

CONTROL DIVISION

# PPS EZ

## Solid State Controller w/Bypass

### Instruction Manual

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#### PPS EZ Model Numbers

MODEL PPS EZ	AMPS	CONT. MAX HP		
		230V	460V	575V
180	270	100	200	250
240	360	150	300	300
360	540	200	400	500
500	750	300	600	700
800	800	350	700	800



### WARNING



*Equipment is at possibly lethal AC line voltage when AC power is connected. Pressing "STOP" pushbutton does not remove AC line voltage. All phases must be disconnected before it is safe to touch motor terminals or control equipment parts.*

*Never connect power capacitors on the load side of a solid state starter. Refer to factory wiring diagrams or consult factory before connecting power factor capacitors in circuit. Capacitors connected on the load side of the solid state starter can cause severe damage to the SCRs.*

# 1. DESCRIPTION

## 1.1. OVERVIEW

RAM's PPS EZ Solid State Reduced Voltage Starters contain 6 SCRs (Solid State Rectifiers), electronically controlling the current supplied to an AC induction motor. The SCRs are connected in 3 back to back pairs, phase controlled over 180 degrees of each cycle of power line frequency by a phase locked loop digital firing circuit. This unique circuit continuously synchronizes to any frequency variations and requires no customer adjustment.

The PPS EZ starters can be programmed to provide a gradual build up of torque from zero to almost full motor locked rotor torque, since a motor's torque varies as the square of the applied current. This method provides a gentle, jolt free method of starting for any AC induction motor. In addition, they can be programmed to limit peak starting currents to a constant low value, and so prevent excessive voltage drops during motor starting.

## 1.2 STANDARD FEATURES

**Universal Source Matching:** The PPS EZ starter automatically adjusts itself to any input voltage and frequency applied between 200V to 600V and from 45HZ to 65HZ, irrespective of phase rotation.

**Closed Loop Starting:** The PPS EZ starts a motor in a continuous controlled current mode, eliminating any motor jerking or hunting that could be experienced in other forms of reduced voltage starting.

**Automatic Bypass:** The PPS EZ starters are complete with a Horsepower Rated Bypass Contactor which is engaged automatically after startup. This reduces power losses and heat build up in the enclosure and can also serve as an emergency starting device.

**Electronic Motor Overload Protection:** The PPS EZ starters are provided as standard with a RAM KL-1 Electronic Motor Protective Module. This microprocessor based device provides excellent motor overload protection and also displays numerous system alarm conditions such as: Locked Rotor, Stall Condition, Jam Detection, Short Circuit, Phase Loss, Phase Unbalance, Phase Reversal, and Thermal Faults. See separate copy of "Operator's Guide and Instructional Manual" for a full explanation of the RAM KL-1 Motor Protector.

**Shorted SCR Protection:** The PPS EZ starter will detect a shorted SCR or a welded contact in the Bypass contactor and in such cases will:

- a. Inhibit Start Sequence
- b. Operate the fault relay when Stop command is initiated

The fault relay contact will remove power by energizing the main circuit breaker shunt trip supplied on this device thus shutting off power to the circuit.

**Multiple LED Diagnostics:** The following LEDs are provided on the Control Card in the EZ Starter.

"LED ON" means a healthy condition.

1. +12VDC Power Supply
2. 3 Phase Present
3. No Shorted SCR
4. Phase Locked Loop
5. Motor Overload
6. Instantaneous Overcurrent
7. Ready
8. Run
9. Starter On

LEDs 1 through 6 must be "On" before the READY LED illuminates. This indicates that the starter is healthy and OK to start. See Troubleshooting Section 5 for LED description.

**Main Circuit Breaker w/Shunt Trip:** The PPS EZ starter is complete with a properly sized Main Circuit Breaker with a 120V Shunt Trip. The Circuit Breaker offers disconnect and short circuit protection.

**Dual Starting Mode:** Dual starting modes provide optimum performance to match the PPS EZ Starter to the motor load characteristics.

- a) **Constant Current Mode:** In this mode, the current during starting is maintained at a factory preset value of 400% FLA (Full Load Motor Amps). This mode is field adjustable from 200-400%. At full speed, the current is determined by the motor load.
- b) **Step Ramp (Current Ramp) Mode:** In this mode, the starter provides an initial current (Factory set at 400%), field adjustable from 200% to 400% of FLA (Full Load Motor Amps). The current is then ramped from its initial current setting to 500% over a time adjustable period between 3 seconds to 30 seconds. (Factory set at 8 seconds). At full speed, current is determined by the motor load.

## 2. SPECIFICATIONS

### 2.1 ELECTRICAL

#### 2.1.1 POWER SUPPLY REQUIRED:

3 Phase, 200V to 600V, 45HZ to 65HZ.

#### 2.1.2 CONTROL POWER:

Single Phase, 115V, 50/60 HZ control power from fused secondary of Control Transformer supplied in PPS EZ starter. Consult Factory for optional ratings.

#### 2.1.3 OPERATOR DEVICES: (Supplied by Customer)

PPS EZ starter is set up to accept starting and run contacts from customer supplied devices such as:

- Start/Stop pushbuttons for 3 wire control
- Run Contact or On/Off Selector Switch for 2 wire control
- Jog Pushbutton
- Fault Interlock or Motor Overtemperature Switch

See RAM wiring diagram for starting details.

#### 2.1.4 OUTPUT CONTACTS: PPS EZ starter is complete with the following Dry Contacts rated at 5A 220VAC.

- Run Contact - 1 Normally Open Contact (not available if 3 wire control is used)
- Fault Contact - 1 N.O./1 N.C. contact

See RAM wiring diagram for contact details.

#### 2.1.5 RATINGS:

TABLE 1

MODEL PPS EZ	AMPS	CONT. MAX HP		
		230V	460V	575V
180	270	100	200	250
240	360	150	300	300
360	540	200	400	500
500	750	300	600	700
800	800	350	700	800

OVERLOAD CAPACITY - 350% FOR 30 SECONDS

#### 2.1.6. PROTECTION PROVIDED IN STARTER:

##### - Short Circuit Protection:

A Thermal Magnetic Circuit Breaker with a 120VAC Shunt Trip is supplied as standard for short-circuit protection and disconnecting means.

##### - Electronic Motor Overload Protection:

The RAM KL-1 Electronic Motor Protector is supplied as standard to provide superior motor protection and to display and monitor key information on motor operating conditions and faults.

##### - Single Phase Protection:

The PPS EZ starter will not operate if single phase is detected before starting. If motor is running under full load when a single phase fault occurs, the EZ starter will trip.

- **Shorted SCR:**

The starter will not operate if an SCR is shorted or the contact of a bypass contactor is welded. If an SCR fails shorted while running, the starter will remain ON until Stop is commanded. At this time, the shorted SCR is detected and the fault relay energizes the shunt trip on the Main Circuit Breaker shutting down the starter.

- **Surge Protection:**

The starter is protected by large MOVs across each pair of SCRs.

- **Heatsink Overtemperature:**

Thermal switches are provided to protect the heatsink assembly from overheating.

- **Fault Relay:**

The Fault Relay will operate if any of the following conditions are detected.

- Instantaneous Overcurrent (IOC)
- Shorted SCR

### 3. RECEIVING AND INSTALLATION

#### 3.1 INSTALLATION:

The enclosure containing the PPS EZ starter must be installed in an area where the following conditions exist:

- Ambient Temperature does not exceed 40 Degrees C (104 Degrees F).
- Ambient Temperature is not less than 10 Degrees C (50 Degrees F).
- Altitude above sea level is 6000 ft (2000 meters) or less.
- Ambient air is reasonably clean, dry, and free of flammable or combustible vapors, steam, or corrosive gases.

The PPS EZ enclosure must be installed away from any heat source and a minimum clearance of 1 ft. (30 cm) is required around the air inlet and outlet louvers on ventilated units. The PPS EZ starter is designed for 40 Degrees C (104 Degrees F) ambient with a 15 Degree C rise inside the enclosure as maximum.

#### 3.2 DERATING FACTOR:

**Warning:** When a PPS EZ starter enclosure is mounted in an environment not in accordance with Paragraph 3.1 as described above, it must be derated as follows:

- Derate starter size 1.5% per Degrees C above 40 Degree C Ambient Temperature or .75% per Degree F above 104 Degree F Ambient Temperature.
- Derate starter size 1% for every 100m above 1000m or every 300 ft. above 6000 ft. elevation.

#### 3.3 WIRING:

The PPS EZ starter is to be wired in accordance with the National Electrical Code and other Electrical Codes in customer's area.

### 4. START UP INSTRUCTIONS

**CAUTION!**

*Equipment is at possibly lethal AC line voltage when AC power is connected. Pressing "STOP" pushbutton does not remove AC line voltage. All phases must be disconnected by shutting down main power feed to this unit before it is safe to touch motor terminals or control equipment parts.*

#### 4.1 INSPECTION

Ensure that the starter has been installed according to the preceding guidelines. Ensure that the unit has been wired according to the schematics and all electrical codes. Check that all connections are tight. Check that the motor shaft rotates freely.

#### 4.2 PRESTART ADJUSTMENTS - CURRENT LIMIT (STANDARD SETTING)

Each RAM solid state starter is preset at the factory to operate in the “Current Limit” (Constant Current) mode. In this operating mode, the starting torque of this device has been preset to that of an autotransformer type starter with taps set at 65%. The “Current Limit” mode is recommended for light and moderate inertial type loads. This method limits the maximum initial current to 400% and sets the maximum % of LR Torque to approximately 42%. **See Chart A below** for Maximum % Locked Rotor Torque developed in Current Limit mode and its capability to start RAM Standard High Efficient motors. **See Chart B below** for Maximum % locked Rotor Torque developed in Current Limit mode and its capability to start RAM “Premium Efficient” motors. At rated horsepower, the Current Limit mode is capable of smoothly starting most loads without making any adjustments.

**CHART A**

PPS EZ STARTING DUTY - SET FOR "LIGHT DUTY" CURRENT LIMIT (CONSTANT CURRENT) MODE - 400% CURRENT LIMIT FOR RAM STANDARD EFFICIENT MOTORS						
HP RATING 460V	CATALOG NUMBER	RAM STANDARD EFFICIENT FLA	RAM STANDARD EFFICIENT LRA	CURRENT SETTING (SW1)	ACCEL. AMPS	MAX % LOCKED ROTOR TORQUE
200	EZ6180	228	1316	E	904	47%
250	EZ6240	285	1800	B	1152	41%
300	EZ6240	340	2200	F	1440	43%
350	EZ6360	390	2550	A	1620	40%
400	EZ6360	445	2900	D	1944	45%
450	EZ6500	505	3200	9	2100	43%
500	EZ6500	560	3570	A	2248	40%
600	EZ6500	665	4070	D	2700	44%
700	EZ6800	760	4500	E	3040	46%

**CHART B**

EZ STARTING DUTY - SET FOR "LIGHT DUTY" CURRENT LIMIT (CONSTANT CURRENT) MODE - 400% CURRENT LIMIT FOR RAM PREMIUM EFFICIENT MOTORS						
HP RATING 460V	CATALOG NUMBER	RAM PREMIUM EFFICIENT FLA	RAM PREMIUM EFFICIENT LRA	CURRENT SETTING (SW1)	ACCEL. AMPS	MAX % LOCKED ROTOR TORQUE
200	EZ6180	225	1450	F	952	43%
250	EZ6240	280	1825	C	1224	45%
300	EZ6240	330	2200	F	1440	43%
350	EZ6360	382	2550	B	1728	46%
400	EZ6360	430	2900	D	1944	45%
450	EZ6500	480	3220	9	2100	43%
500	EZ6500	528	3600	B	2400	44%
600	EZ6500	640	4535	F	3000	44%
700	EZ6800	760	4500	E	3040	46%

#### 4.2 PRESTART ADJUSTMENTS - STEP RAMP (OPTIONAL SETTING)

On heavy inertia and friction type loads, an alternate method of operating this starter at its rated horsepower can be accomplished by making one simple link movement causing controller to operate in the “Step Ramp” (Current Ramp) mode (see Section 4.2.2) and, in some cases, as noted in Chart C & D, by adjusting SW1. In the Step Ramp mode, the initial current is set at 400% and then ramped to a maximum of 500%. The “Step Ramp” mode significantly increases the maximum % of locked rotor current. **See Chart C below** for Maximum % Locked Rotor Torque developed in this mode and its ability to start RAM Standard High Efficient motors. **See Chart D below** for Maximum % Locked Rotor Torque developed in Step Ramp mode and its capability to start RAM “Premium Efficient” motors.

**CHART C**

PPS EZ STARTING DUTY - SET FOR "LIGHT DUTY" STEP RAMP (CURRENT RAMP) MODE - 500% CURRENT RAMP FOR RAM STANDARD EFFICIENT MOTORS						
HP RATING 460V	CATALOG NUMBER	RAM STANDARD EFFICIENT FLA	RAM STANDARD EFFICIENT LRA	CURRENT SETTING (SW1)	ACCEL. AMPS	MAX % LOCKED ROTOR TORQUE
200	EZ6180	228	1316	E	1130	74%
250	EZ6240	285	1800	B	1440	64%
300	EZ6240	340	2200	F	1800	67%
350	EZ6360	390	2550	A	2025	63%
400	EZ6360	445	2900	D	2430	70%
450	EZ6500	505	3200	9	2625	67%
500	EZ6500	560	3570	A	2810	62%
600	EZ6500	665	4070	D	3375	69%
700	EZ6800	760	4500	E	3800	71%

**CHART D**

PPS EZ STARTING DUTY - SET FOR "LIGHT DUTY" STEP RAMP (CURRENT RAMP) MODE - 500% CURRENT RAMP FOR RAM PREMIUM EFFICIENT MOTORS						
HP RATING 460V	CATALOG NUMBER	RAM PREMIUM EFFICIENT FLA	RAM PREMIUM EFFICIENT LRA	CURRENT SETTING (SW1)	ACCEL. AMPS	MAX % LOCKED ROTOR TORQUE
200	EZ6180	225	1450	F	1190	67%
250	EZ6240	280	1825	C	1530	70%
300	EZ6240	330	2200	F	1800	67%
350	EZ6360	382	2550	B	2160	72%
400	EZ6360	430	2900	D	2430	70%
450	EZ6500	480	3220	9	2625	66%
500	EZ6500	528	3600	B	3000	69%
600	EZ6500	640	4535	F	3750	68%
700	EZ6800	760	4500	E	3800	71%

#### 4.2.1. STARTER DUTY

Starter is set at "Light Duty" by means of P6 link on the controller card AA1021. *This setting must not be changed as it will reduce the maximum current rating that can be achieved by this controller by 50% when controller starter duty is changed to "Heavy Duty".*

#### 4.2.2 STARTING MODE

Starter is factory set for "Step Ramp." If less starting torque is required, the starting mode can be changed by one simple action of moving the "Link" on P7 located on Controller Card AA1021 in the drive from "Step Ramp" to "Constant Current" (see diagram).

#### 4.2.3 CALIBRATION CURRENT SETPOINT

Switch S1 on the High Voltage Card AA1022 has been factory set for the current rating indicated on the drawings or tables listed above.

#### 4.2.4 CURRENT STEP

Factory set for 400% initial current. This switch is adjustable from 200-400% for smooth acceleration.

#### 4.2.5 RAMP TIME

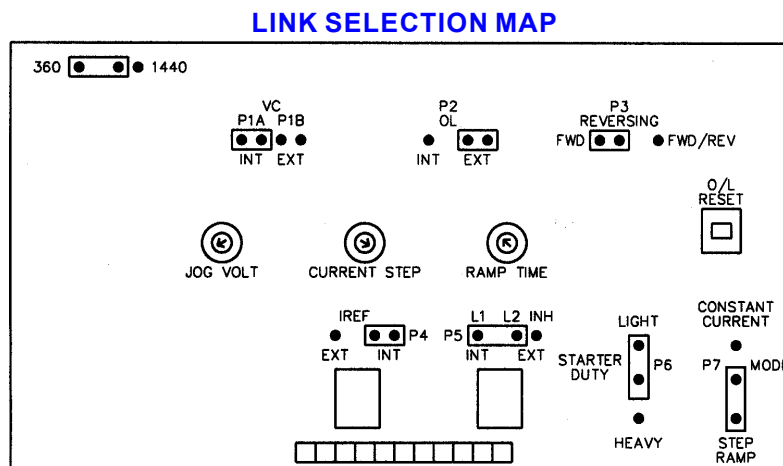
Factory set for 8 seconds. The ramp time is adjustable from 3-30 seconds.

#### 4.2.6 LINK SELECTION

The PPS EZ controller card, AA1021, has 7 programmable links built in. These links must be set as noted in Table 2 below. When option cards are used, refer to the card instruction sheet for proper selection.

LINK	POSITION	FUNCTION
VC	INT	Phase Angle Control (VC)
P2	EXT	Overload (External)
P3	FWD	Forward Only
P4	INT	I Reference
P5	INT	L2 L3 Inhibit
P6	LIGHT	Light Duty
P7	STEP RAMP	Step Ramp Mode

Location of the (7) removable links on the Controller Card, AA1021, are shown on the following LINK SELECTION MAP. Also shown in the top left hand corner of this map is another link which should be set to the 360HZ position. The link settings as shown are factory set. All changes in link selections must be done before power is applied to controller.



### 4.3 START-UP

When starting the PPS EZ unit, it is recommended that a clamp-on AC Ammeter be used to continuously monitor the motor current during the start-up procedure. A Voltmeter placed across the starter output is also desirable.

#### 4.3.1 POWER UP

Once the prestart adjustments have been checked and correctly set up, it is ready for power up.

Check that all personnel are clear of the starter and motor, then apply power.

After power is applied, all LEDs in the AA1021 card must be "ON", except "RUN", "STARTER ON", and "MOTOR O/L" lights. If they are not, refer to Section 5 - Troubleshooting.

#### 4.3.2 STARTING

To start the unit, energize the "Compressor Start" relay CR-1 and determine if the motor accelerates smoothly to full speed. If the motor does not accelerate, confirm all adjustments and make sure the compressor is starting unloaded. If necessary, increase the motor load pot (SW1) one position to increase the starting current.

**CAUTION: DO NOT ALLOW THE MOTOR TO STALL. IF THE MOTOR FAILS TO ACCELERATE, SHUT DOWN POWER TO THE "START" CONTACTOR IMMEDIATELY.**

For remotely located motor, it will be necessary to have another person stand by the motor to communicate motor rotation during initial Start Up.

With the clamp-on Ammeter, check that all three line currents are balanced.

#### 4.3.3 RE-ADJUSTMENT

After the motor has been started, fine adjustment might be required. It is a good practice to set the starter to reach full speed in the minimum time permissible without causing any appreciable power dip or excessive mechanical stress. The longest acceleration time is not necessarily the best setting.

#### 4.3.4 JOG SETTING

If you desire to use the "JOG" function, set the "JOG VOLTAGE" pot at minimum. Insert "JOG" pushbutton in circuit and press button, then increase jog voltage until the motor rotates and release "JOG" button. Jog Voltage must be increased to permit the motor to rotate under the heaviest of circumstances.

## 5. TROUBLESHOOTING

### **CAUTION!**

*Equipment is at possible lethal AC line voltage when AC power is connected. Pressing "STOP" pushbutton does not remove AC line voltage. All phases must be disconnected by shutting down main power feed to this unit before it is safe to touch motor terminals or control equipment parts.*

### 5.1 DIAGNOSTICS

The PPS EZ has been designed with extensive LED indication for quick diagnostics. The controller card contains the LEDs listed hereafter. They are visible from the front of the controller. In all cases, LED "ON" means a healthy condition.

#### 5.1.1 +12V LED

This LED indicates the status of the internal +12V power supply required by the electronic circuitry. It is "ON" when 115VAC control voltage is present. All other LEDs will be "OFF" if this LED is "OFF". If +12V LED is "OFF", check the 115VAC supply across L1-L2 on the terminal block. If OK, check the fuse F1 on the controller card. If fuse is OK, then replace this card.

### 5.1.2 3 PH. PRESENT LED

LED will be "ON" when the three phase power supply is present. If this LED is "OFF", then look at the LEDs on the high voltage card, AA1022, to find which line is missing. There are three LEDs: 01, 02, and 03 on the high voltage card. These LEDs must be "ON" when the phase power is present. The LED "OFF" indicates which line is missing.

### 5.1.3 NO SHORTED SCR LED

LED will be "ON" as soon as power is applied. If this LED is "OFF", then look at the high voltage card to find which SCR is shorted. The same LEDs as discussed above indicate which SCR pair is shorted, 01, 02, or 03. These LEDs will also be "OFF" when the starter output is open. The output will be open if the motor is not connected or if a contactor is open between the starter and motor. A shorted SCR fault will cause the fault relay to trip, or if present before starting, will prevent the PPS EZ from being started.

### 5.1.4 NO MOTOR OVERLOAD LED

LED will be "OFF" as soon as power is applied, as this function has been disabled by selecting "EXT/OL" on link P2. The RAM KL-1 motor protector module serves as the motor overload protection for this starter. This LED can therefore be "OFF" when external overload is used and it will have no effect on the starter's operation.

### 5.1.5 PLL LOCK LED (PHASE LOCKED LOOP)

LED must be "ON" when three phase is present. This LED indicates the status of the phase locked loop circuitry which synchronizes the starter with the AC supply. If a PLL fault is present, LED "OFF", the starter will not run.

### 5.1.6. IOC LED

The IOC (Instantaneous Overcurrent) LED must be "ON" when control voltage is present. If an IOC fault occurs, the LED will stay "OFF" until the O/L RESET pushbutton in the main board is reset. If an IOC fault is indicated before starting, check the C/T connections on the high voltage card and ensure that the connector to the C/Ts is securely plugged in. If this fault occurs after the start command, then look for a short circuit across the starter output terminals. This fault will trip the Fault Relay.

### 5.1.7. READY LED

This LED will be "ON" when:

- All of the above LEDs are OK
- Any Option Cards which are used are fault free, and
- Heatsink O/T switch is closed (normal)

### 5.1.8. RUN LED

"ON" when the starter is in "RUN" condition.

### 5.1.4. STARTER ON LED

This LED will be "ON" when the starter is in "RUN" of "JOG" mode.

