DM

DIAGNOSIS MANUAL
COMMON RAIL SYSTEM

KX060-5, U56-5
(V2607-CR-E5-BH1, V2607-CR-E5-BH2)

Kubota

KiSC issued 03, 2020 A

CONTENTS

I INFORMATION

INFORMATION

CONTENTS

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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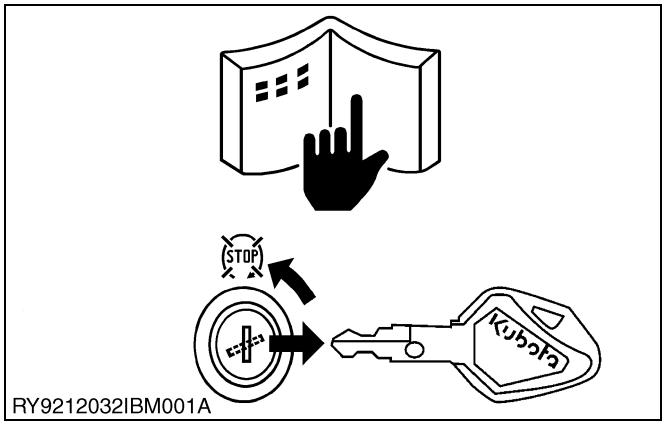

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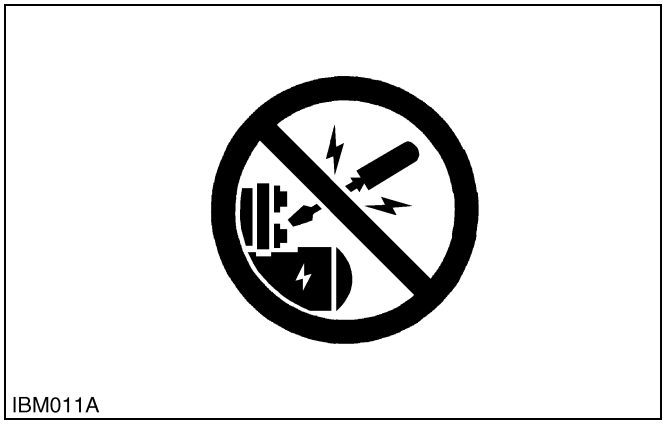
IBM011A

BEFORE SERVICING AND REPAIRING

- Read all instructions and safety instructions in this manual and on your engine safety decals.
- Clean the work area and engine.
- Park the machine on a stable and level ground.
- Let the temperature of the engine decrease before you start a job.
- Stop the engine, then remove the key.
- Disconnect the battery negative cable.
- Hang a **"DO NOT OPERATE"** tag in the operator station.

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SAFETY STARTING

- Do not do the procedures below when you start the engine.
  - short across starter terminals
  - bypass the safety start switch
- Do not make unauthorized modifications to the engine. This can cause damage and decrease the engine life.

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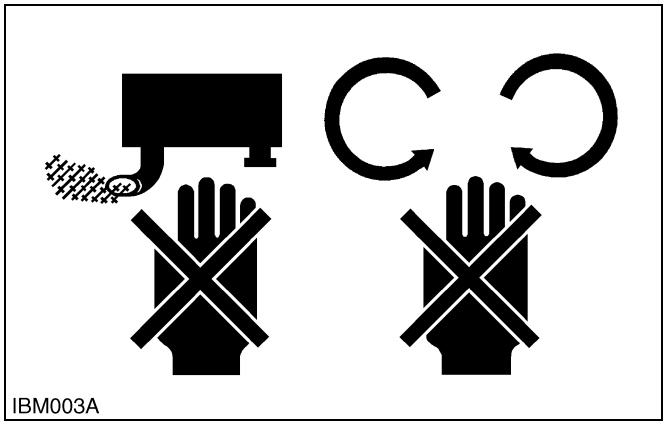
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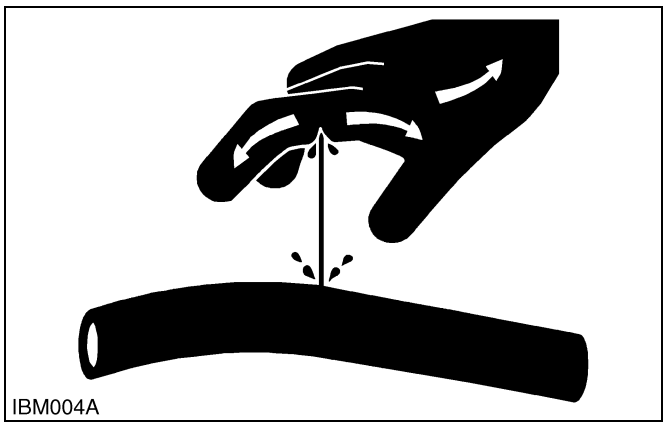
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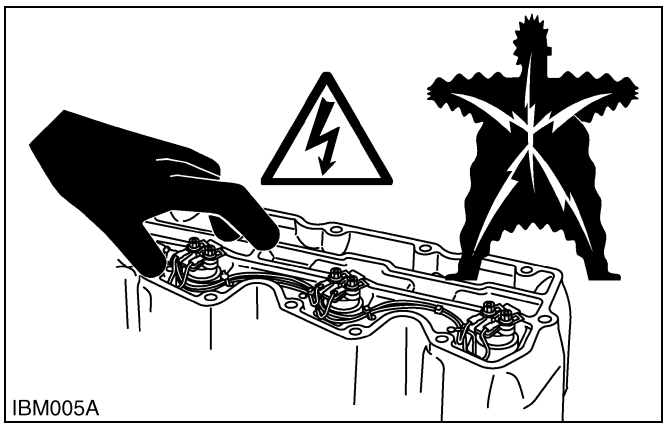
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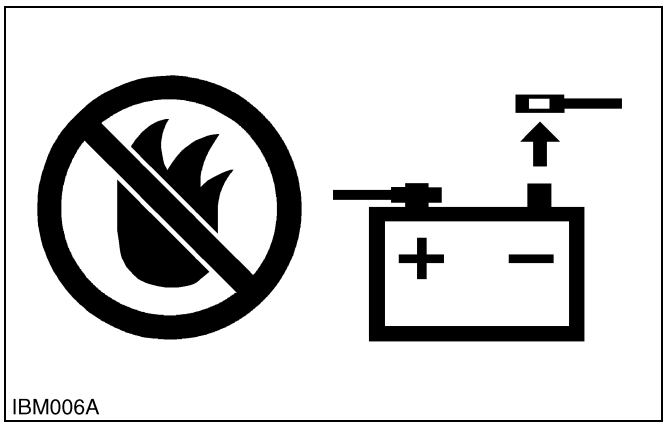
IBM006A

SAFETY WORKING

- Do not use the machine after you consume alcohol or medication or when you are tired.
- Put on applicable clothing and safety equipment.
- Use applicable tools only. Do not use alternative tools or parts.
- When 2 or more persons do servicing, make sure that you do it safely.
- Do not touch the hot parts or parts that turn when the engine operates.
- Do not remove the radiator cap when the engine operates, or immediately after it stops. If not, hot water can spout out from the radiator. Only remove the radiator cap when it is at a sufficiently low temperature to touch with bare hands. Slowly loosen the cap to release the pressure before you remove it fully.
- Released fluid (fuel or hydraulic oil) under pressure can cause damage to the skin and cause serious injury. Release the pressure before you disconnect hydraulic or fuel lines. Tighten all connections before you apply the pressure.
- Do not open a fuel system under high pressure.
  The fluid under high pressure that stays in fuel lines can cause serious injury. Do not disconnect or repair the fuel lines, sensors, or any other components between the fuel pump and injectors on engines with a common rail fuel system under high pressure.
- Put on an applicable ear protective device (earmuffs or earplugs) to prevent injury against loud noises.
- Be careful about electric shock. The engine generates a high voltage of more than DC100 V in the ECU and is applied to the injector.

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AVOID FIRES

- Fuel is very flammable and explosive under some conditions. Do not smoke or let flames or sparks in your work area.
- To prevent sparks from an accidental short circuit, always disconnect the battery negative cable first and connect it last.
- The battery gas can cause an explosion. Keep the sparks and open flame away from the top of battery, especially when you charge the battery.
- Make sure that you do not spill fuel on the engine.

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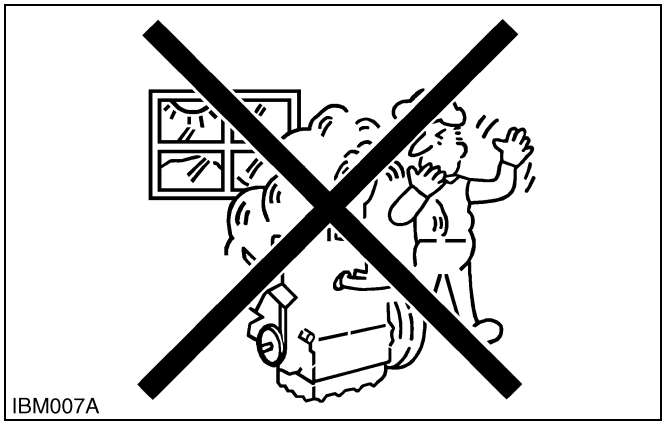
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KEEP A GOOD AIRFLOW IN THE WORK AREA

- If the engine is in operation, make sure that the area has good airflow. Do not operate the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.

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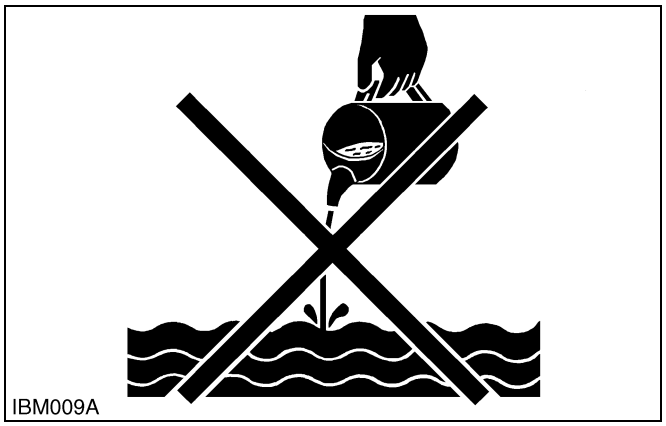
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DISPOSE OF FLUIDS CORRECTLY

- Do not discard fluids on the ground, down the drain, into a stream, pond, or lake. Obey related environmental protection regulations when you discard oil, fuel, coolant, electrolyte and other dangerous waste.

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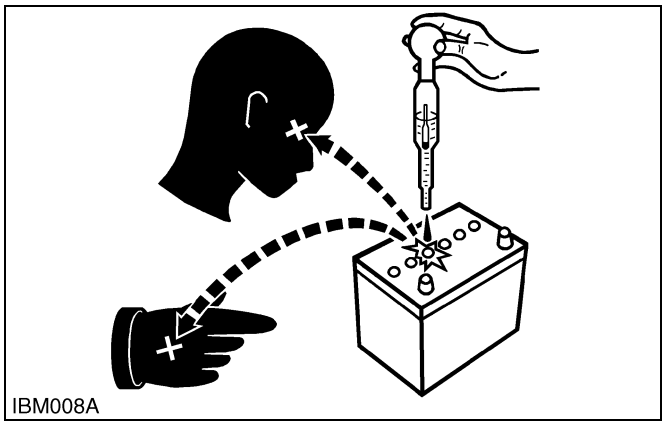
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PREVENT ACID BURNS

- Keep electrolyte away from your eyes, hands and clothing. Sulfuric acid in battery electrolyte is poisonous and it can burn your skin and clothing and cause blindness. If you spill electrolyte on yourself, clean yourself with water, and get medical aid immediately.

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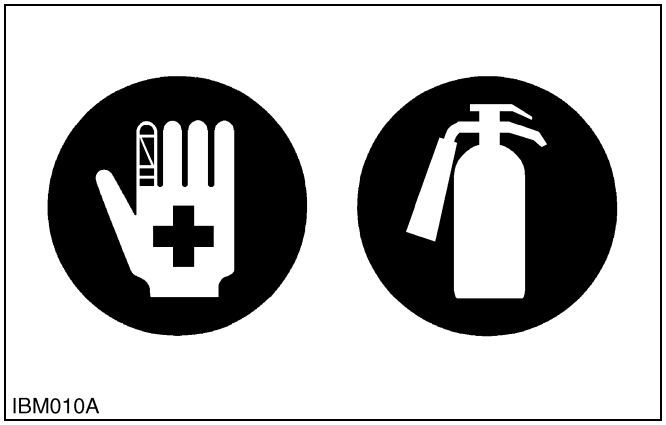
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PREPARE FOR EMERGENCIES

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

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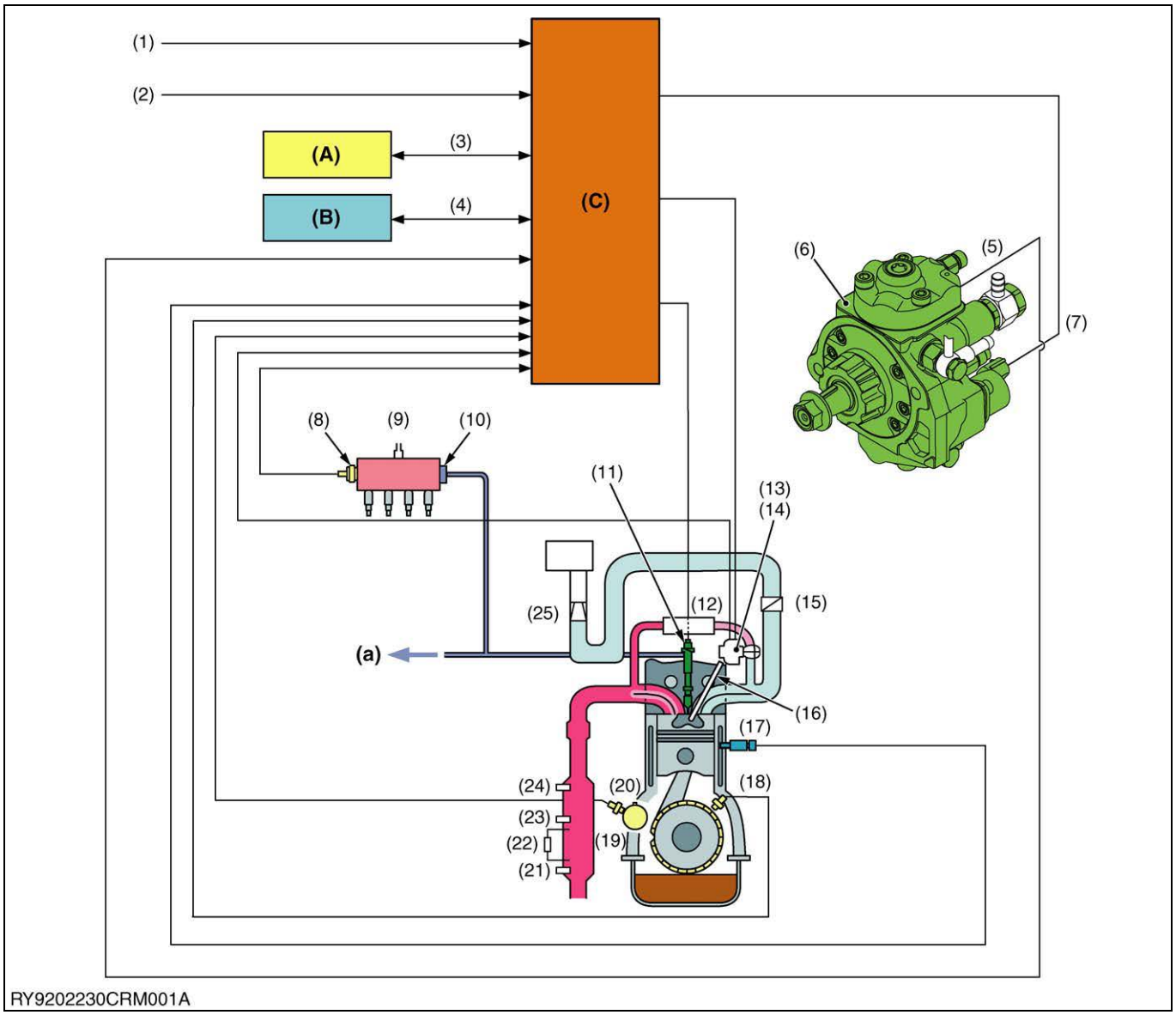
1 COMMON RAIL SYSTEM

MECHANISM

CONTENTS

1. BASIC SYSTEM INFORMATION

[1] SYSTEM CONFIGURATION



(1) Key Switch Signal
(2) Water Level Signal (Water Separator)
(3) CAN Communication for Main ECU
(4) CAN Communication for Service (Engine DM)
(5) Fuel Temperature Sensor
(6) Supply Pump
(7) SCV (Suction Control Valve)
(8) Rail Pressure Sensor
(9) Rail
(10) Pressure Limiter
(11) Injector
(12) EGR Cooler
(13) EGR DC Motor
(14) EGR Lift Sensor
(15) Intake Throttle Valve
(16) Intake Air Heater (Glow Plug)
(17) Coolant Temperature Sensor
(18) Crankshaft Position Sensor
(19) Diesel Particulate Filter (Hereinafter Referred to as the "DPF") Muffler
(20) Camshaft Position Sensor
(21) Exhaust Gas Temperature Sensor2 (T2) (DPF Outlet Exhaust Gas Temperature)
(22) Differential Pressure Sensor (DPF Differential Pressure) (ΔP)
(23) Exhaust Gas Temperature Sensor1 (T1) (DPF Inlet Exhaust Gas Temperature)
(24) Exhaust Gas Temperature Sensor0 (T0) (DOC Inlet Exhaust Gas Temperature)
(25) Mass Air Flow Sensor (Built-in Temperature Sensor)
(A) CAN2 Connector (for Main ECU)
(B) CAN1 Connector (for Engine DM)
(C) Engine ECU
(a) To Fuel Tank

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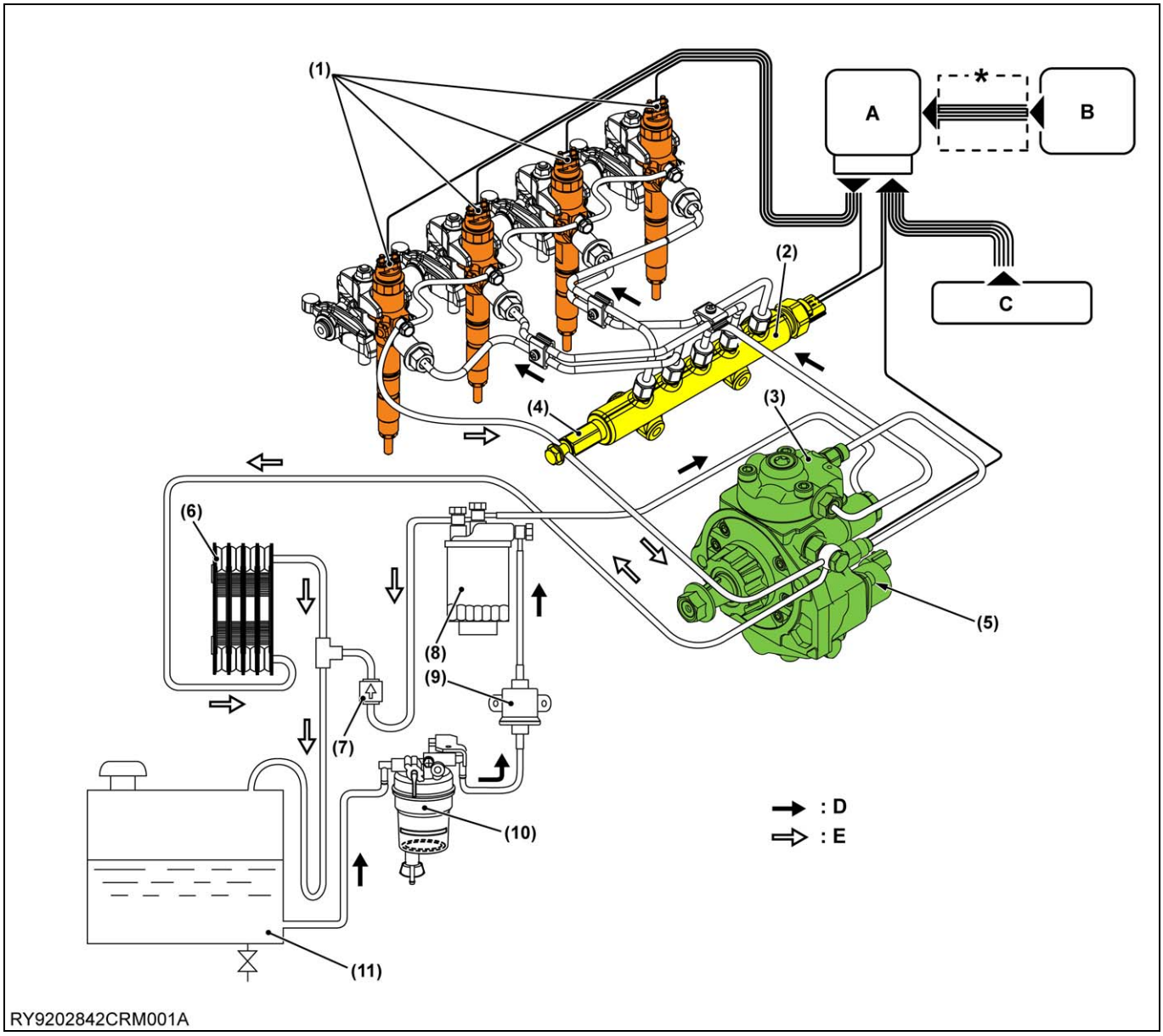
[2] FUEL SYSTEM



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(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: Engine ECU
B: Main ECU
C: Sensors
D: Injected Fuel Flow
E: Returned Fuel Flow

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

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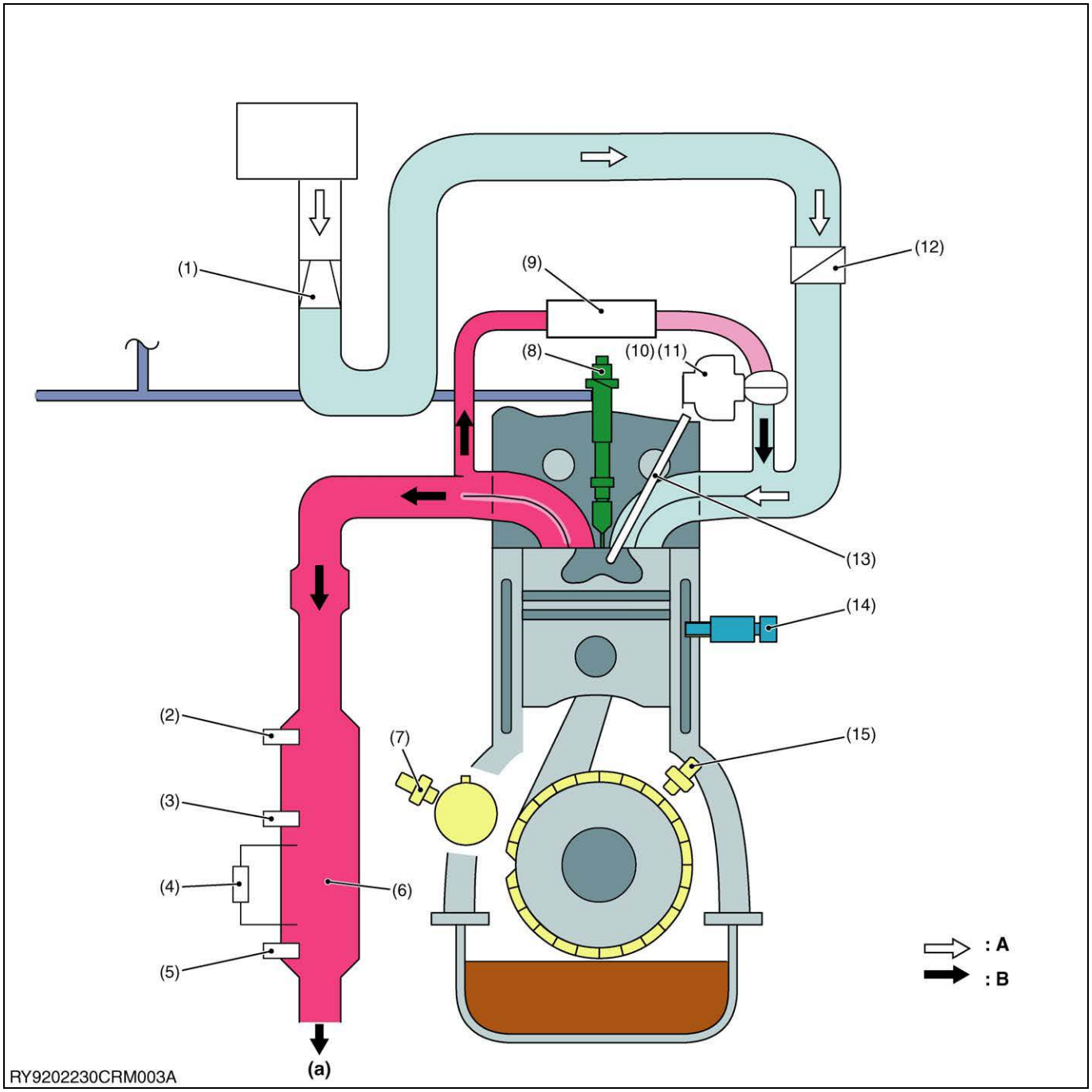
[3] INTAKE AND EXHAUST SYSTEM



(1) Mass Air Flow Sensor (Built-in Temperature 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 Cooler
(10) EGR DC Motor
(11) EGR Lift Sensor
(12) Intake Throttle Valve
(13) Intake Air Heater (Glow Plug)
(14) Coolant Temperature Sensor
(15) Crankshaft Position Sensor

A: Intake Air Flow
B: Exhaust Gas Flow

(a) To Muffler

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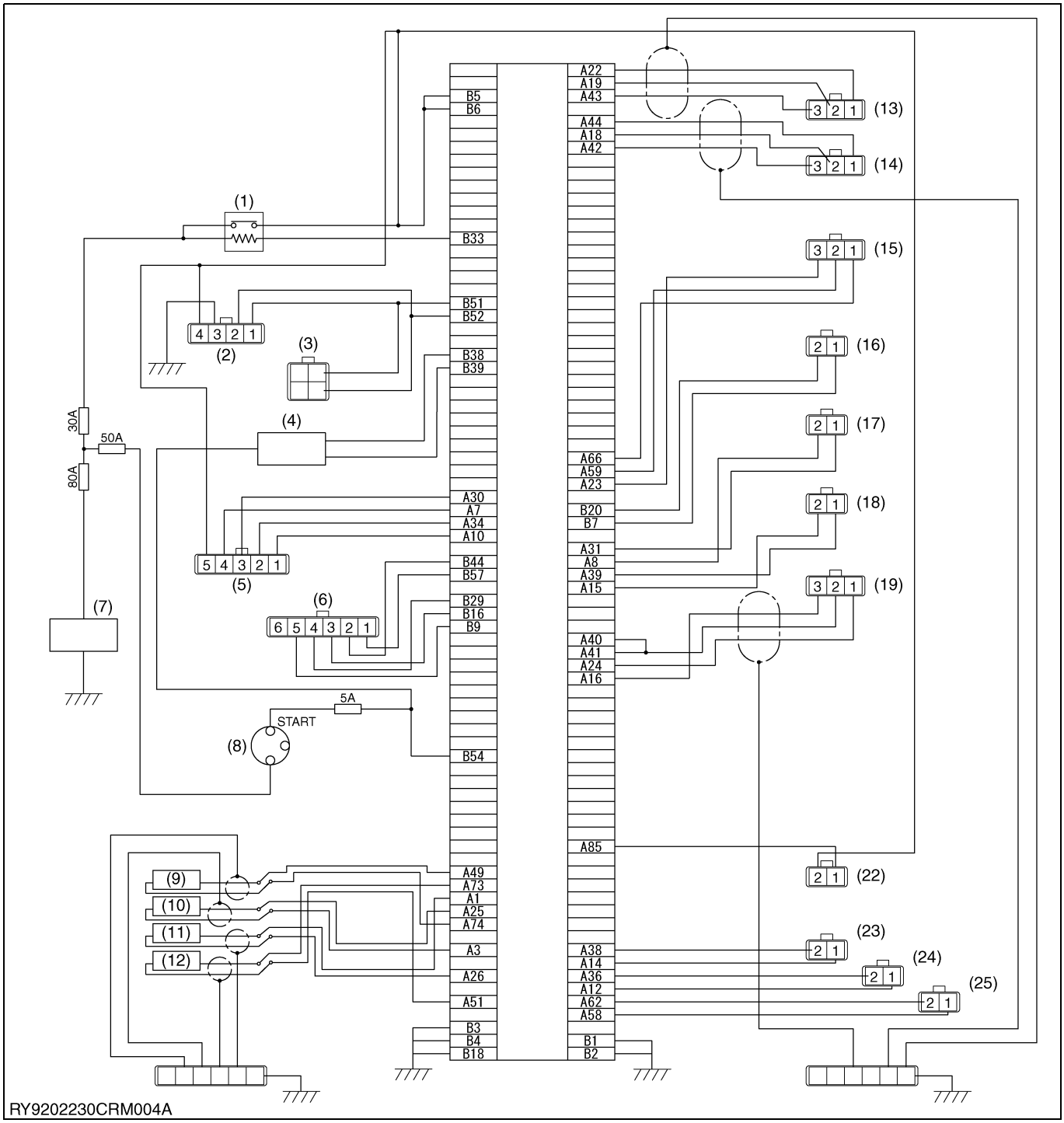
[4] SYSTEM WIRING DIAGRAM



(1) Main Relay
(2) EGR Valve
(3) CAN1 Connector (Engine DM)
(4) Main ECU
(5) Mass Air Flow Sensor
(6) Intake Throttle Valve
(7) Battery
(8) Starter Switch
(9) Injector 1
(10) Injector 2
(11) Injector 3
(12) Injector 4
(13) Crankshaft Position Sensor
(14) Camshaft Position Sensor
(15) DPF Differential Pressure Sensor
(16) SCV (Suction Control Valve)
(17) Fuel Temperature Sensor
(18) Coolant Temperature Sensor
(19) Rail Pressure Sensor
(20) Water Level Sensor (Fuel Filter)
(21) DPF Exhaust Gas Temperature Sensor (T_0)
(22) DPF Exhaust Gas Temperature Sensor (T_1)
(23) DPF Exhaust Gas Temperature Sensor (T_2)

DPF: Diesel Particulate Filter

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[5] AVAILABLE DATA MONITOR SIGNALS

(1) Monitor Items

Classification	Signal Name	Unit	Terminal No.
Revolution and pulse signal	Engine speed active flag	–	–
	Cam speed active flag	–	–
	Engine speed	min^{-1} (rpm)	A-43 / A-19
	Vehicle speed	km/h	–
Analog signal	Accelerator pedal position	%	–
	Accelerator pedal position sensor 1 output voltage	V	–
	Accelerator pedal position sensor 2 output voltage	V	–
	Boost pressure	kPa	–
	Boost pressure sensor output voltage	V	A-61
	Fuel temperature	°C	–
	Fuel temperature sensor output voltage	V	A-31
	Coolant temperature	°C	–
	Coolant temperature sensor output voltage	V	A-39
	Intake air temperature	°C	–
	Intake air temperature sensor output voltage	V	B-28
	Atmospheric pressure	kPa	–
	Atmospheric pressure sensor output voltage	V	–
	Battery voltage	V	B-5 / B-6
Digital signal	Key switch	–	–
	Start switch	–	B-54
	Neutral switch	–	–
Basic control signal	Final fuel injection quantity	mm^3/st	–
	Target rail pressure	MPa	–
	Actual rail pressure	MPa	–
	Rail pressure sensor output voltage	V	A-40 / A-41
	Target suction control valve (SCV) current	mA	–
	Actual suction control valve (SCV) current	mA	–
	Pump learning condition	–	–
	Pump difference learning correction value	mA	–
	Idle control target	–	–
	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)	–	–

Classification	Signal Name	Unit	Terminal No.
Actuator	Exhaust gas recirculation (EGR) valve target position	%	
	Exhaust gas recirculation (EGR) valve actual position	%	
	Glow relay	–	
DPF data	Differential pressure 1 output voltage	V	A-66
	Exhaust gas temperature 0 output voltage	V	A-38
	Exhaust gas temperature 1 output voltage V ODOC E63	V	A-36
	Exhaust gas temperature 2 output voltage V ODPF E43	V	A-62
	Intake air temperature built-in MAF output voltage V IATS V49	V	A-34
	Intake throttle valve lift output voltage V ITS V48	V	B-29
	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	L	–
	Target mass air flow at regeneration	kg/h	–
	Pump learning end time h - -	h	–
	Hour meter h - -	h	–
	DPF regeneration last active time sec - -	sec	–
	Regeneration progress	%	–
	Source address of TSC1 - - -	–	–
	Parking 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	–	–
	DPF cleaning interval	h	
	DPF cleaning index	%	
	Driver request torque ratio	%	
	Final request torque ratio	%	
	Engine percent load at current speed	%	

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(2) Normal Value

Classification	Signal Name	Unit	Engine Stops	During Start-Up	Idling	Maximum engine speed with-out load
Revolution and pulse signal	Engine speed active flag	–	OFF	ON		
	Cam speed active flag	–	OFF	ON		
	Engine speed	min^{-1} (rpm)	0	0 to 1000	Approx. 1100	Approx. 2300
	Vehicle speed	km/h	0			
Analog signal	Accelerator pedal position	%	0			
	Accelerator pedal position sensor 1 output voltage	V	Sensor are unused by CAN input			
	Accelerator pedal position sensor 2 output voltage	V				
	Boost pressure	kPa	Not equipped			
	Boost pressure sensor output voltage	V				
	Fuel temperature	°C	Reference value: Approx. 20 °C (68 °F) → Approx. 2.4 V Approx. 40 °C (104 °F) → Approx. 1.5 V Approx. 60 °C (140 °F) → Approx. 0.9 V Approx. 80 °C (176 °F) → Approx. 0.5 V			
	Fuel temperature sensor output voltage	V				
	Coolant temperature	°C	Reference value: Approx. 20 °C (68 °F) → Approx. 2.4 V Approx. 40 °C (104 °F) → Approx. 1.5 V Approx. 60 °C (140 °F) → Approx. 0.9 V 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 Approx. 40 °C (104 °F) → Approx. 1.5 V Approx. 60 °C (140 °F) → Approx. 0.9 V Approx. 80 °C (176 °F) → Approx. 0.5 V			
	Intake air temperature sensor output voltage	V				
	Atmospheric pressure	kPa	Reference value: Approx. 100 kPa → 3.7 V (Depending on the atmospheric pressure)			
	Atmospheric pressure sensor output voltage	V				
	Battery voltage	V	Reference value: 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			
	Start switch	–	OFF	ON	OFF	
	Neutral switch	–	Lever lock up: ON Lever lock down: OFF			

Classification	Signal Name	Unit	Engine Stops	During Start-Up	Idling	Maximum engine speed without load
Basic control signal	Final fuel injection quantity	mm^3/st	0 (Indication value - 50)	0 to 40	Approx. 10	Approx. 12
	Target rail pressure	MPa	Depends on the rotation speed, load (After warm-up) When idling: Approx. 55 to 60 MPa During no-load maximum speed: Approx. 80 MPa			
	Actual rail pressure	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: Approx. 1.6 to 1.7 V During no-load maximum speed: Approx. 2.5 V			
	Target suction control valve (SCV) current	mA	1760	1700 - 1800	Approx. 1800	Approx. 1630
	Actual suction control valve (SCV) current	mA	1720	Approx. 1700	Approx. 1750	Approx. 1630
	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 difference learning correction value	mA	113 *2			
	Idle control target	–	1075		1100	2100
	Engine stop flag	–	ON	OFF		
	Low temperature start mode flag	–	OFF	ON	OFF	
	Registration history (#1 cylinder)	–	Complete			
	Registration history (#2 cylinder)	–				
	Registration history (#3 cylinder)	–				
	Registration history (#4 cylinder)	–				
	Number of registrations (#1 cylinder)	–	Number of the registration is displayed			
	Number of registrations (#2 cylinder)	–				
	Number of registrations (#3 cylinder)	–				
	Number of registrations (#4 cylinder)	–				

<table>
<tr><th>Classification</th><th>Signal Name</th><th>Unit</th><th colspan="2">Engine Stops</th><th>During Start-Up</th><th>Idling</th><th>Maximum engine speed with-out load</th></tr>
<tr><td rowspan="3">Actuator</td><td>Exhaust gas recirculation (EGR) valve target position</td><td>%</td><td colspan="3">0</td><td>Approx. 19</td><td>Approx. 30</td></tr>
<tr><td>Exhaust gas recirculation (EGR) valve actual position</td><td>%</td><td colspan="3">0</td><td>Approx. 20</td><td>Approx. 30</td></tr>
<tr><td>Glow relay</td><td>–</td><td colspan="5">When cold start-up (before-and-after):
ON (CAN communication)</td></tr>
<tr><td rowspan="16">DPF data</td><td>Differential pressure 1 output voltage</td><td>V</td><td colspan="5">0.5 to 4.5 V</td></tr>
<tr><td>Exhaust gas temperature 0 output voltage</td><td>V</td><td colspan="5" rowspan="8">Reference value:
Approx. 100 °C (212 °F) → Approx. 4.4 V
Approx. 150 °C (302 °F) → Approx. 3.7 V
Approx. 200 °C (392 °F) → Approx. 3.0 V
Approx. 250 °C (482 °F) → Approx. 2.3 V</td></tr>
<tr><td>Exhaust gas temperature 0</td><td>°C</td></tr>
<tr><td>Exhaust gas temperature 1 output voltage</td><td>V</td></tr>
<tr><td>Exhaust gas temperature 1</td><td>°C</td></tr>
<tr><td>Exhaust gas temperature 2 output voltage</td><td>V</td></tr>
<tr><td>Exhaust gas temperature 2</td><td>°C</td></tr>
<tr><td>Intake air temperature built-in MAF output voltage</td><td>V</td><td colspan="5" rowspan="2">Reference value:
Approx. -20 °C (-4 °F) → Approx. 4.5 V
Approx. 0 °C (32 °F) → Approx. 4.0 V
Approx. 20 °C (68 °F) → Approx. 3.0 V
Approx. 40 °C (104 °F) → Approx. 2.2 V</td></tr>
<tr><td>Intake air temperature built-in MAF</td><td>°C</td></tr>
<tr><td>Intake throttle valve lift output voltage</td><td>V</td><td colspan="3">Approx. 4.375 V</td><td colspan="2">0 to 4.375 V</td></tr>
<tr><td>Differential pressure 1</td><td>kPa</td><td colspan="5">–1.7 to 34.5 kPa</td></tr>
<tr><td>Mass air flow for intake throttle</td><td>kg/h</td><td colspan="5">12.96 to 698.4</td></tr>
<tr><td>Target intake throttle valve opening</td><td>%</td><td colspan="5">93</td></tr>
<tr><td>Intake throttle final duty control quantity</td><td>%</td><td colspan="2">0</td><td>Approx. 15</td><td>Approx. 17</td></tr>
<tr><td>Intake throttle valve lift</td><td>%</td><td colspan="4">100</td><td>0 to 93</td></tr>
<tr><td>Parking SW - - -</td><td>–</td><td colspan="5">ON</td></tr>
</table>

Classification	Signal Name	Unit	Engine Stops	During Start-Up	Idling	Maximum engine speed without load
DPF data	DPF auto regeneration inhibit SW - - -	–	Inhibit switch: ON Inhibit switch: OFF			
	DPF manual regeneration force SW - - -	–	DPF under regeneration: ON DPF not under regeneration: OFF			
	Oil pressure SW	–	OFF			
	Target speed of isochronous control	min^{-1} (rpm)	–		1100	2000
	DPF regeneration control level	–	0 to 5			
	DPF regeneration control status	–	0 to 2 0: normal, 1: under auto-regeneration, 2: active regeneration			
	DPF cleaning interval	h	0 to 6000. This is the accumulated time from the last DPF cleaning.			
	DPF cleaning index	%	0, 50, 75 or 100. This number means the soot accumulation level in the DPF.			
	Driver request torque ratio	%	-20	125	Approx. 14	Approx. 15
	Final request torque ratio	%	-20	Approx. 80	Approx. 14	Approx. 15
	Engine percent load at current speed	%	0			

■ **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.

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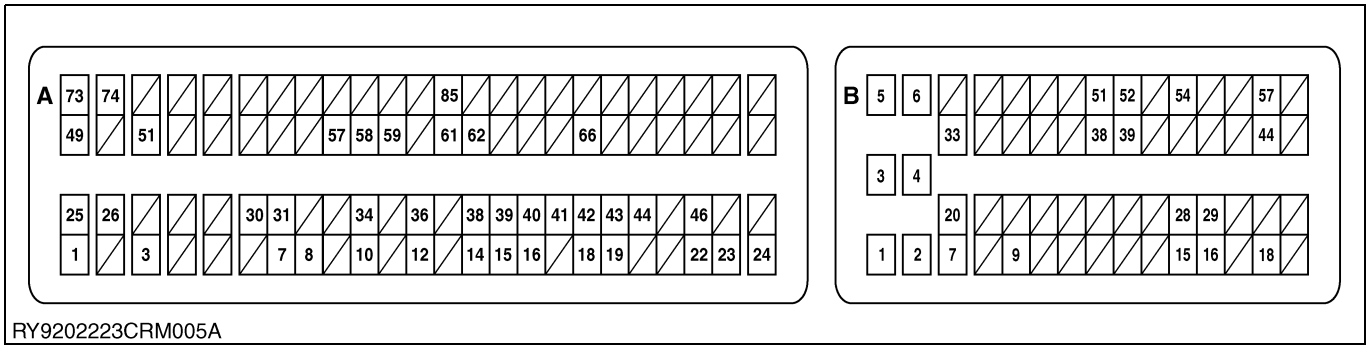
[6] ECU TERMINAL LAYOUT

(1) ECU Terminal Layout (Wire Harness Side)



RY9202223CRM005A

No.	Signal Name	No.	Signal Name
A-1	INJECTION COMMON 2 (No.3 CYLINDER)	A-31	FUEL TEMPERATURE SENSOR
A-2	–	A-32	–
A-3	INJECTION DRIVE 4 (No.2 CYLINDER)	A-33	–
A-4	–	A-34	INTAKE AIR TEMPERATURE SENSOR (IN MASS AIR FLOW SENSOR)
A-5	–	A-35	–
A-6	–	A-36	OUTLET DOC (DPF EXHAUST GAS TEMPERATURE SENSOR T1)
A-7	MASS AIR FLOW SENSOR GROUND	A-37	–
A-8	FUEL TEMPERATURE SENSOR RTN	A-38	INLET DOC (DPF EXHAUST GAS TEMPERATURE SENSOR T0)
A-9	–	A-39	COOLANT TEMPERATURE SENSOR
A-10	MASS AIR FLOW SENSOR GROUND	A-40	RAIL PRESSURE SENSOR 1
A-11	–	A-41	RAIL PRESSURE SENSOR 2
A-12	DPF EXHAUST GAS TEMPERATURE SENSOR T1 GROUND	A-42	CAMSHAFT POSITION SENSOR (+)
A-13	–	A-43	CRANKSHAFT POSITION SENSOR (+)
A-14	DPF EXHAUST GAS TEMPERATURE SENSOR T0 GROUND	A-44	CAMSHAFT POSITION SENSOR (POWER SUPPLY)
A-15	WATER TEMPERATURE SENSOR RTN	A-45	–
A-16	RAIL PRESSURE SENSOR RTN	A-46	–
A-17	–	A-47	–
A-18	CAMSHAFT POSITION SENSOR (GROUND)	A-48	–
A-19	CRANKSHAFT POSITION SENSOR (GROUND)	A-49	INJECTION COMMON 1 (No.1 CYLINDER)
A-20	–	A-50	–
A-21	–	A-51	INJECTION DRIVE 3 (No.4 CYLINDER)
A-22	CRANKSHAFT POSITION SENSOR (POWER SUPPLY)	A-52	–
A-23	DIFFERENTIAL PRESSURE SENSOR (POWER SUPPLY)	A-53	–
A-24	RAIL PRESSURE SENSOR (POWER SUPPLY)	A-54	–
A-25	INJECTION COMMON 2 (No.2 CYLINDER)	A-55	–
A-26	INJECTION DRIVE 2 (No.3 CYLINDER)	A-56	–
A-27	–	A-57	–
A-28	–	A-58	DPF EXHAUST GAS TEMPERATURE SENSOR T2 GROUND
A-29	–	A-59	DIFFERENTIAL PRESSURE SENSOR GROUND
A-30	MASS AIR FLOW SENSOR	A-60	–

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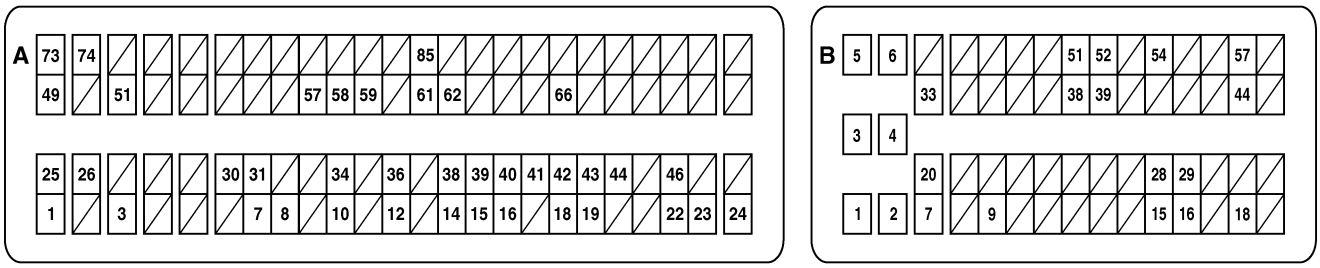

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No.	Signal Name	No.	Signal Name
A-61	–	A-91	–
A-62	OUTLET DPF (DPF EXHAUST GAS TEMPERATURE SENSOR T2)	A-92	–
A-63	–	A-93	–
A-64	–	A-94	–
A-65	–	A-95	–
A-66	DIFFERENTIAL PRESSURE SENSOR (+)	A-96	–
A-67	–	B-1	SIGNAL GND
A-68	–	B-2	SIGNAL GND
A-69	–	B-3	POWER GND
A-70	–	B-4	POWER GND
A-71	–	B-5	BATTERY+
A-72	–	B-6	BATTERY+
A-73	INJECTION COMMON 1 (No.4 CYLINDER)	B-7	SCV (SUCTION CONTROL VALVE) (–)
A-74	INJECTION DRIVE 1 (No.1 CYLINDER)	B-8	–
A-75	–	B-9	INTAKE THROTTLE POSITION SENSOR (POWER SUPPLY)
A-76	–	B-10	–
A-77	–	B-11	–
A-78	–	B-12	–
A-79	–	B-13	–
A-80	–	B-14	–
A-81	–	B-15	INTAKE AIR TEMPERATURE SENSOR RTN
A-82	–	B-16	INTAKE THROTTLE POSITION SENSOR (GROUND)
A-83	–	B-17	–
A-84	–	B-18	CASE GROUND
A-85	WATER LEVEL SW	B-19	–
A-86	–	B-20	SCV (SUCTION CONTROL VALVE) (+)
A-87	–	B-21	–
A-88	–	B-22	–
A-89	–	B-23	–
A-90	–	B-24	–

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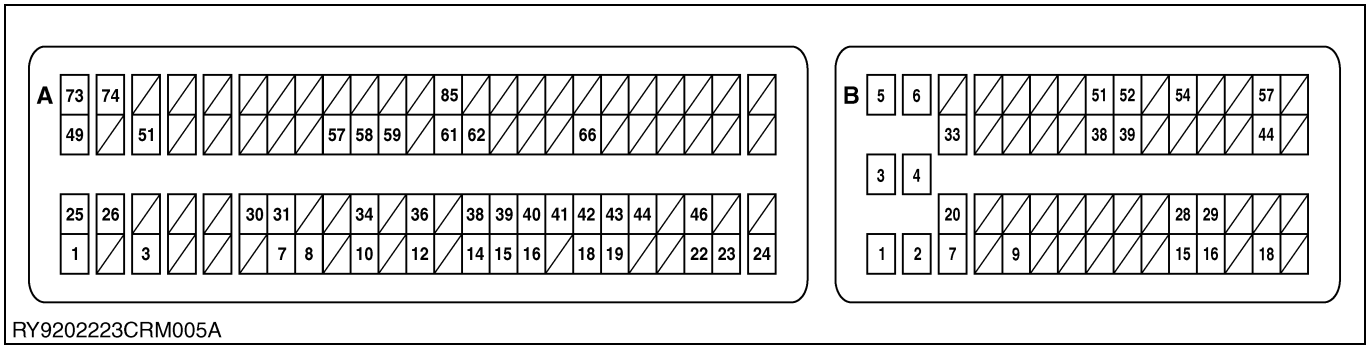

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No.	Signal Name	No.	Signal Name
B-25	–	B-42	–
B-26	–	B-43	–
B-27	–	B-44	INTAKE THROTTLE VALVE MOTOR (–)
B-28	INTAKE AIR TEMPERATURE SENSOR	B-45	–
B-29	INTAKE THROTTLE POSSITION SENSOR	B-46	–
B-30	–	B-47	–
B-31	–	B-48	–
B-32	–	B-49	–
B-33	MAIN RELAY	B-50	–
B-34	–	B-51	CAN1-H (FOR ENGINE DM)
B-35	–	B-52	CAN1-L (FOR ENGINE DM)
B-36	–	B-53	–
B-37	–	B-54	STARTER SWITCH
B-38	CAN2-H (FOR MAIN ECU)	B-55	–
B-39	CAN2-L (FOR MAIN ECU)	B-56	–
B-40	–	B-57	INTAKE THROTTLE VALVE MOTOR (+)
B-41	–	B-58	–

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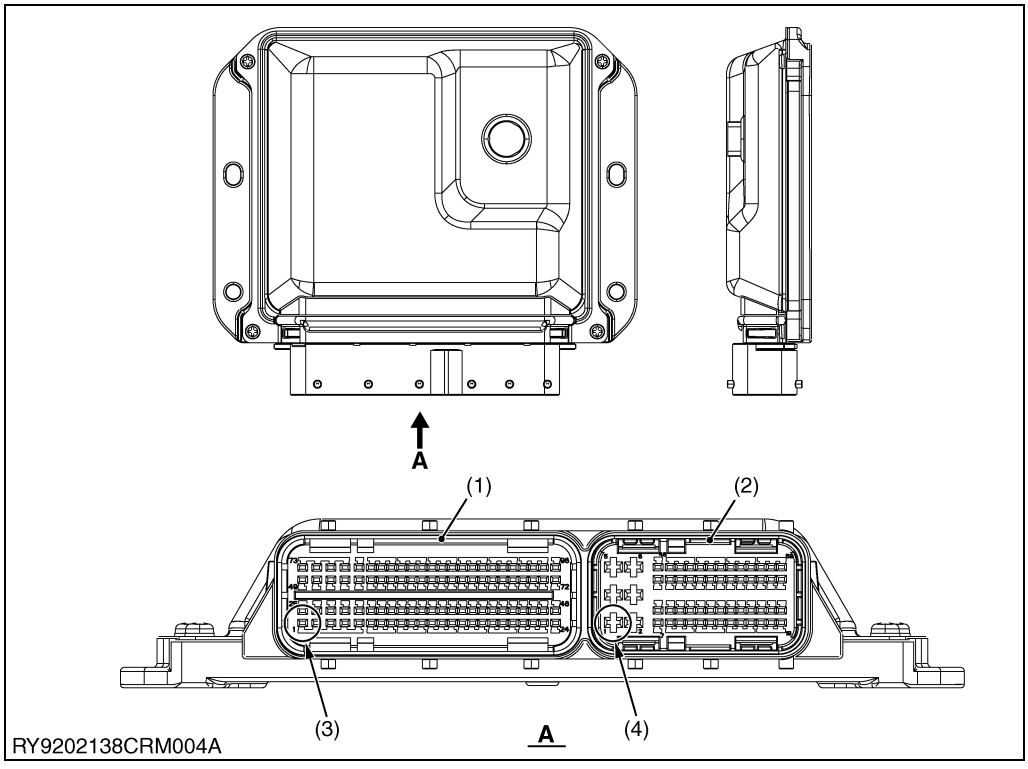

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(1) ECU Connector 1 (96P)
(2) ECU Connector 1 (58P)
(3) Pin Position A-1
(4) Pin Position B-1

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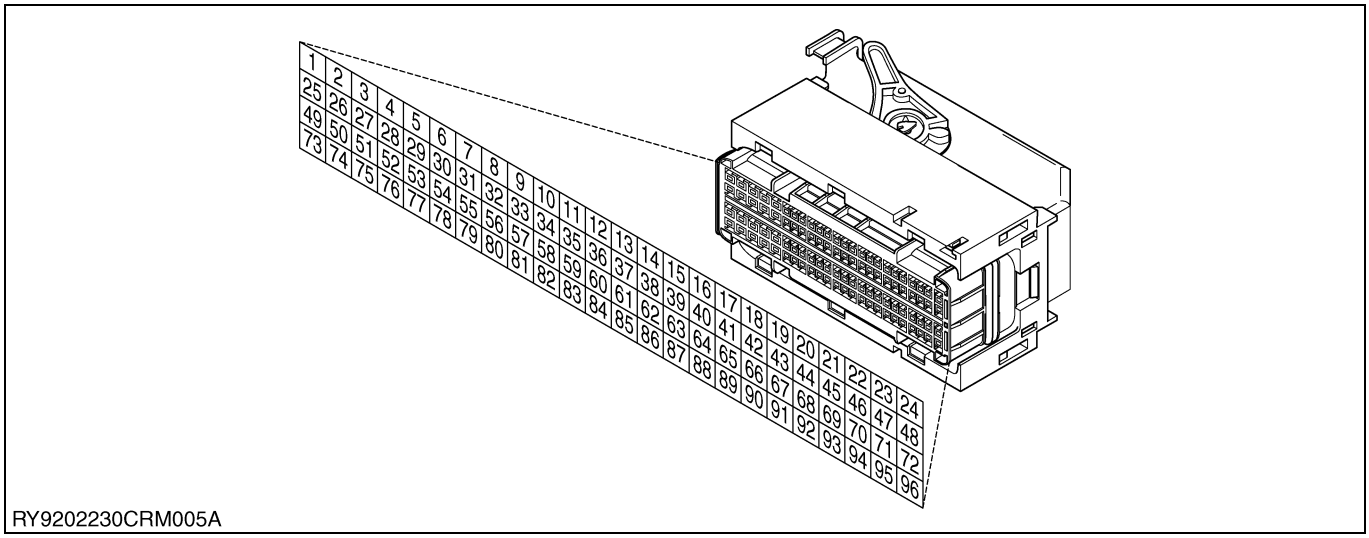
(2) ECU Connector A Terminal Layout



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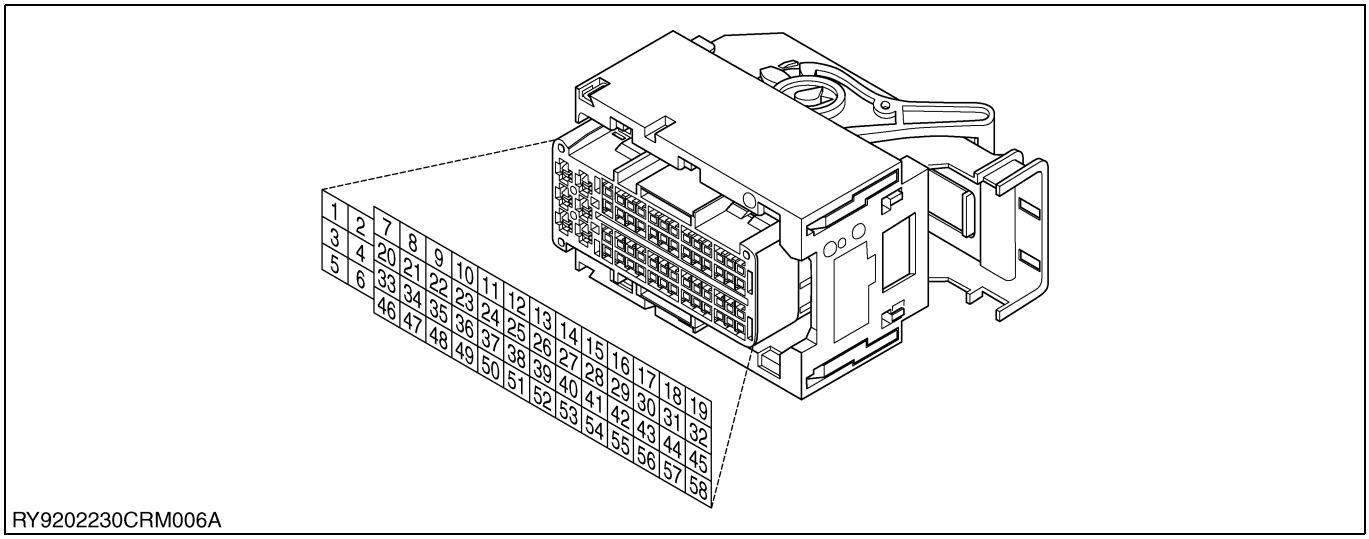
(3) ECU Connector B Terminal Layout



RY9202230CRM006A

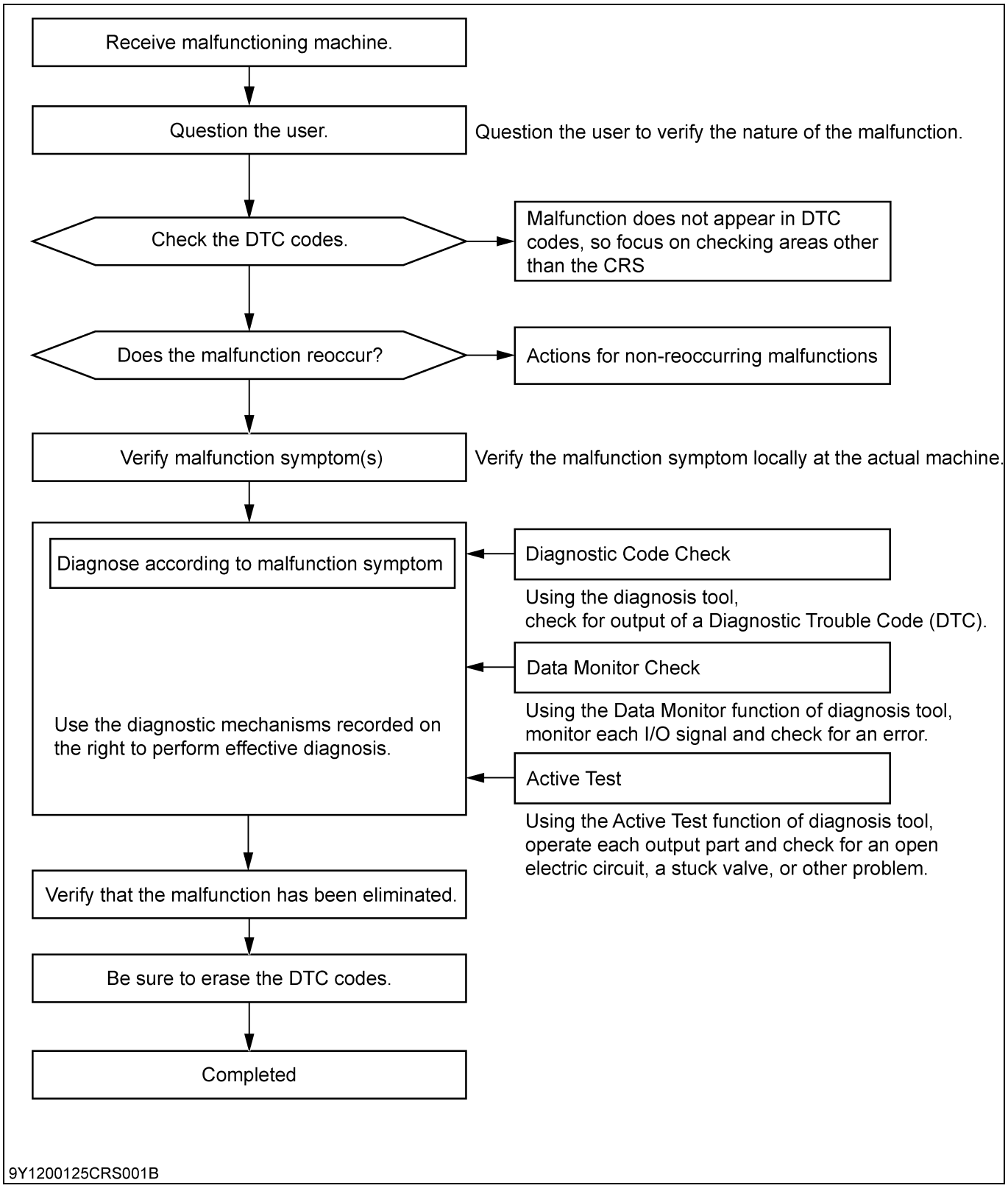
RY9202230CRM0008US0

SERVICING

CONTENTS

1. GENERAL

[1] OVERALL DIAGNOSTIC PROCEDURE



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[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.

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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.

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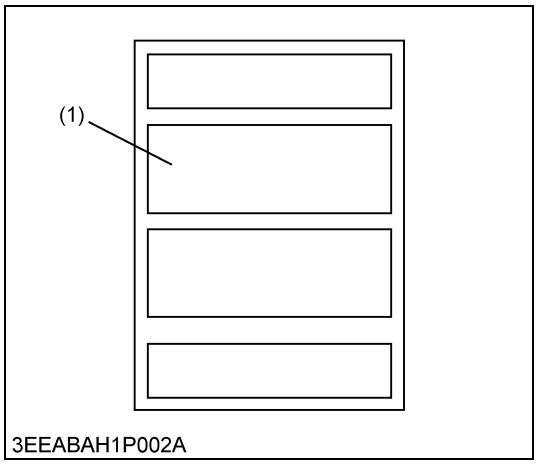

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Trouble Check Sheet for KUBOTA Common Rail System

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.

RY9202138CRS0004US0

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					

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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 coolant temperature gauge.  RY9202842CRS001A
	☐ 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. 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 ( )	

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[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 pump operation fault.	Replace fuel 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 (intake air heater) fault.	Replace starting assist device (intake air 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.

RY9202138CRS0007US0

[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 pump (fuel 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.

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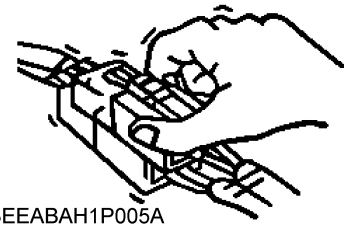
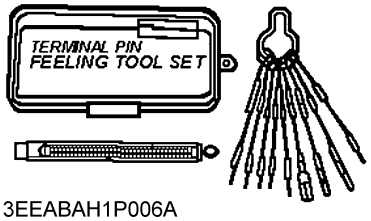
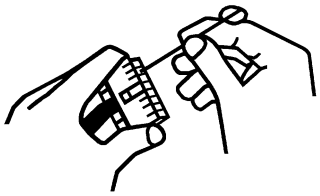
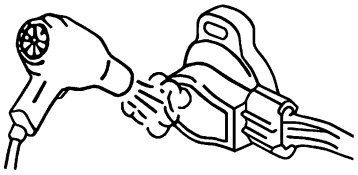
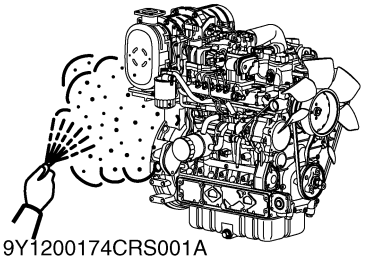
Action	Malfunction symptom		
	Dead battery	Engine will not start	Idle speed abnormal engine stall sluggish poor acceleration
Verify that there is no Diagnostic Trouble Code (DTC) stored in the memory.	–	m	m
Using the trouble check sheet as a base, perform a reoccurrence test in "Reoccurrence" mode. Use this data (engine ECU (PCM) voltage value, etc.) to determine the cause of the malfunction.	m	m	m
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	–	m	m
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	–	m	m

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	–	–	m
Verify whether or not malfunction symptoms occur under heavy engine loads (headlights, A/C, wiper, etc. switches ON).	m	–	m
If any commercial electrical products have been installed, remove them and verify whether or not the malfunction symptoms occur.	m	m	m
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.**  9Y1200174CRS001A	m	m	m

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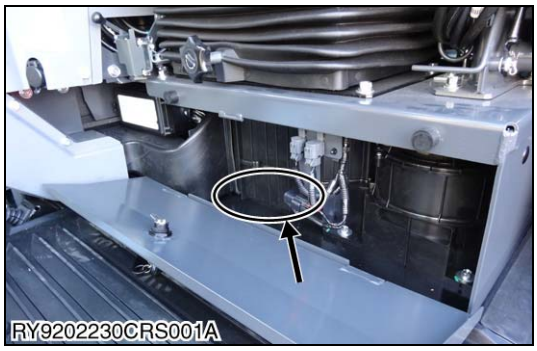
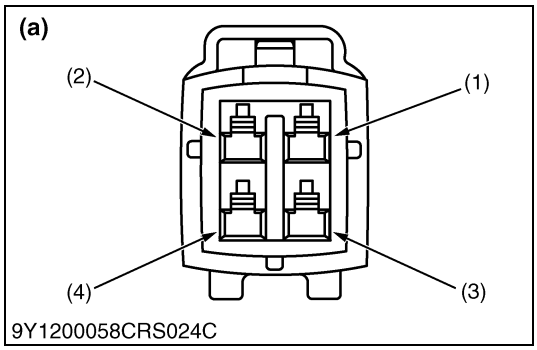
2. DIAGNOSTIC TOOL CONNECTION PROCEDURE

[1] DIAGNOSTIC CONNECTOR POSITIONS





The CAN1 connector for connecting the diagnosis tool is installed at the position shown left.

(1) CAN1-H terminal (B51)
(2) +BP terminal (B5, B6)
(3) CAN1-L terminal (B52)
(4) S-GND terminal

(a) CAN1 connector

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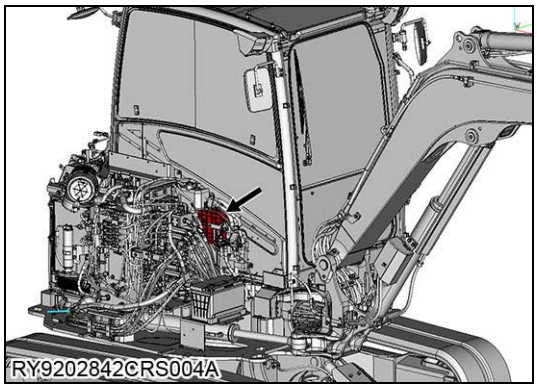
[2] ENGINE ECU MOUNTING POSITION



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[3] 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.**

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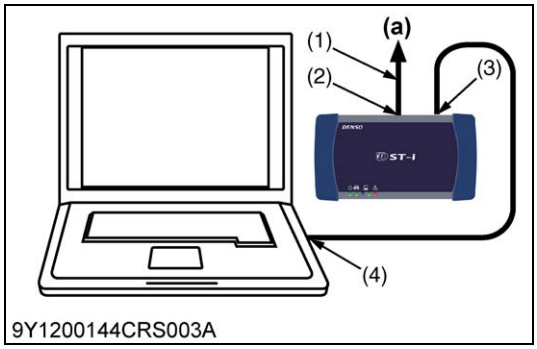

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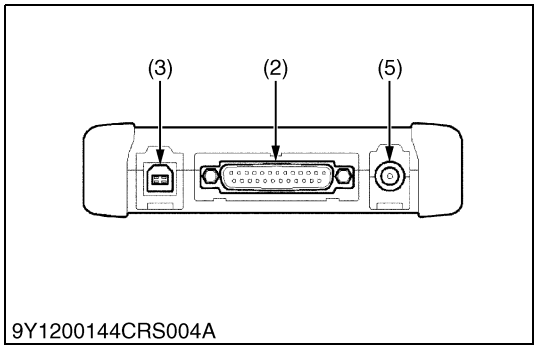

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1. Start up a PC on which the diagnostic software has been installed with administrator user account.
2. Connect the machine-side CAN1 connector **(a)** to the interface connector (To Machine) (2) with the cable (To Machine) (1).
3. Connect the cable (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

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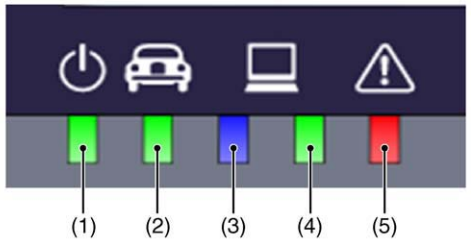
[4] CHECKING THE COMMUNICATION OPERATION OF THE INTERFACE (DST-i)



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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

RY9202138CRS0013US0

DST-i operation Status and Display Specification

n Light Operation During Normal Conditions

DST-i Status	LED Status			
	Power	Machine	USB	Error
Power OFF	☐	☐	☐	☐
Power ON	n	☐	☐	☐
USB stand-by status	n	☐	l	☐
USB cable has not connected to PC or USB driver has not installed to PC	n	☐	☐	☐
Machine stand-by for communication	n	☐	n	☐
Machine / USB communication in progress	n	H	H	☐

n Light Operation During Abnormal Operation

DST-i Status	LED Status			
	Power	Machine	USB	Error
System Error	n	l	l	l
	n	n	n	l

☐: Light OFF n: Light ON l: Light Flashing H: Light Flashing (Synchronized with communication)

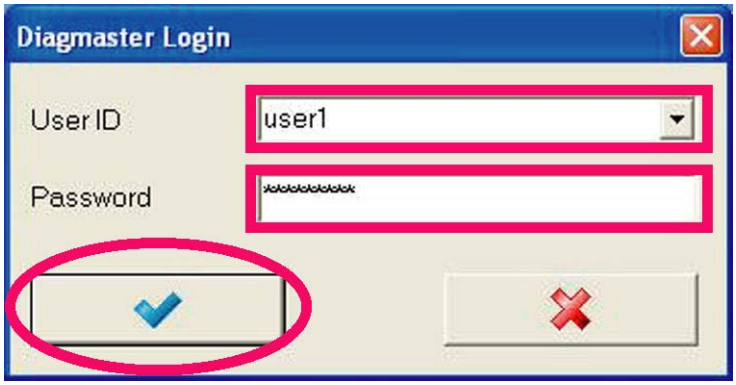
RY9202138CRS0014US0

[5] CHECKING THE OPERATION OF THE ECU

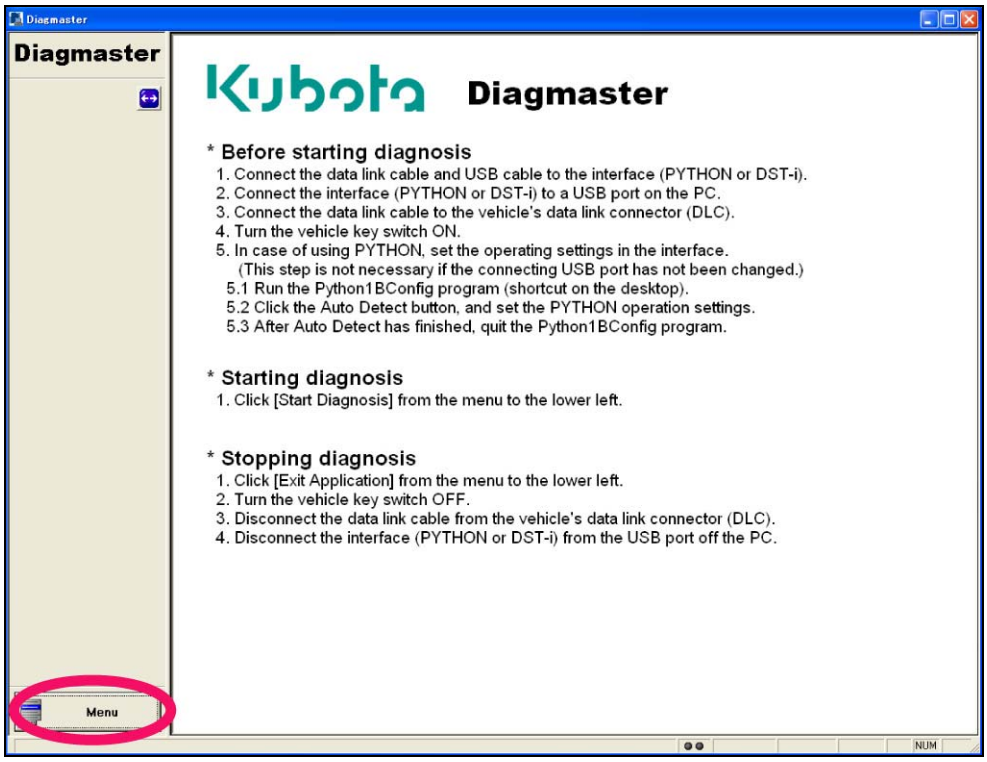
(1) Starting Diagmaster

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

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



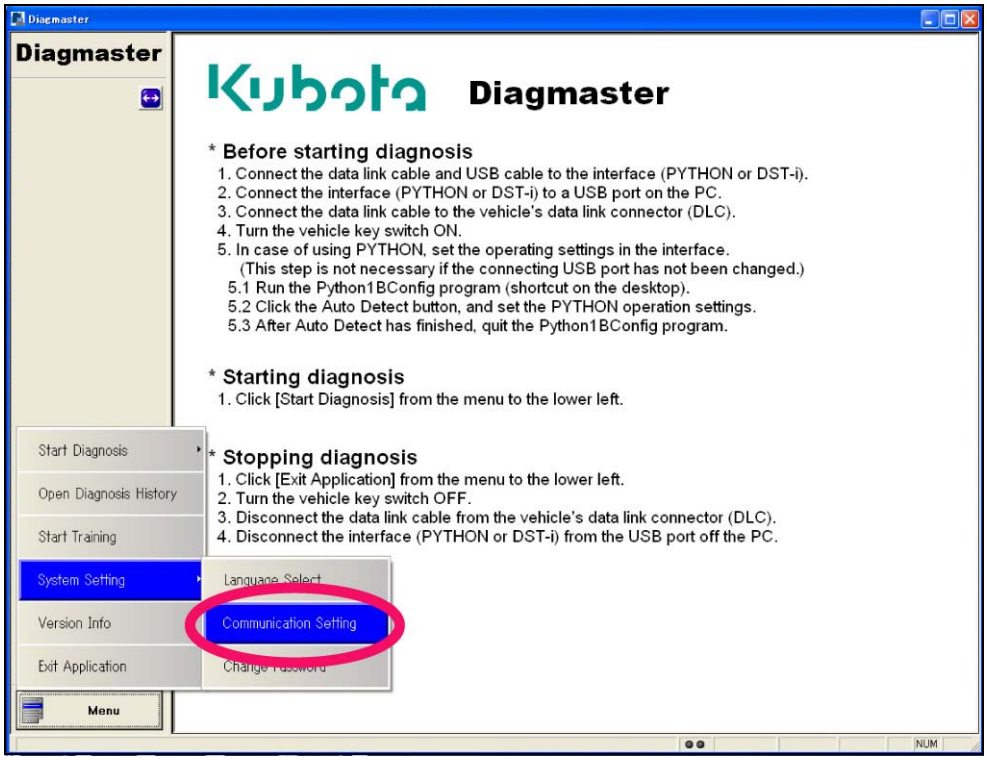
3. The Diagmaster initial screen appears.



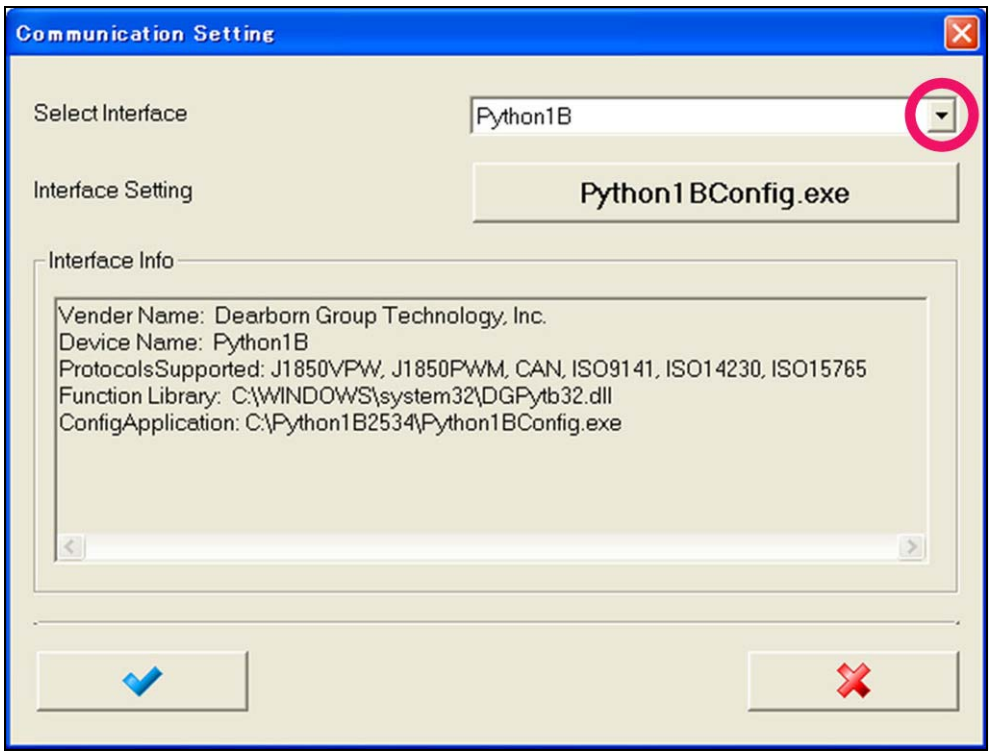
RY9202138CRS0015US0

(2) DST-i Communication Settings

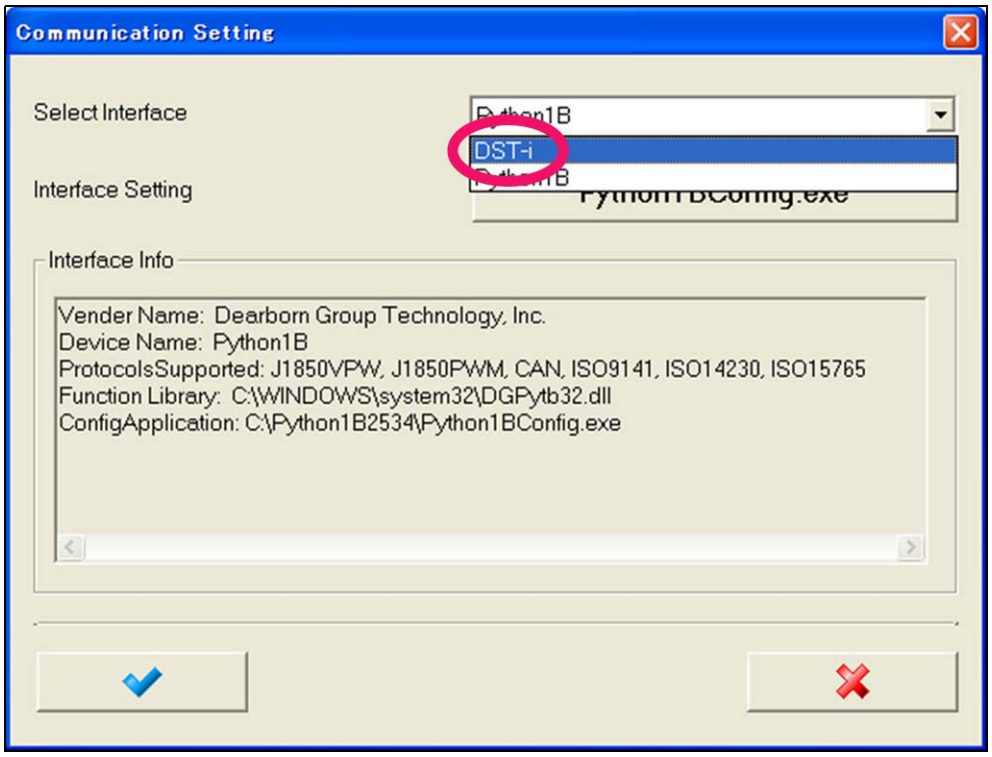
1. From the "Menu", select "System Setting", and then "Communication Setting"



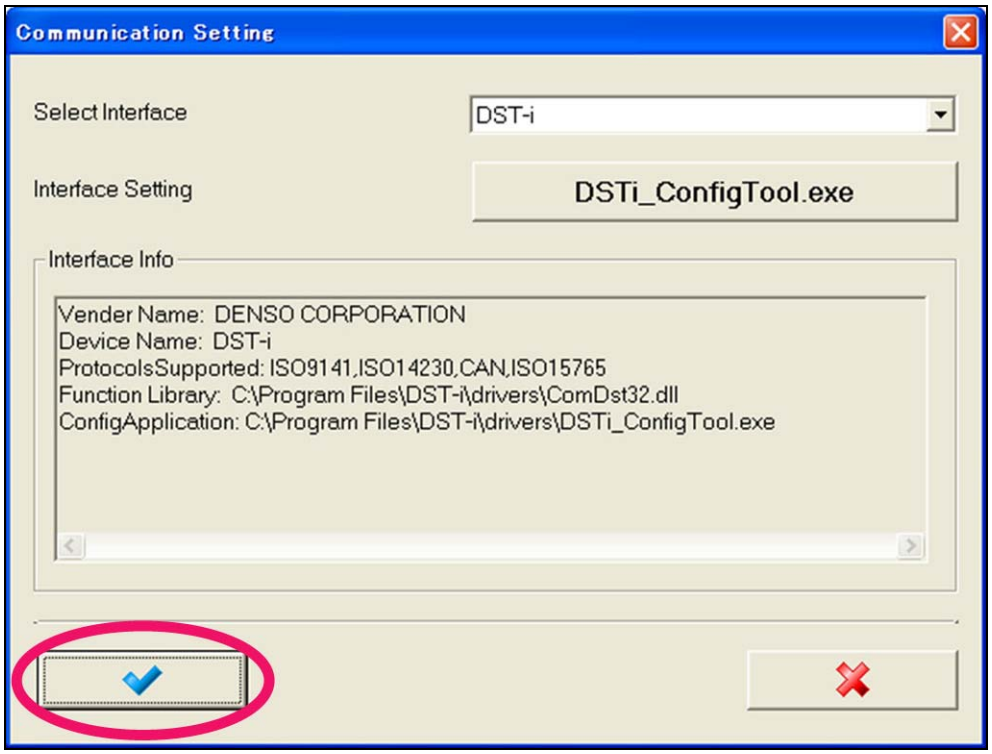
2. Click the interface select button.



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



4. Click the  button.

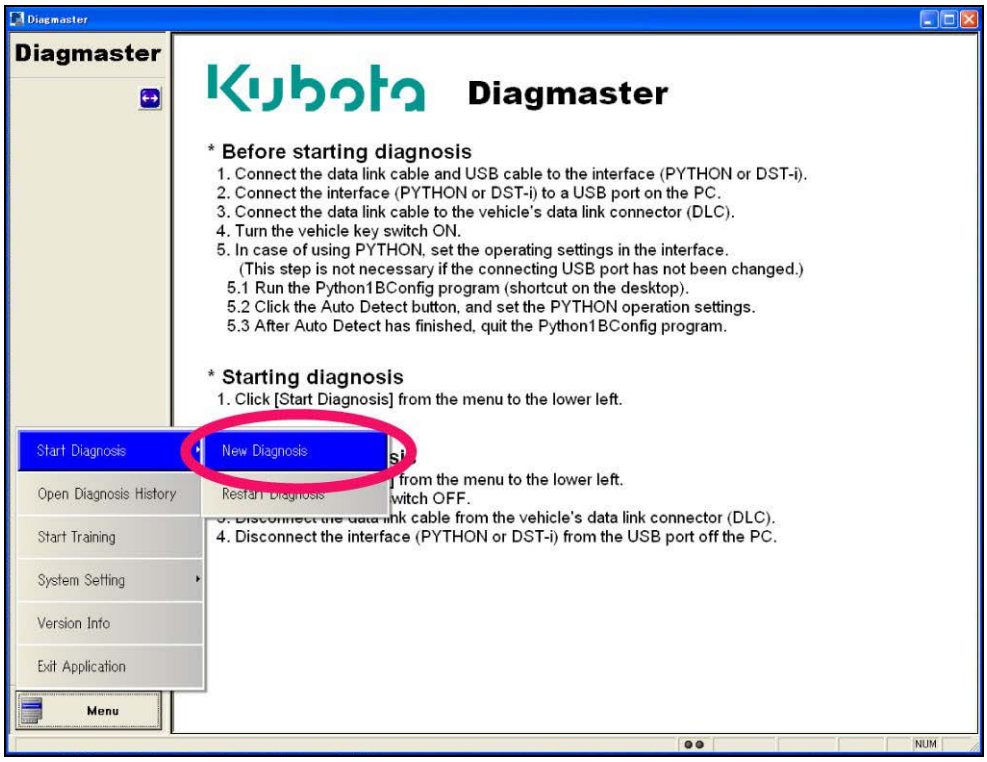


■ **NOTE**

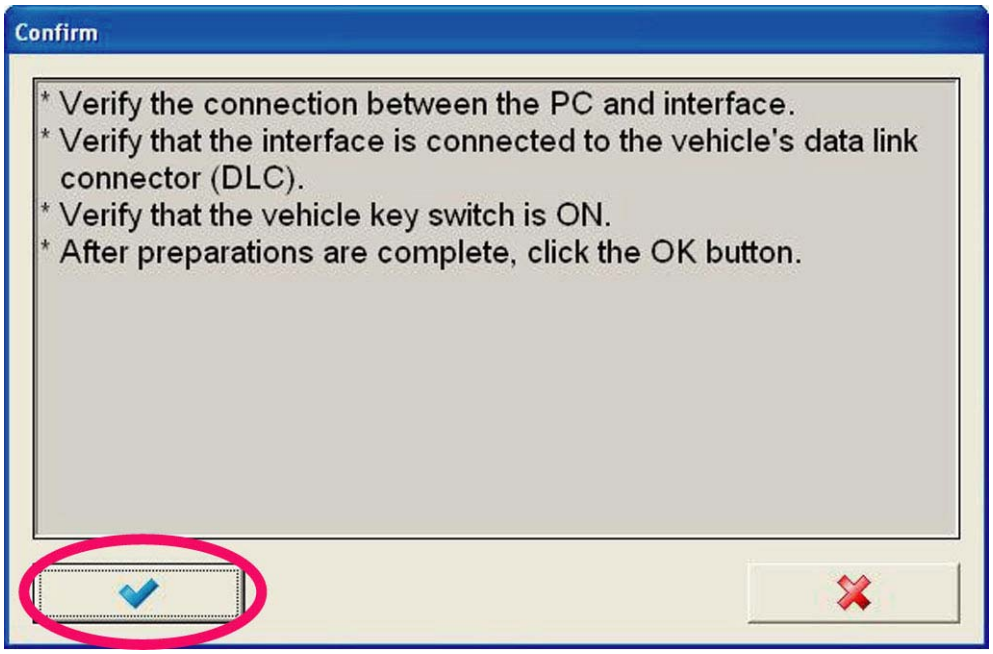
- **If you failed in the setting, confirm the connection and start again from procedure 1. to 4..**

RY9202138CRS0016US0

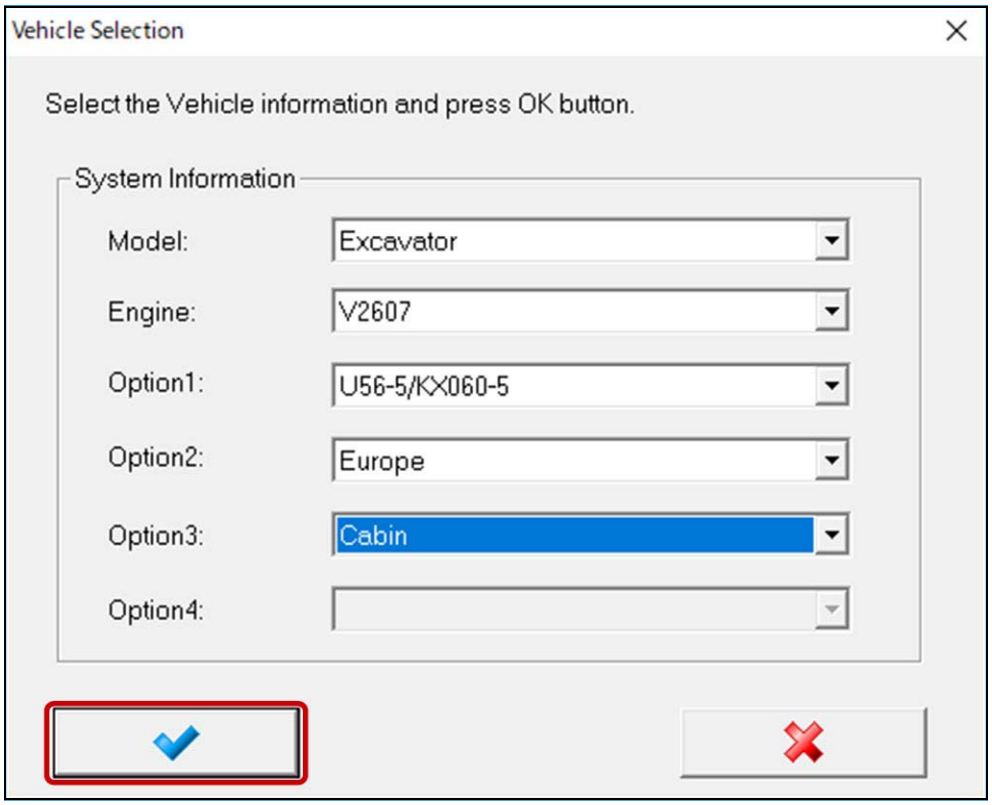
5. From "Menu", select "Start Diagnosis", and then "New Diagnosis".



6. Click the  button.

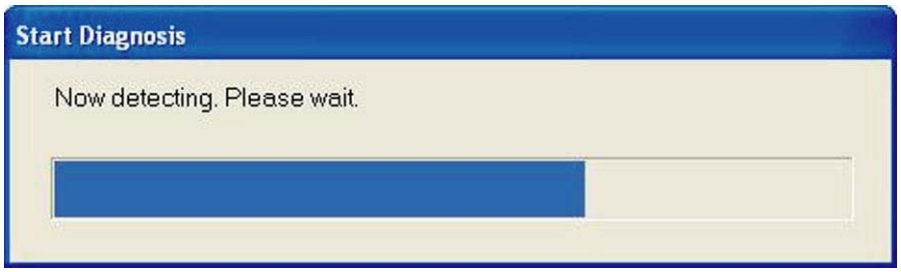


7. Select system information and click the  button.

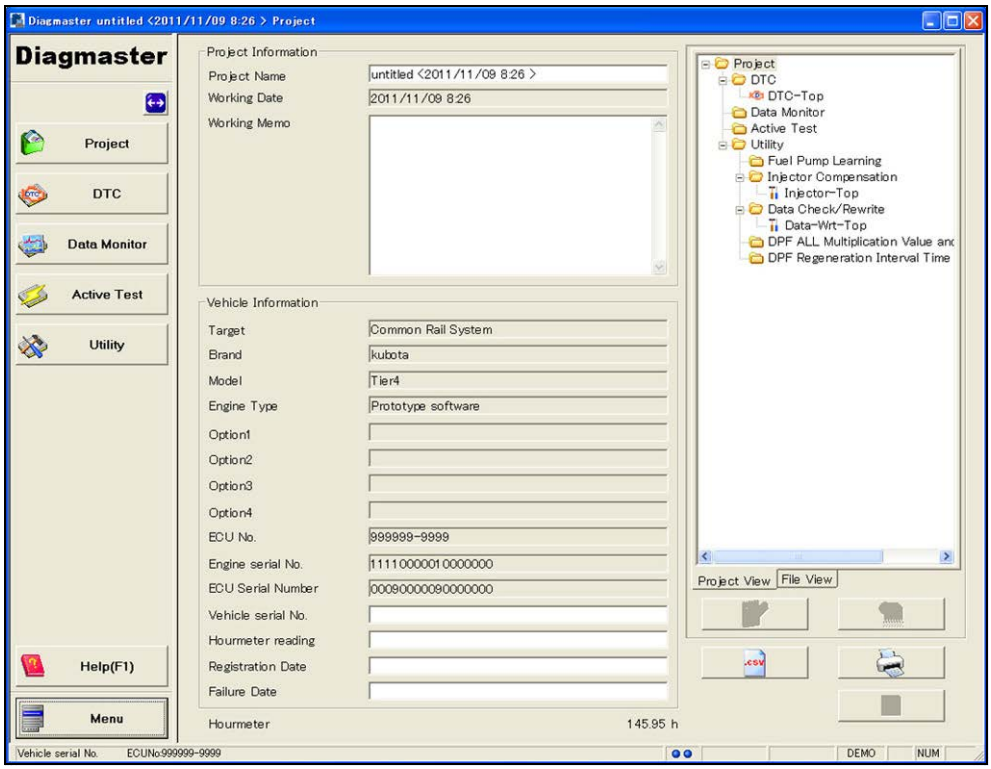


RY9202842CRS0004US0

8. The transmitting to ECU progress indicator appears.



9. The "Project" screen appears.



■ **NOTE**

- **If you failed in the setting, confirm the content of procedure 6. and start again from procedure 5. to 9..**

RY9202223CRS0005US0

3. DIAGNOSIS FUNCTIONS

Function buttons	Main function and purpose
Project	Enter/Change diagnosis information (project information) and vehicle information
DTC	Display and erase fault codes and details, and record results
Data Monitor	Display past and current vehicle control data, and compare data
Active Test	A function for forcibly switching the actuator on/off, based on a command from the tool. Used to check the circuit from the ECU to the actuator, and to check actuator performance.
Utility	Updates the ECU data after replacing a component

Project	
Item	**Function and purpose**
Edit Memo	Enter/Change diagnosis information or vehicle information (project name, job memo, vehicle number, use time, registration date, fault date)
Save data in CSV format	Saves the project to a PC
Print project information	Prints the history file

DTC (Diagnostic Trouble Code)	
Item	**Function and purpose**
Read DTC	Reads the latest DTC stored in the ECU internal memory
Successive Read DTC	Reads the previously saved DTC
Read FF (Freeze Frame Data)	Displays the vehicle control data (engine rpm, water temperature, etc.) stored in the ECU internal memory, as soon as DTC is detected. Used to identify the cause of a fault.
Save data (PC) in CSV format	Saves DTC and FF to a PC
Clear DTC	Erases DTC
Save DTC	Save DTC and FF in the project
Print DTC List	Prints a list of DTC
Replay data	Replays the previously saved DTC

Data Monitor	
Item	**Function and purpose**
Select Signal and Set Monitor Condition	Selects a monitor item that can be measured (Note: Depending on the vehicle, some items may be incompatible.)
Select graph display	Selects an individual graph or all graph display
Flag	Attaches a symbol to a desired time on the graph
Save Data	Saves data to a PC

Active test	
Item	**Function and purpose**
No. 1 Cylinder Injector Stop	Issues an on/off command to check that the injector is working. If the injector is switched off but there is no change in the engine rpm or vibrations, then there may be an abnormality with the injector. (E.g.: nozzle blockage at injector tip, or internal sticking)
No. 2 Cylinder Injector Stop	
No. 3 Cylinder Injector Stop	
No. 4 Cylinder Injector Stop	
Exhaust Gas Recirculation (EGR) Valve ON/OFF Function	Sends an on/off command to check that the EGR valve opens and closes properly. If there is a large difference between the target and actual data, then either the valve is obstructed by dirt or excessive deposits, or the valve has an abnormality.
Glow Relay ON/OFF Function	Issues an on/off command to check that the glow relay is working. If the relay is switched on but doesn't operate, there may be an abnormality with the circuit or the glow relay.
Intake throttle Valve ON/OFF Function	Sends an on/off command to check that the intake throttle valve opens and closes properly. If there is a large difference between the target and actual data, then either the valve is obstructed by dirt or excessive deposits, or the valve has an abnormality.
NCD Check Function	Reproduces engine output limit by NCD (NOx Control Diagnosis) for 15 minutes.

Utility			
Item		**Use**	**Function**
Supply Pump Learning		When the engine ECU or supply pump has been replaced.	Writes the characteristics of the supply pump to the ECU.
Injector Compensation	QR Code #1	When the engine ECU or injector has been replaced.	Writes the injector characteristics to the ECU.
	QR Code #2		
	QR Code #3		
	QR Code #4		
Data Check/Rewrite	Q Correction Number for QLQC1	When checking data	–
	Q Correction Number for QLQC2		
	Q Correction Number for QLQC3		
	Injection Timing Correction	When the engine ECU, flywheel, clutch shaft, gear case or pulsar gear has been replaced.	Any disparity between the TDC of pistons 1 - 4 and the TDC identified by the crank position sensor is written to the ECU.
	ECU Serial Number H	When checking data.	–
	Engine Serial Number H		
	Kubota H/W Part Number H		
	Kubota S/W Part Number H		
DPF Soot Load Reset		When the engine ECU or DPF has been replaced.	Resets the values related to DPF regeneration.
DPF Regeneration Interval Time Reset			
HMI for NCD		When checking NCD inducement status.	Displays checking NCD inducement Status.
HMI for PCD		When checking PCD status and violation history.	Displays PCD status and violation history.
DPF Manual Regeneration Request Function		When automatic regeneration is not possible.	Forcibly carries the DPF

H: Display only. Not rewriteable.

RY9202842CRS0005US0

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 Does Not Start.	Engine does not crank (starter motor does not rotate).
		Engine stops when the key switch returns to the RUN position from the START position (engine does not rotate under its own power).
2	Takes A Long Time Before Engine Starts.	Takes a long time before engine starts.
		May accompany idle failure.
3	Idle Failure	Idle speed is lower than the standard value or unstable.
		Engine may stall.
4	Engine Noise	Abnormal noises come from inside the engine.
		Engine sound is loud.
5	High Fuel Consumption	Fuel consumption has increased significantly.
6	Insufficient Output	Power feels insufficient compared with previously. Large amount of rotation drop.
7	Black Smoke Emitted.	The amount of black smoke in the exhaust gas has increased abnormally compared with previously.
8	White Smoke Emitted.	The amount of white smoke in the exhaust gas has increased abnormally compared with previously.

RY9202223CRS0006US0

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 Does Not Start	○	○	○	○	○						○	○	○		○		
2	Takes A Long Time Before Engine Starts		○	○	○	○					○	○	○	○		○		
3	Idle Failure		○	○				○	○	○		○	○	○		○		
4	Engine Noise		○	○								○	○	○	○	○		
5	High Fuel Consumption		○	○								○	○	○	○	○	○	
6	Insufficient Output		○	○				○	○	○	○	○	○	○	○	○	○	
7	Black Smoke Emitted		○	○									○	○	○	○	○	
8	White Smoke Emitted		○	○									○	○	○	○		

RY9202223CRS0007US0

		Malfunction Cause													
		Control System							Engine Electrical System				Intake System		
		Rail pressure sensor		Fuel temperature sensor		SCV malfunction	Main relay malfunction	EGR valve fault	Battery		Charging system malfunction	Air cleaner clogging	Intake system components	Glow system	
	Malfunction Cause	No signal output	False signal output	No signal output	False signal output				Does not charge	Does not discharge			Leak	Faulty relay	Glow plug fault
1	Engine Does Not Start	○	○			○	○		○	○	○			○	○
2	Takes A Long Time Before Engine Starts	○	○			○				○				○	○
3	Idle Failure	○	○			○									
4	Engine Noise	○	○			○							○		
5	High Fuel Consumption	○	○			○						○	○		
6	Insufficient Output	○	○			○						○	○		
7	Black Smoke Emitted	○	○			○		○				○	○		
8	White Smoke Emitted	○	○			○		○				○	○	○	

RY9202230CRS0003US0

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 supply malfunction *1	Large resistance *1	Loose fit parts	Defective CAN communication
1	Engine Does Not Start		○	○	○	○	○	○	○					○		
2	Takes A Long Time Before Engine Starts		○	○	○	○	○	○	○					○		
3	Idle Failure	○	○	○	○	○	○	○	○					○		
4	Engine Noise	○	○	○	○						○			○	○	
5	High Fuel Consumption	○	○	○	○	○	○	○	○				○	○		
6	Insufficient Output	○	○	○	○	○	○	○	○				○	○		○
7	Black Smoke Emitted	○	○	○			○	○	○							
8	White Smoke Emitted	○	○	○	○	○	○	○	○							

*1: It emphatically searches for the machine side.

RY9202223CRS0009US0

[2] DIAGNOSIS BY MALFUNCTION SYMPTOM

(1) Engine Does Not Start

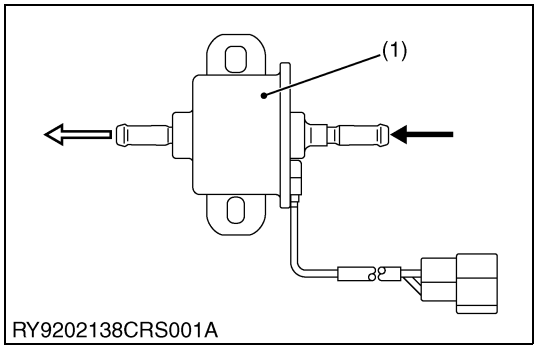
Possible causes:

1. Fuel pump operation fault.
2. Starting assist device (glow plug)
   - Applicable only when the temperature is low: -10 °C (14 °F) or less
   - Refer to the workshop manual for the machine and check the glow plug, 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 relay fault
   - Glow plug 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 resistance for start

RY9202223CRS0010US0



RY9202138CRS001A

1. Check the Fuel Pump Operation

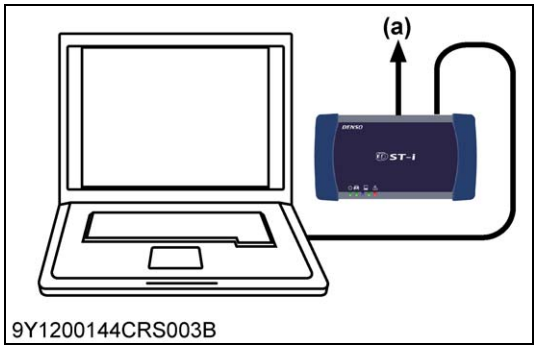
1. Turn the key switch ON and check that the fuel pump is operating.

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 Pump".

(1) Fuel Pump

RY9202138CRS0027US0



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

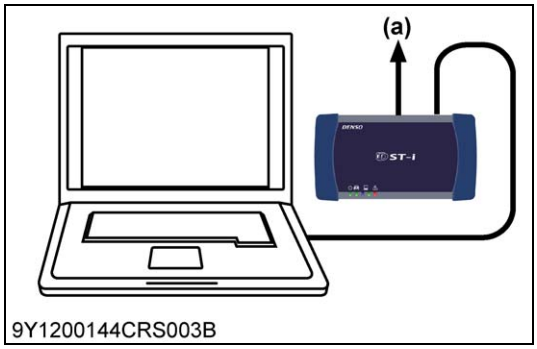
OK	Go to "3. Check the Starting Assist Device".
NG	Check in accordance with the troubleshooting procedures for each DTC.

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

RY9202138CRS0028US0



9Y1200144CRS003B

3. Check the Starting Assist Device

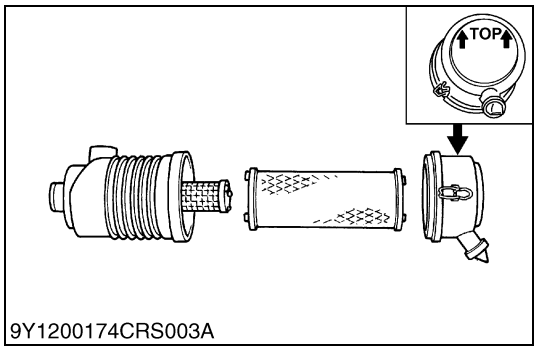
1. Refer to the workshop manual for the machine and check the glow plug, relay and related wiring harness.
2. In case the engine can not start when it is new or after the maintenance, make sure to connect the injector harness connector of the head cover position.
3. Perform an active test for models 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 (glow plug).

(a) CAN1 Connector

RY9202223CRS0011US0



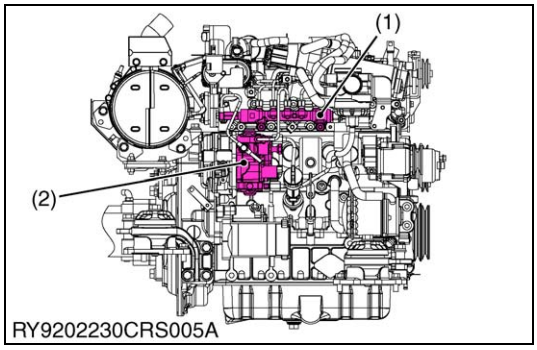
9Y1200174CRS003A

4. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

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

RY9202138CRS0030US0



RY9202230CRS005A

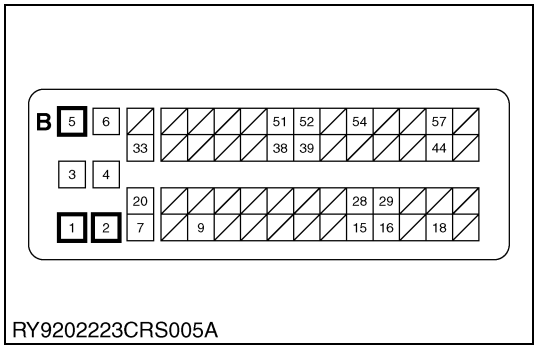
5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "6. Check the ECU Power Supply and Grounding".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

(1) Rail (2) Supply Pump

RY9202230CRS0004US0



RY9202223CRS005A

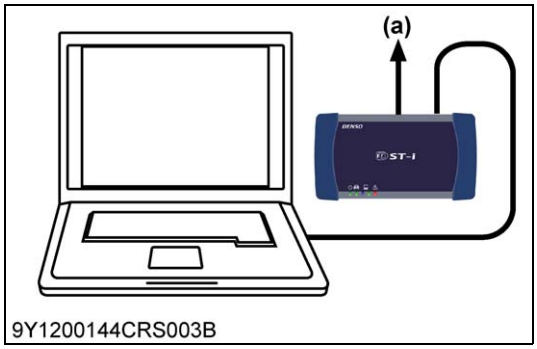
6. Check the ECU Power Supply and Grounding

1. Turn the key switch ON and measure the voltage between the ECU +BP terminals (B-5) and ground (body / battery terminal) and ECU S-GND terminal (B-1 / B-2) 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)".

RY9202223CRS0013US0



9Y1200144CRS003B

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

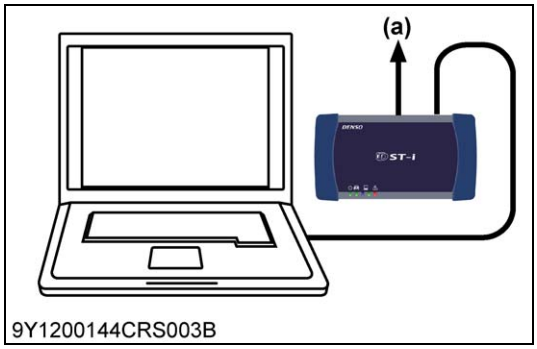
1. Set the key switch to START position and crank the engine. Check the "Engine speed active flag" and "Cam speed active flag" using the diagnosis tool data monitor function.

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 and P0340, P0341 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 and P0340, P0341 in "5.[2] DIAGNOSIS BY DTC" as was the case in the above.

(a) CAN1 Connector

RY9202138CRS0033US0



9Y1200144CRS003B

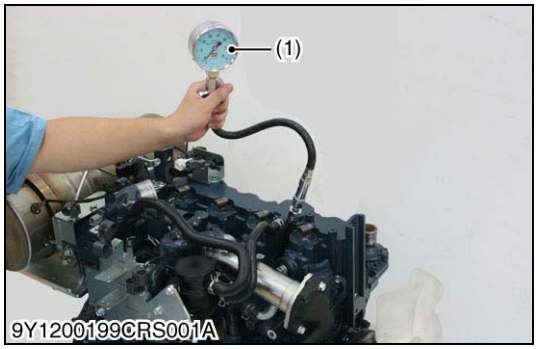
8. Supply Pump Difference Learning and Checking the Monitor

1. Perform difference learning for the supply pump in accordance with "3. ACTIVE TEST AND SUPPLY PUMP DIFFERENCE LEARNING".
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 and battery voltage.

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

(a) CAN1 Connector

RY9202223CRS0206US0



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

RY9202223CRS0014US0

(2) Takes a Long Time Before Engine Starts

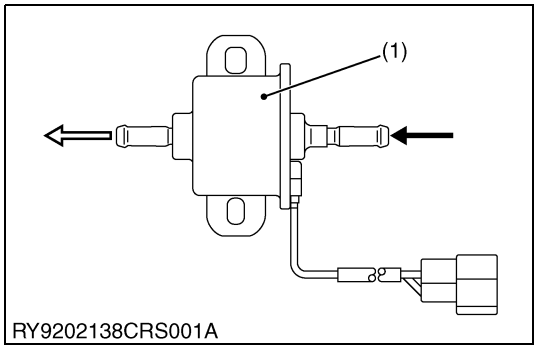
Possible causes:

1. Fuel 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 relay fault
   - Glow plug 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 resistance for start

RY9202223CRS0015US0



RY9202138CRS001A

1. Check the Fuel Pump Operation

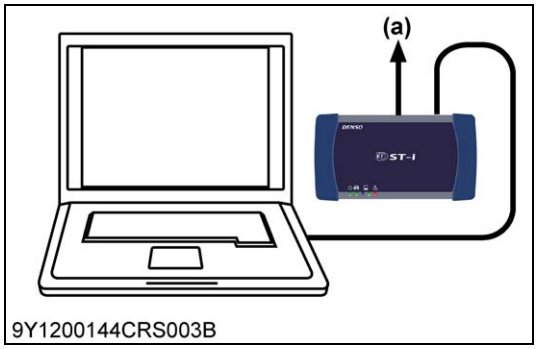
1. Turn the key switch ON and check that the fuel pump is operating.

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 Pump".

(1) Fuel Pump

RY9202138CRS0027US0



9Y1200144CRS003B

2. Check the DTC

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

Factory specification	No DTC is output.

DTC presently existing

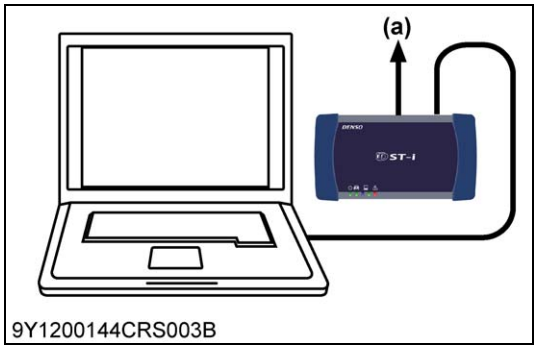
OK	Go to "3. Check the Starting Assist Device".
NG	Check in accordance with the troubleshooting procedures for each DTC.

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

RY9202138CRS0037US0



3. Check the Starting Assist Device

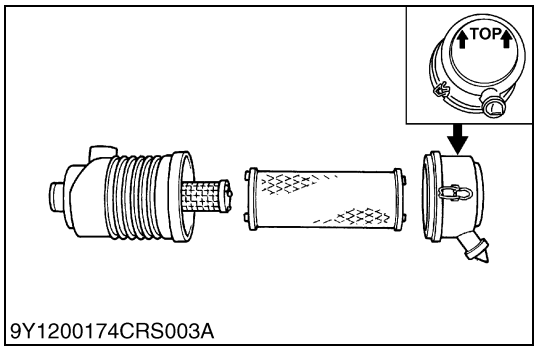
1. Refer to the workshop manual for the machine and check the glow plug, relay and related wiring harness.
2. In case the engine can not start when it is new or after the maintenance, make sure to connect the injector harness connector of the head cover position.
3. Perform an active test for models 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 (glow plug).

(a) CAN1 Connector

RY9202223CRS0016US0

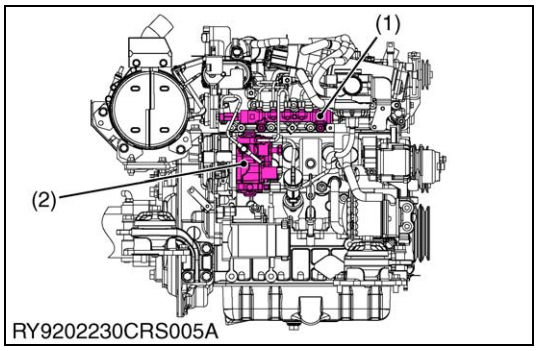


4. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

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

RY9202138CRS0030US0



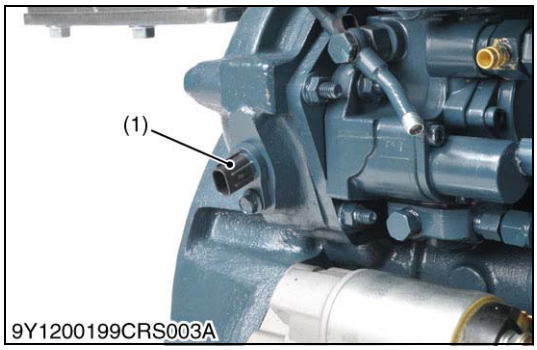
5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "6. Check the Crankshaft Position Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

(1) Rail (2) Supply Pump

RY9202230CRS0005US0



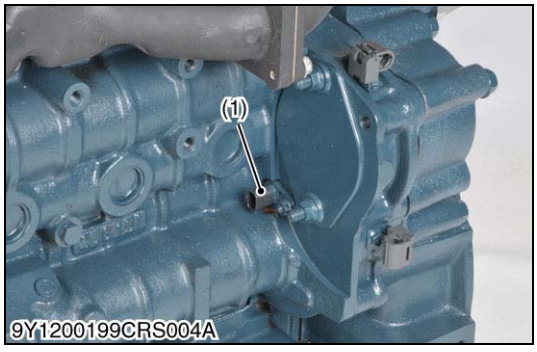
6. Check the Crankshaft Position Sensor

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)

RY9202223CRS0018US0



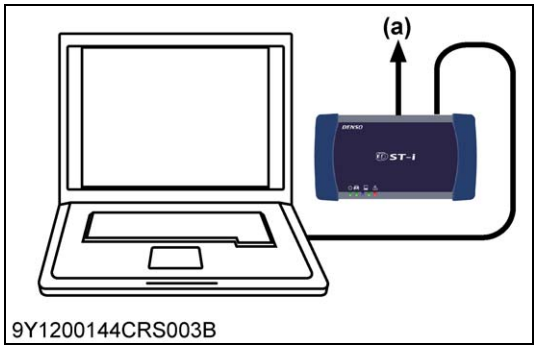
7. Check the Camshaft Position Sensor

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)

RY9202223CRS0019US0



8. Check the Data Related to Pressure Control

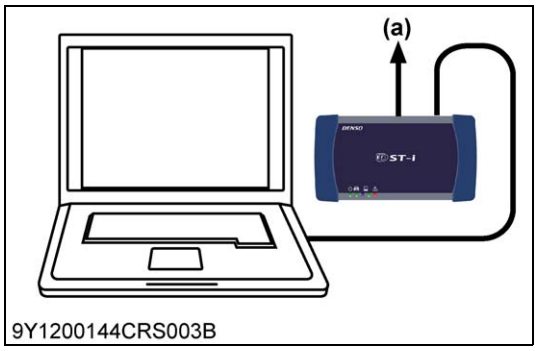
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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) and SCV abnormality items (P0628 and P0629) 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

RY9202230CRS0006US0



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

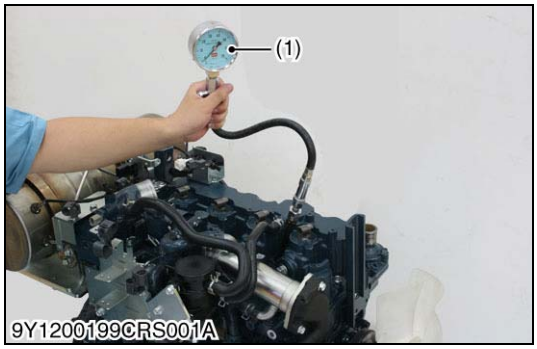
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

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

RY9202138CRS0041US0



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

RY9202223CRS0021US0

(3) Idle Failure

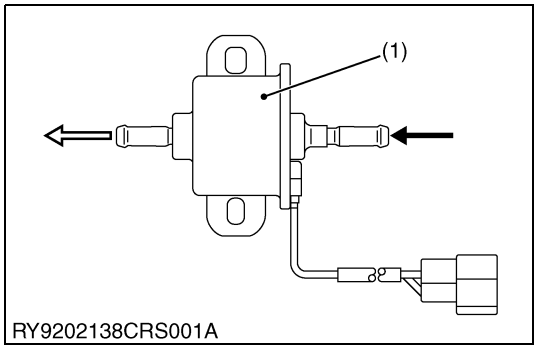
Possible causes:

1. Fuel 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 resistance for actuation

RY9202223CRS0022US0



RY9202138CRS001A

1. Check the Fuel Pump Operation

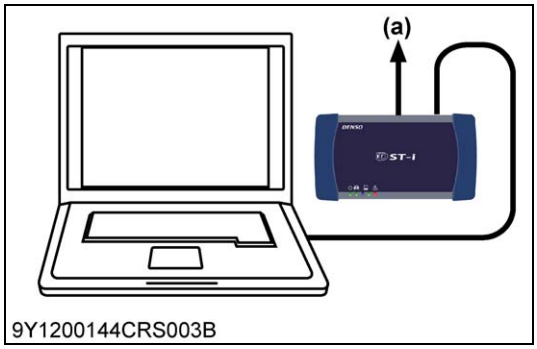
1. Turn the key switch ON and check that the fuel pump is operating.

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 Pump".

(1) Fuel Pump

RY9202138CRS0027US0



9Y1200144CRS003B

2. Check the DTC

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

Factory specification	No DTC is output.

DTC presently existing

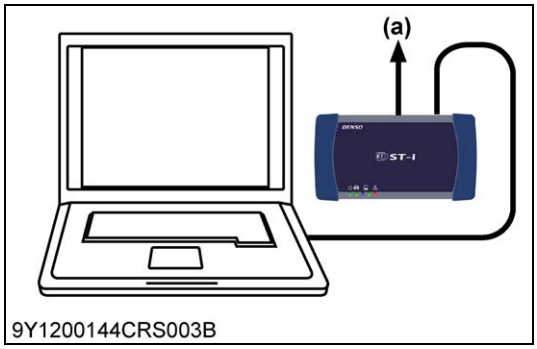
OK	Go to "3. Check the Injector (Including the Pipes, etc.)".
NG	Check in accordance with the troubleshooting procedures for each DTC.

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

RY9202138CRS0043US0



9Y1200144CRS003B

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

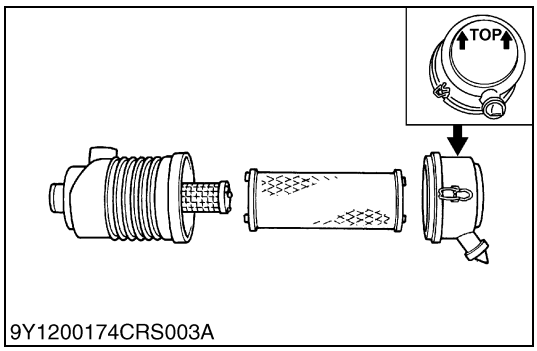
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

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

RY9202138CRS0044US0



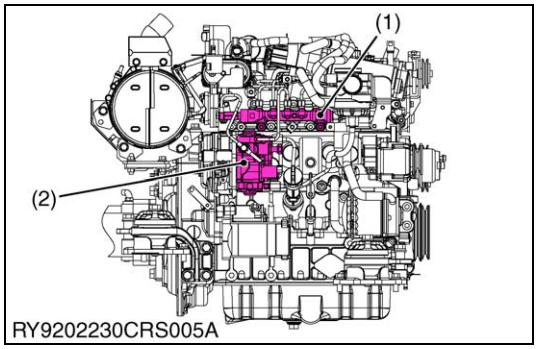
9Y1200174CRS003A

4. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

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

RY9202138CRS0030US0



RY9202230CRS005A

5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "6. Check the Accelerator Position Sensor.
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

(1) Rail (2) Supply Pump

RY9202230CRS0007US0

6. Check the Accelerator Position Sensor

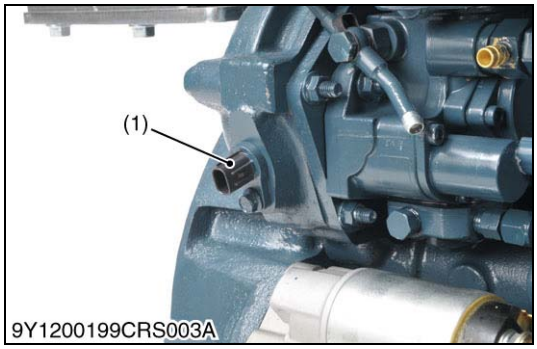
CAUTION

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

1. Refer to DTC P2131 and Work Shop Manual for the machine.

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

RY9202223CRS0024US0



9Y1200199CRS003A

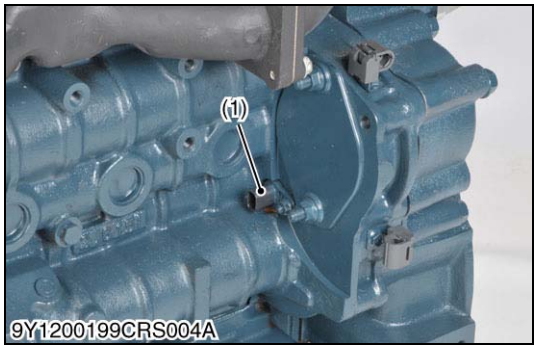
7. Check the Crankshaft Position Sensor

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)

RY9202223CRS0201US0



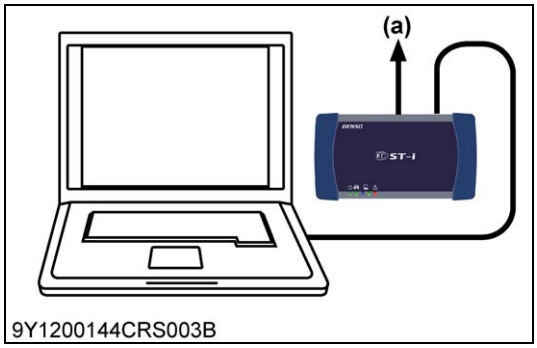
8. Check the Camshaft Position Sensor

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)

RY9202223CRS0025US0



9. Check the Data Related to Pressure Control

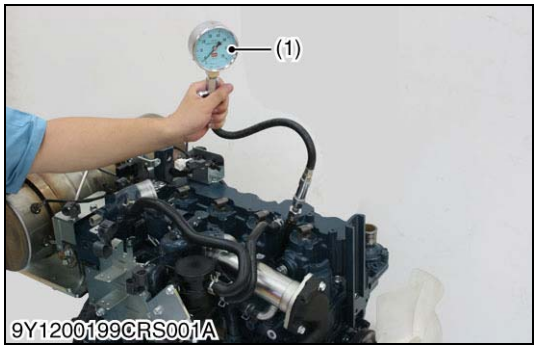
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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) and SCV abnormality items (P0628 and P0629) 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

RY9202230CRS0008US0



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

RY9202223CRS0027US0

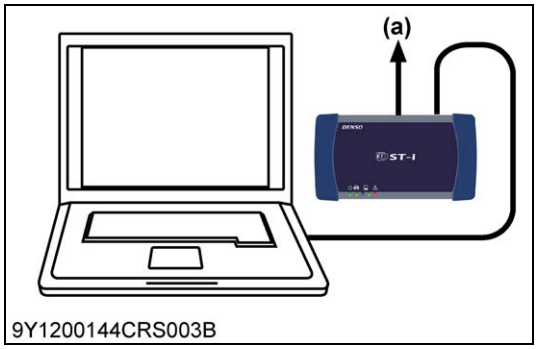
(4) Engine Noise

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 resistance for actuation
   - Loose parts (including part interference sound)

RY9202223CRS0028US0



1. Check the DTC

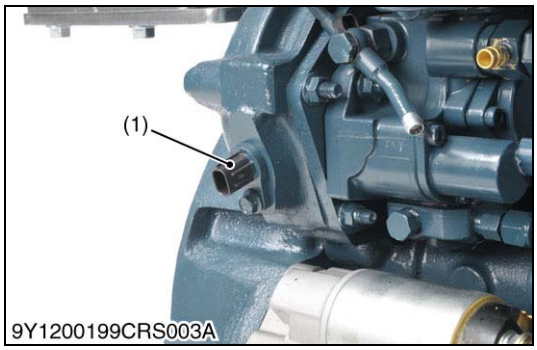
1. Turn the key switch ON and check the DTC.

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

RY9202138CRS0050US0



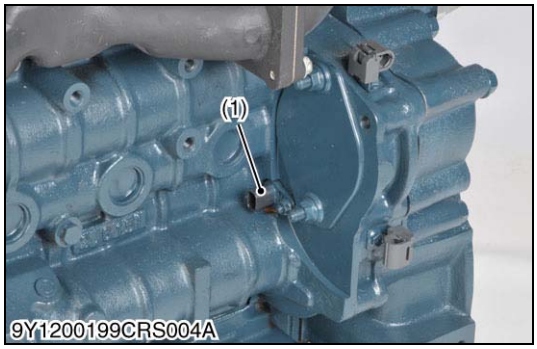
2. Check the Crankshaft Position Sensor

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)

RY9202223CRS0029US0



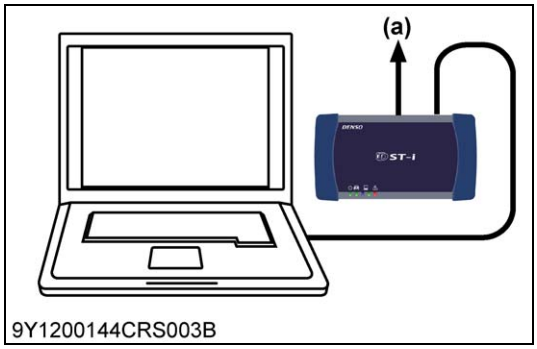
3. Check the Camshaft Position Sensor

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)

RY9202223CRS0030US0



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

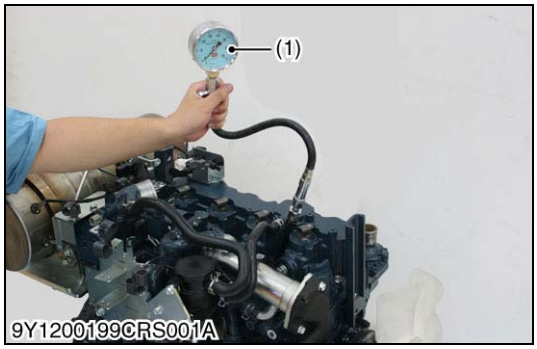
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

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

RY9202138CRS0053US0



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

RY9202223CRS0031US0

(5) 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

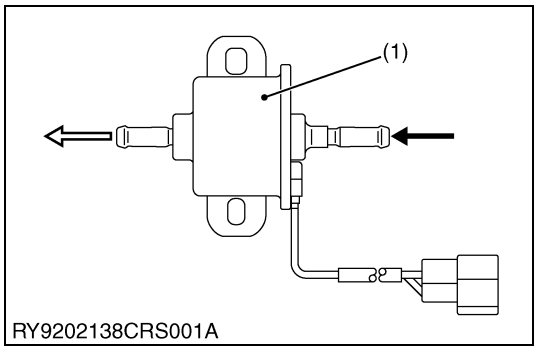
Reduced engine performance is not detected but the fuel consumption is higher.

1. Usage habits of the user or use of non-standard parts
   - Not the standard specification
     - 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
   - Faulty maintenance
     - Engine oil (dirt)
     - Air filter, fuel filter (dirt, clogging)
     - Radiator clogging
2. Powertrain malfunctions not involving the engine
   - Large resistance for actuation
     - Large resistance for hydraulic pump
3. Fuel 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
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

RY9202230CRS0009US0



RY9202138CRS001A

1. Check the Fuel Pump Operation

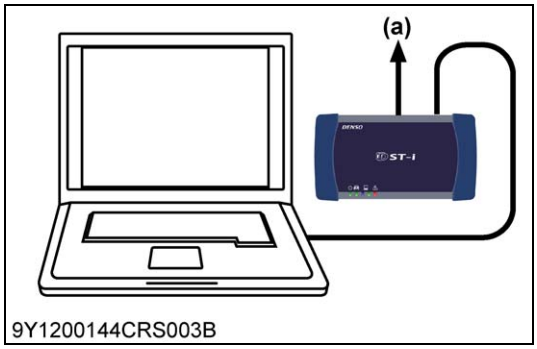
1. Turn the key switch ON and check that the fuel pump is operating.

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 Pump".

(1) Fuel Pump

RY9202138CRS0027US0



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

RY9202138CRS0056US0

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".

RY9202138CRS0057US0


9Y1200199CRS005A

4. Check the Engine and Machine Condition

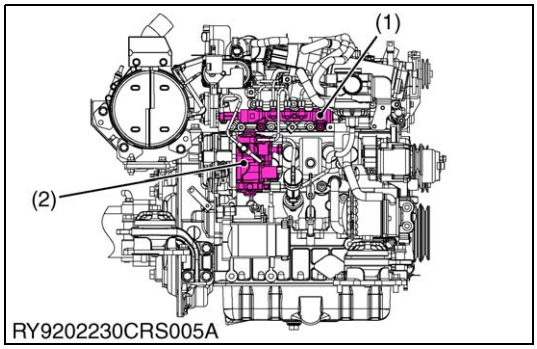
1. Check for the usage habits of the user or use of non-standard parts.
   - Use of non-standard parts such as intake / exhaust system parts
   - Used under poor fuel consumption conditions
     – Engine used for a long time under a high load
     – Long idling time
   - Faulty maintenance
     – Engine 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 resistance for actuation
     – Does hydraulic pump increase resistance?

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

RY9202230CRS0010US0



RY9202230CRS005A

5. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

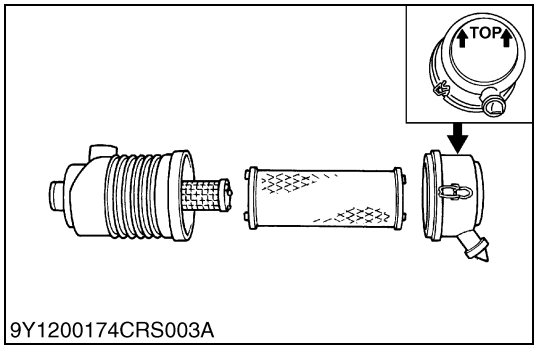
(Reference)

Pay attention particularly to the following two points:
- Service fuel (for summer / winter seasons, and cold region)
- Fuel leak from the fuel line

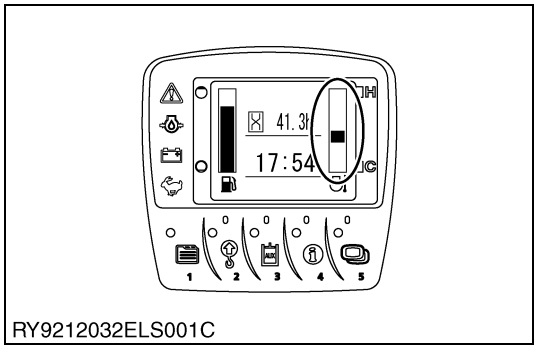
OK	Go to "6. Check the Intake System".
NG	Repair or replace the malfunctioning component.

(1) Rail (2) Supply Pump

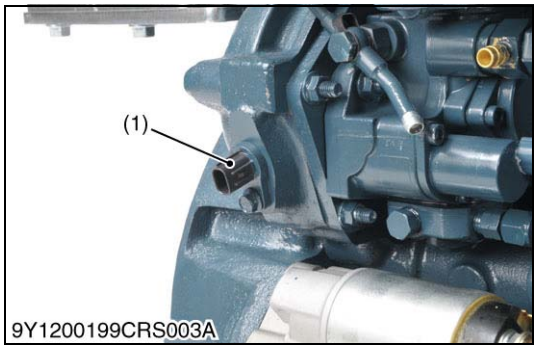
RY9202230CRS0011US0



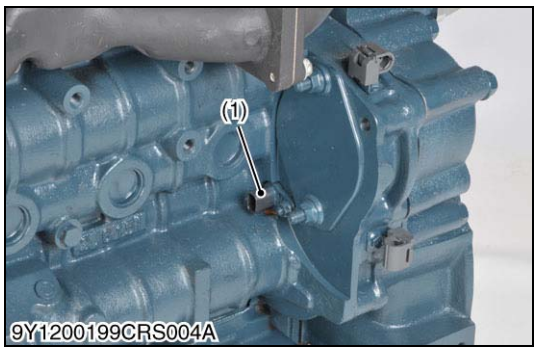
9Y1200174CRS003A



RY9212032ELS001C



9Y1200199CRS003A



9Y1200199CRS004A

6. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

(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.

RY9202138CRS0060US0

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.

RY9202223CRS0202US0

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)

RY9202223CRS0035US0

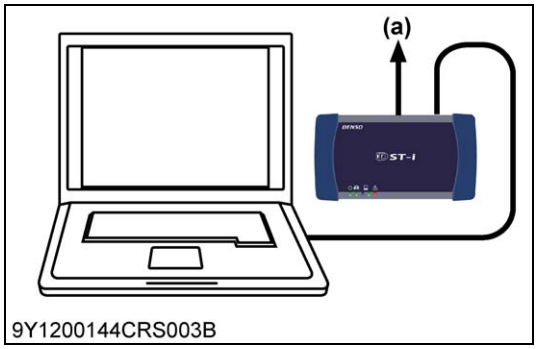
9. Check the Camshaft Position Sensor

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)

RY9202223CRS0036US0



10. Check the Data Related to Pressure Control

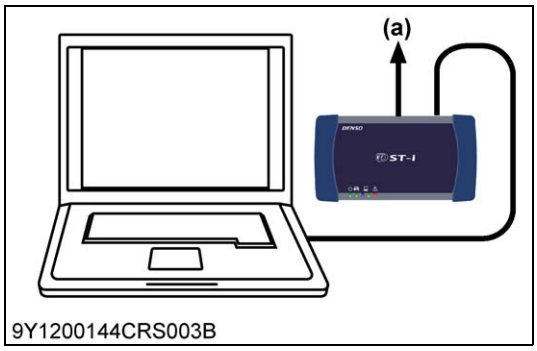
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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) and SCV abnormality items (P0628 and P0629) 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

RY9202230CRS0012US0



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

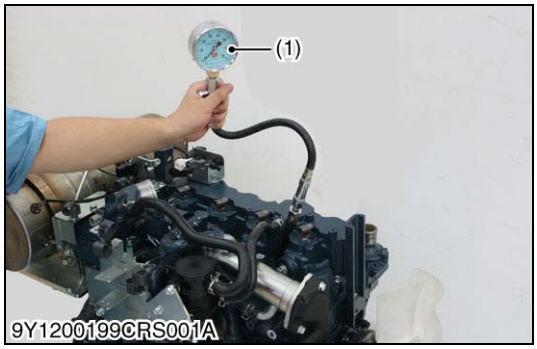
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

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

RY9202138CRS0065US0



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.

OK	Normal.
NG	Repair or replace the related parts.

(1) Compression Tester

RY9202230CRS0013US0

(6) Insufficient Output

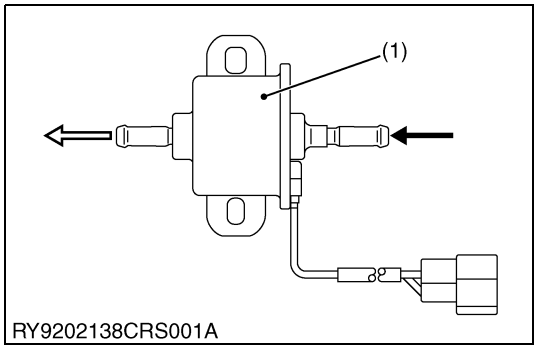
Possible causes:

1. Fuel pump operation fault
2. Trouble on the machine
   - Large resistance for actuation

***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
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
   - Defective CAN communication

RY9202230CRS0014US0



RY9202138CRS001A

1. Check the Fuel Pump Operation

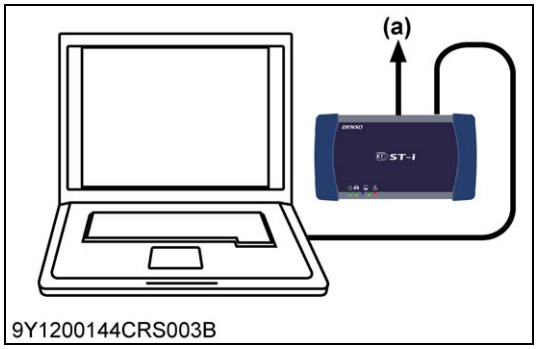
1. Turn the key switch ON and check that the fuel pump is operating.

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 Pump".

(1) Fuel Pump

RY9202138CRS0027US0



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

RY9202138CRS0068US0

3. Check the Accelerator Position Sensor

CAUTION

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

1. Refer to DTC P2131 and Work Shop Manual for the machine.

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

RY9202223CRS0040US0


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.

RY9202223CRS0041US0


9Y1200199CRS005A

5. Malfunction Verification - 1

1. Reproduce running conditions (engine speed, machine speed, etc.) as pointed out by the driver. Compare with another machine of the same model and check whether 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.
NG	Go to "6. Malfunction Verification - 2".

RY9202223CRS0042US0

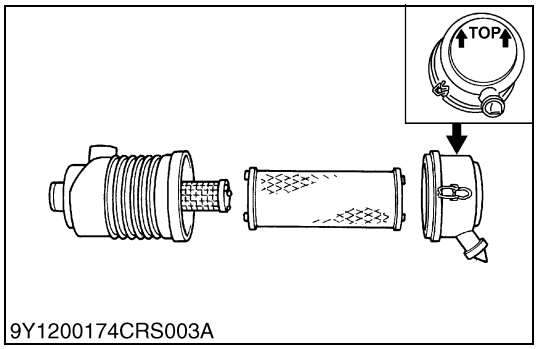

9Y1200199CRS005A

6. Malfunction Verification - 2

1. Check trouble on the machine.
   - Large resistance for actuation

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

RY9202223CRS0043US0



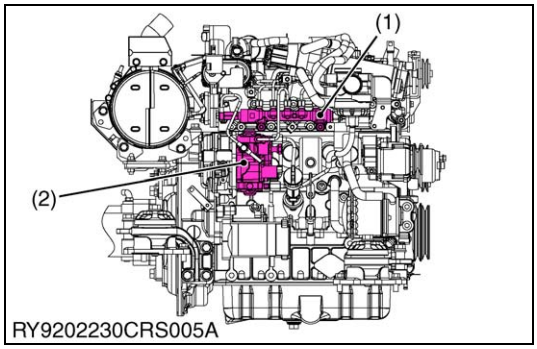
9Y1200174CRS003A

7. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

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

RY9202138CRS0073US0



RY9202230CRS005A

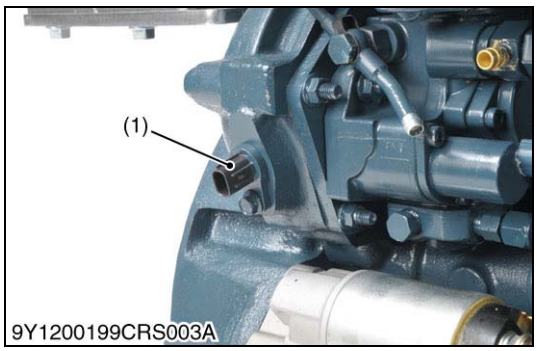
8. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "9. Check the Crankshaft Position Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

(1) Rail (2) Supply Pump

RY9202230CRS0015US0



9Y1200199CRS003A

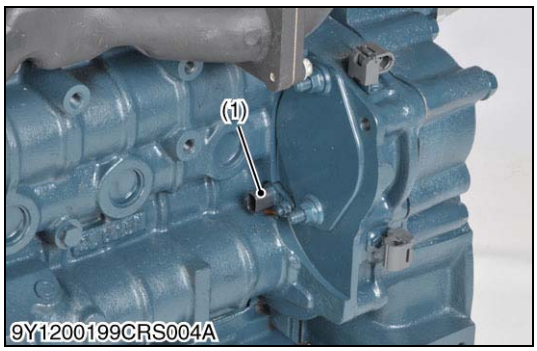
9. Check the Crankshaft Position Sensor

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)

RY9202223CRS0045US0



9Y1200199CRS004A

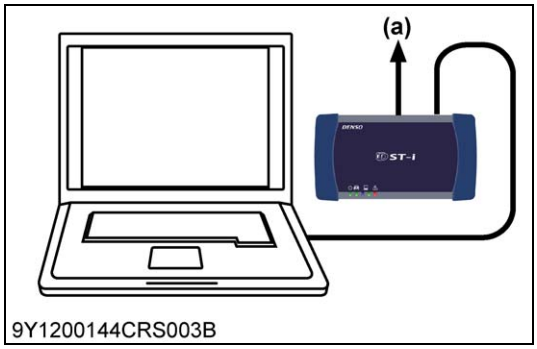
10. Check the Camshaft Position Sensor

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)

RY9202223CRS0046US0



11. Check the Data Related to Pressure Control

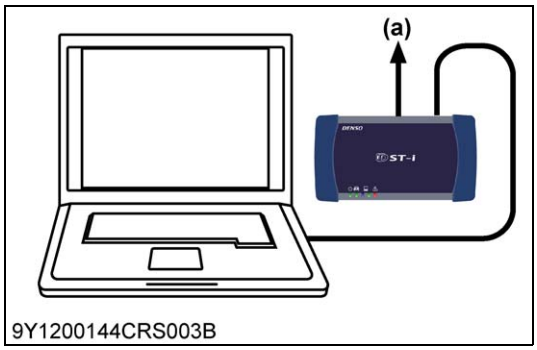
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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) and SCV abnormality items (P0628 and P0629) 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

RY9202230CRS0016US0



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

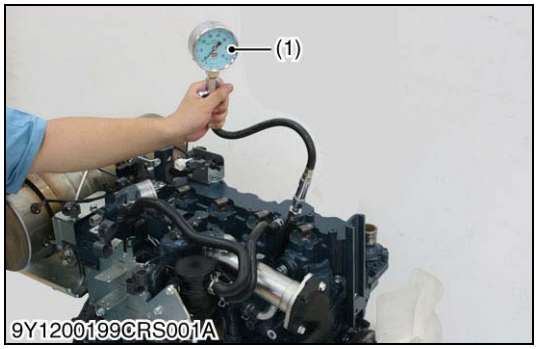
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

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

RY9202138CRS0078US0



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.

OK	Normal.
NG	Repair or replace the related parts.

(1) Compression Tester

RY9202230CRS0017US0

(7) Abnormal Black Smoke Emitted

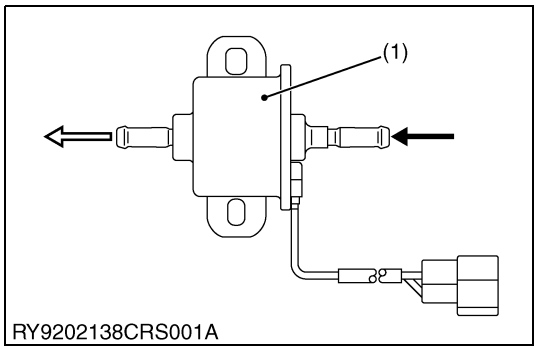
Possible causes:

1. Fuel 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
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

RY9202230CRS0018US0



RY9202138CRS001A

1. Check the Fuel Pump Operation

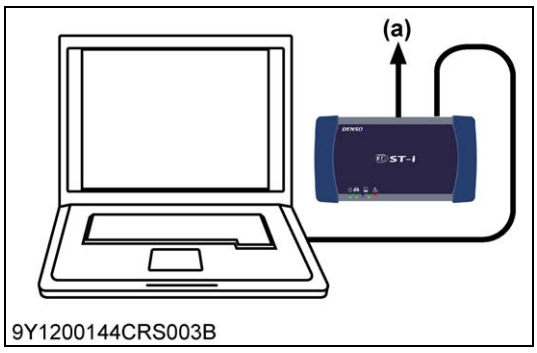
1. Turn the key switch ON and check that the fuel pump is operating.

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 Pump".

(1) Fuel Pump

RY9202138CRS0027US0



9Y1200144CRS003B

2. Check the DTC

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

Factory specification	No DTC is output.

DTC presently existing

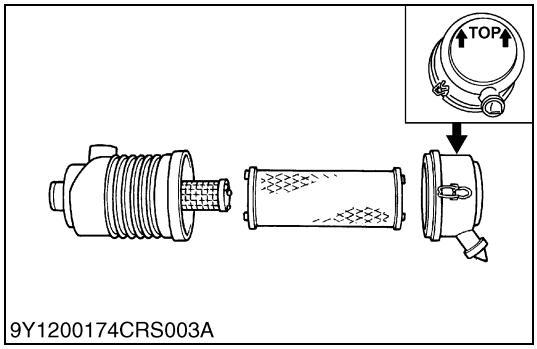
OK	Go to "3. Check the Intake System".
NG	Check in accordance with the troubleshooting procedures for each DTC.

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

RY9202138CRS0080US0

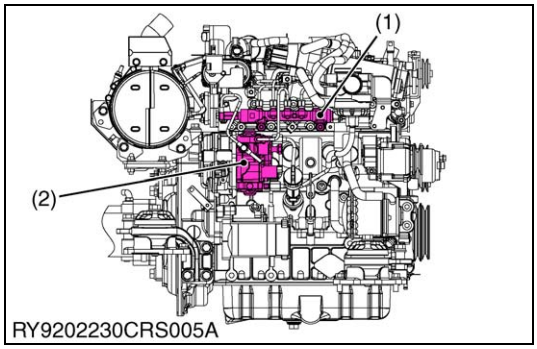


3. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

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

RY9202138CRS0081US0



4. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "5. Check the Accelerator Position Sensor.
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

(1) Rail (2) Supply Pump

RY9202230CRS0019US0

5. Check the Accelerator Position Sensor

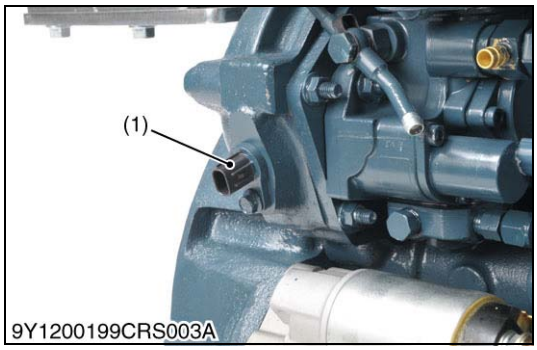
CAUTION

- **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.

RY9202138CRS0083US0



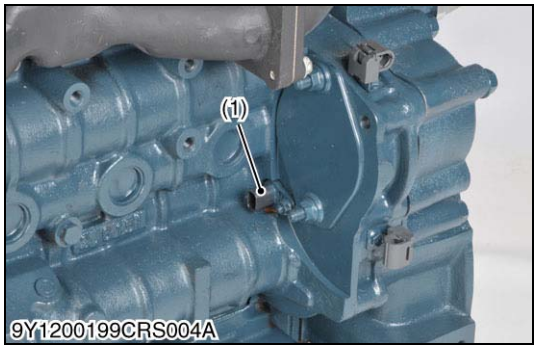
6. Check the Crankshaft Position Sensor

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)

RY9202223CRS0050US0



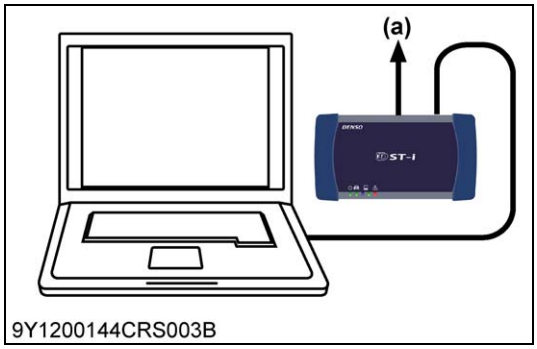
7. Check the Camshaft Position Sensor

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)

RY9202223CRS0051US0



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.

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.

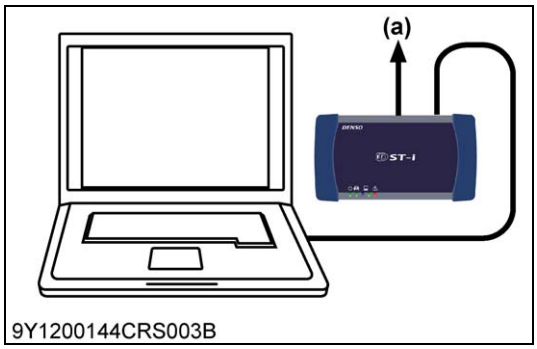
Factory specification	Refer to "1.[5].(2) Normal Value". In addition, for the check procedures refer to "5.[2] DIAGNOSTIC PROCEDURE BY DTC".

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

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

(a) CAN1 Connector

RY9202223CRS0207US0



9. Check the Data Related to Pressure Control

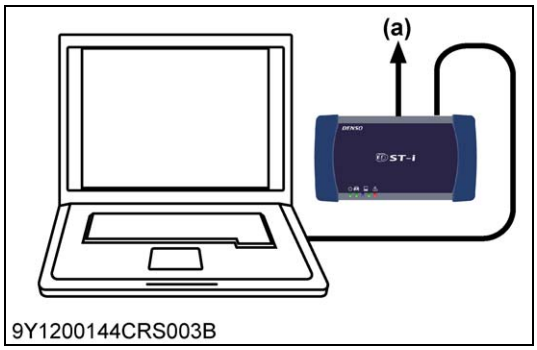
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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) and SCV abnormality items (P0628 and P0629) 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

RY9202230CRS0020US0



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

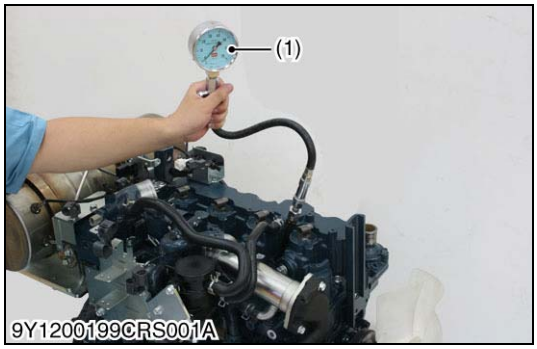
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

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

RY9202138CRS0088US0



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.

OK	Normal.
NG	Repair or replace the related parts.

(1) Compression Tester

RY9202230CRS0021US0

(8) Abnormal White Smoke Emitted

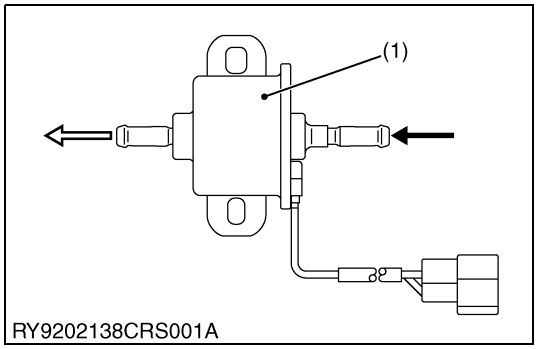
Possible causes:

1. Fuel pump operation fault
2. Starting assist device fault (glow 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 relay 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

RY9202230CRS0022US0



RY9202138CRS001A

1. Check the Fuel Pump Operation

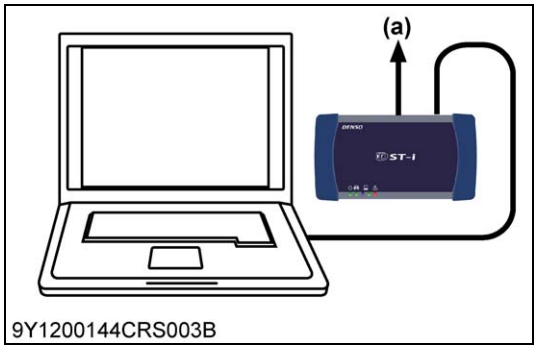
1. Turn the key switch ON and check that the fuel pump is operating.

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 Pump".

(1) Fuel Pump

RY9202138CRS0027US0



9Y1200144CRS003B

2. Check the DTC

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

Factory specification	No DTC is output.

DTC presently existing

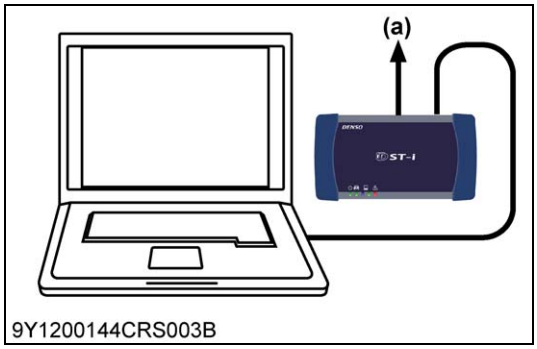
OK	Go to "3. Check the Starting Assist Device".
NG	Check in accordance with the troubleshooting procedures for each DTC.

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

RY9202138CRS0090US0



9Y1200144CRS003B

3. Check the Starting Assist Device

1. Refer to the workshop manual for the machine and check the glow plug, 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 (glow plug).

(a) CAN1 Connector

RY9202223CRS0055US0


9Y1200199CRS005A

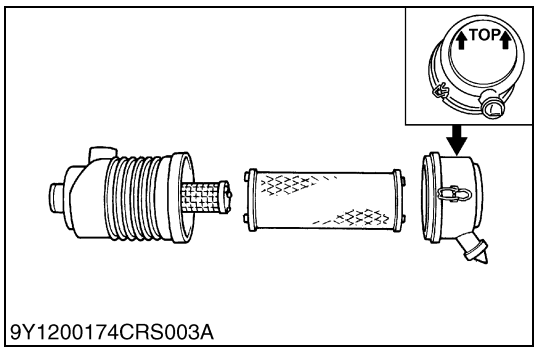
4. Check the Idle Condition

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.

RY9202223CRS0056US0



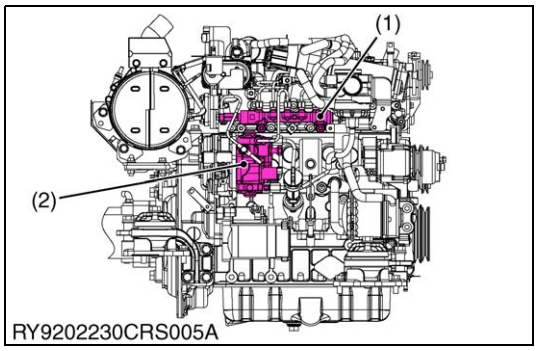
9Y1200174CRS003A

5. Check the Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

OK	Go to "6. Check the Fuel System".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

RY9202138CRS0093US0



RY9202230CRS005A

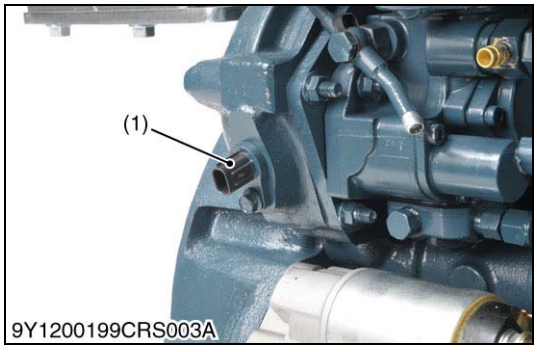
6. Check the Fuel System

1. Check in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "7. Check the Crankshaft Position Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

(1) Rail (2) Supply Pump

RY9202230CRS0023US0



9Y1200199CRS003A

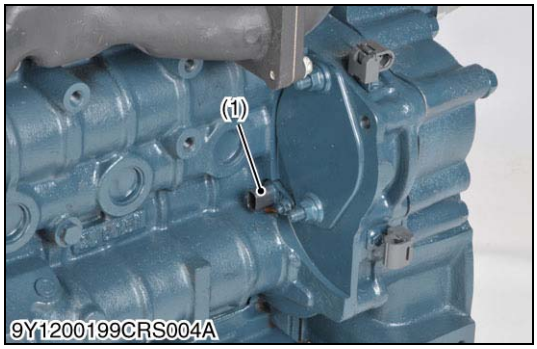
7. Check the Crankshaft Position Sensor

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)

RY9202223CRS0203US0



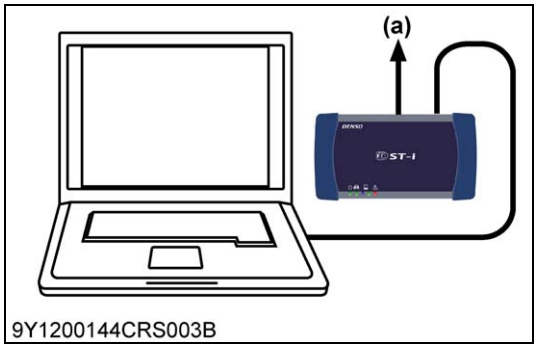
8. Check the Camshaft Position Sensor

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)

RY9202223CRS0059US0



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.

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.

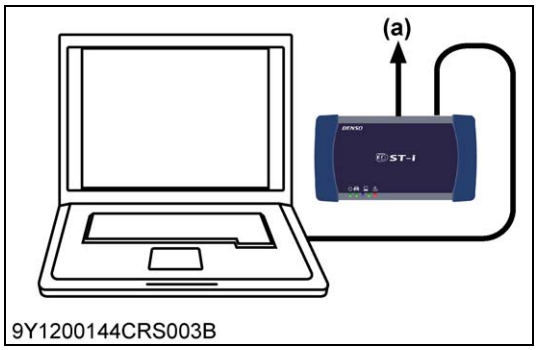
Factory specification	Refer to "1.[5].(2) Normal Value". In addition, for the check procedures refer to "5.[2] DIAGNOSTIC PROCEDURE BY DTC".

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

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

(a) CAN1 Connector

RY9202230CRS0068US0



10. Check the Data Related to Pressure Control

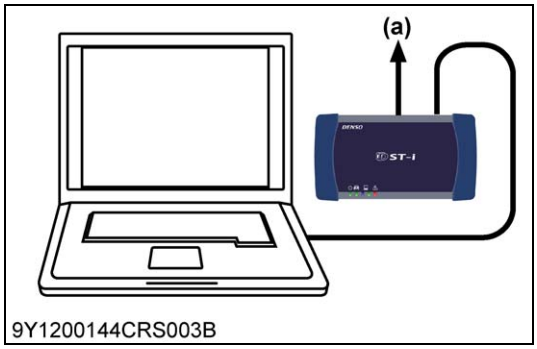
1. Measure the "Target rail pressure" and "Actual rail pressure" when accelerator is operated as indicated below using the diagnosis tool data monitor function.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure". 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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) and SCV abnormality items (P0628 and P0629) 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

RY9202230CRS0024US0



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

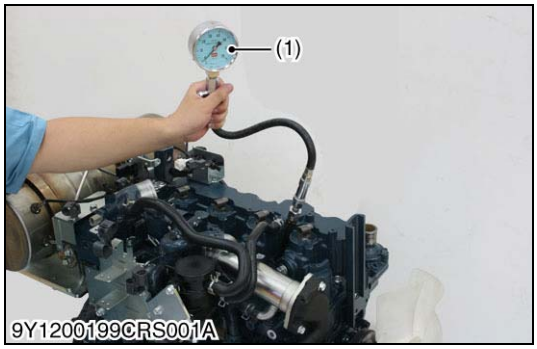
1. Perform the diagnosis tool active test (stopping the injector injection by cylinder) and check the injector performance.

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

RY9202138CRS0065US0



12. 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	Check and repair faulty parts including the high pressure line of the defective cylinder.

(1) Compression Tester

RY9202230CRS0025US0

5. DIAGNOSTIC PROCEDURE BY DTC

[1] 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.

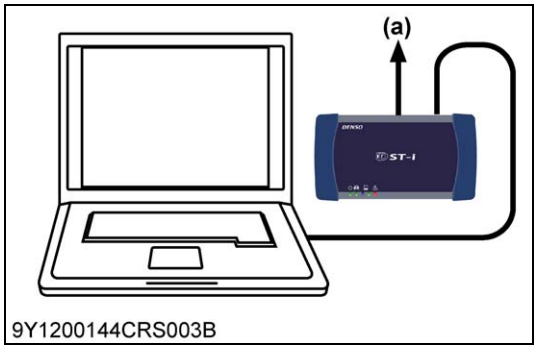
SPN	FMI	DTC	Name	Reference Page
636	7	P0016	NE-G phase shift	1-S59
190	0	P0219	Engine overrun	1-S60
636	8	P0335	Crankshaft position sensor (NE sensor) abnormality	1-S61
636	2	P0336		
723	8	P0340	Camshaft position sensor (G sensor) abnormality	1-S64
723	2	P0341		
157	4	P0192	Rail pressure sensor abnormality	1-S67
157	3	P0193		
1347	4	P0628	SCV drive system abnormality	1-S70
1347	3	P0629		
172	4	P0112	–	–
172	3	P0113		
110	4	P0117	Water temperature sensor abnormality	1-S72
110	3	P0118		
174	4	P0182	Fuel temperature sensor abnormality	1-S74
174	3	P0183		
523535	0	P0200	Injector charge voltage: High	1-S76
651	3	P0201	Open circuit of harness/coil	1-S77
653	3	P0202		
654	3	P0203		
652	3	P0204		
523525	1	P0611	Injector charge voltage: Low	1-S79
523523	2	P2146	Common 1 system injector drive circuit open	1-S81
523523	4	P2147	Common 1 TWV actuation system short	1-S84
523523	3	P2148		
523524	2	P2149	Common 2 system injector drive circuit open	1-S87
523524	4	P2150	Common 2 TWV actuation system short	1-S90
523524	3	P2151		
102	4	P0237	–	–
102	3	P0238		
168	4	P0562	Battery voltage abnormality	1-S93
168	3	P0563		
3509	4	P0642	Sensor supply voltage 1 abnormality	1-S95
3509	3	P0643		
3510	4	P0652	Sensor supply voltage 2 abnormality	1-S96
3510	3	P0653		
1485	2	P0687	Main relay is locked in closed position	1-S97

SPN	FMI	DTC	Name	Reference Page
108	4	P2228	Barometric pressure sensor error	1-S99
108	3	P2229		
523574	3	P0403	EGR actuator abnormality	1-S100
523574	4	P0404		
523572	4	P0409		
523575	7	P2413	EGR (DC motor) abnormality	1-S101
523576	2	P2414		
523577	2	P2415		
–	–	–	–	–
110	0	P0217	Engine overheat	1-S104
–	–	–	–	–
523538	2	P0602	QR data abnormality	1-S105
523538	7			
628	2	P0605	ECU FLASH ROM and CPU abnormality	1-S106
1077	2	P0606		
523527	2			
523543	2	P2131	Accelerator position sensor error (CAN)	1-S107
523547	2	U0075	CAN2 Bus off	1-S108
523604	2	U0077	CAN1 bus off	1-S109
523548	2	U0081	CAN2 frame error	1-S110
523591	2	U0082		
523592	2	U0083		
523596	2	U0087		
171	4	P0072	Intake air temperature built-in MAF sensor abnormality	1-S111
171	3	P0073		
132	3	P0103	MAF sensor abnormality	1-S113
523580	2	P2108	Intake throttle feedback error	1-S114
523582	4	P2621	Intake throttle lift sensor abnormality	1-S115
523582	3	P2622		
3251	4	P2454	Differential pressure sensor 1 abnormality	1-S116
4765	4	P0546	Exhaust gas temperature sensor 0 (T0) abnormality	1-S119
4765	3	P0547		
3242	4	P0543	Exhaust gas temperature sensor 1 (T1) abnormality	1-S121
3242	3	P0544		
3246	4	P242C	Exhaust gas temperature sensor 2 (T2) abnormality	1-S123
3246	3	P242D		
523599	0	P3018	All exhaust gas temperature sensor failure	1-S125
3252	0	P3001	Emission deterioration	1-S126
523590	16	P3013	Active regeneration time up	1-S127
523589	17	P3012	Low water temperature in active regeneration	1-S128
523602	0	P3024	High frequency of regeneration	1-S129
633	7	P0087	Pressure limiter emergency open	1-S130

SPN	FMI	DTC	Name	Reference Page
157	0	P0088	High rail pressure	1-S134
1239	1	P0093	Fuel leak (in high pressured fuel system)	1-S137
1347	7	P0089	SCV stuck	1-S141
523539	2	P1274	Pump seizing	1-S144
523540	2	P1275		
132	1	P0101	Intake air volume: Low	1-S148
132	15	P3011	–	–
4765	0	P3002	Emergency Exhaust gas temperature sensor 0: High	1-S149
3242	0	P3003	Emergency Exhaust gas temperature sensor 1: High	1-S151
3246	0	P3004	Emergency Exhaust gas temperature sensor 2: High	1-S153
523601	0	P3023	Starter relay start warning	1-S155
3936	7	P1A28	Removal of DPF (PCD)	1-S156
3936	2	P3015	Loss of function of DPF (PCD)	1-S158
3251	3	P2455	Differential pressure sensor 1: High (PCD)	1-S116
523578	2	U0076	No communication with EGR (NCD)	1-S102
132	4	P0102	MAF sensor abnormality (NCD)	1-S113

RY9202842CRS0006US0

(1) NE - G Phase Shift (DTC P0016)



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" and "Camshaft Position Sensor (G sensor) Abnormality".	

■ **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.**

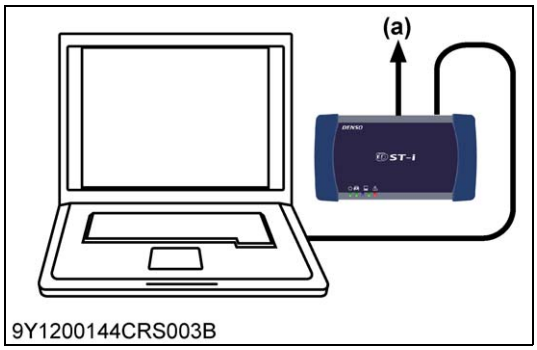
(Camshaft position sensor side)

- **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

RY9202138CRS0249US0

(2) Engine Overrun (DTC P0219)



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	Normal.
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.

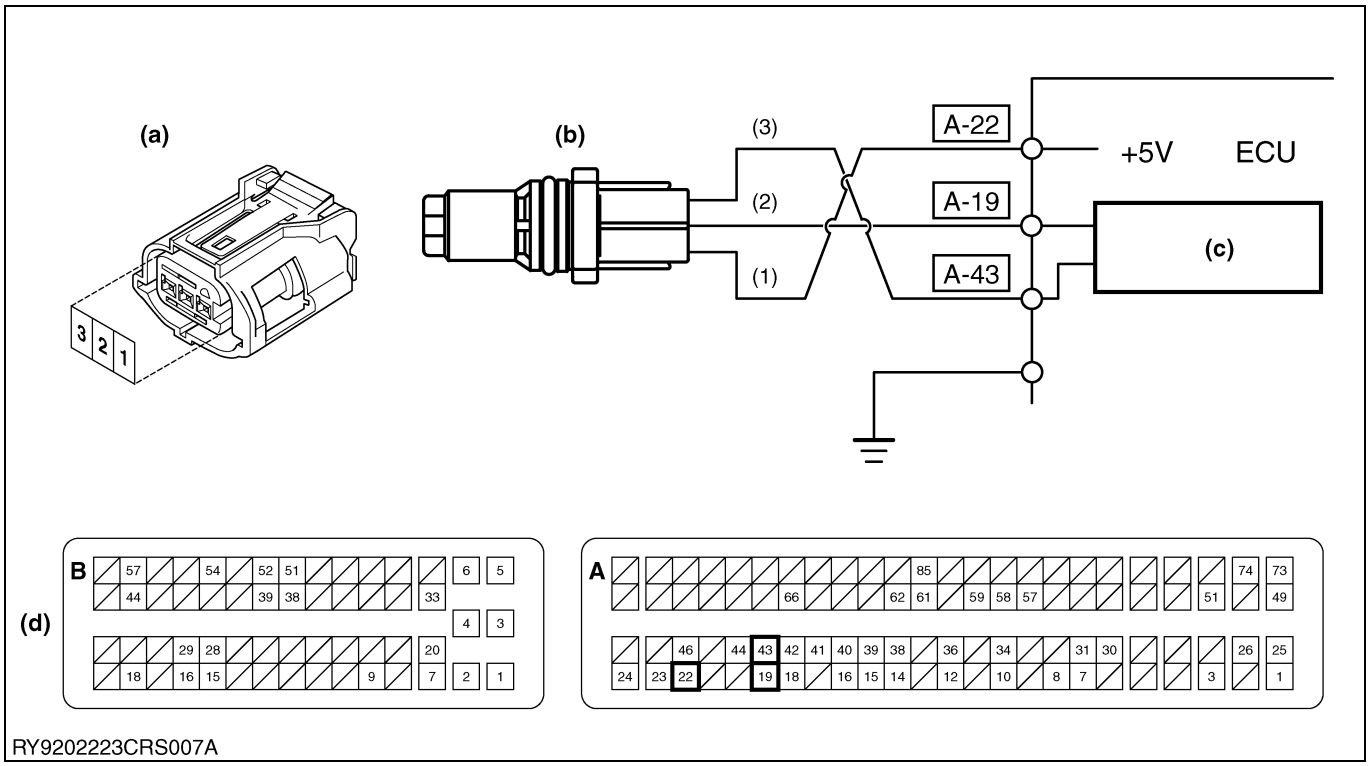
(a) CAN1 Connector

RY9202223CRS0063US0

(3) Crankshaft Position Sensor (NE Sensor) Abnormality (DTC P0335, P0336)

- Engine will stop if both NE sensor and G sensor fail

RY9202223CRS0064US0



RY9202223CRS007A

(1) Terminal A-VCC1
(2) Terminal NE–
(3) Terminal NE+

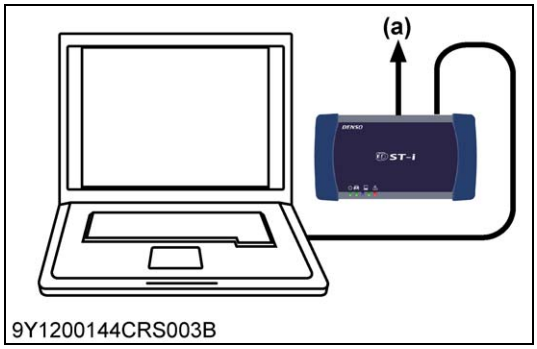
(a) Terminal Layout (Wire Harness Side)

(b) Crankshaft Position Sensor (NE Sensor)

(c) NE Sensor Input Circuit

(d) ECU Connector (Wire Harness Side)

RY9202223CRS0065US0



9Y1200144CRS003B

1. Check the Crankshaft Position Sensor Signals

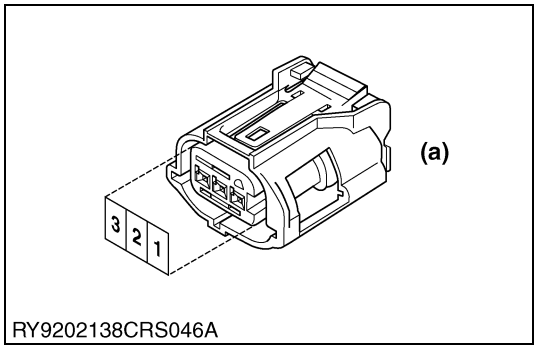
1. Rotate the engine, and check the "Engine speed active flag" value on the diagnosis tool data monitor.

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

RY9202138CRS0331US0



RY9202138CRS046A

2. Check the Voltage Between Crankshaft Position Sensor Terminals

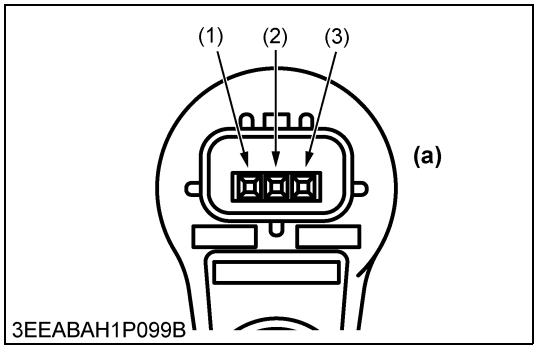
1. Place the key switch in the OFF position, and unplug the crankshaft position sensor connector from the socket.
2. Place the key switch in the ON position, and measure the voltage between A-VCC1 terminal and NE– terminal at the wiring harness side.

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 (Wire Harness Side)

RY9202138CRS0332US0



3EEABAH1P099B

3. Check the Connectors

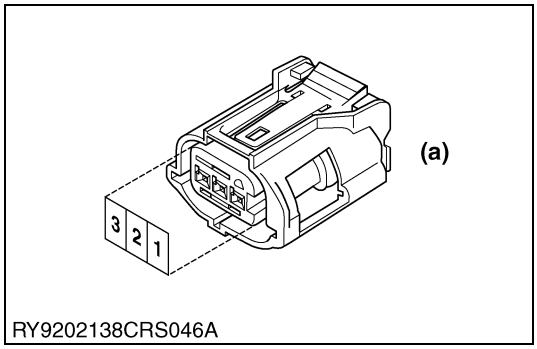
1. Check the sensor and wiring harness connectors for incorrect connection, inappropriate fitting, poor contact or other faulty areas.

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 (Sensor Side)

RY9202138CRS0333US0



RY9202138CRS046A

4. Check the Wiring Harness

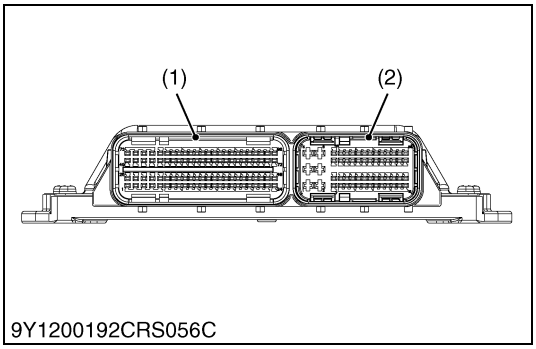
1. Check the wiring harness between NE+ terminal of sensor and ECU for a short or an open circuit.

Factory specification	Must be free from shorts and open circuit.

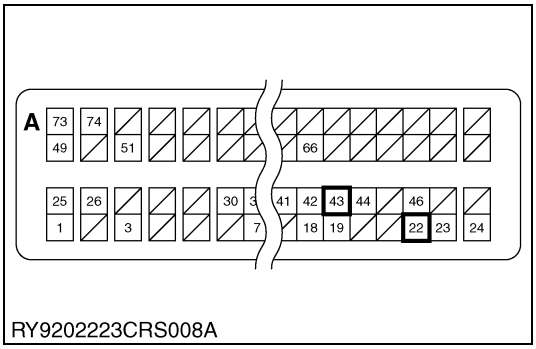
OK	The sensor has abnormality. → Replace.
NG	Repair.

(1) Terminal A-VCC1
(2) Terminal NE–
(3) Terminal NE+
(a) Terminal Layout (Wire Harness Side)

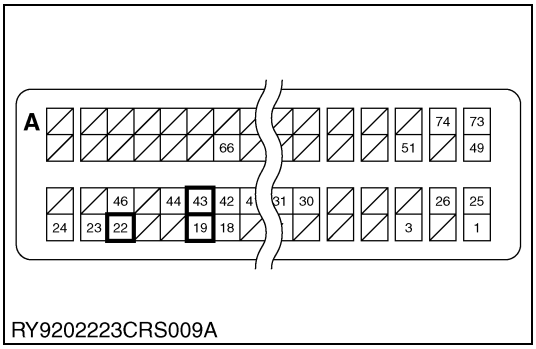
RY9202138CRS0334US0



9Y1200192CRS056C



RY9202223CRS008A



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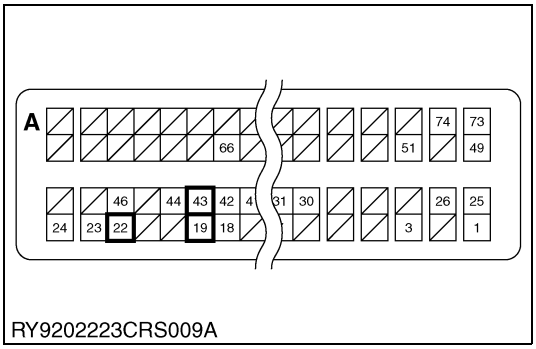

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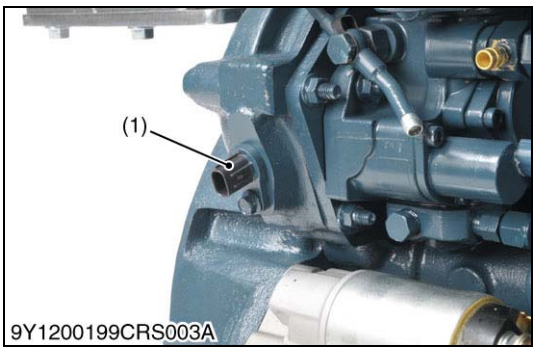


9Y1200199CRS003A

5. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector (96 pin) (1) from the socket.
2. Place the key switch in the ON position, and measure the voltage between ECU terminals A-22 and A-43.

Factory specification	Approx. 5 V

OK	Go to "6. Check the connectors".
NG	Replace the ECU.

(1) ECU Connector (96 Pin) (2) ECU Connector (58 Pin)

RY9202223CRS0066US0

6. Check the Connectors

1. Check ECU terminals A-22, A-19 and A-43 (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.

RY9202223CRS0067US0

7. Check the Wiring Harness

1. Check the wiring harness being connected to ECU terminals A-22, A-19 and A-43 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.

RY9202223CRS0068US0

8. Check the 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.

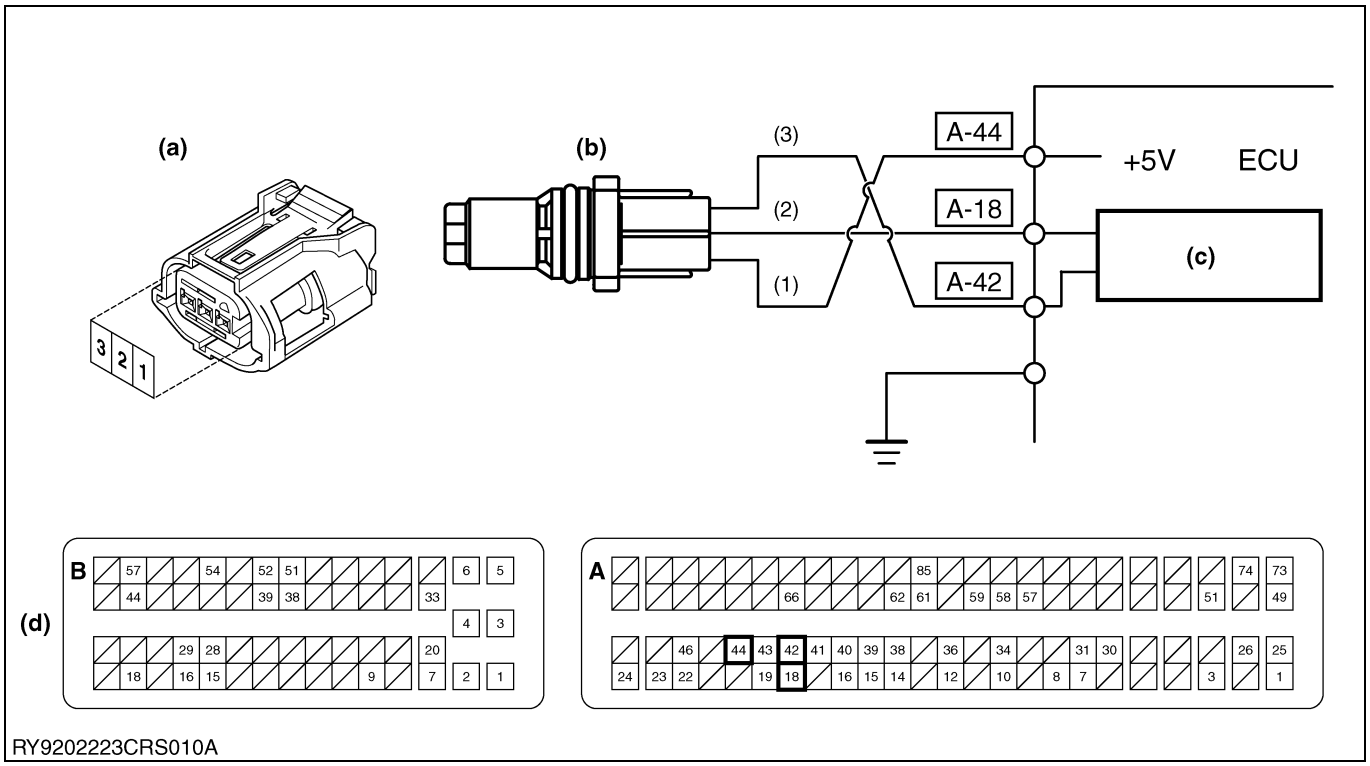
(1) Crankshaft Position Sensor (NE Sensor)

RY9202223CRS0069US0

(4) Camshaft Position Sensor (G Sensor) Abnormality (DTC P0340, P0341)

- Engine will stop if both NE sensor and G sensor fail

RY9202223CRS0064US0



RY9202223CRS010A

(1) Terminal G-VCC
(2) Terminal G-GND
(3) Terminal G+

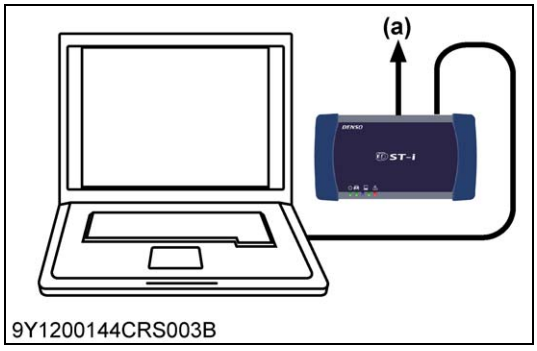
(a) Terminal Layout (Wire Harness Side)

(b) Camshaft Position Sensor (G Sensor)

(c) G Sensor Input Circuit

(d) ECU Connector (Wire Harness Side)

RY9202223CRS0070US0



9Y1200144CRS003B

1. Check the Camshaft Position Sensor Signals

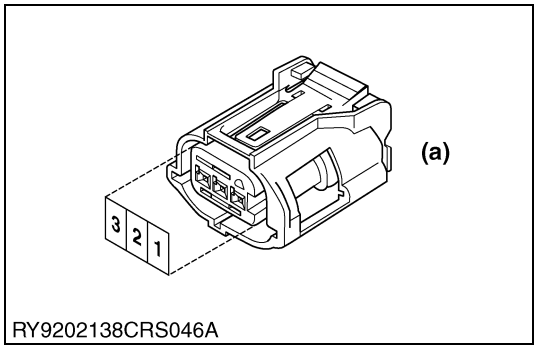
1. Rotate the engine, and check the "Cam speed active flag" value on the diagnosis tool data monitor.

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

RY9202138CRS0340US0



RY9202138CRS046A

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.

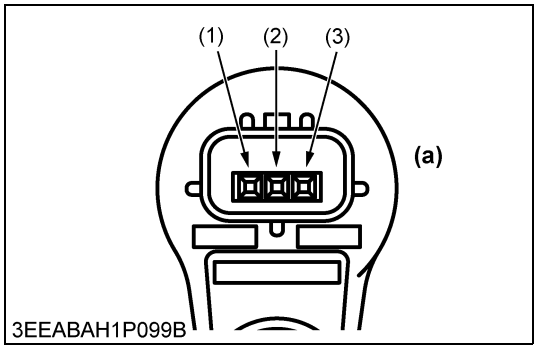
Factory specification	Approx. 5 V

OK	Go to "3. Check the Connectors".
NG	Go to "5. Measure the ECU Terminal Voltage".

(1) Terminal G-VCC
(2) Terminal G-GND
(3) Terminal G+

(a) Terminal Layout (Wire Harness Side)

RY9202138CRS0341US0



3EEABAH1P099B

3. Check the Connectors

1. Check the sensor and wiring harness connectors for incorrect connection, inappropriate fitting, poor contact or other faulty areas.

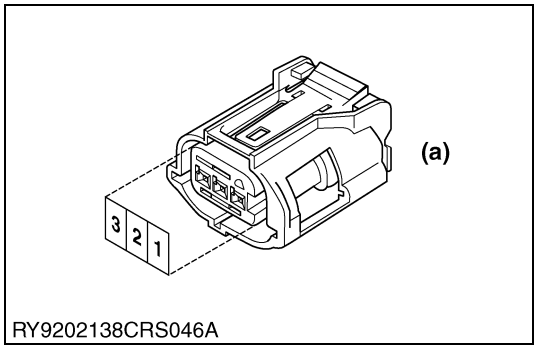
Factory specification	Must be free from incorrect connection, inappropriate fitting, poor contact.

OK	Go to "4. Check the Wiring Harness".
NG	Repair or replace.

(1) Terminal G-VCC
(2) Terminal G-GND
(3) Terminal G+

(a) Terminal Layout (Sensor Side)

RY9202138CRS0342US0



RY9202138CRS046A

4. Check the Wiring Harness

1. Check the wiring harness between G+ terminal of sensor and ECU for a short or an open circuit.

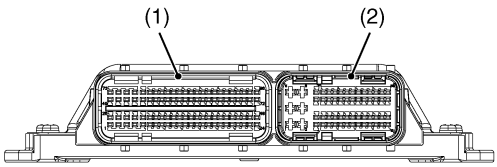
Factory specification	Must be free from shorts and open circuit.

OK	The sensor has abnormality. → Replace.
NG	Repair.

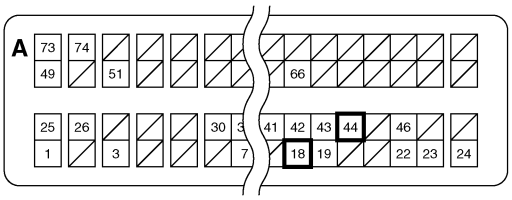
(1) Terminal G-VCC
(2) Terminal G-GND
(3) Terminal G+

(a) Terminal Layout (Wire Harness Side)

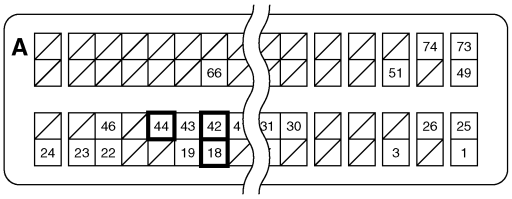
RY9202138CRS0343US0



9Y1200192CRS056C



RY9202223CRS008B



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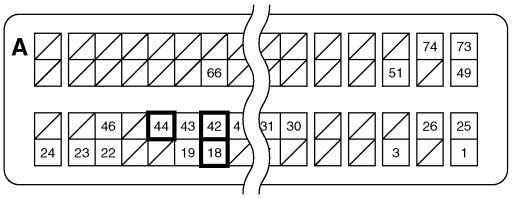

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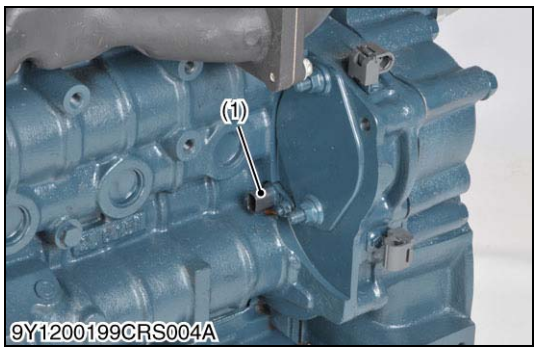


9Y1200199CRS004A

5. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector (96 pin) (1) from the socket.
2. Place the key switch in the ON position, and measure the voltage between ECU terminals A-44 and A-18.

Factory specification	Approx. 5 V

OK	Go to "6. Check the Connectors".
NG	Replace the ECU.

(1) ECU Connector (96 Pin) (2) ECU Connector (58 Pin)

RY9202223CRS0071US0

6. Check the Connectors

1. Check ECU terminals A-44, A-42 and, A-18 (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.

RY9202223CRS0072US0

7. Check the Wiring Harness

1. Check the wiring harness being connected to ECU terminals A-44, A-42 and A-18 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.

RY9202223CRS0073US0

8. Check the Sensor

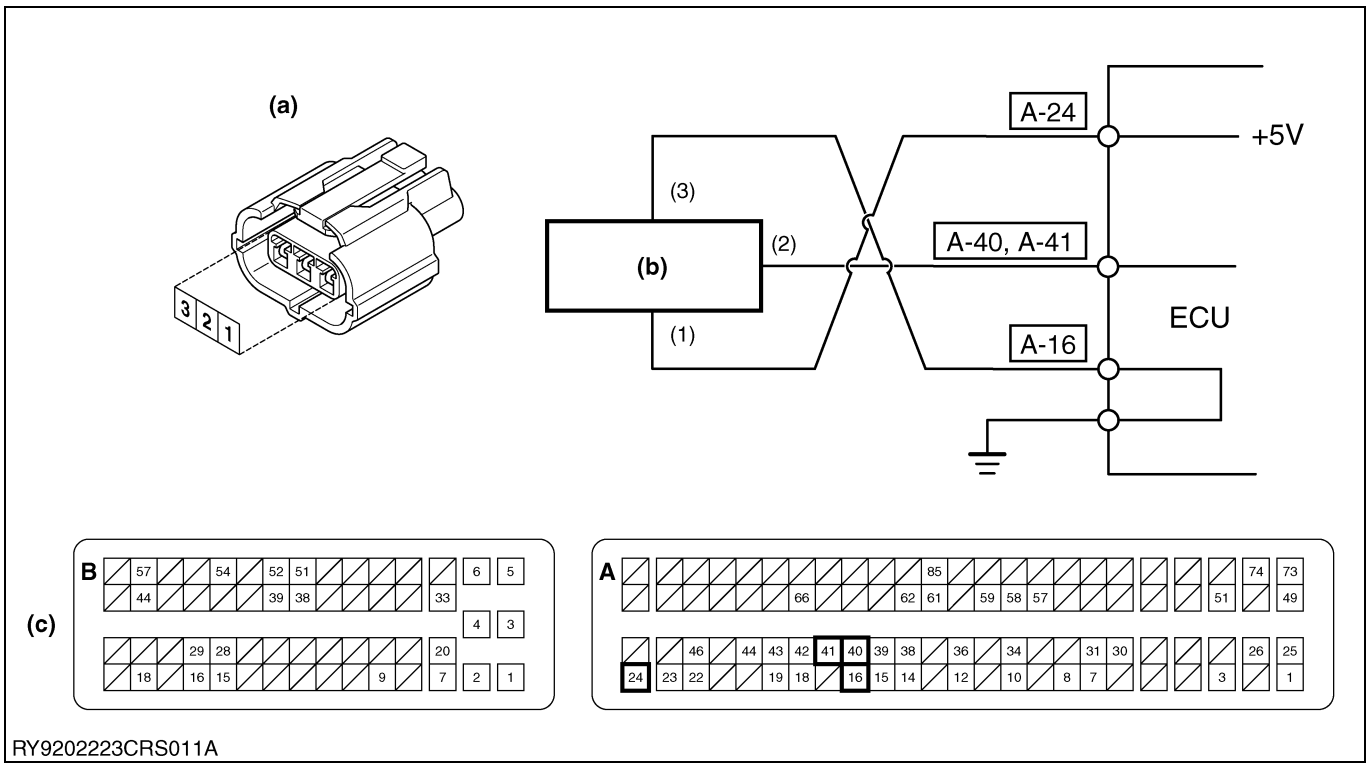
1. Disconnect the sensor and check the following items.
   - Is there a large amount of magnetic foreign material adhering to the sensor surface?
   - Are there interference marks of the pulsar and the sensor?
   - Are there any pulsar gear abnormalities?

OK	Replace the ECU and test.
NG	Repair or replace the sensor.

(1) Camshaft Position Sensor (G Sensor)

RY9202223CRS0074US0

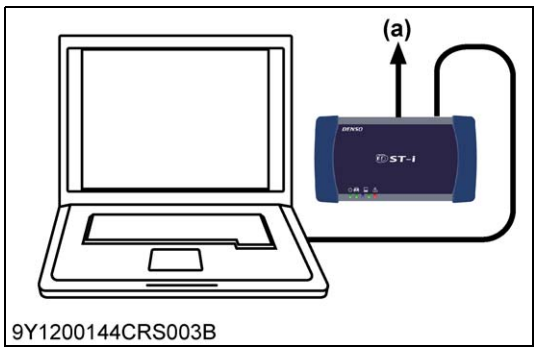
(5) Rail Pressure Sensor Abnormality (DTC P0192, P0193)



RY9202223CRS011A

(1) Terminal A-VCC1
(2) Terminal PFUEL
(3) Terminal PFUEL RTN
(a) Terminal Layout (Wire Harness Side)
(b) Rail Pressure Sensor
(c) ECU Connector (Wire Harness Side)

RY9202223CRS0075US0



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 amount of the accelerator dial to increase/decrease RPM 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: 1.80 to 1.96 V 3. During no-load maximum speed: 2.20 to 2.44 V

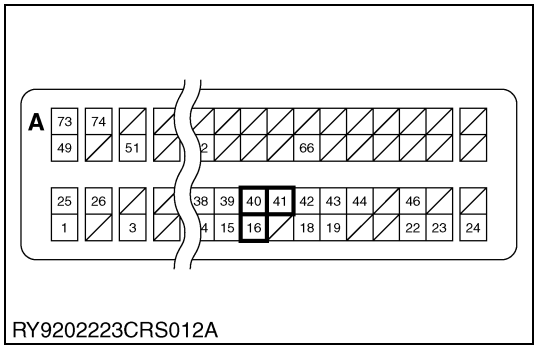
■ **NOTE**

- **When idling: Approx. 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi)**
  During no-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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

RY9202230CRS0027US0



RY9202223CRS012A

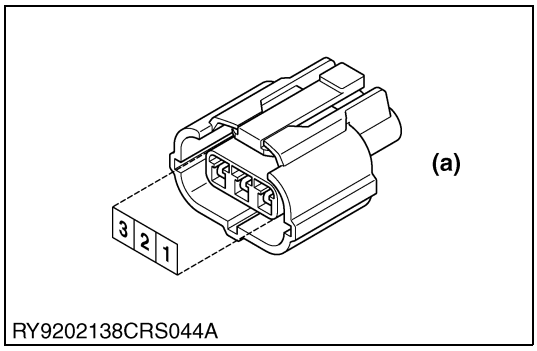
2. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals A-16 and A-40 and between terminals A-16 and A-41.
2. Next, start the engine, change the amount of the accelerator dial to increase/decrease RPM 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: 1.80 to 1.96 V 3. During no-load maximum speed: 2.20 to 2.44 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".	

RY9202230CRS0028US0



RY9202138CRS044A

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 amount of the accelerator dial to increase/decrease RPM and check the same items again.

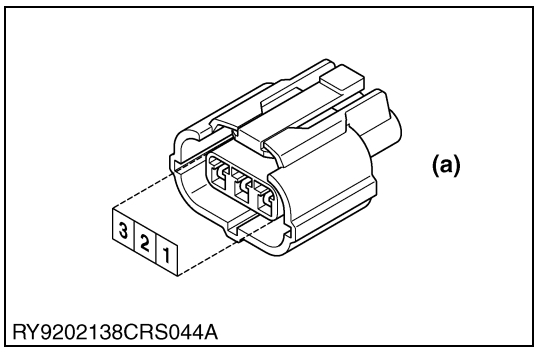
Factory specification	Depends on the rotation speed, load (After warm-up) 1. When stopped: Approx. 1.0 V 2. When idling: 1.80 to 1.96 V 3. During no-load maximum speed: 2.20 to 2.44 V

OK	Check the wiring harness (between ECU terminals A-40 / A-41 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 (Wire Harness Side)

RY9202230CRS0029US0



RY9202138CRS044A

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).

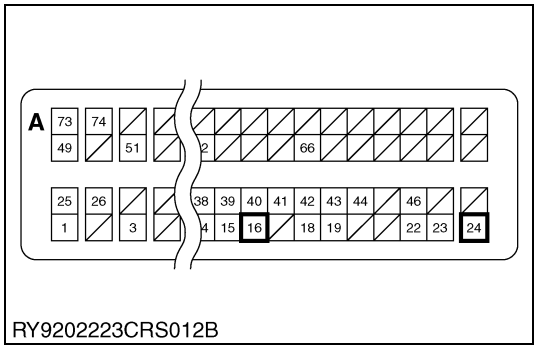
Factory specification	Approx. 5 V

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 (Wire Harness Side)

RY9202138CRS0310US0



RY9202223CRS012B

5. Measure the ECU Terminal Voltage

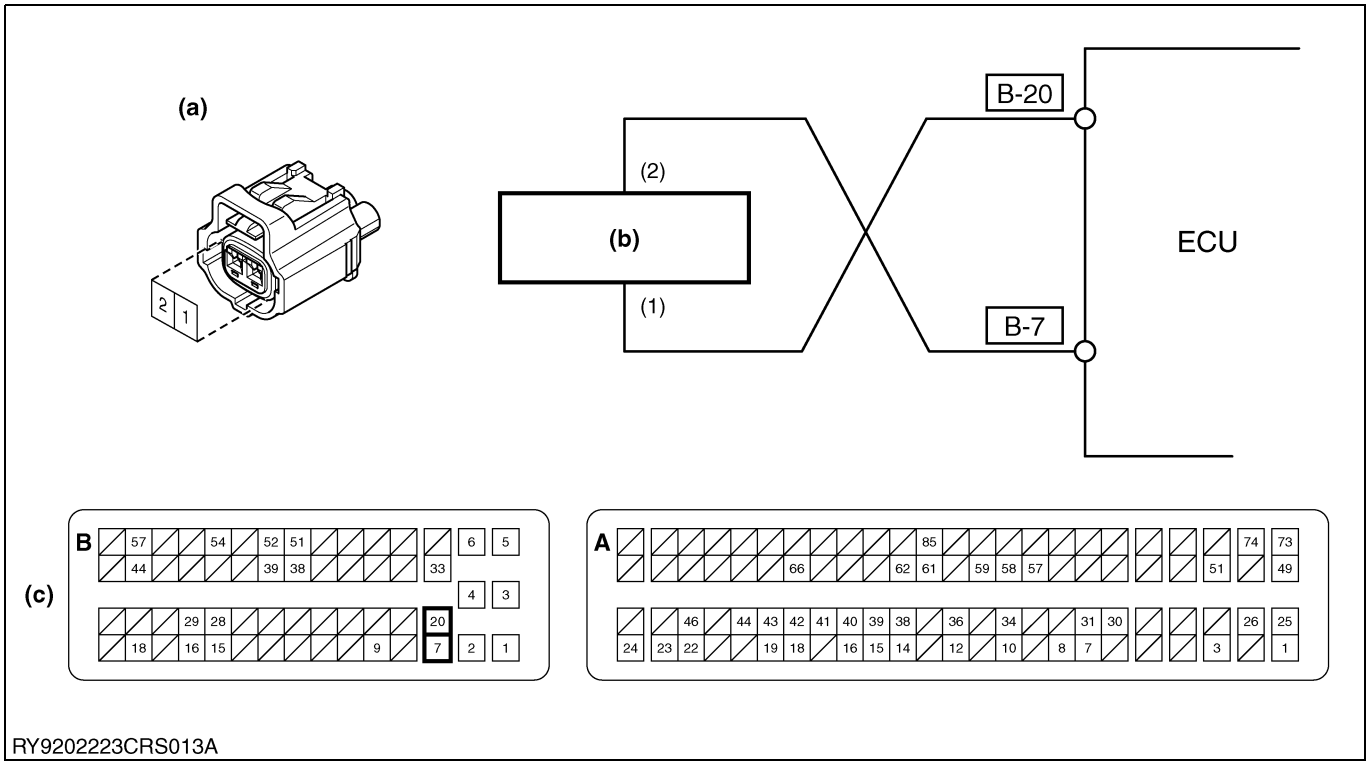
1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals A-16 and A-24.

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 A-24 and sensor terminal (1) and between ECU terminal A-16 and sensor terminal (3)). → Repair the faulty area.	

RY9202223CRS0079US0

(6) SCV Drive System Abnormality (DTC P0628, P0629)



RY9202223CRS013A

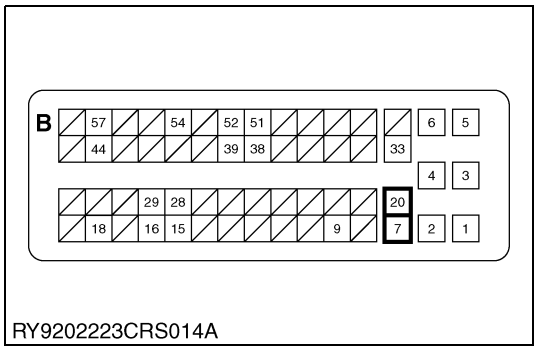
(1) Terminal SCV–
(2) Terminal SCV+

(a) Terminal Layout (Wire Harness Side)

(b) SCV (Suction Control Valve)

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0080US0



RY9202223CRS014A

1. 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 B-7 and B-20 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".

RY9202223CRS0081US0

2. Check the SCV

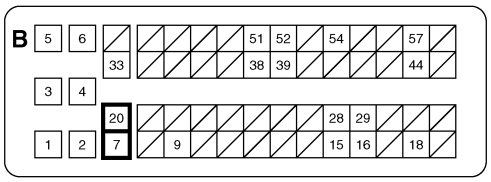
1. Turn the key switch OFF, remove the connector from the SCV side and measure the resistance between the terminals on the SCV side.

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)

RY9202223CRS0082US0



RY9202223CRS005B

3. Measure the ECU Terminal Voltage

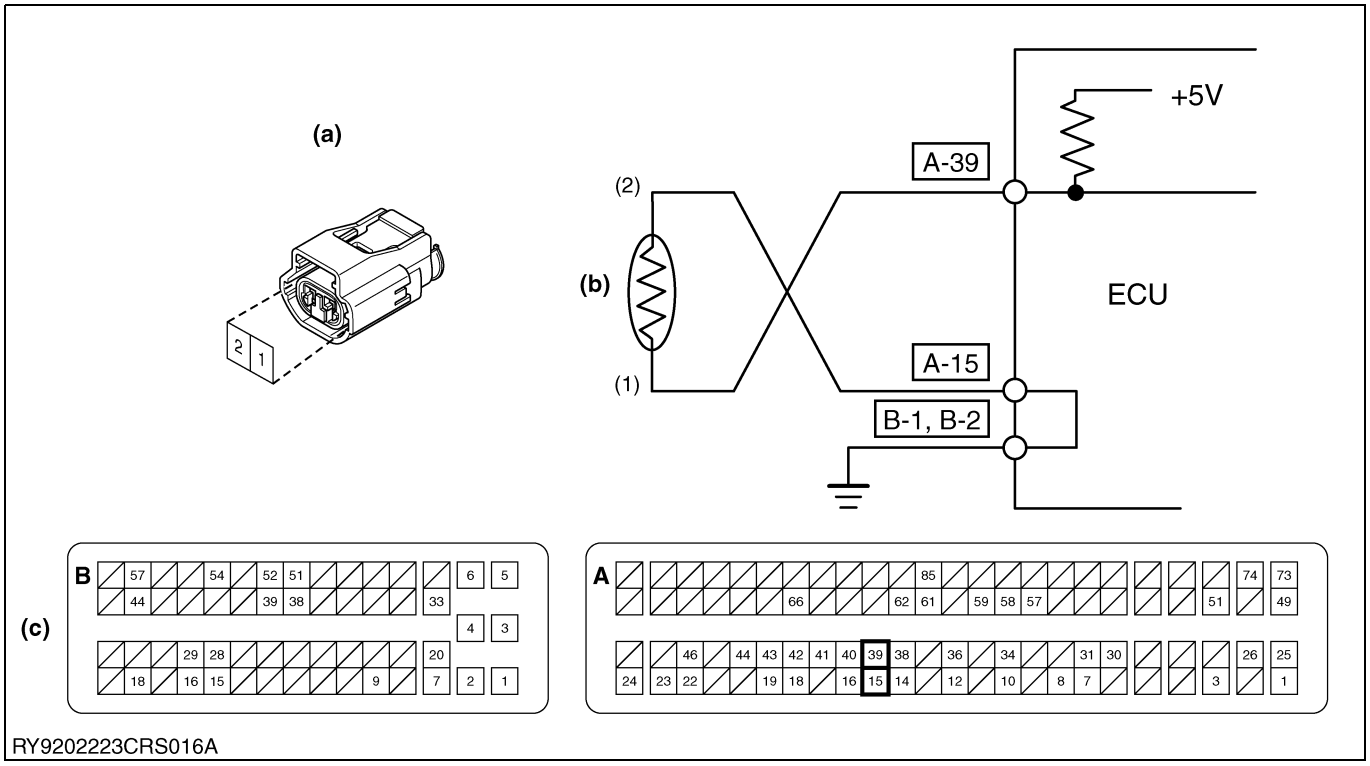
1. Unplug the ECU wiring harness connector 1 from socket, and measure the voltage between ECU terminals B-20 and B-7 and the ground (at the wiring harness side).

Factory specification	Both must be approx. 0 V.

OK	Normal.
NG	Repair the wiring harness.

RY9202223CRS0083US0

(7) Coolant Temperature Sensor Abnormality (DTC P0117, P0118)



RY9202223CRS016A

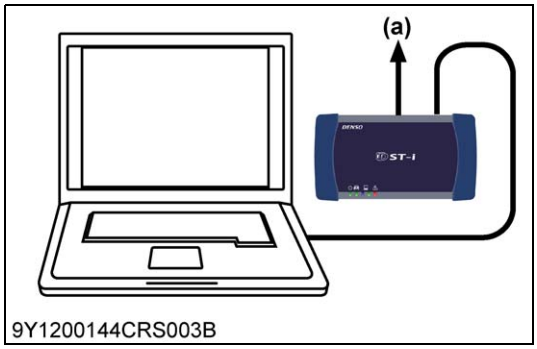
(1) Terminal THW
(2) Terminal THW RTN

(a) Terminal Layout (Wire Harness Side)

(b) Coolant Temperature Sensor

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0088US0



9Y1200144CRS003B

1. Check the Coolant Temperature Sensor Signals

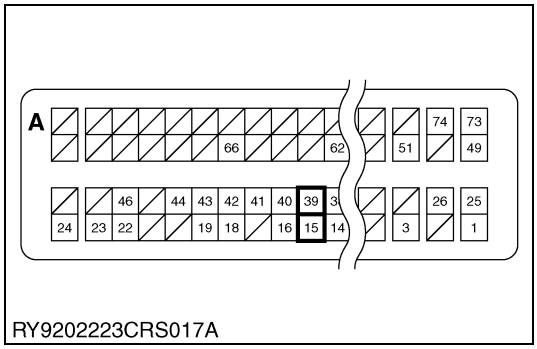
1. Place the key switch in the ON position, and check the "Coolant temperature" and "Coolant temperature sensor output voltage" on the diagnosis tool data monitor.

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

RY9202138CRS0297US0



RY9202223CRS017A

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 A-15 and A-39 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".

RY9202223CRS0089US0

9Y1200199CRS007A

3. Check the Sensor

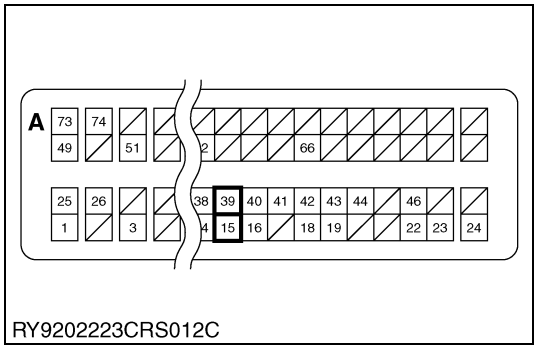
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.5 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

RY9202223CRS0090US0



RY9202223CRS012C

4. Measure the ECU Terminal Voltage

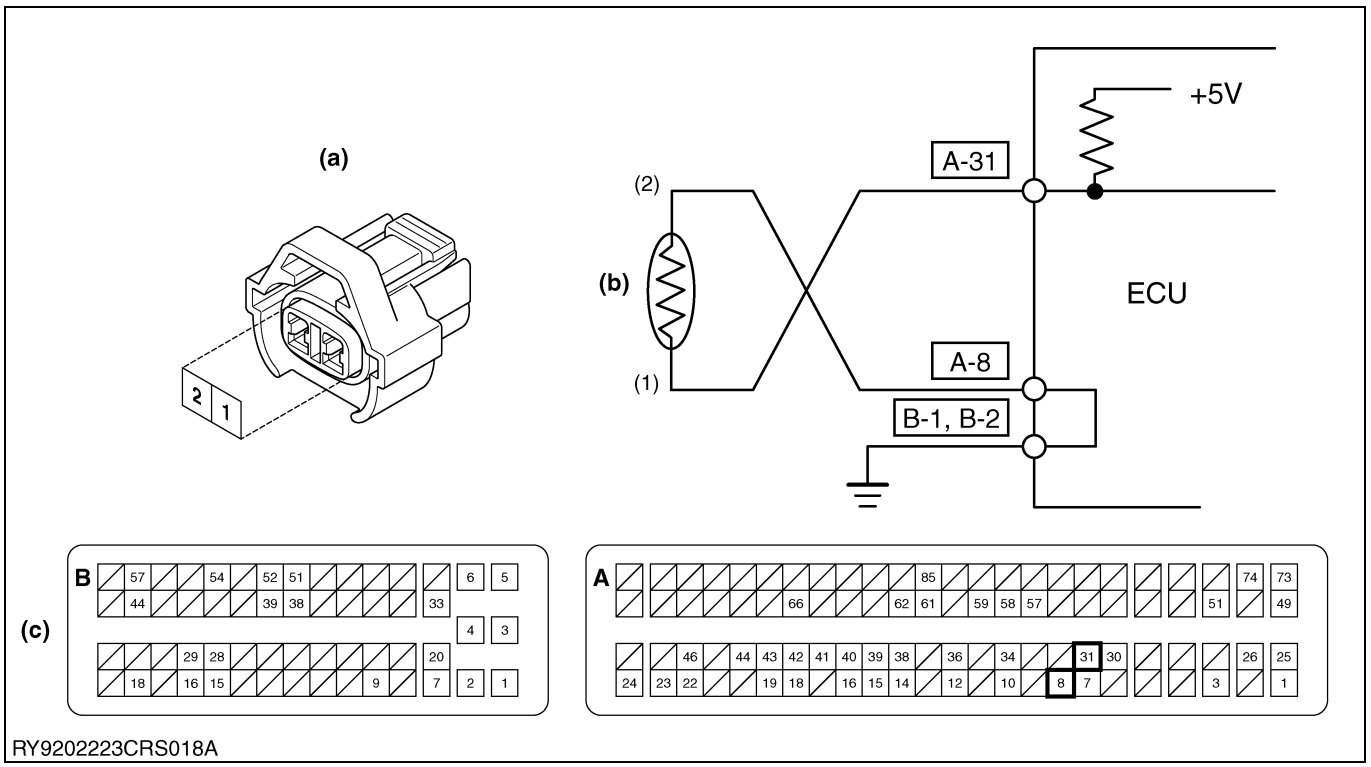
1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals A-15 and A-39 at the ECU side.

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.

RY9202223CRS0091US0

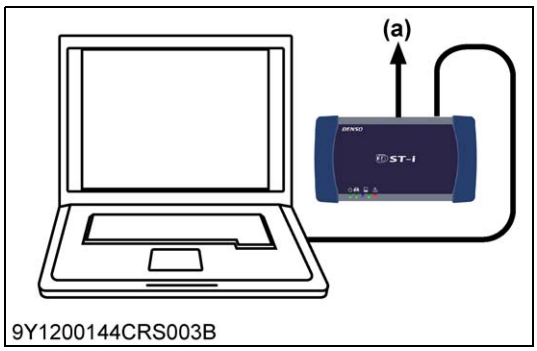
(8) Fuel Temperature Sensor Abnormality (DTC P0182, P0183)



RY9202223CRS018A

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

RY9202223CRS0092US0



9Y1200144CRS003B

1. Check the Fuel Temperature Sensor Signals

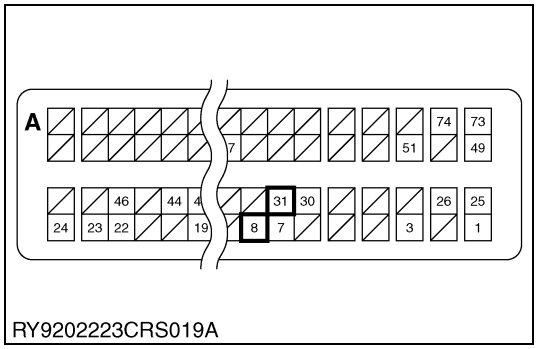
1. Place the key switch in the ON position, and check the "Fuel temperature" and "Fuel temperature sensor output voltage" on the diagnosis tool data monitor.

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

RY9202138CRS0302US0



RY9202223CRS019A

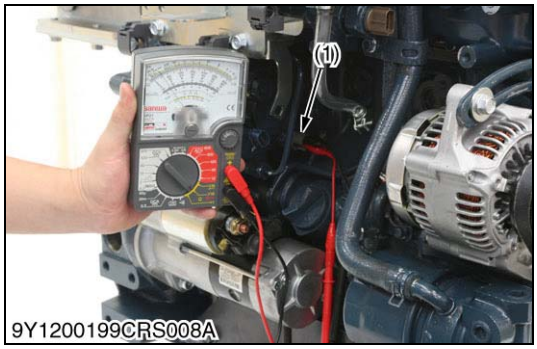
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals A-8 and A-31 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".

RY9202223CRS0093US0



9Y1200199CRS008A

3. Check the Sensor

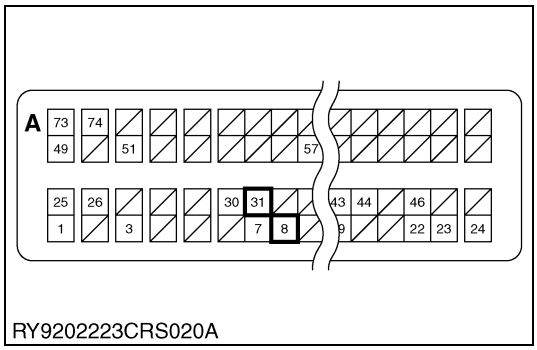
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

Factory specification	
Temperature	Resistance
20 °C (68 °F)	Approx. 2.5 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

RY9202223CRS0094US0



RY9202223CRS020A

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 A-8 and A-31 at the ECU side.

Factory specification	Approx. 5 V

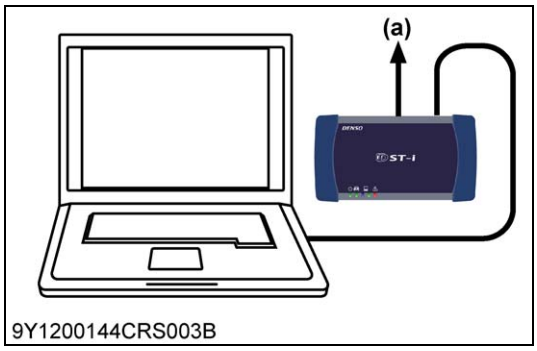
OK	The ECU connector is faulty or its wiring harness is shorted.
NG	Confirm by using other sensors that there is no ground short malfunction before replacing the ECU.

RY9202223CRS0095US0

(9) Injector Charge Voltage: High (DTC P0200)

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

RY9202223CRS0096US0



1. Checking Whether the DTC is Detected Again

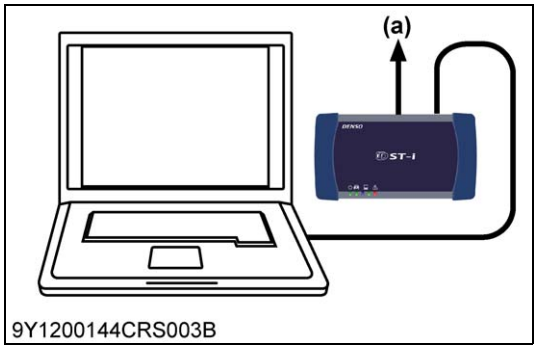
1. Turn the key switch OFF and then ON again.
2. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
3. Check whether or not the same DTC (P0200) is detected.

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

RY9202138CRS0312US0



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

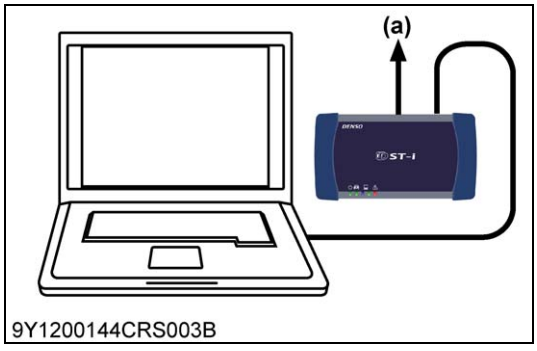
1. Replace the injector.
2. Turn the key switch OFF and then ON again.
3. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
4. Check whether or not the same DTC (P0200) is detected.

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

RY9202138CRS0313US0



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.

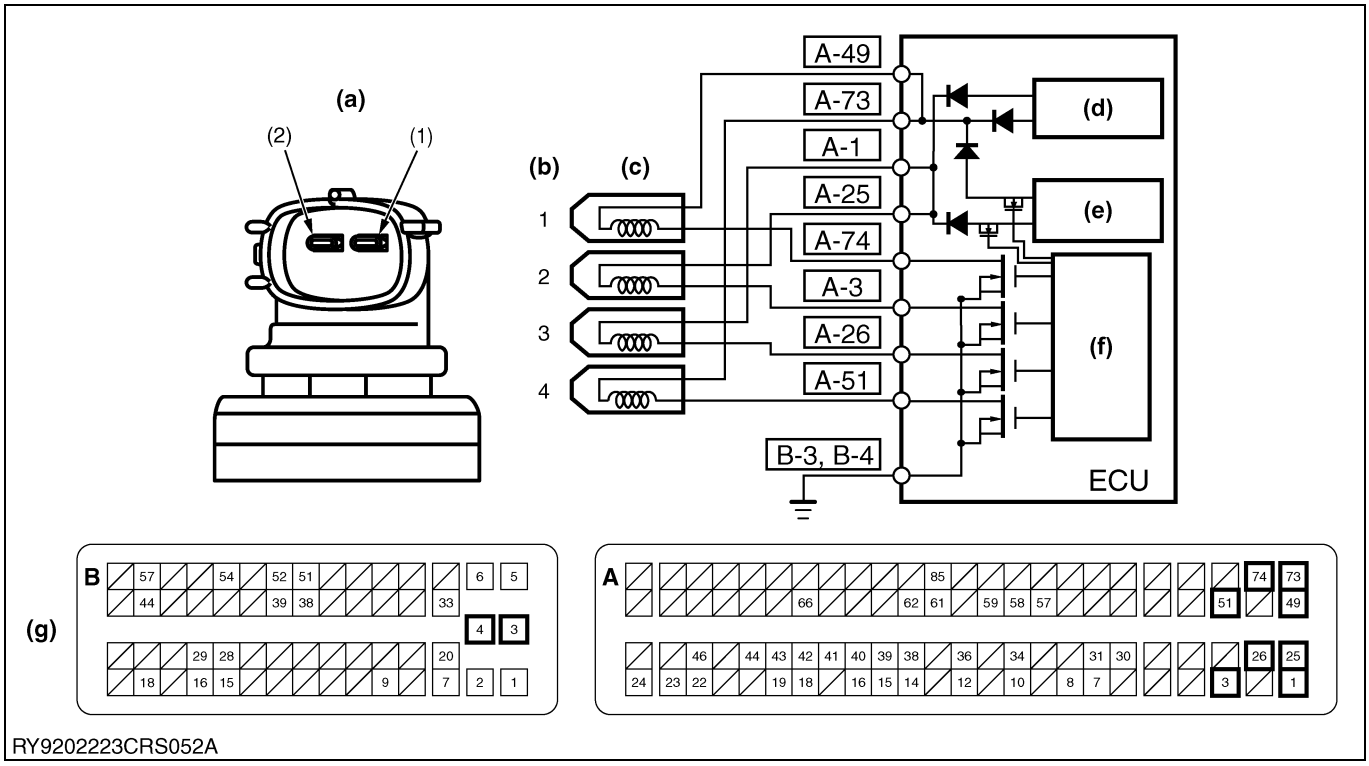
(a) CAN1 Connector

RY9202138CRS0314US0

(10) Open Circuit of Harness/Coil (DTC P0201, P0202, P0203, P0204)

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

RY9202223CRS0097US0

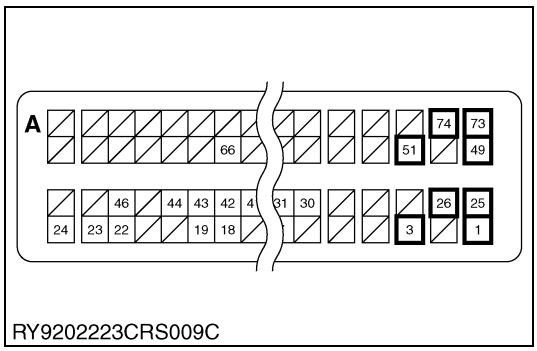


RY9202223CRS052A

(1) Terminal COMMON
(2) Terminal TWV

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

RY9202223CRS0098US0



RY9202223CRS009C

1. Measure the Resistance Between ECU Terminals

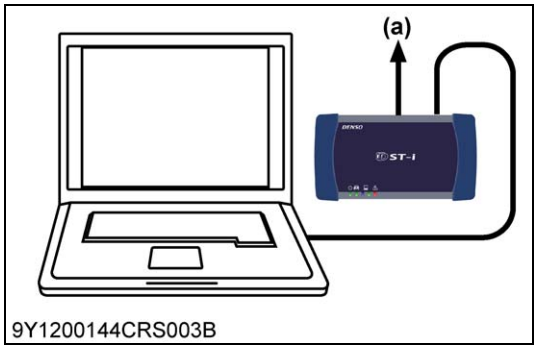
1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance each terminal of the connector.

Engine cylinder / TWV number	Measurement terminal
No. 1 cylinder / TWV1	A-49 ←→ A-74
No. 3 cylinder / TWV2	A-1 ←→ A-26
No. 4 cylinder / TWV3	A-73 ←→ A-51
No. 2 cylinder / TWV4	A-25 ←→ A-3

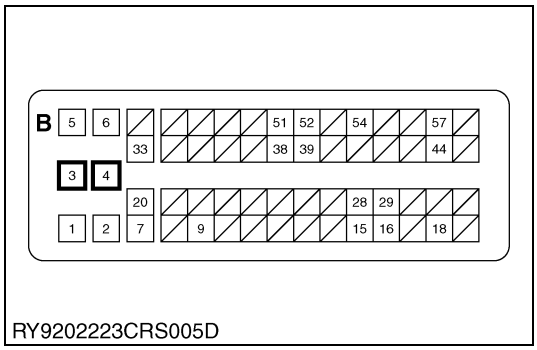
Factory specification	1.5 Ω or lower

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

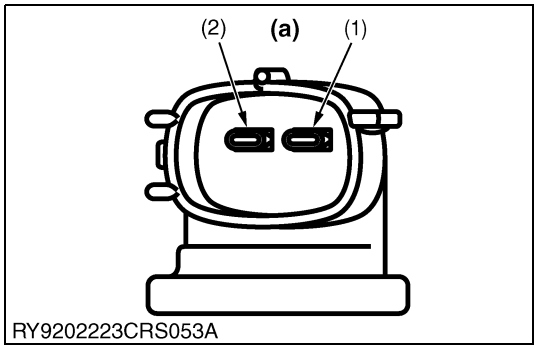
RY9202223CRS0099US0



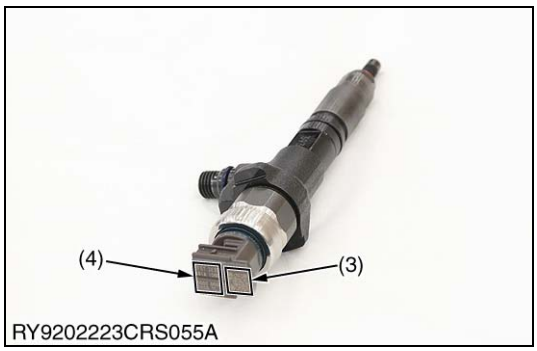
9Y1200144CRS003B



RY9202223CRS005D



RY9202223CRS053A



RY9202223CRS055A

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

RY9202138CRS0317US0

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.

OK	Check the wiring harness and connector of P- GND terminal (ECU terminals B-3 and B-4). → Repair.
NG	Check the injector wiring harnesses and connectors. → Repair.

RY9202223CRS0100US0

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.)

(1) Terminal COMMON
(2) Terminal TWV
(3) QR Code
(4) ID Code

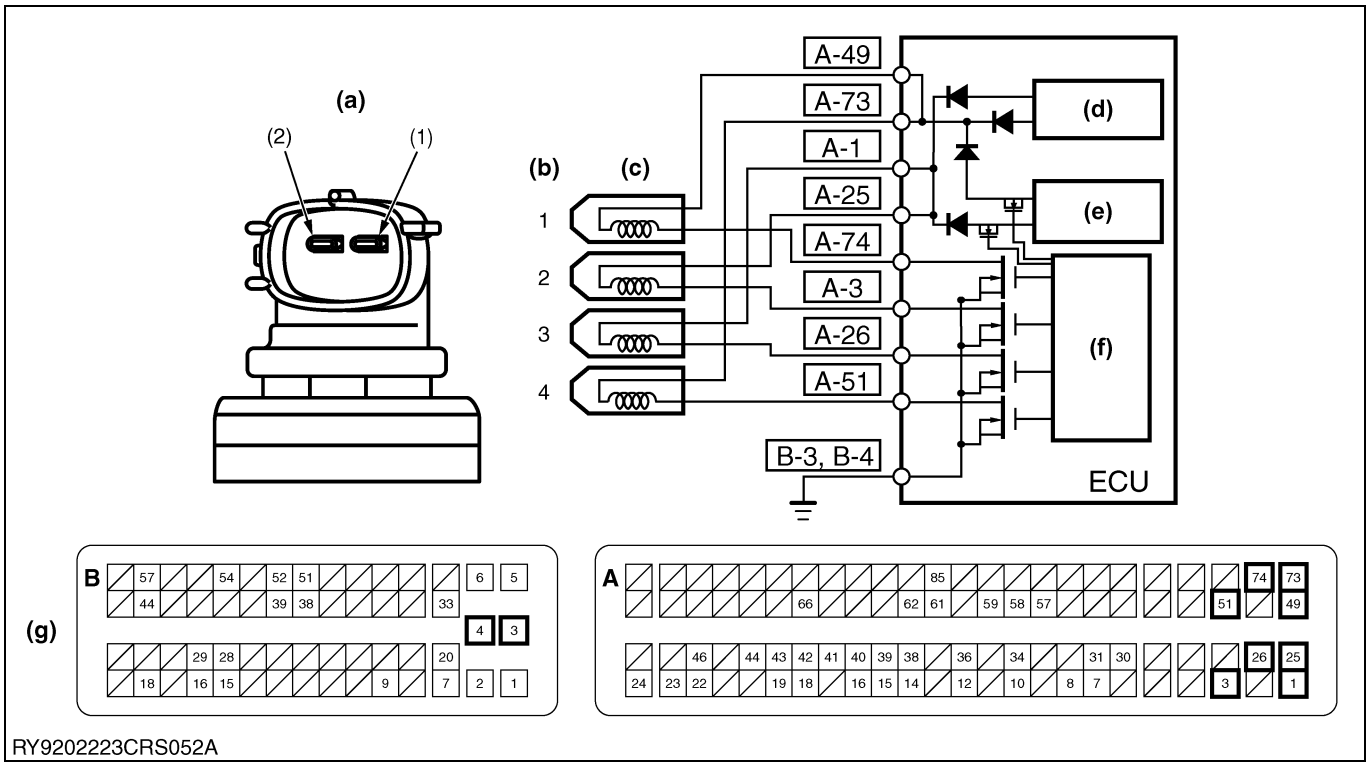
(a) Injector

RY9202223CRS0208US0

(11) Injector Charge Voltage Abnormality (DTC P0611)

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

RY9202223CRS0101US0

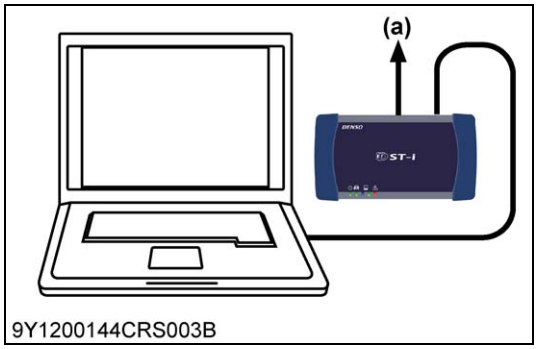


RY9202223CRS052A

(1) Terminal COMMON
(2) Terminal TWV

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

RY9202223CRS0098US0



9Y1200144CRS003B

1. Checking Whether the DTC Is Detected Again

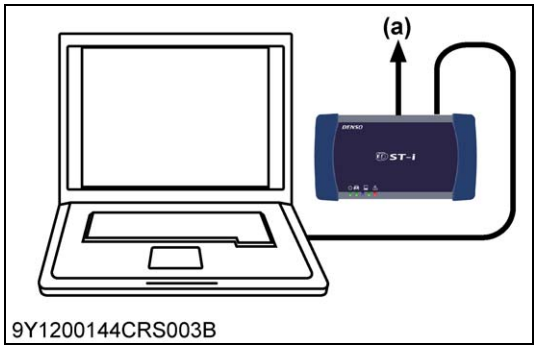
1. Turn the key switch OFF and then ON again.
2. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
3. Check whether or not the same DTC (P0611) is detected.

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

RY9202138CRS0367US0



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

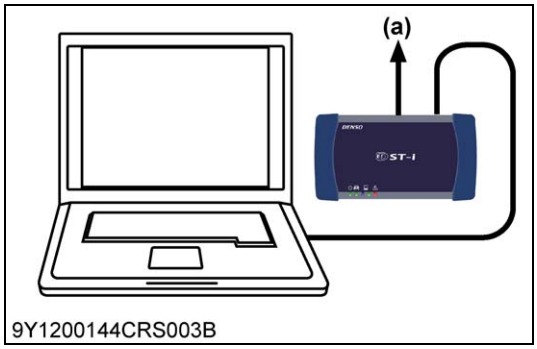
1. Replace the injector.
2. Turn the key switch OFF and then ON again.
3. After clearing the DTC, turn the key switch OFF and then ON again, and start the engine.
4. Check whether or not the same DTC (P0611) is detected.

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

RY9202138CRS0368US0



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.

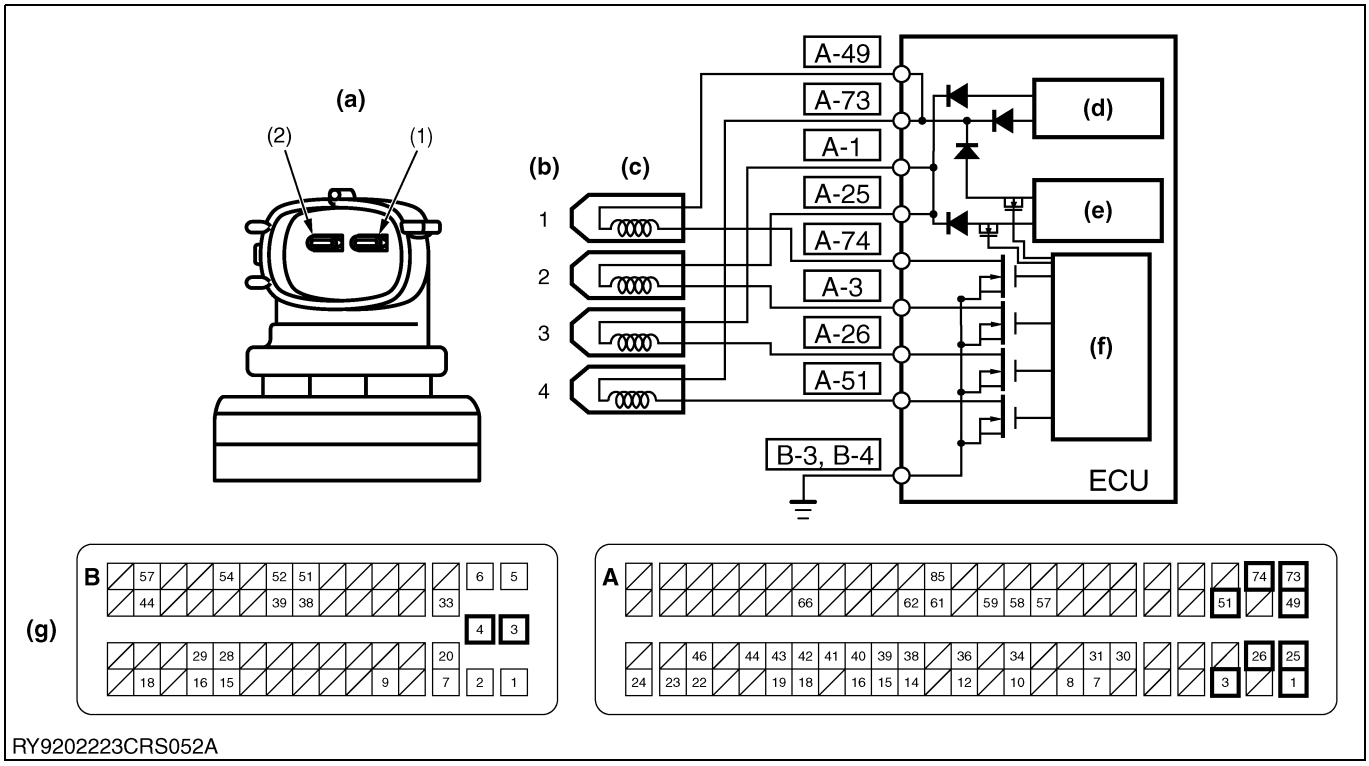
Factory specification	DTC is not detected.

OK	ECU fault → Replace the ECU.

(a) CAN1 Connector

RY9202138CRS0369US0

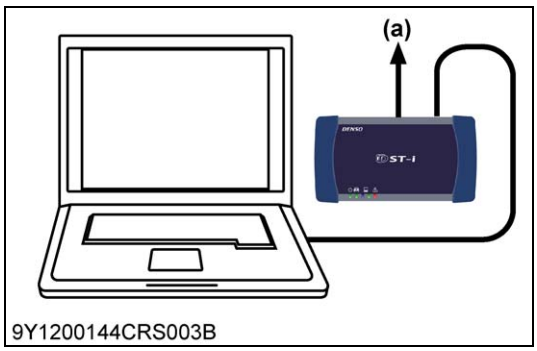
(12) Common 1 System Injector Drive Circuit Open (DTC P2146)



(1) Terminal COMMON
(2) Terminal TWV

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

RY9202223CRS0098US0



1. DTC Judgment

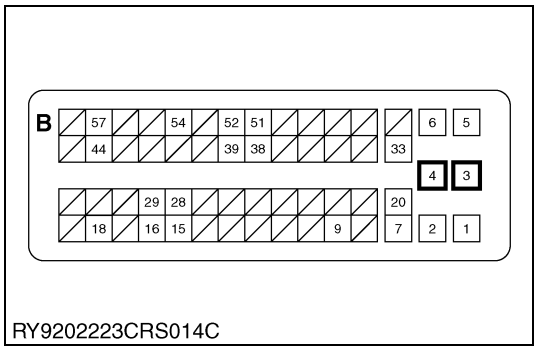
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position, check whether the DTC (P2146, P2149) is output or not.

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

RY9202138CRS0400US0



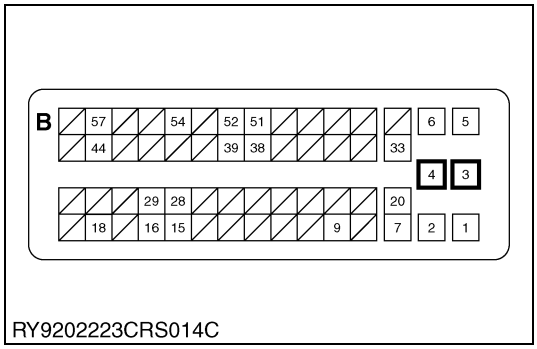
2. Check the "P- GND" Wiring Harness

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 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.

RY9202223CRS0102US0



RY9202223CRS014C

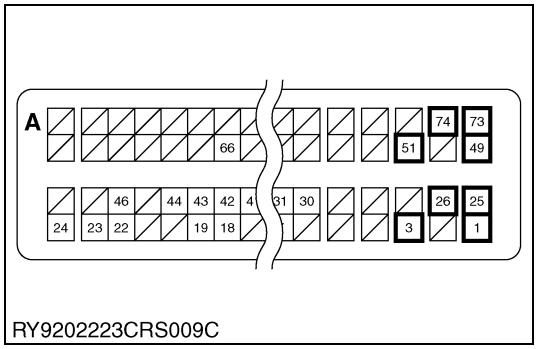
3. Check the "P- GND" Wiring Harness Connector and ECU Pins

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.

RY9202223CRS0103US0



RY9202223CRS009C

4. Measure the Resistance Between ECU Terminals

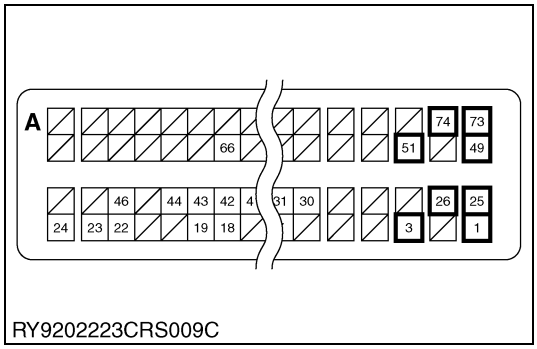
1. Place the key switch in the OFF position, unplug the ECU wiring harness connector, and measure the resistance between each terminal at the connector side as shown on the following table.

DTC	ECU Terminals Measured	
P2146	A-49 / A-73	No. 1 cylinder A-74
		No. 4 cylinder A-51
P2149	A-1 / A-25	No. 3 cylinder A-26
		No. 2 cylinder A-3

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".

RY9202223CRS0104US0

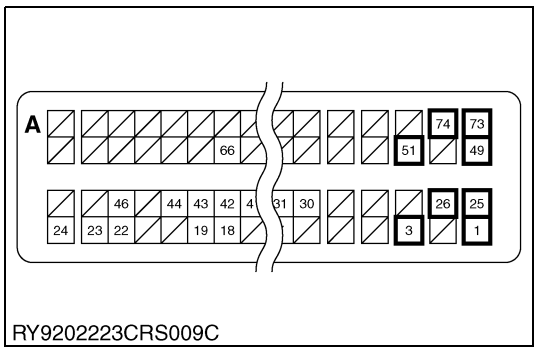


RY9202223CRS009C

5. Check the Wiring Harness → Repair or Replace the Faulty Area

Check the wiring harness between ECU terminals A-1, A-25 and each injector terminal (A-3, A-26, A-51 or A-74), and locate the open harness,

RY9202223CRS0105US0



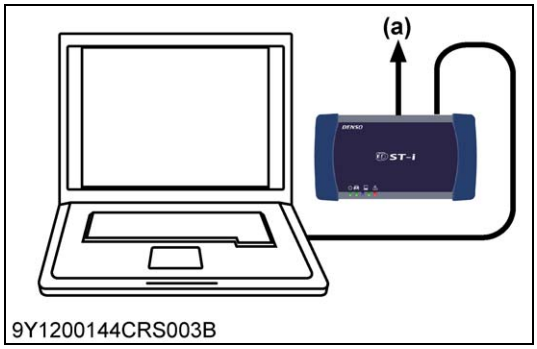
RY9202223CRS009C

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.

RY9202223CRS0106US0



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.

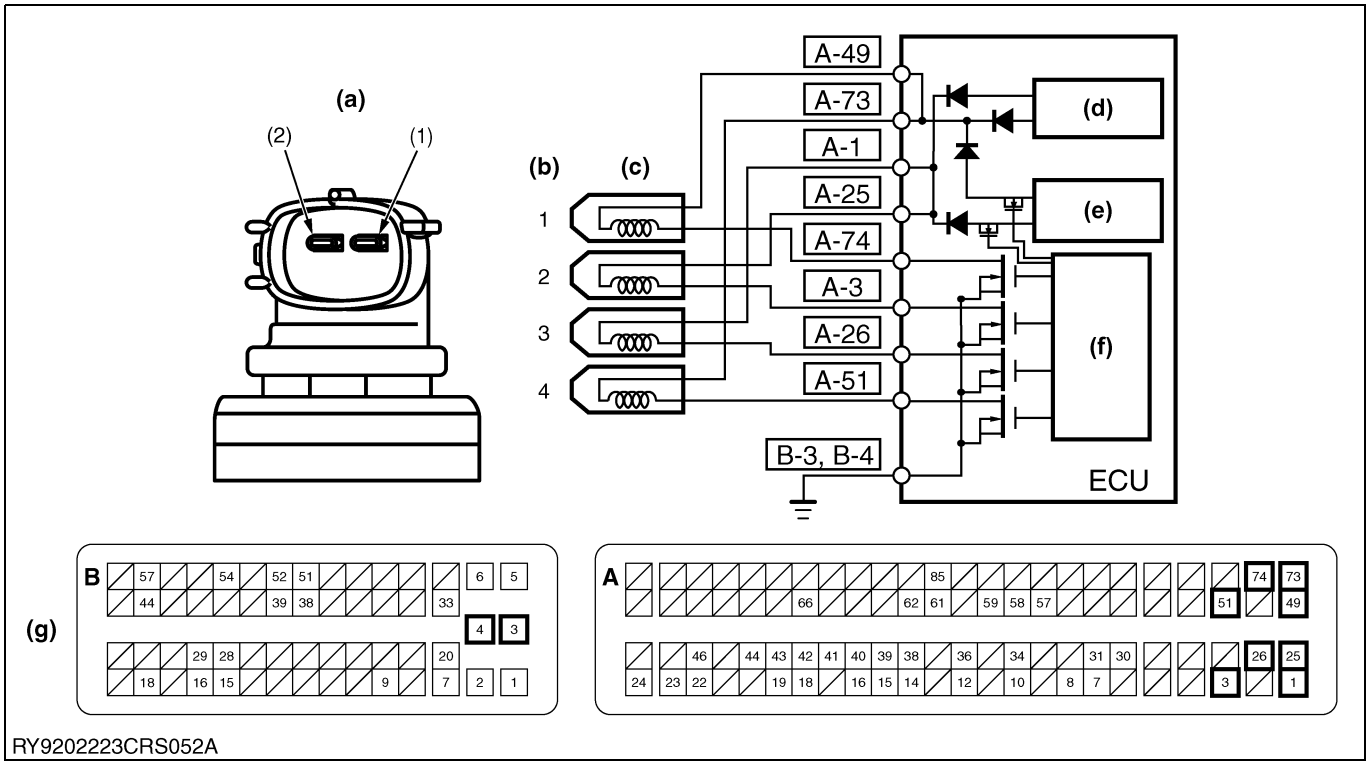
Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

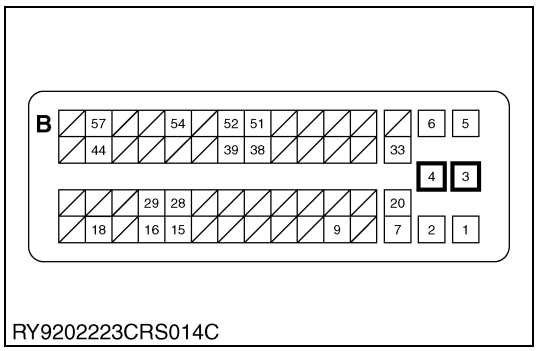
RY9202138CRS0406US0

(13) Common 1 TWV Actuation System Short (DTC P2147, P2148)



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

RY9202223CRS0098US0



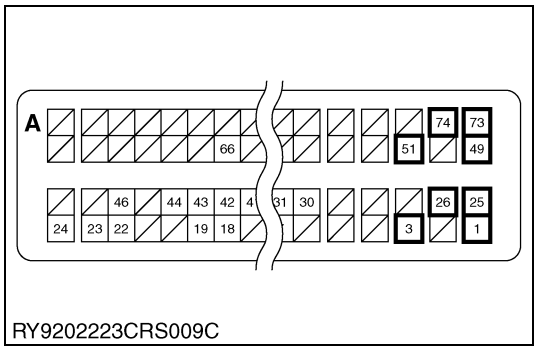
1. Check the "P- GND" Wiring Harness

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector (58 pin) from the socket, and measure the resistance between each of ECU terminals B-3 or B-4 and the 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.

RY9202223CRS0107US0



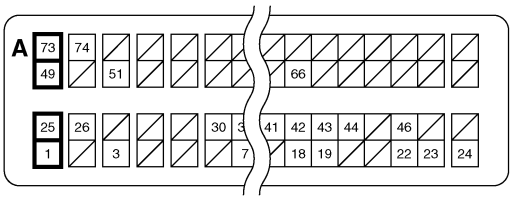
2. Check the Wiring Harness Connectors and ECU Pins

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector (96 pin) from the socket, and check the ECU pins for faulty connection, deformation, poor contact or other defects.

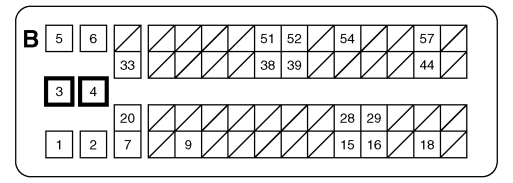
Factory specification	Must be free from faulty connection, deformation, poor contact or other defects.

OK	Go to "3. Measure the ECU Terminal Voltage (Part 1)".
NG	Repair wiring harness connectors and ECU pins, or replace them if defective.

RY9202223CRS0108US0



RY9202223CRS008C



RY9202223CRS005D

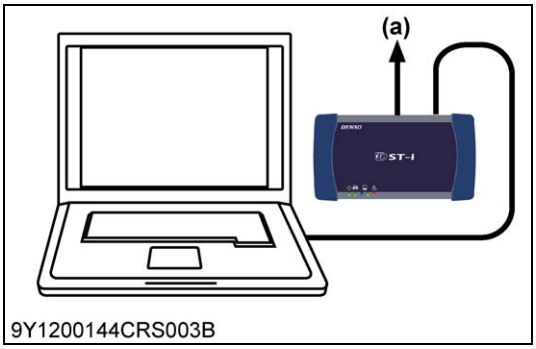
3. Measure the ECU Terminal Voltage (Part 1)

1. Place the key switch in the ON position, and measure the voltage between ECU terminal A-49 / A-73 or A-1 / A-25 and "P-GND" terminal (B-3, B-4).

Factory specification	Approx. 6 V

OK	Go to "4. Check the DTC".
NG	Go to "5. Measure the ECU Terminal Voltage (Part 2)".

RY9202223CRS0109US0



9Y1200144CRS003B

4. Check the DTC

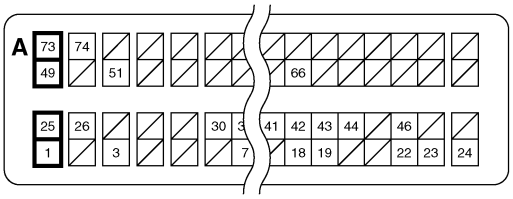
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Start the engine, and clear the past DTCs.
3. Read the DTC again.

Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

RY9202138CRS0411US0



RY9202223CRS008C

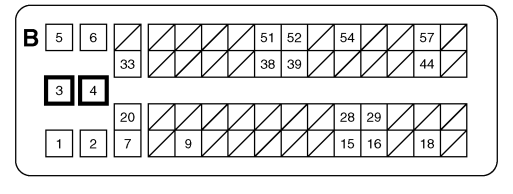
5. Measure the ECU Terminal Voltage (Part 2)

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector (96 pin) from the socket, return the key switch to the ON position again, and measure the voltage between each of ECU terminal pins A-49 / A-73 and A-1 / A-25 and the "P -GND" terminal (B-3, B-4) (at the wiring harness side).

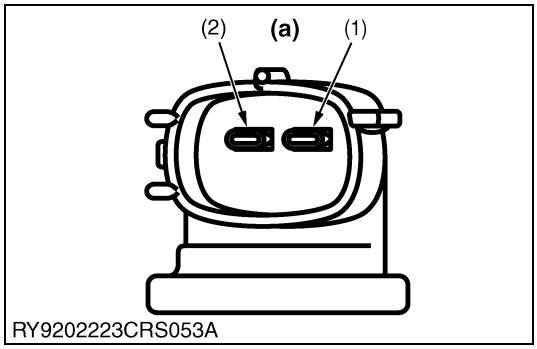
Factory specification	Approx. 6 V

OK	Go to "6. Check the Wiring Harness".
NG	Faulty ECU → Replace.

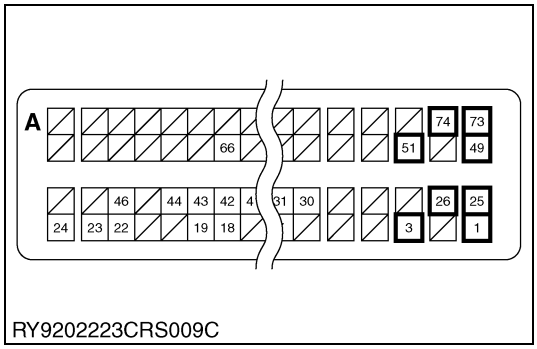
RY9202223CRS0110US0



RY9202223CRS005D



RY9202223CRS053A



RY9202223CRS009C

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 A-49 / A-73 or A-1 / A-25 (A-3, A-26, A-51, A-74 occurring simultaneously)	Ground
P2148	Terminal A-49 / A-73 or A-1 / A-25 (A-3, A-26, A-51, A-74 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 ground (at the injector side).

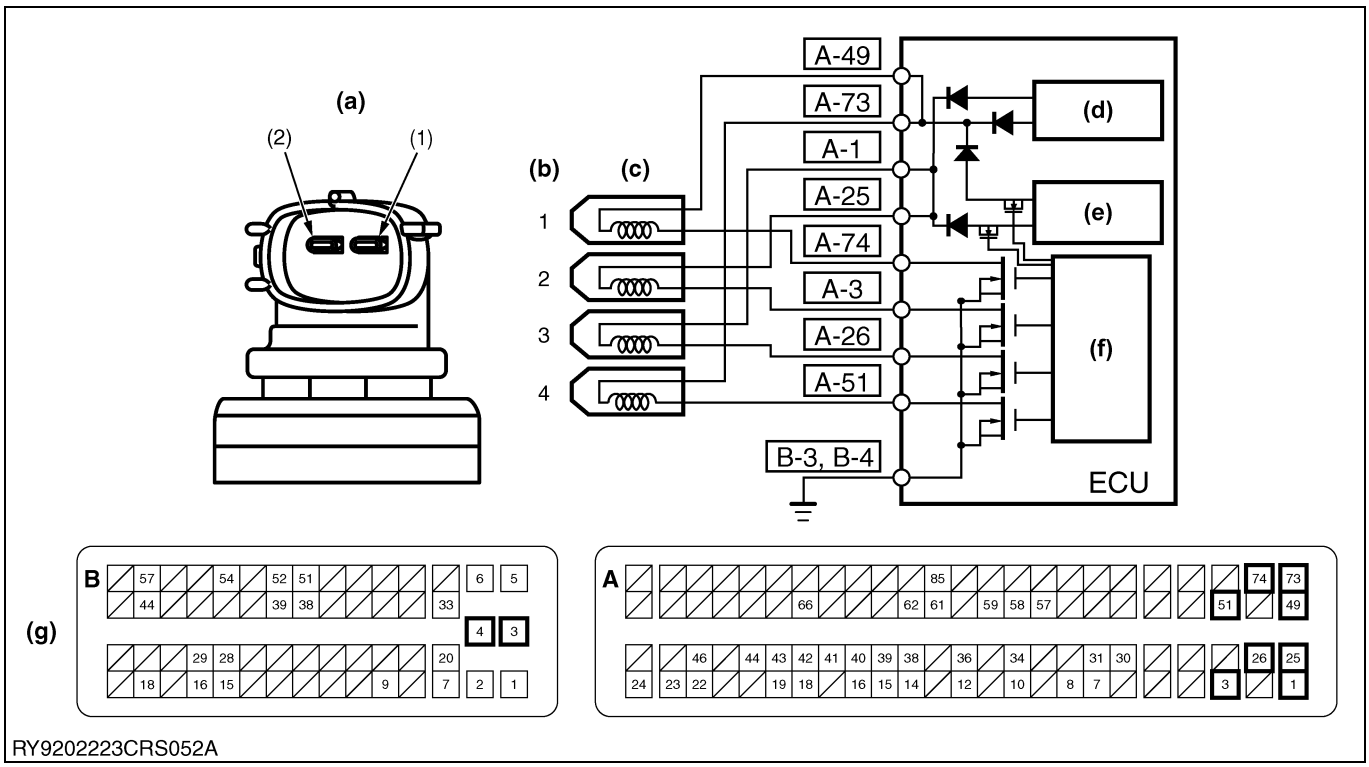
Factory specification	10 MΩ or higher

OK	The injector functions normally. Locate another cause.
NG	Faulty injector → Replace.

(1) Terminal COMMON
(2) Terminal TWV
(a) Injector

RY9202223CRS0111US0

(14) Common 2 System Injector Drive Circuit Open (DTC P2149)

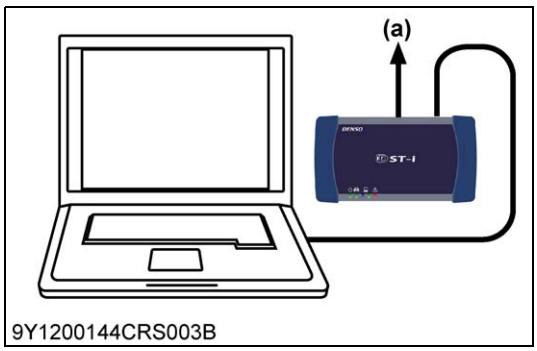


RY9202223CRS052A

(1) Terminal COMMON
(2) Terminal TWV

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

RY9202223CRS0098US0



9Y1200144CRS003B

1. DTC Judgment

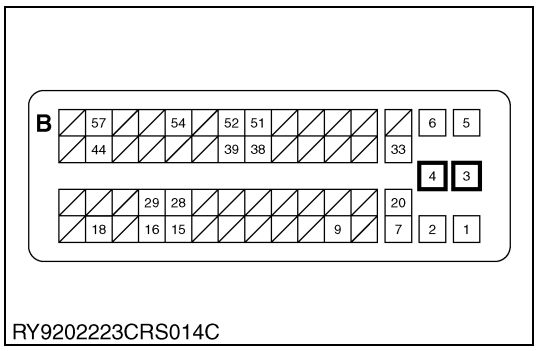
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position, check whether the DTC (P2146, P2149) is output or not.

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

RY9202138CRS0400US0



RY9202223CRS014C

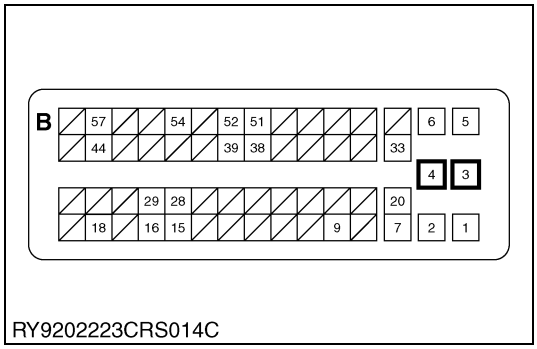
2. Check the "P- GND" Wiring Harness

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 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.

RY9202223CRS0102US0



RY9202223CRS014C

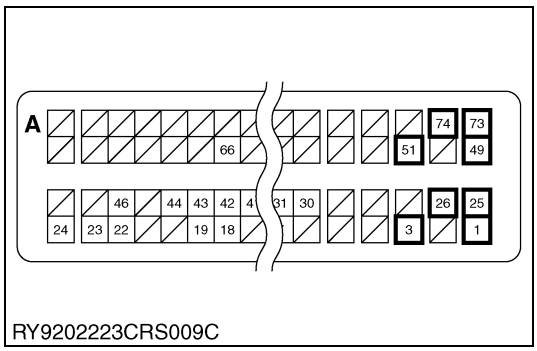
3. Check the "P- GND" Wiring Harness Connector and ECU Pins

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.

RY9202223CRS0103US0



RY9202223CRS009C

4. Measure the Resistance Between ECU Terminals

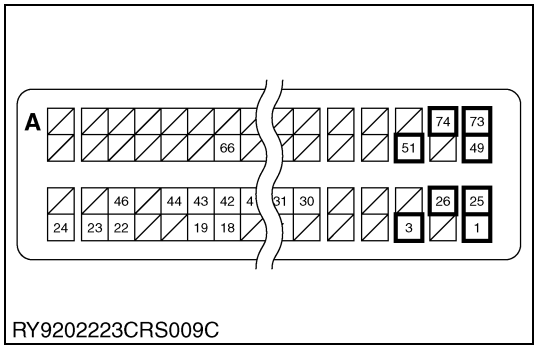
1. Place the key switch in the OFF position, unplug the ECU wiring harness connector, and measure the resistance between each terminal at the connector side as shown on the following table.

DTC	ECU Terminals Measured	
P2146	A-49 / A-73	No. 1 cylinder A-74
		No. 4 cylinder A-51
P2149	A-1 / A-25	No. 3 cylinder A-26
		No. 2 cylinder A-3

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".

RY9202223CRS0104US0

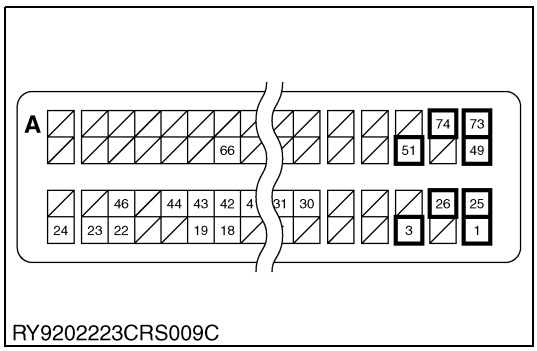


RY9202223CRS009C

5. Check the Wiring Harness → Repair or Replace the Faulty Area

Check the wiring harness between ECU terminals A-1, A-25 and each injector terminal (A-3, A-26, A-51 or A-74), and locate the open harness,

RY9202223CRS0105US0



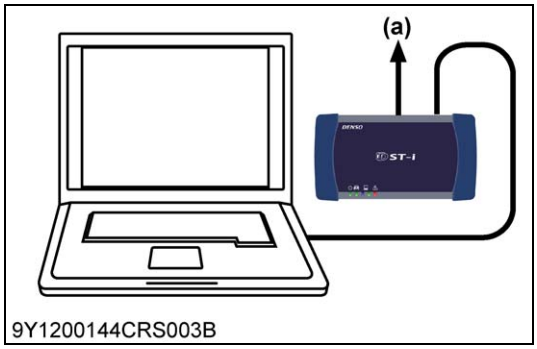
RY9202223CRS009C

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.

RY9202223CRS0106US0



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.

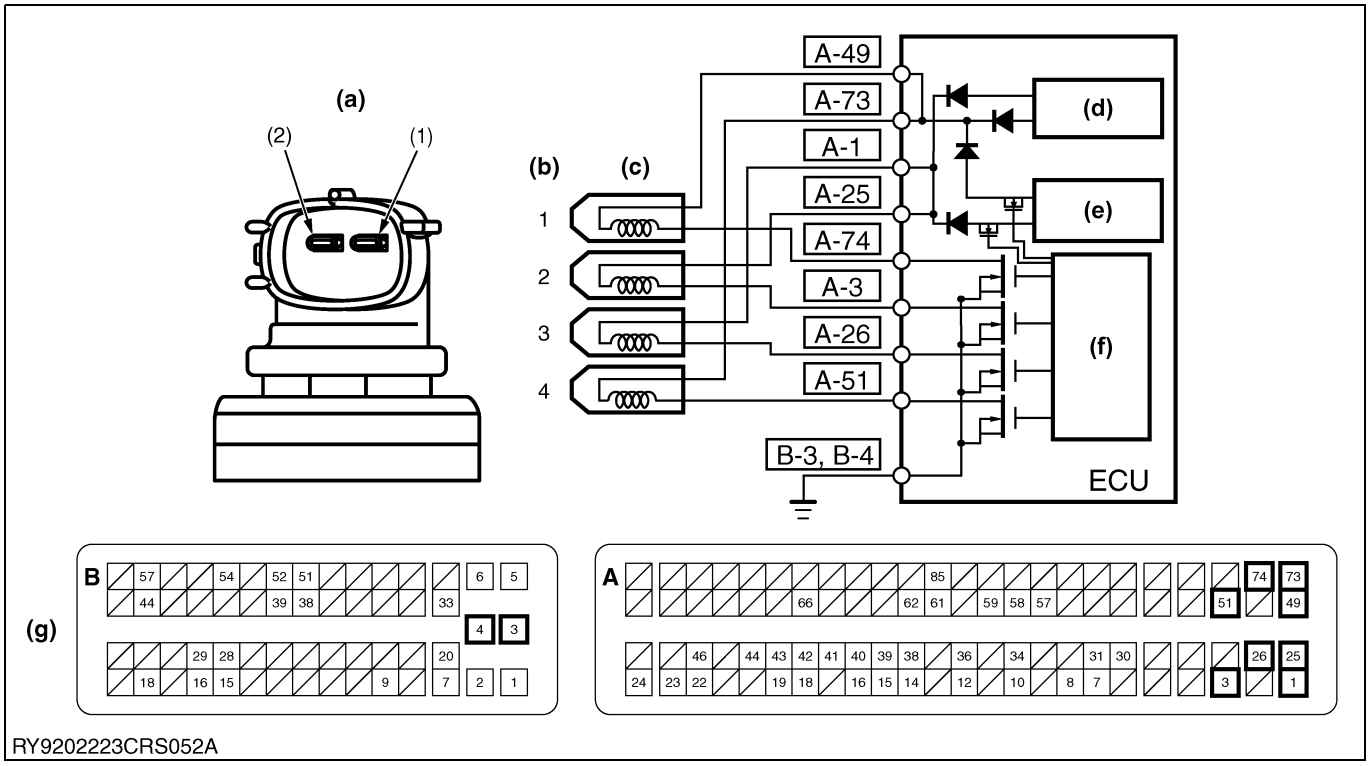
Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

RY9202138CRS0406US0

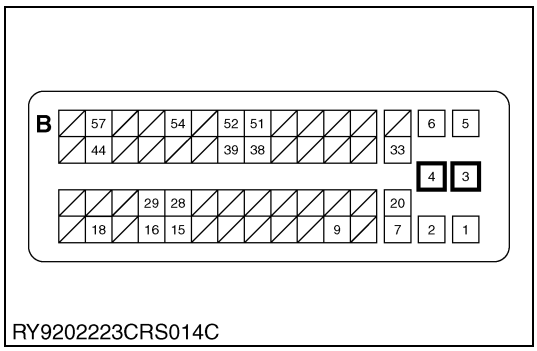
(15) Common 2 TWV Actuation System Short (DTC P2150, P2151)



RY9202223CRS052A

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

RY9202223CRS0098US0



RY9202223CRS014C

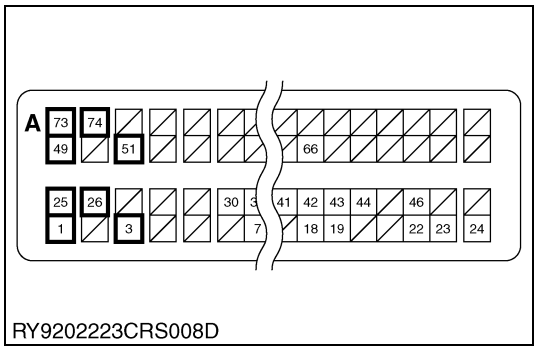
1. Check the "P- GND" Wiring Harness

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector (58 pin) from the socket, and measure the resistance between each of ECU terminals B-3 or B-4 and the 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.

RY9202223CRS0107US0



RY9202223CRS008D

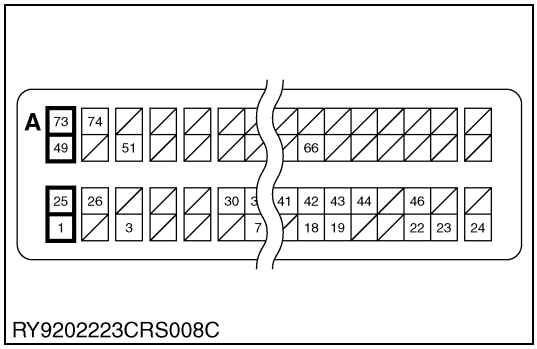
2. Check the Wiring Harness Connectors and ECU Pins

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector (96 pin) from the socket, and check the ECU pins for faulty connection, deformation, poor contact or other defects.

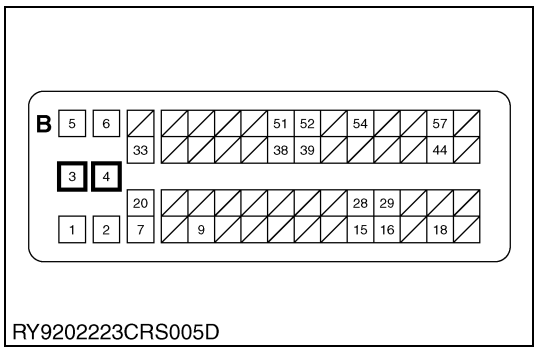
Factory specification	Must be free from faulty connection, deformation, poor contact or other defects.

OK	Go to "3. Measure the ECU Terminal Voltage (Part 1)".
NG	Repair wiring harness connectors and ECU pins, or replace them if defective.

RY9202223CRS0112US0



RY9202223CRS008C



RY9202223CRS005D

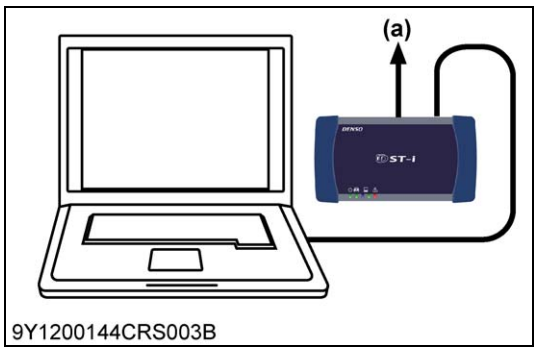
3. Measure the ECU Terminal Voltage (Part 1)

1. Place the key switch in the ON position, and measure the voltage between ECU terminal A-49 / A-73 or A-1 / A-25 and "P-GND" terminal (B-3, B-4).

Factory specification	Approx. 6 V

OK	Go to "4. Check the DTC".
NG	Go to "5. Measure the ECU Terminal Voltage (Part 2)".

RY9202223CRS0109US0



9Y1200144CRS003B

4. Check the DTC

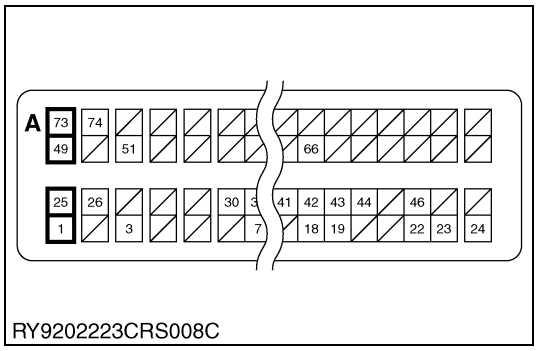
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Start the engine, and clear the past DTCs.
3. Read the DTC again.

Factory specification	Normal (No DTC is output.)

OK	Normal.
NG	Faulty ECU → Replace.

(a) CAN1 Connector

RY9202138CRS0426US0



RY9202223CRS008C

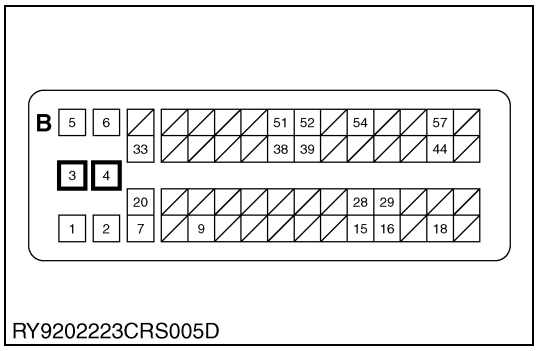
5. Measure the ECU Terminal Voltage (Part 2)

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector (96 pin) from the socket, return the key switch to the ON position again, and measure the voltage between each of ECU terminal pins A-49 / A-73 and A-1 / A-25 and the "P -GND" terminal (B-3, B-4) (at the wiring harness side).

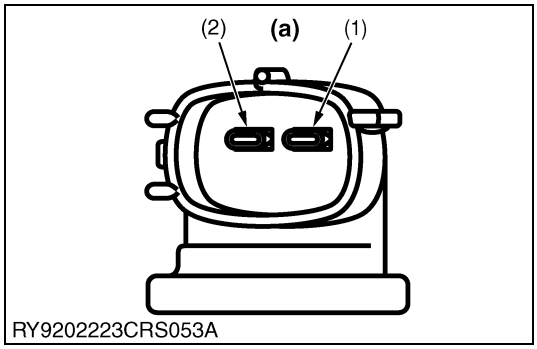
Factory specification	Approx. 6 V

OK	Go to "6. Check the Wiring Harness".
NG	Faulty ECU → Replace.

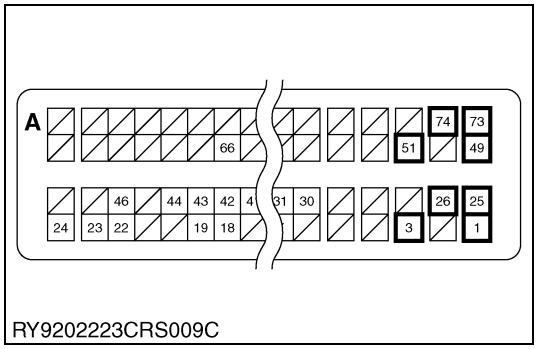
RY9202223CRS0110US0



RY9202223CRS005D



RY9202223CRS053A



RY9202223CRS009C

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 A-49 / A-73 or A-1 / A-25 (A-3, A-26, A-51, A-74 occurring simultaneously)	Ground
P2148	Terminal A-49 / A-73 or A-1 / A-25 (A-3, A-26, A-51, A-74 occurring simultaneously)	Power supply

■ **NOTE**

- **If DTC P2150 (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 ground (at the injector side).

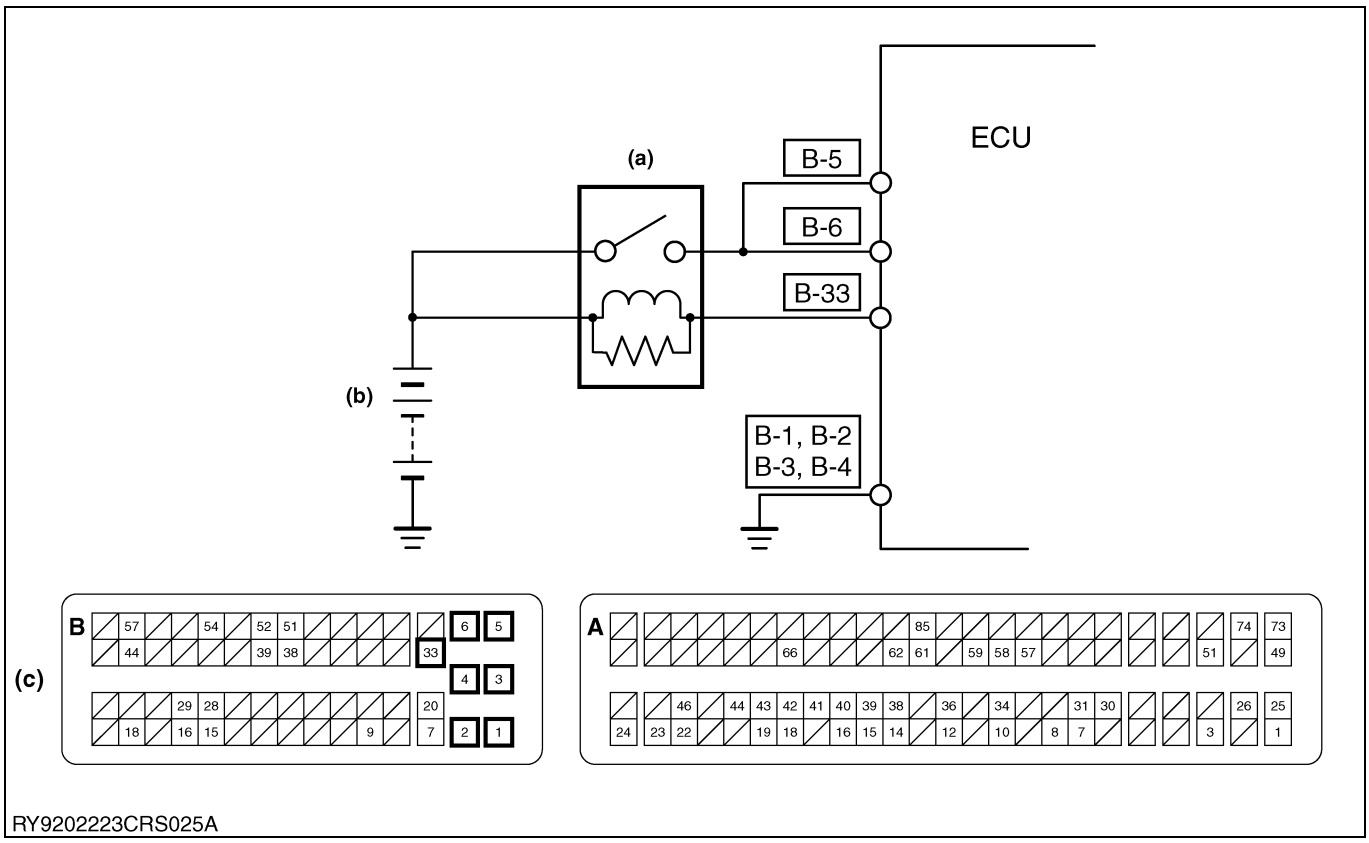
Factory specification	10 MΩ or higher

OK	The injector functions normally. Locate another cause.
NG	Faulty injector → Replace.

(1) Terminal COMMON
(2) Terminal TWV
(a) Injector

RY9202223CRS0113US0

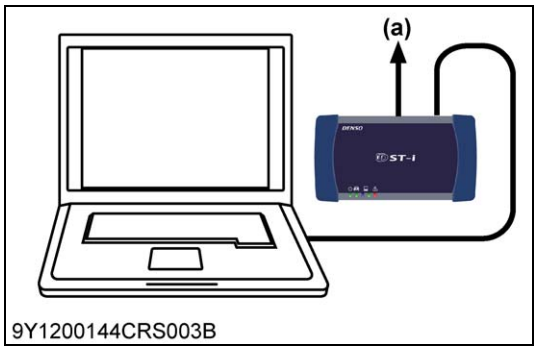
(16) Battery Voltage Abnormality (DTC P0562, P0563)



RY9202223CRS025A

(a) Main Relay (b) Battery (c) ECU Connector (Wire Harness Side)

RY9202223CRS0119US0



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)

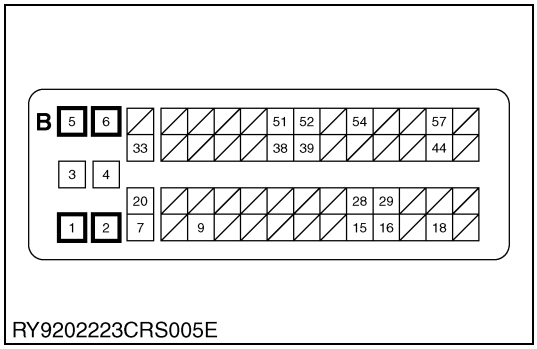
■ **NOTE**

- **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

RY9202138CRS0361US0



RY9202223CRS005E

2. Check the ECU Terminal Voltage (Part 1)

1. Change the engine operation status, and measure the voltage between ECU terminals B-5 and B-1 / B-2 and between terminals B-6 and B-1 / B-2.

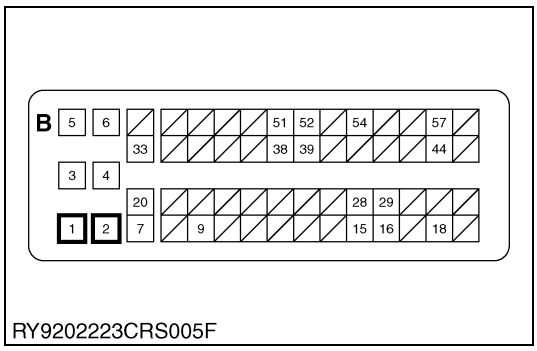
Factory specification	8 V or higher, 15 V or lower (except intense cold temperature)

■ **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)".	

RY9202223CRS0120US0



RY9202223CRS005F

3. Check the ECU Terminal Voltage (Part 2)

1. Change the engine operation status, and measure the voltage between ECU terminal B-1 / B-2 and ground terminal.

Factory specification	Always 0.5 V or lower

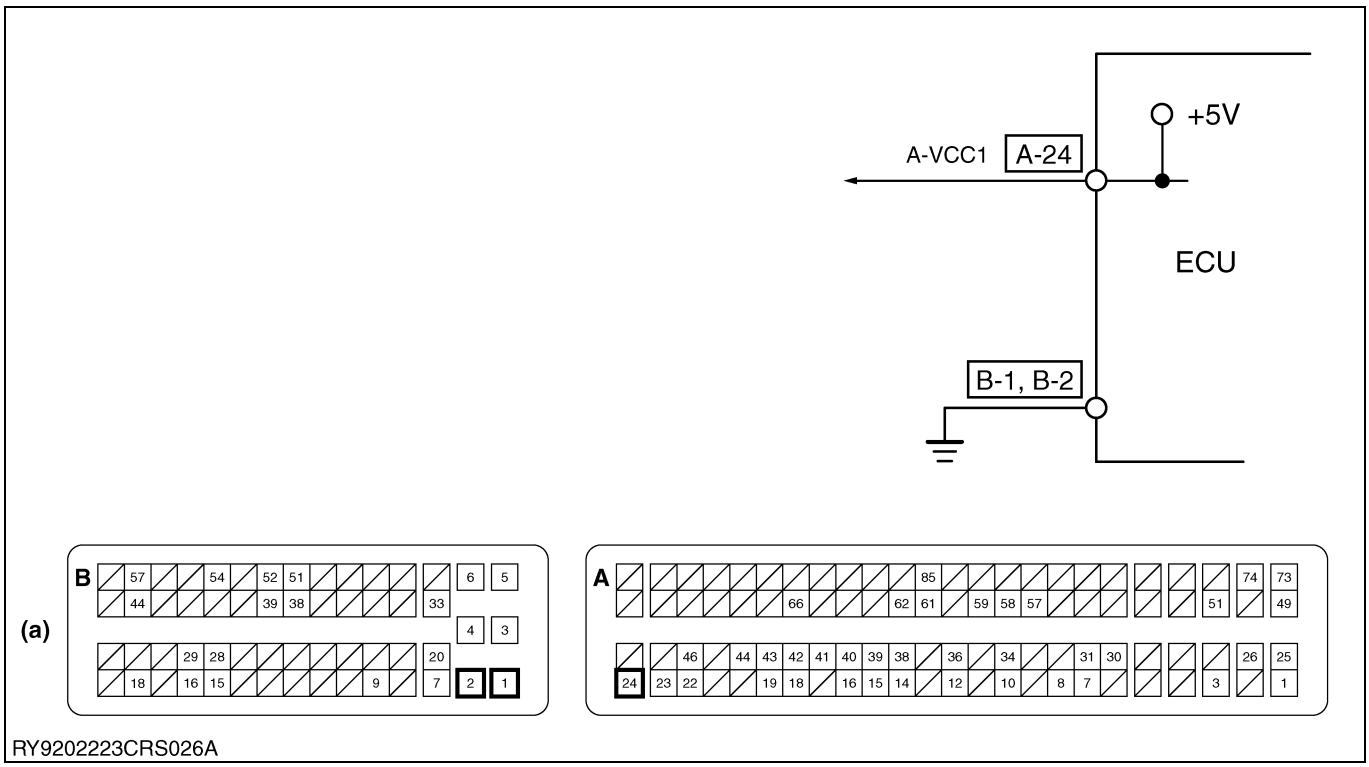
■ **NOTE**

- **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.

RY9202223CRS0121US0

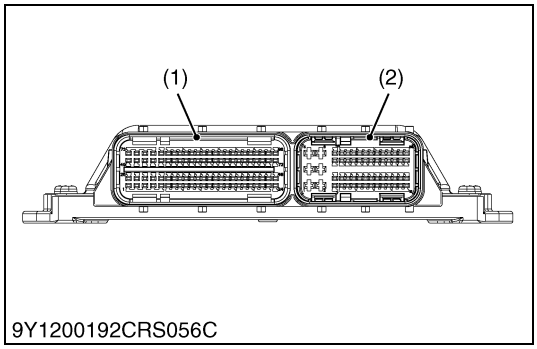
(17) Sensor Supply Voltage 1 Abnormality (DTC P0642, P0643)



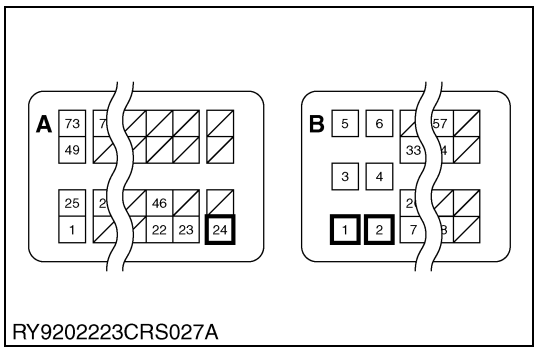
RY9202223CRS026A

(a) ECU Connector (Wire Harness Side)

RY9202223CRS0122US0



9Y1200192CRS056C



RY9202223CRS027A

1. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector (96 pin) (1) from the socket.
2. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals A-24 and B-1 / B-2.

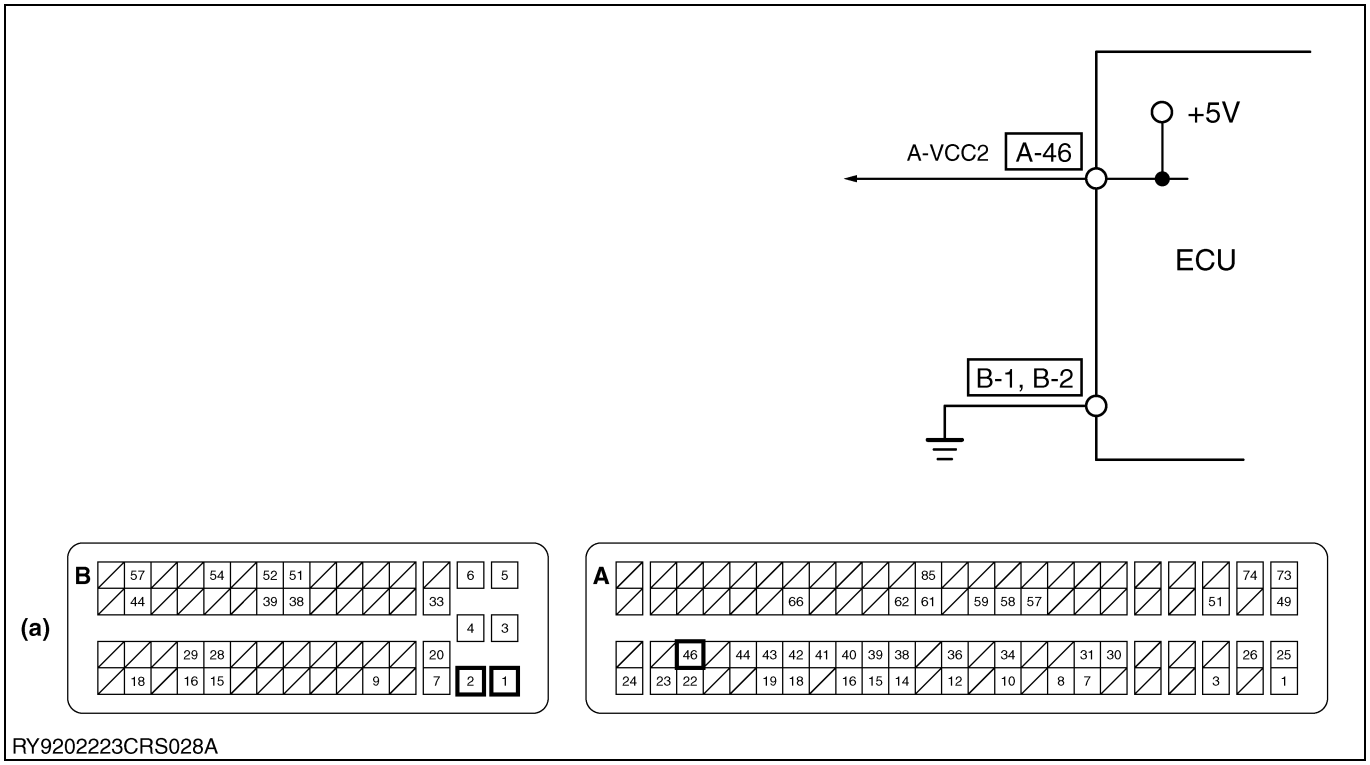
Factory specification	Approx. 5 V

OK	Check the wiring harness (ECU terminal A-24) 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 Connector (96 Pin) (2) ECU Connector (58 Pin)

RY9202223CRS0123US0

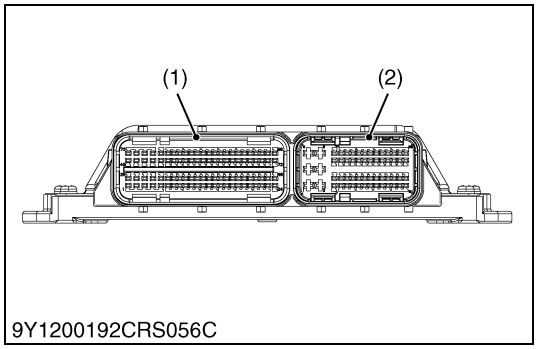
(18) Sensor Supply Voltage 2 Abnormality (DTC P0652, P0653)



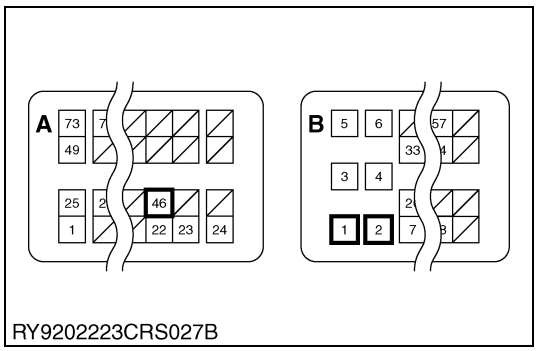
RY9202223CRS028A

(a) ECU Connector (Wire Harness Side)

RY9202223CRS0124US0



9Y1200192CRS056C



RY9202223CRS027B

1. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and unplug the ECU wiring harness connector (96 pin) (1) from the socket.
2. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals A-46 and B-1 / B-2.

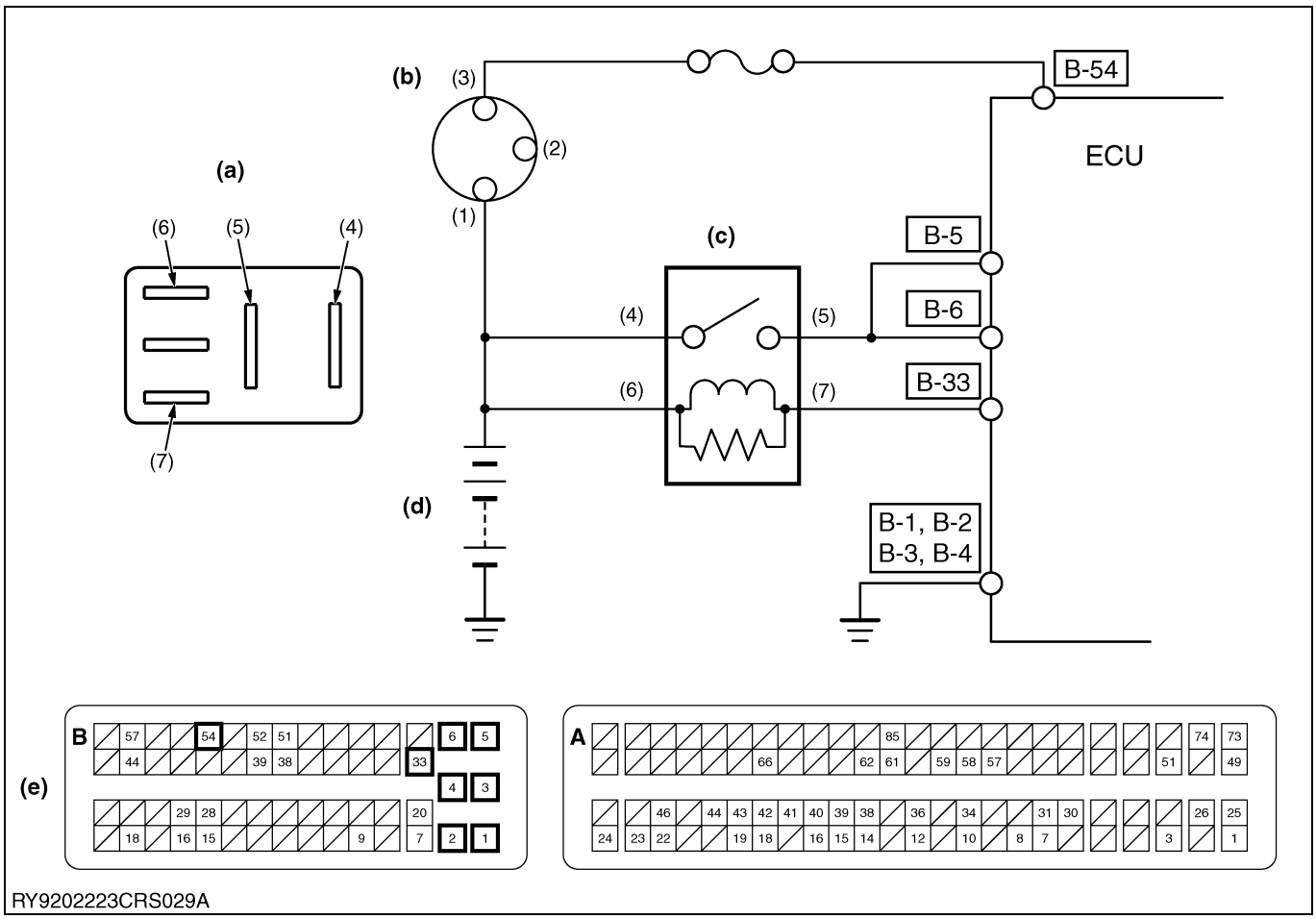
Factory specification	Approx. 5 V

OK	Check the wiring harness (ECU terminal A-46) 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 Connector (96 Pin) (2) ECU Connector (58 Pin)

RY9202223CRS0125US0

(19) Main Relay is Locked in Closed Position (DTC P0687)

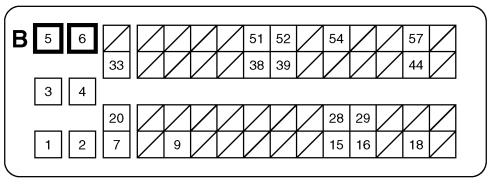


RY9202223CRS029A

(1) OFF
(2) ON
(3) START
(4) Terminal 1
(5) Terminal 2
(6) Terminal 3
(7) Terminal 4

(a) Main Relay Terminal Layout
(b) Key Switch
(c) Main Relay
(d) Battery
(e) ECU Connector (Wire Harness Side)

RY9202223CRS0126US0



RY9202223CRS005G

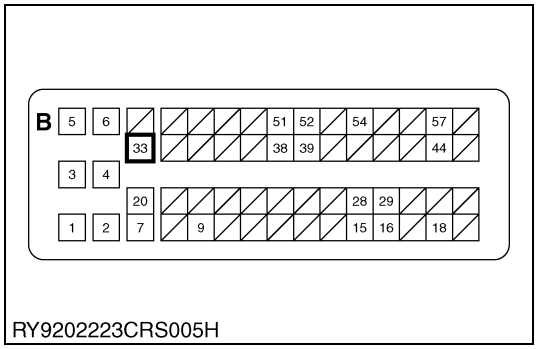
1. Measure the ECU Terminal Voltage

1. Place the key switch in the OFF position, and measure the voltage between ECU terminals B-5 and B-6 and the ground.

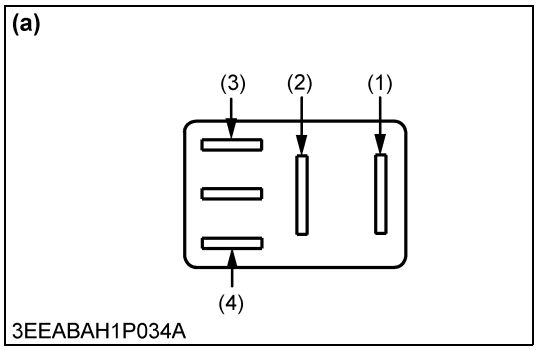
Factory specification	0 V

OK	Clear the DTC and check whether it is detected again or not.	
	OK	Normal.
	NG	Replace the ECU.
NG	Locate the cause of constant voltage supply to the wiring harness.	

RY9202223CRS0127US0



RY9202223CRS005H



3EEABAH1P034A

2. Check the ECU Terminal Voltage

1. Keep the key switch in the OFF position, and measure the voltage at ECU main relay terminals B-33.

Factory specification	10 V or higher

OK	Go to "3. 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.

RY9202223CRS0128US0

3. 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

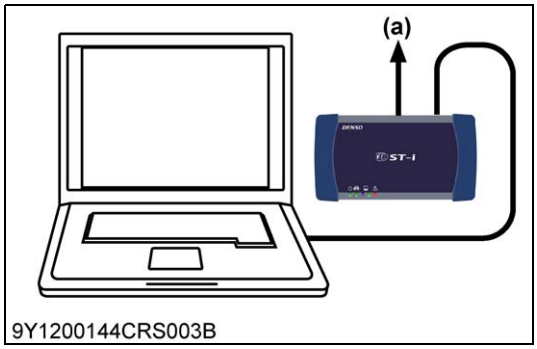
NG	Faulty main relay → Replace.

(1) Terminal 1 (Coil Operating Terminal)
(2) Terminal 2 (Coil Operating Terminal)
(3) Terminal 3 (Contact Terminal)
(4) Terminal 4 (Contact Terminal)

(a) Terminal Layout

RY9202223CRS0129US0

(20) Barometric Pressure Sensor Error (DTC P2228, P2229)



1. Check the Atmospheric Pressure Signals

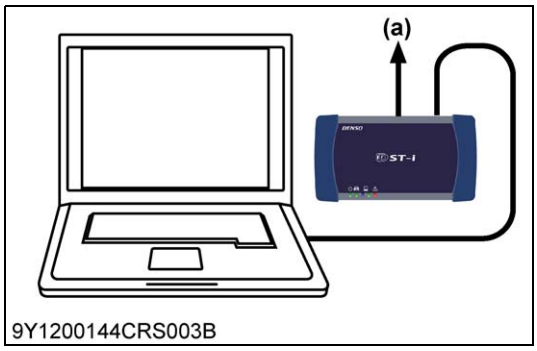
1. Place the key switch in the ON position, and check the "Atmospheric pressure" on the diagnosis tool data monitor.

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

RY9202138CRS0429US0



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.

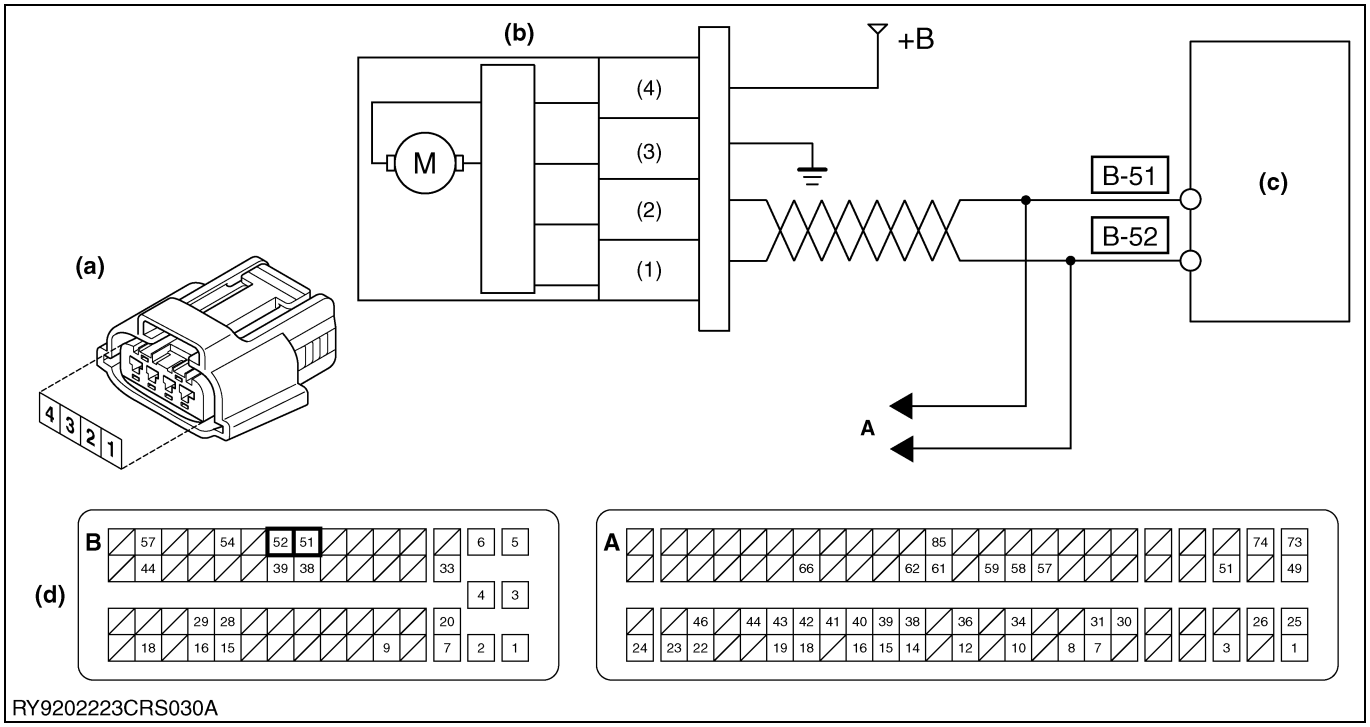
Factory specification	OK

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

RY9202138CRS0430US0

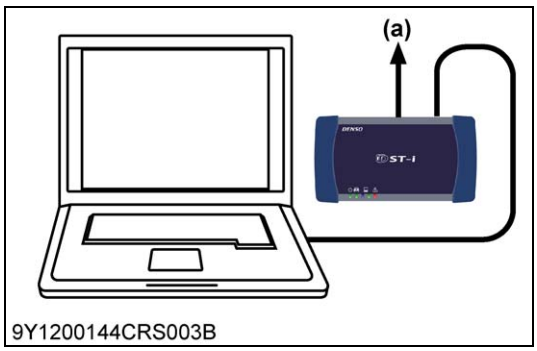
(21) EGR Actuator Abnormality (DTC P0403, DTC P0404, P0409)



(1) Terminal CAN1_H
(2) Terminal CAN1_L
(3) Terminal Ground
(4) Terminal Power (+12 V)

(a) Terminal Layout (Wire Harness Side)
(b) EGR Valve Assembly
(c) Engine ECU
(d) ECU Connector (Wire Harness Side)
A: To Diagnosis Tool (To CAN1 Connector)

RY9202223CRS0130US0



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).

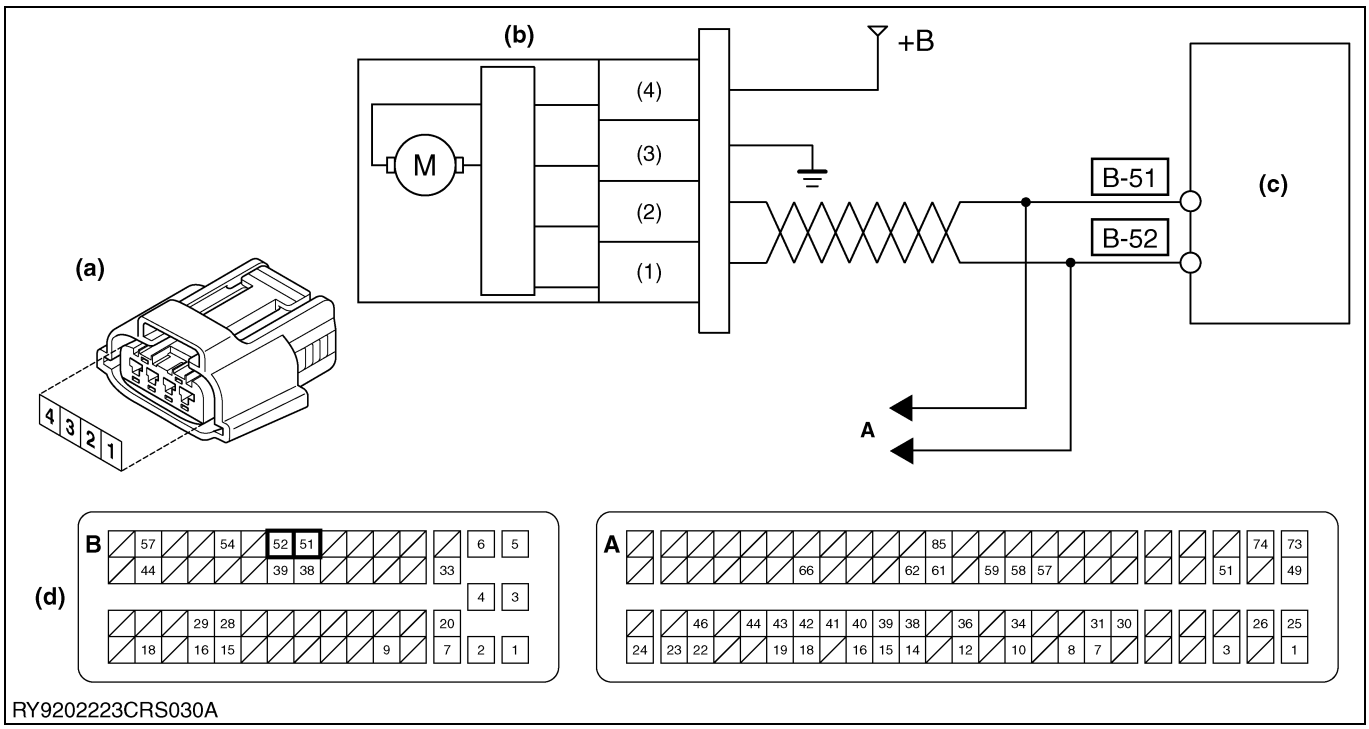
Factory specification	DTC must not be output.

OK	Normal.
NG	Replace the EGR assembly.

(a) CAN1 Connector

RY9202138CRS0349US0

(22) EGR (DC Motor) Abnormality (DTC P2413, P2414, P2415)

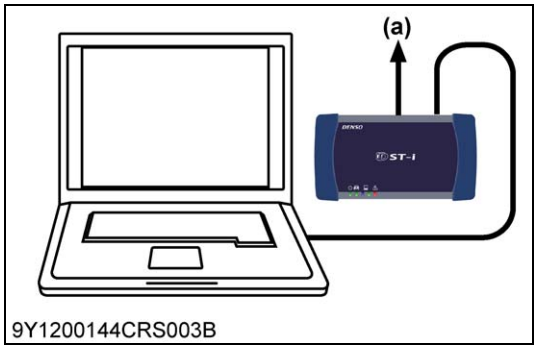


RY9202223CRS030A

(1) Terminal CAN1_H
(2) Terminal CAN1_L
(3) Terminal Ground
(4) Terminal Power (+12 V)

(a) Terminal Layout (Wire Harness Side)
(b) EGR Valve Assembly
(c) Engine ECU
(d) ECU Connector (Wire Harness Side)
A: To Diagnosis Tool (To CAN1 Connector)

RY9202223CRS0130US0



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).

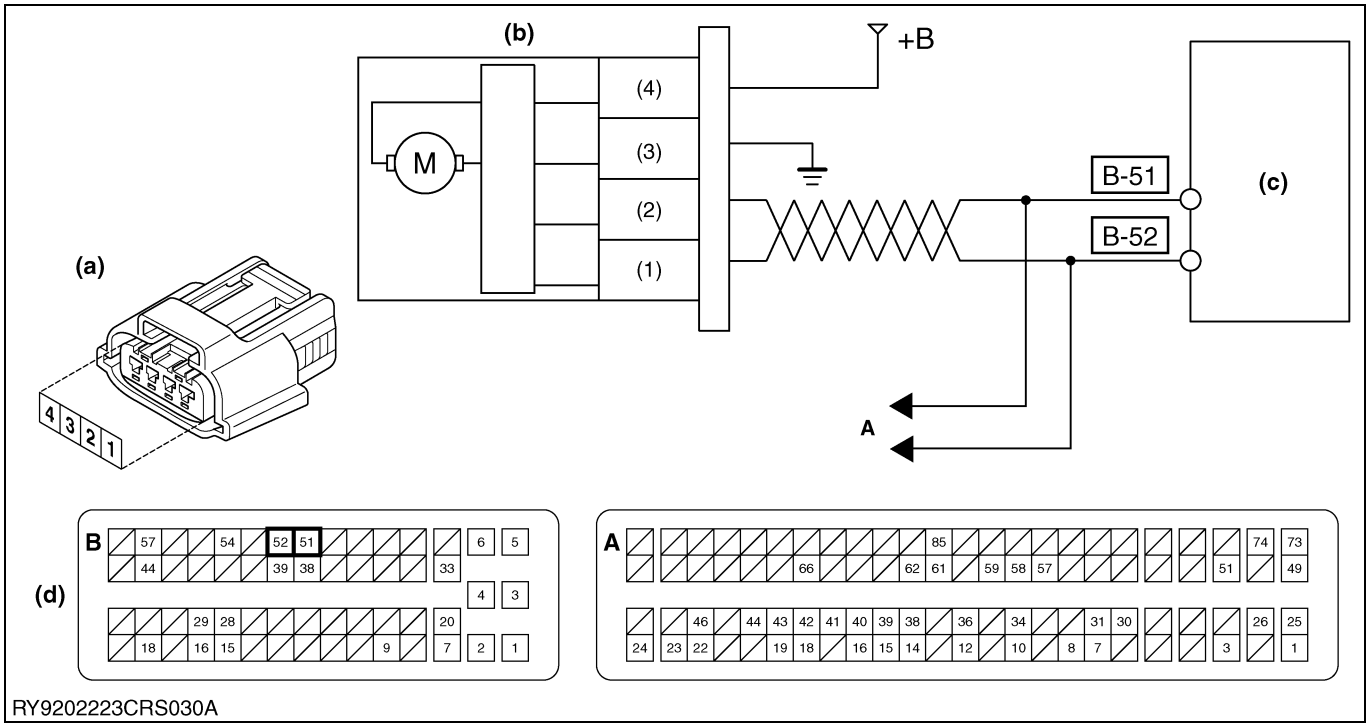
Factory specification	DTC must not be output.

OK	Normal.
NG	Replace the EGR assembly.

(a) CAN1 Connector

RY9202138CRS0349US0

(23) No Communication with EGR (DTC U0076)

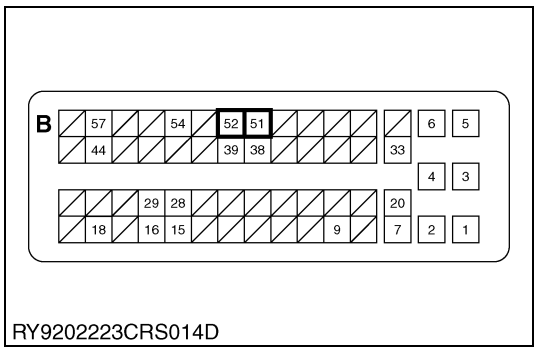


RY9202223CRS030A

(1) Terminal CAN1_H
(2) Terminal CAN1_L
(3) Terminal Ground
(4) Terminal Power (+12 V)

(a) Terminal Layout (Wire Harness Side)
(b) EGR Valve Assembly
(c) Engine ECU
(d) ECU Connector (Wire Harness Side)
A: To Diagnosis Tool (To CAN1 Connector)

RY9202223CRS0130US0



RY9202223CRS014D

1. Check the Wiring Related to the CAN of the Common Rail System

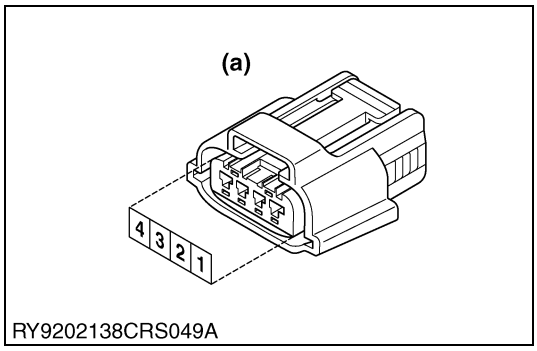
1. Check the connector and the wiring harness being connected to ECU terminal B-51 and B-52 for a short or an open circuit.

■ **IMPORTANT**
- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems".**

■ **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.

RY9202223CRS0131US0



RY9202138CRS049A

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).

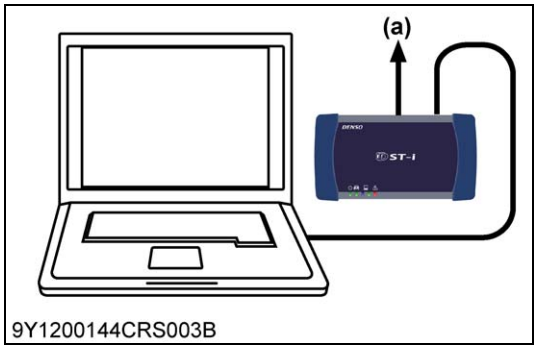
Factory specification	Approx. 10 to 16 V

OK	Go to "3. Check the DTC Again".
NG	Repair or replace the faulty areas.

(1) Terminal CAN1_H
(2) Terminal CAN1_L
(3) Terminal Ground
(4) Terminal Power (+12 V)

(a) EGR Terminal (Wire Harness Side)

RY9202138CRS0474US0



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**

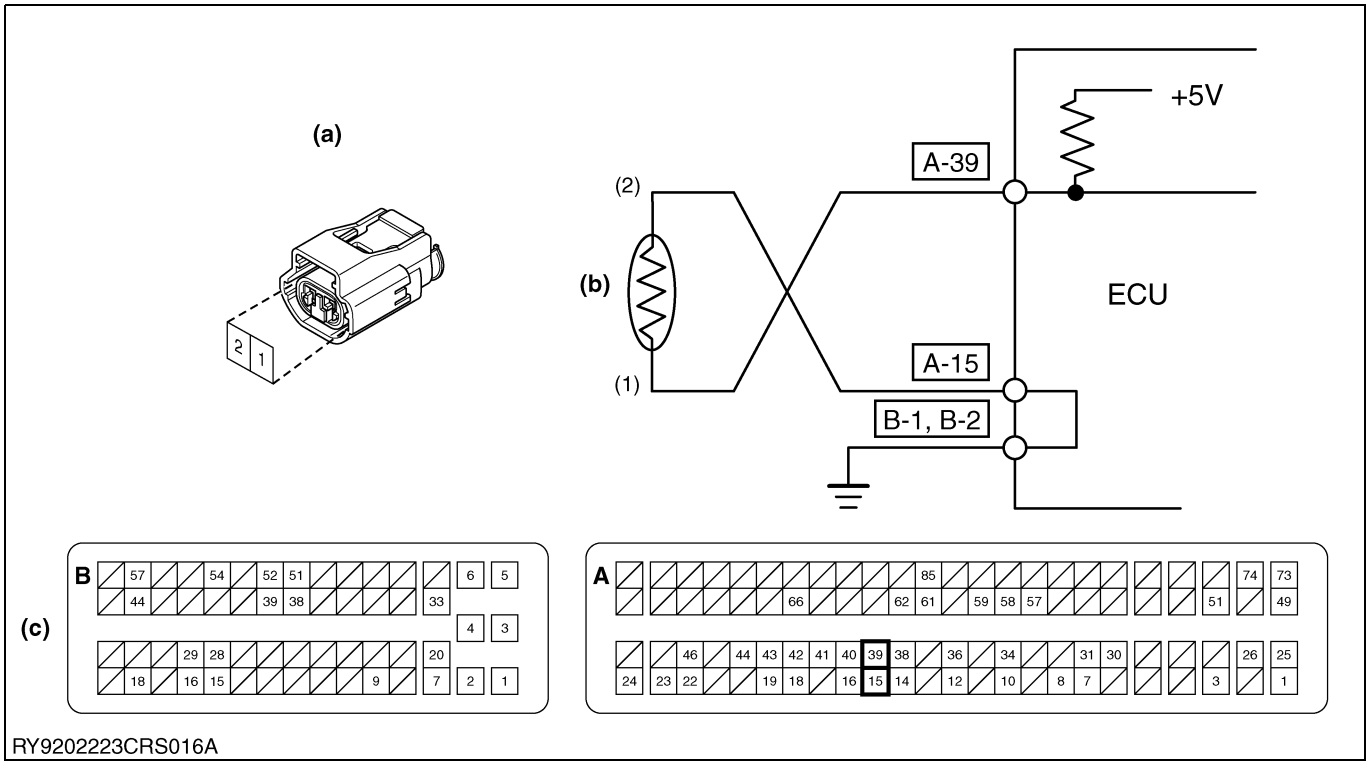
- **Check the DTC again after starting up the engine with the engine with the coolant temperature over 65 °C (149 °F).**

OK	Normal.
NG	Replace the EGR assembly.

(a) CAN1 Connector

RY9202138CRS0475US0

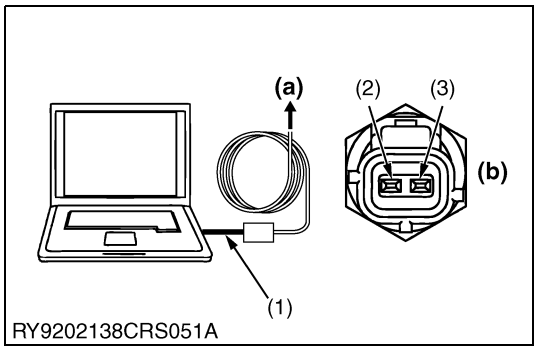
(24) Engine Overheat (DTC P0217)



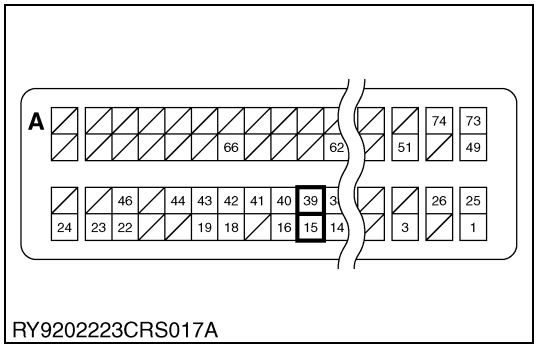
RY9202223CRS016A

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

RY9202223CRS0088US0



RY9202138CRS051A



RY9202223CRS017A

1. Check the Coolant Temperature Sensor Characteristics for An Error

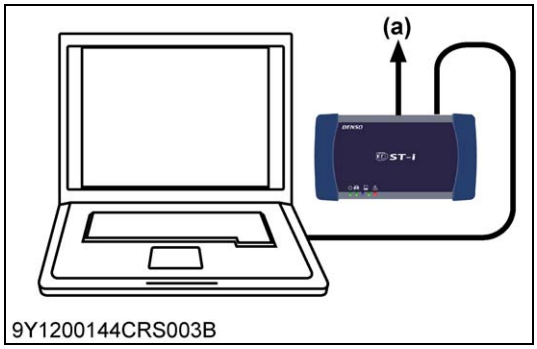
1. Refer to DTC P0117, P0118, and check the ECU, wiring harness and sensor for an error.

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) Diagnosis Tool CAN-USB Cable
(2) Terminal THW
(3) Terminal THW RTN
(a) CAN Connector (2 Pin)
(b) Terminal Layout (Sensor Side)

RY9202223CRS0132US0

(25) QR Data Abnormality (DTC P0602)



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.

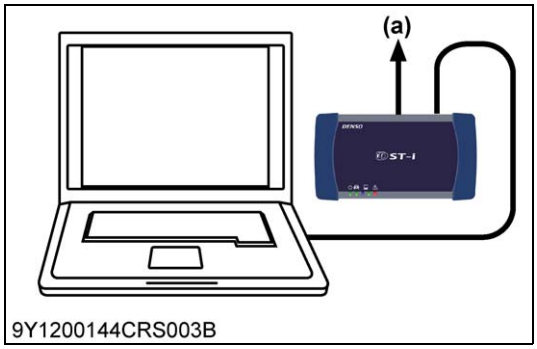
Factory specification	OK

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

RY9202138CRS0364US0

(26) ECU Flash-ROM and CPU Abnormality (DTC P0605, P0606)



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.

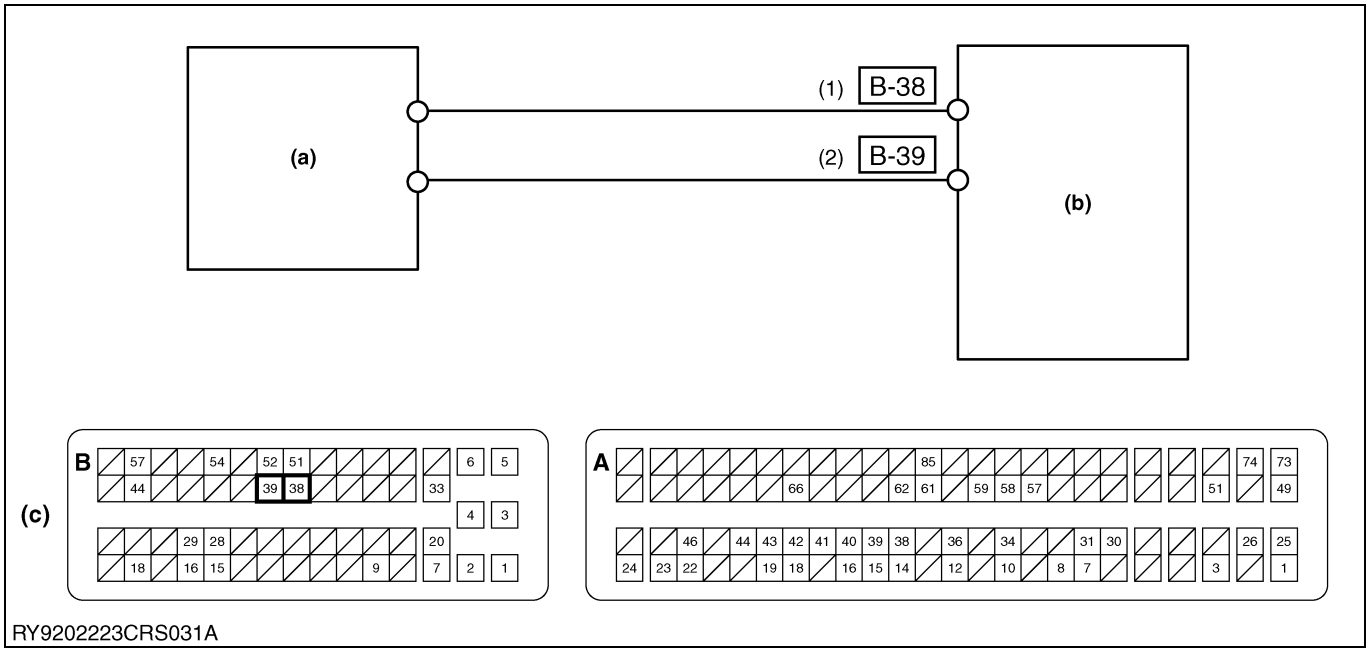
Factory specification	No DTC is output.

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

RY9202138CRS0365US0

(27) Accelerator Position Sensor Error (CAN) (DTC P2131)



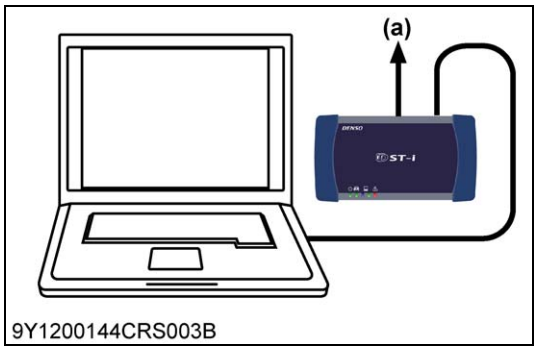
RY9202223CRS031A

(1) CAN2-H
(2) CAN2-L

(a) Main ECU
(b) Engine ECU

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0133US0



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

RY9202138CRS0397US0

2. Check the Monitor of the Machine

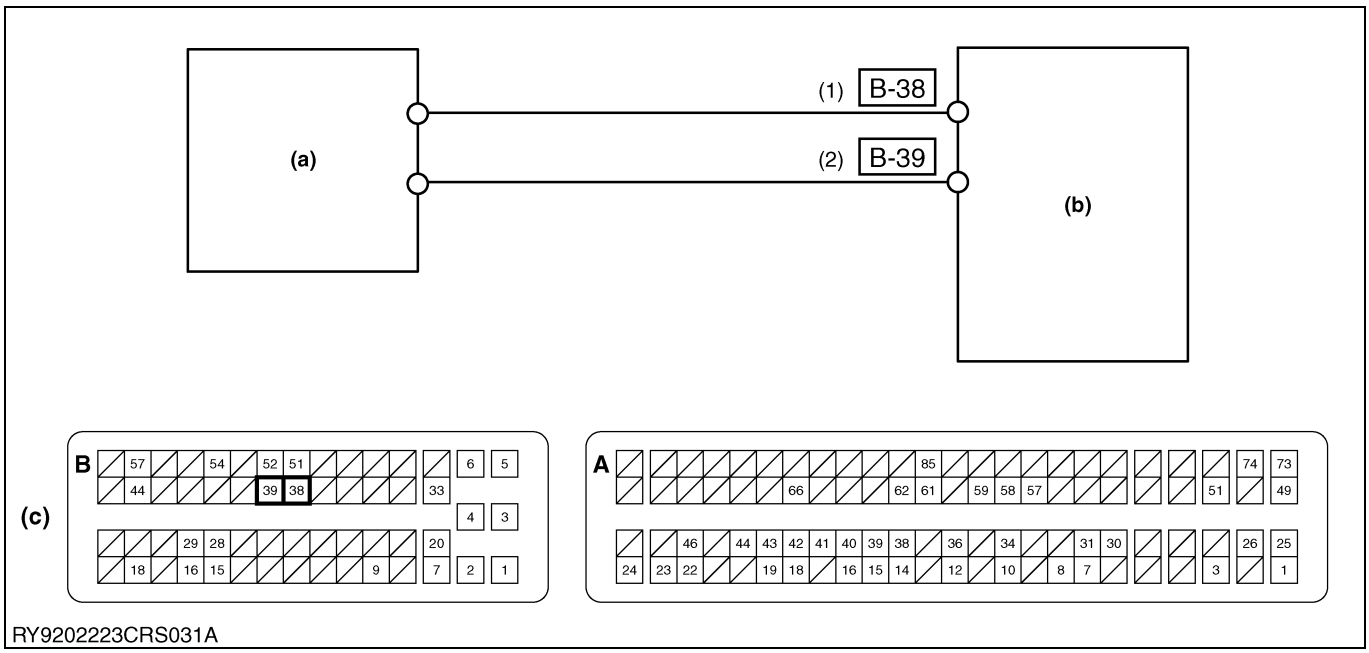
1. Turn on the key switch and confirm that no defects except those in the engine occur.

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.

RY9202138CRS0398US0

(28) CAN2 Bus Off (DTC U0075)



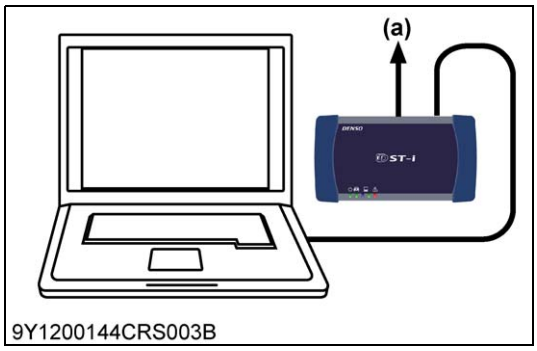
RY9202223CRS031A

(1) CAN2-H
(2) CAN2-L

(a) Main ECU
(b) Engine ECU

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0133US0



9Y1200144CRS003B

1. DTC Judgment

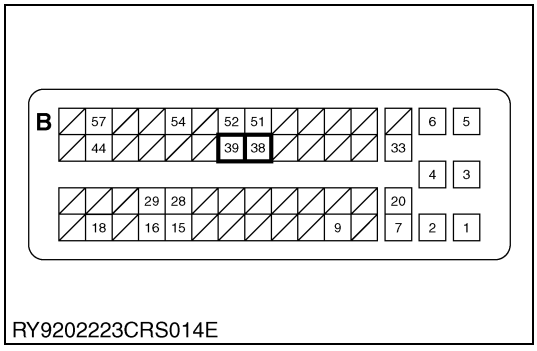
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Place the key switch in the ON position, check whether the DTC (U0075) is output or not.

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

RY9202138CRS0471US0



RY9202223CRS014E

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 B-38 and B-39 for a short or an open circuit.

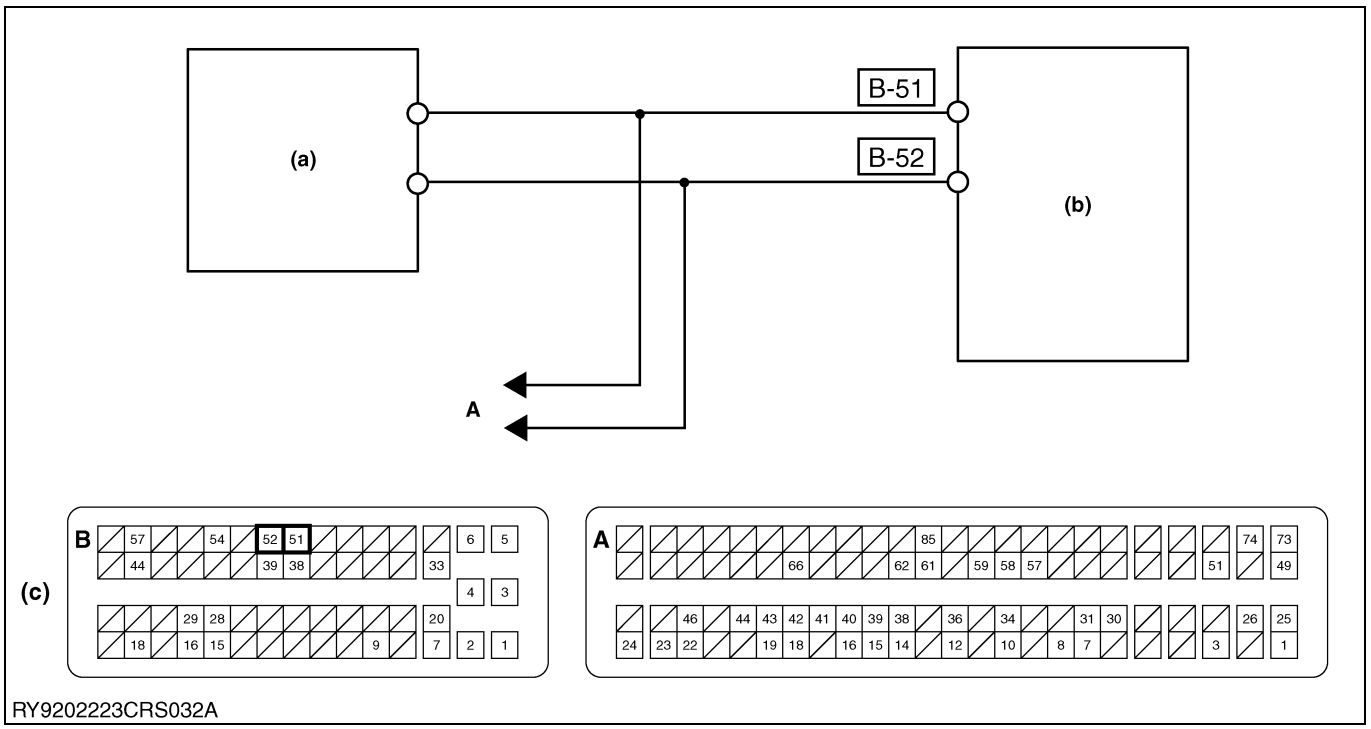
■ **IMPORTANT**

- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems".**

OK	Replace the ECU.
NG	Repair or replace the faulty areas.

RY9202223CRS0135US0

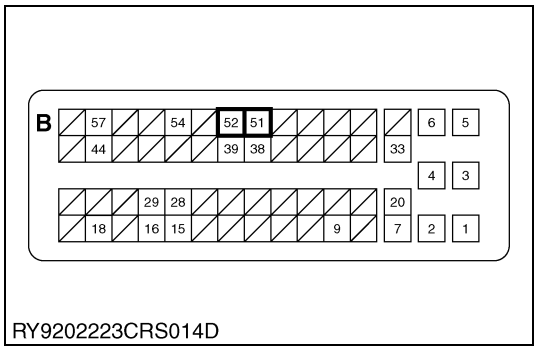
(29) CAN1 Bus Off (DTC U0077)



RY9202223CRS032A

(a) EGR Valve Assembly **(b) Engine ECU** **(c) ECU Connector (Wire Harness Side)** **A: To Diagnosis Tool (To CAN1 Connector)**

RY9202223CRS0136US0



RY9202223CRS014D

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 B-51 and B-52 for a short or an open circuit.

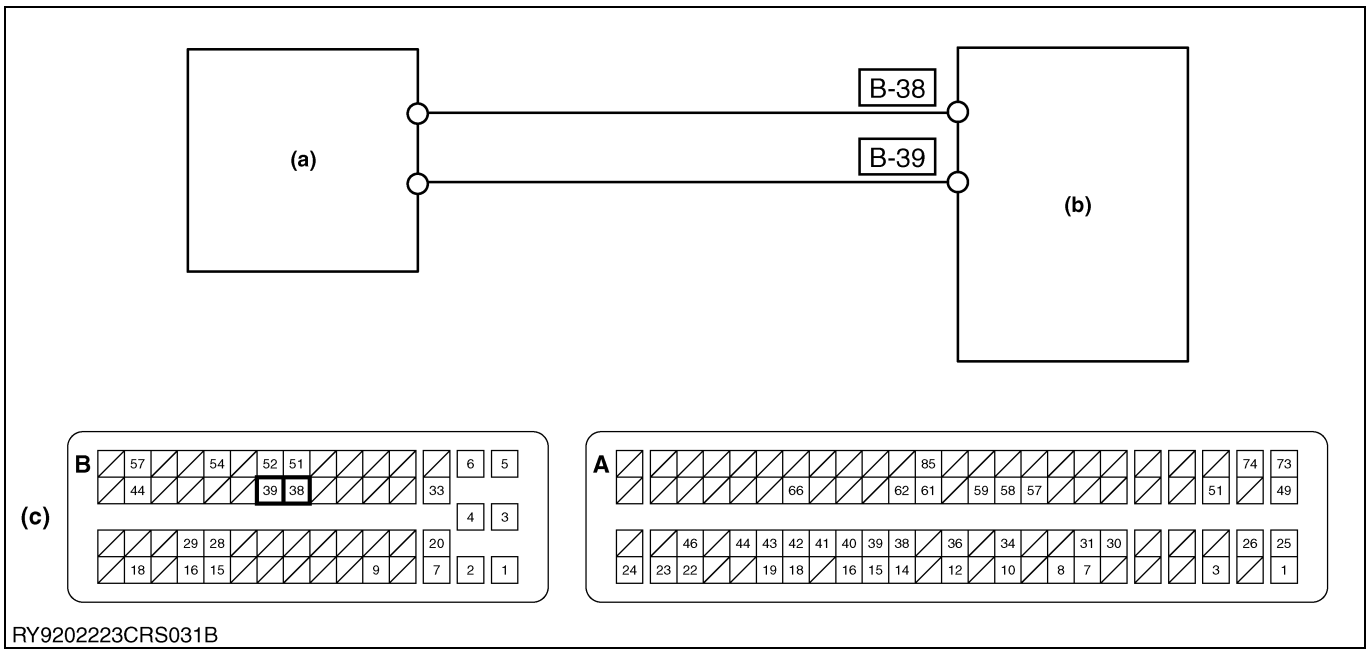
■ **IMPORTANT**

- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems".**

OK	Replace the ECU.
NG	Repair or replace the faulty areas.

RY9202223CRS0137US0

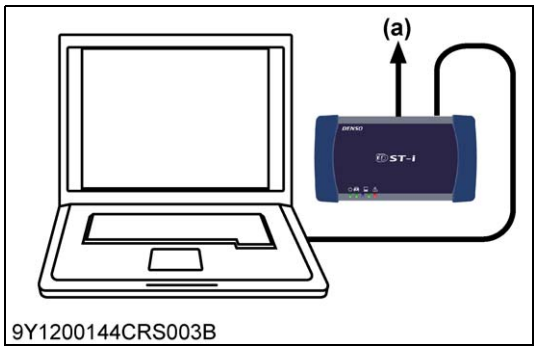
(30) CAN2 Frame Error (DTC U0081, U0082, U0083, U0087)



RY9202223CRS031B

(a) Main ECU **(b) Engine ECU** **(c) ECU Connector (Wire Harness Side)**

RY9202223CRS0134US0



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**

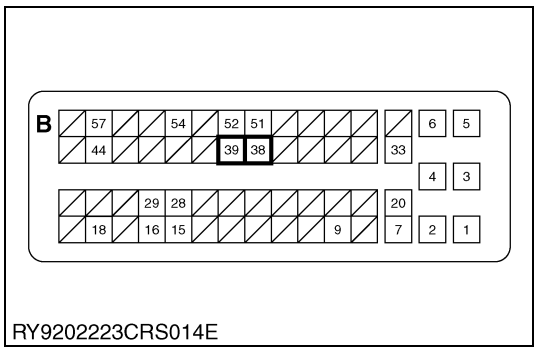
- **If the "CAN 2 Bus off error" is output at the same time, carry out this inspection first.**
- **Make sure that the ECU on the machine side operates properly.**

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

RY9202138CRS0479US0



RY9202223CRS014E

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 B-38 and B-39 for a short or an open circuit.

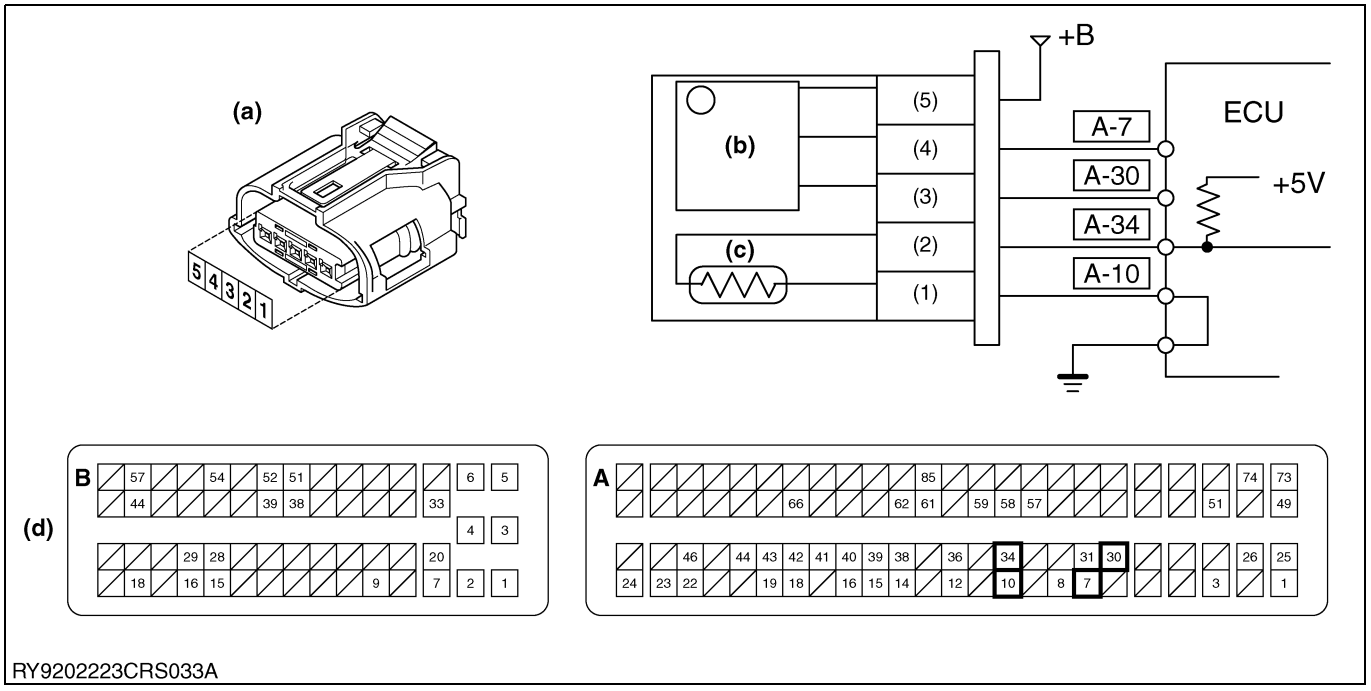
■ **IMPORTANT**

- **Refer to "6.[3] ELECTRIC SYSTEM INSPECTION PROCEDURE - (1) Basics of Checking Electrical / Electronic Circuit Systems".**

OK	Replace the ECU.
NG	Repair or replace the faulty areas.

RY9202223CRS0135US0

(31) Intake Air Temperature Built-in MAF Sensor: Abnormality (DTC P0072, P0073)

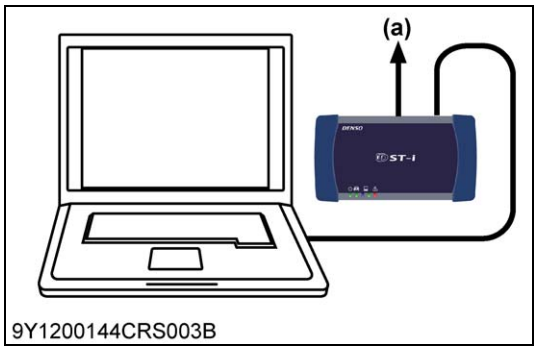


RY9202223CRS033A

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

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

RY9202223CRS0138US0



9Y1200144CRS003B

1. Check the Intake Air Temperature Sensor Signals

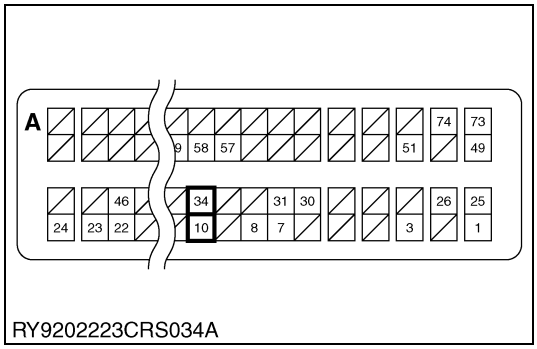
1. Place the key switch in the ON position, and check the "Intake air temperature" and "Intake air temperature sensor output voltage" on the diagnosis tool data monitor.

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

RY9202223CRS0139US0



RY9202223CRS034A

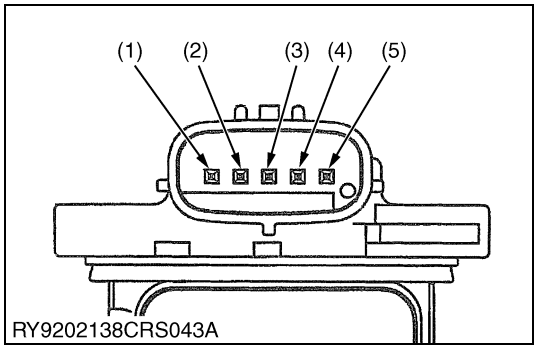
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals A-10 and A-34 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".

RY9202223CRS0140US0



RY9202138CRS043A

3. Check the Sensor

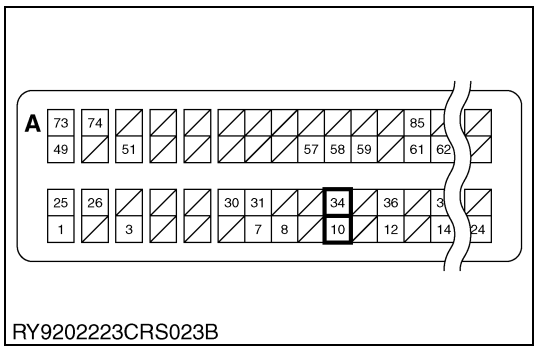
1. Turn the key switch OFF, remove the connector from the sensor side and measure the resistance between the terminals on the sensor side.

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

RY9202138CRS0253US0



RY9202223CRS023B

4. Measure the ECU Terminal Voltage

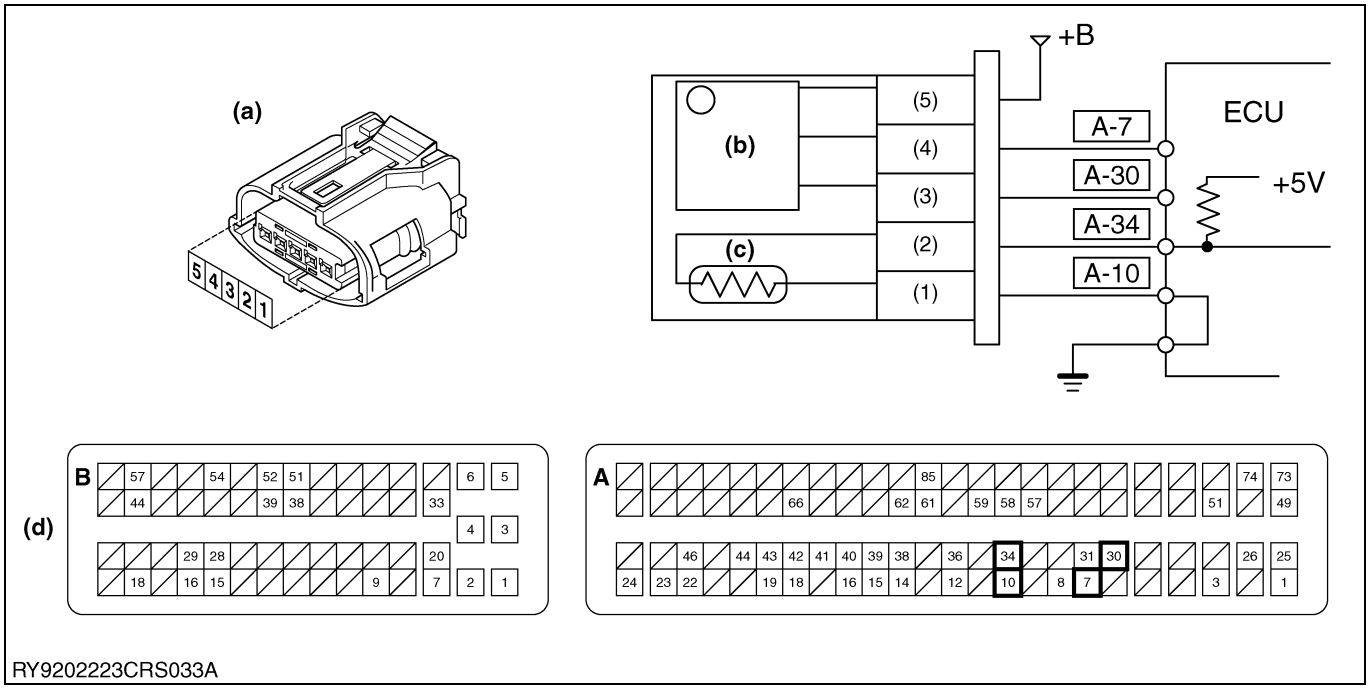
1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals A-10 and A-34 at the ECU side.

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.

RY9202223CRS0141US0

(32) MAF Sensor Abnormality (DTC P0102, P0103)

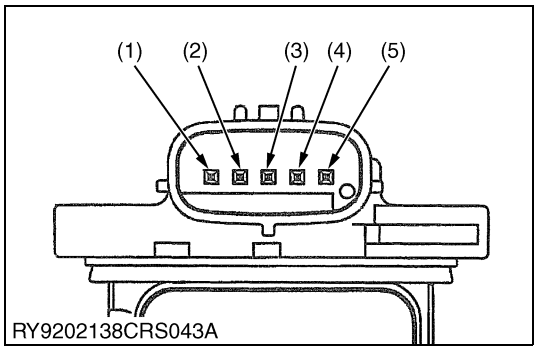


RY9202223CRS033A

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

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

RY9202223CRS0138US0



RY9202138CRS043A

1. Measure the Sensor Terminal Voltage

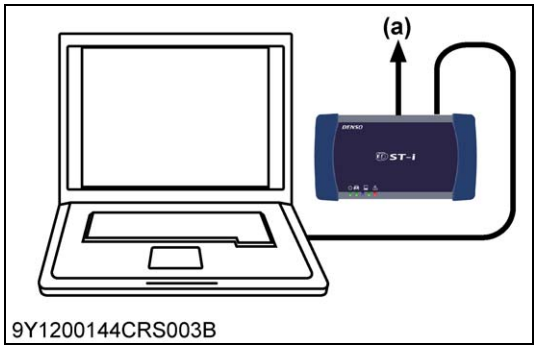
1. Move the key switch from the OFF to the ON position, and measure the voltage between sensor terminals 4 and 5.

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 A-GND-A
(3) Terminal AFS
(4) Terminal IATS
(5) Terminal A-GND10

RY9202138CRS0289US0



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.

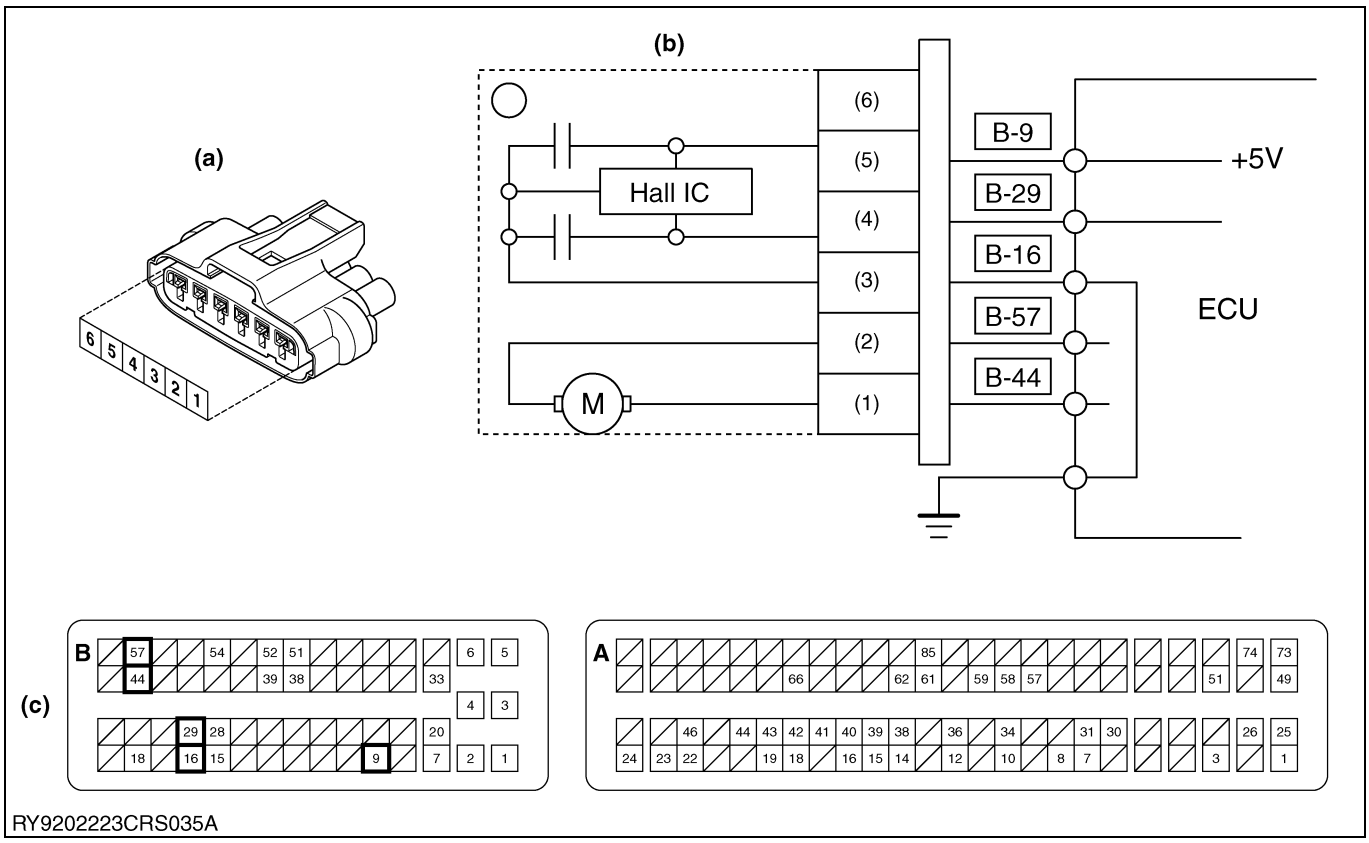
Factory specification	Either DTC is output.

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

(a) CAN1 Connector

RY9202138CRS0287US0

(33) Intake Throttle Feedback Error (DTC P2108)

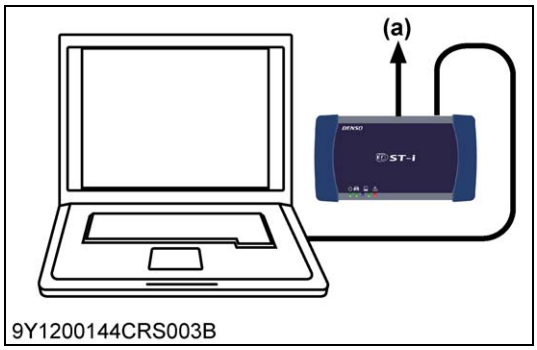


RY9202223CRS035A

(1) Terminal ITV–
(2) Terminal ITV+
(3) Terminal Ground
(4) Terminal ITS (Output)
(5) Terminal Power (+5 V)
(6) No Connection

(a) Terminal Layout (Wire Harness Side)
(b) Intake Throttle Valve
(c) ECU Connector (Wire Harness Side)

RY9202223CRS0142US0



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.

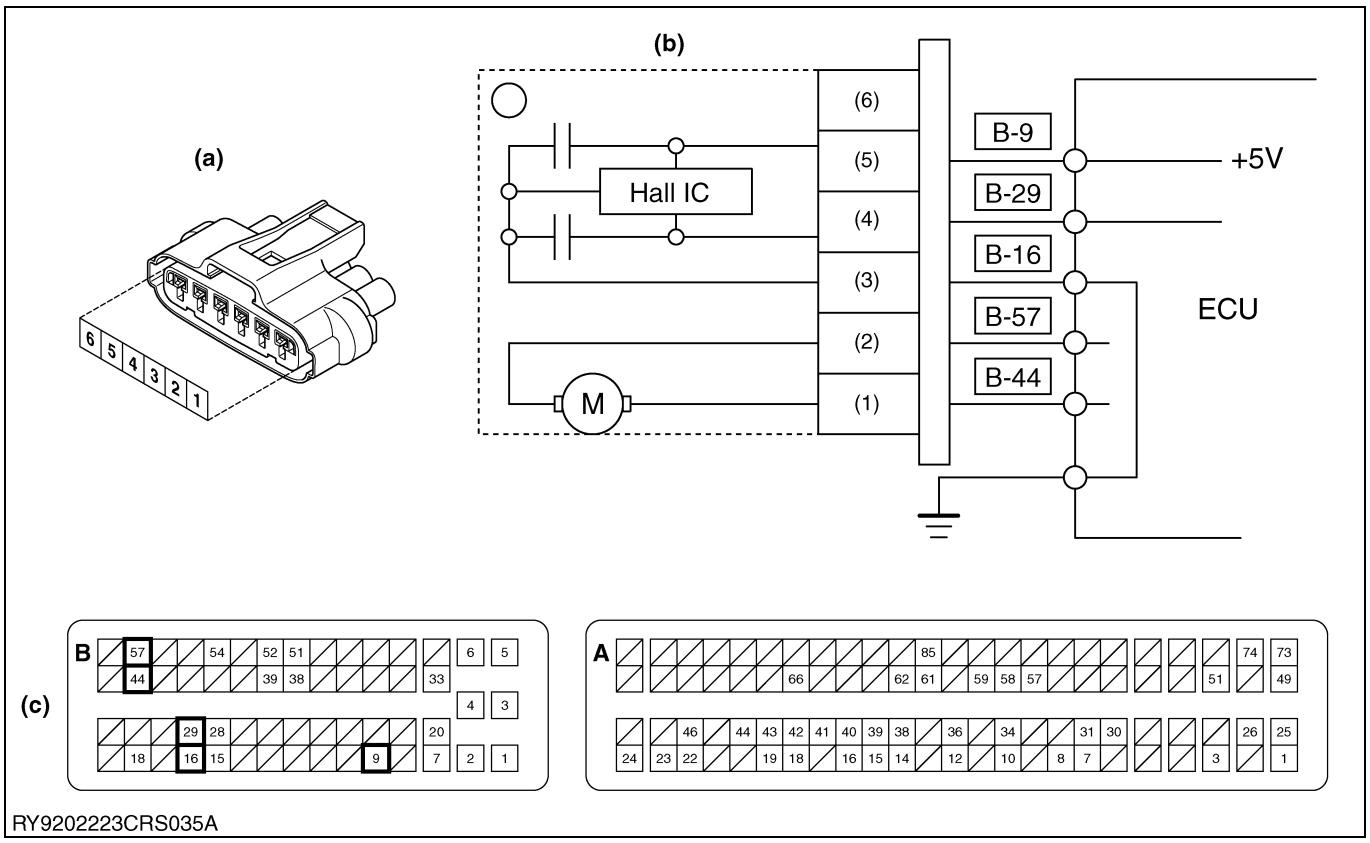
Factory specification	No DTC is output.

OK	Normal.
NG	Replace the intake throttle assembly.

(a) CAN1 Connector

RY9202138CRS0395US0

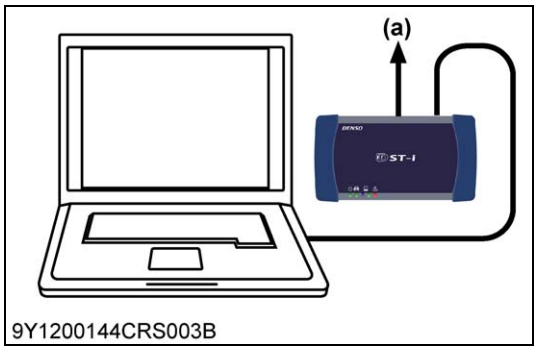
(34) Intake Throttle Lift Sensor Abnormality (DTC P2621, P2622)



(1) Terminal ITV–
(2) Terminal ITV+
(3) Terminal Ground
(4) Terminal ITS (Output)
(5) Terminal Power (+5 V)
(6) No Connection

(a) Terminal Layout (Wire Harness Side)
(b) Intake Throttle Valve
(c) ECU Connector (Wire Harness Side)

RY9202223CRS0142US0



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.

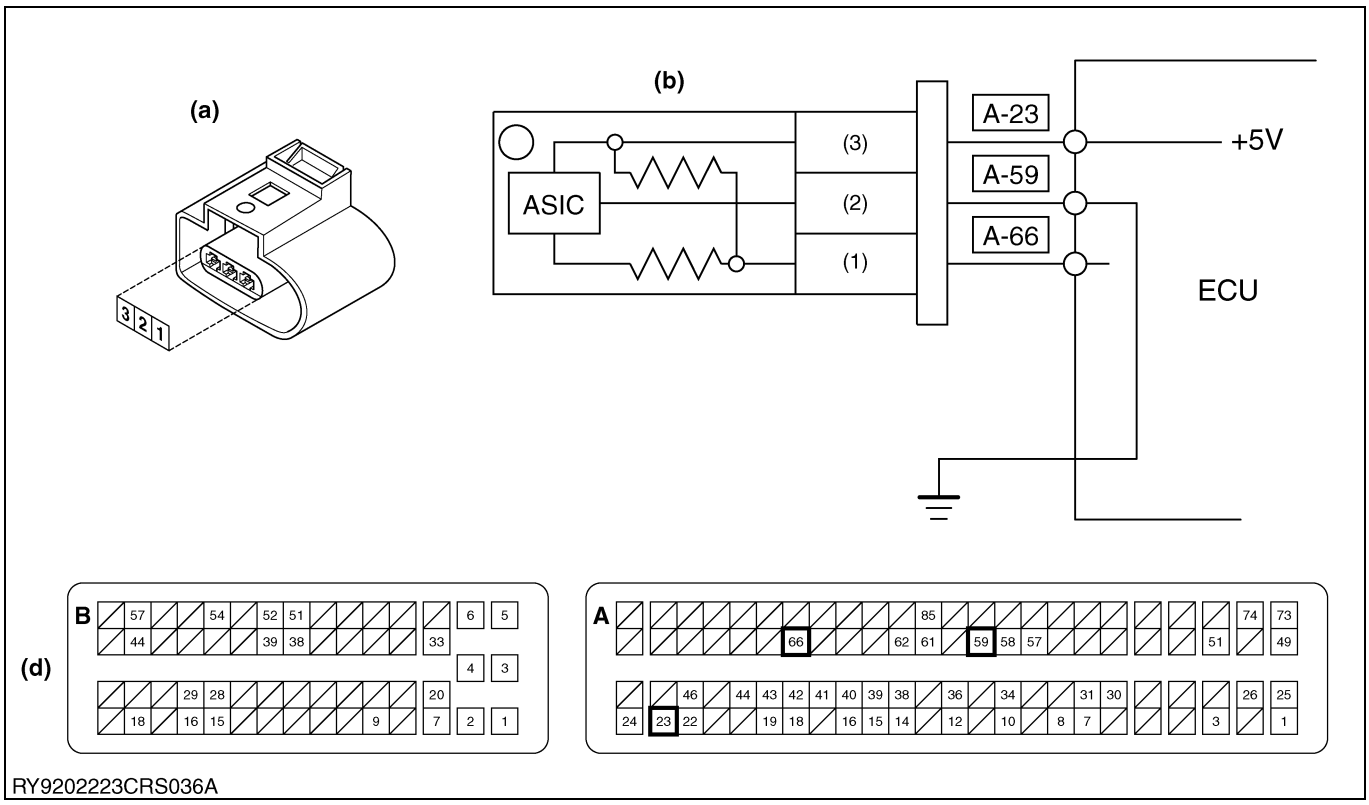
Factory specification	No DTC is output.

OK	Normal.
NG	Replace the intake throttle assembly.

(a) CAN1 Connector

RY9202138CRS0395US0

(35) Differential Pressure Sensor 1 Abnormality (DTC P2454, P2455)



RY9202223CRS036A

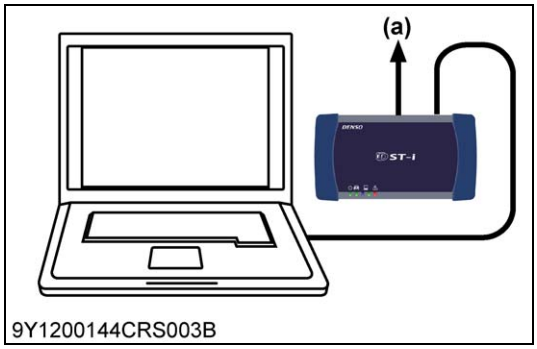
(1) Terminal DPS
(2) Terminal A-GND3
(3) Terminal A-VCC12

(a) Terminal Layout (Wire Harness Side)

(b) Differential Pressure Sensor

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0143US0



9Y1200144CRS003B

1. Check the Differential Pressure Signals

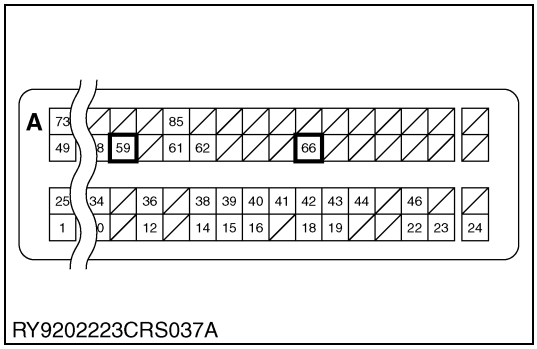
1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again. Then, check the "Differential pressure1" and "Differential pressure 1 output voltage" on the diagnosis tool data monitor.

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

RY9202223CRS0144US0



RY9202223CRS037A

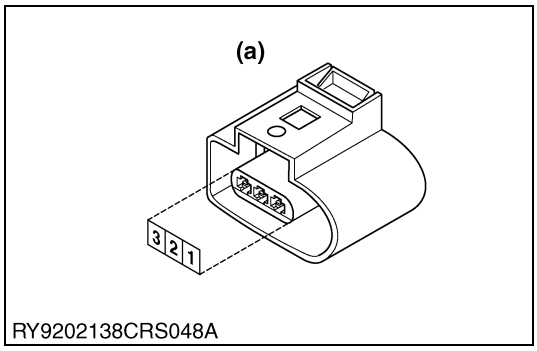
2. Measure the ECU Terminal Voltage

1. Move the key switch from the OFF to the ON position, and measure the voltage between ECU terminals A-59 and A-66.

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".	

RY9202223CRS0145US0



RY9202138CRS048A

3. Measure the Voltage Between Differential Pressure Sensor Terminals

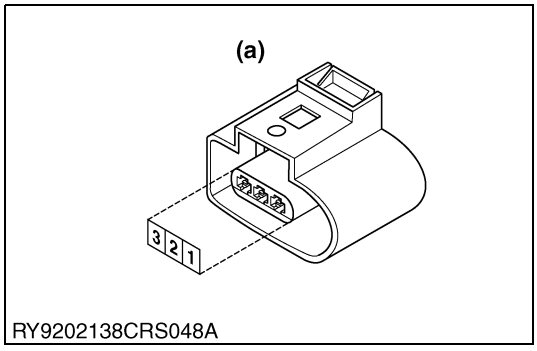
1. Place the key switch in the ON position, and measure the voltage between terminals (2) and (3) of the differential pressure sensor at the wiring harness side.

Factory specification	
Engine state	Output voltage
Key switch ON	Approx. 0.7 V

OK	Check the wiring harness (between ECU terminal A-66 and sensor terminal (3)). → Repair the faulty area.
NG	Go to "4. Measure the Voltage Between Differential Pressure Sensor Terminals".

(1) Terminal DPS
(2) Terminal A-GND3
(3) Terminal A-VCC12
(a) Differential Pressure Sensor Connector (Wire Harness Side)

RY9202223CRS0146US0



RY9202138CRS048A

4. Measure the Voltage Between Differential Pressure Sensor Terminals

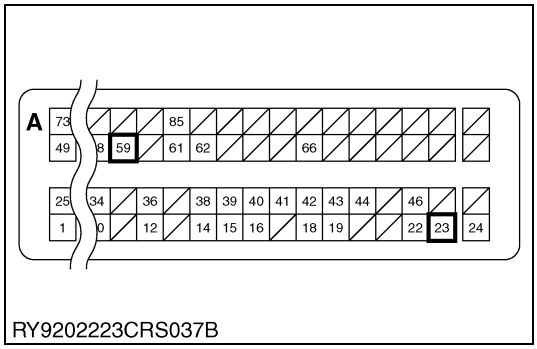
1. Set the key switch to the OFF position, and unplug the differential pressure sensor connector from the socket.
2. Place the key switch in the ON position, and measure the voltage between terminals (1) and (2) of the differential pressure sensor connector (at the wiring harness side).

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 DPS
(2) Terminal A-GND3
(3) Terminal A-VCC12
(a) Differential Pressure Sensor Connector (Wire Harness Side)

RY9202138CRS0440US0



RY9202223CRS037B

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 A-23 and A-59.

Factory specification	Approx. 5 V

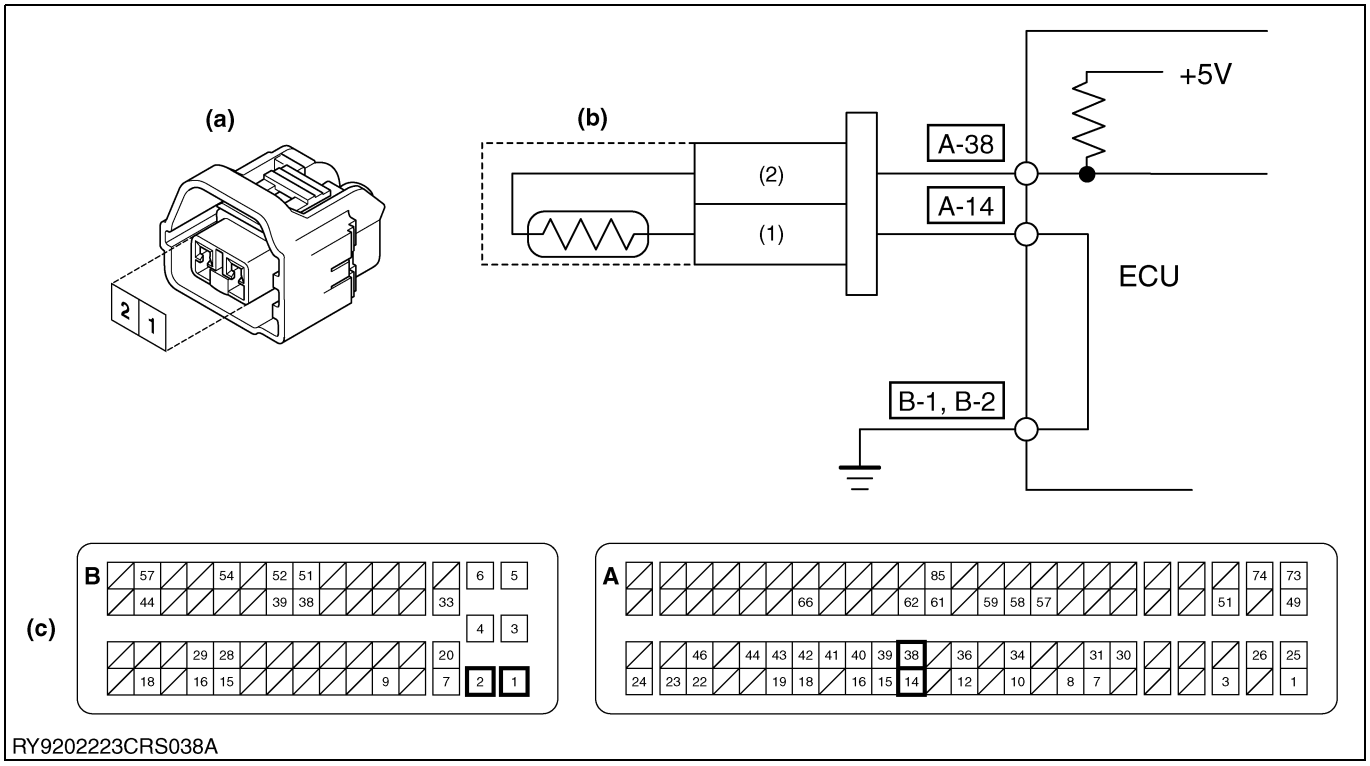
OK	Check the harness connectors and ECU pins.	
	OK	Faulty ECU → Replace.
	NG	Repair or replace the wiring harness, or replace the ECU.
NG	Check the wiring harness (between ECU terminal A-59 and sensor terminal (2) and between ECU terminal A-23 and sensor terminal (1)). → Repair the faulty area.	

■ **NOTE**

- **Check the pipe between diesel particulate filter (DPF) and sensor, When it is damaged, the differential pressure can not reach the sensor.**

RY9202223CRS0147US0

(36) Exhaust Gas Temperature Sensor 0 (T0) Abnormality (DTC P0546, P0547)



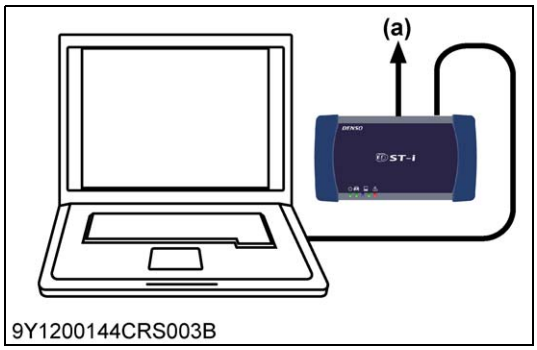
(1) Terminal A-GND3
(2) Terminal IDOC

(a) Terminal Layout (Wire Harness Side)

(b) Exhaust Gas Temperature Sensor 0 (T0)

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0148US0



1. Check the Exhaust Gas Temperature Sensor Signals

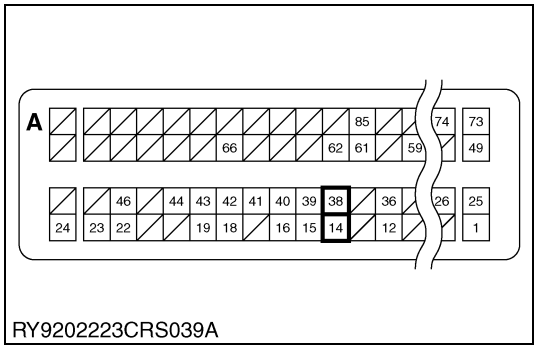
1. Place the key switch in the ON position, and check the "Exhaust gas temperature" and "Exhaust gas temperature sensor output voltage" on the diagnosis tool data monitor.

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

RY9202138CRS0351US0



RY9202223CRS039A

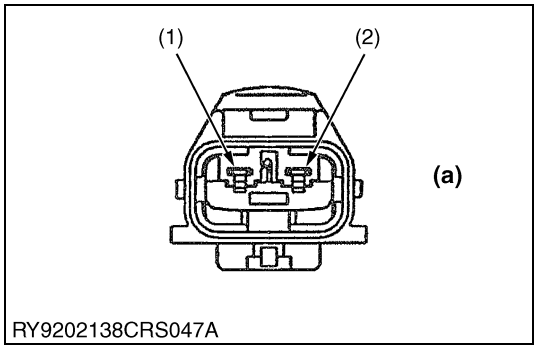
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals A-14 and A-38 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".

RY9202223CRS0149US0



RY9202138CRS047A

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.

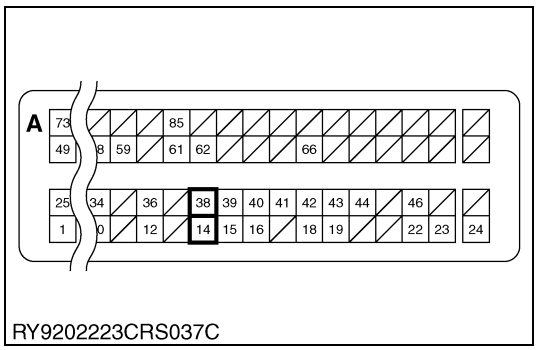
Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

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

(a) Terminal Layout (Sensor Side)

RY9202138CRS0358US0



RY9202223CRS037C

4. Measure the ECU Terminal Voltage

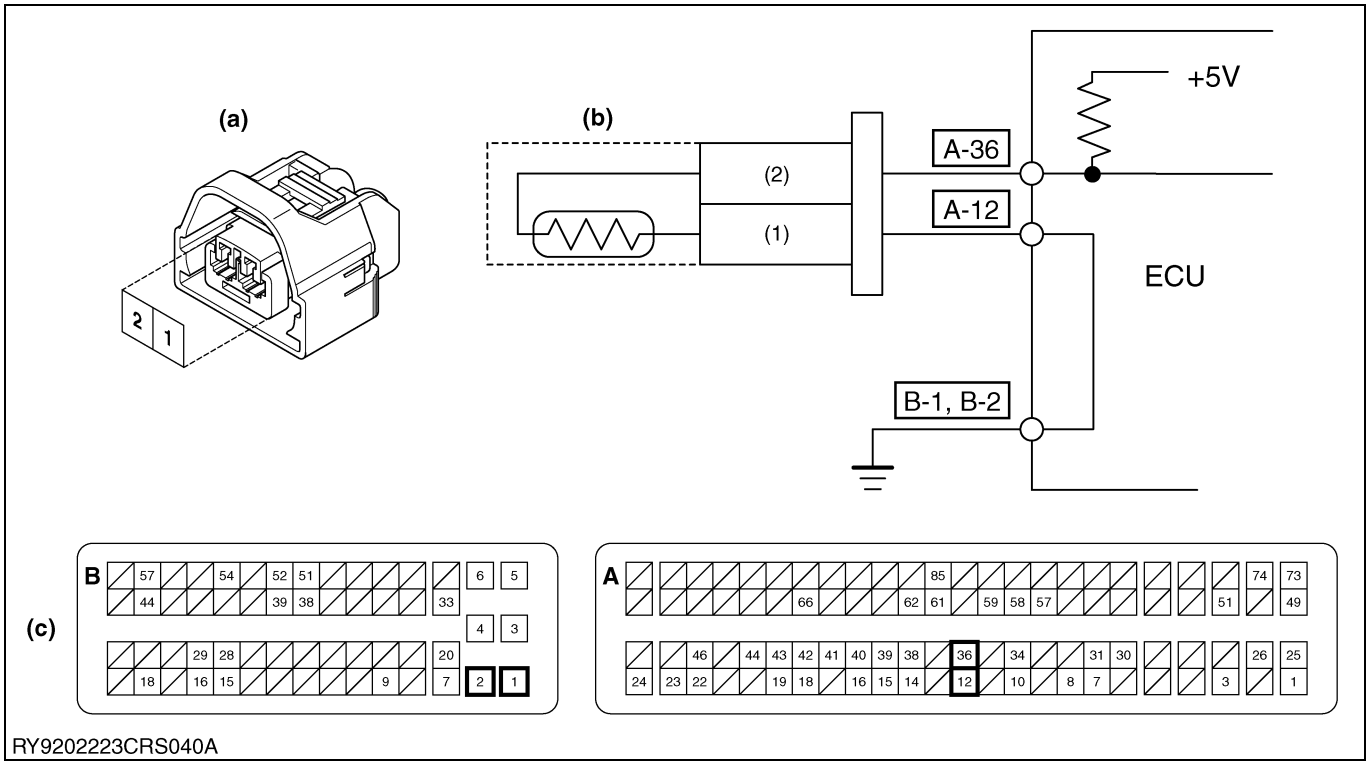
1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals A-14 and A-38 at the ECU side.

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.

RY9202223CRS0150US0

(37) Exhaust Gas Temperature Sensor 1 (T1) Abnormality (DTC P0543, P0544)



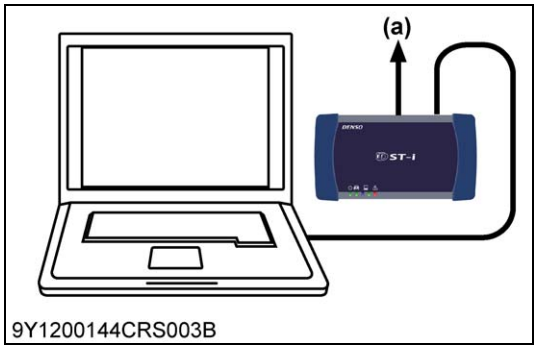
(1) Terminal A-GND3
(2) Terminal ODOC

(a) Terminal Layout (Wire Harness Side)

(b) Exhaust Gas Temperature Sensor 1 (T1)

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0151US0



1. Check the Exhaust Gas Temperature Sensor Signals

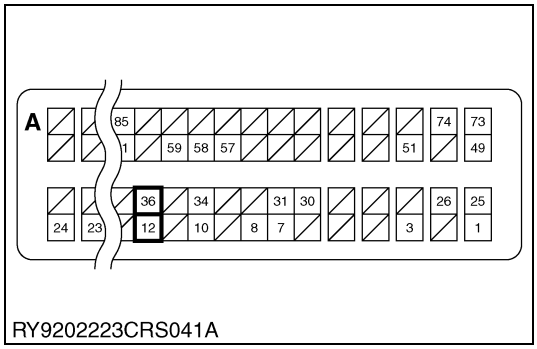
1. Place the key switch in the ON position, and check the "Exhaust gas temperature" and "Exhaust gas temperature sensor output voltage" on the diagnosis tool data monitor.

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

RY9202138CRS0351US0



RY9202223CRS041A

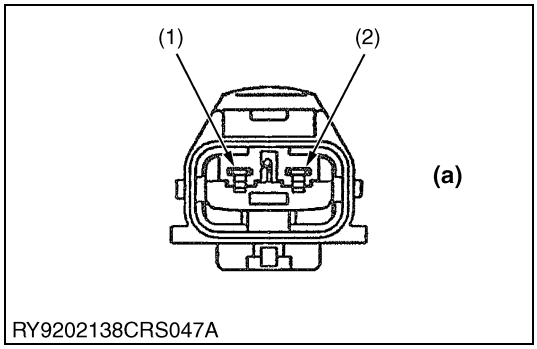
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals A-12 and A-36 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".

RY9202223CRS0152US0



RY9202138CRS047A

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.

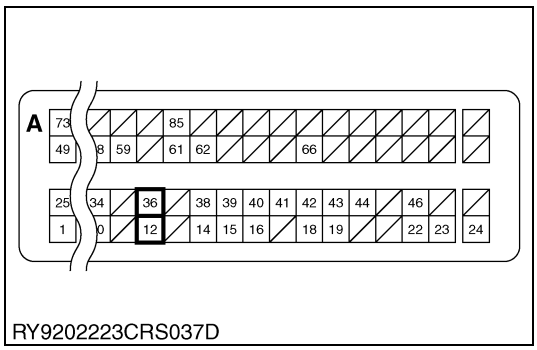
Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

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

(a) Terminal Layout (Sensor Side)

RY9202138CRS0353US0



RY9202223CRS037D

4. Measure the ECU Terminal Voltage

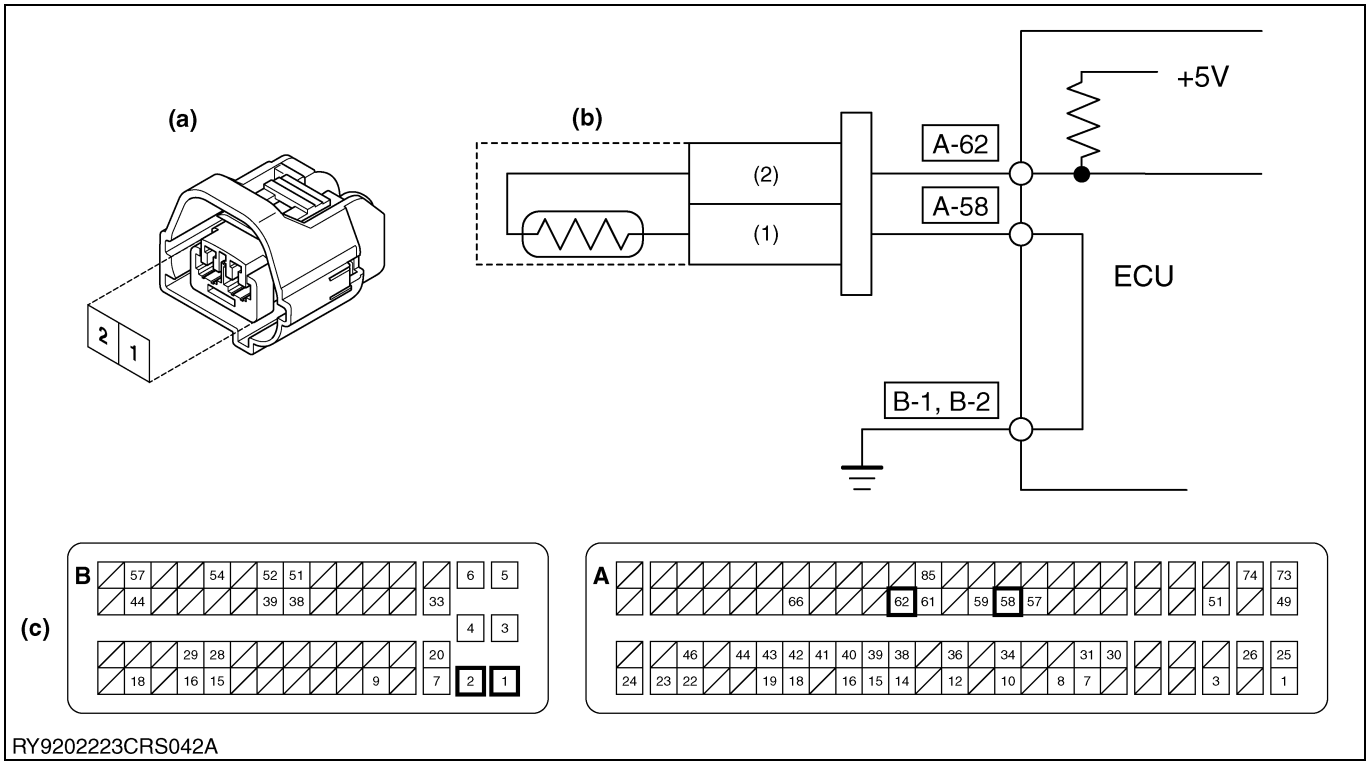
1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals A-12 and A-36 at the ECU side.

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.

RY9202223CRS0153US0

(38) Exhaust Gas Temperature Sensor 2 (T2) Abnormality (DTC P242C, P242D)



RY9202223CRS042A

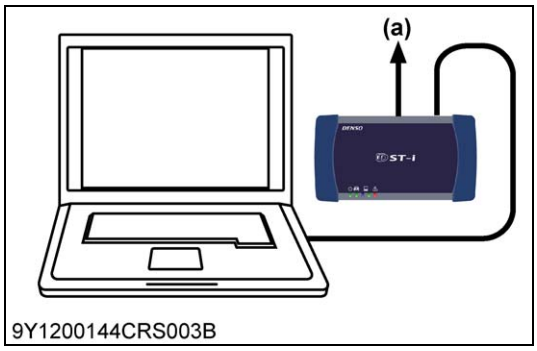
(1) Terminal A-GND3
(2) Terminal ODPF

(a) Terminal Layout (Wire Harness Side)

(b) Exhaust Gas Temperature Sensor 2 (T2)

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0154US0



9Y1200144CRS003B

1. Check the Exhaust Gas Temperature Sensor Signals

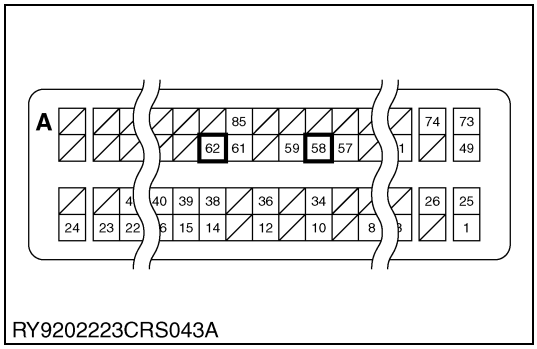
1. Place the key switch in the ON position, and check the "Exhaust gas temperature" and "Exhaust gas temperature sensor output voltage" on the diagnosis tool data monitor.

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

RY9202138CRS0351US0



RY9202223CRS043A

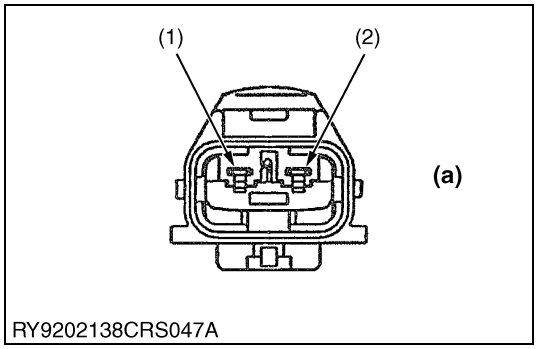
2. Measure the Resistance Between Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals A-58 and A-62 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".

RY9202223CRS0155US0



RY9202138CRS047A

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.

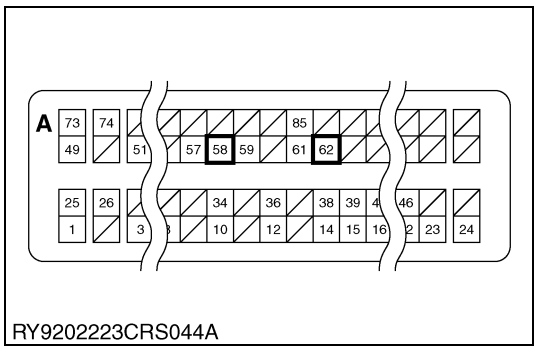
Factory specification	
Temperature	Resistance
100 °C (212 °F)	Approx. 18.3 kΩ
150 °C (302 °F)	Approx. 7.88 kΩ
200 °C (392 °F)	Approx. 4.00 kΩ
250 °C (482 °F)	Approx. 2.30 kΩ

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
(2) Terminal ODPF

(a) Terminal Layout (Sensor Side)

RY9202138CRS0434US0



RY9202223CRS044A

4. Measure the ECU Terminal Voltage

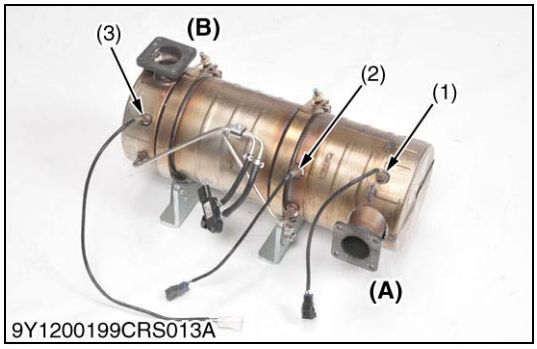
1. Plug the ECU wiring harness connector into socket again, unplug the sensor connector, and measure the voltage between ECU terminals A-58 and A-62 at the ECU side.

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.

RY9202223CRS0156US0

(39) All Exhaust Gas Temperature Sensor Failure (DTC P3018)



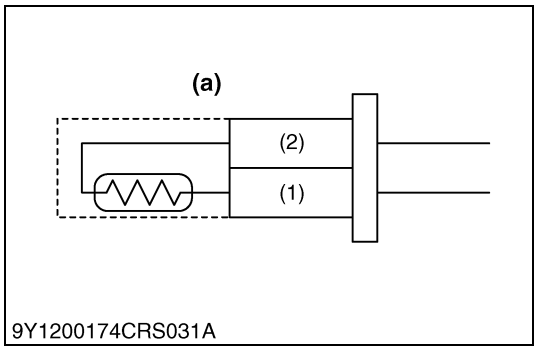
1. Check the Installation of Exhaust Gas Temperature sensor

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

RY9202230CRS0030US0



2. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

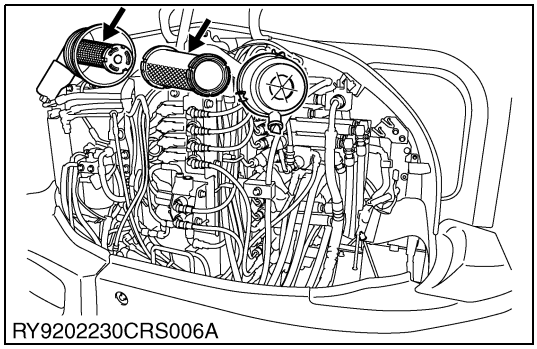
1. Check the exhaust gas temperature sensors (T0, T1 and T2).

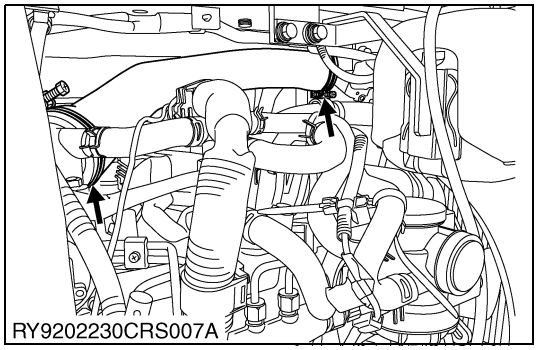
OK	Normal.
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

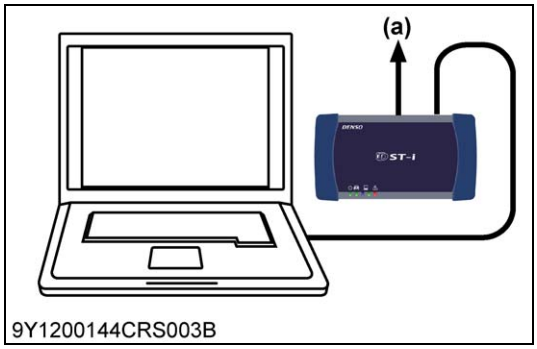
(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF
(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

RY9202138CRS0467US0

(40) Emission Deterioration (DTC P3001)


RY9202230CRS006A


RY9202230CRS007A



9Y1200144CRS003B

1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

■ **NOTE**
- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **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 the engine noise and vibration after starting up the engine. (sound and externals)**

OK	Go to "2. Check the DTC".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

RY9202230CRS0031US0

2. Check the DTC

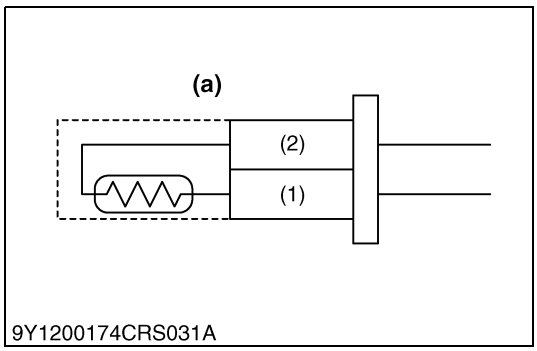
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust Gas Temperature sensor 0", "Exhaust gas temperature sensor 1" and "Exhaust gas temperature sensor 2" on the data monitor function.
3. Check 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

RY9202138CRS0443US0



9Y1200174CRS031A

3. Check the Exhaust Gas Temperature Sensors

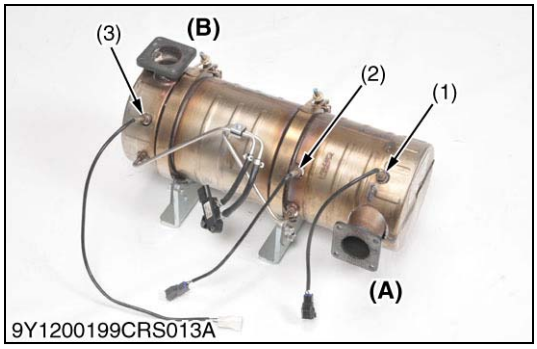
1. Check the exhaust gas temperature sensors (T0, T1 and T2).

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)

RY9202138CRS0444US0

(41) Parked Regeneration Time Out (DTC P3013)



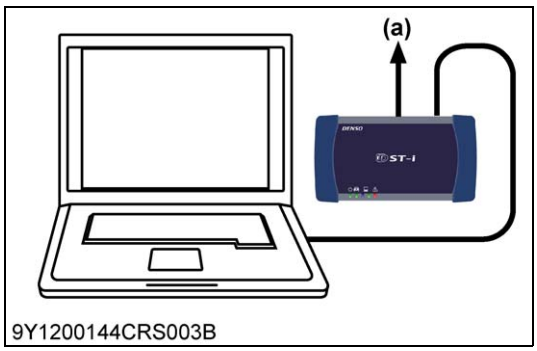
1. Check the Installation of Exhaust Gas Temperature sensor

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

RY9202230CRS0032US0



2. DPF Manual Regeneration

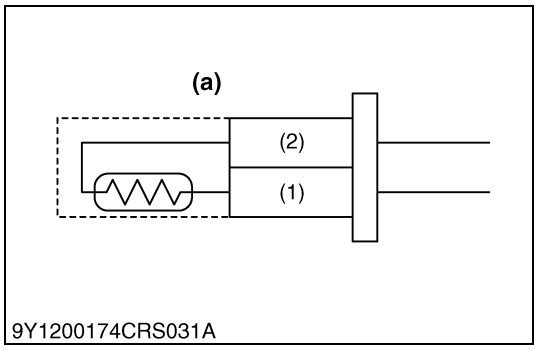
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust Gas Temperature Sensor 0", "Exhaust Gas Temperature Sensor 1" and "Exhaust Gas Temperature Sensor 2" on the data monitor.function.
3. Perform 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

RY9202138CRS0464US0



3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

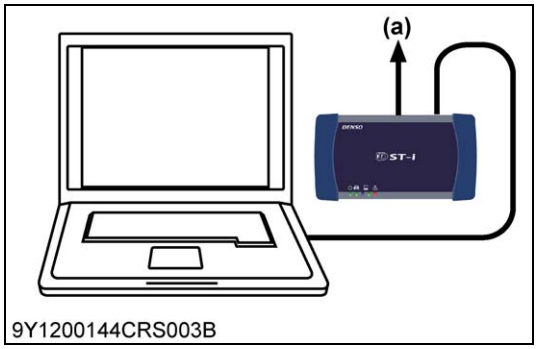
1. Check the exhaust gas temperature sensors (T0, T1 and T2).

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)

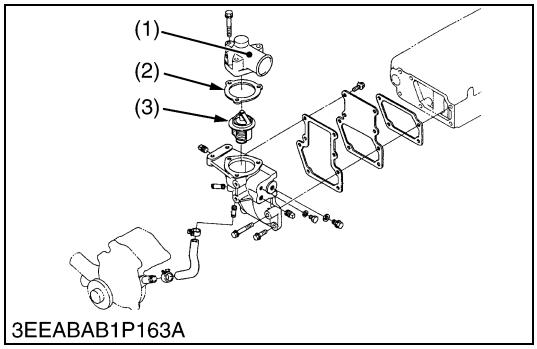
(1) Terminal A-GND3
(2) Terminal IDOC, ODOC or ODPF
(a) Exhaust Gas Temperature Sesnsor (T0, T1 and T2)

RY9202138CRS0465US0

(42) Low Coolant Temperature in Parked Regeneration (DTC P3012)



9Y1200144CRS003B



3EEABAB1P163A

9Y1200199CRS007A

1. Check the Coolant Temperature

1. 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

RY9202138CRS0460US0

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

RY9202138CRS0461US0

3. Check the Coolant Temperature Sensor (Refer to items P0117 and P0118)

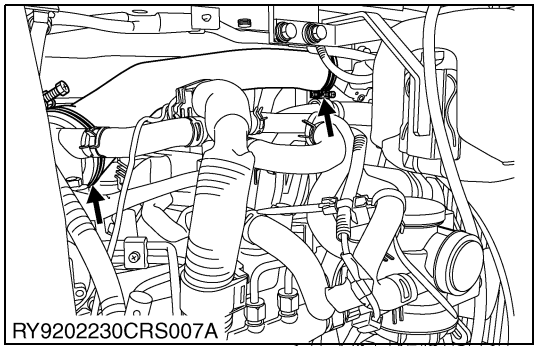
1. Check the coolant temperature sensor.

OK	Normal.
NG	Repair or replace the coolant temperature sensor or engine coolant system. (Follow the diagnostic procedure of items P0117 and P0118)

(1) Coolant Temperature Sensor

RY9202223CRS0158US0

(43) High Frequency of Regeneration (DTC P3024)


RY9202230CRS007A

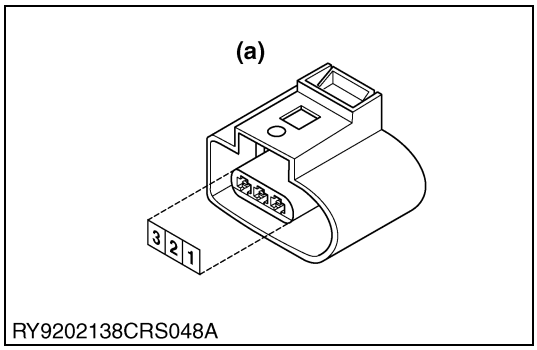
1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

■ **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".

RY9202230CRS0033US0



RY9202138CRS048A

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 (Wire Harness Side)

RY9202138CRS0469US0

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.

RY9202138CRS0470US0

(44) Pressure Limiter Emergency Open (DTC P0087)

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

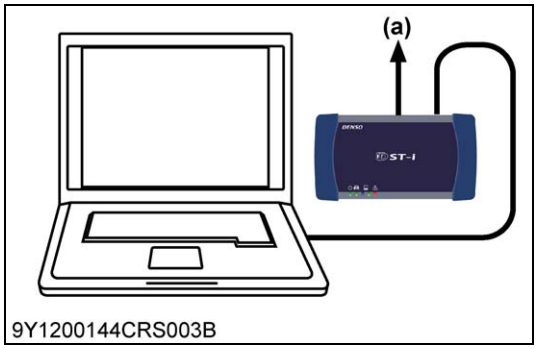
[Abnormal pressure]
1. P0089: SCV stuck
2. P1274: Pump seizing 1
3. P1275: Pump seizing 2

■ **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.**

RY9202138CRS0255US0

■ **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.**

RY9202138CRS0256US0



9Y1200144CRS003B

1. Check the Data Related to the Rail Pressure

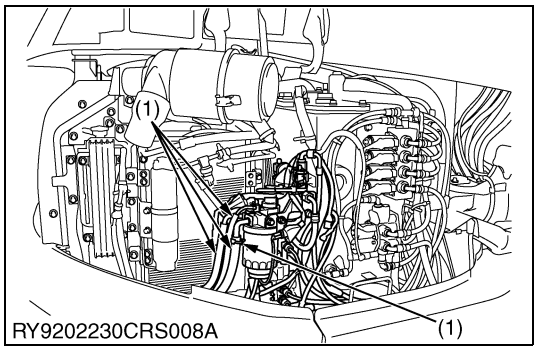
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator dial.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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 dial 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

RY9202230CRS0034US0



RY9202230CRS008A

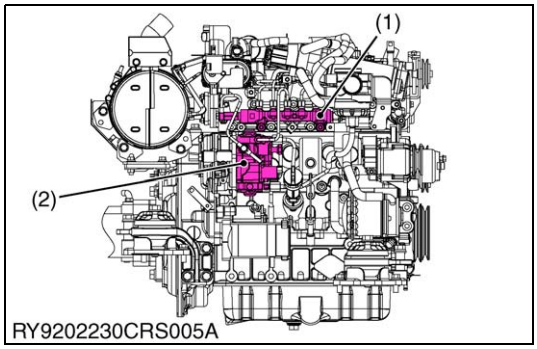
2. Check the Fuel System for the Existence of Air

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

RY9202230CRS0035US0



RY9202230CRS005A

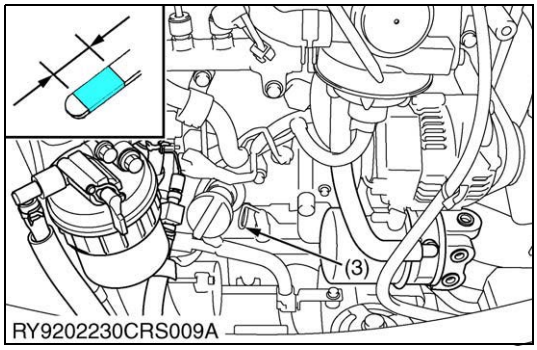
3. Check the Fuel System

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".

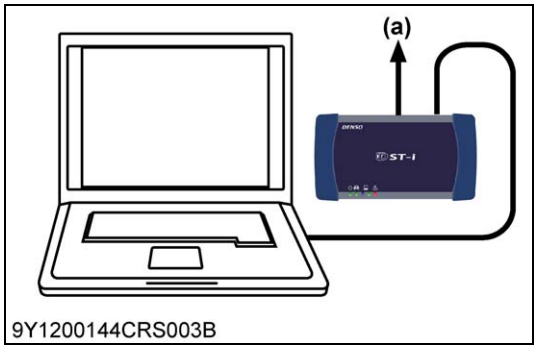
OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".



RY9202230CRS009A

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

RY9202230CRS0036US0



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

1. Check the rail pressure sensor.

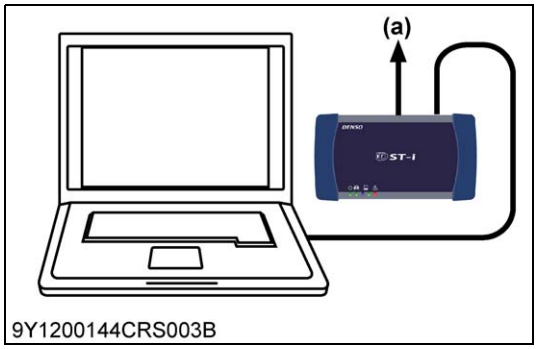
■ **NOTE**

- **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.)

(a) CAN1 Connector

RY9202138CRS0260US0



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.)

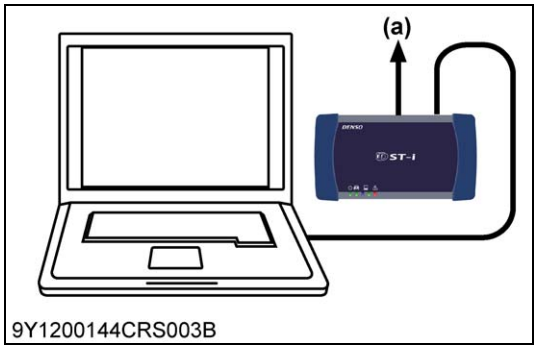
■ **NOTE**

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

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

(a) CAN1 Connector

RY9202223CRS0209US0



9Y1200144CRS003B

6. Check the SCV-related Data

1. Check the "Target rail pressure", "Actual rail pressure", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.

Factory specification	1. The "Pressure feedback integral guard executing flag" must be OFF. 2. 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

RY9202223CRS0163US0

(45) High Rail Pressure (DTC P0088)

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.

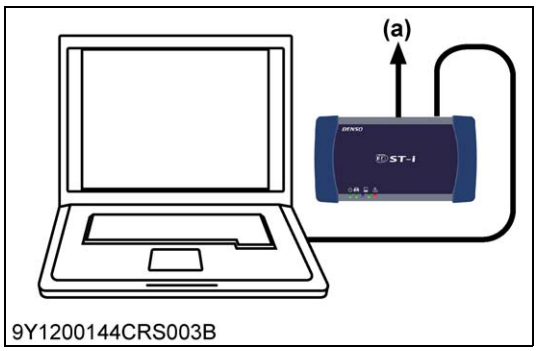
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[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.**

RY9202138CRS0263US0



9Y1200144CRS003B

1. Check the Data Related to the Rail Pressure

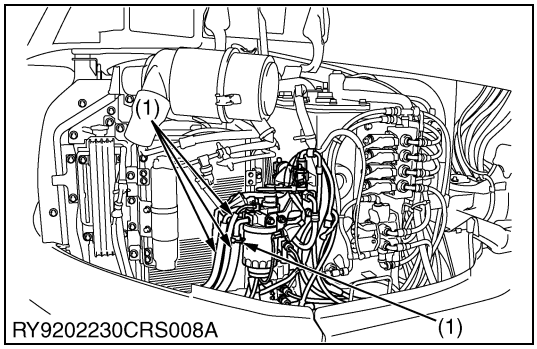
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator dial.

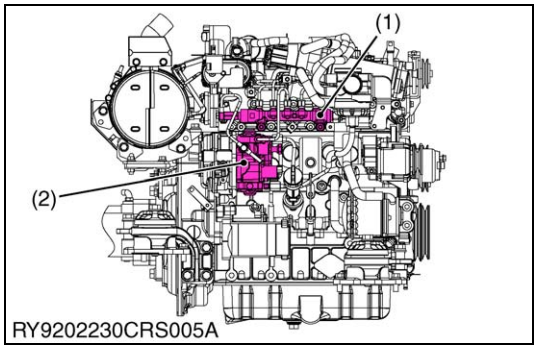
Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 psi) 4. The numerical value is stable under normal operating and the target value corresponds with actual pressure value.

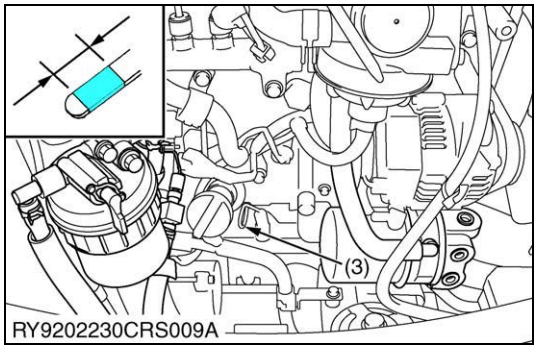
OK	Use all of the available information and try to reproduce the problem by operating the accelerator dial in different ways and by changing the environmental conditions.
NG	Go to "2. Check the Fuel System for the Existence of Air".

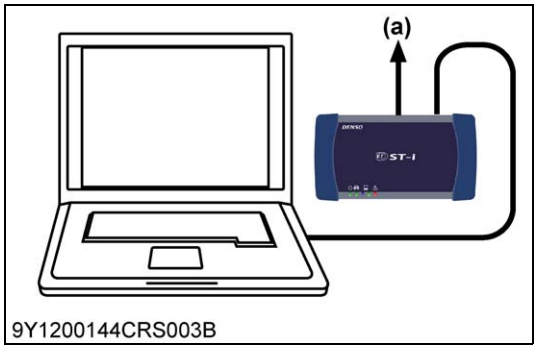
(a) CAN1 Connector

RY9202230CRS0037US0









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

RY9202230CRS0038US0

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".

OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

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

RY9202230CRS0039US0

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

1. Check the rail pressure sensor.

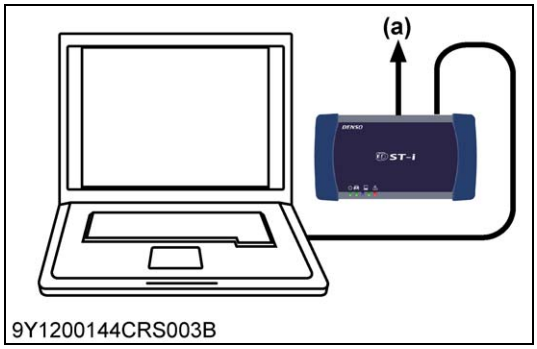
NOTE

- **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.)

(a) CAN1 Connector

RY9202138CRS0260US0



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.)

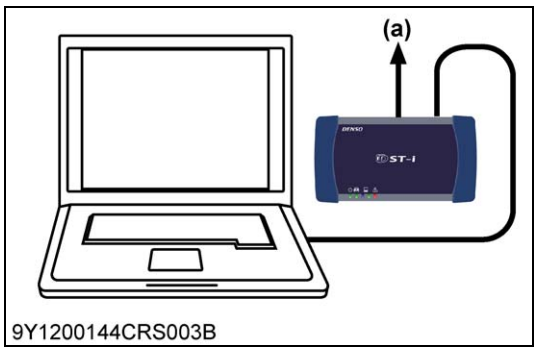
■ **NOTE**

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

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

(a) CAN1 Connector

RY9202223CRS0166US0



6. Check the SCV-related Data

1. Check the "Target rail pressure", "Actual rail pressure", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.

Factory specification	1. The "Pressure feedback integral guard executing flag" must be OFF. 2. 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. (1) It does as well as NE–G phase shift (DTC P0016).

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

RY9202223CRS0167US0

(46) Fuel Leak (in High Pressured Fuel System) (DTC P0093)

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.

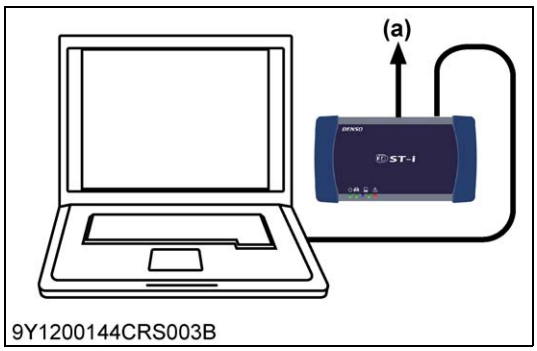
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[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.**

RY9202138CRS0270US0



9Y1200144CRS003B

1. Check the Data Related to the Rail Pressure

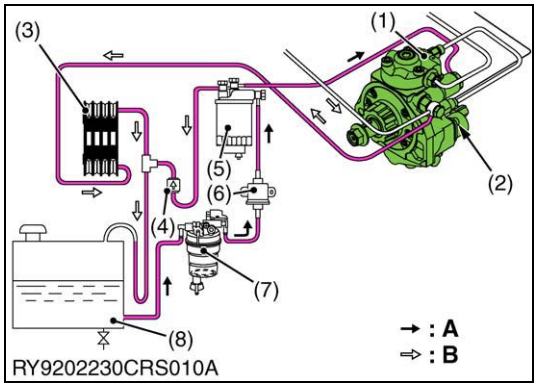
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator dial.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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 dial 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

RY9202230CRS0041US0



2. Check the Fuel System for the Existence of Air

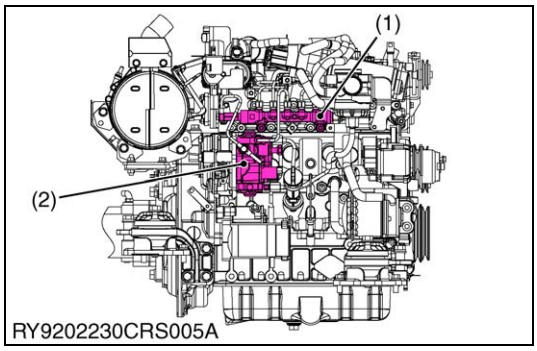
1. Check each joint of the fuel system for the existence of air.
   To detect the existence of air effectively, replace the fuel hose with a transparent one.

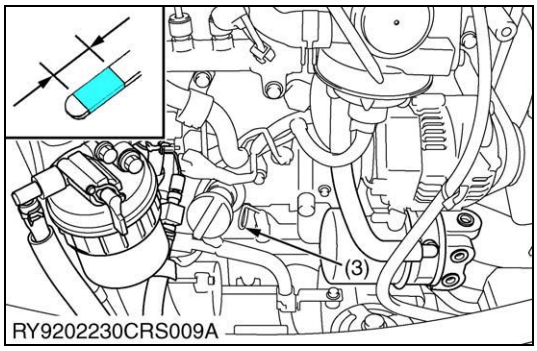
OK	Go to "3. Check the Fuel System".
NG	Rotate the fuel pump sufficiently and bleed the air. Locate the position of the fuel leakage in the piping and repair it.

(1) Supply Pump
(2) SCV (Suction Control Valve)
(3) Fuel Cooler
(4) Check Valve
(5) Fuel Filter (Water Volume Switch, with Heater)
(6) Fuel Feed Pump
(7) Water Separator
(8) Fuel Tank

A : Injected Fuel Flow
B : Returned Fuel Flow

RY9202230CRS0042US0





3. Check the Fuel System

CAUTION

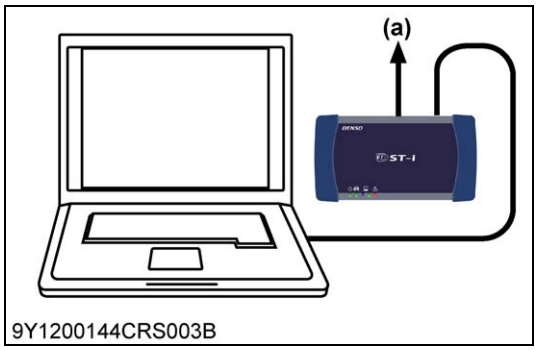
- **Visually check there is no leak in the high pressure fuel pipe system.**
- **A visual check is not possible if a leak (high pressure system) occurs inside the head cover, so check that the oil level has not increased.**

1. Check in accordance with "6. [2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

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

RY9202230CRS0043US0



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

1. Check the rail pressure sensor.

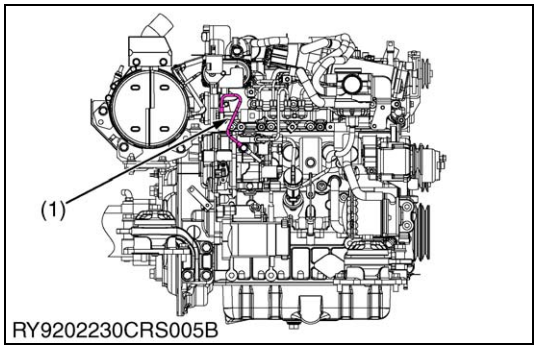
NOTE

- **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.)

(a) CAN1 Connector

RY9202138CRS0281US0



RY9202230CRS005B

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.

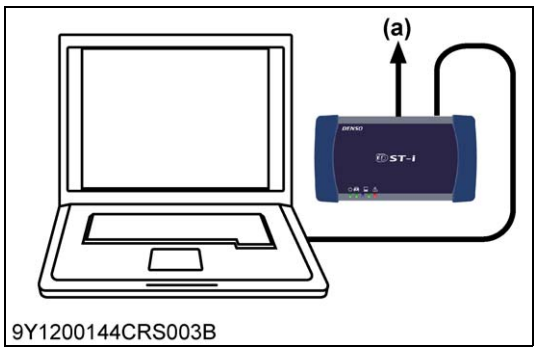
(Reference)

- 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

RY9202230CRS0045US0



9Y1200144CRS003B

6. Check for a Fuel Leakage

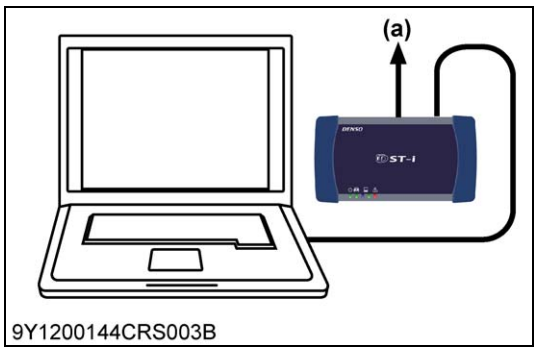
1. Increase the rail pressure by operating the accelerator dial, and check for a fuel leakage.

Factory specification	No fuel leaks.

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

(a) CAN1 Connector

RY9202223CRS0171US0



9Y1200144CRS003B

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.)

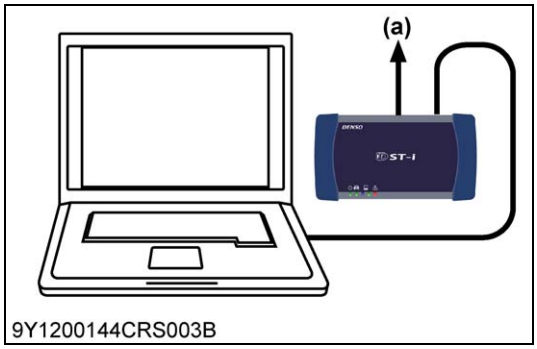
■ **NOTE**

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

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

(a) CAN1 Connector

RY9202223CRS0172US0



9Y1200144CRS003B

8. Check the SCV-related Data

1. Check the "Target rail pressure", "Actual rail pressure", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.

Factory specification	1. The "Pressure feedback integral guard executing flag" must be OFF. 2. 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

RY9202223CRS0173US0

(47) SCV Stuck (DTC P0089)

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.

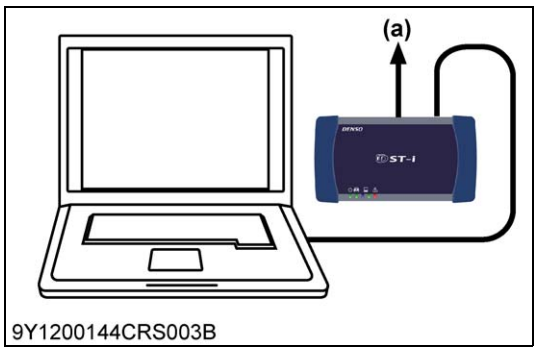
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[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.**

RY9202138CRS0270US0



9Y1200144CRS003B

1. Check the Data Related to the Rail Pressure

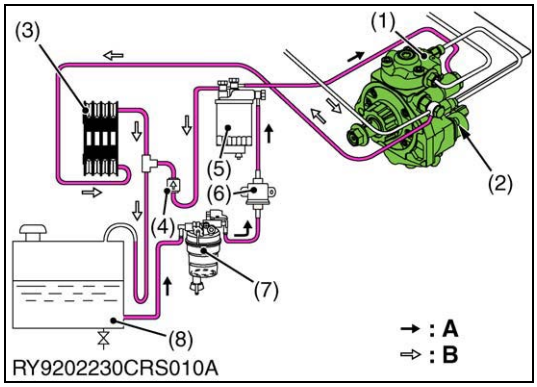
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator dial.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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 dial 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

RY9202230CRS0046US0



2. Check the Fuel System for the Existence of Air

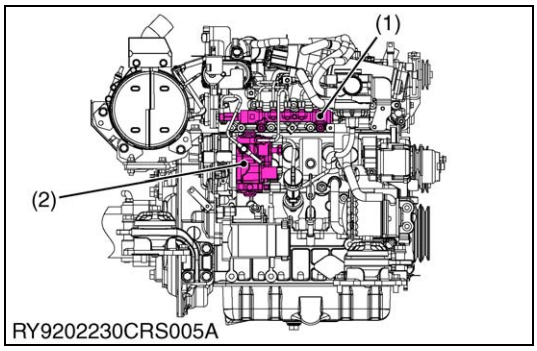
1. Check each joint of the fuel system for the existence of air.
   To detect the existence of air effectively, replace the fuel hose with a transparent one.

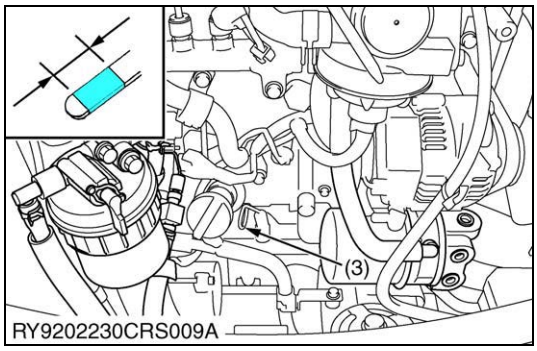
OK	Go to "3. Check the Fuel System".
NG	Rotate the fuel pump sufficiently and bleed the air. Locate the position of the fuel leakage in the piping and repair it.

(1) Supply Pump
(2) SCV (Suction Control Valve)
(3) Fuel Cooler
(4) Check Valve
(5) Fuel Filter (Water Volume Switch, with Heater)
(6) Fuel Feed Pump
(7) Water Separator
(8) Fuel Tank

A : Injected Fuel Flow
B : Returned Fuel Flow

RY9202230CRS0047US0





3. Check the Fuel System

CAUTION

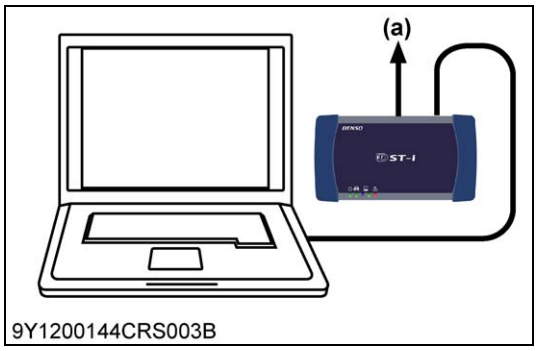
- **Visually check there is no leak in the high pressure fuel pipe system.**
- **A visual check is not possible if a leak (high pressure system) occurs inside the head cover, so check that the oil level has not increased.**

1. Check in accordance with "6. [2] FUEL SYSTEM INSPECTION PROCEDURE".

OK	Go to "4. Check the Rail Pressure Sensor".
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

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

RY9202230CRS0048US0



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

1. Check the rail pressure sensor.

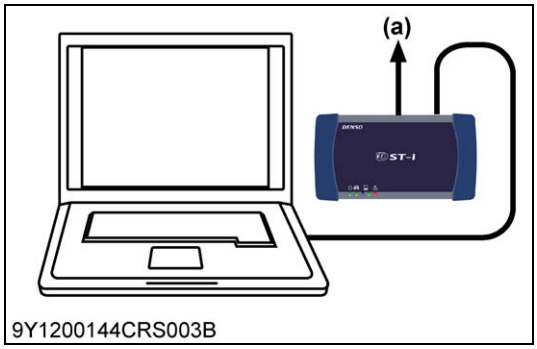
■ NOTE

- **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.)

(a) CAN1 Connector

RY9202138CRS0260US0



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.)

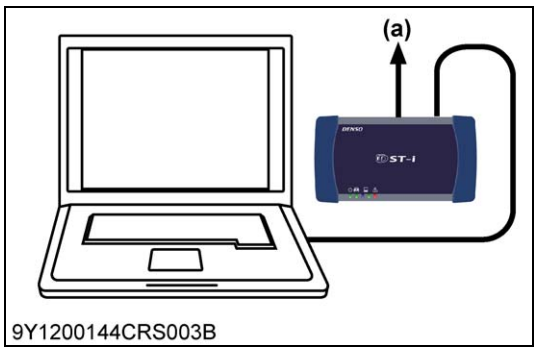
■ **NOTE**

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

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

(a) CAN1 Connector

RY9202223CRS0166US0



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", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.

Factory specification	1. The "Pressure feedback integral guard executing flag" must be OFF. 2. 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.**

2. Perform repeated sudden accelerations and decelerations, and check 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

RY9202223CRS0175US0

(48) Pump Seizing (DTC P1274, P1275)

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.

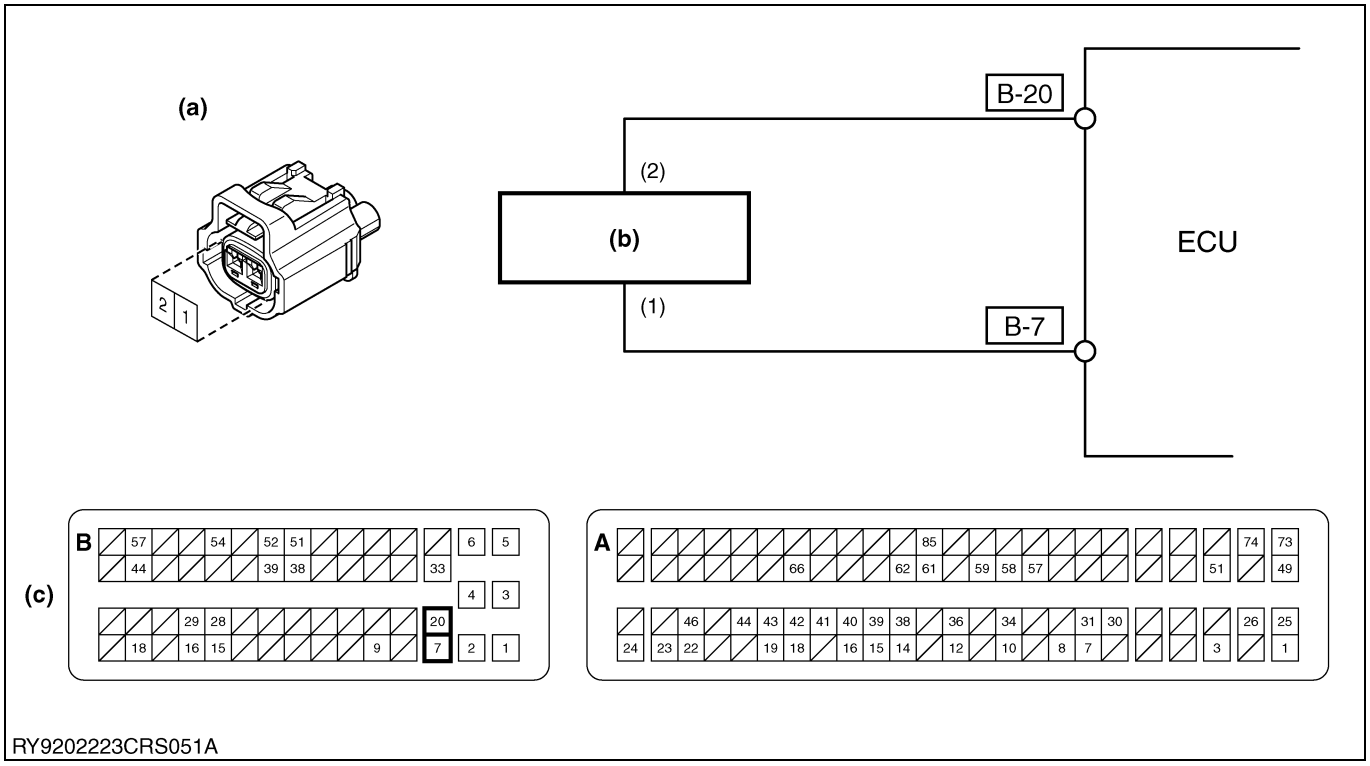
***Pressure system DTCs**
[High pressure abnormality]
1. P0088: High rail pressure

[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.**

RY9202138CRS0385US0



RY9202223CRS051A

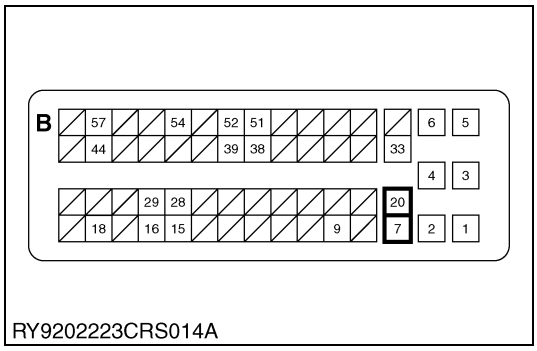
(1) Terminal SCV–
(2) Terminal SCV+

(a) Terminal Layout (Wire Harness Side)

(b) SCV (Suction Control Valve)

(c) ECU Connector (Wire Harness Side)

RY9202223CRS0205US0



RY9202223CRS014A

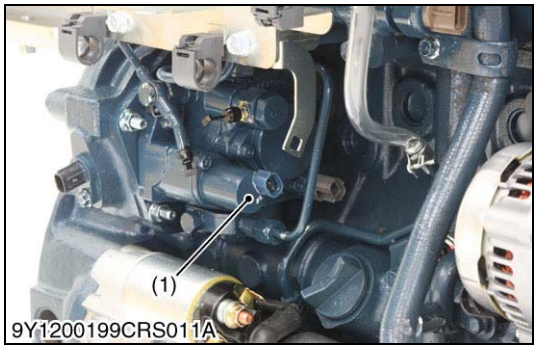
1. Measure the Resistance Between SCV Terminals

1. Place the key switch in the OFF position, unplug the ECU wiring harness connector from the socket, and measure the resistance between terminals B-20 and B-7 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".

RY9202223CRS0176US0



9Y1200199CRS011A

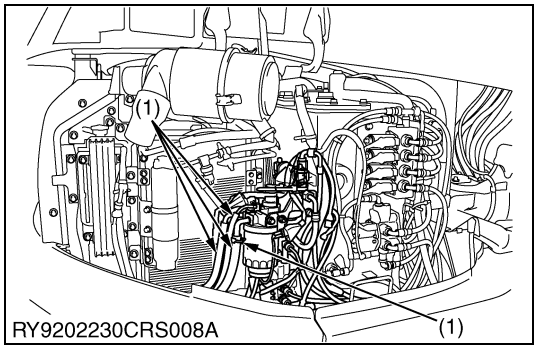
2. Measure the Resistance Between Terminals of SCV Unit

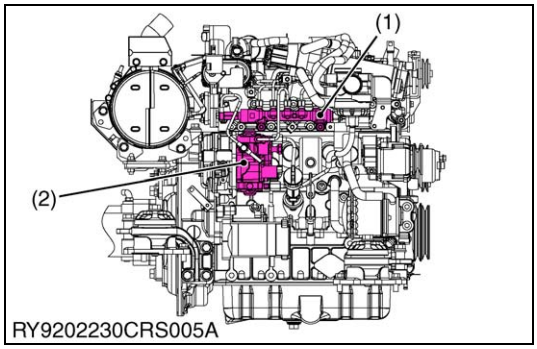
1. Refer to the SCV unit inspection procedures.

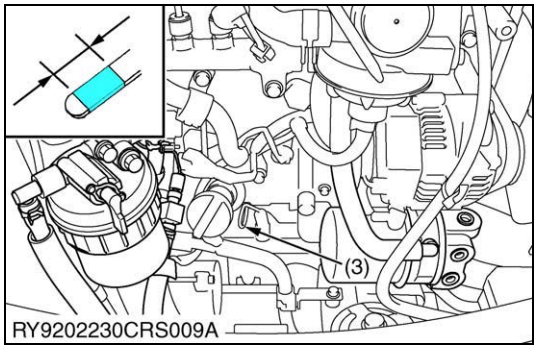
OK	Wiring harness open circuit or connector fault → Check and repair.
NG	Faulty SCV → Repair or replace the pump.

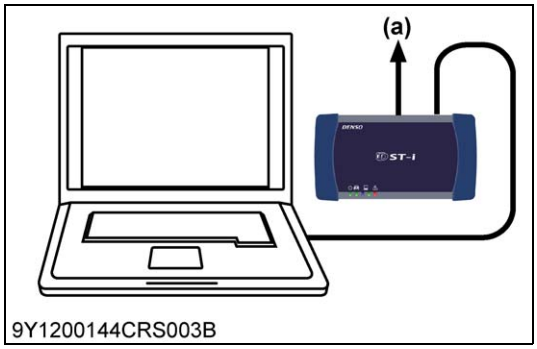
(1) SCV (Suction Control Valve)

RY9202223CRS0177US0









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 pump sufficiently and bleed the air. 2. Locate the position of the fuel leakage in the piping and repair it.

(1) Fuel Hose

RY9202230CRS0050US0

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".

OK	5. Check the data related to the rail pressure
NG	Repair in accordance with "6.[2] FUEL SYSTEM INSPECTION PROCEDURE".

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

RY9202230CRS0051US0

5. Check the Data Related to the Rail Pressure

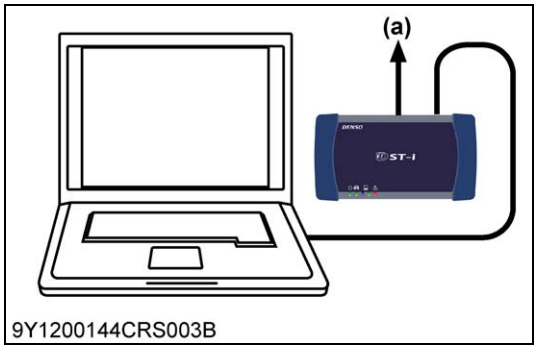
1. Connect the diagnosis tool to the CAN1 connector, and select the "Actual rail pressure" and "Target rail pressure" on the data monitor.
2. Observe the data signals by operating the accelerator dial.

Factory specification	The "Actual rail pressure" always follow to the "Target rail pressure" 1. When idling: 50 to 60 MPa (510 to 610 kgf/cm^2, 7300 to 8700 psi) 2. Accelerator opening 0 → 100 % (During acceleration): Maximum value 80 to 110 MPa (816 to 1120 kgf/cm^2, 11600 to 15900 psi) 3. No-load maximum speed: 75 to 95 MPa (770 to 910 kgf/cm^2, 11000 to 13000 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 dial in different ways and by changing the environmental conditions.
NG	Go to "6. Check the Rail Pressure Sensor".

(a) CAN1 Connector

RY9202230CRS0052US0



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

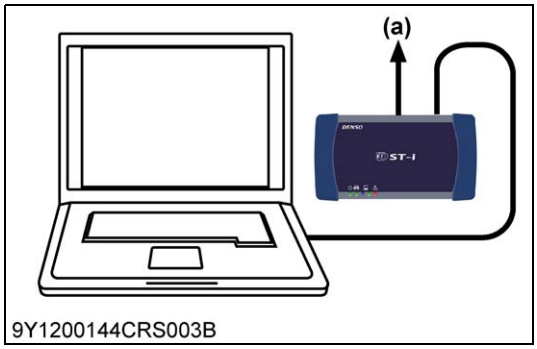
1. Check the rail pressure sensor.

■ **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.)

(a) CAN1 Connector

RY9202138CRS0392US0



7. Check the SCV-related data

1. Check the "Target rail pressure", "Actual rail pressure", "Pump deviation learning status", "Pump deviation learning correction value" and "Pressure feedback integral guard execution flag" on the data monitor.

Factory specification	1. The "Pressure feedback integral guard executing flag" must be OFF. 2. 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.**

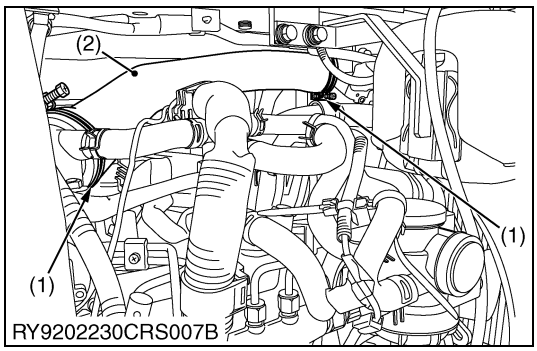
■ **NOTE**
- **"Pump difference learning status"**
  It must be "2" (Learning completed) or "3" (During relearning). If not, keep idling the engine after warming up and when the learning status becomes "2" or "3", make the judgment. Occasionally, it does not shift from 3 to 2. Perform pump difference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

RY9202223CRS0181US0

(49) Intake Air Volume: Low (DTC P0101)



1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

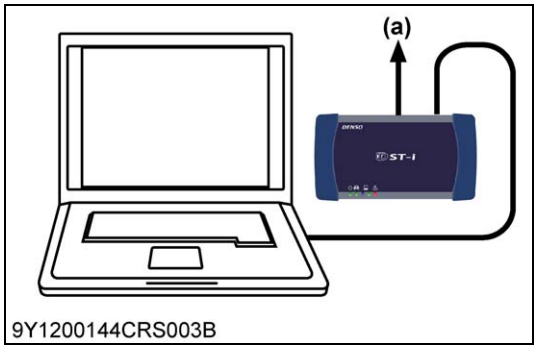
■ **NOTE**

- **Check if the suction hose 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".

(1) Hose Clamp (2) Hose

RY9202230CRS0053US0



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.

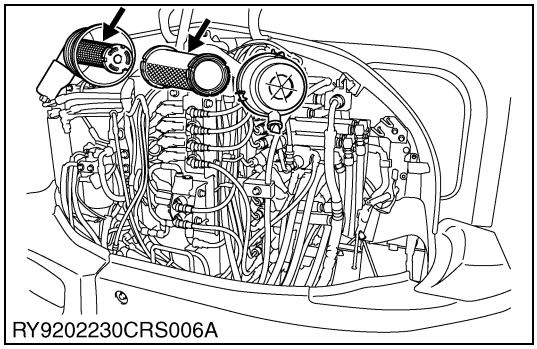
Factory specification	Either DTC is output.

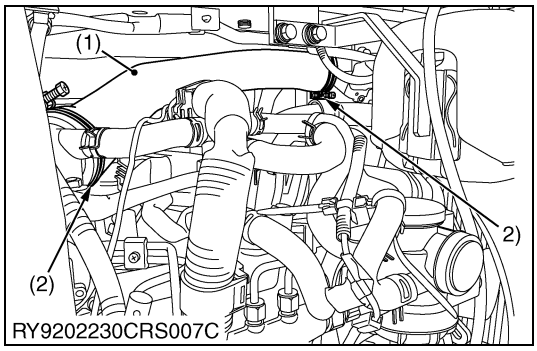
OK	Normal.
NG	Replace the MAF Sensor or replace the ECU.

(a) CAN1 Connector

RY9202138CRS0287US0

(50) Exhaust Gas Temperature Sensor 0: Emergency High (DTC P3002)


RY9202230CRS006A



RY9202230CRS007C

1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

■ **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.**

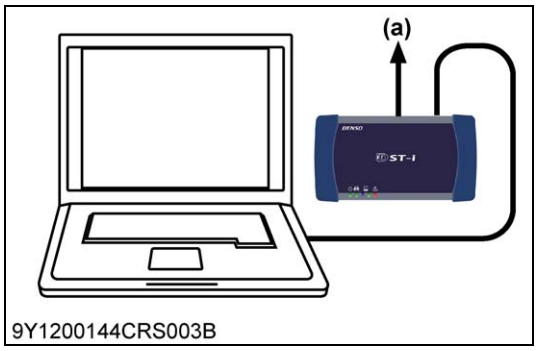
■ **NOTE**

- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **Check if the suction hose 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".

(1) Hose Clamp (2) Hose

RY9202230CRS0054US0



9Y1200144CRS003B

2. Check the Exhaust Gas Temperature

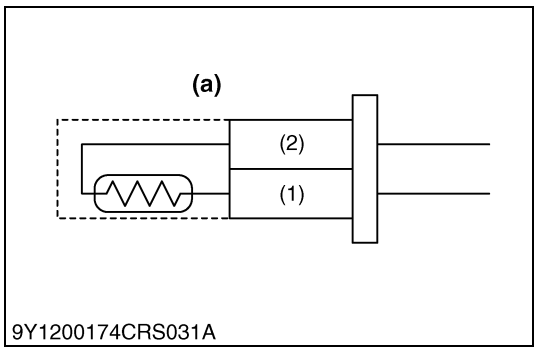
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust gas temperature Sensor 0", "Exhaust Gas Temperature Sensor 1" and "Exhaust Gas Temperature Sensor 2" on the data monitor function.
3. If 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

RY9202138CRS0446US0



9Y1200174CRS031A

3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

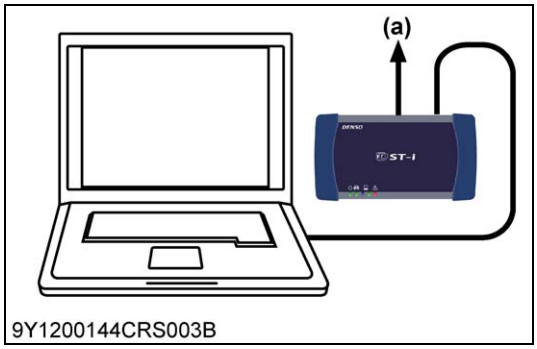
1. Check the exhaust gas temperature sensors (T0, T1 and T2).

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 Sensor (T0, T1 and T2)

RY9202138CRS0447US0



9Y1200144CRS003B

4. Check the DTC

1. Check the engine noise and vibration after starting up the engine. (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.

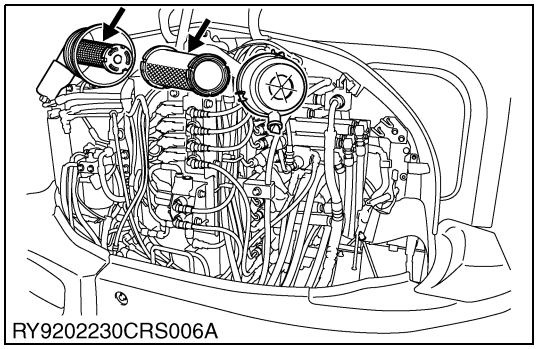
Factory specification	No DTC is output.

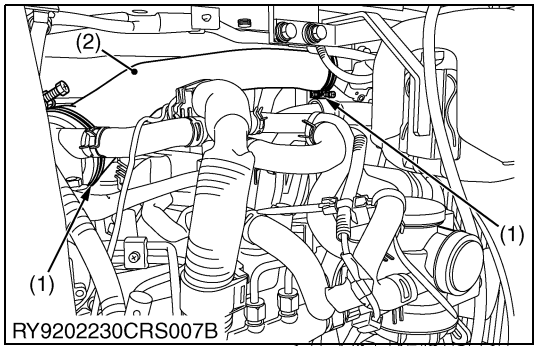
OK	Normal.
NG	Repair or replace the exhaust gas temperature sensor or engine combustion main parts. (Follow the diagnostic procedure of items P0543, P0546 and P242C)

(a) CAN1 Connector

RY9202230CRS0055US0

(51) Exhaust Gas Temperature Sensor 1: Emergency High (DTC P3003)


RY9202230CRS006A



RY9202230CRS007B

1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

■ **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.**

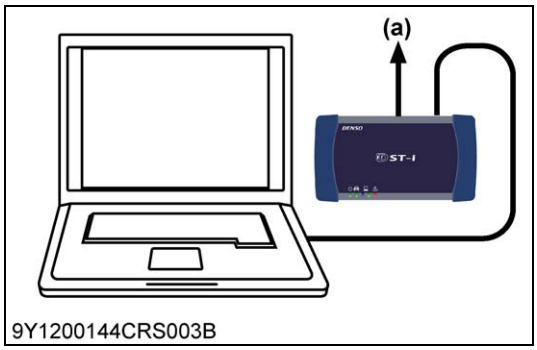
■ **NOTE**

- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **Check if the suction hose 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".

(1) Hose Clamp (2) Hose

RY9202230CRS0056US0



9Y1200144CRS003B

2. Check the Exhaust Gas Temperature

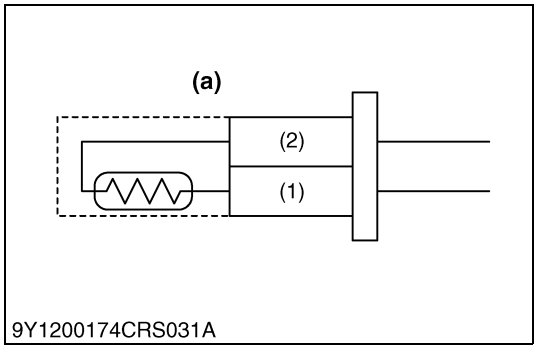
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust gas temperature Sensor 0", "Exhaust Gas Temperature Sensor 1" and "Exhaust Gas Temperature Sensor 2" on the data monitor function.
3. If 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

RY9202138CRS0446US0



9Y1200174CRS031A

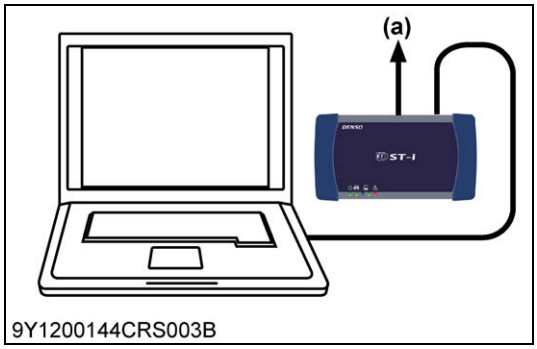
3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

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 Sensor (T0, T1 and T2)

RY9202138CRS0447US0



9Y1200144CRS003B

4. Check the DTC

1. Check the engine noise and vibration after starting up the engine. (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.

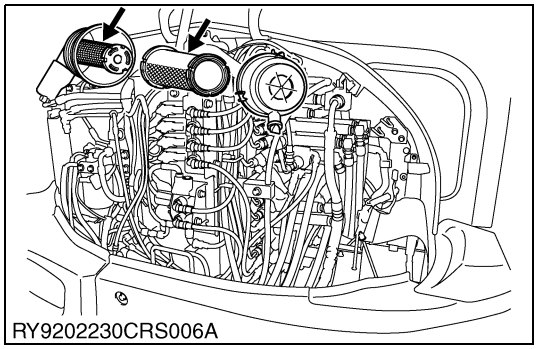
Factory specification	No DTC is output.

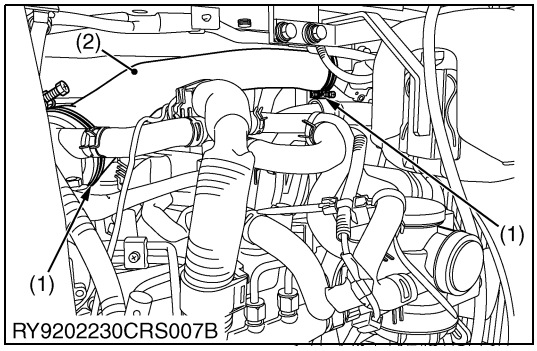
OK	Normal.
NG	Replace the DPF assembly.

(a) CAN1 Connector

RY9202230CRS0057US0

(52) Exhaust Gas Temperature Sensor 2: Emergency High (DTC P3004)


RY9202230CRS006A



RY9202230CRS007B

1. Check the Air Intake System

1. Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

■ **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.**

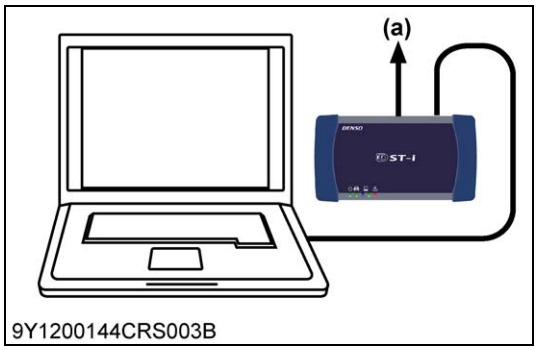
■ **NOTE**

- **Check the clogging condition of the air cleaner. If it is very dirty, replace the new one.**
- **Check if the suction hose 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".

(1) Hose Clamp (2) Hose

RY9202230CRS0058US0



9Y1200144CRS003B

2. Check the Exhaust Gas Temperature

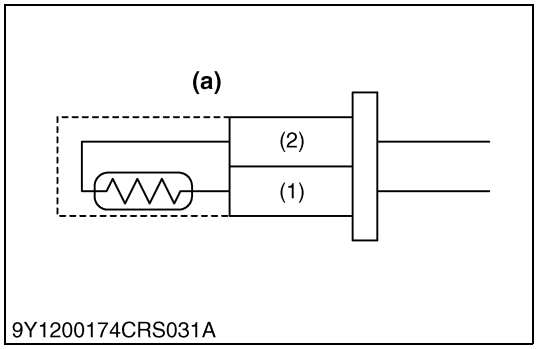
1. Place the key switch in the OFF position, and attach the diagnosis tool to the CAN1 connector.
2. Turn the key switch to the ON position and select the "Exhaust gas temperature Sensor 0", "Exhaust Gas Temperature Sensor 1" and "Exhaust Gas Temperature Sensor 2" on the data monitor function.
3. If 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

RY9202138CRS0446US0



9Y1200174CRS031A

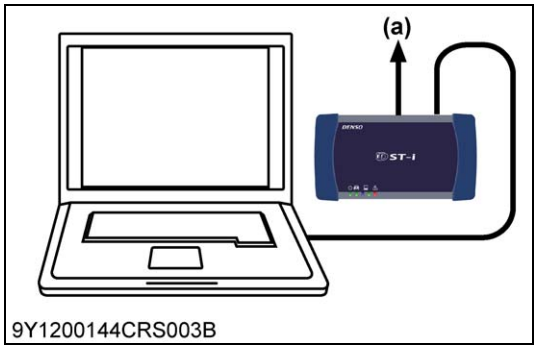
3. Check the Exhaust Gas Temperature Sensors (Refer to items P0543, P0546 and P242C)

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 Sensor (T0, T1 and T2)

RY9202138CRS0447US0



4. Check the DTC

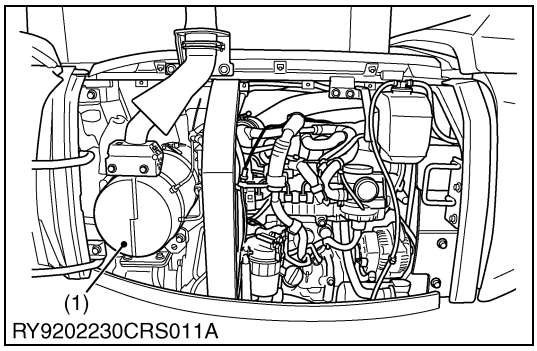
1. Check the engine noise and vibration after starting up the engine. (sound and externals)
2. Check whether the other DTC is output or not by operating the engine in the normal condition.
3. If it is OK, restart and operate the engine for 10 minutes with the engine in the no-load maximum speed status.
   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

RY9202230CRS0059US0



5. Check the DPF

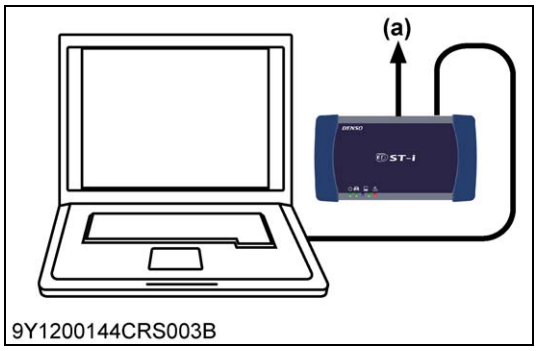
1. Visually check if soot is not attached to the tail pipe which is connected to the DPF assembly.
2. Check whether the intake throttle opens completely after starting up the engine.
3. Check whether the coolant temperature is over 65 °C (149 °F) by operating the engine in the normal condition.

OK	Replace the ECU.
NG	Replace the DPF assembly.

(1) DPF Assembly

RY9202230CRS0060US0

(53) Starter Relay Start Warning (DTC P3023)



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

RY9202223CRS0187US0

(54) Removal of PDF (PCD) (DTC P1A28)

Behaviour during malfunction:
- None

Detection item:
- Removal of DPF

DTC set preconditions:
- Refer to P3018 and P2455

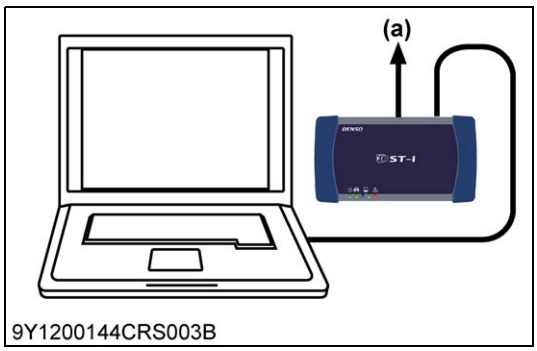
DTC set parameter:
- Exhaust gas temperature sensor T_0, T_1, T_2 and differential pressure sensor are fault (open circuit)

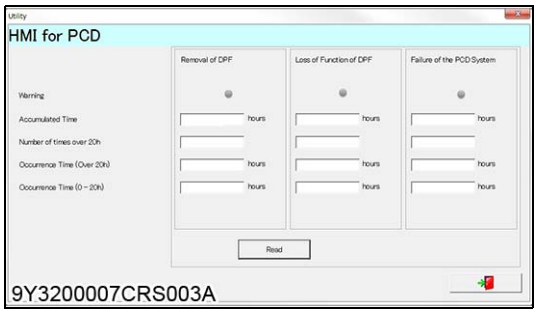
Engine warning light:
- ON (Blinking)

Limp home action by engine ECU (system action):
- No Derating

Recovery from error:
- –

RY9202732CRS0005US0





1. Check the Warnings

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. Check the "HMI for PCD" screen and confirm that which warnings are displayed.
3. Check whether the device is under tampering.

Service specification	No warnings are displayed

OK	Normal
NG	Go to "2. Check the DPF Muffler Assembly".

(a) CAN1 Connector

RY9202732CRS0006US0

2. Check the DPF Muffler Assembly

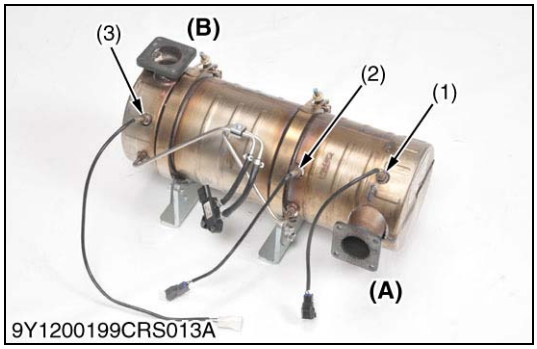
1. Check the installation of the DPF muffler assembly.

■ **NOTE**
- **Check in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".**

OK	Go to "3. Check the Installation of All Exhaust Gas Temperature Sensors".
NG	Repair in accordance with "6.[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE".

(1) DPF Muffler Assembly

RY9202732CRS0007US0



9Y1200199CRS013A

3. Check the Installation of All Exhaust Gas Temperature Sensors

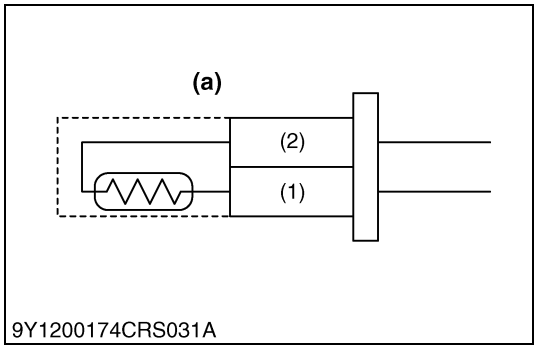
1. Check the installation of all exhaust gas temperature sensors (T_0, T_1 and T_2).

OK	Go to "4. 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 T_0
(2) Exhaust Gas Temperature Sensor T_1
(3) Exhaust Gas Temperature Sensor T_2

(A) Exhaust Inlet Side
(B) Exhaust Outlet Side

RY9202732CRS0008US0



9Y1200174CRS031A

4. Check the Exhaust Gas Temperature Sensors (Refer to Items P0543, P0546 and P242C)

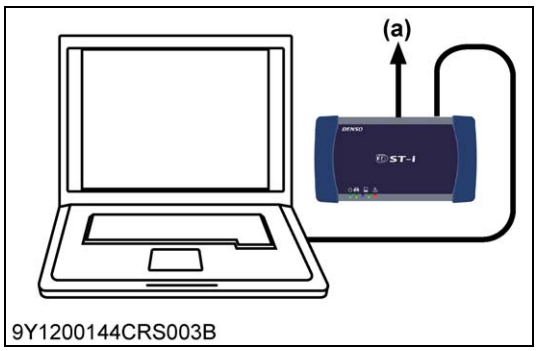
1. Check the exhaust gas temperature sensors (T_0, T_1 and T_2).

OK	Go to "5. Check the Differential Pressure Sensor (Refer to Item P2455)".
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 (T_0, T_1 and T_2)

RY9202732CRS0009US0



9Y1200144CRS003B

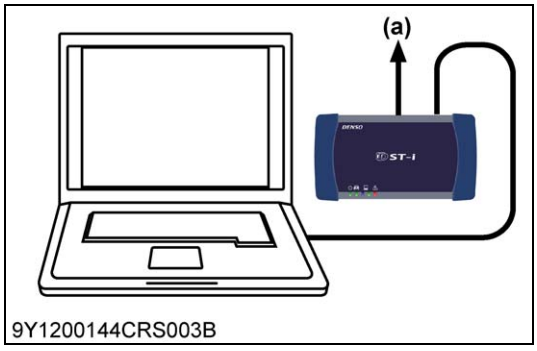
5. Check the Differential Pressure Sensor (Refer to Item P2455)

1. Check the installation of the differential pressure sensor.

OK	Go to "6. Check the DTC Again".
NG	Repair or replace the differential pressure sensor or related parts. (Follow the diagnostic procedure of item P2455)

(a) CAN1 Connector

RY9202732CRS0010US0



9Y1200144CRS003B

6. Check the DTC

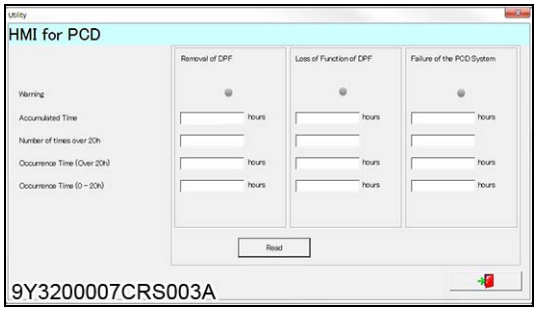
1. Place the key switch in the OFF position, attach the diagnosis tool to the CAN1 connector, and return the key switch to the ON position again.
2. Clear the DTC, and check whether the same DTC (P1A28) is output again or not.
3. Check the "HMI for PCD" screen and confirm that no warning is displayed.

Service specification	No DTC is output and no warnings are displayed.

OK	Normal
NG	Start again from procedure 2. to 6. and confirm the content of procedure.

(a) CAN1 Connector

RY9202732CRS0011US0



9Y3200007CRS003A

(55) Loss of Function of DPF (PCD) (DTC P3015)

Behaviour during malfunction:
- None

Detection item:
- Loss of function of DPF

DTC set preconditions:
- Barometric pressure sensor is normal
- Exhaust gas temperature sensor T_0 is normal
- Differential pressure sensor is normal

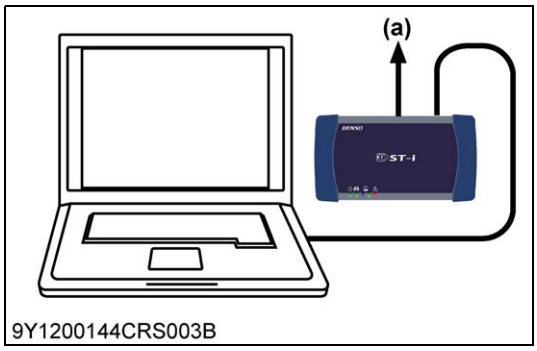
DTC set parameter:
- Duration time in the zone (a certain areas: Engine speed vs Differential Pressure (DP) sensor MAP) ≥ xx sec. (One driving cycle) and DP sensor is normal

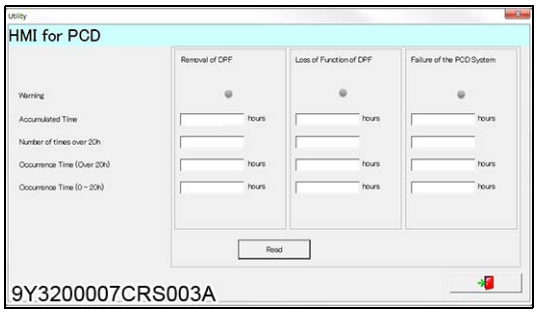
Engine warning light:
- ON (Blinking)

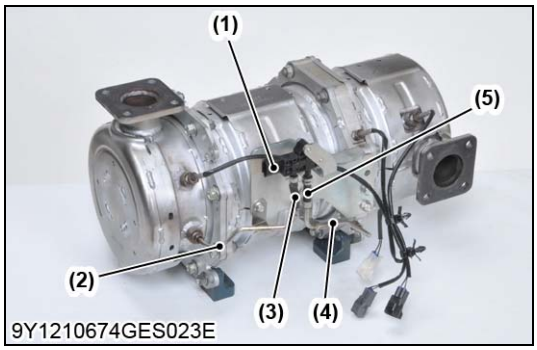
Limp home action by engine ECU (system action):
- No Derating

Recovery from error:
- –

RY9202732CRS0012US0







1. Check the Warnings

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. Check the "HMI for PCD" screen and confirm that which warnings are displayed.
3. Check whether the device is under tampering.

Service specification	No warnings are displayed

OK	Normal
NG	Go to "2. Check the Differential Pressure Sensor (Refer to Items P2454 and P2455)".

(a) CAN1 Connector

RY9202732CRS0013US0

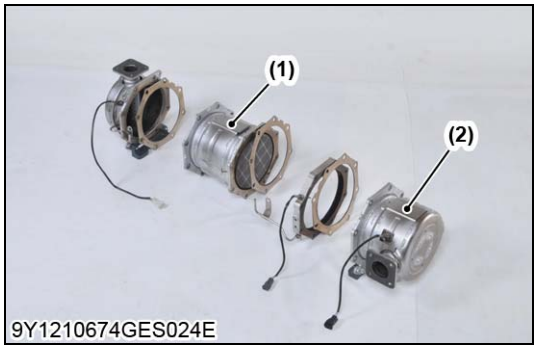
2. Check the Differential Pressure Sensor (Refer to Items P2454 and P2455)

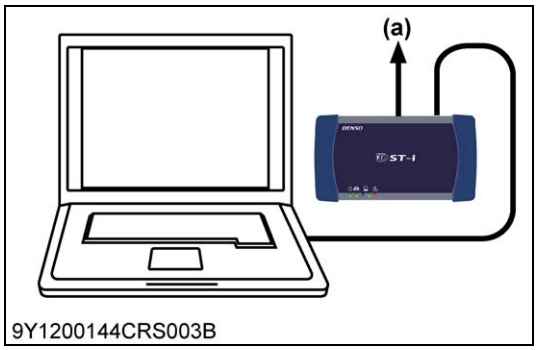
1. Check the installation of the differential pressure sensor.
2. Check the differential pressure sensor (Refer to items P2454 and P2455)

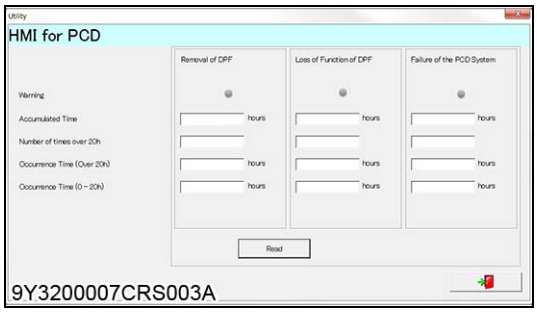
OK	Go to "3. Check the DPF Ceramics Element".
NG	Repair or replace the differential pressure sensor or related parts. (Follow the diagnostic procedure of items P2454 and P2455)

(1) Differential Pressure Sensor
(2) Differential Pressure Pipe
(3) Tube
(4) Differential Pressure Pipe
(5) Tube

RY9202732CRS0014US0







3. Check the DPF Ceramics Element

1. Remove the DPF and check whether there is no crack and loss of the ceramics element.

OK	Reassemble the DPF in the correct direction (Follow the work shop manual procedure of item "Cleaning of DPF") and go to "4. Check the DTC".
NG	Replace the DPF with new one and reassemble in the correct direction. (Follow the work shop manual procedure of item "Cleaning of DPF")

(1) DPF (2) Catalyst (DOC)

RY9202732CRS0015US0

4. 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 (P3015) is output again or not.
3. Check the "HMI for PCD" screen and confirm that no warning is displayed.

Service specification	No DTC is output and no warnings are displayed.

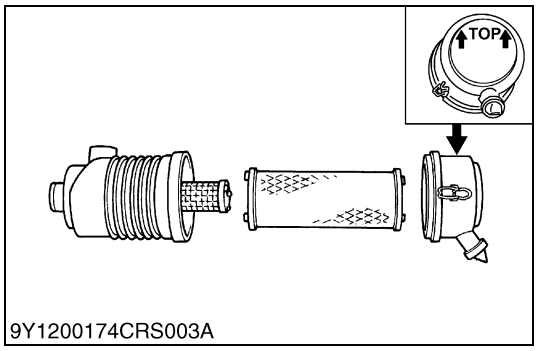
OK	Normal
NG	Start again from procedure 2. to 4. and confirm the content of procedure.

(a) CAN1 Connector

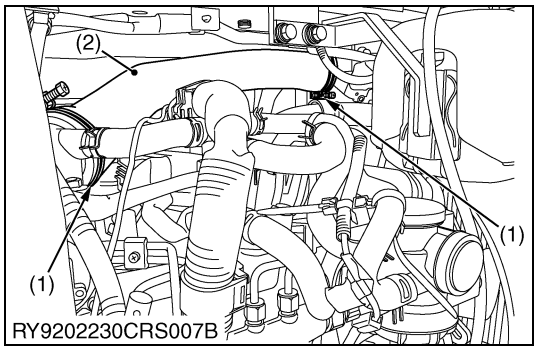
RY9202732CRS0016US0

6. INSPECTION PROCEDURE FOR EACH SYSTEM

[1] AIR INTAKE SYSTEM INSPECTION PROCEDURE



9Y1200174CRS003A



RY9202230CRS007B

1. Check the Air Cleaner

1. Check the air cleaner for clogging.
   - Clean air cleaner element (Outer element) every 200 hours.
   - Replace the air cleaner element (Outer element and Inner element) every 1000 hrs.

OK	Go to "2. Check the Suction Path".
NG	Clean or replace.

RY9202223CRS0188US0

2. Check the Suction Path

1. Check the suction path for leaks. (including EGR valve)
   - 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

RY9202230CRS0061US0

[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.

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 transparent hose. Pay sufficient caution to contamination.
- Critical load: (at all operating conditions) -30kPa or more
  - Perform a measurement of the pressure depending on the situation.

RY9202138CRS0483US0

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).

RY9202138CRS0484US0

2. Check the Inside of the Tank (Checking for Tank Modification / Additions, Position of Fuel Pipe Inlet / Outlet, Clogging and Holes)

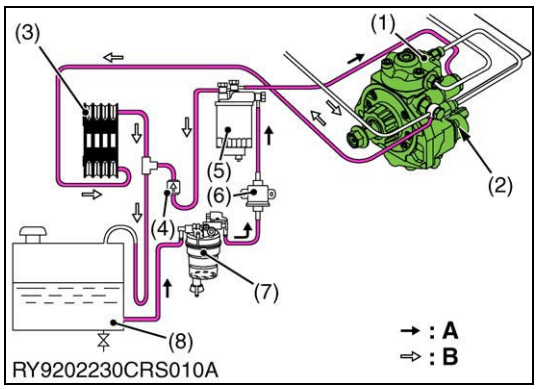
1. Check the tank for modifications or additions. Consult with the customer.
   - Fuel inlet / outlet position, tank piping.
   - Foreign material inside the tank, water separation, rust.

■ **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.

RY9202138CRS0485US0



RY9202230CRS010A

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).

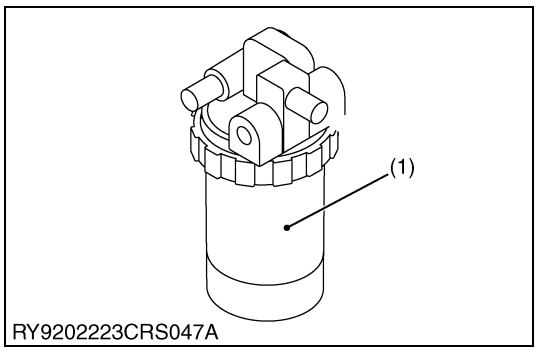
■ **NOTE**
- **Be cautious when vacuum pressure is present, as air will be drawn into the hose.**

OK	Go to "4. Check the Water Separator".
NG	Repair or replace the hose.

(1) Supply Pump
(2) SCV (Suction Control Valve)
(3) Fuel Cooler
(4) Check Valve
(5) Fuel Filter (Water Volume Switch, with Heater)
(6) Fuel Feed Pump
(7) Water Separator
(8) Fuel Tank

A : Injected Fuel Flow
B : Returned Fuel Flow

RY9202230CRS0062US0



RY9202223CRS047A

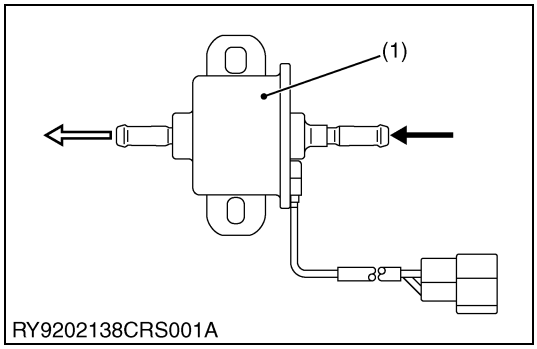
4. Check the Water Separator

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 Pump".
NG	Replace the filter and drain the water from the water separator.

(1) Water Separator

RY9202223CRS0191US0



5. Check the Fuel Pump

1. Set the key switch to the ON position, check the fuel pump alone, and check and repair the wiring harnesses.
2. Check the operation of the fuel pump by touching it directly by hand.

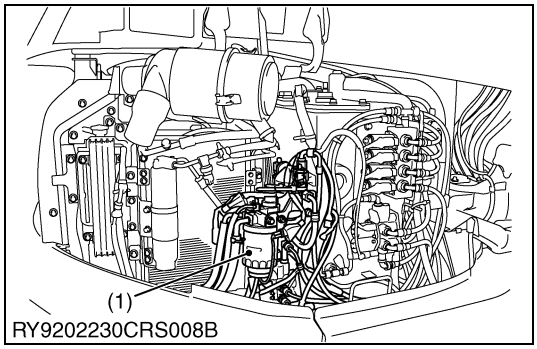
■ **NOTE**

- **If there is a fuel 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 pump.

(1) Fuel Pump

RY9202138CRS0488US0



6. Fuel Filter Clogged

1. Check the fuel filter for clogging and dirt.

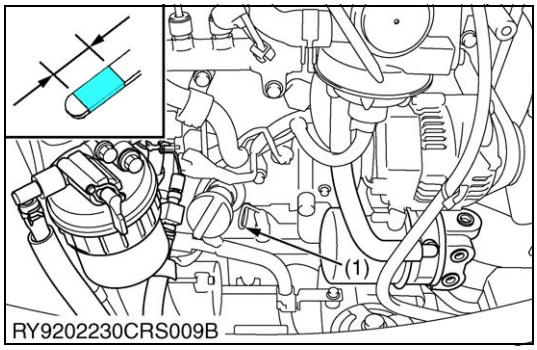
■ **NOTE**

- **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

RY9202230CRS0063US0



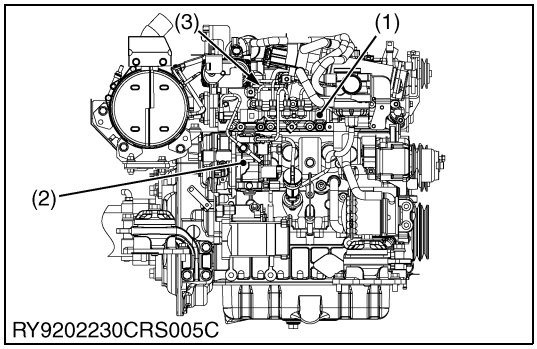
7. Engine oil Level Increase (Engine Internal Leak)

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

RY9202230CRS0064US0



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.

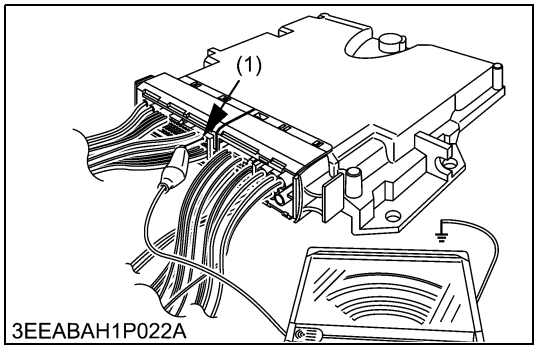
OK	Normal.
NG	Repair leaking high pressure pipe, etc. or replace leaking parts.

(1) Rail
(2) Supply Pump
(3) Injection Pipe

RY9202230CRS0065US0

[3] ELECTRIC SYSTEM INSPECTION PROCEDURE

(1) Basics of Checking Electrical / Electronic Circuit Systems



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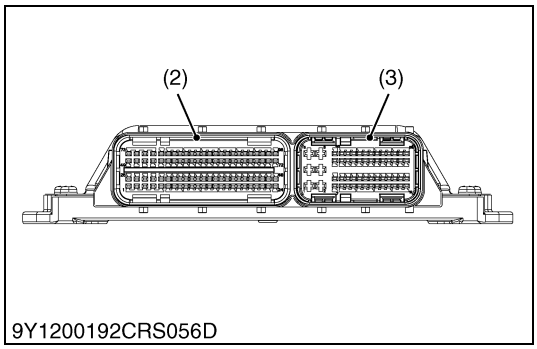


9Y1200192CRS056D

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.

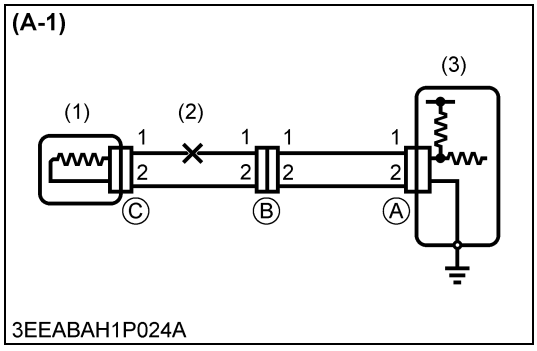
■ **IMPORTANT**

- **When inserting a fine metal wire for measurement purposes, ensure that the connector waterproof rubber is not damaged.**

(1) Needle
(2) ECU Connector (96 Pin)
(3) ECU Connector (58 Pin)

RY9202138CRS0492US0

(A-1)



3EEABAH1P024A

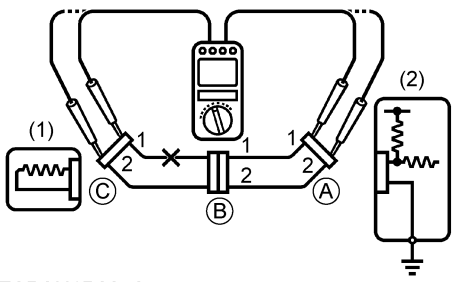
Open Circuit Check

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

RY9202138CRS0493US0

(A-2)



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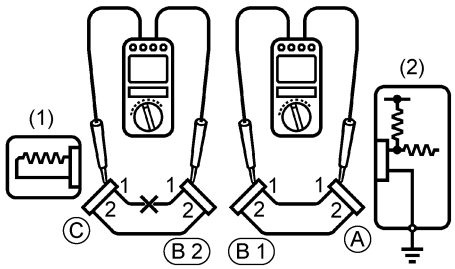
(A-3)



3EEABAH1P026A

Check for Continuity

1. Remove connectors **"A"** and **"C"** and measure resistance between the two.

Factory specification	Less than 1 Ω

(Reference)

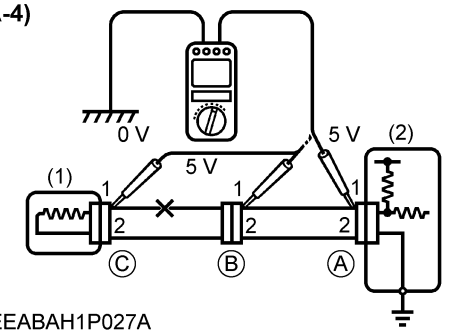
- Measure resistance while gently shaking the wiring harness up and down, and side-to-side.

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"**.

(1) Sensor (2) ECU

RY9202138CRS0494US0

(A-4)



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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.

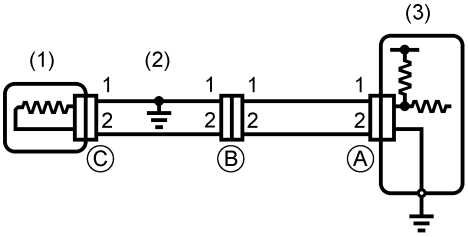
(Faulty Circuit)

- There is an open circuit between terminal 1 of connector **"B"** and terminal 1 of connector **"C"**.

(1) Sensor (2) ECU

RY9202138CRS0495US0

(A-5)



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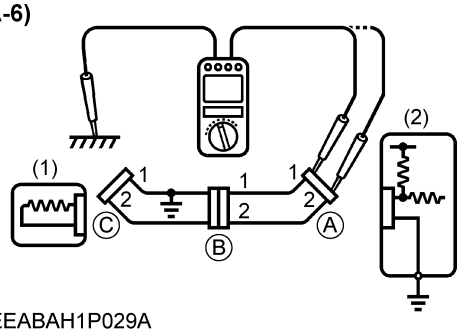
Short Circuit Check

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

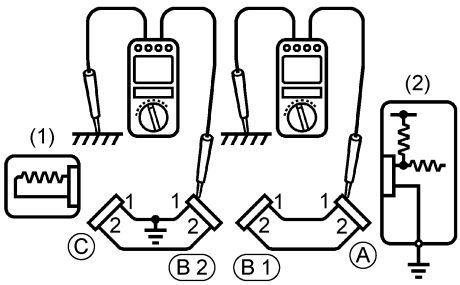
RY9202138CRS0496US0

(A-6)



3EEABAH1P029A

(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.

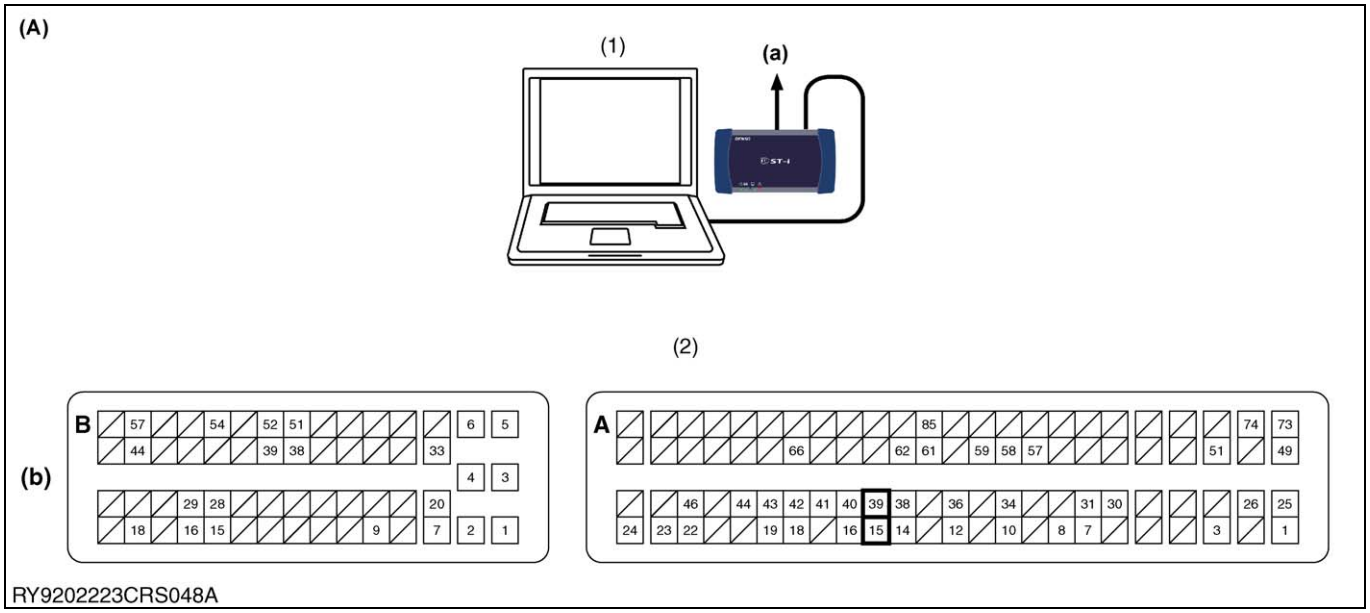
(Faulty Circuit)

- There is a short circuit between terminal 1 of connector **"B2"** and terminal 1 of connector **"C"**.

(1) Sensor (2) ECU

RY9202138CRS0497US0

(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 (Wire Harness 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.

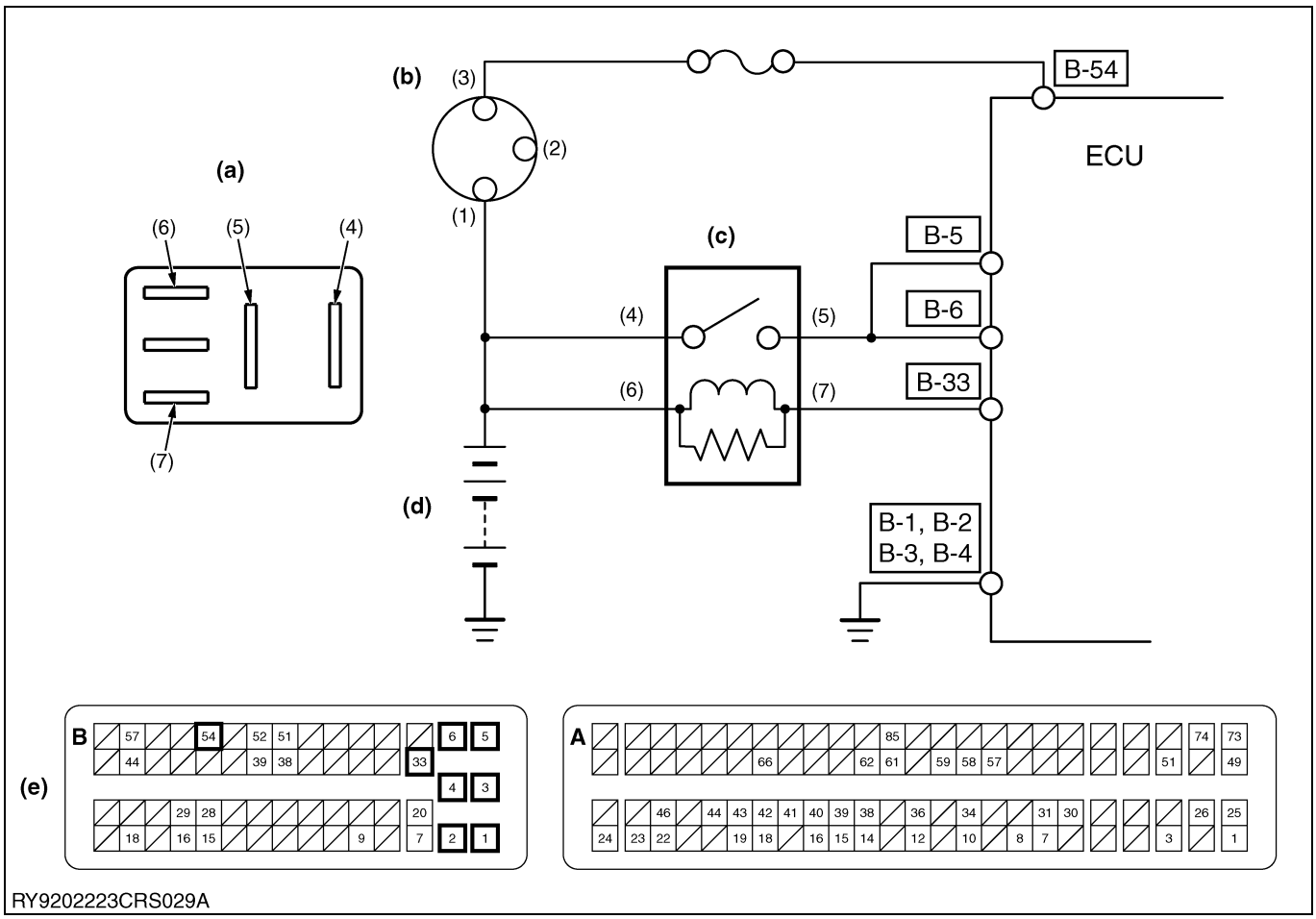
RY9202223CRS0195US0

(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.
- A diagnosis tool communication error occur.

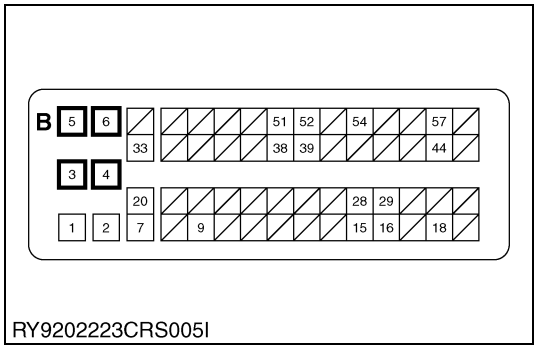


RY9202223CRS029A

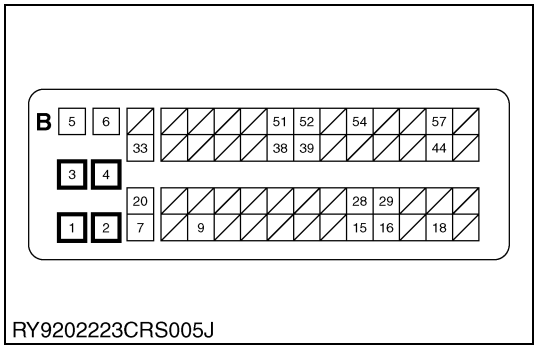
(1) OFF
(2) ON
(3) START
(4) Terminal 1
(5) Terminal 2
(6) Terminal 3
(7) Terminal 4

(a) Main Relay Terminal Layout
(b) Key Switch
(c) Main Relay
(d) Battery
(e) ECU Connector (Wire Harness Side)

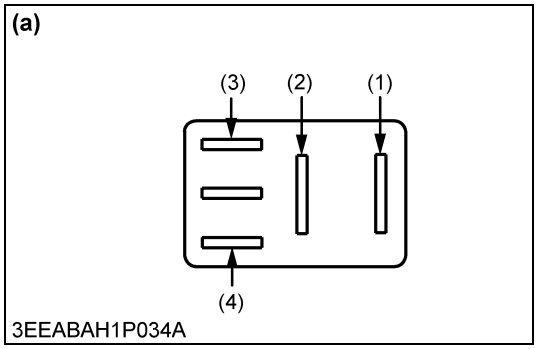
RY9202223CRS0196US0



RY9202223CRS005I



RY9202223CRS005J



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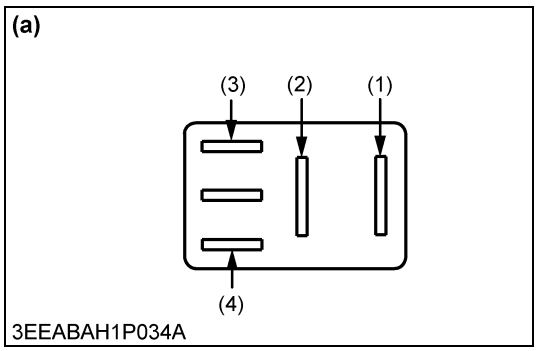

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1. Measure the ECU +BP and Ground Voltage

1. Turn the key switch ON and measure the voltage between the ECU +BP terminals (B-5 / B-6) and ground (body / battery terminal). Then measure voltage between the ECU ground terminals (B-3 / B-4) 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.

RY9202223CRS0197US0

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

RY9202138CRS0501US0

3. Check the Relay Terminal Voltage - 2

1. Measure voltage at relay terminal 1 (1).

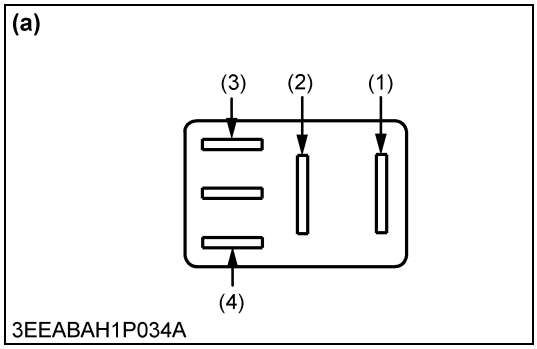
Factory specification	10 V or higher

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

RY9202138CRS0502US0



4. Check the Relay Terminal Voltage - 3

1. Measure voltage at relay terminal 3 (3).

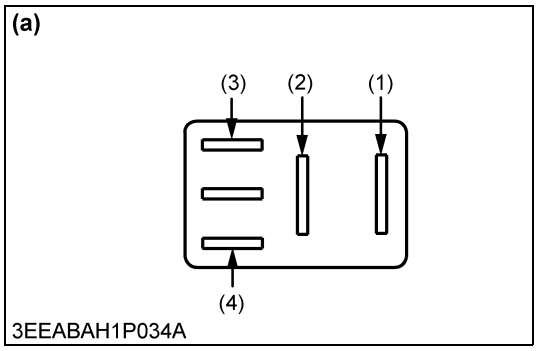
Factory specification	10 V or higher

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

RY9202138CRS0503US0



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.**

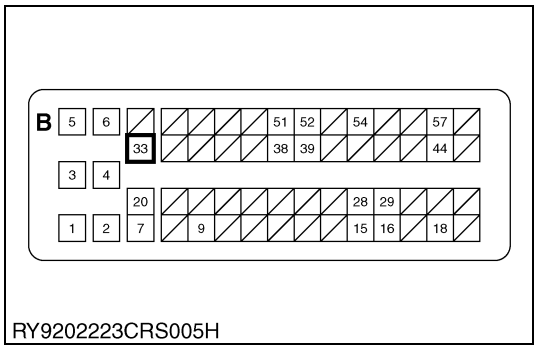
Factory specification	10 V or higher

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

RY9202138CRS0504US0



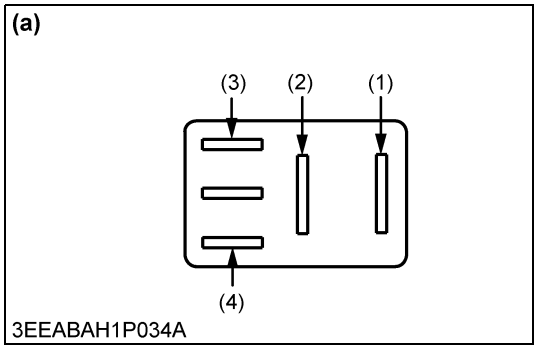
6. Check the Relay Terminal Voltage - 5

1. With the key switch OFF, measure voltage at the ECU main relay terminals (B-33).

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.

RY9202223CRS0198US0



7. Check the Relay Terminal Voltage - 6

1. Turn the key switch ON and measure voltage at relay terminal 4 (4).

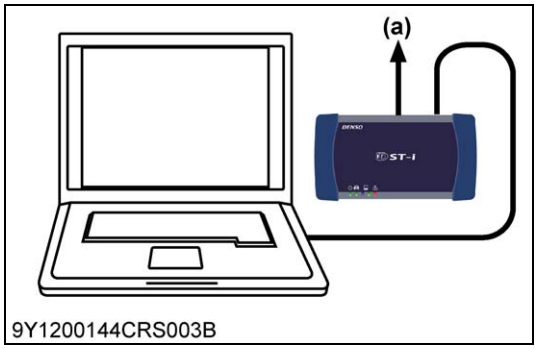
Factory specification	Approx. 0 V

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

RY9202138CRS0506US0



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.

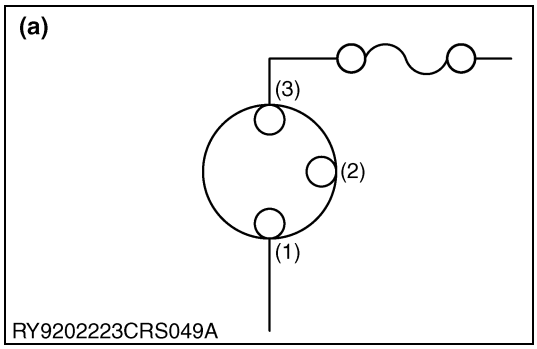
■ **IMPORTANT**

- **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	Constantly ON	ECU internal fault → Replace the ECU.
	Consistently OFF	Go to "10. Check the Key Switch -2".

(a) CAN1 Connector

RY9202223CRS0199US0



RY9202223CRS049A

9. 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) OFF
(2) ON
(3) START

(a) Key Switch

RY9202223CRS0200US0

7. DTC TROUBLE DIAGNOSIS LIST

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
636	7	RPM sensor system	P0016	NE-G phase shift	Large phase shift between NE (crankshaft position sensor) pulse and G (camshaft position sensor) pulse	• 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 • Water temperature is 10 °C (50 °F) or higher	(Approximate) Phase difference between NE pulse and G pulse is within ±0.26 rad (±15 °)	10 times or more	Diagnostic counter = zero	(Invalid G signal) Engine hesitates at start-up	None
190	0		P0219	Engine overrun	Engine speed exceeds threshold speed	Key switch is ON	Engine speed ≥ 3500 min^{-1} (rpm)	3 revolutions or more	Diagnostic counter = zero	Overrun	Stop injection (Q = 0 mm^3/st)
636	8		P0335	No input of NE sensor (Crankshaft position sensor) pulse	• Open circuit or short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Engine is not stalled	No recognition of Ne sensor pulse	10 times or more	Key switch turn OFF	(Running only with G signal) • Faulty starting • Vibration is slightly large • Insufficient output	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
636	2		P0336	NE sensor (Crankshaft position sensor) pulse number error	• Open circuit or short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal • 350 min^{-1} (rpm) or higher	Pulse count per rotation is not 56 teeth	10 times or more	Key switch turn OFF	(Running only with G signal) • Faulty starting • Vibration is slightly large • Insufficient output	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
723	8		P0340	No input of G sensor (Camshaft position sensor) pulse	• Open circuit or short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Engine is not stalled	No recognition of G sensor pulse	10 times or more	Diagnostic counter = zero	(Invalid G signal) Engine hesitates at start-up	None
723	2		P0341	G sensor (Camshaft position sensor) pulse number error	• Open circuit or short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Engine speed is 350 min^{-1} (rpm) or higher	Pulse count per rotation is not 5 teeth	10 times or more	Diagnostic counter = zero	(Invalid G signal) Engine hesitates at start-up	None
157	4	Fuel / rail pressure system	P0192	Rail pressure sensor: Low	• Ground short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal	Voltage of rail pressure sensor is 0.7 V or less	Transient	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance • Worsening running noise • Increase in white smoke • Engine stops	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop • Engine forcibly stopped 60 sec. later
157	3		P0193	Rail pressure sensor: High	• Open circuit or +B short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal	Voltage of rail pressure sensor is 4.9 V or more	Transient	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance • Worsening running noise • Increase in white smoke • Engine stops	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop • Engine forcibly stopped 60 sec. later

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
1347	4	SCV system error	P0628	SCV drive system error	Open circuit or ground short circuit of SCV	• Battery voltage is normal • Key switch is ON • Starter Switch signal (ECU: B-54 terminal) is not activated	Open circuit or ground short of SCV	2.6 sec. or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % of normal condition • Rail pressure limitation: Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop
1347	3		P0629	+B short circuit of SCV	+B short circuit of SCV	• Battery voltage is normal • Key switch is ON • Starter Switch signal (ECU: B-54 terminal) is not activated	+B short circuit of SCV	2.6 sec. or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop
172	4	Intake temperature sensor system	P0112	Intake air temperature error: Low	Ground short circuit of sensor / harness	Battery voltage is normal	Voltage of intake air temperature sensor is 0.05 V or less	2.8 sec. or more	Diagnostic counter = zero	Amount of white smoke increases at low temperatures	• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 40 °C (104 °F) [default value]
172	3		P0113	Intake air temperature error: High	Open circuit or +B short circuit of sensor / harness	Battery voltage is normal	Voltage of intake air temperature sensor is 4.9 V or more	2.8 sec. or more	Diagnostic counter = zero	Amount of white smoke increases at low temperatures	• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 40 °C (104 °F) [default value]
110	4	Water temperature sensor system	P0117	Water temperature sensor: Low	Ground short circuit of sensor / harness	Battery voltage is normal	Voltage of Water temperature sensor is 0.1 V or less	2.8 sec. or more	Key switch turn OFF	• Amount of white smoke increases at low temperatures • Insufficient output • Worsening exhaust gas performance	• During start-up = −25 °C (−13 °F) [default value] • Under other conditions = 80 °C (176 °F) [default value] • Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop
110	3		P0118	Water temperature sensor: High	Open circuit or +B short circuit of sensor / harness	Battery voltage is normal	Voltage of Water temperature sensor is 4.9 V or more	2.8 sec. or more	Key switch turn OFF	• Amount of white smoke increases at low temperatures • Insufficient output • Worsening exhaust gas performance	• During start-up = −25 °C (−13 °F) [default value] • Under other conditions = 80 °C (176 °F) [default value] • Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop
174	4	Fuel temperature sensor system	P0182	Fuel temperature sensor: Low	Ground short circuit of sensor / harness	Battery voltage is normal	Voltage of temperature sensor in supply pump is 0.1 V or less	2.8 sec. or more	Diagnostic counter = zero	None	• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 45 °C (113 °F) [default value]
174	3		P0183	Fuel temperature sensor: High	Open circuit or +B short circuit of sensor / harness	Battery voltage is normal	Voltage of temperature sensor in supply pump is 4.9 V or more	2.8 sec. or more	Diagnostic counter = zero	None	• During start-up = −20 °C (−4 °F) [default value] • Under other conditions = 45 °C (113 °F) [default value]

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
523535	0	Injector system	P0200	Injector charge voltage: High	• Injector charge voltage: High • Failure of ECU charge circuit	• Battery voltage is normal • CPU is normal	• Injector charge voltage: High • Failure of ECU charge circuit	10 sec. or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance • Engine stops	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop • Engine forcibly stopped 60 sec. later
651	3		P0201	Open circuit of harness/coil in 1st cylinder injector	• Open circuit of harness • Open circuit of injector coil	• Engine is operating • Battery voltage is normal • During injection • CPU is normal	Open circuit of harness or open circuit of injector coil	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop
653	3		P0202	Open circuit of harness/coil in 3rd cylinder injector	• Open circuit of harness • Open circuit of injector coil	• Engine is operating • Battery voltage is normal • During injection • CPU is normal	Open circuit of harness or open circuit of injector coil	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop
654	3		P0203	Open circuit of harness/coil in 4th cylinder injector	• Open circuit of harness • Open circuit of injector coil	• Engine is operating • Battery voltage is normal • During injection • CPU is normal	Open circuit of harness or open circuit of injector coil	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop
652	3		P0204	Open circuit of harness/coil in 2nd cylinder injector	• Open circuit of harness • Open circuit of injector coil	• Engine is operating • Battery voltage is normal • During injection • CPU is normal	Open circuit of harness or open circuit of injector coil	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop
523525	1		P0611	Injector charge voltage: Low	• Injector charge voltage: Low • Failure of charge circuit of ECU	• Battery voltage is normal • CPU is normal	• Injector charge voltage: Low • Failure of charge circuit of ECU	Transient	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop • Only main injection permitted
523523	2		P2146	Injector drive circuit open in No.1 and 4 Cylinder simultaneously	Wiring harness open circuit	• Engine is operating • Battery voltage is normal • During injection • CPU is normal	When wiring harness open circuit	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop
523523	4		P2147	1 and 4 cylinder injector short to ground at power supply side, or all cylinder injector short to ground	Wiring harness short to ground	• Engine is operating • Battery voltage is normal	When wiring harness short to ground occurs	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Injectors which have error stop injection • EGR stop
523523	3		P2148	1 and 4 cylinder injector short to +B at power supply side, or all cylinder injector short to +B	Wiring harness short to +B	• Engine is operating • Battery voltage is normal	When wiring harness short to +B occurs	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Injectors which have error stop injection • EGR stop
523524	2		P2149	Injector drive circuit open in No.2 and 3 Cylinder simultaneously	Wiring harness open circuit	• Engine is operating • Battery voltage is normal • During injection • CPU is normal	When wiring harness open circuit	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
523524	4	Injector system	P2150	2 and 3 cylinder injector short to ground at power supply side, or all cylinder injector short to ground	Wiring harness short to ground	• Engine is operating • Battery voltage is normal	When wiring harness short to ground occurs	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Injectors which have error stop injection • EGR stop
523524	3		P2151	2 and 3 cylinder injector short to +B at power supply side, or all cylinder injector short to +B	Wiring harness short to +B	• Engine is operating • Battery voltage is normal	When wiring harness short to +B occurs	8 times or more	Key switch turn OFF	• Insufficient output • Large vibration • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Injectors which have error stop injection • EGR stop
168	4	Battery voltage related	P0562	Battery voltage: Low	• Open circuit, short circuit or damage of harness • Failure of battery	• Key switch is ON • Starter Switch signal (ECU: B-54 terminal) is not activated	ECU recognition of battery voltage is below 8 V in 12 V system (ECU data value: 0.9615)	1 sec. or more	Diagnostic counter = zero	• Faulty starting • Insufficient output • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop • Intake throttle 100 % open • Only main injection permitted
168	3		P0563	Battery voltage: High	• Open circuit, short circuit or damage of harness • Failure of battery	• Key switch is ON • Starter Switch signal (ECU: B-54 terminal) is not activated	ECU recognition of battery voltage is above 16 V in 12 V system (ECU data value: 1.9231)	1 sec. or more	Key switch turn OFF	• Faulty starting • Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • EGR stop • Intake throttle 100 % open
3509	4	Sensor voltage related	P0642	Sensor supply voltage 1: Low	Sensor supply voltage 1 error or recognition error	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: B-54 terminal) is not activated	Voltage to sensor is below 3.5 V	Transient	Key switch turn OFF	• Faulty starting • Insufficient output • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation:50 % or less of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop • Intake throttle 100 % open
3509	3		P0643	Sensor supply voltage 1: High	Sensor supply voltage 1 error or recognition error	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: B-54 terminal) is not activated	Voltage to sensor is above 4.5 V	Transient	Key switch turn OFF	• Faulty starting • Insufficient output • Worsening exhaust gas performance • Engine stops in some case	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop • Intake throttle 100 % open
3510	4		P0652	Sensor supply voltage 2: Low	Sensor supply voltage 2 error or recognition error	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: B-54 terminal) is not activated	Voltage to sensor is below 3.5 V	Transient	Key switch turn OFF	• Faulty starting • Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
3510	3		P0653	Sensor supply voltage 2: High	Sensor supply voltage 2 error or recognition error	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: B-54 terminal) is not activated	Voltage to sensor is above 4.5 V	Transient	Key switch turn OFF	• Faulty starting • Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
1485	2	Main relay related	P0687	Main relay is locked in closed position	Failure of main relay	• Key switch is OFF • Engine stops	Main relay stays active longer than 1 sec. without command and battery voltage is 8 V or more	2 times or more	Diagnostic counter = zero	Dead battery	None

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
108	2	Atmospheric pressure sensor related	P2228	Barometric pressure sensor error (Low side)	Sensor / ECU internal circuit short to ground	Battery voltage is normal	Barometric pressure sensor voltage: 1.6 V or less	2.8 sec. or more	Diagnostic counter = zero	Insufficient output	65 kPa (0.6628 kgf/cm^2, 9.426 psi) [default value]
108	3		P2229	Barometric pressure sensor error (High side)	Sensor / ECU internal circuit short to +B	Battery voltage is normal	Barometric pressure sensor voltage: 4.4 V or more	2.8 sec. or more	Diagnostic counter = zero	Insufficient output	65 kPa (0.6628 kgf/cm^2, 9.426 psi) [default value]
523574	3	EGR valve related	P0403	EGR actuator open circuit	EGR actuator open circuit	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	EGR actuator open error signal received via CAN	approx. 2.8 s	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
523574	4		P0404	EGR actuator coil short	EGR actuator coil short	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	EGR actuator coil short error signal received via CAN	approx. 2.8 s	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
523572	4		P0409	EGR position sensor failure	EGR position sensor failure	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	EGR position sensor error signal received via CAN	approx. 2.8 s	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
523575	7		P2413	EGR actuator valve stuck	EGR actuator valve stuck	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	EGR actuator valve stuck error signal received via CAN	approx. 2.8 s	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
523576	2		P2414	EGR (DC motor) overheat	EGR (DC motor) overheat	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	EGR (DC motor) temperature error signal (thermistor: 125 °C (257 °F) or more) received via CAN	approx. 2.8 s	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
523577	2		P2415	EGR (DC motor) temperature sensor failure	EGR (DC motor) temperature sensor failure	• Battery voltage is normal • No DTC of U0077 "CAN1 Bus off" • EGR control line is normal	EGR (DC motor) temperature sensor error signal received via CAN	approx. 2.8 s	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
–	–	EGR starting to close warning	–	–	EGR elevated water temp.	–	When the OverHeatLamp signal is received	–	–	–	–
110	0	Emissions warning	P0217	Engine overheat	Overheat of engine water temperature	Water temperature sensor is normal	Engine water temperature ≥ 120 °C (248 °F)	5 sec. or more	Diagnostic counter = zero	• Insufficient output • Overheat	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
–	–	Air heater related	Air heater does not relate to this error; no display								

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
523538	2	Engine ECU	P0602	QR data error	QR data read error from EEPROM	Key switch is ON	• 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)	Transient	Key switch turn OFF	Insufficient output	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
523538	7		P0602	No QR data	Area of QR data on EEPROM is vacant	Key switch is ON	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)	Transient	Key switch turn OFF	Insufficient output	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
628	2		P0605	ECU FLASH ROM error	FLASH ROM error	Key switch is ON	3 times or more consecutive inconsistencies in checksum	1 time or more	Key switch turn OFF	Engine stop	Engine stop
1077	2		P0606	ECU CPU (Main IC) error	Failure of CPU	Key switch is ON	• Battery voltage ≥ 10 V • Starter switch is OFF • CPU abnormality counter ≥ 5 times (RUN pulse abnormality occurs 5 times or more)	1 time or more	Key switch turn OFF	Engine stop	Engine stop
523527	2		P0606	ECU CPU (Monitoring IC) error	Failure of monitoring IC of CPU	Key switch is ON	• Battery voltage ≥ 10 V • Starter switch continues OFF for 500 sec or more • Abnormality continues for 2000 sec or more after the ECU is turned ON • RUN pulse abnormality • Above conditions occur continuously for 700 sec or more	1 time or more	Key switch turn OFF	Engine stop	Engine stop
523543	2		P2131	Accelerator position sensor error (CAN)	Accelerator position sensor signal error (sensor / harness open circuit, ground short circuit etc)	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: B-54 terminal) is not activated	Accelerator position sensor error signal received by CAN	Transient	Diagnostic counter = zero	Insufficient output	Accelerator limitation: 0 %

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
523547	2	Communication error	U0075	CAN2 Bus off	CAN2 +B / GND short circuit or high traffic error	• Battery voltage is normal • Key switch is ON	CAN2 Bus off	2 sec. or more	Key switch turn OFF	• Insufficient output • Transmitted data is invalid	Accelerator limitation: 0 %
523604	2		U0077	CAN1 Bus off	CAN1 +B / GND short circuit or high traffic error	• Battery voltage is normal • Key switch is ON	CAN1 Bus off	2 sec. or more	Key switch turn OFF	• Insufficient output • Transmitted data is invalid	• Output limitation: Approximately 75 % or less of normal condition • EGR stop
523548	2		U0081	CAN-KBT frame error	CAN-KBT original frame open circuit error	• Battery voltage is normal • Key switch turn ON • Starter Switch signal (ECU: B-54 terminal) is not activated • No error of "CAN2 Bus off" (U0075)	CAN2 KBT frame open circuit error	Transient	Key switch turn OFF	Insufficient output	Accelerator limitation: 0 %
523591	2		U0082	CAN CCVS (Parking SW and Vehicle speed) frame error	CAN CCVS communication stopping	• Battery voltage is normal • Starter Switch signal (ECU: B-54 terminal) is not activated	CAN CCVS frame time out error	0.5 sec. or more	Key switch turn OFF	None	Non-renewable active regeneration [default value]
523592	2		U0083	CAN CM1 (Regen SW) frame error	CAN CM1 communication stopping	• Battery voltage is normal • Starter Switch signal (ECU: B-54 terminal) is not activated	CAN CM1 frame time out Error	2.0 sec. or more	Key switch turn OFF	None	Active regeneration output = OFF Non-renewable active regeneration [default value]
523596	2		U0087	CAN TSC1 frame error	CAN TSC1 communication stopping	• Battery voltage is normal • Starter Switch signal (ECU: B-54 terminal) is not activated	No request to "TSC1 buffer" continues 3 times after over-ride control request (other than 0x00)	Transient	Diagnostic counter = zero	None	TSC1 uncontrol [default value]
132	3	Mass airflow sensor related	P0103	MAF sensor: High	• +B short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • 700 min^{-1} (rpm) ≤ engine speed ≤ 2800 min^{-1} (rpm) and target intake mass air flow is 300 or less and it continues for 3 secs	Mass air flow sensor voltage: 4.9 V or more	approx. 2.8 s	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Sensor output: 0.7 times of target value at normal condition [default value] • Output limitation: Approximately 75 % or less of normal condition • EGR stop • Intake throttle 100 % open
171	4		P0072	Intake air temperature built-in MAF sensor: Low	• Ground short circuit of sensor / harness • Failure of sensor	Battery voltage is normal	Intake air temperature built-in MAF sensor voltage: 0.1 V or less	approx. 2.8 s	Diagnostic counter = zero	None	25 °C (77 °F) [default value]
171	3		P0073	Intake air temperature built-in MAF sensor: High	• Open circuit or +B short circuit of sensor / harness • Failure of sensor	Battery voltage is normal	Intake air temperature built-in MAF sensor voltage: 4.9 V or more	approx. 2.8 s	Diagnostic counter = zero	None	25 °C (77 °F) [default value]
523580	2	Intake throttle	P2108	Intake throttle feedback error	Intake throttle feedback error	Battery voltage is normal	(Approximate parameter) Deviation of throttle position is not corrected in 20 times	approx. 5.0 s	Key switch turn OFF	None	Intake throttle 100 % open
523582	4		P2621	Intake throttle lift sensor: Low	• Open circuit or ground short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal	Intake throttle lift sensor voltage: 0.1 V or less	approx. 2.8 s	Key switch turn OFF	None	Intake throttle 100 % open
523582	3		P2622	Intake throttle lift sensor: High	• +B short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal	Intake throttle lift sensor voltage: 4.89 V or more	approx. 2.8 s	Key switch turn OFF	None	Intake throttle 100 % open
3251	4	Pressure differential sensor related	P2454	Differential pressure sensor 1: Low	• Ground short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Starter Switch signal (ECU: B-54 terminal) is not activated	DPF differential pressure sensor voltage: 0.21 V or less	approx. 2.8 s	Key switch turn OFF	None	0 kPa (0.0 kgf/cm^2, 0.0 psi) [default value]

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
4765	4	Exhaust temperature sensor (DOC intake) *1	P0546	Exhaust gas temperature sensor 0: Low	• Ground short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Other exhaust gas temperature sensors are normal	DOC inlet temperature sensor (T0) voltage: 0.08 V or less	approx. 5.0 s	Key switch turn OFF	None	0 °C (32 °F) [default value]
4765	3		P0547	Exhaust gas temperature sensor 0: High	• Open circuit or +B short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Other exhaust gas temperature sensors are normal • Water 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.	DOC inlet temperature sensor (T0) voltage: 4.92 V or more	approx. 120 s	Key switch turn OFF	None	0 °C (32 °F) [default value]
3242	4	Exhaust temperature sensor (DOC outlet) *1	P0543	Exhaust gas temperature sensor 1: Low	• Ground short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Other exhaust gas temperature sensors are normal	Diesel Particulate Filter (hereinafter referred to as the "DPF") inlet temperature sensor (T1) voltage: 0.08 V or less	approx. 5.0 s	Key switch turn OFF	None	0 °C (32 °F) [default value]
3242	3		P0544	Exhaust gas temperature sensor 1: High	• Open circuit or +B short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Other exhaust gas temperature sensors are normal • Water temperature is 65 °C (149 °F) or more: continues longer than 10 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.	DPF inlet temperature sensor (T1) voltage: 4.92 V or more	approx. 120 s	Key switch turn OFF	None	0 °C (32 °F) [default value]
3246	4	Exhaust temperature sensor (DPF outlet) *1	P242C	Exhaust gas temperature sensor 2: Low	• Ground short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Other exhaust gas temperature sensors are normal	DPF outlet temperature sensor (T2) voltage: 0.08 V or less	approx. 5.0 s	Key switch turn OFF	None	0 °C (32 °F) [default value]
3246	3		P242D	Exhaust gas temperature sensor 2: High	• Open circuit or +B short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Other exhaust gas temperature sensors are normal • Water 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.	DPF outlet temperature sensor (T2) voltage: 4.92 V or more	approx. 120 s	Key switch turn OFF	None	0 °C (32 °F) [default value]

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
523599	0	Simultaneous break in all exhaust temperature sensors	P3018	All exhaust gas temperature sensor failure	All exhaust gas temperature sensor failure simultaneously	• Engine speed is 1400 min^{-1} (rpm) or more • Quantity of injection is 30 mm^3/st or more • Water 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	All exhaust gas temperature sensor failure (sensor high) simultaneously	approx. 100 s	Diagnostic counter = zero	None	None
3252	0	DOC reaction	P3001	Emission deterioration	DOC is heated up due to unburned fuel	• Other than during regeneration mode • Water temperature is 65 °C (149 °F) or more: continues longer than 5 min after engine starting	T1 − T0 ≥ 250 °C (482 °F)	approx. 60 s	Key switch turn OFF	Insufficient output	• EGR stop • Intake throttle 100 % open • Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
523590	16	Active regeneration time up	P3013	Active regeneration time up	Active regeneration time up	Active regeneration in process	Water temperature reaches above 65 °C (149 °F) and regeneration process (less than 30 sec.)is not completed within 2700 sec	Transient	Diagnostic counter = zero	None	None
523589	17	Low water temperature in active regeneration	P3012	Low water temperature in active regeneration	Low water temperature in active regeneration	Active regeneration in process (DPF STATUS = 5 or 7)	Engine water temperature stays below 65 °C (149 °F) for over 1500 seconds under parked regeneration in preprocessing and engine water temperature stays below 65 °C (149 °F) for over 25 seconds under parked regeneration in burning process	Transient	Diagnostic counter = zero	None	None
523602	0	Regeneration too frequent	P3024	High frequency of regeneration	Time interval from the end time to the start time of the regeneration	• Battery voltage is normal • Key switch is ON	Regeneration time interval within 30 min. occurs three times continuously	Transient	Key switch turn OFF	Worsening exhaust gas performance (NOx)	• Output limitation: Approximately 50 % or less of normal condition (Renewable active regeneration) • EGR stop
633	7	Engine fuel system (P/L)	P0087	Pressure limiter emergency open	Pressure limiter emergency open	• Rail pressure sensor is normal • Sensor supply voltage VCC# is normal	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)]	1 time or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation: Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop
157	0	Engine fuel system (rail pressure)	P0088	High rail pressure	Actual pressure exceeds the command pressure	• Rail pressure sensor is normal • Sensor supply voltage VCC# is normal	Actual pressure ≥ 197 MPa (2010 kgf/cm^2, 28600 psi)	1 sec. or more	Diagnostic counter = zero	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation: Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
1239	1	Engine fuel system (fuel leak)	P0093	Fuel leak (in high pressured fuel system)	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)	• 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	(a): the flow volume which is calculated from the difference of rail pressure (decrease) (b): total volume of injection and leakage 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	1 time or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance (NOx) • Engine stops	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop
1347	7	Engine fuel system (SCV)	P0089	SCV stuck	SCV stuck at open position (Actual rail pressure continuously exceeds the command rail pressure)	• Supply pump is normal and pump calibration has been executed and 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	• Discharge request of supply pump goes below 0 mm3/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	1 time or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance (NOx) • Engine stops	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation: Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop
523539	2	Engine fuel system (Supply pump)	P1274	Pump seizing 1	High pressure 1 error	• Sensor supply voltage VCC# is normal • Rail pressure sensor is normal	(Approximate parameter) Rail pressure of 230 Mpa (2350 kgf/cm^2, 33400 psi) or more continues 1 second under the condition of above 500 min^{-1} (rpm) [Threshold changes depending on the engine speed. 2600 min^{-1} (rpm) should be used as a reference]	1 time or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation: Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop
523540	2		P1275	Pump seizing 2	High pressure 2 error	• Sensor supply voltage VCC# is normal • Rail pressure sensor is normal	(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 [Threshold changes depending on the engine speed. 2600 min^{-1} (rpm) should be used as a reference] • Or, rail pressure of above 80 MPa (820 kgf/cm^2, 12000 psi) continues total time for 1 second under condition of below 500 min^{-1} (rpm) [Threshold changes depending on the engine speed. 200 min^{-1} (rpm) should be used as a reference]	1 time or more	Key switch turn OFF	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition • Rail pressure limitation:Command pressure ≤ 80 MPa (820 kgf/cm^2, 12000 psi) • EGR stop

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
132	1	Engine air intake system (Insufficient intake)	P0101	Intake air volume: Low	Engine inlet air mass flow rate lacking (Disconnect turbo blower intake hose)	• Engine is operating [1000 min^{-1} (rpm) or higher] • Water temperature is 15 °C (59 °F) or higher (Water temperature sensor is normal) • MAF sensor is normal • EGR valve is normal • Intake throttle valve is normal • Battery voltage is normal	Engine Inlet Air Mass Flow Rate: less than half of target value	approx. 10 s	Key switch turn OFF	Insufficient output	• EGR stop • Output limitation: Approximately 50 % or less of normal condition • Accelerator limitation: 50 % or less of normal condition
4765	0	Engine exhaust temperature (DOC inlet temperature error) *1 *2	P3002	Emergency Exhaust gas temperature sensor 0: High	DOC inlet temperature (T0) high	• Exhaust gas temperature sensor T0,T1 and T2 are normal • Battery voltage is normal	DOC inlet temperature (T0): 700 °C (1292 °F) or more	approx. 2.0 s	Key switch turn OFF	• Engine stops • Inhibiter cranking until 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)
3242	0	Engine exhaust temperature (DPF inlet temperature error) *1 *2	P3003	Emergency Exhaust gas temperature sensor 1: High	DPF inlet temperature (T1) high	• Exhaust gas temperature sensor T0,T1 and T2 are normal • Battery voltage is normal	DPF inlet temperature (T1): 715 °C (1319 °F) or more	approx. 9 min	Key switch turn OFF	• Engine stops • Inhibiter cranking until 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)
3246	0	Engine exhaust temperature (DPF outlet temperature error) *1 *2 *3	P3004	Emergency Exhaust gas temperature sensor 2: High	DPF outlet temperature (T2) high	• Exhaust gas temperature sensor T0, T1 and T2 are normal • Battery voltage is normal	DPF outlet temperature (T2): 820 °C (1508 °F) or more	approx. 2.0 s	Key switch turn OFF	• Engine stops • Inhibiter cranking until down to 300 °C (572 °F)	• 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)
523601	0	Starter relay start warning *2	P3023	Starter relay start warning	Starter relay start inhibit mode	Battery voltage is normal	Starter relay start inhibit mode	Transient	Diagnostic counter = zero	None	Inhibit starter relay activation until exhaust gas temperature reduces down to 300 °C (572 °F)
3936	7	PCD (Particulate Control Diagnosis) error	P1A28	Removal of DPF (PCD)	Removal of DPF	• Battery voltage is normal • Sensor supply voltage is normal • Starter Switch signal is notactivated • Engine speed is 1400 min^{-1} or more • Quantity of injection is 30 mm^3/st or more • Water 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	Exhaust gas temperature sensor T0, T1, T2 and differential pressure sensor are fault (open circuit)	Transient	–	No Derating	None
3936	2		P3015	Loss of function of DPF (PCD)	Loss of function of DPF	• Barometric pressure sensor is normal • Exhaust gas temperature sensor T0 is normal • Differential pressure sensor is normal	Duration time in the zone (a certain areas: Engine speed vs Differential Pressure sensor MAP) ≥ xx sec. (One driving cycle) and differential pressure sensor is normal	Transient	–	No Derating	None
3251	3		P2455	Differential pressure sensor 1: High (PCD)	• Open circuit or +B short circuit of sensor / harness • Failure of sensor	• Battery voltage is normal • Sensor supply voltage VCC# is normal • Starter Switch signal (ECU: B-54 terminal) is not activated	DPF differential pressure sensor voltage: 4.7 V or more	approx. 2.8 s	Key switch turn OFF	None	• 0 kPa (0.0 kgf/cm^2, 0.0 psi) [default value] • Output limitation: Approximately 75% of normal condition

SPN	FMI	Error Location	DTC	DTC Name	Detection Item	DTC Set Preconditions	DTC Set Parameter	Time to Action or Number of Error Detection	Recovery from Error	Behaviour During Malfunction	System Action
523578	2	NCD (Nox Control Diagnosis) error	U0076	No communication with EGR (NCD)	No communication with EGR	• Battery voltage is normal • Starter Switch signal (Engine ECU: V12 terminal) is not activated	Interruption of CAN	1.3 sec. or more	Diagnostic counter = zero	• Insufficient output • Worsening exhaust gas performance	• Output limitation: Approximately 75% of normal condition • EGR stop
132	4		P0102	MAF Sensor Abnormality (NCD)	Open circuit or ground short circuit of sensor / harness	• Battery voltage is normal • Starter Switch signal (Engine ECU: V12 terminal) is not activated • Sensor supply voltage is normal	Air flow sensor voltage: 0.1 V or less	2.8 sec. or more	Diagnostic counter = zero	• Insufficient output • Worsening exhaust gas performance	• 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
3701	15	Excessive PM3	P3006	Excessive PM3	PM accumulation level3	Battery voltage is normal	PM accumulation more than trigger level (26000 mg)	Transient	Diagnostic counter = zero	Insufficient output	Output limitation: Approximately 50 % or less of normal condition (Renewable active regeneration)
3701	16	Excessive PM4	P3007	Excessive PM4	PM accumulation level4	Battery voltage is normal	PM accumulation more than trigger level (31000 mg)	Transient	Diagnostic counter = zero	Insufficient output	Output limitation: Approximately 50 % or less of normal condition (Renewable active regeneration)
3701	0	Excessive PM5	P3008	Excessive PM5	PM accumulation level5	Battery voltage is normal	PM accumulation more than trigger level (36000 mg)	Transient	Key switch turn OFF	Insufficient output	Output limitation: Approximately 50 % or less of normal condition (Renewable active regeneration)

*1: When Exhaust gas temperature sensor error of the one of P3002/P3003/P3004 is displayed, inspect Exhaust gas temperature sensor Low error of the one of P0546/P0543/P242C as well.
*2: If P3002/P3003/P3004 (abnormal rising of the exhaust temp.) appears on the screen, error continues until the all exhaust temp. reaches below 300 °C.
*3: Inspect the DPF when "Exhaust gas temperature sensor 2 High error (P3004)" appears on the screen. The DPF is highly likely melt-damaged.

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