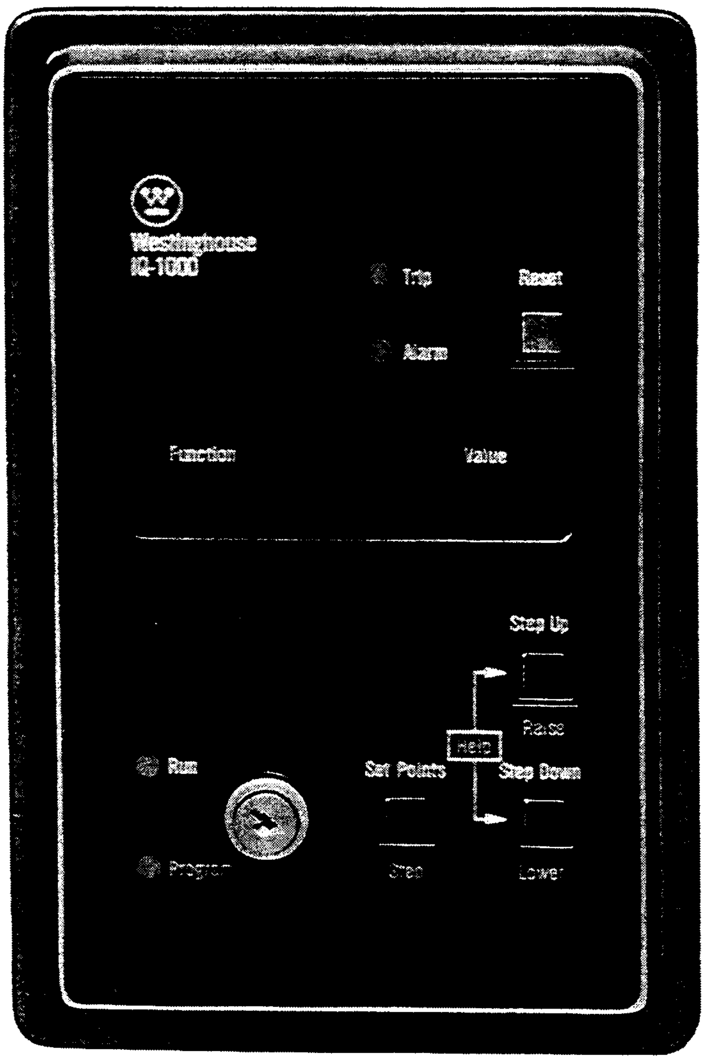
TD 17194

IQ-1000

MOTOR PROTECTION SYSTEM
USER'S MANUAL



Westinghouse

Effective February, 1987

ELECTRICAL COMPONENTS DIVISION

NOTE

All possible contingencies which may arise during installation, operation, or maintenance, and all details and variations of this equipment do not purport to be covered by these instructions. If further information is desired by purchaser regarding his particular installation, operation, or maintenance of his equipment, the local Westinghouse Electric Corporation representative should be contacted.

Effective February, 1987

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Westinghouse Electric Corporation
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Pittsburgh, PA 15220

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Section 1

INTRODUCTION

1.0 General — The IQ-1000™ is a self-contained, door-mounted, motor protection device which may be applied to any 3-phase motor starter or switchgear. This includes low-, medium-, and high-voltage equipment.

The IQ-1000 monitors 3-phase AC motor currents to develop an accurate thermal model of motor heating. An RTD Option, located in a separate enclosure, allows the IQ-1000 to combine the monitored motor stator temperature with the motor current information. The resulting combination of data allows the IQ-1000 to develop an even more accurate picture of the motor's temperature, thereby allowing maximum motor utilization.

The IQ-1000 operates by monitoring motor current, and will take the motor off-line only when it detects a problem such as an overcurrent or overtemperature condition. Having detected that an operating parameter has exceeded its set point value, the IQ-1000 initiates a trip condition.

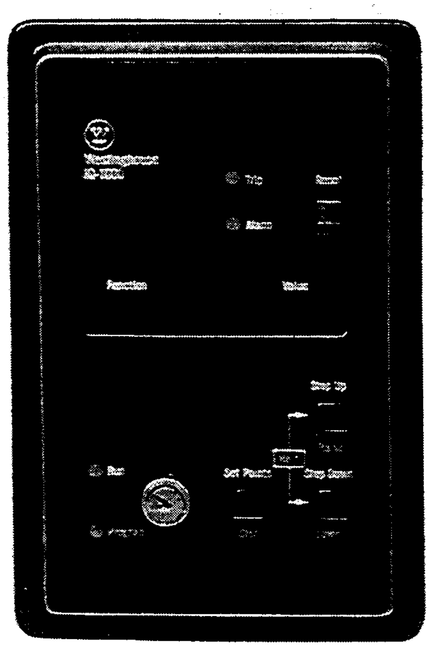


Figure 1.1 — IQ-1000

1.1 Contents/Use of Manual — This Manual contains the following numbered Sections:

1 — **Introduction.**

2 — **Hardware Description.** Itemizes the hardware features and lists the specifications of the IQ-1000.

3 — **Functional Theory.** Describes how the hardware and software function together to control, monitor, and protect the motor.

4 — **Operator Panel.** Describes the uses of the Operator Panel. Various operations such as loading set points or examining metered data are described.

5 — **Installation.** Outlines the installation procedures to be followed by a plant electrician or wiring crew when installing the IQ-1000.

6 — **Startup.** Lists a step-by-step procedure to follow when first applying power to the IQ-1000.

7 — **Application Considerations.** Intended as an aid to the application engineer considering how and when to apply the various features of the IQ-1000. Hardware characteristics as well as set point and control background information are included.

8 — **Programming The IQ-1000 And Set Point Description.** Lists the various application considerations associated with each of the functions of the IQ-1000. Available set point ranges or settings are detailed.

9 — **Troubleshooting.** Provides background information on how to use the Operator Panel to recognize malfunctions. Also, a specific troubleshooting approach is listed.

This Manual is designed for use during installation and troubleshooting and, if necessary, unit replacement for the IQ-1000.

This Manual contains information of specific importance for the user application engineer who is planning the motor control system and who is determining the set point values for the IQ-1000.

The Manual is broad enough in scope to form the basis of new employee familiarization, refresher training sessions, and ongoing maintenance.

It is strongly advised that the application engineer carefully read Chapters 2 thru 8 before beginning the application's Wiring Plan Drawings and Set Point Record Sheet. Installation teams should carefully read all of Chapter 5, Installation, and all previous Chapters, before starting final installation. Maintenance personnel should be familiar with Chapters 2 thru 9 before attempting to service the IQ-1000.

1.2 Product Overview

The IQ-1000 offers 38 operating set points, each referred to as a function. The set points associated with these functions are individually entered through the Operator Panel located on the front of the IQ-1000.

Table 1.A

COMMUNICATION ARRANGEMENTS

Communication to an IBM PC or clone. This Computer acts as the master and can also be used as the interface to other microprocessor based devices.	Using the Westinghouse Local Area Network, INCOM, 2 or more IQ-1000s, (or other IQ products) each with a PONI Communications module, can be connected to a personal computer via a shared non-shielded twisted pair of wire. The personal computer acts as a master. A CONI Communications Card is used in an expansion slot of the personal computer.
Communications via RS232C to other microprocessor based products or phone modems.	Using INCOM, 2 or more IQ-1000s (or other IQ products), each with PONI Communication Module, can be connected to the two wire network to transmit data to a single Translator Module. This module converts INCOM formatted messages to RS232C for use with other RS232C compatible devices.

The entry method is simple. There is no need to learn a specialized language or purchase additional programming equipment.

The functions consist of the following types of entries:

- **Alarm condition settings.** An Alarm Relay closes when various conditions, such as motor currents or temperatures, exceed the selected set points. The alarm serves as an early warning. The motor's operation is not affected.
- **Trip condition settings.** A Trip Relay closes (or opens) when various conditions, such as motor current or temperature, exceed separately selected set points. (The determination of whether the Trip Relay opens or closes when a trip condition occurs is itself a selectable function.)
- **Specific application-related information.** Entries such as the ratio of current transformers or the incoming AC line frequency are required by the IQ-1000 to properly monitor the motor.

Together, the functions tailor the IQ-1000 for each specific application. After entry is completed, the set point values can be examined or modified. The actual values are stored in a non-volatile memory requiring no backup batteries or special power supplies. In instances where a particular function is not required, it can usually be effectively bypassed by entering a specific disable value.

1.3 Options — Options associated with the IQ-1000 consist of external hardware. The following options are available:

- **RTD Option.** The RTD Option is required when resistance temperature devices are used to monitor motor winding, load and motor bearing temperatures.
- **Communications Options.** The Communications Options, listed in Table 1.A, provides motor data/status to a remote device such as a computer.

1.4 External Hardware — The following items are required in addition to the IQ-1000:

- **Current transformers.** Current transformers are used by the IQ-1000 to obtain load current information. Current transformers with 5 amp secondaries and ratios ranging from 2:1 to 800:1 can be used.
- **Ground fault transformer.** A ground fault transformer with a 50/5 ratio can be used with the IQ-1000 in grounded system applications to provide ground fault protection.

1.5 Features and Benefits — A list of features and benefits is contained in Table 1.B.

1.6 Level of Repair — This Manual is written with the assumption that only unit-level troubleshooting will be performed. If the cause of a malfunction is traced to the IQ-1000 unit, it should be replaced with a spare. The malfunctioning IQ-1000 should then be returned to Westinghouse for factory repairs.

1.7 Factory Correspondence — All correspondence with Westinghouse, whether verbal or written, should include the "software version" number. This number appears in the Display Window when the program mode is first entered, or the program menu is first initiated. (This is item 0 in Table 8.B.) The software version number is used by Westinghouse to identify the specific IQ-1000 type being discussed.

Table 1.B

IQ-1000 FEATURES AND BENEFITS

Feature	Benefit
Micro-processor based control	Reliable service without need for numerous discrete components
Panel mounted	Small size allows application to virtually any motor starter or switchgear.
Single model unit	Low inventory of spares Quick interchangeability during maintenance Simplified ordering and installation
Simplified Operator Panel	No elaborate, complex keyboard Functions and diagnostic messages displayed in a readable format
Display window shows a number of diagnostic conditions	Install and maintain without extra or special test equipment
All set point functions available in all units	Allows for widespread standardization of control types regardless of parameters or starter types
Undesired functions are simply programmed out	No extra costs for unwanted features In-field removal of reactivation of functions
Nonvolatile memory	No lost programs or special back-up batteries
Simplified programming	No special language to be learned Set point values easily written with everyday numbers
Set points easily determined	Motor manufacturer's data and a knowledge of the application are sufficient
Auxiliary contacts	Allow for additional process operations beyond the basic motor starting/stopping Allow for external warning devices when approaching set point thresholds
Keylock mode switch	Provides protection against set point tampering while allowing the monitoring of programmed set point values Minimizes shut-downs for noncritical reasons
Communication data port	All metering data, trip data, status annunciation, set points, trip/reset capability, and diagnostic data are optionally available for remote analysis and storage via INCOM — a two-wire, local area network.

Section 2

HARDWARE DESCRIPTION

2.0 General — The purpose of this Section is to familiarize the reader with the IQ-1000 hardware, its nomenclature, and to list the specifications of the unit.

2.1 Hardware Description — The description here is divided into the following areas:

- Operator Panel (Par. 2.1.1)
- Rear access area (Par. 2.1.2)
- Options (Par. 2.1.3)
- Specifications (Par. 2.2)

2.1.1 Operator Panel — The Operator Panel, which is normally accessible from the outside of the enclosure door, provides a means to:

- Monitor the actual metered values on the Display Window. (Figure 4.1 shows the Operator Panel.)
- Enter or modify the IQ-1000's set point values or settings.
- Step through the program or run-monitor menus while running.
- Determine that a trip or alarm condition exists by means of 2 distinct LEDs

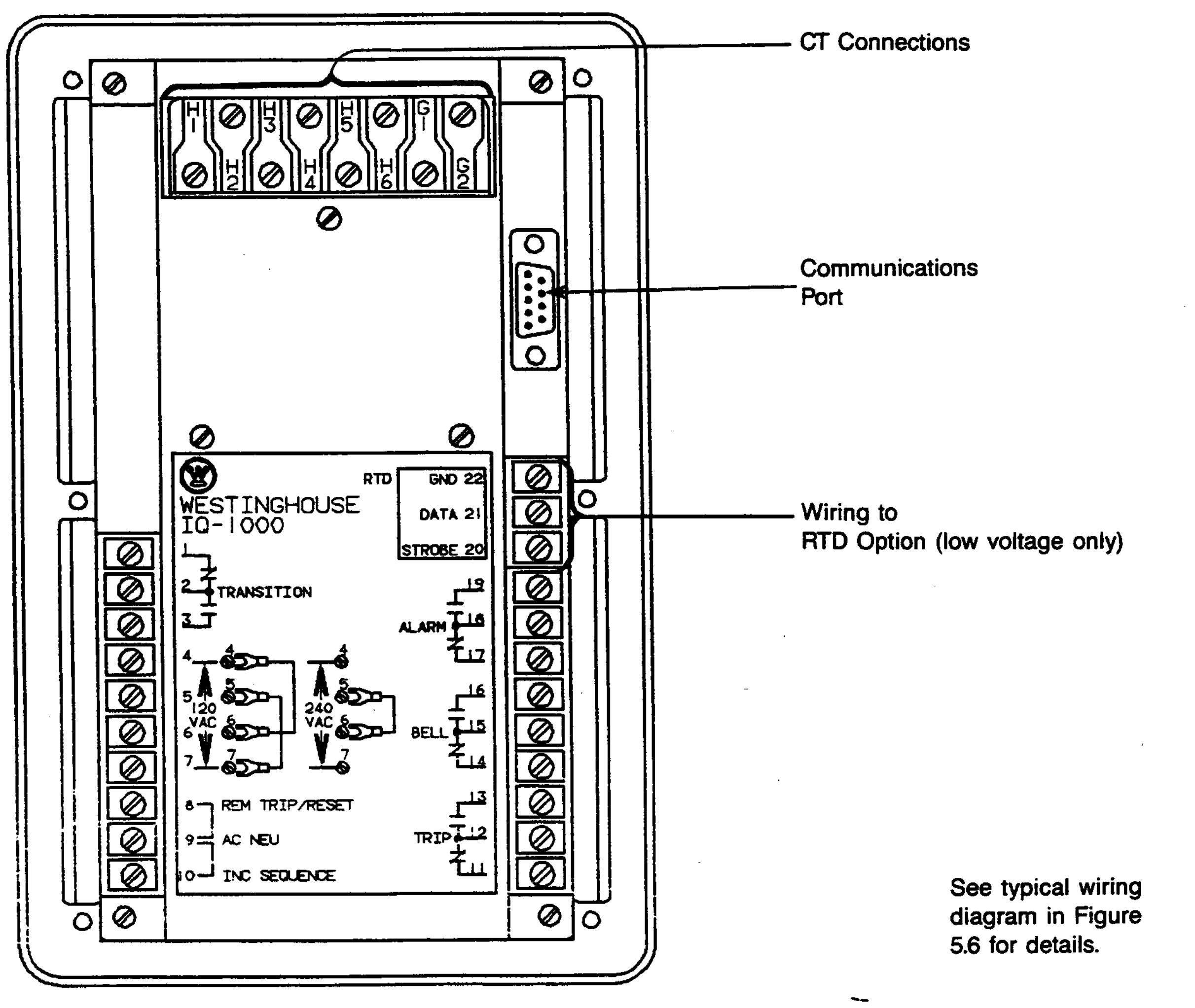


Figure 2.1 — Rear Panel

- Determine the cause of a trip or alarm condition by means of the Display Window. (A description of each trip and alarm condition is given in Section 9.)
- Attempt to reset the unit after a trip or alarm condition has occurred by means of a Reset pushbutton.

The use of the Operator Panel is detailed in Section 4.

2.1.2 Rear Access Area — The rear of the IQ-1000 is normally accessible from the rear of the mounting cabinet's door. (See Figure 2.1.) All wiring connections to the unit are made on the back of the IQ-1000, as follows:

- Terminals 11 thru 22 provide access to the Alarm, Bell, and Trip Relays' contacts, as well as the wiring to the RTD Option. (The Bell Relay energizes whenever the Trip Relay is energized.)
- Terminals 1, 2, and 3 provide access to the Transition Relay's contacts.
- Terminals 4 and 7 receive the incoming AC control voltage.
- Terminals 5 and 6 are jumpered to select 120 VAC or 240 VAC operation.
- Terminal 8 is used with the remote trip/reset function. It is the high side of a user-supplied 120 VAC signal input.
- Terminal 10 is used with the incomplete sequence report back function. It is the high side of a user-supplied input signal.

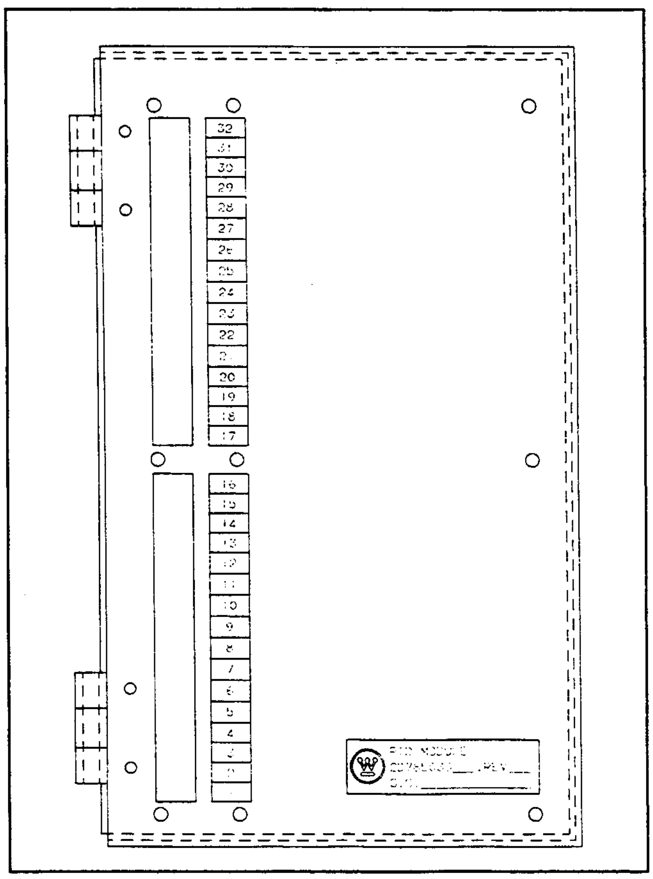


Figure 2.2 — RTD Chassis

Table 2.A

SPECIFICATIONS

Input Supply Requirements

120/240 VAC
(+15%, −30%)

Frequency

50 or 60 Hz
(software selectable)

Power Consumption

IQ-1000 = 6 VA
RTD Option = 6 VA
Com. Card = .08 VA

Output Contact Rating

10 A at 120 VAC Resistive
10 A at 30 VDC Resistive

Current Transformer Burden

0.003 VA

Operating Temperature

0 to 70°C
(32 to 158 F)

Storage Temperature

-20 to 85°C
(-4 to 185°F)

Humidity

0 to 95%
(noncondensing)

IQ-1000 Dimensions

Height = 10.24 in. (26 cm)
Width = 6.75 in. (17.2 cm)
Depth = 2.5 in. (6.4 cm) without Communications option
3.67 in. (9.3 cm) with Communications option

Shipping Weight

7 lbs
(15.4 kg)

- Terminal 9 is the AC neutral, or common, wire associated with terminals 8 and 10.
- The CT terminals connect with the three required, user-provided, external current transformers and, if used, an optional user provided zero sequence ground fault transformer.
- The Communications Port is used with the optional communications card mounted on the back of the IQ-1000.

2.1.3 Options — Two options are available with the IQ-1000:

- RTD Option (Par. 2.1.3.1)
- Communication Option (Par. 2.1.3.2)

2.1.3.1 RTD Option — The RTD Option comes in a separate enclosure. (See Figure 2.2.) The RTDs connect with the large terminal block, as described in Paragraph 5.2. 120 VAC control power must be supplied to RTD module for operation.

2.1.3.2 Communication Option — The Communication Module, or "PONI" Card, consists of a small printed circuit module mounted onto the back of the IQ-1000. This Module is supplied separately.

2.2 Specifications — The specifications for the IQ-1000 are listed in Table 2.A.

Section 3

FUNCTIONAL THEORY

3.0 General — This Section describes how the IQ-1000's hardware and software function together to control, monitor, and protect the motor.

The explanations are divided into the following areas:

- Sensing inputs (Par. 3.1)
- Protective functions (Par. 3.2)
- Metering functions (Par. 3.3)

3.1 Sensing Inputs — The IQ-1000 receives information about motor current levels, and, optionally, may also receive feedback on ground fault current levels and actual motor operating temperature data. (See Figure 3.1.) Motor current is derived from 3 separate current transformers, each of which monitors one phase of an AC line to the motor. If an optional zero sequence ground fault transformer is used, the IQ-1000 can monitor ground fault current levels and compare them with a user-selected set point. If optional RTDs are used, the IQ-1000 can gather winding temperature data from 6 RTDs embedded in the stator windings of the motor. Additionally, 4 RTDs associated with the motor bearings and load bearings can also be monitored for temperature levels.

3.2 Protective Functions — Protective functions monitor motor operating conditions such as current and temperature in an ongoing manner. When these exceed user-selected levels, an alarm condition is first initiated, and then, if necessary, a trip condition occurs. These 2 conditions have the following functions:

- An alarm condition energizes the IQ-1000's internal Alarm Relay.
- A trip condition—other than AC line loss—removes the power from the motor and either energizes or de-energizes the Trip Relay and Bell Relay. These Relays are used for protective control and reporting purposes within the application.

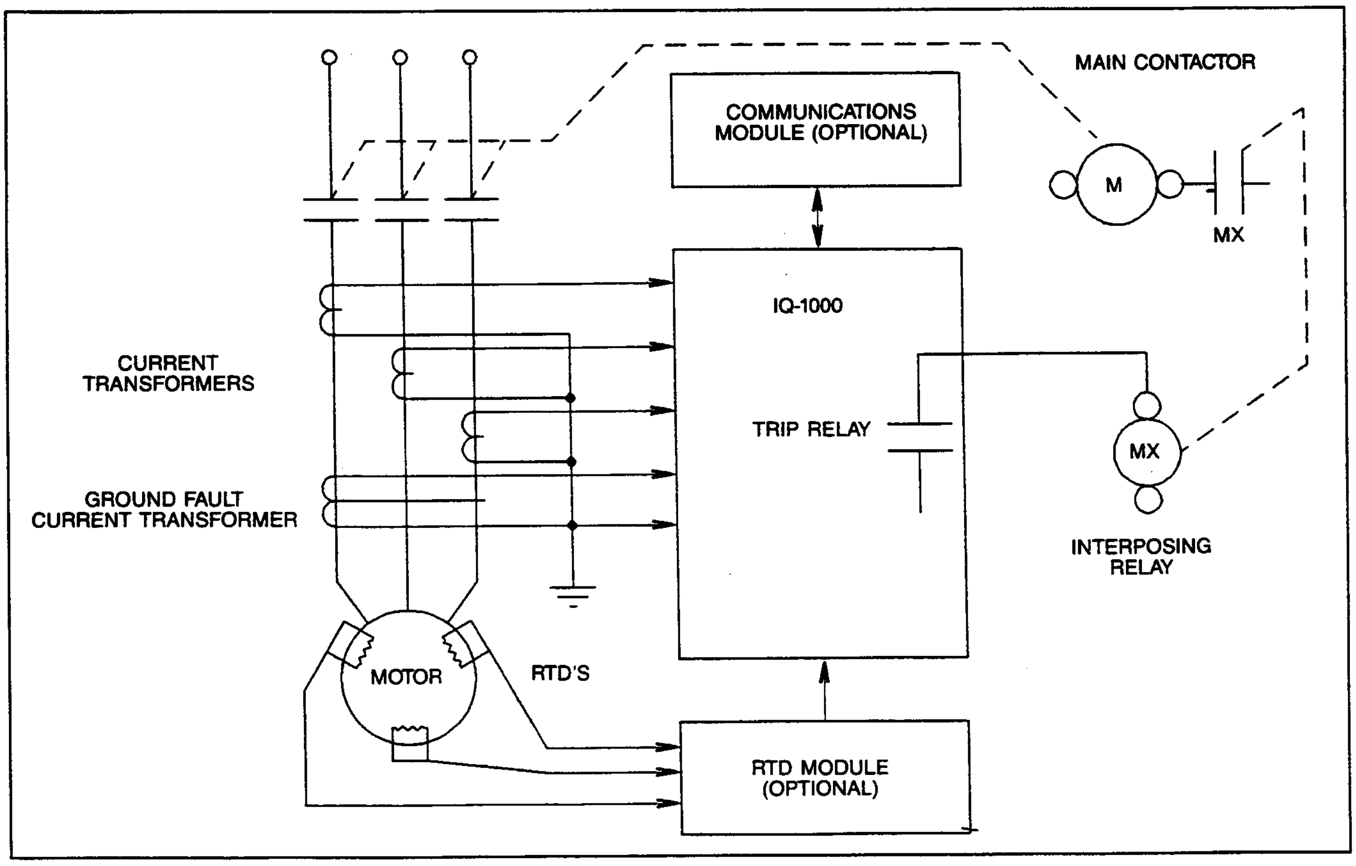


Figure 3.1 — System Overview (Simplified)

- When a trip condition occurs, the IQ-1000 stores such metering functions as motor current levels, temperatures, etc. This "picture" is maintained for use by maintenance personnel and is stored until a Reset is performed.

The IQ-1000 can maintain the metering data stored just prior to a trip condition indefinitely, assuming a reset from the Reset pushbutton, remote input or INCOM is not received.

The IQ-1000's fault monitoring can be divided into the following types:

- Load-associated protection (Par. 3.2.1)
- Rotor temperature protection (Par. 3.2.2)

3.2.1 Load-Associated Protection — The monitored level of actual motor current is used to determine when the instantaneous overcurrent trip, jam trip, and underload trip set points have been reached. Actual temperature feedback from the load bearing RTDs are compared with the load bearing temperature set point. If necessary, alarm and/or trip conditions are initiated. (Refer to Table 8.B for a complete listing of these functions.)

3.2.2 Rotor Temperature Protection — Each design of motor has a specific damage curve. Usually it is called the I^2T curve (current squared multiplied by time). In AC motors, the current balance between phases is of major concern because of the additional heating associated with an unbalanced phase condition. Current unbalance is mainly caused by voltage unbalance, the result of single-phase loads on a 3-phase system, and motor winding unbalance.

With larger horsepower motors, the design is usually rotor-limited. It therefore becomes important to determine the total heating effect on the rotor. For analysis, the motor can be considered to have two rotors. (See Figure 3.2.) One is the effect resulting from balanced current. The other is the effect of unbalanced current. If perfect current balance existed in each phase of the motor current, then I_1 would be the line current squared with no error in the heating projected from this current. This positive component of current generates the motor output torque or work.

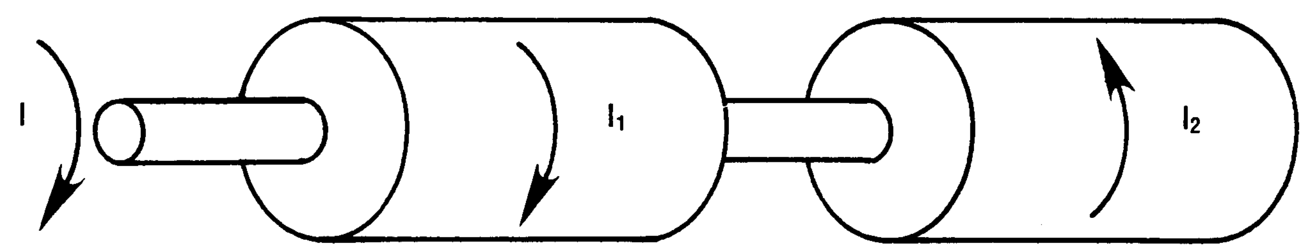
The second component of the current is the negative sequence, represented as I_2. It is a 3-phase current with a reverse phase rotation from that of the AC source. This current generates countertorque to the motor output torque, or negative work. Because the torque generated by I_2 does not leave the rotor, it is absorbed as heat and therefore has a more significant effect on the rotor heating than the I_1. Any 3 phase AC current can be represented by the addition of I_1 plus I_2. Using vector analysis to determine the positive sequence, one rotates phase B in the positive direction 120 degrees and phase C in the positive direction 240 degrees. (Refer to Figures 3.3 and 3.4.) The formula for I_1 is:

$$I_1 = \frac{IA + (IB + 120) + (IC + 240)}{3}$$

The negative sequence is determined by rotating phase B in the opposite, or negative, direction for 120 and phase C rotated in the negative direction for 240. (Refer to Figure 3.5.) The formula for I_2 becomes:

$$I_2 = \frac{IA + (IB - 120) + (IC - 240)}{3}$$

Prior to the use of a microprocessor in a motor protection system, there was no practical way of determining the total heating effect of the positive and negative sequence on a continuous basis. Therefore, less-than adequate assumptions had to be made. This resulted in nuisance tripping and actual, or near-actual, motor burnouts. The IQ-1000 microprocessor uses a unique, patented system for determining these values.



$$I^2 = I_1^2 + KI_2^2$$

Figure 3.2 — Symmetrical Components

The current squared, as used in the calculation of the rotor heat, is:

$$I^2 = I_1^2 + KI_2^2$$

Here I_2^2 is weighted by K because of the disproportional heating caused by the negative sequence.

With the use of a microprocessor, the effects of both the positive and negative sequence currents are accurately taken into account. Their **combined** effect is incorporated into a "rotor protection algorithm." The algorithm effectively keeps track of the temperature of the rotor.

It is not necessary to pick an arbitrary phase unbalance set point to trip the motor. As long as the combined effect of the positive and negative sequence currents does not approach the motor damage curve, the motor is allowed to be utilized.

3.3 Metering Functions — The IQ-1000 calculates and displays the accumulated values obtained by monitoring characteristics such as motor current level, RTD temperature levels, etc. (Chapter 9 describes the monitoring capabilities of the IQ-1000 in detail.)

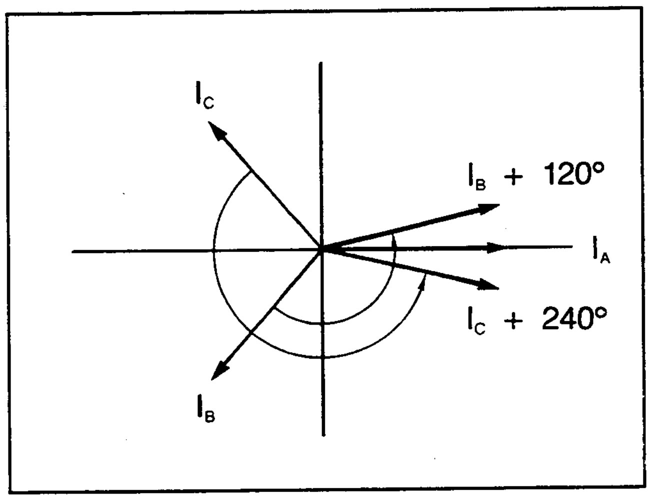


Figure 3.4 — Positive Sequence Currents

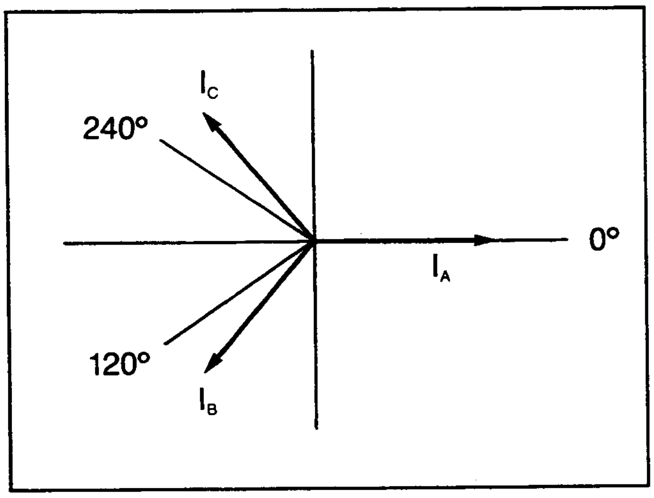


Figure 3.3 — Symmetrical Components

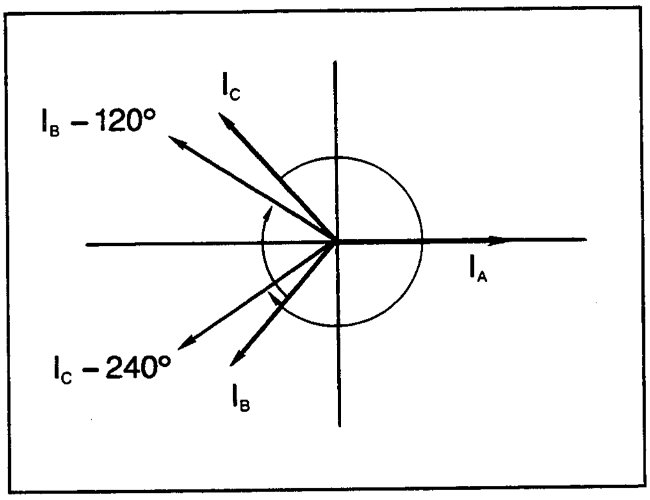


Figure 3.5 — Negative Sequence Currents

Section 4

OPERATOR PANEL

4.0 Introduction — This Section describes the IQ-1000's Operator Panel. It also details its major components and discusses how the Panel is to be used.

The Section is divided into the following areas:

- General description (Par. 4.1)
- Component descriptions (Par. 4.2)
- Set point entry, modification, examination (Par. 4.3)
- Monitoring of metered values (Par. 4.4)
- "HELP" function description (Par. 4.5)

4.1 General Description — The Operator Panel's pushbuttons are designed to be **multifunctional** in relation to the position of the Run/Program keyswitch. (See Figure 4.1.) This keyswitch controls the IQ-1000's two modes: program and run-monitor.

The colored designations on the Panel correspond to the operations that the functions perform in each of these modes of operation. (See Figure 4.1.)

The **blue** colored lettering is related to the **program** mode. Thus, when the keyswitch is in the (blue) Program position, the following components have these functions:

- "Step" sequences through the set point functions that appear in the program menu. (See Table 8.B.)
- "Raise" increases the displayed numeric set point value associated with a chosen function.
- "Lower" decreases the displayed numeric set point value associated with a chosen function.
- "Reset" returns the display to the beginning of the set points list.

The **white** colored lettering is related to the **run** mode. Thus, when the keyswitch is in the (white) Run position, the following components have these functions:

- "Step Up" sequences up through the metered levels of individual functions available on the run-monitor menu. (See Table 4.A.)
- "Step Down" sequences down through the metered levels of individual functions available on the run-monitor menu. (See Table 4.A.)
- "Trip" and "Alarm" LEDs, when lit, indicate that either a trip or alarm condition exists. (During normal operation, these are not lit.)
- "Set Points" pushbutton steps thru the display of the program menu even though the keyswitch is in the Run position. This allows an operator to review previously chosen set points while the motor is running. (See Paragraph 4.3.2 for details.)
- "Reset", when pressed, causes the IQ-1000 to clear itself from a trip condition, assuming the cause(s) of the condition is resolved. If no trip had occurred, the display returns to the status of the motor.

Understanding this multifunctional design makes the following descriptions relatively simple.

4.2 Component Descriptions — This Paragraph gives a description of each of the components that appear on the front of the Operator Panel.

4.2.1 Display Window — The Display Window consists of 8 alphanumeric illuminated characters which indicate the following types of data:

- Set point values, selections (Par. 4.3)
- Metered data of actual operating conditions (Par. 4.4)
- Causes of a trip or alarm condition (Sec. 9)
- Scrolling "Help" messages (Par. 4.5)

The Display Window shows the "Function" name or abbreviation on the left side of the display, followed by the actual "Value" on the right.

4.2.2 Run/Program Keyswitch — As the name implies, the Run/Program keyswitch allows selection of either mode of operation. These modes are briefly described in the following subparagraphs.

The key can be removed only when the switch is in the Run position.

4.2.2.1 Run Mode — When the keyswitch is in the Run position, the controlled motor can be started or stopped. The IQ-1000 performs metering and protection functions.

Individual set points can be examined in the run mode, but they may not be modified. (See Paragraph 4.3.2.)

4.2.2.2 Program Mode — When the keyswitch is in the Program position, the controlled motor cannot be started.

NOTE

As a precondition to entering the program mode, the motor must be stopped. Placing the keyswitch in the Program position does **not** initiate the mode if the motor is running. **The motor must first be stopped before the Program mode can be entered.**

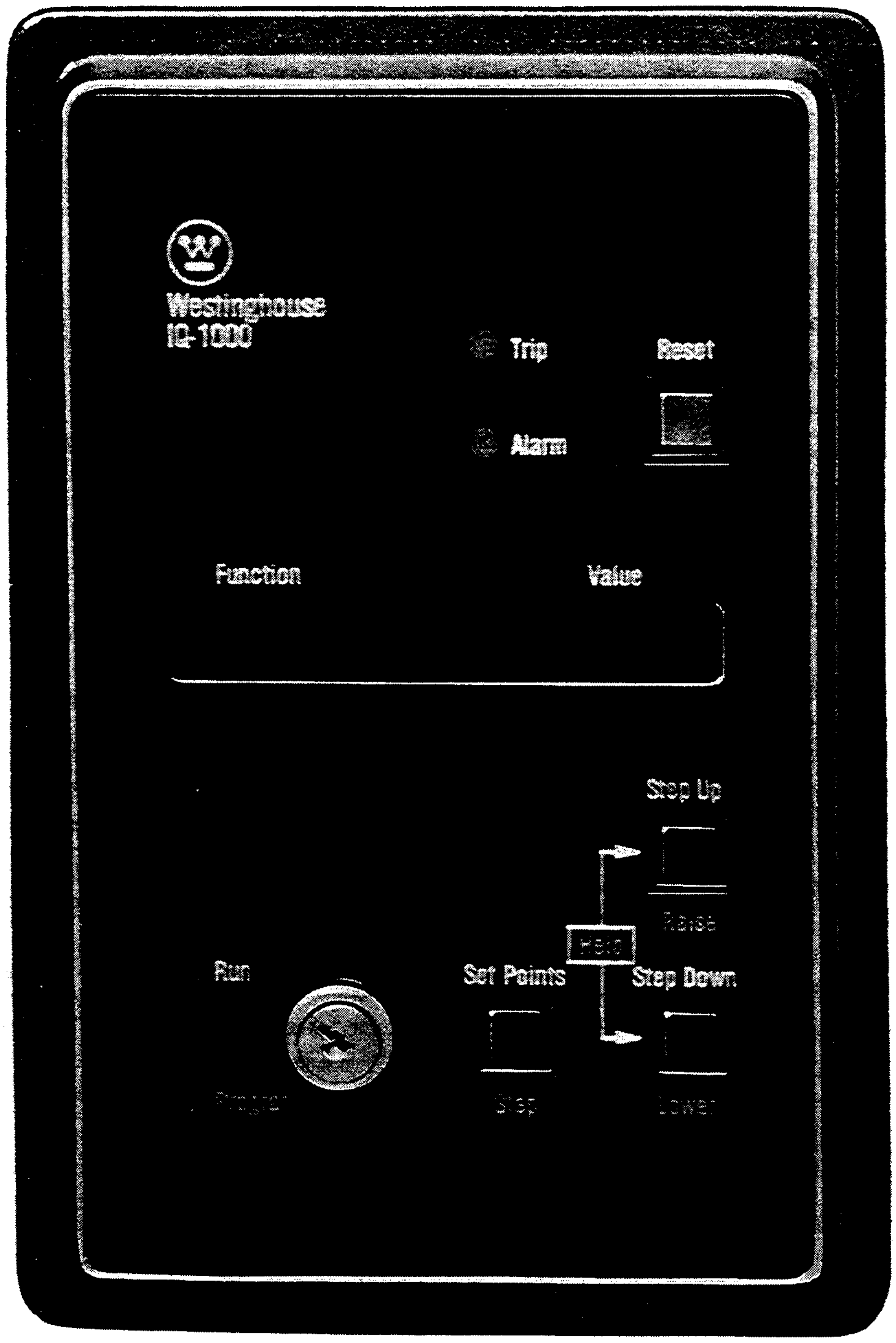


Figure 4.1 — Operator Panel

Table 4.A

RUN-MONITOR MENU

Item No. 1	Display 2	Complete "Help" Description 3, 4	Resolution
	(Status of Motor)		
0	READY/START/RUN	READY TO START MOTOR / ATTEMPTING TO START MOTOR / MOTOR IS RUNNING	-
1	IA XXX	PHASE A CURRENT IN AMPS	1 amp
2	IB XXX	PHASE B CURRENT IN AMPS	1 amp
3	IC XXX	PHASE C CURRENT IN AMPS	1 amp
4	%IA XXX	PERCENT FULL LOAD CURRENT PHASE A	1%
5	%IB XXX	PERCENT FULL LOAD CURRENT PHASE B	1%
6	%IC XXX	PERCENT FULL LOAD CURRENT PHASE C	1%
7	WT1 XXX	WINDING TEMP 1 IN DEGREES C	1 C
8	WT2 XXX	WINDING TEMP 2 IN DEGREES C	1 C
9	WT3 XXX	WINDING TEMP 3 IN DEGREES C	1 C
10	WT4 XXX	WINDING TEMP 4 IN DEGREES C	1 C
11	WT5 XXX	WINDING TEMP 5 IN DEGREES C	1 C
12	WT6 XXX	WINDING TEMP 6 IN DEGREES C	1 C
13	MBT1 XXX	MOTOR BEARING TEMP 1 IN DEGREES C	1 C
14	MBT2 XXX	MOTOR BEARING TEMP 2 IN DEGREES C	1 C
15	LBT1 XXX	LOAD BEARING TEMP 1 IN DEGREES C	1 C
16	LBT2 XXX	LOAD BEARING TEMP 2 IN DEGREES C	1 C
17	OCNT XX	OPERATION COUNT	1 count
18	RT X	RUN TIME IN HOURS	1 hr.
19	RMST XX	REMAINING STARTS	1 start
20	OST XXX	TIME LEFT ON OLDEST START IN MINUTES	1 min.

4.2.3 Set Points/Step — The function of the Set Points (white)/Step (blue) pushbutton varies depending on the mode of operation.

- In the **program** mode, pressing Step (blue) allows sequencing through the program menu in one direction only.
- In the **run** mode, pressing the Set Points (white) initiates a display of the program menu. (The run-monitor menu is normally displayed when the run mode is first entered.) Although the Run LED remains lit, the Program LED blinks as a reminder of the state. If the button is depressed again, the display returns to the same run/monitor display it was previously displaying.

4.2.4 Step Up/Raise, Step Down/Lower — Each of the Step Up/Raise and the Step Down/Lower pushbuttons has 2 separate functions, as indicated by the different colors. These are:

- White Step Up and Step Down are used, in the run mode, to step through the run-monitor and/or program menus in **either** direction, up or down.
- Blue Raise and Lower are used, in the program mode, to increase or decrease, respectively, a set point value.

In addition, these 2 pushbuttons, when pressed simultaneously, initiate the "Help" mode. This means the complete display of the menu item appears in a scrolling fashion (See Paragraph 4.5).

4.2.5 Trip, Alarm LEDs — The Alarm LED lights when an alarm set point level is reached. The Trip LED lights when a trip set point level is reached.

4.2.6 Reset — The Reset pushbutton has 2 functions. It is primarily used to reset the IQ-1000 after a trip condition is detected. This assumes the factor(s) which caused the trip have been cleared. (Study Table 8.B, item 37 for related information.)

During normal operation, the Reset pushbutton may also be used to quickly redisplay the status of the motor (first item of the run-monitor menu).

4.2.7 Run, Program LEDs — The Run LED lights when the keyswitch is in the Run position. The Program LED lights when the keyswitch is in the program position.

Additionally, the Program LED blinks continuously when the keyswitch is in the Run position and the Set Point/Step pushbutton is pressed. This indicates that the program menu, not the run-monitor menu, is being displayed.

4.3 Set Points — This Paragraph details how set point values for the IQ-1000's functions can be entered, modified, and examined. (Complete descriptions for the functions are contained in Section 8.)

4.3.1 Set Point Entry — Set point values may be entered or modified only when the IQ-1000 is in the program mode. Although the method of entry is very simple, there are a number of guidelines which must always be kept in mind during the entry procedure. These are:

Guideline 1 — Once the program menu is displayed, progression through the list is sequential, one item at a time.

Guideline 2 — At any time during normal operation, the Reset pushbutton can be used to return to the first item in the program menu.

Guideline 3 — If the abbreviated functions are not clear, press the "Help" combination of pushbuttons for the complete display. (Press the Step Up/Raise and Step Down/Lower pushbuttons simultaneously.)

Guideline 4 — Some IQ-1000 functions, as listed in Table 8.B, require a set point value entry. Others require only that one of two choices must be selected by means of a toggling operation.

Guideline 5 — In cases where a numerical value is required, press and hold the blue Raise or Lower pushbutton to increase or decrease, respectively, the displayed value. Changes occur at the approximate rate of 2 per second. After the pushbutton is held continuously for approximately 7 seconds, the rate changes to 20 per second. (This provides a more convenient entry with larger ranges.)

> NOTE
>
> Set point values wrap from maximum to minimum in both directions to prevent the user from going out of the usable range.

Guideline 6 — Be familiar with the explanations of each IQ-1000 function, as given in Section 8.

The following typical procedure details how to enter or modify set points. It is assumed that the actual set points for a specific application are available on a Set Point Record Sheet. (See Paragraph 8.0 and Table 8.B.)

Step 1 — If the associated motor is running, turn it off. (Entry and/or modification is not possible unless the motor is stopped even if the keyswitch is in the Program position.)

Step 2 — Place the Run/Program keyswitch in the Program position. At this time the Program LED lights, and the Run LED is not lit. The software version display (program menu item 0) is shown.

Step 3 — Press the (blue) Step pushbutton to display menu item 1, WD T XXX. Here the letters XXX represent some numerical value. At this time the set point value of the function can be entered or modified using the Raise and Lower pushbuttons.

Step 4 — When the value is acceptable, simply press the (blue) Step pushbutton to move on to the next item.

Step 5 — If there is no need to step through each item, press (blue) Step repeatedly to arrive at the desired function.

Step 6 — Repeat Steps 3 thru 5 for other functions.

4.3.2 Set Point Examination — After initial entry, program menu set points can be examined in either the program or run mode.

4.4 Monitoring Metered Values — The Operator Panel allows a user to monitor the actual operating values of a group of 20 "metered functions."
"Metered" means a measured readout of various operating levels.

The metered values are displayed by means of the run-monitor menu, shown in Table 4.A.

Follow these procedures to display the run-monitor menu:

Step 1 — Place the keyswitch in the Run position. (The motor can be running or stopped.)

When the run mode is first entered, the system status message is changed automatically. (The system status messages are described in Paragraph 9.1.1.)

> NOTE
>
> Values in the grey box of Table 4.A are not displayed if no RTD board is connected or if one is improperly connected. This is an indication of whether the RTD board is functioning at all.

1 When the run mode is first entered or when the Reset pushbutton is pressed, the system status message is automatically displayed, as described in Paragraph 9.1.1. The READY indication is only one possible status message.

2 The Xs shown on the right of the Display represent the possible values.

3 The "Help" descriptions are displayed by pressing the Step Up and Step Down pushbuttons simultaneously. (Par. 4.5)

4 **Note** — a "—" will be displayed when trying to address an unconnected RTD. **Also**, all of the RTD displays will be ignored if the IQ-1000 is not connected to an RTD module.

Step 2 — Press either the (blue) Step Up or Step Down pushbutton to display individual metered values.

Values appear in abbreviated format.

4.5 "Help" function description — Pressing the Step Up and Step Down pushbuttons simultaneously actuates the "Help" function. "Help" is a scrolling description of the display, including the units of measure, for any displayed value. All of the IQ-1000 displays can be further described for the user by using this "Help" function.

Section 5

INSTALLATION

5.0 General — This Section describes general mounting, wiring, and wire routing procedures to be followed by the electrical installation crew when installing the IQ-1000. The information listed here builds on earlier Sections in this manual.

5.1 Mounting — This Paragraph describes the mounting of both the IQ-1000 and the RTD and Communication Options.

5.1.1 IQ-1000 — The IQ-1000 is a self-contained unit which is intended to be mounted through a cutout in an enclosure door. It is necessary to prepare a cutout in which it will be placed. The dimensions for this cutout, along with the location of 6 required mounting holes, are shown in Figure 5.1. Before actually cutting the metal panel, be sure that the required 3-dimensional clearances for the IQ-1000 chassis allow mounting in the desired location. (Clearances are shown in Figure 5.2.)

It is necessary to hold fairly close to tolerances when making the cutout and placing the holes for the mounting screws. In particular, the horizontal dimension between the center of the mounting holes and the cutout's vertical edge must be within 0 and +0.050 in. (0.13 cm).

NOTE

Do not use a tap on the face of the IQ-1000 since this will remove excessive plastic from the holes, resulting in less threaded material to secure the IQ-1000 to its mounting panel.

Place the IQ-1000 through the cutout in the enclosure from the front. Be sure the Operator Panel faces outward. Use 0.375 in. (0.75 cm) long screws (included with the IQ-1000) to mount the unit on a single-thickness metal panel. Be sure to start the screws from inside the enclosure so that they go through the metal first.

5.1.2 RTD Option — The RTD Option consists of a standalone enclosure containing the RTD Module. It is recommended that the user-provided 3 conductor shielded cable which runs between the RTD chassis and IQ-1000 not exceed 500 ft (152 m).

This cable should be a shielded, 3 conductor cable using the three conductors to connect the IQ-1000 to the RTD module and the shield grounded to the starter ground. (See Figure 5.8) The wire should be at least AWG No. 14 stranded copper.

There are no restrictions on the actual orientation of the RTD enclosure as long as the terminal blocks are accessible for wiring.

NOTE

Tie the shield to the ground of the starter. Do not tie the shield to terminal 22 of the IQ-1000 or to the gnd terminal of the RTD module. The line used to connect the shield to ground should be a **non-current** carrying ground. This means no other device which is tied to the control power transformer uses this line as a return for the control power ground.

Figure 5.3 shows the mounting dimensions, and Figure 5.4 shows the clearance dimensions for the RTD enclosure. The wiring from the RTDs is performed at the terminal block accessible with the RTD enclosure closed. Observe Figure 5.5, which shows the RTD enclosure opened, and note the following:

- Wiring between the IQ-1000 and the RTD module is connected at J2 of the RTD Board.
- The incoming AC supply line used by the RTD module is wired to TB-1.

5.1.3 Communication Option — Mounting and clearance information for the Communication Option is contained in a separate Instruction Leaflet, IL 17158.

5.2 Wiring—General — The wiring of the IQ-1000 must follow a suitable "Wiring Plan Drawing." When the starter and the IQ-1000 are supplied together from Westinghouse, the wiring is factory-installed, and a suitable Wiring Plan Drawing is supplied. Otherwise, the term refers to the drawings made for the specific application. They describe all electrical connections between the IQ-1000 and the machine or process equipment. These are made up by the user or OEM and must include at least the following items:

- Wiring between IQ-1000 and any interposing relays used
- Main contactor wiring
- Current transformers, ground fault transformer, and control power transformer wiring
- The RTD Option, if included in the application

A typical wiring plan is shown in Figure 5.6. Observe the Figure and note the following:

- A jumper, or pair of jumpers, connect between terminals 4, 5, 6, and 7, depending on whether the AC supply is either 120 or 240 VAC. The correct jumper wiring configuration is shown on the wiring label attached to the rear of the chassis. This is also shown in Figure 5.8.

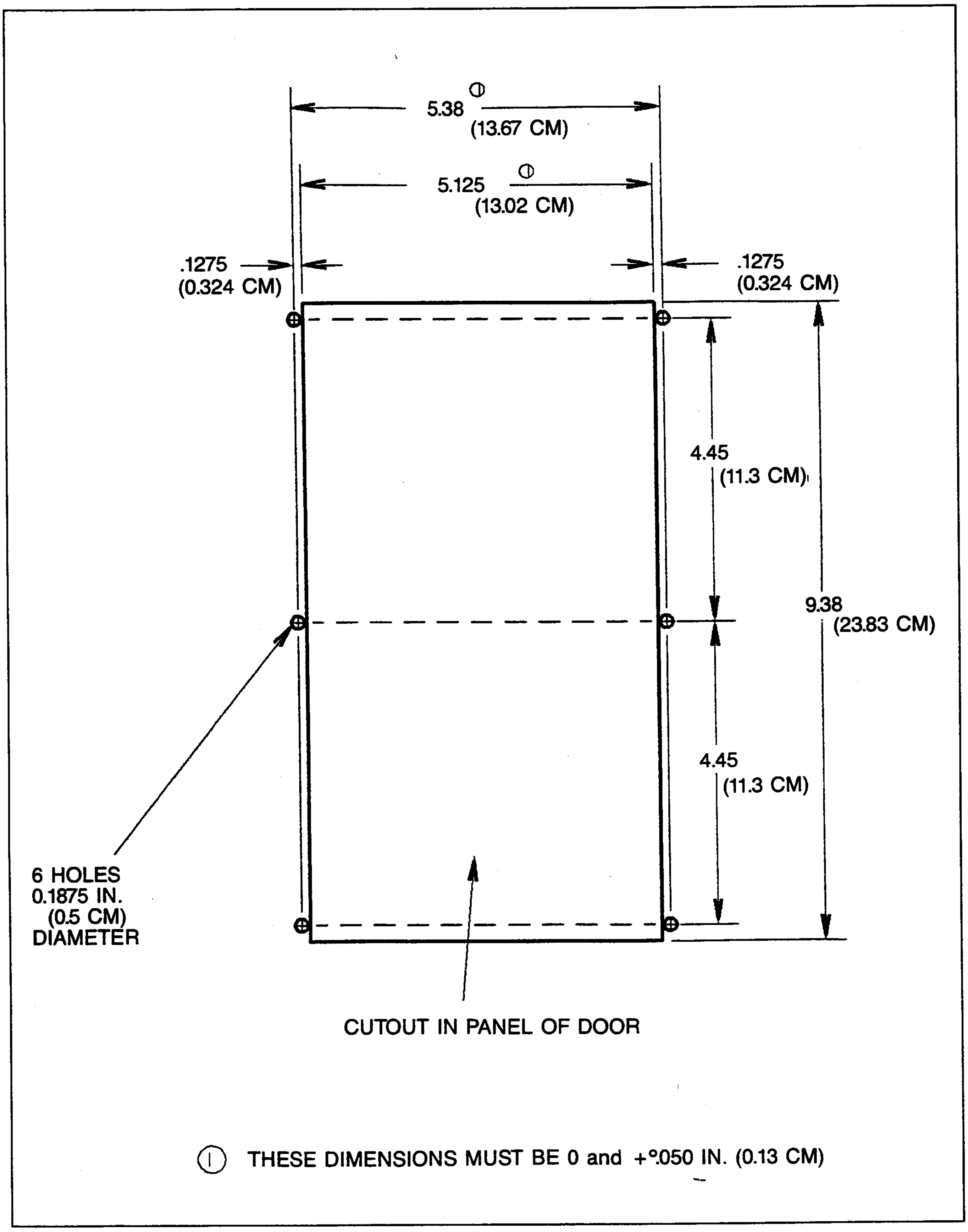


Figure 5.1 — IQ-1000 Chassis Cutout Dimensions

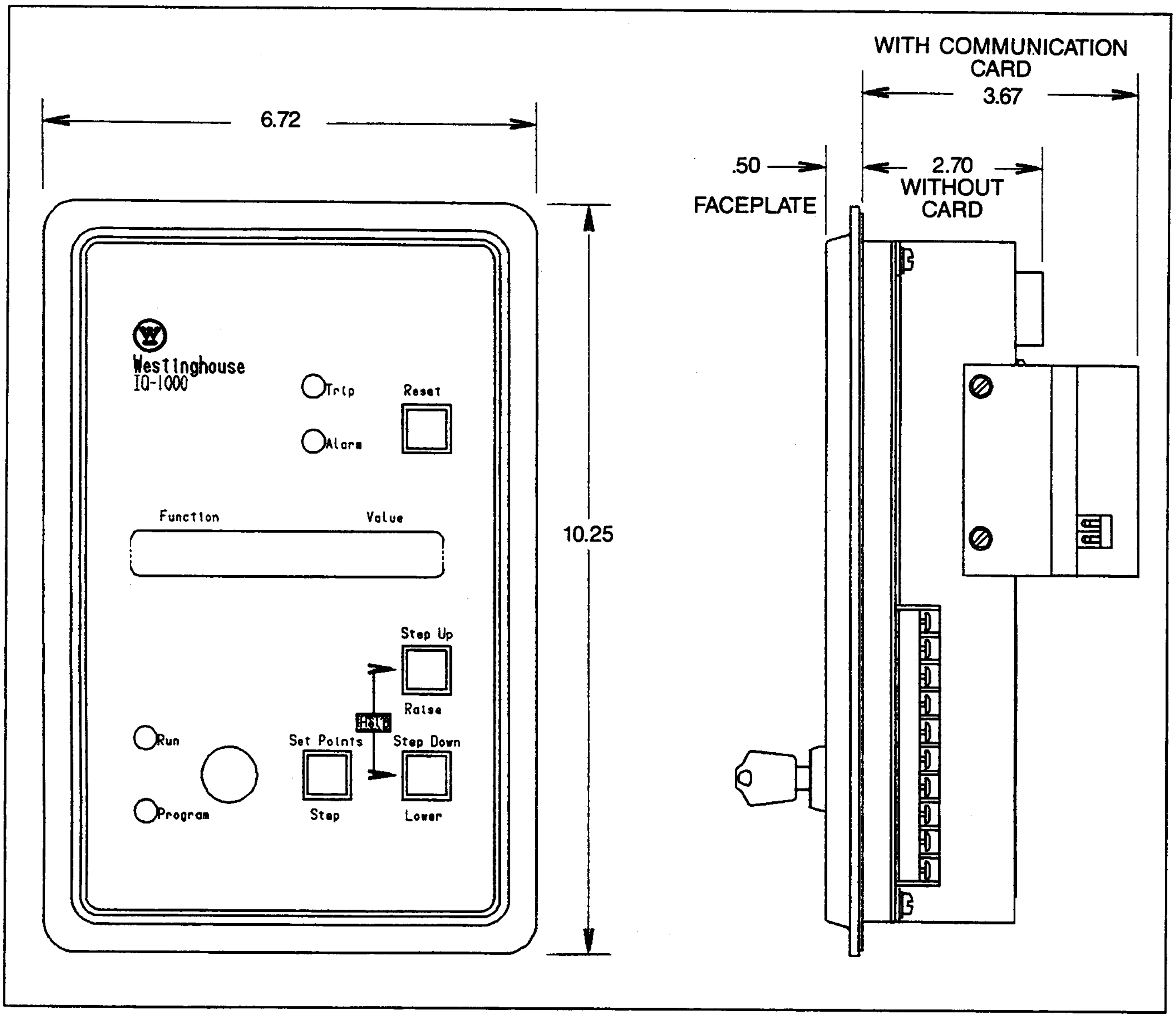


Figure 5.2 — IQ-1000 Chassis Mounting Clearances

- Two additional jumpers are factory supplied for the Incomplete Sequence input. Jumpers are supplied between terminals 6 and 10 and terminals 5 and 9. These two jumpers should be removed **only** if the Incomplete Sequence input is used in the application. For proper operation, these jumpers **must** remain in place if the Incomplete Sequence input is **not** used.

NOTE

The factory supplied jumpers are for **120 VAC** operation. If the unit is used on a **240 VAC** system, the incomplete sequence jumper connections must be moved from 6 to 4 and 5 to 7. See 6/1/90 note on p.61 for correct connection.

NO and NC contacts from the Alarm, Bell, Transition, and Trip Relays can be used to control external devices. In this case the Trip Relay disables the coil of the motor contactor. These contacts are rated at 10 amperes (resistive) for 120 VAC or 10 amperes for 30 VDC.

NOTE

System noise may disrupt the IQ-1000 if it is improperly tied to system ground through a current carrying ground. As shown in Fig. 5.6: Tie the IQ-1000's CTs into the system ground; ground the IQ-1000 cable shield with a non-current carrying ground, as shown in Fig. 5.5.

Typical wiring for the RTD Option is shown in Figure 5.7. The exact RTD wiring for each application should be included in the Wiring Plan Drawings.

5.3 Wiring Guidelines — The following guidelines must be observed by the electrical crew when installing the IQ-1000.

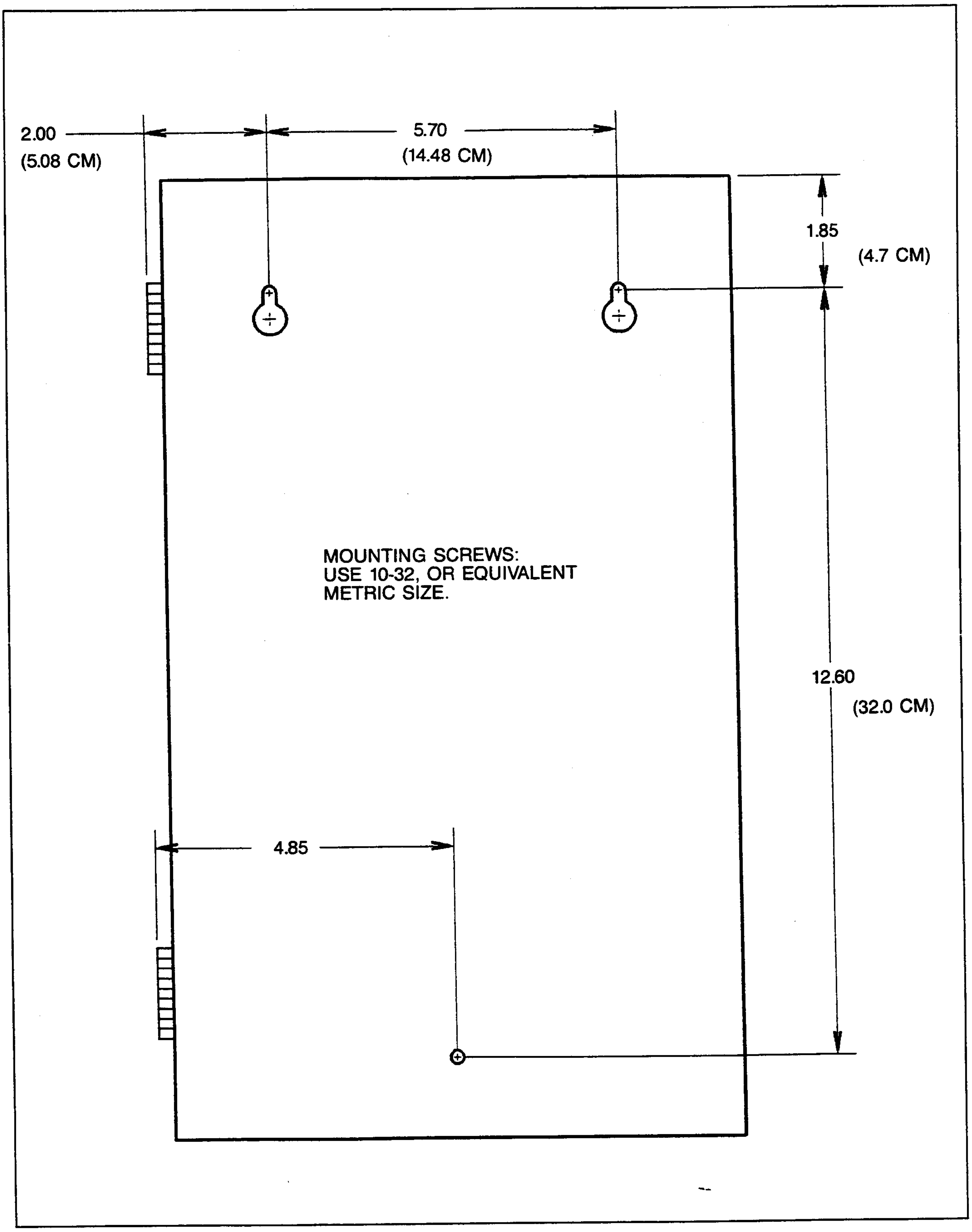


Figure 5.3 — RTD Module Mounting Pattern

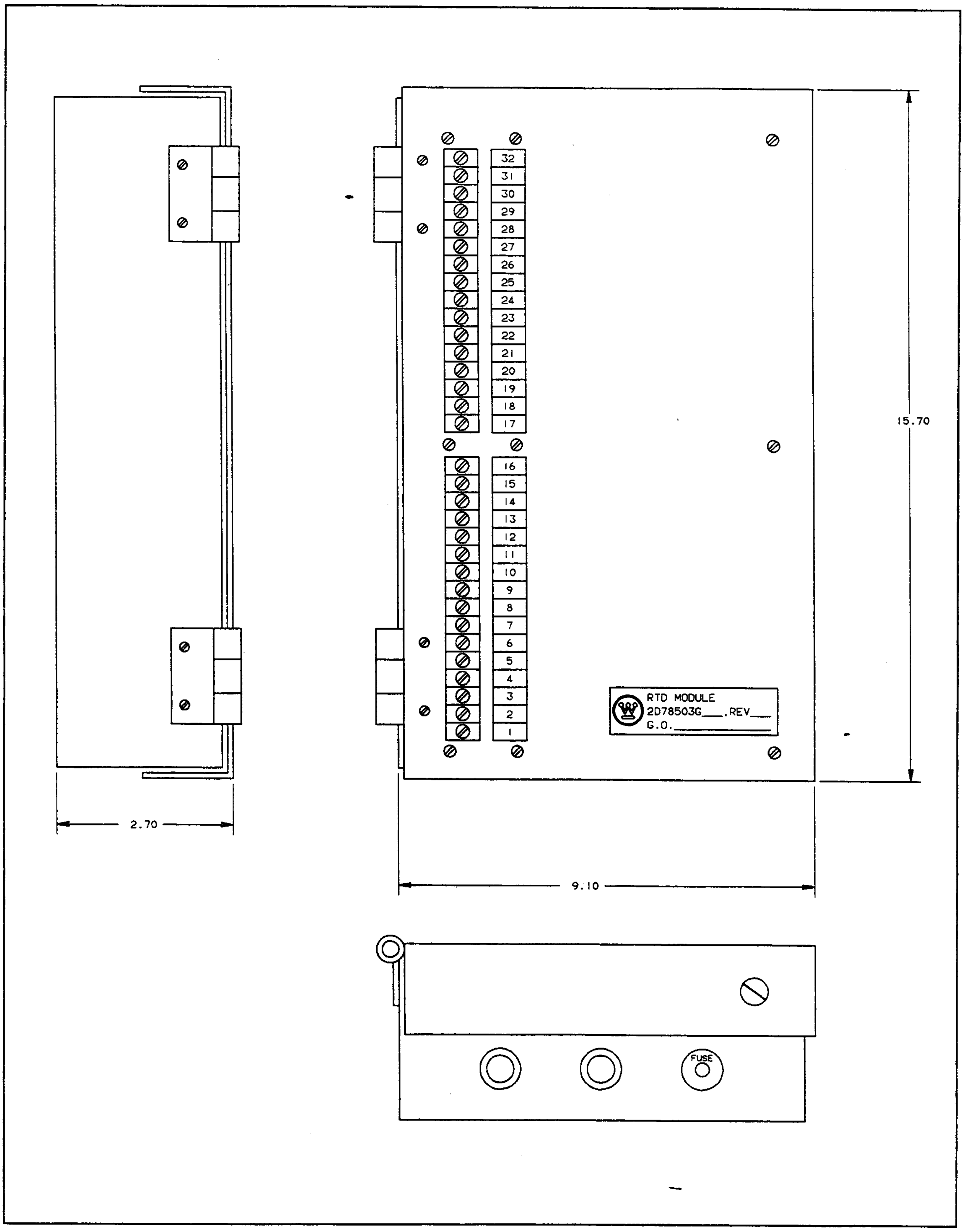


Figure 5.4 — RTD Chassis Clearance

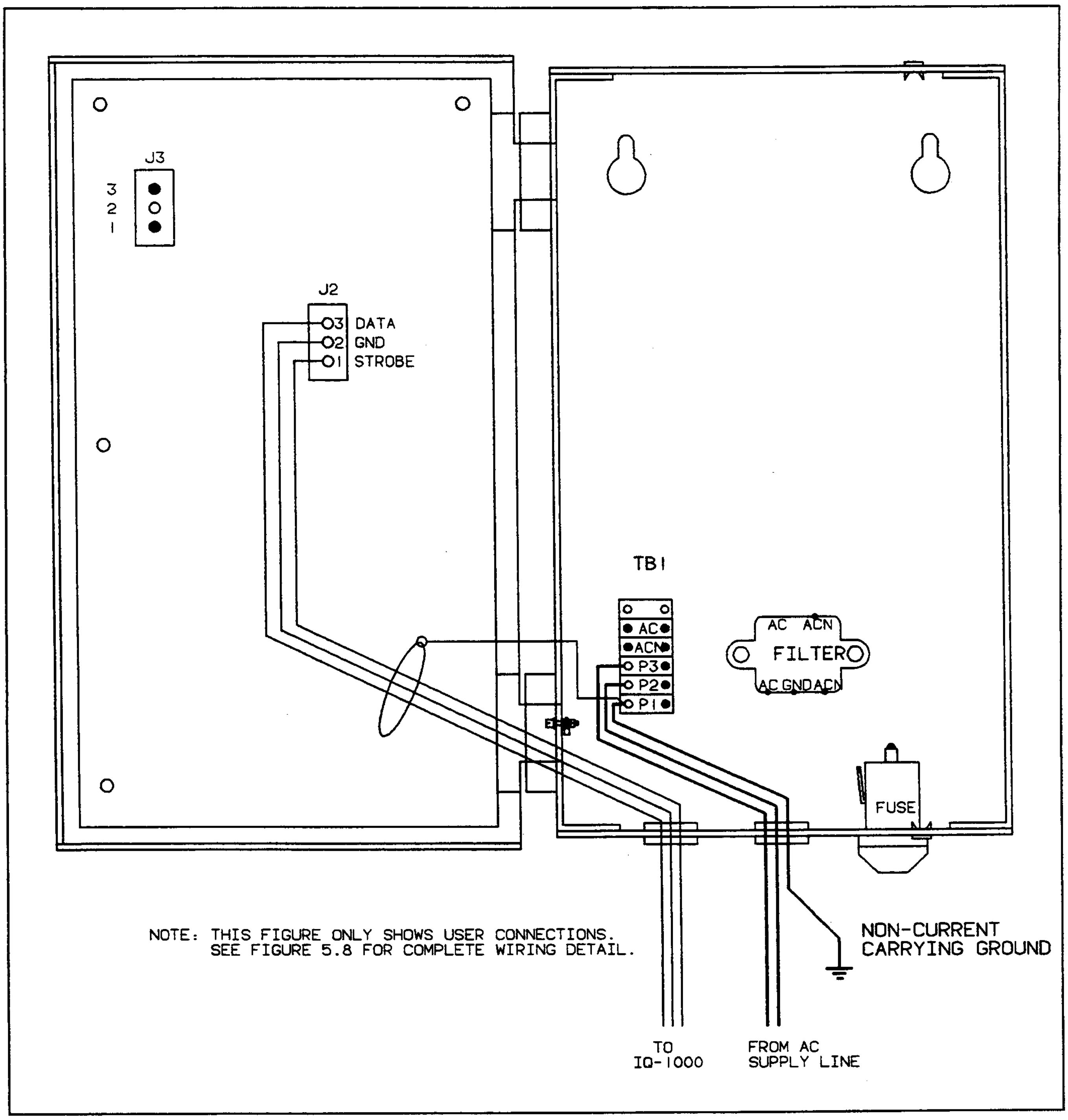


Figure 5.5 — RTD Wiring Locations

5.3.1 Wire Routing — When routing wires between the starter and the associated machine or process equipment, follow these guidelines:

> **DANGER**
>
> Insure that the incoming AC power and all "foreign" power sources are turned OFF and locked out before performing any work on the motor starter or IQ-1000. Failure to observe this practice can result in serious or even fatal injury and/or equipment damage.

Guideline 1 — Do not route the control, RTD, or Communication Card conductors through the high-voltage compartment of the motor starter. If it is necessary to do so, consult Westinghouse Control Division for specific instructions.

Guideline 2 — Separate the low-voltage (120 VAC) from the high-voltage (440 VAC, or higher) conductors as much as possible. In general, maintain a minimum distance of 1.5 ft (45 cm) between the two types.

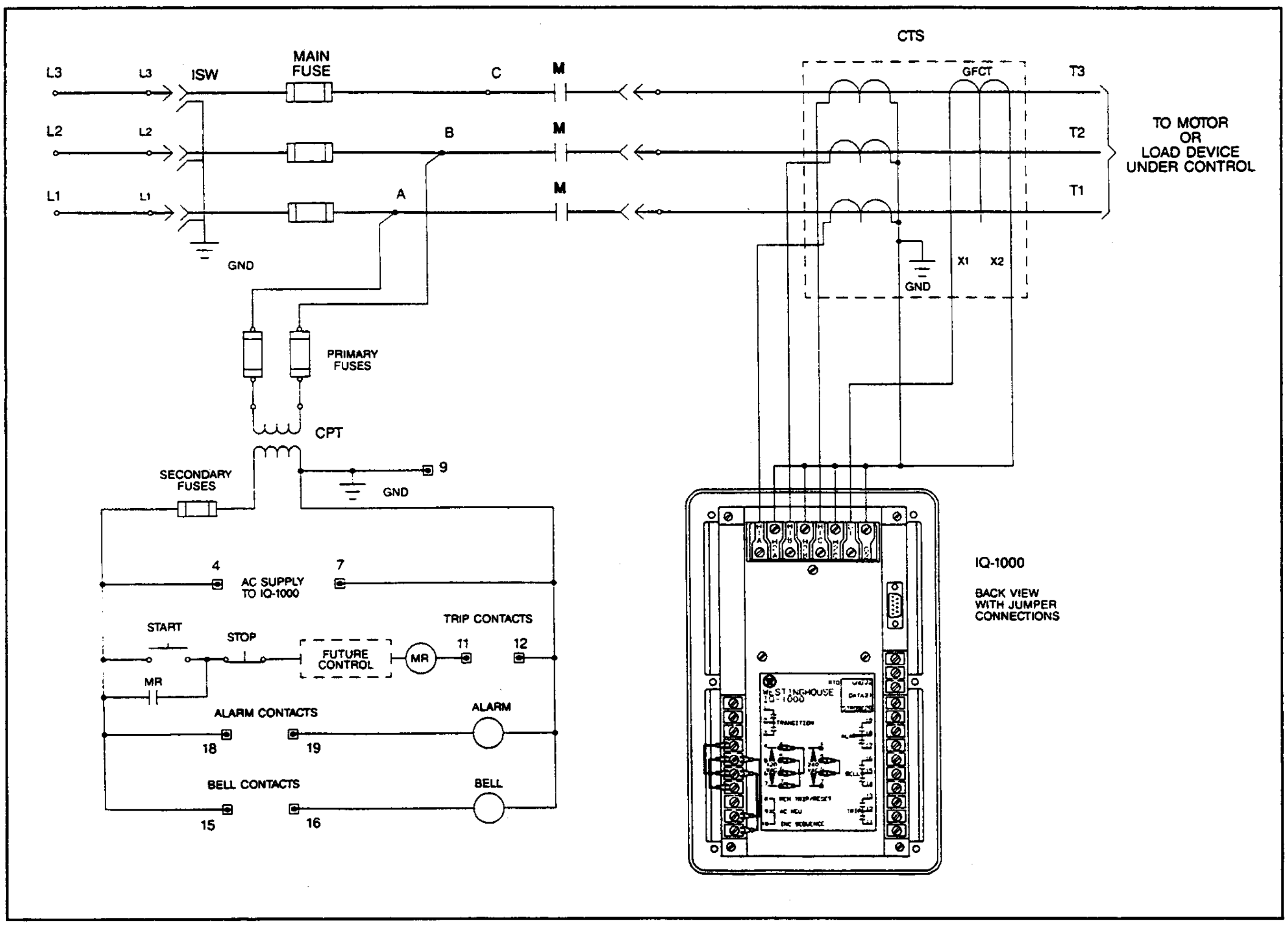


Figure 5.6 — Wiring Plan Drawing (typical)

5.3.2 Types of Wire — The following guidelines list the generally acceptable types of conductors and wiring practices used in the industrial environment. For specific types of wire, consult your application engineer.

Guideline 3 — Any low-voltage control wiring routed out of the motor starter cabinet should be at least AWG No. 14 stranded copper wire.

Guideline 4 — The wiring between the RTD Module and the RTDs in the motor must be AWG No. 18, 3-conductor, shielded cable. (See Figure 5.7.)

NOTE

In cases where the leads from the motor or other resistance temperature devices provide only 2 leads each, connect 2 conductors from the RTD Module to one of these leads. Follow Figures 5.7 and 5.9 carefully when selecting the 2 conductors to tie together; it is important to connect the 2 conductors as close to the motor as possible.

Guideline 5 — Connect the shield and drain wire from RTD cables to the common terminals on the RTD Module, as shown in Figure 5.7.

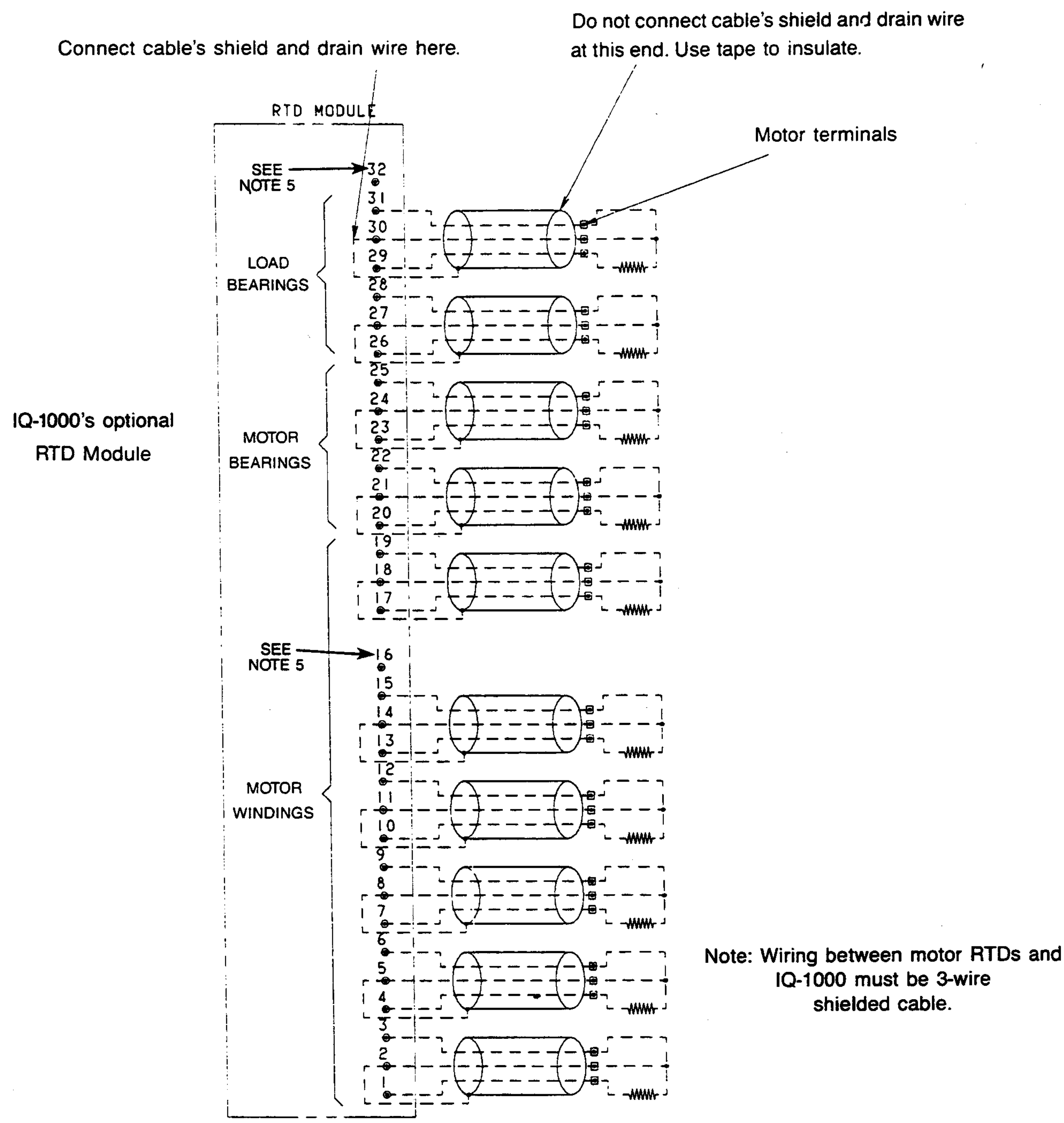
NOTE

Connect the shield only at the RTD Module. Use shrink tubing or electrical tape to insure that the shields do not make accidental contact with ground or other terminals at the RTD end.

5.3.3 Grounding — The IQ-1000 needs only to be grounded at its AC neutral terminal (AC NEU) and control power terminal 7. There is a single guideline to be followed for this procedure. (It is sequentially numbered.)

Guideline 6 — Install a ground line to terminal 7 and 9, from the grounded side of the AC control transformer used to power the IQ-1000. Do not connect terminals 7 and 9 to terminal 22, the RTD ground terminal.

5.3.4 Initial Startup — Before applying AC power to the IQ-1000 for the first time, read the information contained in Section 6, Startup.



1 Each shielded cable's conductors must be connected on IQ-1000 as shown.

2 Use of 3-lead RTDs is recommended.

3 RTDs must not be grounded at the motor, and no common connections between RTDs should be made at the IQ-1000 or the motor.

4 If motor or load bearing RTDs are used, they must be the same ohmic value and material.

5 Terminal 16 or 32 should be connected to a suitable earth ground.

Figure 5.7 — RTD Wiring (3-Lead Type)

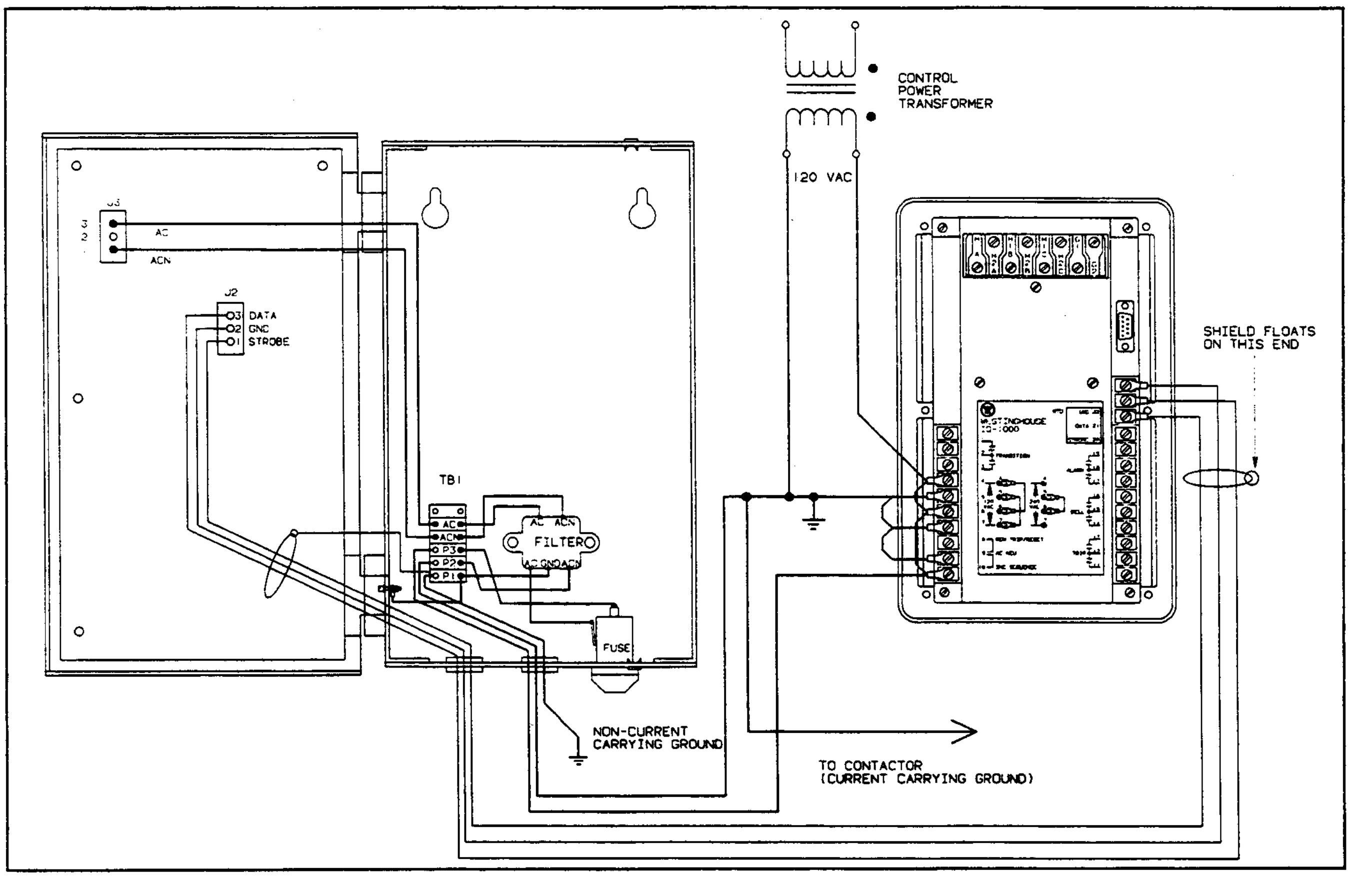


Figure 5.8 — IQ-1000 to RTD Module Wiring

> **CAUTION**
>
> The 2 leads that are connected together must be wired to the correct terminals on the RTD Module (in this case they are No. 2 and 3. See figure 5.7 for other terminal identifications.)

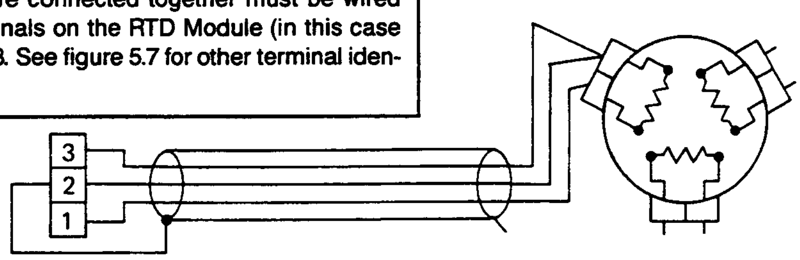


Figure 5.9 — Two-Lead RTD Wiring

Section 6

STARTUP

6.0 General — This Chapter describes a procedure to be followed when applying AC power to an application containing an IQ-1000. It assumes that AC power has never been applied to the IQ-1000 before. Each of the various steps, or items, in these procedures is shown below with a box to the immediate left. In this way it can be used as a checklist to reduce the chance of omitting or skipping an item.

CAUTION

Only qualified personnel familiar with the IQ-1000, the motor starter, and its associated mechanical equipment should perform the startup procedures listed here. Failure to comply can result in serious or fatal injury and/or equipment damage.

CAUTION

The IQ-1000 is a solid state device. Do not use a megger or perform high-potential testing on the connections associated with the unit. Failure to comply will result in equipment damage.

6.1 Power Off Checks — With the incoming AC power locked off at the isolation switch, perform these checks:

- ☐ Verify that the isolation switch feeding the IQ-1000 is in the off position.
- ☐ Verify that there is no possibility of the backfeeding of control power through the control transformer, thereby resulting in high voltage being present on the primary side of the transformer.
- ☐ Verify that any foreign sources of power, such as those connected at the IQ-1000's Alarm or Bell Relay's external terminals, are turned off.
- ☐ Place the Keyswitch of the IQ-1000 in the Program position.
- ☐ Verify that the wiring associated with the application has been performed properly as shown on the Wiring Plan Drawing which was produced for the application.

6.2 Initial AC Power Checks — The following procedures describe the initial items to be performed when power is first applied to the IQ-1000.

- ☐ Disconnect the AC control power line to terminal 4, which is the terminal providing control power to the IQ-1000.
- ☐ Connect an AC voltmeter between the wire just disconnected from terminal 4 and terminal 7.
- ☐ Turn AC power on.
- ☐ Measure the voltage and verify that a level of:

  120 VAC is applied if jumpers are placed between terminals 4 and 6 and between 5 and 7.

  240 VAC is applied if a jumper is placed between terminals 5 and 6.
- ☐ Remove AC power.
- ☐ If the AC power level is correct, reconnect the wire to terminal 4.
- ☐ If the AC power level is incorrect, consult the Wiring Plan Drawing and rewire, as necessary.

6.3 Initial AC Power On — The following procedure describes the initial items to be performed when AC power is first applied to the IQ-1000.

- ☐ Place the Keyswitch in the Program position.
- ☐ Apply AC power to the application.

The message THINKING is displayed for a few seconds while the IQ-1000 "initializes." Next, the software version number is displayed. At this time the IQ-1000 is ready to accept set point values.

NOTE

While THINKING is present on the display, the IQ-1000 is not protecting the motor. If the unit is in mode 2, the trip relay contacts will be blocked open for 6 seconds.

DANGER

Do not attempt to enter any values without using the appropriate Set Point Record Sheet. Improper operation and/or personal injury could result if this procedure is not followed.

Obtain the Set Point Record Sheet which was filled out specifically for the application and enter the set points as described in Paragraph 4.3.

After the set point entries are completed, verify that each entry has been made properly.

CAUTION

When the Keyswitch is placed in the Run position, the IQ-1000's Trip Relay will no longer prevent the motor's main contactor from closing. At this time the motor associated with the application can be started. It is important to ensure that all safety precautions associated with rotating equipment and the associated driven mechanism be taken. Failure to do so can result in serious or fatal injury and/or equipment damage.

Ensure that all rotating members and driven mechanisms associated with the application's motor are properly and securely connected and free of any loose or foreign objects.

Ensure that all personnel are cleared from the area of the application's motor and driven mechanics.

Refer to any startup procedures which may accompany the equipment and/or to the application engineer who developed the Set Point Record Sheet or the associated mechanics.

Place the Keyswitch of the IQ-1000 in the Run position. At this time the external start switch or contacts can be used to energize the motor.

Using the information supplied by the application engineer or equipment manufacturer, verify that the motor is operating properly.

NOTE

If a trip condition occurs, write down the displayed message. If the cause is not obvious, refer to Section 9, Troubleshooting, for a discussion of how to interpret the various error messages.

With the motor running, use a clamp-on type ammeter to measure the AC line current on the main motor supply lines.

Verify that the I_A, I_B, and I_C currents displayed in the monitor menu on the Operator Panel are within 15% of the currents measured with the ammeter. This is to verify proper wiring of the current transformers and correct setting of the CT ratio. This is not meant to verify accuracy. If necessary, see Paragraph 4.4 for information on using the Operator Panel to monitor the motor current.

CAUTION

This item verifies that the feedback currents obtained by the IQ-1000 are correct. If they are incorrect, equipment damage can result. Typical causes of errors are: incorrect current transformer ratios; improper current transformer wiring; incorrect CT ratio set point.

Section 7

APPLICATION CONSIDERATIONS

7.0 General — This Section describes the protective and control characteristics of the IQ-1000. It is intended for the engineer who is responsible for matching the control to an individual application. Information presented here is especially useful for understanding set point considerations described in Section 8.

It may be helpful to read Sections 7 and 8 quickly, and then to reread and study Section 7 slowly. After doing so, reread Chapter 8 in order to select those set points from the program menu given in Table 8.B which relate to the specific application.

> NOTE
>
> Throughout these explanations when specific functions are discussed, the program menu item number is also noted. This technique will help a reader understand the concept by relating it to Table 8.B, where more details are located.

7.1 Motor Protection — The IQ-1000 protects the motor, starter, and load in the following ways:

- Motor overload protection
- Overtemperature protection
- Instantaneous overcurrent protection
- Ground fault protection
- Phase reversal protection
- Motor bearing temperature monitoring
- Jam protection
- Underload protection
- Load bearing temperature monitoring
- Incomplete sequence protection

7.1.1 Overload Protection without RTDs — The motor overload protection feature, called the I^2T algorithm, calculates the rotor temperature of the motor based on the amount of current flowing into the motor. If no RTDs are present, the IQ-1000 will procede toward a trip only when the average current level of the 3 phases is above the ultimate trip level. A programmable I^2T alarm (program menu item 15) is provided to inform the user when the IQ-1000 is between 60% and 100% of the way to a trip.

The overload trip set point is determined as the maximum amount of I^2T in the IQ-1000 which can be translated to the rotor. When the IQ-1000 has accumulated enough I^2T, a trip occurs and message LRC/I^2T (Locked Rotor/Thermal Overload) is displayed. **The motor cannot restart until the temperature of the rotor, as calculated by the IQ-1000, falls below the alarm level set point entered into the I^2T alarm level function (item 15).** (The algorithm has both a heating and cooling calculation.)

To do this, the IQ-1000 maintains a short-term history of the motor's operation. (See Figure 7.1.) The following variables are used as input data for the history:

- Motor current (I_1), the positive sequence current
- Motor current (I_2), the negative sequence, or "unbalanced," current
- Time

This data can be considered as the current feedback from the motor.

In addition to the current feedback from the motor, certain motor constants are needed. They are supplied to the IQ-1000 when the user-chosen set points are programmed into memory. These are:

- Full-load amperes (item 33)
- Locked-rotor current (item 12)
- Maximum allowable Stall time (item 13)
- Ultimate trip (item 14)

With these motor constants, sampled motor currents, and time, the IQ-1000 can track the calculated rotor temperature, always assuming a 40°C ambient temperature.

7.1.2 Overload Protection with RTDs — The temperature data obtained from the addition of optional RTDs is used by the IQ-1000 in the following 2 ways to protect the motor:

(1) Direct measurement of the winding temperature-versus-programmed trip temperature. (This gives a fixed trip point based on actual, measured stator winding heating and cooling.)

(2) RTD winding temperatures—when combined with the monitored positive/negative sequence motor current and the I^2T algorithm for motor protection—incorporates the anticipated cooling of the rotor based on the actual stator winding temperature. (This is described in more detail in subparagraphs 7.1.3.6 and 7.1.4.)

The following motor input variables are used by the IQ-1000 when the optional RTDs are used:

- Motor current (I_1), the positive sequence current
- Motor current (I_2), the negative sequence, or "unbalanced," current
- Time

- Stator winding temperature

This data can be considered as the feedback from the motor. (See Figure 7.1.)

In addition to the variable data, certain motor constants are needed. They are supplied to the IQ-1000 when these user-chosen set points are programmed into memory. These are:

- Full-load amperes (item 33)
- Locked-rotor current (item 12)
- Maximum allowable Stall time (item 13)
- Ultimate trip (item 14)
- Winding temperature trip value (item 1)

The IQ-1000 stores the chosen set point levels in memory and also makes an accurate measurement of feedback variables. Thus the device can more accurately protect the rotor, while the stator is protected by direct measurement through the RTDs.

7.1.3 Protection Curve — The motor protection curve defines the motor-versus-time relationship that exists as a direct result of the IQ-1000's hardware and programmed set point values. (See Figure 7.2.) Ideally this curve is located as close as possible to the motor damage curve, thus allowing maximum utilization of the motor without damage.

(The motor damage curve is defined as that point in the relationship between the motor current and time where thermal damage results.)

When the motor current-versus-time relationship exceeds this damage curve, a trip condition occurs, and the motor is turned off.

The IQ-1000 automatically calculates the correct motor protection curve for a specific application after the following items are entered: full-load amperes rating (item 33); locked-rotor current (item 12); maximum allowable stall time (item 13); and ultimate trip (item 14).

A brief discussion of how these values affect the motor pro-

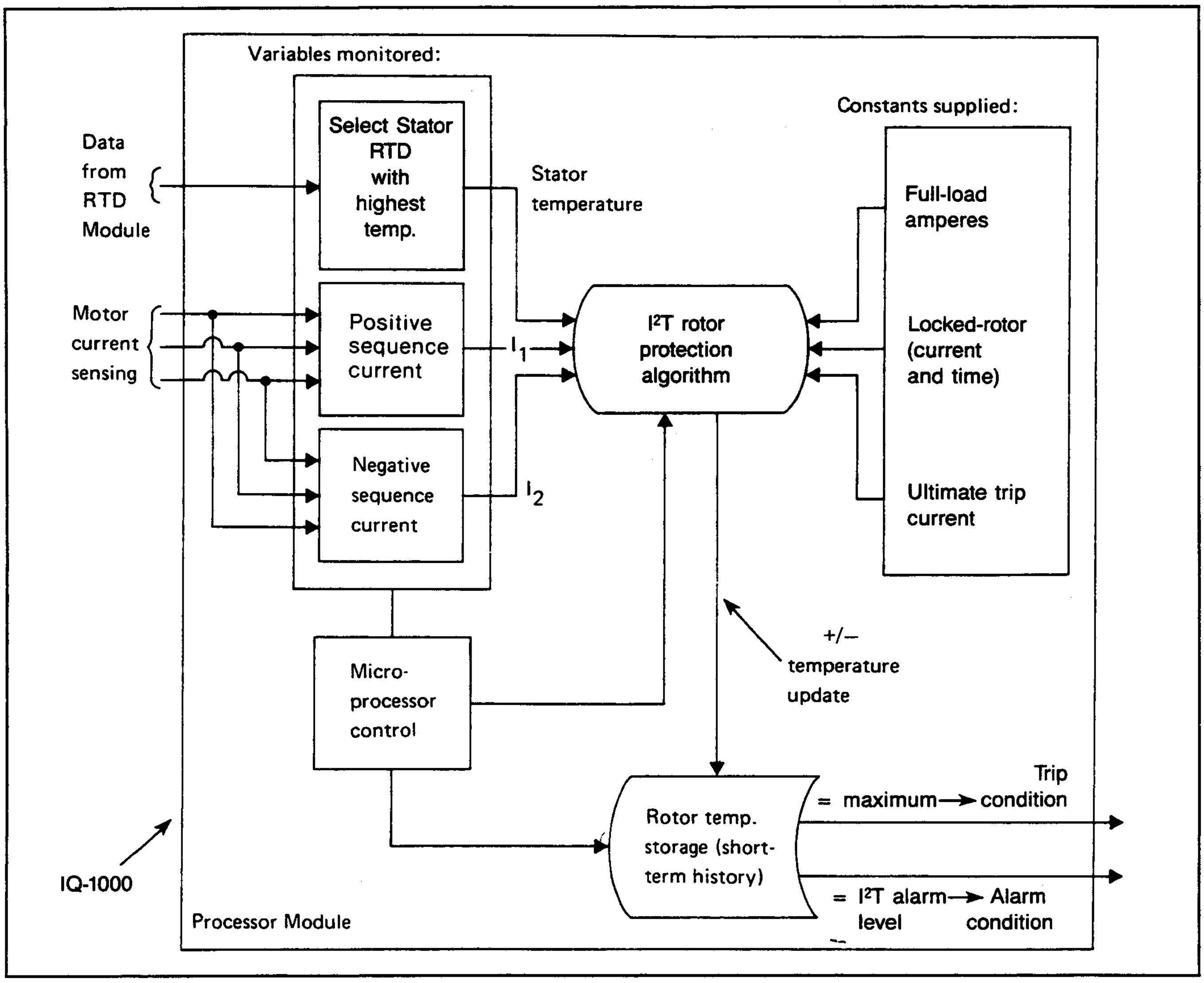


Figure 7.1 — Rotor Temperature Tracking

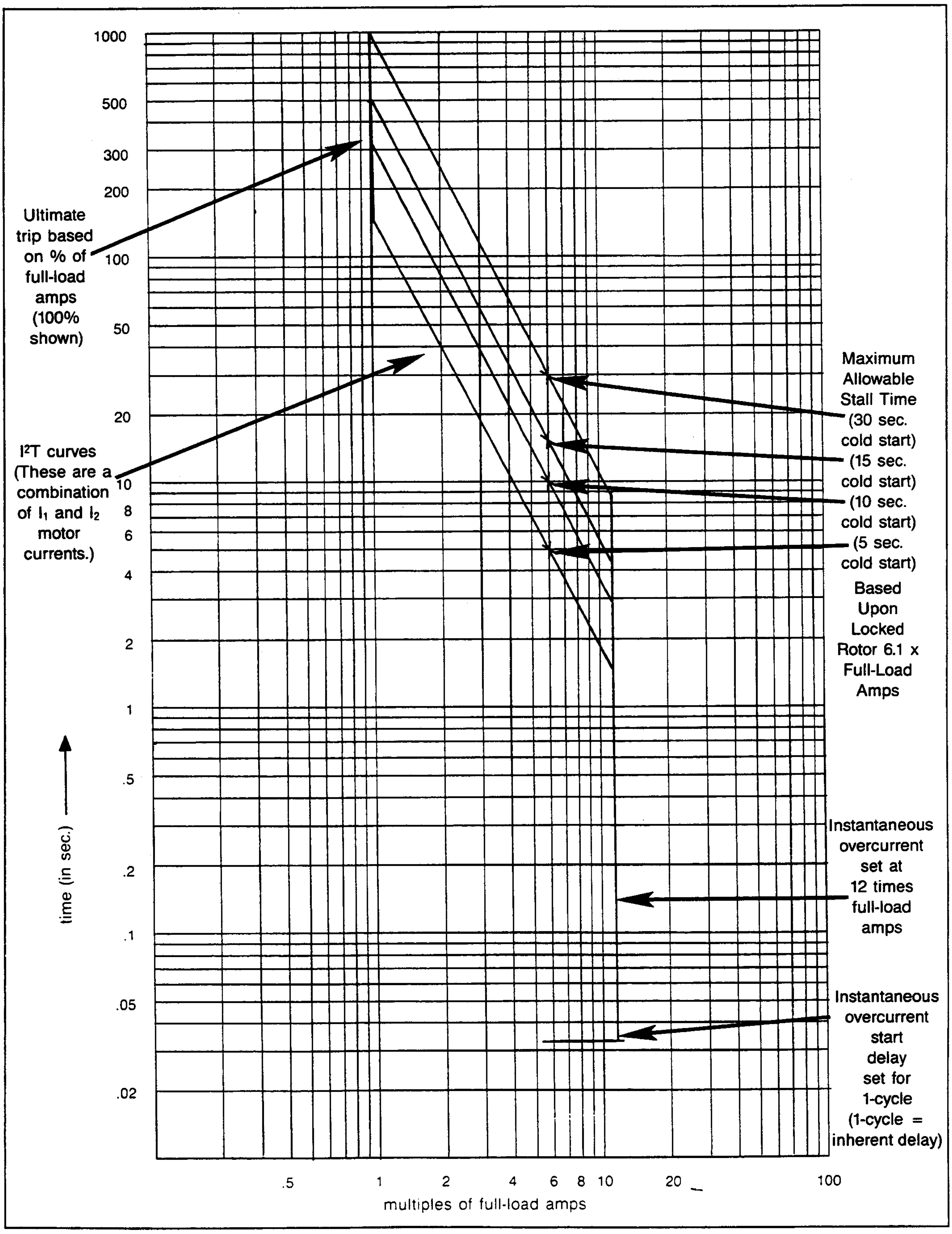


Figure 7.2 — Motor Protection Curve

tection curve is given in the following subparagraphs. The typical curve shown in Figure 7.2 is the result of the factors listed in these explanations.

7.1.3.1 Instantaneous Overcurrent Function — The specific instantaneous overcurrent (item 10) set point used in Figure 7.2 is 12 times (1200%) full-load amperes (item 33). In general the instantaneous overcurrent set point for all applications should be a least 1.6 times the locked-current ratio if not provided by the motor manufacturer. The instantaneous overcurrent set point available range is 300 thru 1500% of full-load amperes.

NOTE

For the I.O.C. trip level to be effective, set it below your fuse interrupting rating *or* your contactor withstand capacity.

NOTE

The instantaneous overcurrent start delay function (item 11) has a fixed minimum 1-cycle delay to detect the condition. The available set point range for additional start delay is actually 1 thru 10 AC line cycles.

7.1.3.2 Locked-Rotor Function — The family of curves shown in Figure 7.2 is based upon a locked-rotor current set point (item 12) of 6.1 times (610%) the full-load amperes function's (item 33) set point and a variable locked-rotor stall time set point (item 13).

All curves shown in the Figure are based on a maximum allowable stall time from a cold start. Since the IQ-1000's algorithm retains a history of both the operating current and operating time of the motor, it is not necessary to program it for hot starts.

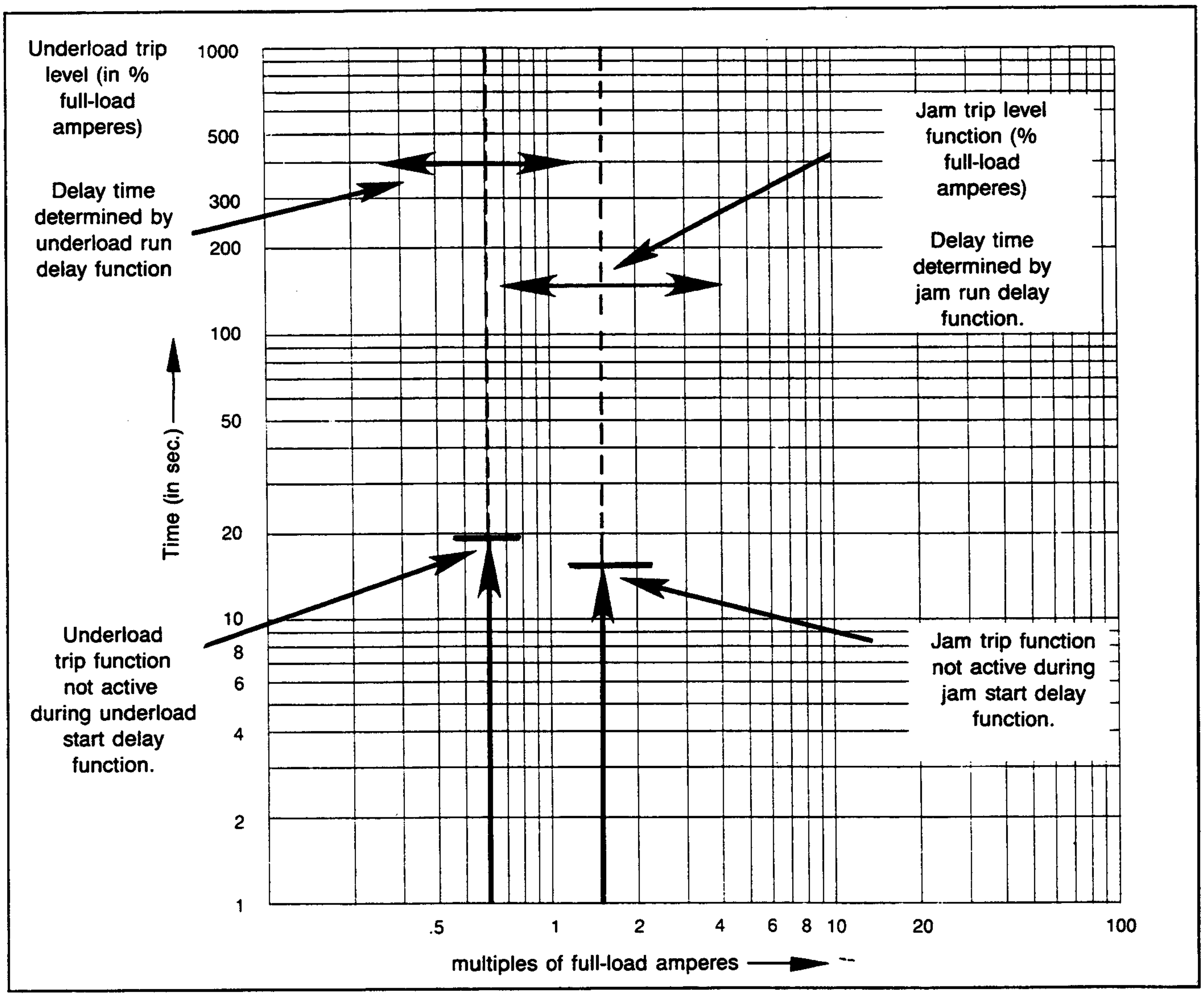


Figure 7.3—Jam Protection

The unit automatically takes into consideration whether it is a hot or cold start. The locked-rotor set point, however, should be set for a cold start.

7.1.3.3 Ultimate Trip — The ultimate trip function's (item 14) set point is the lowest value of current above which the motor can be damaged over time. If the motor has a service factor larger than 100%, the ultimate trip level can be increased accordingly. A service factor of 1.25 could be used with a 125% ultimate trip level.

7.1.3.4 Underload Functions — When the motor is running, a sudden reduction of current below a programmed value for a programmed (run delay) time (items 20 and 22) indicates a malfunction in the driven equipment, and an underload trip condition occurs.

Underload protection is used in the event of mechanical problems such as a blocked flow in a pump, loss of back pressure in a pump, or a broken drive belt or drive shaft. A programmable start delay (item 21) is provided to lockout the underload function during starting of unloaded motors to prevent nuisance tripping. The run delay (item 22) is useful in applications where the motor is operated under light loads for short periods of time such as a conveyer system. To disable the underload function, a value of 0 should be programmed for item 20.

7.1.3.5 Jam Functions — Once the motor is running, if the monitored current level exceeds the set point entered for the jam trip level (item 17), a trip occurs. (See Figure 7.3 in which the jam set point is 180% of full-load current.)

In cases where the RTD Option is used, protection against a jam is especially desirable with gear train or other mechanical-type loads. In such cases an overload or physical jam could cause damage. A programmable start and run delay are provided to compensate for inrush current and momentary surges in the load.

If the jam function (item 17) is not desired, a value of 1200% should be entered along with a start delay of 1 second. (See Paragraph 8.9 for more details.) Its use is not required, but it may be desirable to use it for additional system protection.

7.1.3.6 Temperature Effects — Motor protection is directly affected by the calculated temperature of the rotor. If RTDs are not used, the IQ-1000 assumes the ambient temperature to be 40°C. Thus the actual ambient temperature has no effect on either the starting or running of the motor.

The customer application engineer should take these factors into consideration and compensate for them if a higher ambient temperature is anticipated. The best solution is to use RTDs since any compensation for a higher ambient temperature results in overprotecting the motor during conditions of lower temperatures.

Without RTDs, the IQ-1000 calculates the current and time, and then converts them to a calculated stator/rotor temperature. The constant I^2T curve, as established by the locked-rotor current and maximum allowable time functions (items 12 and 13), must be assumed to adequately protect the motor for all levels of motor current above the ultimate trip set point level. Should the curve not be adequate to protect the motor due to stator limitations at elevated ambient temperatures, then the use of RTDs is recommended. They allow a full utilization of the power available from the motor, and they reduce unnecessary shutdowns.

7.1.4 Typical Motor Protection Curves — To illustrate the effects of the IQ-1000's protection features, 2 sample curves are shown here. Using specific motor data, typical motor protection curves of the IQ-1000 without RTDs are shown in Figure 7.4. The use of RTDs is assumed in Figure 7.5. The following data were used:

- Instantaneous overcurrent of 12 times full-load amperes
- Locked-rotor amperes of 6.1 times full-load amperes
- Maximum allowable stall time of 15 seconds, cold start
- Ultimate trip level of 100% of full-load amperes
- Start cycle set at 10 seconds (assumes a single-stage motor). (See items 28 and 29.)
- Motor running; loaded at 90% of full-load amperes
- Underload protection set point is 60% of full-load amperes
- Jam protection functions of 180% full-load amperes for a 5-second delay

The difference in the typical curve caused by the addition of RTDs is shown in Figure 7.5. It centers on the time period after 60 seconds. (When RTDs are used, the actual monitored temperature automatically overrides the ultimate trip function's set point.)

It should be noted that the ambient conditions under which the motor is operating affect the top portion of the curve. The curve is shifted to the left with increasing ambient temperature, and to the right with decreasing ambient temperature.

The effects of the motor winding temperature (items 1 and 4) set points, which can be used with RTDs, are not evident in Figure 7.5. These functions are independent of the effects of temperature on the I^2T algorithm's trip curve. These functions' set points are based on the recommended maximum stator temperature, as supplied by the motor manufacturer. Depending upon the specific motor winding temperature set points, the temperature trip curve shifts to the left or right.

The IQ-1000 allows maximum utilization of the power available from the motor by setting its trip conditions as close as possible to the motor damage curve.

7.1.5 Motor Current — The IQ-1000 monitors both positive and negative sequence currents. Each is described in the following subparagraphs.

7.1.5.1 Negative Sequence Currents — Throughout the discussion of motor protection curves, the effects of negative sequence currents cannot be emphasized too strongly. For maximum motor utilization, the actual load should be matched closely to the full horsepower of the motor. However, when this is done, the effect of motor voltage unbalance—that results in the negative sequence current—becomes more critical.

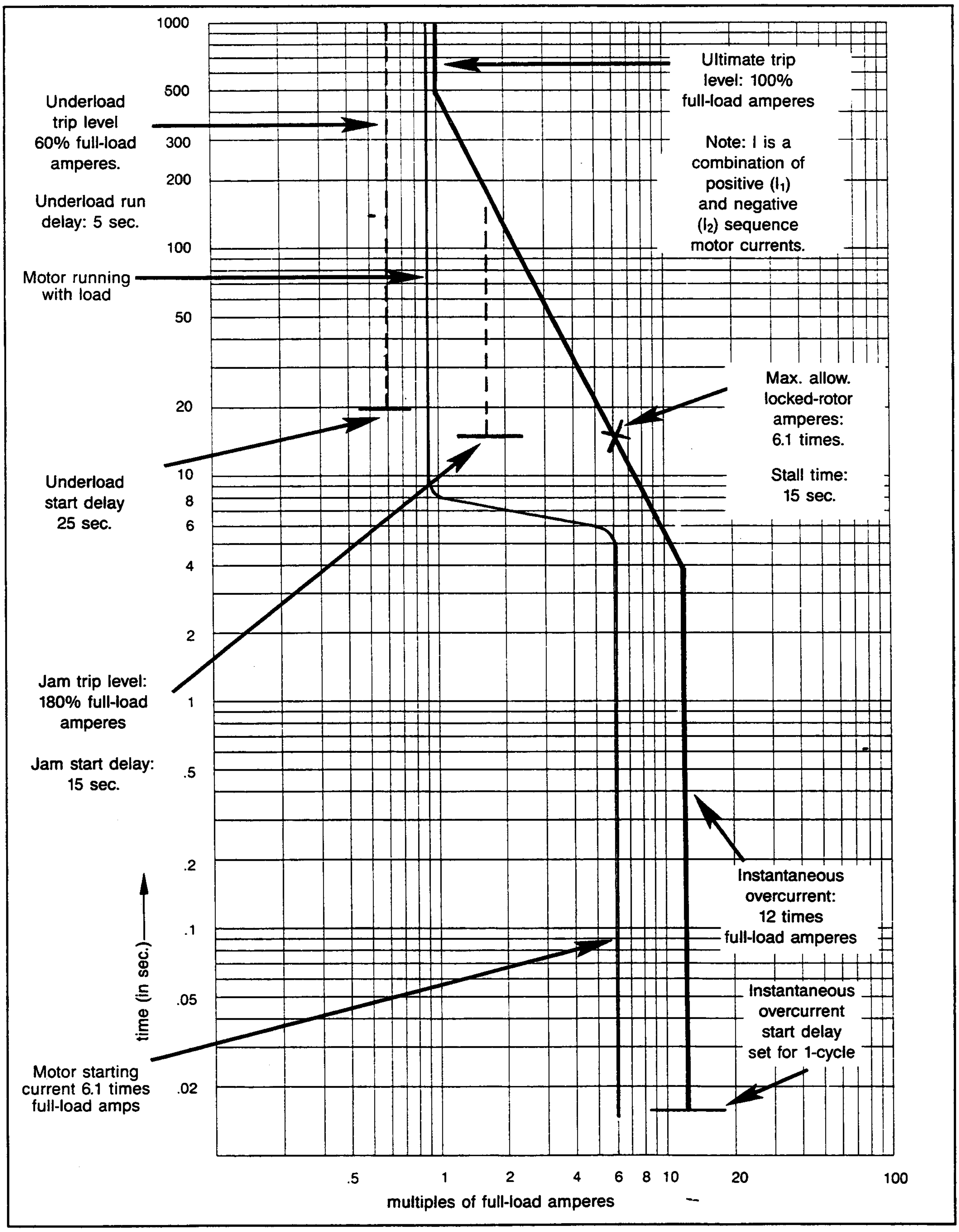


Figure 7.4 — Motor Protection Curve (without RTDs)

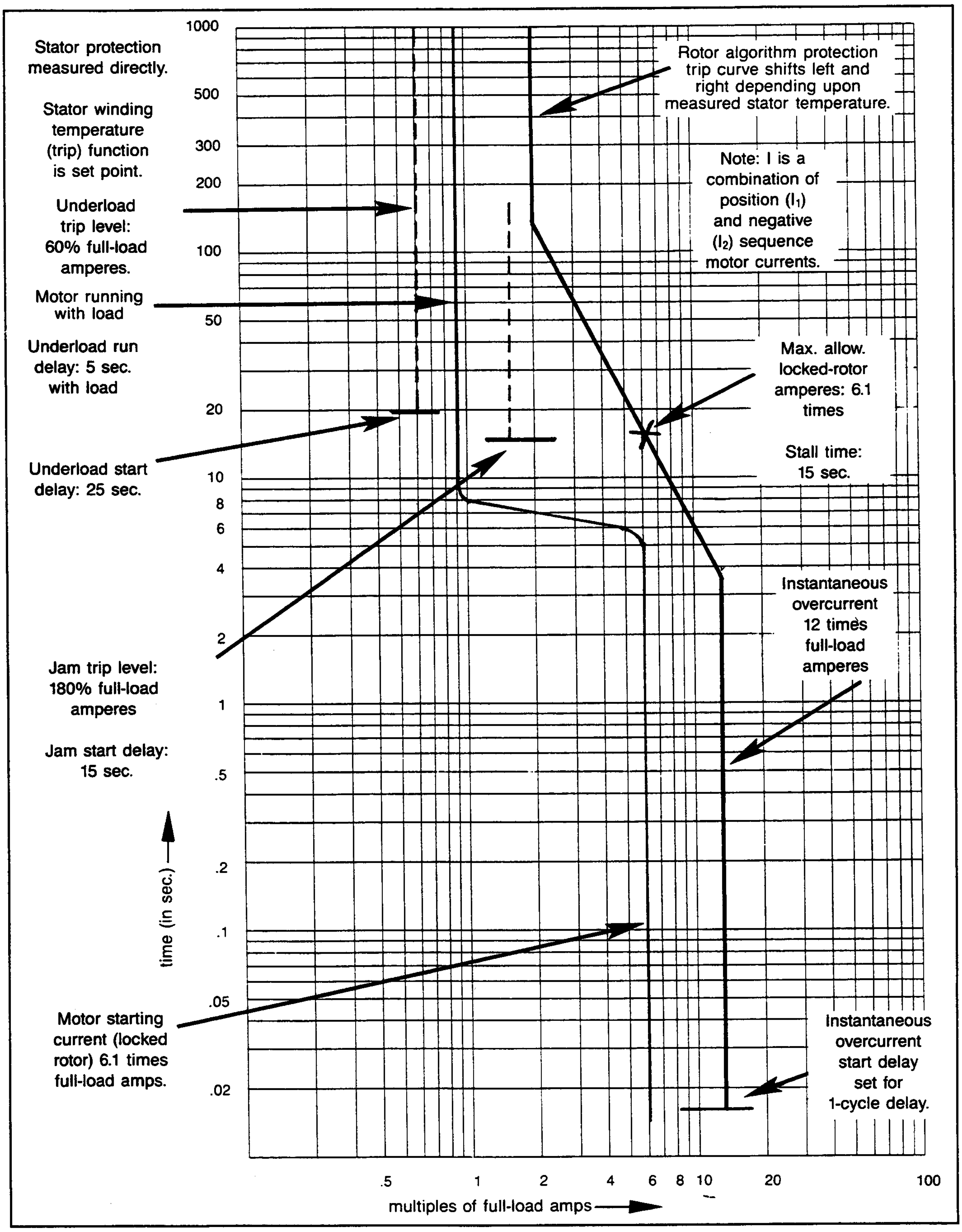


Figure 7.5 — Motor Protection Curve (with RTDs)

The IQ-1000 accurately calculates negative sequence currents in an ongoing manner. It is not necessary for the user to arbitrarily pick a specific set point percent of unbalance to shut the motor down. (However, see program items 23 and 24.) As long as the rotor temperature, as calculated by the IQ-1000, does not equal the motor damage curve, the motor continues to operate.

7.1.5.2 Positive Sequence Currents — The IQ-1000 monitors true RMS motor current. It takes a total of 36 samples in each phase during a 1 cycle period in order to calculate the positive and negative sequence currents.

The sampling point is constantly shifting; thus the IQ-1000 also monitors non-sinusodial wave forms. This is important for applications where power factor-correction capacitors and rectified systems are on the same main bus.

7.1.6 Ground Fault Protection — The IQ-1000's ground fault function (program menu item 7) provides protection against excessive leakage current levels. (The specific level is chosen by the user.)

Use of this function is restricted to a grounded system; it may not be used in an ungrounded system. The function requires that an optional ground fault (zero sequence) transformer be installed in the grounded system in which the secondary of the main power transformer feeding the motor is wired in a wye grounded configuration.

The optional ground fault transformer chosen must have a current transformer ratio of 50:5 to allow the IQ-1000 to properly interpret the ground fault current level.

7.2 Motor Cycle Monitoring — As used here, the term "motor cycle monitoring" refers to the IQ-1000 "passively" monitoring the motor during periods of normal operation. Normal operation includes the:

- Start cycle
- Run cycle
- Stop cycle

The word "passive" implies that the IQ-1000 monitors motor current levels. It does not actually switch nor directly affect the motor's contactors except when the Transition Relay, described in Paragraph 8.14, is used for reduced voltage starting or a Trip Relay is used to take the motor off line in a fault situation.

The following explanations center on the timing associated with motor starting, running, and stopping.

7.2.1 Start Cycle — The relationship between the IQ-1000 and the motor current level during a start cycle is shown in Figure 7.6, which is to be studied as these explanations are read.

The motor start cycle is initiated when the motor current

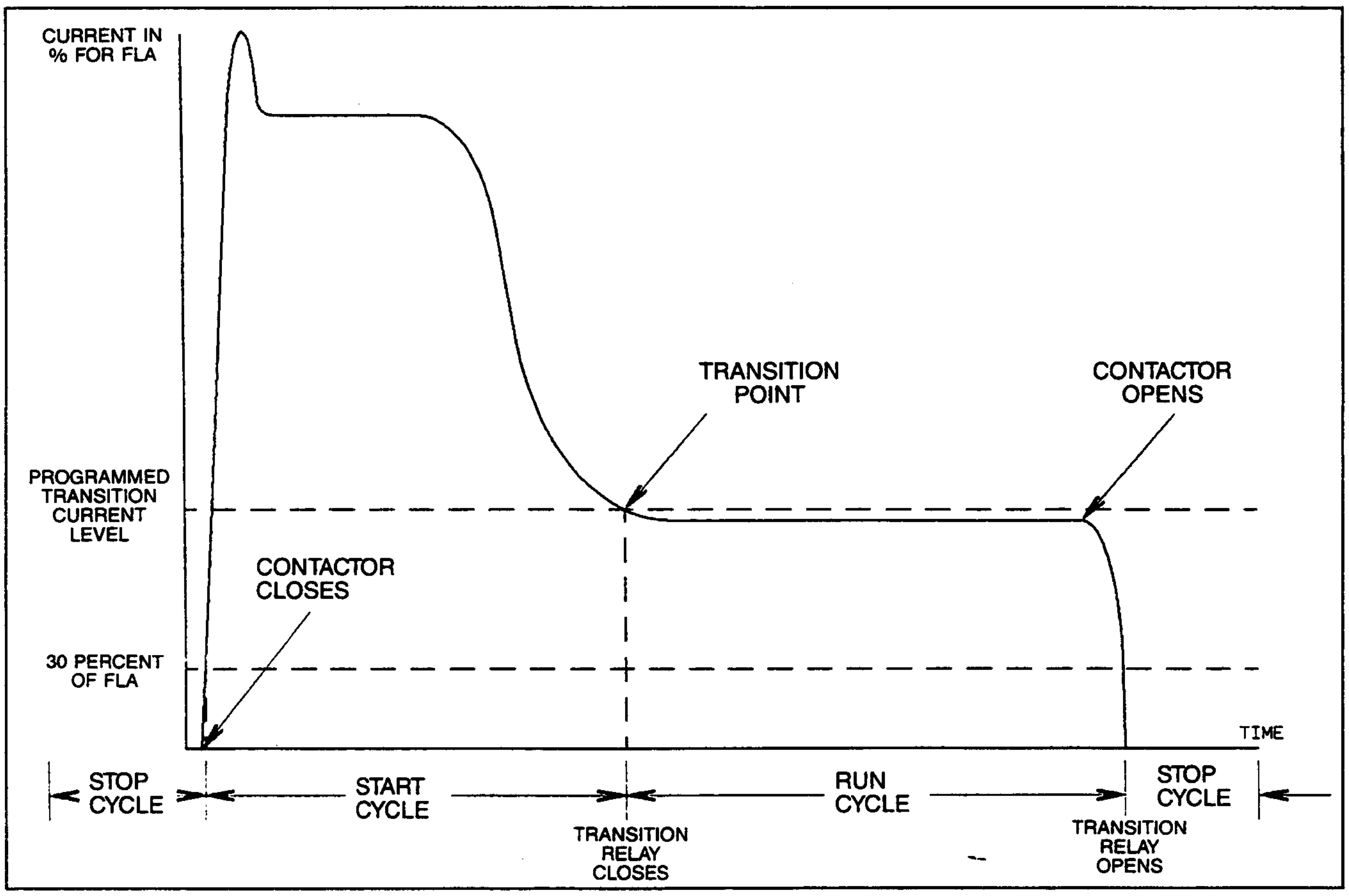


Figure 7.6 — Motor Start and Run Cycles

exceeds 30% of the full-load amperes set point (program menu item 33) assuming the motor was not in a trip condition. At this time the message "START" is displayed and the transition timer begins. The duration of the timer is determined by the motor start transition time (item 29) set point, which may be set to 0 seconds to disable the transition function.

The IQ-1000 will transition if the current falls below the transition set point level (item 28). If a transition does not occur before the transition time expires, the IQ-1000 will trip or transition at the user's choice. The run cycle begins as soon as the transition takes place. If transition time (item 29) is set to 0, the run cycle will begin immediately or a transition trip will occur, depending on Item 30 of Table 8.B.

Once a start is declared, a group of other timers will also begin timing, unless they are disabled. This group includes:

described in Paragraph 8.3.2.)

- Instantaneous overcurrent start delay timer. (Program menu item 11; described in Paragraphs 8.4.2 and 7.1.3.1.)
- Jam start delay timer. (Program menu item 18; described in Paragraph 8.9.2.)
- Underload start delay timer. (Program menu item 21; described in Paragraphs 8.10.2 and 7.1.3.4.)

Disabling the motor start transition (time) function (item 29) cancels any transition time, but these timers, if used, continue to operate independently of the duration of the start cycle. (See Paragraph 8.14 for details.)

7.2.2 Run Cycle — Once the transition occurs, the motor's run cycle is initiated and the message "RUN" is displayed. The run cycle continues until the monitored motor current level falls below 5% of its full-load amperes set point (item 33) at which point a stop is declare and the IQ-1000 returns to the "READY" or stop mode. (See Figure 7.6.)

The run cycle is also considered a normal motor operating state. Protection functions with run delays are active in this state once the start delay has transpired. The primary function of the run delays is to prevent nuisance tripping. These are:

- Ground fault run delay timer. (Program menu item 9; described in Paragraph 8.3.3.)
- Jam run delay timer. (Program menu item 19; described in Paragraphs 8.9.3 and 7.1.3.5.)
- Underload run delay timer. (Program menu item 22; described in Paragraphs 8.10.3 and 7.1.3.4.)
- Phase unbalance run delay timer — Alarm only (Program menu item 24; described in Paragraph 8.11.2.)

It should be kept in mind that run delays become enabled only after the start delay for that function has timed out. The actual run delay begins timing only after the trip condition occurs. (See Paragraph 8.1)

7.2.3 Stop Cycle — When the monitored motor current level falls below 5% of the full-load amperes set point (program menu item 33), the stop cycle begins. When the IQ-1000 is in the stop cycle, it can be in the program mode, ready mode, or any trip mode.

When the anti-backspin delay time function (item 32) is used, it is initiated along with the stop cycle. The purpose of this function is to prevent a start cycle's initiation until the function's user-selected set point time elapses. (The Trip Relay is used in this instance to prevent a motor start.) See Paragraph 8.16 for more details.)

A second function also affects the stop cycle. This is the starts per time allowed function (program menu item 26). It prevents a motor from being restarted once the user-selected set point, in number of starts per a given time, is reached. (Here again the Trip Relay prevents the restart.) Only when the time allowed (for starts) function's set point (item 27) has elapsed can a start cycle be initiated. (See Paragraph 8.13.2.)

7.3 AC Line Interruptions — The IQ-1000 operates in a controlled and predictable manner during incoming AC line interruptions. The events flow chart shown in Figure 7.7 lists the predictable events which occur during various AC line interrupts for a typical motor. The chart assumes a complete, or nearly complete, loss of AC line power.

Study the Figure and note that at least 3 AC cycles must occur before any of the following events occurs. What can occur is that either the IQ-1000 initiates a power-down condition or the main contactor drops out. As indicated in the Figure, the factors which determine which of the conditions occurs are:

- The loading of the IQ-1000's power supply at that time
- The type of contactor being used

In either case, if AC power remains off, eventually the IQ-1000 initiates a "power-down condition." In this case the microprocessor has lost intellegence due to the low voltage condition and will perform a powerup reset when power is restored.

> NOTE
>
> The IQ-1000 will display the message "THINKING" for approximately six seconds after the unit is powered up. The motor is not being protected during this time and will not be allowed to start if the unit is in mode 2 operation. (See Paragraph 8.19)

7.4 Control Signal Wiring — The IQ-1000 communicates with the motor, contactor, and the associated machine or process through the following means:

- Discrete inputs from devices such as pushbuttons or relay contacts
- Outputs, in the form of relay contacts

Each of these topics is discussed separately in the following subparagraphs.

Additionally, there are other sensing inputs from the optional ground fault transformer and current transformers. (These are not discussed here.)

The following 2 inputs are available and may optionally be used:

- REM TRIP/RESET (terminal 8 on rear of unit). This input is used either to reset from a trip condition, or to initiate a trip condition externally. (See Paragraph 8.21.)
- INC SEQUENCE (terminal 10 on rear of unit). This input affects the incomplete sequence report back function (program menu item 31) associated with the transition operation. (See Paragraphs 7.2.1 and 8.15 for details.)

7.4.1 Discrete Inputs — The discrete input terminals, if used, accept user supplied 120 VAC from such field devices as switches, pushbuttons, relay contacts, etc. The characteristics of the circuits associated with these inputs are listed in Table 7.A.

DANGER

When planning discrete input wiring, care must be taken to insure that the leakage current to the input terminals does not exceed 10 mA. The 50/60 Hz leakage currents can be excessive when discrete input signals are derived from certain control devices or located remotely from the starter with long wire runs. The results can cause personal injury and/or equipment damage. An example of this dangerous situation could involve the remotely located contacts of a programmable controller's output module. These could have a leakage greater than 10.0 mA. Excessive leakage currents can result in the reception of false signals at the IQ-1000's discrete input terminals. These may interfere with the start and run cycle's motor sequences. Erratic sequences may cause an injury.

Table 7.A

INPUT CIRCUIT CHARACTERISTICS

Characteristic	Specification
Opto isolation	1500 volts
Input impedance	26K ohms
Input current drain (ON)	4.5 mA
Input current drain (OFF, max.)	10.0 mA

NOTE

The IQ-1000's input contacts must remain closed for a minimum time of 17 cycles in order for the new state to be reliably sensed by the IQ-1000. This duration allows for a distinction to be made between electrical noise and the actual 50/60 Hz signal.

7.4.2 Output Contacts — The IQ-1000's output contacts correspond to the externally accessible terminals of the internal relays, as shown in Figure 2.1. These are all rated as:

- 120 VAC at 10 amperes (resistive)
- 30 VDC at 10 amperes (resistive)

The Trip, Transition, and Bell Relays are discussed throughout Section 8, but especially in Paragraphs 8.13 thru 8.19.2. Also, see Paragraph 3.2 for the Bell Relay.

7.5 Wiring Considerations — A suitable wiring plan that shows the interconnections between the IQ-1000 and the associated machine or process must be developed by the user. This paragraph contains general guidelines to be followed by the application engineer who is developing a specific wiring plan. A wiring plan, which can be considered a typical example, is shown in Figure 5.6.

All wiring must be in conformance with the National Electrical Code as well as any other applicable state and/or local codes.

7.5.1 RTD Wiring — If the optional RTD Module is used, each RTD must be wired as shown in Figure 7.8. Also, note the following requirements:

- Use 10-ohm copper, 100-ohm platinum, or 120-ohm nickel RTD device. The RTD type must be specified at the time of order.
- Use AWG No. 18, 3-conductor, stranded, shielded, copper wires.
- At the RTD, 2 return lines must be wired together, as shown in Figure 7.8.
- In cases where the motor provides only 2 leads from the RTD, connect 2 of the 3 conductor wires together at one of the leads. Make this connection as close to the RTDs as possible. (See Figure 7.8.) If only 2 wire leads are connected between the motor and the IQ-1000, the unit does not function properly.

The cable's shield and drain wire must be connected to the appropriate terminal on the RTD Module. At the opposite end, cut the shield and drain wire short, and insulate them with tape or shrinkable tubing to prevent shorts. Do not connect these at the RTD device end.

In cases where one or more of the 10 possible RTDs is/are not used, it is recommended to jumper out each set of unused RTD inputs separately. For example, if load bearing RTD *2 inputs are not used, jumper terminals 29, 30 and 31 together and separately jumper terminals 26, 27 and 28.

A portion of a typical RTD wiring diagram is shown in Figure 7.8 while a complete RTD wiring plan is shown in Figures 5.7 and 5.8.

7.5.2 Grounding — The IQ-1000 is grounded at terminal 9. This terminal should be connected to the grounded side of the control transformer used to power the IQ-1000. Do not jumper terminals 9 and 22.

The sizing and type of insulation for the AC supply line and the grounding electrode conductor must be in conformance with the National Electrical Code.

7.5.3 Wire Routing — Wire routing is divided into 2 types:

- High-voltage (440 VAC and higher)
- Low-voltage (120 VAC and VDC signals)

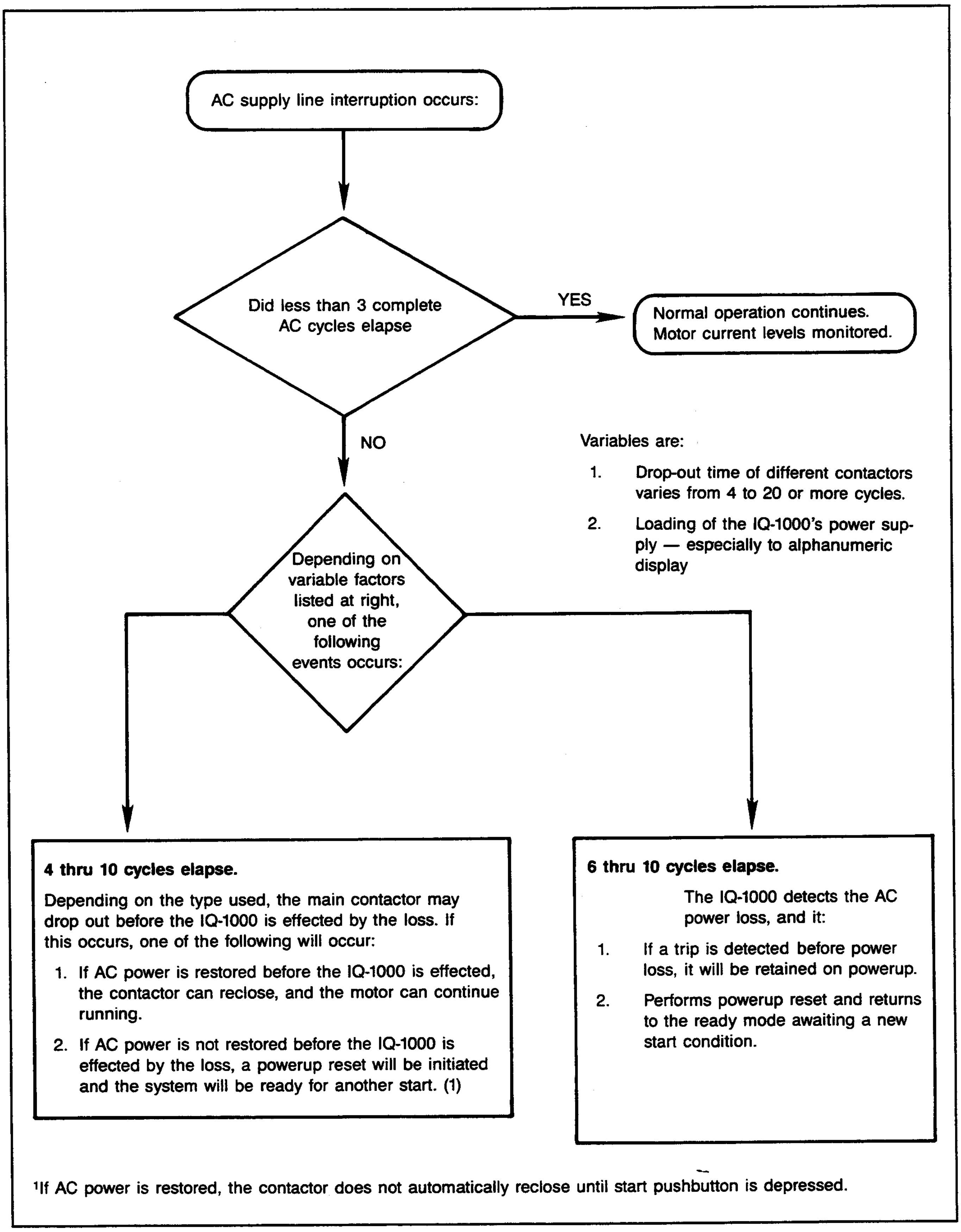


Figure 7.7 — AC Interrupt Events Flow Chart

Low-voltage wires are generally used for control and RTD wiring.

Follow these guidelines when routing:

- Maintain a separation of at least 1 to 2 ft (40 to 60 cm) between high- and low-voltage conductors.
- Never route high- and low-voltage lines in the same raceway.
- Never route low-voltage wires through a high-voltage compartment of the associate starter. (In extreme cases, if it is necessary to do so, contact Westinghouse Control Division for information.)

7.6 Environmental Considerations — Consideration must be given to the actual location of the IQ-1000 enclosure in the plant. The unit operates within an ambient range between 0 to 70°C (32 to 158°F) with a humidity factor of 95% non-condensing.

The IQ-1000's circuit boards are Conformal-coated to withstand environmental contaminants. However, special precautions may be required for extremely dirty or corrosive environments. (Consult Westinghouse Control Division)

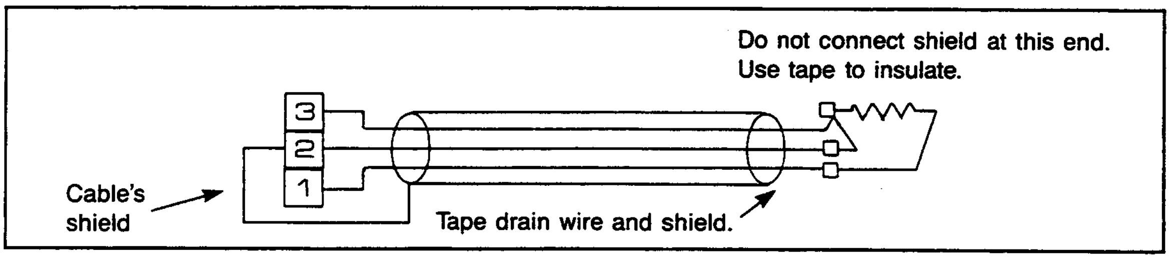


Figure 7.8 — RTD Wiring

Section 8

PROGRAMMING THE IQ-1000 AND SET POINT DESCRIPTION

8.0 General — This Chapter contains information needed by an application engineer to organize the set point values for a specific IQ-1000 so that they may be easily entered. Thirty-eight separate functions are provided. (See Table 8.A which acts as a quick locator alphabetized listing.) It is strongly recommended that **all** the set points be established and verified **before** any entry is begun. For assistance, a Set Point Record Sheet is included here to act as a permanent record of the set point values for an individual application. (See Table 8.B.) Copies of it can be made and stored in a number of locations, including the enclosure containing the IQ-1000.

Not all set point functions and associated values or settings may be required by a given IQ-1000. In such cases, make one of the following notations on the Record Sheet.

- Place N/A or some other notation in the space if the function/value has no effect on operation. (For example, winding temperature, when there is no RTD Module.)
- Write in the value required to disable the function. (Specific instructions on disabling set point functions are given in the following descriptions.)

A copy of a correctly filled-in Set Point Record Sheet must be given to the individual responsible for value entry. The IQ-1000 displays its set point functions in a fixed sequence that is duplicated on the Set Point Record Sheet. Thus the sheet minimizes programming time. (Specific entry procedures are described in Paragraph 4.3.)

Note: Unless specifically stated otherwise, it can be assumed that when operating conditions are greater than the user-selected set point, the function is initiated.

8.1 Start and Run Delays — Start and run delays are used with many of the protection functions of the IQ-1000 to aid in starting and keeping the motor running. Attention should be paid to the units of different delays due to the varying requirements of different types of protection.

8.1.1 Start Delays — Start delays (start lockout delays) disable their related protection functions to prevent transient motor conditions, during the motor inrush period, from creating a trip.

All start delays are tied to the transition cycle in one respect **only**. The beginning of most start delays are initiated by the IQ-1000 declaring a start. The only exception to this rule is the instantaneous overcurrent and ground fault functions which must react in line cycles instead of seconds. Once a start is declared, start delays may time out before or after the IQ-1000 has transitioned to the run state depending on the type of protection. If a trip condition during a start is maintained past the end of the start delay, a trip may occur, never allowing the IQ-1000 to transition to the run mode.

The start delays provided in the IQ-1000 are as follows:

- Ground Fault Start Delay — in line cycles
- Instantaneous Overcurrent Start Delay — in line cycles
- Jam Start Delay — in seconds
- Underload Start Delay — in seconds

8.1.2 Run Delays — Run delays are used to provide a time based filter on transient trip conditions which might cause nuisance tripping.

The run delay is initiated by the occurrence of a trip condition after the associated start delay has timed out. Once the run delay has begun, the trip condition must be maintained for the full length of the run delay. If at any time the condition goes away and then returns, the run delay is reset. The trip condition must remain present for the full length of the run delay time to initiate a trip.

The fastest response for a function with both delays is found by adding the two programmed delays together. This would be the response time if the trip condition were detected at any point during the start delay.

The run delays provided in the IQ-1000 are the following:

- Ground Fault Run Delay — in cycles
- Jam Run Delay — in seconds
- Underload Run Delay — in seconds
- Phase Unbalance Alarm Run Delay — in seconds

8.2 RTD Monitoring — Assuming that optional RTDs are used, and the optional RTD Module is installed, the IQ-1000 is capable of monitoring the operating temperatures at 3 key motor locations. Both trip and alarm set points are available for the 3 placement areas. These are the motor's:

- Stator windings
- Motor bearings
- Load bearings

If the optional RTD Module is not used with the IQ-1000, there is no need to enter these values or to read this information.

If the RTD Module is installed with no RTDs connected, the IQ-1000 will display a "-" for each RTD. This same display is used for shorted or open RTDs. However, it is recommended that unused RTD Module terminals still be jumpered, as described in Paragraph 5.3.1. All valid RTD readings will display a numeric value.

NOTE

If an RTD board is not connected or is connected improperly, all RTD information will be removed from the metering display. This is shown in Table 4.A.

8.2.1 Stator Winding Temperature — The IQ-1000 is capable of monitoring the temperature of a motor's stator windings and using this data to determine the motor protection curve.

Individual set point values can be selected for both trip and alarm conditions. These settings apply to all winding RTDs. The function is displayed in the program menu as:

WD T xxx
WD A xxx

Here the letters T and A represent trip and alarm, respectively. The letters xxx represent the user-chosen value. These program menu items are numbered 1 and 4 in Table 8.B.

The ranges of available set point values are:

Trip: 0 thru 199°C (in 1°C increments)
Alarm: 0 thru 199°C (in 1°C increments)

8.2.2 Motor Bearing Temperature — The IQ-1000 is capable of monitoring two motor bearing RTDs.

Individual set points can be selected and entered for both trip and alarm conditions. The function is displayed in the program menu as:

MB T xxx
MB A xxx

Here the letters T and A represent trip and alarm, respectively. The letters xxx represent the user-chosen value. These menu items are numbered 2 and 5 in Table 8.B.

The ranges of available set point values are:

Trip: 0 thru 199°C (in 1°C increments)
Alarm: 0 thru 199°C (in 1°C increments)

8.2.3 Load Bearing Temperature — The IQ-1000 is capable of monitoring two of the motor's load bearing temperatures.

Individual set points can be selected and entered for both trip and alarm conditions. The function is displayed in the program menu as:

LB T xxx
LB A xxx

Here the letters T and A represent trip and alarm, respectively. The letters xxx represent the user-chosen value. These menu items are numbered 3 and 6 in Table 8.B.

Table 8.A

ALPHABETIZED FUNCTION LISTING

Function	Paragraph
Anti-backspin delay	8.16
Auto reset	8.8
Current Transformer ratio	8.22
Frequency (50/60 Hz)	8.18
Full-load amperes	8.17
Ground fault run delay	8.3.3
Ground fault start delay	8.3.2
Ground fault trip level	8.3.1
Incomplete sequence	8.15
Instantaneous overcurrent start delay	8.4.2
Instantaneous overcurrent % FLA	8.4.1
I^2T alarm level	8.7
I^2T trip level	8.12
Jam run delay	8.9.3
Jam start delay	8.9.2
Jam trip level	8.9.1
Locked-rotor current	8.5.1
Load bearing temperature (alarm)	8.2.3
Load bearing temperature (trip)	8.2.3
Manual reset	8.8
Motor bearing temperature (alarm)	8.2.2
Motor bearing temperature (trip)	8.2.2
Motor start transition (current level)	8.14.1
Motor start transition (time)	8.14.2
Phase unbalance alarm	8.11.1
Phase unbalance run delay	8.11.2
Reset on remote input	8.21.1
Reversing/Non-Reversing	8.20
Stall time	8.5.2
Starts allowed	8.13.1
Time (for starts) allowed	8.13.2
Transition on time out	8.14.1
Trip on time out	8.14.2
Trip relay mode 1	8.19.1
Trip relay mode 2	8.19.2
Trip on remote input	8.21
Ultimate trip	8.6
Underload run delay	8.10.3
Underload start delay	8.10.2
Underload trip level	8.10.1
Winding temperature (alarm)	8.2.1
Winding temperature (trip)	8.2.1
2-second delay (I^2T trip)	8.12

The ranges of available set point values are:

Trip: 0 thru 199°C
(in 1°C increments)
Alarm: 0 thru 199°C
(in 1°C increments)

8.3 Ground Fault — The IQ-1000's ground fault function provides protection against excessive ground leakage currents. Use of this function requires an external ground fault current transformer to be installed in the application. The turns ratio assumed by the IQ-1000 is always 50/5. This set point function can only be applied to a grounded system, as described in Paragraph 7.1.6.

There are 3 distinct set points associated with this function. These are:

Trip level (in primary amperes)
Start delay (in cycles)
Run delay (in cycles)

Assuming a ground fault transformer is being used, all 3 of these set point functions must be "used" in the IQ-1000. The delay functions can be defeated by setting the start delay to 1 line cycle and the run delay to 0 line cycles. If no ground fault current transformer is connected, these set points are ignored and no ground fault protection is provided.

NOTE

If the run delay is set to 0, trips may occur at a lower current level than specified due to the sampling used in maintaining the high speed response of this function.

8.3.1 Trip Level — The IQ-1000 has a selectable ground fault trip level above which a trip will occur after the specified start and run delays. The set point is defined in amperes. The ground fault trip level is displayed in the program menu as:

GF xx

Here the letters xx represent the user-determined current level above which a trip condition occurs. This menu item is numbered 7 in Table 8.B.

The range of available set point values is:

Trip: 4 thru 12 amperes
(in 1-ampere increments)

8.3.2 Start Delay — The IQ-1000 provides a start lockout delay to allow the ground current that can be generated by power factor correction capacitors during starting to clear. The application of a start delay is described in Paragraph 8.1.1.

The ground fault start delay function is displayed in the program menu as:

GFSD xx

Here the letters xx represent the user-determined delay, which, when reached, allows a trip condition to be initiated. This menu item is numbered 8 in Table 8.B.
The range of available set point values is:

Start delay: 1 thru 20 AC line cycles
(in 1 cycle increments)

** Disable Setting for GFSD — 1 line cycle **

8.3.3 Run Delay — The IQ-1000 provides a run delay to prevent momentary disturbances in the system from causing a nuisance trip. The application of a run delay is described in Paragraph 8.1.2.

The ground fault run delay function is displayed in the program menu as:

GFRD xx

Here the letters xx represent the user-determined delay, which, when reached, allows the trip condition. This menu item is numbered 9 in Table 8.B.

The range of available set point values is:

Run delay: 0 thru 10 AC line cycles
(in 1 cycle increments)
** Disable Setting for GFRD—0 cycles **

8.4 Instantaneous Overcurrent Protection — The IQ-1000's instantaneous overcurrent function monitors motor current on a continuous basis. It requires no more than 2 line cycles to detect a trip condition. Because of the magnitudes of current that can be seen in an instantaneous overcurrent, no run delay is provided.

There are 2 distinct set points associated with this function. These are:

Instantaneous overcurrent (in percent of **peak** full-load amperes)
Instantaneous overcurrent start delay (in cycles)

(Paragraph 7.1.3.1 details those application conditions involved in selecting the appropriate value.)

8.4.1 % Full-load Amperes — The IQ-1000 provides an instantaneous overcurrent trip level in percent of the **peak** full load amps. This is done to give the fastest response possible when a fault condition occurs.

NOTE

The chosen set point value **must** be equal to, or higher, than 1.6 times the locked-rotor current ratio, provided by the motor manufacturer.

NOTE

For the I.O.C. trip level to be effective, set it below your fuse interrupting rating *or* your contactor withstand rating.

The instantaneous overcurrent function, in percent of full-load amperes, is displayed in the program menu as:

IOC xxxx

Here the letters xxxx represent the user-determined level, which, when reached, allows a trip condition. This menu item is numbered 10 in Table 8.B.

Table 8.B

SET POINT RECORD SHEET

Program Date ____________ **Control Schematic** ____________

Unit ID/Starter Type ____________ **W. Order #** ____________

Motor HP ________ **Mfgr.** ________ **Serial** ________ **Volts** ________

FLA ________ **LRA** ________ **Stall Time** ________ **Accel Time** ________

SF ________ **RTD Type** ________ **Other** ________

Item No.	Program Menu Display (1) (2)	Selected Value	Set Point Ranges Selections
0	S VER XX SOFTWARE VERSION NUMBER (3)	N/A	N/A
1	WD T XXX WINDING TEMP TRIP IN DEGREES C		0 thru 199°C (1 incre.)
2	MB T XXX MOTOR BEARING TRIP IN DEGREES C		0 thru 199°C (1 incre.)
3	LB T XXX LOAD BEARING TRIP IN DEGREES C		0 thru 199°C (1 incre.)
4	WD A XXX WINDING TEMP ALARM IN DEGREES C		0 thru 199°C (1 incre.)
5	MB A XXX MOTOR BEARING ALARM IN DEGREES C		0 thru 199°C (1 incre.)
6	LB A XXX LOAD BEARING ALARM IN DEGREES C		0 thru 199°C (1 incre.)
7	GF XX GROUND FAULT TRIP LEVEL IN AMPS		4 thru 12 amps (1-amp incre.)
8	GFSD XX GROUND FAULT START DELAY IN CYCLES		1 thru 20 AC cycles (1-cycle incre.)
9	GFRD XX GROUND FAULT RUN DELAY IN CYCLES		0 thru 10 AC cycles (1-cycle incre.)
10	IOC XXXX INSTANTANEOUS OVERCURRENT IN % FLA (5)		300 thru 1500% (1% incre.)
11	IOCSD XX INSTANTANEOUS OVERCURRENT START DELAY IN CYCLES		1 thru 20 cycles (1-cycle incre.)
12	LRC XXXX LOCKED ROTOR CURRENT IN % FLA		300 to 1200% (1% incre.)
13	LRT XX STALL TIME IN SECONDS		1 thru 60 sec. (1-sec. incre.)
14	UTC XXX ULTIMATE TRIP CURRENT IN % FLA		85 thru 125% (1% incre.)
15	I^2TA XXX I^2T ALARM LEVEL IN % I^2T TRIP		60 thru 100% (1% incre.)
16	MAN RST (4) MANUAL I^2T RESET AUTO RST (4) AUTO I^2T RESET		Toggles between MAN RST and AUTO RST displays

Table 8.B

SET POINT RECORD SHEET
(Cont'd.)

Item No.	Program Menu Display (1) (2)	Selected Value	Set Point Ranges Selections
17	JAM XXXX JAM TRIP LEVEL IN % FLA		100 thru 1200% (1% incre.)
18	JAMS XX JAM START DELAY IN SECONDS		0 thru 60 sec. (1-sec. incre.)
19	JAMR XXX JAM RUN DELAY IN SECONDS		0 thru 240 sec. (1-sec. incre.)
20	UL XX UNDERLOAD TRIP LEVEL IN % FLA		0 thru 90% (1% incre.)
21	ULSD XXX UNDERLOAD START DELAY IN SECONDS		0 thru 100 sec. (1-sec. incre.)
22	ULRD XX UNDERLOAD RUN DELAY IN SECONDS		0 thru 10 sec. (1-sec. incre.)
23	PU A XX PHASE UNBALANCE ALARM LEVEL		10 thru 50% (1% incre.)
24	PURD XXX PHASE UNBALANCE ALARM RUN DELAY IN SECONDS		0 thru 240 sec. (1-sec. incre.)
25	I^2T TRIP (4) I^2T TRIP 2 SEC (4) 2 SECOND DELAY ON PHASE UNBALANCE		Toggles between I^2T TRIP and 2 SEC displays
26	ST/T XX STARTS PER TIME ALLOWED		1 thru 10 starts/ time (incre. of 1)
27	T/ST X TIME ALLOWED FOR STARTS COUNT IN HOURS		0 to 4 hours duration (1 hour incre.)
28	TRNC XXX MOTOR START TRANSITION CURRENT LEVEL IN % FLA		50 thru 150% (1% incre.)
29	TRNT XXX MOTOR START TRANSITION TIME IN SECONDS		0 thru 240 sec. (1-sec. incre.)
30	TRN TOUT (4) TRANSITION ON TIME OUT TRP TOUT (4) TRIP ON TIME OUT		Toggles between TRN TOUT and TRP TOUT displays
31	INSQ XX INCOMPLETE SEQUENCE REPORT BACK TIME IN SECONDS		1 thru 60 sec. (1-sec. incre.)
32	ABKS XXX ANTI-BACKSPIN DELAY TIME IN SECONDS		0 thru 600 sec.
33	FLA XXXX FULL-LOAD AMPS		10 thru 3000 amps (1-amp incre.)

Table 8.B

SET POINT RECORD SHEET (Cont'd.)

Item No.	Program Menu Display (1) (2)	Selected Value	Set Point Ranges Selections
34	FREQ 50 (4) 50 OR 60 HERTZ LINE FREQUENCY FREQ 60 (4)		Toggles between FREQ 50 and FREQ 60 displays
35	MODE 1 (4) TRIP MODE 1 — TRIP RELAY ENERGIZES ON TRIP CONDITION (4) MODE 2 (4) TRIP MODE 2 — TRIP RELAY ENERGIZES ON POWER UP AND DE-ENERGIZES ON TRIP CONDITION (4)		Toggles between MOT1 and MOT2
36	NON REV (4) REVERSING OR NONREVERSING STARTER REV (4)		Toggles between REV and NONREV displays
37	REM TRIP (4) TRIP OR RESET ON REMOTE INPUT REM RST (4)		Toggles between REM TRIP and REM RST displays
38	CTR XXX CT RATIO—N TURNS TO 1		Available CT turns:1 ratios are: 2, 4, 5, 8, 10, 15, 20, 30, 40, 50, 60, 80, 100, 120, 160, 200, 240, 300, 400, 500, 600, 800

(1) The letters X used here represent the set point values.

(2) Press the Step Up and Step Down pushbuttons simultaneously to initiate the "help" display of the complete message shown here. The Display scrolls left to right.

(3) The software version number is used by Westinghouse. There is no selection associated with it. All correspondence with Westinghouse should refer to the specific software version number of the IQ-1000 installed.

(4) One of the 2 choices must be selected.

(5) I.O.C. trip setting should be lower than your Fuse Interrupting Rating *or* your Contactor Withstand Rating.

The range of available set point values is:

Trip: 300 thru 1500%
of full-load amperes
(in 1% increments)

NOTE

When IOC trips occur, the displayed metered values will normally not reflect the actual fault current. This is due to the averaging used in the display value to make them easier to read.

8.4.2 Start Delay — The IQ-1000 provides a start delay to allow the IQ-1000 to ride through the first cycles of inrush current during starting. The application of a start delay is described in Paragraph 8.1.1. (For more details on the motor's start and stop cycles, refer to Paragraph 7.2.)

The instantaneous overcurrent start delay set point function is displayed in the program menu as:

IOCSD xx

Here the letters xx represent the user-determined delay.

This menu item is numbered 11 in Table 8.B. A nonabbreviated display is available by means of the "help" screen, as indicated in the same Table.

The range of available set point values is:

Delay: 1 thru 20 AC line cycles
(in 1-cycle increments)

** Disable Setting for IOCSD—1 line cycle **

8.5 Locked-rotor Protection — Two IQ-1000 functions operate together to specify a point on the motor damage curve. This current and time, when reached, create a locked-rotor trip condition. These are:

- Locked rotor current (in percent of full-load amperes)
- Stall time (in seconds)

(More information on how these set point functions affect the motor protection curve is contained in Paragraphs 7.1.3.2 and 7.1.4.)

NOTE

The locked-rotor current and the maximum allowable stall time values must be obtained from the motor manufacturer.

CAUTION

The rotor temperature protection algorithm uses the locked-rotor current and the maximum allowable stall time values to calculate the rotor protection curve. Incorrectly chosen set point values for these functions can result in excessive rotor temperatures and eventual motor damage.

8.5.1 Locked-rotor Current — The locked-rotor current value specified by the motor manufacturer is the current a motor will draw if the rotor is stalled. This set point along with the stall time defines the thermal capacity of the motor.

The locked-rotor current function is displayed in the program menu as:

LRC xxxx

Here the letters xxxx represent the level determined by the motor manufacturer. This menu item is numbered 12 in Table 8.B.

The range of available set point values is:

Trip: 300 thru 1200%
of full-load amperes
(in 1% increments)

8.5.2 Stall Time — The maximum allowable stall time function specifies the amount of time a locked rotor condition can be maintained before damage is done to the motor. This value is supplied by the manufacturer and should be used in conjunction with the locked rotor current.

The stall time set point function is displayed in the program menu as:

LRT xx

Here the letters xx represent the maximum allowable time determined by the motor manufacturer. This menu item is numbered 13 in Table 8.B. The range of available set point values is:

Time: 1 thru 60 seconds
(in 1-second increments)

8.6 Ultimate Trip — The ultimate trip function defines the current level above which a trip will eventually happen. This value represents an asymptotic line on the motor damage curve below which the motor will never be damaged.

This setpoint is used when RTDs are not used to define the level above which the I^2T accumulator will start to migrate toward a trip. If a service factor is supplied with the motor, it can be multiplied times the full load amp rating to give the maximum ultimate trip level. For example, a motor with a 1.25 service factor can use an ultimate trip level of 125 percent of full load. (Paragraph 7.1.3.3 describes application considerations related to value selection.)

Some possible reasons for using a conservative approach in which the ultimate trip is less than 100% are:

- When ambient temperatures above 40° C are anticipated and the optional RTD Module is **not** used in the application. (Environmental temperature considerations are discussed in Paragraph 7.1.3.6.)
- When the motor is properly rated, yet additional safety is critical for the application.

CAUTION

If the ultimate trip set point value is **above** 100% and the motor does **not** have a service factor rating higher than 1, motor damage can result.

The ultimate trip function is displayed in the program menu as:

UTC xxx

Here the letters xxx represent the user-determined percent of full-load amperes for the ultimate trip level. This menu item is numbered 14 in Table 8.B.

The range of available set point values is:

Trip: 85 thru 125%
of full-load amperes
(in 1% increments)

8.7 I^2T Alarm — The I^2T alarm function refers to the current-squared multiplied-by-time algorithm discussed at Paragraph 3.2.2. The accumulated I^2T is directly proportional to the rotor temperature. The I^2T trip is a level selected in percent of the I^2T trip value. This gives the user some idea of how close to a trip the IQ-1000 is since the I^2T trip point is derived from the programmed motor parameters and maintained internally. (The maximum rotor temperature trip point is explained in Section 3.)

NOTE

This function also determines when the I^2T trip condition can be reset, as described in Paragraph 8.7. The closer to 100% the alarm is set, the sooner the motor can be restarted, however, the motor inrush may create another trip if the motor has not been allowed to cool.

The I^2T alarm function is displayed in the program menu as:

I^2TA xxx

Here the letters xxx represent the user-entered percent, at which level the alarm condition is initiated. This menu item is numbered 15 in Table 8.B.

The range of available set point values is:

Alarm: 60 thru 100%
of the "I^2T trip level"
(in 1% increments)
** Disable Setting — 100 % of trip **

The I^2T alarm level is explained on the help screen as I^2T ALARM LEVEL IN % I^2T TRIP. However, there is no precise trip level set point function. The actual trip level is calculated by the IQ-1000 internally, as discussed in Paragraph 3.2.2.

NOTE

The I^2T accumulator is cleared every time the IQ-1000 is placed in program mode. This can be used to clear an I^2T trip without waiting for the motor to cool.

8.8 Reset Function — The reset function allows either manual or automatic resetting from a Locked rotor or an "I^2T" trip. In the automatic mode, the IQ-1000 will reset an I^2T trip after the I^2T accumulator has cooled below the I^2T alarm level discussed in Paragraph 8.7 or is cleared in program mode.

In the manual mode, an I^2T trip must be reset by the user in one of three ways **after** the I^2T accumulator has cooled below the I^2T alarm level. One is to push the reset button on the operator's panel. The second is to set remote trip/reset to the reset mode (menu item 37) and apply 120 VAC across terminals 8 and 9 on the back of the IQ-1000. The third way to reset an I^2T trip is to issue a command over the communications port from a host computer.

With this function, one of these two functions **must** be selected for every application. Pressing either the Raise or Lower pushbutton causes the display to toggle between the two following messages:

MAN RST AUTO RST

This menu item is numbered 16 in Table 8.B

8.9 Jam Functions — The IQ-1000 provides a jam function for initiating a trip for mechanical failures in a driven load. (More information on the jam functions is given in Paragraph 7.1.3.5.)

There are 3 distinct set points associated with the jam function. These are:

Trip level (in % FLA)
Start delay (in seconds)
Run delay (in seconds)

8.9.1 Trip Level — The jam trip level set point function specifies the current level above which a trip condition is initiated. (This level is measured as a percent of full-load amperes.)

The jam trip level set point function is displayed in the program menu as:

JAM xxxx

Here the letters xxxx represent the user-entered percent of full-load amperes. This menu item is numbered 17 in Table 8.B.

The range of available set point values is:

Trip: 100 thru 1200%
of full-load amperes
(in 1% increments)

For applications which do not require the use of this function, set the trip value to 1200%.

8.9.2 Start Delay — The IQ-1000 provides a start delay to allow high inertia loads to be accelerated over a long period of time without a nuisance trip. The application of a start delay is described in Paragraph 8.1.1. The jam start delay function is displayed in the program menu as:

JAMS xx

Here the letters xx represent the number of seconds selected to block out the jam function.This menu item is numbered 18 in Table 8.B.

The range of available set point values is:

Start delay: 0 thru 60 seconds
(in 1-second increments)
** Disable Setting for JAMS — 0 seconds **

8.9.3 Run Delay — The IQ-1000 provides a jam run delay to allow for heavy loads which are loaded and unloaded, such as a conveyer belt drive. The application of a run delay is described in Paragraph 8.1.2.

The jam run delay function is displayed in the program menu as:

JAMR xxx

Here the letters xxx represent the user-selected delay, at which time the trip occurs.

This menu item is numbered 19 in Table 8.B. A nonabbreviated display is available by means of the help screen, as indicated in the same Table.

The range of available set point values is:

Run delay: 0 thru 240 seconds
(in 1-second increments)
** Disable Setting for JAMR — 0 seconds **

8.10 Underload Functions — The IQ-1000's underload functions initiate a trip condition if the motor's driven load drops **below** a selected value for a selected time. (More information about underload is given in Paragraph 7.1.3.4.)

There are 3 distinct set points associated with the underload function. These are:

Trip level (in % FLA)
Start delay (in seconds)
Run delay (in seconds)

8.10.1 Trip Level — The underload trip level function specifies the current level at which the IQ-1000 assumes the motor lost its load and trips the motor off line.

The underload trip level set point function is displayed in the program menu as:

UL xx

Here the letters xx represent the trip level in percent of full-load amperes. This menu item is numbered 20 in Table 8.B.

The range of available set point values is:
Trip: 0 thru 90%
of full-load amperes
(in 1% increments)
** Disable value for UL—0 % of full load amps **

8.10.2 Start Delay — The IQ-1000 provides a start delay to allow a motor to be started while unloaded and reach full speed before the load is applied. The application of a start delay is described in Paragraph 8.1.1.

The underload start delay function is displayed in the program menu as:

ULSD xxx

Here the letters xxx represent the user-selected delay, at which time the trip occurs. This menu item is numbered 21 in Table 8.B.

The range of available set point values is:

Delay: 0 thru 100 seconds
(in 1-second increments)
** Disable Setting for ULSD — 0 seconds **

8.10.3 Run Delay — The IQ-1000 provides a run delay for varying loads such as a power factor corrected motor which is run at very light loads intermittently. The application of a run delay is defined in Paragraph 8.1.2.

The underload run delay function is displayed in the program menu as:

ULRD xx

Here the letters xx represent the underload run delay. This menu item is numbered 22 in Table 8.B.

The range of available set point values is:

Run Delay: 1 thru 10 seconds
(in 1-second increments)
** Disable Setting for ULRD—1 second **

8.11 Phase Unbalance Functions — The phase unbalance functions involve the IQ-1000's monitoring of the AC line for a possible phase unbalance condition of the actual motor currents.

There are 2 distinct set points associated with this function. These are:

Alarm level (in % unbalance)
Run delay (in seconds)

These 2 functions, however, do not cause a trip condition. (The functions described in Paragraph 8.12 control the phase unbalance trip condition.)

(Keep in mind that unbalance-detection factors are also incorporated into the I^2T protection algorithm. Should the calculated negative sequence become too high due to a combination of excessively high current levels and/or a phase unbalance condition, the IQ-1000 will trip on a locked rotor trip.)

8.11.1 Alarm Level — The phase unbalance alarm level specifies the point at which a detected phase unbalance condition initiates an alarm condition. The level is in percent of unbalance. This is calculated by comparing the ratio of the negative sequence current to the positive sequence current (See section 3.2.2 for more details). If the negative sequence is 10% of the positive sequence, there is a 10% unbalance between I_A, I_B, and I_C.

The phase unbalance alarm set point function is displayed in the program menu as:

PU A xx

Here the letters xx represent the Phase unbalance alarm level above which an alarm condition exists. This menu item is numbered 23 in Table 8.B.

The range of available set point values is:

Alarm: 10% thru 50%
of unbalance
(in 1% increments)
** Disable Setting for PU A — 50% unbalance**
(Same level as a phase loss trip)
(See Paragraph 8.12)

NOTE

If a phase unbalance alarm is active and the unbalance condition is removed, the alarm is reset automatically.

8.11.2 Run Delay — The IQ-1000 provides a run delay to allow for power system voltage variations which could cause short term unbalance conditions. The application of a run delay is described in Paragraph 8.1.2.

The phase unbalance run delay function is displayed in the program menu as:

PURD xxx

Here the letters xxx represent the user-selected delay, at which time the alarm is initiated. This menu item is numbered 24 in Table 8.B.

The range of available set point values is:

Delay: 0 thru 240 seconds
(in 1-second increments)
** Disable Setting for PURD—0 seconds **

8.12 Trip/Delay Phase Unbalance Function — This IQ-1000 setpoint pertains to the phase unbalance **trip** function and not the alarm function. A phase unbalance trip condition is defined as the negative sequence being equal to half of the positive sequence or a 50% phase unbalance (See Section 3 for more detail).

The phase unbalance protection function provides a choice between (1) initiating a trip 2 seconds after the phase unbalance level is reached and (2) disabling this function to wait on an I^2T trip. The set 2 second delay on phase unbalance is necessary to prevent nuisance tripping associated with momentary disturbances in the system.

Waiting on the I^2T trip allows the motor to run until the last possible minute before tripping for critical applications where the motor must keep running as long as possible. One such application would be a chemical process which, if stopped, would ruin the material in the process.

With this function, one of these two choices **must** be selected for every application. Pressing either the Raise or Lower push-button causes the display to toggle between the two following messages:

I^2T TRIP 2 SEC

This menu item is numbered 25 in Table 8.B.

8.13 Starts, Time Functions — Two separate set point functions control the number of motor starts allowed within a given period of time. These are:

- Starts (number of starts per time period allowed)
- Time period allowed (for those starts)

Should the user-specified number of motor starts exceed the set point within the specified time period, any further start cycles are prevented until the oldest start is returned.

These functions must be "used" in the sense that the user must always make a set point entry for both. However, by following the procedures described below, they can, in effect, be disabled.

NOTE

The number of starts is cleared every time the IQ-1000 is placed in the program mode. This can be used to clear a starts/exceeded trip.

8.13.1 Starts Allowed — The starts (per time) allowed set point function specifies the maximum number of motor starts permitted (within a given period). If this set point is reached, an alarm condition will appear with the message "STEX XXX" on the display. STEX stands for "starts exceeded" and the XXX is the number of minutes the user must wait before the oldest start is restored. If the motor is stopped while this message in on the screen, the alarm will become a trip and the motor cannot be started until the oldest start is returned.

All starts, including aborted starts, are counted by this function.

The starts allowed set point function is displayed in the program menu as:

ST/T xx

Here the letters xx represent the user-selected maximum number of allowed starts. This menu item is numbered 26 in Table 8.B.

The range of available set point values is:
Starts: 1 thru 10 starts
(within the time period)

This function can be indirectly disabled, thereby permitting an unlimited number of starts. (See Paragraph 8.13.2 for details.) Under these circumstances, any entry (1 thru 10) would be acceptable.

8.13.2 Time Allowed — The time allowed (for starts) set point function specifies the duration in which the maximum number of starts occurs. Each start has a "life span" equal to the time allowed set point. This means every start that is used will not be returned until it has been logged for the duration of this setpoint. This function works like a sliding window and will return starts in the same pattern they were used.

It is important to note that the set point is programmed in hours in the program mode. However in the run mode, the display indicates the minutes remaining in the time period.

The time allowed set point function is displayed in the program menu as:

T/ST x

Here the letter x represents the user-selected time period in which the maximum number of starts is allowed. This menu item is numbered 27 in Table 8.B.

The range of available set point values is:
Time: 0 thru 4 hours
(in 1-hour increments)
** Disable Setting for T/ST—0 hours **

By entering 0 hours, the time allowed function is, in effect, disabled. Additionally, this entry disables the starts allowed function, (item 26) thereby permitting an unlimited number of starts over any time period.

NOTE

When the time per allowed starts is set to 0, the display values 19 and 20 in Table 4.A will be "—" to denote this function is disabled.

8.14 Motor Start Transition — The IQ-1000 provides a relay which can be set to energize on certain current levels or timing delays. Programmable set points are required for the transition current level (item 28), the transition time (item 29), and action to take on transition time out (item 30). This "Transition" Relay can be used to control:

- Soft-start type motor starts
- Low- and high-voltage reduced voltage motor starters
- Any type of clutch between the motor and the driven load. (The clutch will be engaged after the motor attains the desired speed.)

8.14.1 Motor Start Transition (Current Level) — The motor start transition (current level) function specifies the current level below which the IQ-1000's Transition Relay will be energized. The current level is measured as a percent of full-load amperes.

The primary transition function is based on current. The transition time (item 29) is used as a backup in case the motor

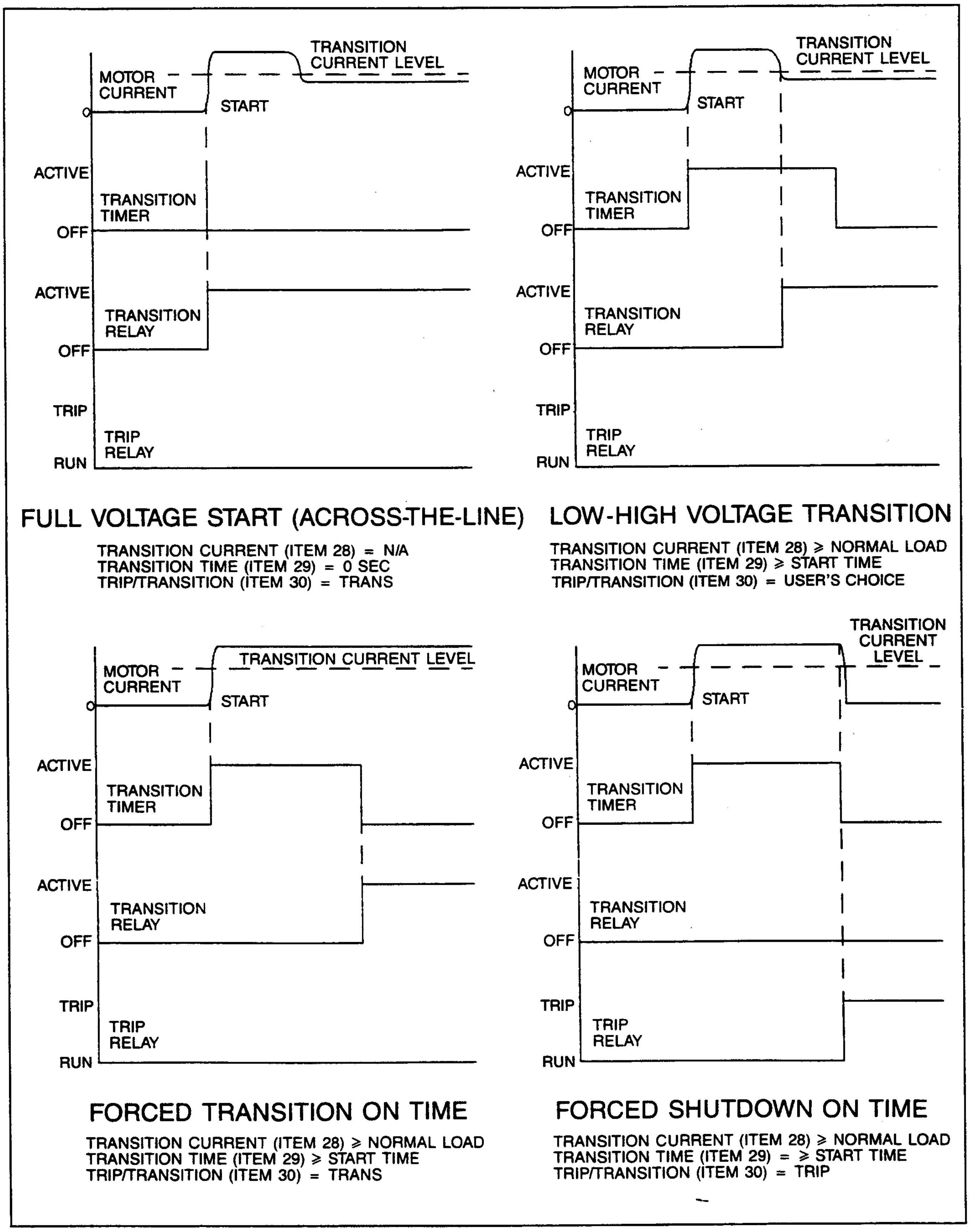


Figure 8.1: Transition/Trip on Time Out Timing

is stalled during starting. When 30% of full load is detected in any phase by the IQ-1000, a start is declared. The normal inrush currents of a motor (even a solid state starter with the voltage phased back) will exceed any of the allowable transition current levels immediately. If the current in any phase falls below the transition level within the transition time, the transition relay is energized and will remain so until a stop or trip condition occurs (See Figure 8.1(b).). Once a start has occurred, the current must go above the transistion level within 8 line cycles or an immediate transition may be initiated.

If the transition relay is not used, the transition current should be set to the maximum setting of 150%.

The motor start transition set point function is displayed in the program menu as:

TRNC xxx

Here the letters xxx represent the user-selected current level below which point the Transition Relay will be energized. This menu item is numbered 28 in Table 8.B.

The range of available set point values is:

Current: 50 thru 150%
of the full-load amperes rating
(in 1% increments)

8.14.2 Motor Start Transition (Time) — The motor start transition (time) specifies the maximum duration, in seconds, of the motor's start or "transition" cycle. The transition time is used as a backup timer only when the IQ-1000 has not transitioned on current. If this happens, the IQ-1000 will force a transition or create a transition trip depending on the trip/transition set point (item 30).

(For more details on the motor's start and run cycles, refer to Paragraph 7.2.)

The motor start transition (time) set point function is displayed in the program menu as:

TRNT xxx

Here the letters xxx represent the user-selected duration of the start or "transition" cycle. This menu item is numbered 29 in Table 8.B.

The range of available set point values is:

Time: 0 thru 240 seconds
(in 1-second increments)
** Disable Setting for TRNT—0 seconds **

If the transition relay is not used (across the line starts), the transition current (item 28) should be set to a maximum (150%) and the transition time to 0 seconds to force an immediate transition eliminating the start cycle (See Figure 8.1(a)). However, if the transition current is set to a minimum to force the IQ-1000 to transition on time, the transition relay can be used as a generic timer programmed by the transition time. Care must be take to insure the current will never fall below 50% (minimum transition current level) before the transition time.

8.14.3 Trip/Transition on Time Out Function — The IQ-1000 allows the user a choice of action when the transition time (item 29) expires before a transition on current is made. One action is to force the transition and energize the transition relay shown in Figure 8.1(c). The other is to create a transition trip to shut down the motor as in Figure 8.1(d). A transition trip will generate a message of "TRANS" on the display.

With this function, pressing either the Raise or Lower pushbutton causes the display to toggle between the messages:

TRN TOUT TRP TOUT

This menu item is numbered 30 in Table 8.B.

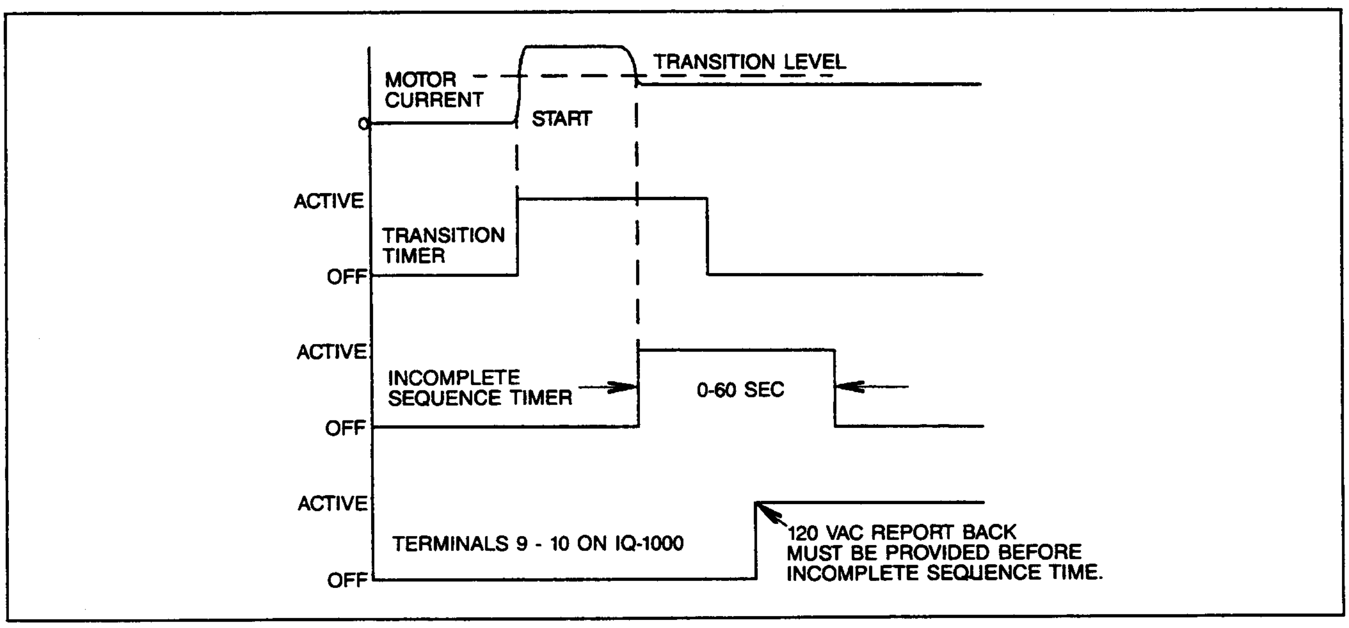


Figure 8.2—Incomplete Sequence Timing

8.15 Incomplete Sequence Time — The incomplete sequence report back timer function is used to confirm that when the transition relay is energized, the proper action was generated within a specified amount of time. The timer begins simultaneously with the closing of the transition relay. If 120 VAC is not applied to terminals 9 and 10 on the back of the IQ-1000 within the incomplete sequence time, a trip is generated and the message "INC SEQ" is displayed. Once the report back is acknowledged, the 120 VAC is no longer monitored and can be removed.

One common use of this report back is with auxiliary contacts on the main contactor to make sure it closed. The timing cycle of events is shown in Figure 8.2.

The incomplete sequence report back function is displayed in the program menu as:

INSQ xx

Here the letters xx represent the incomplete sequence timer duration. This menu item is numbered 31 in Table 8.B.

The range of available set point values is:
Time: 1 thru 60 seconds
(in 1-second increments)

NOTE

This function is disabled from the factory with jumpers from terminal 9 to 5 and 10 to 6 on 120 VAC operation. If this function is to be connected these jumpers must be removed.

NOTE

Once a transition has taken place and the incomplete sequence feedback has been detected, the input is no longer monitored.

8.16 Anti-backspin Delay — The anti-backspin delay function prevents a motor restart for the duration of the user-specified time. Timing begins concurrently with a trip or stop condition. This function guards against any attempt to start the motor while it is rotating in a reverse direction, as may be caused with certain types of loads. A typical example is the backspin of a pump and motor caused by the descent of a column of water after pumping is terminated. (This assumes that enough time has been entered to assure a complete stop.)

The anti-backspin delay function is displayed in the program menu as:

ABKS xxx

Here the letters xxx represent the user-specified duration. This menu item is numbered 32 in Table 8.B.

The range of available set point values is:

Time: 0 thru 600 seconds
(in 1-second increments)
** Disable Setting for ABKS- 0 seconds **

8.17 Full-load Amperes — The full-load amperes function specifies the maximum continuous RMS current that can be permitted in a motor stator. This value is user-entered, but determined by the motor manufacturer's full-load ampere rating at unity service factor.

Primarily this function is used internally by the IQ-1000. It is used in conjunction with the current transformer ratio (item 38) to scale the incoming currents into a per unit basis for calculation and then again to display metered values of current.

NOTE

When in the run mode, the run-monitor percent of full-load current (monitor menu items % IA, % IB, % IC) is established by the full-load amperes set point function.

CAUTION

Many of the IQ-1000's protection functions, including the motor temperature protection algorithm, use the full-load ampere set point value to calculate trip points. If the user enters an incorrectly determined set point, motor damage can result.

The full-load amperes function is displayed in the program menu as:

FLA xxxx

Here the letters xxxx represent the manufacturer's recommended full-load amperes specification for the motor. This menu item is numbered 33 in Table 8.B.

The range of available set point values is:
Time: 10 thru 3000 amperes
(in 1-ampere increments)
This function **must** be programmed into the IQ-1000.

8.18 Frequency — The IQ-1000 may operate from either a 60-Hz or 50-Hz AC line. A selection must be made by means of the 50/60-Hz line frequency function. There are no hardware settings necessary.

The 50/60-Hz line frequency function is displayed in the program menu as:

FREQ 50 FREQ 60

With either of these 2 displays showing, pressing either the Raise or Lower pushbutton causes the other to appear.

This menu item is numbered 34 in Table 8.B.

NOTE

Selecting the wrong frequency can create an opto error if voltage is applied to the Remote Trip/Reset terminal (8) or the Incomplete Sequence terminal (10).

8.19 Trip Relay Modes — One of two different Trip Relay reaction modes may be selected by the user in response to a number of operating conditions. These are:

Mode 1: Trip Relay is de-energized normally and energizes during a trip condition

Mode 2: Trip Relay is energized normally and de-energizes during a trip condition

One of these two selections must be made for each application. The selection depends on the desired effect of an AC power loss on an application, as described in Paragraphs 8.19.1 and 8.19.2.

8.19.1 Mode 1 — When the trip mode 1 function is selected, the Trip Relay will energize only on a trip condition. The Trip Relay is in the de-energized state when any of the following conditions occur:

- When AC line power to the IQ-1000 is lost or interrupted
- When certain IQ-1000 hardware—such as a blown fuse or failed power supply—experiences an internal failure
- During normal motor run operations
- During the normal AC power-up sequence

The Trip Relay is only energized when a trip condition is detected. The user should tie to the **normally closed** contacts for normal operation.

The advantage of this setting is that the application's motor can continue to operate even though the IQ-1000 has shut down. This situation could occur in those cases where the continuation of the process or running of the machine is more important than the immediate protection of the motor.

NOTE

It is the application engineer's responsibility to choose the N.O./N.C. pair of Trip Relay contacts to properly enable the motor contactor.

The trip mode 1 function is displayed in the program menu as:

MODE 1

In this case pressing either the Raise or Lower pushbutton causes the MODE 2 display to appear.

This menu item is numbered 35 in Table 8.B.

8.19.2 Mode 2 — When the trip mode 2 function is selected, the Trip Relay energizes after power up initialization (approximately 6 seconds) and de-energizes on a trip condition. The Trip Relay is in the energized state when any of the following conditions occur:

- After the normal AC power-up sequence
- During normal motor run operations

The Trip Relay is de-energized when a trip condition is detected. The user should tie to the **normally open** contacts for normal operation.

The advantage of this setting is that the application's motor is turned off when the IQ-1000 stops operating. Here the continuation of the process or running of the machine is seen

NOTE

It is the application engineer's responsibility to choose the N.O./N.C. pair of Trip Relay contacts to properly enable the motor contactor.

to be less valuable than the protection of the motor.

The trip mode 2 function is displayed in the program menu as:

MODE 2

In this case, pressing either the Raise or Lower pushbutton causes the MODE 1 display to appear.

This menu item is numbered 35 in Table 8.B.

8.20 Reversing/Non-reversing Starter — The reversing/non-reversing starter function specifies the type of starter actually used in the application.

The reversing/non-reversing starter is displayed as one of the following in the program menu:

REV NON REV

With either of these 2 displays showing, pressing either the Raise or Lower pushbutton causes the other to appear. This menu item is numbered 36 in Table 8.B.

This function **must** be properly selected and entered according to application requirements. If non-reversing is selected and the motor is reversed, a phase reversal trip will occur and the message "PH REVRS" will be displayed.

8.21 Trip/Reset on Remote Input — The trip/reset on remote input function specifies which one of two available ways the REM TRIP/RESET (terminal 8 on the back of the IQ-1000) will function. In the trip mode, the IQ-1000 will generate a trip and display the message "REMOTE" on the display. If the reset button is pushed or a reset command sent over INCOM, the trip will reset only if voltage has been removed from terminal 8.

When this function is placed in the reset mode, the IQ-1000 will perform a reset according to the present mode of the unit. For example, if the unit is in program mode, it will return to the top of the program list. If the unit is in the run mode, it will display the status of the motor. This reset function will react in the same manner as pushing the reset push button.

When this function is diplayed it will toggle between the following two messages:

REM TRIP REM RST

This menu item is numbered 37 in Table 8.B.

8.22 Current Transformer Ratio — The current transformer ratio function specifies the turns ratio of the application's current transformers.

Only the first factor of the ratio is entered for this set point. Thus the entry of 60 represents 60:1. This value is used internally by the IQ-1000.

Available C.T. turns ratio set point values are:

2:1	20:1	100:1	400:1
4:1	30:1	120:1	500:1
5:1	40:1	160:1	600:1
8:1	50:1	200:1	800:1
10:1	60:1	240:1	
15:1	80:1	300:1	

The C.T. turns ratio function is displayed in the program menu as:

CTR xxx

Here the letters xxx represent the digit/digits that appear in front of the ratio in the list above.

For set point entry purposes, refer to the application's wiring plan drawings for the correct C.T. ratio. Use the following criteria to select a current transformer:

- Select a unit which, at 100% full-load amperes, delivers from 2.5 to 5 amperes at the secondary. This is a fixed requirement.
- Select the C.T. which supplies as close to 3.75 amperes as possible at 100% full-load amperes.

  For example, assume an application where the motor starter delivers 300 full-load amperes. A 400:5 primary-to-secondary ratio will deliver:

$$300 \times \frac{5}{400} = 3.75 \text{ amperes}$$

This is within the recommended range of 2.5 to 5.0 amperes. The C.T. ratio for this example would be 80:1 (that is, 400:5).

CAUTION

Be careful when determining C.T. turns ratio. An improper value can cause the IQ-1000 to receive incorrect motor current data. Motor damage could result.

Section 9

TROUBLESHOOTING

9.0 General — This Chapter is designed to assist maintenance personnel carry out troubleshooting procedures. It is divided into 2 general areas of information:

- Operator Panel monitoring procedures (Par. 9.1)
- Troubleshooting (Par. 9.2.)

DANGER

All maintenance procedures **must** be performed only by qualified personnel who are familiar with the IQ-1000 and its associated motor and machines. Failure to observe this caution can result in serious or even fatal personal injury and/or equipment damage.

DANGER

The following procedures at times involve working in equipment areas where the hazard of fatal electrical shock is present. Live parts are exposed. Personnel must exercise extreme caution to avoid injury, including possible fatal injury.

All correspondence with Westinghouse, whether verbal or written, should include the software version which appears as the first display on the program menu (item 0 in Table 8.B).

9.1 Panel Operations — The Operator Panel performs the following operations:

- System status message reporting (Par. 9.1.1)
- Programming set point values (See Par. 4.2.)
- Reviewing set point values (Par. 9.1.2)
- Monitoring electrical characteristics (Par. 9.1.3)
- Internal diagnostics (Par. 9.1.4)

9.1.1 System Status Messages — The Display Window provides a reporting function that occurs during the normal operation of the IQ-1000. This group of messages is referred to as the system status messages. Table 9.A lists the normal operation reporting messages.

9.1.2 Reviewing Set Points — The 38 set points can be reviewed while the IQ-1000 is in the run mode—even when the motor is actually running.

To review set points in the run mode, simply press the (white) Set Points pushbutton once to enable the program menu. At this time the Step Up/Raise or Step Down/Lower pushbuttons can be used to step through the program menu in either direction to the desired IQ-1000 function.

(The program menu, listed in Table 8.B, is also referred to as the Set Point Record Sheet since the Table provides a convenient place to document the set points for a given application.)

9.1.3 Monitoring Characteristics — The run-monitor menu allows maintenance personnel/operators to observe selected operating parameters associated with the motor and motor starter. A listing and description of these electrical characteristics is contained in Table 9.B.

NOTE

As long as the Reset pushbutton is not pressed, the states or operating levels of the metering functions just prior to the occurrence of the trip are retained indefinitely by the IQ-1000 for diagnostic purposes. Even if AC power is removed and restored, the data remains.

Table 9.A

SYSTEM STATUS MESSAGES
(Normal Operational Reporting)

Display	Complete Help Message	Description
READY	READY TO START MOTOR	Indicates motor can be started.
START	ATTEMPTING TO START MOTOR	Displayed during motor start cycle.
RUN	MOTOR IS RUNNING	Indicates normal condition when motor is running with no alarm or trip condition. This message is displayed after a transition has occurred.

Table 9.B

RUN-MONITOR MENU DISPLAYS

Display	Complete Help Message	Description
IA XXX IB XXX IC XXX	PHASE A CURRENT IN AMPS PHASE B CURRENT IN AMPS PHASE C CURRENT IN AMPS	Actual AC line motor current.
% IA % IB % IC	PERCENT FULL LOAD CURRENT PHASE A PERCENT FULL LOAD CURRENT PHASE B PERCENT FULL LOAD CURRENT PHASE C	The percents of the actual monitored current (in amps).
WT1	WINDING TEMP 1 IN DEGREES C	Reading from RTD connected to terminals 1, 2, 3
WT2	WINDING TEMP 2 IN DEGREES C	Reading from RTD connected to terminals 4, 5, 6
WT3	WINDING TEMP 3 IN DEGREES C	Reading from RTD connected to terminals 7, 8, 9
WT4	WINDING TEMP 4 IN DEGREES C	Reading from RTD connected to terminals 10, 11, 12
WT5	WINDING TEMP 5 IN DEGREES C	Reading from RTD connected to terminals 13, 14, 15
WT6	WINDING TEMP 6 IN DEGREES C	Reading from RTD connected to terminals 17, 18, 19
MBT1	MOTOR BEARING TEMP 1 IN DEGREES C	Reading from RTD connected to terminals 20, 21, 22
MBT2	MOTOR BEARING TEMP 2 IN DEGREES C	Reading from RTD connected to terminals 23, 24, 25
LBT1	LOAD BEARING TEMP 1 IN DEGREES C	Reading from RTD connected to terminals 26, 27, 28
LBT2	LOAD BEARING TEMP 2 IN DEGREES C	Reading from RTD connected to terminals 29, 30, 31
OCNT	OPERATION COUNT	The number of motor starts logged since unit went into service (program menu item 26).
RT	RUN TIME IN HOURS	Total motor run time, as accumulated by the IQ-1000, to date from the first time AC power was applied.
RMST	REMAINING STARTS	Number of starts remaining before motor will not be allowed to start. This is the remainder of OCNT minus actual starts.
OST	TIME LEFT ON OLDEST START IN MINUTES	This is the remaining time allowed for count (in hours) function (program menu item 27). If the motor starts/time is exceeded, this is the time which must elapse before a restart is possible.

> NOTE
>
> Values in the shaded area above are not displayed if no RTD board is not connected or one is improperly connected. This is an indication of whether the RTD board is functioning at all.

The metering functions are averaged over a period of time to give stability to the readings presented. As a result, the metering function data retained may be the data which occurred up to 1 second before the trip occurred. This is in contrast to the instantaneous response of certain trip conditions such as:

- Instantaneous overcurrent
- Ground fault

Because the instantaneous overcurrent is actuated within a line cycle of the trip condition occurring, the frozen trip values for the phase currents will not reflect the actual current seen to cause the trip.

9.1.4 Internal Diagnostics — The IQ-1000 performs continuous internal diagnostic checks. The longest is the ROM check sum which is completed approximately every minute when the keyswitch is in the Run position. If a malfunction is detected during a diagnostic check, one of the messages listed in Table 9.C is displayed. In each case, if any of the failure messages listed in the Table occurs, a trip condition is initiated. The following actions should be taken:

- Press the Reset pushbutton to clear the display, if possible.
- Try to restart the motor.

If the same display occurs again, the IQ-1000 is malfunctioning, and the unit should be replaced.

9.2 Troubleshooting — In the event that a malfunction occurs, certain troubleshooting procedures can be used to assist in localizing its cause. This troubleshooting approach is divided into 2 broad situations:

- Operator Panel operating (Par. 9.2.1)
- Operator Panel not operating (Par. 9.2.2)

9.2.1 Panel Operating — The Operator Panel continues to operate after a trip or alarm condition. Its monitoring abilities can provide valuable information, which can be divided into 2 groups:

- Alarm conditions (Par. 9.2.1.1)
- Trip conditions (Par. 9.2.1.2)

9.2.1.1 Alarm Conditions — An alarm condition occurs when one of the electrical characteristics exceeds its programmed set point value. Note, however, that some alarm characteristics must exceed the set point value for a programmed time value **before** the alarm condition occurs.

When this condition happens, the red Alarm LED lights. Also, a message appears in the Display Window to assist with the isolation process.

Table 9.C

INTERNAL DIAGNOSTIC FAILURE MESSAGES

Display	Complete Help Message
A/D ERR	A/D CONVERTER ERROR TRIP
RAM ERR	RAM ERROR TRIP
ROM ERR	ROM ERROR TRIP
OPTO ERR	OPTO COUPLER FAILURE TRIP (2)
X — CTR	THE RATIO OF FLA TO CT RATIO EXCEEDED 5. PLEASE REDUCE FLA SETTING OR INCREASE CT RATIO. (1) Note: This help message may be different on some of the early production units.
ZRAM ERR	NON VOLATILE MEMORY ELEMENT SHOULD BE REPLACED

(1) The current transformer ratio (item 38) and/or full load ampere (item 33) set point values are incorrectly selected. Verify that the set points for these menu items on the application's Set Point Record Sheet are entered correctly.
(2) Refer to Table 9.F

External devices connected to the IQ-1000's Alarm Relay can be used to give additional warning.

Alarm conditions all have the following in common:

- The IQ-1000's Alarm Relay is energized when the condition occurs.
- The form C relay contacts (available at terminals 17, 18, and 19) are brought out from the Alarm Relay.
- The condition is automatically cleared if the characteristic causing the condition falls to or below the set point. At this time the Alarm LED and Alarm Relay reset.

All possible alarm conditions are listed in Table 9.D. Related probable causes and solutions are also shown.

9.2.1.2 Trip Conditions — A trip condition is a situation that changes the state of the Trip and Bell Relays, thereby causing the main contactor to open and the motor to stop running. These conditions fall into 2 groups:

- When the selected characteristics are greater than the programmed set point values (including, in some cases, a time set point), a trip condition occurs. The red Trip LED lights, and a message appears in the Display Window to assist the operator.
- The IQ-1000 may also detect a malfunction. These may be external to the control — such as a broken report-back signal wire from the machine or process. There also are conditions which may be internal to the control — such

Table 9.D

ALARM CONDITIONS

Display	Complete Help Message	Probable Cause	Solution
I^2TA	I SQUARED T ALARM LEVEL	The monitored rotor temperature exceeded the alarm level set point (60 to 100% of max. temp.).	Monitor electrical characteristics to further isolate the malfunction to an area such as the incoming AC line, or motor/load.
STEX	ALLOWED STARTS EXCEEDED, WAIT IN MINUTES	All of the allowed starts have been used	Wait the number of minutes shown on display or reset by entering program mode.
WD AA	WINDING TEMP ALARM	In each case the actual electrical value monitored is equal to or greater than the alarm set point value for the function displayed.	With each of the 4 different displays (at left), perform a monitoring function to further isolate the malfunction. Note: If the actual temperature of one or more of the RTDs does not correspond to the reading in C, suspect the RTDs, RTD wiring, or the RTD Module.
MB AA	MOTOR BEARING ALARM		
LB AA	LOAD BEARING ALARM		
PU AA	PHASE UNBALANCE ALARM		

as an opto-coupler failure, already discussed in Paragraph 9.1.4.

NOTE

Both the I^2T and STEX alarms are conditionals. While the motor is running they are alarms. If the motor is stopped, they become trips.

Trip conditions have these characteristics in common:

- A picture of the metering functions just prior to the occurrence of a trip is stored in memory and can be recalled by pressing the (white) Step Up or Step Down pushbuttons to step through the run monitor menu. The order of the electrical characteristics displayed is identical to the listing in Table 9.B.
- The Display Window automatically alternates between the last run-monitor menu or program menu item displayed and the trip condition's cause. If 2 trip conditions occur at the same time, the display alternates between the menu item and the cause of each trip.
- The internal Trip and Bell Relays are actuated when the condition occurs.
- The form C relay contacts (terminals 11, 12, and 13) are brought out from the Trip Relay. (Bell Relay contacts are terminals 14, 15 and 16.)
- The trip condition must be manually reset. (Use the Reset pushbutton.The remote reset input (terminal 8), REM TRIP/RESET, or INCOM command can also be used to reset the trip condition.

NOTE

The picture of the metering function data is retained by the IQ-1000, as described in Paragraph 9.1.3. Pressing the Reset pushbutton clears the electrical characteristics stored when the trip condition occurred. If, after depressing the Reset pushbutton the LRC/I^2T (Locked Rotor or Thermal Model) or STEX (Starts per allowed time exceeded) message appears, wait for the trip to reset itself.

Trip conditions which are not the result of a possible internal malfunction are listed in Table 9.E. Related probable causes and solutions are also shown.

NOTE

If the program menu is being examined while the IQ-1000 is in the run mode and a trip condition occurs, the run-monitor menu will not be automatically displayed. Press the (white) Set Points pushbutton to display the run-monitor menu.

9.2.2 Panel Inoperative — If the Operator Panel is inoperative (either the LEDs and Display Window are off, or they are

Table 9.E

TRIP CONDITIONS

Display	Complete Help Message	Probable Cause	Solution
IOC	INSTANTANEOUS OVERCURRENT TRIP	In each case the actual electrical value monitored is greater than the trip set point value for the function displayed.	Monitor the associated electrical characteristics (as listed in Table 9.B) to further isolate the problem. Note: If the actual temperature of one or more of the RTDs does not correspond to the reading (in°C), suspect the RTDs, RTD wiring, or the RTD Module.
GND FLT	GROUND FAULT TRIP		
JAM	LOAD JAM TRIP		
UNDER L	UNDERLOAD RUN TRIP		
MB TEMP	MOTOR BEARING OVER TEMPERATURE TRIP		
LB TEMP	LOAD BEARING OVER TEMPERATURE TRIP		
WD TEMP	STATOR WINDING OVER TEMPERATURE TRIP		
LRC/I^2T	LOCKED ROTOR/THERMAL OVERLOAD TRIP	The rotor winding temperature storage, as directed by the IQ-1000's motor temperature algorithm, has exceeded the maximum allowable value of the I^2T protection curve (motor overload curve.)	Monitor the electrical characteristics associated with the motor current to further isolate a problem to areas such as the AC line or motor overload.
INC SEQ	INCOMPLETE SEQUENCE TRIP	The INC SEQUENCE input (terminal 10) was not energized within the incomplete sequence time after a transition has taken place.	Monitor terminal 10 after a transition to the run mode. Check circuits connected to terminal 10, such as incomplete sequence, field loss, pull-out protection, etc.
REMOTE	REMOTE TRIP	The REM TRIP/RESET (terminal 8), used to initiate the remote trip, was energized.	Observe wiring to terminal 8 to determine external cause of trip.
PH UNBAL	PHASE UNBALANCE TRIP	Single phasing of motor.	Monitor the incoming AC line.
PH REVRS	PHASE REVERSAL TRIP	During initial startup a "phase reversal" condition exists.	Rotate 2 of the incoming power leads L1, L2, or L3. Check for proper motor rotation. Alternately, change the IQ-1000 current transformer wiring by rotating the current transformer wiring terminal H1B with H1C. Clearly mark the new wiring and update the drawings for future reference.

Table 9.E

TRIP CONDITIONS
(cont'd)

Display	Complete Help Message	Probable Cause	Solution
T BYPASS	TRIP BYPASS (JUMPER BYPASS OF IQ-1000 TRIP RELAY)	A trip condition is active, yet the IQ-1000 still monitors motor current. This indicates Trip Relay's contacts have been "bypassed."	Examine wiring of Trip Relay's contacts and remove bypass condition.
INCOM	INCOM REMOTE TRIP	The INCOM Communication Option has initiated a trip condition.	Determine and correct cause of remote trip external to the IQ-1000.
STEX	MAX # STARTS PER TIME REACHED, WHILE RUNNING ALARM ONLY, IF STOPPED BECOMES TRIP	Too many starts were used in the allowed period of time.	Wait for the starts to be returned or clear starts by entering program mode.
TRANSIT (1)	LOW TO HIGH VOLTAGE TRANSITION ERROR TRIP	IQ-1000 did not transition on current before the transition time was complete	Reset trip, check reason for slow start and restart motor.

(1) This trip is initiated only if the program menu item 30 is selected for the trip on time out function (TRP TOUT) and the motor current remained too high during the motor's start cycle. Paragraph 8.14 describes transition timing.

Table 9.F

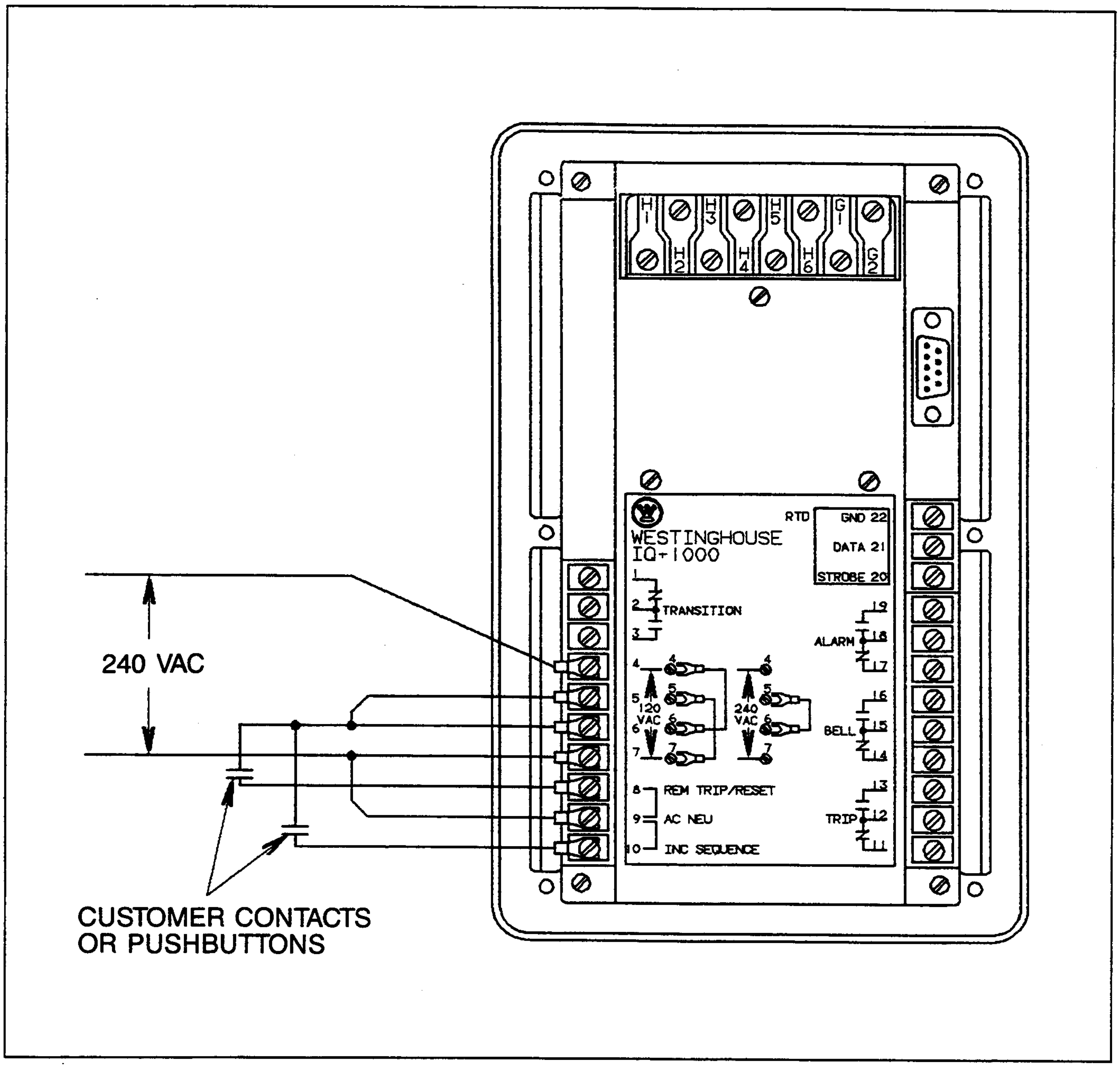
TROUBLESHOOTING: OPERATOR PANEL MALFUNCTIONING

Symptom	Probable Cause	Solution
All LEDs and Display Window are off or unintelligible.	Incoming AC deficient.	Verify that the 120 or 240 VAC (15%) exists between terminals 4 and 7. (Refer to the electrical drawings to further isolate a deficient AC line.)
	IQ-1000 malfunctioning.	Verify that all connections to the terminal blocks are secure. Turn keyswitch to the Program position for 5 seconds. Then return to the Run position. If all connections are secure and the Operator Panel is still inoperative, then replace the IQ-1000.
"OPTO ERR"	Optocoupler failure trip	Check frequency setting
Metered readings too low	Incorrect CT's — secondary amp's not within 2.5-5 amps	Match CT's, CT ratio to deliver 2.5-5 Amps secondary

not responding properly), use the procedures listed in Table 9.F. When doing so, keep in mind that the most probable problems or the simplest to verify are listed first. For this reason, always follow the order of the Table's suggestions.

DANGER

If the IQ-1000 is replaced, it is necessary to reprogram all set point values that apply to the specific IQ-1000 application. **Do not** attempt to restart the motor until all values are entered and validated. (Use the application's Set Point Record Sheet and Paragraph 4.2.) Damage to equipment and/or personnel may occur if this procedure is not followed.



INPUT WIRING FOR 240 VAC CONTROL POWER

Tear along perforation. Fold the top half down and tape.

IQ-1000 & IQ DATA PLUS USER MANUAL
Customer Comments

Did you find any corrections that need to be made to this manual? (Include page number.)

Were any parts of the manual unclear? Do any require further detail or description? (List parts.)

What are your special application needs?

As part of a constant effort to serve your needs, Westinghouse is interested in any information you can supply about your application or use of the IQ-1000/IQ DATA PLUS. If you would like to share this information, please check the box below.

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