2017.05.16

MSG MS004 COM

TEST BENCH FOR DIAGNOSTICS OF ALTERNATORS, STARTERS AND VOLTAGE REGULATORS

USER MANUAL

QUALITY WARRANTY INNOVATION SERVICE TRAINING UNIQUENESS

CONTENTS

1. DESCRIPTION

MSG MS004 COM is a table multifunctional test bench. The equipment is used for quick and quality diagnostics of starters, alternators and voltage regulators without applying any additional measuring devices.

The test bench possesses high power, thus, units can be diagnosed under different loads. The equipment has small dimensions, it can be placed both in small service centers and big shops specialized in selling equipment.

The bench includes the following diagnostic functions: testing of 12V and 24V alternators under load, 12V and 24V voltage regulators, 12V and 24V starters in idle running mode. The device carries out testing of different alternators under load up to 100A. Power supply is single-phase 220V. Connection of the 2nd battery is conducted from outside to the terminals on the bench body to achieve power supply of 24V for more convenient connection. Thus, usage of the 2nd battery is optional.

New algorithms of testing have been implemented, meter accuracy has also been improved.

2. TECHNICAL CHARACTERISTICS

Fig. 1. MS004 COM

Supply voltage, V	230±10% or 110±10%
Supply type	Single-phase
Battery model (not concluded in the set)	Bosch 0092S50010 or similar
Battery charge 1	Yes
Battery charge 2	No
Dimensions, mm (length, width, height)	570*490*450
Weight, kg	70
Testing of alternators	
Voltage, V	12/24
Drive power, kW	2.2
Load 12V/24V, A	0-100/0-50
Load adjustment	Smoothly
Drive rotation, rpm	0-3000
Drive rotation direction	Both directions
Transmission type (drive/alternator)	Belt

Belt type	V belt Poly-V belt
Connection terminals	COM (LIN, BSS), P-D, DFM, D+, RLO, C, SIG, F
Read parameters	- Voltage - Alternating current - Constant current - Drive rotation - COM voltage regulators: protocol, speed of exchange, protocol type, errors
Testing of starters	
Voltage, V	12/24
Power, kW	Up to 4
Measured parameters	- Voltage - Alternating current - Constant current
Testing of voltage regulators	
Voltage, V	12/24
Tested parameters	- Stabilizing voltage - Current through rotor winding - COM voltage regulators: protocol, speed of exchange, protocol type, errors
Voltage meter accuracy, V	0.1
Ampere meter accuracy, A	0.1
Short circuit protection	Yes
Short circuit sound alert	Yes
Connection terminals	COM (LIN, BSS), P-D, DFM, D+, RLO, C, SIG
Total check, sec	30 and longer

3. RECEIPT AND INSPECTION

Check the set received. It must contain:

- test bench
- 2 cables for external battery connection **(Fig. 19)**
- wires to connect an alternator, starter, voltage regulator to the bench sockets
- User Manual

Inspect the test bench for existence of damage. If it is found, please contact either the manufacturer or trade representative before launching the equipment.

⚠ **WARNING! In case of obvious damage, use of equipment is forbidden.**

4. TEST BENCH DESCRIPTION

4.1 Mounting Face and Front Panel

Mounting face consists of (Fig. 2):

- Chain fixer 1
- Chain 2
- Belts 3,4
- Covers 5 (battery box cover 1).

The chain fixer **(1)** is used to latch the chain **(2)**.

The belts **(3)** and **(4)** are used to transfer engine torque of the bench on a tested pulley of an alternator.

The battery 1 is placed under the cover **(5)**.

Front panel consists of (Fig. 3):

- Test bench emergency deactivation 6
- Test bench activation 7
- Power cables 8 и 9.

Fig. 2. MS004 COM - Mounting face

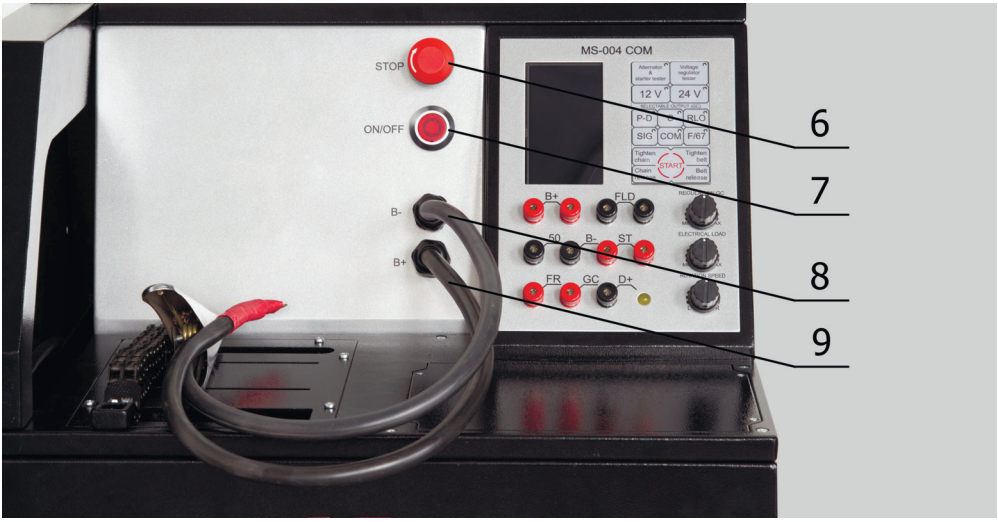


Fig 3. MS004 COM - Front panel

Button 6 is specified as **STOP**. It is used for emergency deactivation of the bench.

Button 7 is specified as **ON/OFF**. It is used for activation/deactivation of the bench. When button 6 is on, button 7 is out of operation.

Power cable 8 is specified as **B-**. It is used to connect power negative potential of an alternator or starter.

Power cable 9 is specified as **B+**. It is used to connect power positive potential of an alternator or starter.

4.2 Control Units

Fig. 4. MS004 COM - Control Panel

1 – Display; **2** – Sockets; **3** – Buttons; **4** – Adjustment knobs

4.2.1 Display. Data output

Display Data Output when Testing an Alternator or Starter

Display Indicators

- **VOLTAGE, DC:** generation voltage indicator (alternator testing) or consuming voltage indicator (starter testing).
- **DFM,%:** indicator of load on an alternator.
- **AMP, DC:** constant current indicator. Generation indicator (alternator testing) or consuming voltage indicator (starter testing).
- **AMP, AC:** alternating current indicator.
- **TACHOMETER:** drive rotation indicator. It is not used when testing a starter.
- **D:** indicator of set generation voltage when testing alternators with P-D terminal **(Fig. 6)**.
- **P:** stator winding frequency indicator when testing alternators with P-D terminal **(Fig. 6)**.
- **C:** indicator of set generation voltage when testing alternators with C terminal **(Fig. 7)**.
- **RLO:** indicator of set generation voltage when testing alternators with RLO terminal **(Fig. 8)**.
- **SIG:** indicator of set generation voltage when testing alternators with SIG terminal **(Fig. 9)**.
- **PROTOCOL:** voltage regulator protocol indicator (alternators with COM terminal only) **(Fig. 10)**.
- **BAUD:** indicator of data exchange speed indicator of a voltage regulator (alternators with COM terminal only) **(Fig. 10)**.
- **COM:** indicator of set generation voltage when testing alternators with COM terminal **(Fig. 10)**.
- **ID/TYPE:** ID and voltage regulator type indicator (alternators with COM terminal only) **(Fig. 10)**.
- **ERROR:** voltage regulator error indicator (alternators with COM terminal only) **(Fig. 10)**.
- **VOLTAGE REG:** indicator of set generation voltage (alternators without a voltage regulator only) **(Fig. 11)**.

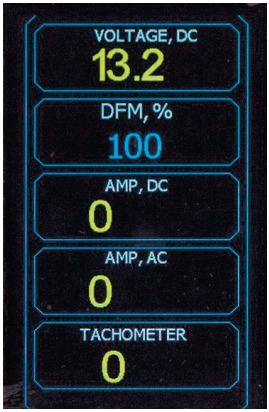


Fig. 5. Display data output when testing an alternator with D+ terminal or a starter

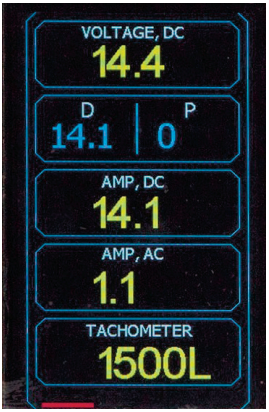


Fig. 6. Display data output when testing an alternator with P-D terminal

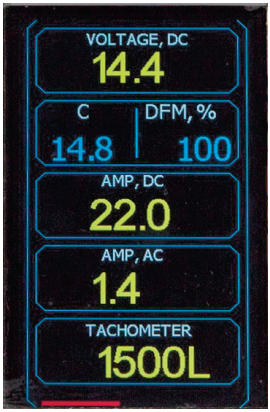


Fig. 7. Display data output when testing an alternator with C terminal

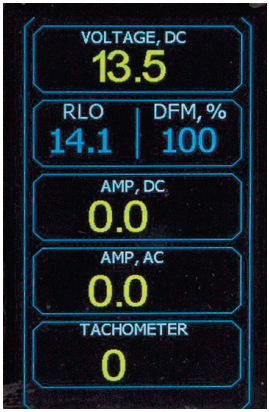


Fig. 8. Display data output when testing an alternator with RLO terminal

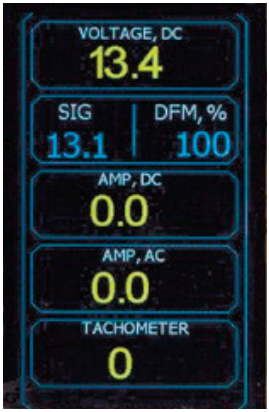


Fig. 9. Display data output when testing an alternator with SIG terminal

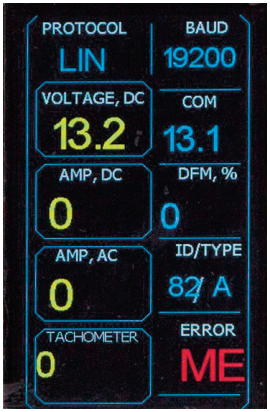


Fig. 10. Display data output when testing an alternator with COM (LIN, BSS) terminal

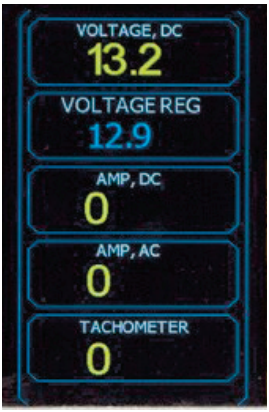


Fig. 11. Display data output when testing an alternator without a voltage regulator F(67)

Display Data Output when Testing a Voltage Regulator

Display Indicators

- **VOLTAGE, DC:** stabilizing voltage indicator of a voltage regulator.
- **DFM,%:** indicator of load on a voltage regulator.
- **AMP, DC:** indicator of constant current through winding of simulated rotor.
- **D:** indicator of set stabilizing voltage of a voltage regulator (voltage regulators with P-D terminal only) **(Fig. 13)**.
- **P:** stator winding frequency indicator of a voltage regulator (voltage regulators with P-D terminal only) **(Fig. 13)**.
- **C:** indicator of set stabilizing voltage of a voltage regulator (voltage regulators with C terminal only) **(Fig. 14)**.
- **RLO:** indicator of set stabilizing voltage of a voltage regulator (voltage regulators with RLO terminal only) **(Fig. 15)**.
- **SIG:** indicator of set stabilizing voltage of a voltage regulator (voltage regulators with SIG terminal only) **(Fig. 16)**.
- **PROTOCOL:** voltage regulator protocol indicator (voltage regulators with COM terminal only) **(Fig. 17)**.
- **BAUD:** indicator of data exchange speed indicator of a voltage regulator (voltage regulators with COM terminal only) **(Fig. 17)**.
- **COM:** indicator of set stabilizing voltage of a voltage regulator (voltage regulators with COM terminal only) **(Fig. 17)**.
- **ID/TYPE:** ID and voltage regulator type indicator (voltage regulators with COM terminal only) **(Fig. 17)**.
- **ERROR:** voltage regulator error indicator (voltage regulators with COM terminal only) **(Fig. 17)**.

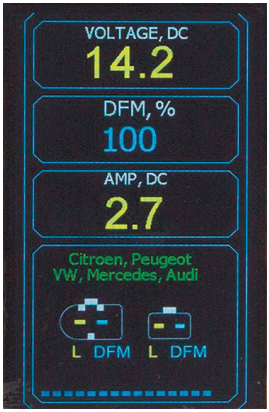


Fig. 12. Display data output when testing a voltage regulator with L/D+ terminal

Fig. 13. Display data output when testing a voltage regulator with P-D terminal

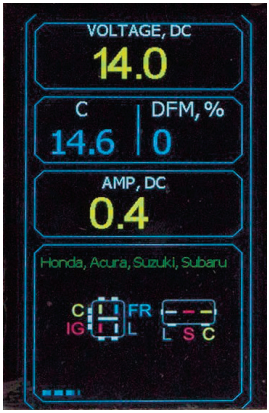


Fig. 14. Display data output when testing a voltage regulator with C terminal

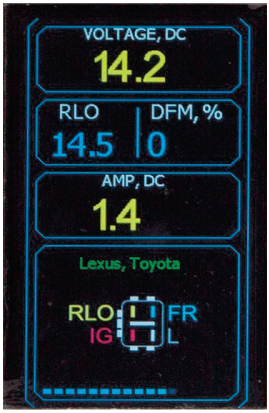


Fig. 15. Display data output when testing a voltage regulator with RLO terminal

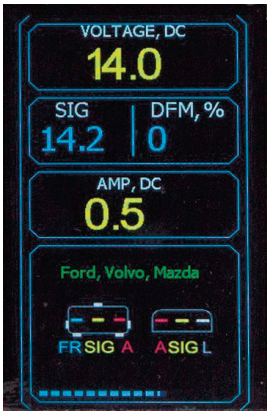


Fig. 16. Display data output when testing a voltage regulator with SIG terminal

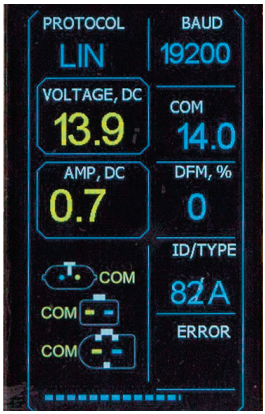


Fig. 17. Display data output when testing a voltage regulator with COM terminal

4.2.2 Buttons

- **Alternator & starter tester**: activation/deactivation of testing mode of starters and alternators. The button is lightened in active mode with option to choose voltage and connection terminal. Testing mode of an alternator with D+ terminal default is on. Operation of the drive belt and fixing chain is forbidden.
- **12V/24V**: buttons to set voltage for testing an alternator, starter, voltage regulator. 12V voltage default is set. The pressed button is lightened.
- **Voltage regulator tester**: activation/deactivation of testing mode of voltage regulators. The button is lightened in active mode with option to choose voltage and connection terminal. Testing mode of a voltage regulator with D+ terminal default is on.
- **P-D, C, RLO, SIG, COM**: control signal injection to GC socket to test alternators or voltage regulators with the corresponding terminal. The button is lightened when the mode is active. To deactivate the mode, press the button one more time.
- **F (67)**: potential injection to GC socket to test alternators without a voltage regulator. The voltage is set by positive potential, 2nd terminal of brush assembly is connected to alternator housing. The button is lightened when the mode is active.

- **START:** activation/deactivation of positive potential through 50 socket to the terminal of starter solenoid.
- **Tighten chain:** Button of chain tightening. The tightening is off automatically on sufficient fixing of a unit.
- **Chain release:** Button of chain release.
- **Tighten belt:** Button of drive belt tightening.
- **Belt release:** Button of drive belt release.

4.2.3 Terminals

- **D+:** used for testing alternators and voltage regulators with L, D+, I, IL, 61 terminals. LAMP indicator (control lamp simulation on instrument cluster) is lightened next to D+ socket.
- **DFM:** used to control load on an alternator. It is connected to FR, DFM, M voltage regulator terminals.
- **B+:** used for positive potential injection to a voltage regulator. It is connected to IG, S, AS, BVS, A, 15, 30 voltage regulator terminals.
- **GC:** used to test alternators with COM, P-D, RLO, C, SIG, 67 terminals.
- **B-:** used for negative potential injection to a voltage regulator.
- **St:** used for simulation of rotor winding terminals of an alternator in the mode of testing a voltage regulator.
- **FLD:** used to connect voltage regulator brushes or terminals corresponding to the sockets.
- **50:** used to test starters. Starter solenoid terminal is connected.

4.2.4 Adjustment Knobs

- **REGULATION GC:** the knob to adjust generation voltage of an alternator or stabilizing voltage of a voltage regulator. It is used to connect a voltage regulator or alternator to GC socket. The set voltage parameters reset on short pressing.
- **ELECTRICAL LOAD:** the knob to adjust electrical load on an alternator (simulates car consumers). The set load parameters reset on short pressing.
- **ROTATION SPEED:** the knob to adjust drive rotation and rotation direction. The drive stops and electrical load parameters reset on short pressing. Rotation of the adjustment knob to the left sets drive rotation of the bench to the left (anticlockwise rotation alternators). Rotation of the adjustment knob to the right sets drive rotation of the bench to the right (clockwise rotation alternators).

5. SETTING INTO OPERATION

5.1 Connection

Install the bench in the premises with temperate humidity and temperature. Unscrew 4 bolts and open cover 5 of the mounting face **(Fig. 2)**. Insert battery 1 **(Fig. 18)**, the model is indicated in the table 'Technical Characteristics'. Connect the battery to the relevant wires, according to the marks of the terminals. Connect the bench to single-phase alternating current supply (supply voltage is indicated in the table 'Technical Characteristics').

Use power cables **(Fig. 19)** to achieve 24V test voltage, and connect the external battery to the relevant terminals of the test bench body **(Fig. 20)**. The bench terminals are marked with B+ (battery positive potential), B- (battery negative potential). The cables are fixed in the corresponding sockets and turned clockwise until tight. Dismounting of cables is conducted in reversed order.

Fig. 18. MS004COM - Inserted battery with connected terminals

Fig. 19. MS004COM - Power cables to connect the additional battery (battery 2)

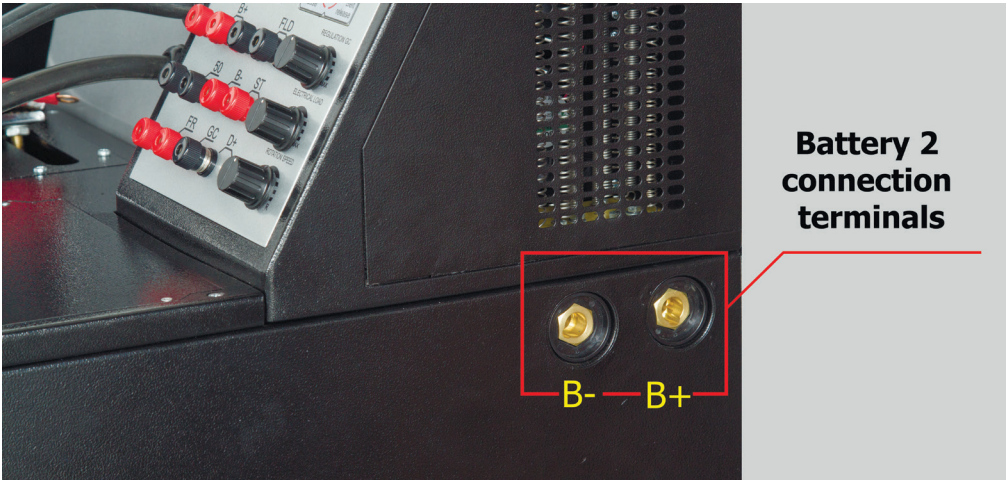


Fig. 20. MS004COM - Terminals for power cables to connect the external battery

⚠ **WARNING! Use battery 1 of a specified model only.**

⚠ **WARNING! Observe polarity of the terminal posts, otherwise, it may cause failure of the test bench. In this case a customer loses warranty package, provided by the manufacturer.**

⚠ **WARNING! Make sure that mains voltage corresponds to the technical characteristics of the test bench.**

⚠ **WARNING! Make sure that disconnected cables of the additional battery are far enough from the contact surface.**

6. STEP-BY-STEP INSTRUCTION

Before testing the unit, make sure that all bolts are tightened, the test bench is not damaged and has no cracks.

6.1 Alternator Testing

- Install the unit must on the mounting face.
- The pulley must align with the belt.
- Release the chain to the required length (by pressing the button **Chain release** on the control panel), latch the chain over the chain fixer **(1)** of the mounting face.

• Fix the unit on the mounting face (by pressing the button **Tighten chain** on the control panel). Tightening will stop automatically.

• Release the belt to the required length (by pressing the button **Belt release**), latch the belt over an alternator pulley. Tighten the belt (by pressing the button **Tighten belt**) until tension of the belt is the same as in the car. Belt tension is set manually. Belt tension stops by pressing the button **Tighten belt** one more time.

• Connect the power cable **(Fig. 3)** B- with multi-functional tightening, called 'crocodile', to the body of the tested unit, which is earth, connected to negative terminal of the battery.

• Press the button **Alternator & Starter tester**, set required voltage with **12V/24V** buttons, according to the technical characteristics of a tested alternator.

• Connect B+ wire **(Fig. 3)** to the power terminal of an alternator.

• Connect terminals of a voltage regulator to the corresponding sockets of the test bench.

• Press the button of the corresponding terminal on the control panel, according to the connection terminal of an alternator.

• Rotate the adjustment knob **ROTATION SPEED** to the left or to the right, depending on rotation direction of an alternator. Mostly alternators rotate to the left.

• Faultless alternator starts power generation from 700 to 850 drive rotation.

• If voltage regulator connection terminals are P-D, C, RLO, SIG, COM, F(67), set preliminary generation voltage with the adjustment knob REGULATION GC from 13.5V to 14.5V.

• Reach 3 000 rpm maximum drive rotation.

• Increase the load on an alternator. Rotate the adjustment knob **ELECTRICAL LOAD** clockwise; anticlockwise rotation decreases the load.

• If voltage regulator connection terminals are L or D+, generation voltage must not go lower than 13.5V under maximum load, and must not go higher than 14.5V under minimum load.

⚠ **WARNING! Generation voltage must correspond to the technical data of a tested alternator.**

⚠ **WARNING! Discharged batteries may consume up to 50 A of generated current.**

On finishing testing of an alternator:

• Reset the set load by short pressing the adjustment knob **ELECTRICAL LOAD**.

• Stop the drive by short pressing the adjustment knob **ROTATION SPEED**.

• Deactivate testing mode with **Alternator & starter tester** button.

- Disconnect the wires from an alternator.
- Release the drive belt.
- Release the fixing chain.
- Remove an alternator from the mounting face.

6.2 Starter Testing

- Install a starter on the mounting face.
- Release the chain to the required length, latch the chain over the chain fixer of the mounting face.
- Fix the unit on the mounting face. Tightening will stop automatically.
- Connect the power cable B- with multi-functional tightening, called 'crocodile', to the body of the tested unit, which is earth, connected to negative terminal of the battery.
- Press the button Alternator & Starter tester, set required voltage with 12V/24V buttons, according to the technical characteristics of a tested starter.
- Connect B+ wire to the power terminal of a starter.
- Connect 50 socket to the power terminal of starter solenoid.
- Press START button. A faultless starter will switch on at once.
- Follow the indicators of current and voltage characteristics.

On finishing testing of a starter:

- Deactivate testing mode with Alternator & starter tester button.
- Disconnect the wires from a starter.
- Release the fixing chain.
- Remove a starter from the mounting face.

6.3 Voltage Regulator Testing

Connect a voltage regulator to the test bench by 2 ways:

1) Connect a voltage regulator to the corresponding outputs of the bench the same way it is connected to an alternator.

2) Connect a voltage regulator according to APPENDIX 3.

⚠ **WARNING! When testing 24V voltage regulators, battery 2 is not used.**

Testing Procedure:

• Activate the testing mode of a voltage regulator by pressing **Voltage regulator tester button**.

• Set required voltage of a tested voltage regulator with **12V/24V** buttons.

• Connect a voltage regulator to the test bench sockets in the following order: B+; B-; D+ and/or GC; FLD (both brushes); St.

Voltage indicators of faultless voltage regulator ranges from 13,8V to 14,7V.

• If voltage regulator connection terminals are P-D, C, RLO, SIG, COM, set preliminary stabilizing voltage with the adjustment knob REGULATION GC from 13.5V to 14.5V. Stabilizing voltage must correspond to the set voltage.

7. TEST CERTIFICATE

Test Bench MSG MS004 COM for diagnostics of starters, alternators and voltage regulators meets technical requirements of Directive 2014/30/EU - Electromagnetic Compatibility (EMC) EN Directive 2014/35/EU - Low voltage (LVD) Directive 2006/42/EC - Machinery (MD) and is qualified for exploitation.

APPENDIX 1

Connection Terminals of Alternators

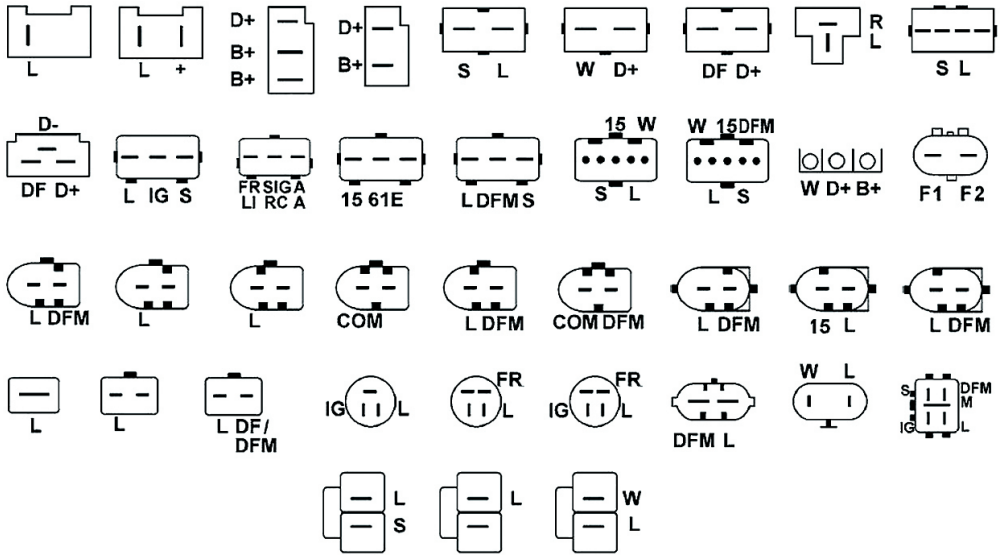
Symbols	Functional purpose	Connection
B+	Battery (+)	B+
30		
A	(Ignition) Input for starting ignition	
IG		
15		
AS	Alternator Sense	
BVS	Battery Voltage Sense	
S	(Sense) Input for voltage comparison at control point	
B-	Battery (-)	B-
31		
E	(Earth) Earth, battery (-)	
D+	Used for connection to an indicator lamp that transfers initial driving voltage, and indicates alternator operability	L/D+
I	Indicator	
IL	Illumination	
L	(Lamp) Output for alternator operability indicator lamp	
61		
FR	(Field Report) Output for load control on an alternator by engine management block	DFM
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 Mitsubishi (Mazda) and Hitachi (Kia Sephia 1997-2000)	D
D	(Digital) Input of code voltage installation on American Ford, same as SIG	SIG
RC	(Regulator Control) same as SIG	
SIG	(Signal) Input of code voltage installation	

RVC(L)	(Regulated Voltage Control) Similar to SIG, but voltage change ranges from 11.0 V to 15.5 V. Control signal is sent to L terminal	
C	(Communication) Voltage regulator input to control engine operation block. Japanese cars	C
G		
RLO	(Regulated Load Output) Input to control stabilizing voltage with range from 11,8 to 15 V (TOYOTA)	RLO
COM	(Communication) General term for physical interface, 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 control interface and alternator diagnostics, con- ducted under protocol LIN (Local Interconnect Network)	
DF	Voltage adjustment output	F67
F		
FLD		
67		
P	Output of one of alternator stator windings. Used for measuring alternator driving voltage	
S		
STA		
Stator		
W	(Wave) Output of one of alternator stator windings for connection of tachometers in diesel engine cars	
N	(Null) Output of average stator winding point. Usually used to regulate alternator operability with mechanically regulated voltage by an indicator lamp	
D	(Dummy) Blank, no connection, mostly in Japanese cars	
N/C	(No connect) No connection	
Options of LRC voltage regulators	(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	

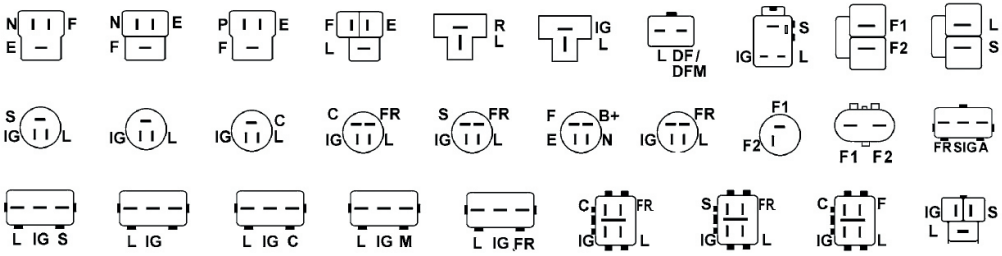
APPENDIX 2

Sockets of Alternators

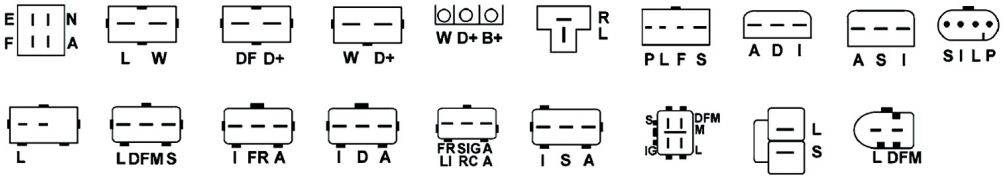
Bosch



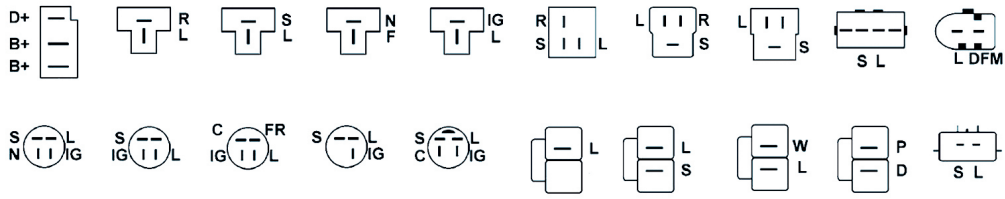
Denso



Ford/Lucas

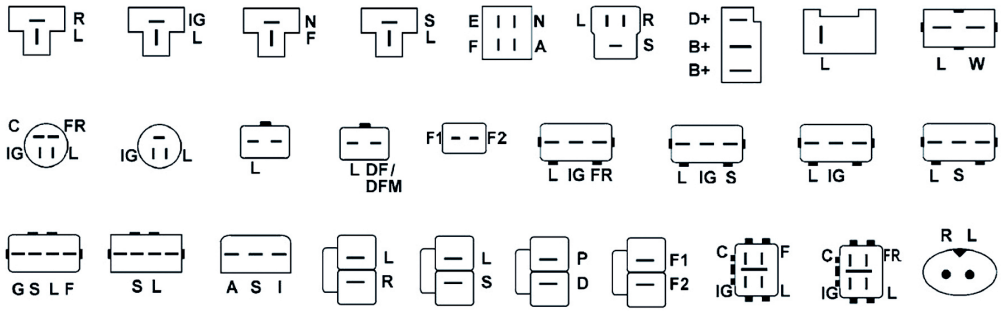


Hitachi

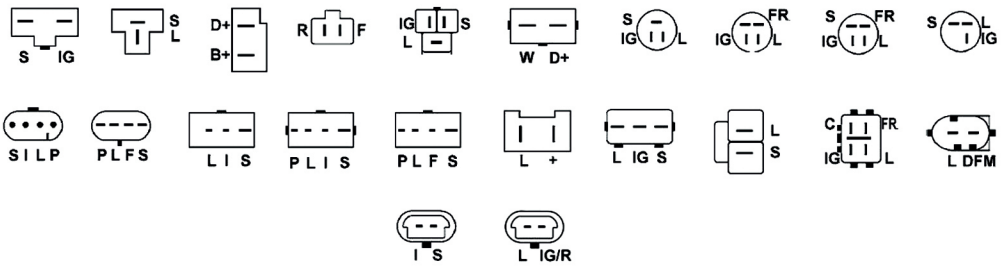


Magneti Marelli

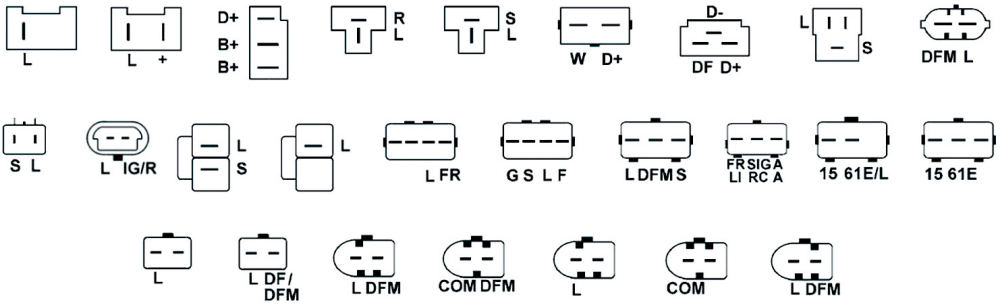
Mitsubishi



Delco Remy



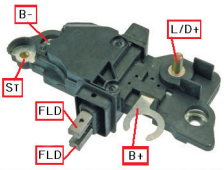
Valeo

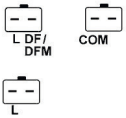


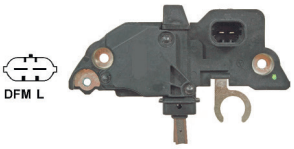
APPENDIX 3

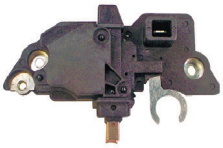
Connection of Voltage Regulators to the Test Bench

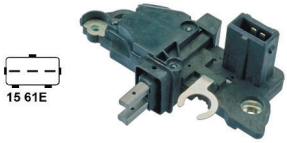
BOSCH

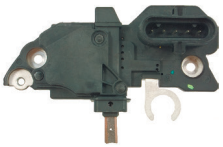


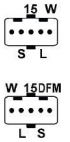


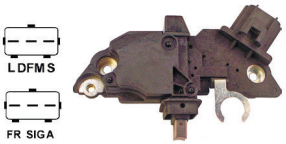


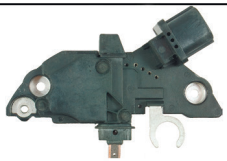


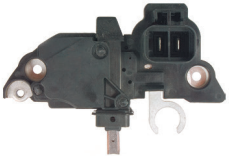


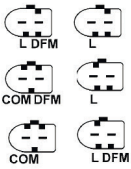


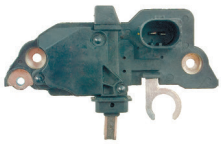




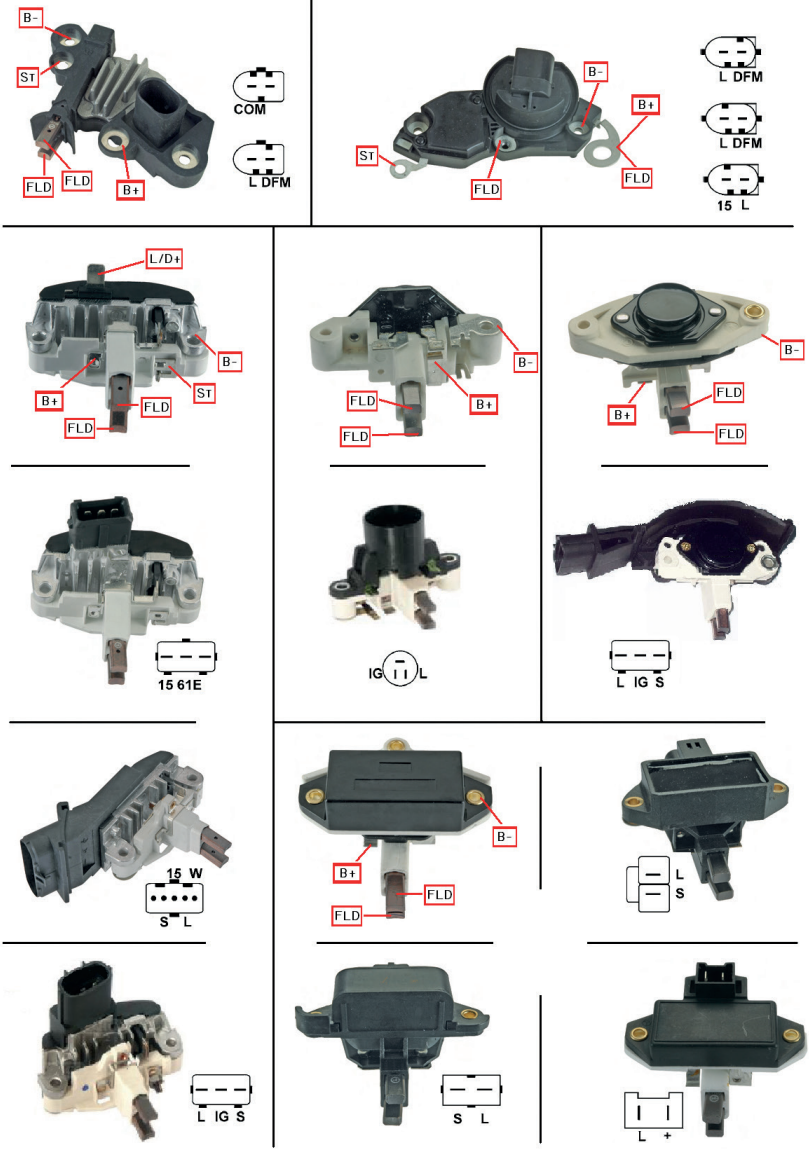






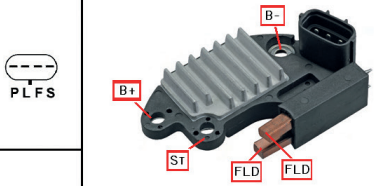


BOSCH

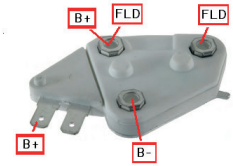

B-
ST
FLD
FLD
B+
COM
L DFM
B-
B+
ST
FLD
FLD
L DFM
L DFM
15 L
L/D+
B-
B+
ST
FLD
FLD
B-
FLD
B+
FLD
B-
B+
FLD
FLD
15 61E
IG
L
L IG S
15 W
S L
B-
B+
FLD
FLD
L
S
L IG S
S L
L +

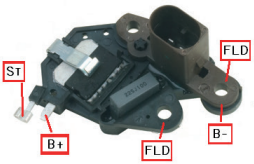
DELCO REMY


FLD
FLD
ST
B-
B+

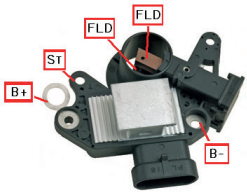

B-
B+
ST
FLD
FLD


FLD
FLD
ST
B-
B+

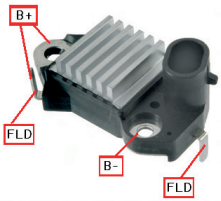

B+
FLD
FLD
B+
B-

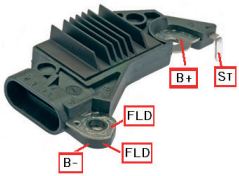

ST
FLD
B-
B+
FLD

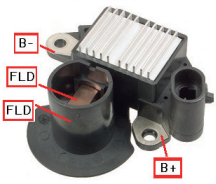

B+


FLD
FLD
ST
B+
B-


B+

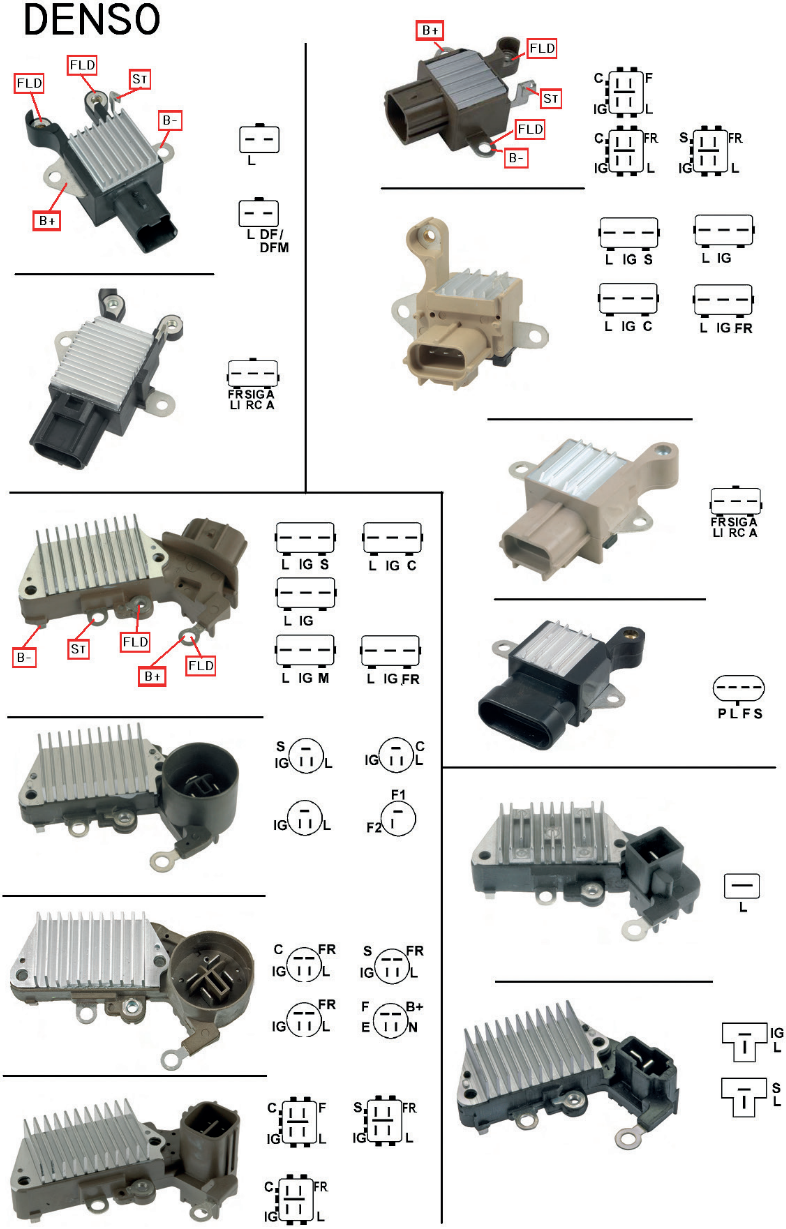

B+
FLD
B-
FLD


B+
ST
FLD
FLD
B-

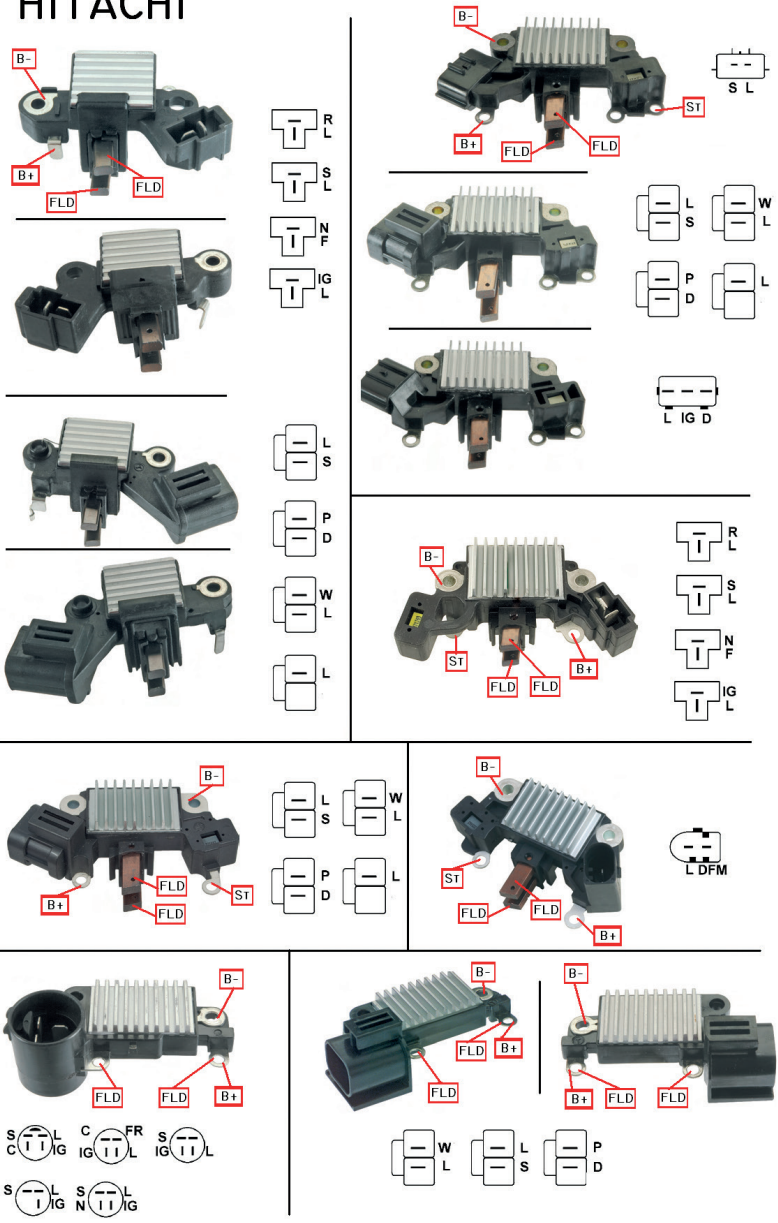

B-
FLD
FLD
B+


C
FR
IG
L

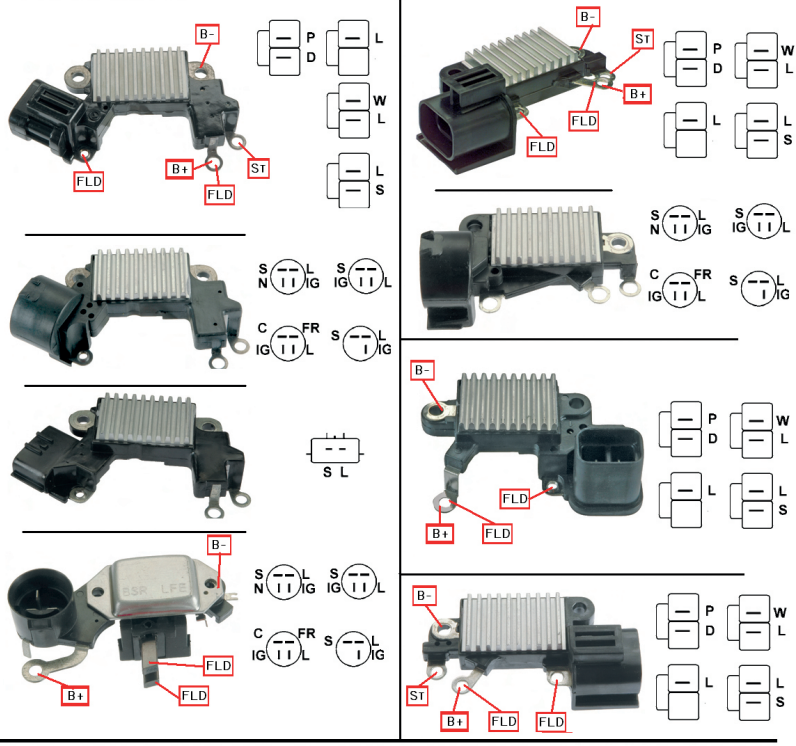
DENSO


FLD
FLD
ST
B-
B+
L
L DF/ DFM
FR SIG A
LI RC A
B+
FLD
ST
FLD
B-
C F IG L
C FR IG L
S FR IG L
L IG S
L IG
L IG C
L IG FR
FR SIG A
LI RC A
B-
ST
FLD
B+
FLD
L IG S
L IG C
L IG
L IG M
L IG FR
P L F S
S IG L
IG C L
IG L
F1 F2
L
C FR IG L
S FR IG L
FR IG L
F B+ E N
IG L
S L
C F IG L
S FR IG L
C FR IG L

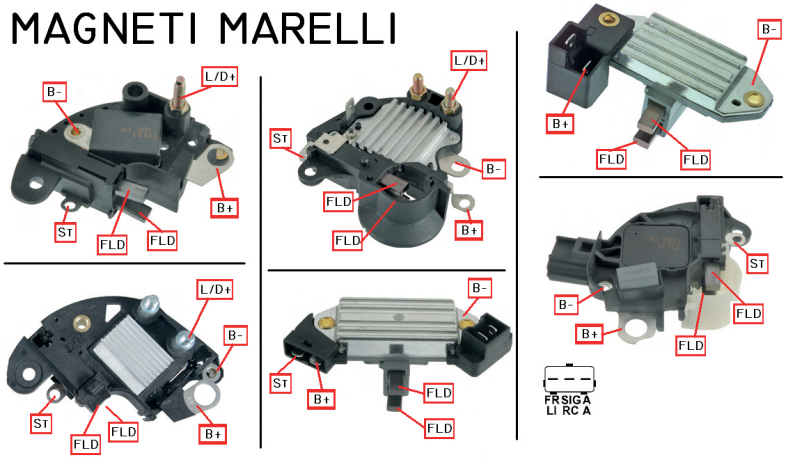
HITACHI


B-
B+
FLD
FLD
R
L
S
L
N
F
IG
L
L
S
P
D
W
L
L
B-
B+
FLD
FLD
ST
S L
L
S
W
L
P
D
L
L IG D
B-
ST
B+
FLD
FLD
R
L
S
L
N
F
IG
L
B-
B+
FLD
FLD
ST
L
S
W
L
P
D
L
B-
ST
FLD
FLD
B+
L DFM
B-
FLD
FLD
B+
S
C
L
IG
C
IG
FR
L
S
IG
L
S
IG
L
S
N
L
IG
B-
FLD
B+
FLD
B-
B+
FLD
B-
B+
FLD
FLD
W
L
L
S
P
D

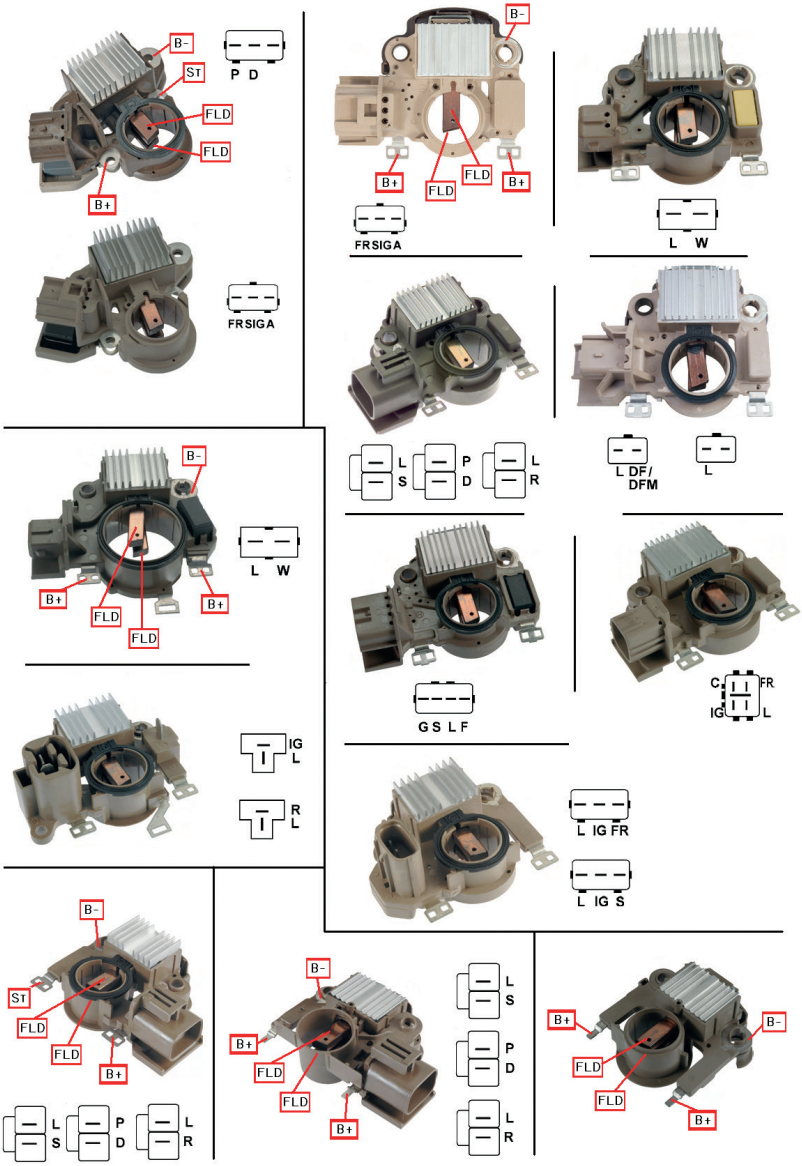
HITACHI



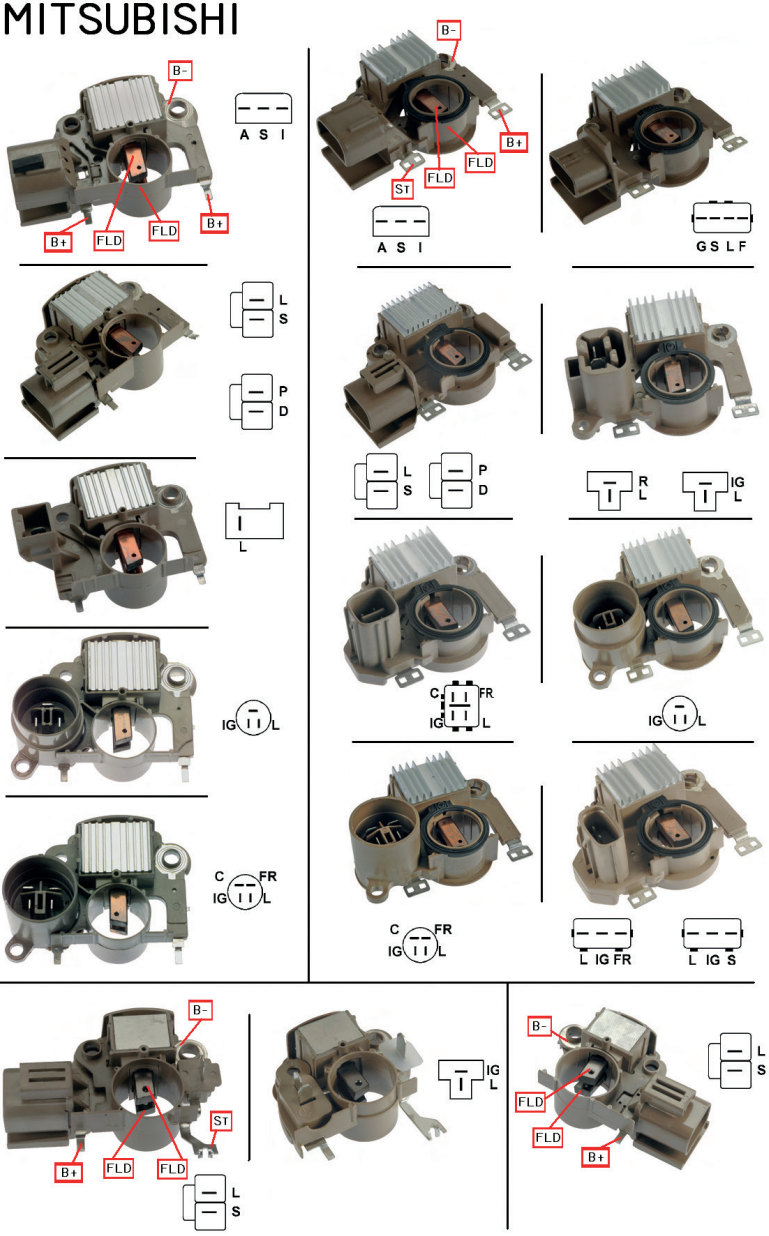
MAGNETI MARELLI



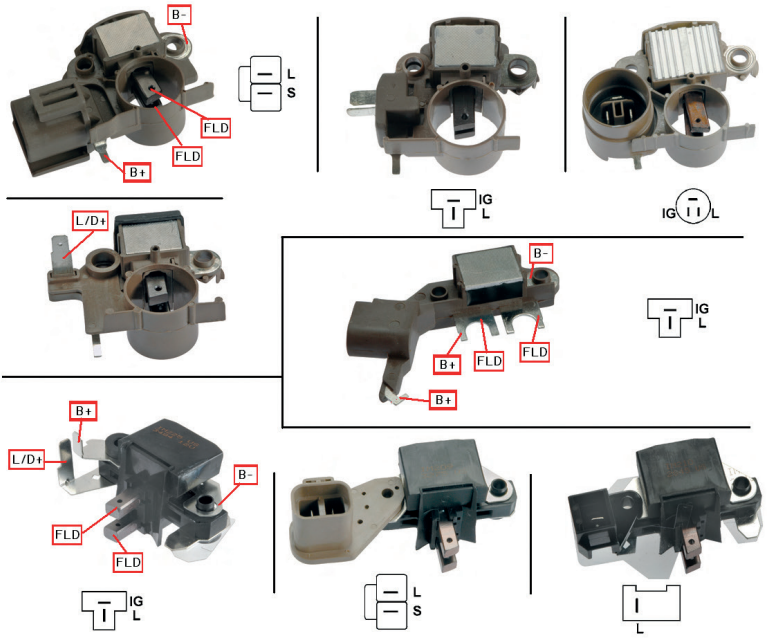
MITSUBISHI


B-
ST
FLD
FLD
B+
P D
FRSIGA
B-
B+
FLD
FLD
B+
FRSIGA
L W
L S
P D
L R
L DF/ DFM
L
B-
B+
FLD
FLD
B+
L W
G S L F
C
FR
IG
L
IG L
R L
L IG FR
L IG S
B-
ST
FLD
FLD
B+
L S
P D
L R
B-
B+
FLD
FLD
B+
B+
B-
FLD
FLD
B+

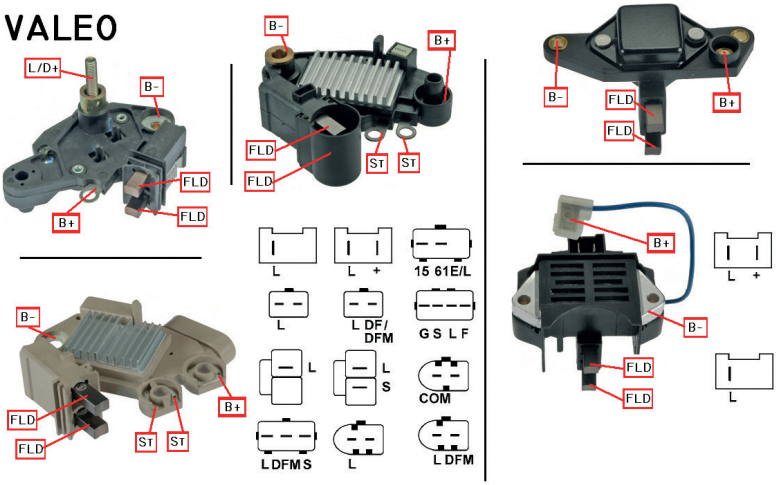
MITSUBISHI


B-
B+
FLD
FLD
B+
A S I
B-
B+
FLD
FLD
ST
A S I
GS L F
L
S
P
D
L
S
P
D
R
L
IG
L
L
IG
L
C
FR
IG
L
IG
L
C
FR
IG
L
L IG FR
L IG S
B-
ST
B+
FLD
FLD
L
S
IG
L
B-
L
S
FLD
FLD
B+

MITSUBISHI



VALEO




MSG
equipment


CE