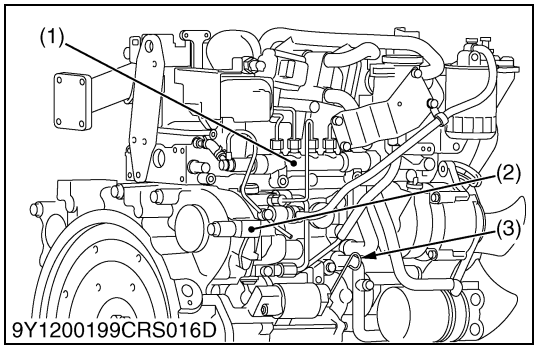
1. Refer to the SCV unit inspection procedures. (Refer to page 1-S212)

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Faulty SCV → Repair or replace the pump.

(1) SCV (Suction Control Valve)

9Y1200199CRS1011US0





3. Check the Fuel System for the Existence of Air

1. Check each joint of the fuel system for the existence of air. To detect the existence of air effectively, replace the fuel hose with a transparent one.

OK	Go to "4. Check the Fuel System".
NG	1. Rotate the fuel feed pump sufficiently and bleed the air. 2. Locate the position of the fuel leakage in the piping and repair it.

(1) Fuel Hose

9Y1200199CRS1012US0

4. Check the Fuel System

CAUTION

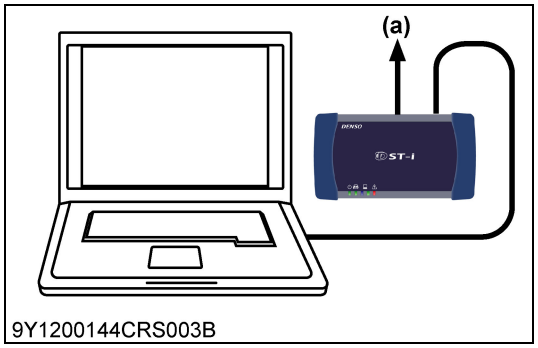
- **Visually check there is no leak in the high pressure fuel pipe system.**
- **A visual check is not possible if a leak (high pressure system) occurs inside the head cover, so check that the oil level has not increased.**

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

OK	5. Check the data related to the rail pressure
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S299)

(1) Rail
(2) Supply Pump
(3) Dipstick

9Y1200199CRS1013US0



5. Check the Data Related to the Rail Pressure

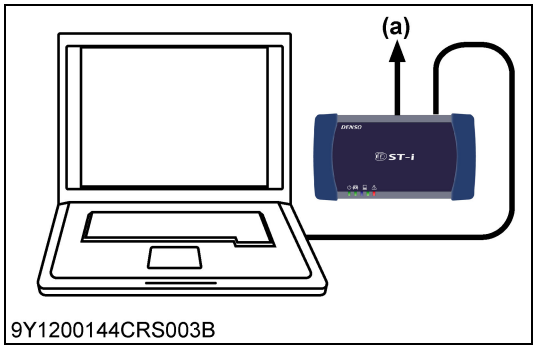
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 40 to 50 MPa (410 to 500 kgf/cm^2, 5800 to 7200 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 95.0 to 130 MPa (969 to 1320 kgf/cm^2, 13800 to 18800 psi) 3. No-load maximum speed: 95.0 to 115 MPa (969 to 1170 kgf/cm^2, 13800 to 16600 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

OK	Use all of the available information and try to reproduce the problem by operating the accelerator pedal in different ways and by changing the environmental conditions.
NG	Go to "6. Check the Rail Pressure Sensor".

(a) CAN1 Connector

9Y1200199CRS1014US0



9Y1200144CRS003B

6. Check the Rail Pressure Sensor (*Refer to Items P0192 and P0193)

1. Check the rail pressure sensor.

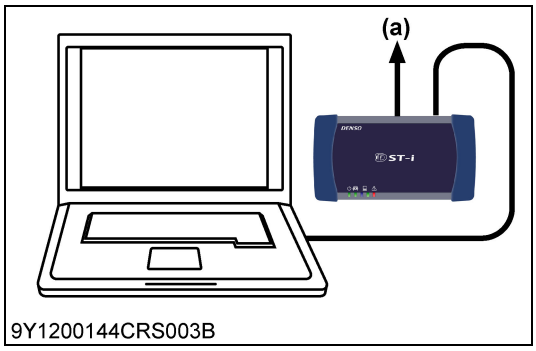
■ **NOTE**

- **Closely check sensor signals for a noise component and an abnormality that exists for a short time.**

OK	Go to "7. Check the SCV-related Data".
NG	Repair or replace the rail pressure sensor or its related parts. (Follow the diagnostic procedure of items P0192 and P0193.) (Refer to page 1-S161)

(a) CAN1 Connector

9Y1200199CRS1015US0



9Y1200144CRS003B


9Y1200199CRS005A

7. Check the SCV-related data

1. Check the "Target rail pressure", "Actual rail pressure", "Target SCV current", "Actual SCV current", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.
2. Observe the data signals by operating the accelerator pedal and others and by performing the actual run test.

Factory specification	1. The "Actual SCV current value" always follow to the "Target SCV current value". • When idling: Approx. 1800 mA • Accelerator opening: 0→100 % (During acceleration): Approx. 1400 mA minimum • During no-load maximum speed: Approx. 1600 mA • The numerical value is stable under normal operating and the target value corresponds with actual pressure value. *** The current shall be used as a reference only as this value varies depending on the pump used.** 2. The "Pressure feedback integral guard executing flag" must be OFF. 3. The "Pump deviation learning correction value" must be within ±200 mA. ■ **NOTE** • **As the following value of A varies depending on pump, the table above is for guideline. If the value of A has a wider shift than the initial learning value, there may be out of the range of the above table. A net normal value is the value that provided by the forced-learning several times.: Compared with A 12 V spec.: A-100 ≤ normal value ≤ A+50 Therefore, if the value is out of the range above, perform the forced-learning.**

■ **NOTE**

- **"Pump difference learning status"**
  It must be "2" (Learning completed) or "3" (During relearning). If not, keep idling the engine after warming up and when the learning status becomes "2" or "3", make the judgment. Occasionally, it does not shift from 3 to 2. Perform pump difference learning to take into account the above status, then compare with the status before learning.

OK	After confirming that an intermittent malfunction (such as power supply system or noise generation) does not occur in relation to the ECU, replace the ECU.
NG	Replace the supply pump.

(a) CAN1 Connector

9Y1200199CRS1016US0

(36) EEPROM Check Sum Error (DTC P1990 / 523700-13, P1991 / 523701-13, P1992 / 523702-13)

P1990 / 523700-13: EEPROM check sum error
Behaviour during malfunction:
- None

Detection item:
- KBT-EEPROM check sum error

DTC set preconditions:
- Battery voltage is normal

DTC set conditions (Guideline):
- EEPROM check sum error

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1017US0

P1991 / 523701-13: EEPROM check sum error (DST1)
Behaviour during malfunction:
- None

Detection item:
- DST1-EEPROM check sum error

DTC set preconditions:
- Battery voltage is normal

DTC set conditions (Guideline):
- EEPROM check sum error (DST1)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1018US0

P1992 / 523702-13: EEPROM check sum error (DST2)
Behaviour during malfunction:
- None

Detection item:
- DST2-EEPROM check sum error

DTC set preconditions:
- Battery voltage is normal

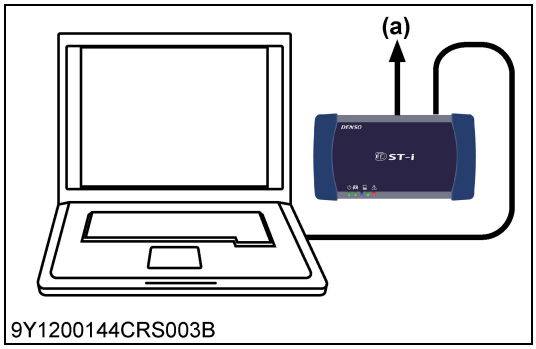
DTC set conditions (Guideline):
- EEPROM check sum error (DST2)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1019US0



1. Check the DTC

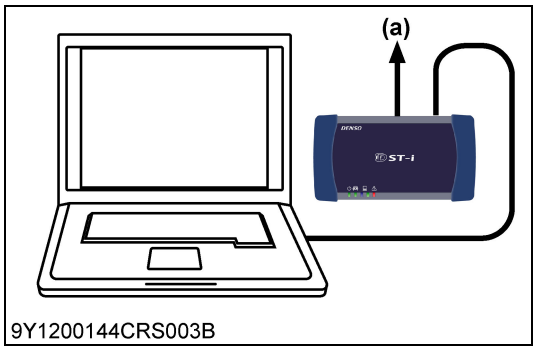
1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again.
2. Clear the DTC, and check whether the same DTC is output again or not.

Factory specification	No DTC is output.

OK	An electromagnetic interference (EMI) may have caused the temporary malfunction. There is no problem if the system has recovered.
NG	Go to "2. Write the Trim Data and Read the DTC Again".

(a) CAN1 Connector

9Y1200199CRS1020US0



2. Write the Trim Data and Read the DTC Again

1. Using the diagnosis tool, write the correct trim data in the ECU.
2. Clear the DTC and check whether the same DTC is output again or not.

Factory specification	No DTC is output.

OK	An electromagnetic interference (EMI) may have caused the temporary malfunction. There is no problem if the system has recovered.
NG	Faulty Engine ECU → Replace.

(a) CAN1 Connector

9Y1200199CRS1021US0

(37) Intake Throttle Feedback Error (DTC P2108 / 523580-2)

Behaviour during malfunction:
- None

Detection item:
- Intake throttle feedback error

DTC set preconditions:
- Battery voltage is normal

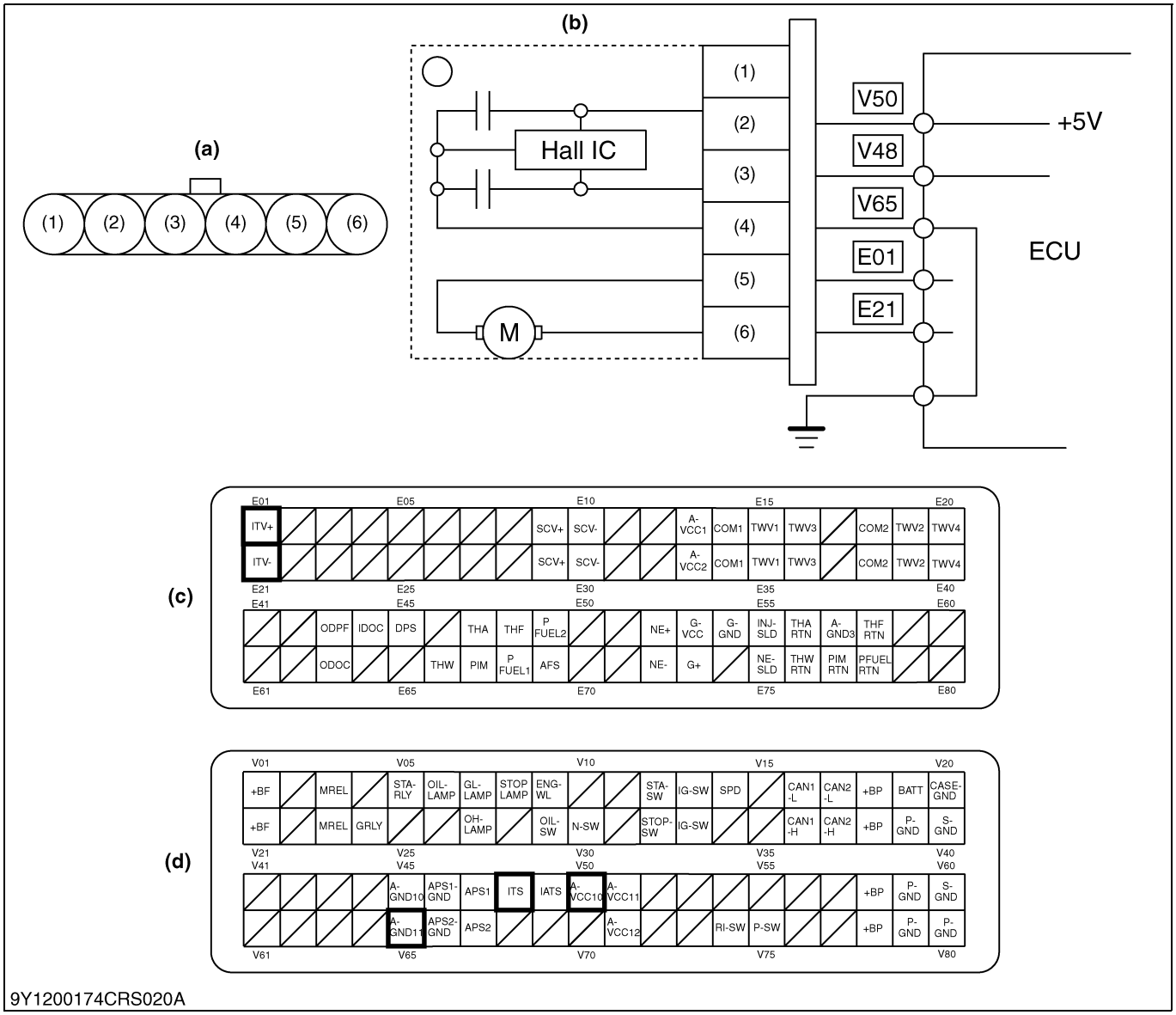
DTC set parameter (Approximate parameter):
- Deviation of throttle position is not corrected in 20 times

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- Intake throttle 100 % open

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1022US0



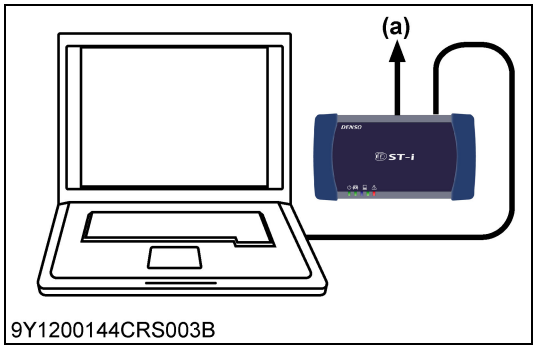
9Y1200174CRS020A

(1) No Connection
(2) Terminal Power (+5 V)
(3) Terminal ITS (Output)
(4) Terminal Ground
(5) Terminal ITV+
(6) Terminal ITV–

(a) Terminal Layout
(b) Intake Throttle Valve

(c) ECU Connector 1 (Engine Side)
(d) ECU Connector 2 (Machine Side)

9Y1200199CRS1023US0



9Y1200144CRS003B

1. Check the Intake Throttle Signal

1. After operating the engine, perform an active test.
   Monitor the "Actual intake throttle valve opening" and "Intake throttle opening output voltage", and check the values.
   *** For details, refer to the active test section.**
2. Clear the DTC and check whether it is output again or not.

Factory specification	No DTC is output.

OK	Normal.
NG	Replace the intake throttle assembly.

(a) CAN1 Connector

9Y1200199CRS1024US0

(38) Accelerator Position Sensor 1 Abnormality (DTC P2122 / 91-4, P2123 / 91-3)

P2122 / 91-4: Accelerator position sensor 1 abnormality (Low side)
Behaviour during malfunction:
- Insufficient output

Detection item:
- Sensor / wiring harness open circuit, ground short

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage (A-VCC11) is normal

DTC set parameter:
- Accelerator position sensor voltage 1 is 0.3 V or lower

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Accelerator opening limit: ACCPF ≤ 25 %

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1025US0

P2123 / 91-3: Accelerator position sensor 1 abnormality (High side)
Behaviour during malfunction:
- Insufficient output

Detection item:
- Sensor / wiring harness power supply short

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage (A-VCC11) is normal

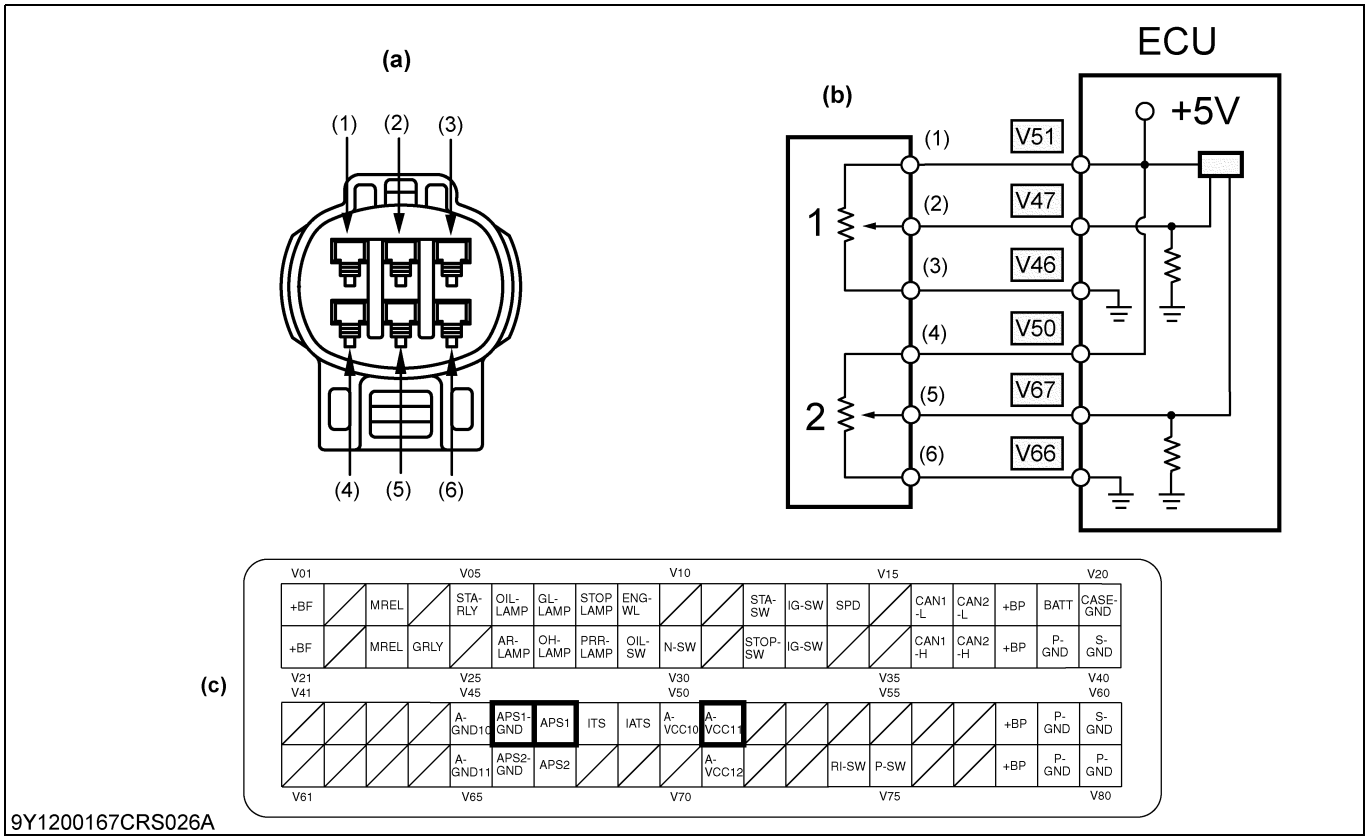
DTC set parameter:
- Accelerator position sensor voltage 1 is 4.8 V or higher

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Accelerator opening limit: ACCPF ≤ 25 %

Recovery from error:
- Diagnostic counter = zero

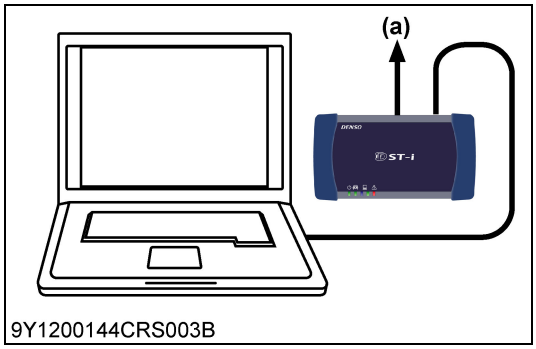
9Y1200199CRS1026US0



(1) Terminal A-VCC11
(2) Terminal APS1
(3) Terminal APS1 GND
(4) Terminal A-VCC10
(5) Terminal APS2
(6) Terminal APS2 GND

(a) Terminal Layout
(b) Accelerator Position Sensor
(c) ECU Connector 2 (Machine Side)

9Y1200199CRS1027US0



1. Check the Accelerator Position Sensor Signals

1. Place the key switch in the ON position, and check the "Accelerator position" and "Accelerator position sensor 1 output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual accelerator pedal position	Accelerator pedal position	Output voltage
Fully close	0 %	1.35 V or lower (1.1) ( ): Follow the OEM adjusted value
Fully open	100 %	4.0 V or higher (4.2) ( ): Follow the OEM adjusted value

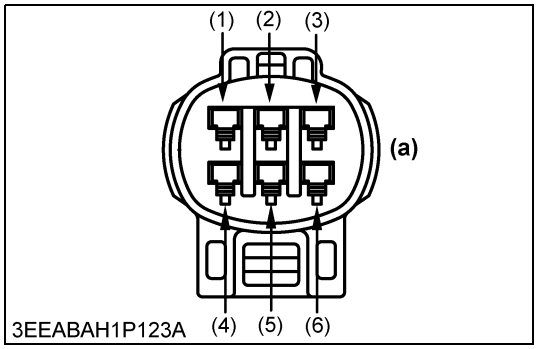
■ **NOTE**

- **"Full close" and "Full open" are with the accelerator position sensor, not with the accelerator pedal or hand accelerator.**

OK	Clear the DTC and check whether it is detected again or not. ▼	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Voltage Between Sensor Terminals".	

(a) CAN1 Connector

9Y1200199CRS1028US0



3EEABAH1P123A

2. Measure the Voltage Between Sensor Terminals

1. Place the key switch in the OFF position, unplug the accelerator position sensor connector from the socket, and return the key switch to the ON position again.
2. Measure the voltage between terminals (1) and (3) of accelerator position sensor connector (at the machine wiring harness side).

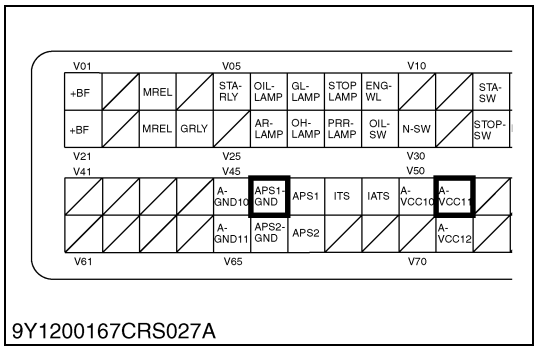
Factory specification	4.5 to 5.5 V

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Measure the Terminal Voltage".

(1) Terminal A-VCC11
(2) Terminal APS1
(3) Terminal APS1 GND
(4) Terminal A-VCC10
(5) Terminal APS2
(6) Terminal APS2 GND

(a) Terminal Layout

9Y1200199CRS1029US0



9Y1200167CRS027A

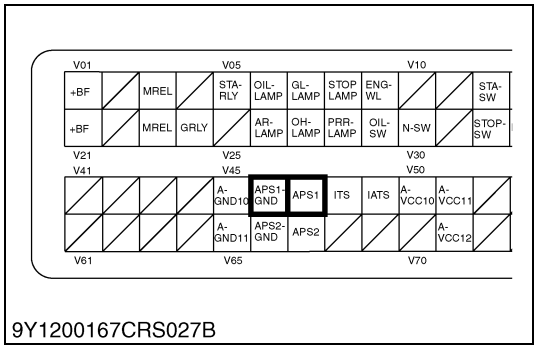
3. Measure the Terminal Voltage

1. Measure the voltage between ECU terminals V46 and V51.

Factory specification	4.5 to 5.5 V

OK	The wiring harness between the ECU and sensor is faulty. → Repair.	
NG	Check the ECU connectors.	
	OK	Faulty ECU → Replace.
	NG	Repair the ECU connectors.

9Y1200199CRS1030US0



9Y1200167CRS027B

4. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and plug the accelerator position sensor connector into the socket.
2. Place the key switch in the ON position, and measure the voltage between ECU terminals V47 and V46.

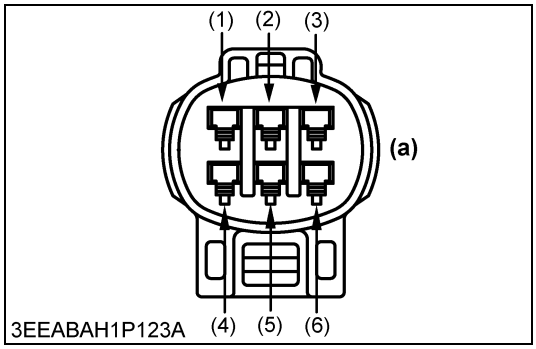
Factory specification	Accelerator pedal fully closed: 1.35 V or lower (1.1) Accelerator pedal full throttle: 4.0 V or higher (4.2) ( ): Follow the OEM adjusted value

■ **NOTE**

- **"Full close" and "Full open" are with the accelerator position sensor, not with the accelerator pedal or hand accelerator.**

OK	Check the ECU connectors.	
	OK	Faulty ECU → Replace.
	NG	Repair the ECU connectors.
NG	Go to "5. Measure the Voltage Between Sensor Terminals".	

9Y1200199CRS1031US0



5. Measure the Voltage Between Sensor Terminals

1. Keep the accelerator position sensor connector plugged into socket.
2. Measure the voltage between terminals (2) and (3) of accelerator position sensor connector (at the machine wiring harness side).

Factory specification	Accelerator pedal fully closed: 1.35 V or lower (1.1) Accelerator pedal full throttle: 4.0 V or higher (4.2) ( ): Follow the OEM adjusted value

OK	Wiring harness open circuit, short → Check and repair.
NG	Faulty accelerator sensor → Replace.

(1) Terminal A-VCC11
(2) Terminal APS1
(3) Terminal APS1 GND
(4) Terminal A-VCC10
(5) Terminal APS2
(6) Terminal APS2 GND

(a) Terminal Layout

9Y1200199CRS1032US0

(39) Accelerator Position Sensor 2 Abnormality (DTC P2127 / 29-4, P2128 / 29-3)

P2127 / 29-4: Accelerator position sensor 2 abnormality (Low side)
Behaviour during malfunction:
- Insufficient output

Detection item:
- Ground short circuit / open circuit of sensor / harness

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC1 is normal

DTC set parameter:
- Voltage of accelerator position sensor 2 is 0.3 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Forced Idle (Accelerator = 0 %)

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1033US0

P2128 / 29-3: Accelerator position sensor 2 abnormality (High side)
Behaviour during malfunction:
- Insufficient output

Detection item:
- Battery short circuit out of sensor / harness

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC1 is normal

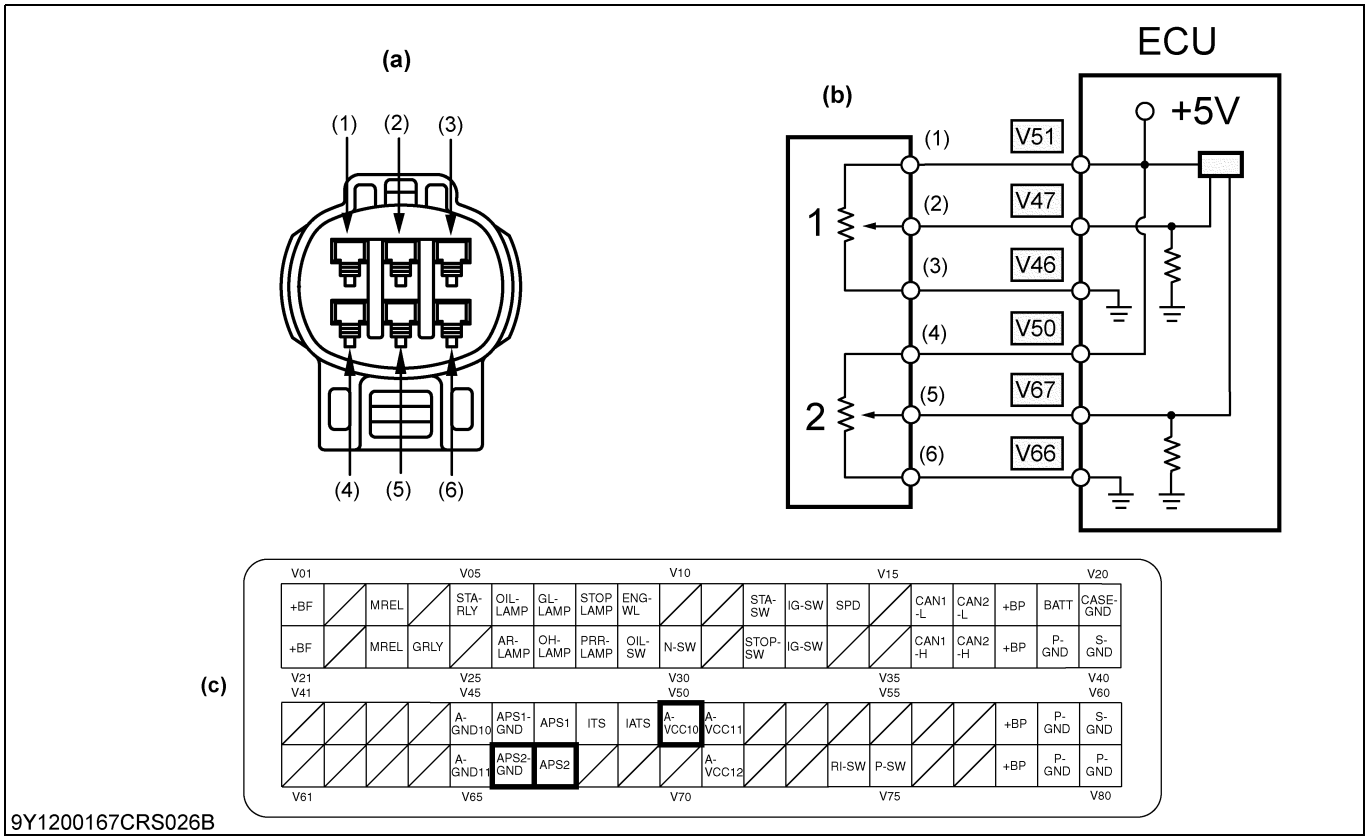
DTC set parameter:
- Voltage of accelerator position sensor 2 is 4.8 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Forced Idle (Accelerator = 0 %)

Recovery from error:
- Diagnostic counter = zero

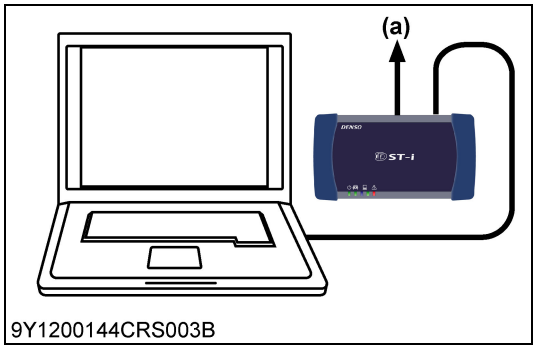
9Y1200199CRS1034US0



(1) Terminal A-VCC11
(2) Terminal APS1
(3) Terminal APS1 GND
(4) Terminal A-VCC10
(5) Terminal APS2
(6) Terminal APS2 GND

(a) Terminal Layout
(b) Accelerator Position Sensor
(c) ECU Connector 2 (Machine Side)

9Y1200199CRS1035US0



1. Check the Accelerator Position Sensor Signals

1. Place the key switch in the ON position, and check the "Accelerator position" and "Accelerator position sensor 2 output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual accelerator pedal position	Accelerator pedal position	Output voltage
Fully close	0 %	1.35 V or lower (1.1) ( ): Follow the OEM adjusted value
Fully open	100 %	4.0 V or higher (4.2) ( ): Follow the OEM adjusted value

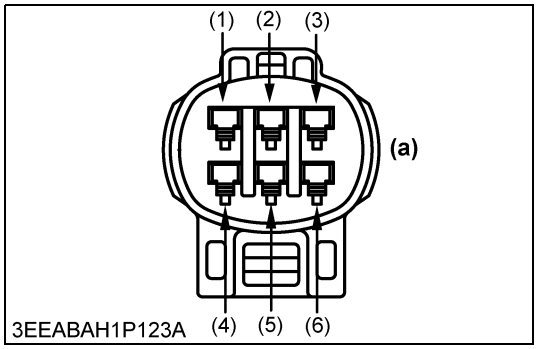
■ **NOTE**

- **"Full close" and "Full open" are with the accelerator position sensor, not with the accelerator pedal or hand accelerator.**

OK	Clear the DTC and check whether it is detected again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Voltage Between Sensor Terminals".	

(a) CAN1 Connector

9Y1200199CRS1036US0



3EEABAH1P123A

2. Measure the Voltage Between Sensor Terminals

1. Place the key switch in the OFF position, unplug the accelerator position sensor connector from the socket, and return the key switch to the ON position again.
2. Measure the voltage between terminals (4) and (6) of accelerator position sensor connector (at the machine wiring harness side).

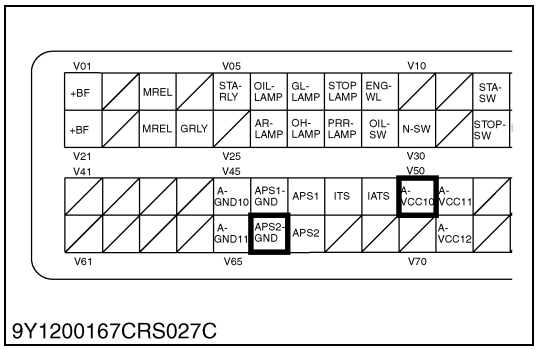
Factory specification	4.5 to 5.5 V

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Measure the Terminal Voltage".

(1) Terminal A-VCC11
(2) Terminal APS1
(3) Terminal APS1 GND
(4) Terminal A-VCC10
(5) Terminal APS2
(6) Terminal APS2 GND

(a) Terminal Layout

9Y1200199CRS1037US0



9Y1200167CRS027C

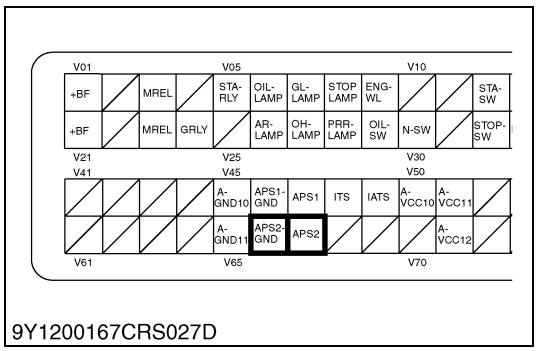
3. Measure the Terminal Voltage

1. Measure the voltage between ECU terminals V50 and V66.

Factory specification	4.5 to 5.5 V

OK	The wiring harness between the ECU and sensor is faulty. → Repair.	
NG	Check the ECU connectors.	
	OK	Faulty ECU → Replace.
	NG	Repair the ECU connectors.

9Y1200199CRS1038US0



9Y1200167CRS027D

4. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and plug the accelerator position sensor connector into the socket.
2. Place the key switch in the ON position, and measure the voltage between ECU terminals V66 and V67.

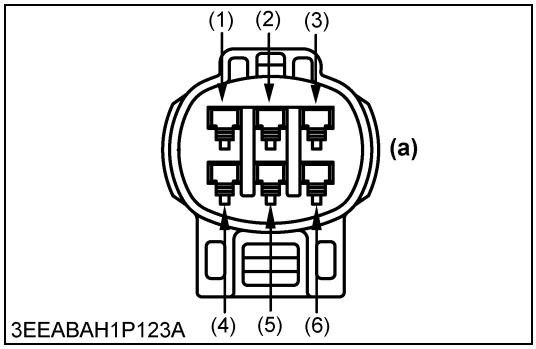
Factory specification	Accelerator pedal fully closed: 1.35 V or lower (1.1) Accelerator pedal full throttle: 4.0 V or higher (4.2) ( ): Follow the OEM adjusted value

■ **NOTE**

- **"Full close" and "Full open" are with the accelerator position sensor, not with the accelerator pedal or hand accelerator.**

OK	Check the ECU connectors.	
	OK	Faulty ECU → Replace.
	NG	Repair the ECU connectors.
NG	Go to "5. Measure the Voltage Between Sensor Terminals".	

9Y1200199CRS1039US0



5. Measure the Voltage Between Sensor Terminals

1. Keep the accelerator position sensor connector plugged into socket.
2. Measure the voltage between terminals (5) and (6) of accelerator position sensor connector (at the machine wiring harness side).

Factory specification	Accelerator pedal fully closed: 1.35 V or lower (1.1) Accelerator pedal full throttle: 4.0 V or higher (4.2) ( ): Follow the OEM adjusted value

OK	Wiring harness open circuit, short → Check and repair.
NG	Faulty accelerator sensor → Replace.

(1) Terminal A-VCC11
(2) Terminal APS1
(3) Terminal APS1 GND
(4) Terminal A-VCC10
(5) Terminal APS2
(6) Terminal APS2 GND

(a) Terminal Layout

9Y1200199CRS1040US0

(40) Accelerator Position Sensor Error (CAN) (DTC P2131 / 523543-2)

Behaviour during malfunction:
- Insufficient output

Detection item:
- Accelerator position sensor signal error (sensor / harness open circuit, short to ground etc)

DTC set preconditions:
- Battery voltage is normal
- Key switch turn OFF to ON
- No ST signal

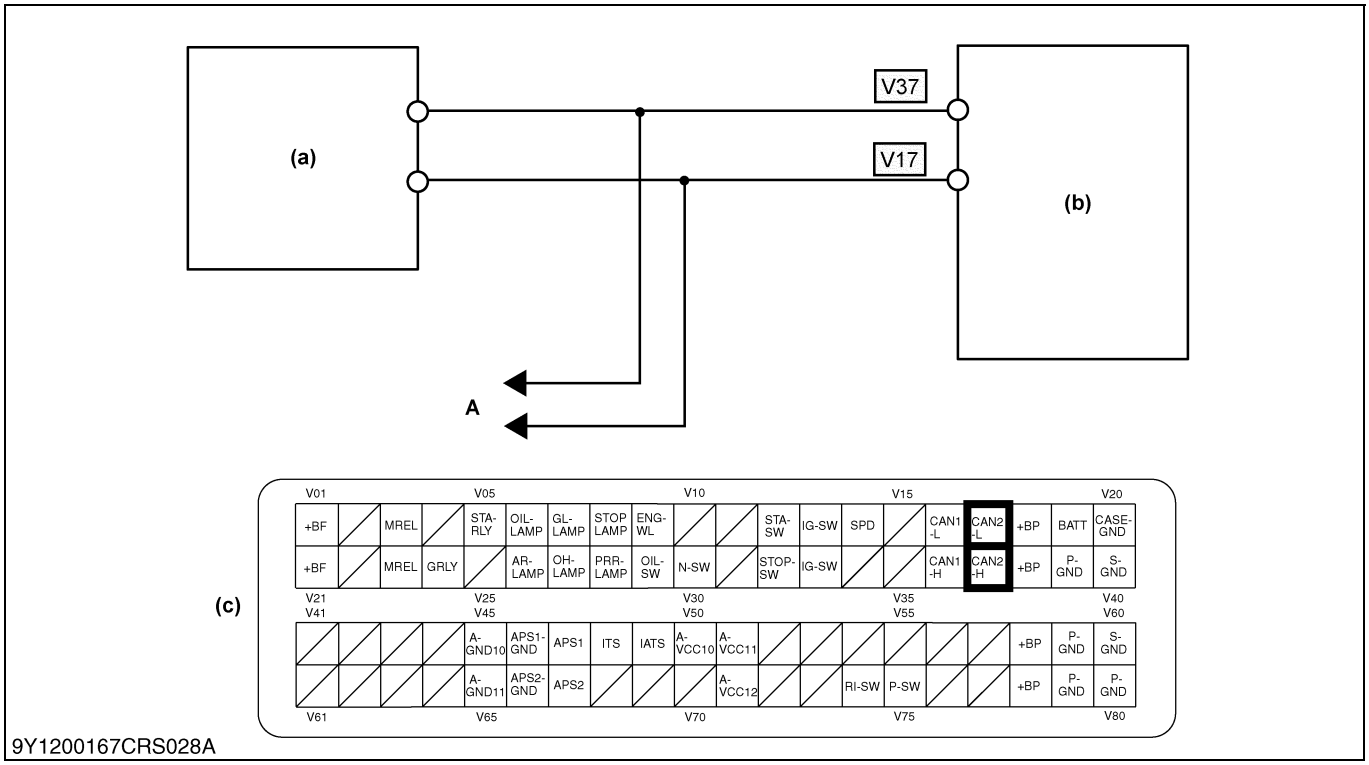
DTC set parameter:
- When accelerator position sensor error signal received by CAN

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Not applicable

Recovery from error:
- Diagnostic counter = zero (CAN signal recovers)

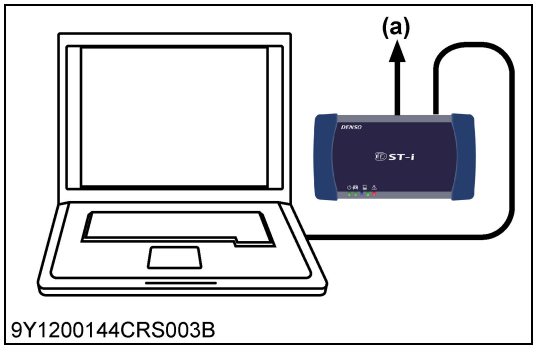
9Y1200199CRS1041US0



9Y1200167CRS028A

(a) ECU for Machine **(b) Engine ECU** **(c) ECU Connector 2 (Machine Side)** **A: To Other ECU**

9Y1200199CRS1042US0



9Y1200144CRS003B

1. DTC Judgment

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position, check whether the DTC (P2131) is output or not.

Factory specification	No DTC (P2131) is output.

OK	Normal.
NG	Go to "2. Check the Monitor of the Machine".

(a) CAN1 Connector

9Y1200199CRS1043US0

2. Check the Monitor of the Machine

1. Turn on the key switch and confirm that no defects except those in the engine occur.

Factory specification	No defects except that in the engine occur.

OK	Possible defects in the ECU for the machine. Execute the diagnosis according to the workshop manual for the machine.
NG	Defects in the accelerator sensor signal. Execute the diagnosis according to the workshop manual for the machine.

9Y1200199CRS1044US0

(41) Accelerator Position Sensor Correlation Error (DTC P2135 / 91-2)

Behaviour during malfunction:
- Insufficient output

Detection item:
- Deviation from designed correlation in two sensors

DTC set preconditions:
- Battery voltage is normal
- Accelerator position sensor 1 is normal
- Accelerator position sensor 2 is normal

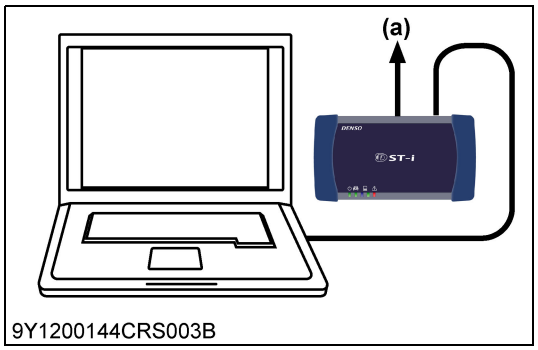
DTC set parameter:
- Deviation from designed correlation in two sensors
- It depends on engine application

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Forced Idle (Accelerator = 0 %)

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1045US0



9Y1200144CRS003B

1. Check the Accelerator Position Sensor 1 and 2 (Refer to items P2122, P2123, P2127 and P2128)

1. Check the accelerator position sensor 1 and 2. (Refer to page 1-S229)

■ **NOTE**
- **This DTC is used to detect the characteristic difference between the two sensors' output. So, check the both sensors in the same way as the procedure of the "Accelerator Position Sensor 1 (or 2) Abnormality"**
- **The adjustment value of the sensor signal needs to be followed by the specification of the machine.**

OK	Normal
NG	Replace the accelerator position sensor 1 or 2.

(a) CAN1 Connector

9Y1200199CRS1046US0

(42) Common 1 System Injector Drive Circuit Open (DTC P2146 / 523523-2)

Behaviour during malfunction:
- Insufficient output
- Large vibration
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Wiring harness open circuit

DTC set preconditions:
- Engine is operating
- Battery voltage is normal
- During injection
- CPU is normal

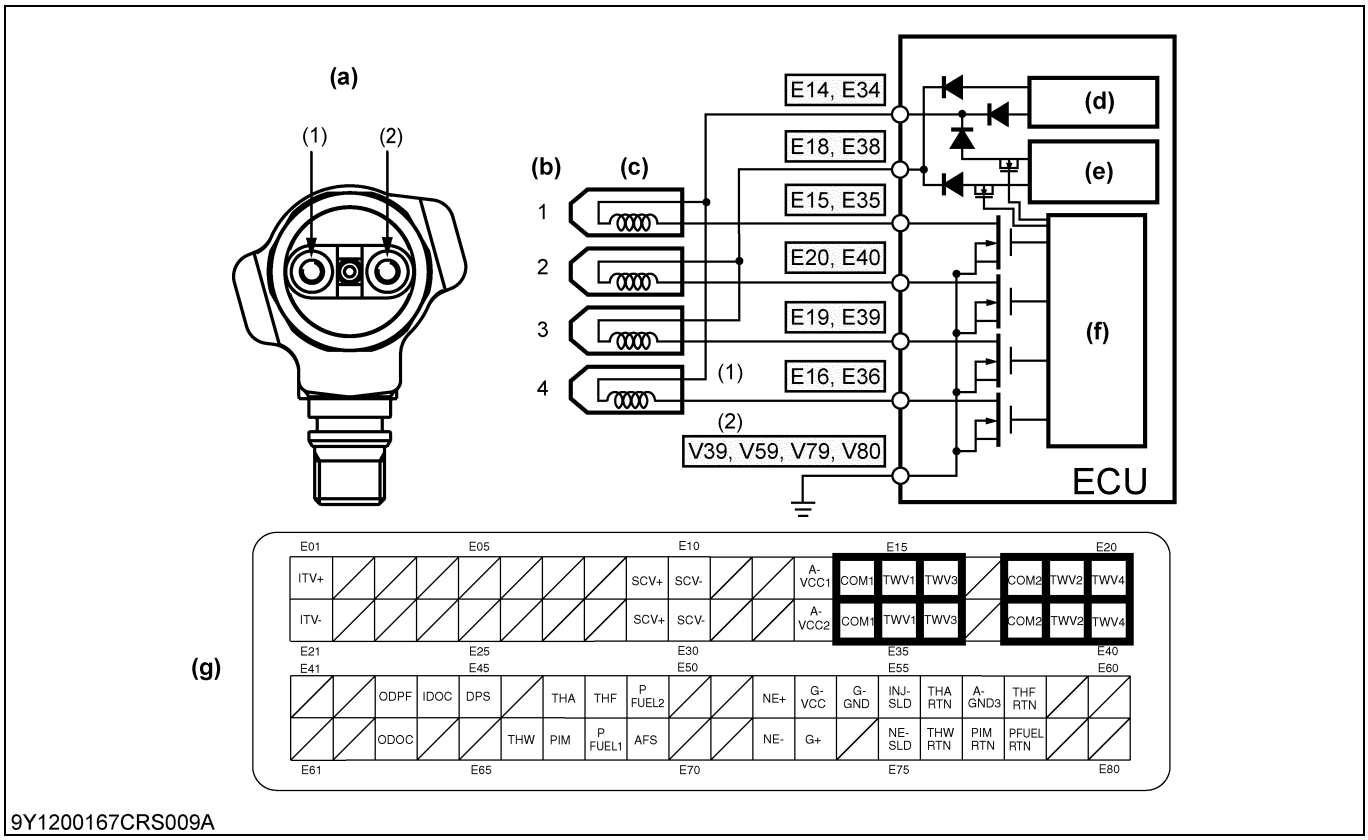
DTC set parameter:
- When wiring harness open circuit

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1047US0

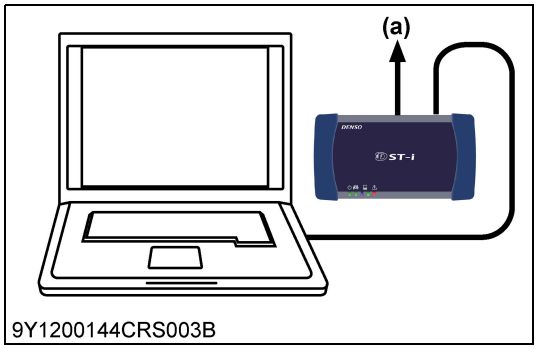


9Y1200167CRS009A

(1) Terminal COMMON
(2) Terminal TWV

(a) Terminal Layout
(b) Engine Cylinder No.
(c) Injectors
(d) Constant Amperage Circuit
(e) High Voltage Generation Circuit
(f) Control Circuit
(g) ECU Connector 1 (Engine Side)

9Y1200199CRS1048US0



9Y1200144CRS003B

1. DTC Judgment

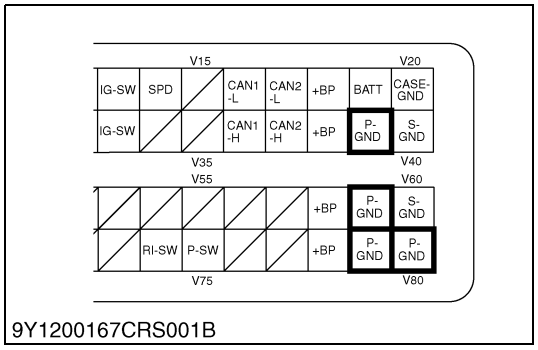
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position, check whether the DTC (P2146, P2149) is output or not.

Factory specification	Either DTC P2146 or P2149 is output.

OK	Go to "4. Measure the Resistance Between ECU Terminals".
NG	Go to "2. Check the "P- GND" Wiring Harness".

(a) CAN1 Connector

9Y1200199CRS1049US0



9Y1200167CRS001B

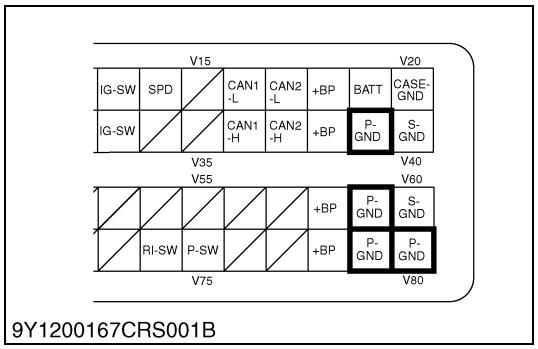
2. Check the "P- GND" Wiring Harness

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between each ECU terminal and the chassis ground (at the wiring harness side).

Factory specification	1.5 Ω or lower

OK	Go to "3. Check the "P- GND" Wiring Harness Connector and ECU Pins".
NG	1. Check the "P- GND" wiring harness → Repair. 2. Locate the cause of open circuit, or increase its resistance value.

9Y1200199CRS1050US0



9Y1200167CRS001B

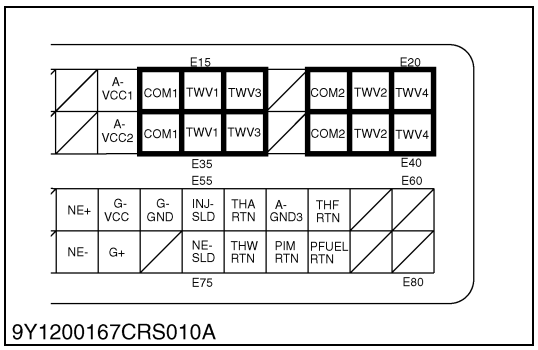
3. Check the "P- GND" Wiring Harness Connector and ECU Pins

1. Place the key switch in the OFF position, unplug the ECU connector from the socket, and check the ECU pins for faulty connection, deformation, poor contact or other defects.

Factory specification	Must be free from faulty connection, deformation, poor contact or other defects.

OK	Go to "4. Measure the Resistance Between ECU Terminals".
NG	Repair wiring harness connectors and ECU pins, or replace them if defective.

9Y1200199CRS1051US0



9Y1200167CRS010A

4. Measure the Resistance Between ECU Terminals

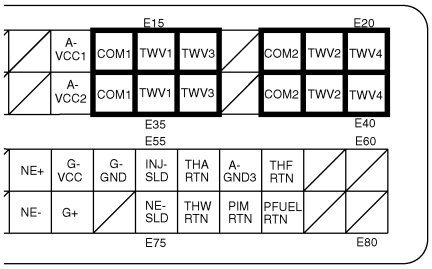
1. Place the key switch in the OFF position, unplug the ECU wiring harness connector, and measure the resistance between each terminal at the connector side as shown on the following table.

DTC	ECU Terminals Measured	
P2146	E14, E34	No. 1 cylinder E15, E35
		No. 4 cylinder E16, E36
P2149	E18, E38	No. 3 cylinder E19, E39
		No. 2 cylinder E20, E40

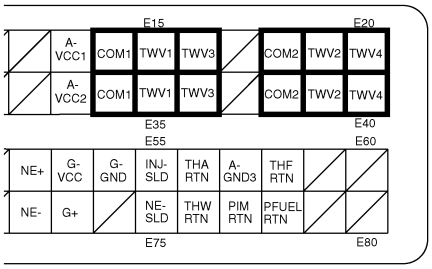
Factory specification	Both system cables must have 1.5 Ω or lower.

OK	Go to "6. Check the Wiring Harness Connectors and ECU Pins".
NG	Go to "5. Check the Wiring Harness → Repair or Replace the Faulty Area".

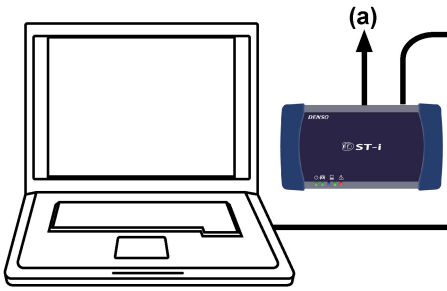
9Y1200199CRS1052US0



9Y1200167CRS010A



9Y1200167CRS010A



9Y1200144CRS003B

5. Check the Wiring Harness → Repair or Replace the Faulty Area

Check the wiring harness between ECU terminals E14 / E34 or E18 / E38 and each injector terminal (E15 / E35, E16 / E36, E19 / E39 or E20 / E40), and locate the open harness,

9Y1200199CRS1053US0

6. Check the Wiring Harness Connectors and ECU Pins

1. Check the wiring harness connectors of each ECU terminal and the ECU pins for faulty connection, deformation or other defects.

OK	Go to "7. Check the DTC".
NG	The connectors or ECU pins are faulty. → Repair them or replace the ECU.

9Y1200199CRS1054US0

7. Check the DTC

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Start the engine, and clear the past DTCs.
3. Read the DTC again.

Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

9Y1200199CRS1055US0

(43) Common 1 TWV Actuation System Short (DTC P2147 / 523523-4, P2148 / 523523-3)

P2147 / 523523-4: Common 1 TWV actuation system ground short

Behaviour during malfunction:
- Insufficient output
- Large vibration
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Wiring harness short to ground

DTC set preconditions:
- Engine is operating
- Battery voltage is normal

DTC set parameter:
- When wiring harness short to ground occurs

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Injectors which have DTC stop injection
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1056US0

P2148 / 523523-3: Common 1 TWV actuation system +B short

Behaviour during malfunction:
- Insufficient output
- Large vibration
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Wiring harness short to +B

DTC set preconditions:
- Engine is operating
- Battery voltage is normal

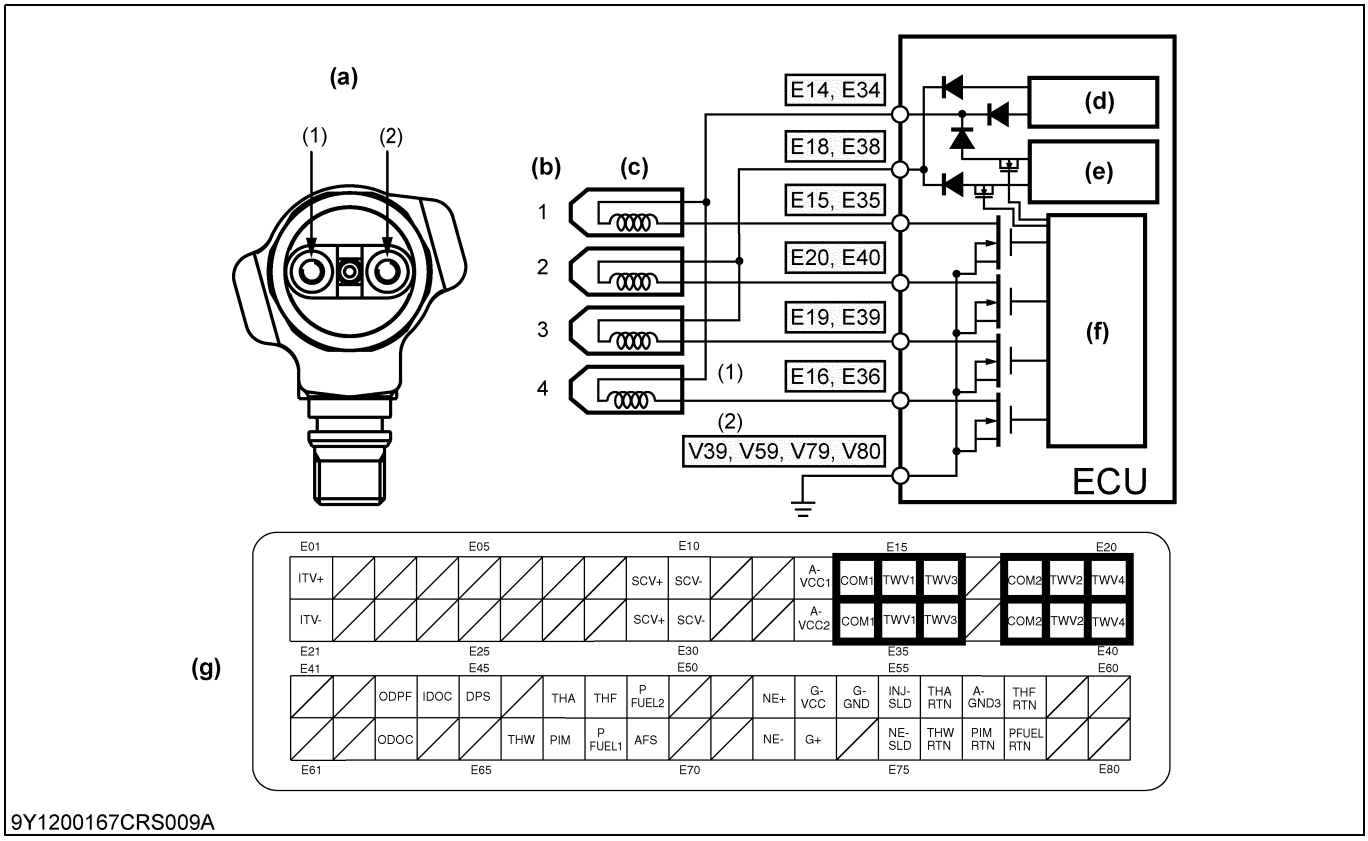
DTC set parameter:
- When wiring harness short to +B occurs

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Injectors which have DTC stop injection
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1057US0

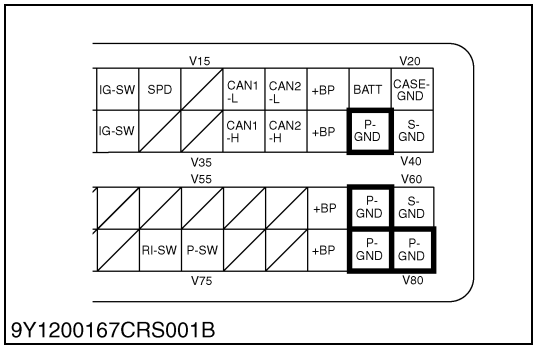


9Y1200167CRS009A

(1) Terminal COMMON
(2) Terminal TWV

(a) Terminal Layout
(b) Engine Cylinder No.
(c) Injector
(d) Rated amperage circuit
(e) High-voltage generating circuit
(f) Control circuit
(g) ECU Connector 1 (Engine Side)

9Y1200199CRS1058US0



9Y1200167CRS001B

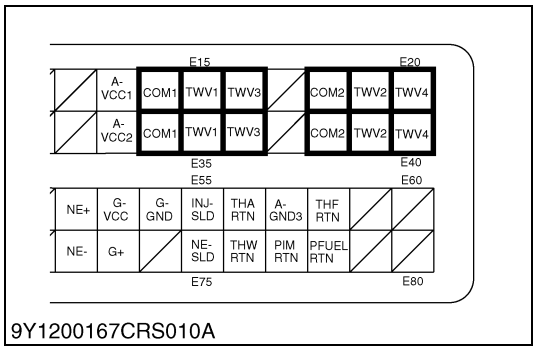
1, Check the "P- GND" Wiring Harness

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector 2 (machine side) from the socket, and measure the resistance between each of ECU terminals V39, V59, V79 or V80 and the chassis ground (at the wiring harness side).

Factory specification	1.5 Ω or lower

OK	Go to "2. Check the Wiring Harness Connectors and ECU Pins".
NG	Check the "P- GND" wiring harness. → Repair. Locate the cause of open circuit, or increase its resistance value.

9Y1200199CRS1059US0



9Y1200167CRS010A

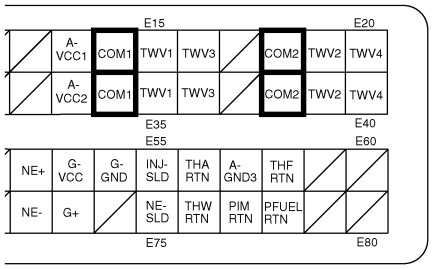
2. Check the Wiring Harness Connectors and ECU Pins

1. Place the key switch in the OFF position, unplug the ECU connector 1 (engine side) from the socket, and check the ECU pins for faulty connection, deformation, poor contact or other defects.

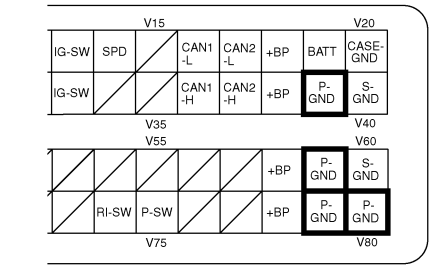
Factory specification	Must be free from faulty connection, deformation, poor contact or other defects.

OK	Go to "3. Measure the ECU Terminal Voltage (Part 1)".
NG	Repair wiring harness connectors and ECU pins, or replace them if defective.

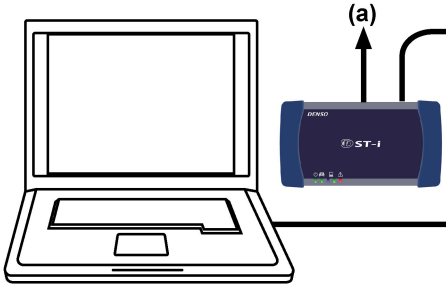
9Y1200199CRS1060US0



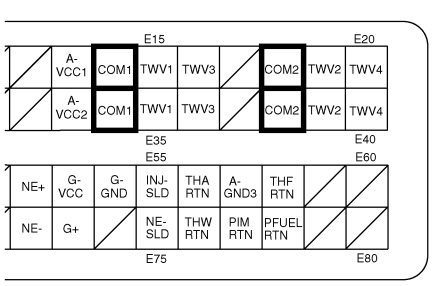
9Y1200167CRS010E



9Y1200167CRS001B



9Y1200144CRS003B



9Y1200167CRS010E

3. Measure the ECU Terminal Voltage (Part 1)

1. Place the key switch in the ON position, and measure the voltage between ECU terminal E14 / E34 or E18 / E38 and "P-GND" terminal.

Factory specification	Approx. 6 V

OK	Go to "4. Check the DTC".
NG	Go to "5. Measure the ECU Terminal Voltage (Part 2)".

9Y1200199CRS1061US0

4. Check the DTC

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Start the engine, and clear the past DTCs.
3. Read the DTC again.

Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

9Y1200199CRS1062US0

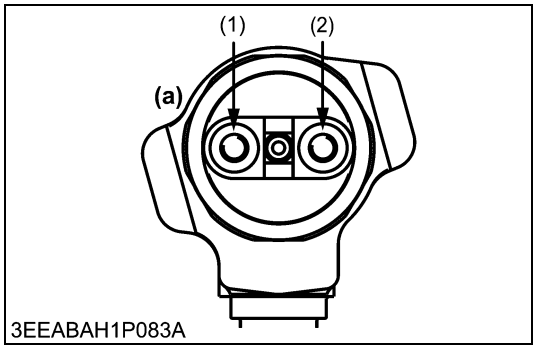
5. Measure the ECU Terminal Voltage (Part 2)

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector 1 (engine side) from the socket, return the key switch to the ON position again, and measure the voltage between each of ECU terminal pins E14 / E34 and E18 / E38 and the "P -GND" terminal (at the wiring harness side).

Factory specification	Approx. 6 V

OK	Go to "6. Check the Wiring Harness".
NG	Faulty ECU → Replace.

9Y1200199CRS1063US0



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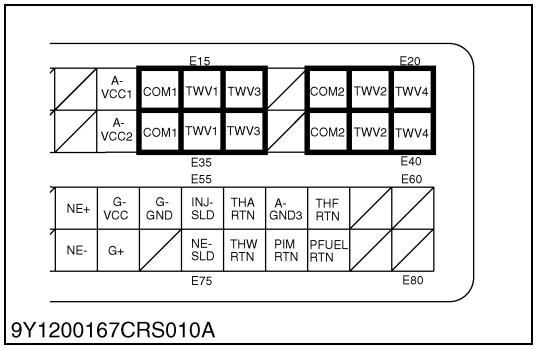


9Y1200167CRS010A

6. Check the Wiring Harness

Locate the cause of wiring harness ground short, and repair the faulty area.

DTC	Relating ECU Terminals	Shorted Harness Side
P2147	Terminal E14 / E34 or E18 / E38 (E15 / E35, E16 / E36, E19 / E39, E20 / E40 occurring simultaneously)	Ground
P2148	Terminal E14 / E34 or E18 / E38 (E15 / E35, E16 / E36, E19 / E39, E20 / E40 occurring simultaneously)	Power supply

■ **NOTE**

- **If DTC P2147 (Shorted injector actuation circuit to the ground) has occurred, be sure to check the insulation of injector itself in the following procedure.**

1. Place the key switch in the OFF position, unplug each injector connector from socket, and visually check the connector status.

Factory specification	Must be free from sludge and sparks.

2. Using an insulation resistance tester (megger tester), measure the resistance between each of terminals (1) and (2) and the chassis ground (at the injector side).

Factory specification	10 MΩ or higher

OK	The injector functions normally. Locate another cause.
NG	Faulty injector → Replace.

(1) Terminal COMMON
(2) Terminal TWV
(a) Injector

9Y1200199CRS1064US0

(44) Common 2 System Injector Drive Circuit Open (DTC P2149 / 523524-2)

Behaviour during malfunction:
- Insufficient output
- Large vibration
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Wiring harness open circuit

DTC set preconditions:
- Engine is operating
- Battery voltage is normal
- During injection
- CPU is normal

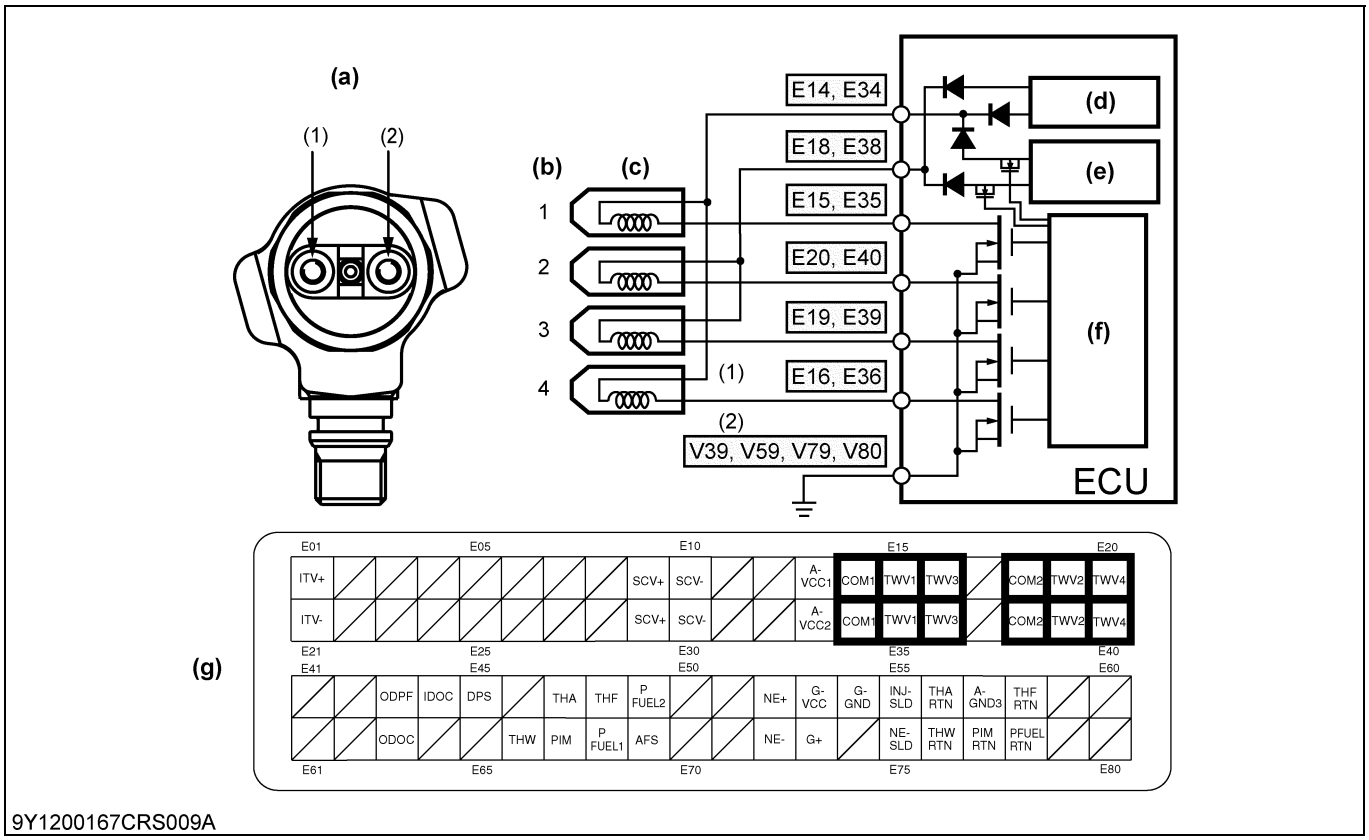
DTC set parameter:
- When wiring harness open circuit

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1065US0

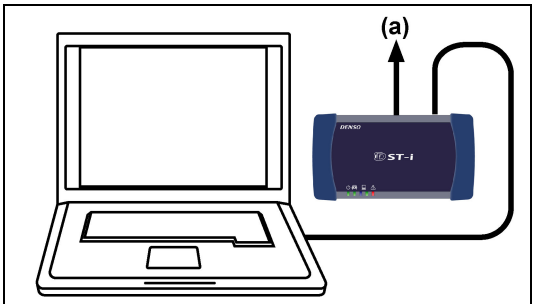


9Y1200167CRS009A

(1) Terminal COMMON
(2) Terminal TWV

(a) Terminal Layout
(b) Engine Cylinder No.
(c) Injectors
(d) Constant Amperage Circuit
(e) High Voltage Generation Circuit
(f) Control Circuit
(g) ECU Connector 1 (Engine Side)

9Y1200199CRS1066US0



9Y1200144CRS003B

1. DTC Judgment

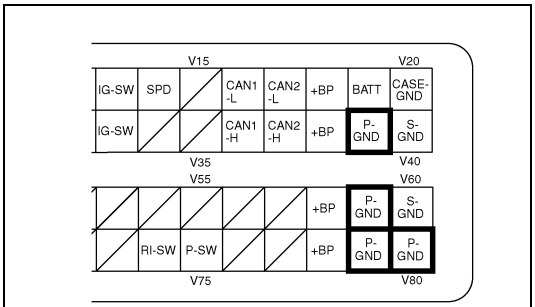
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position, check whether the DTC (P2146, P2149) is output or not.

Factory specification	Either DTC P2146 or P2149 is output.

OK	Go to "4. Measure the Resistance Between ECU Terminals".
NG	Go to "2. Check the "P- GND" Wiring Harness".

(a) CAN1 Connector

9Y1200199CRS1049US0



9Y1200167CRS001B

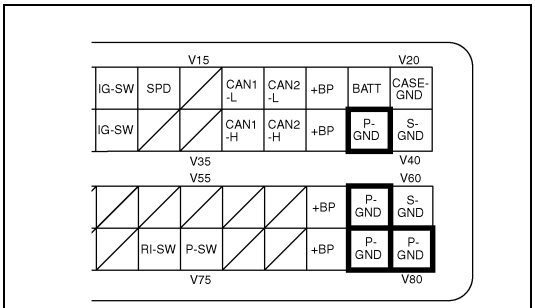
2. Check the "P- GND" Wiring Harness

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between each ECU terminal and the chassis ground (at the wiring harness side).

Factory specification	1.5 Ω or lower

OK	Go to "3. Check the "P- GND" Wiring Harness Connector and ECU Pins".
NG	1. Check the "P- GND" wiring harness → Repair. 2. Locate the cause of open circuit, or increase its resistance value.

9Y1200199CRS1050US0



9Y1200167CRS001B

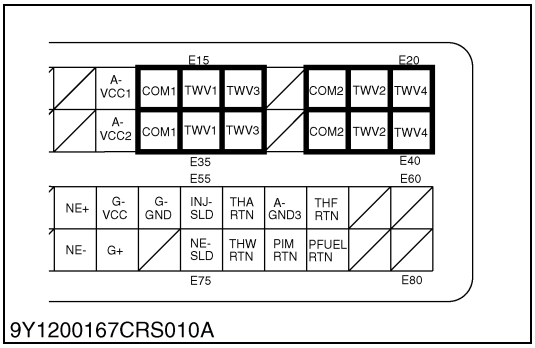
3. Check the "P- GND" Wiring Harness Connector and ECU Pins

1. Place the key switch in the OFF position, unplug the ECU connector from the socket, and check the ECU pins for faulty connection, deformation, poor contact or other defects.

Factory specification	Must be free from faulty connection, deformation, poor contact or other defects.

OK	Go to "4. Measure the Resistance Between ECU Terminals".
NG	Repair wiring harness connectors and ECU pins, or replace them if defective.

9Y1200199CRS1051US0



9Y1200167CRS010A

4. Measure the Resistance Between ECU Terminals

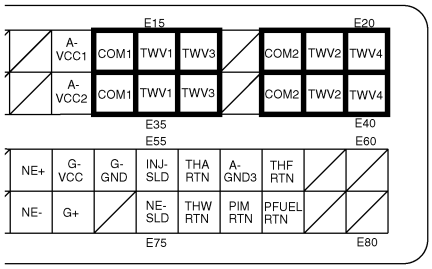
1. Place the key switch in the OFF position, unplug the ECU wiring harness connector, and measure the resistance between each terminal at the connector side as shown on the following table.

DTC	ECU Terminals Measured	
P2146	E14, E34	No. 1 cylinder E15, E35
		No. 4 cylinder E16, E36
P2149	E18, E38	No. 3 cylinder E19, E39
		No. 2 cylinder E20, E40

Factory specification	Both system cables must have 1.5 Ω or lower.

OK	Go to "6. Check the Wiring Harness Connectors and ECU Pins".
NG	Go to "5. Check the Wiring Harness → Repair or Replace the Faulty Area".

9Y1200199CRS1052US0



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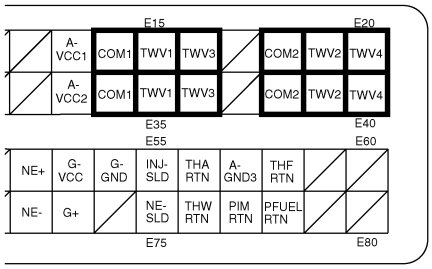

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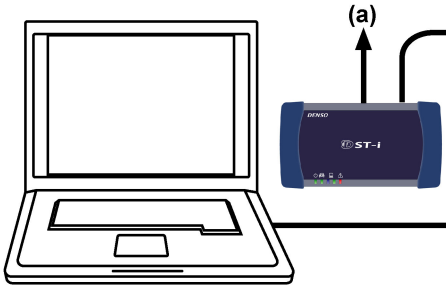


9Y1200144CRS003B

5. Check the Wiring Harness → Repair or Replace the Faulty Area

Check the wiring harness between ECU terminals E14 / E34 or E18 / E38 and each injector terminal (E15 / E35, E16 / E36, E19 / E39 or E20 / E40), and locate the open harness,

9Y1200199CRS1053US0

6. Check the Wiring Harness Connectors and ECU Pins

1. Check the wiring harness connectors of each ECU terminal and the ECU pins for faulty connection, deformation or other defects.

OK	Go to "7. Check the DTC".
NG	The connectors or ECU pins are faulty. → Repair them or replace the ECU.

9Y1200199CRS1054US0

7. Check the DTC

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Start the engine, and clear the past DTCs.
3. Read the DTC again.

Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

9Y1200199CRS1055US0

(45) Common 2 TWV Actuation System Short (DTC P2150 / 523524-4, P2151 / 523524-3)

P2150 / 523524-4: Common 2 TWV actuation system ground short

Behaviour during malfunction:
- Insufficient output
- Large vibration
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Wiring harness short to ground

DTC set preconditions:
- Engine is operating
- Battery voltage is normal

DTC set parameter:
- When wiring harness short to ground occurs

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Injectors which have DTC stop injection
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1074US0

P2151 / 523524-3: Common 2 TWV actuation system +B short

Behaviour during malfunction:
- Insufficient output
- Large vibration
- Worsening exhaust gas performance
- Engine stops in some case

Detection item:
- Wiring harness short to +B

DTC set preconditions:
- Engine is operating
- Battery voltage is normal

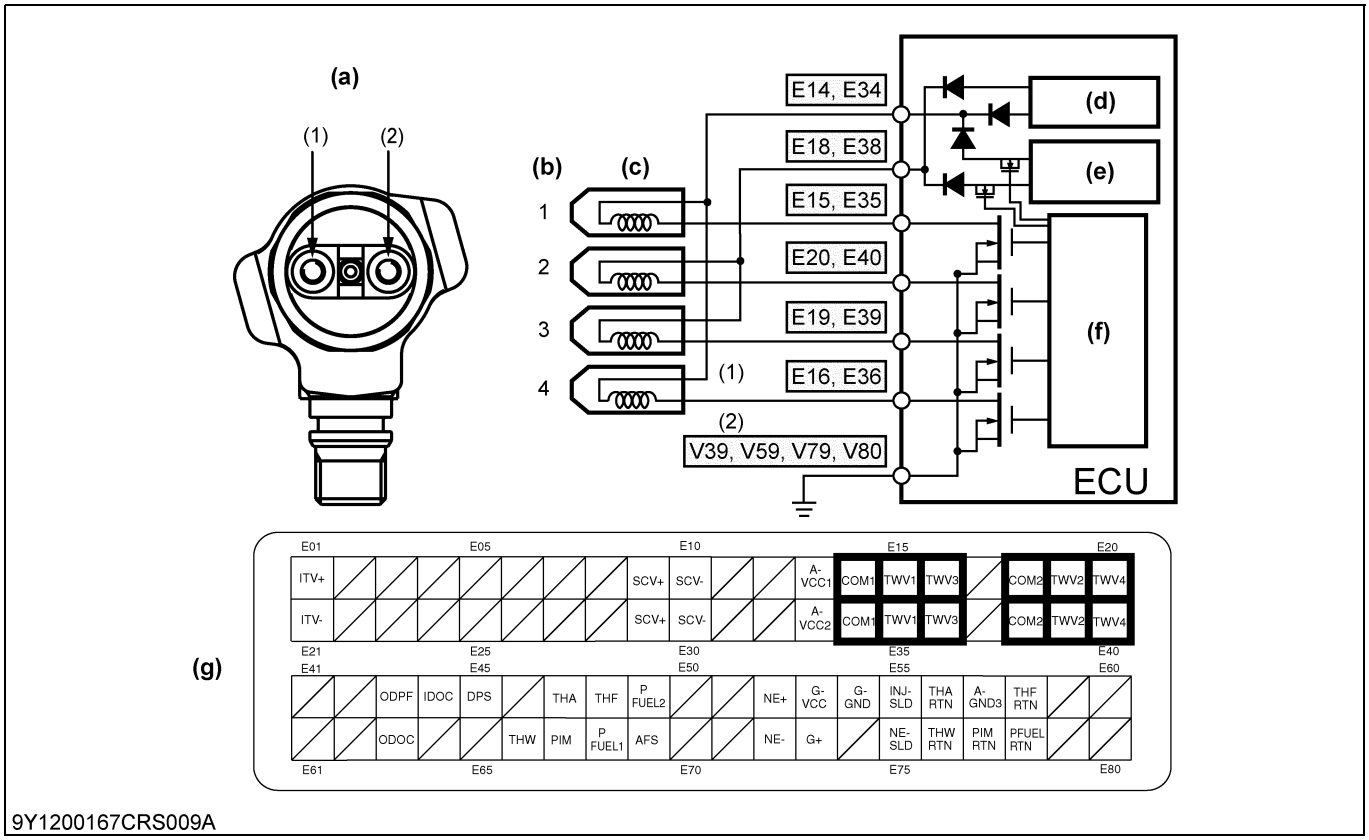
DTC set parameter:
- When wiring harness short to +B occurs

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Injectors which have DTC stop injection
- Output limitation: Approximately 75 % of normal condition
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1075US0

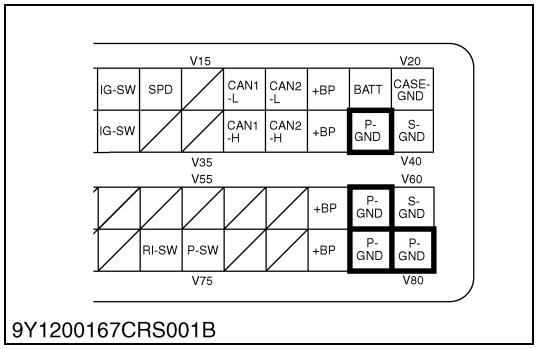


9Y1200167CRS009A

(1) Terminal COMMON
(2) Terminal TWV

(a) Terminal Layout
(b) Engine Cylinder No.
(c) Injector
(d) Rated amperage circuit
(e) High-voltage generating circuit
(f) Control circuit
(g) ECU Connector 1 (Engine Side)

9Y1200199CRS1076US0



9Y1200167CRS001B

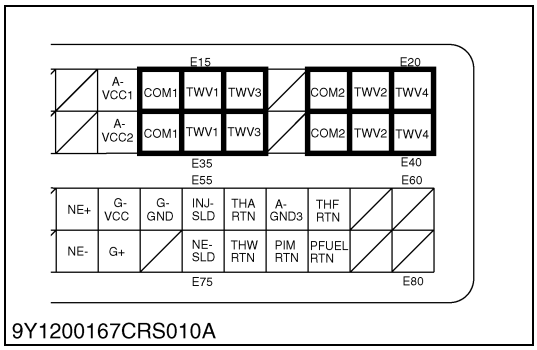
1, Check the "P- GND" Wiring Harness

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector 2 (machine side) from the socket, and measure the resistance between each of ECU terminals V39, V59, V79 or V80 and the chassis ground (at the wiring harness side).

Factory specification	1.5 Ω or lower

OK	Go to "2. Check the Wiring Harness Connectors and ECU Pins".
NG	Check the "P- GND" wiring harness. → Repair. Locate the cause of open circuit, or increase its resistance value.

9Y1200199CRS1059US0



9Y1200167CRS010A

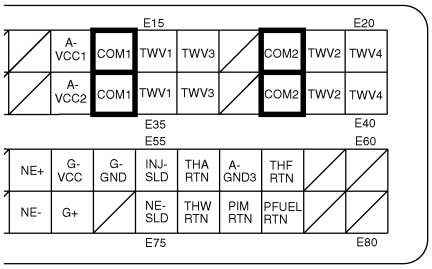
2. Check the Wiring Harness Connectors and ECU Pins

1. Place the key switch in the OFF position, unplug the ECU connector 1 (engine side) from the socket, and check the ECU pins for faulty connection, deformation, poor contact or other defects.

Factory specification	Must be free from faulty connection, deformation, poor contact or other defects.

OK	Go to "3. Measure the ECU Terminal Voltage (Part 1)".
NG	Repair wiring harness connectors and ECU pins, or replace them if defective.

9Y1200199CRS1060US0



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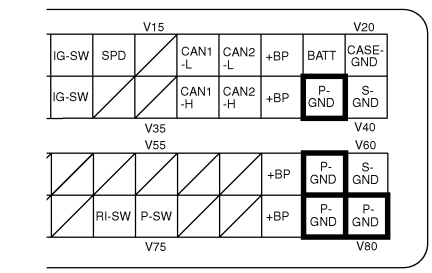

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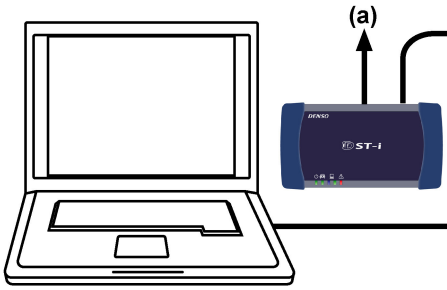

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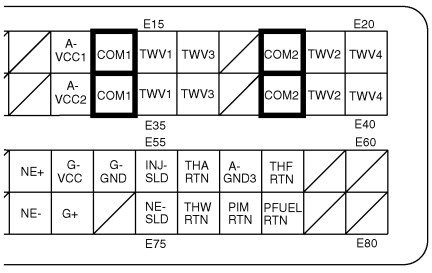


9Y1200167CRS010E

3. Measure the ECU Terminal Voltage (Part 1)

1. Place the key switch in the ON position, and measure the voltage between ECU terminal E14 / E34 or E18 / E38 and "P-GND" terminal.

Factory specification	Approx. 6 V

OK	Go to "4. Check the DTC".
NG	Go to "5. Measure the ECU Terminal Voltage (Part 2)".

9Y1200199CRS1061US0

4. Check the DTC

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Start the engine, and clear the past DTCs.
3. Read the DTC again.

Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

9Y1200199CRS1062US0

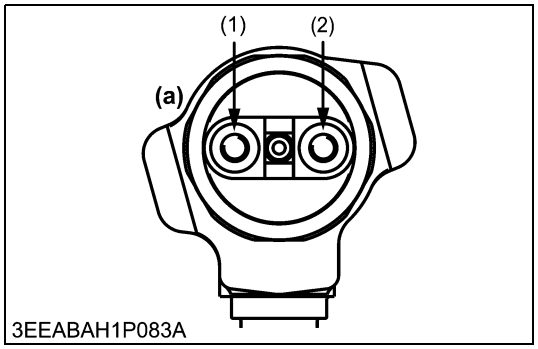
5. Measure the ECU Terminal Voltage (Part 2)

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector 1 (engine side) from the socket, return the key switch to the ON position again, and measure the voltage between each of ECU terminal pins E14 / E34 and E18 / E38 and the "P -GND" terminal (at the wiring harness side).

Factory specification	Approx. 6 V

OK	Go to "6. Check the Wiring Harness".
NG	Faulty ECU → Replace.

9Y1200199CRS1063US0



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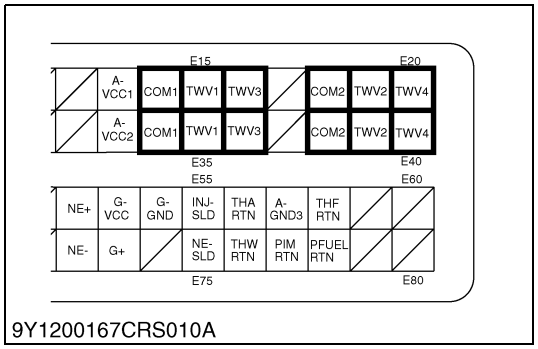


9Y1200167CRS010A

6. Check the Wiring Harness

Locate the cause of wiring harness ground short, and repair the faulty area.

DTC	Relating ECU Terminals	Shorted Harness Side
P2147	Terminal E14 / E34 or E18 / E38 (E15 / E35, E16 / E36, E19 / E39, E20 / E40 occurring simultaneously)	Ground
P2148	Terminal E14 / E34 or E18 / E38 (E15 / E35, E16 / E36, E19 / E39, E20 / E40 occurring simultaneously)	Power supply

■ **NOTE**

- **If DTC P2147 (Shorted injector actuation circuit to the ground) has occurred, be sure to check the insulation of injector itself in the following procedure.**

1. Place the key switch in the OFF position, unplug each injector connector from socket, and visually check the connector status.

Factory specification	Must be free from sludge and sparks.

2. Using an insulation resistance tester (megger tester), measure the resistance between each of terminals (1) and (2) and the chassis ground (at the injector side).

Factory specification	10 MΩ or higher

OK	The injector functions normally. Locate another cause.
NG	Faulty injector → Replace.

(1) Terminal COMMON
(2) Terminal TWV
(a) Injector

9Y1200199CRS1064US0

(46) Barometric Pressure Sensor Error (DTC P2228 / 108-4, P2229 / 108-3)

P2228 / 108-4: Barometric pressure sensor error (Low side)
Behaviour during malfunction (At high altitude):
- Insufficient output

Detection item:
- Sensor / ECU internal circuit short to ground

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- Barometric pressure sensor voltage: 1.6 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 65 kPa (0.66 kgf/cm^2, 9.4 psi) [default value]

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1083US0

P2229 / 108-3: Barometric pressure sensor error (High side)
Behaviour during malfunction (At high altitude):
- Insufficient output

Detection item:
- Sensor / ECU internal circuit short to +B

DTC set preconditions:
- Battery voltage is normal

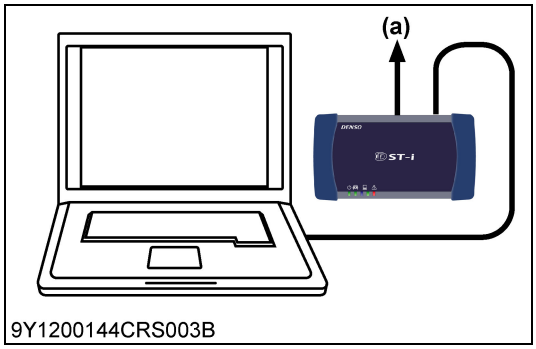
DTC set parameter:
- Barometric pressure sensor voltage: 4.4 V or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 65 kPa (0.66 kgf/cm^2, 9.4 psi) [default value]

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1084US0



9Y1200144CRS003B

1. Check the Atmospheric Pressure Signals

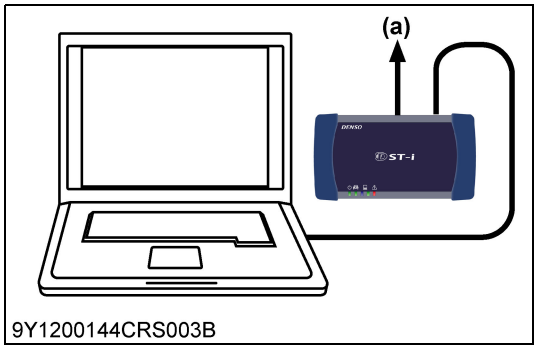
1. Place the key switch in the ON position, and check the "Atmospheric pressure" on the diagnosis tool data monitor.

Factory specification	Atmospheric pressure Actual atmospheric pressure (Approx. 100 kPa (1.02 kgf/cm^2, 14.5 psi))

OK	Clear the DTC and check whether it is detected again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Check the DTC".	

(a) CAN1 Connector

9Y1200199CRS1085US0



9Y1200144CRS003B

2. Check the DTC

1. Place the key switch to the OFF position first, then return it to the ON position again.
2. Clear the past DTCs, and check whether the same DTC (P2228 or P2229) is output again or not.

Factory specification	OK

OK	An electromagnetic interference (EMI) may have caused the temporary malfunction. There is no problem if the system has recovered.
NG	Faulty atmospheric pressure sensor → Replace the engine ECU.

(a) CAN1 Connector

9Y1200199CRS1086US0

(47) EGR (DC Motor) Abnormality (DTC P2413 / 523575-7, P2414 / 523576-2, P2415 / 523577-2)

P2413 / 523575-7: EGR actuator valve stuck

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- EGR actuator valve stuck

DTC set preconditions:
- Battery voltage is normal
- No DTC of U0077 "CAN1 Bus off"
- EGR control line is normal

DTC set parameter:
- EGR actuator valve stuck error signal received via CAN

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition EGR stop

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1087US0

P2414 / 523576-2: EGR (DC motor) overheat

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- EGR (DC motor) overheat

DTC set preconditions:
- Battery voltage is normal
- No DTC of U0077 "CAN1 Bus off"
- EGR control line is normal

DTC set parameter:
- EGR (DC motor) temperature error signal (thermistor: 125 °C (257 °F) or more) received via CAN

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1088US0

P2415 / 523577-2: EGR (DC motor) temperature sensor failure

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- EGR (DC motor) temperature sensor failure

DTC set preconditions:
- Battery voltage is normal
- No DTC of U0077 "CAN1 Bus off"
- EGR control line is normal

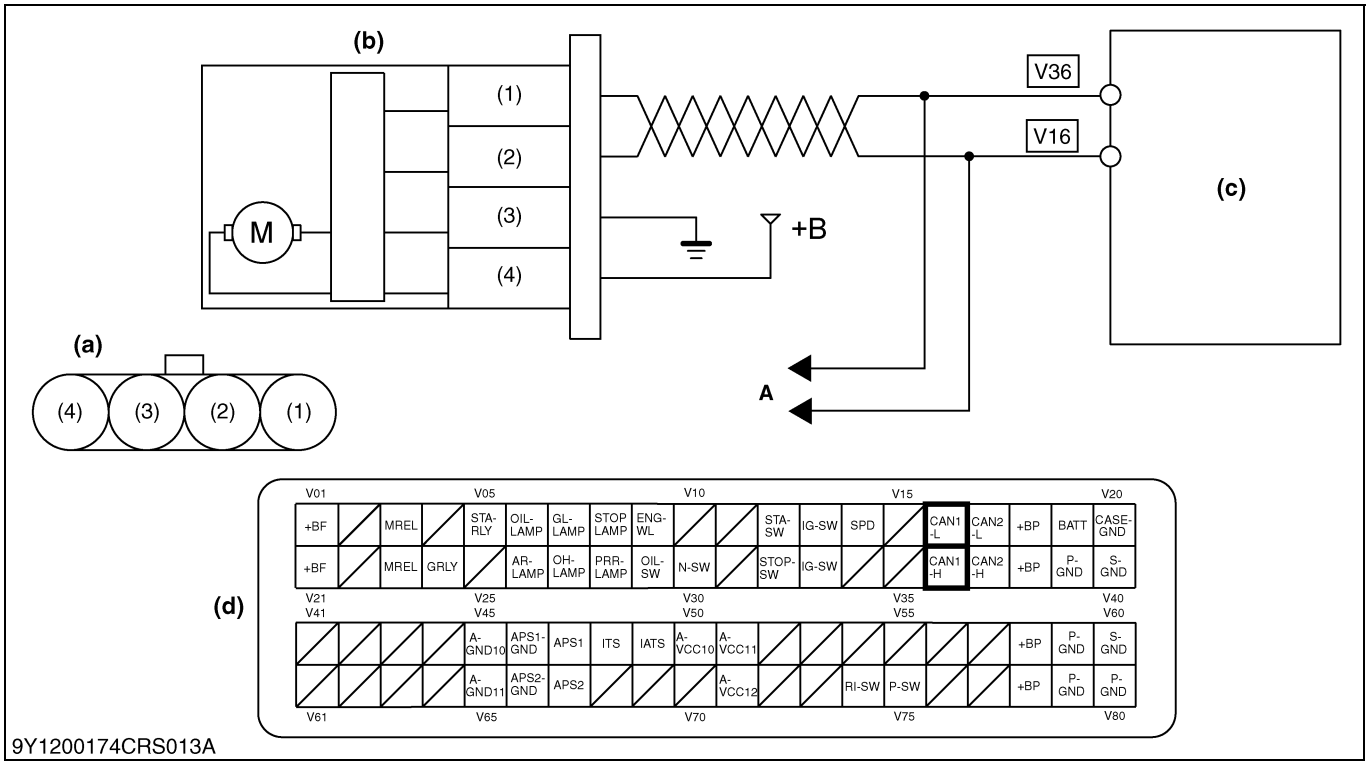
DTC set parameter:
- EGR (DC motor) temperature sensor error signal received via CAN

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop

Recovery from error:
- Key switch turn OFF

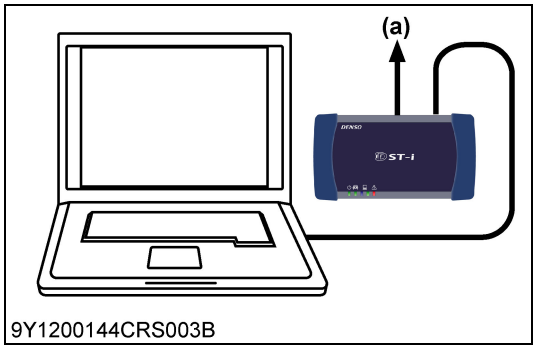
9Y1200199CRS1089US0



9Y1200174CRS013A

(1) Terminal CAN-H
(2) Terminal CAN-L
(3) Terminal Ground
(4) Terminal Power (+12 V)
(a) Terminal Layout
(b) EGR Valve Assembly
(c) Engine ECU
(d) ECU Connector 2 (Machine Side)
A: To Diagnosis Tool

9Y1200199CRS0944US0



9Y1200144CRS003B

1. DTC Judgment

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Place the key switch in the ON position, check whether the DTC is output or not.
3. Check the DTC again after starting up the engine with the coolant temperature over 65 °C (149 °F).

Factory specification	DTC must not be output.

OK	Normal.
NG	Replace the EGR assembly.

(a) CAN1 Connector

9Y1200199CRS0945US0

(48) Exhaust Gas Temperature Sensor 2 (T2) Abnormality (DTC P242C / 3246-4, P242D / 3246-3)

P242C / 3246-4: Exhaust gas temperature sensor 2 (T2) abnormality (Low side)

Behaviour during malfunction:
- None

Detection item:
- Sensor / Harness short to ground

DTC set preconditions:
- Battery voltage is normal

DTC set parameter:
- DPF outlet temperature sensor (T2) voltage: 0.08 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 °C (32 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1092US0

P242D / 3246-3: Exhaust gas temperature sensor 2 (T2) abnormality (High side)

Behaviour during malfunction:
- None

Detection item:
- Sensor / Harness open circuit and short to +B

DTC set preconditions:
- Battery voltage is normal
- Coolant temperature is 65 °C (149 °F) or more: continues longer than 10 min.100 °C (212 °F) ≤ T0 ≤ 800 °C (1472 °F): continues longer than 10 sec. or 100 °C (212°F) ≤ T1 ≤ 800 °C (1472 °F): continues longer than 10 sec.

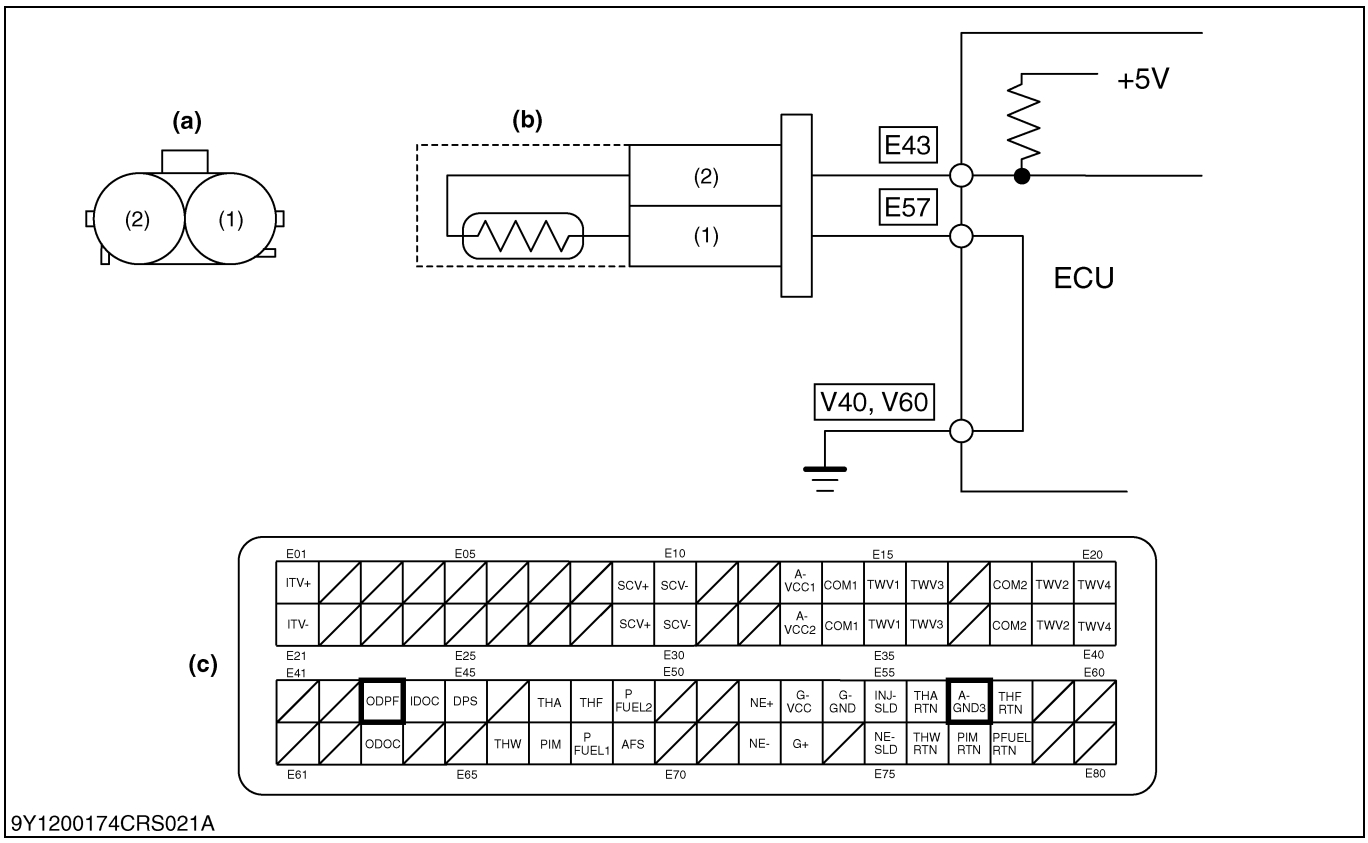
DTC set parameter:
- DPF outlet temperature sensor (T2) voltage: 4.92 V or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 °C (32 °F) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Recovers when the key switch is OFF

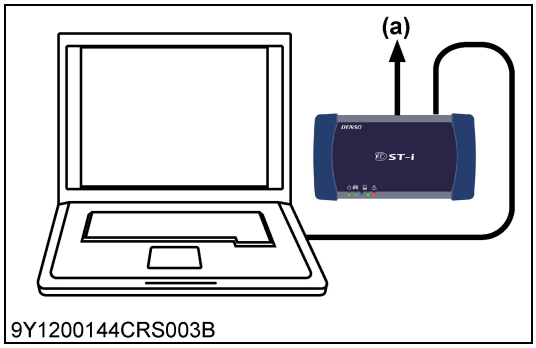
9Y1200199CRS1093US0



9Y1200174CRS021A

(1) Terminal A-GND3
(2) Terminal ODPF
(a) Terminal Layout
(b) Exhaust Gas Temperature Sensor 2 (T2)
(c) ECU Connector 1 (Engine Side)

9Y1200199CRS1094US0



9Y1200144CRS003B

1. Check the Exhaust Gas Temperature Sensor Signals

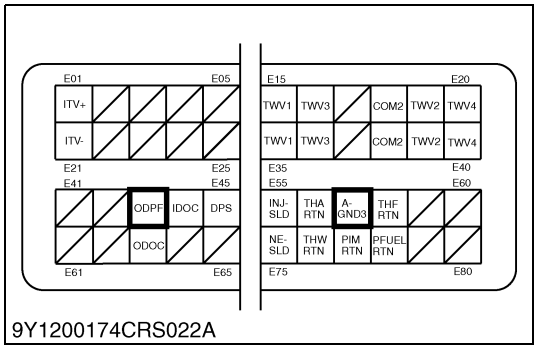
1. Place the key switch in the ON position, and check the "Exhaust gas temperature" and "Exhaust gas temperature sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Actual exhaust gas temperature	Exhaust gas temperature	Output voltage
100 °C (212 °F)	100 °C (212 °F)	Approx. 4.4 V
150 °C (302 °F)	150 °C (302 °F)	Approx. 3.7 V
200 °C (392 °F)	200 °C (392 °F)	Approx. 3.0 V
250 °C (482 °F)	250 °C (482 °F)	Approx. 2.3 V

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the Resistance Between Terminals".	

(a) CAN1 Connector

9Y1200199CRS0962US0



9Y1200174CRS022A

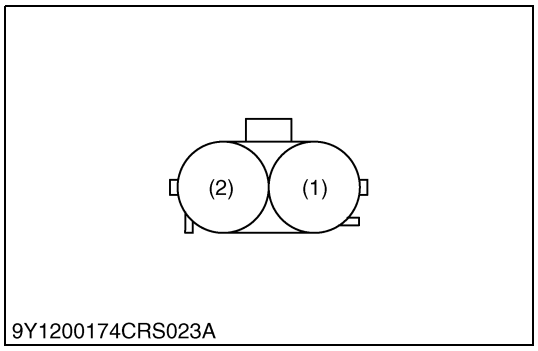
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals E43 and E57 of the connector.

Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

OK	Go to "4. Measure the ECU Terminal Voltage".
NG	Go to "3. Check the Sensor".

9Y1200199CRS1096US0



9Y1200174CRS023A

3. Check the Sensor

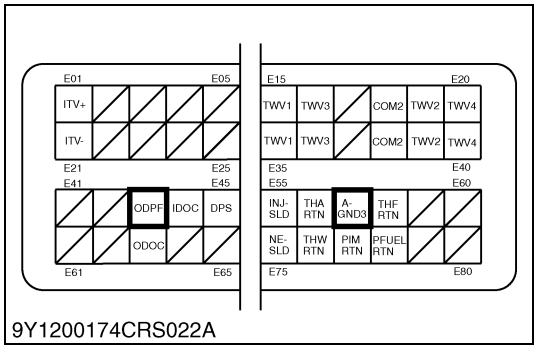
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Exhaust gas temperature sensor fault → Replace the exhaust gas temperature sensor 2 (T2).

(1) Terminal A-GND3 (1) Terminal ODPF

9Y1200199CRS1097US0



9Y1200174CRS022A

4. Measure the ECU Terminal Voltage

1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals E43 and E57 at the ECU side.

Factory specification	Approx. 5 V

OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

9Y1200199CRS1098US0

(49) Differential Pressure Sensor 1 Abnormality (DTC P2454 / 3251-4, P2455 / 3251-3)

P2454 / 3251-4: Differential pressure sensor 1 abnormality (Low side)

Behaviour during malfunction:
- None

Detection item:
- Sensor / Harness short to ground

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- No ST signal

DTC set parameter:
- DPF differential pressure sensor voltage: 0.21 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 kPa (0.0 kgf/cm^2, 0.0 psi) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1099US0

P2455 / 3251-3: Differential pressure sensor 1 abnormality (High side)

Behaviour during malfunction:
- None

Detection item:
- Sensor / Harness open circuit and short to +B

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal
- No ST signal

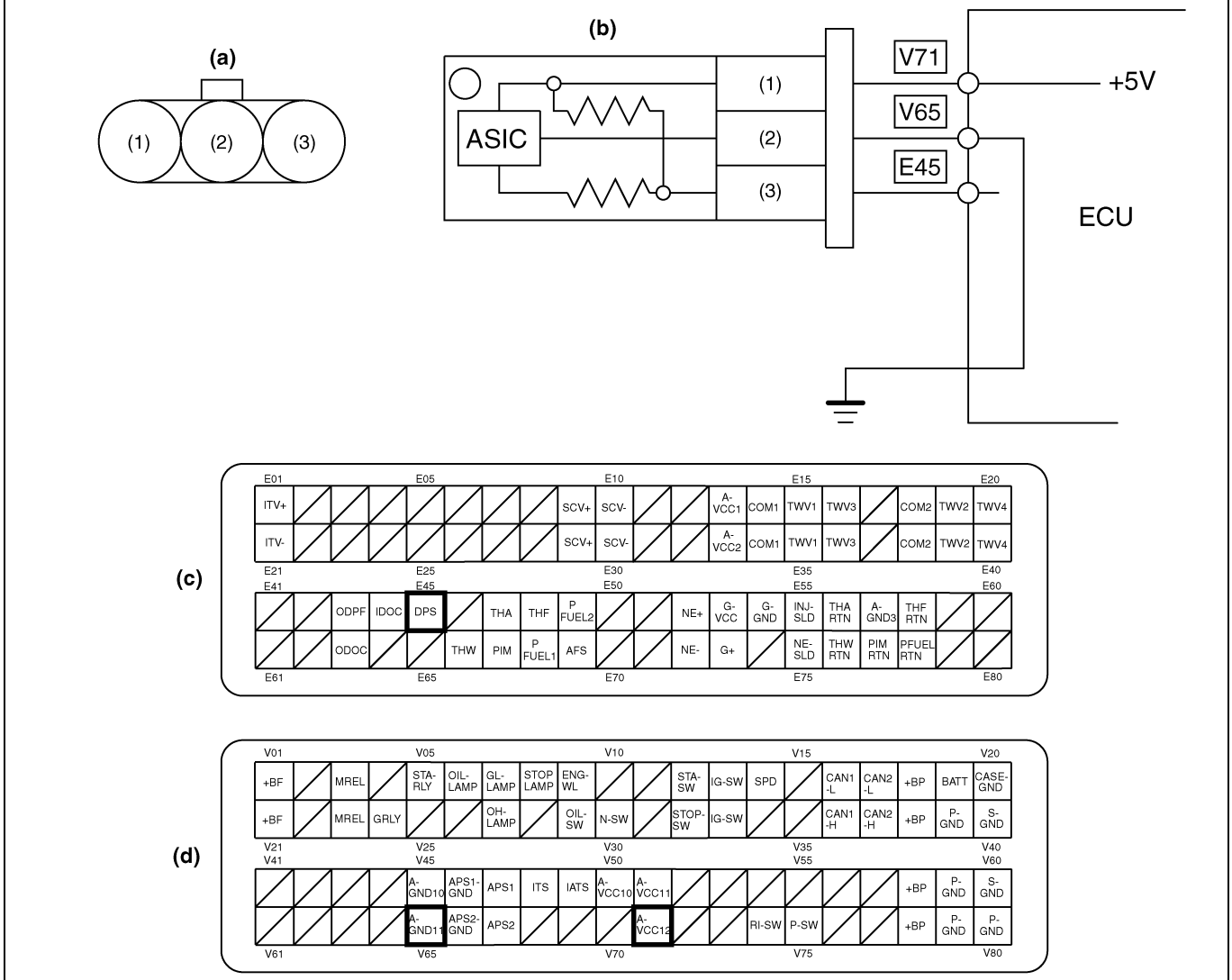
DTC set parameter:
- DPF differential pressure sensor voltage: 4.7 V or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- 0 kPa (0.0 kgf/cm^2, 0.0 psi) [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1100US0

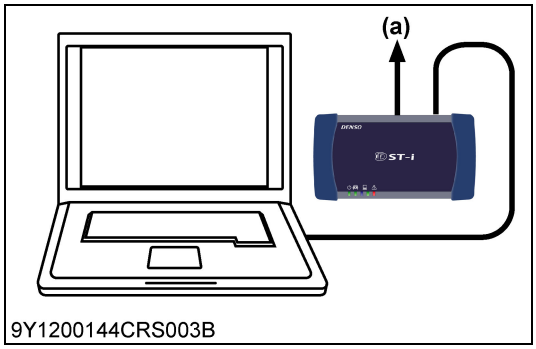


9Y1200174CRS024A

(1) Terminal A-VCC12
(2) Terminal A-GND11
(3) Terminal DPS

(a) Terminal Layout
(b) Differential Pressure Sensor
(c) ECU Connector 1 (Engine Side)
(d) ECU Connector 2 (Machine Side)

9Y1200199CRS1101US0



9Y1200144CRS003B

1. Check the Differential Pressure Signals

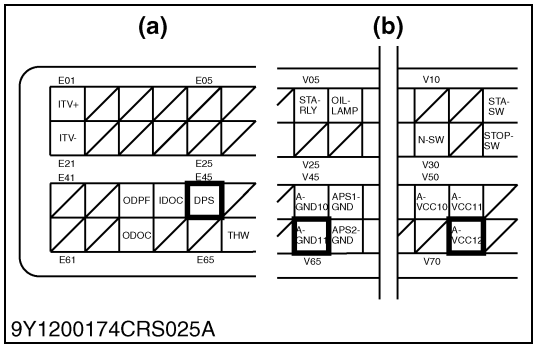
1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again. Then, check the "Differential pressure" and "Differential pressure sensor output voltage" on the diagnosis tool data monitor.

Factory specification		
Engine state	Actual differential pressure	Output voltage
Key switch is ON	Approx. 0 Pa (0 kgf/cm^2, 0 psi)	Approx. 0.7 V

OK	Clear the DTC and check whether it is output again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Go to "2. Measure the ECU Terminal Voltage".	

(a) CAN1 Connector

9Y1200199CRS1102US0



9Y1200174CRS025A

2. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals E45 and V71.

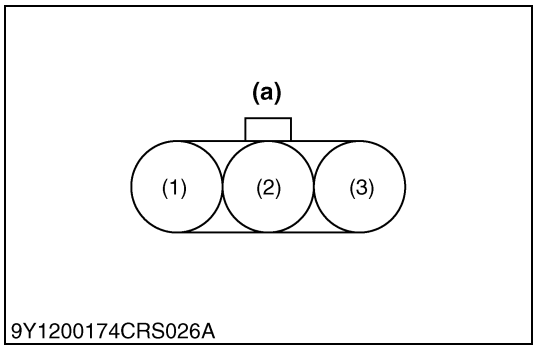
Factory specification	
Engine state	Output voltage
Key switch ON	Approx. 0.7 V

OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Go to "3. Measure the Voltage Between Differential Pressure Sensor Terminals".	

(a) ECU Connector 1 (Engine Side)

(b) ECU Connector 2 (Machine Side)

9Y1200199CRS1103US0



9Y1200174CRS026A

3. Measure the Voltage Between Differential Pressure Sensor Terminals

1. Place the key switch in the ON position, and measure the voltage between terminals (2) and (3) of the differential pressure sensor at the wiring harness side.

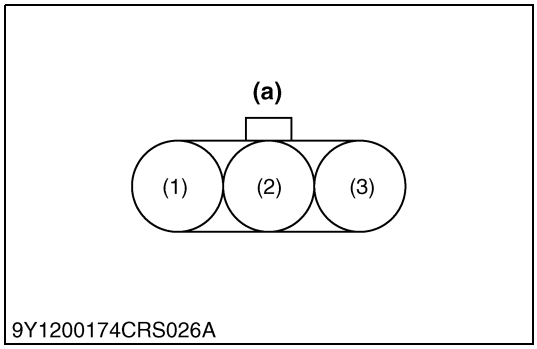
Factory specification	
Engine state	Output voltage
Key switch ON	Approx. 0.7 V

OK	Check the wiring harness (between ECU terminal E45 and sensor terminal (3)). → Repair the faulty area.
NG	Go to "4. Measure the Voltage Between Differential Pressure Sensor Terminals".

(1) Terminal A-VCC12
(2) Terminal A-GND11
(3) Terminal DPS

(a) Differential Pressure Sensor Connector

9Y1200199CRS1104US0



9Y1200174CRS026A

4. Measure the Voltage Between Differential Pressure Sensor Terminals

1. Set the key switch to the OFF position, and unplug the differential pressure sensor connector from the socket.
2. Place the key switch in the ON position, and measure the voltage between terminals (1) and (2) of the differential pressure sensor connector (at the wiring harness side).

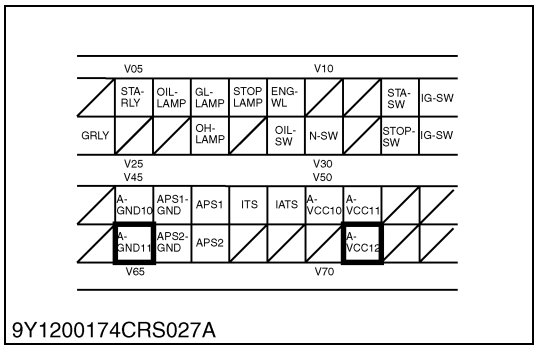
Factory specification	Approx. 5 V

OK	Check the wiring harness connector and sensor pins.	
	OK	Faulty differential pressure sensor → Replace.
	NG	1. Repair or replace the wiring harness. 2. Replace the differential pressure sensor.
NG	Go to "5. Measure the ECU Terminal Voltage".	

(1) Terminal A-VCC12
(2) Terminal A-GND11
(3) Terminal DPS

(a) Differential Pressure Sensor Connector

9Y1200199CRS1105US0



9Y1200174CRS027A

5. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals V65 and V71.

Factory specification	Approx. 5 V

OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Check the wiring harness (between ECU terminal V65 and sensor terminal (2) and between ECU terminal V71 and sensor terminal (1)). → Repair the faulty area.	

■ **NOTE**

- **Check the pipe between diesel particulate filter (DPF) and sensor, When it is damaged, the differential pressure can not reach the sensor.**

9Y1200199CRS1106US0

(50) Intake Throttle Lift Sensor Abnormality (DTC P2621 / 523583-4, P2622 / 523582-3)

P2621 / 523583-4: Intake throttle lift sensor (Low side)
Behaviour during malfunction:
- None

Detection item:
- Intake throttle lift sensor low

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal

DTC set parameter:
- Intake throttle lift sensor voltage: 0.1 V or less

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- Intake throttle 100 % open

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1107US0

P2622 / 523582-3: Intake throttle lift sensor (High side)
Behaviour during malfunction:
- None

Detection item:
- Intake throttle lift sensor high

DTC set preconditions:
- Battery voltage is normal
- Sensor supply voltage VCC# is normal

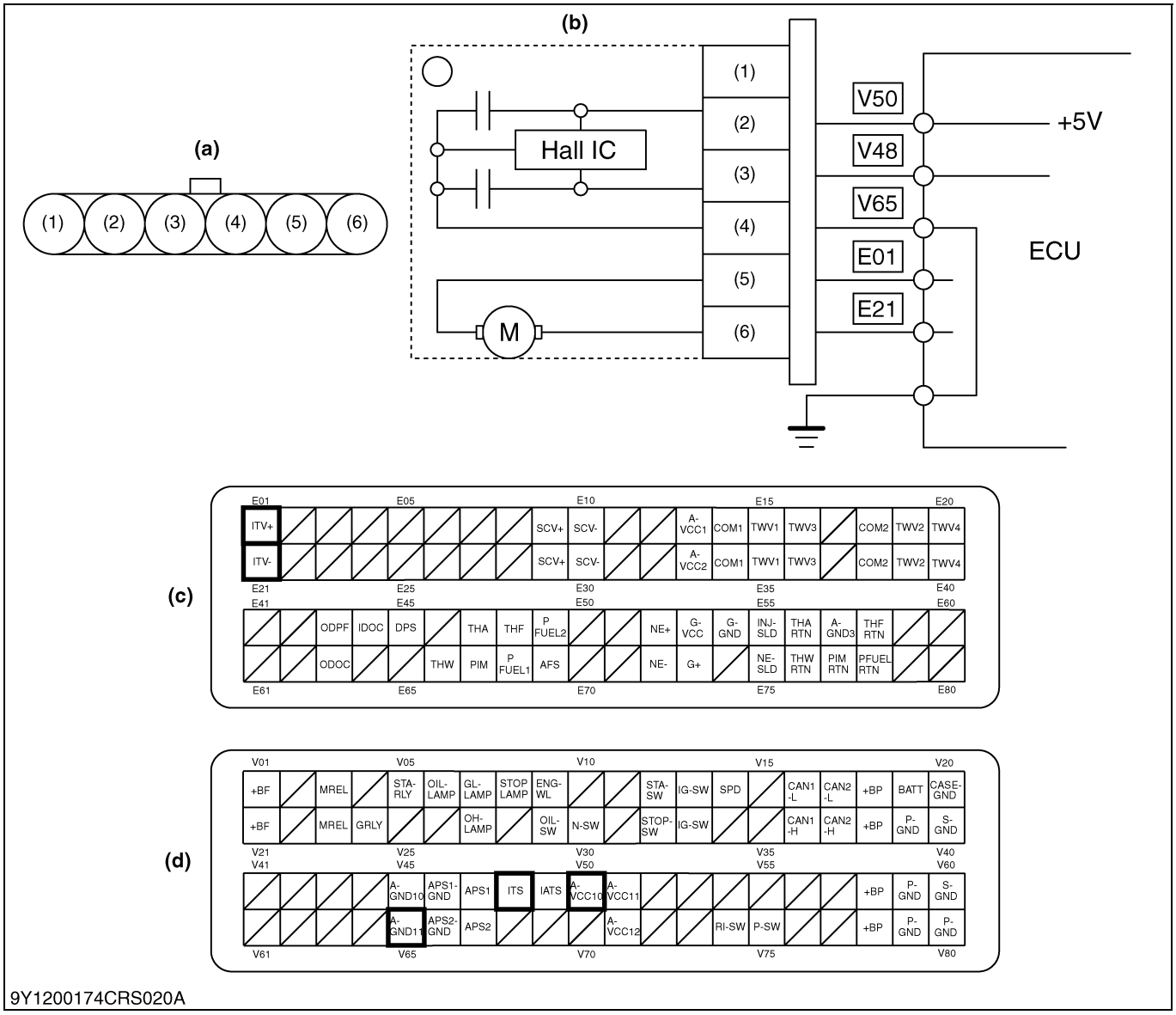
DTC set parameter:
- Intake throttle lift sensor voltage: 4.89 V or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- Intake throttle 100 % open

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1108US0

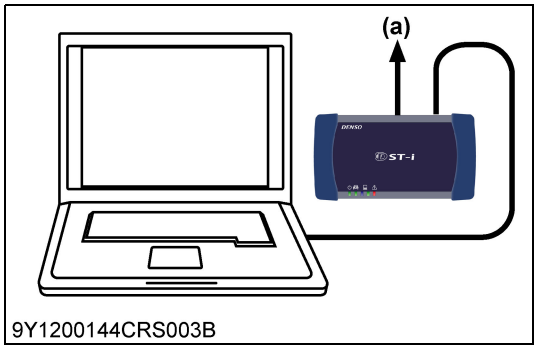


9Y1200174CRS020A

(1) No Connection
(2) Terminal Power (+5 V)
(3) Terminal ITS (Output)
(4) Terminal Ground
(5) Terminal ITV+
(6) Terminal ITV–

(a) Terminal Layout
(b) Intake Throttle Valve
(c) ECU Connector 1 (Engine Side)
(d) ECU Connector 2 (Machine Side)

9Y1200199CRS1023US0



9Y1200144CRS003B

1. Check the Intake Throttle Signal

1. After operating the engine, perform an active test.
   Monitor the "Actual intake throttle valve opening" and "Intake throttle opening output voltage", and check the values.
   *** For details, refer to the active test section.**
2. Clear the DTC and check whether it is output again or not.

Factory specification	No DTC is output.

OK	Normal.
NG	Replace the intake throttle assembly.

(a) CAN1 Connector

9Y1200199CRS1024US0

(51) Emission Deterioration (DTC P3001 / 3252-0)

Behaviour during malfunction:
- Insufficient output

Detection item:
- DOC is heated up due to unburned fuel

DTC set preconditions:
- Not in the Regeneration mode
- Coolant temperature is 65 °C (149 °F) or more: continues longer than 5 min

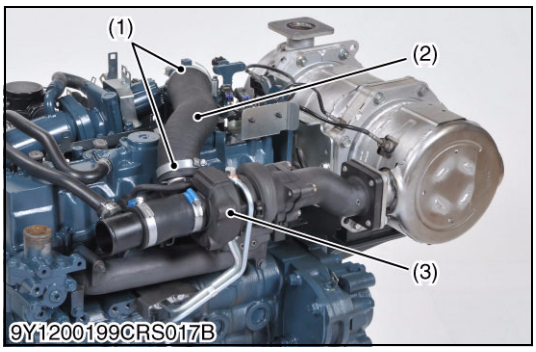
DTC set parameter:
- T1 − T0 ≥ 250 °C (482 °F)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1111US0



1. Check the Air Intake System

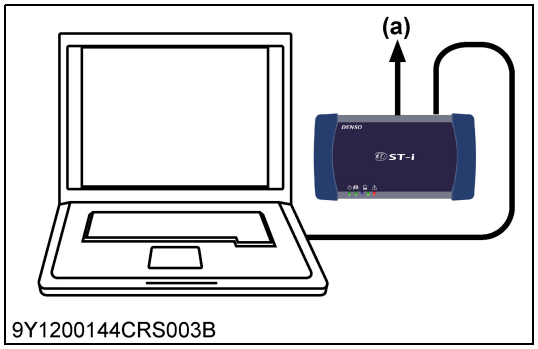
1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

■ **NOTE**
- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **Check if the suction hose of the turbo blower does not come off. If the hose comes off, install it.**
- **Check the suction path for leaks. (Suction path joints, suction pipes, hoses)**
- **Check the installation of all exhaust gas temperature sensors (T0, T1 and T2).**
- **Check the engine oil level.**
- **Check the engine coolant level.**
- **Check whether turbo has abnormality. (sound and externals)**

OK	Go to "2. Check the DTC".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS1112US0



9Y1200144CRS003B

2. Check the DTC

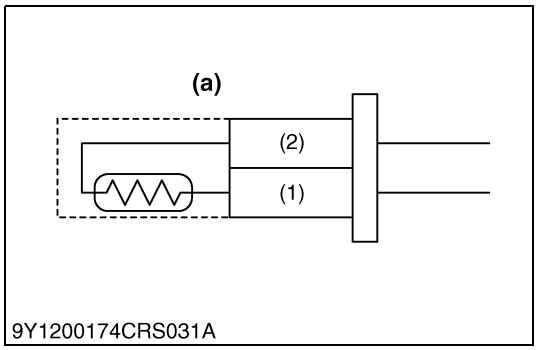
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust Gas Temperature sensor 0", "Exhaust gas temperature sensor 1" and "Exhaust gas temperature sensor 2" on the data monitor.function.
3. Check whether the DTC is output or not after starting up the engine by monitoring the data signals.

Factory specification	No DTC is output.

OK	Normal.
NG	Go to "3. Check the Exhaust Gas Temperature Sensor".

(a) CAN1 Connector

9Y1200199CRS1113US0



9Y1200174CRS031A

3. Check the Exhaust Gas Temperature Sensors

1. Check the exhaust gas temperature sensors (T0, T1 and T2).

OK	Normal.
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF

(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

9Y1200199CRS1114US0

(52) Exhaust Gas Temperature Sensor 0: Emergency High (DTC P3002 / 4765-0)

Behaviour during malfunction:
- Engine stops
- Inhibit cranking until down to 300 °C (572 °F)

Detection item:
- DOC inlet temperature (T0) high

DTC set preconditions:
- Exhaust gas temperature sensor T0, T1 and T2 are normal
- Battery voltage is normal

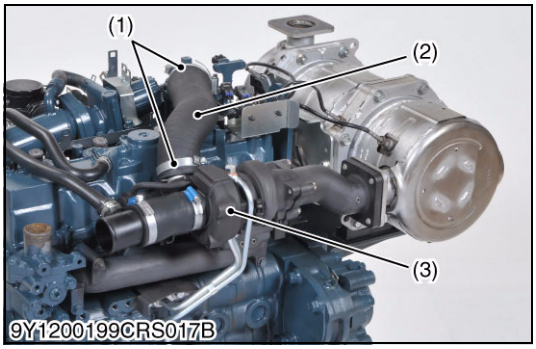
DTC set parameter:
- DOC inlet temperature (T0): 700 °C (1292 °F) or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Stop injection (Q = 0 mm^3/st)
- Engine stop
- Inhibit starter relay activation until Exhaust Gas Temperature reduces down to 300 °C (572 °F)

Recovery from error:
- Under 300 °C (572 °F) & key switch turn OFF

9Y1200199CRS1115US0



1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

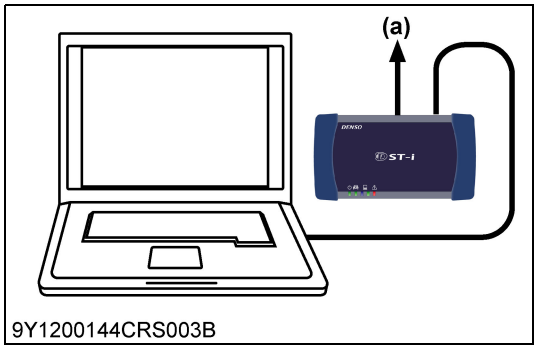
■ **IMPORTANT**
- **If the two errors occur from "Emergency exhaust gas temperature sensor T0 high", "Emergency exhaust gas temperature sensor T1 high", and "Emergency exhaust gas temperature T2 high" at the same time, check the exhaust gas temperature starting from a bigger number.**

■ **NOTE**
- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **Check if the suction hose of the turbo blower does not come off. If the hose comes off, install it.**
- **Check the suction path for leaks. (Suction path joints, suction pipes, hoses)**
- **Check the clogging condition of the fuel filter. If it is very dirty, replace the new one.**
- **Check the installation of all exhaust gas temperature sensors (T0, T1 and T2).**
- **Check the engine oil level.**
- **Check the engine coolant level.**

OK	Go to "2. Check the Exhaust Gas Temperature".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS1116US0



9Y1200144CRS003B

2. Check the Exhaust Gas Temperature

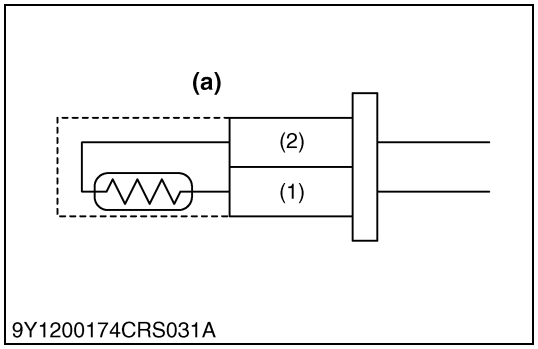
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust gas temperature Sensor 0", "Exhaust gas temperature Sensor 1" and "Exhaust gas temperature Sensor 2" on the data monitor.function.
3. If the exhaust gas temperature is above 300 °C (572 °F), wait till the temperature decreases below 300 °C (572 °F).

Factory specification	The actual exhaust gas temperature and monitoring exhaust gas temperature should be approximately the same.

OK	Go to "4. Check the DTC".
NG	Go to "3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)".

(a) CAN1 Connector

9Y1200199CRS1117US0



9Y1200174CRS031A

3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

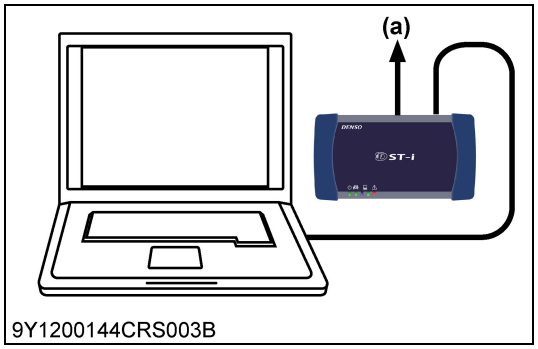
1. Check the exhaust gas temperature sensors (T0, T1 and T2).

OK	Go to "4. Check the DTC".
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF

(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

9Y1200199CRS1118US0



9Y1200144CRS003B

4. Check the DTC

1. Check the engine noise and vibration after starting up the engine.
   Check whether turbo has abnormality. (sound and externals)
2. Check whether the other DTC is output or not by operating the engine in the normal condition.
3. If it is OK, restart and operate the engine for 10 minutes with the engine in the no-load maximum speed status.
   Check whether the DTC is output or not.

Factory specification	No DTC is output.

OK	Normal.
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(a) CAN1 Connector

9Y1200199CRS1119US0

(53) Exhaust Gas Temperature Sensor 1: Emergency High (DTC P3003 / 3242-0)

Behaviour during malfunction:
- Engine stops
- Inhibit cranking until down to 300 °C (572 °F)

Detection item:
- DPF inlet temperature (T1) high

DTC set preconditions:
- Exhaust gas temperature sensor T0, T1 and T2 are normal
- Battery voltage is normal

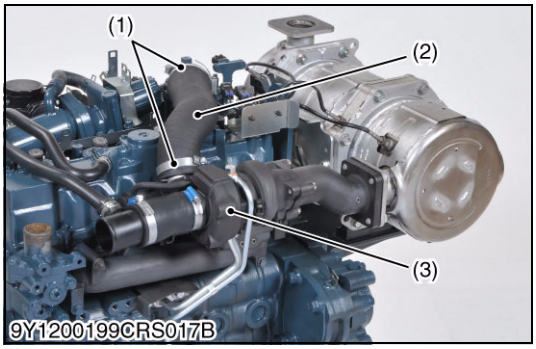
DTC set parameter:
- DPF inlet temperature (T1): 715 °C (1319 °F) or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Stop injection (Q = 0 mm^3/st)
- Engine stop
- Inhibit starter relay activation until Exhaust Gas Temperature reduces down to 300 °C (572 °F)

Recovery from error:
- Under 300 °C (572 °F) & key switch turn OFF

9Y1200199CRS1120US0



1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

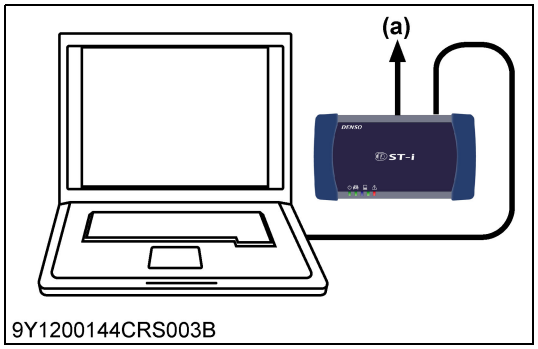
■ **IMPORTANT**
- **If the two errors occur from "Emergency exhaust gas temperature sensor T0 high", "Emergency exhaust gas temperature sensor T1 high", and "Emergency exhaust gas temperature T2 high" at the same time, check the exhaust gas temperature starting from a bigger number.**

■ **NOTE**
- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **Check if the suction hose of the turbo blower does not come off. If the hose comes off, install it.**
- **Check the suction path for leaks. (Suction path joints, suction pipes, hoses)**
- **Check the clogging condition of the fuel filter. If it is very dirty, replace the new one.**
- **Check the installation of all exhaust gas temperature sensors (T0, T1 and T2).**
- **Check the engine oil level.**
- **Check the engine coolant level.**

OK	Go to "2. Check the Exhaust Gas Temperature".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS1116US0



9Y1200144CRS003B

2. Check the Exhaust Gas Temperature

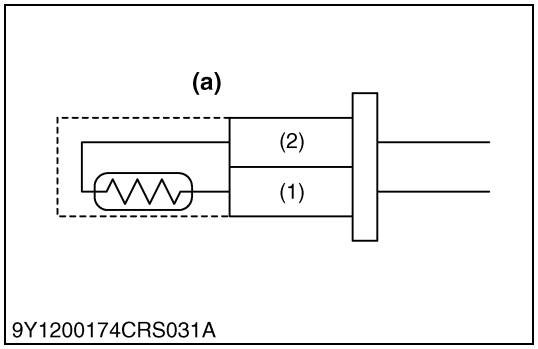
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust Gas Temperature Sensor 0", "Exhaust Gas Temperature Sensor 1" and "Exhaust Gas Temperature Sensor 2" on the data monitor function.
3. If the exhaust gas temperature is above 300 °C (572 °F), wait till the temperature decreases below 300 °C (572 °F).

Factory specification	The actual exhaust gas temperature and monitoring exhaust gas temperature should be approximately the same.

OK	Go to "4. Check the DTC".
NG	Go to "3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)".

(a) CAN1 Connector

9Y1200199CRS1122US0



9Y1200174CRS031A

3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

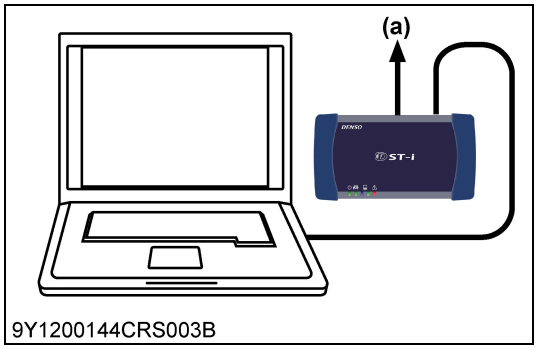
1. Check the exhaust gas temperature sensors (T0, T1 and T2).

OK	Go to "4. Check the DTC".
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF

(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

9Y1200199CRS1123US0



9Y1200144CRS003B

4. Check the DTC

1. Check the engine noise and vibration after starting up the engine. Check whether turbo has abnormality. (sound and externals)
2. Check whether the other DTC is output or not by operating the engine in the normal condition.
3. If it is OK, restart and operate the engine for 10 minutes with the engine in the no-load maximum speed status.
   Check whether the DTC is output or not.

Factory specification	No DTC is output.

OK	Normal.
NG	Replace the DPF assembly.

(a) CAN1 Connector

9Y1200199CRS1124US0

(54) Exhaust Gas Temperature Sensor 2: Emergency High (DTC P3004 / 3246-0)

Behaviour during malfunction:
- Engine stops
- Inhibit cranking until down to 300 °C (572 °F)

Detection item:
- DPF outlet temperature (T2) high

DTC set preconditions:
- Exhaust gas temperature sensor T0, T1 and T2 are normal
- Battery voltage is normal

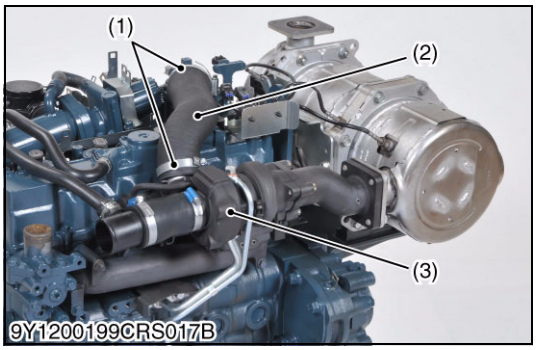
DTC set parameter:
- DPF outlet temperature (T2): 820 °C (1508 °F) or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Stop injection (Q = 0 mm^3/st)
- Engine stop
- EGR stop
- Intake throttle 0 % open (Close)
- Inhibit starter relay activation until exhaust gas temperature reduces down to 300 °C (572 °F)

Recovery from error:
- Under 300 °C (572 °F) & key switch turn OFF

9Y1200199CRS1125US0



1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

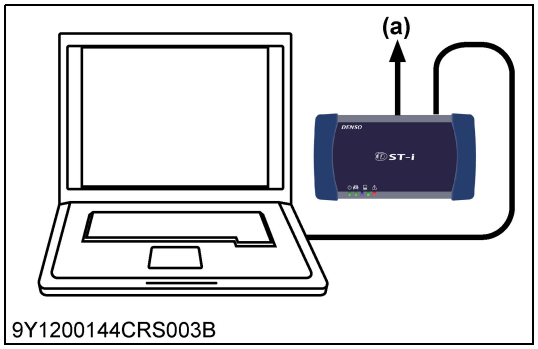
■ **IMPORTANT**
- **If the two errors occur from "Emergency exhaust gas temperature sensor T0 high", "Emergency exhaust gas temperature sensor T1 high", and "Emergency exhaust gas temperature T2 high" at the same time, check the exhaust gas temperature starting from a bigger number.**

■ **NOTE**
- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **Check if the suction hose of the turbo blower does not come off. If the hose comes off, install it.**
- **Check the suction path for leaks. (Suction path joints, suction pipes, hoses)**
- **Check the clogging condition of the fuel filter. If it is very dirty, replace the new one.**
- **Check the installation of all exhaust gas temperature sensors (T0, T1 and T2).**
- **Check the engine oil level.**
- **Check the engine coolant level.**

OK	Go to "2. Check the Exhaust Gas Temperature".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS1116US0



9Y1200144CRS003B

2. Check the Exhaust Gas Temperature

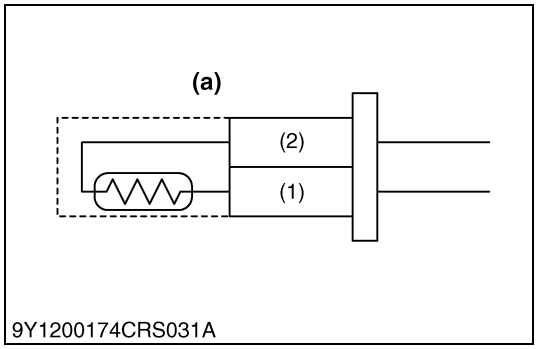
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust Gas Temperature Sensor 0", "Exhaust Gas Temperature Sensor 1" and "Exhaust Gas Temperature Sensor 2" on the data monitor.function.
3. If the exhaust gas temperature is above 300 °C (572 °F), wait till the temperature decreases below 300 °C (572 °F).

Factory specification	The actual exhaust gas temperature and monitoring exhaust gas temperature should be approximately the same.

OK	Go to "4. Check the DTC".
NG	Go to "3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)".

(a) CAN1 Connector

9Y1200199CRS1127US0



9Y1200174CRS031A

3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

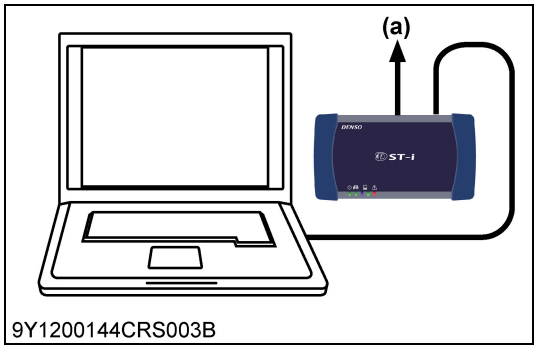
1. Check the exhaust gas temperature sensors (T0, T1 and T2).

OK	Go to "4. Check the DTC".
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF

(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

9Y1200199CRS1128US0



9Y1200144CRS003B

4. Check the DTC

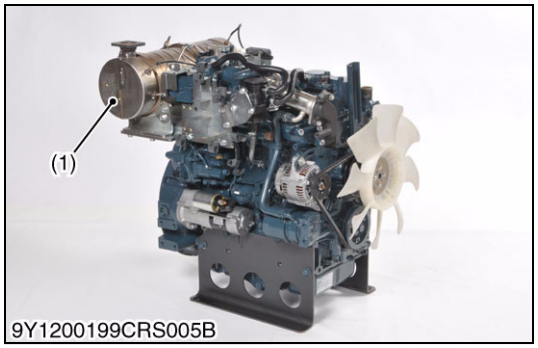
1. Check the engine noise and vibration after starting up the engine. Check whether turbo has abnormality. (sound and externals)
2. Check whether the other DTC is output or not by operating the engine in the normal condition.
3. If it is OK, restart and operate the engine for 10 minutes with the engine in the no-load maximum speed status.
   Check whether the DTC is output or not.

Factory specification	No DTC is output.

OK	Normal.
NG	Go to "5. Check the DPF".

(a) CAN1 Connector

9Y1200199CRS1129US0



9Y1200199CRS005B

5. Check the DPF

1. Visually check if soot is not attached to the tail pipe which is connected to the DPF assembly.
2. Check whether the intake throttle opens completely after starting up the engine.
3. Check whether the coolant temperature is over 65 °C (149 °F) by operating the engine in the normal condition.

OK	Replace the ECU.
NG	Replace the DPF assembly.

(1) DPF Assembly

9Y1200199CRS1130US0

(55) Excessive PM3 (DTC P3006 / 3701-15)

Behaviour during malfunction:
- Insufficient output

Detection item:
- PM accumulation level3

DTC set preconditions:
- Battery voltage is normal

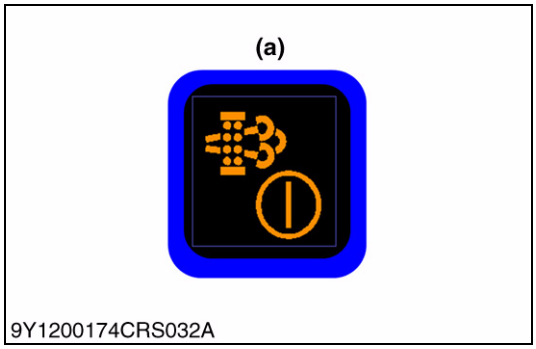
DTC set parameter:
- PM accumulation more than trigger level
  Regeneration level = 3

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1131US0



9Y1200174CRS032A

1. DPF Manual Regeneration

1. Start DPF Manual Regeneration immediately.

■ **NOTE**
- **This DTC means the warning to urge to start regeneration rather than error. (Basically, Service Call is not necessary.)**
- **Followings are potential causes.**
  - **A low load operation has been continuing.**
  - **An engine is often left idling.**
  - **A short time operation below 30 minutes has been continuing.**

(a) DPF Manual Regeneration Reguest Button

9Y1200199CRS1132US0

(56) Excessive PM4 (DTC P3007 / 3701-16)

Behaviour during malfunction:
- Insufficient output

Detection item:
- PM accumulation level4

DTC set preconditions:
- Battery voltage is normal

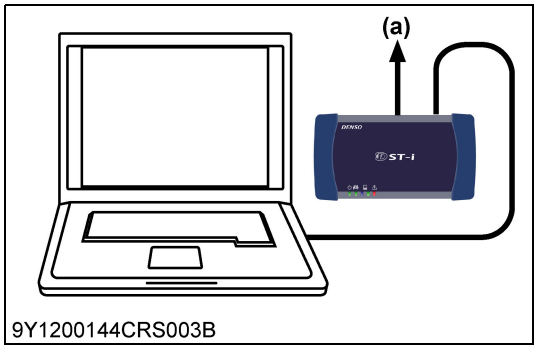
DTC set parameter:
- PM accumulation more than trigger level
  Regeneration level = 4

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1133US0



9Y1200144CRS003B

1. DPF Manual Regeneration Reguest Function

1. Perform the diagnosis tool active test ("DPF Manual Regeneration").

■ **NOTE**
- **Followings are potential causes.**
  - **A manual regeneration has not been carried out. Start DPF manual regeneration immediately when the manual regeneration warning light comes ON.**

(a) CAN1 Connector

9Y1200199CRS1134US0

(57) Excessive PM5 (DTC P3008 / 3701-0)

Behaviour during malfunction:
- Insufficient output

Detection item:
- PM accumulation level5

DTC set preconditions:
- Battery voltage is normal

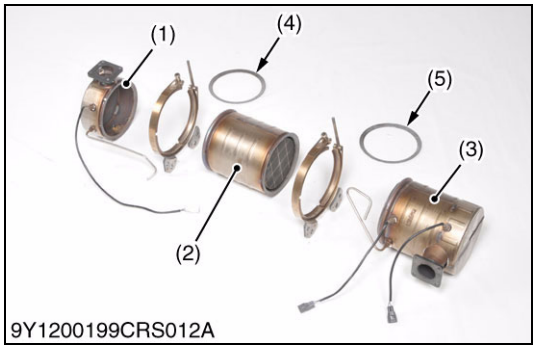
DTC set parameter:
- PM accumulation more than trigger level
  Regeneration level = 5

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1135US0



9Y1200199CRS012A

1. Replace of DPF

1. Replace the DPF.

■ **NOTE**
- **Followings are potential causes.**
  - **A manual regeneration has not been carried out.**

(1) DPF Outlet Body
(2) DPF Filter Comp
(3) DOC Catalyst
(4) DPF Gasket
(5) DPF Gasket

9Y1200199CRS1136US0

(58) Boost Pressure Low (DTC P3011 / 132-15)

Behaviour during malfunction:
- Insufficient output

Detection item:
- Dismount the hose between the turbo blower out and intake flange

DTC set preconditions:
- Not in the Regeneration mode
- Engine speed is 1600 rpm or more
- Target intake air flow value is 950 mg/cyl or more
- MAF sensor is normal
- EGR valve is normal
- Intake throttle valve is normal
- Boost pressure sensor is normal
- Barometric pressure sensor is normal
- Coolant temperature sensor is normal

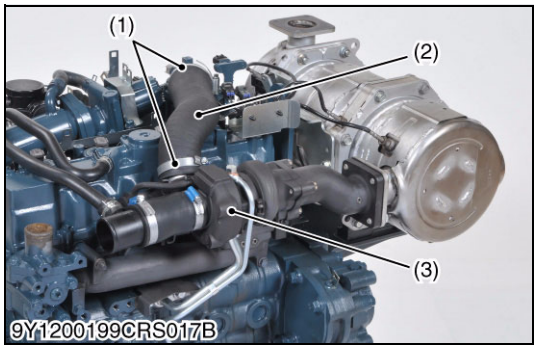
DTC set parameter:
- Boost pressure sensor output is below target level in high air flow operating condition

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- Speed limitation (Accelerator limitation: 50 %)
- EGR stop
- Intake throttle 100 % open (except DOC model)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1137US0



1. Check the Air Intake System

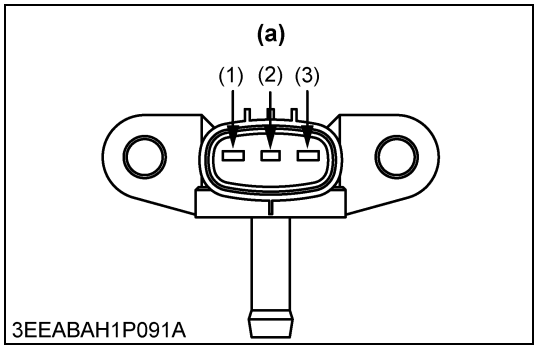
1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

■ **NOTE**
- **Check if the suction hose of the turbo blower does not come off.**
- **Check if the hose of the boost pressure sensor does not come off.**

OK	Go to "2. Check the Boost Pressure Sensor (Refer to items P0237 and P0238)".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS1138US0



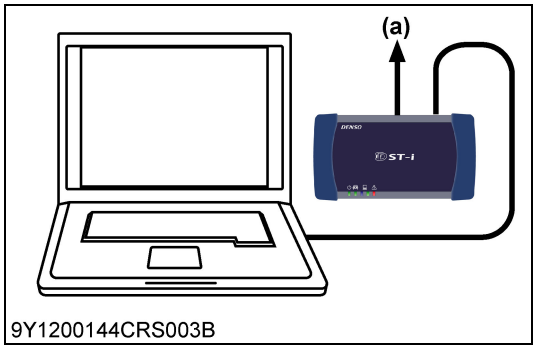
2. Check the Boost Pressure Sensor (Refer to items P0237 and P0238)

1. Check the boost pressure sensor.

OK	Go to "3. Check the DTC".
NG	Repair or replace the boost pressure sensor or its related parts. (Follow the diagnostic procedure of items P0237 and P0238)

(1) Terminal A-VCC2
(2) Terminal PIM
(2) Terminal PIM RTN
(a) Boost Pressure Sensor

9Y1200199CRS1139US0



9Y1200144CRS003B

3. Check the DTC

1. Check the engine noise and vibration after starting up the engine.
   Check whether turbo has abnormality. (sound and externals)
2. Check whether the other DTC is output or not by operating the engine in the normal condition.
3. If it is OK, restart and operate the engine for 10 minutes with the engine in the no-load maximum speed status. Check whether the DTC is output or not.

Factory specification	No DTC is output.

OK	Normal.
NG	Replace the ECU

(a) CAN1 Connector

9Y1200199CRS1140US0

(59) Low Coolant Temperature in Parked Regeneration (DTC P3012 / 523589-17)

Behaviour during malfunction:
- None

Detection item:
- During regeneration mode, engine warm-up condition is not formed (coolant temperature is low)

DTC set preconditions:
- In the manual Regeneration mode [DPFSTATUS = 5]

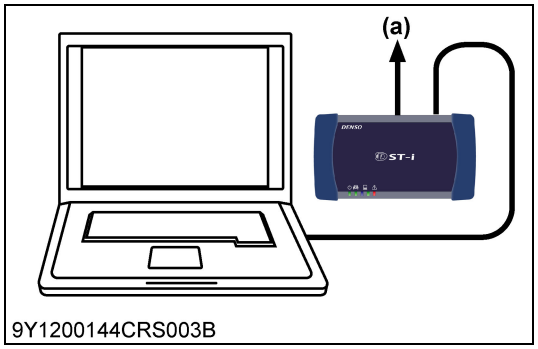
DTC set parameter:
- Engine coolant temperature stays below 65 °C (149 °F) under parked regeneration process. when the state above continues for 1500 seconds or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Diagnostic counter = zero (Leaving from parked active regeneration status)

9Y1200199CRS1141US0



9Y1200144CRS003B

1. Check the Coolant Temperature

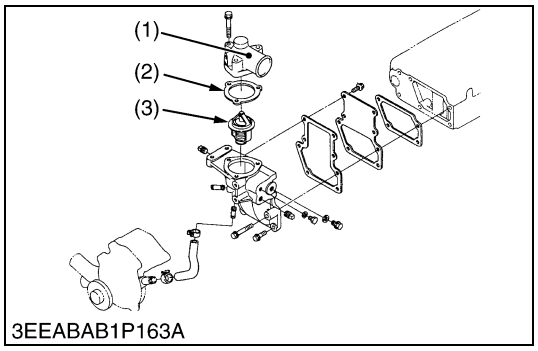
1. Perform the DPF Manual Regeneration again after warming up the engine.
2. Monitor the coolant temperature in the no-load maximum speed status with the diagnosis tool.

Factory specification	The coolant temperature should be 65 °C (149 °F) or more within 10 minutes.

OK	Normal.
NG	Go to "2. Check the Thermostat".

(a) CAN1 Connector

9Y1200199CRS1142US0



3EEABAB1P163A

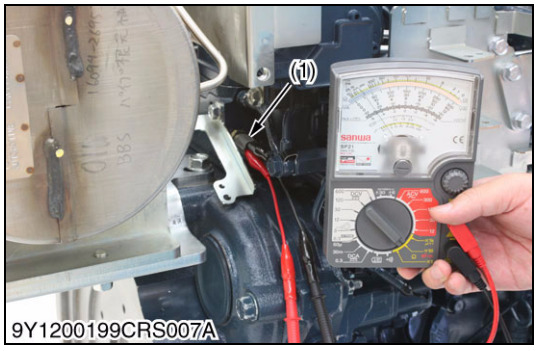
2. Check the Thermostat

1. Check the thermostat.

OK	Go to "3. Check the Coolant Temperature Sensor (Refer to items P0117 and P118)"
NG	Replace the thermostat.

(1) Thermostat Cover
(2) Thermostat Cover Gasket
(3) Thermostat Assembly

9Y1200199CRS1143US0



9Y1200199CRS007A

3. Check the Coolant Temperature Sensor (Refer to items P0117 and P118)

1. Check the coolant temperature sensor.

OK	Normal.
NG	Repair or replace the coolant temperature sensor or engine coolant system. (Follow the diagnostic procedure of items P0117 and P118)

(1) Coolant Temperature Sensor

9Y1200199CRS1144US0

(60) Parked Regeneration Time Out (DTC P3013 / 523590-16)

Behaviour during malfunction:
- None

Detection item:
- Time out error: regeneration imcomplete due to low temperature of DPF

DTC set preconditions:
- In the manual Regeneration mode [DPFSTATUS = 7]

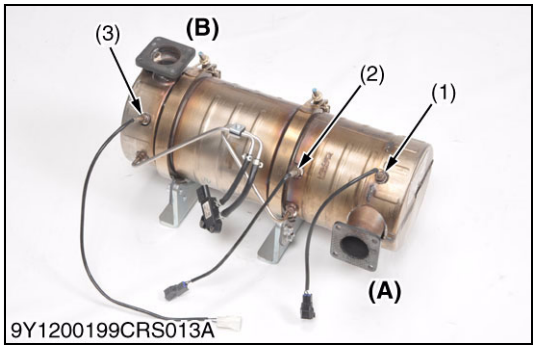
DTC set parameter:
- Coolant temperature is 65 °C (149 °F) or more and Regeneration was not completed within target time (approximately 30 min.) when the state above continues for 2700 seconds or more

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Diagnostic counter = zero (Leaving from parked active regeneration status)

9Y1200199CRS1145US0



9Y1200199CRS013A

1. Check the Installation of Exhaust Gas Temperature sensor

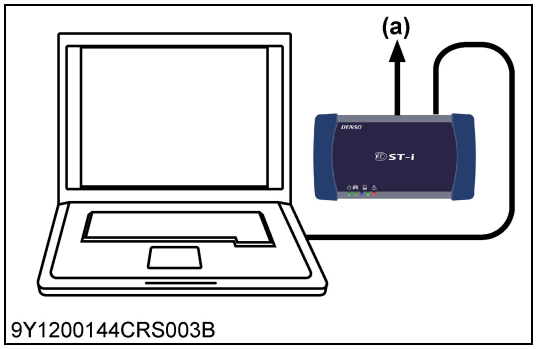
1. Check the installation of all exhaust gas temperature sensors (T0, T1 and T2).
2. Check the installation condition of the thermostat, and whether rust is not occurred.
3. Reinstall or replace the thermostat as necessary.

OK	Go to "2. 2. DPF Manual Regeneration".
NG	Repair or replace the exhaust gas temperature sensor or thermostat. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Exhaust Gas Temperature Sensor T0
(2) Exhaust Gas Temperature Sensor T1
(3) Exhaust Gas Temperature Sensor T2

(A) Exhaust Inlet Side
(B) Exhaust Outlet Side

9Y1200199CRS1146US0



9Y1200144CRS003B

2. DPF Manual Regeneration

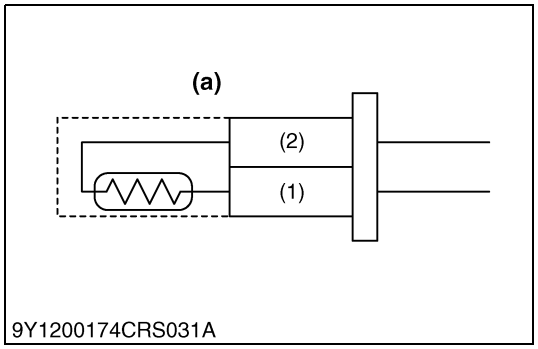
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust Gas Temperature Sensor 0", "Exhaust Gas Temperature Sensor 1" and "Exhaust Gas Temperature Sensor 2" on the data monitor.function.
3. Perform the diagnosis tool active test ("DPF Manual Regeneration").

Factory specification	No DTC is output.

OK	Normal.
NG	Go to 3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)".

(a) CAN1 Connector

9Y1200199CRS1147US0



9Y1200174CRS031A

3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

1. Check the exhaust gas temperature sensors (T0, T1 and T2).

OK	Normal.
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF
(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

9Y1200199CRS1148US0

(61) All Exhaust Gas Temperature Sensor Failure (DTC P3018 / 523599-0)

Behaviour during malfunction:
- None

Detection item:
- All exhaust gas temperature sensor failure simultaneously

DTC set preconditions:
- Engine speed is 1400 min^{-1} (rpm) or more
- Quantity of injection is 30 mm^3/st or more
- Coolant temperature is 65 °C (149 °F) or more: continues longer than 300 sec.
- Intake air temperature is 0 °C (32 °F) or more
- It continues longer than 100 sec. after cranking mode

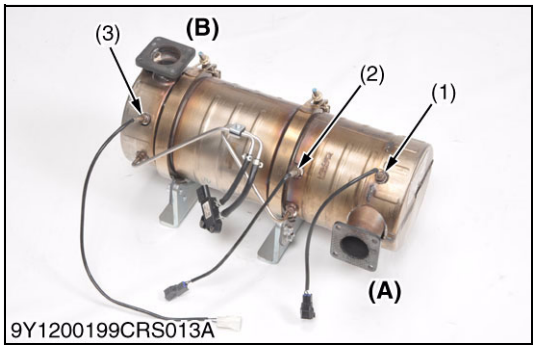
DTC set parameter:
- All exhaust gas temperature sensor failure (sensor low) simultaneously

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1149US0



9Y1200199CRS013A

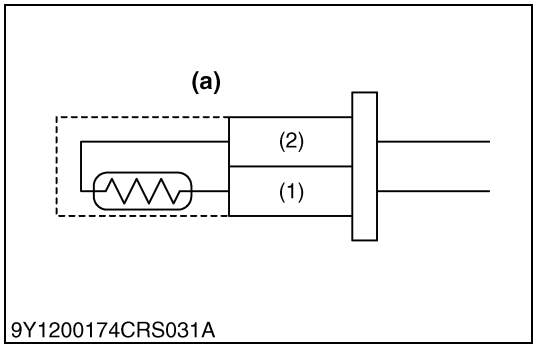
1. Check the Installation of Exhaust Gas Temperature sensor

1. Check the installation of all exhaust gas temperature sensors (T0, T1 and T2).

OK	Go to "2. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)".
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Exhaust Gas Temperature Sensor T0
(2) Exhaust Gas Temperature Sensor T1
(3) Exhaust Gas Temperature Sensor T2
(A) Exhaust Inlet Side
(B) Exhaust Outlet Side

9Y1200199CRS1150US0



9Y1200174CRS031A

2. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

1. Check the exhaust gas temperature sensors (T0, T1 and T2).

OK	Normal.
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF
(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

9Y1200199CRS1151US0

(62) Initial Pump-calibration Incomplete (DTC P3019 / 523600-0)

Behaviour during malfunction:
- None

Detection item:
- Pump-calibration history

DTC set preconditions:
- Battery voltage is normal

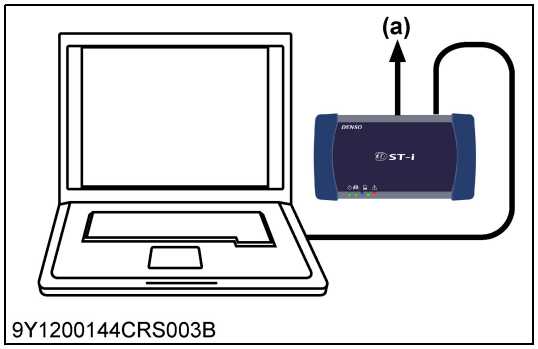
DTC set parameter:
- Initial pump calibration incomplete

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Diagnostic counter = zero (Leaving from parked active regeneration status)

9Y1200199CRS1152US0



9Y1200144CRS003B

1. Initial Pump-calibration

1. Place the key switch in the OFF position, attach the diagnosis tool the CAN1 connector, and perform the supply pump difference learning on the utility function.

■ **NOTE**
- **This warning indicates that supply pump difference learning not performed after replacing ECU on the site.**

(a) CAN1 Connector

9Y1200199CRS1153US0

(63) High Exhaust Gas Temperature After Emergency High Temperature DTC (DTC P3023 / 523601-0)

Behaviour during malfunction:
- None

Detection item:
- Exhaust gas temperature sensor 0, 1, 2 output

DTC set preconditions:
- Battery voltage is normal

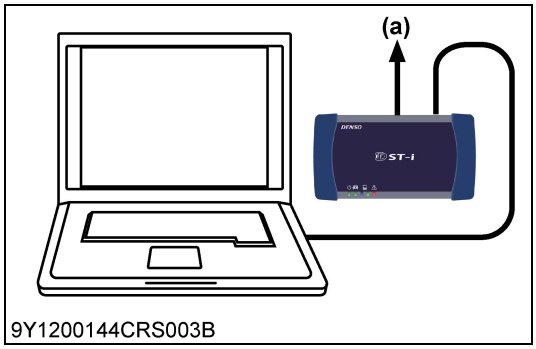
DTC set parameter:
- All exhaust gas temperature (T0, T1 and T2) reduces down to 300 °C (572 °F)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Engine stop
- Inhibit starter relay activation until all exhaust gas temperature (T0, T1 and T2) reduces down to 300 °C (572 °F)

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1154US0



9Y1200144CRS003B

1. Check the DTC

1. If DTC is output when the key switch is ON, do not start-up the engine. (Engine can not be started-up)
2. Engine can be started up after the DTC goes off.

■ **NOTE**
- **This DTC does not mean error.**
  This warning indicates that error of emergency exhaust gas temperature sensor has been continuing.

(a) CAN1 Connector

9Y1200199CRS1155US0

(64) High Frequency of Regeneration (DTC P3024 / 523602-0)

Behaviour during malfunction:
- Worsening exhaust gas performance (NOx)

Detection item:
- Time interval from the end time to the start time of the regeneration

DTC set preconditions:
- Battery voltage is normal
- Key switch is ON

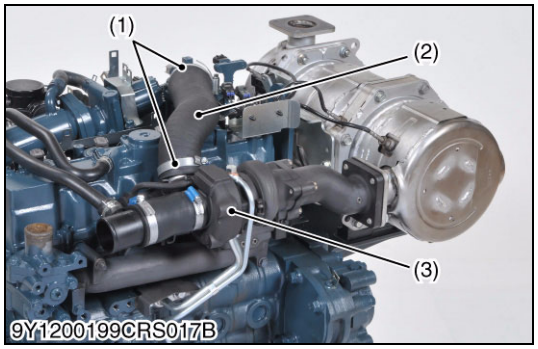
DTC set parameter:
- Regeneration time interval within 30 min. occurs three times continuously

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 50 % of normal condition
- EGR stop

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1156US0



1. Check the Air Intake System

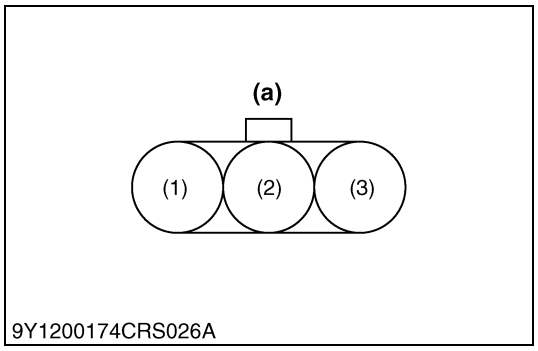
1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

■ **NOTE**
- **Check the installation of the differential pressure sensor pipes.**
- **Check the engine oil maintenance history (Oil consumption).**

OK	Go to "2. Check the Differential Pressure Sensor (Refer to items P2454 and P2455)".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE". (Refer to page 1-S298)

(1) Hose Clamp
(2) Hose
(3) Turbocharger

9Y1200199CRS1157US0



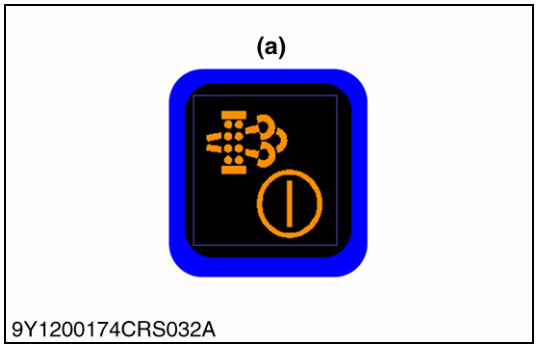
2. Check the Differential Pressure Sensor (Refer to items P2454 and P2455)

1. Check the differential pressure sensor.

OK	Go to "3. Check the Function of DPF".
NG	Repair or replace the differential pressure sensor or its related parts. (Follow the diagnostic procedure of items P2454 and P2455).

(1) Terminal A-VCC12
(2) Terminal A-GND11
(3) Terminal DPS
(a) Differential Pressure Sensor Connector

9Y1200199CRS1158US0



3. Check the Function of DPF

1. Operate the engine for 30 minutes in the normal condition.

Factory specification	"DPF Regeneration Request" is not detected within 30 minutes.

OK	Normal.
NG	Replace the DPF assembly.

(a) DPF Manual Regeneration Reguest Button

9Y1200199CRS1159US0

(65) Over Heat Pre-caution (DTC P3025 / 523603-15)

Behaviour during malfunction:
- Worsening exhaust gas performance (NOx)

Detection item:
- Limitation of EGR valve activation due to High temperature AECD

DTC set preconditions:
- Coolant temperature sensor is normal

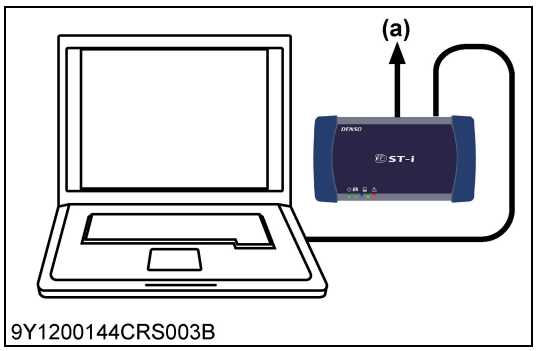
DTC set parameter:
- Engine coolant temperature ≥ 110 °C (230 °F)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- None

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1160US0



9Y1200144CRS003B

1. Check the DTC

1. This DTC does not mean error.
   The EGR operation is restricted when the coolant temperature rises above 110 °C (230 °F).
   So, this warning indicates that emission could worsen due to the limitation.

(a) CAN1 Connector

9Y1200199CRS1161US0

(66) CAN2 Bus Off (DTC U0075 / 523547-2)

Behaviour during malfunction:
- Insufficient output
- Transmitted data is invalid

Detection item:
- CAN2 + B/GND open circuit or high traffic error

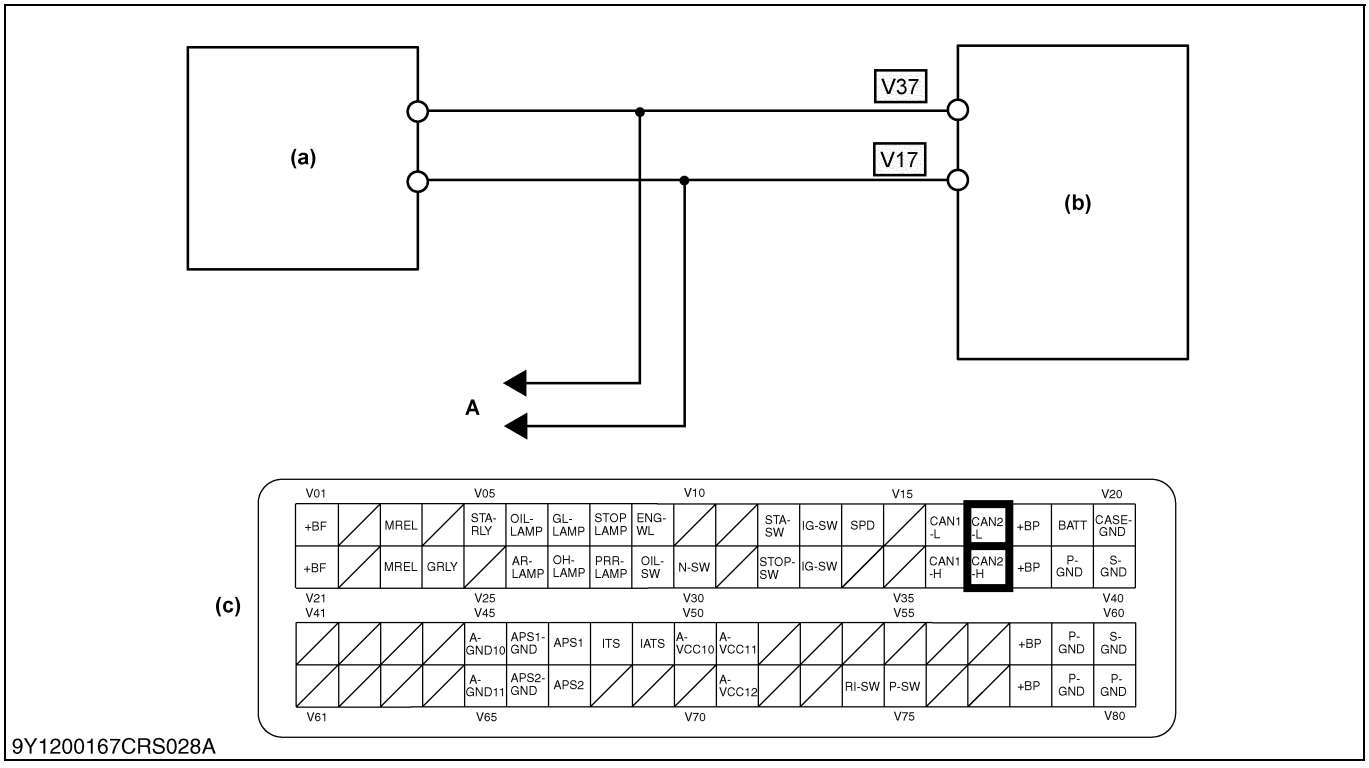
DTC set preconditions:
- Battery voltage is normal
- Key switch is ON

DTC set parameter:
- CAN2 Bus off

Engine warning light:
- ON

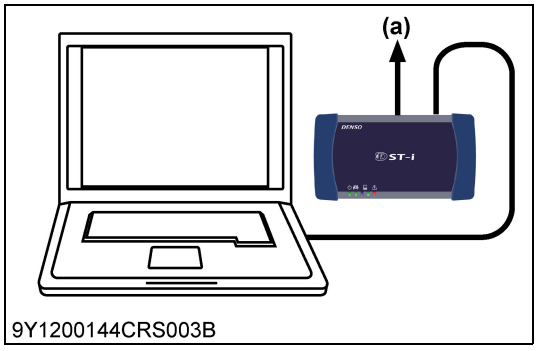
Limp home action by engine ECU (system action):
- Forced Idle (Accelerator = 0 %)

Recovery from error:
- Key switch turn OFF



(a) ECU for Machine **(b) Engine ECU** **(c) ECU Connector 2 (Machine Side)** **A: To Other ECU**

9Y1200199CRS1162US0



1. DTC Judgment

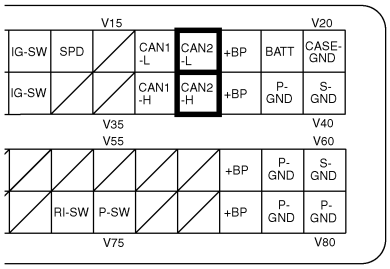
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Place the key switch in the ON position, check whether the DTC (U0075) is output or not.

Factory specification	DTC (U0075) must not be output.

OK	Normal.
NG	Go to "2. Check the Wiring Related to the CAN of the Common Rail System".

(a) CAN1 Connector

9Y1200199CRS1163US0



9Y1200167CRS001E

2. Check the Wiring Related to the CAN of the Common Rail System

1. Check the wiring harness and connectors being connected to ECU terminals V17 and V37 for a short or an open circuit.

■ **IMPORTANT**

- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems". (Refer to page 1-S304)**

OK	Replace the ECU.
NG	Repair or replace the faulty areas.

9Y1200199CRS1164US0

(67) No Communication with EGR (DTC U0076 / 523578-2)

Behaviour during malfunction:
- Insufficient output
- Worsening exhaust gas performance

Detection item:
- No communication with EGR

DTC set preconditions:
- Battery voltage is normal
- No ST signal

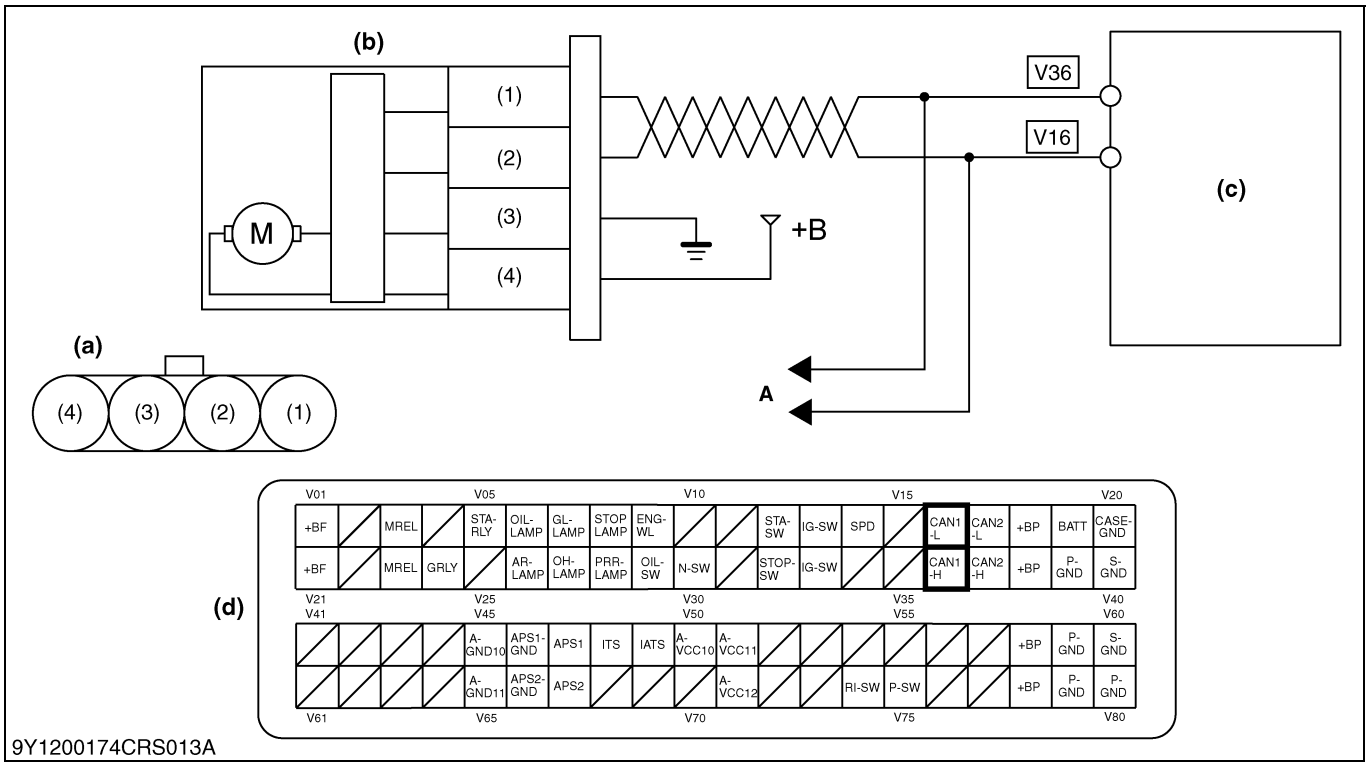
DTC set parameter:
- Interruption of CAN

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop

Recovery from error:
- Key switch turn OFF

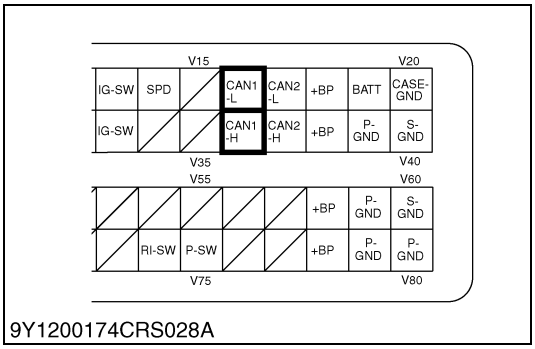
9Y1200199CRS1165US0



9Y1200174CRS013A

(1) Terminal CAN-H
(2) Terminal CAN-L
(3) Terminal Ground
(4) Terminal Power (+12 V)
(a) Terminal Layout
(b) EGR Valve Assembly
(c) Engine ECU
(d) ECU Connector 2 (Machine Side)
A: To Diagnosis Tool

9Y1200199CRS0944US0



9Y1200174CRS028A

1. Check the Wiring Related to the CAN of the Common Rail System

1. Check the connector and the wiring harness being connected to ECU terminal V16 and V36 for a short or an open circuit.

■ **IMPORTANT**

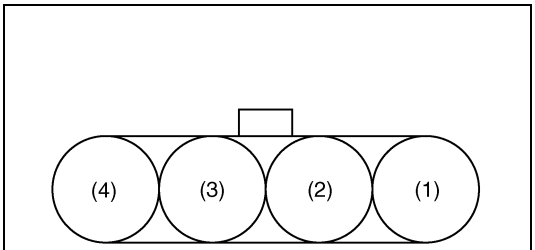
- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems". (Refer to page 1-S304)**

■ **NOTE**

- **If the "CAN 1 Bus off error" is output at the same time, carry out this inspection first.**

OK	Go to "2. Measure the EGR Terminal Voltage".
NG	Repair or replace the faulty areas.

9Y1200199CRS1167US0



9Y1200174CRS029A

2. Measure the EGR Terminal Voltage

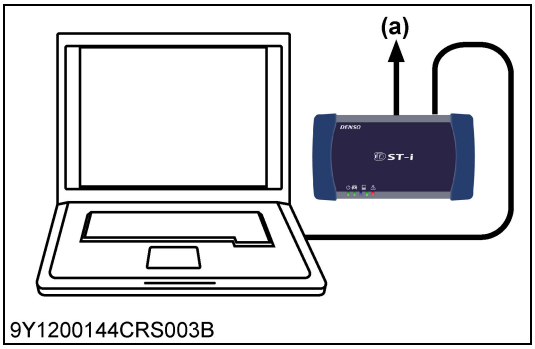
1. Place the key switch in the ON position, and measure the voltage between EGR terminals (3) and (4).

Factory specification	Approx. 10 to 16 V

OK	Go to "3. Check the DTC Again".
NG	Repair or replace the faulty areas.

(1) Terminal CAN-H
(2) Terminal CAN-L
(3) Terminal Ground
(4) Terminal Power (+12 V)

9Y1200199CRS1168US0



9Y1200144CRS003B

3. Check the DTC Again

1. Clear the past malfunction data, and make sure that the same DTC is output again in the reproduction test.

Factory specification	Normal (No DTC is output.)

■ **NOTE**

- **Check the DTC again after starting up the engine with the engine with the coolant temperature over 65 °C (149 °F).**

OK	Normal.
NG	Replace the EGR assembly.

(a) CAN1 Connector

9Y1200199CRS1169US0

(68) CAN1 Bus Off (DTC U0077 / 523604-2)

Behaviour during malfunction:
- Insufficient output
- Transmitted data is invalid

Detection item:
- CAN1 +B/GND open circuit or high traffic error

DTC set preconditions:
- Battery voltage is normal
- Key switch is ON

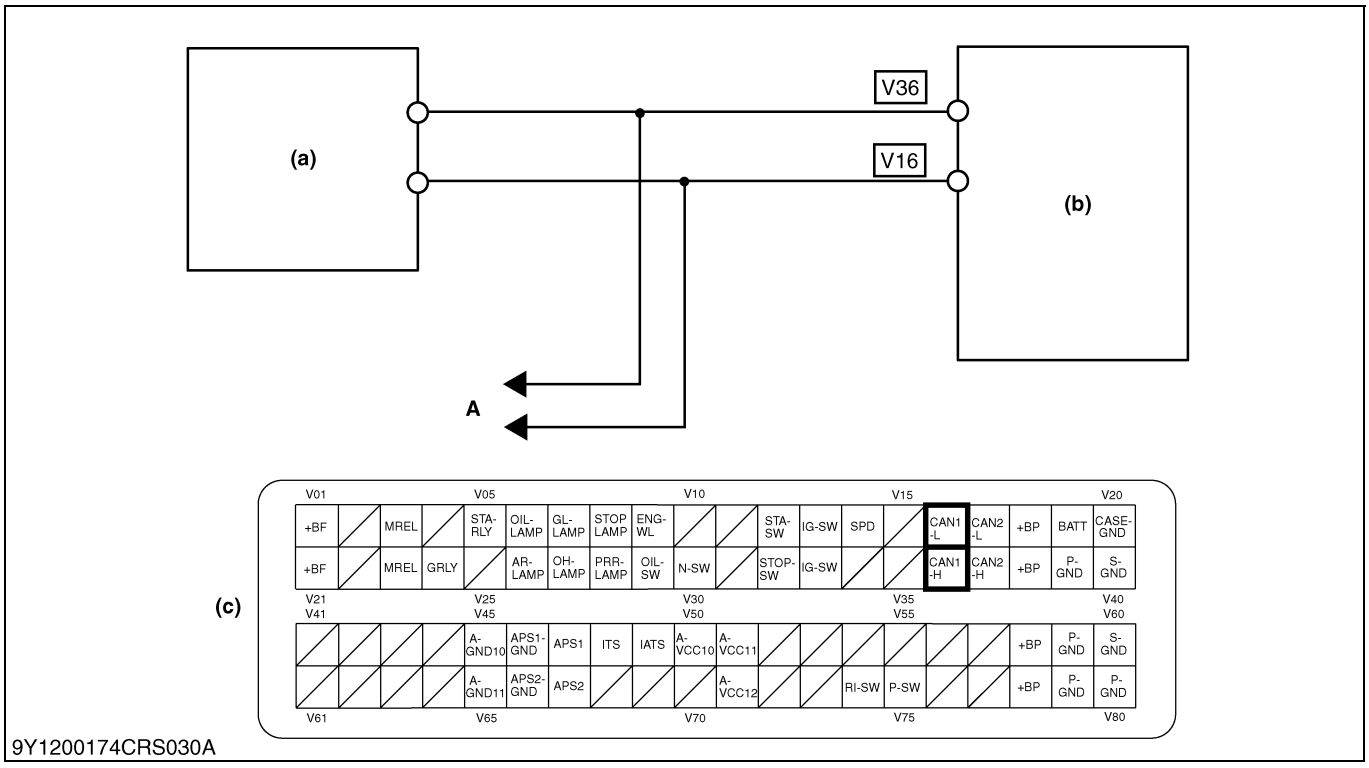
DTC set parameter:
- CAN1 Bus off

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Output limitation: Approximately 75 % of normal condition
- EGR stop

Recovery from error:
- Key switch turn OFF

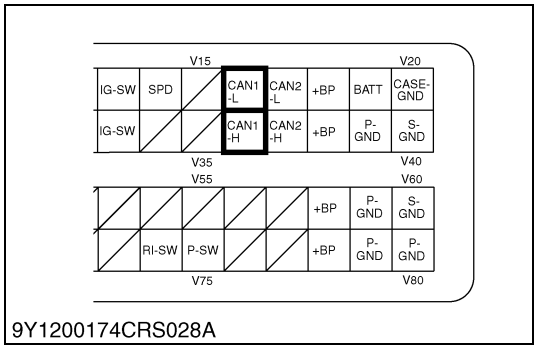
9Y1200199CRS1170US0



9Y1200174CRS030A

(a) EGR Valve Assembly **(b) Engine ECU** **(c) ECU Connector 2 (Machine Side)** **A: To Diagnosis Tool**

9Y1200199CRS1171US0



9Y1200174CRS028A

1. Check the Wiring Related to the CAN of the Common Rail System

1. Check the connector and the wiring harness being connected to ECU terminal V16 and V36 for a short or an open circuit.

■ **IMPORTANT**
- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems". (Refer to page 1-S304)**

OK	Replace the ECU.
NG	Repair or replace the faulty areas.

9Y1200199CRS1172US0

(69) CAN2 Frame Error (DTC U0081 / 523548-2, U0082 / 523591-2, U0083 / 523592-2, U0084 / 523593-2, U0085 / 523594-2, U0086 / 523595-2, U0087 / 523596-2, U0089 / 523598-2)

U0081 / 523548-2: CAN-KBT frame error

Behaviour during malfunction:
- Insufficient output

Detection item:
- CAN-KBT original frame error

DTC set preconditions:
- Battery voltage is normal
- Key switch turn OFF to ON
- No ST signal
- No error of "CAN2 Bus off"

DTC set parameter:
- CAN2 KBT frame error open circuit or short circuit

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Forced Idle (Accelerator = 0 %)

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1173US0

U0082 / 523591-2: CAN CCVS (Parking SW and Vehicle Speed) frame error

Behaviour during malfunction:
- None

Detection item:
- CAN_CCVS communication stopping

DTC set preconditions:
- Battery voltage is normal
- No ST signal

DTC set parameter:
- CAN CCVS frame time out error

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Parking SW = OFF, Vehicle speed = 0 [default value]

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1174US0

U0083 / 523592-2: CAN CM1 (Regen SW) frame error

Behaviour during malfunction:
- None

Detection item:
- CAN_CM1 communication stopping

DTC set preconditions:
- Battery voltage is normal
- No ST signal

DTC set parameter:
- CAN CM1 frame time out error

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Regeneration inhibit = ON, Parked regeneration switch = OFF [default value]

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1175US0

U0084 / 523593-2: CAN DDC1 (Transmission) frame error
Behaviour during malfunction:
- None

Detection item:
- CAN_DDC1 communication stopping

DTC set preconditions:
- Battery voltage is normal
- No ST signal

DTC set parameter:
- CAN DDC1 frame time out error

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Accelerator non-linear processing flag = 0 [default value]
- Accelerator non-linear processing invalid

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1176US0

U0085 / 523594-2: CAN ETC2 (Neutral SW) frame error
Behaviour during malfunction:
- None

Detection item:
- CAN_ETC2 communication stopping

DTC set preconditions:
- Battery voltage is normal
- No ST signal

DTC set parameter:
- CAN ETC2 frame time out error

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Neutral SW = OFF [default value]

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1177US0

U0086 / 523595-2: CAN ETC5 (Neutral SW) frame error
Behaviour during malfunction:
- None

Detection item:
- CAN_ETC5 communication stopping

DTC set preconditions:
- Battery voltage is normal
- No ST signal

DTC set parameter:
- CAN ETC5 frame time out error

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Neutral SW = OFF [default value]

Recovery from error:
- Key switch turn OFF

9Y1200199CRS1178US0

U0087 / 523596-2: CAN TSC1 frame error
Behaviour during malfunction:
- None

Detection item:
- CAN_TSC1 communication stopping

DTC set preconditions:
- Battery voltage is normal
- No ST signal

DTC set parameter:
- When not receive the request to "TSC1 buffer" 3 times continuously at each timing after receiving over-ride control request (other than 0x00)

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Override control mode = Normal mode [default value]

Recovery from error:
- Diagnostic counter = zero

9Y1200199CRS1179US0

U0089 / 523598-2: CAN EBC1 frame error
Behaviour during malfunction:
- None

Detection item:
- CAN_EBC1 communication stopping

DTC set preconditions:
- Battery voltage is normal
- No ST signal

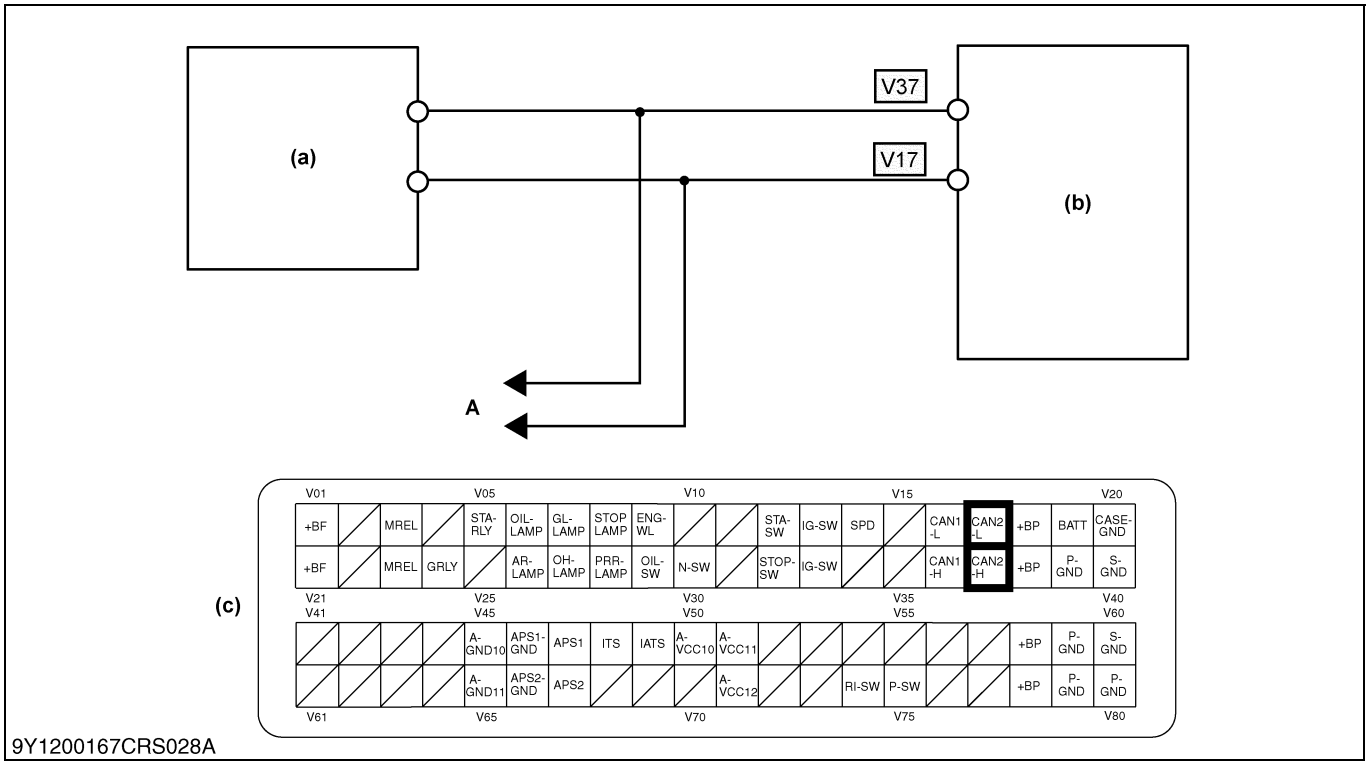
DTC set parameter:
- CAN EBC1 frame time out error

Engine warning light:
- ON

Limp home action by engine ECU (system action):
- Non shutdown [default value]
- Output limitation: Approximately 75 % of normal condition

Recovery from error:
- Diagnostic counter = zero

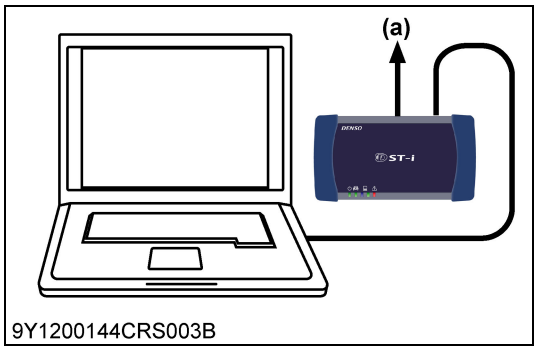
9Y1200199CRS1180US0



9Y1200167CRS028A

(a) ECU for Machine **(b) Engine ECU** **(c) ECU Connector 2 (Machine Side)** **A: To Other ECU**

9Y1200199CRS1181US0



9Y1200144CRS003B

1. DTC Judgment

1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Place the key switch in the ON position, check whether the DTC is output or not.

■ **NOTE**

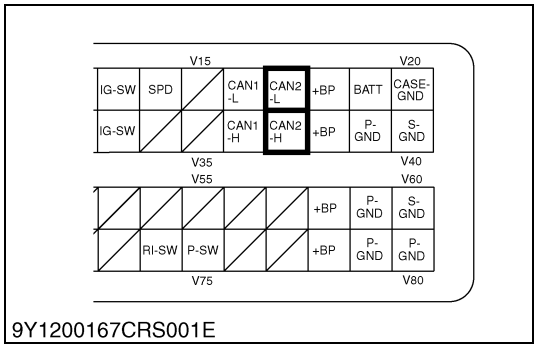
- **If the "CAN 2 Bus off error" is output at the same time, carry out this inspection first.**
- **Make sure that the ECU on the machine side operates properly.**

Factory specification	DTC must not be output.

OK	Normal.
NG	Go to "2. Check the Wiring Related to the CAN of the Common Rail System".

(a) CAN1 Connector

9Y1200199CRS1182US0



9Y1200167CRS001E

2. Check the Wiring Related to the CAN of the Common Rail System

1. Check the wiring harness and connectors being connected to ECU terminals V17 and V37 for a short or an open circuit.

■ **IMPORTANT**

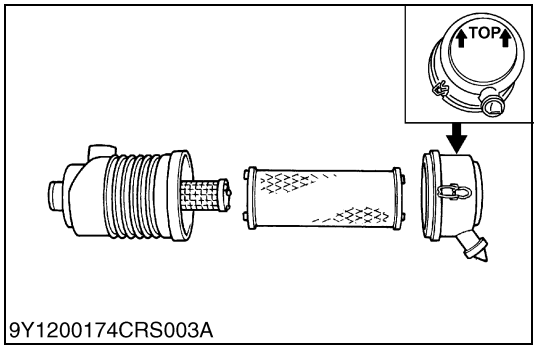
- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems". (Refer to page 1-S304)**

OK	Replace the ECU.
NG	Repair or replace the faulty areas.

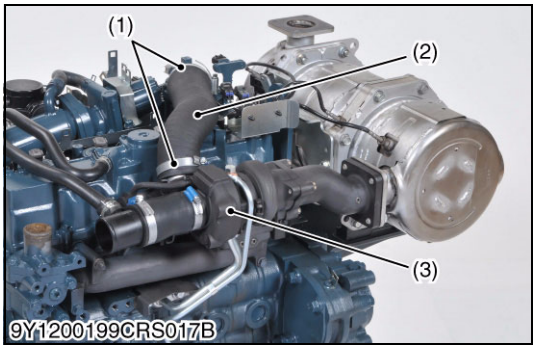
9Y1200199CRS1183US0

6. INSPECTION PROCEDURE FOR EACH SYSTEM

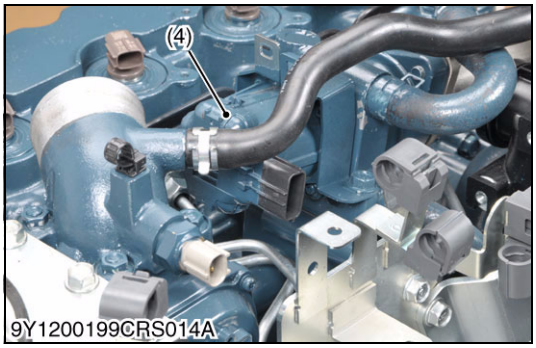
[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE



9Y1200174CRS003A



9Y1200199CRS017B



9Y1200199CRS014A

1. Check the Air Cleaner

1. Check the air cleaner for clogging.
   - Clean air cleaner element (Primary and Secondary) every 250 hours.
   - Replace air cleaner element:
     Once yearly or after every sixth cleaning, whichever comes first.

OK	Go to "2. Check the Suction Path".
NG	Clean or replace.

9Y1200199CRS1184US0

2. Check the Suction Path

1. Check the suction path for leaks. (including EGR valve, turbocharger, intercooler, etc.)
   - Suction path joints.
   - Suction pipes, hoses.

■ **NOTE**

- **A small amount of gas and water bleeds from the valve chamber gas bleeding hole of the EGR valve. This is normal.**

OK	Normal.
NG	Repair or replace the malfunctioning component.

(1) Hose Clamp
(2) Hose
(3) Turbocharger
(4) EGR Valve

9Y1200199CRS1185US0

[2] FUEL SYSTEM INSPECTION PROCEDURE

Fuel:

Fuel is flammable and can be dangerous.
You should handle fuel with care.

- Cetane Rating: The minimum recommended Fuel Cetane Rating is 45.
  A cetane rating greater than 50 is preferred, especially for ambient temperatures below –20 °C (–4 °F) or elevations above 1500 m (5000 ft).
- Diesel Fuel Specification Type and Sulfur Content % (ppm) used, must be compliant with all applicable emission regulations for the area in which the engine is operated.
- DO NOT USE Fuels that have sulfur content greater than 0.0015 % (15 ppm).
- Diesel fuels specified to EN 590 or ASTM D975 are recommended.
- No.2-D is a distillate fuel of lower volatility for engines in industrial and heavy mobile service. (SAE J313 JUN87)
- These engines utilize Interim Tier 4 standards, the use of ultra low sulfur fuel is mandatory for these engines, when operated in US EPA regulated areas.

Therefore, please use No.2-D S15 diesel fuel as an alternative to No.2-D, and use No.1-D S15 diesel fuel as an alternative to No.1-D for ambient temperatures below −10 °C (14 °F).

1. SAE: Society of Automotive Engineers
2. EN: European Norm
3. ASTM: American Society of Testing and Materials
4. US EPA: United States Environmental Protection Agency
5. No.1-D or No.2-D, S15: Ultra Low Sulfur Diesel (ULSD) 15 ppm or 0.0015 wt.%

- When biodiesel fuel is used, change the fuel filter cartridge, fuel rubber piping and clamp bands with new ones at intervals half of the usual ones.

■ **IMPORTANT**

- **Be sure to use a strainer when filling the fuel tank, or dirt or sand in the fuel may cause trouble.**
- **Do not run the fuel tank level too low or completely out of fuel. Additionally, fuel system bleeding may be necessary if air enters the fuel system.**

Biodiesel fuel:

[When the B7 blended fuel is used]

When the finally blended Biodiesel fuel is B7, make sure it conforms to the updated EN590 (European) standard. Be also sure that the mineral oil diesel fuel, if used, conforms to the updated EN590 (European) standard and that the B100 blend conforms to the updated EN14214 (European) standard.

[When the B5 blended fuel is used]

When the finally blended Biodiesel fuel is B5, make sure it conforms to the updated EN590 (European) standard. Be also sure that the mineral oil diesel fuel, if used, conforms to the updated EN590 (European) standard or the ASTM D975 (U.S.) standard and that the B100 blend conforms to the updated EN14214 (European) standard or the ASTM D6751 (U.S.) standard.

(To be continued)

(Continued)

[Precautions in handling Biodiesel fuels]

1. Keep the fuel tank full whenever possible to prevent water vapor from accumulating inside the fuel tank.
   Tighten up the fuel tank filler cap to avoid the entry of moisture.
2. Routinely check the oil level before the operation.
   Also strictly follow the specified oil change intervals.
3. Biodiesel fuels (BDF) during the supply process or in the machine easily deteriorate due to oxygen, water, heat and other foreign substances. With this in mind, take the following precautions.
   - Do not leave those fuels in the fuel tank or a metallic drum longer than 3 months.
   - Before storing the engine for a prolonged period, change such fuel for a conventional type of diesel fuel and run the engine for 30 minutes or longer to clean up the fuel system.
4. Bear it in mind that Biodiesel fuels have the characteristics below.
   Referring to the servicing intervals specified in the KUBOTA product's Operator's Manuals, be sure to maintain and clean up the fuel system, replace the fuel rubber piping with new ones and take other necessary measures. It is advisable to replace the fuel filter, fuel rubber piping and clamp bands with new ones after half the specified replacement intervals.
   (Compared with the use of mineral oil diesel fuels, the filtration performance of fuel filters gets degraded earlier than expected.)
   - Biodiesel fuels easily induce the growth of microorganisms and foul themselves.
     This may get the fuel system corroded and the fuel filter clogged.
   - In cold weather, some problems may occur: the clog of the fuel line or fuel system, starting failure, and other unforeseen troubles.
   - Biodiesel fuels easily soak up moisture, which means that they may contain higher moisture content than conventional diesel fuels.
5. Palm oil-based Biodiesel fuels are inferior in low temperature fluidity to soy-based and rapeseed-based Biodiesel fuels.
   In cold season in particular, this may clog the fuel filter.
6. If Biodiesel fuels are spilt on a coated surface, the coating may get damaged.
   Immediately wipe the spill off the surface.

Fuel filter:

- At least, filter mesh below is required.
  5 µm dust - dust collecting efficiency 95 % or more (Standard spec. filter)
  – An additional filter which has higher cleaning efficiency may be required depending on the spec. (working condition) or area. Even the maximum period of operation time is same, in case the cleaning efficiency has improved, it is required to expand the size of a filter (A filter needs to be bigger.).

Criteria at the entrance of supply pump:

- Water content: Less than 0.05 % (500ppm)
  – Use to compare with the analysis result by the third-party organization.
- Air: No existence (Do not modify the specific fuel pipe)
  – Visually check is possible by using clear hose. Pay sufficient caution to contamination.
- Critical load: (at all operating conditions) −30 kPa or more
  – Perform a measurement of the pressure depending on the situation.

9Y1200199CRS1186US0

1. Check the Fuel System (Remaining Fuel Quantity and Properties)

1. Check the amount of fuel remaining in the tank.
2. Check properties of fuel. Request fuel analysis from a third party as necessary.
   - Color (no color, brownish, white turbidit).
   - Odor (kerosene, heavy oil, irritating odor).
   - Separation of materials (water, foreign objects).
   - Viscosity (high / low viscosity, wax consistency).

■ **NOTE**
- **Always use the specified fuel.**

OK	Go to "2. Check the Inside of the Tank (Checking for Tank Modification / Additions, Position of Fuel Pipe Inlet / Outlet, Clogging and Holes)".
NG	Add fuel or change fuel (clean tank).

9Y1200199CRS1187US0

2. Check the Inside of the Tank (Checking for Tank Modification / Additions, Position of Fuel Pipe Inlet / Outlet, Clogging and Holes)

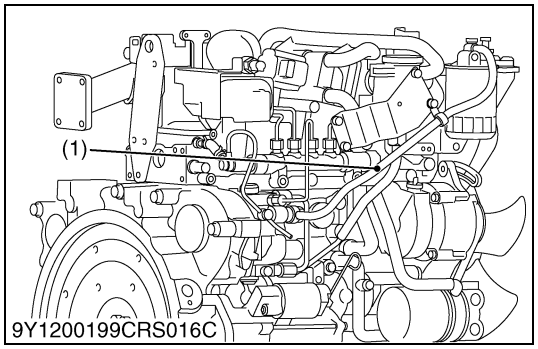
1. Check the tank for modifications or additions. Consult with the customer.
   - Fuel inlet / outlet position, tank piping.
   - Foreign material inside the tank, water separation, rust.

■ **NOTE**
- **Use resin tanks when making tank additions.**

2. Check the tank internal fuel piping for the following.
   - Inlet / outlet position (below position "Empty").
   - Inlet clogging, whether there is bent or deformed piping (crushed pipe).
   - Crushing at pipe connections.

OK	Go to "3. Tank External Fuel Path Conditions (Crushed Hose, Clogging, Air Introduction at Hose Connection)".
NG	Restore the fuel tank.

9Y1200199CRS1188US0



3. Tank External Fuel Path Conditions (Crushed Hose, Clogging, Air Introduction at Hose Connection)

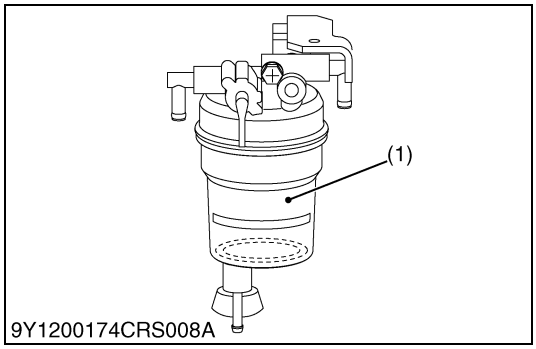
1. Check the condition of the hose.
   - Crushing around bands, over bending.
   - Pinched or crushed by other parts.
2. Check the connection (air introduction).
   - Looseness.
   - Hose deterioration (verify that there is no rubber hardening / splitting by hand or visually).

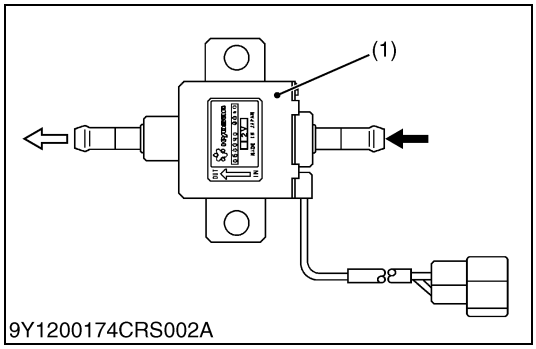
■ **NOTE**
- **Be cautious when vacuum pressure is present, as air will be drawn into the hose.**

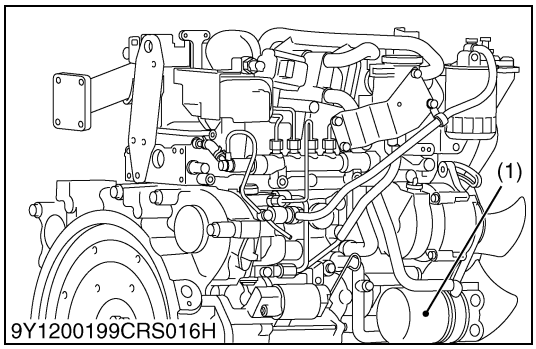
OK	Go to "4. Check the Water Separator".
NG	Repair or replace the hose.

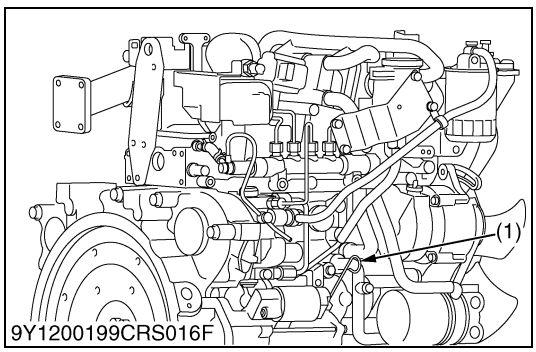
(1) Fuel Hose

9Y1200199CRS1189US0









4. Check the Water Separator

1. Check the water level of the water separator and discharge some water as necessary.
2. Check for element deformation and dirt.
   Clean or replace the element as necessary.

OK	Go to "5. Check the Fuel Feed Pump".
NG	Replace the filter and drain the water from the water separator.

(1) Water Separator

9Y1200199CRS1190US0

5. Check the Fuel Feed Pump

1. Set the key switch to the ON position, check the fuel feed pump alone, and check and repair the wiring harnesses.
2. Check the operation of the fuel feed pump by touching it directly by hand.

■ **NOTE**

- **If there is a fuel feed pump malfunction, the fuel cannot be supplied and so there is greater likelihood of improper recognition of DTC codes related to the pressure and injector. (Items where improper recognition is possible.)**
- **Injector COM1 TWV actuation system short**
- **SCV actuation system abnormality**
- **Others**

OK	Go to "6. Fuel Filter Clogged".
NG	Repair the wiring harness, and replace the fuel feed pump.

(1) Fuel Feed Pump

9Y1200199CRS1191US0

6. Fuel Filter Clogged

1. Check the fuel filter for clogging and dirt.

■ **NOTE**

- **Replace the fuel filter every 500 operation hours.**

OK	Go to "7. Engine Oil Level Increase (Engine Internal Leak)".
NG	Clean or replace the fuel filter and fuel pipe system.

(1) Fuel Filter

9Y1200199CRS1192US0

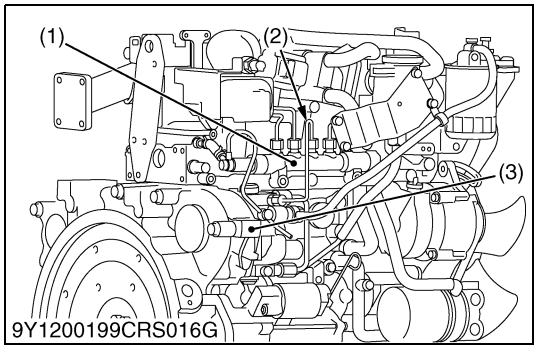
7. Engine oil Level Increase (Engine Internal Leak)

1. Check the engine oil level increase with dipstick.
2. Request fuel dilution analysis or oil analysis from a third party as necessary.

OK	Go to "8. Check the High Pressure Piping and CRS Components (Such as the Fuel Injector and the Supply Pump) for Fuel Leakage (Engine External Leak)".
NG	Check and repair interior pipes.

(1) Dipstick

9Y1200199CRS1193US0



8. Check the High Pressure Piping and CRS Components (Such as the Fuel Injector and the Supply Pump) for Fuel Leakage (Engine External Leak)

1. Visually check and specify areas leaking fuel.
2. Be cautious because there may be oil leaks in the high pressure pipe and injector areas.

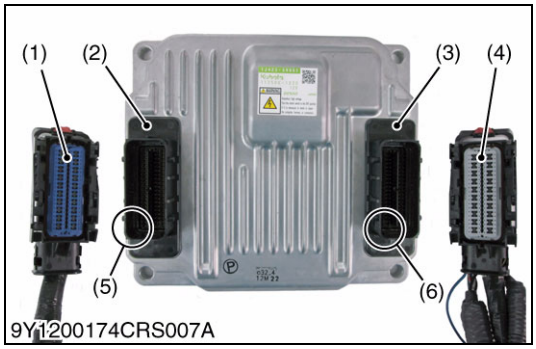
OK	Normal.
NG	Repair leaking high pressure pipe, etc. or replace leaking parts.

(1) Rail
(2) Injection Pipe
(3) Supply Pump

9Y1200199CRS1194US0

[3] ELECTRIC SYSTEM INSPECTION PROCEDURE

(1) Basics Of Checking Electrical / Electronic Circuit Systems



9Y1200174CRS007A

Measure the ECU Terminal Voltage and Resistance

1. When measuring the voltage and resistance of each terminal, insert the multimeter probe into the rear side of the wiring harness connector. If connectors are small making it difficult to insert the probe, insert a fine metal wire into the rear of the connector and touch the wire to the probe.

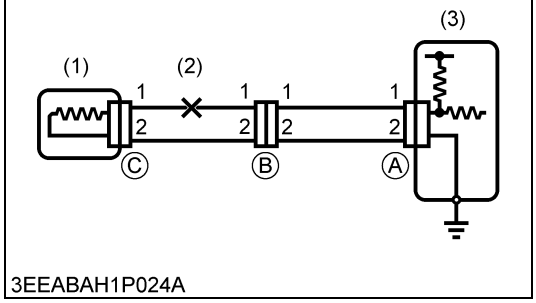
■ **IMPORTANT**

- **When inserting a fine metal wire for measurement purposes, ensure that the connector waterproof rubber is not damaged.**

(1) ECU Wiring Harness Connector 1 (Engine Side)
(2) ECU Connector 1 (Engine Side)
(3) ECU Connector 2 (Machine Side)
(4) ECU Wiring Harness Connector 2 (Machine Side)
(5) EO1 Position
(6) VO1 Position

9Y1200199CRS1195US0

(A-1)



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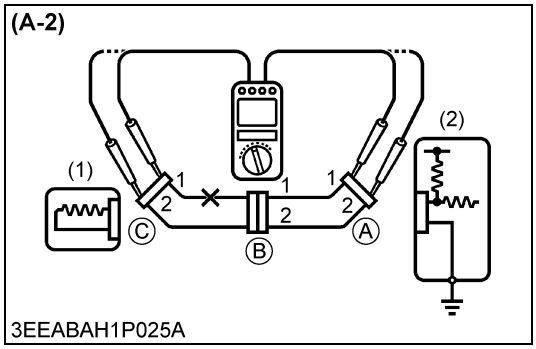
Open Circuit Check

1. When dealing with a wiring harness open circuit like that depicted in Figure **A-1**, check continuity or voltage to determine the location of the open circuit.

(1) Sensor
(2) Open Circuit
(3) ECU

9Y1200199CRS1196US0

(A-2)



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Check for Continuity

1. Remove connectors **"A"** and **"C"** and measure resistance between the two.

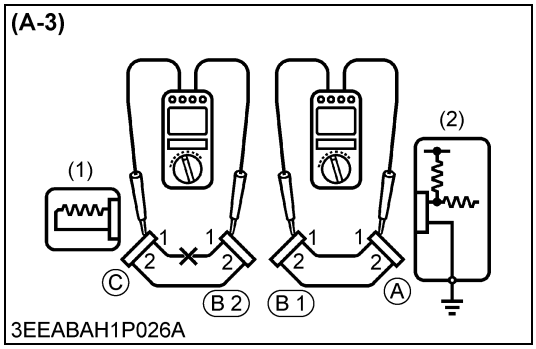
Factory specification	Less than 1 Ω

(Reference)

- Measure resistance while gently shaking the wiring harness up and down, and side-to-side.

2. In the case of Figure **A-2**, there is no continuity (open circuit) between terminal 1 of connector **"A"** and terminal 1 of connector **"C"**. However, there is continuity between terminal 2 of connector **"A"** and terminal 2 of connector **"C"**. As a result, it can be said that there is an open circuit between terminal 1 of connector **"A"** and terminal 1 of connector **"C"**.
3. Remove connector **"B"** and measure the resistance in the connector.
4. In the case of Figure **A-3**, there is continuity between terminal 1 of connector **"A"** and terminal 1 of connector **"B1"**. However, there is no continuity (open circuit) between terminal 1 of connector **"B2"** and terminal 1 of connector **"C"**. As a result, it can be said that there is an open circuit between terminal 1 of connector **"B2"** and terminal 1 of connector **"C"**.

(A-3)



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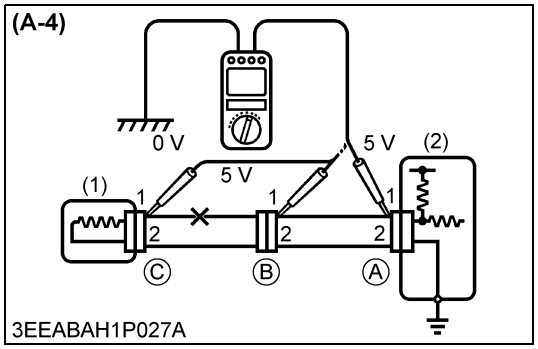
(1) Sensor
(2) ECU

9Y1200199CRS1197US0



Check Voltage

1. In the case of the circuit that supplies voltage to the ECU connector terminals, check for an open circuit by performing a voltage check.
2. As depicted in Figure **A-4**, measure the voltage of the ECU 5 V output terminal between the body ground and terminal 1 of connector **"A"** with all connectors connected. Next, measure in order the voltage between terminal 1 of connector **"B"** and the body ground, and terminal 1 of connector **"C"** and the body ground.
3. The faulty circuit and measurement results are as per below.

(Measurement Results)

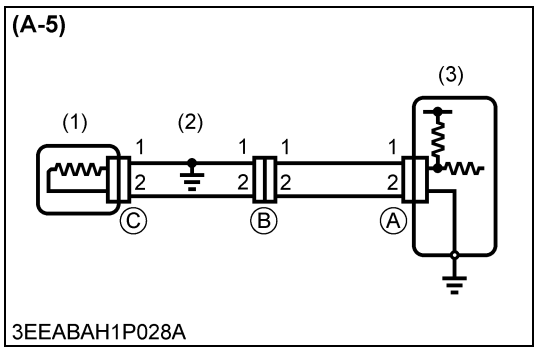
- Voltage between terminal 1 of connector **"A"** and the body ground is 5 V.
- Voltage between terminal 1 of connector **"B"** and the body ground is 5 V.
- Voltage between terminal 1 of connector **"C"** and the body ground is 0 V.

(Faulty Circuit)

- There is an open circuit between terminal 1 of connector **"B"** and terminal 1 of connector **"C"**.

(1) Sensor (2) ECU

9Y1200199CRS1198US0



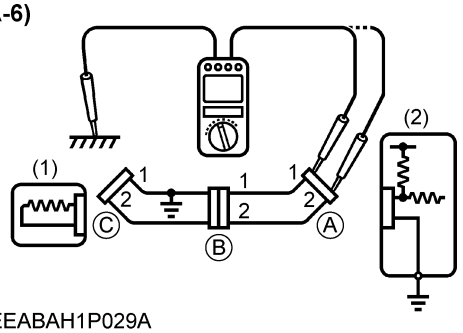
Short Circuit Check

1. As per Figure **A-5**, if there is a short in the wiring harness ground, perform a **"Ground continuity check"** to determine the source of the short.

(1) Sensor (3) ECU
(2) Short Circuit

9Y1200199CRS1199US0

(A-6)



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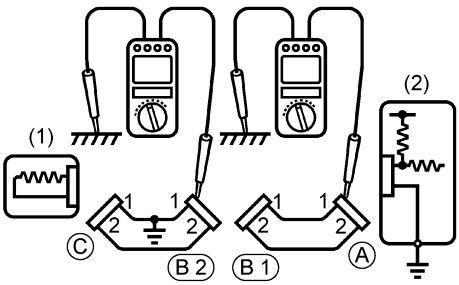
(A-7)



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Ground Continuity Check

1. Remove connector **"A"** and connector **"C"**, then measure the resistance between terminals 1 and 2 of connector **"A"** and ground.

Factory specification	No continuity

(Reference)

- Measure resistance while gently shaking the wiring harness up and down, and side-to-side.

2. In the case of Figure **A-6**, there is continuity between terminal 1 of connector **"A"** and the body ground (short circuit). However, there is no continuity between terminal 2 of connector **"A"** and the body ground. As a result, it can be said that there is an open circuit between terminal 1 of connector **"A"** and terminal 1 of connector **"C"** .
3. Remove connector **"B"** and measure the resistance between terminal 1 of connector **"A"** and the body ground, and between terminal 1 of connector **"B2"** and the body ground.
4. The faulty circuit and measurement results are as per below.

(Measurement Results)

- No continuity between terminal 1 of connector **"A"** and the body ground.
- Continuity between terminal 1 of connector **"B2"** and the body ground.

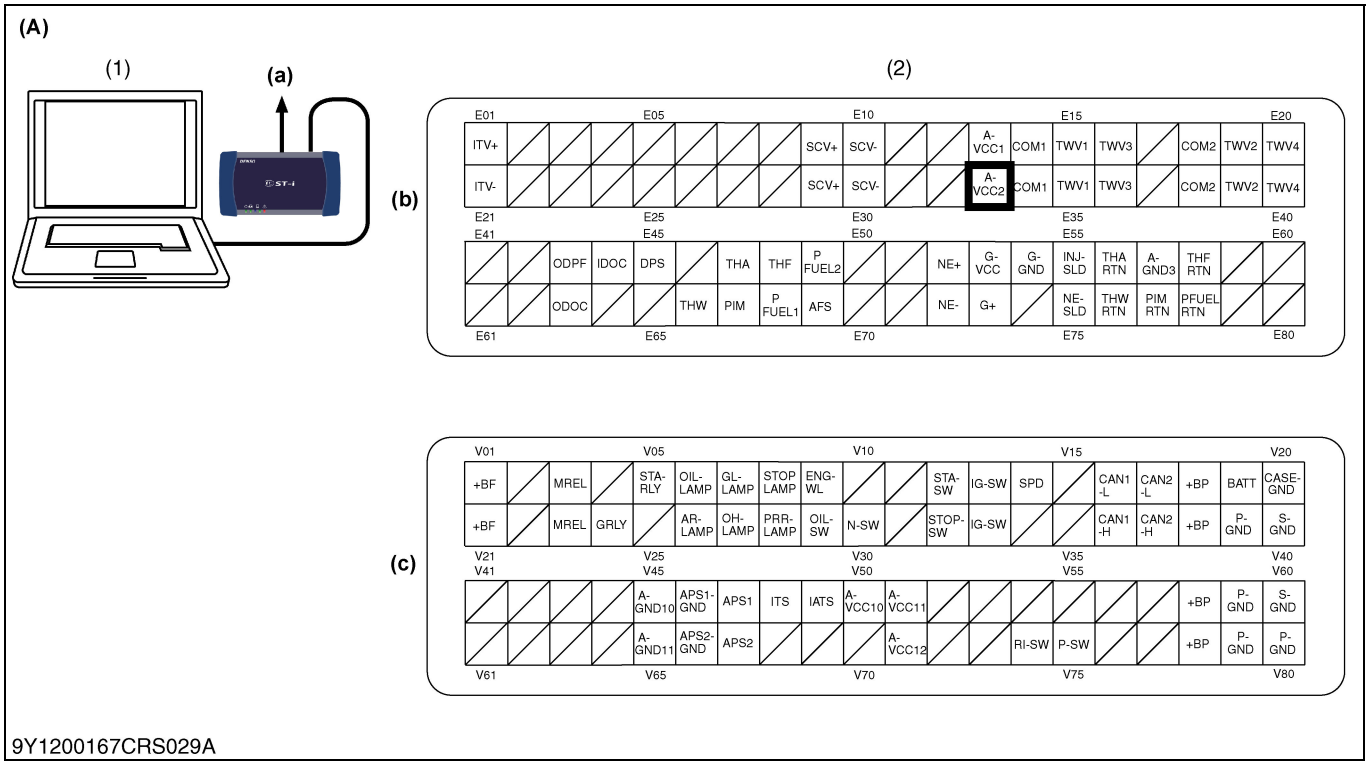
(Faulty Circuit)

- There is a short circuit between terminal 1 of connector **"B2"** and terminal 1 of connector **"C"**.

(1) Sensor (2) ECU

9Y1200199CRS1200US0

(2) Connector Connection Fault Verification Method



(1) Diagnosis Tool Data Monitor (Sensor Output Voltage)
(2) Voltage Measurement
(A) Sensor Example
(a) CAN1 Connector
(b) ECU Connector 1 (Engine Side)
(c) ECU Connector 2 (Machine Side)

As per the diagram above, measure both the data monitor and connector voltage simultaneously.

Ex.) Coolant temperature sensor

a) Read in the "Coolant Temperature Output Voltage" value from the data monitor.

b) Measure the voltage directly from the corresponding ECU terminal.

Judge as a connector connection fault if **b)** is satisfactory and **a)** is unsatisfactory. Since some malfunctions only occur intermittently, measure voltage while pulling and shaking the wires in order to try to get the malfunction to reoccur.

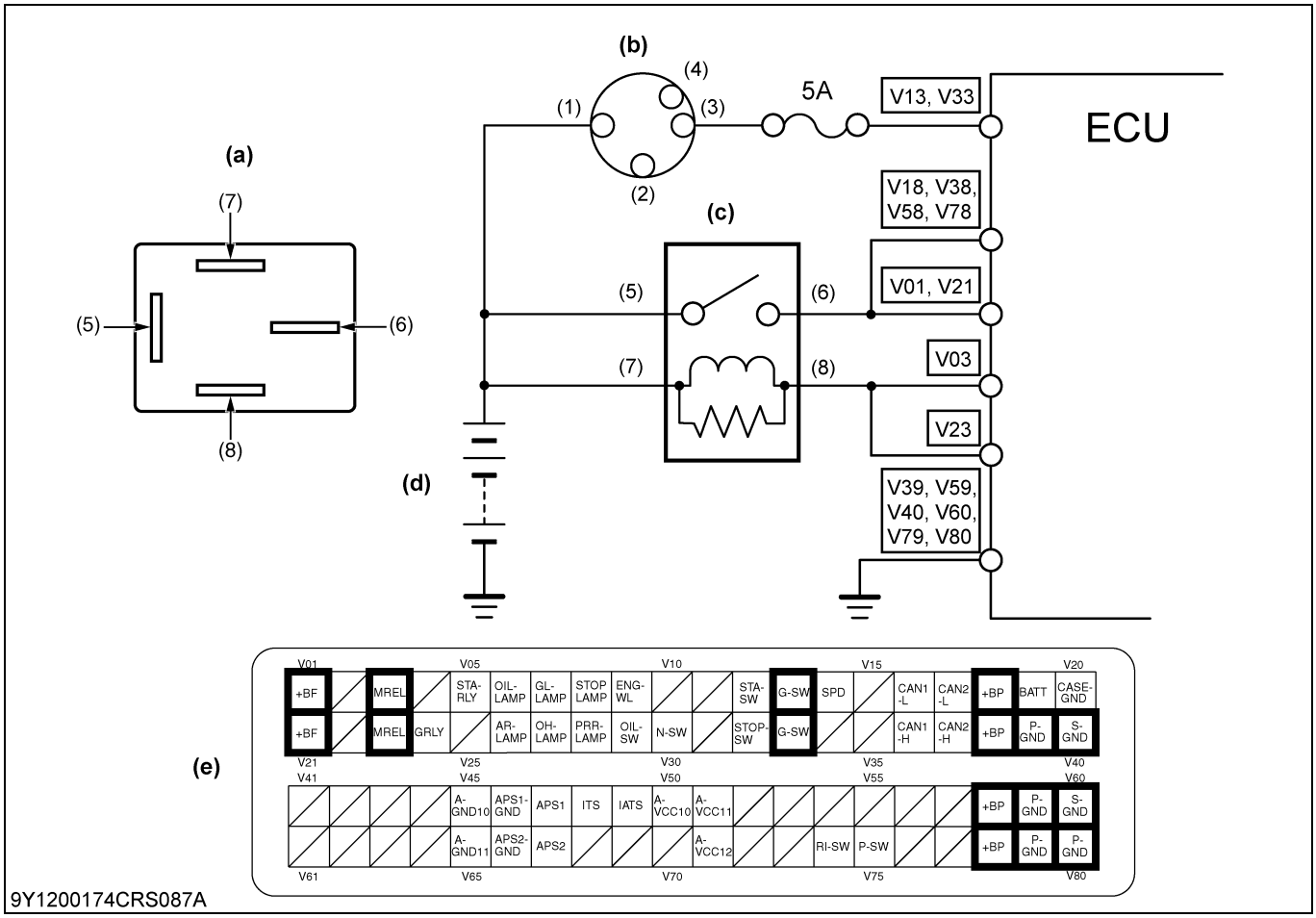
9Y1200199CRS1201US0

(3) Checking The Power And Ground System (Main Relay, ECU Circuit)

If the ECU is not operating, check the following.

Malfunction symptoms:

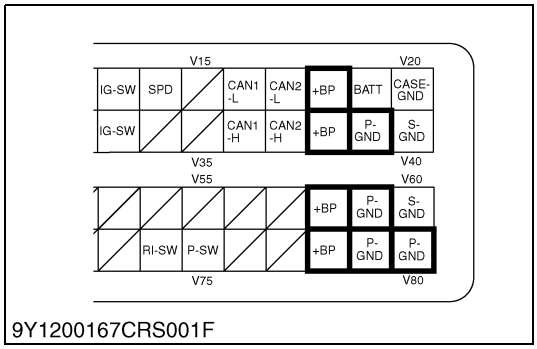
- Engine does not start.
- Engine warning light is not lit.
- A diagnosis tool communication error occur.



(1) Input Terminal
(2) ACC
(3) Output Terminal
(4) START
(5) Terminal 1
(6) Terminal 2
(7) Terminal 3
(8) Terminal 4

(a) Main Relay Terminal Layout
(b) Key Switch
(c) Main Relay
(d) Battery
(e) ECU Connector 2 (Machine Side)

9Y1200199CRS1202US0



9Y1200167CRS001F

1. Measure the ECU +BP and Ground Voltage

1. Turn the key switch ON and measure the voltage between the ECU +BP terminals (V18 / V38 / V58 / V78) and ground (body / battery terminal). Then measure voltage between the ECU ground terminals (V40 / V60) and ground (body / battery terminal).

Factory specification	+BP terminal - Ground; greater than or equal to 10 V P-GND terminal - Ground; Less than or equal to 0.5 V

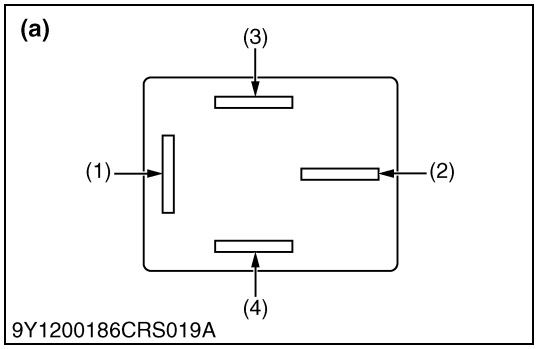
+BP terminal unsatisfactory

OK	Normal.	
NG	Check battery, wiring harness, ground wire.	
	OK	Go to "2. Check the Relay Terminal Voltage -1".
	NG	Repair or replace.

Ground terminal unsatisfactory

OK	Normal.
NG	Check ECU wiring harness ground.

9Y1200199CRS1203US0



9Y1200186CRS019A

2. Check the Relay Terminal Voltage -1

1. Turn the key switch ON and measure voltage at relay terminal 2 (2).

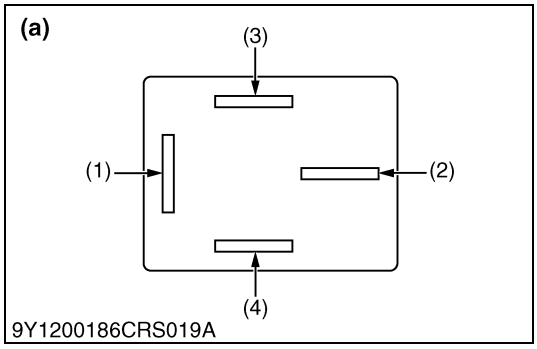
Factory specification	10 V or higher

OK	Check wiring between relay and ECU. → Repair. Check for connector connection fault. → Repair.
NG	Go to "3. Check the Relay Terminal Voltage - 2".

(1) Terminal 1
(2) Terminal 2
(3) Terminal 3
(4) Terminal 4

(a) Main Relay Terminal Layout

9Y1200199CRS1204US0



9Y1200186CRS019A

3. Check the Relay Terminal Voltage - 2

1. Measure voltage at relay terminal 1 (1).

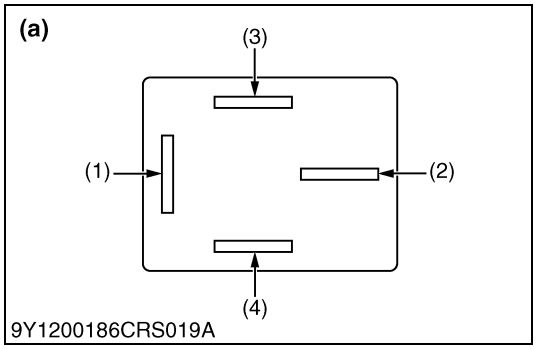
Factory specification	10 V or higher

OK	Go to "4. Check the Relay Terminal Voltage - 3".
NG	Check for a wiring harness open circuit and / or connector connection fault. → Repair. Inspect fuse. → Replace.

(1) Terminal 1
(2) Terminal 2
(3) Terminal 3
(4) Terminal 4

(a) Main Relay Terminal Layout

9Y1200199CRS1205US0



4. Check the Relay Terminal Voltage - 3

1. Measure voltage at relay terminal 3 (3).

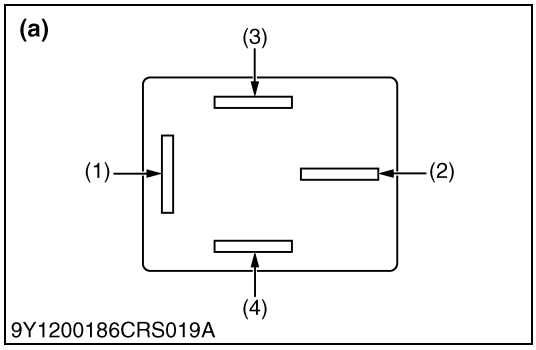
Factory specification	10 V or higher

OK	Go to "5. Check the Relay Terminal Voltage - 4".
NG	Check for a wiring harness open circuit and / or connector connection fault. → Repair. Inspect fuse. → Replace.

(1) Terminal 1
(2) Terminal 2
(3) Terminal 3
(4) Terminal 4

(a) Main Relay Terminal Layout

9Y1200199CRS1206US0



5. Check the Relay Terminal Voltage - 4

1. Turn the key switch OFF and measure voltage at relay terminal 4 (4).

■ **NOTE**

- **Perform measurement two seconds after cycling the key switch ON → OFF.**

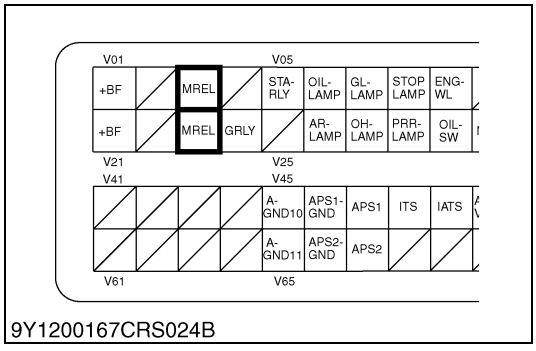
Factory specification	10 V or higher

OK	Go to "6. Check the Relay Terminal Voltage - 5".
NG	Check the relay. → Repair.

(1) Terminal 1
(2) Terminal 2
(3) Terminal 3
(4) Terminal 4

(a) Main Relay Terminal Layout

9Y1200199CRS1207US0



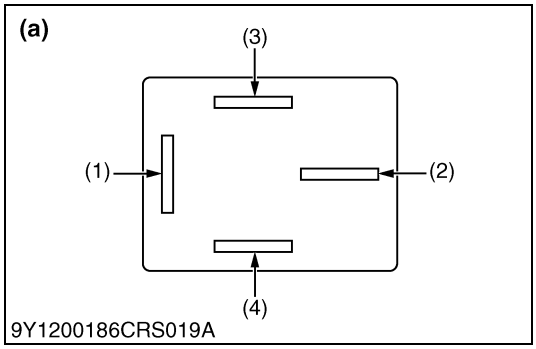
6. Check the Relay Terminal Voltage - 5

1. With the key switch OFF, measure voltage at the ECU main relay terminals (V03 / V23).

Factory specification	10 V or higher

OK	Go to "7. Check the Relay Terminal Voltage - 6".
NG	Check wiring harness between relay and ECU and connectors. → Repair.

9Y1200199CRS1208US0



7. Check the Relay Terminal Voltage - 6

1. Turn the key switch ON and measure voltage at relay terminal 4 (4).

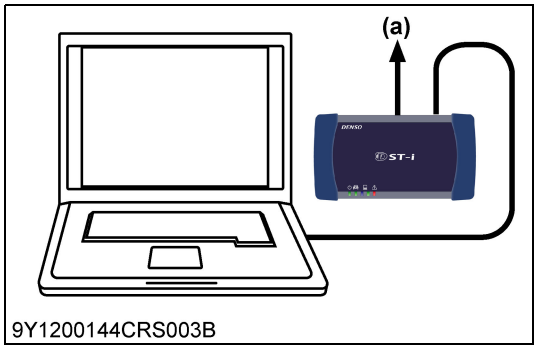
Factory specification	Approx. 0 V

OK	Faulty relay contacts → Replace.
NG	Go to "8. Check the Key Switch Signal -1".

(1) Terminal 1
(2) Terminal 2
(3) Terminal 3
(4) Terminal 4

(a) Main Relay Terminal Layout

9Y1200199CRS1209US0



9Y1200144CRS003B

8. Check the Key Switch Signal -1

1. Connect the diagnosis tool to diagnostic connector (CAN1 connector) and turn the key switch ON.
2. Using the diagnosis tool data monitor function, verify the "Key Switch" data when the key switch is turned ON then OFF.

Factory specification	When the key switch is set to the ON and OFF, the data output is turned ON and OFF respectively.

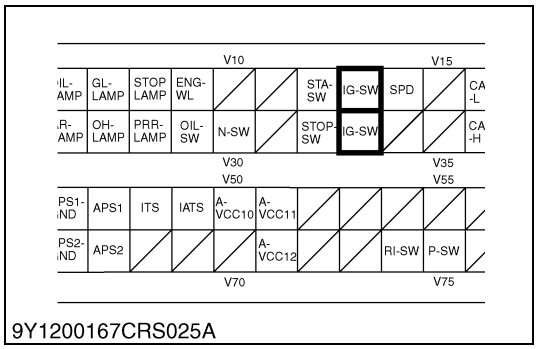
■ **IMPORTANT**

- **Do not keep the key switch in the OFF position for more than 2 seconds, otherwise a communication error will occur.**

OK	ECU internal fault → Replace the ECU.	
NG	Con-stantly ON	ECU internal fault → Replace the ECU.
	Consis-tently OFF	Go to "9. Check the Key Switch Signal -2".

(a) CAN1 Connector

9Y1200199CRS1210US0



9Y1200167CRS025A

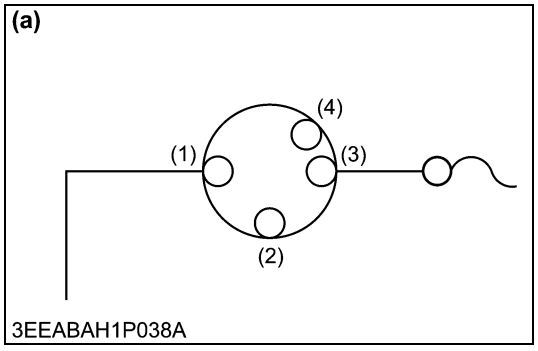
9. Check the Key Switch Signal -2

1. Place the key switch in the ON position, and measure the voltage at ECU terminal V13 / V33.

Factory specification	10 V or higher

OK	Check whether the connector is poorly connected.	
	OK	Replace the ECU.
	NG	Repair the connector.
NG	Go to "10. Check the Key Switch -1".	

9Y1200199CRS1211US0



3EEABAH1P038A

10. Check the Key Switch -1

1. Set the key switch to the ON position, and measure the voltage at the key switch output terminal (3).

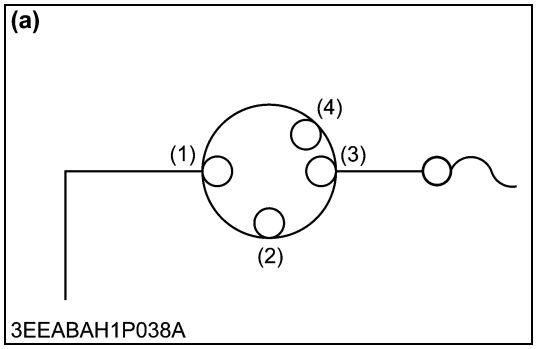
Factory specification	10 V or higher

OK	Check the wiring harness between the key switch output terminal and ECU terminal (V13 / V33), and the fuse. → Repair or replace.
NG	Go to "11. Check the Key Switch - 2".

(1) Input Terminal
(2) ACC
(3) Output Terminal
(4) START

(a) Key Switch

9Y1200199CRS1212US0



3EEABAH1P038A

11. Check the Key Switch - 2

1. Measure the voltage at the key switch input terminal (1).

Factory specification	10 V or higher

OK	Check the key switch. → Replace.
NG	Check the wiring harness between the battery and key switch, and the fuse. → Repair or replace.

(1) Input Terminal
(2) ACC
(3) Output Terminal
(4) START

(a) Key Switch

9Y1200199CRS1213US0

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Printed in Japan 2015. 03, S, EI, EI, engusa Code No.9Y110-01991
2012. 12, S, EI, EI, engusa

KUBOTA Corporation