Robertshaw CONTROLS COMPANY
Uni-Line North America A SIEBE COMPANY

Control Tips

June 1996

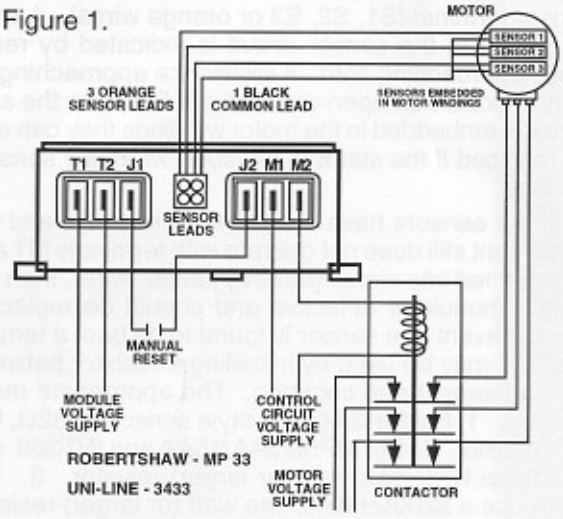
SOLID-STATE MOTOR PROTECTORS

Basic Motor Protection

Solid state sensor-style Motor Protectors provide protection against high motor temperatures resulting from locked rotor, loss of charge, or motor overload.

Sensor-style motor protectors have been produced by Robertshaw Controls Company since the early 1960s and have included the MP13, MP23, and the current generation MP33(3433) and MC20(3420) series. These units utilize an "**RTD**" (**resistance temperature detector**) sensor which senses temperatures from 50 to 310°F and produce a linear resistance from approximately 70 Ohms to 126 Ohms. (Figure 1.)

Figure 1.



Robertshaw MP50(3450); Texas Instrument 3AA, 15AA, and 31AA; and Kriwan INT369 units all utilize **"PTC" (positive temperature coefficient)** sensors. The control module resistance trip (cut-out) is 13K ohms and the resistance reset (cut-in) is 3.25K ohms for PTC units. (Figures 2 and 3.)

RTD and PTC modules and sensors cannot be interchanged.

The appropriate RTD or PTC sensors are mounted internally in the windings of the motor. They are not field replaceable or serviceable. The characteristics of the sensors is such that a change in temperature causes a change in the sensor's electrical resistance. The relation between temperature and resistance remains stable and exact, so that calibration of the protection system can be made on the basis of resistance readings.

The control module is a sealed enclosure containing a relay or triac, transformer, and several electronic components. Leads from the internal motor sensors are connected to the module as shown on the wiring diagrams. While the exact internal circuitry is quite complicated, basically the module senses the change in resistance of the sensors. As the motor temperature rises or falls, the resistance also rises and falls, triggering the action of the control circuit at predetermined opening and closing settings.

All of the control modules are built for specific AC power voltage applications. (i.e. 24V, 120V, or 208/240V) except the Klixon® 31AA which will accept either 120V or 208/240V.

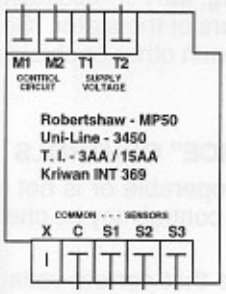


Figure 2.

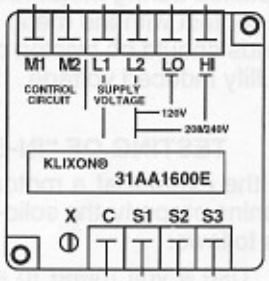


Figure 3.

A combination of low voltage sensing and time delay built into the MP50 (3450)/3AA/15AA and 31AA modules provides for additional protection against low voltage conditions which can occur in the event of a single phase condition on a three phase circuit, or due to low voltage ("brown-out") conditions. The module locks the compressor off the line until the voltage rises to the cut-in level.

The time delay provides a two minute delay before restarting each time the power circuit is opened, providing protections against "blips" in the power supply or a chatter condition in the line power circuit.

Service personnel must be alert to the time delay since it is possible in checking the compressor or system, power may be applied, disconnected, and reapplied in less than two minutes. In such case, the time delay feature will prevent operation until the time delay has expired, and this may be misinterpreted by service personnel as a module malfunction.

To aid in checking the system, these units have a shortened "X" terminal which may be jumpered momentarily to common (C), to reduce the time delay from 2 minutes to 50 milliseconds.

For operation and testing purposes, some versions of the Robertshaw MP33(3433) and MC20(3420) modules have terminals J1 and J2 which may be wired for remote, manual reset.

If the system design is such that the operating controls are wired to the module power circuit, the time delay will provide two minute short cycle protection.

If the system refrigerant charge is small enough so that a pump down control circuit is not required, the control devices may be mounted in the line circuit. This provides the maximum electrical protection against short cycling or contactor chattering.

With larger refrigerant charges a pump down system is essential to protect the compressor against liquid refrigerant. Typically the liquid line solenoid is wired through the protector to prevent refrigerant migration in the event of a protector trip. This application uses an oil pressure control with a control switch isolated from its control circuit power connections.

Schematics for these applications are available through compressor manufacturers and distributors.

TEST PRECAUTIONS

WARNING: All tests should be done by qualified A/C service technicians, as improper wiring could result in damage to equipment and/or personal injury due to the presence of high voltages.

MODULE: Do not short across the terminals as the control module may be damaged. No attempt should be made to adjust or repair the control module

SENSORS: Do not use more than 6 volts or a battery powered test light to check sensors. USE AN OHMMETER ONLY. Where sensors are being replaced or installed during motor rewinding, they should never be in contact with the metal dividers of the stator. Sensor leads should be twisted over each other or shielded to nullify induced voltage.

TESTING OF "IN-SERVICE" CONTROLS

In the event that a motor is inoperable or is not functioning properly, the solid-state control may be checked as follows:

1. Use a volt meter to assure that correct voltage is being supplied to the module. Set meter to module supply voltage (24V, 120V, or 208/240V) and probe terminals T1 and T2 on MP33/MP50 style modules, and L1 and L2 (Lo or Hi) on 31AA modules. (Refer to figures below).

2. Turn off all electrical power to the equipment and allow equipment to cool.

3. Wire the control circuit supply voltage (using jumper wires) so that it bypasses the load or control circuit terminals (M1, M2) on the module.

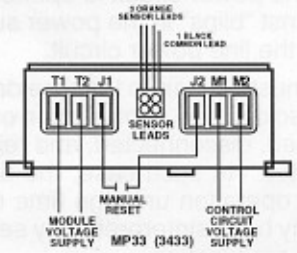
4. Turn electrical power back on.

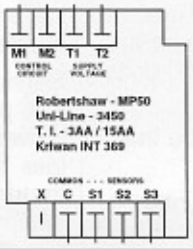
5. If the equipment will not operate, the module is not the problem. If the motor operates with the supply voltage bypassing the load terminals, but will not operate if this bypassed connection is removed, then the module's circuit is open or the external control circuit fuses are open. Replace control circuit fuses and recheck. If the module still remains open, check the sensors. (Step 6.)

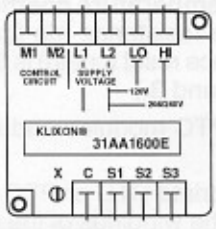
6. Temperature sensors may be checked by taking a resistance reading though them. (See Test Precautions before proceeding.) With ohmmeter set, probe at the sensor common (terminal C or black wire) and each sensor terminal (S1, S2, S3 or orange wires). A short or ground in the sensor circuit is indicated by resistance approaching zero. A resistance approaching infinity indicates an open connection. Because the sensors are embedded in the motor windings they can only be replaced if the stator is rewound with new sensors in place.

7. If the sensors have the proper resistance and the equipment still does not operate with terminals M1 and M2 restored into circuit (remove jumper wire), then the control module is defective and should be replaced.

• In the event one sensor is found to be bad, a temporary "fix" may be used by installing a resistor between the bad sensor and common. The appropriate resistors are: 1. For MP33 (RTD) style sensor an 82Ω, two watt resistor. 2. For MP50/3AA/15AA and INT369 use a 2700Ω±10%, one watt (or larger) resistor. 3. For 31AA use a 2200Ω±10%, one watt (or larger) resistor. This "fix" should only be used for one sensor, and is not considered a permanent repair to the system.







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