

Version .99 ( Rev E )



# KL SERIES

## Microprocessor Based Motor Protection Modules



## Operator's Guide & Instruction Manual

# **RAM** INDUSTRIES INCORPORATED

## RAM STANDARD WARRANTY POLICY

### STANDARD WARRANTY

The Company warrants that all products or parts sold by it to the purchaser will be free from defects in materials and workmanship under normal and proper usage. THIS STANDARD WARRANTY SHALL EXPIRE EIGHTEEN (18) MONTHS FOLLOWING THE DATE OF SHIPMENT OF SUCH PRODUCTS OR PARTS TO THE PURCHASER OR TWELVE (12) MONTHS AFTER SUCH PARTS OR PRODUCTS ARE FIRST PLACED IN OPERATION, WHICHEVER PERIOD SHALL FIRST EXPIRE. The Company shall, at its option, repair or replace, F.O.B. point of shipment any such product or part which is defective within the terms of the foregoing warranty, provided such products and parts have at all times been operated or used under normal operating conditions for which they were designed. THE COMPANY HEREBY DISCLAIMS ALL OTHER EXPRESSED OR IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION ON ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE PERTAINING TO ANY SUCH PRODUCTS OR PARTS. THE FOREGOING OBLIGATION TO REPAIR OR REPLACE SUCH PRODUCTS OR PARTS SHALL BE THE SOLE AND EXCLUSIVE REMEDY OF THE PURCHASER, ITS CUSTOMERS, OR USERS OF THE PRODUCTS OR PARTS. THE COMPANY SHALL HAVE NO OBLIGATION TO REPAIR OR REPLACE SUCH PRODUCTS OR PARTS UNLESS IT RECEIVES AT ITS OFFICES AT LEESPORT, PENNSYLVANIA, WRITTEN NOTICE OF SUCH DEFECT WITHIN THE ABOVE MENTIONED WARRANTY PERIOD.

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- (a) proper storage, installation, use and maintenance, and conformance with any applicable recommendations of RAM and,
- (b) buyer promptly notifying RAM of any defects and promptly making the product available for correction.

Please contact RAM Industries, Inc., for a detailed description of the RAM warranty policy on your specific product order.

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# THE KL SERIES OF MOTOR PROTECTION DEVICES

The KL-1 is a self-contained, microprocessor-based controller which accepts three-phase current inputs and three-phase voltage inputs. Based on these input signals and user presets, the module generates a unique model of operating limits for the motor it is protecting and also records the operating history of the motor. This information can be valuable for trouble-shooting and maintenance purposes.

Because of its ability to continuously monitor current conditions seen by the motor, it is able to measure the thermal capacity of the motor during starting and running. With the inclusion of a real time clock, it computes changes in the thermal capacity even while the motor is not running, and shows time remaining before successive starts can be attempted.

With its non-volatile memory, it can report a number of fault and alarm conditions. These conditions are displayed by nine separate LEDs mounted on the KL-1 base unit. The actual trip and alarm levels can be displayed as messages through the use of the separate KL-4 display modules.

The KL-4 control display units are equipped with a 2 line x 20 character back-lit liquid crystal display and four operating buttons. These units enable the user to view the operating conditions of the motor, view fault history, and edit several system set-up and set-point parameters.

The KL-4 is an external door mounted unit which permits the user to view and edit pertinent motor and operating data when the KL-1 is mounted inside a control panel. It is connected to the KL-1 through the use of DB9 auxiliary cable connection.

When applied to a reduced voltage type controller, the KL-1 module can be used to provide dynamic transition from start to run. This can be based on a change in accelerating current levels, or set to make the transition based on an internal timer. This eliminates the need for separate timing relays inside the controller.

Heavy duty form C contacts are available on the base module to provide control and alarm indications. A 4-20ma output signal is available for remote indication of motor load, or to serve as a control input to other processors.

# OPERATIONAL SPECIFICATIONS

## KL-1 BASE UNIT

- n Microprocessor controlled system
- n A/D converter for analog interfacing
- n Non-volatile memory for data retention (10,000 read/write cycles, indefinite retention)
- n 1 fault reset push button
- n 3 current transformer inputs
- n 3 voltage inputs
- n 1 serial port
- n 3 form C relay outputs 10 Amps at 120 VAC
  - GRN - OK
  - YEL - RUN
  - RED - ALARM
- n 1 remote reset switch input
- n 110V AC power input at 0.1 amperes
- n ALARM/TRIPLE LEDs (Large 5mm LED)
  - GRN - RUN
  - RED - OVERLOAD
  - RED - JAM
  - RED - SHORTCIRCUIT
  - RED - PHASE LOSS
  - RED - PHASE UNBALANCE
  - RED - PHASE REVERSAL
  - RED - THERMAL OVERLOAD
- n 4-20 mA output
  - proportional to current drawn by motor
  - proportional to thermal capacity of the motor
- n Overload history storage
  - last trip recording

## KL-4 DISPLAY UNIT

- n Microprocessor controlled system
- n 20 character by 2 line liquid crystal display
- n 1 enter push button
- n 1 up push button
- n 1 down push button
- n 1 select push button
- n 1 serial port
- n 12V DC power input @ 0.2 amperes

## GENERAL SPECIFICATIONS

### POWER REQUIREMENTS

- 120 VAC (+/- 15%) at 7.5 VA with Display unit attached. 6 VA without Display unit.
- 45 to 60 Hertz

### TEMPERATURE

- 0 to 40 degrees C operating
- -20 to 70 degrees C storage

### CONTROL CONTACT RATINGS

- 10 Amps at 120 VAC Resistive
- 1/3 HP at 120 VAC

### CURRENT INPUT

- 5 Amps RMS Nominal

### HIGH VOLTAGE INPUT

- 600 VAC RMS Maximum
- 90 VAC RMS Minimum
- 200 Kohms Loading

# KL-1 BASE UNIT

## INTRODUCTION

This guide provides a basic description of the installation and operation of the KL-1 base unit.

## INSTALLATION

The KL-1 is designed to be mounted inside an enclosure that will provide protection from dust and moisture. Mounting tabs are provided on the top and bottom of the KL-1 for easy installation. Control wiring should be routed to maximize isolation from high-voltage current carrying wires.

External current transformers must be supplied to monitor the current consumed by the motor, which is being protected by the KL-1. These CTs must be selected so that the ratio provides an output as close to five amps as possible when the motor is running at its full load amp (FLA) rating.

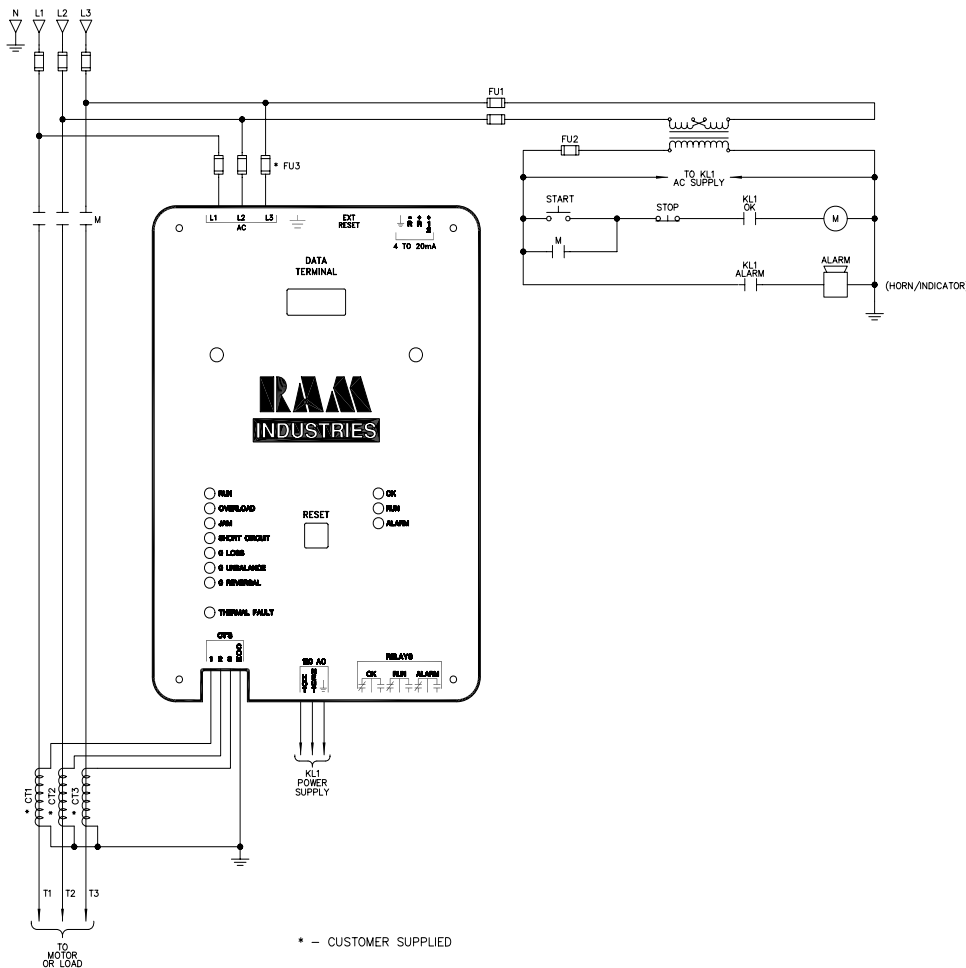
In order to meet UL and CSA requirements, the enclosure and control circuitry must also be UL and CSA recognized.

It is recommended that the entire manual is read and understood before the unit is operated to ensure correct operation. Failure to do so may cause damage to the motor or starter.

## CONNECTIONS

The connections to the KL-1 are furnished with removable terminal blocks that will accept up to a single 12 gauge wire. When using stranded wire, be sure that all of the strands enter the wire openings to avoid electrical shorts and possible damage.

**NOTE:** The CT connector is not removeable on the latest revision KL-1.



***For Quick Installation follow the bold italicized steps below (steps 6 & 7 are optional)***

## **120 AC INPUT**

**Step 1. Connect the control power to the 120 VAC input.**

This connection is the KL-1 power input and will accept 102-138VAC, 50-60Hz. It must be connected as shown with the hot and neutral in the correct locations. The ground connection should be tied to the chassis. This is required to allow the unit to operate.

## **AC INPUTS**

**Step 2. Connect the 3 phase power leads to the AC inputs of the KL-1. Be sure to connect the power leads in the correct order (L1-L2-L3). The KL-1 unit will not operate correctly if the phase sequence is incorrect, a phase reversal trip will occur. See trip conditions on page 14 to resolve this problem.**

This is the 3 phase high voltage input and will accept up to 600VAC, 50-60Hz. This isolated input is phase sensitive and must have the same phase relationship as the CT inputs.

## **CT INPUTS**

**Step 3. Connect the CT outputs to the CT inputs of the KL-1. Inputs 1,2 and 3 should be connected to the outputs of the corresponding external CT's. The common outputs of the CT's should all be connected to the COM input.**

These are the current transformer inputs.

The CT input connector is equipped with a safety jumper in the last two positions (unmarked) to protect the external CTs from being open circuited when the motor is running.

**The KL-1 will not allow the motor to start if this jumper and connector are not installed.  
CT ERR message will be displayed.**

**NOTE:** This only applies to older revision KL-1 with removeable CT connector.

## **RELAY OUTPUTS**

**Step 4. If the unit is being used as a starter control, wire the control circuitry to the relay as required.**

Three form C control output relays are available to provide control switching. These contacts are rated for 10 amps at 120VAC.

### **CONTROL RELAY OPERATION**

The OK relay is intended to enable the motor to be started and to shut it down in the event of a fault. The relay will be energized when the high voltage AC inputs are in the correct phase rotation. In the READY mode, this output will remain enabled until a trip condition occurs. In the RUN mode, the relay will remain enabled until a trip condition occurs.

The RUN relay is intended to initiate the transition sequence for a reduced voltage starter, enable the bypass for a solid state starter, or enable the load after the motor is up to speed. This relay operation does not depend on the motor start/stop circuit, but instead is based on load current. In a normal start sequence, the motor current will initially rise to a level between 100% and 600% FLA for the time required to accelerate the motor. As the motor approaches full speed, the average current will drop below the TRANSITION LEVEL, causing the RUN relay to be energized. A transition timer is initiated when the motor starting current is detected. In the event that the current does not drop below the TRANSITION LEVEL, the RUN relay will force a transition when the timer reaches the TRANSITION TIME. If the starting current does not exceed the TRANSITION LEVEL, the relay will be enabled immediately. It will remain energized until a trip condition occurs or the average current drops below 5% FLA.

The ALARM relay is intended to activate an alarm or emergency stop such as a shunt trip on the main circuit breaker. This relay is energized when an alarm condition or trip condition has occurred. The Alarm can be acknowledged by pressing the Reset button on the KL-1 or the Enter key on the KL-4. If the Alarm condition still exists after it is acknowledged, the ALARM relay will remain enabled until the Alarm condition goes away.

## EXT RESET - REMOTE INPUT SETUP

**Step 5. Wire the EXT RESET control circuitry to the connections as required for your desired usage.**

This input is intended to be used with a DRY CONTACT ONLY. It can be programmed to be used in one of three ways.

RESET - Remote fault reset

TRIP - Shunt trip for use in a cascaded system

TRANS - Incomplete transition sequence - used to sense if the transition does not complete properly due to mechanical failure. It will expect an open condition within one second of the transition.

## 4 TO 20mA OUTPUT

**Step 6.\* Connect this output to the appropriate external device as desired.**

This output provides a 4-20mA signal to be used by a panel meter, PLC, etc. It can be programmed to represent Thermal Capacity or Current.

## DATA TERMINAL

**Step 7. Connect this output to the connection cable of the KL-4.**

This port provides the connection to the KL-4.

**Step 8. Turn on the control power and check that the unit is working correctly.**

***When the KL-1 is initially powered, the fault indicators may rapidly "count" or flash for up to 20 seconds. This sequence indicates that the present thermal capacity is being updated for the time that the KL-1 was not powered.***

**Step 9. If the motor parameters and starter configuration are not programmed into the unit, this must be done from the set-point and system set-up menus on the KL-4.**

***RAM custom programs the motor parameters and starter configuration to customer specifications before shipment.***

**Step 10. If the unit does not work as expected, refer to the troubleshooting section of this manual.**

## INDICATORS/PUSH BUTTON

### RELAY INDICATORS

The relay indicators, located on the right side of the KL-1, provide a visual status of the control relays.

If the indicator is on, the relay is energized.

OK - green LED - Energized in "Ready" and "Running" mode

RUN - yellow LED - Energized in "Running" mode

ALARM - red LED - Energized in "Alarm" or "Trip" condition

Refer to CONTROL RELAY OPERATION for further information.

### RUN INDICATOR

The Run indicator, located on the left side of the KL-1, shows the unit status at all times.

OFF - "Not Ready" or "Trip"

BLINKING - "Ready" - 1 sec. on, 1 sec. off

- "Starting" - 1/2 sec. on, 1/2 sec. off

ON STEADY - "Running"

## LED CONDITION TABLE

	LEDS		RELAYS		
	RUN	FAULT	OK	RUN	ALARM
POWER ON	OFF	1-2-3	OFF	OFF	OFF
HIGH VOLTAGE NOT PRESENT	OFF	OFF	OFF	OFF	OFF
HIGH VOLTAGE OK (READY)	1 Sec	OFF	ON	OFF	OFF
MOTOR STARTING	1/2 Sec	OFF	ON	OFF	OFF
MOTOR RUN AFTER TRANSITION	ON	OFF	ON	ON	OFF
ALARM UNACKNOWLEDGED	N/A	1/2 Sec	N/A	N/A	ON
ALARM ACKNOWLEDGED	N/A	1 Sec	N/A	N/A	ON
TRIP	OFF	ON	OFF	OFF	ON

OFF = LED is OFF

1-2-3 = FAULT LEDES COUNTING

ON = LED is ON

1/2 Sec = LED is BLINKING 1/2 Sec ON/OFF

1 Sec = LED is BLINKING 1 Sec ON/OFF

### FAULT INDICATORS

The fault indicators, located on the left side of the KL-1, show an alarm or fault condition.

- OFF - No fault or alarm
- BLINKING - Acknowledged alarm - 1 sec. on, 1 sec. off
- BLINKING - Unacknowledged alarm - 1/2 sec on, 1/2 sec off
- STEADY ON - Alarm or Fault condition

The Alarm/Fault conditions represented by the fault indicators are listed below.

- OVERLOAD** - I<sup>2</sup>T
- STALL
- ULTIMATE I
- INSTANTANEOUS I
- UNDERLOAD
- TRANS TIMEOUT
- TRANS SEQ INCOMPLETE
- REMOTE INPUT TRIP

**JAM** - JAM

**SHORT CIRCUIT** - SHORT CIRCUIT

**PHASE LOSS** - PHASE LOSS

**PHASE UNBALANCE** - PHASE (CURRENT) UNBALANCE

**PHASE REVERSAL** - PHASE REVERSAL

**THERMAL FAULT** - THERMAL CONDITION

Refer to ALARM/TRIP CONDITIONS for further information.

**When power is removed from the KL-1, pressing the RESET button on the front panel will light the fault indicator that caused the trip. When power is applied, the fault can be cleared by pressing the RESET button.**

**When the KL-1 is initially powered, the fault indicators may rapidly "count" or flash for up to 20 seconds. This sequence indicates that the present thermal capacity is being updated for the time that the KL-1 was not powered.**

## ALARM CONDITIONS

(These are fault conditions that will cause an alarm)

**I<sup>2</sup>T** - I<sup>2</sup>T ALARM LEVEL has been exceeded.

- The I<sup>2</sup>T level represents the percentage of the thermal capacity that has been consumed. This level is computed using the current squared multiplied by the time that the current level exists. The current used in this calculation is the highest of the three phases. The thermal capacity is dependent on the LOCKED ROTOR CURRENT, STALL TIME of the motor, FLA setting, and the ULTIMATE TRIP I setting. This value can be programmed from 60 to 100% of thermal capacity.

\* Remember - The motor starting current consumes a large portion of thermal capacity. Repetitive starts in a short time span can exhaust the thermal capacity.

**PHASE UNBALANCE** - Current Unbalance has remained above the PHASE UNBALANCE ALARM LEVEL until the PHASE UNBALANCE RUN DELAY has expired.

- The PHASE UNBALANCE level determines the percentage of current unbalance which is allowed between phases. This value can be programmed from 2 to 25% of FLA. The run delay determines how long the unbalance condition must exist before an alarm will occur. This time can be programmed from 0 to 240 seconds.

## TRIP CONDITIONS

(These are fault conditions that will cause a trip)

**STALL** - Current has remained above LOCKED ROTOR CURRENT until the STALL TIME has expired.

- The STALL time is specified by the motor manufacturer. This is the amount of time the motor can be at the locked rotor current and not cause damage to the motor.

**ULTIMATE I** - Thermal capacity has exceeded 100%.

- This value is calculated similarly to the I<sup>2</sup>T alarm value, however, ULTIMATE I is a trip condition. As in the I<sup>2</sup>T, the thermal capacity level is dependent on the LOCKED ROTOR CURRENT, STALL TIME of the motor, FLA setting, and the ULTIMATE TRIP I setting. This level is programmed as a percentage of the FLA current and can be set from 75 to 125%.

**CAUTION** - When LRC/I<sup>2</sup>T TRIP RESET is set to AUTO, motor will restart after the Thermal Capacity has decreased enough to allow for a start.

**INSTANTANEOUS I** - Current has remained above the INSTANTANEOUS I until the INSTANTANEOUS DELAY has expired.

- The INSTANTANEOUS I trip level represents the percentage of FLA that any one phase of the current is allowed to reach. If the instantaneous current exceeds this value for the INSTANTANEOUS DELAY time, this trip will occur. The trip level can be programmed from 300 to 1200% of FLA. The instantaneous current delay allows the initial inrush current to be disregarded as the power is being applied to the motor. This time range can be set from 1 to 20 cycles.

**JAM** - Current has remained above the JAM TRIP LEVEL until the JAM START DELAY has expired while in STARTING mode or until the JAM RUN DELAY has expired while in RUNNING mode.

- The JAM trip is similar to the INSTANTANEOUS I trip, however, it is set at a lower percentage of FLA, and it has two different delay times - a start delay and a run delay. The JAM trip level can be programmed from 100 to 900% of FLA. The Jam Start Delay determines the length of time during a start that the current must be above the jam trip level for a jam trip to occur. That value can be programmed from 1 to 60 seconds. The Jam Run Delay determines the length of time during the motor run condition that the current must be above the jam trip level to cause a jam trip. This value can be programmed from 0 to 240 seconds.

**UNDERLOAD** - Average current has remained below the UNDERLOAD TRIP LEVEL until the UNDERLOAD RUN DELAY has expired.

- This value determines the current level which indicates an underload situation on the motor. The value is programmable from 0 to 90% of the FLA value. The Underload Run Delay set the time which the motor is allowed to run before an underload trip occurs. The motor must be out of the start sequence before this trip can occur. The value can be programmed from 1 to 25 seconds.

**TRANS TIMEOUT** - TRIP\TRAN ON TIMEOUT is set to TRIP and average current has remained above the TRANSITION LEVEL until the TRANSITION TIME has expired.

- The TRANS TIMEOUT trip can be set to one of two options which will determine what the response of the unit will be when the transition time has expired. During a normal start, the motor current will initially rise to a level between 100% and 600% FLA for the time required to accelerate the motor. As the motor approaches full speed, the average current should drop below the TRANSITION LEVEL, causing the RUN relay to be energized. In the event that the current does not drop below the TRANSITION LEVEL before the transition time-out has expired, the protection device can be programmed to cause the transition relay (RUN) to energize, or it can cause the unit to trip.

**PHASE LOSS** - Loss of current in one of the motor leads has been detected.

**PHASE REVERSAL** - Incorrect phase rotation has been detected on the High Voltage input.

**TRANS SEQ INCOMPLETE** - REMOTE INPUT is set to TRANS and the EXT RESET input has been shorted for more than 1 second after the unit has entered the RUNNING mode.

**REMOTE INPUT TRIP** - REMOTE INPUT is set to TRIP and the EXT RESET input has been shorted.

## **SHORT CIRCUIT OPERATION**

(Operating mode is changeable in the System Setup Menu)

- **SHORT CKT TRIP ENABLE** - set to Enab

If, at any time, the motor current exceeds the level set by the INSTANTANEOUS I setpoint (300-1200%) for the time limited by the INSTANTANEOUS DELAY setpoint (1-20 cycles), the unit will trip immediately, and indicate an INSTANTANEOUS I fault.

- **SHORT CKT TRIP ENABLE** - set to OFF

If, at any time, the motor current exceeds the levels set by the INSTANTANEOUS I and INSTANTANEOUS DELAY, the KL module will continue to follow the thermal trip curve and not trip. This allows sufficient time for upstream protective devices to open, preventing excessive damage to the power contactors.

# KL-4 DISPLAY UNIT

## INTRODUCTION

This guide provides a reference for operating the KL-4 display unit when it is connected to a KL-1 base unit. The KL-4 allows an operator to view the KL-1 operating status and history. It also provides the ability to view and edit operating set points and system configuration.

The KL-4 is a door-mounted display unit which allows the user to program and collect data as well as view the continuous monitoring of the base unit while the panel door is closed. The KL-4 has an alarm LED to the right side of the programming buttons which shows the state of the alarm relay.

## DISPLAY

The KL-4 is equipped with a 20 character x 2 line Liquid Crystal Display with backlight. The display shows the current menu selection, operating mode, associated value, and unit of measurement.

## ALARM

The KL-4 is equipped with an alarm that will beep at a one second rate when an unacknowledged alarm condition exists.

## PROGRAMMING

The four keys found on the front of the KL-4 are used to move through the menu selections, edit set point values, and clear alarms or trips.

Programming changes cannot be made while the motor is running.

**ENTER** - The Enter key is used to enter the EDIT mode when SET POINT or SYSTEM SETUP menu items are displayed. It is also used to clear alarm and trip conditions while in the MONITOR menu.

**UP/DOWN** - The Up and Down keys are used to open the selected menu and scroll through the menu parameters. They are also used to increment or decrement parameter values while in the EDIT mode.

**SELECT** - The Select key is used to select the menu to be viewed. It will also abort an attempted edit if pressed while in the EDIT mode.

## OPERATING MODE

The operating mode indicates the status of the KL-1. This can be viewed in the bottom left corner of the KL-4 display window while in the MONITOR menu.

**READY** - The high voltage is in the proper phase sequence.  
\* OK relay will be energized.

**NOT READY** - The motor is not ready to start because the high voltage is not in proper phase rotation or no three phase voltage is present.

**CT ERR** - The CT connector is removed or the safety jumper is not installed.

**NOTE:** This only applies to older revision KL-1 with removeable CT connector.

**STARTING** - Motor starting current has been detected but the unit has not entered the RUNNING mode.  
\* OK relay will be energized.

**RUNNING** - The average current has decreased to the TRANSITION LEVEL or TRIP/TRAN ON TIMEOUT is set to TRAN and the average current has remained above the TRANSITION LEVEL until the TRANSITION TIME has expired. Unit will remain in RUNNING mode until the average current has dropped below 5% FLA or a TRIP has occurred.  
\* OK and RUN relay will be energized.

**THERMAL** - The motor has exceeded its thermal capacity and will not be allowed to start until enough time has elapsed to allow the motor to cool. The time before another start will be allowed can be viewed in the Monitor Menu under TIME TILL START.  
\*Thermal Fault LED will be lit.

**TRIP** - An unacknowledged fault condition exists. This will be cleared when the trip is acknowledged.

## EDIT MODE

If SET POINT SECURITY is set to OFF, the Edit mode is entered when the ENTER key is pressed while SET POINT or SYSTEM SETUP menu items are displayed. If SET POINT SECURITY is set to ENAB, pressing the ENTER key will result in an ENTER SECURITY CODE prompt. The Security Code can be selected by using the UP/DOWN keys. The ENTER key must then be pressed to accept the selected code. If an incorrect code is entered, the previously selected menu item will be restored.

When the Edit mode is entered, the word "Edit" will be flashing in the lower left corner of the display. The selected value can be changed by pressing the UP/DOWN keys. When the desired value is displayed, the ENTER key must be pressed to accept the new value. If the SELECT key is pressed or there is no key activity for 30 seconds while in the Edit mode, the previously selected menu item will be restored.

A Security Code can be entered by selecting SET POINT SECURITY in the system set-up menu and pressing the ENTER key. Select a value between 1 and 999 using the UP/DOWN keys and store the value by pressing the ENTER key. To clear security code, select CLEAR SECURITY code in system set-up menu, select 123 using the UP/DOWN keys and press ENTER.

The EDIT mode can not be entered while unit is in RUNNING mode.

## 4-20mA CALIBRATION

External devices can be calibrated to match the KL-1 4-20mA output. If 4 TO 20mA SOURCE is set to CALIB in the system set-up menu, this output will generate 4mA. If the RESET button is pressed, 20mA will be produced.

## MENU SELECTIONS

KL-4 menu selections are listed below.

<b>MONITOR MENU</b>	<b>Units</b>	<b>Description</b>
AVERAGE CURRENT	Amps	<ul style="list-style-type: none"><li>The current measured by the three current inputs averaged together and displayed as an rms value.</li></ul>
ELAPSED RUN TIME	Mins	<ul style="list-style-type: none"><li>The time that has expired since the unit has entered the run mode.</li></ul>
TIME TILL START	Mins	<ul style="list-style-type: none"><li>The time remaining before the thermal capacity drops low enough for the motor to be allowed to start.</li></ul>
OPERATING FREQUENCY	Hz	<ul style="list-style-type: none"><li>The frequency which the motor protection device senses at the voltage inputs.</li></ul>
CURRENT PHASE A	Amps	<ul style="list-style-type: none"><li>The "live" current reading for phase A.</li></ul>
CURRENT PHASE B	Amps	<ul style="list-style-type: none"><li>The "live" current reading for phase B.</li></ul>
CURRENT PHASE C	Amps	<ul style="list-style-type: none"><li>The "live" current reading for phase C.</li></ul>
THERM CAPACITY USED	%CAP	<ul style="list-style-type: none"><li>The calculated thermal capacity used by the motor.</li></ul>
ALARM - ENTER = ACK		
TRIP - ENTER = CLEAR		

## SET POINT MENU

	Units	Range	Default	Description
FULL LOAD AMPS	Amps	1 - 2000	100	• The motor nameplate current.
LOCKED ROTOR CURRENT	%FLA	300 - 1200	600	• The motor manufacturer's specified current draw for a stalled motor.
STALL TIME	Secs	1 - 60	10	• Time at which the motor can be at the lock rotor current and not cause damage to the motor.
ULTIMATE TRIP I	%FLA	75 - 125	115	• The motor service factor.
CT RATIO	:5	5 - 2000	300	• Entry for internal calculations. The ratio is entered as XXXX:5.
INSTANTANEOUS I	%FLA	300 - 1200	900	• See TRIP CONDITIONS.
INSTANTANEOUS DELAY	Cycl	1 - 20	15	• Allows the initial inrush current to be disregarded as the power is being applied to the motor.
I <sup>2</sup> T ALARM LEVEL	%CAP	60 - 100	100	• See ALARM CONDITIONS
JAM TRIP LEVEL	%FLA	100 - 900	300	• See TRIP CONDITIONS
JAM START DELAY	Secs	1 - 60	30	• See TRIP CONDITIONS
JAM RUN DELAY	Secs	0 - 240	10	• See TRIP CONDITIONS
UNDERLOAD TRIP LEVEL	%FLA	0 - 90	5	• See TRIP CONDITIONS
UNDERLOAD RUN DELAY	Secs	1 - 25	20	• See TRIP CONDITIONS
PHASE UNB ALARM LEVEL	%FLA	2 - 25	25	• See ALARM CONDITIONS
PHASE UNB RUN DELAY	Secs	0 - 240	5	• See TRIP CONDITIONS
TRANSITION TIME	Secs	0 - 240	10	• See TRIP CONDITIONS
TRANSITION LEVEL	%FLA	50 - 250	100	• See TRIP CONDITIONS

## FAULT HISTORY MENU

	Units	Description
MAXIMUM AVG CURRENT	Amps	• The maximum average RMS current measured by the unit when the unit is in run mode.
TOTAL NO. OF STARTS		• The count of completed starts executed on this unit.
TOTAL RUN TIME	Hrs	• The total motor run time the unit has measured.
LAST RUN TIME	Mins	• The run time in minutes of the last start to stop sequence of the motor.
LAST TRIP CONDITION		• Text message of the last trip condition which the motor protection device signaled.
LAST TRIP CURRENT	Amps	• The average rms current measured when the last trip condition occurred.
OVERLOAD TRIPS		• The number of overload trips.
JAM TRIPS		• The number of jam trips. See ALARM CONDITIONS for more information.
SHORT CIRCUIT TRIPS		• The number of short circuit trips. Caused by the INSTANTANEOUS I TRIP.
PHASE LOSS TRIPS		• The number of phase loss trips. See TRIP CONDITIONS for more information.
UNBALANCE TRIPS		• The number of unbalance trips. See TRIP CONDITIONS for more information.
PHASE REVERSAL TRIPS		• The number of phase reversal trips. See TRIP CONDITIONS for more information.
I <sup>2</sup> T TRIPS		• The number of I <sup>2</sup> T trips. See TRIP CONDITIONS for more information.

To clear fault history, enter SYSTEM SET-UP MENU, select CLEAR FAULT HISTORY, select 13 using the UP/DOWN keys and press ENTER.

## SYSTEM SETUP MENU

	<b>Options</b>	<b>Default</b>
LRC/I <sup>2</sup> T TRIP RESET	Manual - Auto	Manual
TRIP/TRAN ON TIMEOUT	Trip - Trans	Trans
SHORT CKT TRIP ENABL	Off - Enab	Enab
REMOTE INPUT	Reset - Trip - Trans	Trans
4 TO 20 mA SOURCE	Thcap - I - Calib	Thcap
SET POINT SECURITY	Off - Enab (1 - 999)	Off
SOFTWARE VERSION	Displays Software Version	
CLEAR THERMAL CAP*	Select #12	Resets Thermal Overload
CLEAR FAULT HISTORY*	Select #13	
LOAD FACTORY SETUP*	Select #987	Restores Factory Set Points
CLEAR SECURITY	Select #123	

## PARTS LIST

<b>Part#</b>	<b>Description</b>
KL-1-400433	RAM KL-1 Motor Protection Module
RAM-400437-01	RAM KL-4 Door Mount Display
WC-0031 60"	Cable Interface Between KL-1 and KL-4
WC-0032 72"	Cable Interface Between KL-1 and KL-4
CN-0485	Current Transformer Plug Note: Only used on older Revision KL
CN-0487	External Reset Plug
CN-0484	120 Volt AC Plug
CN-0486	Relay Plug
TB-0170	3-Phase Plug
TB-0219	4-20mA Plug

# START-UP PROBLEMS

PROBLEM	PROBABLE CAUSE	SOLUTION
1. OK LED not on. "NOT READY" message displayed in Monitor Mode.	No 3 phase voltage present.  Incorrect phase rotation.	Confirm 3 phase voltage input.  Reverse any 2 phases into high voltage input of KL-1 module.
2. Phase Loss Trip. (Phase loss LED on)	Open input fuse to high voltage terminals of KL module.	Check for 3 phase voltage present at KL module.
3. Phase Reversal Trip. (Phase reversal LED on)	Incorrect phase rotation into KL module.	Reverse any 2 phases into high voltage input of KL module.
4. OK LED not on. "CT ERR" message displayed in Monitor Mode.	Current transformer plug not installed or jumper missing. <b>NOTE:</b> This only applies to older revision KL-1 with removeable CT connector.	Check CT plug for jumper between terminals 7 & 8. Remove and re-insert CT plug to confirm good connection.
5. Controller does not make transition to Run. RUN. LED blinking.	Motor leads not connected to starter.  FLA set point or CT ratio not programmed.  Motor not properly connected.	Connect motor leads. Module must see inrush current to start transition timing.  Confirm proper FLA and CT ratio in SETPOINT menu.  Confirm motor connections.
6. Changing transition time delay has no effect on operation.	Motor is lightly loaded and is making transition based on current curve only.	This is correct operation.
7. Cannot enter EDIT mode to change values.	Unit will not allow changes while motor is running.	Stop motor before editing any value.
8. Ampere readings incorrect.	Incorrect or mismatched CT's installed.  Incorrect CT ratio programmed in KL module.	Confirm CT ratios and proper connection to KL connector.  Change CT ratio programmed in setpoint menu.

# TRIP CONDITIONS

TRIP	PROBABLE CAUSE	SOLUTION
1. Jam Trip	<p>Current remained higher than Jam trip level until delay timed out during starting.</p> <p>Current remained higher than Jam trip level until delay timed out during running.</p>	<p>Confirm Jam Start delay setpoint and increase if required due to long acceleration time.</p> <p>Confirm Jam Run delay setpoint and Jam trip level and check equipment for mechanical problems.</p>
2. Transition Seq. Incomplete Trip. (Overload LED blinking)	<p>Bad auxiliary contact on 1A contactor.</p> <p>Mechanical interlock not functioning properly.</p>	<p>Check operation of 1A contact. Opening must occur in 1 second during transition to run.</p> <p>Check mechanical operation of interlock between power contactor for freedom of movement.</p>
3. Ultimate I Trip (Overload LED blinking, Thermal Fault LED on, KL-4 beeps, and display shows time to restart)	<p>Computed thermal capacity of motor has been exceeded.</p>	<p>Check all setpoints are programmed per supplied data sheet. Confirm that load conditions are not being exceeded.</p>
4. Phase Loss Trip (Phase loss LED on)	<p>Open input fuse to high voltage terminals of KL module.</p>	<p>Check for 3 phase voltage present at KL module.</p>
5. Phase Reversal Trip (Phase reversal LED on)	<p>Incorrect phase rotation into KL module.</p>	<p>Reverse L1 and L2 phases into the high voltage input of KL module, and also reverse the corresponding CT inputs (1 &amp; 2).</p>
6. Thermal Fault Trip (Thermal Fault LED on, display shows time to restart)	<p>Computed thermal capacity remaining is not sufficient to allow the motor to start.</p>	<p>Allow motor to cool.</p>

# TROUBLESHOOTING

Web Revision  
08/04/09

PROBLEM	PROBABLE CAUSE	SOLUTION
1. Abnormal operation after a power failure or lightning.	Software corruption.	Go to System Setup Menu and <u>Load Factory Setup Code #987</u> .  Reload motor parameters under Set Point Menu per motor data sheet.  If problem still exists, contact factory.

# KL-1 LOG

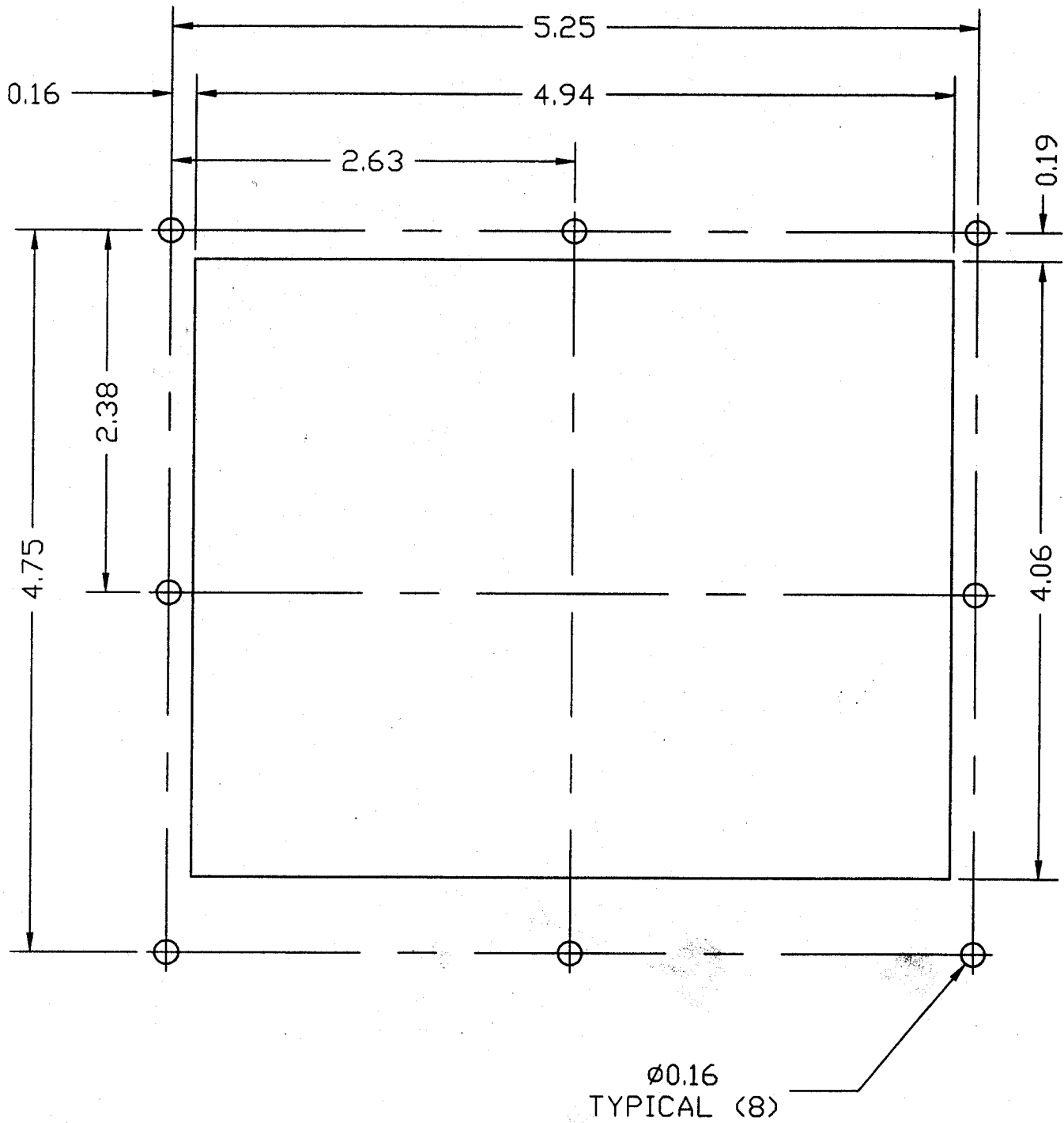
## SET POINT MENU

FULL LOAD AMPS \_\_\_\_\_ Amps  
 LOCKED ROTOR CURRENT \_\_\_\_\_ % FLA  
 STALL TIME \_\_\_\_\_ Specs  
 ULTIMATE TRIP I \_\_\_\_\_ % FLA  
 CTRATIO \_\_\_\_\_ :5  
 INSTANTANEOUS I \_\_\_\_\_ % FLA  
 INSTANTANEOUS DELAY \_\_\_\_\_ Cycl  
 I<sup>2</sup>T ALARM LEVEL \_\_\_\_\_ % CAP  
 JAM TRIP LEVEL \_\_\_\_\_ % FLA  
 JAM START DELAY \_\_\_\_\_ Secs  
 JAM RUN DELAY \_\_\_\_\_ Secs  
 UNDERLOAD TRIP LEVEL \_\_\_\_\_ % FLA  
 UNDERLOAD RUN DELAY \_\_\_\_\_ Secs  
 PHASE UNBALANCE LEVEL \_\_\_\_\_ % FLA  
 PHASE UNB RUN DELAY \_\_\_\_\_ Secs  
 TRANSITION TIME \_\_\_\_\_ Secs  
 TRANSITION LEVEL \_\_\_\_\_ % FLA

## FAULT HISTORY MENU

MAXIMUM AVG CURRENT \_\_\_\_\_ Amps  
 TOTAL NO. OF STARTS \_\_\_\_\_  
 TOTAL RUN TIME \_\_\_\_\_ Hrs  
 LAST RUN TIME \_\_\_\_\_ Mins  
 LAST TRIP CONDITION \_\_\_\_\_  
 LAST TRIP CURRENT \_\_\_\_\_ Amps  
 OVERLOAD TRIPS \_\_\_\_\_  
 JAM TRIPS \_\_\_\_\_  
 SHORT CIRCUIT TRIPS \_\_\_\_\_  
 PHASE LOSS TRIPS \_\_\_\_\_  
 UNBALANCE TRIPS \_\_\_\_\_  
 PHASE REVERSAL TRIPS \_\_\_\_\_  
 I<sup>2</sup>T TRIPS \_\_\_\_\_

# KL-4 CUTOUT TEMPLATE





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