POWEREFFICIENCY
CORPORATION

E-SAVE TECHNOLOGY

USER MANUAL

Single Phase Motor Efficiency Controller

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1. General Information

1.1. Important User Information

Due to the vast applications that this equipment can be used, it is the user's responsibility for the application and use of this control equipment. The user should validate that the equipment meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

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1.2. Safety Guidelines

To avoid an electric shock hazard, verify that all power sources have been disconnected and that no voltage exists on the motor terminals.

When the POWER LED is off, this is not an indication that capacitors have discharged to safe voltage levels.

Only qualified personnel familiar with solid state devices and associated machinery should perform installation, commissioning and maintenance. Failure to comply may result in personal injury and/or equipment damage.

Do not install power factor correction capacitors between the product and the motor.

This product contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing or servicing.

2. Product Overview

2.1. Description

The Motor Efficiency Controller is a solid state motor controller that is designed to dynamically optimize the efficiency of a single phase AC electric motor. In constant speed variable load applications, the patented E-Save Technology® provides precisely the right amount of power to meet the demands of your application. In numerous tests, performed by independent third parties, the Motor Efficiency Controller has proven to save up to 60% of the energy normally used in appropriate applications.

The Motor Efficiency Controller integrates soft start functionality to provide a smooth acceleration of the motor to normal operating speed.

Since the Motor Efficiency Controller provides only the voltage and current required for the application, it reduces the operating temperature of the motor, thereby extending its useful life. Another benefit of the soft start functionality is reduced stresses on the mechanical system which reduces costly maintenance expenses.

The Motor Efficiency Controller Evaluation Module was developed for the design engineer to experiment on specific applications that use constant speed AC motors. Just like the standard Motor Efficiency Controller, the Evaluation Module is setup for out-of-the box installation and operation. However, the Evaluation Module provides additional components that allow the design engineer to fine tune the controller to a specific application and/or motor.

2.2. Operation

2.2.1. Timed Soft Start

The Motor Efficiency Controller provides a timed soft start to the motor. During the soft start the output voltage to the motor is gradually increased until it reaches full voltage. (See Figure 1.) The start time is user adjustable via the ADJUSTMENT potentiometer. See Section 4.1 for more details on adjusting the soft start time. After the motor reaches full speed, the Motor Efficiency Controller will sense the load of the motor and will then go into energy savings mode if appropriate. The factory default setting for the soft start time is 3 seconds.

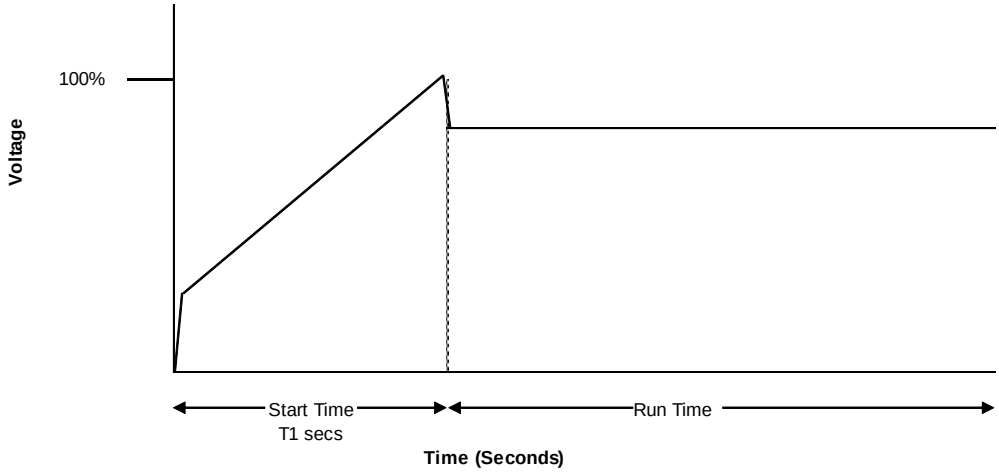

Figure 1 – Timed Soft Start

2.2.2. Energy Savings

The Motor Efficiency Controller provides energy savings when it detects the motor typically has a load of less than 80%. When the controller is in energy savings mode, the E-SAVE LED will be lit red and the controller will reduce the voltage and current to the motor. Energy savings will increase as the motor load decreases and savings can reach up to 60% when a motor has no load. When the motor load is typically higher than 80% the motor is running very efficiently and the controller may not be able to reduce the current and voltage to the motor. In this case, the E-SAVE LED will turn off and the controller will exit energy savings mode.

The default energy savings algorithm should provide energy savings for all motors when they are lightly loaded. However, it is possible to increase energy savings with certain motors and /or applications. With the Motor Efficiency Controller Evaluation Module the amount of energy savings is user adjustable via the ADJUSTMENT potentiometer. See Section 4.1 for more details on adjusting the amount of energy savings.

3. Wiring and Installation

3.1. Receiving, Inspecting and Storing

Thoroughly inspect the controller before accepting the shipment. If any items are damaged, it is the user's responsibility to not accept delivery until the freight agent has noted the damage on the freight bill. Should the user discover any concealed damage during unpacking, it is the responsibility of the user to notify the freight agent of the damage.

The controller should remain in its shipping packaging prior to installation or use and stored in a dry and clean location with an ambient temperature range of –20°C to +70°C (–4°F to +158°F).

3.2. Mounting

The Motor Efficiency Controller Evaluation Module is attached to a heat sink that that is used to dissipate the heat generated by the controller. If the Motor Efficiency Controller Evaluation Module is mounted such that it is unable to dissipate heat, it may not function properly. The controller should be mounted vertically and in a position that allows air to flow from the bottom to the top of the heatsink. If the controller is mounted horizontally, other methods of cooling the heatsink maybe required. A fan with greater than 5 CFM is recommended for use when the product is mounted horizontally.

WARNING: The metal heatsink, or surface that the Motor Efficient Controller Evaluation Module is mounted on, can become hot. The user should mount the product in such a way to reduce the risk of harmful burns from personnel that may come in contact with the heatsink.

3.3. Power Wiring and Installation

Incoming single phase power connections are made to terminals L1 and L2. Load connections to the motor are made to terminals T1 and T2. See Figure 2 for a typical wiring diagram. The Motor Efficiency Controller power wiring locations are shown below in Figure 3.

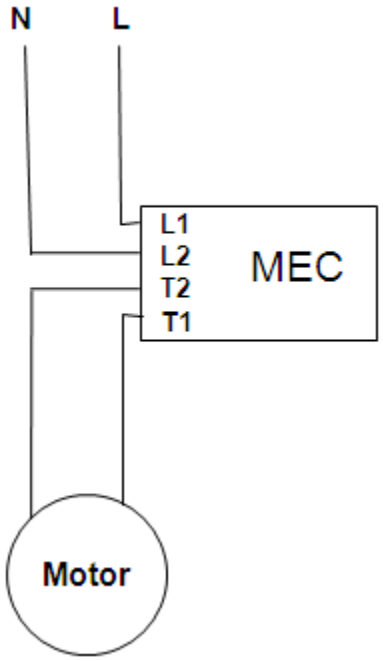

Figure 2 – Wiring Diagram

WARNING: Only one motor should be connected to the Motor Efficiency Controller Evaluation Module. Connecting more than one motor may damage the module and will cause unpredictable results.

The Motor Efficiency Controller will function on motors with or without start or run capacitors, but to achieve maximum savings, the location of installation is important. For optimal energy savings, connect the Motor Efficiency Controller as the last component before the motor windings. If the motor design is such that it is not possible or physically practical to connect the device on the motor side of any capacitors, it can be placed on the line side of any capacitors. However, the resulting energy savings will not be as much as could be achieved were the Motor Efficiency Controller installed downstream of any capacitors.

4. Programming

4.1. Settings

The Motor Efficiency Controller Evaluation Module has a push button (labeled MODE) and a potentiometer (labeled ADJUSTMENT) that are used to setup the functionality of the controller. See Figure 3 below.

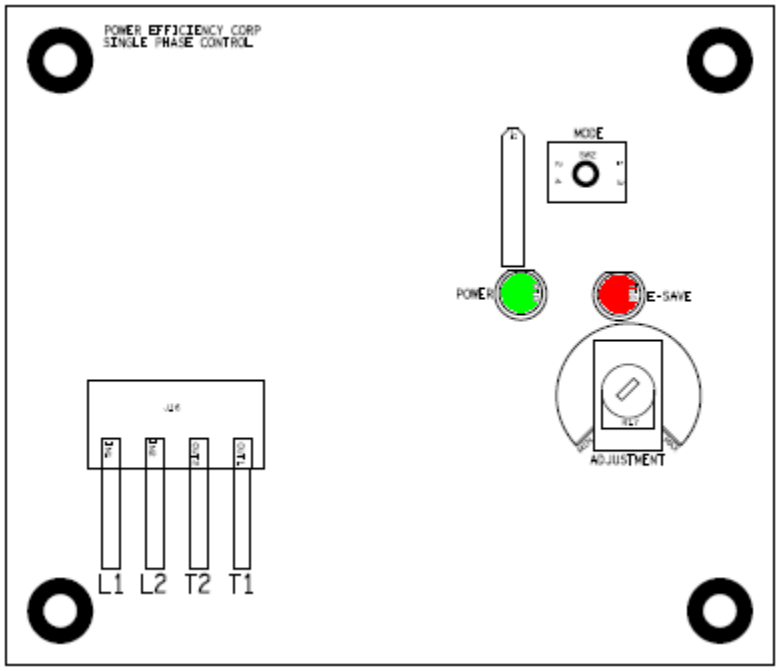

Figure 3 – Power wiring, Settings and LED's

The soft start time and amount of energy savings are configurable with the MODE button and ADJUSTMENT potentiometer. By default the controller is in RUN mode when power is applied to the Motor Efficiency Controller Evaluation Module. In this mode the controller will soft start the motor and then go into energy savings when appropriate. When the Motor Efficiency Controller Evaluation Module is in RUN mode, the Power LED will be lit green and any changes to the ADJUSTMENT potentiometer will have no effect on the Motor Efficiency Controller Evaluation Module. To exit RUN mode and adjust the behavior of the controller, the user must press the MODE button.

From RUN mode, hold the MODE button down for two seconds and then release it. The Motor Efficiency Controller Evaluation Module will exit RUN mode and enter SOFT START ADJUSTMENT mode. When in SOFT START ADJUSTMENT mode the green POWER LED will flash in one second intervals.

The ramp time of the soft start will be modified according to the position of the ADJUSTMENT potentiometer. When the ADJUSTMENT potentiometer is turned fully

counter-clockwise the Motor Efficiency Controller Evaluation Module will start at full voltage (no soft start). By turning the ADJUSTMENT potentiometer fully clockwise the Motor Efficiency Controller Evaluation Module will SOFT start at a three second ramp time. All other values are distributed evenly between the minimum and maximum location of the ADJUSTMENT potentiometer.

Once the soft start time is set, hold the MODE button for two seconds to get back to RUN mode. The POWER LED should be lit green to indicate that the Motor Efficiency Controller Evaluation Module is now in RUN mode.

From RUN mode, hold the MODE button down for four seconds and then release it. The Motor Efficiency Controller Evaluation Module will exit RUN mode and enter ENERGY SAVINGS ADJUSTMENT mode. When in ENERGY SAVINGS ADJUSTMENT mode the green POWER LED will flash twice in one second and then off for one second, and repeat.

The aggressiveness of the savings algorithm can be adjusted to the needs of a given motor. For steady state loads the algorithm can often operate much more aggressively and achieve greater energy savings. It is possible to set to potentiometer for overly aggressive control of a given motor application, so it is best to adjust this with the motor attached and running at the application's maximum load to achieve maximum energy savings.

The aggressiveness of the savings algorithm will be modified according to the setting of the ADJUSTMENT potentiometer. Fully counter clock wise will disable energy savings and run the motor at full voltage. Begin with the potentiometer in this position and slowly turn the potentiometer clockwise while monitoring the current the motor is drawing. The current should drop slowly as the potentiometer is adjusted clockwise. Once the current stops dropping stop turning the ADJUSTMENT potentiometer as the Motor Efficiency Controller Evaluation Module could increase energy consumption or stall the motor.

After the Energy Savings adjustment setting is completed, hold the MODE button for two seconds to get back to RUN mode. The POWER LED should be lit green to indicate that the Motor Efficiency Controller Evaluation Module is now in RUN mode.

4.2. Status Indicators

The Motor Efficiency Controller Evaluation Module provides two LED status indicators to provide the user with the status of the controller. The location of these status indicators is shown in Figure 3.

4.2.1. POWER LED

The POWER LED is green and is the labeled POWER on the PCB. This LED will be solid green when power is supplied to the controller and will be off when the Motor Efficiency Controller Evaluation Module has no power being supplied.

WARNING: Do not use the POWER LED as an indication of no voltage present in the device. Before performing any maintenance on the Motor Efficiency Controller Evaluation Module, make sure all power sources are disconnected or off.

4.2.2. E-SAVE LED

The energy savings LED is Red and is labeled E-SAVE on the PCB. This LED will be solid Red when the controller is in energy savings mode and will be off when the controller is running across the line. The controller will be in energy savings mode when the motor is approximately 80% loaded or less. Generally, when a motor is running at over 80% load the motor runs very efficiently and the controller may not be able to reduce energy consumption. However, single phase motors can vary significantly and it is possible to save small amounts of energy on some motors while running at full load.

5. Start Up and Troubleshooting

Startup Checklist

- Verify Incoming Power connections are securely connected.
- Verify Motor connections are securely connected.
- Verify incoming and motor ground connections are securely connected.
- Apply power and start motor to verify motor is turning in the correct direction and operates properly.

For the safety of all maintenance personnel, please follow the local safety related work practices (for example, the NFPA 70E, Part II in the United States). Maintenance personnel must be trained in the safety practices, procedures, and requirements that pertain to solid state motor controllers.

Symptoms:

Power LED is not Green

- Check for open line and verify Voltage at L1 and L2
- Check wiring
- Contact Technical Support

Motor will not start

- Check motor wiring at T1 and T2
- Verify motor or equipment is not jammed

Motor stops

- Check control and power wiring
- Verify energy savings and soft start settings

Motor doesn’t reach full speed within soft start time

- The time it takes for the motor to come up to speed may be more or less than the time programmed, depending on the size of the connected load. Therefore, the soft start time may need to be increased.

6. Specifications

6.1. Electrical

Power Circuit	
Rated Operational Voltage	100V – 240V (+/- 5%)
Rated Insulation Voltage	300V
Rate Operational Current	11A
Rated Motor Size	½ Hp (0.37 kW) @ 110V 1 Hp (0.75 kW) @ 230V
AC Operating Frequency	50 / 60 Hz
Protection	IP 00
Wire Size	
L1, L2, T1, T2	26 AWG to 12 AWG / 0.1 mm^2 to 3.3mm^2
Torque	
L1, L2, T1, T2	4.5 lb-in / 0.5 N-m

6.2. Environmental

Operating Temperature	0 to 40^{o} C / 32 to 104^{o} F
Storage Temperature	-20 to 70 ^{o} C / -4 to 158^{o} F