

marathon[®]
Generators

PM500 v1.2

Voltage Regulator

Installation, Operation and
Maintenance Manual



A Regal Brand

REGAL

Introduction

The PM500 is an encapsulated electronic voltage regulator intended for use with the Marathon PMG system and most Marathon AC generators. The PM500 controls the output of a brushless AC generator by regulating the DC current input to the exciter field. The PM500 is designed as a three phase or single phase true RMS sensing regulator that is capable of accepting analog voltage adjustment input. The PM500 is UL Recognized and UL Certified for Canada – Component per UL File E222903. The PM500 bears the CE mark for the European Union.

Specifications

Sensing Input	175 - 600Vac, True RMS, 60/50Hz, 3 Phase/1 Phase
Power Input	175 - 260Vac, 300Hz PMG, 60/50Hz Shunt
Power Output, Continuous	85Vdc at 3.5A _{dc} with 240Vac input power
Power Output, Forcing	170Vdc at 7A _{dc} for 10 sec. with 240Vac input power
Fuse	5 x 20mm S505-5A, Slow Blow Type
Voltage Regulation	± 0.25%, with 4% engine governing
Excitation Resistance	9 ohms, minimum
Over Excitation Protection	Excitation exceeds 190Vdc or 7A _{dc} for more than 10 seconds
Manual Voltage Adjustment Range	± 20% with 2000 ohm rheostat ± 10% with 1000 ohm rheostat
Analog Voltage Input A1 & A2	± 20% with 0-10Vdc or ± 5Vdc bias
Under Frequency Factory Setting	58Hz preset for 60Hz operation and 48Hz preset for 50Hz operation
Voltage Build-up	Voltage build up from input voltage ≥ 5Vac at 25Hz.
Response Time	<1 Cycle
Weight	16.6 oz.
Operating Temperature	-40°C to +60°C
Storage Temperature	-40°C to +85°C
Power Dissipation	12 watts, maximum
Size	5.9" L x 5.3" W x 2.2" H
Thermal Drift	0.05% / °C change in AVR ambient temperature
Electromagnetic Compatibility Tests	Immunity IEC61000-4-2 - Electrostatic Discharge IEC61000-4-3 - Radiated RF IEC61000-4-4 - Electrical Fast Transient IEC61000-4-5 - Surge IEC61000-4-6 - Conducted RF IEC61000-4-11 Emission EN61204-3 - Conducted RF CISPR 22 IEC61000-3-2 - Harmonic IEC IEC61000-3-3 - Flicker IEC

Installation

⚠️ WARNING

TO PREVENT PERSONAL INJURY OR EQUIPMENT DAMAGE, ONLY QUALIFIED PERSONNEL SHOULD INSTALL, OPERATE OR SERVICE THIS DEVICE.

⚠️ CAUTION

DO NOT megger or high-pot the generator with the regulator connected. DO NOT high-pot the regulator. All voltage readings are to be taken with an rms voltmeter.

MOUNTING

The PM500 is mounted through a keyed hole in the generator conduit box and secured with a plastic mounting nut.

The PM500 should be mounted directly to the conduit box panel with the rubber gasket positioned between the outside of the conduit box panel and the mounting nut.

Protect front panel adjustment pots by installing clear or black plastic cover.

Mounting nut torque is 26 – 43 lbf-in.

Refer to the Figure 1 for dimensions.

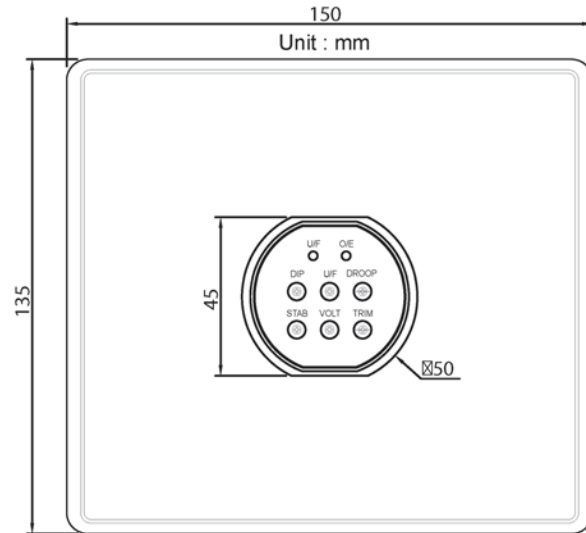


Figure 1

Wiring and Connections

EXCITER FIELD POWER CIRCUIT

The exciter field resistance must be ≥ 9 ohms.

If the exciter field resistance is less than 9 ohms and the full load field current does not exceed 3.5 amps, add a resistor in series of sufficient wattage to increase the total resistance to 9 ohms.

Connect the generator F+ (F1) field lead to the regulator F+ terminal. Connect the generator F- (F2) field lead to the regulator F- terminal. Refer to Figure 3 for typical connection points.

POWER INPUT CIRCUIT

The PM500 is designed to be powered by a PMG and capacitor. A $7.5\mu\text{f}$ capacitor is connected in parallel between the PMG leads and the regulator power input terminals.

The regulator power input terminals are labeled P1 and P2. Connect leads from P1 and P2 to the capacitor terminals.

Connect regulator terminals P1 & P2 to generator leads that will provide 240Vac output. No capacitor is used with the PM500 in shunt mode.

Refer to Figure 3 for typical connection points.

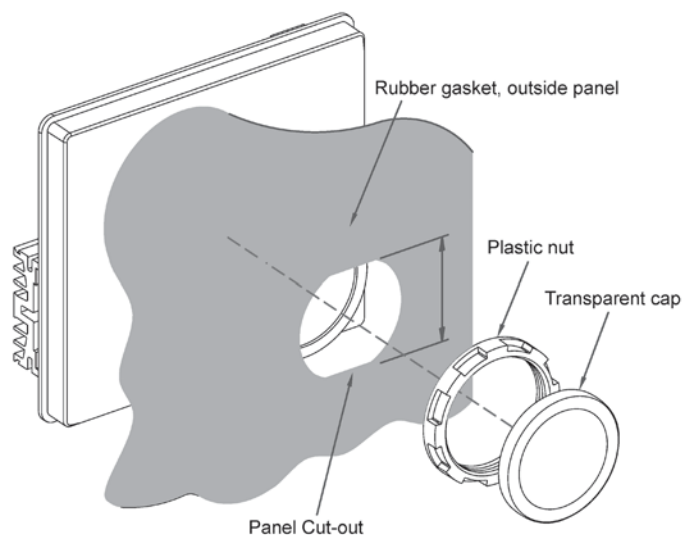


Figure 2

Wiring and Connections (cont'd)

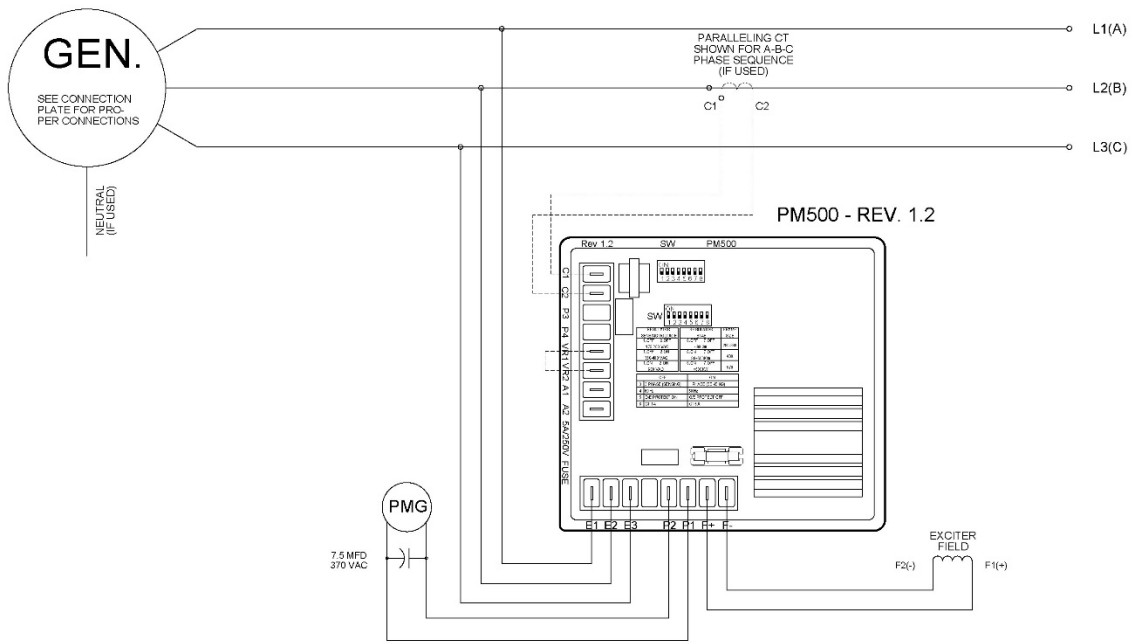


Figure 3a – Three Phase

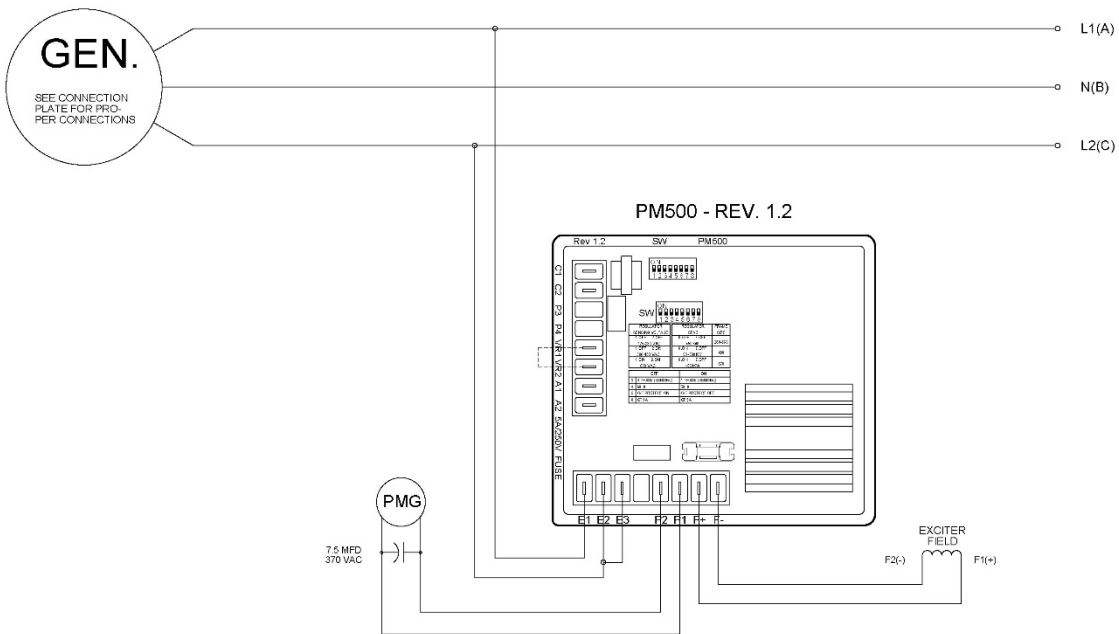


Figure 3b – Single Phase

SENSING CIRCUITS

Sensing input range is 175 - 600Vac. DIP switch SW1 and SW2 must be set appropriately. Refer to Figures 3a & 3b for typical connections.

Single Phase Sensing

Connect PM500 terminal E1 to output lead L1 and E2 to output lead L2. PM500 terminal E3 is jumpered to E2.

3 Phase Sensing

Connect PM500 terminal E1 to output lead L1, E2 to output lead L2 and E3 to output lead L3.

If used in a paralleling application, a paralleling CT will be required in the generator B phase. Paralleling CT must be sized to provide either a 1A or 5A signal when the generator is under full load.

Wiring and Connections (cont'd)

DIP SWITCH PROGRAMMING

Eight DIP switches located on the back of the regulator must be set appropriately for correct regulator operation and generator control. Refer to Figure 4.

Switches 1 & 2 set the regulator sensing range.

Switches 3 – 8 Configure multiple functions: 3 or Single Phase Sensing, Frequency, Over Excitation Protection, kW Range and Paralleling CT Range.

SW1 : OFF	SW2 : OFF	Volts \leq 280Vac
SW1 : OFF	SW2 : ON	Volts \leq 480Vac
SW1 : ON	SW2 : ON	Volts \leq 600Vac

	OFF	ON
SW3 :	3 Phase Sensing	1 Phase Sensing
SW4 :	60 Hz	50 Hz
SW5 :	O/E Protect On	O/E Protect Off
SW8 :	CT 1A	CT 5A

SW6 : OFF	SW7 : OFF	< 90kW
SW6 : ON	SW7 : OFF	90 - 500kW
SW6 : ON	SW7 : ON	> 500kW

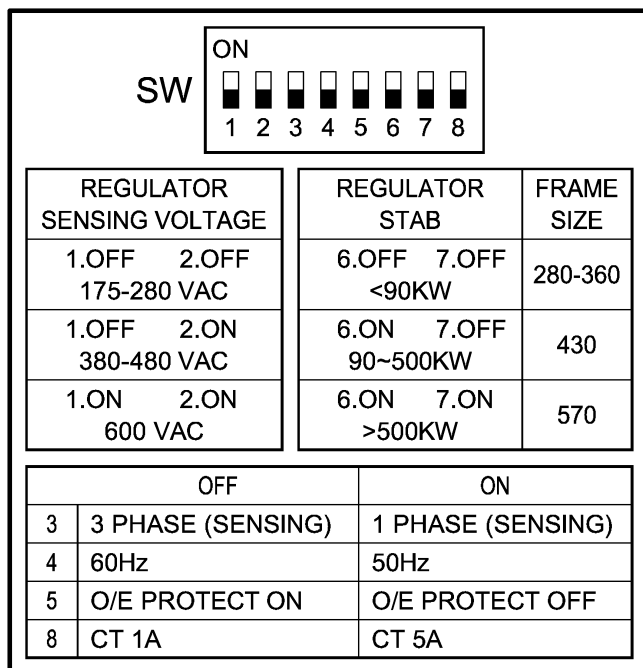


Figure 4

PROTECTION FUNCTIONS

The PM500 has built in protection functions for Over Excitation, Under Frequency and Over Voltage Protection.

Over Excitation

The Over Excitation function protects the PM500 and generator components in the event the excitation system demands excessive levels of voltage and/or current to maintain output.

The Over Excitation function will trip when excitation output exceeds 190Vdc or 7Adc for more than 10 sec. with 220Vac input power.

The Over Excitation O/E LED on the front panel will be illuminated when the PM500 when the Over Excitation system has tripped. Replace the fuse on the back panel if required and inspect the generator. The PM500 will reset when power is cycled

Under Frequency

Under Frequency protection allows the generator voltage to decrease when the output frequency drops below the Roll-Off point. This reduces the load on the engine, allowing engine RPM to recover. This is normal operation and no reset is required.

Operating Adjustments

Six adjustable potentiometers are accessible on the front panel of the PM500. These are: VOLT, STAB, U/F, DIP, DROOP and TRIM.

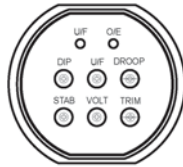


Figure 6

VOLTAGE ADJUST (VOLT)

Set Point

Output voltage may be adjusted via the VOLT potentiometer on the front panel of the regulator. The set point range is 175 - 600Vac.

Remote Voltage Adjust

A 2000 ohm, 2 watt rheostat may be connected to VR1 and VR2 - replacing the factory jumper, providing a $\pm 10\%$ voltage adjustment range. Terminals A1 & A2 may not be used when a rheostat is installed.

Analog Voltage Adjust

Regulator terminals A1 & A2 may be connected to the analog output of a gen-set controller. The allowable voltage input range is 0-10Vdc or ± 5 Vdc will provide a 20% range. Jumper VR1 & VR2 when analog voltage adjustment terminals are used.

TRIM ADJUST (TRIM)

The analog bias range is adjusted via the TRIM potentiometer on the front panel. Set the TRIM potentiometer fully clockwise to provide a $\pm 20\%$ adjustment range.

DROOP ADJUST (DROOP)

Requires a 1A or 5A CT in the B Phase.

DIP switch SW8 must be set appropriately.

In a paralleling system, the PM500 adjusts the generator output voltage when the B phase current leads or lags the B phase voltage.

The adjustment range may be preset via the DROOP potentiometer. The default setting is full counter clockwise for minimum range. Maximum range is $\pm 7\%$ at 1.7 PF lagging to 0.7 PF leading.

UNDER FREQUENCY ROLL-OFF ADJUST (U/F)

The Roll-Off point is the frequency at which the generator output voltage is allowed to decrease and is

factory preset at 57Hz for 60Hz operation and at 47Hz for 50Hz operation.

When the U/F LED on the front panel is lit, the PM500 is operating in Under Frequency mode.

To change the roll-off point, first verify that the gen-set is operating at the intended speed and voltage.

Fixed Engine RPM

On most new engines (Tier 4i and up), the engine speed is fixed at 1800RPM or 1500RPM.

Adjust the roll-off point by block loading the generator and observing the U/F LED on the front panel. To ensure the generator maintains voltage under a given block load, adjust U/F potentiometer until the U/F LED remains off during the block load test.

Adjustable Engine RPM

Adjust engine speed to the new roll-off point. Verify that the output voltage still matches the intended set-point voltage.

Next, adjust the U/F potentiometer clockwise until the voltage starts to drop off, then slightly adjust the potentiometer counterclockwise until the voltage returns to rated voltage. Re-adjust engine speed to rated speed.

U/F DIP ADJUST (DIP)

When Under Frequency (U/F) protection is activated, the voltage dip follows a linear Volts / Hertz curve. The voltage dip ratio may be adjusted via the DIP potentiometer with an adjustable range of 3-10V/Hz. The default setting is full clockwise for 10V/Hz.

STABILITY ADJUST (STAB)

Stability is the ability of the generator to respond to load changes. Decreasing the stability setting allows the generator to respond faster to load changes. If the stability setting is too low, the generator voltage will tend to hunt under steady state conditions.

Correct stability adjustment must be conducted while the generator is operating unloaded.

Adjust the STAB potentiometer clockwise until the voltage becomes unstable, then slightly adjust counterclockwise (Approximately 1/5 turn) until the voltage becomes stable.

Warnings & Cautions



IMPORTANT INFORMATION Please Read Carefully



This document is not intended to provide operational instructions. Appropriate Marathon Electric instructions provided with the generator and precautions attached to the generator should be read carefully prior to installation, operations and/or maintenance of the equipment. Injury to personnel or generator failure may be caused by improper installation, maintenance or operation.

The following  **WARNING** and  **CAUTION** information is supplied to you for your protection and to provide you with many years of trouble free and safe operation of your Marathon Electric product:



- Buyer shall be solely responsible for determining the adequacy of the product for any and all uses to which Buyer shall apply the product. The application by Buyer shall not be subject to any implied warranty of fitness for a particular purpose.
- For safety, Buyer or User should provide protective guards over all shaft extensions and any moving apparatus mounted thereon. The User is responsible for checking all applicable safety codes in his area and providing suitable guards. Failure to do so may result in bodily injury and/or damage to equipment.
- Hot oil can cause severe burns. Use extreme care when removing lubrication plugs.
- Disconnect power and lock out drive equipment before working on a generator.
- Always keep hands and clothing away from moving parts.
- The lifting eyes on the generator are not to be used to lift the entire generator set. Only the generator may be safely lifted by the lifting eyes. Do not use the conduit box for lifting or support of the generator.
- Install and ground the generator per local and national codes.
- Discharge all capacitors before servicing the generator.
- Misapplication of a generator in a hazardous environment can cause fire or an explosion and result in serious injury.
- Never attempt to measure the temperature rise of a generator by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector or thermocouple.
- Operation of a generator at higher than its nameplate ratings may result in fire, damage to equipment or serious injury to personnel.
- Do not apply any force to the generator fan when rotating the generator rotor.
- Generators should not be operated faster than their rated speed.
- The following statement is only applicable to high voltage generators (above 5000 V). A grounding strap is supplied from the generator neutral to ground. This grounding strap not only bleeds off any voltage potential on the main stator after the high potential test, but also bleeds off any static charge that can build-up on the main stator during shipment and storage. THIS GROUND STRAP IS NOT A PERMANENT PART OF THE GENERATOR CONSTRUCTION. REMOVE THIS GROUND STRAP ONLY AFTER A PERMANENT GROUND IS INSTALLED ON THE GENERATOR MAIN STATOR (not supplied by Marathon Electric), OR THE GENERATOR FINAL INSTALLATION IS COMPLETE.



- Mounting bolts should be routinely checked to ensure that the unit is firmly anchored for proper operation.
- Consult qualified personnel with questions. All electrical repairs must be performed by trained and qualified personnel only.
- For inverter applications, follow the inverter manufacturer's installation guidelines.
- Make sure the generator is properly secured and aligned before operation.
- When installing the generator, insure that loose parts or tools do not fall inside the generator.
- When connecting the generator, be sure to follow the correct wiring diagram for the desired voltage. Insure that the voltage regulator is connected per the wiring diagram.

RESALE OF GOODS

In the event of the resale of any of the goods, in whatever form, Resellers/Buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranty or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will the manufacturer be liable for consequential, incidental or other damages. Even if the repair or replacement remedy shall be deemed to have failed of its essential purpose under Section 2-719 of the Uniform Commercial Code, the manufacturer shall have no liability to Buyer for consequential damages.

Resellers/Buyers agree to also include this entire document including the cautions and warnings above in a conspicuous place and in a conspicuous manner in writing to instruct users on the safe usage of the product.

This information should be read together with all other printed information supplied by Marathon Electric.

For more information contact: Regal Beloit America, Inc., 100 E. Randolph St., Wausau, WI 54401
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