

GROUP 16a

CHARGING SYSTEM

CONTENTS

GENERAL INFORMATION..... 16a-2

GENERAL SPECIFICATIONS..... 16a-2

SERVICE SPECIFICATIONS..... 16a-3

CHARGING SYSTEM DIAGNOSIS..... 16a-3

SPECIAL TOOL..... 16a-5

ON-VEHICLE SERVICE..... 16a-6

GENERATOR OUTPUT LINE VOLTAGE DROP
TEST..... 16a-6

OUTPUT CURRENT TEST..... 16a-8

REGULATED VOLTAGE TEST..... 16a-10

WAVE PATTERN CHECK USING AN
OSCILLOSCOPE..... 16a-11

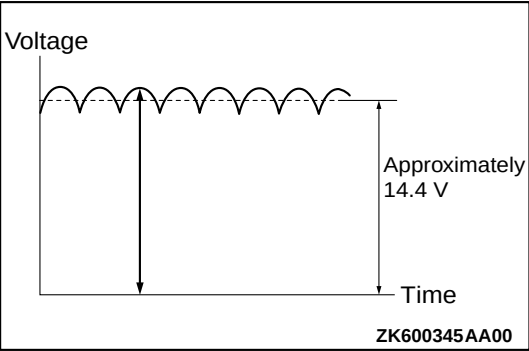
GENERATOR ASSEMBLY..... 16a-13

REMOVAL AND INSTALLATION..... 16a-13

GENERAL INFORMATION

M11601000001USA0000010000

The charging system charges the battery with the generator output to keep the battery charged at a constant level during varying electrical load.



OPERATION

Rotation of the excited field coil generates AC voltage in the stator.

This alternating current is rectified through diodes to DC voltage having a waveform shown in the illustration above.

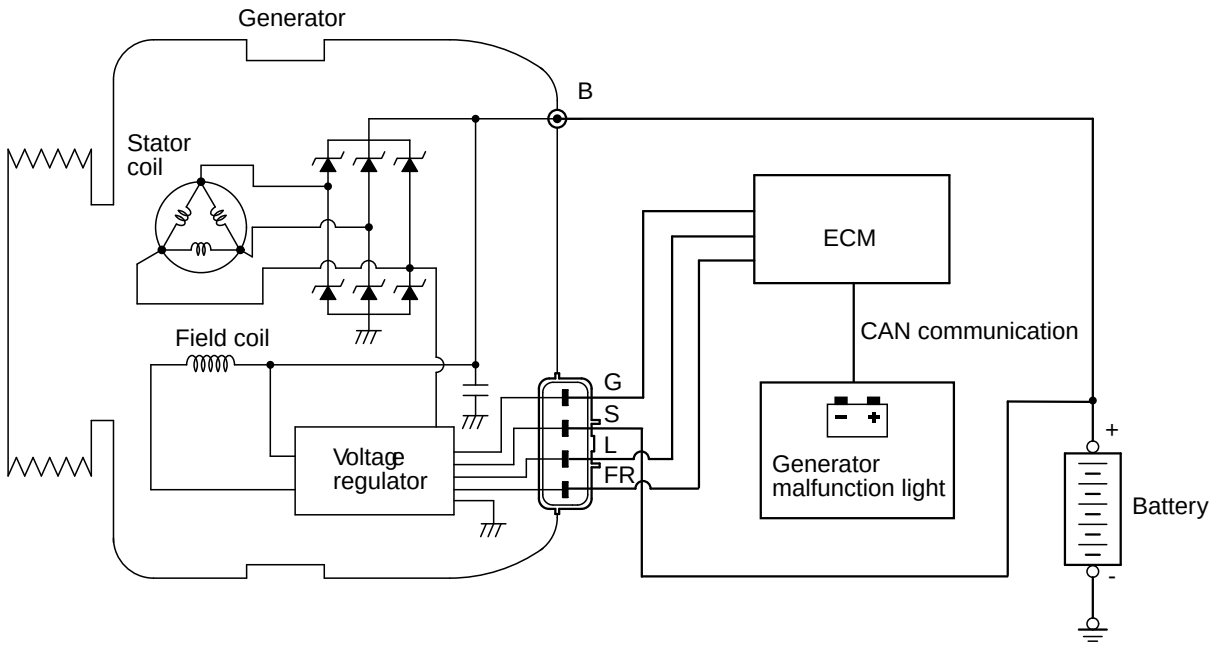
The average output voltage fluctuates slightly with the generator load condition.

When the ignition switch is turned on, current flows in the field coil and initial excitation of the field coil occurs.

When the stator coil begins to generate power after the engine is started, the field coil is excited by the output current of the stator coil.

The generator output voltage rises as the field current increases and it falls as the field current decreases. When the battery positive voltage (generator S terminal voltage) reaches a regulated voltage of approximately 14.4 V, the field current is cut off. When the battery positive voltage drops below the regulated voltage, the voltage regulator regulates the output voltage to a constant level by controlling the field current.

In addition, when the field current is constant, the generator output voltage rises as the engine speed increases.



ZK600346AA00

GENERAL SPECIFICATIONS

M11601000002USA0000010000

Item	Specification
Type	Positive battery positive voltage sensing
Identification number	A3TG4491

Item	Specification
Part No.	1800A141
Rated output V/A	12/120
Voltage regulator	Electronic built-in type

SERVICE SPECIFICATIONS

M11601000003USA0000010000

Item	Standard value	Limit
Regulated voltage (Ambient temperature at voltage regulator)	-20°C (-4°F)	14.2 - 15.4
	20°C (68°F)	13.9 - 14.9
	60°C (140°F)	13.4 - 14.6
	80°C (176°F)	13.1 - 14.5
Generator output line voltage drop (at 30 A) V	-	Maximum 0.3
Output current	-	70 % of normal output current
Field coil resistance Ω	Approximately 2 - 5	-
Brush protrusion length mm (in)	-	Minimum 2 (0.08)

CHARGING SYSTEM DIAGNOSIS

M11601000007USA0000010000

TROUBLESHOOTING HINTS

Generator malfunction light dose not go on when the ignition switch is turned to ON, before the engine starts.

•Check the bulb.

Generator malfunction light dose not switch off after the engine starts.

•Check the IC voltage regulator inside the generator.

Discharged or overcharged battery.

•Check the IC voltage regulator inside the generator.

The generator malfunction light illuminates dimly.

•Check the diode (inside the combination meter) for a short-circuit.

TROUBLESHOOTING GUIDE

The charging system troubleshooting guide is shown in the following steps.

STEP 1.

Q: Is the battery in good condition? (Refer to GROUP 54A, Chassis Electrical - Battery - On-vehicle Service - Battery Check P.54Aa-2.)

YES: Go to Step 2.

NO: Charge or replace the battery.

STEP 2.

Q: Is the generator drive belt in good condition? (Refer to GROUP 00, General - Maintenance Service - Drive Belts (For Generator and Air Conditioning) (Check) P.00-58.)

YES: Go to Step 3.

NO: Adjust the belt tension or replace the belt.

STEP 3.

Q: Does the generator malfunction light come on when the ignition switch is turned on?

YES: Go to Step 4.

NO:

- Check the ignition switch (Refer to GROUP 54A, Chassis Electrical - Ignition Switch - Ignition Switch - Inspection P. 54Ag-15).

- Check for burnt-out generator malfunction light.

- Check the generator malfunction light-related circuits.

STEP 4.

Q: Does the generator malfunction light go out after starting the engine?

YES: Go to Step 5.

NO: Check the generator malfunction light-related circuits.

STEP 5.

Q: Is an oscilloscope available?

YES: Go to Step 6.

NO: Go to Step 7.

STEP 6.

Q: Does the oscilloscope show a normal wave pattern? (Refer to Charging System - On-vehicle Service - Wave Pattern Check Using an Oscilloscope P.16a-11.)

YES: Go to Step 7.

NO: Check the generator related circuit. If the circuit is normal, replace the generator (Refer to Charging System - Generator Assembly - Generator Assembly Removal and Installation P.16a-13).

STEP 7.

- Engine: 2,500 r/min

- Headlight: ON (high beam)

- Voltage between generator terminal B and the positive battery terminal

OK: 0.5 V or less

- Voltage between the negative battery terminal and generator body

OK: 0.5 V or less

Q: Are the generator output line and ground line in good condition?

YES: Go to Step 8.

NO: Check the generator output line and ground line.

STEP 8.

Q: Is the output current normal? (Refer to Charging System - On-vehicle Service - Output Current Test P.16a-8.)

YES: Go to Step 9.

NO: Check the generator related circuit. If the circuit is normal, replace the generator (Refer to Charging System - Generator Assembly - Generator Assembly Removal and Installation P.16a-13).

STEP 9.

Q: Is the regulated voltage normal? (Refer to Charging System - On-vehicle Service - Regulated Voltage Test.)

YES: Go to Step 10.

NO: Check the generator related circuit. If the circuit is normal, replace the generator (Refer to Charging System - Generator Assembly - Generator Assembly Removal and Installation P.16a-13).

STEP 10.

Q: Is the voltage drop in the generator output line normal?

YES: Generator is normal. Check other systems.

NO: Check the output line.

SPECIAL TOOL

M11601000006USA0000010000

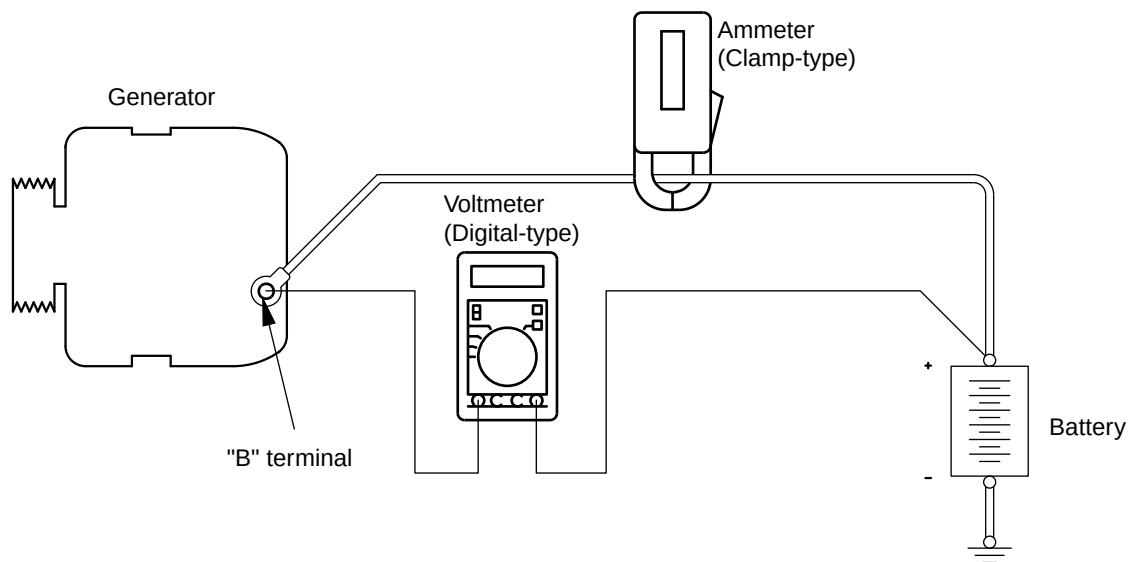
TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
	MB991958 Scan tool (M.U.T.-III sub assembly) A: MB991824 Vehicle communication interface (V.C.I.) B: MB991827 M.U.T.-III USB cable C: MB991910 M.U.T.-III main harness A (Vehicles with CAN communication system) D: MB991911 M.U.T.-III main harness B (Vehicles without CAN communication system) E: MB991914 M.U.T.-III main harness C (for Daimler Chrysler models only) F: MB991825 M.U.T.-III measurement adapter	MB991824-KIT <i>NOTE: M. U. T. -III Trigger Harness is not necessary when pushing V. C. I. ENTER key.</i>	Checking of engine speed ⚠ CAUTION For vehicles with CAN communication, use M.U.T.-III main harness A to send simulated vehicle speed. If you connect M.U.T.-III main harness B instead, the CAN communication does not function correctly.

TOOL	TOOL NUMBER AND NAME	SUPERSESSON	APPLICATION
	G: MB991826 M.U.T.-III trigger harness		
	MB991519 Generator connector harness	MIT530 Micrd 530 charging system tester.	Checking of generator ("S" terminal voltage)

ON-VEHICLE SERVICE

GENERATOR OUTPUT LINE VOLTAGE DROP TEST

M11601000009USA0000010000



ZK600347AA00

Required Special Tool:

MB991958: Scan Tool (M.U.T.-III Sub Assembly)

▪MB991824: V.C.I.

▪MB991827: M.U.T.-III USB Cable

▪MB991910: M.U.T.-III Main Harness A

This test determines whether the wiring from the generator "B" terminal to the positive battery terminal (including the fusible link) is in good condition or not:

⚠ WARNING

Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

1. Always be sure to check the following before the test.

- Generator installation

- Generator drive belt tension (Refer to GROUP 00, General - Maintenance Service - Drive Belts (For Generator, and Air Conditioning) (Check) P. 00-58.)

- Fusible link

- Abnormal noise from the generator while the engine is running.

2. Turn the ignition switch to the "LOCK" (OFF) position.

3. Disconnect the negative battery cable.

4. Connect a clamp-type DC test ammeter with a range of 0 - 150 A to the generator "B" terminal output wire.

NOTE: The way of disconnecting the generator output wire and of connecting the ammeter is possibly not found the problem that the output

current is dropping due to the insufficient connection between terminal "B" and the output wire.

5. Connect a digital-type voltmeter between the generator "B" terminal and the positive battery terminal. (Connect the positive lead of the voltmeter to the "B" terminal, and then connect the negative lead of the voltmeter to the positive battery cable.)
6. Reconnect the negative battery cable.
7. Connect an engine tachometer or scan tool MB991958.
8. Leave the hood open.
9. Start the engine.
10. With the engine running at 2,500 r/min, turn the headlights and other lights on and off to adjust the generator load so that the value displayed on the ammeter is slightly above 30 A.
Read the voltmeter. Voltage reading at or below limit value means voltage drop between generator and battery is OK.

Limit value: maximum 0.3 V

NOTE: When the generator output is high and the value displayed on the ammeter does not decrease to 30 A, set the value to 40 A. Read the value displayed on the voltmeter at this time. In this case the limit value becomes

maximum 0.4 V. Adjust the engine speed by gradually decreasing it until the value displayed on the ammeter is 30 A. Take a reading of the value displayed on the voltmeter at this time.

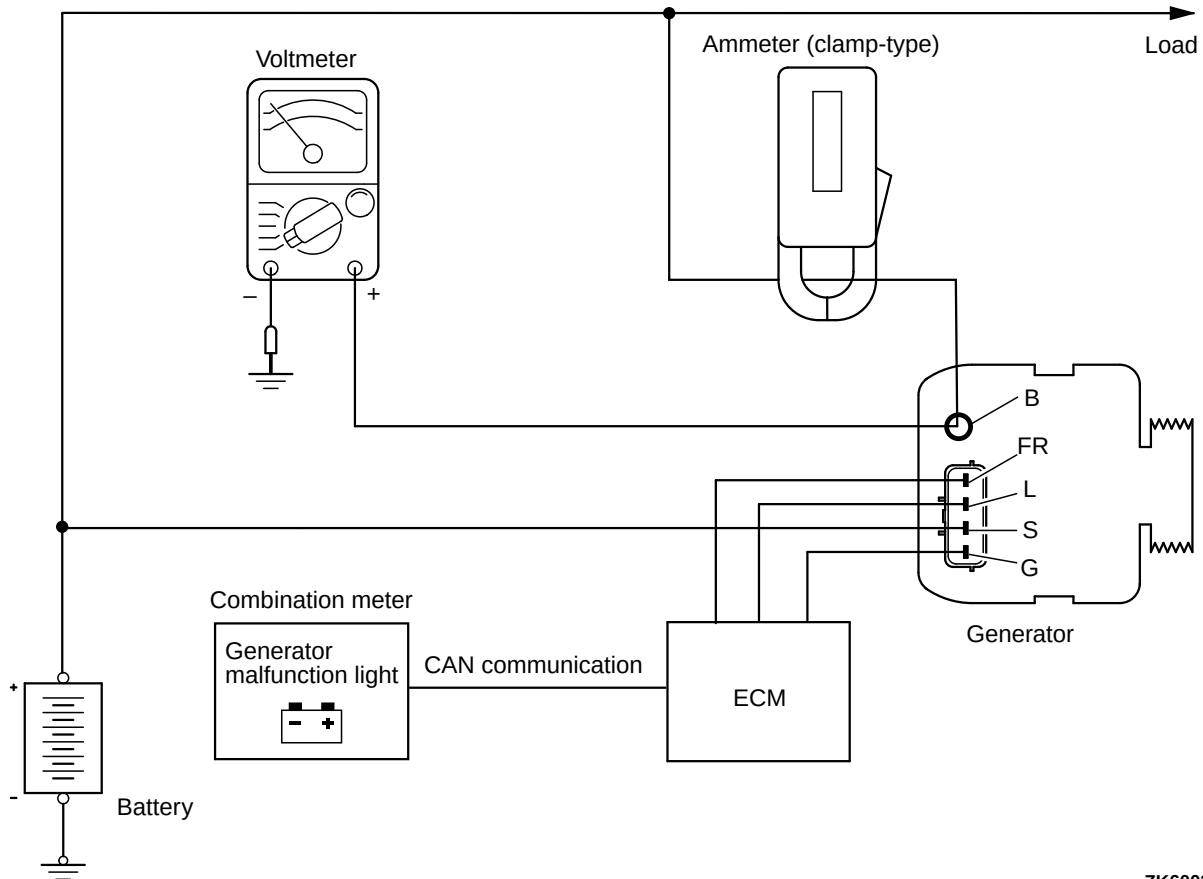
11. If the value displayed on the voltmeter is above the limit value, there is probably a malfunction in the generator output wire. Check the wiring between the generator "B" terminal and the positive battery terminal (including fusible link).
If a terminal is not sufficiently tight or if the harness has become discolored due to overheating, repair and then test again.
12. After the test, run the engine at idle.
13. Turn off all lights and turn the ignition switch to the "LOCK" (OFF) position.

NOTE: Vehicles for Canada, the headlight, taillight, etc. remain lit even when the lighting switch is in "OFF" position.

14. Disconnect the engine tachometer or scan tool MB991958.
15. Disconnect the negative battery cable.
16. Disconnect the ammeter and voltmeter.
17. Connect the negative battery cable.
18. Run the engine for 10 minutes at an idle.

OUTPUT CURRENT TEST

M11601000010USA0000010000



ZK600348AA00

Required Special Tool:

MB991958: Scan Tool (M.U.T.-III Sub Assembly)

▪MB991824: V.C.I.

▪MB991827: M.U.T.-III USB Cable

▪MB991910: M.U.T.-III Main Harness A

This test determines whether the generator outputs normal current. For best results, use a charging system tester. If not available, follow the steps below.

⚠ WARNING

Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

1. Before the test, always be sure to check the following.

- Generator installation

- Battery (Refer to GROUP 54A, Chassis Electrical - Battery - On-vehicle Service - Battery Check P. 54Aa-2.)

NOTE: The battery to be used should be slightly discharged. The load in a fully-charged battery will be insufficient and the test may not be able to be carried out correctly.

- Generator drive belt tension (Refer to GROUP 00, General - Maintenance Service - Drive Belts (For Generator, Power Steering Pump and Air Conditioning) (Check) P.00-58.)

- Fusible link

- Abnormal noise from the generator while the engine is running.

2. Turn the ignition switch to the "LOCK" (OFF) position.

3. Disconnect the negative battery cable.



Never use clips to connect the line. Loose connections (for example, using clips) will lead to a serious accident because of high current.

4. Connect a clamp-type DC test ammeter with a range of 0 - 150 A to the generator "B" terminal output wire.

NOTE: The way of disconnecting the generator output wire and of connecting the ammeter is possibly not found the problem that the output current is dropping due to the insufficient connection between terminal "B" and the output wire.

5. Connect a voltmeter with a range of 0 - 20 V between the generator "B" terminal and ground. (Connect the positive lead of the voltmeter to the "B" terminal, and then connect the negative lead of the voltmeter to ground.)
6. Connect the negative battery cable.
7. Connect an engine tachometer or scan tool MB991958.
8. Leave the hood open.
9. Check to be sure that the reading on the voltmeter is equal to the battery positive voltage.

NOTE: If the voltage is 0 V, the cause is probably an open circuit in the wire or fusible link between the generator "B" terminal and the battery positive terminal or malfunctioning voltmeter.

10. After turning on the headlights, start the engine.

NOTE: Because the current from the battery will soon drop after the engine is started, step 11 should be carried out as quickly as possible in order to obtain the maximum current output value.

11. Immediately after setting the headlights to high beam and turning the heater blower switch to the highest position, increase the engine speed to 2,500 r/min and read the maximum current output value displayed on the ammeter.

Limit value: 70 % of nominal current output

NOTE: For the nominal current output, refer to the Generator Specifications.

NOTE: The current output value will depend on the electrical load and the temperature of the generator body.

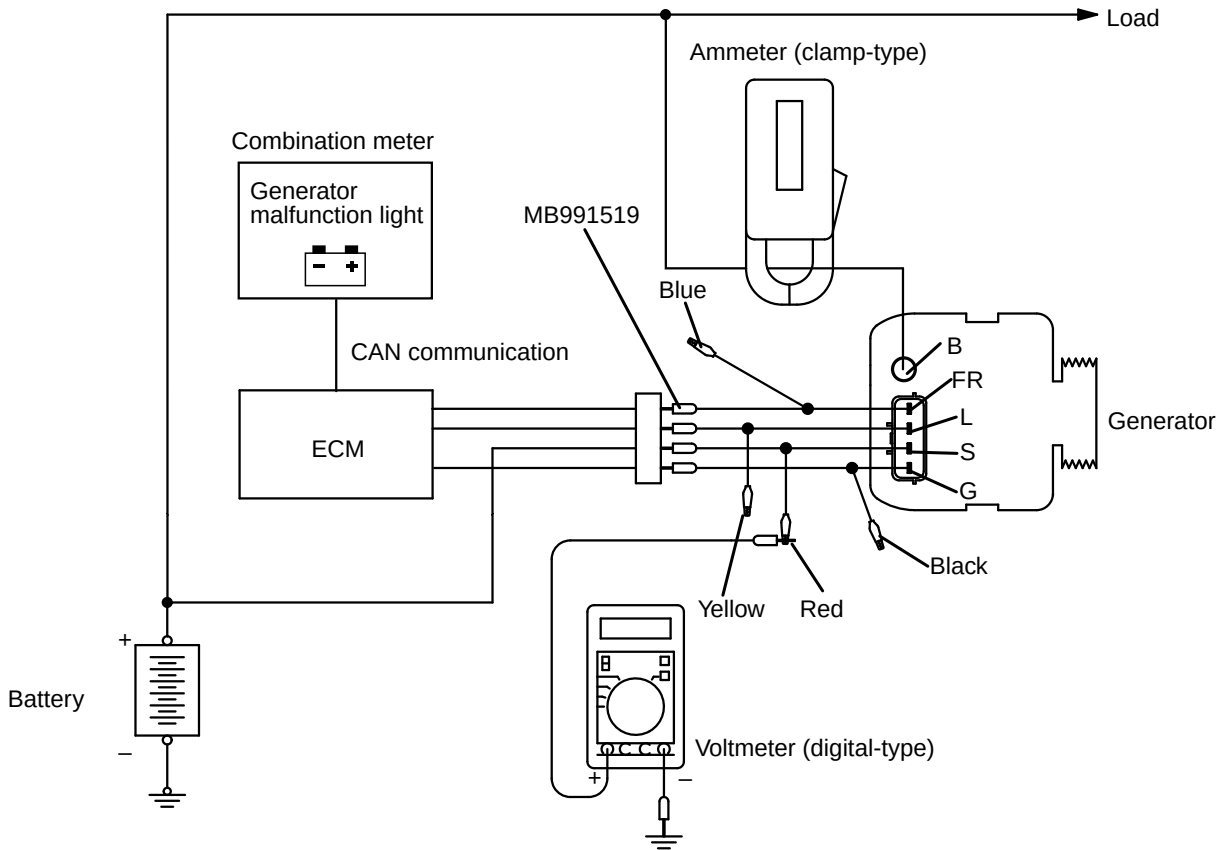
NOTE: If the electrical load is small while testing, the specified level of current may not be output even though the generator is normal. In such cases, increase the electrical load by leaving the headlights turned on for some time to discharge the battery or by using the lighting system in another vehicle, and then test again.

NOTE: The specified level of current also may not be output if the temperature of the generator body or the ambient temperature is too high. In such cases, cool the generator and then test again.

12. The reading on the ammeter should be above the limit value. If the reading is below the limit value and the generator output wire is normal, remove the generator from the engine and check the generator.
13. Run the engine at idle speed after the test.
14. Turn the ignition switch to the "LOCK" (OFF) position.
15. Disconnect the engine tachometer or scan tool MB991958.
16. Disconnect the negative battery cable.
17. Disconnect the ammeter and voltmeter.
18. Connect the negative battery cable.
19. Run the engine for 10 minutes at an idle.

REGULATED VOLTAGE TEST

M11601000011USA0000010000



ZK500349AA00

Required Special Tools:

- MB991958: Scan Tool (M.U.T.-III Sub Assembly)
- MB991824: V.C.I.
- MB991827: M.U.T.-III USB Cable
- MB991910: M.U.T.-III Main Harness A
- MB991519: Generator Harness Connector

This test determines whether the voltage regulator is correctly controlling the generator output voltage.

⚠ WARNING

Battery posts, terminals and related accessories contain lead and lead compounds. WASH HANDS AFTER HANDLING.

1. Always be sure to check the following before the test:

- Generator installation
- Check to be sure that the battery installed in the vehicle is fully charged. (Refer to GROUP 54A, Chassis Electrical - Battery - On-vehicle Service - Battery Check P.54Aa-2.)

- Generator drive belt tension (Refer to GROUP 00, General - Maintenance Service - Drive Belts (For Generator, and Air Conditioning) (Check) P. 00-58.)
- Fusible link
- Abnormal noise from the generator while the engine is running.

2. Turn the ignition switch to the "LOCK" (OFF) position.
3. Disconnect the negative battery cable.
4. Use the special tool (Generator harness connector: MB991519) to connect a digital-type voltmeter between the generator "S" terminal and ground. (Connect the positive lead of the voltmeter to the "S" terminal, and then connect the negative lead of the voltmeter to a secure ground or to the negative battery terminal.)
5. Connect a clamp-type DC test ammeter with a range of 0 - 150 A to the generator "B" terminal output wire.
6. Reconnect the negative battery cable.

7. Connect an engine tachometer, or scan tool MB991958.
8. Turn the ignition switch to the "ON" position and check that the reading on the voltmeter is equal to the battery positive voltage.
NOTE: If the voltage is 0 V, the cause is probably an open circuit in the wire or fusible link between the generator "S" terminal and the battery positive terminal or malfunctioning voltmeter.
9. Check to be sure that all lights and accessories are off.
10. Start the engine.
11. Increase the engine speed to 2,500 r/min.
12. Read the value displayed on the voltmeter when the current output by the generator becomes 10 A or less.
13. If the voltage reading conforms to the value in the voltage regulation table, then the voltage regulator is operating normally.
If the voltage is outside the standard value, there is a malfunction of the voltage regulator or the generator (Refer to the following table).
14. After the test, lower the engine speed to idle.
15. Turn the ignition switch to the "LOCK" (OFF) position.
16. Disconnect the engine tachometer or scan tool MB991958.
17. Disconnect the negative battery cable.
18. Disconnect the ammeter and voltmeter.
19. Remove the special tool (Generator harness connector: MB991519), and return the connector to the original condition.
20. Connect the negative battery cable.
21. Run the engine for 10 minutes at an idle.

VOLTAGE REGULATION TABLE

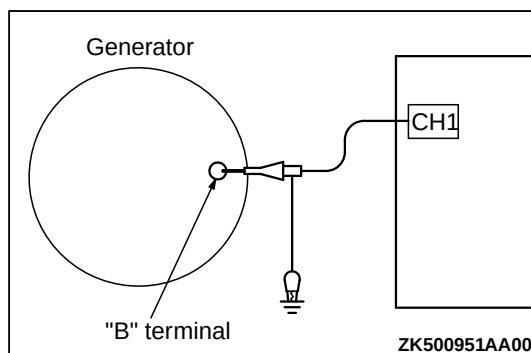
INSPECTION TERMINAL	VOLTAGE REGULATOR AMBIENT TEMPERATURE [°C (°F)]	STANDARD VALUE (V)
Terminal "S"	-20 (-4)	14.2 - 15.4
	20 (68)	13.9 - 14.9
	60 (140)	13.4 - 14.6
	80 (176)	13.1 - 14.5

WAVE PATTERN CHECK USING AN OSCILLOSCOPE

M11601000012USA0000010000

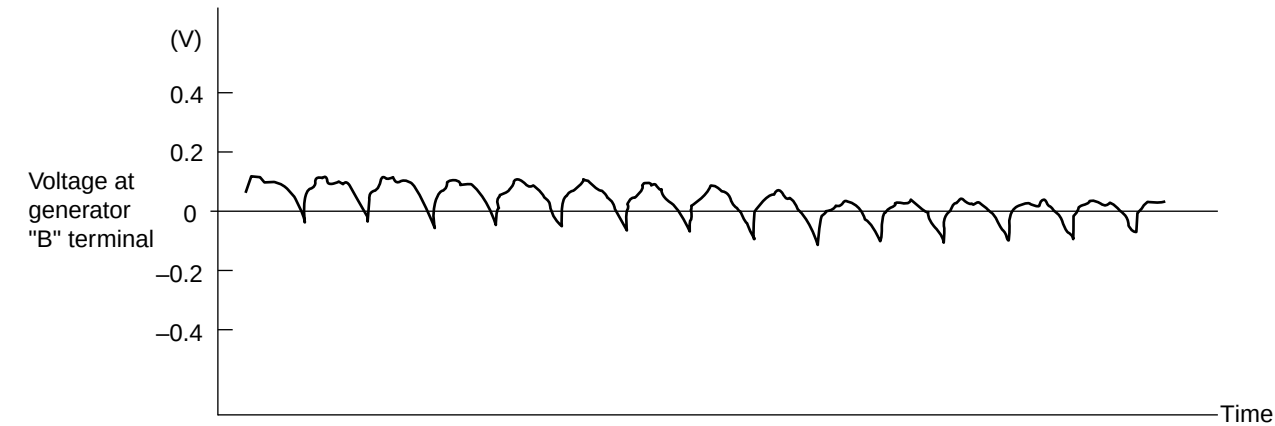
MEASUREMENT METHOD

Connect the oscilloscope special patterns pick-up to the generator "B" terminal.

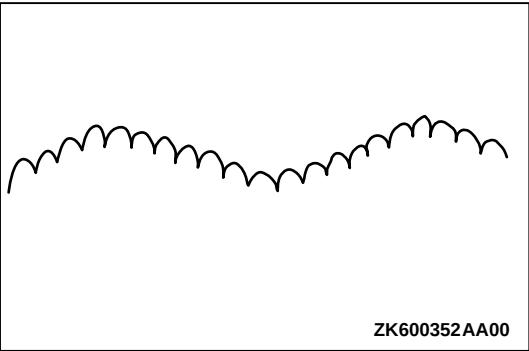


STANDARD WAVEFORM

Observation Conditions	
FUNCTION	SPECIAL PATTERNS
Pattern height	Variable
Variable knob	Adjust while viewing the wave pattern
Pattern selector	Raster
Engine revolutions	Curb idle speed



ZK600351AA00



***NOTE:** The voltage waveform of the generator "B" terminal can undulate as shown at left. This waveform is produced when the regulator operates according to fluctuations in the generator load (current), and is normal for the generator. If the ripple height is abnormally high (approximately 2 V or more during idling), the wires between the generator "B" terminal and the battery have broken due to fuse blowing, etc. The generator is usually operating properly.*

ABNORMAL WAVEFORMS EXAMPLES

***NOTE:** The size of the waveform patterns can differ greatly, depending on the adjustment of the variable knob on the oscilloscope.*

***NOTE:** Identification of abnormal waveforms is easier when there is a large output current (regulator is not operating). (Waveforms can be observed when the headlights are illuminated.)*

***NOTE:** Check the conditions of the generator malfunction light (illuminated/not illuminated) also, and carry out a total check.*

ABNORMAL WAVEFORMS

- Example 1
PROBABLE CAUSE: Open circuit in diode
- Example 2
PROBABLE CAUSE: Short-circuit in diode
- Example 3
PROBABLE CAUSE: Open circuit in stator coil
- Example 4
PROBABLE CAUSE: Short-circuit in stator coil



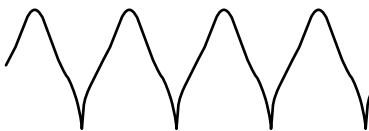
ZK600353AA00



ZK600354AA00



ZK600355AA00



ZK600356AA00

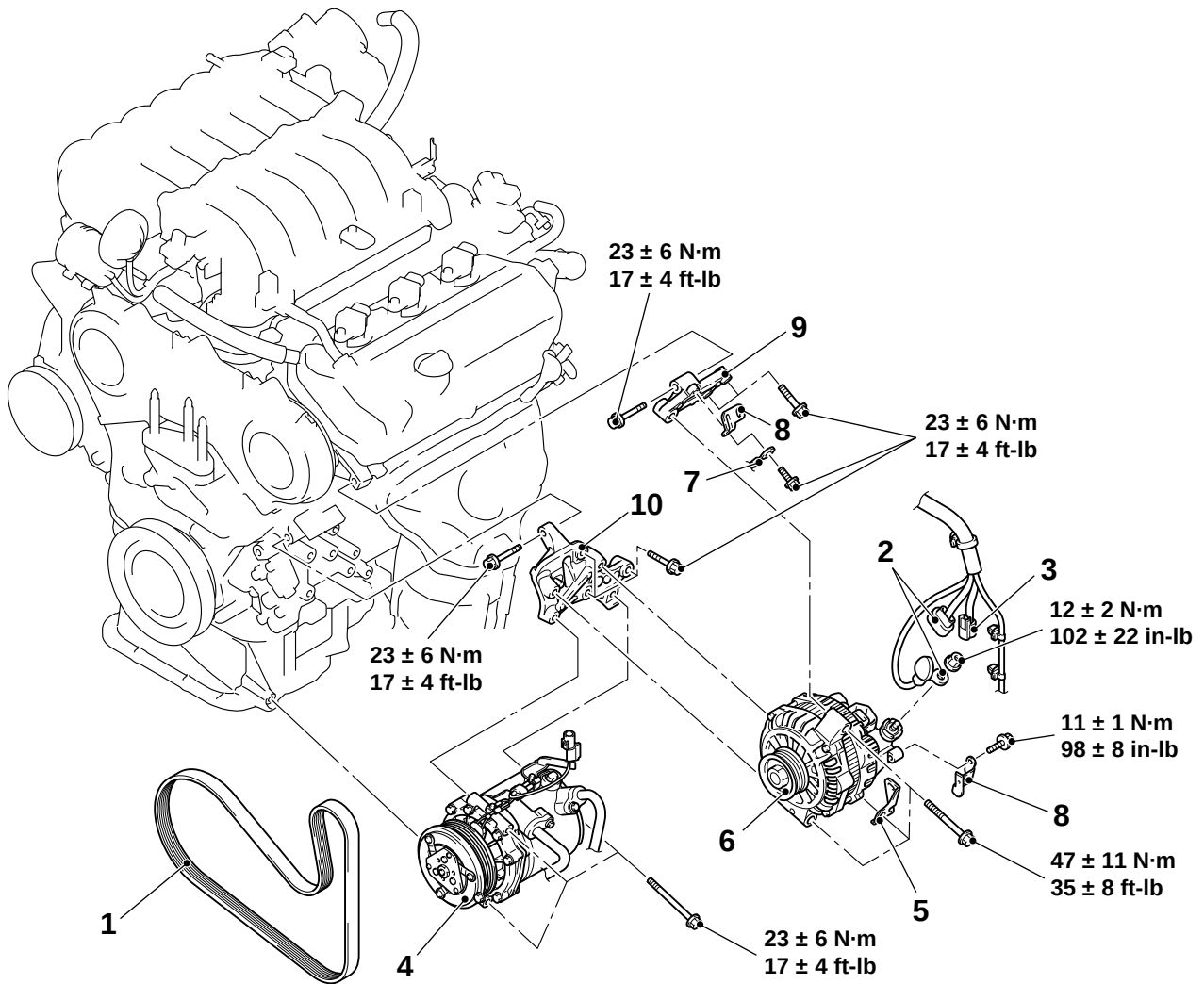
GENERATOR ASSEMBLY

REMOVAL AND INSTALLATION

M11601000014USA0000010000

Pre-removal and Post-installation Operation

- Engine Room Under Cover and Engine Room Side Cover Removal and Installation (Refer to GROUP 51A, Under Cover P. 51A-18).



ZC600573AA00

Removal steps

1. Generator drive belt
2. Generator connector and terminal
3. A/C compressor connector
4. A/C compressor assembly
5. Harness bracket
6. Generator assembly

<<A>>

<> >>A<<

Removal steps

7. Ground cable connection
8. Harness bracket
9. Generator upper bracket
10. Generator lower bracket

REMOVAL SERVICE POINTS**<<A>> A/C COMPRESSOR ASSEMBLY REMOVAL**

1. Remove the A/C compressor from the A/C compressor bracket with the hose still attached.
2. Place the removed A/C compressor where it will not be a hindrance when removing and installing the generator, and secure it with a cord or wire.

<> GENERATOR ASSEMBLY REMOVAL

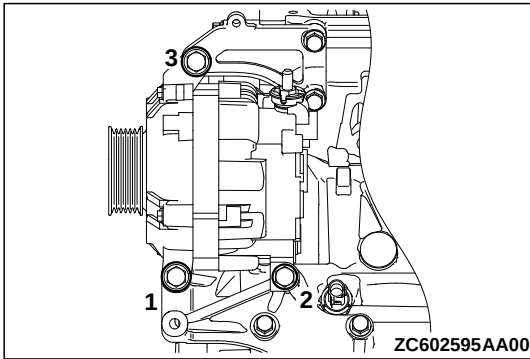
Move the A/C compressor assembly to one side, and then remove the generator assembly from under the vehicle.

INSTALLATION SERVICE POINT

>>A<< GENERATOR ASSEMBLY INSTALLATION

1. Temporarily tighten the generator to the generator bracket.
2. In accordance with the tightening order shown in the illustration, tighten the installation bolts for the generator bracket to the specified torque.

Tightening torque: 47 ± 11 N·m (35 ± 8 ft-lb)



MEMO