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MSG equipment

MS016

OPERATION MANUAL ON DIAGNOSTICS OF ALTERNATORS AND VOLTAGE REGULATORS

INSTRUKCJA DIAGNOSTYKI ALTERNATORÓW I REGULATORÓW NAPIĘCIA

ИНСТРУКЦИЯ ПО ДИАГНОСТИКЕ ГЕНЕРАТОРОВ И РЕГУЛЯТОРОВ НАПРЯЖЕНИЯ

QUALITY WARRANTY INNOVATION SERVICE TRAINING UNIQUENESS

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INTRODUCTION

The actual instruction describes the technique of voltage regulator diagnostics (hereinafter “the voltage regulator”) with tester MS016 (hereinafter “the tester”) to detect faults in alternator and voltage regulator performance.

⚠ **WARNING! The actual instruction does not provide a description of all the diagnostic aspects. If you lack knowledge or experience, we recommend you to take training at the equipment manufacturing facility.**

⚠ **WARNING! MSG Equipment shall not be held liable for any damage to the tester resulted from its improper use.**

The tester performs the following operations:

1. Performance evaluation of automotive alternators with electromagnetic excitation and nominal voltage of 12/24V. An alternator can be tested either directly in a car or on the test bench that provides its drive.

2. Performance evaluation of voltage regulators with electromagnetic excitation and nominal voltage of 12/24V separately from alternators. The diagnostics of alternators and voltage regulators is carried out on the following parameters:

- Setting accuracy of stabilizing voltage;
- Assessment of control lamp performance;
- FR (load on alternator).

For COM regulators (additionally):

- ID;
- Protocol;
- Data exchange rate;
- Type of LIN protocol;
- Self-diagnostics errors.

1 TESTER DESCRIPTION

The tester is a portable device, its functions controlled via the touch-screen (Fig.1).

Figure 1 - General view of the tester

In the upper part of the device, there is a terminal for connection of diagnostic cables (Fig.2).

Figure 2 – Terminal for connection of diagnostic cables

There is a USB Type-C port in the bottom part of the tester, through which the power is supplied to the tester during the diagnostics of voltage regulators. The USB port serves as well for connection of the tester to a computer either for software updating or for data copying (Fig.3).

Figure 3 - USB port, Type-C

A diagnostic cable for voltage regulators (Fig.4) and adapter cables (Fig.5) for easy connection to the voltage regulator output terminals are included in the tester set.

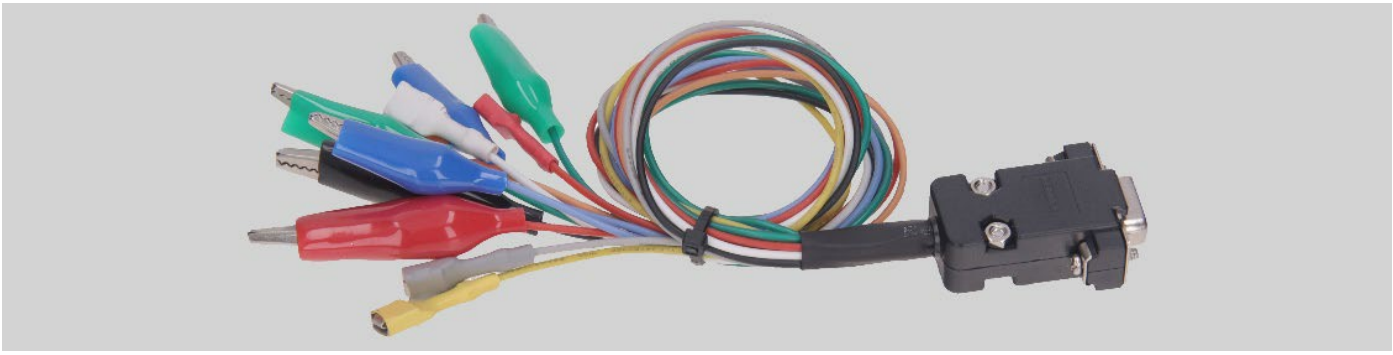


Figure 4 – Diagnostic cable for voltage regulators MS-33502

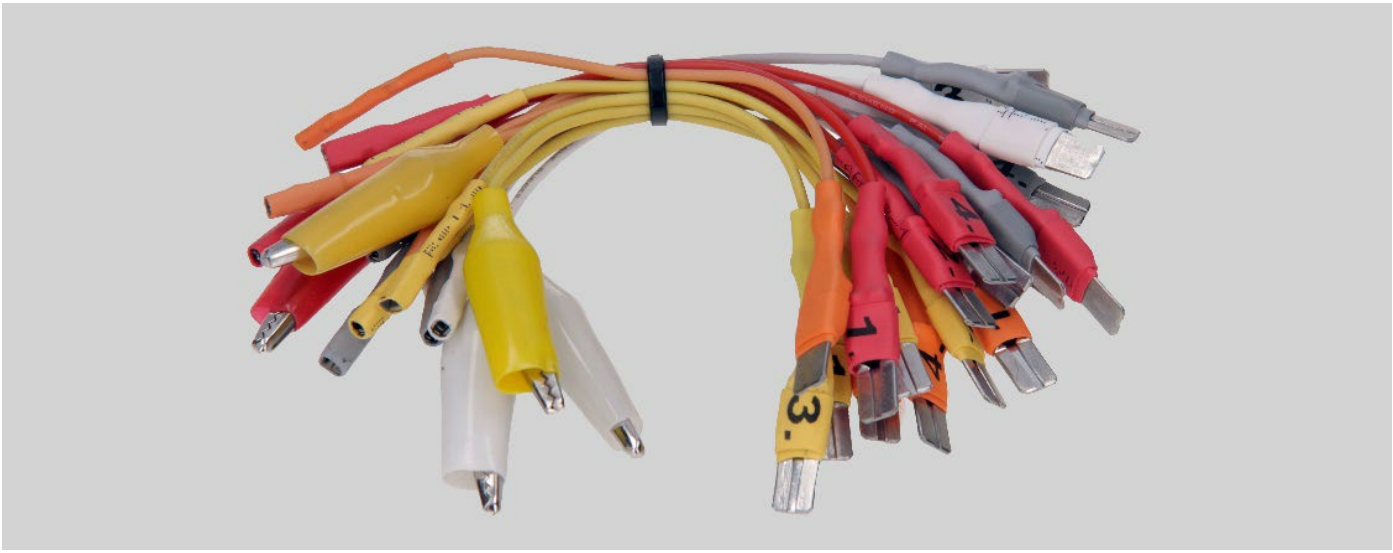


Figure 5 – Adapter cables for diagnostics of voltage regulators

The diagnostic cable for voltage regulators (Fig.4) has the following color markings (Table 1):

- Red cable with a clip – **B+** – voltage regulator terminal B+ (terminal 30);
- Black cable with a clip – **B-** – voltage regulator terminal B- (GND, terminal 31);
- Orange cable with a terminal – **S** (Sense pin) – through this terminal, the voltage regulator measures the battery voltage and compares it with the alternator/voltage regulator output voltage. This cable is connected to terminals S of the voltage regulator;
- Red cable with a terminal – **IG** (Ignition) – the ignition terminal (terminal 15, A, IG);
- White cable with a terminal – **FR** – through this terminal, the data on the voltage regulator load are transmitted. The cable connects to FR, DFM, and M terminals of the voltage regulator;
- Grey cable with a terminal – **D+** – the terminal through which the control lamp of the voltage regulator is connected to terminals D+, L, IL, and 61 of the voltage regulator;
- Yellow cable with a terminal – **GC** – for connection of the tester to the control channel of the voltage regulator through voltage regulator terminals COM, SIG, and others;
- Green cables with clips – **F1, F2** – for connection of the tester to the brushes of the voltage regulator or their corresponding terminals: DF, F, FLD;
- Blue cables with clips – **ST1, ST2** – for connection of the tester to the stator terminals of the voltage regulator: P, S, STA, Stator.

Table 1 – Color markings of cable MS-33502

Clip/Terminal	Tester output terminal
	**B+**
	**B-**
	**S**
	**IG**
	**FR**
	**D+**
	**GC**
	**F1, F2**
	**ST1, ST2**

The equipment set includes a cable for alternator diagnostics (Fig.6).

Figure 6 – Diagnostic cable for alternators MS-33501

The diagnostic cable (Fig.6) has the following color markings:

- Red clip, big – „**B+**”;
- Black clip, big – „**B-**”;
- Orange clip, small - „**S**” (Sense pin);
- Red clip, small – „**IG**” (Ignition);
- White clip, small – „**FR**”;
- Grey clip, small – „**D+**”;
- Yellow clip, small – „**GC**”.

2 MENU TESTERA

The tester main menu (Fig. 7) contains:

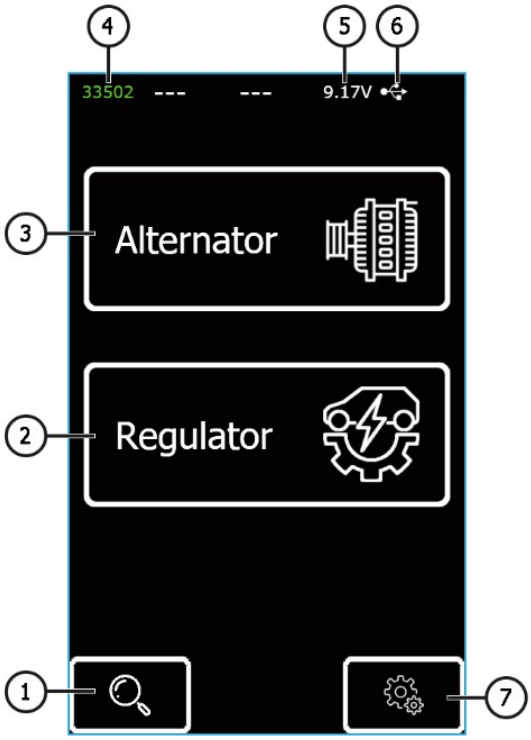


Figure 7 - Tester main menu

1 – Button to enter a search menu of the voltage regulator database;

2 – Button to enter the menu for selection of the tested voltage regulator type;

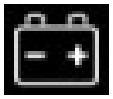
3 – Button to enter the menu for selection of the tested alternator type;

4 – Tag number of the connected cable;

5 – Current power supply voltage;

6 – Power supply of the tester:

 – USB,

 – BATTERY.

7 – Button to enter the tester settings.

The tester is supplied with an integrated database of voltage regulators along with their connection diagrams. Press  to enter the database search menu (Fig.7, n.1).

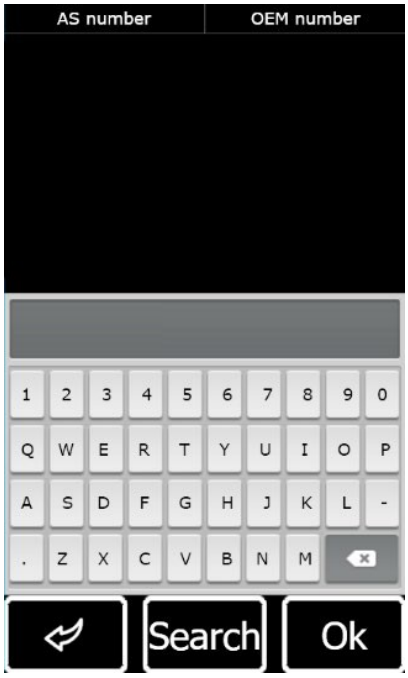


Figure 8 - Database search menu

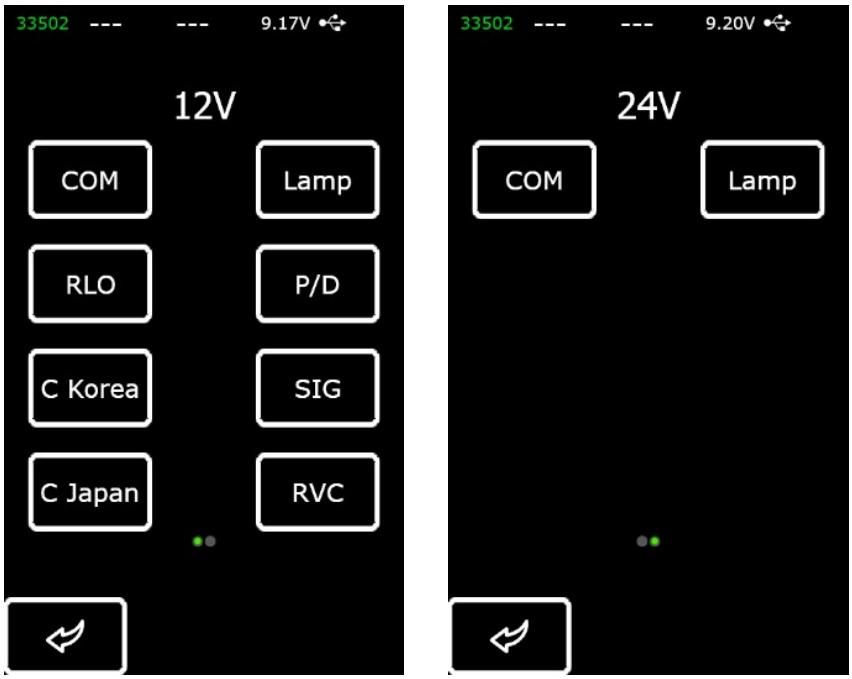


Figure 9 - Menu for selection of the tested voltage regulator type

Press the button with the required type of the voltage regulator to enter the alternator/voltage regulator test mode.

Press  to return to the main menu.

2.1 Test modes menu

Upon entering the test mode for voltage regulators, the following information will appear on the screen (Fig.10):

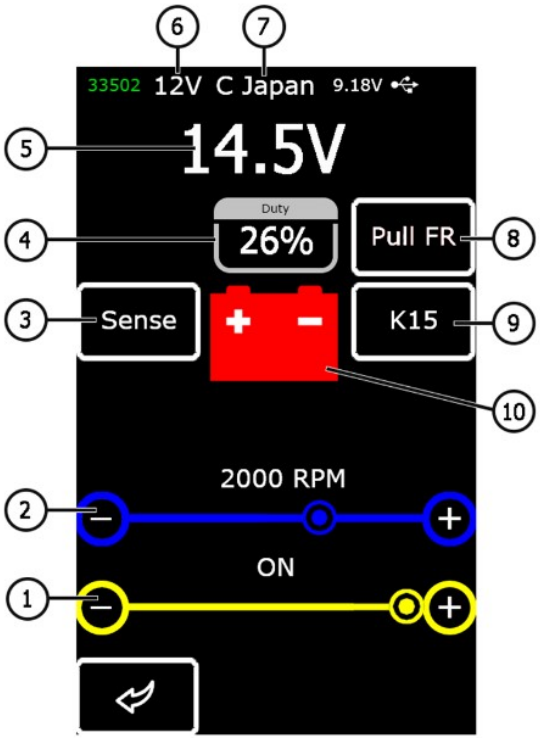


Figure 10 - Diagnostic screen information

1 – Preset stabilizing voltage (for controlled voltage regulators);

2 – Preset rpm (this parameter will not be displayed in alternator test mode);

3* – Button to check the SENSE terminal through which the voltage regulator measures the battery voltage (red indication: the voltage across SENSE is lower by 0.5V-0.7V than the voltage across B+);

4 - Duty cycle of PWM signal received through FR channel (the proportion of the rotor winding “on” time);

5 – Measured stabilizing voltage;

6 – Test mode nominal voltage;

7 – Voltage regulator type;

8* – Button to switch the mode of data readout through FR channel;

9* – Switch starting button;

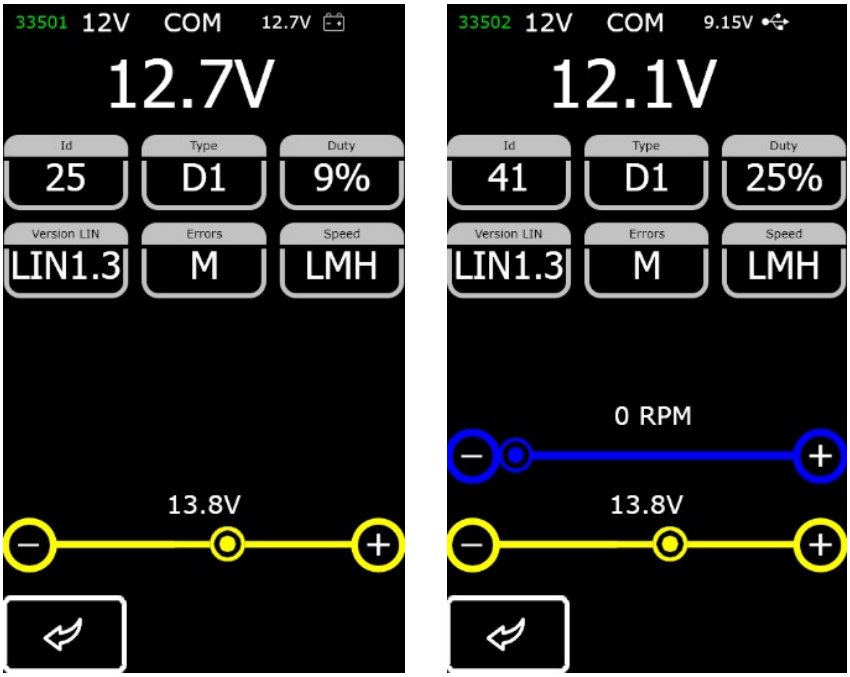
10 - Alternator control lamp indicator (for voltage regulators that directly control the lamp).

*** Color indication of the button:**

red – ON;

white – OFF.

The diagnostic screen for voltage regulators of COM type displays the following information:



alternator **voltage regulator**

Figure 11 - Diagnostic screen for alternators/voltage regulators (12/24V) of COM type

„**ID**" - voltage regulator identification number. The engine control unit identifies the type of the installed alternator by this number;

„**Type**" – voltage regulator type. The type codes of voltage regulators operating under LIN protocol are as follows: A1, A2, A3, A4, B1, B2, B3, B4, C3, D1, D2, E1;

„**Duty**" - PWM signal duty cycle (the proportion of the rotor winding "on" time);

„**Version LIN**" – indicator of voltage regulator protocol version (LIN1 or LIN2);

„**Errors**" - indicator of errors transmitted by the voltage regulator to the engine control unit. Types of potential errors:

• E – electrical error;

• M – mechanical error;

• TH – thermal error.

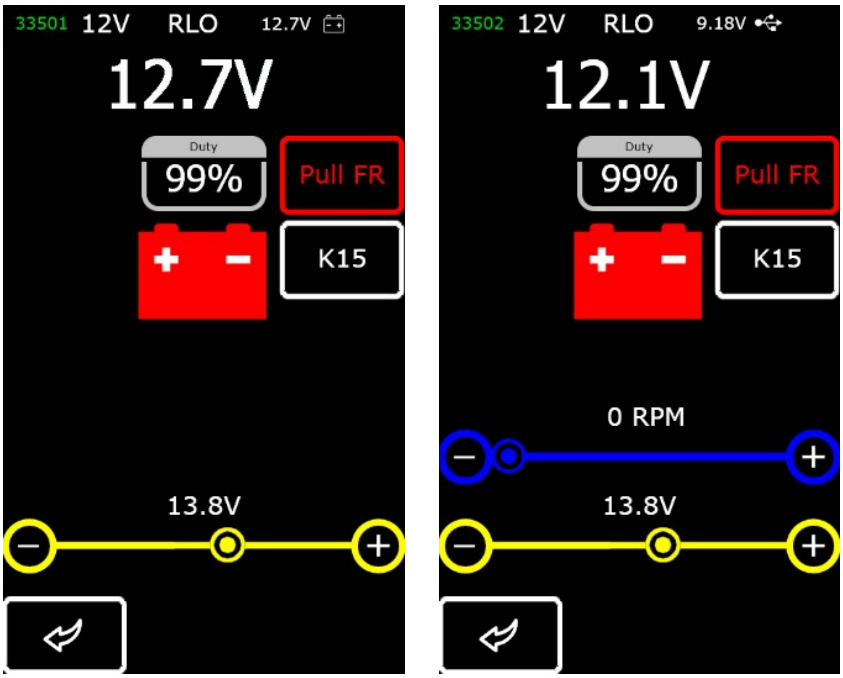
„**Speed**" - indicator of data exchange rate under LIN protocol supported by a COM voltage regulator. The following rate values may be displayed:

• „L" – 2400 baud (low);

• „M" – 9600 baud (medium);

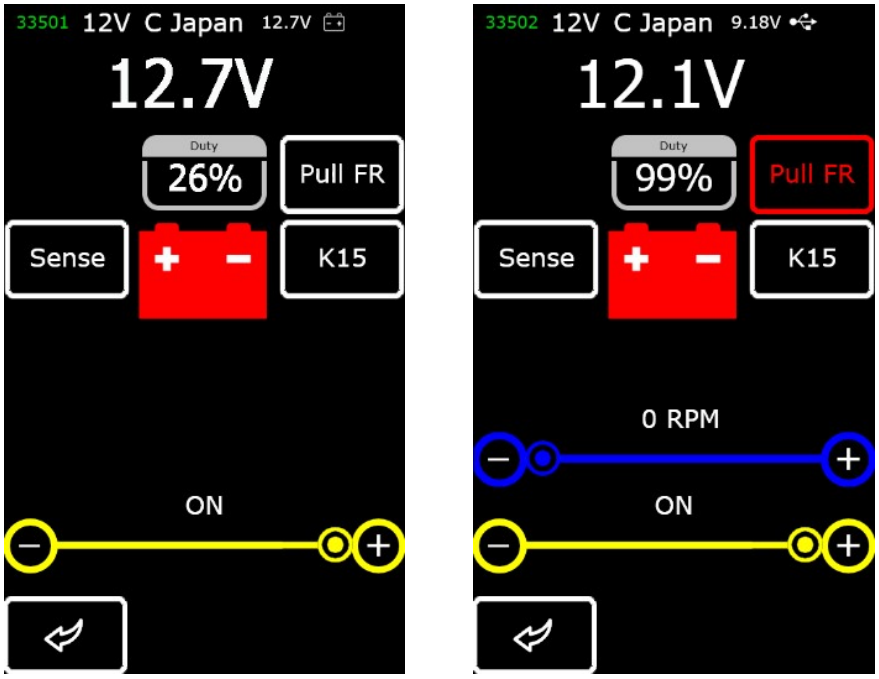
• „H" – 19200 baud (high).

Figures 12-15 show the information displayed when different voltage regulator types are tested.



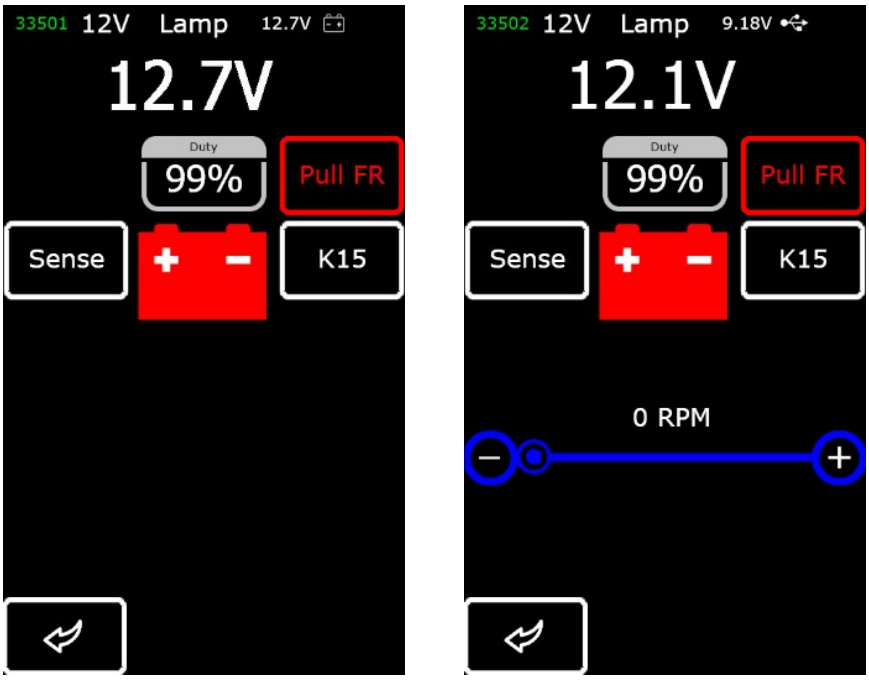
alternator **voltage regulator**

Figure 12 - Diagnostic screen for alternators/voltage regulators of RLO, RVC, C KOREA types



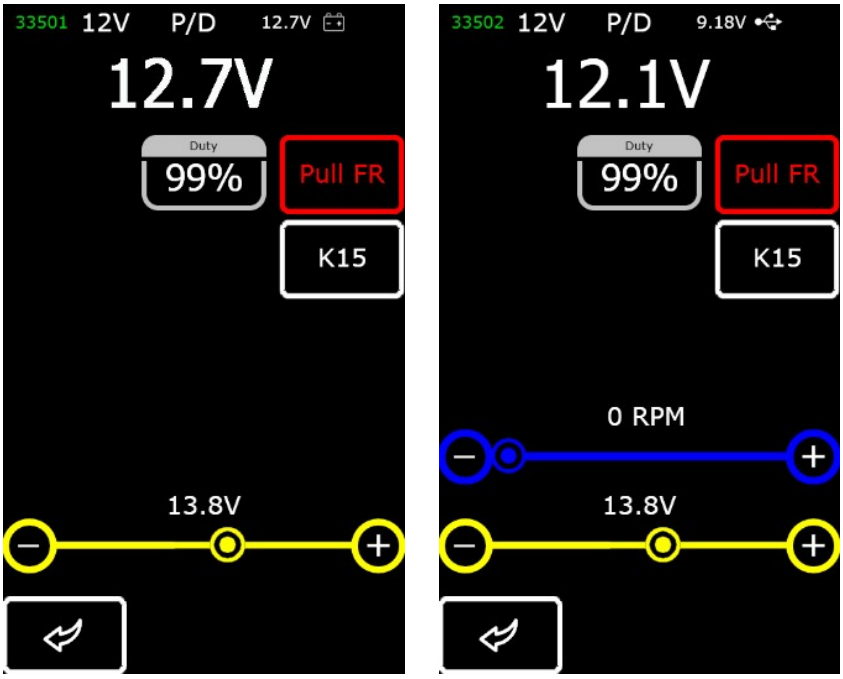
alternator **voltage regulator**

Figure 13 - Diagnostic screen for alternators/voltage regulators of C JAPAN type



alternator **voltage regulator**

Figure 14 - Diagnostic screen for alternators/voltage regulators (12/24V) of Lamp type



alternator **voltage regulator**

Figure 15 - Diagnostic screen for alternators/voltage regulators of SIG and P/D types

3 INTENDED USAGE

1. Use the tester as intended (see Section 1 of User Manual).
2. The tester is designed for indoor use. Be aware of the following operating constraints:
   2.1. Observe the environmental conditions for the equipment operation specified in Section 2 of User Manual. Do not use the device when the air temperature is negative or the humidity is high (over 75%). Do not turn on the tester immediately after moving it from a cold room (or from outdoors) into a warm one as its components may be covered with a condensate. Keep it off at room temperature for at least 30 min.
   2.2. Avoid leaving the device in direct sunlight.
   2.3. Keep away from heating devices, microwaves, and other temperature-raising equipment.
   2.4. Avoid dropping the tester or spilling technical liquids on it.
   2.5. Any interference with the electric diagram of the device is strictly prohibited.
   2.6. Make sure the crocodile clips are completely insulated before connecting them to the alternator/voltage regulator terminals.
   2.7. Avoid the crocodile clips short circuit between themselves or to any conductive parts of a vehicle, including its body.
   2.8. Do not put the tester on the vehicle battery or other elements of the underhood space. Avoid short circuit of the tester housing to the conductive parts of a vehicle.

2.9. Do not use the device with a faulty power unit.
2.10. Turn off the tester when it is not in operation.
In case of failure, contact the technical support service or sales representative.

3.1 Safety regulations

The operation of the tester requires technical proficiency of the operator, he must be authorized to operate certain types of test benches (devices) and receive safety training.

4 VOLTAGE REGULATOR TESTING

Generally, most voltage regulators are tested as follows:
1) Connection of a voltage regulator to the tester;
2) Selection of the type and nominal voltage of the tested voltage regulator;
3) Assessment of the control lamp operability: when speed is about 0 rpm, the battery indicator must light up (red). As the speed increases up to 800-1200 rpm, the indicator must go out.
4) Assessment of the „S" terminal operability;
5) Assessment of the voltage regulator capability to adjust to the preset stabilizing voltage. Use a cursor (Fig.10, n.1) to set the voltage.

⚠ **WARNING! The test mode (Fig.9) should correspond to the type of the tested voltage regulator.**

Connect both cable MS-33502 and a power unit equipped with «Quick Charge 2.0» to the tester through USB Type-C port to launch the diagnostic procedure.

⚠ **WARNING! If the connected power unit doesn't feature «Quick Charge 2.0», the tester can test 12V voltage regulators only.**

⚠ **WARNING! Operation of some TM Bosch voltage regulators requires a heavy current, the tester cannot deliver. Voltage regulators of this type cannot be tested.**

4.1 Voltage regulator connection

Assessment of the voltage regulator operability requires a proper connection of the diagnostic cable to the voltage regulator.

Use the voltage regulator OEM number to search the terminal markings against the database (Fig.16).

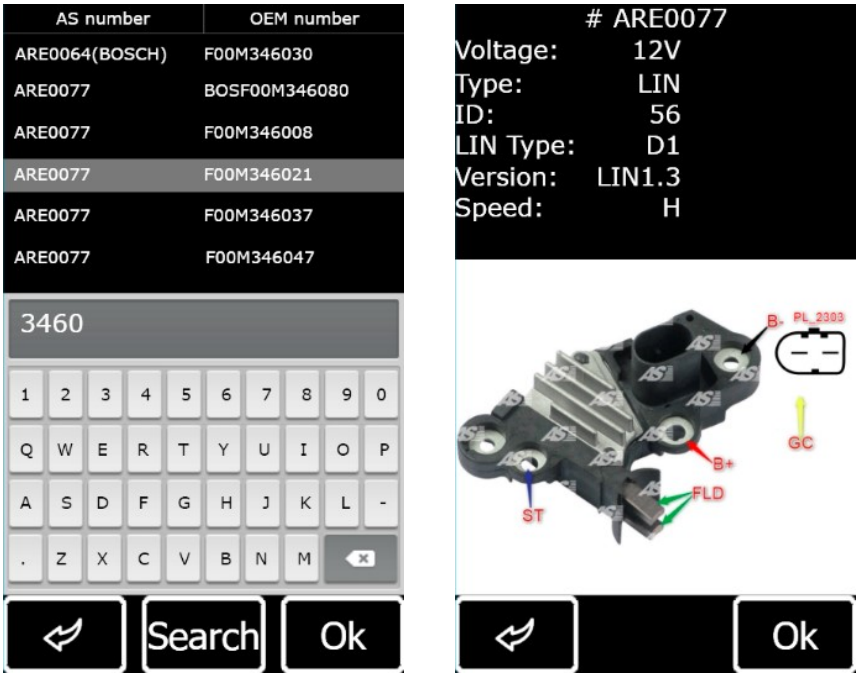


Figure 16 - Voltage regulator search against the database and search results

Connect the diagnostic cable to the voltage regulator as shown on the diagram.

⚠ **WARNING! To avoid damage (failure) to the voltage regulator, extra care should be taken when connecting the cable clips to the contacts in the terminals. Use either a well-insulated clip (Fig.17) or a proper adapter cable (Fig.5).**

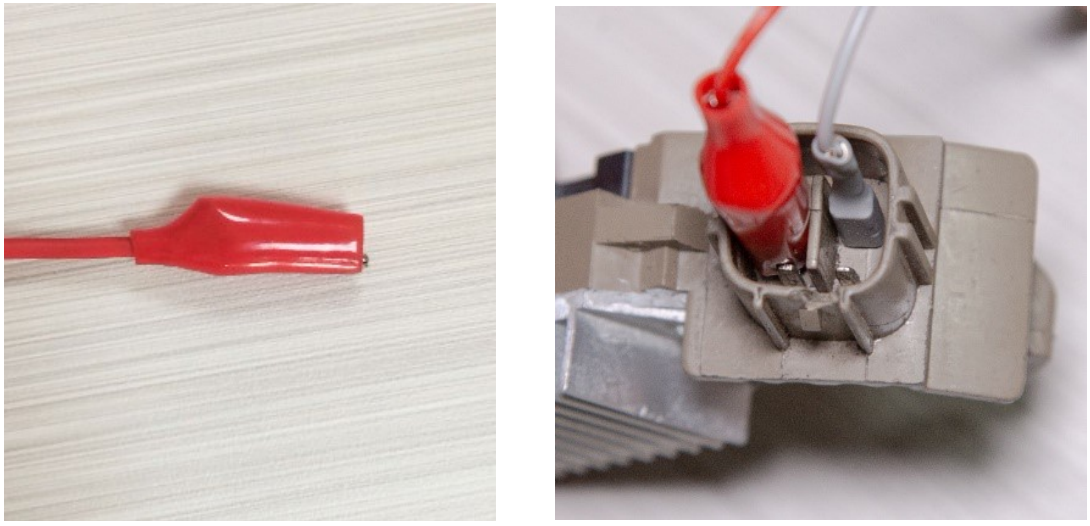


Figure 17 - Connection of cable clips to the contacts in the terminals

When the connection is made, press «OK» - the tester will automatically switch over to the test mode appropriate for the tested voltage regulator. Then, proceed to the voltage regulator testing (the process is described below).

If the information on the markings of the voltage regulator terminals cannot be found in the database, research online. Appendix 3 is yet another source of information. There you can find connection diagrams of the most common voltage regulator types. Use the diagram with terminal markings found online and the examples below to connect the diagnostic cable.

Figure 18 shows a diagram (an example) for connection of voltage regulator ARE1054.

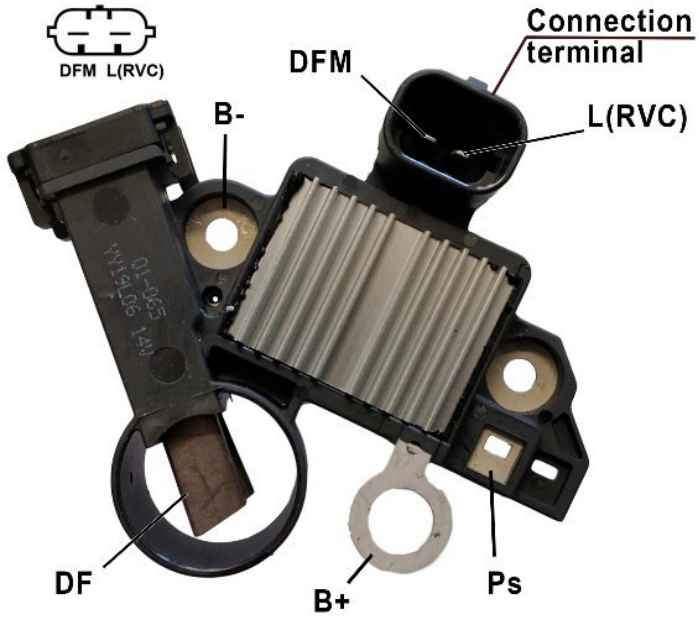


Figure 18 - Voltage regulator ARE1054

Identify the type of the voltage regulator by the terminal contacts shown in Fig.18 and use information set out in Appendices 1, 2 of the actual Instruction. Shown here are terminals DFM and L(RVC) (can also be marked as L(PWM)). By terminal L (RVC) we identify this voltage regulator as RVC type.

Then, using Appendix 1, we determine which clips (connectors) of the diagnostic cable must be connected to the voltage regulator. A diagram of voltage regulator ARE1054 connection to the tester is shown both in Table 2 and Figure 19.

Table 2 – Connection of voltage regulator ARE1054 to the tester

Voltage regulator terminal	Tester output terminal	Color marking of cable
DFM	FR	white
L(RVC)	GC	yellow
Ps	ST1	blue
B+	B+	red
DF	F1	green
	F2	green
B-	B-	black

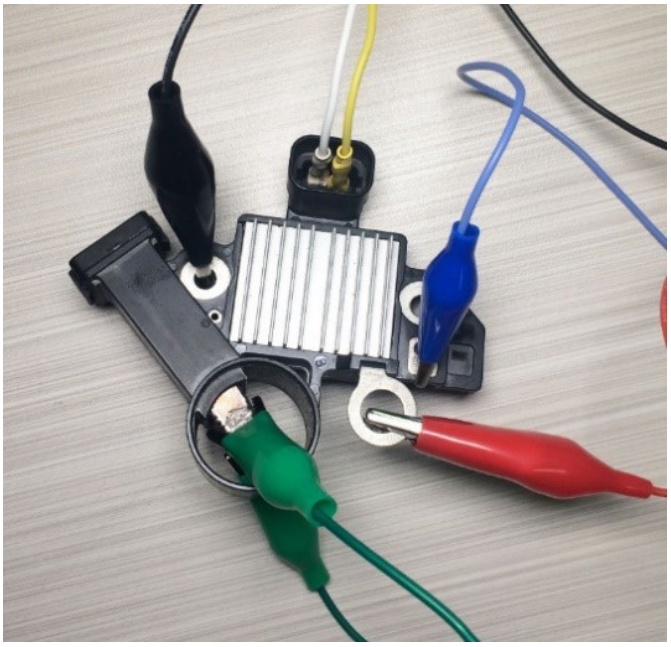


Figure 19 - Diagram of voltage regulator ARE1054 connection to the tester

Figure 20 shows a diagram of voltage regulator ARE6076 connection as an example.

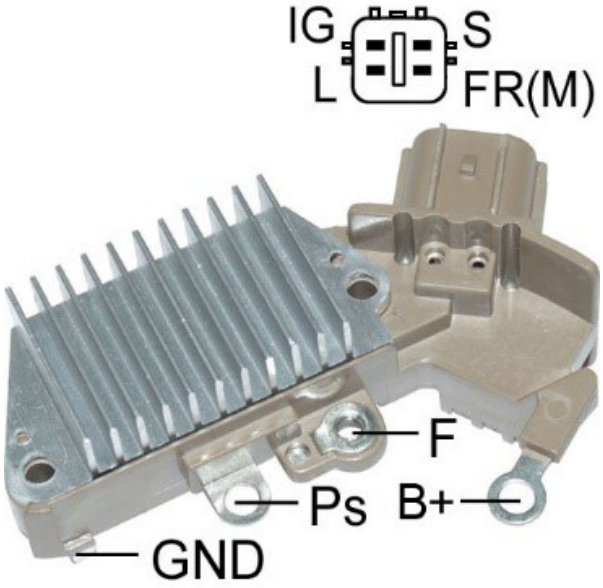


Figure 20 - Voltage regulator ARE6076

The voltage regulator type is identified by the terminal contacts and based on the information set out in Appendices 1, 2. In the example given, terminals IG, S, FR(M) do not identify the type of the voltage regulator. Terminal L identifies it as a Lamp type.

Then we refer to Appendix 1 to determine which clips (connectors) of the diagnostic cable must be connected to the voltage regulator. The connection diagram of voltage regulator ARE6076 is shown in both Table 3 and Figure 21.

Table 3 – Connection of voltage regulator ARE6076 to the tester

Voltage regulator terminal	Tester output terminal	Color marking of cable
IG	IG	red
L	D+	grey
S	S	orange
FR(M)	FR	white
B+	B+	red
	F2	green
F	F1	green
Ps	ST1	blue
GND	B-	black

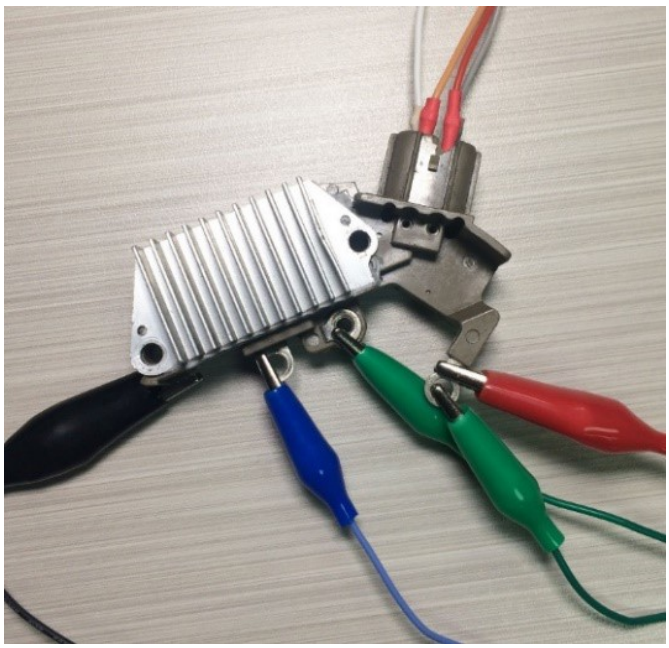


Figure 21 - Diagram of voltage regulator ARE6076 connection to the tester

Connection of voltage regulator ARE6076 has a specific feature. There is only one terminal shown in Figure 20 – terminal F, to which we connect cable F1. The other green cable (F2) must be connected to terminal B+, since one of the brushes is permanently connected to B+ while the excitation winding is controlled through the brush connected to the alternator negative terminal (A-circuit type).

Figure 22 shows the connection diagram of voltage regulator ARE6149P as an example.

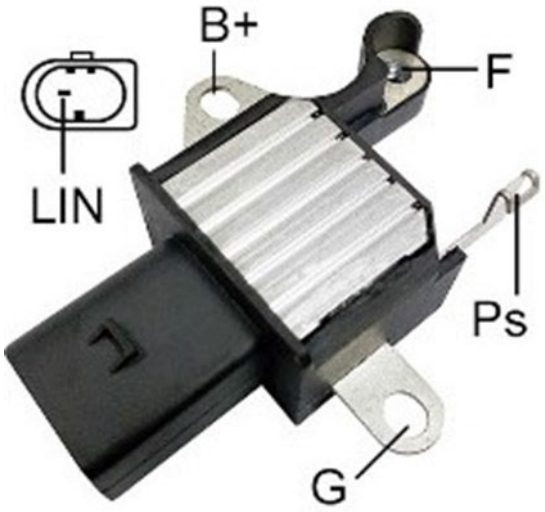


Figure 22 - Voltage regulator ARE6149P

The voltage regulator type is identified by terminal contacts and based on the information set out in Appendices 1, 2. There is only one terminal – LIN, which identifies this voltage regulator as COM type.

Consult Appendix 1 to determine which clips (connectors) of the diagnostic cable must be connected to the voltage regulator. The diagram of voltage regulator ARE6149P connection to the tester is shown in both Table 4 and Figure 23.

Table 4 – Connection of voltage regulator ARE6149P to the tester

Voltage regulator terminal	Tester output terminal	Color marking of cable
B+	B+	red
F	F1	green
Ps	ST1	blue
LIN	GC	yellow
G	B-	black
	F2	green

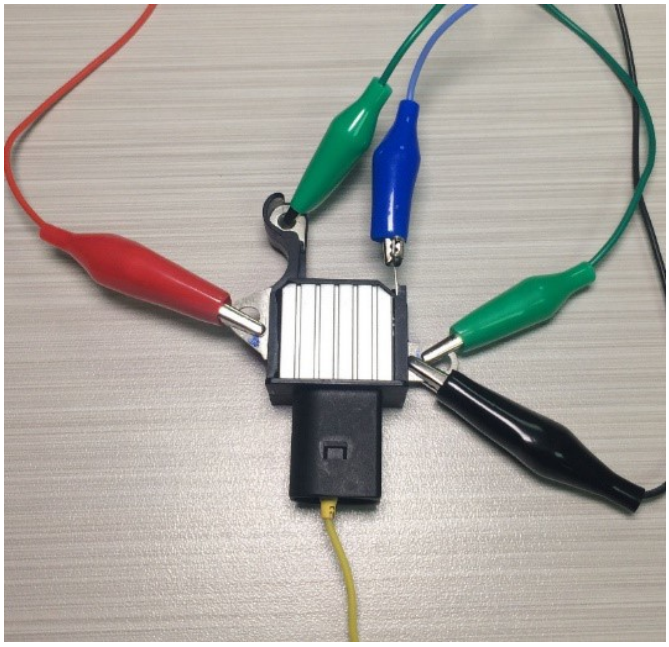


Figure 23 - Voltage regulator ARE6149P connected to the tester terminals

Connection of voltage regulator ARE6149P has a specific feature. We connect cable F1 to the only terminal – F. As the actual voltage regulator is B-circuit type, the other cable (F2) must be connected to terminal B-. Consequently, one of the brushes is permanently connected to B- of the alternator, while the excitation winding is controlled through terminal B+.

4.2 Diagnostics of Lamp-type voltage regulators

1. Connect the voltage regulator as described in item 4.1.

2. Enter the menu for voltage regulator type selection, select the nominal voltage (12V or 24V) and activate the test mode for Lamp-type regulators.

3. Upon activation, stabilizing voltage must set in the range from 14 to14.8 volts for 12V voltage regulators and from 28 to 29.8 volts - for 24V regulators, and must correspond to the voltage regulator characteristics.

4. Turn off simulation of the alternator rotation by pressing K15 and setting rpm to zero – the control lamp indicator (Fig.10, n.10) will light up. Press K15 again to restart simulation, the control lamp indicator must go out.

5. If the voltage regulator is equipped with terminal S, press SENSE to check its operability – the stabilizing voltage must increase. Press SENSE once again – the stabilizing voltage must decrease to its initial values.

6. Failure to perform as described in sub-items 3-5 signals the voltage regulator malfunction.

7. Press BACK to exit the test mode. Disconnect the clips form the voltage regulator.

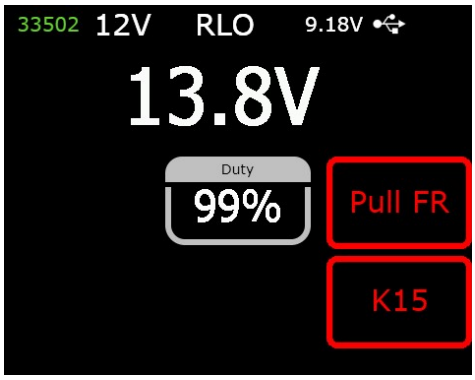
4.3 Diagnostics of voltage regulators of RLO, RVC, and C KOREA types

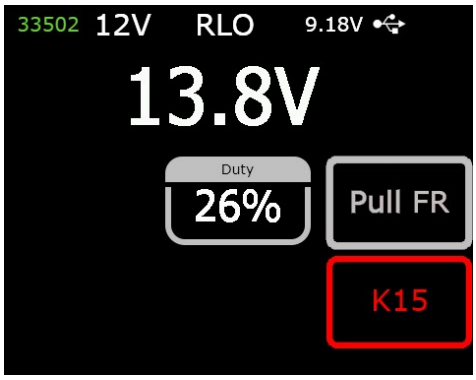
1. Connect the voltage regulator as described in item 4.1.

2. Enter the menu for voltage regulator type selection (Fig.9), select the nominal voltage and activate the test mode that corresponds to the type of the tested voltage regulator.

3. Upon diagnostic mode activation, the stabilizing voltage must set at 13.8V, the allowable deviation is ±0,2V.

⚠ **WARNING! If "Duty" value is 99%, press "Pull FR" to switch over.**





4. Turn off simulation of the alternator rotation by pressing K15 and setting rpm to zero. The control lamp indicator (Fig.10, n.10) will light up. Press K15 again to restart simulation, the control lamp indicator must go out.

5. Adjust the preset stabilizing voltage in the range from 13.2 to 14.5 volts. The measured voltage must vary in proportion to the pre-set one.

6. Press BACK to exit the test mode. Disconnect the clamps form the voltage regulator.

7. Failure to perform as described in sub-items 3-5 indicates the voltage regulator malfunction.

4.4 Diagnostics of voltage regulators of C JAPAN type

1. Connect the voltage regulator as described in item 4.1.

2. Select and activate the test mode (Fig.9) for regulators of C JAPAN type.

3. In diagnostic mode the stabilizing voltage must set in the range from 14 to 14.5 volts.

4. Press K15 and set rpm to zero to stop simulation of the alternator rotation. The control lamp indicator (Fig.10, n.10) must light up. Press K15 once again to turn the simulation on – the control lamp indicator will go out.

5. Switch the preset stabilizing voltage to OFF. The measured stabilizing voltage must set in the range from 12 to 12.7 volts.

6. If the voltage regulator is equipped with terminal S, press SENSE to check its operability – the stabilizing voltage must increase. Press SENSE once again, the stabilizing voltage must decrease to its initial values.

7. Press BACK to exit the test mode. Disconnect the clips from the voltage regulator.

8. Failure to perform as described in sub-items 3-5 signals the voltage regulator malfunction.

4.5 Diagnostics of voltage regulators of SIG and P/D types

1. Connect the voltage regulator as described in item 4.1

2. Enter the menu for voltage regulator type selection (Fig.9), select the nominal voltage and activate the test mode that corresponds to the type of the tested voltage regulator.

3. Upon diagnostic mode activation, the stabilizing voltage must set at 13.8V, the allowable deviation is ±0,2V.

4. Adjust the preset stabilizing voltage in the range from 13.2 to 14.5 volts. The measured voltage must vary in proportion to the preset one.

5. Press BACK to exit the test mode. Disconnect the clips from the voltage regulator.

6. Failure to perform as described in sub-items 3-4 signals the voltage regulator malfunction.

4.6 Diagnostics of 12/24V voltage regulators of COM type

1. Connect the voltage regulator as described in item 4.1.

2. Enter the voltage regulator type selection mode, select the nominal voltage (12 or 24 volts) and activate the test mode for COM voltage regulators.

3. Wait for the tester to read-out data. As soon as the values are displayed in ID, Version LIN, and Type boxes we can proceed to testing.

3.1. After the data read-out is completed, the stabilizing voltage must set at 13.8V. The allowable deviation is ±0,2V.

4. Set rpm to zero, the M value must appear in box ERRORS. As soon as the alternator speed increases up to 800-1200 rpm, M is no longer displayed in the box ERRORS. It means, the system of voltage regulator self-diagnosis is fault-free.

4.1 The E value displayed in box ERRORS upon speeding up the rotation to 1200 rpm, signals electrical fault of the voltage regulator. At this point any further diagnostics makes no sense.

5. Change the preset stabilizing voltage in the range from minimum to maximum values. The measured stabilizing voltage must vary in proportion to it.

6. Failure to perform as described in sub-items 3-5 signals the voltage regulator malfunction.

7. Press BACK to exit the test mode. Disconnect the clips form the voltage regulator

5 ALTERNATOR TESTING

Alternator testing on a vehicle is performed as follows:

⚠ **WARNING! The tester does not allow the diagnostics of alternators without voltage regulators.**

1. Search the information on markings of the alternator terminals by the voltage regulator OEM number. Identify the alternator type by the contacts of the alternator terminals and based on the information set out in Appendices 1 and 2.

2. Connect the tester to the alternator observing the markings of cable MS-33501 (see Section 1). Follow the instructions set out in Appendix 1.

2.1 Connect cable clip B+ to the alternator positive terminal. Connect cable clip B- either to the alternator frame or to the negative battery terminal. Being powered by the alternator, the tester will turn on and the main menu will appear on the screen (Fig.7).

2.2. Connect the clips of MS-33501 cable to the respective contacts in the alternator terminals.

3. In the tester menu select the test mode for alternators (Fig.7, n.3) and then, select the alternator type (Fig.9). The tester will switch over to the test mode.

3.1* Upon activation of the test mode, the control lamp indicator must light up.

*** This does not apply to the alternators of SIG and P/D types.**

3.2 If this is the alternator with COM terminal, wait for the tester to readout the data. As soon as the values appear in ID, Version LIN, and Type boxes, proceed to testing.

4. Start the vehicle engine and turn the load off. Wait for it to run steadily at idle speed. The stabilizing voltage shall set at 13.8V, the allowable deviation is ±0,2V.

4.1 The stabilizing voltage for Lamp-type alternators must set as follows: for 12V alternators - in the range from 14 to 14.8 volts, for 48V alternators – from 28 to 29.8 volts.

4.2 The stabilizing voltage for alternators of C JAPAN type must set in the range from 14 to 14.5 volts.

5**. Change the stabilizing voltage in the range from 13.2 to 14.8 volts. The measured voltage must vary in proportion.

**** This does not apply to Lamp-type alternators.**

5.1 When testing alternators of C JAPAN type, switch the preset stabilizing voltage to OFF. The measured stabilizing voltage must set in the range from 12 to 12.7 volts.

6. Set the alternator voltage in the range from 13.2 to 14.8 volts. For C JAPAN alternators, switch the preset voltage to ON. Increase the engine crankshaft rotation speed to medium. The measured voltage must not change (the deviation by ±0,2V, is within the norm).

7. Without reducing the engine crankshaft speed, increase the load on the alternator by switching on headlights and other lights. The voltage must not change (the voltage can reduce no more than by 0.3V from the preset one).

8. Stop the engine.

9. Disconnect the cable clips from the alternator.

10. Failure to perform as described in sub-items 2.1, 3-7 indicates the voltage regulator malfunction.

⚠ **WARNING! Test alternators either outdoors or in premises equipped either with a supply-and-extract ventilation or an exhaust system.**

APPENDIX 1
Connection of terminals to alternators and regulators

Indicial notation	Functional purpose	Voltage regulator type	Output terminal
B+	Battery (+)		B+
30			
A	(Ignition) Input for switch starting		IG
IG			
15			
AS	Alternator Sense		S
BVS	Battery Voltage Sense		
S	(Sense) Input for comparing voltages at the test point		
B-	Battery (-)		B-
31			
E	Earth, battery (-)		
D+	Used for connection to an indicator lamp that transfers initial driving voltage and indicates alternator operability	Lamp	D+
I	Indicator		
IL	Illumination		
L	(Lamp) Output for alternator operability indicator lamp		
61			
FR	(Field Report) Output for alternator load control by an engine control unit		FR
DFM	Digital Field Monitor		
M	Monitor		
LI	(Load Indicator) Same as FR, but with universal signal		
D	(Drive) Input of voltage regulator control with terminal P-D of Mitsubishi (Mazda) and Hitachi (KiaSephia1997-2000) alternators	P/D	GC

Indicial notation	Functional purpose	Voltage regulator type	Output terminal
SIG	(Signal) Input of code voltage installation	SIG	GC
D	(Digital) Input of code voltage installation on Ford, same as SIG		
RC	(Regulator control), same as SIG		
L(RVC)	(Regulated Voltage Control) Similar to SIG but voltage change ranges from 11V to 15.5V. Control signal is sent to L terminal.	RVC	
L(PWM)			
C	(Communication) Voltage regulator input to control engine ECU. Korean cars.	C KOREA	
G	Voltage regulator input to control engine ECU. Japanese cars.	C JAPAN	
RLO	(Regulated Load Output) Input to control stabilizing voltage in the range of 11.8-15V (TOYOTA)	RLO	
COM	(Communication) General term for physical interface for alternator control and diagnostics. Protocols of use: BSD (Bit Serial Device), BSS (Bit Synchronized Signal, or LIN (Local Interconnect Network)	COM	
LIN	Direct indication on interface of alternator control and diagnostics under LIN protocol (Local Interconnect Network)		
DF	An output of one of stator windings of an alternator. Through this output a voltage regulator detects the alternator excitation.		F1; F2
F			
FLD			
67			
P	Output of one of alternator stator windings. Used for measuring alternator driving voltage		ST1; ST2
S			
STA			
Stator			

Indicial notation	Functional purpose	Voltage regulator type	Output terminal
W	(Wave) Output of one of alternator stator windings for connection of a tachometer in diesel engine cars		
N	(Null) Output of average stator winding point. Usually used to control operability indicator lamp of the alternator with mechanical voltage regulator		
D	(Dummy) Blank, no connection, mostly in Japanese cars		
N/C	(No connect) No connection		
LRC (Opcja regulatoró w)	(Load Response Control) Function of voltage regulator response delay on load increase on an alternator. Delay duration ranges from 2.5 to 15 seconds. On increasing the load (lights, cooler fan on), a voltage regulator adds driving voltage smoothly ensuring stability of engine drive rotation. Remarkably seen under idle running.		