# RC-1000

## REFRIGERATION CONTROL

## OPERATIONS AND INSTALLATION MANUAL

## VERSION 5.2

## RELEASE : 2/1/93

# ATTENTION

We strongly recommend that you read the RC-1000

installation manual before installing this unit.


Pages 19 through 27 concentrate on Installation


**ALWAYS REMOVE POWER FROM THE REFRIGERATION SYSTEM PRIOR TO INSTALLING THE RC-1000**

# TABLE OF CONTENTS

# CHAPTER 1 - USER ORIENTATION

## INTRODUCTION

The RC-1000 is a microprocessor-based system designed to control virtually all parameters of a commercial refrigeration system. It can be used as either a wall-mounted or rack-mounted control. The state-of-the-art hardware and software combine to provide advanced control strategies and I/O flexibility. This is accomplished within a non-intimidating, user-friendly environment that is uncommon to other units of similar capability.

## ABOUT THIS MANUAL ......

You are **STRONGLY ENCOURAGED** to read this **ENTIRE** manual prior to installing and operating the RC-1000.

| IF YOU WANT | THEN READ |
|---|---|
| To learn about the RC-1000's capabilities. | Chapter 1 - USER ORIENTATION |
| To become familiar with the RC-1000 user interface. | Chapter 1 - USER ORIENTATION |
| To install and label an RC-1000. | Chapter 2 - INSTALLATION INSTRUCTIONS |
| To install and label any of of the RC-1000 I/O Module Kits. | Chapter 2 - INSTALLATION INSTRUCTIONS |
| To learn how to enter setpoints and assign sensors and outputs. | Chapter 3 - PROGRAMMING AND INTERROGATING THE RC-1000 |
| To diagnose a problem with the RC-1000. | Chapter 4 - TROUBLESHOOTING GUIDE |
| To obtain part numbers for replacement parts. | Appendix A - WARRANTY AND REPLACEMENT PARTS |
| Installation diagrams for probes, inverters, etc. | Appendix B - INSTALLATION DRAWINGS |

# RC-1000 HARDWARE SYSTEM OVERVIEW

The RC-1000 system is comprised of a power source, a CPU Base Unit, and up to sixteen plug in I/O (Input/Output) module kits. The RC-1000 is UL Listed and CSA approved in both the cabinet enclosure and the OEM style panel. (UL number 4L53, CSA number LR 89864)

## POWER SOURCE

The RC-1000 CPU Board, I/O Modules, and Relay Boards require two (2) separate 12 VAC sources. If desired, the customer can supply the power sources, or obtain them from EIL. EIL offers a power source: model TF-5 transformer. The transformer is pre-wired with color coded wire terminations.

The TF-5 when used for the CPU Board and I/O Modules, provides a dual voltage primary and produces an isolated 12 VAC secondary output. The TF-5 can be powered by 120 VAC or 240 VAC (208V) sources. (see Figures 5 and 14) The primary of the transformer should be wired through a 5A max circuit breaker. The CPU board is fused at 2 amps.

The TF-5 when used for the relay boards, can power up to eight relay boards. The TF-5 provides a dual voltage primary and produces one isolated 12 VAC secondary output. The TF-5 can be powered by 120 VAC or 240 VAC (208V) sources (see Figures 5 and 14). Each relay board is fused at one amp.

## CPU BASE UNIT

The CPU Base Unit consists of a sturdy enclosure that houses the CPU (Central Processing Unit) Board, a four-line, forty-character wide (4x40) LCD (liquid crystal display), a keypad, a sixteen-position card cage to receive I/O Modules (described later), and a snap track for mounting the Termination Boards packaged with each I/O Module kit. The door contains a keyed latch and is removable from the enclosure for ease of installation, wiring, and maintenance. Conveniently placed knockouts provide pilot holes for conduit fittings used during installation. Listed are some features of the components contained within the CPU Base Unit:

**CPU Board** - This compact design features a state-of-the-art V40 microprocessor that can address up to 1MB (one megabyte) of memory. The RC-1000 currently uses 128K bytes (one hundred twenty eight kilobytes) of RAM (Random Access Memory) and 128K bytes of ROM (Read-Only Memory).  An expanded RAM option is available that will add another 128K bytes. (see parts list for part number) A watchdog timer circuit is provided to insure proper recovery from a processor lock-up.  The system I/O interface is achieved with an optically coupled, twenty-pin data bus that isolates the processor circuitry from electrical noise present in harsh environments.  Both power and communications hookups are made on this board. The 8 position dip switch has several purposes. Switches 1 through 5 are for setting the unit ID as follows:

              Unit 1     switch 1 closed
              Unit 2     switch 2 closed
              Unit 3     switch 3 closed
              Unit 4     switch 4 closed
              Unit 5     switch 5 closed
              Unit 6     switch 1 + 5 closed
              Unit 7     switch 2 + 5 closed
              Unit 8     switch 3 + 5 closed

Dip switch 6 is used to set the remote baud rate setting. For 1200 baud, switch 6 should be open. For 2400 baud, switch 6 should be closed.

     Switches 7 and 8 are not used on the current version of cpu and should remain open.

**LCD and Rubber Keypad** - Mounted on the RC-1000 door, these two components work together with the firmware to provide the smartest user interface on the market. An standard back lit display is supplied and uses power supplied from the cpu board power supply. The user responds to clear menu choices on each screen by using the number and arrow keys available on the keypad (refer to Chapter 3, Programming and Interrogating the RC-1000).
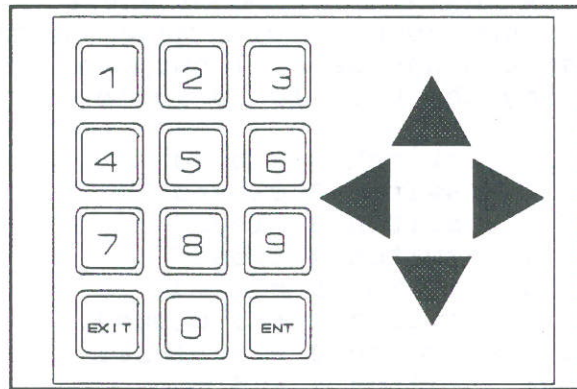


**Keypad**

**Sixteen-Position Card Cage and Snap Track** - Mounted on the back wall of the RC-1000 cabinet, these two components provide the mounting mechanism for interfacing the I/O module kits with the CPU Base Unit. Sixteen slots are available for plugging in any required combination of I/O cards. Off-center connectors make it **impossible** to plug in the cards incorrectly. All I/O card types except the Relay Driver connect to I/O Termination Boards that mount on the snap track below the card cage. This provides terminal strips for connecting the RC-1000 I/O to the various types of sensors and loads. Up to ten of these boards can fit on the snap track at one time. If additional termination boards are required, they can be mounted in an expansion cabinet.
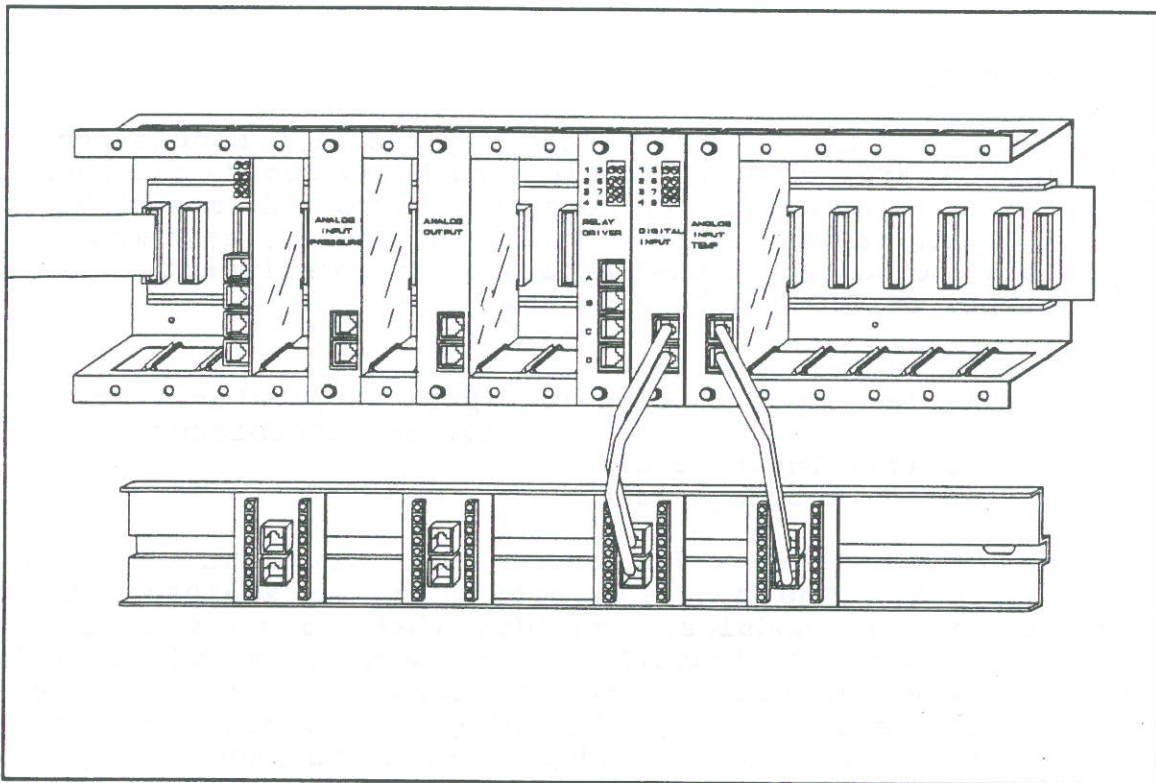


**Card Cage and Termination Boards**

**Backup Battery** – Each RC-1000 is supplied with a 3VDC Lithium battery that is U.L. approved for installation in electronic equipment. The battery is located near the top-middle of the CPU Board and is mounted in a holding clip. The battery is sufficient to retain all data (setpoints, etc.) for a minimum period of one year when the RC-1000 loses power. The life expectancy of the battery is eight years under normal conditions. **The battery should only be replaced by a qualified technician. Consult the factory for battery replacement**.
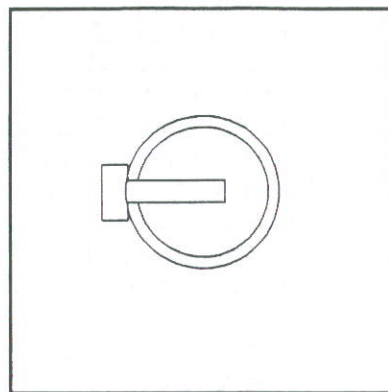


Battery in Holding Clip

## I/O MODULE KITS

At present there are four basic types of I/O modules and one type of Relay Board. The I/O Modules and Relay Boards are packaged in "kits" containing all of the necessary parts and labels required for installation in the CPU Base Unit. In general, each module kit is installed and tested at the factory prior to shipment. The four existing types of I/O Module kits are:

* Relay Driver Module
* Analog Input Modules (4 types: Temperature, Pressure, 0-10V and thermistor.)
* Digital Input Module
* Analog Output Module

Each I/O Module provides either four or eight channels of input or output. **The user can configure the RC-1000 with any combination of I/O Modules, provided that no more than eight modules of one type are installed, and the maximums of sixty-four inputs and sixty-four outputs are not exceeded.** Also, it makes no difference which slot an I/O card is plugged into because each card contains an eight-position DIP (dual in-line package) switch that is used to identify it to the RC-1000's microprocessor (further information is provided in the section titled "Switch Block" in Chapter 2).

## Relay Driver Module

Kit contains:    Relay Driver Module
                 Mounting plate

Description:     These I/O cards are the only cards with four
                 connectors and eight LEDs (see figure below).

Connects to:     Relay Board via four, six-conductor phone cables
                 marked A,B,C, and D.  Each module drives a single,
                 eight-channel Relay Board.  The A and B connectors
                 are outputs (from the module) and the C and D
                 connectors are feedbacks which indicate override
                 status.
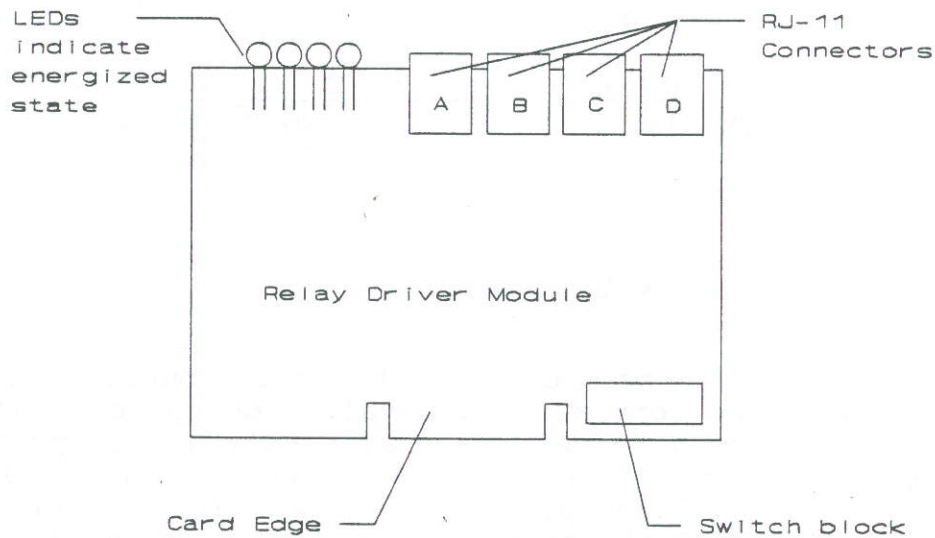


(further information on the phone cables is provided in the section
titled "Making Cables" in Chapter 2).

## Relay Board

Kit contains:   Relay Board

Description:    Relay Boards have eight relays, eight fuses, a 24-
                position terminal block, and eight control
                switches.  It also has four modular quick-connect
                (phone cable) jacks.

Connects to:    Relay Driver Module via four, six-conductor phone
                cables (refer back to the Relay Driver Module
                section).  This board requires 12 VAC supply (specs
                are provided in Chapter 2: see Figure 1).
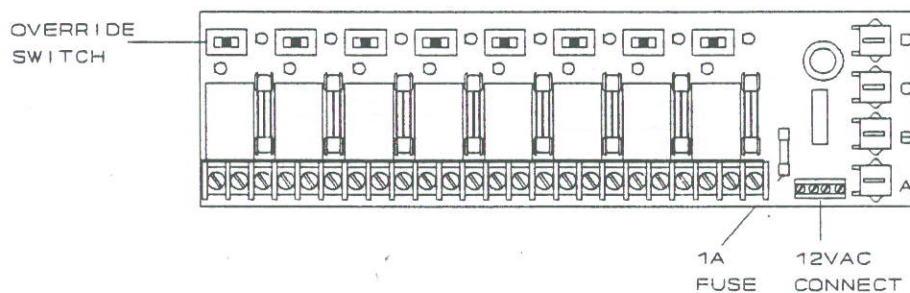


**Relay Board**

The Relay Board should be located in the rack control panel, as it
is interfaced to the compressor and valve control circuits.  Each
Relay Board requires a 12 VAC external supply and is protected by
a 1A fuse on the relay board. The Relay Boards contain eight
individual DPST (double-pole, single-throw) relays.  Terminals are
provided for common (C-#), normally open (NO), and normally closed
(NC) relay operations.  All relays are fused at 3A, 240 VAC through
the common terminal.

    A three-position control switch is provided for each relay.
The positions are marked "ENERG" (energized), "AUTO" (automatic or
programmable), and "DE-ENERG" (de-energized).  The positions
"ENERG" and "DE-ENERG" override the RC-1000's control of the
relay's state.  When a relay is energized, either by the RC-1000 or
the "ENERG" override, a red LED is lit, indicating that the relay
**coil** is energized.  A green LED is lit when the control switch is
moved from the "AUTO" position to either of the two override
positions.  ( On the new relay boards R8/12, a yellow led is lit
indicating a relay is in override). Relay Driver Modules have eight
red LEDs that correspond directly with the red LEDs on the Relay
Boards.

## Analog Input Modules

There are four types of Analog Input Modules:    Temperature, Pressure, Thermistor and 0-10V.

Kit contains:    Required Analog Input Module
                 Mounting plate
                 Termination Board
                 Two ten-inch, six-conductor phone cables

Description:    No Analog Input Modules have LEDs.
                Most Analog Input Modules have five test points and four calibration potentiometers (see figure below). Temperature Boards have transistors next to the phone connectors (see ID area in figure below). Pressure Boards have no transistors in the ID area. 0-10V Boards have resistors in the ID area.

                The standard temperature module ranges from -30° to 97°. A specially calibrated high temperature module is available which ranges from 0° to 255°. This hi-temp module must be set up during Unit System Configuration.

                There are two style of thermistor boards available. One is for use with 2.2k thermistors and the other is for use with 10k thermistors. The operation of these cards are transparent to the user and no special setup is required.

Connects to:    The two phone cables supplied in the kit connect to the Termination Board.    Termination Boards are mounted in the PCB track located below the card cage.  When the Analog Input Module is installed in the card cage, the phone connectors on the card plug into the respective phone connectors on the Termination Board (top to top, bottom to bottom, see Figure 3).



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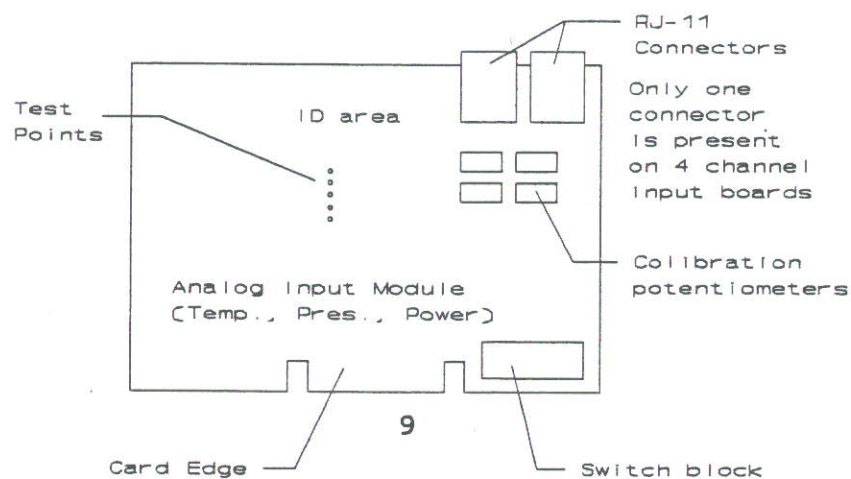
Analog Input Modules provide for eight channels of input from temperature sensors (EIL TP-1s), thermistors, pressure transducers (EIL SA-100s and 500s), watt transducers, and other standard measurement devices.  The Pressure and 0-10v termination Boards supply 12 VDC for use with sensors.  The 0-10V Board accepts 0-10 VDC or 0-1 mA (milliampere) input.  Possible uses are for refrigerant liquid level monitoring, variable speed compressor frequency and current feedback. Figure 3 shows a typical RC-1000 analog temperature input and pressure transducer hookup. Figure 7 shows an EIL watt transducer hookup. Figure 16 shows an EIL refrigerant leak sensor unit hookup. Figure 23 shows a liquid level gauge hookup.

A High Temperature Analog Input module will have a cover plate labeled "HI-TEMP".

## Digital Input Module

Kit contains:     Digital Input Module
                    Mounting plate
                    Termination Board
                    Two ten-inch, six-conductor phone cables

Description:     This module has two phone connectors and eight LEDs. There are very few components on this board (approximately three chips).

Connects to:    The two phone cables supplied in the kit connect to the Termination Board. Termination Boards are mounted in the PCB track located below the card cage. When the Digital Input Module is installed in the card cage, the phone connectors on the card plug into the respective phone connectors on the Termination Board (top to top, bottom to bottom).
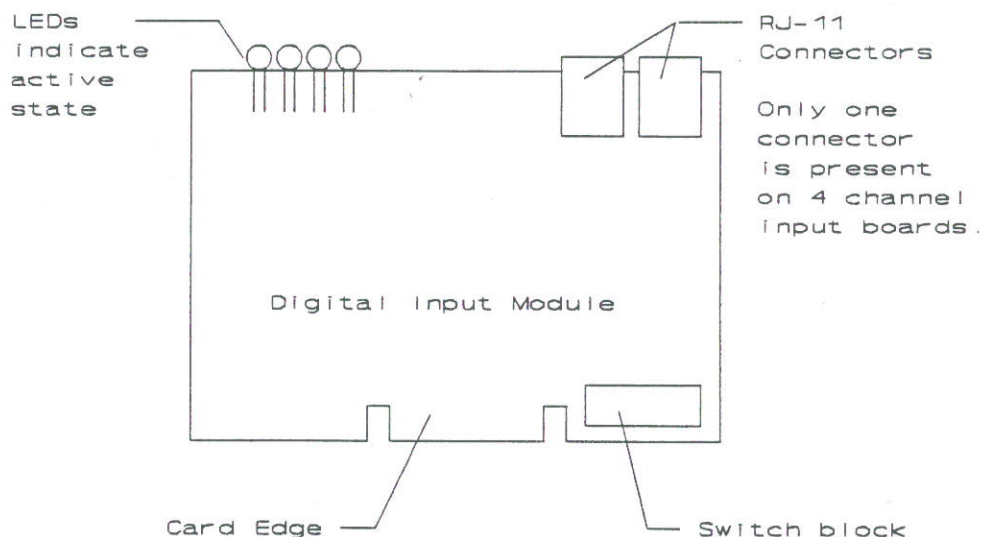


The Digital Input Module provides eight channels of digital input (**dry contact closures**) such as defrost termination, defrost initiation, phase-loss alarm, proof of run verification, or any other digital input supported by the RC-1000 firmware. Eight red LEDs are provided that light when the respective inputs are active. Figure 19 shows a high voltage to dry contact digital input connection diagram.

## Analog Output Module

Kit contains:       Analog Output Module
                      Mounting plate
                      Termination Board
                      Two ten-inch, six-conductor phone cables

Description:      This board has one or two phone connectors and no LEDs. However, unlike the Analog Input Module, this board has no test points or calibration potentiometers.

Connects to:     The two phone cables supplied in the kit connect to the Termination Board. Termination Boards are mounted in the PCB track located below the card cage. When the Analog Output Module is installed in the card cage, the phone connectors on the card plug into the respective phone connectors on the Termination Board (top to top, bottom to bottom).
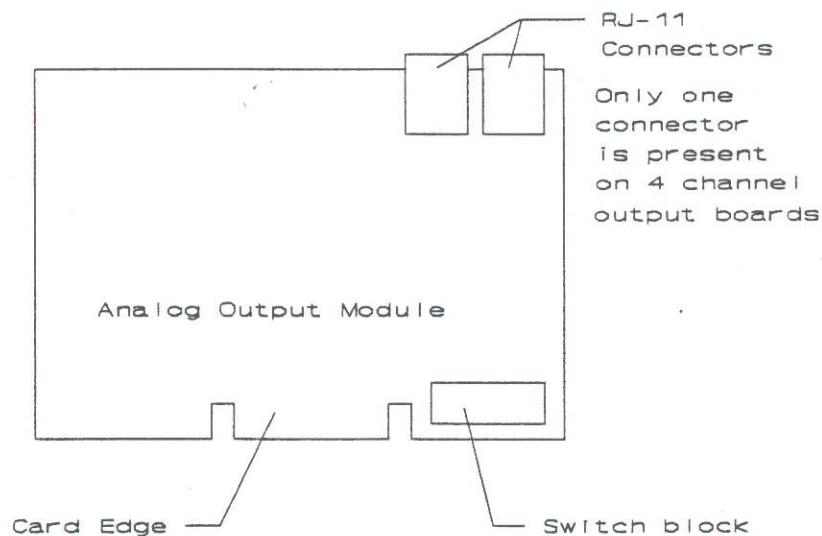


Each Analog Output Module provides eight channels for sending 0-10 VDC control signals to other control systems such as DC Inverters (for variable speed compressors) This 0-10 VDC output is connected to the inverter via a Termination Board (see Figure 2). See figures 12 and 13 of the appendix section of this manual for examples of two inverter interface diagrams.

# RC-1000 SOFTWARE CAPABILITIES OVERVIEW

The control software of the RC-1000 is divided in three functional groups: **CIRCUITS, RACKS and AUX FUNCTIONS.** The CIRCUITS area contains software for controlling the temperature and defrost in the case line-ups. The RACKS area contains software for controlling the suction and head pressure on commercial refrigeration systems. The AUX FUNCTIONS area provides the REFRIGERANT LEAK MONITORING and LOGIC (Boolean) STATEMENTS. Other miscellaneous software capabilities include LOGGING, COMMUNICATIONS, and ALARMING.

A brief list of the control strategies that come standard with the RC-1000 follows. (Chapter 3 will cover this area in complete detail)

## CIRCUITS - TEMPERATURE/DEFROST CONTROL

This software group will control up to 32 individual circuits, supporting time or temperature termination, digital termination, demand defrost initiation, and programmable hot-gas relay outputs. Included also are refrigeration and runoff time delays, high and low alarm setpoints, and defrost skipping on dewpoint. Up to six defrost times are available per day.

Each CIRCUIT and SENSOR can be given a name (or description) up to 34 characters long. Both the input sensors and output relays are programmable for ultimate flexibility in meeting each individual installation's requirements. A simple configuration section allows the user to add or subtract features. This feature will be discussed more fully later, but the result is that if certain features are not used, the various screens do not contain needless references to them.

Other features included are:

- Suction and/or liquid line solenoid control by temperature.

- Industrial hot gas defrost control strategy:
        pump out phase
        defrost phase
        equalize phase

- Individual case defrost control.

- Defrost restart control option.

- Temperature dead band.

## RACKS - SUCTION/HEAD PRESSURE CONTROL

This software group will control Suction and Head pressure on up to 4 racks (i.e. individual suction pressures). Extensive research has yielded an advanced new algorithm (software decision making process) that requires only cut-in and cut-out setpoints, the actual capacities of the motors (usually rated in horsepower, or B.T.U), a control gain, and a few anti-short cycle time delays. Built into the algorithm is the ability to optimize run-time on virtually any type of RACK, even those with uneven capacity compressors. The same algorithm is used for condenser fan control. For both Suction and Head control, alternating or sequential cycling is available. The strategy also includes the ability to control variable speed compressors, either alone, or in tandem with the standard motors. (Much more on this strategy will appear in Chapter 3)

Other features included are:

- Temperature Compensation of the suction setpoints by automatically referencing the most critical CIRCUITS.

- Digital inputs that activate auxiliary suction and/or head setpoints.

- Digital inputs for phase loss, liquid level, oil failure, defrost sensing, and run verification.

- Oil pressure input for variable speed compressors (used to monitor pressure against user-defined minimum differential pressure, alarm and take action on failure).

- Head pressure control via temperature differential. Condenser fans cycle based on ambient temperature, with upper and lower pressure control limits.

- Two stage interlocking of racks. (ie: lock-out the low temperature rack if the medium temp rack compressors are not running.

- Additional monitor only points for up to 8 temperature sensors, 8 pressure sensors, 4 relays, 4 digital inputs and 1 analog input per rack.

- Desuperheater control based on manifold temperatures.

- High head pressure override of compressors.

As in the CIRCUIT software, each RACK and SENSOR can be given a name (or description). Each Rack description can be up to 16 characters long, and each Sensor description can be up to 24 characters long. Both the input sensors and output relays are

programmable for ultimate flexibility in meeting each individual installation's requirements. A simple configuration section allows the user to add or subtract features. This feature will be discussed more fully later, but the result is that if certain features are not used, the various screens do not contain needless references to them.

## REFRIGERANT LEAK MONITORING

The RC-1000 can provide four systems for refrigerant leak monitoring. Each system can monitor either one digital contact or three analog inputs from a remotely located leak detector. Each analog input can have a separate alarm setpoint.

## LOGIC STATEMENTS

Logic statements are used to design a custom control system based on a variety of input and output configurations. Basic operation is based on 'If ..., Then ...' decisions.

The RC-1000 provides a maximum of thirty-two logic statements. These statements can be 'stand alone system control' or used to supplement existing control of CIRCUIT or RACK loads. Loads can be put into a software override condition at any time. When a load is returned to its normal system control, it assumes the state called for by the current logic statement control.

## LOGGING

The RC-1000 automatically logs all analog inputs, all digital outputs (Relay Driver), and all analog outputs that are assigned. A logging interval must be used to have this information available. The default interval is 180s. This logging information is available from a remote computer via graphs, or at the unit via a tabular data format. These logs are classified as interval logs. In addition, the RC-1000 logs power/demand consumption, run-times, and cycles. This information is accessible on site or remotely for analysis of overall system performance.

## COMMUNICATIONS

Each RC-1000 includes a dual serial port which allows for connection to any Hayes-compatible telephone modem rated for 1200 or 2400 baud. All RC-1000 units in the facility can be "daisy chained" together (see Figure 9 + 11) to create a local network accessible either on site or remotely with a "dumb terminal" or EIL's CNET terminal software package. This package features high resolution graphics and state-of-the-art user interface technology.

## ALARMING

Virtually all measured inputs can be compared against user defined setpoints for the purpose of alarming. All alarms are listed in the alarm log, and can be "sent out" via system relays or dial out capability through the modem. As is the case throughout this system, the user has complete flexibility in selecting how many and which relays will be used for this purpose. Additionally, all major alarm types can either be enabled or disabled for dial out activity. Each circuit, rack, refrigerant leak group and logic statement has individual control of the dialout parameters. Alarms can be sent to a local dumb terminal and up to 6 occupied phone numbers and 6 unoccupied phone numbers. Daily out tests are provided up to twice per day. All dial outs are logged whether successful or not.

## THE RC-1000 CHANNEL NUMBERING SYSTEM

Due to the relatively large number of inputs and outputs the RC-1000 can control (64 analog inputs, 64 analog outputs, 64 digital inputs and 64 digital outputs), a special channel numbering convention has been adopted.

Each input or output module may contain at most eight channels. There can be up to a total of eight modules of any one specific type, each numbered one to eight according to their switch block setting (refer to the section titled "Switch Block" in Chapter 2). The numbering convention is defined as follows:

Each channel number contains two digits separated by a dash ("-"). The first digit indicates which module the channel can be found on, and the second digit indicates the actual channel number on that module. For example, digital input channel 6-5 would correspond to the fifth channel on the sixth Digital Input Module.

This channel numbering convention is consistent throughout the RC-1000 environment, including channel references found on hardware labels, firmware menus and screens, and within the remote communications software.

## THE WINDOW/PAGE APPROACH TO USER INTERFACE

The 4x40 character LCD used by the RC-1000 presents a concise, organized view of system control and status information. The 'smart' numeric keypad makes programming and interrogating the RC-1000 quick and easy. However, in order to efficiently access the RC-1000's stored information, the user must have a general understanding of how the firmware organizes data.

A single user-accessible data item (such as a setpoint) is referred to as a **data field**. Related data fields are grouped into **screens**. In the event that a screen contains information concerning multiple circuits or racks, the screen will be subdivided into a series of **pages**. Screens are then grouped into **menus,** which are in turn placed into a tree-like hierarchy that begins with the RC-1000 Main Menu (refer to the diagram in the "Introduction" section of Chapter 3).

The RC-1000's LCD acts as a four line view port, or **window**, to a single page of RC-1000 information. By using the up arrow and down arrow keys, the user can move the four line window **vertically over the contents of a single page**, analogous to moving a magnifying glass **down one column** of the classified section in a newspaper. This action is referred to as **scrolling down a page**. Similarly, using the left arrow and right arrow keys, the user can move the four line window **horizontally from one page to the next**, like moving the magnifying glass **over to an adjacent column**. This action is referred to as **changing pages**. The user can also "jump" to a specific page by simply typing the appropriate page number (e.g. pressing the keys marked "0" and "8" would then display page number eight).

This type of intuitive approach is consistently adhered to throughout the RC-1000 firmware to keep keystrokes to an absolute minimum. When moving through menus, screens, pages, and data fields, the user can speed the process by holding down the desired arrow key, causing the action to be repeated until the key is released.

Note that when moving from page to page (column to column), the window **remains in the same relative position** on each page. For example, on the Rack Setpoint screen, the user can scroll down the page to the area showing relay assignments and view the relay assignments for **each** configured rack by simply changing pages. Further information regarding user interface specifics will be provided in Chapter 3.

## CHAPTER 2 - INSTALLATION INSTRUCTIONS

## MOUNTING AND POWER CONNECTION

### UNPACKING

1. Remove the RC-1000 from its shipping container and verify that it has not been physically damaged. The I/O cards and cables are stored inside the cabinet prior to shipment.

2. You should receive:

   RC-1000 Refrigeration Control Unit.
   Requested order of I/O module kits.
   This instruction manual.
   Labels.
   Ordered relay boards and cable.
   Transformer and supply box assembly (if ordered).

3. Select a mounting area on the compressor rack system (uni-strut or other mounting base) or the compressor room wall. The preferred location would be near eye-level in the middle of the rack for easy viewing of the LCD.

4. Remove cables (shipped in plastic bags) from inside the RC-1000 cabinet. There are four mounting holes inside the cabinet: two between the I/O card cage and the snap track and two below the snap track (see Figure 4). Mount the unit securely with four 1/4-inch mounting screws. For OEM units refer to figure 22 for the mounting diagram. Mount the card cage such that the capacitors are toward the top of the card cage.

5.  Determine the arrangement of I/O cards in the card cage that is best suited to the I/O wiring requirements. I/O cards can be inserted into any slot in the card cage. However, make sure that I/O cards of the same type have unique switch settings (further information is provided in the section titled "Switch Blocks" found later in this chapter). The I/O section must be de-powered prior to working with I/O cards. All cards should be handled with extreme care to avoid touching circuitry.

6.  All sensor wires and analog outputs must be connected to Termination Boards mounted in the snap track below the card cage. Quick-connect cables connect the Termination Boards to the proper I/O cards. The Termination Boards are identical to each other, so it is not essential that they remain paired with a specific I/O Module. See Figures 2, 3, 7, 16 and 23. All connections to termination boards should be done with the interconnecting cables removed from the I/O cards.

## RELAY BOARDS

7. RC-1000 Relay Boards are mounted inside the Rack Control Panel and also require a 12 VAC supply (see Figure 14). A TF-5 transformer should be used here.

8. Connect refrigeration and defrost control circuits to relay outputs in accordance with the manufacturer's specifications. Make connections to the terminal block below each relay. Note that each relay provides both normally open (NO) and normally closed (NC) connections along with a common (C-#) which is fused at 3A.

9. The relay boards are connected to the Relay Driver boards in the RC-1000 card cage via four, six-conductor cables matching the labeled socket letters (A to A, B to B, etc.; see Figure 1 & 4). Further information is provided in the section titled "Making Cables" found later in this chapter.

## SYSTEM POWER CONNECTION

10. The shield plate (mounted with thumb screws) attaches to the cabinet door to protect the RC-1000 CPU Board. Notice the power switch, fuses, and terminal block in the lower right-hand corner (see Figure 4).

11. The RC-1000 requires one external 12 VAC, 2A (minimum) supply lines which are connected to the CPU Board's terminal block (see Figure 4). The input is fused on the CPU board. A 12 VAC transformer, TF-5, (described in Chap.1, 'Power Source' section) is available from the factory. The TF-5 can be powered from either 115 VAC or 230 VAC (208V) and provides one isolated secondary output (see Figure 5). It is preferred that the RC-1000 have its own circuit, either protected by a breaker or fuse.

12. Power-on the RC-1000 microprocessor by moving the slide switch found on the lower right-hand corner of the CPU Board, to the up position (see Figure 4). The I/O bus board and I/O cards (mounted on the bottom of the card cage) will receive power from the Microprocessor Board through this same switch.

## INSTALLING AND INTERFACING TO I/O MODULE KITS

In general, I/O module kits are labelled and installed prior to shipment. Therefore, the following installation instructions are provided primarily as reference information.

### TERMINATION BOARDS

Termination Boards are used simply to provide input/output connections between the I/O Modules (not the Relay Driver), dry contacts (digital inputs), sensors, and inverters for the Analog Output Module. The Termination Boards are assigned to one I/O Module and therefore are labelled with the same module number sticker. Connections between the I/O Modules and the Termination Board are made via the six-conductor RJ-11 cables. Each Termination Board has eight input/output connections, eight common connections, and two 12 VDC supply connections (active only on the pressure and 0-10v modules)
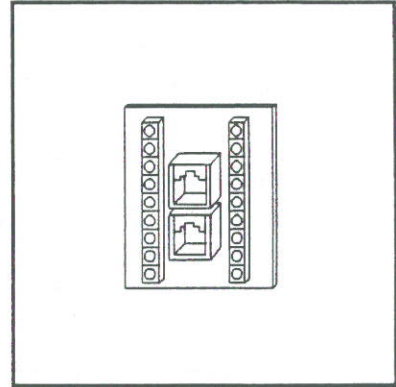


**Termination Board**

### SWITCH BLOCK

Each I/O module contains an eight-position switch block. The switch setting distinguishes its card number from other installed cards of the same type. Therefore, you can have up to eight cards of the same type (e.g. eight Relay Driver Modules) inserted in the sixteen-position card cage at one time. **DO NOT SET ANY MORE THAN ONE OF THE SWITCHES TO "ON"** ("OFF" is OPEN). The four card types are Relay Driver, Analog Input, Digital Input, and Analog Output. Note that there are up to four kinds of Analog Input cards for the RC-1000, but because they are all Analog Inputs, they must have different switch settings (e.g. you cannot insert both a Pressure Board and a Temperature Board if they have the same switch setting).

Once the switch settings are selected for the cards, the cards are inserted and the mounting plates secured.  Since the switch block will normally be out of view once the card is installed,  a number sticker is placed in the white square on the module's mounting plate to identify the module number (switch setting) during normal operation.

I/O Module

1 2 3 4 5 6 7 8
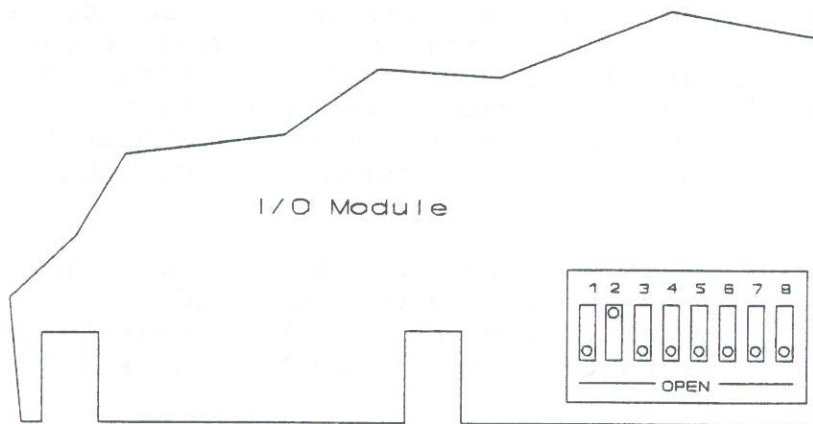
OPEN

NOTE:  Only one switch should be ON, the other seven should be set to OPEN.

**Switch Block**

## MAKING CABLES

Many of the required field connections are made using six-conductor cables with modular, quick-connects (RJ-11 style) on each end. They are easily recognizable as "telephone cables". The main difference between these cables and those found on the standard house phone is that the RC-1000 cables have six conductors, while regular telephone cables have only four. This style was chosen for the same reasons used by the telephone industry -- they offer a high quality connection, are easy to use, are durable, and are inexpensive. In most cases, the installation will be completed using cables supplied by EIL. For custom cable lengths or repair, a Cable Termination Kit is available from the factory that contains a crimping tool and simple instructions for making these connections in the field. The standard cable assembly used by EIL is shown below and in Figure 6. A cable tester is available from EIL (p/n CC/60028400).

> Note: **White on Right rule** - Cables manufactured at EIL are assembled with the white wire on right side of connector, as shown. If one end of cable needs to be shortened, make sure the proper orientation is maintained.

BLUE
YELLOW
GREEN
RED
BLACK
WHITE
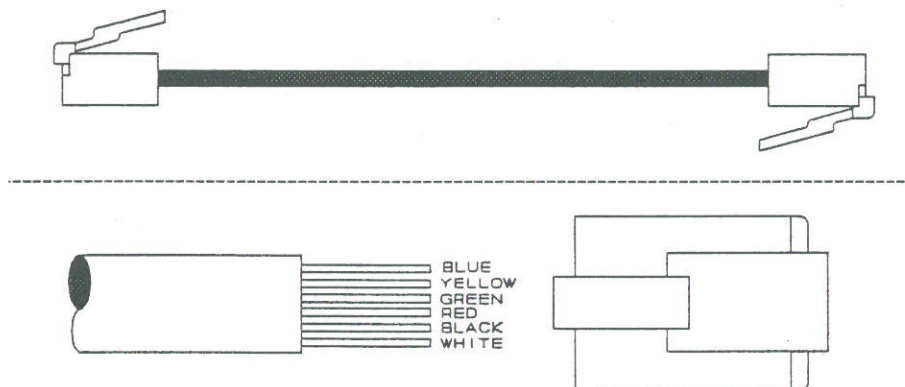
**Cable Orientation**

## INSERTING I/O MODULE CARDS INTO CARD CAGE

Slide each I/O module card into the card cage (cage contains guides) until the card-edge seats into the connector on the bus board at the bottom of the cage. The card should be oriented with its components facing the left side of the cabinet. The cards fit correctly only in this orientation.

**Caution:** When handling an I/O Module, it is important to hold the card by the plastic phone jacks. Do not touch any of the board components or tracks because the boards are static-sensitive. The RC-1000 should always be de-powered before handling any I/O cards. Prior to removing I/O cards, remove adjacent mounting plates in order to prevent hitting static-sensitive components.
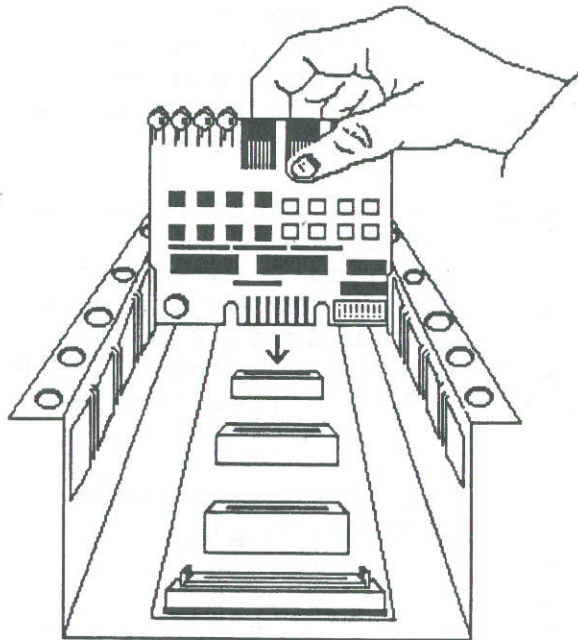
## COMMUNICATION CONNECTIONS

The RC-1000 CPU board has two RJ-11 phone connectors used for serial communication.  One connector is hooked to a modem and the other connector is used for communicating to other RC-1000's.
The necessary adapters are as follows:

For RC-1000s only:

* RC/Modem Adapter EIL part # CC/01665400
This adaptor is used to connect a 25 pin RS232 port on the back of the modem to a 6 conductor flat phone cable that plugs directly into the CPU Board (see Fig. 9).

For RC-1000s with COM-99:

* RC/COM-99 Adapter EIL part # CC/01665400
This adapter is used to connect a 25 pin RS232 port on the back of the modem to a 6 conductor flat phone cable that plugs into the COM Interface Board, marked "MODEM", found in the card cage of the #1 RC-1000 (see Fig. 10).

* COM-99/RJ-11 Adapter EIL part # CC/01665401
This adapter is used to connect a 25 pin RS232 port on the left side of the COM-99 to a 6 conductor flat phone cable that plugs into the COM Interface Board, marked "COM-99" (see Fig. 11).

Misc. Adapters:

* PC Direct Connect Adapter EIL part # CC/01664400 (25 pin) or CC/01682400 (9 pin)
This adapter is used to connect the RS232 com port on a computer directly to the com port on the RC-1000 using a standard 6 conductor flat phone cable. This adapter can only be used when plugged directly into the RC-1000 CPU.
When direct connection to the COM-99 Interface Board, an interface adapter is required. Use either EIL part # CC/01665400 (male) or EIL part # CC/01665401 (female), depending on the sex of the computer port.

## MODEM SWITCH SETTINGS

EIL currently offers a Hayes Smartmodem 1200 and Hayes Optima 2400 baud external modem for each installation. The following modem switch settings should be set on the 1200 baud modem before attempting to communicate via modem:

### In Field

| | |
|---|---|
| Only RC-1000 in store | 5,7, and 10 up |
| Only COM-99 in store | 5,7, and 10 up |
| RC-1000 and Com-99 | 5,7, and 10 up |

For the 2400 baud modem, the modem must be set up using a software package such as Procomm or Xtalk to communicate to the modem before installation. For modems to be installed in the field, the set up is as follows:

```
AT&K0&Q0S0=1&W
```

Modems provided by EIL should be set correctly for operation in the field.

Refer to appropriate manufacturer's manuals when using modems other than the Hayes Smartmodem 1200 or Optima 2400 baud external types. Refer to the Communications Connections section in this manual for hook-up and adapter information.

## CHAPTER 3 - PROGRAMMING AND INTERROGATING THE RC-1000

### INTRODUCTION

The hierarchical organization of the menus and screens throughout the RC-1000 firmware and in this manual is based on frequency of screen usage when the system is in operation (see chart below). However, programming the RC-1000 during installation should be done in the following sequence: 1) configuration screens, 2) setpoint screens, 3) names screens. Note that the RC-1000 is best programmed using CNET terminal software (available from the factory) with a remote PC or laptop computer.

Each menu or screen generally consists of a title line and one or more lines of text and data. For some screens, the title line consists of a page number and either a screen title or a user-defined identifier. If the screen consists of more than three data lines, all subsequent lines can be scrolled into view by pressing the up arrow or down arrow on the keypad. Any screen that can be scrolled is terminated by two rows of double asterisks to separate the first and last data lines.

In general, the position of the cursor, which indicates the current page, menu selection, or data field, is denoted by an "arrow" (">") symbol. If more than one page of information is available for a given screen, the cursor appears to the left of the page number when the screen or a new page is selected.

# RC-1000 DATA ACCESS AND DATA ENTRY

Although the user interface of the RC-1000 was designed to be both easy to understand and simple to use, a quick reading of the following items is recommended to all new users of the RC-1000.

- To change menu selections or data fields, use the appropriate arrow keys to move the cursor around the menu or screen and press enter.

- To change menus, press the numeric key that corresponds to the number of the desired menu selection, or press the 'ENTER' key when the cursor is to the left of the number of the desired menu selection.

- To change pages (e.g. from CIRCUIT A01 to CIRCUIT A02), press the right or left arrow keys when the cursor is to the left of the page number.

- To enter the data portion of a programmable screen from the title line, press the 'ENTER' key; the cursor will appear to the left of the first programmable data field on the screen.

- To begin data entry for any selected field, press the 'ENTER' key; the arrow cursor will change to an underline, indicating that new data will be accepted.

- To enter data for numeric fields, press either the appropriate numeric keys or use the up and down arrow keys to advance each digit in the field to the desired value.

- To change position, use the left arrow and right arrow keys. To enter data for alphanumeric fields, press either the appropriate numeric keys or use the up arrow and down arrow keys to advance each character in the field to one of the following:

      0 1 2 3 4 5 6 7 8 9 A B C D E F G H I J K L M N O P Q R
      S T U V W X Y Z . , : # * ! / &

- To enter data for multiple-choice fields, use the up arrow and down arrow keys to cycle through the available choices.

- To complete your data entry for any field, press the 'ENTER' key; the cursor will reappear either at the next field or to the left of the current field.

- To leave a field without changing its value, press the 'EXIT' key.


Notes:

1. If more than one page of information is available for a particular screen, press the 'EXIT' key to return the cursor to the page number of the screen.

2. To cause a feature or setpoint to be unused on a RACK or CIRCUIT, simply set the input or output designation to channel number 0-0.

# RC-1000 MENU FLOW CHART

Version 5.2

**MAIN MENU**

---

**CIRCUIT MENU**
- STATUS
- SETPOINTS
- OVERVIEW
- DEFROST MAP
- CKT./SENSOR NAMES
- CONFIGURATION

**RACK MENU**
- STATUS
- SETPOINTS
- OVERVIEW
- RACK NAMES
- SENSOR NAMES
- CONFIGURATION

SETPOINTS
- RACK SETPOINTS
- DESUPERHEATER
- MONITORING STPTS

---

**AUX FUNCTIONS**

LEAK DETECT
- STATUS
- SETPOINTS
- OVERVIEW
- GROUP NAMES
- SENSOR NAMES
- CONFIGURATION

LOGIC STATEMENTS
- STATUS
- SETPOINTS
- CLEAR LATCH
- LOGIC STATE. NAMES
- SENSOR NAMES
- CONFIGURATION

OVERRIDES
- TEMP CONTROL
- ALARM
- OVERRIDE LOG
- DIGITAL OUTPUTS
- DIGITAL INPUTS
- SENSOR OFFSETS

---

**LOGS**

RUN–TIME LOG
- CIRCUIT LOG
- RACK LOG

NOTE LOG

ALARM LOG

EVENT LOG

POWER LOG
- POWER HOURLY
- POWER DAILY

I/O LOGS
- ANALOG INPUTS
- ANALOG OUTPUTS
- DIGITAL INPUTS
- DIGITAL OUTPUTS

---

**EMERG. DEFROST**

---

**SYSTEM**
- DATE/TIME
- DLITE SAVINGS

ALARM DIAL OUT

I/O LIST
- ANALOG INPUTS
- ANALOG OUTPUTS
- DIGITAL INPUTS
- DIGITAL OUTPUTS

SYSTEM CONFIG
- MISCELLANEOUS
- TEMP BOARD CONFIG

---

ALARM DIALOUT
- PHONE NUMBERS
- ALARM SETUP
- DIAL LOG
- MISCELLANEOUS

ALARM SETUP
- CIRCUIT MENU
- RACK MENU
- LEAK DETECT
- LOGIC STATEMENTS
- SYSTEM

## RC-1000 MENUS, SCREENS, AND RELATED DATA FIELDS

Presented in the following pages are examples of all the RC-1000 menus and screens, complete with brief explanations of their content and application.

### RC-1000 INITIAL TITLE SCREEN

```
        EIL RC-1000 SOFTWARE VERSION X.XX
        *** CONTROL NOT CONFIGURED ***
             Enter Access Code: _
```

The RC-1000 Initial Title Screen appears after the RC-1000 is powered-up, either during installation or after a total power failure (loss of both line and battery power). **This screen will remain as the access screen until the number of racks or the number of circuits is set to a value greater than '00.'** The Rack Configuration and Circuit Configuration screens must be programmed before any Setpoint or Status screens can be viewed (see the Rack Configuration Screen (pg. 49) and the Circuit Configuration Screen (pg. 40)).

**You should become familiar with all of the menus, screens, and data fields of the RC-1000 prior to attempting to program your system**.

### NOTE ON ACCESS CODES

Special access codes are required to program your RC-1000. The factory settings for these access codes are 1234 (level-1) and 9876 (level-2); 'view-only' access (level-0) is granted when you do not enter a level-1 or level-2 access code. Once the RC-1000 has been installed and completely programmed, you should change the level-1 and level-2 access codes and give them only to people who are qualified to program your RC-1000.

Indicated under the individual screens in this manual are the access codes required to change a setpoint. When an access code is not entered, all screens except 'Rack Configuration', 'Circuit Configuration', 'Leak Detect Configuration', 'Logic Configuration' and 'Access Codes' can be **viewed**.

Entering a level-1 access code will allow the user to **view and change** the setpoints on all screens except 'Rack Configuration', 'Circuit Configuration', 'Leak Detect Configuration', 'Logic Configuration' and 'Access Codes'.

Entering a level-2 access code will allow the user to **view and change** the setpoints and I/O assignments on <u>any</u> screen. Once an access code is entered, the Initial Title Screen changes to the RC-1000 Main Menu; programming of the RC-1000 can now begin.

## RC-1000 TITLE SCREEN

```
┌─────────────────────────────────────────────────┐
│                                                   │
│        EIL RC-1000 SOFTWARE VERSION X.XX          │
│                                                   │
│             Enter Access Code: _                  │
│                                                   │
└─────────────────────────────────────────────────┘
```

The RC-1000 Title Screen appears when keypad input to the RC-1000 has ceased for more than fifteen minutes or when the RC-1000 has recovered from a temporary loss of line power. When you enter an access code or press the 'ENTER' key, this screen changes to the RC-1000 Main Menu.

Note the version number of the installed firmware and be sure to reference it when discussing any questions or problems that concern your RC-1000 with an E.I.L. sales representative or engineer.

Once your RC-1000 has been programmed, it will be accessed primarily to review system status and performance information; for 'view-only' access, just press the 'ENTER' key. However, during maintenance or repair of your refrigeration control system, you may need access to certain programmable data fields. Remember to enter the access code that is appropriate for your programming needs. Level-1 access codes are required to changed setpoints only. Level-2 access codes are usually required for maintenance purposes, and should be avoided.

If an alarm condition occurs, this screen will also indicate "NEW ALARMS IN SYSTEM". This message will remain displayed until the alarm log is viewed either at the unit or remotely.

If the battery voltage falls below an acceptable level, this screen will indicate " * RAM BACKUP BATTERY IS LOW * ". The battery should be replaced. This message will be displayed until the battery voltage is returned to an acceptable range.

## RC-1000 MAIN MENU

```
┌─────────────────────────────────────────────┐
│            RC-1000 MAIN MENU                  │
│    1-Circuit Menu      4-Overrides            │
│    2-Rack Menu         5-Emergency Defrost     │
│    3-Aux Functions     6-System               │
└─────────────────────────────────────────────┘
```

Required Access Level: None.

The RC-1000 Main Menu appears after you have entered an access code and/or pressed the 'ENTER' key at either the RC-1000 Initial Title Screen or the RC-1000 Title Screen. This menu is a table of contents to the configuration and control functions of your system.


## CIRCUIT MENU

```
┌─────────────────────────────────────────────┐
│               CIRCUIT MENU                    │
│    1-Status           4-Defrost Map           │
│    2-Setpoints        5-Ckt/Snsr Names        │
│    3-Overview         6-Configuration         │
└─────────────────────────────────────────────┘
```

Required Access Level: None.

The Circuit Menu is selected from the RC-1000 Main Menu. It is a table of contents to the RC-1000's circuit configuration and control functions. If you intend to make any programming changes to screens on this menu, keep in mind that different levels of access are required by different data fields.

## Circuit Status Screen

```
  01 CIRCUIT A01
  Refr off    Temp    Term    Hi alrm  Lo alrm
  Setpoint    -10F    65F      70F      -30F
  Actual      -11F   -15F     -10F      -14F


Sensors:
Temp 3-4 FROZEN FOOD                      -11F
Term 3-4 FROZEN FOOD                      -11F
Alrm 3-1 -11 FROZEN FOOD
Term 2-1 FROZEN FOOD DEF TERM             off
Init 2-2 FROZEN FOOD DEF INIT             off
                  **
                  **
```

Required Access Level: None.

The Circuit Status Screen displays all relevant data concerning the current status of each circuit configured for temperature/defrost control. The screen title line contains the circuit number and the user-defined name of the circuit.

The second line of the Circuit Status Screen consists of a status field and several headings. The status field can display the following descriptions:

```
Refr ON      = Refrig phase ON
Refr OFF     = Refrig phase OFF
Refr OVR     = Refrig relay override
Relay ON     = Refrig is on due to another circuits action
               using the same relay
Defr OVR     = Master defrost relay override
DEF XXXm     = Normal defrost, master relay on, XXX min. left
DEFon XXXm   = Normal defrost, master relay off, XXX min. left
EMG XXXm     = Emerg defrost, master relay off, XXX min. left
EMGon XXXm   = Emerg defrost, master relay on, XXX min. left
ECase XXXm   = Case emerg defrost, XXX min. left
Case XXXm    = Case normal defrost, XXX min. left
Rn OFF XXXm  = Runoff phase, XXX min. left
PumpO XXXm   = Pumpout phase, XXX min. left
Equal XXXm   = Equalize phase, XXX min. left
EvpFn XXXm   = Evaporator fan delay, XXX min. left
T ovr XXXm   = Temp override, XXX minutes left
- Ph Loss    = Phase loss of the assigned rack, refrig off
```

("XXXm" being a timer value in minutes).

The headings are for the circuit setpoint and actual sensor fields that follow on the next two lines. Temperature setpoints and actual sensor readings are displayed in degrees Fahrenheit (Celsius is available as an option - see Miscellaneous Screen under System Menu). Those temperatures read from or programmed for a standard temp card (-30 to 97 degrees) have 'f' as units. Those temperatures read from or programmed for the high temp card (0 to 255 degrees) have 'F' as units. If there are no sensors assigned for a given category (ie:term., alarm) the status will show "n/a". These symbols indicate specific alarm conditions and are defined as follows:

L (reverse video)   -   low temperature

H (reverse video)   -   high temperature

O (reverse video)   -   alarm override

Please note that "reverse video" means the character will appear to be white on a black background as opposed to black on a white background.

When individual case defrost is selected, each case status is displayed. In this case, the actual 'Temp' status above is displayed as '*'. This indicates to look further below for actual case status. The individual case status is displayed as:

| Case: | 1 | 2 | 3 | 4 | 5 | 6 |
|-------|-----|-----|-----|-----|-----|-----|
| *Act: | 22F | 25F | 29F | 25F | 23F | 25F |
| Defr: | ON | ON | OFF | n/a | OVR | OFF |

The '*ACT' row indicates the current case temperatures. If termination sensors were not assigned to a particular case, the actual value shows as '-30F'. If digital termination of defrost is configured, each field on the '*ACT' row shows '-', and the status of the digital input replaces the '*' within the primary status block.

The 'Defr' row shows the state of the case defrost relays. If a defrost relay was not assigned to a case, the field shows 'n/a'.

Under the heading 'Sensors:', the analog input type, I/O board-channel number, status, and user-defined name are displayed for each assigned temperature, alarm, and defrost termination sensor. Only the sensors being used will have data displayed.

Under the heading 'Inputs:', the digital input type, I/O board-channel number, and status are displayed for the assigned digital defrost termination and initiation inputs.

Note that the types of sensors and inputs associated with the temperature/defrost control circuits are determined by the options selected on the Circuit Configuration Screen.

When 'Defrost Termination' is selected, the termination under 'Sensors' is deleted from the display, and is replaced by assignment/status.

## Circuit Setpoints Screen

```
   01 CIRCUIT A01
 Temp setpoint -10F     High alarm      13F
 Low alarm      -15F    Defr term       50F
 Defr restart   20F     Evp fan start 30F

 Skip Defr @dp  45f     Max dp skips     2
 Refrig delay   01m     Alarm delay     15m
 Pumpout time   05m     Defrost time    30m
 Equalize time  05m     Evap fan dly    10m
 Defrost start times: 01:00  05:00  09:00
                      13:00 17:00 21:00
 Def init input     2-1
 Def term input     2-2
 Temp sensors       3-4 0-0 0-0 0-0 0-0 0-0
 Alrm sensors       3-4 0-0 0-0 0-0 0-0 0-0
 Term sensors       3-4 0-0 0-0 0-0 0-0 0-0
 Suction relay      1-1  Liquid relay   1-2
 Case defr rlys     2-1 2-2 2-3 2-4 2-5 2-6
 Mastr HGas rly     2-7  Evap fan rly   2-8
 Equalize relay     4-1  Alarm relay    4-2
 Suct vrfy inpt     1-1  Liq vrfy inpt  1-2
 Def vrfy inpts     2-1 2-2 2-3 2-4 2-5 2-6
 Defr init inpt     3-7  Defr term inpt 3-8
 Alrm ovrd inpt     3-1
 Temp compensation priority 01
 Rack number        01
                        **
                        **
```

Required Access Levels: 1 or 2 (see text)

The Circuit Setpoints Screen provides access to all programmable parameters affecting the temperature/defrost control circuits of the RC-1000. The title line of this screen consists of the circuit number and user-defined circuit name.

The setpoint data fields on the first few lines of the screen are self-explanatory; temperature units are Fahrenheit (Celsius is available as an option - see Miscellaneous Screen under System Menu); time delays are in minutes.

The 'Temp Setpoint' is the desired operating temperature for the circuit. When using low temp probes, the minimum setting is -30° f and the maximum setting is 97° f. When using high temp probes, the minimum setting is 0° f and the maximum setting is 255° f. If 'Temperature Deadband' is configured, this field will be replaced by 'Cut in' and 'Cut out' setpoints.

The 'High alarm' and 'Low alarm' setpoints are for critical temperature monitoring use. If the alarm setpoints are exceeded for the 'Alarm time' period, an alarm will be generated.

'Defr term' is the temperature that all assigned termination sensors must be above before the defrost cycle is terminated.

'Defr restart' is the temperature that the case termination temperatures must all fall below within a current defrost time period, then the case will return to defrost. This is intended to allow cases that are iced up, complete a more complete defrost cycle.

'Evp fan start' is the temperature that after a defrost, the coil must be below before the evaporator will restart. Otherwise, following the evap fan delay time, the fan will restart.

When the 'Dewpoint controlled skip' option is selected on the Circuit Configuration Screen, the data fields 'Skip defr @dp' and 'Max dp skips' are added to the Circuit Setpoint Screen. The 'Skip defr @dp' is the dewpoint temperature at which the defrost cycle will be inhibited or skipped if the dewpoint temperature has been below for the time between one complete defrost cycle. 'Max dp skips' is the maximum number of times that dewpoint will be permitted to skip the defrost cycle before a mandatory defrost. Note that dewpoint-controlled defrost skip and digitally-initiated defrost are mutually exclusive, that is they cannot both be enabled at the same time.

'Refrig delay' is the minimum time period that must pass after the refrigeration relay has been turned off before it can come back on again. Used to prevent short cycling.

The 'Alarm delay' is the time period that an alarm condition must be in before an alarm is logged. Note that the alarm is inactive during defrost and 15 minutes plus the alarm delay after defrost.

The 'Pumpout time' is the amount of time allowed for pumpout if the 'Pumpout phase' option is configured. When a defrost is initiated, the liquid relay will turn off for the programmed time period to allow the circuit to 'pump out'. Following this time, normal defrost will occur.

The 'Runoff time' is the amount of time after defrost that the refrigeration relay will be off. After this time expires, normal circuit refrigeration will begin. This is used to allow for condenser coils to drip off completely before refrigeration. If 'Pumpout phase' is configured, this field will not be shown.

The 'Defrost time' is the maximum amount of time a normal time initiated normal defrost will last unless it is terminated by termination sensor(s) temperature.

'Equalize time' is the amount of time allowed for equalizing pressures if the 'Equalize phase' option is configured. Following a defrost cycle, the equalize relay will be energized for this time period before normal refrigeration control is resumed.

'Evp fan dly' is the maximum amount of time after a defrost that the evaporator fan will stay off. (see 'Evap fan start')

For 'Defrost start times', six separate time fields in hours:minutes (military time) are provided. Program only as many of these as are needed.

NOTE: Up to twelve each of temperature, defrost termination, and alarm sensors can be assigned. For multiple sensor assignments, the following application rules should be noted: temperature control sensors are averaged; both low temperature alarm and defrost termination look at the sensor with the lowest reading; high temperature alarm looks at the sensor with the highest reading.

The 'Suction relay' is the relay used for controlling the suction line solenoid on the circuit. (use N/C contacts)

The 'Liquid relay' is the relay used for controlling the liquid line solenoid on a circuit. (use N/C contacts)

Individual 'Case defr rlys' are assigned for each defrost relay needed. The case relays line up with the corresponding temp/term/alarm sensors entered above them. (use N/O contacts)

'Defrost relay' is the relay used for a defrost load. (use N/O contacts)

'Mstr HGas rly' is the relay controlling the hot gas defrost valve. (use N/O contacts)

The 'Evap fan rly' is the relay controlling the evaporator fan. (use N/C contacts)

The 'Equalize relay' is the relay controlling the equalize valve. (use N/O contacts)

The 'Alarm relay' the relay used for all alarm functions on a circuit. It is normally energized if nothing is in alarm. (use N/C contacts)

The 'Suct vrfy inpt', 'Liq vrfy inpt' and 'Def vrfy inpts' are digital inputs used for proof of run verification. If a system is on, the corresponding digital contact should be closed.

'Alrm ovrd inpt' is a digital input that when closed, overrides all temperature alarms. Normal alarm monitoring will resume when the contacts are opened.

The 'Temp compensation priority' is used to assign priorities to each circuit when using floating setpoints on the rack. This field will only show up if 'Select' is chosen on the rack configuration screen for Temp Controlled Setpoints. The rack setpoints will float (up to the max cut in setpoint on the rack setpoint screen) only if priority 1 circuit is satisfied. If priority 1 circuit is in defrost, then the rack setpoints will float only if priority 2 circuit is satisfied, etc. The rack setpoints will float down to normal when the circuit with priority 1 refrigeration comes on. If 'Default' is selected on the rack configuration for Temp Controlled Setpoints, the circuit with the lowest setpoint must be satisfied for the rack setpoints to float (up to the max cut in setpoint on the rack setpoint screen). If the circuit with the lowest setpoint is in defrost, the associated circuit with the next lowest setpoint must be satisfied for the rack to float. When the circuit with the lowest setpoint goes above the setpoint, the rack setpoints will float back down, but will not go below the standard cut-in and cut-out values.

The 'Rack number' field allows you to specify the rack which this circuit uses. The number should correspond to an actual RC-1000 rack number. This assignment is important as it is a key for the software when using the Defrost Sense and Temperature Controlled Setpoints features described in the Rack Section of this manual. This parameter will affect both hot gas defrosting and temperature controlled setpoints (see Rack Menu section).

NOTE: When floating setpoints are used, all associated circuits will have the setpoints adjusted to 2° below the programmed value. The rack cut-in and cut-out setpoints will float up to but not exceed the 'Max cut-in' value.

## Circuit Overview

```
                    CIRCUIT OVERVIEW
      01-04  -11F -R     10F -R     30F D-     25F E-
      05-08  05F -R     43F D-     30F -R     30F o-
      09-12  20F --     23F -R    -09F -R    -30F oo
```

Required Access Level: None.

The Circuit Overview Screen provides a condensed view of the current status of all circuits configured for temperature/defrost control.

Each data line of the Circuit Overview Screen consists of temperature readings and pairs of status indicators for up to four circuits. A status indicator for defrost and one for refrigeration combine to reveal the current state of each circuit. These status indicators and their meanings are as follows:

    -   = system off
    o   = override
    E   = emergency defrost on, master case relay on
    e   = emergency defrost on, master case relay off
    D   = normal defrost on, master case relay on
    d   = normal defrost on, master case relay off
    R   = refrig phase, relay on
    r   = refrig phase, relay off
    H (reverse video) = high temp alarm
    L (reverse video) = low temp alarm
    P   = pumpout cycle
    Q   = equalize cycle

## DEFROST MAP SCREEN

```
              PROGRAMMED DEFROST TIMES
     ID   Circuit Name        Start    Dur    Rack
     01   Ice Cream Case      01:00   035m    01
     02   Meat Cases          02:00   020m    02

     03   Produce Storage     03:00   030m    02
     04   Fish box            04:00   030m    02
     05   Frozen Juice        05:00   030m    01
     06   Chicken case        06:00   020m    02
     07   10' Produce         07:00   020m    02
     08   Frozen Fish doors   08:00   040m    01
                              **
                              **
```

Required Access Level: None.

The defrost map is a display of all configured circuits and their defrost schedules in a time based sorted list. It is used for determining the efficient operation of defrost schedules and for quick reference of defrost times. The circuit number, name, defrost start time, defrost duration and associated rack is displayed. This information can be used to check for overlapping of defrost times which might affect operation of the overall refrigeration operation.


## CIRCUIT/SENSOR NAMES MENU

```
              CIRCUIT/SENSOR NAMES
     1-Circuit Names
     2-Sensor Names
```

Required Access Level: None.

The Circuit Menu is selected from the RC-1000 Circuit Menu. It is a table of contents to the RC-1000's circuit and sensor names functions. If you intend to make any changes to screens on this menu, keep in mind that different levels of access are required to change data fields.

## Circuit Name Screen

```
NUM                CIRCUIT NAME
01   CIRCUIT A01
02   CIRCUIT A02
03   CIRCUIT A03

04   CIRCUIT A04
05   CIRCUIT A06
06   CIRCUIT A06
07   CIRCUIT A07
08   CIRCUIT A08
09   CIRCUIT A09
10   CIRCUIT A10
11   CIRCUIT A11
12   CIRCUIT A12
13   CIRCUIT A13
14   CIRCUIT A14
15   CIRCUIT A15
16   CIRCUIT A16
                          **
                          **
```

Required Access Level: 1 or 2.

The Circuit Name Screen enables you to enter descriptive names for each of the circuits configured for temperature/defrost control. Both numeric and alphabetic data entry are permitted.

To change the description:

A. Press enter key, and arrow will appear beside '► CIRCUIT A01'

B. To select the circuit that you wish to change the description of, use the up arrow or down arrow key on the keypad and press enter.

C. The cursor will now appear under the first character of the description 'CIRCUIT A01'.

D. Use the up arrow or down arrow key to scroll through the alphabet. When the desired character appears, use the right arrow key to move the cursor to the next character.

E. If a space is required, it is located after the '9' and before the 'A'.

## Circuit Sensor Name Screen

```
NUM                 SENSOR NAME
3-1    FROZEN FD 1 T/A
3-2    FROZEN FD 2 T/A
3-3    FROZEN FD 3 T/A

3-4    FROZEN FD 1 TERM
3-5    FROZEN FD 2 TERM
3-6    FROZEN FD 3 TERM
3-7    ICE CREAM T/A
3-8    ICE CREAM TERM
4-1    SENSOR 4-1
4-2    SENSOR 4-2
4-3    SENSOR 4-3
                          **
                          **
```

Required Access Level: 1 or 2.

The Circuit Sensor Name Screen enables you to enter descriptive names, up to 24 characters long, for each sensor assigned to a configured circuit. Both numeric and alphabetic data entry are permitted. Descriptions can only be entered after the sensor assignment in the 'Circuit Setpoint' screen. The ability to describe a sensor can only be done following the assignment of the sensor in the 'Circuit Setpoint' Screen.

## Circuit Configuration Screen

```
┌─────────────────────────────────────────────────────────┐
│  ┌───────────────────────────────────────────────────┐  │
│  │              CIRCUIT CONFIGURATION                 │  │
│  │  Number of circuits (max 32) ... 10                │  │
│  │  Number of temp snsrs per ckt .. 6                 │  │
│  │  Refrig relay control .......... Suction           │  │
│  └───────────────────────────────────────────────────┘  │
│                                                          │
│     Temperature dead band .......... NO                  │
│     Defrost initiation  ........... TIME                 │
│     Defrost termination ........... TIME/TMP             │
│     Defrost restart ............... YES                  │
│     Multi-case defrost term ... ... YES                  │
│     Hot gas defrost ............... YES                  │
│     Pumpout phase ................. YES                  │
│     Equalize phase  ............... YES                  │
│     Evap fan control  ............. YES                  │
│     Dewpoint controlled skip ...... YES                  │
│     Digital alarm override ........ YES                  │
│     Valve verification ............ YES                  │
│                    **                                    │
│                    **                                    │
└─────────────────────────────────────────────────────────┘
```

Required Access Level: 2

The Circuit Configuration Screen enables you to select the circuit configuration options that apply to your particular refrigeration control system. Note that these options have corresponding data fields on the Circuit Status and Circuit Setpoint screens.

The most critical configuration field on this screen is the first one, which enables you to specify the number of circuits that are to be controlled by the RC-1000. **As long as the value of this data field is '00', you will be unable to view the other screens listed on the Circuit Menu.**

The "Number of temp sensors per circuit' is selectable from 6 to 12. This allows up to 12 temp sensors <u>and</u> 12 termination sensors <u>and</u> 12 alarm sensors per circuit. The default value is 6 sensors of each type per circuit.

'Refrig relay control' allows three choices. The first is the default of 'Suction' control. This allows one relay to be assigned as control of the suction stop valve. The next choice is 'Liquid'. This allows a relay to be assigned as control of the liquid line solenoid. The final choice is 'Suc/Liq'. This allows two relays to be assigned. One for a suction valve and one for a liquid line solenoid.

If 'Temperature dead band' is selected, there will be areas provided for cut in and cut out temperature setpoints.

'Defrost initiation' offers a choice between system clock 'TIME' and a 'TIME/DIGITAL' input. When the latter is selected, a 'Def init input' field is added to the Circuit Setpoint Screen and an 'Init' input field is added to the Circuit Status Screen under the 'Inputs:' heading. Note that when the 'DIGITAL' defrost initiation option is selected, the dewpoint option is forced to 'NO', they cannot both be active at the same time. To initiate a defrost, the contacts must be closed to the assigned digital input and the defrost time must be active. If the defrost time schedule is not entered, then defrost is initiated only by the digital input closure. If 'TIME' is selected, defrost is initiated only by the defrost time schedule.

'Defrost termination' offers a choice between a 'TIME/TEMP' and 'TIME/DIGITAL'. The first allows the defrost to continue the entire defrost time as long as the termination temperature is below the setpoint. If the termination exceeds the termination setpoint, the defrost will terminate. When the latter is selected, a 'Def term input' field is added to the Circuit Setpoint Screen and a 'Term' input field is added to the Circuit Status Screen under the 'Inputs' heading. To terminate a defrost, the programmed digital input must see a contact closure (Klixon or case thermostat), or defrost will end when the defrost duration has expired.

Actual implementation of the digital defrost options is on a per-circuit basis and is dependent upon input assignment, sensor assignments, and defrost times.

'Defrost restart' is provided to better use the total defrost time programmed for a circuit. The defrost phase will be active for the entire defrost time programmed. Within that duration, any defrost relay (master or case), will turn off when that circuit/case termination condition is satisfied. If temp termination of defrost is specified, any defrost relay can turn back on if the associated temp meets a specified defrost restart setpoint and the defrost time duration has not expired. If digital termination of defrost is configured, all assigned relays will turn back on if the termination input has been for 2 minutes. Defrost relay cycling, based on the above description, will continue for the full defrost duration.

'Multi-case defrost term' allows use of a master defrost relay or individual case defrost relays. When configured each individual case defrost relay is associated with a defrost termination sensor which is displayed vertically above the relay assignment on the setpoints screen. If 12 sensors per circuit is configured, each case defrost relay will have 2 termination sensors associated to it. If temperature termination of defrost is configured. each case turns off its individual defrost relay. Once all the cases have terminated (or the defrost duration has expired), the circuits defrost phase is complete and refrigeration control is returned to normal. If defrost is configured to terminate by digital signal, all case relays are switched simultaneously. (only one digital termination input is provided).

When the 'Hot gas defrost' option is selected, the 'Hot gas relay' field is added to the Circuit Setpoint Screen. It is important to note that the Hot gas relay should be wired to the main liquid line solenoid or head pressure modulating valve. The 'Hot gas defrost' option should be programmed on only those circuits that use hot gas for their defrost.

'Pumpout phase' allows for a time period before actual defrost, that the liquid relay is turned off and the suction relay is turned on. After the pump out time has expired, the normal defrost will occur. This is provided to pump out the evaporator coil before the defrost.

The 'Equalize phase' is used to equalize the pressure across the evaporator coil after a defrost cycle. If this option is configured, the 'Run off' time field will be replaced with 'Equalize time' and a corresponding equalize relay assignment field. After the normal defrost cycle, the equalize relay will energize for the equalize time period before normal refrig control is allowed.

'Evap fan control' is available to separately control the evaporator fan. If this option is configured, three entry fields will be provided. The first is for the evaporator fan temp setpoint. The next is for the evaporator fan delay. The final is for the evaporator fan relay assignment. Following return to refrigeration control after defrost, the evaporator time delay period is started. The evaporator fan will restart once the evaporator coil temperature drops below the evap fan setpoint <u>or</u> the evap fan delay period has expired, whichever comes first. This option requires that at least one defrost termination sensor be assigned. If more than one sensor is assigned, the <u>maximum</u> of all the sensors is used to control the evap fan restart.

When the 'Dewpoint controlled skip' option is selected, the fields 'Skip defr @ dp' and 'Max skips' are added to the Circuit Setpoint Screen. If this option is selected, the defrost cycle will be skipped (up to the max number of skips) when the dewpoint is below the dewpoint skip setpoint. If this option is configured, a dewpoint sensor will need to be installed. Note that this feature cannot be configured at the same time as digital initiated defrost.

The 'Digital Alarm Override' feature allows use of a digital input to override alarms for a circuit. If the contacts are closed, the circuit will not alarm on high or low temperature conditions. Normal operation is resumed when the contacts are opened. This may be useful when servicing a circuit or when stocking a case.

The 'Valve verification' feature allows remote monitoring of the actual refrigeration valve or defrost valve, on a per-circuit basis, by using a digital input. If the RC-1000 calls for refrigeration and the ref valve is not energized, the alarm log will show 'date and time', circuit description, and will also activate the remote alarm. Defrost valve verification works in a similar manner.

## RACK MENU

```
┌─────────────────────────────────────────────────┐
│                  RACK MENU                        │
│   1-Status              4-Rack Names              │
│   2-Setpoints           5-Sensor Names            │
│   3-Overview            6-Configuration           │
└─────────────────────────────────────────────────┘
```

Required Access Level: None.

The Rack Menu is selected from the RC-1000 Main Menu. It is the table of contents to the RC-1000's compressor rack configuration and control functions. If you intend to make any programming changes to screens on this menu, keep in mind that different levels of access are required by different programmable data fields.

## Rack Status Screen

```
  01 RACK A              SUCT        HEAD
  Units on     1750rpm   1_34        123_
  Capacity ACT-REQ      060%-060%   050%-050%
  Actual reading         010p        175p


  Cut in-Cut out         012p-009p  200p-165p
  Temperature Diff                    0.0F
  Desuper Units On       1-    MaxTemp:  82F
  Power                  0000kw
  Anlg Liquid Level      038%
  Motor data:
  Speed             1750rpm
  Frequency         60hz
  Capacity          100%
  Current           035a
  Oil pres          000


  AI  1-1   Ambient Temp Sensor      27.0F
  AI  1-2   Drop Leg Temp Sensor     27.0F
  AI  1-1   Rack A Suction Pres      050p
  AI  1-2   Rack A Head Pres         175P
  DI  1-1   Rack A Aux Enable        off
  DI  1-2   Rack A Phase Loss        off
  Compr 1   1-2  Rack A Comp 2       off
  Compr 2   1-3  Rack A Comp 3       off
  Compr 3   1-4  Rack A Comp 4       off
  Comprsr speed Rack A VS Comp       0000rpm
                      **
                      **
```

Required Access Level: 1 or 2 (see text)

The Rack Status Screen displays all relevant data concerning the current status of each configured compressor rack. The screen title line contains the rack number and the user-defined rack name.

The second line of the Rack Status Screen consists of the rack compressor speed, suction, and head status fields. The status fields contain either a blank (no alarm) or a lowercase 'o'. This symbol indicates that there is an override condition in effect. A reverse video 'O' appearing just to the right of these fields indicates an oil failure alarm condition.

The third line consists of the actual vs. required capacity (shown as percentages) for the suction and head sides of the rack.

The next two data lines consist of the actual readings for suction and head pressures and their cut-in and cut-out setpoints. A reverse video "H" or a reverse video "L" to the right of either of the two pressure fields indicates a high or low pressure condition, respectively. If the condenser fans are being controlled by temperature differential, the cut in and cut out pressure settings will be replaced by the temperature differential settings. A reverse video "A" or a reverse video "F" to the right of either of the two setpoint fields indicates auxiliary or floating setpoints, respectively. A reverse video "T", to the right of the suction reading, indicates low liquid level. A reverse video "O" to the right of the suction and pressure readings indicate an alarm override. This override occurs after any power failure and lasts for a 3 minute period.

If temperature differential control of the condenser fans is configured, the next line will display the actual temperature difference between the actual ambient and drop leg temperatures.

If Desuperheater control is configured, the next line will be the status of the Desuperheater relays and the average (or max temperature) of all the Desuperheater manifold temperature sensors.

The next line will indicate the actual rack KW , if used. Phase loss is indicated by a reverse video "P" beside the power KW line. If neither phase loss or rack KW is used on any rack, this line will not be displayed.

If an analog liquid level input is used, the actual liquid level % is displayed next. A reverse video "L" is displayed if the liquid level is lower than the alarm setpoint and in alarm.

When the 'Variable speed' option is selected on the Rack Configuration Screen, an additional section labeled 'Motor Data' is displayed with the following data fields: compressor speed, compressor motor frequency, percentage capacity, compressor amperage, and net oil pressure reading.  If the oil pressure reading is considered low, a reverse video "O" symbol will appear to the right of the oil pressure reading.

During normal operation, the variable speed compressor will ramp between the "Max RPM" setpoint and the "Min RPM" setpoint. If during the course of normal operation the oil pressure goes below the "min oil press" setpoint for five seconds, the RC-1000 will ramp the RPMs of the variable speed compressor to the maximum setpoint in an attempt to regain a safe oil pressure. This also prevents the mechanical oil safety switch from shutting off the compressor unless there is an actual oil problem. The variable

speed compressor will resume normal operation after thirty seconds of good oil pressure.

> **Note:** Oil pressure displayed is the net oil pressure.
> Oil pump output - Suction pressure = net oil pressure.

The next lines of data only are displayed if the monitor option is configured. All sensors assigned are displayed along with their descriptions and actual readings.

## RACK SETPOINTS MENU

```
                    SETPOINTS
      1-Rack Setpoints
      2-Desuperheater Setpoints
      3-Monitoring Setpoints
```

Required Access Level: None.

The Rack Setpoint Menu is selected from the RC-1000 Rack Menu. It is the table of contents to the Rack setpoints areas. The Rack Setpoint selection is always available. The selections for Desuperheater Setpoint and Monitor Setpoint are only displayed if these functions are configured in the Rack Configuration. If Desuperheater and Monitor setpoints are not configured, this menu will be skipped and you will be directly brought into the Rack Setpoint screen when the setpoints selection is made from the Rack Menu.

## Rack Setpoint Screen

```
01 RACK A                   SUCT        HEAD
  Cut in                    012p        200p
  Cut out                   009p        165p
  Aux cut in                020p        250p
```

```
Aux cut out                 015p        185p
Max cut in                  030p
High alarm                  040p        300p
Low alarm                   005p        095p
Shutdown                    015p
Head Override                           320p
Alarm delay            15m              20m
Liquid Level Alarm     020%
HR Override Level      010%
HR Override Diff        002%
HR Override Delay       030s
Min on time             000s           000s
Min off time            060s           060s
Control gain             020            100
Derivative Gain          040            150
Unit combinations        ALT            SEQ
Pres sensor              1-1            1-2
Alarm relay              2-7            2-7
Ambient Temperature Sensor    0-0
Drop Leg Temperature Sensor   0-0
Temp Differential Cut-In      00
Temp Differential Offset      00
Anlg Liq. Lev. Snsr 0-0
HR Override Relay   0-0
Aux enable input    1-1
Phase loss input    1-2
Oil failure input   1-5


Compr      1    2    3    4    5    6    7    8
Relay     0-0  1-2  1-3  1-4  1-5  1-6  0-0  0-0
Capacity  000  100  100  100  050  050  000  000
Unloaders  0    0    0    0    1    0    0    0
Run inpt  0-0  2-2  2-3  2-4  2-5  0-0  0-0  0-0


Variable Speed Compressor:
Max rpm          1750     Min rpm         0875
Capacity          100     Min oil pres   015p
Analog output     1-1     Oil pres sensr 1-3
Freq sensor       0-0     Current sensr  0-0
Control relay     1-1     Reset relay     2-5
Switchovr relay   3-2     Fault input     1-2
Run input         2-1
```

```
Fan          1    2    3    4    5    6
Relay       2-1  2-2  2-3  2-4  2-5  2-6
Run Inpt    0-0  0-0  0-0  0-0  0-0  0-0

Power Sensr    0-0        Max Power      1000
Associated medium temperature rack   02
                    **
                    **
```

Required Access Level: 1 or 2.

The Rack Setpoint Screen provides access to all programmable parameters affecting the control of each configured compressor rack. The screen title line contains the rack number and user-defined rack name. Many areas may not be displayed on all units depending on the rack configuration setup. Pressures are in psi and times are in either minutes ('m') or seconds ('s'). In general, these data fields are self-explanatory.

The 'Cut in' and Cut out' fields are for setting the general operating pressures of the rack. The 'Cut in' must be higher than or equal to the 'Cut out' value.

'Aux cut in' and Aux cut out' are the setpoints to be used when the auxiliary enable digital input contacts are closed.

The 'Max cut in' value is used to determine a maximum pressure for the system to operate under when floating setpoints are used.

The 'High Alarm' and 'Low Alarm' setpoints are values that when exceeded, will effect an alarm in the RC-1000. These alarms will honor the alarm time delay.

The 'Shutdown' field is provided to allow shutdown of all compressors on the rack if the suction pressure falls below this value. Normal operation will resume when the pressure rises back above the shutdown value. The compressors must honor the min off time before restarting. The minimum value for proper operation is '001'. This feature can be disabled by setting the shutdown value to '000'.

The 'Head Override' setpoint is used to set a high pressure point where, if exceeded, the compressors would begin an orderly shutdown. As this setpoint is exceeded, the suction % required is decreased allowing compressors to shutdown. The farther above this setpoint, the faster the compressors will shutdown. When the head pressure drops below the head override setpoint, the compressors will be allowed to return to normal operation.

'Alarm Delay' is the time period that must pass after an alarm condition has been met, before an alarm will be logged.

'Liquid level alarm' is the value (in %) that when the analog liquid level sensor falls below, an alarm will be generated.

'HR override level' is the value (in %) that the liquid level must be below, for the specified time period, for the HR override relay to open.

'HR override diff' is the level (in %) that the liquid level must exceed (HR override level + HR override diff) before the HR override relay is returned to normal operation.

'HR override delay' is the time period that the liquid level must be below the HR override level before HR override action occurs.

The 'Min on' and 'Min off' times are intended to supply time delays for short cycle protection of the compressors and condenser fans. The default times are 30 seconds.

The most important parameter for correct rack operation is the 'Control gain'. This regulates the response of the RC-1000 to changes in pressures. Typical starting values are 10 for suction and 100 for head. The higher the gain, the faster the RC-1000 will respond and calculate capacities . These values can be tailored to suit the particular compressor installation for optimal performance. There must be a value for control gain in order for the system to operate. The minimum value is '000' and the maximum value is '255'.

The 'Derivative Gain' field allows the RC-1000 to sense the direction and magnitude of pressure changes. This function can help with sharp rises and falls of pressure. It can be thought of as an 'anticipator'. Typical values for this field should start at 4 times the control gain. The higher the derivative gain, the faster the RC-1000 will respond and calculate additional capacities. These values can be tailored to suit the particular compressor installation for optimal performance. This feature is optionally used. If it is not desired to use the derivative gain, set these fields to '000'. The minimum value is '000' and the maximum value is '255'.

The method of sequencing compressors and condenser fans is set by either 'Seq' (sequential) or 'Alt'(alternating). In seq mode, the stages are brought on from left to right, and brought off from right to left. If alt mode is selected, the RC-1000 alternates stages based on run times and capacity required.

The 'Pres Sensor' assignments are made according to which analog input the pressure sensors are connected to on the termination boards. The suction pressure is used with a 100 psi transducer and the head pressure is used with a 500 psi transducer.

The 'Alarm Relay' is the relay assignment which will be activated upon an alarm condition logged by the RC-1000. (use N/C contacts)

The 'Ambient Temperature Sensor' is the analog input temperature sensor that will be used for monitoring the outdoor ambient temperature. It will be used only if Temperature Differential for head pressure control is configured in the Rack setpoints screen. Either high and low temperature sensors can be used. This sensor type must be the same as the drop leg sensor.

The 'Drop Leg Temperature Sensor' is the analog input temperature sensor that will be used to monitor the condenser manifold temperature. It will be used only if Temperature Differential for head pressure control is configured in the Rack setpoints screen. Either high or low temperature sensors can be used. This sensor type must be the same as the ambient sensor.

'Temp Differential cut in' is the value that reflects the maximum difference of the drop leg temperature minus the ambient temperature that is desired. If the difference in temperatures is greater than this setpoint, the condenser fans will begin to calculate percent required and stage on. When the temperature difference is less than this setpoint minus the 'Temp Differential Offset', the condenser fans will begin to stage off.
The 'Temp Differential Offset' can be set to '00' to allow a single setpoint control.

The 'Analog Liq. Lev. Snsr' is the analog input that reads the amount of refrigerant liquid level in the receiver. The sensor used is a 0 to 10 k ohm pot, with 0 = 0% and 10 k = 100%.

'Liquid level input' is the digital input used for monitoring a digital liquid level sensor. If the contacts are closed, an alarm will be generated.

'Defrost sense input' is the digital input that identifies that a corresponding circuit is in defrost. If the contacts are closed, the circuit indicates it is in defrost.

'HR Override Relay' is the relay that will be de-energized when the liquid level in the receiver falls below the 'HR Override Level'. The 'HR Override Delay' will be active before the relay is de-energized. The relay will energize when the liquid level returns above the 'HR Override Level' plus the 'HR Override Diff'. (use N/C contacts)

'Aux Enable Input' is the digital input that when closed, will activate the 'Aux cut in' and 'Aux cut out' setpoints. The RC-1000 will immediately react to the new setpoints. When this input is active, an inverse 'A' will appear next to the setpoints field on the Rack Status screen.

The 'Phase loss input' field is the digital input that when opened, will shut down all compressors and associated circuits as defined by the circuit setpoint screen.

The 'Oil failure input' is the digital input used to monitor rack oil pressure. This is a monitor only input, no action will occur on rack components. An alarm will be logged upon opening the contacts. All oil fail contacts should be connected in series such that any failure will open the digital input. When the contacts are closed, the alarm condition will clear.

The 'Capacity' values should be proportional for all the compressors used. Values of HP, BTU or % can be used. For example: assume three compressors at 7.5 hp are used, since 7.5 cannot be entered as capacity, use 75 for all three. If a variable speed compressor was used also at capacity of 10 hp, use 100 as its capacity for compatibility with the fixed compressor capacities. Generally, higher numbers for variable speed capacity, (multiply actual capacity by 10) , provide finer control of the variable speed compressor.

The 'Unloaders' value indicates how many unloaders are provided for the compressor assigned directly above it. The RC-1000 then assumes that the next 'Unloaders' number of compressors are actually unloaders. For example, compressor 1 (10 hp total) has 4 unloaders (each has 1/5 total capacity) relay assignments 1-1 through 1-5, compressors 3 (15 hp) and 4 (15 hp) have no unloaders, relay assignments 1-6 and 1-7. The assignments would be:

| Compr | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|
| Relay | 1-1 | 1-2 | 1-3 | 1-4 | 1-5 | 1-6 | 1-7 | 0-0 |
| Capacity | 020 | 020 | 020 | 020 | 020 | 150 | 150 | 000 |
| Unloaders | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

The RC-1000 will not allow a programmed unloader to come on without its master compressor on first.

The 'Run Inpt' setpoints are used for digital proof of run contacts for each compressor. The RC-1000 expects closed contacts when the compressor is running and open contacts when the compressor is off. An alarm will be logged is the proof contacts do not agree with the compressor run condition.

When the 'Variable speed' option is selected on the Rack Configuration Screen, additional data fields are displayed under the heading 'Variable speed compressor. Not all of these parameters must be used, depending on the complexity of the inverter installation. Refer to figures 12 and 13 for connection of these features. When using the advanced features of the inverter (ie: fault feedback, reset, switch over, etc) the operation of the system is more complicated. If the inverter sends a fault signal to the RC-1000, the RC-1000 will attempt to reset the inverter three times, if unsuccessful, the RC-1000 will enable the switch over relay and the inverter will run in bypass mode. When the fault condition clears, the inverter control will return to normal.

V.S. Setpoints:

'Max RPM' is the maximum value of RPM for the compressor under V.S. control. This corresponds to the maximum output of the analog out card (10 vdc) The maximum value allowed is 5000 rpm.

'Min RPM' is the lowest value for the V.S. to operate. The compressor will never operate below this RPM. The V.S. compressor will shut down only when the required capacity is at 0%.

The 'Capacity' uses the same capacity setup as for fixed compressors. The higher the capacity, the more defined increments for the V.S. output.
For example:
cap = 10, max RPM = 1750
V.S. steps 175 RPM
cap = 100, max RPM = 1750
V.S. steps 17.5 RPM

'Min oil pres' is the minimum operating pressure desired for the V.S. compressor to operate under. If the oil pressure goes below the min oil pressure, the V.S. compressor will speed to max RPM until the oil pressure is restored for a 30 second period.

The 'Analog output' is the output assignment for the analog output card that is connected to the V.S. inverter.

The 'Oil pres sensor' is the assignment for the pressure sensor used to monitor oil pressure in the compressor. A standard SA-1000 transducer is used and should be 'snubbed' to prevent the 'hammer' effect. The oil pressure is calculated as: Oil pump output- suction pressure = net oil pressure.

The 'Freq sensor' is used for an external monitor of the operating frequency of the inverter. The signal should be 0-10 vdc.

The 'Current sensor' is used for an external monitor of the operating current of the V.S. compressor. The signal should be 0-10 vdc.

The 'Control Relay' is used to control the main power contactor for the inverter. The control relay is energized whenever the analog output is active. (use N/C contacts)

The 'Reset relay' is used to send a reset signal to the inverter. If a fault is detected from the inverter, the reset relay will pulse three times and attempt to get the inverter running properly. If after three resets the inverter is still in a fault condition, the inverter will go into switchover mode.

The 'Switchover relay' is used to bypass the inverter control and run the inverter as an on/off compressor. If the inverter has a fault and does not recover, the switchover relay will energize and the external bypass relay will control the compressor. This relay can be connected either N/O or N/C as configured in the rack configuration.

The 'Fault input' accepts a digital fault signal from the inverter. If the contacts are closed, the RC-1000 will attempt to reset the inverter using the reset relay.

'Run input' is a digital input used for proof of run verification of the V.S. inverter. If the contacts are closed, the compressor is assumed to be running. If the run input does not match the actual run condition of the compressor, an alarm is generated.

Condenser 'Fan Relays' are assigned next along with their respective proof of run digital input assignments (if used).

The 'Power Sensor' is a 0-10 volt analog input from a kw transducer. 'Max Power' is the equivalent to a scale factor for the transducer used. For the EIL watt transducers the max kw is determined as follows:(refer to figures 7, 27 and 28)

| TRANSDUCER | RATING | MAX KW |
|---|---|---|
| A12080 | 208v,3 phase,3 wire | .36 x (ct size) |
| A12081 | 480v,3 phase,3 wire | .83 x (ct size) |

The 'Associated low temperature rack' interlocks the rack to another for lock out purposes. Intended for two stage systems. If the med temp rack compressors are not running, the low temp rack will be locked out (all compressors off) This number should be set on the medium temp rack. On the associated low tem rack, this field will show 'N/A".

## Rack Desuperheater Setpoint Screen

```
01-RACK A
                      Unit:  #1       #2
    Cut in setpoints ......  70F      90F
    Dead bands (cut out)...  05F      05F
  Desuperheater relays..    8-1      8-2
  Temperature control on.  Average temp
            Manifold Sensors
     7-1    7-2    7-3    7-4    7-5    7-6
                      **
```

Required Access Level: 1 or 2.

The Desuperheater Setpoint screen allows setpoints for Desuperheater relay control and two stage rack control interlock. Up to six manifold temperature sensors can be assigned. The control will operate on the average of these sensors or on the Highest Temperature (user selectable). Up to two relays can be assigned with individual cut in setpoints and deadband offsets. The relay will come on when the temperature goes above the setpoint and will go off when the temperature goes below the setpoint minus the deadband.

## Rack Monitor Setpoint Screen

```
01- RACK A
      Type       Assignments
    Temp  snsr:   1-1    0-0    0-0    0-0
    Low  Press:   3-1    3-2    0-0    0-0
    High Press:   3-3    3-4    0-0    0-0
    Other snsr:   7-1    7-2    0-0    0-0
    Dig Inputs:   2-1    2-2    0-0    0-0
    Relay Outp:   4-1    4-2    4-3    4-4
    Analog Out:   0-0
                       **
```

Required Access Level: 1 or 2.

The monitor setpoints allows for monitoring in a convenient group, a variety of inputs and outputs. There is no control action from these setpoints. The inputs and outputs can be either independent assignments or duplicate assignments from any other area of the RC-1000.

## Rack Overview Screen

```
              RACK OVERVIEW
      SUCT                      HEAD
  01  030p   123----   1750rpm   248p   12---
  02  012p   --34---             260p   1234-
  03  000p                       000p
                    **
```

Required Access Level: 1 or 2.

The Rack Overview Screen shows a condensed status of the racks. The data includes the rack number, the suction pressure, the variable speed rpm, compressor stages on, head pressure and condensor fan stages. High and low alarms are indicated on this screen.

## Rack Name Screen

```
  NUM             RACK NAME
  01   RACK A LOW TEMP
  02   RACK B MED TEMP
  03   A/C COMPRESSOR
  04   SATELLITE
                    **
                    **
```

Required Access Level: 1 or 2.

The Rack Name Screen enables you to enter descriptive names, up to 16 characters long, for each of the configured refrigeration racks. Both numeric and alphanumeric data entry are permitted. Descriptions can only be entered after the racks have been configured in the 'Rack Configuration' screen.

## Rack Sensor Names Menu

```
                    Sensor Names
          1-Rack Sensor Names
          2-Monitor Sensor Names
```

Required Access Level: 1 or 2.

The Rack Sensor Names Menu is selected from the Rack Menu. It allows access to assign sensor name description to standard Rack sensors and to the Monitor sensors. Both numeric and alphanumeric data entry are permitted. Descriptions can only be entered after the racks have been configured in the 'Rack Configuration' screen.

## RACK Sensor Names Screen

```
01-Rack A
3-1 Suct Pr  RACK A SUCTION PRESSURE
3-2 Head Pr  RACK A HEAD PRESSURE
4-1 Liq Lev  RACK A LIQUID LEVEL

4-1  Ambient  OUTDOOR AMBIENT TEMPERATURE
4-2  Drop Lg  CONDENSER DROP LEG TEMP
2-7  Phase    RACK A PHASE LOSS MONITOR
2-8  Oil Inp  RACK A OIL FAIL INPUT
                   **
                   **
```

Required Access Level: 1 or 2.

The Rack Sensor Name Screen enables you to enter descriptive names, up to 24 characters long, for each sensor assigned to a configured compressor rack. Both numeric and alphabetic data entry are permitted. The ability to describe a sensor can only be done following the assignment of the sensor in the 'Rack Setpoint' Screen.

## RACK Monitor Names Screen

```
01-Rack A
3-1 Suct Pr    RACK A SUCTION PRESSURE
3-2 Head Pr    RACK A HEAD PRESSURE
4-1 Liq Lev    RACK A LIQUID LEVEL
4-1  Ambient   OUTDOOR AMBIENT TEMPERATURE
4-2  Drop Lg   CONDENSER DROP LEG TEMP
2-7  Phase     RACK A PHASE LOSS MONITOR
2-8  Oil Inp   RACK A OIL FAIL INPUT
                    **
                    **
```

Required Access Level: 1 or 2.

The Rack Monitor Names Screen enables you to enter descriptive names, up to 24 characters long, for each sensor assigned to a configured monitor group. Both numeric and alphabetic data entry are permitted. The ability to describe a sensor can only be done following the assignment of the sensor in the 'Monitor Setpoint' Screen.

## Rack Configuration Screen

```
┌─────────────────────────────────────────────────┐
│  ┌───────────────────────────────────────────┐  │
│  │           RACK CONFIGURATION              │  │
│  │  Number of racks (Max:4) ........ 4       │  │
│  │  Variable speed ................. YES     │  │
│  │  Run verification ............... YES     │  │
│  └───────────────────────────────────────────┘  │
│     Aux setpoints ................. YES          │
│     Temp controlled setpoints ..... YES          │
│     Phase loss input .............. YES          │
│     Refrigerant liquid level ...... YES          │
│     Defrost sense input ........... INTERNAL     │
│     Oil failure input ............. YES          │
│     Compr relay Energized on ...... YES          │
│     Desuperheater control ......... YES          │
│     Additional Monitoring ......... YES          │
│     TD head pressure control ...... YES          │
│     Two stage rack control ........ YES          │
│     Head Pressure Override ........ YES          │
│     Polarity of switchover relay .. EOFF         │
│                    **                            │
│                    **                            │
└─────────────────────────────────────────────────┘
```

Required Access Level: 1 or 2.

The Rack Configuration Screen enables you to select the compressor rack configuration options that apply to your particular refrigeration control system.

The most critical configuration field on this screen is the first one, which enables you to specify the number of racks that are to be controlled by the RC-1000. **Remember, as long as the value of this data field is '00', you will be unable to view the other screens listed on the Rack Menu.**

The next configuration option, 'Variable speed', provides the capability to control one compressor speed for each configured refrigeration rack. When this option is selected (YES or NO), additional data fields appear on the status and setpoint screens (see the Rack Status and Rack Setpoint screens for details).

The 'Run verification' option offers the capability to sense the actual state of individual compressors ('ON' or 'OFF'), via digital inputs (i.e. when the compressor turns on, the digital input will close to indicate a run condition). When this option is selected, eight 'Run inpt' fields (digital input assignments) are added to the Rack Setpoints Screen. A suction alarm will occur when the state of any of these inputs does not match the desired output state of the associated compressor. Also, a 'v' will appear in the Rack Status Screen in place of the compressor number.

The 'Auxiliary setpoints' option offers the capability to control the rack suction and head pressures according to an additional set of setpoints when a special digital input is 'ON' (closed). 'Aux cut in' and 'Aux cut out' setpoint fields and an 'Aux enable input' field are added to the Rack Setpoint Screen when this option is selected.

The 'Temperature controlled setpoints' option allows the user to "float" the suction pressure CI and CO upward based on critical case temperatures. By assigning a max CI value in the 'Rack setpoints' screen, and referencing the appropriate rack number at the bottom of each 'Circuit setpoints' screen, a control algorithm will be initiated.

When floating setpoints are used, all associated circuits will have the setpoints adjusted to 2° below the programmed value. The rack cut-in and cut-out setpoints will float up to but not exceed the 'Max cut-in' value. When any associated circuit goes above the setpoint, the rack setpoints will float back down, but will not go below the standard cut-in and cut-out values.

During the algorithm, the rack side of the RC-1000 will look at the setpoints of all assigned circuits. One circuit will be used to "float" the suction CI and CO. There are two configurations for deciding which circuit to use - 'default' and 'select'. 'Default' uses the circuit with the lowest setpoint. 'Select' uses the circuit with the lowest 'Temperature Compensation Priority'(TCP), which is entered in the Circuit Setpoint screen. A priority of zero indicates that circuit is not to be used for temperature compensation. If that circuit temp is at or below setpoint, the CI and CO will float up.

The rate of floating is 1 psi/(degree x minute). The differential between CI and CO will remain constant. The CI will never float above the max CI or below its original value. In a case where the controlling circuit goes into defrost, the rack side of the RC-1000 will use either the circuit with the next lowest setpoint if 'default' is chosen, or the circuit with the next higher TCP if 'select' is chosen. While a circuit is being used for floating, it will remain in 'refrigeration ON' mode unless the temperature falls to two degrees below setpoint. This allows the temperature to be controlled by the rack side via "floating".

The 'Phase loss input' option offers the capability to sense an AC power line failure via a phase protect relay into a digital input and shut down all configured rack compressors and assigned circuits immediately. Selection of this option adds the 'Phase loss input' field to the Rack Setpoint Screen. Note that the 'open' state signals an alarm condition for this input. During normal operation, the contacts need to be closed (digital input light - ON).

The 'Refrigerant liquid level' option offers the capability to sense the liquid refrigerant level via a digital or analog input and shut down the rack system when the level falls below some minimum. Selection of this option adds the 'Liquid level input' field to the Rack Setpoint Screen. For 'Digital', note that the 'closed' state signals an alarm condition for this input. During normal operation, the contacts need to be open (digital input light - OFF). Using 'Analog ' allows the use of a liquid level float to be incorporated into the RC-1000. The scaling for this sensor 0-100%. If the percent of liquid goes below Liquid Level alarm setpoint, an alarm is generated, and the rack system is shut down. The liquid level input is connected to a '10k ohm potentiometer' style float available on many OEM racks (see Fig. 17).

When using refrigerant liquid level monitoring, a Heat Reclaim override setpoint and a Heat Reclaim override relay are also available.  This allows the RC-1000 to bypass heat reclaim if the receiver level falls below a given point.

The 'Defrost sense input' option has three possible choices, 'Internal', 'External', and  'No'. It offers the capability to sense either a circuit's hot gas defrost cycle (internal--from the defrost initiate times under the Circuit Setpoints Screen) or a digital input (external--closed input initiates defrost). In both cases, the smallest possible compressor capacity will, at minimum, be maintained to supply sufficient hot gas during the defrost cycle. Selection of the external option adds the 'Defrost sense input' field to the Rack Setpoint Screen. To monitor external defrost initiation, the contacts need to be closed during defrost.

The 'Oil failure input' option offers the capability to sense an oil failure (digital input is open) and generate an alarm. Selection of this option adds the 'Oil failure input' field to the Rack Setpoint Screen.  Note that the digital input be closed under normal conditions. During 'Run Verification', 'Phase Loss', 'Liquid Level', and 'Oil Failure', the external alarm relay will be activated, and date and time will be stored in the Alarm Log by the unit.

The 'Compr relay energized on' option offers the capability to have compressor output relays energized either on or off. If 'no' is selected, the compressors will be energized off. If 'yes' is selected, the compressors relay will be energized on. Use the 'ENTER' key to toggle from 'yes' to 'no'.

'Desuperheater control' allows access to the Desuperheater setpoint menu. This allows control of up to two relays based on manifold temperature, a rise in temperature will bring on the loads. Up to 6 manifold temperature can be assigned and control will be based on the average temperature or the maximum temperature (user selectable).

'Additional monitoring points' allows access to the Monitor setpoint screen. This area is provided to allow up to 4 temperature sensors, 4 suction pressure sensors, 4 head pressure sensors, 4 general sensors, 4 digital inputs, 4 digital outputs and 1 analog output per rack for monitoring purposes. There is no control functions from this function.

'TD head pressure control' is provided to allow control of condenser fans based on the temperature difference of a drop leg temperature and the ambient temperature. These setpoints are on the rack setpoint screen. It is intended that maximum and minimum pressures are assigned as backup parameters. If the head pressure exceeds the pressure setpoints the pressure setpoints will override the temperature function and control the condenser fans. Temperature control will return when the head pressure is between the head pressure cut in and cut out setpoints.

The 'Two stage rack control' selection allows you to link a low temp rack to a med temp rack for lockout purposes. If the med temp rack is not running, the low temp rack will be 'locked out' (ie: all compressors off) Normal control of the low temp rack will be returned when at least one compressor is running on the medium temp rack.

The 'Head Pressure Override' is a feature which allows a high head pressure setpoint which if exceeded, will start an orderly shutdown of compressors.

The 'Polarity of Switchover relay' assigns the variable speed switchover relay to either energized on (EON) or energized off (EOFF).

## AUX FUNCTIONS MENU

```
┌─────────────────────────────────────────┐
│              AUXILIARY MENU              │
│          1-Leak Detect                   │
│          2-Logic Statements              │
│          3-Override Menu                 │
└─────────────────────────────────────────┘
```

Required Access Level: None.

The Aux Outputs Menu is selected from the RC-1000 Main Menu. This menu provides selection for the Leak Detect Systems, Logic Statements  and Overrides.

## Leak Detect Menu

```
┌─────────────────────────────────────────┐
│            LEAK DETECT MENU              │
│       1-Status        4-Group Names      │
│       2-Setpoints     5-Sensor Names     │
│       3-Overview      6-Configuration    │
└─────────────────────────────────────────┘
```

Required Access Level: None.

The Leak Detect Menu is selected from the RC-1000 Aux Outputs Menu. This menu provides selection for the Leak Detect setpoints, descriptions and status.

## Leak Detect Status

```
┌─────────────────────────────────────────┐
│  >01   LEAK DETECT Group #01             │
│   Status:  Normal                        │
│   Leak Sensors:        Setpt     Actual  │
│    Sensor 1-1         400 ppm    20 ppm  │
└─────────────────────────────────────────┘
```

Required Access Level: None.

The Leak Detect Status screen provides an interpretation of the refrigeration leak detectors. With an analog sensor, the display will show leaks in units of ppm. Using a digital sensor, the display will indicate 'Leaking' or 'Normal'.

## Leak Detect Setpoints

```
>01 LEAK DETECT GROUP #01
  Leak Sensors:              Alarm Stpt:
    Sensor    1-1              00400 ppm
    Sensor    1-2              00400 ppm

    Sensor    1-3              00400 ppm
  Scale Factor: 01250 ppm
  Alarm Relay:  0-0
  Alarm Delay:  000 secs
                    **
```

Required Access Level: 2.

The Leak Detect setpoints screen allows the refrigerant leak detector to be assigned and alarm parameters programmed. The alarm value for the analog type sensors is typically set to 400 ppm. The scale factor for EIL supplied analog leak detectors is 1250. The Alarm time delay (max 300 secs) is the delay from when the leak is sensed above the alarm setpoint to when the alarm is generated.

## Leak Detect Overview

```
            LEAK DETECT OVERVIEW
   Num   Status        ppm     ppm     ppm
   01    Normal         0       0       0
   02    Normal         0      10       0
```

Required Access Level: None.

The Leak Detect Overview screen shows a complete overview of all configured systems. If analog sensors are used, all leak detector values (ppm) are shown along with a 'Normal' or 'Alarm' status. If digital sensors are used, a 'Normal' or 'Alarm' status is indicated along with a 'No Leaks' or a 'Leaking' indicator for the individual digital sensor.

## Leak Detect Group Names

```
          Leak Detect Group Names
    01  LEAK DETECT GROUP #01
    02  LEAK DETECT GROUP #02
    03  LEAK DETECT GROUP #03
```

Required Access Level: None.

The Group Names area is used to assign a description for each system used. This should indicate the general areas where the sensors are located.

## Leak Detect Sensor Names

```
   >01 LEAK DETECT GROUP  #01
    1-1   Lk Snr Sensor 1-1
    1-2   Lk Snr Sensor 1-2
    1-3   Lk Snr Sensor 1-3
```

Required Access Level: None.

This area is used to assign descriptions and names for each individual sensor in a system. This should indicate precise locations for faster location of leaks when alarms occur.

## Leak Detect Configuration

```
┌──────────────────────────────────────────────────┐
│                                                    │
│          LEAK DETECT CONFIGURATION                 │
│     Number of groups (Max:4) ..... 4               │
│     Leak sensor type ............. ANALOG          │
│                                                    │
└──────────────────────────────────────────────────┘
```

Required Access Level: 2.

The Leak Detect configuration enables you to select the number of refrigerant sensing systems and type of sensors used.

The most critical configuration field on this screen is the first one, which enables you to specify the number of systems used. As long as this number is '00', you will be unable to view the other screens listed on the Leak Detect menu.

Leak sensor type 'Analog' is used if the leak sensors are providing a 0-10 volt dc analog signal proportional to the ppm of refrigerant in a given area. If 'Digital' sensors are chosen, a contact closure indicates a refrigerant leak.

## Logic Statement Menu

```
+---------------------------------------------------+
|              LOGIC STATEMENT MENU                 |
|   1-Status                 4-Logic Statement      |
|   Names                                           |
|   2-Setpoints              5-Sensor Names         |
+---------------------------------------------------+
```

Required Access Level: None.

The Logic Statement Menu is selected from the Aux Output Menu. It is the table of contents to the RC-1000's logic control statements, output configuration and control functions. If you intend to make any programming changes to screens on this menu, keep in mind that different levels of access code are required by the programmable data fields.

## Logic Statement Status Screen

```
+-------------------------------------------------------+
|  01 -BOL  HOT WATER HEATER                            |
|  STATUS: FALSE                                        |
|  OUTPUTS 1-1 OFF                                      |
|  (AIGR1   0   F   [ >]   AIGR2   0   F   >=FALSE      |
|                                                       |
|  [OR ]   ( Digital Inp Group <or > )=FALSE            |
|  [OR ]   ( Refer Input Group <or > )=FALSE            |
|   #    Group    Val.   Eval.       Name               |
|  1-1 AI-GR1   -30F    (min) SENSOR 1-1                 |
+-------------------------------------------------------+
```

Required Access Level: None.

The Logic Statement Status screen title line consists of the logic statement number and user defined description. The data lines the this screen consist of status fields for all associated inputs and outputs assigned to the logic statement, including true/false conditions indicating whether the conditions of the statement are true or false. The STATUS line shows the overall status of the ENTIRE logic statement, either true or false depending on the condition of all logic lines contained in the statement. The true/false conditions further in the status screen only indicate the condition of the specific logic line associated next to the true/false condition. If the count operator is chosen to be used, an indication of the count will be displayed when active.

## Logic Statements Setpoints Screen

```
        01 -BOL    HOT WATER HEATER
   IF Analog [ 0-0   0-0   0-0   ( min)]
    >  Analog [ 0-0   0-0   0-0   ( avg)]
   OR Digital[ 0-0   0-0   0-0   ( or )]

                 ON    ON    ON
   OR   Ref Out[ 0-0   0-0   0-0    ( or )]
                 ON    ON    ON
   THEN Dig Out[ 0-0   0-0   0-0   ( nrm)]
                 ON    ON    ON
   Energized is ON    ON    ON

   True if count equals   (Min 2)   000
   Sensor Type  Lo-T       Setpoint  N/A
   Time  Delay  010 Sec    Min on   000 Sec
   Log Alarm  No         Log Event  No
   Message (10 chars)  N/A
   Scale factor         N/A
   Clear latch input    N/A
   Logic is on from    00:00  to  00:00
                        * *
                        * *
```

Required Access Level: 1+2

The Logic Statement Setpoint screen provides access to all programmable parameters affecting the control of outputs assigned to the logic statement. The title line of this screen consists of the logic statement number and the user defined description.

Logic statements are used to design a custom control system based on a variety of input and output configurations. The logic statement will over-ride the normal operating mode of an output if a logic statement output is assigned to an output being used elsewhere.

The fundamental logic statement, IF... THEN..., is the basis of these control statements. For example:

IF temp. sensor 1-1 is greater than (>) a setpoint of 50° THEN turn output outputs relays 1-1,1-2 and 1-3 ON. For clarity purposes this statement can be reduced as follows:

IF 1-1 > 50° THEN 1-1 + 1-2 + 1-3 ON

This is how the RC-1000 interprets and controls logic statements. A true result is when all conditions for a logic line or statement are met, otherwise a false result is returned. For example:

IF 1-1 > 50°

If the actual temp. from sensor 1-1 was 40° the statement would be false. Had the actual temp. been 65° the statement would be true.

Multiple analog inputs can have the following interaction on the logic control as follows:

AVG- Take the average of all sensors assigned.
MIN- Use the minimum value of any individual sensor assigned.
MAX- Use the maximum value of any individual sensor assigned.
STP-User defined setpoint value. No sensor used.

For example:

IF temp. sensor 1-1, 1-2, 1-3 averaged together is greater then (>) the setpoint of 50° THEN output relay 1-1 goes off

Can be reduced to:

IF 1-1 1-2 1-3 (AVG) > 50° THEN 1-1 off

In this statement the control would compare the setpoint of 50° to the AVERAGE of the three sensors 1-1, 1-2, and 1-3 and if that average was greater than the 50° setpoint then the output 1-1 would go off.

Digital inputs can be used as control points for logic statements. For example:

IF digital input 1-1 is on THEN turn outputs 1-1 and 1-2 on. This can be reduced to:

IF 1-1 on THEN 1-1 + 1-2 off

Multiple digital inputs can be combined in a single statement as follows:

AND- All digital inputs assigned must be true at the same time for the entire statement to be true.
OR- One or more digital inputs must be true for the entire statement to be true. As long as any one digital input is true the statement will be true.

XOR- Only one input at a time can be true for the entire statement to be true. If more than on input is true the statement will become false.

The condition of how the digital input reacts is set to either on or off. This depends on what type of signal is being used. For example: if assigned to ON, the condition will be true if the digital input is ON.

Analog inputs and digital inputs can be combined in a statement for a mixed logic statement. The individual analog input and digital inputs are set up the same but they can be combined as follows:

AND- The analog input statement AND the digital input statement must both be true for the entire logic statement to be true.

OR- Either the analog input statement OR the digital input statement OR both can be true for the entire logic statement to be true.

XOR- Either the analog input statement OR the digital input statement must be true but NOT BOTH for the entire logic statement to be true.

One more element can be entered into the logic statement: Reference outputs. This allows the statement to react based on what the condition of a relay status that is assigned elsewhere in the unit for example: Circuit relay or a Rack output relay. This is labeled as REF OUT on the setpoint screen.

The logic is similar to that of digital inputs. An on/off status can be set indicating which way the reference relay is expected to be in for a true condition to exist. A choice is available to allow the logic statement to be true on any CHANGE for the relay state. For example: either on-to-off or off-to-on. This is abbreviated as CHG.

An example might be:

IF analog input temp. 1-2 is less than (<) setpoint of 100° AND ref out (Circuit load) 1-1 is ON THEN output 1-2 comes on.

Let analog input 1-2 be water temp.
Let ref out be compressor 1-1.
Let output relay 1-2 be the water heater load.

This might be saying: IF the water heater temperature (1-2) is less than 100' AND compressor load (1-1) is on, THEN the water heater output load (1-2) stays on. IF the temp goes above 100° THEN the water heater load (1-2) goes off. Also, IF the reference relay is off indicating an off condition, THEN the water load (1-2) goes off.

As illustrated, the logic statements can be simple or complicated depending on the conditions required to react on. Care must be taken that each statement is thought out completely to insure correct operation.

Outputs from the logic statements can be set on/off and the energized state can be set on/off. The only restriction is when using an output assigned elsewhere, the energized on/ energized off state must be the same.

The way the outputs react can be programmed for several conditions, depending on the needs of the user and equipment being controlled:

NRM- Normal on to off change of state when a true condition occurs in the logic statement.
CHG- Changes the output on-to-off or off-to-on depending on the last state of the relay, when a true condition occurs.
SHD- Normal change of state with more than one assignment to a relay. This is for sharing control of a relay. This selection can turn a load off but cannot turn it back on.
MTY- Momentarily energizes the output for approx. 5 seconds when a true condition occurs for the logic statement.
LCH- Normally changes and latches the output relay when a true condition occurs for the logic statement. This condition must be cleared from the 'Clear Latch Menu', or via the digital input clear latch input.

The ability of the logic statement to count true occurrences is set by the 'True if count equals' setpoint. Enter the number desired for the logic statement to operate on. When the evaluation of the statement sees that number of true occurrences the entire statement will be true.

Sensor types are set from the following list:

Lo-T .... Low Temperature ranges: -30' to 97'
Hi-T .... High Temperature ranges: 0' to 255'
Lo-P .... Low Pressure ranges: 0 to 100 lbs.
Hi-P .... High Pressure ranges: 0 to 500 lbs.
KW ...... Kilo-watt input: 0 to 10 vdc
10V ..... 0 to 10 vdc
Lite .... Analog light level sensor: 2.55 to 3.09 vdc
Leak .... Analog refrigerant leak sensor: 0 to 10 vdc

These settings must agree with the type of board installed and the sensor assignments used.

The setpoint value is programmed when SPT is selected for analog comparison in the logic statement. If SPT is not used in the logic statement, no entry is permitted and the display will show 'N/A'

'Time delay' allows a programmable time delay to be set before an output reaction occurs. This can be used for anti-short cycling or to prevent transient changes in output.

The 'Min on' time is the minimum time that the outputs will be on regardless of the evaluation of the statement.

'Log alarm' and 'Log event' yes/no settings allow logging to be enabled or disabled for the logic statement. When the logic statement changes state a log is recorded which identifies the description, time, date, and a user defined message.

'Message' is the user defined identification for the logic statement. (max 10 characters) If the alarm and event logs are set to NO, this area will display N/A.

The 'Scale fact' setpoint is used when a KW or LEAK type of input is being used. This value scales the kw reading for 0 to the maximum (Scale Fact) value.

'Clear latch input' provides for a digital input to be used for clearing a logic statement once it has been latched. This is useful for a remote switch or button to reset the logic statement.

Each logic statement can be operational based on a time of day schedule. The times that the logic statement is desired to be active is set by the 'Logic is on from' setpoint area. Enter a starting and ending time in 24 hour format. If the logic statement is not active based on the TOD schedule, the status field will indicate: 'STATUS: False on time'. Since the statement is not being evaluated, the status screen will not update the data in the 'OUTPUTS' area.

## Logic Statement Names

```
        LOGIC STATEMENT NAMES
01 HOT WATER HEATER
02 SUB COOLER TEMP
03 LIQUID LEVEL
```

Required Access Level: 1

The logic statement names screen allows you to enter descriptive names for each of the logic statements configured. Both numeric and alphabetic data entry is permitted.

## Logic Statement Clear Latch

```
          CLEAR LATCH
01 HOT WATER HEATER   OFF
02 SUB COOLER TEMP    OFF
03 LIQUID LEVEL       OFF
```

Required Access Level: 1

If the digital output is set up to latch (lch) when a logic statement is true, this screen allows the user to clear the latching and reset the output to normal condition through the keypad.

The cursor is moved to the appropriate statement number latched condition. Press 'ENTER' and use the up and down arrows to toggle the condition on-to-off.

## Logic Statement Sensor Names

```
01 -BOL  HOT WATER HEATER
1-1 Sensor      HEATER TEMP
1-2 Sensor      OUTPUT TEMP
1-3 Sensor      INPUT TEMP

0-0 Sensor      *** unused ***
0-0 Sensor      *** unused ***
0-0 Sensor      *** unused ***
0-0 Dig-In      *** unused ***
0-0 Dig-In      *** unused ***
0-0 Dig-In      *** unused ***
```

Required Access Level: 1

The sensor names screen allows you to enter descriptive names for each sensor and input assigned to a logic statement. Both numeric and alphabetic data entry is permitted.

## Logic Statement Configuration

```
     LOGIC STATEMENT CONFIGURATION

Number of Logic Stms..... 03   (max: 32)
```

Required Access Level: 1

The logic statement output configuration screen allows you to specify the number of logic statements that the RC-1000 is to control. As long as the value of this field is '00', you cannot view the other screens listed on the logic statement menu.

## OVERRIDE MENU

```
            OVERRIDE MENU
1-Temp Control       4-Digital Outputs
2-Alarm              5-Digital Inputs
3-Override Log       6-Sensor Offset
```

Required Access Level: None.

The Override Menu is selected from the RC-1000 Main Menu. It is the table of contents to the RC-1000's I/O control override functions. Level-1 access is required to override any output or input controlled by the RC-1000.

## Temp Control Override Screen

```
01 CIRCUIT A01

   Temp control override time   050m
```

Required Access Level: 1.

The Temp Control Override Screen enables you to set the duration of a temperature control override, i.e. turn refrigeration on for a specified length of time. (Valid rnge is 0 to 999 minutes)Entering a value of '999' results in a permanent override condition that can only be cleared from this screen. Note that defrost functions normally (time/time) during this override condition.

## Alarm Override

```
┌─────────────────────────────────────────────┐
│                                             │
│   01 CIRCUIT A01                            │
│                                             │
│            Alarm override time   050m       │
│                                             │
│                                             │
└─────────────────────────────────────────────┘
```

Required Access Level: 1.

The Alarm Override Screen enables you to initiate and set the duration of a CIRCUIT alarm override. (Valid range is 0 to 9999 minutes)Entering a value of '9999' results in a permanent override condition.

## Override Log

```
┌─────────────────────────────────────────────┐
│                  Override Log               │
│   01-01   05:43   Bd:1   Ch:1   Rly Ovrd   Clr  │
│   01-01   05:30   Bd:1   Ch:1   Rly Ovrd   Off  │
│   01-01   02:30   Bd:4   Ch:2   Rly Hrd    Ovrd │
└─────────────────────────────────────────────┘
```

Required Access Level: 1.

The Override Log Screen enables you to view a list of any hard or soft overrides that have occurred. The date and time the override was initiated and when it was cleared.

## Digital Output Override Screen

```
┌─────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────┐ │
│ │  Board>1    DIGITAL OUTPUT OVERRIDES     │ │
│ │                                          │ │
│ │  1-1 none   1-2 none   1-3 none   1-4 none│ │
│ │  1-5 none   1-6 none   1-7 none   1-8 none│ │
│ └─────────────────────────────────────────┘ │
└─────────────────────────────────────────────┘
```

Required Access Level: 1.

The Digital Output Override Screen provides the capability to override individual digital outputs on a board-by-board basis. Note that for any given relay, the override switch supersedes an active software override (see Fig. 1 - Relay Interface Diagram).

Digital output overrides are performed in the following manner:

a) select desired board by using left arrow and right arrow keys.
b) press 'enter' and select desired output/input by using arrow keys.
c) press 'enter' and use up arrow or down arrow key to select 'on', 'off', or 'none'.
d) when correct override is selected, press 'enter' followed by the 'exit' key.

**Important:** All overrides will remain in override unless removed by the same process used to program the override. Override conditions on/off will depend on the assignment of the load, and does not indicate the relay being energized or de-energized.

## Digital Input Override Screen

```
┌─────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────┐ │
│ │ Board>1      DIGITAL INPUT OVERRIDES     │ │
│ │                                          │ │
│ │ 1-1 none   1-2 none   1-3 none   1-4 none│ │
│ │ 1-5 none   1-6 none   1-7 none   1-8 none│ │
│ └─────────────────────────────────────────┘ │
└─────────────────────────────────────────────┘
```

Required Access Level: 1.

The Digital Input Override Screen provides the capability to override the status of individual digital inputs on a board-by-board basis.

Digital input overrides are performed in the following manner:

   a) select desired board by using left arrow and
      right arrow keys.
   b) press 'enter' and select desired output/input by
      using arrow keys.
   c) press 'enter' and use up arrow or down arrow
      key to select 'on', 'off', or 'none'.
   d) when correct override is selected, press
      'enter' followed by the 'exit' key.

**Important:** All overrides will remain in override unless removed by the same process used to program the override. Override conditions on/off will depend on the assignment of the load, and does not indicate the relay being energized or de-energized.

## Sensor Input Offset Screen

```
┌──────────────────────────────────────────┐
│ Board>1      SENSOR INPUT OFFSET          │
│ SNSR 1:    0  2:    0  3:    0  4:    0    │
│      5:    0  6:    0  7:    0  8:    0    │
│           Type: Temp Units: F             │
└──────────────────────────────────────────┘
```

Required Access Level: 1.

The Sensor Input Offset Screen provides the capability to add or subtract from data from any sensor.  The addition or subtraction is done, board by board, in the temperature units (indicated at bottom of screen) corresponding to the type of board.  To access, select the board that contains the sensor.  Then, using the arrow keys, select the specific input number.  Press 'ENTER' and program the value of offset desired.  To return a sensor to normal operation, enter '00' as offset.  The bottom line of this screen indicates the type of board configured (e.g. temp, pressure, etc.) and the units being used by that board.

## LOG MENU

```
                      LOG MENU
     1-Run Time Log         4-Event Log
     2-Note Log             5-Power Log
     3-Alarm Log            6-I/O Logs
```

Required Access Level: None.

The Log Menu is selected from the RC-1000 Main Menu. It is the table of contents to the RC-1000's system status and performance logs.

## Run Time Log Menu

```
                RUN TIME LOG MENU
     1-Circuit Log
     2-Rack Log
```

Required Access Level: None.

The Log Menu is selected from the RC-1000 Main Menu. It is the table of contents to the RC-1000's system status and performance logs.

## Circuit Log Screen

```
     01 CIRCUIT A01
     Total refrigeration cycles          345
     Refrigeration cycles today           10
     Refrigeration cycles yesterday       27
```

Required Access Level: None.

The Circuit Log Screen displays the number of refrigeration cycles recorded for the following time periods: since system start-up; since 00:00:01 a.m. of the current day; over the previous 24-hour day (00:00:01 to 23:59:59). These values can be reset with level-2 access by choosing the desired field and pressing 'ENTER'.

## Rack Log Screen

```
 01 RACK A
Unit          Today       Yesterday   Total
Compr   1     01:23h      03:17h      000429h
Compr   2     00:47h      02:41h      000356h

Compr   3     00:33h      02:08h      000311h
Compr   4     00:30h      02:14h      000309h
Compr   5     00:00h      00:00h      000000h
Compr   6     00:00h      00:00h      000000h
Compr   7     00:00h      00:00h      000000h
Compr   8     00:00h      00:00h      000000h
Compr   VS    00:00h      00:00h      000000h
Fan     1     05:13h      15:34h      001023h
Fan     2     04:48h      13:56h      000998h
Fan     3     04:23h      13:01h      000897h
Fan     4     04:07h      12:79h      000874h
Fan     5     00:00h      00:00h      000000h
Fan     6     00:00h      00:00h      000000h
                          **
                          **
```

Required Access Level: None.

The Rack Log Screen displays the recorded run-times of refrigeration rack compressors and fans for the following time periods: since 00:00:01 a.m. of the current day; over the previous 24-hour day (00:00:01 to 23:59:59); since system start-up. These values can be reset with level-2 access by choosing the desired field and pressing 'ENTER'.

## Note Log

```
┌────────────────────────────────────────────────────────┐
│ ┌──────────────────────────────────────────────────┐   │
│ │                  Note Logs:                      │   │
│ │    Enter Modifications (max 36 char):            │   │
│ │  1)                                              │   │
│ │  2)                                              │   │
│ └──────────────────────────────────────────────────┘   │
│    3)                                                   │
│    4)                                                   │
│    5)                                                   │
│    6)                                                   │
│    7)                                                   │
│    8)                                                   │
│    9)                                                   │
│   10)                                                   │
│                          **                            │
│                          **                            │
│                                                        │
└────────────────────────────────────────────────────────┘
```

Required Access Level: 1.

The Note Log Screen enables you to enter up to 10 descriptive lines of information relating to the RC-1000. This can be used for changes, or more descriptive information about equipment hooked to the unit. This can be used for remotely monitoring any changes made or to send messages form the remote terminal to a service mechanic at the RC-1000.

## Alarm Log Screen

```
                          ALARM LOG
       01-03 08:45 RACK A          Power fail ok
       01-03 08:40 RACK A          Power fail
                             **
                          **
```

Required Access Level: None.

The Alarm Log Screen displays a list of up to fifty recorded system alarms of the following types: 'Hi temp', 'Lo temp', 'Hi suct p', 'Lo suct p', 'Phase loss', 'Run verify', 'Liq level', 'Oil fail', 'Dial Fail', 'Oil pres', 'Hi head p', 'Lo head p', 'Power fail', and 'Power up'.

Each line of the Alarm Log Screen consists of the date and time of the occurrence, the name of the affected rack or circuit, and the type of alarm. **When an alarm condition is rectified, an updated alarm log entry is displayed with the word 'ok' following the alarm type.**

## Event Log Screen

```
                          EVENT LOG
       01-03 08:11 CIRCUIT A01        Temp term
       01-03 08:00 CIRCUIT A01        Emrg defr
                             **
                          **
```

Required Access Level: None.

The Event Log Screen displays a list of up to fifty recorded system events of the following types: emergency defrost, defrost skip (dewpoint), clear log (indicates that the I/O logging has been cleared) and miscellaneous other non-alarm events.

Each line of the Event Log Screen consists of the date and time of the occurrence, the name of the affected rack or circuit, and the type of event.

## POWER LOG MENU

```
┌─────────────────────────────────────────────┐
│                POWER LOG MENU                │
│ 1- Power: Hourly                             │
│ 2- Power: Daily                              │
│                                              │
└─────────────────────────────────────────────┘
```

Required Access Level: None

The Power Log Menu is selected from the RC-1000 Log Menu. It is the table of contents for the power logs.

## Hourly Power Log Screen

```
┌─────────────────────────────────────────────┐
│ >1 RACK A                KWH      Peak KW    │
│   Fri Time: 10:00        221   183 KW @ 10:12│
│   Fri Time: 09:00        243   190 KW @ 09:23│
│   Fri Time: 08:00        225   175 KW @ 08:57│
└─────────────────────────────────────────────┘
```

Required Access Level: None.

The Hourly Power Log Screen displays up to twenty-five hours of power consumption data for each configured refrigeration rack.

Each line of the Hourly Power Log Screen consists of the starting time of the logging period, the total power consumption for that period, the peak power consumption level for that period, and the time at which the peak occurred.

## Daily Power Log Screen

```
>1 RACK A              KWH        Peak KW
   Date: 01-22        3478    532 KW @ 09:12
   Date: 01-21        3404    519 KW @ 09:47
   Date: 01-20        3463    529 KW @ 09:23
   Date: 01-19        3396    515 KW @ 10:37
   Date: 01-18        3141    473 KW @ 11:09
                       **
                       **
```

Required Access Level: None.

The Daily Power Log Screen displays up to forty-eight days of power consumption data for each configured refrigeration rack.

Each line of the Daily Power Log Screen consists of the log entry date, the total power consumption for that day, the peak power consumption level for that day, and the time at which the peak occurred.

## I/O LOG MENU

```
                     I/O LOG MENU
    1- ANALOG INPUTS        3- DIGITAL INPUTS
    2- ANALOG OUTPUTS
    3- DIGITAL OUTPUTS
```

Required Access Level: None

The Interval Log Menu is selected from the RC-1000 Log Menu. It is the table of contents for the interval logs.

## I/O Log-Analog Input; Analog Output; Digital Output;Digital Input

```
                     INTERVAL LOG
    1- SELECT BOARD & CHANNEL
    2- DISPLAY DATA
```

Required Access Level: None

The Interval Log selection allows the user to display a historical record of the analog inputs, analog outputs, and digital outputs. To access, select '1' from the menu and select the appropriate channel for the desired input/output. Exit '1', and select '2' from the menu to display the data, which is set up in page format. Times on the left-hand side correspond to the current time and previous times based on the logging interval chosen. Each line contains four data records. The total number of data records is dependent upon the logging interval and the total number of inputs/outputs assigned.

## EMERGENCY DEFROST SCREEN

```
01 CIRCUIT A01
1 Normal
2 Time only          State: Refr off
3 End defrost
```

Required Access Level: None.

The Emergency Defrost Screen enables you to initiate or return to the programmed defrost control by placing the cursor next to the desired action and pressing the 'ENTER' key. The status of the particular circuit will be displayed beside the state. The circuit status and event log will show emergency defrost as "EMG _ _ _m" and the number of minutes left in the defrost. The case temperature must be below the termination temperature before initiating a normal defrost, or it will immediately terminate.

## SYSTEM MENU

```
                    SYSTEM
1-Date / Time        4-I/O List
2-Dlite Savings      5-Access codes
3-Alarm Dial Out     6-System Config
```

Required Access Level: none.

The System menu is selected from the RC-1000 Main Menu. It is a table of contents to the RC-1000's miscellaneous system configuration and status screens. Note that level-1 access is required to program the screens on this menu. A level-2 access code is required to change or view the access codes screen.

## Date & Time Screen

```
┌─────────────────────────────────────┐
│             DATE & TIME             │
│                                     │
│          Date 08-24-88 Mon          │
│          Time 11:05:04 DT           │
└─────────────────────────────────────┘
```

Required Access Level: 1.

The Date & Time Screen enables you to set the RC-1000 system clock.  Note that changes to the RC-1000 system clock may have an immediate effect on any time-driven events.  A "DT" or "ST" to the right of the time reflects whether the time is in Daylight Savings Time or Standard Time. Remember, the time must be in military time. Press 'enter' to bring arrow on to display and enter data.

## Daylight Savings Screen

```
┌─────────────────────────────────────┐
│          DAYLIGHT SAVINGS           │
│                                     │
│  Spring forward on first Sun after 04-01 │
│    Fall back on first Sun after 10-25    │
└─────────────────────────────────────┘
```

Required Access Level: 1.

The Daylight Savings Screen enables you to specify the dates on which daylight savings time starts and ends. The system clock is adjusted accordingly on those dates. Press 'enter' to bring arrow on to display and enter data.

## Alarm Dial Out Menu

```
┌─────────────────────────────────────┐
│             Alarm Dial Out          │
│  1-Phone Numbers    3-Dial Log      │
│  2-Alarm Setup      4-Miscellaneous │
└─────────────────────────────────────┘
```

Required Access Level: None.

The Alarm Dial Out menu is selected from the RC-1000 System Menu. It is a table of contents to the RC-1000's alarm dial out and selectable alarm dial out screens. Note that level-1 access is required to program the sub-screens on this menu.

## Alarm Phone Numbers Screen

```
1  Grp 1
Unoccupied Phone #s  Occupied Phone #s
>1-800-555-1234      >1-800-555-4321
>555-1212            >555-2000

>555-0101            >555-2525

          Occupied Schedule
     Sun From: 00:00   To: 00:00
     Mon From: 08:00   To: 05:00
     Tue From: 08:00   To: 05:00
     Wed From: 08:00   To: 05:00
     Thu From: 08:00   To: 05:00
     Fri From: 08:00   To: 05:00
     Sat From: 08:00   To: 12:00
               **
               **
```

```
1  Grp 2
Unoccupied Phone #s  Occupied Phone #s
>1-800-555-1234      >1-800-555-4321
>555-2468            > 555-2000

>555-0101            >555-2525

          Occupied Schedule
     Sun From: 00:00   To: 00:00
     Mon From: 08:00   To: 05:00
     Tue From: 08:00   To: 05:00
     Wed From: 08:00   To: 05:00
     Thu From: 08:00   To: 05:00
     Fri From: 08:00   To: 05:00
     Sat From: 08:00   To: 12:00
               **
               **
```

Required Access Level: 1.

The Alarm Phone Numbers Screens enables you to specify several phone numbers to be used for alarm dial-out by the RC-1000. Two groups are provided for maximum flexibility in setting up a dial out system. Each system on the RC-1000 can be configured to dial to one or both groups. During an alarm state, the RC-1000 will attempt to dial out to either a remote serial printer or a dumb terminal. In addition to sending the alarm information, a device ID, up to 30 characters long, is transmitted. If the phone number is local, it is not necessary to enter an area code. Press 'enter' to bring the arrow to the desired display area and enter data.

Dialout dials the 'Occupied Phone #s' during the occupied schedule times. 'Unoccupied Phone #s' are dialed at all other times or if the occupied scheduled stop time for the current day is 00:00. All numbers are dialed regardless of whether or not the modem picked up on the previous number. If an alarm occurs and Dialout has not completed before the time changes from occupied to unoccupied, Dialout will stop trying to call the unoccupied numbers and start calling the first occupied number. If a new alarm occurs during a dialout sequence, the RC-1000 will add the new alarm to the numbers left to be dialed out and then redial any numbers which did not receive the new alarm.

If a local printer is connected for alarm printouts use a phone number of "LO". This feature is only available with a special communications interface card and special wiring hookup. Consult the factory for more information.

Dialout is effectively disabled if there is not a valid phone number in the list for the specified time of day. Phone numbers must be entered in order staring at the top of each list. All numbers must be left justified.

24 hours is the maximum amount of 'on' time in any given day. Keep in mind that the RC-1000 uses military time (e.g., 04:00 = 4:00 a.m., 16:00 = 4 p.m.). If a start time equals a stop time, nothing will happen. 00:00 is a valid start time, but not a valid stop time.

## Alarm Setup Menu

```
┌─────────────────────────────────────────────┐
│                                             │
│                 Alarm Setup                 │
│      1- Circuit Menu    4- Logic Statements │
│      2- Rack Menu       5- System           │
│      3- Leak Detect                         │
│                                             │
└─────────────────────────────────────────────┘
```

Required Access Level: None.

This menu allows access to selection of the types of alarms that will initiate an alarm dial out sequence. Enter the desired field and proceed to set up each system on the RC-1000.

## Circuit Alarm Setup

```
>1 24' Ice Cream Doors
  Alarm type          Local  Grp1 Grp2 Delay
-----------------     -----  ---- ---- -----
High Temperature       NO     YES  YES  001m


Low Temperature        NO     YES  NO   001 m
Valve Verify           NO     YES  NO   001 m
OK (Cleared)           NO     YES  NO   001 m
                        **
                        **
```

Required Access Level: 1.

This screen allows setup of the dial out parameters by each individual circuit. The first line shows the circuit name as described in the circuit names screen. There are as many pages of dial out screens as there configured circuits. To go to other circuits use the right and left arrows. The categories for dial out are 'Local' which enables a locally connected dumb terminal or printer, 'Grp 1' enables or disables the phone numbers and time of day schedule for group 1, 'Grp 2' enables or disables the phone numbers and time of day schedule for group 2, and 'Delay' is the delay between dialouts of each phone number. If grp 1 and grp 2 are not being used, the 'Delay' fields will show 'N/A'. This delay does not apply to local.

    'High Temperature' is the circuit high temp alarms
    'Low Temperature' is the circuit low temp alarms
    'Valve Verify' is the circuit valve verification alarm
    'OK (Cleared)' is the OK indication the an alarm is cleared

## Rack Alarm Setup

```
>01 Medium Temp Rack
  Alarm Type          Local Grp1 Grp2  Delay
---------------       ----- ---- ----  -----
High Pressure          NO   YES   NO   001 m

Low Pressure           NO    NO  YES   010 m
Run Verify             NO   YES   NO   010 m
Miscellaneous          YES  YES  YES   010 m
OK (Cleared)           NO    NO   NO
                   **
                   **
```

Required Access Level: 1.

This screen allows setup of the dial out parameters by each individual rack. The first line shows the rack name as described in the rack names screen. There are as many pages of dial out screens as there configured racks. To go to other racks use the right and left arrows. The categories for dial out are 'Local' which enables a locally connected dumb terminal or printer, 'Grp 1' enables or disables the phone numbers and time of day schedule for group 1, 'Grp 2' enables or disables the phone numbers and time of day schedule for group 2, and 'Delay' is the delay between dialouts of each phone number. If grp 1 and grp 2 are not being used, the 'Delay' fields will show 'N/A'. This delay does not apply to local.

'High Pressure' is the rack high pressure alarms.
'Low Pressure' is the rack low pressure alarms.
'Run Verify' is the compressor and condenser fan run
    verification alarms.
'Miscellaneous' alarms are phase loss, low liquid level and
    oil pressure.
'OK (Cleared)' is the OK indication that an alarm is cleared.

## Leak Detect Alarm Setup

```
                        Leak Detect
            Name          Local  Grp1  Grp2   Delay
    ----------------      -----  ----  ----   -----
    Compressor Room        NO    YES    NO    000 m

    Leak Group #2          NO    YES    NO    001m
                          -- -- -- -- -- --
    OK (Cleared)           NO    NO     NO
                      **
                      **
```

Required Access Level: 1.

This screen allows setup of the dial out parameters by each individual leak detect group. The description under 'Name' shows the leak detect name as described in the leak detect names screen. There is only one page of this dial out screen. The categories for dial out are 'Local' which enables a locally connected dumb terminal or printer, 'Grp 1' enables or disables the phone numbers and time of day schedule for group 1, 'Grp 2' enables or disables the phone numbers and time of day schedule for group 2, and 'Delay' is the delay between dialouts of each phone number. If grp 1 and grp 2 are not being used, the 'Delay' fields will show 'N/A'. This delay does not apply to local.

Since there is only one type of alarm generated by the leak detect groups, each group is only configurable for the local and phone number groups.

'OK (Cleared)' is the OK indication that an alarm is cleared.

## Logic Statements Alarm Setup

```
┌─────────────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────────────┐ │
│ │            Logic Statements                     │ │
│ │    Name        Local Grp1 Grp2  Delay           │ │
│ │ ------------------ ----- ---- ----  -----        │ │
│ │ Logic Rung #1      No    Yes  Yes   010 m        │ │
│ └─────────────────────────────────────────────────┘ │
│                                                      │
│   Logic Rung #2       NO    YES   NO    010m         │
│   High Comp Shtdwn   YES    YES  YES    010m         │
│                      - - - - - -                     │
│   OK (Cleared)        NO    NO    NO                 │
│                    **                                │
│                    **                                │
└─────────────────────────────────────────────────────┘
```

Required Access Level: 1.

This screen allows setup of the dial out parameters by each individual logic statement group. The description under 'Name' shows the logic statement name as described in the logic statement names screen. There is only one page of this dial out screen. The categories for dial out are 'Local' which enables a locally connected dumb terminal or printer, 'Grp 1' enables or disables the phone numbers and time of day schedule for group 1, 'Grp 2' enables or disables the phone numbers and time of day schedule for group 2, and 'Delay' is the delay between dialouts of each phone number. If grp 1 and grp 2 are not being used, the 'Delay' fields will show 'N/A'. This delay does not apply to local. If the logic statement is not configured for alarming from the setpoint screen, all these fields will show 'N/A'.

Since there is only one type of alarm generated by the logic statement groups, each group is only configurable for the local and phone number groups.

'OK (Cleared)' is the OK indication that an alarm is cleared.

## System Alarm Setup

```
                Select System Alarms
         Alarm Type        Local  Grp1  Grp2
         ----------------   -----  ----  ----
         Override            NO     YES   NO


         Miscellaneous       NO     YES   YES
         OK (Cleared)        NO     NO    NO
                             **
                             **
```

Required Access Level: 1.

This screen allows set up of system related alarms for dial out. Each category can be set up for local and dial out phone number groups.

'Override' is any override condition (either hard or soft)
'Miscellaneous' alarms are power up, power fail, low battery
    and master clear.
'OK (Cleared)' is the OK indication that an alarm is cleared.

## Dial Log

```
┌─────────────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────────────┐ │
│ │                    Dial Log                     │ │
│ │ 10-02 12:05 Ice Cream Case    Unocc1 #1         │ │
│ │ 10-02 04:30 Rack B            Occup2 #1         │ │
│ │ 10-01 23:50 Rack B            Modem Fail OK      │ │
│ ├─────────────────────────────────────────────────┤ │
│ │ 10-01 23:30 Rack B            Modem Fail         │ │
│ │                      **                          │ │
│ │                      **                          │ │
│ └─────────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────────┘
```

Required Access Level: None.

This screen shows a list of all dial out attempts, whether they are successful or not. This should provide a check that alarms have been sent and to which numbers. If there are failures the source of the problem can be tracked by this log.

Each line of the log will indicate the date and time the dial out occurred, the alarm source (rack, circuit, logic statement, etc.), the phone number associated with that alarm type and which group it was set up under.

    'Unocc1 #1' is the 1st unoccupied number in group #1.
    'Unocc2 #1' is the 2nd unoccupied number in group #1.
    'Unocc3 #1' is the 3rd unoccupied number in group #1.
    'Unocc1 #2' is the 1st unoccupied number in group #2.
    'Unocc2 #2' is the 2nd unoccupied number in group #2.
    'Unocc3 #2' is the 3rd unoccupied number in group #2.
    'Occup1 #1' is the 1st occupied number in group #1.
    'Occup2 #1' is the 2nd occupied number in group #1.
    'Occup3 #1' is the 3rd occupied number in group #1.
    'Occup1 #2' is the 1st occupied number in group #2.
    'Occup2 #2' is the 2nd occupied number in group #2.
    'Occup3 #2' is the 3rd occupied number in group #2.

'Modem Fail' means the modem at the RC-1000 failed to call out. (ie: phone line bad or modem problem)

'Dial Fail' means the modem dialed out but did not get a correct answer. (ie: busy signal or remote printer modem failure)

## Miscellaneous

```
                    Miscellaneous
Device ID: Store 189 RC-1000
Dial Test Choice: None
Retry Dialing in (0-24): 01 hrs

Time Between Dialing      60 min
Modem Cmd: E0V0X1
Daily Dialout Grp1:   1: 01:00   2: 13:00
Daily Dialout Grp2:   1: 01:15   2: 13:15
Gr 1  Name: Grp1
Gr 2  Name: Grp2
                    **
                    **
```

Required Access Level: None.

This screen allows data entry of miscellaneous alarm related parameters. The first line is the user defined 'User ID'. This can be up to 30 characters. The next line selects the 'Dial Test Choice'. This is either: None, All, Local, Grp1, or Grp2. This selects which numbers will be used for an immediate, one time dial out test. The dial out test includes the RC-1000 unit number ID, then the user defined store identification, the current date and time, the date and time of the dial out test, and a tally of alarms recorded that day. 'Retry Dialing in' selects the time allowed before the RC-1000 will retry dialing out alarm data after a modem failure. If 'Retry Dialing' time is set to '00', the RC-1000 will not retry dial out until a new alarm is received. The 'Time Between Dialing' is used to set a time delay between dialing alarms when a modem error is encountered. The unit will wait this time period before attempting to redial an alarm. 'Modem Cmd' sets a user defined modem command string. This is useful when using modems that do not have dip switches to set parameters. 'Daily Dialout' is the times each day that the groups will perform a dial out test. 'Grp x Names' are the user defined dial out group names (up to 24 characters)

The RC-1000 wll try each number five times before noting a failure. If a number fails, the RC-1000 will continue to the next number. This will continue until five failures occur on any number. This failure is then logged.

Remote alarm printer setup:

  Serial Interface
   7 data bits
    (8 bits may be required in some applications)
   1 stop bit
   No parity
   Baud rate set the same as the RC-1000

Remote modem settings are the same as the RC-1000 modem except the Optima 2400 setup string should be:
    AT&K0&Q0V0S0=1&W
  (refer to the section on 'Modem Switch Settings')

## I/O List Menu

```
┌─────────────────────────────────────────────────────┐
│                   I/O LIST MENU                      │
│   1-Analog Inputs        4-Digital Outputs           │
│   2-Analog Outputs                                   │
│   3-Digital Inputs                                   │
└─────────────────────────────────────────────────────┘
```

Required Access Level: None.

The I/O List menu is selected from the System Menu. It is a table of contents to the RC-1000's I/O list screens. These screens provide a board-by-board I/O map detailing all current RC-1000 relay, analog output, sensor, and input assignments.

## Analog Input List Screen

```
┌─────────────────────────────────────────────────────┐
│  ┌───────────────────────────────────────────────┐  │
│  │ Board>1         ANALOG INPUTS                  │  │
│  │ 1-1   1 Lo T   SENSOR 1-1                      │  │
│  │ 1-2   1 Hi T   SENSOR 1-2                      │  │
│  │ 1-3   1 Lo T   SENSOR 1-3                      │  │
│  └───────────────────────────────────────────────┘  │
│     1-4   1 Lo T   SENSOR 1-4                        │
│     1-5   1 Hi T   SENSOR 1-5                        │
│     1-6   1 Lo T   SENSOR 1-6                        │
│     1-7   1 Lo T   SENSOR 1-7                        │
│     1-8   1 Lo T   SENSOR 1-8                        │
│                       **                            │
│                       **                            │
└─────────────────────────────────────────────────────┘
```

Required Access Level: None.

The Analog Input List Screen is a board-by-board view of the current RC-1000 temperature and pressure sensor assignments. The title line consists of the board number and the screen title.

Each data line describes a sensor as follows: its board-channel number; the number of logical inputs to which the sensor is assigned; the sensor type; the user-defined sensor name.

## Analog Outputs List Screen

```
Board>1          ANALOG OUTPUTS
1-1 Comprsr speed   VARUNIT RACK A
1-2 Comprsr speed   VARUNIT RACK B
1-3 Comprsr speed   VARUNIT RACK C

1-4 Comprsr speed   VARUNIT RACK D
1-5 unused
1-6 unused
1-7 unused
1-8 unused
                       **
                       **
```

Required Access Level: None.

The Analog Output List Screen is a board-by-board view of the current RC-1000 variable-speed compressor control assignments. The title line consists of the board number and the screen title.

Each data line describes a control output as follows: its board-channel number; the output type; the user-defined name of the associated compressor rack.

## Digital Input List Screen

```
Board>1          DIGITAL INPUTS
1-1 Defrost init  CIRCUIT A01
1-2 Defrost term  CIRCUIT A01
1-3 Aux setpoints RACK A

1-4 Phase ok      RACK A
1-5 Liquid level  RACK A
1-6 Defrost input RACK A
1-7 Oil pressure  RACK A
1-8 Comprsr 1  RACK A
                  **
                  **
```

Required Access Level: None.

The Digital Input List Screen is a board-by-board view of the current RC-1000 digital input assignments. The title line consists of the board number and screen title.

Each data line describes a digital input as follows: its board-channel number; the input type; the user-defined name of the associated circuit or rack.

## Digital Output List Screen

```
Board>1          DIGITAL OUTPUTS
1-1  1 Compr  1  RACK A                        EON
1-2  1 Compr  2  RACK A                        EON
1-3  1 Compr  3  RACK A                        EON
1-4  1 Compr  4  RACK A                        EON
1-5  1 Compr  5  RACK A                        EON
1-6  1 Compr  6  RACK A                        EON
1-7  1 Compr  7  RACK A                        EON
1-8  1 Compr  8  RACK A                        EON
                         **
                         **
```

Required Access Level: None.

The Digital Output List Screen is a board-by-board view of the current RC-1000 relay assignments. The title line consists of the board number and screen title.

Each line describes a relay as follows: its channel number; the number of logical outputs to which the relay is assigned; the type of output to which the relay is assigned; the output number; and the user-defined name of the rack or circuit associated with the relay.

The field shown along the right side of the screen indicates whether a relay is programmed for energized-on or energized-off use.

## Access Codes Screen

```
┌─────────────────────────────────────────────────┐
│ ┌─────────────────────────────────────────────┐ │
│ │              ACCESS CODES                   │ │
│ │                                             │ │
│ │           Level 1 1234                      │ │
│ │           Level 2 9876                      │ │
│ └─────────────────────────────────────────────┘ │
└─────────────────────────────────────────────────┘
```

Required Access Level: 2.

The Access Codes Screen enables you to redefine the level-1 and level-2 access codes of your RC-1000. <u>Level-2 access is required to view and change these data fields.</u>

The security of the RC-1000 refrigeration control system depends on the proper use and discretionary distribution of these access codes. If at any time you think that the security of your system has been compromised and is at risk of malicious tampering, immediately change these codes. Press 'enter' to bring arrow on to display and enter data.

## System Configuration Menu

```
┌──────────────────────────────────────────────┐
│            System Configuration Menu          │
│        1- Miscellaneous                       │
│        2- Temp Board Config                   │
│        3- Master Clear                        │
└──────────────────────────────────────────────┘
```

Required Access Level: None

The System Configuration Menu is selected from the System
Menu. It is the table of contents for system related functions.

## Miscellaneous Parameters Screen

```
┌────────────────────────────────────────────────┐
│  ┌──────────────────────────────────────────┐  │
│  │          MISCELLANEOUS  PARAMETERS        │  │
│  │   Communication ID    001                 │  │
│  │   Temp units  F         Line Freq 60H     │  │
│  │   Logging interval    180    Size 64k     │  │
│  └──────────────────────────────────────────┘  │
│     Baud 1200                                   │
│     Maximum logging period 130 hrs              │
│                      **                         │
│                      **                         │
│                                                 │
└────────────────────────────────────────────────┘
```

Required Access Level: 2.

The Miscellaneous Parameters Screen enables you to view the
view and change the miscellaneous parameters of the RC-1000.

The 'Communications ID' must be set by a dip switch on the cpu
board (see figure 24 and page 3). The first unit in the
communications loop should have ID number 1. If more than one
series 1000 unit is present, each unit must have a different
communications ID for successful remote communications.

You can select the temperature units to be displayed by the
RC-1000: C = Celsius; F = Fahrenheit. (default is F). Press 'ENTER'
to toggle this field.

For those locations that have power at 50 hz, the Line Freq
option can be changed to allow correct operation of time variable
tasks. (default is 60hz). Press 'ENTER' to toggle this field.

The 'Logging interval' field sets the interval in seconds between recording all logs. The minimum setting is 15 seconds and the maximum setting is 9000 seconds. Typical logging intervals would be between 180 and 300 seconds. (default is 0180s) To change parameters, bring arrow on to the desired field, press 'enter' and enter data.

The 'Size' parameter indicates the amount of logging memory available. It will either be the standard 64K or if an expanded RAM chip is installed it will be 192K. This is not changeable from this screen.

The 'Baud' indicates the baud rate the RC-1000 is operating with. It is set by DIP switch. (see figure 24 and page 3). This is not changeable from this field. Be sure this setting matches the modem installed.

'Maximum logging period' indicates the maximum amount of time that data will be logged in the RC-1000 memory. It is dependent on three factors: the size of the logging memory, the logging interval and the number of I/O points entered. This number will change based on any change of the above three factors. The easiest way to obtain longer logging time is to add an additional memory chip to allow the maximum 192k memory. (refer to the parts list)

## Temperature Board Configuration

```
                   Temp Board Config
  Brds  1:Lo-T    2:Lo-P    3: 10v    4:Lo-T
        5:Lo-T    6:Lo-T    7:Lo-T    8:Lo-T
```

Required Access Level: 2

The Temperature Board Configuration screen allows the user to change the low temperature board configuration (-30° to 97°) to high temperature (0° to 255°). Select the desired board and press 'ENTER' to toggle from Lo-T to Hi-T. A specially calibrated high temperature input card must be used for Hi-T operation. Use of an incorrect input card will result in invalid readings.

If a board is configured for a function other than temperature, (ie: pressure or 0-10v) the function type will be displayed on the bottom line. This is for information only and are not changeable.

## Master Clear Screen

```
                   Master Clear

      Select the Reset Function: No Action
```

Required Access Level: 2

This screen allows either a soft reset or master clear from the keypad. To use either function, press enter and use the up and down arrows to select 'Reset', 'Master Clear' or 'No Action', then press enter to accept. When this screen is exited, the desired function will occur within a few seconds. The reset is the same as if the power was turned off and back on again. A master clear will clear ALL the memory and restore default parameters.

**CAUTION: A MASTER CLEAR WILL DESTROY ALL DATA.**
**USE THIS FEATURE AS A LAST RESORT.**

# CHAPTER 4 - TROUBLESHOOTING

```
┌─────────────────────────────────────────────────┐
│                                                 │
│        EIL RC-1000 SOFTWARE VERSION X.XX        │
│        *** CONTROL NOT CONFIGURED ***           │
│             Enter Access Code:  _               │
│                                                 │
└─────────────────────────────────────────────────┘
```

If the above screen appears in the display, it is an indication
that the RC-1000 unit has one of the following conditions:

1. The unit is new and has never been configured or
   programmed.
2. The internal 'Watchdog' circuit has received non-
   conforming internal data and has initiated a complete
   reset (master clear).

MASTER CLEAR PROCEDURES

   **IMPORTANT:** Invoking the Master Clear function **destroys all
           existing data.** Therefore, Master Clear should be
           used as a last resort.
   Hardware method:

1. Remove metal plate from RC-1000 door.

2. Place non-conductive material between battery and
   retaining clip on top of battery.

3. Turn switch **OFF** (see figure 4).

4. Leave unit de-powered for a minimum of three minutes.

5. Turn switch **ON** and remove material from under the battery
   clip.

6. The above screen should then appear in the display.

Software Method:

1. Go to the master clear screen.

2. Toggle the field to 'Master Clear'.

3. Exit from this screen.

4. Within seconds, the RC-1000 will master clear.

RC-1000 POWER

Transformer connection terminals, fuses, and ON/OFF switch are located on the CPU Board, which is behind the metal plate on the door of the unit (see figure 4).

**Checkpoints:**

Plug terminals - 12 VAC supplies the CPU Board and is fused with an on board 2 AMP slow-blow fuse.

**Procedure:**

1. Make sure that the power switch on CPU Board is turned on.

2. Check voltage through the fuses:

   a) Set meter for AC voltage.
   b) Read power terminal #1 (from top) to top part of fuse; voltage should read 12 VAC.


TEMPERATURE SENSORS

**Procedure:**

1. Without a sensor attached: Measure voltage between sensor # and common terminals on termination board; voltage should read 5 VDC.

2. With a sensor attached: Measure voltage between sensor # and common terminals on termination board. Using the equation below, determine if the sensor reading in the display agrees with the measured reading.

   **Temperature = (V measured - 2.554) x 180**

3. If calculated temperature does not agree, the RC-1000 is at fault. If other circuits are reading correctly, the I/O Board may be bad.

## PRESSURE TRANSDUCERS

**Procedure:**

1. Measure voltage between +12 V terminal and the common terminals on termination board; voltage should read 13-15 VDC.

2. With transducer attached: Measure voltage between sensor # and common terminals on termination board. Using the equation below, determine if the pressure reading in the display agrees with the measured reading.

    **Suction Pressure = (V measured - 1) x 20**

    **Head Pressure = (V measured - 1) x 100**

    For Variable Speed operation only:

    **Oil Pump Output Pressure = (V measured - 1) x 20**

    **Displayed Oil Pressure = Oil Pump Output Pressure - Suction Pressure**

3. If calculated pressure does not agree, the RC-1000 is at fault. If other circuits are reading correctly, the I/O Board may be bad.

## RELAY BOARD

**Procedure:**

1. Output:
   a) Verify correct connection of N.O. and N.C.
   b) Check 3 AMP 240 VAC fuse on common leg of each relay.

2. Power:
   a) Check 12 VAC supplied to Relay Board on terminals (see Figure 13).
   b) Check 1 AMP 12 VAC fuse on Relay Board.

3. Connections:
   a) Check connection from I/O Board to Relay Board.
   b) Check connections of interconnection cables RJ-11). Red LEDs on Relay Driver and Relay Board should correspond.

4. Override Operation:
   a) Red LEDs indicate relay is energized. Green(yellow) Leds indicate relay is in an override state of energized or de-energized.

   NOTE: A combination of lit green(yellow) and lit red LEDs indicates the relay has been overridden to the energized state.

Note: The override led is designated as green(yellow), this led may be either color depending on version of relay board.

# RC-1000 TROUBLESHOOTING GUIDE

| SYMPTOM | POSSIBLE CAUSE | CORRECTIVE PROCEDURE |
|---------|----------------|----------------------|
| Cases are too hot | a) Sensor wiring | 1) Place Refrig relay in override. If cases get colder, check circuit status for temp. If status = -30°, sensor is shorted or wired backwards. |
| | b) Circuit programming | 1) Place Refrig relay in override. If cases get colder, return override switch to "AUTO", check circuit status for refrig status.<br><br>-IF "ON":<br>  a) Make sure override switch is in "AUTO".<br>  b) Make sure relay code is programmed correctly under "Setpoints".<br>  c) Make sure digital output is not in override in the override menu.<br><br>-IF "OFF":<br>  a) Check circuit setpoints.<br>  b) Make sure digital output is not in override in the override menu.<br><br>-IF "DEF":<br>  a) Check defrost schedule.<br><br>-IF Cases do not get colder<br>  a) Make sure rack circuit switch is on.<br>  b) Check control power to relay terms.<br>  c) Check relay 5A fuse.<br>  d) Check refrig valve. |
| Cases are too cold | a) Sensor | 1) Check circuit status<br><br>-IF "97":<br>  a) Check sensor program in circuit setpoints.<br><br>-IF "94/95":<br>  a) Check for open sensor wiring. |

| | | |
|---|---|---|
| Cases are too cold (con't) | b) Circuit Status | 1) Check circuit status for refrig status.<br><br>-IF "ON":<br>  a) Make sure relay override switch is in "AUTO".<br>  b) Make sure relay code is programmed correctly under "Setpoints".<br>  c) Make sure digital output is not in override. |
| | c) Cables | 1) Make sure the relay LED matches relay driver board.<br>2) Check cable orientation. |
| If compressors not being called for, but should be running. | a) Rack Status | 1) Check pressure reading; do a transducer check.<br>2) Check for phase loss alarm (if configured).<br>3) Check "not off" on shutdown setpoint.<br>4) Check "not off" by soft override in override menu. |
| If compressors are being called for, but not running | a) Cables | 1) I/O board LED and relay LED should be off. If not, check cable and connections. |
| | b) Relay Code | 1) Make sure relay code is programmed correctly under "Setpoints". |
| | c) Relay Override Switches | 1) Make sure circuit relay override switches are in "AUTO". |
| | d) Software Override | 1) Check for "OFF" in Digital Output of override menu. |
| | e) Compressor Switch | 1) Make sure compressor switches are on. |
| | f) Control Voltage | 1) Check control voltage at relay terminals. |
| | g) Fuses | 1) Check fuses on relay boards. |
| | h) Compressor Safeties | 1) Check all compressor circuit safeties (oil pressure, high head, low suction, phase loss). |
| If compressor is not being called for, but still running | a) Rack Status | 1) Check pressure reading;<br><br>-IF "100":<br>  a) Do a Transducer check. |
| | b) Cables | 1) I/O LED and relay LED should be on. If not, check cables and connections. |

| | | |
|---|---|---|
| If compressor is not called for, but still running (con't) | c) Relay Override Switches | 1) Make sure circuit relay override switches are in "AUTO". |
| | d) Override Menu | 1) Check for "On" in Digital Output of override menu. |
| | e) Relay Code | 1) Make sure relay code is programmed correctly under "Setpoints". |
| If condenser fans are not called for, but should be running. | a) Fan Relay | 1) Turn condenser fan relay LED off by override switch.<br><br>-IF fan comes on:<br>  a) Check pressure; do transducer check.<br>  b) Check rack head setpoints and relay programming.<br>  c) Check phase loss alarm (if configured).<br>  d) Check "Not Off" in override menu.<br><br>-IF condenser fan still not on:<br>  a) Check control voltage to relay terminals.<br>  b) Check condenser fan contactor. |
| If condenser fans are called for, but not running. | a) Cable | 1) I/O and relay LED should be off. If not, check cable and connections. |
| | b) Relay Code | 1) Make sure relay assignment programmed correctly under "Setpoints". |
| | ç) Override Switches | 1) Make sure condenser relay override switches are in AUTO. |
| | d) Control Voltage | 1) Check control voltage at relay terminals. |
| | e) Fuses | 1) Check fuses on relay boards. |
| Cannot enter setpoints in circuits or racks. | a) Incorrect Access Code | 1) Use correct access code - level 2. |
| Cannot change rack or circuit configuration | a) Incorrect Access Code | 1) Use correct access code - level 1 or 2. |
| Cannot initiate emergency defrost | a) No Defrost Time programmed - temperature above termination setpoint. | 1) Check setpoint screen for correct entries, and check case temperature. |

| | | |
|---|---|---|
| Unit does not hold on #1 compressor during hot gas defrost. | a) Circuit not assigned to a Rack. | 1) Check that circuit is assigned to proper rack. |
| | b) Defrost Initiate not set to Internal | 1) Check that defrost initiate is set to internal on rack configuration. |
| Cannot communicate remotely | a) Incorrect COM ID | 1) Verify COM ID on System Miscellaneous Parameters, and COM ID dip switch. |
| | b) Bad Phone Cables or Adaptors. | 1) Check phone cables and adapters. |
| | c) Blown I/O Fuse | 1) Check fuse on CPU Board. |
| No logging data | a) No Logging Interval programmed | 1) Set logging interval. |
| Defrost operates at incorrect times. | a) Incorrect Date/Time programmed | 1) Set date/time correctly. |
| Alarm does not dial out | a) No Phone Number programmed | 1) Program phone number. |
| Sensors assigned, but no pressure readings. | a) No power to Transducer | 1) Check fuse on CPU Board.<br>2) Check connections to transducer and termination board. |
| | b) No Gain programmed on Setpoint screen | 1) Program gain. |
| Variable speed operates incorrectly | a) Oil Pressure setpoints | 1) Check oil pressure.<br>2) Check oil pressure setpoints. |
| | b) H.P. rating much higher than other compressors on the rack. | 1) Check H.P. ratings for all compressors. |

# CIRCUIT SETPOINTS DEFINITIONS

SETPOINT:        Degree F or C - Temperature control - 2 digits (3 digits for High Temp application). Use the up/down arrow keys to toggle the +/- signs. Low temp range is from -30 F to +97 F. High temp range is from +00 F to +255 F. When temp goes one degree above setpoint the Refrigeration Relay will turn on and turn back off at the setpoint. Up to 12 sensors can be used for Circuit control. All sensors will average the Temp for control.

CUT-IN/CUT-OUT:
  SETPT        Same as Setpoint except a Deadband is programmable for Temp Control.

HIGH ALARM :    Degree F or C - 2 digits (3 digits for High Temp application)

& LOW ALARM:    Programmed values to Alarm if the Temp sensors exceed these values. Up to 12 Alarm Sensors can be assigned and the Highest and Lowest value will be displayed.

DEFROST TERM:   Degree F or C - 2 digits (3 digits for High Temp application). Programmed value to Terminate the Defrost. Up to 12 sensors can be assigned. All Termination Sensors must reach the setpoint prior to completing the Defrost. Lowest value will be displayed.

DEFR RESTART:   Degree F or C - 2 digits - Several items are monitored and required for proper operation:

    1.   Defrost will be initiated.
    2.   Termination Sensor(s) will be monitored and if all reach the Termination Setpoint the defrosting will stop.
    3.   The Circuit will remain idle (Ref. & Def Off) for the duration of the Defrost Time.
    4.   If the Termination Sensor(s) go below the Defrost Restart Temp. then the Defrost will restart.
    5.   This can happen as often as necessary but the Termination Temp and Defrost duration will be honored.

OR - using DIGITAL ASSIGNMENT for Defrost Restart. Several items are monitored and required for proper operation:

1. Defrost will be initiated.
2. Digital Input will be monitored and when closed the defrosting will stop.
3. The circuit will remain idle (Ref. & Def Off) for the duration of the Defrost Time.
4. A minimum of two (2) minutes must elapse and then if the Digital opens again the Defrost can restart.
5. Repeat the process

SKIP DEFR @DP: Degree F or C - 2 digits. For a Circuit to skip a Defrost the Dewpoint being monitored must remain below the programmed setpoint for the entire time between scheduled Defrost.

MAX DP SKIPS: One (1) digit - Works in conjunction with Skip Defrost. Number of Defrost that can be skipped in a row before a mandatory Defrost must occur.

EVP FAN START: Degree F or C - 2 digits - If Termination Sensor(s) go below the Evaporation Fan Restart Setpoint then the fan will turn on. Otherwise, following the programmed time delay the Fans will start.

REFRIG DELAY: Minutes - 2 digits - Amount of time the Refrigeration must remain off to prevent short cycling.

ALARM DELAY: Minutes - 2 digits - Amount of time Alarm goes into a pending mode, this takes place after the temp has reached the Alarm Setpoints. Alarm is inactive during Defrost and 15 minutes plus the Delay time following a Defrost at which time the Delay becomes active.

PUMPOUT TIME: Minutes - 2 digits - Liquid Relay Assignment required. When a Defrost is initiated the Liquid Relay will turn off for the time programmed to allow for the Circuit to Pump Out. Following this time period the Defrost will begin.

DEF DURATION/: Minutes - 3 digits - Failsafe value. If the Defrost Temp does not reach

DEFROST TIME The programmed Termination Temp the Defrost will and when the Duration Time has elapsed.

EQUALIZE TIME: Minutes - 2 digits - Equalize Relay Assignment required. Following the termination of a Defrost a Circuit can be equalized by a Bleed Line. This would be active for the programmed time.

EVAP FAN DLY: Minutes - 2 digits - (See Evap Fan Start) Time required prior to starting Fans.

RUN OFF TIME: Minutes - 2 digits - Following a defrost the Circuit will not permit Defrost or Refrigeration to be active. This allows for water drainage and equalization of the Refrigerant.

DEFROST TIMES/: 4 digits - Can program up to 6 Defrost using a 2400 hour clock.

DEFROST START 2400 hours is legitimate.
TIME

DEF INIT INPUT: Digital Assignment - Upon a contact closure on the Digital Input the Defrost will begin. It will honor the duration and termination. If Def Start times are programmed, the Defrost will honor both the programmed time and the Digital before activating the Defrost cycle.

DEF TERM INPUT: Digital Assignment - Upon a contact closure on the Digital Input the Defrost will end. Termination Sensor cannot work in conjunction. If there is no contact closure, the Defrost will terminate at the end of the duration.

TEMP SENSORS: Sensor Assignment up to 12 sensors. All sensors will be averaged. The computer will cycle the Refrigeration based on this Temperature. The average will be displayed on the Status Screen as the Temperature. (See Setpoint)

ALARM SENSORS: Sensor Assignment up to 12 sensors. All sensors are monitored. If any sensor exceeds the High or Low programmed value, the Alarm will activate an Alarm Pending State. This will be displayed on the Status Screen showing the Highest and Lowest Temp values. (See High and Low Alarms)

TERM SENSORS:    Sensor Assignment up to 12 sensors.  All sensors must reach the Termination temperature.  The computer will look for the lowest temp and display this value in the Status Screen.  (See Defrost Term)

REFRIG RELAY/:   Relay Assignment connected to N.C. contacts - Will cycle Refrigeration on
SUCTION RELAY    and off due to Temperature Setpoint.  Also works in conjunction with Defrost, Pumpout, and Equalize.

LIQUID RELAY:    Relay Assignment - Connected to N.C. contacts. Will cycle Refrigeration on and off due to Temperature Setpoints, also works in conjunction with Defrost, Pumpout, and Equalization.

CASE DEFR RLYS:  Relay Assignments - Connected to N.O. contacts. Requires each case to have it's own value to control Defrost.  Each case will have it's own Termination Sensor to control the Defrosting of that case.  Each case can have independent Restart and Termination.

DEFROST RELAY:   Relay Assignment connected to N.O. contacts - Will cycle Defrost on and off when required by program

HOT GAS RELAY/:  Relay Assignment connected to N.O. contacts - Can be common relay to all

MASTR HGAS RLY   Hot Gas Circuits.  The relay will activate the Modulating or Differential Valve to allow for Hot Gas operation.

EVAP FAN RLY:    Relay Assignment - Connects to N.C. contacts.  (See Evp Fan Start) Starts Evaporator Fan when conditions are correct.

EQUALIZE RELAY:  Relay Assignment - Connected to N.O. contacts. (See Equalize Time) Activates Bleed Line into Circuit following Defrost.

ALARM RELAY:     Relay Assignment - Connected to N.C. contacts - Can be common relay for all Alarms being monitored for Racks and Circuits.

REFRIG INPUT/:

SUCT VRFY INPT  Digital Assignment - Gives proof that a
                Refrigeration valve is working in conjunction with
                the computer. Any variation from the computer will
                cause a "V" to show in the Status and Log the
                failure.

LIQ VRFY INPT:  Digital Assignment - Gives proof that a
                Refrigeration valve is working in conjunction with
                the computer. Any variation from the computer will
                cause a "V" to show in the Status and Log the
                failure.

DEFROST INPUT/:

DEF VRFY INPTS    Digital Assignment - Gives proof that a
                Master/Case Defrost valve is working in conjunction
                with the computer. Any variation from the computer
                will cause a "V" to show in the Status and Log the
                failure.

TEMP COMPENSATION
SELECT:          2 digits - This is used in conjunction with Racks
                for Temp controlling of the Rack Setpoints
                (Floating of Pressure). With a Priority of "1"
                assigned to a Circuit the temp will be monitored
                and if the temp reaches the Setpoint then:

                1.  A 2° Deadband below Setpoint will become
                    automatic for that circuit.
                2.  The Cut-in and Cut-out pressure will
                    begin to float upward but not to exceed
                    the max Cut-in programmed (Rack).
                3.  When temp of the circuit goes above the
                    programmed Setpoint the Rack Cut-in and
                    Cut-out will return to the original
                    setpoints.

                NOTE:     This process works on a Degree
                          Minute Scale

                During Defrost the Priority 1 will become inactive
                and the Priority 2 will take over until completion
                of Defrost. Rack Number must be programmed in
                order to assure correct Rack is floating its
                pressure.

DEFAULT:         See Rack Number below, item #2.

ALRM OVRD INPUT:   Digital Assignment - Upon contact closure of
          the Digital Input the computer will disallow any
          Alarming on the Circuit from the temperatures.

RACK NUMBER:   2 digits - This will serve 2 purposes:

          1.   Assures the proper Rack acknowledges the
               circuit that is in Hot Gas Defrost.  This
               will assure a compressor continues to run
               during Defrost on that Rack.
          2.   Assures the proper Rack acknowledges the
               circuit is assigned and allows it to
               float the Cut-in and Cut-out Setpoints of
               that Rack.  This method will look for all
               circuits with the same Rack number and
               automatically assign the circuit with the
               lowest temp setpoint for floating of the
               Rack.  While this circuit is defrosting,
               the next circuit with the lowest temp
               setpoint will take over.  (Select Mode)

# RACK SETPOINTS DEFINITIONS

CUT IN/CUT OUT:        Pounds - Target values for maintaining the Suction and Head Pressure, "IN" on Rise; "OUT" on Drop.

AUX CUT IN/CUT OUT:  Pounds - Suction and Head target values will operate by the programmed parameters of the Auxiliary Setpoints when Aux Input enable (Digital In) is closed.

MAX CUT IN:             Pounds - Maximum allowable upward movement of the Suction "Cut In" Setpoint when in the Floating Mode.

HIGH/LOW ALARM:      Pounds - When the Suction and Head programmed parameters are exceeded and the Alarm Time Delay has elapsed then the Alarm Relay will close, Alarm Log will log the alarm and Dial Out (if selected).

HEAD OVERRIDE:       Pounds - If the head pressure exceeds this setpoint, the compressors will begin an orderly shutdown.

SHUTDOWN:              Pounds - If the Suction pressure exceeds (goes below) programmed parameter all the compressors will Shut Down immediately. The compressors now must honor the required capacity and the Minimum Off Time Delay before restarting. With "00" programmed, the Shutdown is deactivated.

ALARM DELAY:           Minutes - All Alarm Parameters will activate when Alarm Delay value is exceeded. All Digital Alarms honor same time delay

LIQUID LEVEL ALARM: Percent - Value at which the Liquid Level must exceed (go below) and honor Alarm Time Delay. This will activate Alarm Relay, log Alarm in the Alarm Log, and Dial Out (if selected).

HR OVERRIDE ALRM:   Percent - Works in conjunction with the Liquid Level Alarm. Value at which the Heat Reclaim Override Relay will open only after the Override Time Delay is honored.

HR OVERRIDE DIFF:   Percent - Value at which the Liquid Level must return to (HR Override Level plus HR Override Diff) in order to close the HR Relay again.

HR OVERRIDE DELAY:      Seconds - Time that must be honored prior to
                        opening the Heat Reclaim Relay when in an
                        Alarm condition.

FREON SCALE FACTOR:     PPM - Maximum value of Refrigerant Leak
                        Detector when inputing 10
     Ver 2              volts to the RC-1000.

FREON ALARM SPT:        PPM - The value at which the Leak Detector
                        must exceed (go above)
     Ver 2              and honor Alarm Time Delay.

MIN ON TIME:            Seconds - Requires each individual compressors
                        or unloaders to honor this time prior to
                        turning off.

MIN OFF TIME:           Seconds - Requires each individual compressors
                        or unloaders to honor this time prior to
                        turning on.

CONTROL GAIN:           001 to 255 - Acts as a Throttle for the
                        calculating speed when trying to maintain
                        Suction and Head Pressures. By raising the
                        Control Gain the calculating process will
                        increase. Lowering the Gain will cause it to
                        decrease.

CONTROL DERIVATIVE:     001 to 255 - Acts as an Anticipator for the
                        Suction and Head Pressures. As the pressure
                        makes sharp changes the calculating process
                        will anticipate and adjust accordingly.
                        Raising the Derivative will increase the
                        reaction. Lowering will decrease it.

UNIT COMBINATIONS:      ALT or SEQ - SEQ = Sequence - compressors and
                        unloaders must turn on as 1,2,3,4, etc and back
                        off as 4,3,2,1. ALT = Alternating -
                        compressors and unloaders will cycle as the
                        computer requires by looking at the following:

                            -Amount of capacity required (see
                            Capacity)

                            -Minimum steps required to get to needed
                            capacity

                            -Honor minimum on and off times

                            -Equalize run times

PRES SENSOR:            Sensor Assignment - Suction = must be an SA-
                        100 Transducer.            Head = must be an SA-
                        500 Transducer.   Connection will be to a
                        Pressure (AIP) card.

ALARM RELAY:            Relay Assignment - Connected to N.C. contacts.
                        Common Relay for all Alarms in Rack Section.

ANLG LIQ LEV SENSR:     Sensor Assignment - Monitors others Liq Level
                        Sensor.   Must be 10K load at 100% and must be
                        connected to a 0-10V card.

HR OVERRIDE RELAY:      Relay Assignment - Connected to N.C. contacts.
                        Wired to interrupt Heat Reclaim valve on rack.

AUX ENABLE INPUT:       Digital  Assignment  -  Digital  must  close
                        contacts to enable, reverts operation to Aux
                        Cut in and Cut out.

PHASE LOSS INPUT:       Digital  Assignment  -  Digital  must  close
                        contacts to signal correct operation. Failure
                        (open  contact)  shuts  down  all  racks  and
                        circuits.

FREON SENSOR:           Sensor Assignment - Monitors Freon Sensor and
                        connects to a 0-10v
  Ver 2 Only            card.

LIQUID LEVEL INPUT:     Digital Assignment - Monitors others Liquid
                        Level Sensor.  Must close contacts for purpose
                        of Alarming.

DEFROST SENSE INPUT:       Digital Assignment - Monitors others
                        Defrost Clock.  Must close contacts for purpose
                        of indicating Defrost condition.  This is used
                        to force a compressor to run during Defrost.

OIL FAILURE INPUT:      Digital Assignment - Digital Oil Inputs must
                        be in series and any oil failure must open
                        Digital contact for Alarm.

FREON INPUT:            Digital Assignment - Monitors Freon Control by
                        others.   Must close
  Ver 2 Only            contact for purpose of Alarming.

COMPRESSOR RELAY:     Relay Assignment - Must be connected to N.C.
                      unless Rack Configuration was programmed for
                      "Comp Energize On" which would require
                      connection to N.O.

CAPACITY:             3 Digits - The computer will compare all
                      capacities and assign each compressor a
                      certain percent of the total. This value can
                      be in Horse Power, BTU's, or Percent (%). The
                      computer will determine what to cycle by
                      looking at the requirements and the capacity
                      of each compressor.

SLAVES:               Single Digit - Unloaders - Standard hook-up is
                      N.O. at the relay. The number entered under a
                      compressor determines how many unloaders for
                      that compressor. The following positions next
                      to the compressor (equal to the Slave number)
                      will be the Unloaders and they must share the
                      capacity of the main compressor, ie: if the
                      compressor is a 15 HP and there are 2
                      Unloaders then - place a 2 under the main
                      compressor at position #1. Positions 1,2,3
                      will be the total capacity and each positions
                      capacity will be 5 HP. NOTE: The computer
                      will require the Unloaders to be unloaded
                      prior to turning on compressors and unload
                      prior to turning off the main compressor.

RUN INPT:             Digital Assignment - Input gives proof that a
                      compressor is working in conjunction with the
                      computer (Digital closes when on). Any
                      variation from what the computer is calling
                      for will put a "V" in place of the compressor
                      number on the status screen and log the
                      failure.

VARIABLE SPEED COMPRESSOR:

MAX RPM:              Maximum value allowed for the variable
                      operation.

MIN RPM:              Minimum value allowed for operation.
                      Compressor will maintain Minimum RPM and only
                      Shutdown when Req Capacity on Status screen is
                      at 0%.

CAPACITY:

See Capacity above, directly related to compressor capacity. The higher the capacity value, the more defined increments for the variable speed, ie: 1750 ÷ 10 (capacity) = 175 (lg increment change)
$$1750 ÷ 100 \text{ (capacity)} = 17.5$$
(sm increment chg)

This would be the RPM Staging of the Variable Speed

| Gain | | RPM | RPM | RPM | RPM | |
|------|---|-----|-----|-----|-----|---|
| 10 | -- | 175 | 350 | 525 | 700 | etc. |
| 100 | -- | 17.5 | 35 | 52.5 | 70 | etc. |

MIN OIL PRES:

Pounds - 3 digits - If net Oil Pressure exceeds (goes below) the programmed value, the Variable Speed will speed up until corrected and will resume variable speed operation only after correction of Oil Pressure.

ANALOG OUTPUT:

Analog Output Assignment - Output signal to the Variable Speed that operates from 0-10 VDC.

0 VDC = 0 RPM                    10 VDC = MAX RPM

OIL PRESS SENSR:

Sensor Assignment - SA-100 Pressure Transducer connected to output of Oil Pump. Should be snubbed to prevent hammer effect. Oil Pressure will be calculated as: Oil Pump Output -Less- Suction Press = Net Oil

FREQ SENSR:

Sensor Assignment - Monitors Invertor giving actual Frequency of the Invertor into 0-10v card.

CURRENT SENSR:

Sensor Assignment - Monitors Invertor giving actual Current of the Invertor into 0-10v card.

CONTROL RELAY:

Relay Assignment - Connected to N.C. - Required to open Control Circuit of Variable Speed when compressor shuts off. The Control signal will drop to 0 VDC to shut down the Compressor and the Control Circuit will open to prevent tripping of the Oil Failure Switch.

RESET RELAY:            Relay Assignment - Used to keep Invertor in
                        the Run Mode but will pulse to restart
                        Invertor if the RC-1000 receives a fault
                        signal from the Invertor.

SWITCHOVR RELAY:        Relay Assignment - Connected to ?? - Will
                        remain in the normal Run Mode (Invertor)
                        unless the Fault Input and Reset Relay have
                        tried 3 times to restart the Variable Speed
                        without success.  At this time the Relay will
                        switch to the By-pass Contactor.

FAULT INPUT:            Digital Assignment - Input signal from
                        Invertor must close Digital Contact to
                        indicate a problem with the Variable Speed.
                        This works in conjunction with the Reset Relay
                        mentioned above.

RUN INPUT:              Digital Assignment - Input gives proof the
                        Variable Speed is working in conjunction with
                        computer (see Run Input for Compressors).

FAN RELAY:              Relay Assignment - Connected to N.C. Contacts
                        - All Fans work in conjunction with Head
                        Setpoints.  The number of Relays assigned will
                        determine the percentage of the Load, ie:

                             2 Assignments  50% & 50%
                             4 Assignments  25%, 25%, 25% & 25%

RUN INPT:               Digital Assignment - Input gives proof the
                        Fans are working in conjunction with the
                        computer (see Run Input for Compressor).

POWER SENSR:            Sensor Assignment - Monitor a K.W. Transducer
                        to indicate the amount of power consumed into
                        a 0-10v card.

MAX POWER:              Programmable variable that works in
                        conjunction with the size of Current
                        Transformers installed.

# TABLE 1, % RH TO VOLTAGE CONVERSION

| % RH | Voltage | % RH | Voltage | % RH | Voltage |
|---|---|---|---|---|---|
| 0 | 2.554 | 34 | 2.743 | 68 | 2.932 |
| 1 | 2.560 | 35 | 2.748 | 69 | 2.937 |
| 2 | 2.565 | 36 | 2.754 | 70 | 2.943 |
| 3 | 2.571 | 37 | 2.760 | 71 | 2.948 |
| 4 | 2.576 | 38 | 2.765 | 72 | 2.954 |
| 5 | 2.582 | 39 | 2.771 | 73 | 2.960 |
| 6 | 2.587 | 40 | 2.776 | 74 | 2.965 |
| 7 | 2.593 | 41 | 2.782 | 75 | 2.971 |
| 8 | 2.598 | 42 | 2.787 | 76 | 2.976 |
| 9 | 2.604 | 43 | 2.793 | 77 | 2.982 |
| 10 | 2.610 | 44 | 2.798 | 78 | 2.987 |
| 11 | 2.615 | 45 | 2.804 | 79 | 2.993 |
| 12 | 2.621 | 46 | 2.810 | 80 | 2.998 |
| 13 | 2.626 | 47 | 2.815 | 81 | 3.004 |
| 14 | 2.632 | 48 | 2.821 | 82 | 3.010 |
| 15 | 2.637 | 49 | 2.826 | 83 | 3.015 |
| 16 | 2.643 | 50 | 2.832 | 84 | 3.021 |
| 17 | 2.648 | 51 | 2.837 | 85 | 3.026 |
| 18 | 2.654 | 52 | 2.843 | 86 | 3.032 |
| 19 | 2.660 | 53 | 2.848 | 87 | 3.037 |
| 20 | 2.665 | 54 | 2.854 | 88 | 3.043 |
| 21 | 2.671 | 55 | 2.860 | 89 | 3.048 |
| 22 | 2.676 | 56 | 2.865 | 90 | 3.054 |
| 23 | 2.682 | 57 | 2.871 | 91 | 3.060 |
| 24 | 2.687 | 58 | 2.876 | 92 | 3.065 |
| 25 | 2.693 | 59 | 2.882 | 93 | 3.071 |
| 26 | 2.698 | 60 | 2.887 | 94 | 3.076 |
| 27 | 2.704 | 61 | 2.893 | 95 | 3.082 |
| 28 | 2.710 | 62 | 2.898 | 96 | 3.087 |
| 29 | 2.715 | 63 | 2.904 | 97 | 3.093 |
| 30 | 2.721 | 64 | 2.910 | 98 | 3.098 |
| 31 | 2.726 | 65 | 2.915 | 99 | 3.104 |
| 32 | 2.732 | 66 | 2.921 | 100 | 3.110 |
| 33 | 2.737 | 67 | 2.926 | | |

# TABLE 2, FOOT CANDLES TO VOLTAGE CONVERSION

| FTC | Voltage | FTC | Voltage | FTC | Voltage |
|-----|---------|-----|---------|-----|---------|
| 0 | 2.554 | 34 | 2.743 | 68 | 2.932 |
| 1 | 2.560 | 35 | 2.748 | 69 | 2.937 |
| 2 | 2.565 | 36 | 2.754 | 70 | 2.943 |
| 3 | 2.571 | 37 | 2.760 | 71 | 2.948 |
| 4 | 2.576 | 38 | 2.765 | 72 | 2.954 |
| 5 | 2.582 | 39 | 2.771 | 73 | 2.960 |
| 6 | 2.587 | 40 | 2.776 | 74 | 2.965 |
| 7 | 2.593 | 41 | 2.782 | 75 | 2.971 |
| 8 | 2.598 | 42 | 2.787 | 76 | 2.976 |
| 9 | 2.604 | 43 | 2.793 | 77 | 2.982 |
| 10 | 2.610 | 44 | 2.798 | 78 | 2.987 |
| 11 | 2.615 | 45 | 2.804 | 79 | 2.993 |
| 12 | 2.621 | 46 | 2.810 | 80 | 2.998 |
| 13 | 2.626 | 47 | 2.815 | 81 | 3.004 |
| 14 | 2.632 | 48 | 2.821 | 82 | 3.010 |
| 15 | 2.637 | 49 | 2.826 | 83 | 3.015 |
| 16 | 2.643 | 50 | 2.832 | 84 | 3.021 |
| 17 | 2.648 | 51 | 2.837 | 85 | 3.026 |
| 18 | 2.654 | 52 | 2.843 | 86 | 3.032 |
| 19 | 2.660 | 53 | 2.848 | 87 | 3.037 |
| 20 | 2.665 | 54 | 2.854 | 88 | 3.043 |
| 21 | 2.671 | 55 | 2.860 | 89 | 3.048 |
| 22 | 2.676 | 56 | 2.865 | 90 | 3.054 |
| 23 | 2.682 | 57 | 2.871 | 91 | 3.060 |
| 24 | 2.687 | 58 | 2.876 | 92 | 3.065 |
| 25 | 2.693 | 59 | 2.882 | 93 | 3.071 |
| 26 | 2.698 | 60 | 2.887 | 94 | 3.076 |
| 27 | 2.704 | 61 | 2.893 | 95 | 3.082 |
| 28 | 2.710 | 62 | 2.898 | 96 | 3.087 |
| 29 | 2.715 | 63 | 2.904 | 97 | 3.093 |
| 30 | 2.721 | 64 | 2.910 | 98 | 3.098 |
| 31 | 2.726 | 65 | 2.915 | 99 | 3.104 |
| 32 | 2.732 | 66 | 2.921 | 100 | 3.110 |
| 33 | 2.737 | 67 | 2.926 | | |

## TABLE 3, PRESSURE TO VOLTAGE CONVERSION: SA-100

| Pres | Voltage | Pres | Voltage | Pres | Voltage |
|------|---------|------|---------|------|---------|
| 0 | 1.000 | 34 | 2.70 | 68 | 4.40 |
| 1 | 1.05 | 35 | 2.75 | 69 | 4.45 |
| 2 | 1.10 | 36 | 2.80 | 70 | 4.50 |
| 3 | 1.15 | 37 | 2.85 | 71 | 4.55 |
| 4 | 1.20 | 38 | 2.90 | 72 | 4.60 |
| 5 | 1.25 | 39 | 2.95 | 73 | 4.65 |
| 6 | 1.30 | 40 | 3.00 | 74 | 4.70 |
| 7 | 1.35 | 41 | 3.05 | 75 | 4.75 |
| 8 | 1.40 | 42 | 3.10 | 76 | 4.80 |
| 9 | 1.45 | 43 | 3.15 | 77 | 4.85 |
| 10 | 1.50 | 44 | 3.20 | 78 | 4.90 |
| 11 | 1.55 | 45 | 3.25 | 79 | 4.95 |
| 12 | 1.60 | 46 | 3.30 | 80 | 5.00 |
| 13 | 1.65 | 47 | 3.35 | 81 | 5.05 |
| 14 | 1.70 | 48 | 3.40 | 82 | 5.10 |
| 15 | 1.75 | 49 | 3.45 | 83 | 5.15 |
| 16 | 1.80 | 50 | 3.50 | 84 | 5.20 |
| 17 | 1.85 | 51 | 3.55 | 85 | 5.25 |
| 18 | 1.90 | 52 | 3.60 | 86 | 5.30 |
| 19 | 1.95 | 53 | 3.65 | 87 | 5.35 |
| 20 | 2.00 | 54 | 3.70 | 88 | 5.40 |
| 21 | 2.05 | 55 | 3.75 | 89 | 5.45 |
| 22 | 2.10 | 56 | 3.80 | 90 | 5.50 |
| 23 | 2.15 | 57 | 3.85 | 91 | 5.55 |
| 24 | 2.20 | 58 | 3.90 | 92 | 5.60 |
| 25 | 2.25 | 59 | 3.95 | 93 | 5.65 |
| 26 | 2.30 | 60 | 4.00 | 94 | 5.70 |
| 27 | 2.35 | 61 | 4.05 | 95 | 5.75 |
| 28 | 2.40 | 62 | 4.10 | 96 | 5.80 |
| 29 | 2.45 | 63 | 4.15 | 97 | 5.85 |
| 30 | 2.50 | 64 | 4.20 | 98 | 5.90 |
| 31 | 2.55 | 65 | 4.25 | 99 | 5.95 |
| 32 | 2.60 | 66 | 4.30 | 100 | 6.00 |
| 33 | 2.65 | 67 | 4.35 | | |

## TABLE 4, PRESSURE TO VOLTAGE CONVERSION: SA-500

| Pres | Voltage | Pres | Voltage | Pres | Voltage |
|------|---------|------|---------|------|---------|
| 0 | 1.00 | 34 | 1.34 | 68 | 1.68 |
| 1 | 1.01 | 35 | 1.35 | 69 | 1.69 |
| 2 | 1.02 | 36 | 1.36 | 70 | 1.70 |
| 3 | 1.03 | 37 | 1.37 | 71 | 1.71 |
| 4 | 1.04 | 38 | 1.38 | 72 | 1.72 |
| 5 | 1.05 | 39 | 1.39 | 73 | 1.73 |
| 6 | 1.06 | 40 | 1.40 | 74 | 1.74 |
| 7 | 1.07 | 41 | 1.41 | 75 | 1.75 |
| 8 | 1.08 | 42 | 1.42 | 76 | 1.76 |
| 9 | 1.09 | 43 | 1.43 | 77 | 1.77 |
| 10 | 1.10 | 44 | 1.44 | 78 | 1.78 |
| 11 | 1.11 | 45 | 1.45 | 79 | 1.79 |
| 12 | 1.12 | 46 | 1.46 | 80 | 1.80 |
| 13 | 1.13 | 47 | 1.47 | 81 | 1.81 |
| 14 | 1.14 | 48 | 1.48 | 82 | 1.82 |
| 15 | 1.15 | 49 | 1.49 | 83 | 1.83 |
| 16 | 1.16 | 50 | 1.50 | 84 | 1.84 |
| 17 | 1.17 | 51 | 1.51 | 85 | 1.85 |
| 18 | 1.18 | 52 | 1.52 | 86 | 1.86 |
| 19 | 1.19 | 53 | 1.53 | 87 | 1.87 |
| 20 | 1.20 | 54 | 1.54 | 88 | 1.88 |
| 21 | 1.21 | 55 | 1.55 | 89 | 1.89 |
| 22 | 1.22 | 56 | 1.56 | 90 | 1.90 |
| 23 | 1.23 | 57 | 1.57 | 91 | 1.91 |
| 24 | 1.24 | 58 | 1.58 | 92 | 1.92 |
| 25 | 1.25 | 59 | 1.59 | 93 | 1.93 |
| 26 | 1.26 | 60 | 1.60 | 94 | 1.94 |
| 27 | 1.27 | 61 | 1.61 | 95 | 1.95 |
| 28 | 1.28 | 62 | 1.62 | 96 | 1.96 |
| 29 | 1.29 | 63 | 1.63 | 97 | 1.97 |
| 30 | 1.30 | 64 | 1.64 | 98 | 1.98 |
| 31 | 1.31 | 65 | 1.65 | 99 | 1.99 |
| 32 | 1.32 | 66 | 1.66 | 100 | 2.00 |
| 33 | 1.33 | 67 | 1.67 | 101 | 2.01 |

## TABLE 4, PRESSURE TO VOLTAGE CONVERSION: SA-500

| Pres | Voltage | Pres | Voltage | Pres | Voltage |
|------|---------|------|---------|------|---------|
| 102 | 2.02 | 136 | 2.36 | 170 | 2.70 |
| 103 | 2.03 | 137 | 2.37 | 171 | 2.71 |
| 104 | 2.04 | 138 | 2.38 | 172 | 2.72 |
| 105 | 2.05 | 139 | 2.39 | 173 | 2.73 |
| 106 | 2.06 | 140 | 2.40 | 174 | 2.74 |
| 107 | 2.07 | 141 | 2.41 | 175 | 2.75 |
| 108 | 2.08 | 142 | 2.42 | 176 | 2.76 |
| 109 | 2.09 | 143 | 2.43 | 177 | 2.77 |
| 110 | 2.10 | 144 | 2.44 | 178 | 2.78 |
| 111 | 2.11 | 145 | 2.45 | 179 | 2.79 |
| 112 | 2.12 | 146 | 2.46 | 180 | 2.80 |
| 113 | 2.13 | 147 | 2.47 | 181 | 2.81 |
| 114 | 2.14 | 148 | 2.48 | 182 | 2.82 |
| 115 | 2.15 | 149 | 2.49 | 183 | 2.83 |
| 116 | 2.16 | 150 | 2.50 | 184 | 2.84 |
| 117 | 2.17 | 151 | 2.51 | 185 | 2.85 |
| 118 | 2.18 | 152 | 2.52 | 186 | 2.86 |
| 119 | 2.19 | 153 | 2.53 | 187 | 2.87 |
| 120 | 2.20 | 154 | 2.54 | 188 | 2.88 |
| 121 | 2.21 | 155 | 2.55 | 189 | 2.89 |
| 122 | 2.22 | 156 | 2.56 | 190 | 2.90 |
| 123 | 2.23 | 157 | 2.57 | 191 | 2.91 |
| 124 | 2.24 | 158 | 2.58 | 192 | 2.92 |
| 125 | 2.25 | 159 | 2.59 | 193 | 2.93 |
| 126 | 2.26 | 160 | 2.60 | 194 | 2.94 |
| 127 | 2.27 | 161 | 2.61 | 195 | 2.95 |
| 128 | 2.28 | 162 | 2.62 | 196 | 2.96 |
| 129 | 2.29 | 163 | 2.63 | 197 | 2.97 |
| 130 | 2.30 | 164 | 2.64 | 198 | 2.98 |
| 131 | 2.31 | 165 | 2.65 | 199 | 2.99 |
| 132 | 2.32 | 166 | 2.66 | 200 | 3.00 |
| 133 | 2.33 | 167 | 2.67 | 201 | 3.01 |
| 134 | 2.34 | 168 | 2.68 | 202 | 3.02 |
| 135 | 2.35 | 169 | 2.69 | 203 | 3.03 |

## TABLE 4, PRESSURE TO VOLTAGE CONVERSION: SA-500

| Pres | Voltage | Pres | Voltage | Pres | Voltage |
|------|---------|------|---------|------|---------|
| 204 | 3.04 | 238 | 3.38 | 272 | 3.72 |
| 205 | 3.05 | 239 | 3.39 | 273 | 3.73 |
| 206 | 3.06 | 240 | 3.40 | 274 | 3.74 |
| 207 | 3.07 | 241 | 3.41 | 275 | 3.75 |
| 208 | 3.08 | 242 | 3.42 | 276 | 3.76 |
| 209 | 3.09 | 243 | 3.43 | 277 | 3.77 |
| 210 | 3.10 | 244 | 3.44 | 278 | 3.78 |
| 211 | 3.11 | 245 | 3.45 | 279 | 3.79 |
| 212 | 3.12 | 246 | 3.46 | 280 | 3.80 |
| 213 | 3.13 | 247 | 3.47 | 281 | 3.81 |
| 214 | 3.14 | 248 | 3.48 | 282 | 3.82 |
| 215 | 3.15 | 249 | 3.49 | 283 | 3.83 |
| 216 | 3.16 | 250 | 3.50 | 284 | 3.84 |
| 217 | 3.17 | 251 | 3.51 | 285 | 3.85 |
| 218 | 3.18 | 252 | 3.52 | 286 | 3.86 |
| 219 | 3.19 | 253 | 3.53 | 287 | 3.87 |
| 220 | 3.20 | 254 | 3.54 | 288 | 3.88 |
| 221 | 3.21 | 255 | 3.55 | 289 | 3.89 |
| 222 | 3.22 | 256 | 3.56 | 290 | 3.90 |
| 223 | 3.23 | 257 | 3.57 | 291 | 3.91 |
| 224 | 3.24 | 258 | 3.58 | 292 | 3.92 |
| 225 | 3.25 | 259 | 3.59 | 293 | 3.93 |
| 226 | 3.26 | 260 | 3.60 | 294 | 3.94 |
| 227 | 3.27 | 261 | 3.61 | 295 | 3.95 |
| 228 | 3.28 | 262 | 3.62 | 296 | 3.96 |
| 229 | 3.29 | 263 | 3.63 | 297 | 3.97 |
| 230 | 3.30 | 264 | 3.64 | 298 | 3.98 |
| 231 | 3.31 | 265 | 3.65 | 299 | 3.99 |
| 232 | 3.32 | 266 | 3.66 | 300 | 4.00 |
| 233 | 3.33 | 267 | 3.67 | 301 | 4.01 |
| 234 | 3.34 | 268 | 3.68 | 302 | 4.02 |
| 235 | 3.35 | 269 | 3.69 | 303 | 4.03 |
| 236 | 3.36 | 270 | 3.70 | 304 | 4.04 |
| 237 | 3.37 | 271 | 3.71 | 305 | 4.05 |

Chapter 4

# TABLE 4, PRESSURE TO VOLTAGE CONVERSION: SA-500

| Pres | Voltage | Pres | Voltage | Pres | Voltage |
|------|---------|------|---------|------|---------|
| 306 | 4.06 | 340 | 4.40 | 374 | 4.74 |
| 307 | 4.07 | 341 | 4.41 | 375 | 4.75 |
| 308 | 4.08 | 342 | 4.42 | 376 | 4.76 |
| 309 | 4.09 | 343 | 4.43 | 377 | 4.77 |
| 310 | 4.10 | 344 | 4.44 | 378 | 4.78 |
| 311 | 4.11 | 345 | 4.45 | 379 | 4.79 |
| 312 | 4.12 | 346 | 4.46 | 380 | 4.80 |
| 313 | 4.13 | 347 | 4.47 | 381 | 4.81 |
| 314 | 4.14 | 348 | 4.48 | 382 | 4.82 |
| 315 | 4.15 | 349 | 4.49 | 383 | 4.83 |
| 316 | 4.16 | 350 | 4.50 | 384 | 4.84 |
| 317 | 4.17 | 351 | 4.51 | 385 | 4.85 |
| 318 | 4.18 | 352 | 4.52 | 386 | 4.86 |
| 319 | 4.19 | 353 | 4.53 | 387 | 4.87 |
| 320 | 4.20 | 354 | 4.54 | 388 | 4.88 |
| 321 | 4.21 | 355 | 4.55 | 389 | 4.89 |
| 322 | 4.22 | 356 | 4.56 | 390 | 4.90 |
| 323 | 4.23 | 357 | 4.57 | 391 | 4.91 |
| 324 | 4.24 | 358 | 4.58 | 392 | 4.92 |
| 325 | 4.25 | 359 | 4.59 | 393 | 4.93 |
| 326 | 4.26 | 360 | 4.60 | 394 | 4.94 |
| 327 | 4.27 | 361 | 4.61 | 395 | 4.95 |
| 328 | 4.28 | 362 | 4.62 | 396 | 4.96 |
| 329 | 4.29 | 363 | 4.63 | 397 | 4.97 |
| 330 | 4.30 | 364 | 4.64 | 398 | 4.98 |
| 331 | 4.31 | 365 | 4.65 | 399 | 4.99 |
| 332 | 4.32 | 366 | 4.66 | 400 | 5.00 |
| 333 | 4.33 | 367 | 4.67 | 401 | 5.01 |
| 334 | 4.34 | 368 | 4.68 | 402 | 5.02 |
| 335 | 4.35 | 369 | 4.69 | 403 | 5.03 |
| 336 | 4.36 | 370 | 4.70 | 404 | 5.04 |
| 337 | 4.37 | 371 | 4.71 | 405 | 5.05 |
| 338 | 4.38 | 372 | 4.72 | 406 | 5.06 |
| 339 | 4.39 | 373 | 4.73 | 407 | 5.07 |

## TABLE 4, PRESSURE TO VOLTAGE CONVERSION: SA-500

| Pres | Voltage | Pres | Voltage | Pres | Voltage |
|------|---------|------|---------|------|---------|
| 408 | 5.08 | 442 | 5.42 | 476 | 5.76 |
| 409 | 5.09 | 443 | 5.43 | 477 | 5.77 |
| 410 | 5.10 | 444 | 5.44 | 478 | 5.78 |
| 411 | 5.11 | 445 | 5.45 | 479 | 5.79 |
| 412 | 5.12 | 446 | 5.46 | 480 | 5.80 |
| 413 | 5.13 | 447 | 5.47 | 481 | 5.81 |
| 414 | 5.14 | 448 | 5.48 | 482 | 5.82 |
| 415 | 5.15 | 449 | 5.49 | 483 | 5.83 |
| 416 | 5.16 | 450 | 5.50 | 484 | 5.84 |
| 417 | 5.17 | 451 | 5.51 | 485 | 5.85 |
| 418 | 5.18 | 452 | 5.52 | 486 | 5.86 |
| 419 | 5.19 | 453 | 5.53 | 487 | 5.87 |
| 420 | 5.20 | 454 | 5.54 | 488 | 5.88 |
| 421 | 5.21 | 455 | 5.55 | 489 | 5.89 |
| 422 | 5.22 | 456 | 5.56 | 490 | 5.90 |
| 423 | 5.23 | 457 | 5.57 | 491 | 5.91 |
| 424 | 5.24 | 458 | 5.58 | 492 | 5.92 |
| 425 | 5.25 | 459 | 5.59 | 493 | 5.93 |
| 426 | 5.26 | 460 | 5.60 | 494 | 5.94 |
| 427 | 5.27 | 461 | 5.61 | 495 | 5.95 |
| 428 | 5.28 | 462 | 5.62 | 496 | 5.96 |
| 429 | 5.29 | 463 | 5.63 | 497 | 5.97 |
| 430 | 5.30 | 464 | 5.64 | 498 | 5.98 |
| 431 | 5.31 | 465 | 5.65 | 499 | 5.99 |
| 432 | 5.32 | 466 | 5.66 | 500 | 6.00 |
| 433 | 5.33 | 467 | 5.67 | | |
| 434 | 5.34 | 468 | 5.68 | | |
| 435 | 5.35 | 469 | 5.69 | | |
| 436 | 5.36 | 470 | 5.70 | | |
| 437 | 5.37 | 471 | 5.71 | | |
| 438 | 5.38 | 472 | 5.72 | | |
| 439 | 5.39 | 473 | 5.73 | | |
| 440 | 5.40 | 474 | 5.74 | | |
| 441 | 5.41 | 475 | 5.75 | | |

Chapter 4

## TABLE 5, DEWPOINT TO VOLTAGE CONVERSION: DPS-1
### At DPI Board, DR(+) to W(−)

| DP | Voltage | DP | Voltage | DP | Voltage |
|----|---------|----|---------|----|---------|
| 0 | 2.694 | 34 | 2.959 | 68 | 3.224 |
| 1 | 2.701 | 35 | 2.967 | 69 | 3.232 |
| 2 | 2.709 | 36 | 2.974 | 70 | 3.240 |
| 3 | 2.717 | 37 | 2.982 | 71 | 3.247 |
| 4 | 2.725 | 38 | 2.990 | 72 | 3.255 |
| 5 | 2.733 | 39 | 2.998 | 73 | 3.263 |
| 6 | 2.740 | 40 | 3.006 | 74 | 3.271 |
| 7 | 2.748 | 41 | 3.013 | 75 | 3.279 |
| 8 | 2.756 | 42 | 3.021 | 76 | 3.286 |
| 9 | 2.764 | 43 | 3.029 | 77 | 3.294 |
| 10 | 2.772 | 44 | 3.037 | 78 | 3.302 |
| 11 | 2.779 | 45 | 3.045 | 79 | 3.310 |
| 12 | 2.787 | 46 | 3.052 | 80 | 3.318 |
| 13 | 2.795 | 47 | 3.060 | 81 | 3.325 |
| 14 | 2.803 | 48 | 3.068 | 82 | 3.333 |
| 15 | 2.811 | 49 | 3.076 | 83 | 3.341 |
| 16 | 2.818 | 50 | 3.084 | 84 | 3.349 |
| 17 | 2.826 | 51 | 3.091 | 85 | 3.357 |
| 18 | 2.834 | 52 | 3.099 | 86 | 3.364 |
| 19 | 2.842 | 53 | 3.107 | 87 | 3.372 |
| 20 | 2.850 | 54 | 3.115 | 88 | 3.380 |
| 21 | 2.857 | 55 | 3.123 | 89 | 3.388 |
| 22 | 2.865 | 56 | 3.130 | 90 | 3.396 |
| 23 | 2.873 | 57 | 3.138 | 91 | 3.403 |
| 24 | 2.881 | 58 | 3.146 | 92 | 3.411 |
| 25 | 2.889 | 59 | 3.154 | 93 | 3.419 |
| 26 | 2.896 | 60 | 3.162 | 94 | 3.427 |
| 27 | 2.904 | 61 | 3.169 | 95 | 3.435 |
| 28 | 2.912 | 62 | 3.177 | 96 | 3.442 |
| 29 | 2.920 | 63 | 3.185 | 97 | 3.450 |
| 30 | 2.928 | 64 | 3.193 | 98 | 3.458 |
| 31 | 2.935 | 65 | 3.201 | 99 | 3.466 |
| 32 | 2.943 | 66 | 3.208 | 100 | 3.474 |
| 33 | 2.951 | 67 | 3.216 | | |

## TABLE 6, DEWPOINT TO VOLTAGE CONVERSION: DPS-1
### At DPI Board, DP(+) to W(-)

| DP | Voltage | DP | Voltage | DP | Voltage |
|----|---------|----|---------|----|---------|
| 0 | 2.554 | 34 | 2.743 | 68 | 2.932 |
| 1 | 2.560 | 35 | 2.748 | 69 | 2.937 |
| 2 | 2.565 | 36 | 2.754 | 70 | 2.943 |
| 3 | 2.571 | 37 | 2.760 | 71 | 2.948 |
| 4 | 2.576 | 38 | 2.765 | 72 | 2.954 |
| 5 | 2.582 | 39 | 2.771 | 73 | 2.960 |
| 6 | 2.587 | 40 | 2.776 | 74 | 2.965 |
| 7 | 2.593 | 41 | 2.782 | 75 | 2.971 |
| 8 | 2.598 | 42 | 2.787 | 76 | 2.976 |
| 9 | 2.604 | 43 | 2.793 | 77 | 2.982 |
| 10 | 2.610 | 44 | 2.798 | 78 | 2.987 |
| 11 | 2.615 | 45 | 2.804 | 79 | 2.993 |
| 12 | 2.621 | 46 | 2.810 | 80 | 2.998 |
| 13 | 2.626 | 47 | 2.815 | 81 | 3.004 |
| 14 | 2.632 | 48 | 2.821 | 82 | 3.010 |
| 15 | 2.637 | 49 | 2.826 | 83 | 3.015 |
| 16 | 2.643 | 50 | 2.832 | 84 | 3.021 |
| 17 | 2.648 | 51 | 2.837 | 85 | 3.026 |
| 18 | 2.654 | 52 | 2.843 | 86 | 3.032 |
| 19 | 2.660 | 53 | 2.848 | 87 | 3.037 |
| 20 | 2.665 | 54 | 2.854 | 88 | 3.043 |
| 21 | 2.671 | 55 | 2.860 | 89 | 3.048 |
| 22 | 2.676 | 56 | 2.865 | 90 | 3.054 |
| 23 | 2.682 | 57 | 2.871 | 91 | 3.060 |
| 24 | 2.687 | 58 | 2.876 | 92 | 3.065 |
| 25 | 2.693 | 59 | 2.882 | 93 | 3.071 |
| 26 | 2.698 | 60 | 2.887 | 94 | 3.076 |
| 27 | 2.704 | 61 | 2.893 | 95 | 3.082 |
| 28 | 2.710 | 62 | 2.898 | 96 | 3.087 |
| 29 | 2.715 | 63 | 2.904 | 97 | 3.093 |
| 30 | 2.721 | 64 | 2.910 | 98 | 3.098 |
| 31 | 2.726 | 65 | 2.915 | 99 | 3.104 |
| 32 | 2.732 | 66 | 2.921 | 100 | 3.110 |
| 33 | 2.737 | 67 | 2.926 | | |

# TABLE 7, TEMPERATURE TO VOLTAGE CONVERSION: TP-1

| °F | °C | Voltage | °F | °C | Voltage | °F | °C | Voltage |
|---|---|---|---|---|---|---|---|---|
| -30 | -34.4 | 2.387 | 2 | -16.7 | 2.565 | 34 | 1.1 | 2.743 |
| -29 | -33.9 | 2.393 | 3 | -16.1 | 2.571 | 35 | 1.7 | 2.748 |
| -28 | -33.3 | 2.398 | 4 | -15.6 | 2.576 | 36 | 2.2 | 2.754 |
| -27 | -32.8 | 2.404 | 5 | -15.0 | 2.582 | 37 | 2.8 | 2.760 |
| -26 | -32.2 | 2.410 | 6 | -14.4 | 2.587 | 38 | 3.3 | 2.765 |
| -25 | -31.7 | 2.415 | 7 | -13.9 | 2.593 | 39 | 3.9 | 2.771 |
| -24 | -31.1 | 2.421 | 8 | -13.3 | 2.598 | 40 | 4.4 | 2.776 |
| -23 | -30.6 | 2.426 | 9 | -12.8 | 2.604 | 41 | 5.0 | 2.782 |
| -22 | -30.0 | 2.432 | 10 | -12.2 | 2.610 | 42 | 5.6 | 2.787 |
| -21 | -29.4 | 2.437 | 11 | -11.7 | 2.615 | 43 | 6.1 | 2.793 |
| -20 | -28.9 | 2.443 | 12 | -11.1 | 2.621 | 44 | 6.7 | 2.798 |
| -19 | -28.3 | 2.448 | 13 | -10.6 | 2.626 | 45 | 7.2 | 2.804 |
| -18 | -27.8 | 2.454 | 14 | -10.0 | 2.632 | 46 | 7.8 | 2.810 |
| -17 | -27.2 | 2.460 | 15 | -9.4 | 2.637 | 47 | 8.3 | 2.815 |
| -16 | -26.7 | 2.465 | 16 | -8.9 | 2.643 | 48 | 8.9 | 2.821 |
| -15 | -26.1 | 2.471 | 17 | -8.3 | 2.648 | 49 | 9.4 | 2.826 |
| -14 | -25.6 | 2.476 | 18 | -7.8 | 2.654 | 50 | 10.0 | 2.832 |
| -13 | -25.0 | 2.482 | 19 | -7.2 | 2.660 | 51 | 10.6 | 2.837 |
| -12 | -24.4 | 2.487 | 20 | -6.7 | 2.665 | 52 | 11.1 | 2.843 |
| -11 | -23.9 | 2.493 | 21 | -6.1 | 2.671 | 53 | 11.7 | 2.848 |
| -10 | -23.3 | 2.498 | 22 | -5.6 | 2.676 | 54 | 12.2 | 2.854 |
| -9 | -22.8 | 2.504 | 23 | -5.0 | 2.682 | 55 | 12.8 | 2.860 |
| -8 | -22.2 | 2.510 | 24 | -4.4 | 2.687 | 56 | 13.3 | 2.865 |
| -7 | -21.7 | 2.515 | 25 | -3.9 | 2.693 | 57 | 13.9 | 2.871 |
| -6 | -21.1 | 2.521 | 26 | -3.3 | 2.698 | 58 | 14.4 | 2.876 |
| -5 | -20.6 | 2.526 | 27 | -2.8 | 2.704 | 59 | 15.0 | 2.882 |
| -4 | -20.0 | 2.532 | 28 | -2.2 | 2.710 | 60 | 15.6 | 2.887 |
| -3 | -19.4 | 2.537 | 29 | -1.7 | 2.715 | 61 | 16.1 | 2.893 |
| -2 | -18.9 | 2.543 | 30 | -1.1 | 2.721 | 62 | 16.7 | 2.898 |
| -1 | -18.3 | 2.548 | 31 | -0.6 | 2.726 | 63 | 17.2 | 2.904 |
| 0 | -17.8 | 2.554 | 32 | 0.0 | 2.732 | 64 | 17.8 | 2.910 |
| 1 | -17.2 | 2.560 | 33 | 0.6 | 2.737 | 65 | 18.3 | 2.915 |

# TABLE 7, TEMPERATURE TO VOLTAGE CONVERSION: TP-1

| Temp °F | Temp °C | Voltage | Temp °F | Temp °C | Voltage | Temp °F | Temp °C | Voltage |
|---|---|---|---|---|---|---|---|---|
| 66 | 18.9 | 2.921 | 98 | 36.7 | 3.098 | 130 | 54.4 | 3.276 |
| 67 | 19.4 | 2.926 | 99 | 37.2 | 3.104 | 131 | 55.0 | 3.282 |
| 68 | 20.0 | 2.932 | 100 | 37.8 | 3.110 | 132 | 55.6 | 3.287 |
| 69 | 20.6 | 2.937 | 101 | 38.3 | 3.115 | 133 | 56.1 | 3.293 |
| 70 | 21.1 | 2.943 | 102 | 38.9 | 3.121 | 134 | 56.7 | 3.298 |
| 71 | 21.7 | 2.948 | 103 | 39.4 | 3.126 | 135 | 57.2 | 3.304 |
| 72 | 22.2 | 2.954 | 104 | 40.0 | 3.132 | 136 | 57.8 | 3.310 |
| 73 | 22.8 | 2.960 | 105 | 40.6 | 3.137 | 137 | 58.3 | 3.315 |
| 74 | 23.3 | 2.965 | 106 | 41.1 | 3.143 | 138 | 58.9 | 3.321 |
| 75 | 23.9 | 2.971 | 107 | 41.7 | 3.148 | 139 | 59.4 | 3.326 |
| 76 | 24.4 | 2.976 | 108 | 42.2 | 3.154 | 140 | 60.0 | 3.332 |
| 77 | 25.0 | 2.982 | 109 | 42.8 | 3.160 | 141 | 60.6 | 3.337 |
| 78 | 25.6 | 2.987 | 110 | 43.3 | 3.165 | 142 | 61.1 | 3.343 |
| 79 | 26.1 | 2.993 | 111 | 43.9 | 3.171 | 143 | 61.7 | 3.348 |
| 80 | 26.7 | 2.998 | 112 | 44.4 | 3.176 | 144 | 62.2 | 3.354 |
| 81 | 27.2 | 3.004 | 113 | 45.0 | 3.182 | 145 | 62.8 | 3.360 |
| 82 | 27.8 | 3.010 | 114 | 45.6 | 3.187 | 146 | 63.3 | 3.365 |
| 83 | 28.3 | 3.015 | 115 | 46.1 | 3.193 | 147 | 63.9 | 3.371 |
| 84 | 28.9 | 3.021 | 116 | 46.7 | 3.198 | 148 | 64.4 | 3.376 |
| 85 | 29.4 | 3.026 | 117 | 47.2 | 3.204 | 149 | 65.0 | 3.382 |
| 86 | 30.0 | 3.032 | 118 | 47.8 | 3.210 | 150 | 65.6 | 3.387 |
| 87 | 30.6 | 3.037 | 119 | 48.3 | 3.215 | 151 | 66.1 | 3.393 |
| 88 | 31.1 | 3.043 | 120 | 48.9 | 3.221 | 152 | 66.7 | 3.398 |
| 89 | 31.7 | 3.048 | 121 | 49.4 | 3.226 | 153 | 67.2 | 3.404 |
| 90 | 32.2 | 3.054 | 122 | 50.0 | 3.232 | 154 | 67.8 | 3.410 |
| 91 | 32.8 | 3.060 | 123 | 50.6 | 3.237 | 155 | 68.3 | 3.415 |
| 92 | 33.3 | 3.065 | 124 | 51.1 | 3.243 | 156 | 68.9 | 3.421 |
| 93 | 33.9 | 3.071 | 125 | 51.7 | 3.248 | 157 | 69.5 | 3.426 |
| 94 | 34.4 | 3.076 | 126 | 52.2 | 3.254 | 158 | 70.0 | 3.432 |
| 95 | 35.0 | 3.082 | 127 | 52.8 | 3.260 | 159 | 70.6 | 3.437 |
| 96 | 35.6 | 3.087 | 128 | 53.3 | 3.265 | 160 | 71.1 | 3.443 |
| 97 | 36.1 | 3.093 | 129 | 53.9 | 3.271 | 161 | 71.7 | 3.448 |

# TABLE 7, TEMPERATURE TO VOLTAGE CONVERSION: TP-1

| Temp °F | Temp °C | Voltage | Temp °F | Temp °C | Voltage | Temp °F | Temp °C | Voltage |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 162 | 72.2 | 3.454 | 194 | 90.0 | 3.632 | 226 | 107.8 | 3.810 |
| 163 | 72.8 | 3.460 | 195 | 90.6 | 3.637 | 227 | 108.3 | 3.815 |
| 164 | 73.3 | 3.465 | 196 | 91.1 | 3.643 | 228 | 108.9 | 3.821 |
| 165 | 73.9 | 3.471 | 197 | 91.7 | 3.648 | 229 | 109.5 | 3.826 |
| 166 | 74.5 | 3.476 | 198 | 92.2 | 3.654 | 230 | 110.0 | 3.832 |
| 167 | 75.0 | 3.482 | 199 | 92.8 | 3.660 | 231 | 110.6 | 3.837 |
| 168 | 75.6 | 3.487 | 200 | 93.3 | 3.665 | 232 | 111.1 | 3.843 |
| 169 | 76.1 | 3.493 | 201 | 93.9 | 3.671 | 233 | 111.7 | 3.848 |
| 170 | 76.7 | 3.498 | 202 | 94.5 | 3.676 | 234 | 112.2 | 3.854 |
| 171 | 77.2 | 3.504 | 203 | 95.0 | 3.682 | 235 | 112.8 | 3.860 |
| 172 | 77.8 | 3.510 | 204 | 95.6 | 3.687 | 236 | 113.3 | 3.865 |
| 173 | 78.3 | 3.515 | 205 | 96.1 | 3.693 | 237 | 113.9 | 3.871 |
| 174 | 78.9 | 3.521 | 206 | 96.7 | 3.698 | 238 | 114.5 | 3.876 |
| 175 | 79.5 | 3.526 | 207 | 97.2 | 3.704 | 239 | 115.0 | 3.882 |
| 176 | 80.0 | 3.532 | 208 | 97.8 | 3.710 | 240 | 115.6 | 3.887 |
| 177 | 80.6 | 3.537 | 209 | 98.3 | 3.715 | 241 | 116.1 | 3.893 |
| 178 | 81.1 | 3.543 | 210 | 98.9 | 3.721 | 242 | 116.7 | 3.898 |
| 179 | 81.7 | 3.548 | 211 | 99.5 | 3.726 | 243 | 117.2 | 3.904 |
| 180 | 82.2 | 3.554 | 212 | 100.0 | 3.732 | 244 | 117.8 | 3.910 |
| 181 | 82.8 | 3.560 | 213 | 100.6 | 3.737 | 245 | 118.3 | 3.915 |
| 182 | 83.3 | 3.565 | 214 | 101.1 | 3.743 | 246 | 118.9 | 3.921 |
| 183 | 83.9 | 3.571 | 215 | 101.7 | 3.748 | 247 | 119.5 | 3.926 |
| 184 | 84.5 | 3.576 | 216 | 102.2 | 3.754 | 248 | 120.0 | 3.932 |
| 185 | 85.0 | 3.582 | 217 | 102.8 | 3.760 | 249 | 120.6 | 3.937 |
| 186 | 85.6 | 3.587 | 218 | 103.3 | 3.765 | 250 | 121.1 | 3.943 |
| 187 | 86.1 | 3.593 | 219 | 103.9 | 3.771 | 251 | 121.7 | 3.948 |
| 188 | 86.7 | 3.598 | 220 | 104.5 | 3.776 | 252 | 122.2 | 3.954 |
| 189 | 87.2 | 3.604 | 221 | 105.0 | 3.782 | 253 | 122.8 | 3.960 |
| 190 | 87.8 | 3.610 | 222 | 105.6 | 3.787 | 254 | 123.3 | 3.965 |
| 191 | 88.3 | 3.615 | 223 | 106.1 | 3.793 | 255 | 123.9 | 3.971 |
| 192 | 88.9 | 3.621 | 224 | 106.7 | 3.798 | | | |
| 193 | 89.5 | 3.626 | 225 | 107.2 | 3.804 | | | |

APPENDIX
# A

# <u>WARRANTY</u>
# <u>AND</u>
# <u>REPLACEMENT PARTS</u>

# WARRANTY

EIL Instruments Inc., will for one year after date of purchase of any EIL product, correct any defect in workmanship or material. Such corrective measures will be limited to repairing or replacing the unit, at EIL's option. This limited warranty shall not apply to equipment which has been subjected to negligence, accident, or damage by operation, maintenance or storage, or to other than normal use or service. This limited warranty does not cover reimbursements for transportation, removal, installation, or repair or replacement, except as may otherwise be specifically agreed to in writing by EIL Instruments.

THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, AND ALL OTHER OBLIGATIONS OR LIABILITIES WHETHER ARISING UNDER CONTRACT, NEGLIGENCE OR OTHERWISE, ON THE PART OF EIL. IN NO EVENT SHALL EIL BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF USE, LOSS OF INCOME, LOSS OF PROFIT OR COST OF REPLACEMENT.

# RC-1000 REPLACEMENT PARTS LIST

| PART NUMBER | DESCRIPTION |
|---|---|
| 5101612400 | DISPLAY ASSEMBLY |
| 5401695400 | DISPLAY ASSEMBLY (BACKLIT) |
| 5401623400 | KEYPAD ASSEMBLY |
| 5101690400 | CPU BOARD |
| 1761706800 | 2A FUSE, CPU BOARD |
| 4464401202 | INSTRUCTION MANUAL (VER 5) |
| CC/01625400 | AI-8 TEMPERATURE KIT |
| CC/01639400 | AI-4 PRESSURE KIT |
| CC/01626400 | AI-8 PRESSURE KIT |
| CC/01654400 | AI-4 KW/0-10V KIT |
| CC/01653400 | AI-8 KW/0-10V KIT |
| CC/01629400 | DI-8 DIGITAL IN KIT |
| CC/01627400 | RELAY DRIVER KIT |
| CC/01650401 | RELAY BOARD KIT |
| CC/01681400 | AI-8 HI-TEMP KIT |
| CC/01687400 | 9 PIN PC DIRECT ADAPTER |
| CC/01665400 | MODEM ADAPTER |
| CC/PCONN | PHONE CONNECTOR |
| CC/CRIMP-1 | PHONE CONNECTOR CRIMPER |
| CC/60028400 | PHONE CABLE TESTER |
| CC/01666401 | COMM INTERFACE MODULE |
| 2662600300 | EXPANDED RAM |
| MOD-2 | 1200 BAUD MODEM |
| MOD-6 | 2400 BAUD MODEM |

## REPAIR PROCEDURE

If repair of a part is required, please use the following procedure:

1.  Call EIL Instruments - (410) 584-7400 ext 289 for a Repair Order (R.O.) number.

2.  At that time, the following is required:

    a.  Purchase Order # for each unit to be repaired
    b.  As much information as possible regarding the nature of the equipment      problem
    c.  Serial number of unit / date of purchase
    d.  Previous repair history, if applicable

3.  Send item to be repaired to:

    > EIL Instruments, Inc.
    > Energy Controls Group
    > 10946A Golden West Drive
    > Hunt Valley, MD 21031

4.  The R.O. number should be clearly marked on the outside of the shipping carton and all applicable paperwork <u>should be included</u> with the shipment <u>INSIDE</u> the carton.

5.  Warranty on repaired units will be 90 days from the date of shipment from EIL Instruments.

## ADVANCE SHIPMENTS

6A.  If "Advance Shipment" of <u>replacement</u> component or parts is required, under certain circumstances EIL will do so, provided that a Purchase Order # is issued for such AND with the understanding that the customer will bear responsibility for excess freight charges and further agrees to return the defective component or parts <u>**within 15 days**</u> of receiving the "Advance Shipment".

B.  After the defective component / system / parts are received back at EIL, they will be repaired and upgraded to current operational standards, ie:  restored to "Like New" condition and the customer will be billed for this restoration work at the Standard Repair Charge rate.

# INSTALLATION DRAWINGS

Appendix B                    158

# Field Wiring Reference Guide

### Wire Types:

Phone Cable: RC-1000 to RC-1000, Relay modules to Relay boards;
    6 conductor flat phone cable; G-C Thorson 30-9965 or equiv.

Sensor Wiring: Temp,Thermistor, KW, Digital inputs, pulse inputs:
    2 wire, 18 awg, shielded cable; Beldon #8760 or equiv.

Pressure transducer wiring:
    3 wire, 18 awg, shielded cable; Beldon # 8760 or equiv.

0-10 volt input wiring:
    3 wire, 18 awg, shielded cable; Beldon # 8760 or equiv.


### Maximum Wire Lengths:

Communications signals with phone line cable:
    @ 1200 baud: 500 feet
        (longest known operational distance: 500 feet)

Relay driver to Relay board: 200 feet

Sensors (all types): 200 feet

If lengths are exceeded for the signal wires or noisy environments are encountered, slight sensor offsets may be necessary at the appropriate control units.

# CIRCUIT WORKSHEET

Store #: _____    Location: _____

Configuration:

```
Number of circuits (max 32) ...  ___  (0-32)
Number of temp snsrs per ckt ..  6/12
Refrig relay control ..........  Suction/Liquid
Temperature dead band .........  YES/NO
Defrost initiation ............  TIME TIME/DIG
Defrost termination ...........  TIME/TMP TIME/DIG
Defrost restart ...............  YES/NO
Multi-case defrost term .......  YES/NO
Hot gas defrost ...............  YES/NO
Pumpout phase .................  YES/NO
Equalize phase ................  YES/NO
Evap fan control ..............  YES/NO
Dewpoint controlled skip ......  YES/NO
Digital alarm override ........  YES/NO
Valve verification ............  YES/NO
```

# CIRCUIT WORKSHEET

Store #: _____    Location: _____

    Setpoints:

Ckt #: _____    Description: _____

Cut-in setpt  ___f    Cut-out setpt ___f
High alarm    ___f    Low alarm     ___f
Defr term     ___f    Defr restart  ___f
Evp fan start ___f
Skip defr @dp ___f    Max dp skips   __

Refrig delay  __m     Alarm delay    __m
Pumpout time  __m     Defrost time  ___m
Equalize time __m     Evap fan dly  ___m
Defrost start times:  __:__ __:__ __:__
                      __:__ __:__ __:__

Temp sensors   _-_ _-_ _-_ _-_ _-_ _-_
               _-_ _-_ _-_ _-_ _-_ _-_
Alrm sensors   _-_ _-_ _-_ _-_ _-_ _-_
               _-_ _-_ _-_ _-_ _-_ _-_
Term sensors   _-_ _-_ _-_ _-_ _-_ _-_
               _-_ _-_ _-_ _-_ _-_ _-_

Case defr rlys _-_ _-_ _-_ _-_ _-_ _-_
Suction relay  _-_    Liquid relay  _-_
Mastr HGas rly _-_    Evap fan rly  _-_
Equalize relay _-_    Alarm relay   _-_

Def vrfy inpts _-_ _-_ _-_ _-_ _-_ _-_
Suct vrfy inpt _-_    Liq vrfy inpt _-_
Defr init inpt _-_    Defr term inpt _-_
Alrm ovrd inpt _-_
Rack number     __

## RACK WORKSHEET

Store #: _____     Location: _____

### Configuration:

```
Number of racks (Max: 4) ......  _  (0-4)
Variable speed ................. YES/NO
Run verification ............... YES/NO
Aux setpoints .................. YES/NO
Temp controlled setpoints ..... NO/SELECT/DEFAULT
Phase loss input .............. YES/NO
Refrigerant liquid level ...... NOT USED/ANALOG/DIGITAL
Defrost sense input ........... NO/INTERNAL/EXTERNAL
Oil failure input ............. YES/NO
Compr relay energized on ...... YES/NO
  Desuperheater Control ........ YES/NO
Additional monitoring points .. YES/NO
TD head pressure control ...... YES/NO
Two stage rack control ........ YES/NO
Head Pressure Override ........ YES/NO
Polarity of switchover relay .. EON/EOFF
```

## RACK WORKSHEET

Store #: _____    Location: _____

### Rack Setpoints:

Rack #: __    Description: _____

| | | |
|---|---|---|
| Cut in | ____p | ____p |
| Cut out | ____p | ____p |
| Aux cut in | ____p | ____p |
| Aux cut out | ____p | ____p |
| Max cut in | ____p | |
| High alarm | ____p | ____p |
| Low alarm | ____p | ____p |
| Head Override | | ____p |
| Shutdown | ____p | |
| Alarm delay | __m | __m |
| Liquid Level Alrm | ____% | |
| HR Override Level | ____% | |
| HR Override Diff | ____% | |
| HR Override Delay | ____s | |
| Min on time | ____s | ____s |
| Min off time | ____s | ____s |
| Control gain | ____ | ____ |
| Derivative gain | ____ | ____ |
| Unit combinations | ALT/SEQ | SEQ/ALT |
| Pres sensor | _-_ | _-_ |
| Alarm relay | _-_ | _-_ |
| Ambient sensor | | _-_ |
| Drop leg sensor | | _-_ |
| Temp diff. cut in | | ____ |
| Temp diff. offset | | ____ |
| Anlg Liq. Lev. Snsr | _-_ | |
| HR Override Relay | _-_ | |
| Aux enable input | _-_ | |
| Phase loss input | _-_ | |
| Defrost sense input | _-_ | |
| Oil failure input | _-_ | |

| Compr | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Relay | _-_ | _-_ | _-_ | _-_ | _-_ | _-_ | _-_ | _-_ |
| Capacity | ___ | ___ | ___ | ___ | ___ | ___ | ___ | ___ |
| Unloaders | | | | | | | | |
| Run inpt | _-_ | _-_ | _-_ | _-_ | _-_ | _-_ | _-_ | _-_ |

```
Variable Speed Compressor:
Max rpm        ____      Min rpm        ____
Capacity       ____      Min oil pres   ___p
Analog output  _-_       Oil pres sensr _-_
Freq sensr     _-_       Current sensr  _-_
Control relay  _-_       Reset relay    _-_
Switchovr relay _-_      Fault input    _-_
Run input      _-_

Fan          1    2    3    4    5    6
Relay       _-_  _-_  _-_  _-_  _-_  _-_
Run inpt    _-_  _-_  _-_  _-_  _-_  _-_

Power sensr    _-_        Max power      ____
Associated medium temperature rack   __
```

# RACK WORKSHEET

Store #: _____   Location: _____


### Desuperheater Setpoints:

```
                  Unit:    #1    #2
Cut-in setpoints ......   ___f  ___f
Dead bands (cut out)...   ___f  ___f
Desuperheater relays..    _-_   _-_
Temperature control on.  Highest temp/Average temp
          Manifold Sensors
      _-_    _-_    _-_    _-_    _-_    _-_
```


### Monitor Only Setpoints:

```
         Type      Assignments
Temp  snsr:  _-_    _-_    _-_    _-_
Low  Press:  _-_    _-_    _-_    _-_
High Press:  _-_    _-_    _-_    _-_
Other snsr:  _-_    _-_    _-_    _-_
Dig Inputs:  _-_    _-_    _-_    _-_
Relay outp:  _-_    _-_    _-_    _-_
Analog out:  _-_
```

## LEAK DETECT WORKSHEET

Store #: _____    Location: _____

### Configuration:

Number of groups (Max: 4) ..... _ (0-4)
Leak sensor type ............... ANALOG/DIGITAL

### Analog Setpoints:

Leak Sensors:              Alarm Setpt:
    Sensor 1      _-_     _____ ppm
    Sensor 2      _-_     _____ ppm
    Sensor 3      _-_     _____ ppm
Scale Factor: _____ ppm
Alarm Relay : _-_
Alarm Delay : ___ secs

### Digital Input

Leak Input  : _-_
Alarm Relay : _-_
Alrm Delay  : ___ secs

## LOGIC STATEMENT WORKSHEET

Store #: _____    Location: _____

Unit: RC-1000

Statement # ___    Description: _____

        IF Analog  [__-__   __-__   __-__]    (avg, max, min, any)

<,<=,==,        Analog  [__-__   __-__   __-__]    (avg, max, min, spt)
>,>=,<>

OR,AND,XOR    Digital [__-__   __-__   __-__]    (or, xor, and, chg)
                       ON/OFF  ON/OFF  ON/OFF

OR,AND,XOR    Ref Out [__-__   __-__   __-__]    (or, xor, and, chg)
                       ON/OFF  ON/OFF  ON/OFF

        THEN Dig Out [__-__   __-__   __-__]    (nrm,lch,mty,chg,shd)
                      ON/OFF  ON/OFF  ON/OFF

    Energized Is   ON/OFF ON/OFF ON/OFF

    True if count equals (min 2) ___

    Sensor Type: Lo-T, Hi-T, 0-10v, Leak    Setpoint _____
            Lite, Lo-P, Hi-P, KW

    Time Delay ____ Sec                  Min On ____ Sec

    Log Alarm  YES/NO              Log Event  YES/NO

    Message (10 chars) _____

    Scale Fact: _____

    Clear Latch Input __-__

    Logic is on from   __:__   to   __:__

# ALARM DIAL OUT WORKSHEET

Store #: _____      Location: _____

### Dial Out Phone Numbers:

## Group 1

Unoccupied Phone #s      Occupied Phone #s
>_____     >_____
>_____     >_____
>_____     >_____

          Occupied Schedule
    Sun From: __:__      To: __:__
    Mon From: __:__      To: __:__
    Tue From: __:__      To: __:__
    Wed From: __:__      To: __:__
    Thu From: __:__      To: __:__
    Fri From: __:__      To: __:__
    Sat From: __:__      To: __:__

## Group 2

Unoccupied Phone #s      Occupied Phone #s
>_____     >_____
>_____     >_____
>_____     >_____

          Occupied Schedule
    Sun From: __:__      To: __:__
    Mon From: __:__      To: __:__
    Tue From: __:__      To: __:__
    Wed From: __:__      To: __:__
    Thu From: __:__      To: __:__
    Fri From: __:__      To: __:__
    Sat From: __:__      To: __:__

## Miscellaneous Dial Out Parameters

```
Device ID:        _____
Dial Test Choice: _____
Modem Cmd:        _____
Retry Dialing in (0-24):  __  Hrs
Daily Dialout Grp1  1: __:__   2: __:__
Daily Dialout Grp2  1: __:__   2: __:__
Group 1 Name:     _____
Group 2 Name:     _____
```


## SYSTEM MISCELLANEOUS CONFIGURATION

```
Communication ID   __
Temp units F/C     Line Freq 50/60H
Logging interval ____s
Baud 1200/2400
```

# MANUAL OVERRIDE SWITCH

## SWITCH POS. VS LOAD STATE

### LOAD TYPES

| SW POS | TEMP | DEFROST | ALARM | COMP | COND FANS |
|--------|------|---------|-------|------|-----------|
| DE-ENGZ | ON | OFF | IN ALARM | ON | ON |
| ENRGZ | OFF | ON | NO ALARM | OFF | OFF |
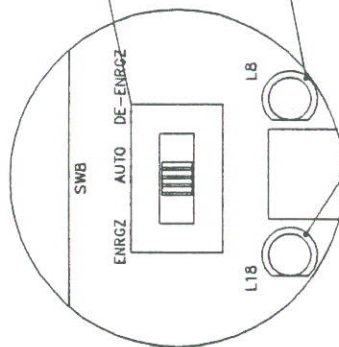
RED COIL LIGHT
—LIT WHEN ENERGIZED.

YELLOW OVERRIDE LIGHT
—LIT WHEN NOT IN "AUTO".

SW8

ENRGZ   AUTO   DE-ENGZ

L8

L18

RELAY DRIVER BOARDS

A = RELAYS 1 thru 4
B = RELAYS 5 thru 8
C = OVERRIDE FEEDBACK 1 thru 4
D = OVERRIDE FEEDBACK 5 thru 8

LIT LED INDICATES
RELAY ENERGIZED

MODULAR QUICK-CONNECT RJ-11 STYLE
CABLES SUPPLIED BY EIL.
(PN 5001637400)

UP TO 200 FEET

TO OTHER RELAY BOARDS

COMMON FUSED ON EACH RELAY.
3A @ 240VAC STANDARD

12 VAC
FROM EIL TF-5
OR OTHER 12 VAC,
1 AMP SOURCE.

SW1 K1
SW2 K2
SW3 K3
SW4 K4
SW5 K5
SW6 K6
SW7 K7
SW8 K8
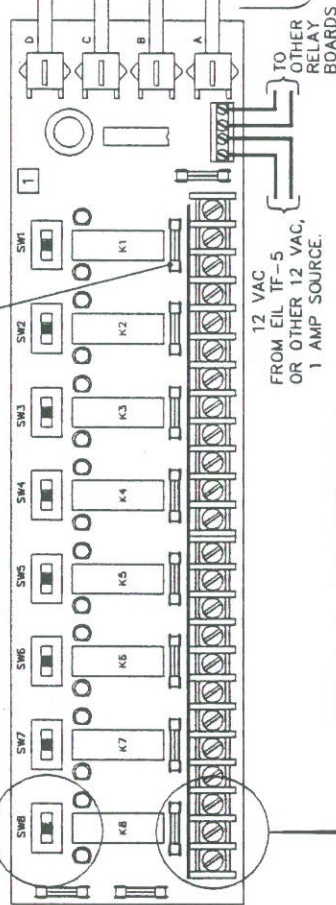
RATINGS:   RELAY COIL 12VDC

CONTACTS 10A @ 120VAC
5A @ 240VAC

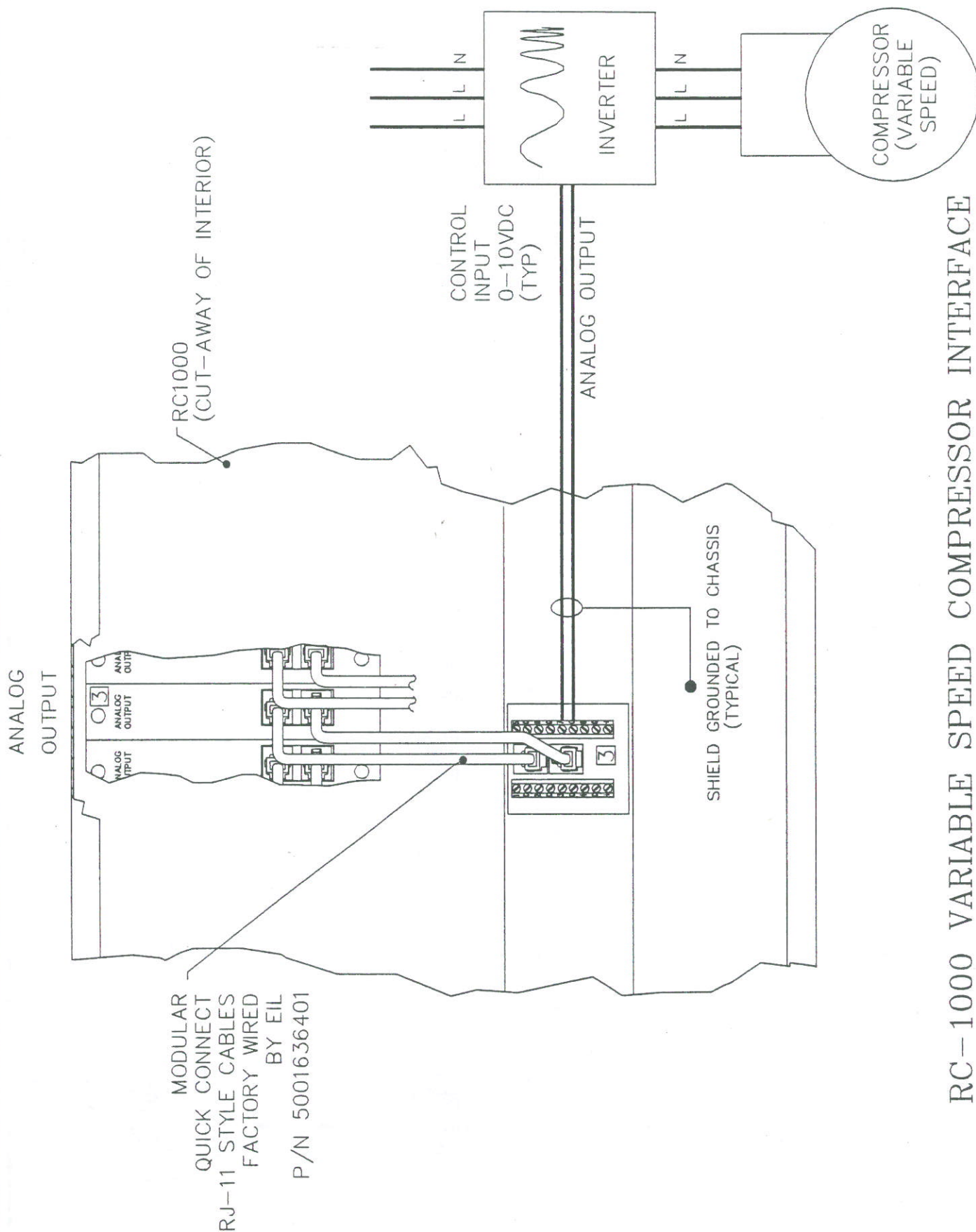BOARD POWER: 1A @ 12VAC

UL APPROVED FOR 480VA PILOT DUTY

## TYPICAL COMPRESSOR INTERFACE
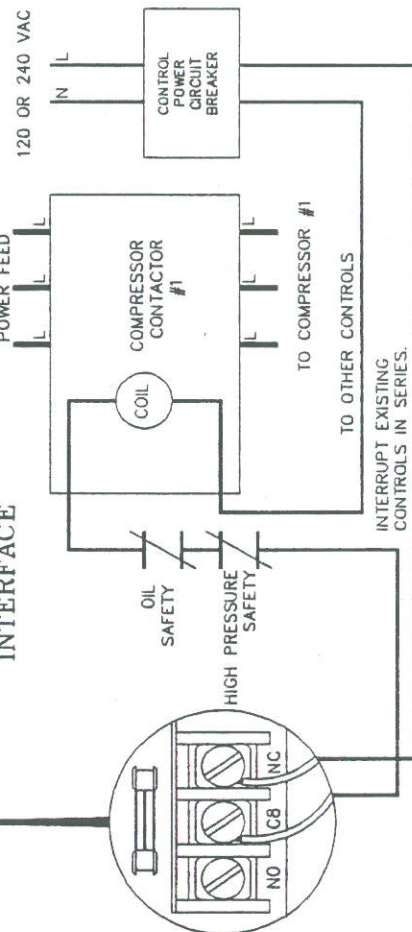
CONTROL POWER CIRCUIT BREAKER

120 OR 240 VAC

L    N    L

COMPRESSOR POWER FEED

COMPRESSOR CONTACTOR #1

COIL

TO COMPRESSOR #1

TO OTHER CONTROLS

INTERRUPT EXISTING CONTROLS IN SERIES.

OIL SAFETY

HIGH PRESSURE SAFETY

NO   C8   NC

RC-1000 RELAY INTERFACE DIAGRAM

FIGURE 1

INVERTER

COMPRESSOR
(VARIABLE
SPEED)

L  L  L  N

L  L  N

RC1000
(CUT–AWAY OF INTERIOR)

CONTROL
INPUT
0–10VDC
(TYP)

ANALOG OUTPUT

ANALOG
OUTPUT

ANALOG
OUTPUT

ANALOG
OUTPUT

ANALOG
OUTPUT

SHIELD GROUNDED TO CHASSIS
(TYPICAL)

MODULAR
QUICK CONNECT
RJ–11 STYLE CABLES
FACTORY WIRED
BY EIL
P/N 5001636401

RC–1000 VARIABLE SPEED COMPRESSOR INTERFACE

FIGURE 2

MODULAR QUICK CONNECT
RJ-11 STYLE CABLES
FACTORY WIRED BY EIL
P/N 5001636401

ANALOG INPUT PRESSURE

ANALOG INPUT TEMP

WHITE

BLACK (COMMON)

+12 VDC (RED)

SUCTION MANIFOLD

HEAD MANIFOLD

ANALOG INPUTS

ANALOG INPUTS

SHIELD GROUNDED TO CHASSIS (TYPICAL)

RED

WHITE (COMMON)

TYPICAL TEMP PROBE HOOKUP

AIR FLOW

FIGURE 3

RC-1000 ANALOG INPUT INTERFACE DIAGRAM

RACK CONTROL PANEL

TYPICAL COMMUNICATIONS HOOKUP

UNISTRUT OR OTHER MOUNTING BASE

INCOMING SENSOR WIRES

I/O CARD WITHOUT MOUNTING PLATE

MOUNTING SCREWS (4 PLC'S)

POWER CONNECTION FROM EIL TF-5 OR OTHER 12VAC, 24VA TRANSFORMER.

FROM MODEM

TO OTHER RC-1000s

12VAC FOR CPU

BLK

BLK

ON

OFF

8 CHANNEL RELAY BD.

DISPLAY CABLE

DISPLAY

CPU BOARD

KEYBOARD CABLE

KEYBOARD

POWER FUSE

TRANSFORMER (TF-6) SEE FIGURE 6

RC-1000 MTG. & PWR. HOOKUP DIAGRAM
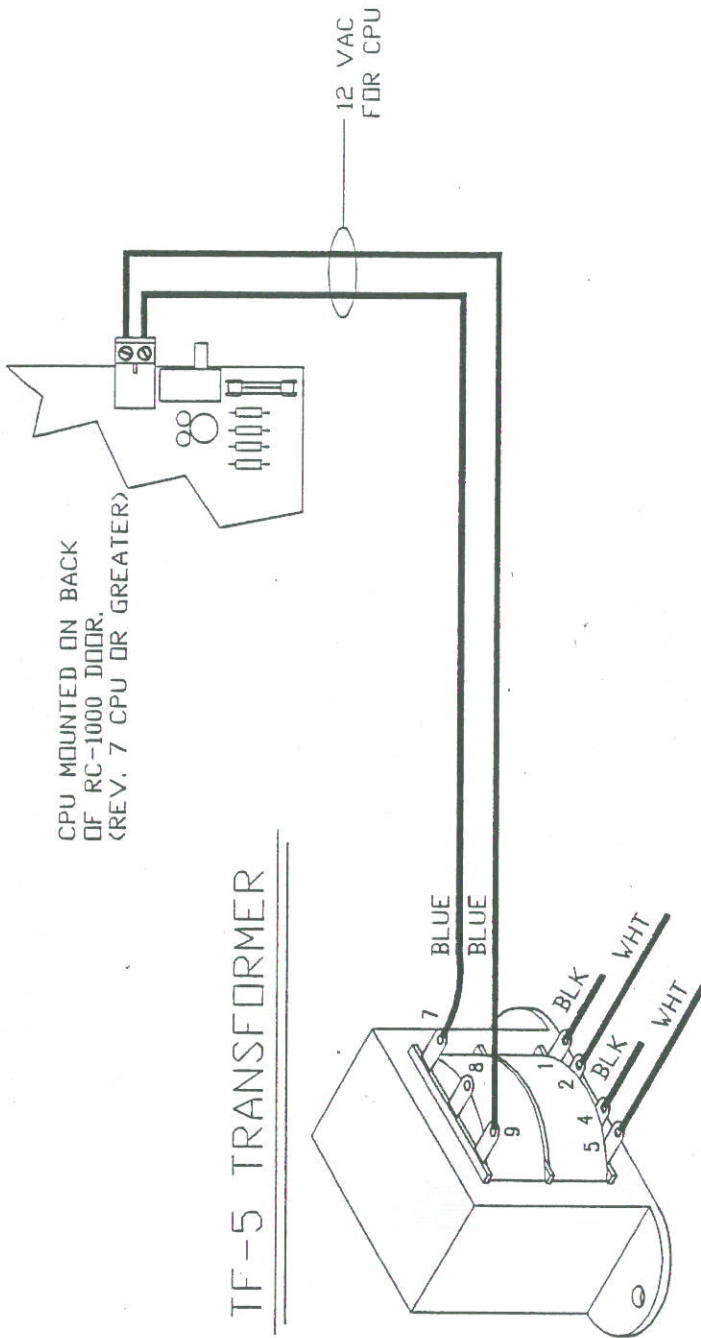
FIGURE 4

CPU MOUNTED ON BACK
OF RC-1000 DOOR.
(REV. 7 CPU OR GREATER)

12 VAC
FOR CPU

TF-5 TRANSFORMER

BLUE
BLUE
BLK
WHT
BLK
WHT

NOTE:

1. THE TF-5 TRANSFORMER IS NOW APPROVED FOR CPU POWER WHICH REQUIRES ONLY ONE 12VAC POWER SOURCE.
2. THE SAME TRANSFORMER SHOULD NOT BE USED TO POWER BOTH CPU AND RELAY BOARDS.
3. FUSE TRANSFORMER PER ELECTRICAL CODE REQUIREMENTS.
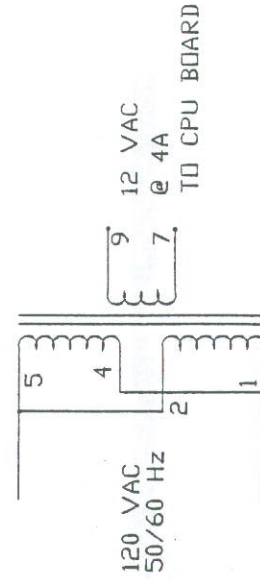
240/208 VAC CONFIGURATION:

240 VAC
50/60 Hz
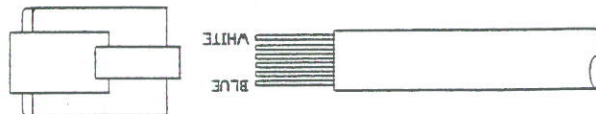(208 ACCEPTABLE)

12 VAC
@ 4A
TO CPU BOARD

120 VAC CONFIGURATION:

120 VAC
50/60 Hz

12 VAC
@ 4A
TO CPU BOARD
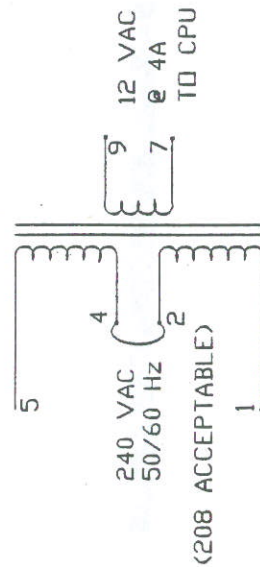
RC-1000 CPU AND I/O POWER HOOKUP (TF-5)

FIGURE 5

| ITEM | DES | DESCRIPTION | EIL PART NO. | QTY. |
|---|---|---|---|---|
| 2 | | WIRE, 6 COND. FLAT PHONE CABLE | 6201600100 | A/R |
| 1 | | CONN. MODULAR TYPE RJ-11 | 0960905900 | 2 |
| | | ASSY, RELAY INTERCONN CABLE | CC/01637400 | |

PARTS LIST

NOTE:
1. WITH TAB FACING TOWARDS YOU, INSTALL CABLE WITH 'WHITE' CONDUCTOR ON RIGHT, FOR BOTH ENDS.

2. P/N CC/016374-02 IS PER FOOT, DETERMINED BY CUSTOMERS SPECIFICATIONS.
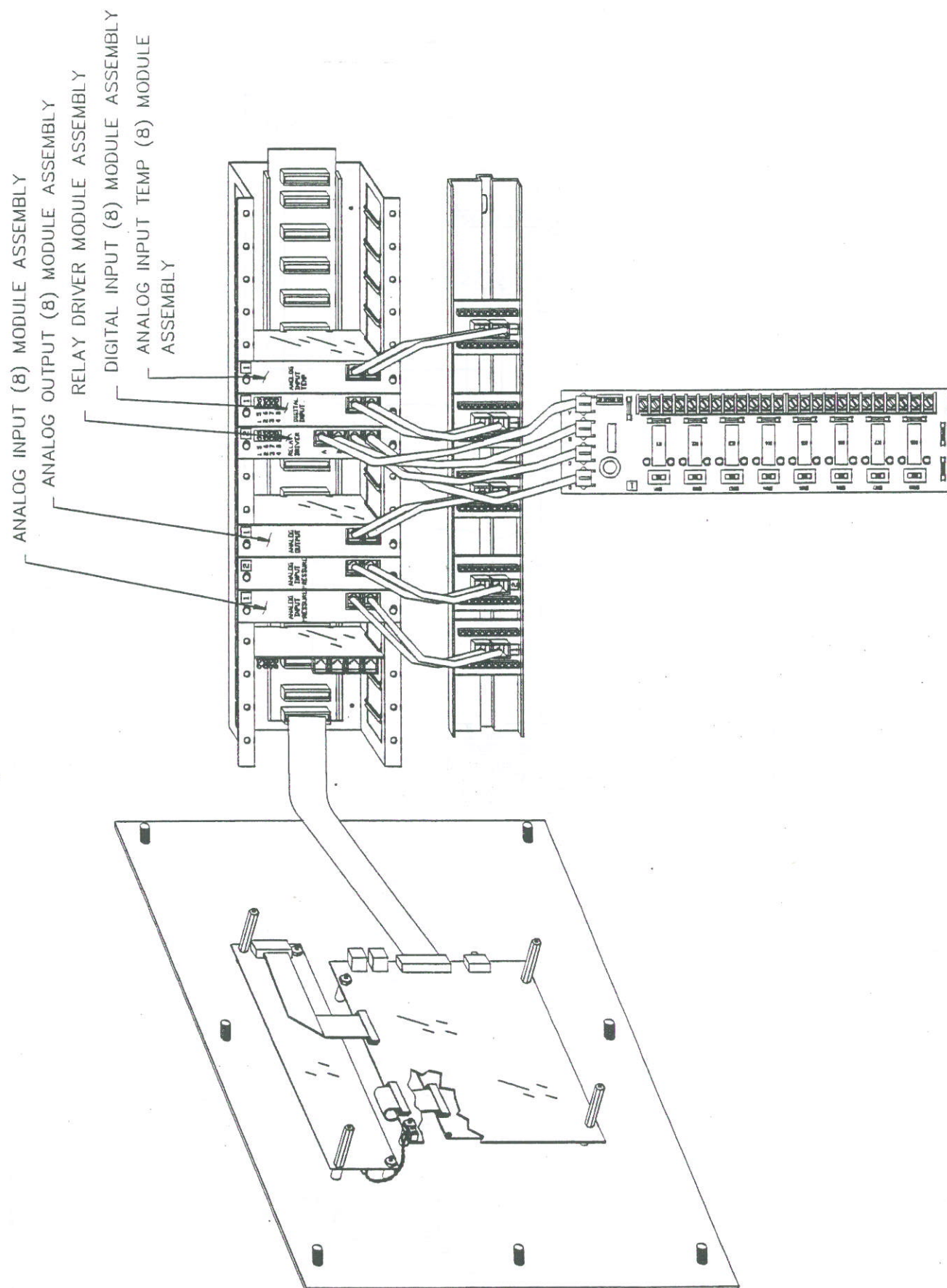
WHITE
BLUE

PHONE CABLE ASSEMBLY

FIGURE 6

RC-1000 RACK POWER MONITORING

FIGURE 7

RC1000
(CUT-AWAY OF INTERIOR)

ANALOG
INPUT
0-10V

SHIELD GROUNDED TO
CHASSIS (TYPICAL)
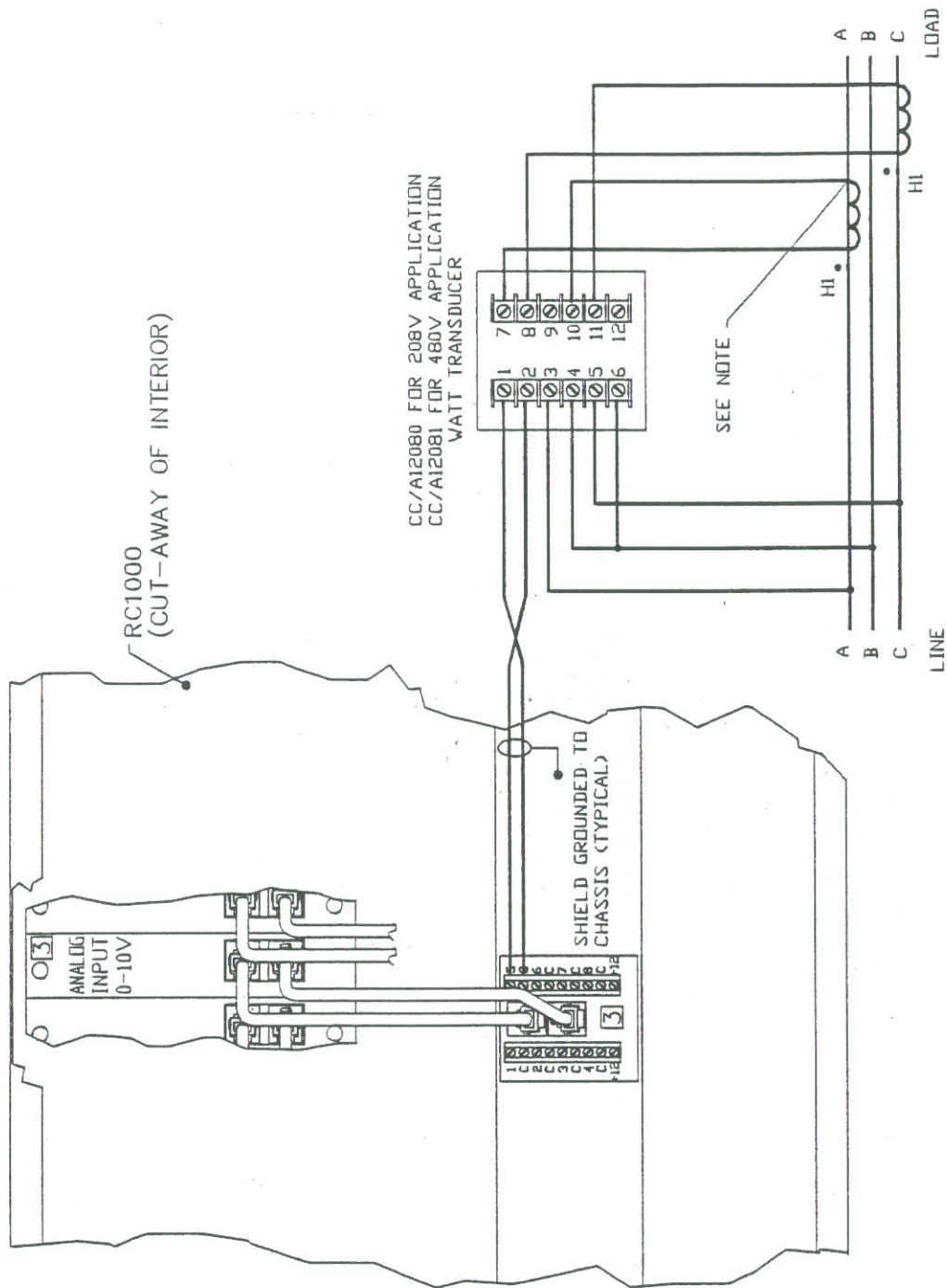
CC/A12080 FOR 208V APPLICATION
CC/A12081 FOR 480V APPLICATION
WATT TRANSDUCER

SEE NOTE

H1

H1

LOAD
A
B
C

LINE
A
B
C

NOTE: WHEN USING EIL SUPPLIED
C.T.'S, ORIENT H1 TOWARD THE
LINE SIDE OF THE CIRCUIT.

WARNING: NEVER OPEN C.T.
SECONDARIES WHILE THE C.T.
PRIMARY IS CARRYING LOAD.
THIS MAY RESULT IN EXPLOSION.

ANALOG INPUT (8) MODULE ASSEMBLY
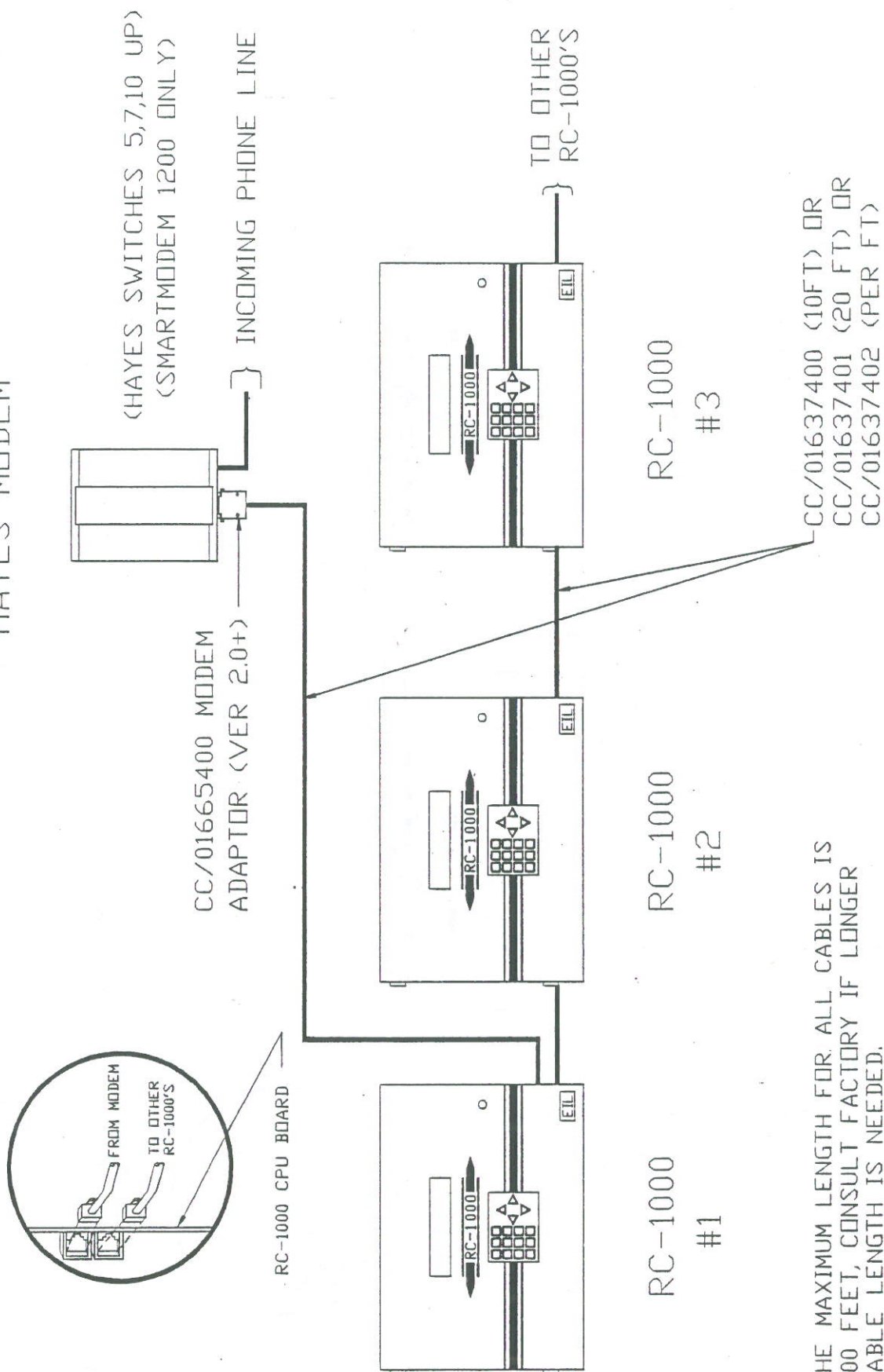ANALOG OUTPUT (8) MODULE ASSEMBLY
RELAY DRIVER MODULE ASSEMBLY
DIGITAL INPUT (8) MODULE ASSEMBLY
ANALOG INPUT TEMP (8) MODULE ASSEMBLY

RC−1000 SAMPLE LAYOUT CONFIGURATION

FIGURE 8

HAYES MODEM

(HAYES SWITCHES 5,7,10 UP)
(SMARTMODEM 1200 ONLY)

} INCOMING PHONE LINE

TO OTHER
} RC-1000'S

TYPICAL COMMUNICATIONS HOOKUP

FROM MODEM

TO OTHER
RC-1000'S

RC-1000 CPU BOARD

CC/01665400 MODEM
ADAPTOR (VER 2.0+)

EIL

RC-1000
#3

RC-1000
#2

RC-1000
#1

EIL

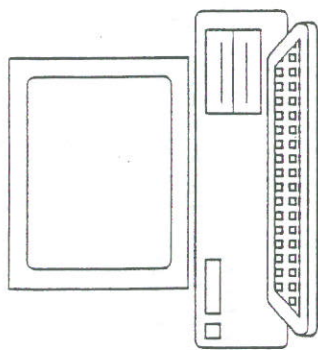EIL

CC/01637400 (10FT) OR
CC/01637401 (20 FT) OR
CC/01637402 (PER FT)

NOTE: THE MAXIMUM LENGTH FOR ALL CABLES IS
200 FEET, CONSULT FACTORY IF LONGER
CABLE LENGTH IS NEEDED.

STORE COMMUNICATIONS TO RC-1000

FIGURE 9

DESKTOP OR LAPTOP COMPUTER

HAYES MODEM

(HAYES SWITCHES 5,7,10 UP)
(SMARTMODEM 1200 ONLY)

INCOMING PHONE LINE

CC/01665400 MODEM
ADAPTOR (VER 2.0+)

TO OTHER
RC-1000'S

RC-1000
#2

EIL

CC/01637400 (10FT) OR
CC/01637401 (20 FT) OR
CC/01637402 (PER FT)
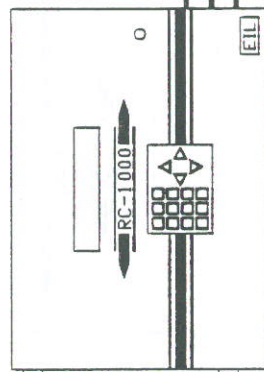
25 PIN ADAPTOR CC/01686400
OR
9 PIN ADAPTOR CC/01687400

TO SERIAL
PORT ON P.C.

DISCONNECT MODEM FROM CPU DURING PC DIRECT COMMUNICATIONS

RC-1000
#1

EIL
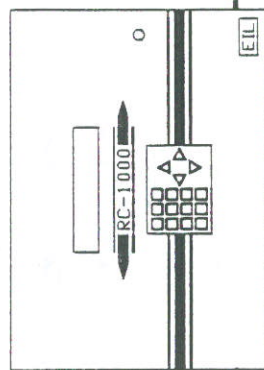
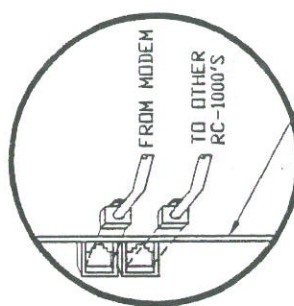RC-1000 CPU BOARD

TYPICAL P.C. DIRECT COMMUNICATIONS HOOKUP

FROM MODEM

TO OTHER
RC-1000'S

P.C. DIRECT STORE COMMUNICATIONS TO RC-1000
VERSION 2.0+

FIGURE 10
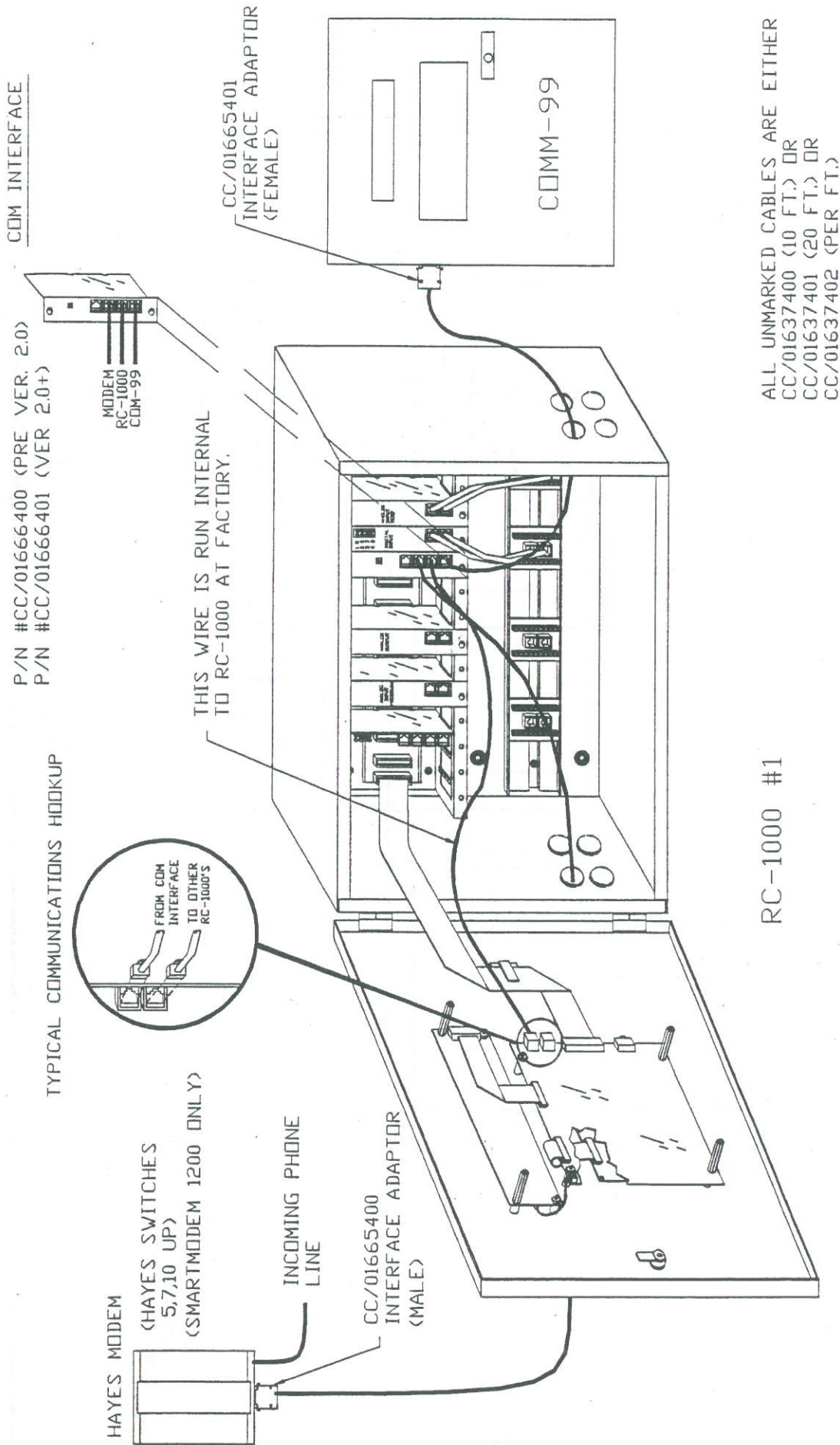
COM INTERFACE

P/N #CC/01666400 (PRE VER. 2.0)
P/N #CC/01666401 (VER 2.0+)

TYPICAL COMMUNICATIONS HOOKUP

MODEM
RC-1000
COM-99

CC/01665401
INTERFACE ADAPTOR
(FEMALE)

COMM-99

THIS WIRE IS RUN INTERNAL
TO RC-1000 AT FACTORY.

FROM COM
INTERFACE

TO OTHER
RC-1000'S

ALL UNMARKED CABLES ARE EITHER
CC/01637400 (10 FT.) OR
CC/01637401 (20 FT.) OR
CC/01637402 (PER FT.)

RC-1000 #1

HAYES MODEM

(HAYES SWITCHES
5,7,10 UP)
(SMARTMODEM 1200 ONLY)

INCOMING PHONE
LINE

CC/01665400
INTERFACE ADAPTOR
(MALE)

NOTE: THE MAXIMUM LENGTH FOR ALL CABLES IS
200 FEET, CONSULT FACTORY IF LONGER
CABLE LENGTH IS NEEDED.

STORE COMMUNICATIONS WHEN COM-99 IS PRESENT

FIGURE 11

REMOVE PLUG FROM CN12

POTENTIOMETERS FOR CALIBRATING CONTROL INPUT.

JUMPER SELECTING VOLTAGE INPUT FROM RC-1000.

MOUNTED ON RACK

CN12

TOSHIBA VF PACK-P1

RH1  RH2  RH3  RH4
IB  GAIN  HL  LL
J3

CC  RST  JOG  R  ST  I  CC  RR  PP  AMP  FREQ.  LOW  P24

OIL SAFETY
O  L  S  T2
M

FROM RC-1000 (CC=C) AO MODULE

24V DC RELAY SUPPLIED BY USER

L1  L2  L3

3 Ø INPUT

I1  I20  I23

INVERTER CONTROL POWER HOOKUP FOR 208VAC.

NOTE: CONSULT INVERTER USER'S MANUAL FOR ADDITIONAL INFORMATION.

INVERTER INTERFACE DIAGRAM

FIGURE 12

TYPICAL INVERTER HOOKUP

FIGURE 13

THIS DRAWING VALID FOR INVERTERS:

-YASKOWA 616G
-SAFETRONICS 616G
-LANCER GPP502 (LOUIS-ALLIS)

RELAY DRIVER BOARDS

A = RELAYS 1 thru 4
B = RELAYS 5 thru 8
C = OVERRIDE FEEDBACK 1 thru 4
D = OVERRIDE FEEDBACK 5 thru 8

LIT LED INDICATES
RELAY ENERGIZED

MODULAR QUICK-CONNECT RJ-11 STYLE
CABLES SUPPLIED BY EIL.
(PN 500163740O)

RLY DRIVER  RLY DR

UP TO 200 FEET

RATINGS:   RELAY COIL 12VDC
           CONTACTS 10A @ 120VAC
                    5A @ 240VAC
           BOARD POWER: 1A @ 12VAC
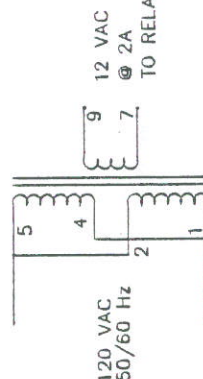           UL APPROVED FOR 480VA PILOT DUTY

COMMON FUSED ON EACH RELAY.
3A @ 240VAC STANDARD
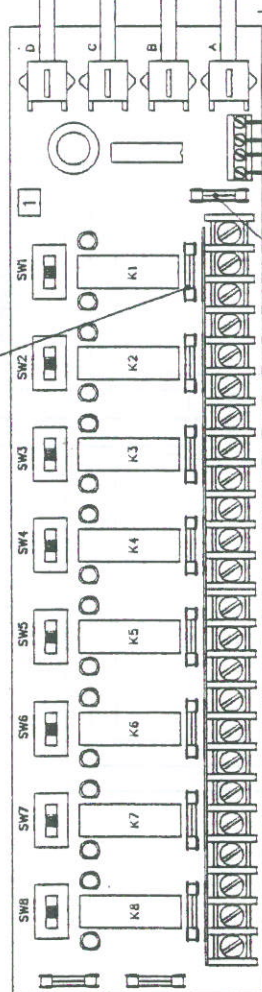
1A
12VAC
FUSE

12 VAC
FROM EIL TF-5
OR OTHER 12 VAC,
1 AMP SOURCE.

TO
OTHER
RELAY
BOARDS

SW1  K1
SW2  K2
SW3  K3
SW4  K4
SW5  K5
SW6  K6
SW7  K7
SW8  K8

120 VAC CONFIGURATION

120 VAC
50/60 Hz

12 VAC
@ 2A
TO RELAY BOARD

240/208 VAC CONFIGURATION:

240 VAC
50/60 Hz

(208 ACCEPTABLE)
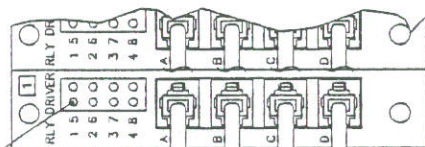
12 VAC
@ 2A
TO RELAY BOARD
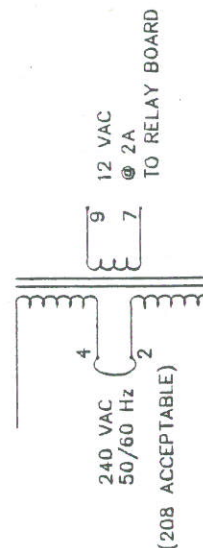
NOTE:
1. FUSE TRANSFORMER PER ELECTRICAL CODE REQUIREMENTS.

RC-1000 RELAY BOARD POWER HOOKUP (TF-5)

FIGURE 14

COMMUNICATIONS/PHONE CABLE (TYPICAL)

TO OTHER
RC-1000'S

RC-1000

EIL

RC-1000
#3

RC-1000

EIL

RC-1000
#2

RC-1000

EIL

RC-1000
#1

TF-5

TF-5

TF-5

12V

12V

12V

120V

120V

120V

120VAC
DEDICATED
SOURCE

IN

OUT

SURGE
PROTECTION
FILTER

RECOMMENDED POWER HOOKUP

FIGURE 15

REFRIGERANT LEAK MONITOR

P/N CC/60030400

0-10V

SENS 1  SENS 2  SENS 3    OUT    FAN  ALARM  115V

10 POS
DIP SW

OFF

TO 115 VAC SUPPLY
—OR—
220 VAC (IF LABELED)

NO HOOK—UP REQUIRED

N/C
B
N/O
GND
1  2  3
1  2

CONNECT TO APPROPRIATE TERMINALS
OF TERMINATION BOARD

COMMON
SENSOR 1
SENSOR 2
SENSOR 3

RED

REMAINING LEAD

BLACK

S/N 1SEN9107004

CONNECTED IN ORDER
ACCORDING TO SERIAL
NUMBER.

REFRIGERANT SENSOR
TYPICAL – 3 LOCATIONS

RC—1000
MODULE

ANALOG
INPUT
0-10V

5
COM
6
COM
7
COM
8
COM
+12V

1
COM
2
COM
3
COM
4
COM
+12V

TERMINATION BOARD

REFRIGERANT SENSOR HOOK—UP DIAGRAM

FIGURE 16

COM INTERFACE

TYPICAL P.C. DIRECT COMMUNICATIONS HOOKUP

P/N #CC/01666400 (PRE VER. 2.0)
P/N #CC/01666401 (VER 2.0+)

MODEM (SEE NOTE)

RC-1000
COM-99
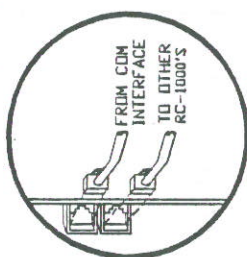
TO SERIAL PORT ON P.C.
CC/01665400 OR CC/01683400
INTERFACE ADAPTOR (MALE)

CC/01665401
INTERFACE ADAPTOR
(FEMALE)

COMM-99

THIS WIRE IS RUN INTERNAL
TO RC-1000 AT FACTORY.

FROM COM
INTERFACE

TO OTHER
RC-1000'S

RC-1000 #1

HAYES MODEM

(HAYES SWITCHES
5,7,10 UP)
(SMARTMODEM 1200 ONLY)

INCOMING PHONE
LINE

CC/01665400
INTERFACE ADAPTOR
(MALE)

ALL UNMARKED CABLES ARE EITHER
CC/01637400 (10 FT.) OR
CC/01637401 (20 FT.) OR
CC/01637402 (PER FT.)

NOTE:
DISCONNECT MODEM CABLE DURING
P.C. DIRECT COMMUNICATIONS.

P.C. DIRECT STORE COMMUNICATIONS WHEN COM-99 IS PRESENT
VERSION 3

FIGURE 17

REFRIGERATION CASE

SUPPLY AIR SENSOR

SUPPLY AIR SENSOR

EVAPORATOR SENSOR

AIR FLOW

RETURN AIR SENSOR

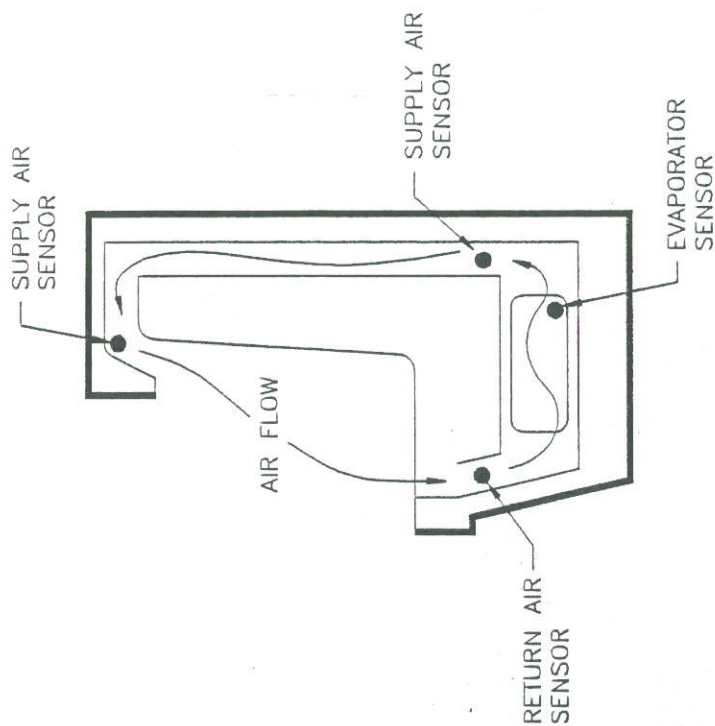2/C #18 GA. SHIELDED CONTROL CABLE

SUPPLY & RETURN AIR SENSOR MOUNTING

USE CLAMP TO MOUNT SENSOR ON CHASSIS

EVAPORATOR SENSOR MOUNTING

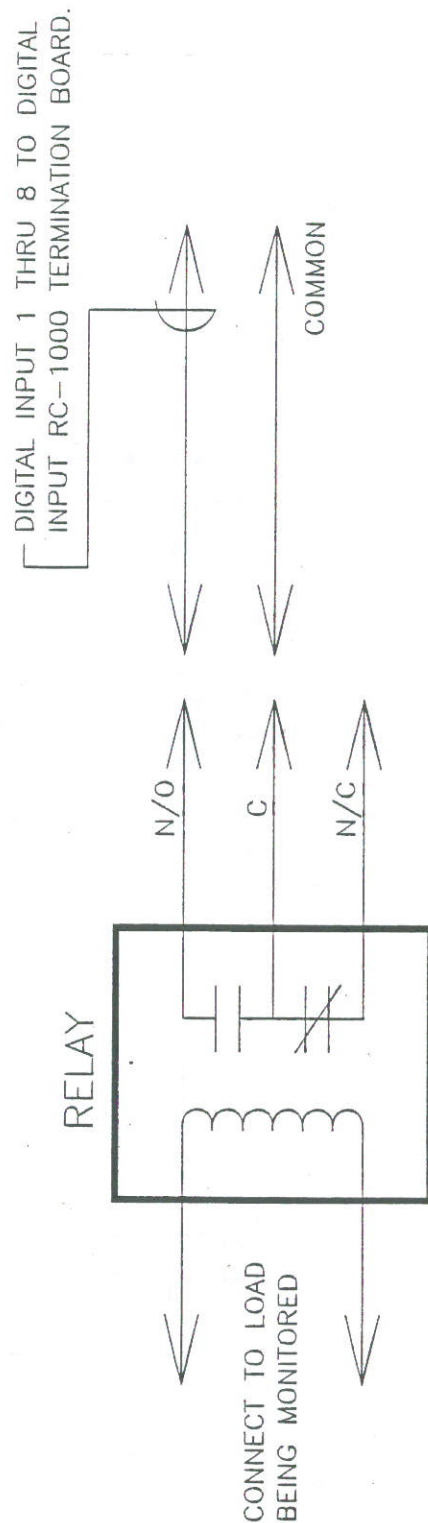USE THERMOCONDUCTIVE SEALANT & CLAMP TO MOUNT SENSOR ON EVAPORATOR PIPING.

RC–1000 CASE SENSOR INSTALLATION

FIGURE 18

DIGITAL INPUT 1 THRU 8 TO DIGITAL
INPUT RC-1000 TERMINATION BOARD.

COMMON

N/O

C

N/C

RELAY

CONNECT TO LOAD
BEING MONITORED

NOTES:

1.) RELAY IS CONTROL TYPE, STEVECO 90-292 OR SIMILAR.

2.) IF LOAD IS ON, RELAY WILL ENERGIZE & PROVIDE
CONTACT CLOSURE FOR DIGITAL INPUT ON EC/RC-1000

3.) COIL RATING TO MATCH LOAD VOLTAGE BEING MONITORED.

EC/RC-1000 HIGH VOLTAGE TO DRY
CONTACT INTERFACE FOR PROOFING

FIGURE 19
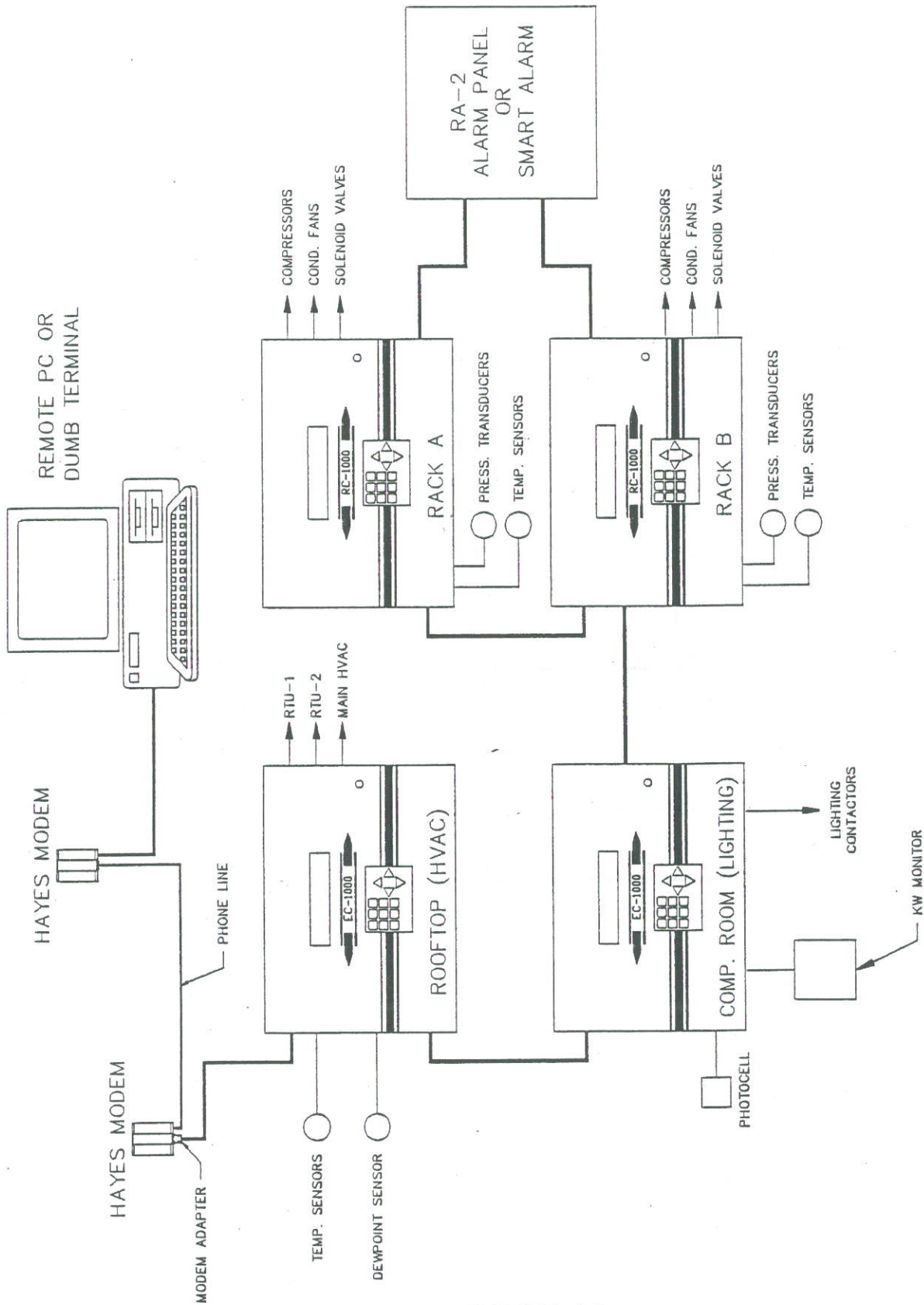
TYPICAL BLOCK DIAGRAM ENERGY MGMT. SYSTEM

FIGURE 20

RA-2

| | | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|

DRY CONTACT

ALARM OUTPUT

120 VAC
SUPPLY

L — 1
N — 2
G — 3

N/C
C
N/O

RACK 'A'
ALARM
RELAY

N/C
C
N/O

RACK 'B'
ALARM
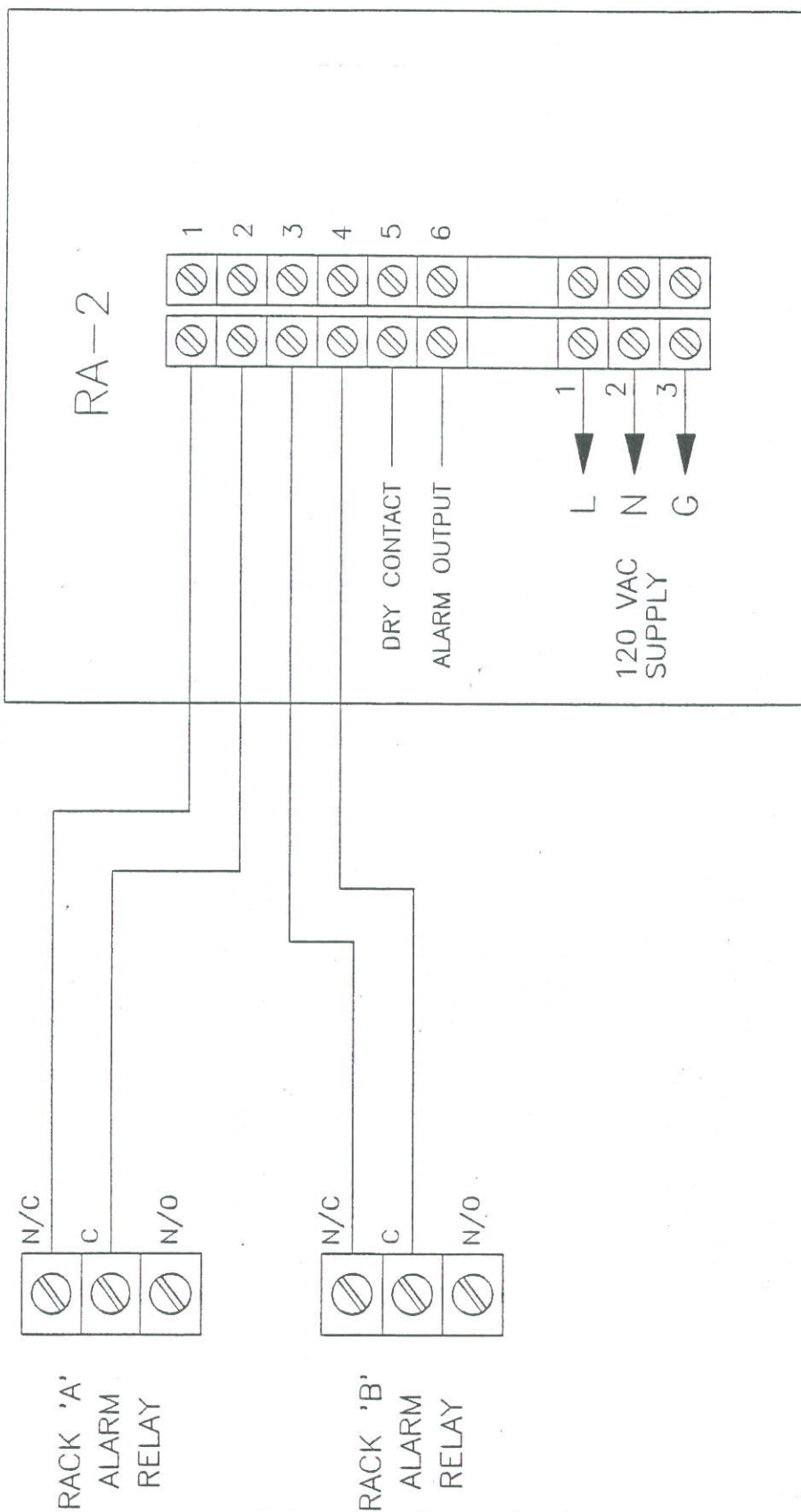RELAY

NOTES:

1.) RA-2 MOUNTED IN STORE FRONT OFFICE.

RA-2 ALARM PANEL WIRING DIAGRAM

FIGURE 21

RACK CONTROL CABINET

TO RELAY
BOARD

RUN WIRING TO/FROM
ALL MODULES SEPARATE
FROM POWER WIRING

TF-5

120/208V SUPPLY (SEE MANUAL FOR
HOOKUP DIAGRAM)

CABINET MUST BE
GROUNDED PER CODE

GROUNDING WIRE

NUT

LOCKWASHER

MOUNTING NOTES:
1. CUT HOLE IN PANEL TO ALLOW
   CLEARANCE FOR CPU AND DISPLAY.
2. DRILL HOLE PATTERN FOR STUDS
   AND PRESS RC-1000 PANEL IN FROM
   FRONT.
3. SECURE USING HARDWARE THAT WILL
   INSURE A GOOD ELECTRICAL GROUND.
   SCRAPE PAINT AS NECESSARY.

TIE CABLE SO THEY WILL
NOT PINCH IN DOOR

RC-1000 PANEL

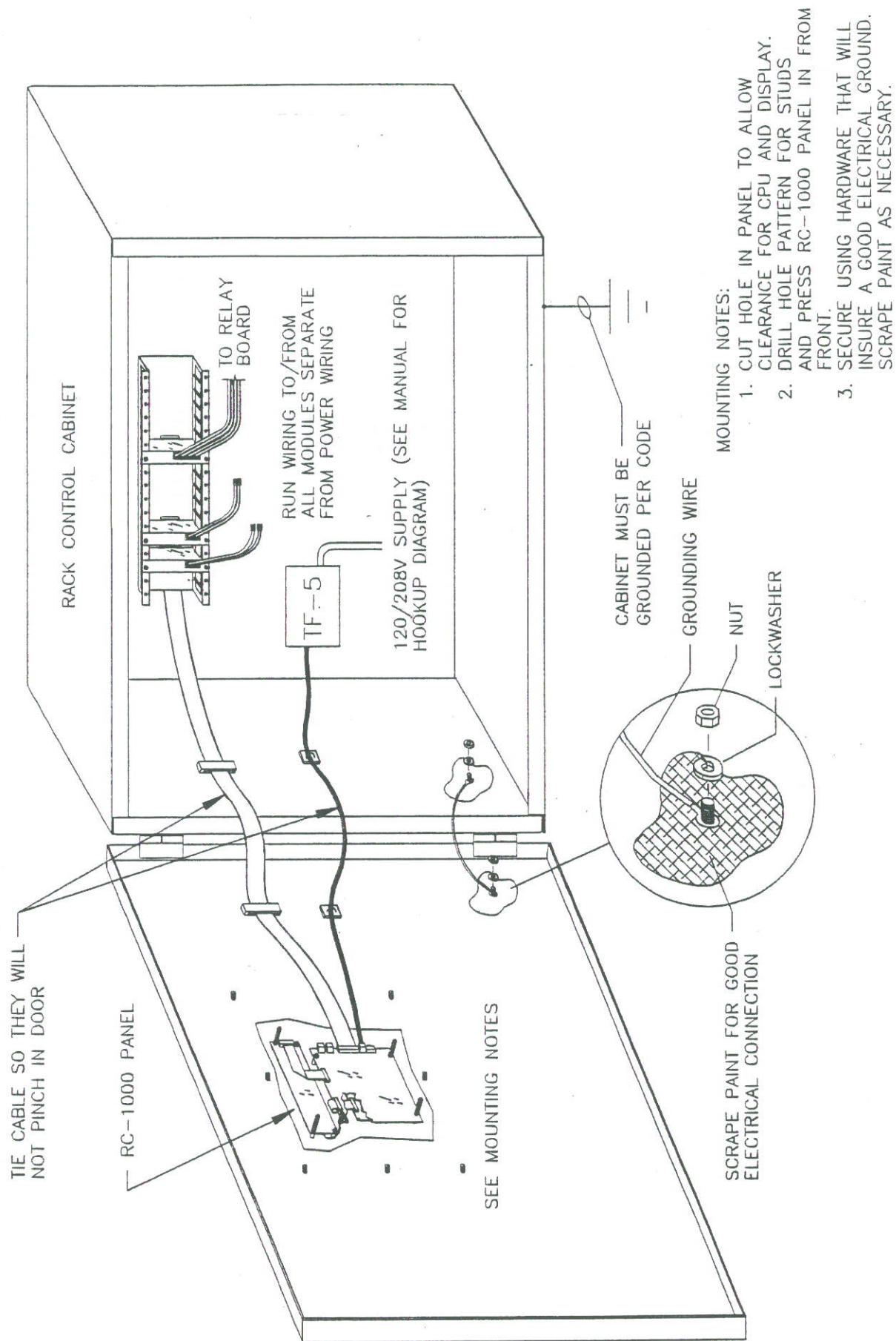SEE MOUNTING NOTES

SCRAPE PAINT FOR GOOD
ELECTRICAL CONNECTION

RC-1000 PANEL MOUNTING DIAGRAM (OEM UNITS)
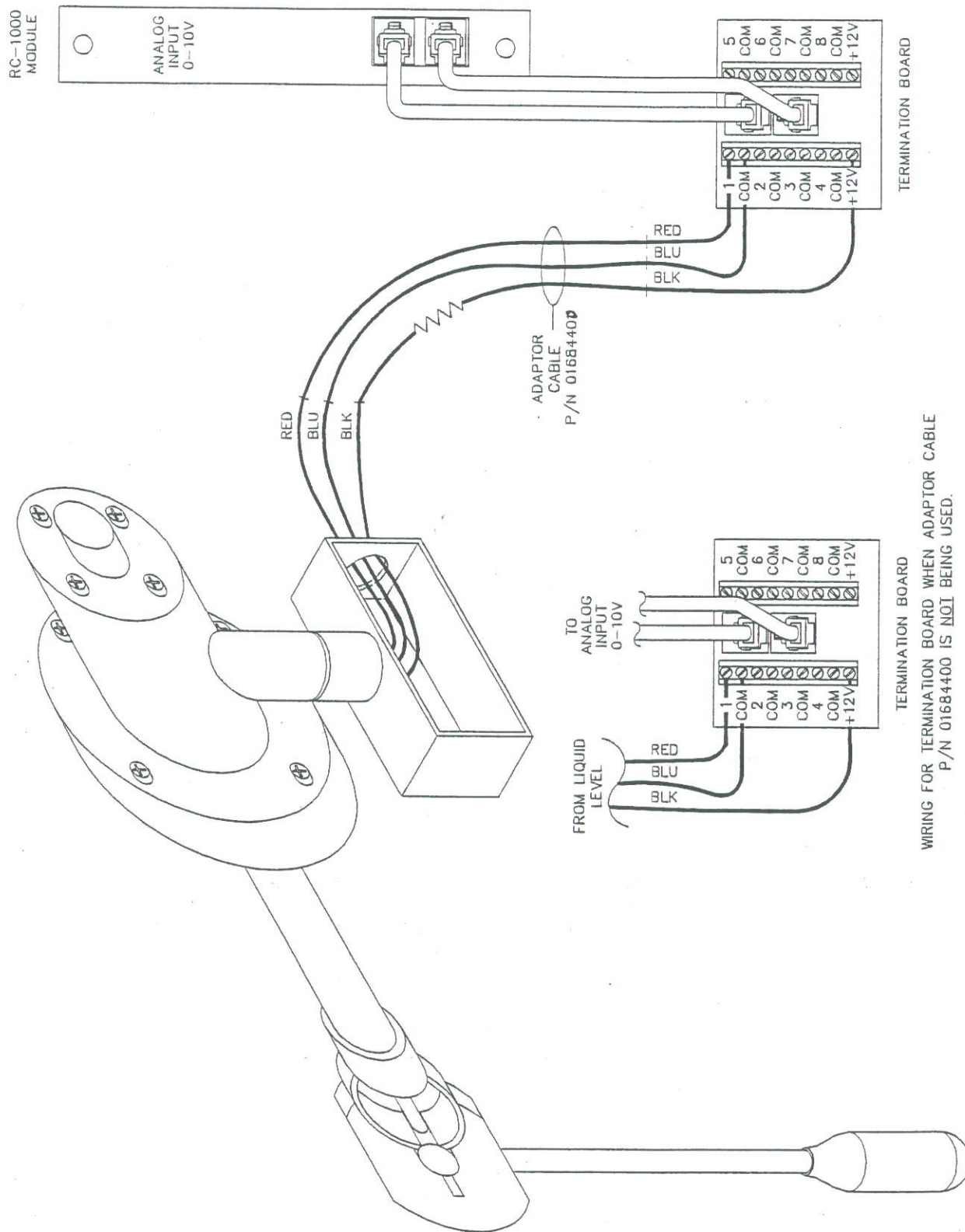
FIGURE 22

LIQUID LEVEL INTERFACE HOOKUP DIAGRAM

RC-1000
MODULE

ANALOG
INPUT
0-10V

5 COM 6 COM 7 COM 8 COM +12V

TERMINATION BOARD

1 COM 2 COM 3 COM 4 COM +12V

RED
BLU
BLK

ADAPTOR
CABLE
P/N 0168440Ø

RED
BLU
BLK

5 COM 6 COM 7 COM 8 COM +12V

TO
ANALOG
INPUT
0-10V

TERMINATION BOARD

1 COM 2 COM 3 COM 4 COM +12V

FROM LIQUID
LEVEL

RED
BLU
BLK

WIRING FOR TERMINATION BOARD WHEN ADAPTOR CABLE
P/N 0168400 IS NOT BEING USED.
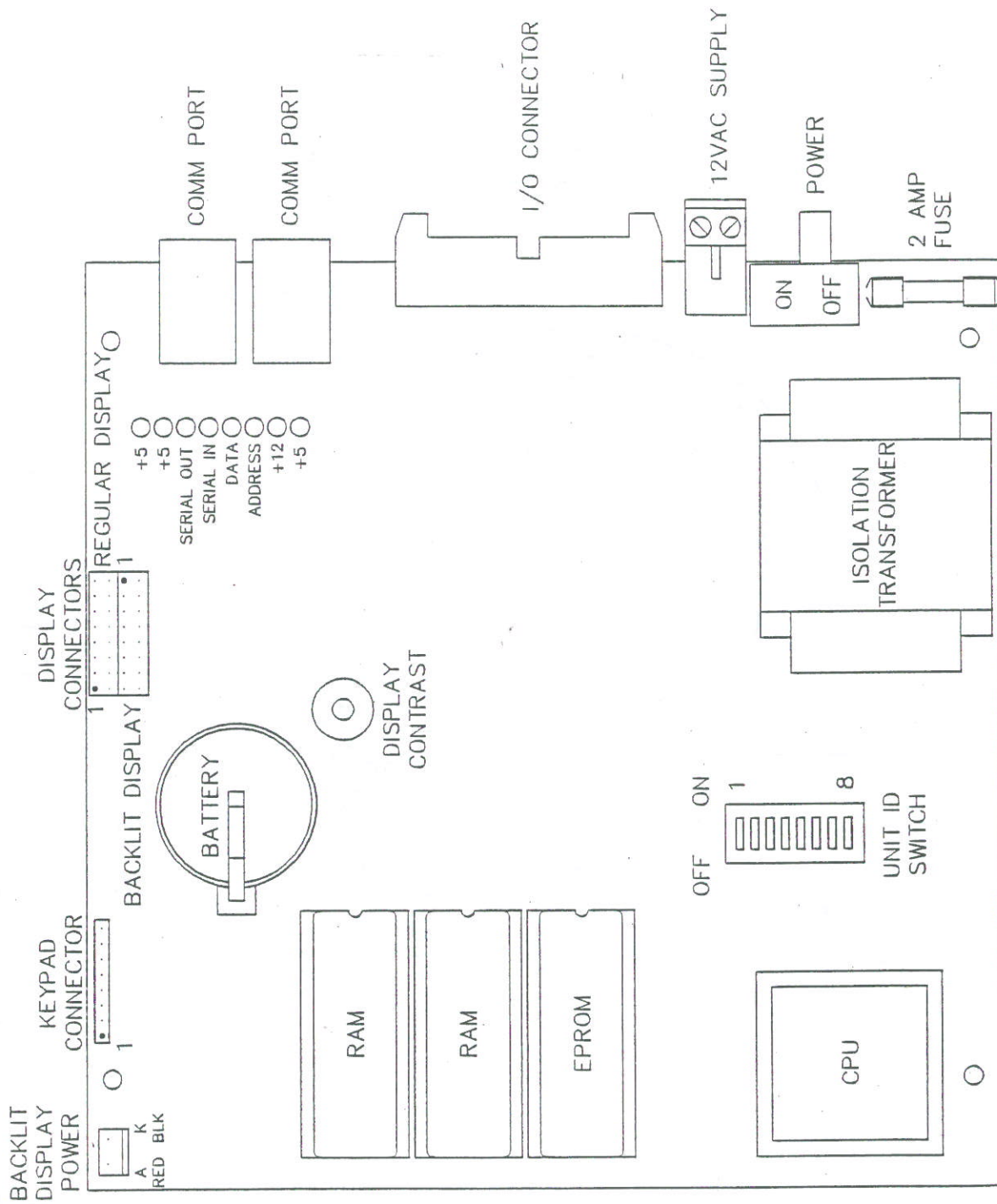
FIGURE 23

CPU IDENTIFICATION DIAGRAM

FIGURE 24

RC-1000 MODULE

ANALOG INPUT 0-10V

5 COM 6 COM 7 COM 8 COM +12V

TERMINATION BOARD

1 COM 2 COM 3 COM 4 COM +12V

SEE NOTE 1

YEL

WHT

SEE PART NUMBER LABEL LOCATED ON BACK OF TRANSDUCER

12 VAC TRANSFORMER EIL PART NO. CC/TF-5

WHT

YEL

BLK

BLK

EIL PART NO. CC/0168O4O1
(4 WIRE TRANSDUCER)

NOTE:
1. ATTACH YELLOW WIRE TO ANY ONE TERMINAL #1-8 AND WHITE WIRE TO ITS CORRESPONDING COM TERMINAL.
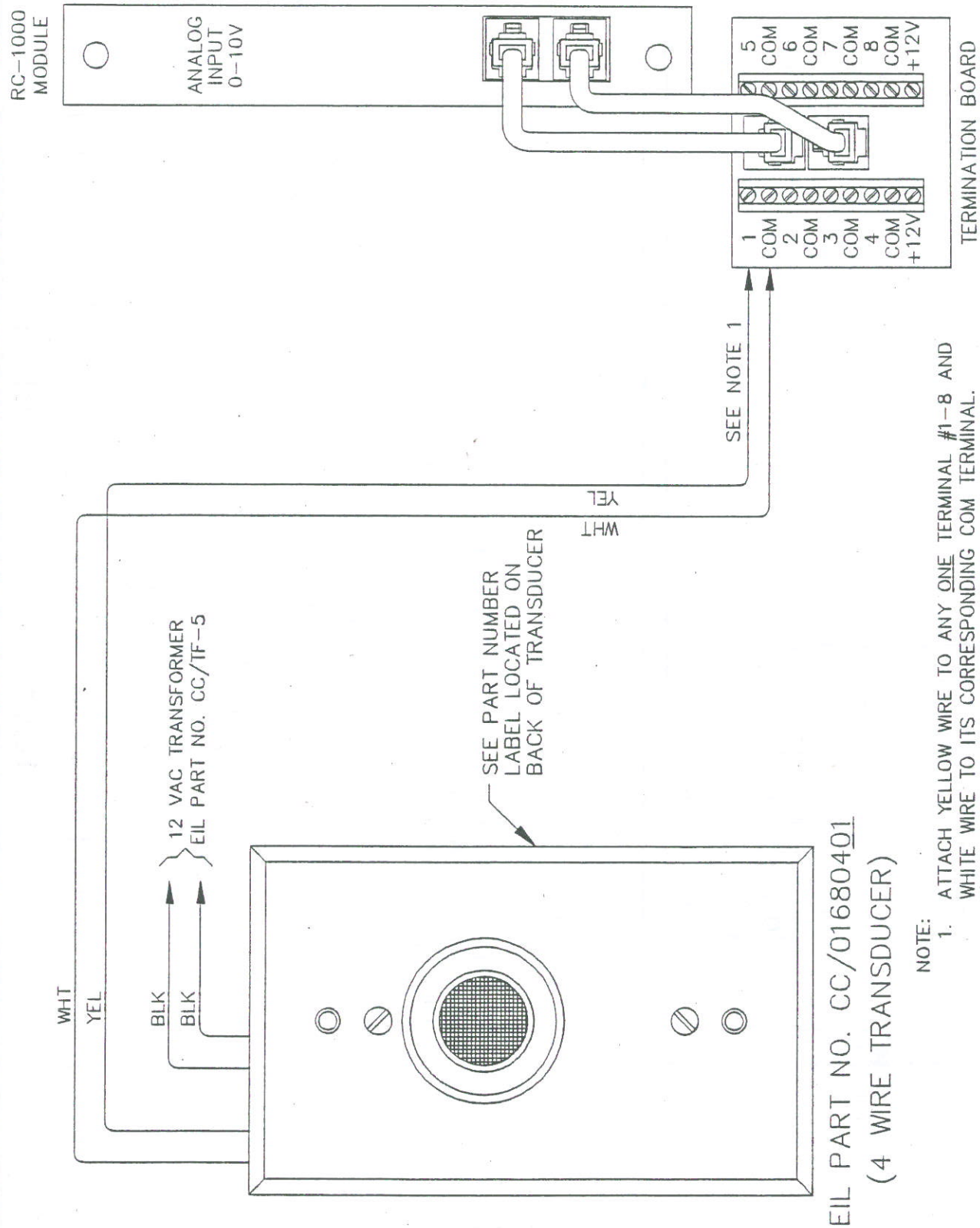
REFRIGERANT LEAK TRANSDUCER WIRING DIAGRAM
(FOR EIL PART NUMBER CC/0168O4O1 "0-10V INPUT")

FIGURE 25

CPU MOUNTED ON BACK
OF RC-1000 DOOR.
(REV. 7 CPU OR GREATER)
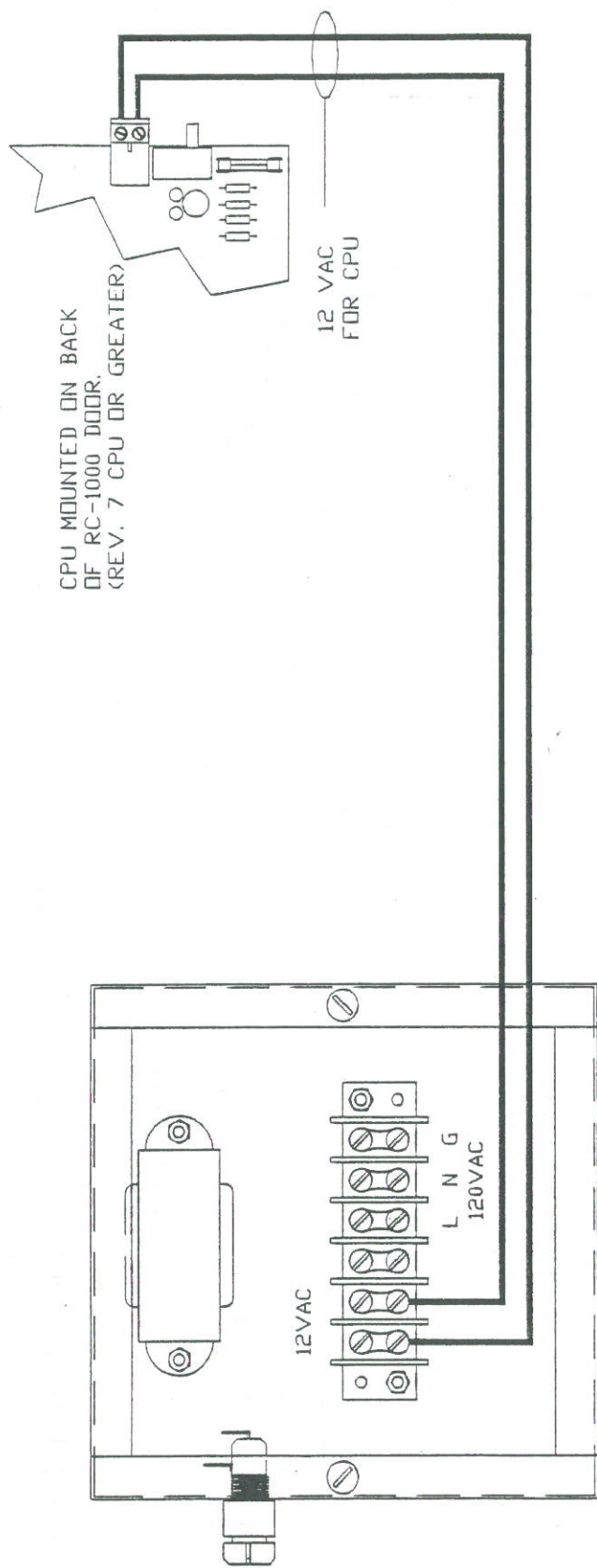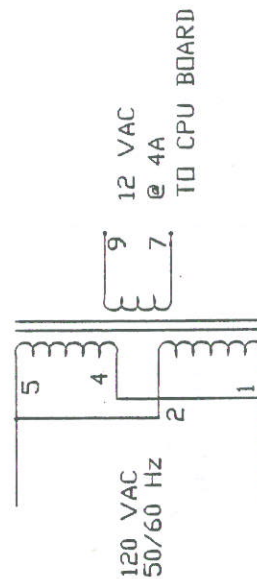
12 VAC
FOR CPU

EIL PART # CC/01679400

NOTE:

1. THE TF-5 TRANSFORMER IS NOW APPROVED FOR CPU POWER WHICH REQUIRES
   ONLY ONE 12VAC POWER SOURCE.
2. THE SAME TRANSFORMER SHOULD NOT BE USED TO POWER BOTH CPU AND RELAY BOARDS.

12VAC

L  N  G
120VAC

120 VAC CONFIGURATION

12 VAC
@ 4A
TO CPU BOARD

9

7

5

4

2

1

120 VAC
50/60 Hz
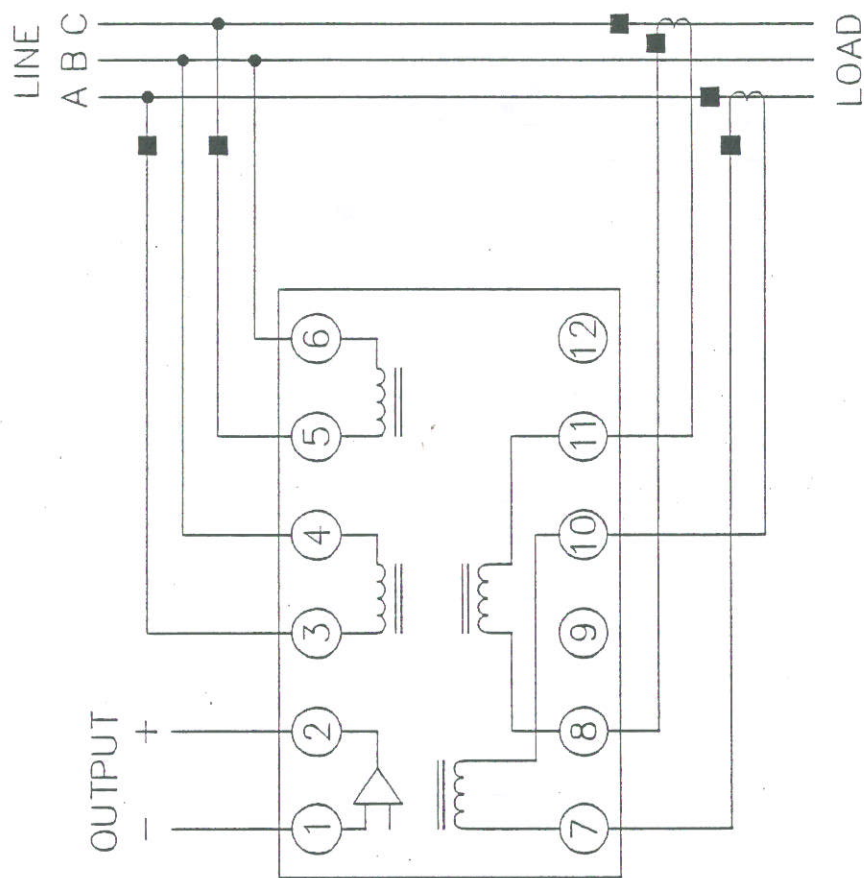
# RC-1000 CPU AND I/O POWER HOOKUP

## 12VAC POWER SUPPLY

FIGURE 26

WATT TRANSDUCER 2 ELEMENT CONNECTION FOR A12080 AND A12081

FIGURE 27

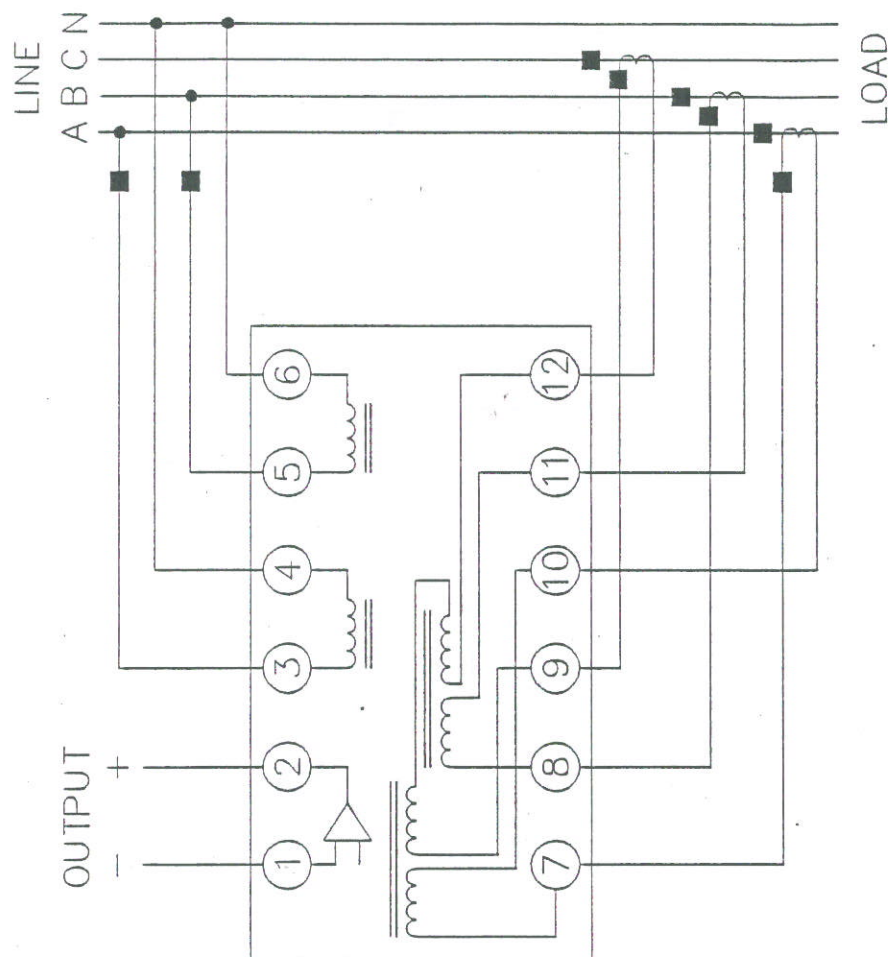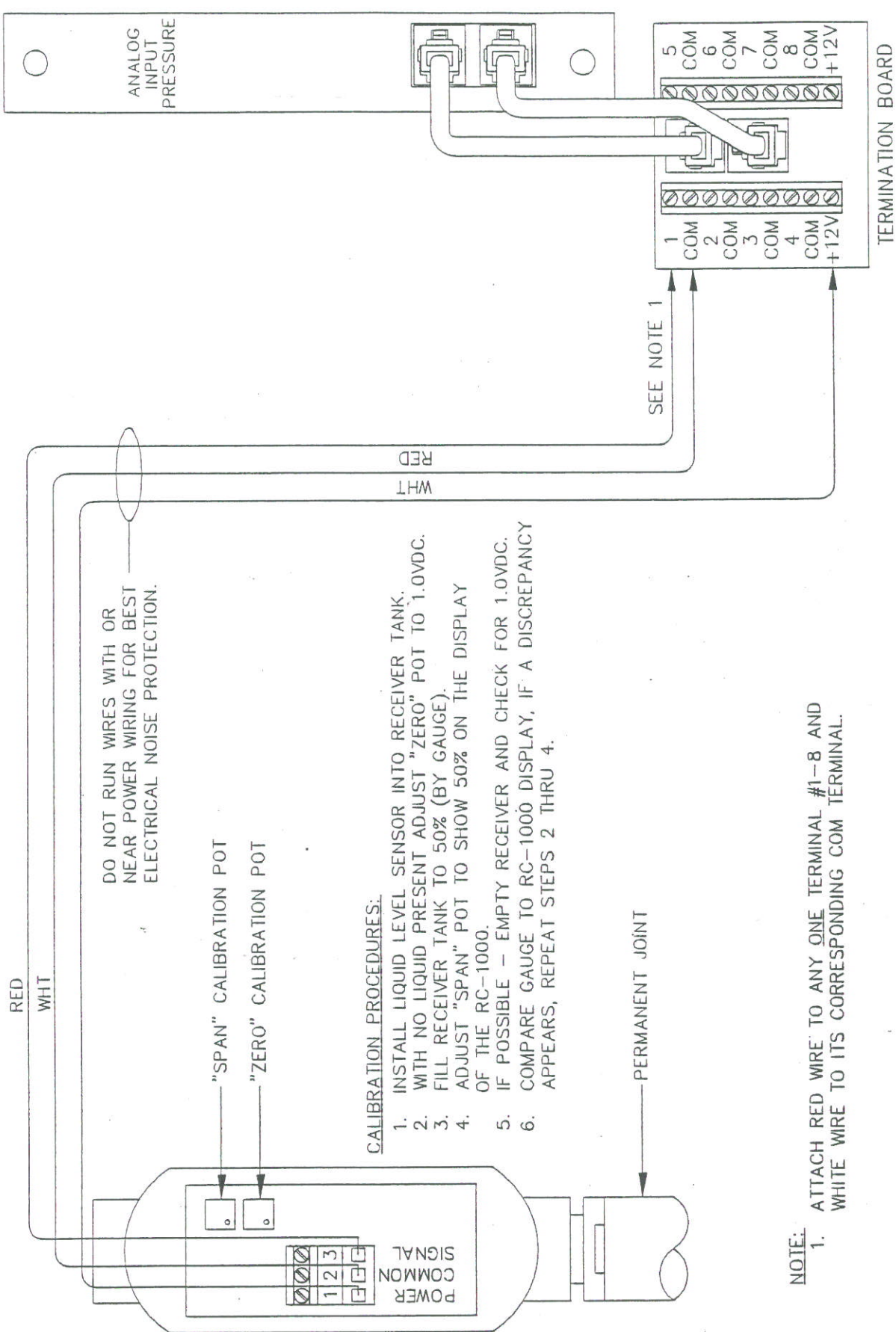WATT TRANSDUCER 2 1/2 ELEMENT CONNECTION FOR A12083 AND A12084

FIGURE 28

RC-1000 MODULE

ANALOG INPUT PRESSURE

5 COM 6 COM 7 COM 8 COM +12V

1 COM 2 COM 3 COM 4 COM +12V

TERMINATION BOARD

SEE NOTE 1

RED

WHT

RED

WHT

DO NOT RUN WIRES WITH OR NEAR POWER WIRING FOR BEST ELECTRICAL NOISE PROTECTION.

"SPAN" CALIBRATION POT

"ZERO" CALIBRATION POT

CALIBRATION PROCEDURES:

1. INSTALL LIQUID LEVEL SENSOR INTO RECEIVER TANK.
2. WITH NO LIQUID PRESENT ADJUST "ZERO" POT TO 1.0VDC.
3. FILL RECEIVER TANK TO 50% (BY GAUGE).
4. ADJUST "SPAN" POT TO SHOW 50% ON THE DISPLAY OF THE RC-1000.
5. IF POSSIBLE — EMPTY RECEIVER AND CHECK FOR 1.0VDC.
6. COMPARE GAUGE TO RC-1000 DISPLAY, IF A DISCREPANCY APPEARS, REPEAT STEPS 2 THRU 4.

PERMANENT JOINT

POWER COMMON SIGNAL

1 2 3

NOTE:
1. ATTACH RED WIRE TO ANY ONE TERMINAL #1-8 AND WHITE WIRE TO ITS CORRESPONDING COM TERMINAL.

0-5V LIQUID LEVEL CAPACITANCE TRANSDUCER TO RC-1000 ANALOG PRESSURE WIRING DIAGRAM

FIGURE 29