



# MSG equipment MS005 Diagnostics of Alternators and Starters Instruction Manual

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**MSG equipment MS005 Diagnostics of Alternators and Starters**



## INTRODUCTION

The present manual contains the description of the methods of evaluation of technical condition of automotive alternators, starters and voltage regulators at the bench MS005 (hereinafter “the bench”).

**WARNING!** MSG Equipment is not responsible for any harm caused by the improper usage of equipment.

Test bench MS005 checks:

1. The technical condition of automotive alternating current alternators with rated voltage 12 and 24V under the load up to 150 and 75 A accordingly, including alternators of system «start-stop» 12V.

The diagnostics of automotive alternators and voltage regulators takes into account the following criteria:

- Stabilizing voltage;
- control lamp working performance capacity;
- FR (displaying of the frequency and FR duty ratio, voltage regulator response).
- The AC pulsation value.

For COM alternator types (voltage regulators):

- ID;
- Protocol;
- data exchange speed;
- LIN protocol type;
- regulator self-diagnostics errors.

2. Automotive starters with power of 11kW with rated voltage 12 and 24 V, without load (at idle).

The diagnostics of the automotive starters considers the voltage changes nature and the currents on the terminals 30, 45 and 50.

3. 12V automotive lead-acid storage batteries by residual capacity.

## TEST BENCH DESCRIPTION

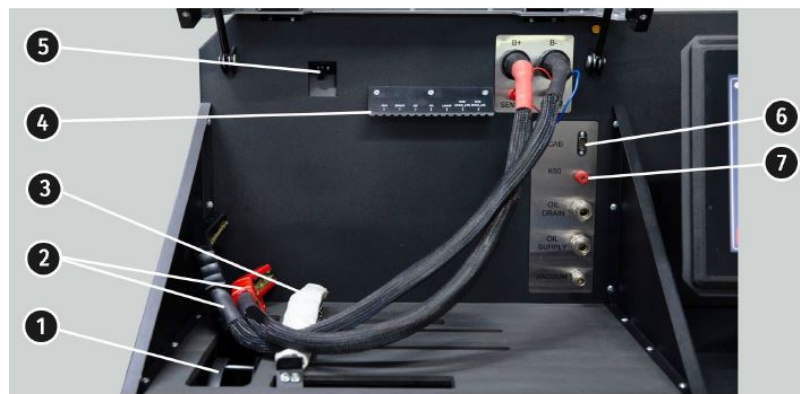
The bench consists of the following main elements (fig. 1):



**Figure 1. Overall view of test bench**

1. Access door to storage battery location.
2. Working spot.
3. Protective housing.
4. Touch screen – to display diagnostic parameters of a diagnosed unit and to control the bench functions.
5. Control panel.
6. Pivot wheels with brake.

The working spot (fig.2) consists of the following components:



**Figure 2. Bench working spot**

1. Alternator drive belts: V-belts and poly V-belts.
2. Power cables «B+» «B-».
3. Unit fixing chain.
4. The bracket for a diagnostic cable alligator clips.
5. Thermal vision camera.
6. Diagnostic cable connection port.
7. Diagnostic cable connection port for starter diagnostics.

**The control panel (fig.3) consists of:**



**Figure 3. Bench control panel**

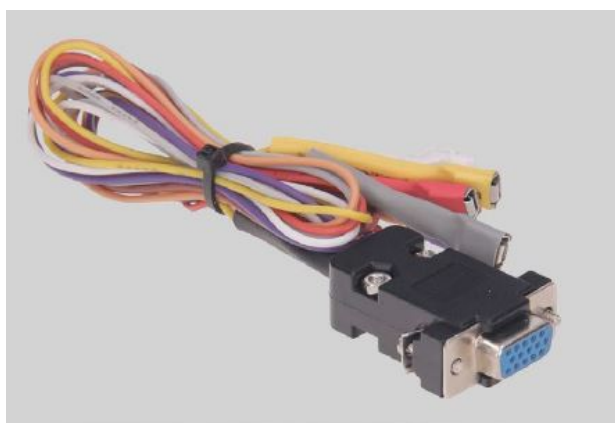
1. buttons to control the tightening and loosening of alternator drive belt.
2. buttons to control the tightening and loosening of unit fixing chain.
3. button «COVER» – opens the protective housing.
4. button «OFF/ON» – is responsible for the power on the bench. The bench is turned off by pressing the button «Turn off the bench» in the main menu of the service program.
5. Button «EMERGENCY STOP» – emergency stop of generator drive and chain/belt tightening.

In the bottom of the touch screen there are two USB ports (fig.4 ref. 1) for connecting the computer periphery (mouse, keyboard, WiFi adapter) and network LAN port (ref. 2).

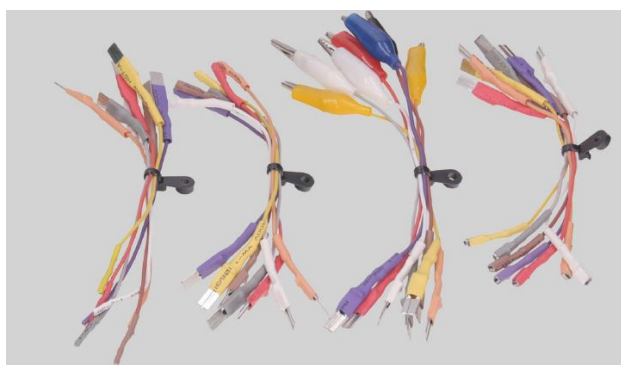


**Figure 4. Position of USB and LAN ports**

The bench supply slip includes the diagnostic cable (fig.5) that consists of the adapting wire kit (fig.6) – for more convenient connection to alternator connection terminals.



**Figure 5. Diagnostic cable MS-33001**










**Figure 6. Adapting wire kit**

The diagnostic cable MS-33001 has the following adapting wire color codes (see also Table 1):

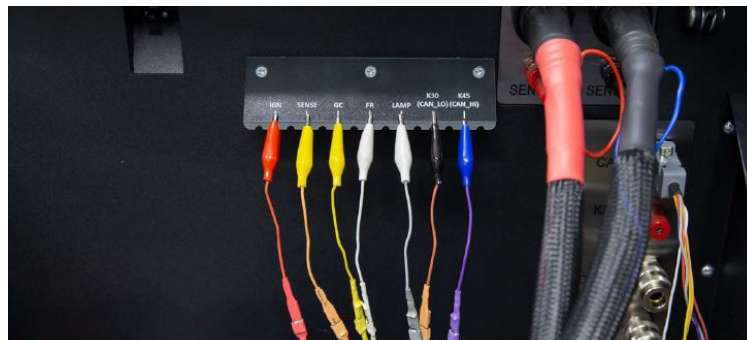
- Orange – S (Sense Pin) – the terminal that enables the measuring of the storage battery voltage by the voltage regulator as well as it compares the storage battery voltage with the alternator output voltage. This adapting cable is connected to terminal S;
- Red – IG (Ignition) – the terminal is used for the connection of the ignition circuit, the terminals: 15, A, IG;
- White – «FR» – the terminal that transmits the data on the regulator load. This adapting wire is connected to the following terminals: «FR», «DFM», «M»;
- Gray – «D+» – the terminal for the connection of the circuit of voltage regulator control lamp. It's connected to the terminals: «D+», «L», «IL», «61»;
- Yellow – «GC» – is used for the connection of the channel of alternator voltage regulator control. This adapting wire is connected to the following terminals: «COM», «SIG», etc.

- Brown – «K30» – is connected to the starter terminal 30 that is connected to the storage battery terminal «+».
- Violet – «K45» – is connected to the starter solenoid output connected with starter electric motor.

**Table 1 – Color codes of cable MS-33001**

Connector	Terminal
	<b>S</b>
	<b>IG</b>
	<b>FR</b>
	<b>Lamp</b>
	<b>GC</b>
	<b>K30 (starter)</b>
	<b>K45 (starter)</b>

For convenient usage of the diagnostic cable, it's recommended to put the alligator clips onto the bracket (ref. 4, fig.2).



**Figure 7. Diagnostic cable alligator clips that are set on the bracket.**

For the diagnostics of the starter, use the cable MS-33001 and the cable for the connection of the terminal 50 (fig.8).



**Figure 8. Cable for the connection of starter terminal 50**

## **TEST BENCH MENU**

The bench main menu (fig. 9) consists of:

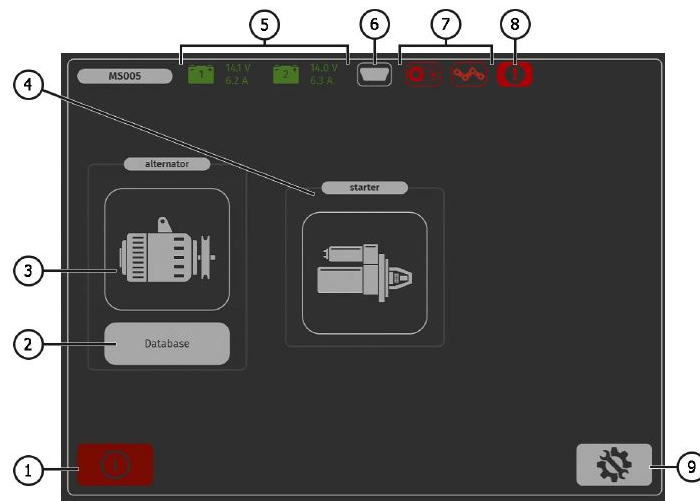


Figure 9. Bench main menu

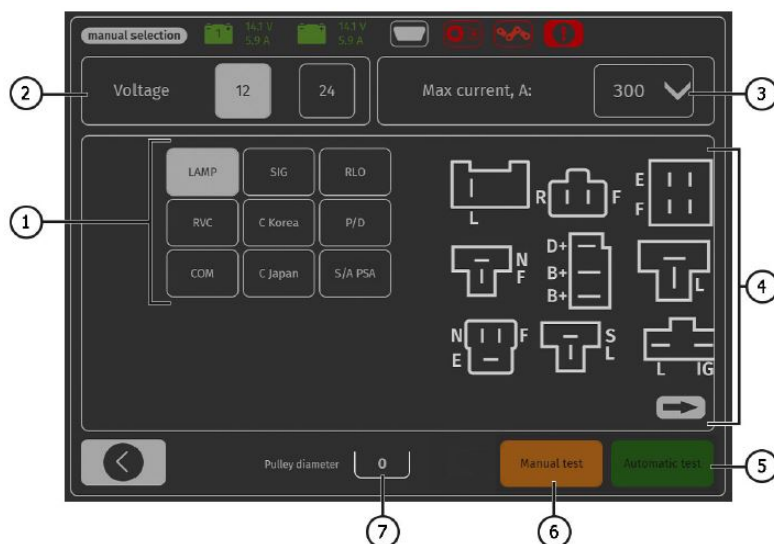
1. Bench OFF button.
2. Button to enter alternator database.
3. Alternator diagnostics activation button.
4. Starter diagnostics activation button.
5. Information on the condition of the batteries connected to the bench.
6. Indicator of the connected diagnostic cable.
7. Indicator button for unit drive belt tightening and fixing chain tightening:
  1. red colour – belt/chain are not tightened;
  2. green colour – belt/chain are tightened.
 Press to access the menu of belt and chain tightening control.
8. Indicator button shows that the diagnostics cannot be performed. Press to open the window where you can read the reasons of blocking:
  1. left service door is open;
  2. front service door is open;
  3. right service door is open;
  4. EMERGENCY STOP button is pressed.
9. SETTINGS button – to enter bench settings menu.
 

In SETTINGS menu, you can change the program interface language only. The rest bench parameters can be set by the manufacturer specialists only.

**WARNING!** It's forbidden to modify any bench calibration data without professional help.

Once the mode of alternator diagnostics is activated, the menu for choosing of the diagnosed alternator type (fig. 10) that contains:





**Figure 10. Menu for choosing of the diagnosed alternator type**

1. Diagnosed alternator type.
2. Rated voltage of the diagnosed alternator.
3. Maximum current for the alternator diagnostics.
4. Connector terminal references of the most popular alternator types for choosing the appropriate one for the diagnosed alternator.
5. Button to switch to automatic diagnostic mode of selected alternator type.
6. Button to switch to the manual diagnostic mode of the selected alternator type.
7. Setting of the diameter value for alternator pulley. This parameter is set when the rotation rate during the alternator diagnostics has to be equal to the vehicle rotation rate.

## APPROPRIATE USAGE

1. Use the bench for the specified purpose only.
2. Turning off the bench should be done through the interface of the service program by pressing the “Turn off the bench” button.
3. Use EMERGENCY STOP button only if you need to immediately stop the bench drive, turn off the belt/chain tightening and turn off the supply of the power cables.
4. The terminals of the diagnostic cable MS-33001 that are used for the diagnostics of alternators and starters shall be connected only to the relay regulator terminals and starter terminals K30 and K45.
5. To protect the touch screen from damages use the stylus (included to supply slip).
6. In case of failures in the operation of the bench, stop further operation and contact the manufacturer or sales representative.

The manufacturer is not responsible for any damage or injury to human health resulting from non-compliance with the requirements of this manual.

## Safety Guidelines

1. The bench has to be operated by the qualified persons who got the access to operate the definite bench types and who were instructed on the safe operating procedures and methods.
2. The bench has to be turned off if the supply is terminated, during the cleaning and tidying up, as well as in the



emergency situations.

3. The work area must always be clean, with good light illumination, and spacious.
4. To ensure electrical and fire safety PROHIBITED:
  - connect the bench to the electrical network having faulty protection against current overloads or not having such protection;
  - use a socket without a grounding contact to connect the bench;
  - use extension cords to connect the bench to the electrical network. If the socket is far from the bench installation site, it is necessary to modify the electrical network and install the socket;
  - operation of the bench in defective condition.
  - Independently to repair and make changes to the design of the bench, because it can lead to serious damage to the bench and deprive the right to warranty repair.
5. It's forbidden to leave the units with running drive on the bench unattended.
6. While mounting and dismounting of a unit from the bench, to prevent the hands from harming, be more cautious.
7. Do not open the access door to the bench power section when the bench is connected to the 400V supply circuit.

## **ALTERNATOR DIAGNOSTICS**

The following general diagnostics stages are considered for all alternator types:

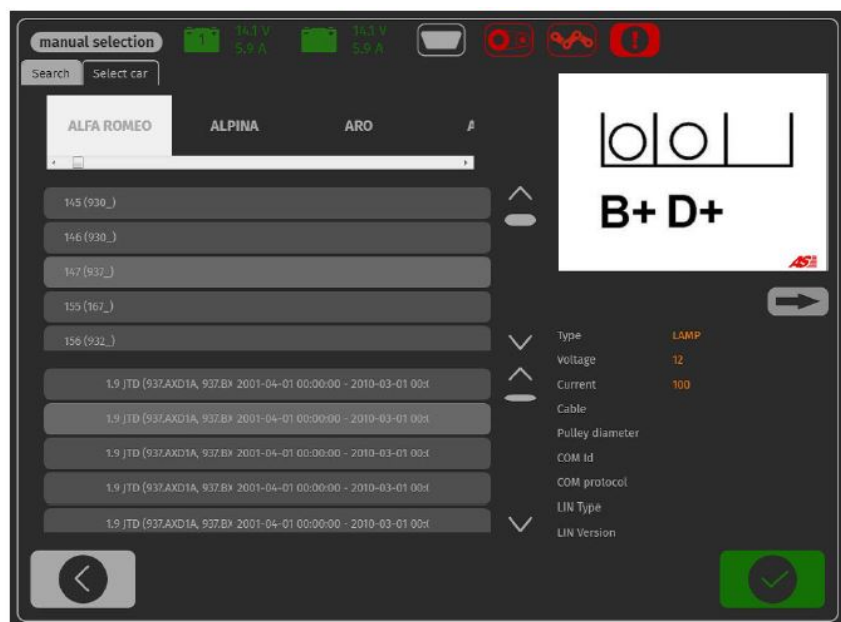
1. The mounting and the fixing of alternator on the bench.
2. The mounting of the belt onto the pulley and the tightening.
3. Connection of the power wires to alternator. For convenient connection of power terminal B+, screw the adapter on the positive terminal of the alternator.
4. Connect the diagnostic cable to the alternator connector terminals.
5. Choose the relevant alternator diagnostics parameters.
6. Alternator diagnostics.
7. The dismounting of unit from the bench.

### **Connection of the wires of diagnostic cable to alternator connector terminals**

To check the alternator performance, the wires of the diagnostic cable have to be properly connected to alternator connector terminals.

Referring to the alternator OEM, that is commonly indicated on the body or rear cover, find the information on the alternator connector terminal references in the bench database (fig. 11):

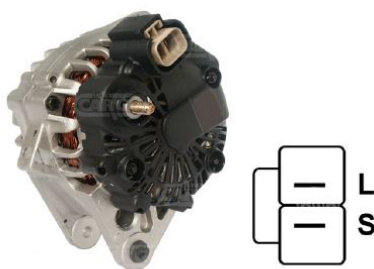
1. Press Database in the bench main menu (fig. 9, ref. 2).
2. In the opened window (fig. 11), in Search tab, enter the alternator serial number and press Search button, or in Select car tab, choose the car make and model of car where the diagnosed alternator was installed.
3. If the bench database has the required alternator, its type, main specifications, photos and connection terminal references (press arrow under alternator image to display the connection terminal references).
4. Use this information and the information from the Appendix 1 for the proper connection of the diagnostic cable wires to the alternator connector.



**Figure 11. Database search menu and search results**

If you can't find the alternator in the database, look for the reference of alternator connector terminals on the Internet. Then connect the diagnostic cable wires to the alternator connector terminals, referring to the table in the Appendix 1. Prior to diagnostics, choose the alternator type referring to the connector terminals.

Below you can see the example of the Bosch 0986049191 alternator connection (fig. 12).



**Figure 12. Bosch alternator 0986049191 and connector terminal references.**

Referring to the terminals on the figure 12 identify the alternator type. Now, the terminal L refers to Lamp alternator type. Next, referring to Appendix 1, check what wires of diagnostic cable should be connected with the alternator connector (connection layout – Table 2).

**Table 2 – Connection of Bosch alternator 0986049191 to the bench**

Alternator connector terminal	Diagnostic cable wire	Diagnostic cable wire colour
L	Lamp	gray
S	S	orange

Below you can see the example of the Toyota 2706020230 alternator connection (fig. 13).



Figure 13. Toyota 2706020230 alternator and connector terminal references.

Referring to the terminals on the figure 13 identify the alternator type. Now, the terminal L refers to Lamp alternator type. Next, referring to Appendix 1, check what wires of diagnostic cable should be connected with the alternator connector (connection layout – Table 3).

Table 3 – Toyota 2706020230 alternator connection

Alternator connector terminal	Diagnostic cable wire	Diagnostic cable wire colour
S	S	orange
IG	IG	red
L	Lamp	gray
DFM (M)	FR	white

Below you can see the example of the Nissan 23100EN000 alternator connection (fig. 14).

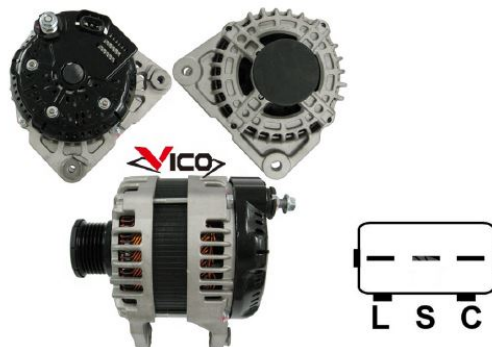


Figure 14. Nissan 23100EN000 alternator and connector terminal references.

Referring to the terminals on the figure 14 identify the alternator type. In this case, the terminal is C, and Japanese car make guides to alternator type – C JAPAN Next, referring to Appendix 1, check what wires of diagnostic cable should be connected with the alternator connector (connection layout – Table 4).

Table 4 – Nissan 23100EN000 alternator connection

Alternator connector terminal	Diagnostic cable wire	Diagnostic cable wire colour	
L	Lamp		gray
S	S		orange
C	GC		yellow

### Alternator diagnostics menu

When starting the diagnostics of Lamp, SIG, RLO, RVC, C KOREA, P-D, C JAPAN alternator types, the following information may be displayed (fig. 15):

1. Test sense pin button – press to check the terminal S performance capacity. The voltage regulator reads the actual battery voltage referring to terminal S (Sense) and increases the alternator output voltage to compensate charge losses.
2. K15 button imitates the ignition start signal that is sent to the alternator voltage regulator. If the alternator configuration includes the terminal (A or IG, or 15), press K15 button prior to the alternator diagnostics.
3. Display field of measured parameter diagram
4. Diagnosed alternator type.



Figure 15. Alternator diagnostics menu view

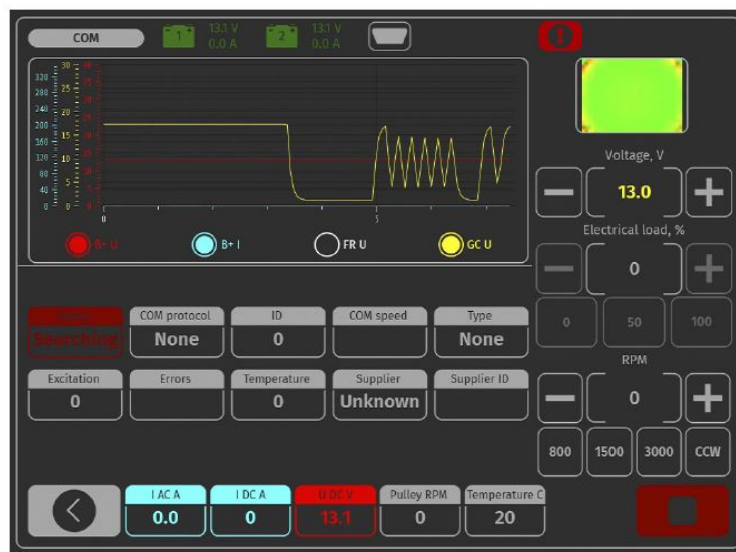
5. Display unit temperature from thermal camera.
6. Alternator output voltage control buttons (if its design enables the voltage adjustment).
7. Alternator load control buttons. The value is rated as % of the set value (fig. 10, ref. 3).
8. Buttons to control the speed and direction of alternator rotation. By default, the bench rotates the alternator clockwise (if you look from the pulley side). If required, change the rotation direction by pressing CCW button.
9. Diagnostics process stop button.
10. Indicator of control lamp operation.

- **K15 U V** – voltage value in the ignition circuit (K15).
- **K15 I mA** – current value in the ignition circuit (K15).
- **Duty %** – duty ratio of PWM signal received through FR, DFM, M channel (on-condition rate of rotor winding coil).
- **Frequency Hz** – signal frequency value received through the channel FR, DFM, M.

- **Speed RPM** – alternator rotation speed measured by regulator.
- **Lamp voltage V** – voltage value on the control lamp.
- **Lamp current mA** – value of electric current on the control lamp.
- **I AC A** – value of alternating current in the circuit B+.
- **I DC A** – value of direct current in the circuit B+.
- **U DC V** – terminal B+ voltage value.
- **Pulley RPM** – alternator pulley rotation speed. If the pulley dimension is not specified in the menu (fig. 10, ref. 7), the drive rotation speed value is indicated.

«**Temperature C**» is the maximum value of the temperature of the diagnosed unit, recorded by thermal camera.

The menu of the COM alternator diagnostics (fig. 16) displays the following information:



**Figure 16. Menu of diagnostics of COM alternator type.**

**Status** – alternator connection status indicator.

**COM protocol** – voltage regulator protocol version indicator: BSS, LIN1 or LIN2.

**ID** – voltage regulator identification number.

**COM speed** – rate indicator for data transmission from control unit to voltage regulator. This parameter is displayed for the alternators that are controlled by LIN protocol.

The following speed values can be displayed:

- **L** – 2400 Bod (low);
- **M** – 9600 Bod (medium);
- **H** – 19200 Bod (high).

**TYPE** – displaying of the type code for the LIN protocol regulator: A1, A2, A3, A4, B1, B2, B3, B4, C3, D1, D2, E1.

**EXCITATION** – current value in the winding coil of alternator excitation. This parameter is read from the voltage regulator by LIN protocol.

**ERRORS** – indicator of errors that the regulator transmits to engine control unit. The following errors may happen:

- **E** (electrical) – electrical failures;
- **M** (mechanical) – mechanical failures;

- **T** (thermal) – overheating.

**TEMPERATURE** – the measured by regulator its own temperature.

**Supplier** – manufacturer of the alternator voltage regulator.

**Supplier ID** – manufacturer identification number of the alternator voltage regulator.

#### **Alternator diagnostics in manual mode**

1. Once the alternator is fixed and connected, enter the menu 'Alternator' on the start window (fig. 9).
2. In the opened window, choose the rated voltage of the diagnosed alternator (12 or 24V), the alternator type, the maximum diagnostics current, pulley diameter. When using the bench alternator database, the diagnostics parameters are set automatically.
3. To start diagnostics, press button «Manual test».

**WARNING!** The diagnostics can be started only when the bench diagnostic outputs have been connected to the alternator voltage regulator terminals.


1. If the diagnosed alternator is of COM type, wait until the bench identifies ID and TYPE of alternator. The notification on the mechanical failure MEC shall appear near the indicator ERRORS.
2. If the alternator configuration includes the terminal A or IG, or 15, activate the button K15.
3. If the alternator configuration includes the control lamp, its indicator shall light up (fig. 15, ref. 10).
4. Alternator drive control buttons (fig. 15, ref. 8) can be used to set the rotation speed within the limits of 100-150 rpm.

**WARNING!** For the alternators with the freewheel clutches, be more cautious when choosing the rotation direction.

1. Visually inspect if the alternator rotates properly. If there are the abnormal noises or alternator vibrations that may inform on the mechanical failure of alternator, stop the diagnostics.
5. Check the rotation speed when the generation starts as follows:
  1. With drive control buttons, increase gradually the speed until the output voltage is equal to rated voltage. Most of the operative alternators start generation from 700-850 rpm. Some alternators of COM type start generation at the speed higher than 1200 rpm, besides, there are LRC alternators (Load Response Control) that have the temporary delay at the output voltage variation.
  2. For Lamp type alternators, the stabilizing voltage value shall be set within 14-14.8V for 12V alternators, and within 28-29.8V for 24V alternators.
  3. If the alternator is equipped with the control lamp indicator it shall go off.
  4. If the diagnosed alternator is of COM type, the mechanical error shall disappear.
6. Check the voltage regulator as follows:
  1. Set the rotation speed within 1500-2000 rpm.
  2. Press the output voltage control buttons (fig. 15, ref. 6) to gradually adjust the alternator output voltage (from min. to max.). The measured voltage shall change proportionally  
For the Lamp type alternators without voltage control, this paragraph is skipped.
  3. For the alternator of C JAPAN type, set the rated stabilizing voltage to 0 mode – the measured stabilizing voltage value shall set equal to battery voltage value (fig. 9 ref. 5). Then, set the rated stabilizing voltage to 1 mode – the measured stabilizing voltage value shall set within 14-14.7V.
7. Check the alternator operation under the load as follows:
  1. Set the rotation speed within the limits of 2500-3000 rpm.

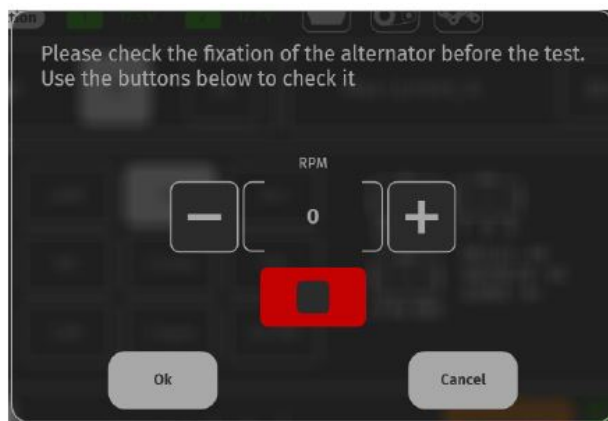
2. Set the generation voltage within 14-14,8V. For the alternators of C JAPAN type, turn on the mode 1.
3. Press electric load control buttons (fig. 15, ref. 7) to gradually increase the alternator load. At the same time, the output voltage value shall remain constant while the alternating current value (I, AC) in the circuit B+ shall not exceed 10% of the nominated load value (e.g., at the load of 50A, the value I, AC shall not exceed 5A). The current oscillogram shall not have the big peaks, the values should vary within the equal limits.

To check the technical condition of the alternator, the load from 50 up to 80A will be enough.

8. To finish the alternator diagnostics, press button  to stop the alternator drive, then click the «back» button to exit the mode and remove power from the power clamps. Now the alternator can be dismantled from the bench.
9. Failure to comply with the one of the paragraphs 3.1, 3.4, 5 – 7.3 points to the alternator defects.

### Alternator diagnostics in automatic mode

1. After fixing and connecting the alternator on the start screen (fig. 9), go to the menu «Alternator».
2. In the opened window, choose: rated voltage of the diagnosed alternator 12V or 24V, type of alternator, maximum test current, diameter of the pulley (if the value is known). When using the alternator base, the verification parameters are set automatically.
3. To start the diagnostic process in automatic mode, click «Automatic test».
4. After pressing the button «Automatic test» there will appear a window with setting the speed of the pre-test of the alternator (see fig. 17). With «+» «-» buttons set the value of the rotation speed in the range of 100 to 150 rpm.



**Figure 17. Alternator preview speed setting window**

1. Visually evaluate if the alternator rotates normally. If there is a noise or vibration of the alternator indicating a mechanical failure, stop the diagnosis by pressing the «CANSEL» button.
2. If the alternator rotates normally and there are no signs of mechanical failure of the unit, press the button «OK» – the window of automatic verification mode will open. fig. 18
5. In the Automatic Check menu, activate each step of the check sequentially. After completion of all stages of testing the result can be stored in the memory of the bench, and the alternator can be dismantled from the bench.



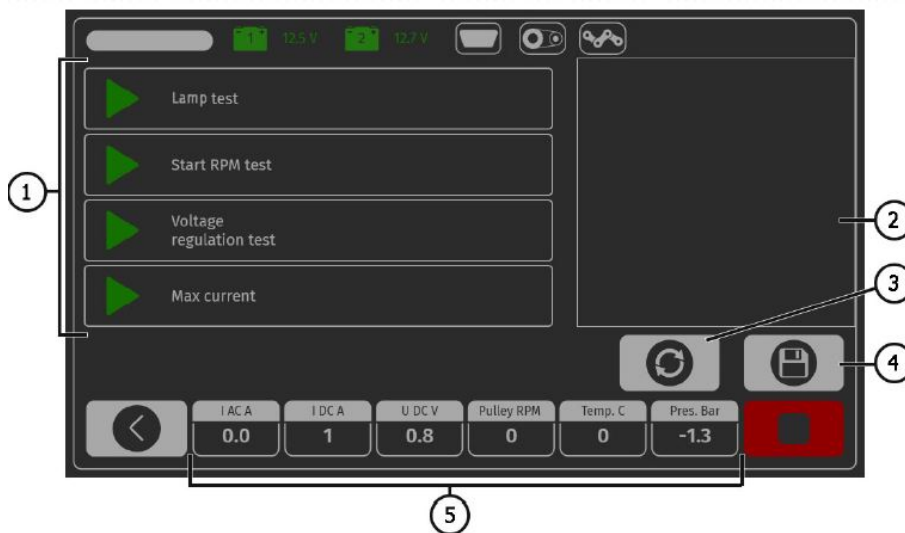


Figure 18. Automatic check mode menu \*:

1. Activation buttons for alternator validation phase:

Lamp test – check of control lamp circuit performance;

Start RPM test – determination of the alternator pulley speed at which generation starts; Voltage regulator test – checking the performance of controlled regulators;

Max current – determination of the maximum current that the alternator is able to produce.

2. Field for displaying test results.

3. Reset button for a new test cycle.

4. The button to save the results of the test.

5. Current values of the measured parameters.

**The automatic test steps are individual for each type of alternator.**

## STARTER DIAGNOSTICS

### Starter diagnostics menu

Getting to the starter diagnostics mode, you'll see the following information on the display (fig. 19):

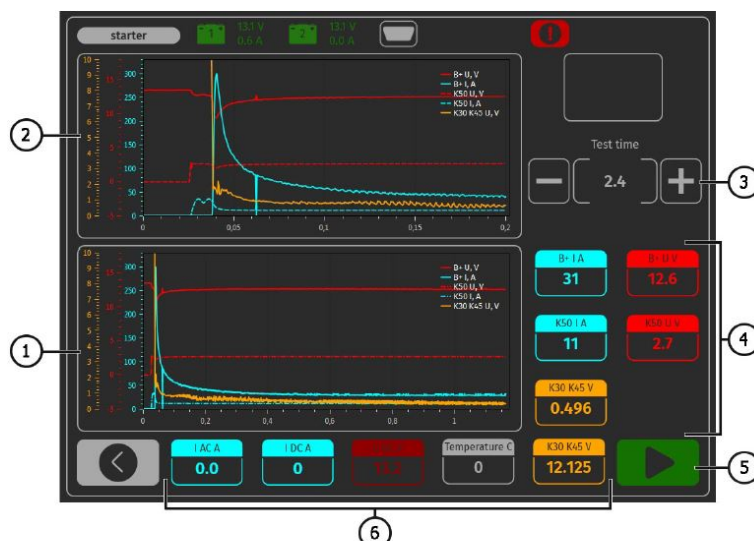


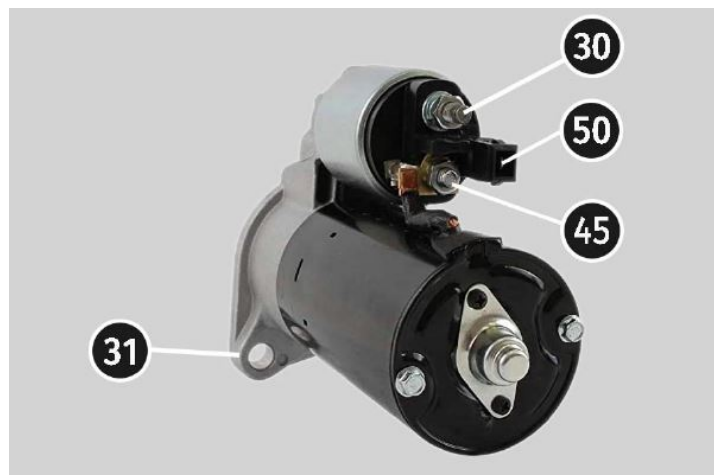
Figure 19. Starter diagnostics menu

1. Diagram of the parameters measured during the whole test time.
2. Diagram of the parameters at the starter start moment.
3. Setting of the test duration.
4. The parameters measured in a second after the test has started:
  - B+ I A – electric current in the terminal 30 (B+);
  - B+ U V – voltage in the terminal 30 (B+);
  - K50 I A – electric current in the terminal 50;
  - K50 U V – voltage in the terminal 50;
  - K30 K45 V – K30, K45 solenoid terminal voltage drop – instant.
5. Diagnostics start button.
6. Current parameters:
  - I AC A – alternating current in the circuit B+ (terminal 30);
  - I DC A – direct current in the circuit B+ (terminal 30);
  - U DC V – voltage in the circuit B+ (terminal 30);
  - K30 K45 V – K30, K45 solenoid terminal voltage drop – average.

#### **Starter diagnostics**

1. Mount the starter on the working spot and fix it there.
2. Screw the adapter onto the positive terminal of the starter and connect with the power cable B+. The power cable B- connect to the unit body.
3. Connect the bench port 50 with the starter solenoid control connector (terminal 50 on the fig. 20).
4. Connect the cables K30 and K45 to the relevant starter terminals (fig. 20).
5. In the main menu, choose the starter diagnostics mode, then the rated voltage (12V or 24V) -referring to the diagnosed unit specifications.
6. Set the diagnostics duration and press start button.
7. When the set time expires, the bench will stop the diagnostics, and the measured parameters will be displayed.

The charts with the voltage and current changes demonstrate the technical condition of starter and the probable reason of malfunctions.
8. Now the starter can be dismounted from the bench.



**Figure 20. Position of terminals on the starter.**

## APPENDIX 1

### Alternator connection terminals

Code	Application		Type of alternator	Diagnostic cable wire
B+	Battery (+)			
30				
A	(Ignition) Ignition start input			IG
IG				
15				
AS	Alternator Sense	Terminal for measuring of battery voltage		S
BVS	Battery Voltage Sense			
S	Sense			
B-	Battery (-)			B-
31				
E	(Earth) Earth, battery (-)			
D+	For the connection of indicating lamp that supplies the initial voltage excitation and indicates the alternator performance capacity.		Lamp	D+
I	Indicator			
IL	Illumination			
L	(Lamp) Output for the alternator performance capacity indicating lamp			
61				
FR	(Field Report) Output for the control of the alternator load by the engine control unit			FR
DFM	Digital Field Monitor			
M	Monitor			
LI	(Load Indicator) Similar to FR, just with the inverted signal			
D	(Drive) Input for the P-D regulator control, for the alternators Mitsubishi (Mazda) and Hitachi  (Kia Sephia 1997-2000)		P/D	GC

Code	Application	Type of alternator	Diagnostic cable wire
SIG	(Signal) Voltage code setting input	SIG	GC
D	(Digital) Input for voltage code setting on the American Ford, similar to SIG		
RC	(Regulator Control) Similar to SIG		
L(RVC)	(Regulated Voltage Control) Similar to SIG, with just the voltage variation range	RVC	
L(PWM)	11.0-15.5V. The control signal is supplied to the terminal L		
C	(Communication) Input for the control of voltage regulator by engine control unit. Korean cars.	C KOREA	
C (G)	Input for the control of voltage regulator by engine control unit. Japanese cars.	C JAPAN	
RLO	(Regulated Load Output) Regulator stabilizing voltage control within 11.8-15V (TOYOTA)	RLO	
COM	(Communication) The general references of the physical control interface and alternator diagnostics. The protocols BSD (Bit Serial Device), BSS (Bit Synchronized Signal) or LIN (Local Interconnect Network) can be used	COM	
LIN	Direct reference to the control and diagnostics of alternator through the protocol LIN (Local Interconnect Network)		
Stop motor Mode	The control of the operation of Valeo alternator that are installed into the cars with the Start-Stop option	S/A PSA	
DF	Rotor winding coil output Connection of the regulator with the rotor winding coil		
F			
FLD			
67			

Code	Application	Type of alternator	Diagnostic cable wire
P	Output of one of the alternator stator winding coils It's used for the identification of the alternator excitation level by the voltage regulator		
S			
STA			
Stator			
W	(Wave) Output of one of the alternator stator winding coils – to connect the speed gauge in the diesel cars		
N	(Null) Stator winding coil centerpoint output For the control of the performance capacity indicating lamp of alternator with the mechanical voltage regulator		
D	(Dummy) Empty, no connection, mainly in Japanese cars		
N/C	(No connect) No connection		
LRC (Regulator option)	(Load Response Control) Option for the delay of voltage regulator reaction to the alternator load increasing. Within 2.5-15 seconds. At the load increasing (light, cooling fan), the regulator smoothly adds the excitation voltage that makes the engine speed stable. It can be easily seen at idle.		

#### HEADQUARTERS AND PRODUCTION MSG equipment

18 Biolohichna st.,  
61030 Kharkiv  
Ukraine  
+38 057 728 49 64  
+38 063 745 19 68  
E-mail: [sales@servicems.eu](mailto:sales@servicems.eu)  
Website: [servicems.eu](http://servicems.eu)

#### REPRESENTATIVE OFFICE IN POLAND STS Sp. z o.o.

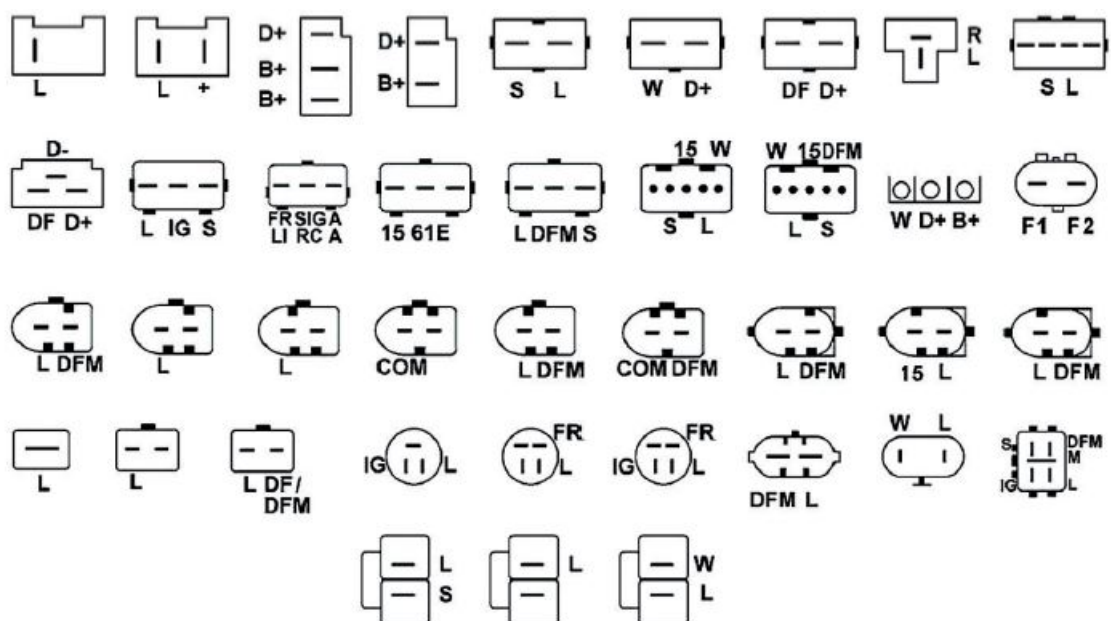
ul. Modlińska, 209,  
Warszawa 03-120  
+48 833 13 19 70  
+48 886 89 30 56  
E-mail: [sales@servicems.eu](mailto:sales@servicems.eu)  
Website: [msgequipment.pl](http://msgequipment.pl)

#### TECHNICAL SUPPORT

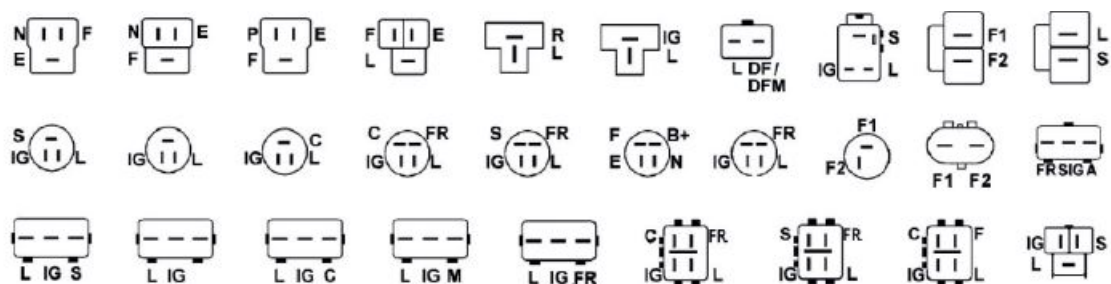
+38 067 434 42 94  
E-mail: [support@servicems.eu](mailto:support@servicems.eu)

## Connection terminals of different voltage regulator types

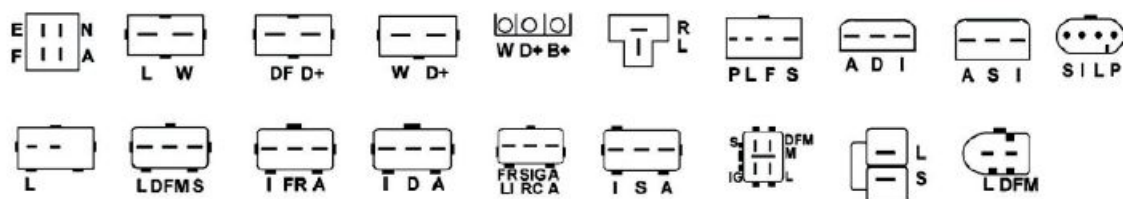
### BOSCH



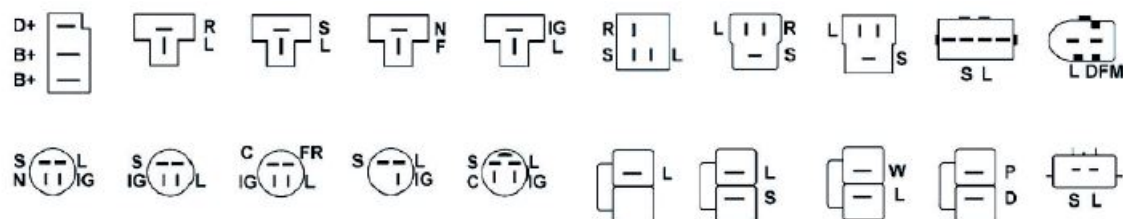
### DENSO



### FORD/LUCAS



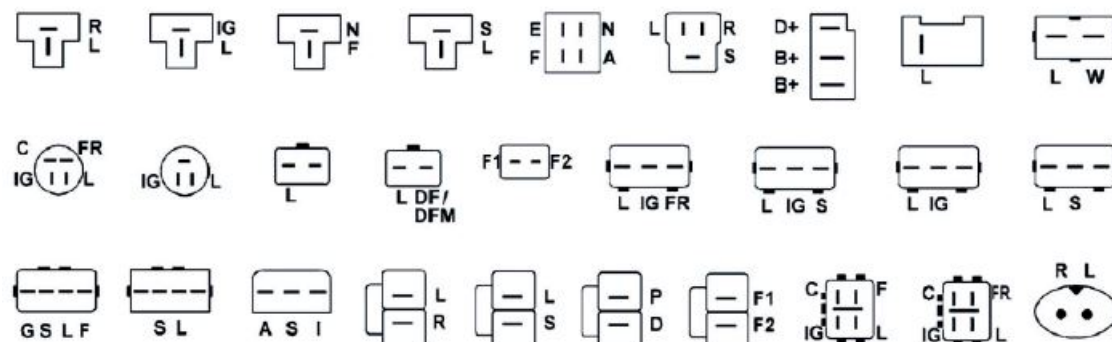
### HITACHI



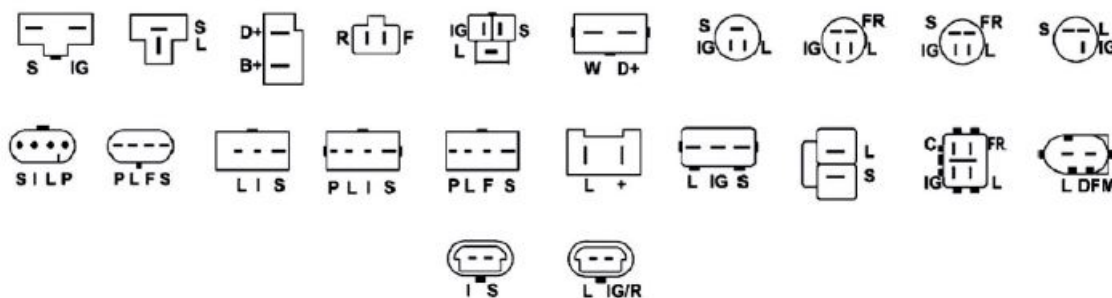
### MAGNETTI MARELLI



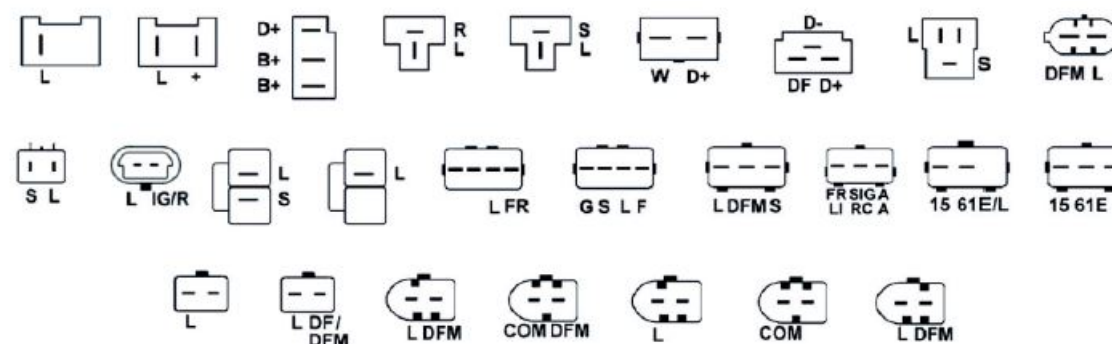
## MITSUBISHI





## DELCO REMNY



## VALEO



## Documents / Resources

 <p><b>MS005</b> MANUAL ON DIAGNOSTICS OF ALTERNATORS AND STARTERS MANUAL DE DIAGNOSTIC ALTERNADORES E MOTOR DE ARRANQUE MANUALE DI DIAGNOSTICA ALTERNATORI E MOTORI DI AVVIO</p> 	<p><a href="#">MSG equipment MS005 Diagnostics of Alternators and Starters</a> [pdf] Instruction Manual MS005 Diagnostics of Alternators and Starters, MS005, MS005 Diagnostics, Diagnostics, Diagnostics of Alternators and Starters</p>
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## References



-  [MSG Equipment - wyposażenie warsztatów TM MSG equipment. - msgequipment.pl](https://msgequipment.pl)

Manuals+.