# SERIES X84 RTD
# TEMPERATURE MONITOR

TABLE OF CONTENTS

## TABLE OF CONTENTS
(Continued)

## 1.0 GENERAL DESCRIPTION

The Ronan X84 System provides continuous monitoring and setpoint control of multiple sensor points. Each system functions with a single master module that provides linearization for one or two non-linear RTD's. Monitor-alarm modules are provided for each RTD and include single or dual setpoints and alarm logic.

The master module contains a three and a half digit panel meter, power supplies, the operating pushbuttons, signal conditioning and linearization circuits. The temperature monitored at each monitor-alarm module and the alarm setpoints can be read on the digital display on the master module.

The monitor-alarm modules contain input signal conditioning and amplification, multiturn, infinite resolution setpoint potentiometers and setpoint circuitry, alarm logic, lamp driver circuits and shutdown relays. Optional current or, voltage transmitters can be added to each point by plug-in cards. Each monitor module contains its own +15V reference supply.

## 1.1 SPECIFICATIONS

"Specifications apply at an ambient temperature of 23 ± 2°C unless otherwise stated."

### 1.1.1 INPUT: RTD

### 1.1.2 RANGES

| | RTD °F | RTD °C |
|---|---|---|
| Copper | 0 to +300 | –20 to +150 |
| Nickel | –50 to +550 | –55 to +290 |
| Platinum | –300 to +1,000 | –180 to +440 |

### 1.1.3 INPUT IMPEDANCE

RTD Input:

| | |
|---|---|
| Copper | > 3K Ohm |
| Nickel | > 20K Ohm |
| Platinum | > 20K Ohm |

### 1.1.4 RTD BURNOUT

Positive overscale.

### 1.1.5 ACCURACY (23 ± 1°C)

All system errors, including curve fitting and meter.
2° + 0.1% of reading.

### 1.1.6 RESOLUTION

1° standard.

| | | |
|---|---|---|
| 1.1.7 | AMBIENT TEMPERATURE EFFECT | ($75 \pm 40^{o}F$)<br><br>Gain: $\pm$ .01% of reading/$^{o}F$<br>Offset: $\pm .05^{o}$ per $^{o}F$ |
| 1.1.8 | SETPOINT RESOLUTION | Better than 0.1% of setpoint range. |
| 1.1.9 | SETPOINT RANGE | Same as standard system temperature range. Setpoint range may be reduced on special order. |
| 1.1.10 | HYSTERESIS | Fixed, standard is $2^{o}F$ |
| 1.1.11 | HORN RELAY | 3 amp contact rating at 115VAC |
| 1.1.12 | SHUTDOWN RELAY | 2 amp contact rating at 24VDC, 1 amp at 115VAC resistive. |
| 1.1.13 | POWER | 24VDC $\pm$ 10%. 10 watts +5 watts per single channel monitor-alarm module.<br>Fuse: 1 - 20 points: 5A Slow Blow<br>20 - 40 points: 10A Slow Blow<br>40 - 70 points: 20A Slow Blow |

## 2.0 INSTALLATION - General

All Ronan manufactured equipment is carefully packaged and shipped in custom designed boxes to prevent shipping damage. Any discrepancies between shipping contents and invoice should be immediately reported to Ronan or to the Ronan representative.

The mechanical design of the Model X84 is intended for flush mounted cabinet, relay rack mounted installation or surface mounting. All operating controls are available on the front panel of the unit.

The normal calibration and service adjustments are readily accessible from the front. All power, alarm input and output connections are available at the rear of the chassis.

## 2.1 DIMENSIONS

For dimensional information, refer to the certified drawings related to the specific system being installed.

## 2.2 INSTALLATION - Rack Mounting

Rack mounting X84 series are best installed on standard RETMA rails which come predrilled and tapped at the proper spacing. Should mounting on a non-standard rail be attempted, refer to mechanical drawings for dimensions.

2.3 INSTALLATION - Window Model

Window model X84 systems are equipped with four panel clinching screws which are to be tightened into the rear of the panel. Prior to installation, remove these screws from their floating nut pairs, and remove the nuts from the groove in the trim extrusion. Insert the cabinet into the panel cutout and reinstall the nuts and screws, noting that the the threaded nut goes nearest the panel.

2.4 POWER REQUIREMENTS

The Ronan X84 system is designed to operate from a 24VDC power supply or battery, or optionally from 115VAC, 60 Hz.

2.5 WIRING INSTRUCTIONS

System wiring will depend upon the functional requirements of any particular system. Refer to the drawings and schematics of the specific system for complete wiring information.

CAUTION

Do not apply power before completion of all wiring. Carefully review and verify the correctness of the wiring using an ohm meter.

2.6 THREE-WIRE RTD CONFIGURATION

All X84 systems are shipped in the three-wire configuration, unless otherwise specified.

Connect the plus RTD wire to the "+" terminal and the RTD minus to the "–" terminal. The third connection serves as a return from the RTD. The wire attached to Terminal "C" must be connected to the same side of the RTD element as the "RTD –" lead wire.

NOTE

No damage will result if this polarity is not observed. However, the equipment will not respond properly.

2.7 TWO-WIRE RTD CONFIGURATION

Connect the RTD plus wire to the "+" terminal and the RTD minus to the "–" terminal. Add a jumper between terminals "–" and "C".

2.8 TWO-WIRE VERSUS THREE-WIRE CONFIGURATION

If the two wire configuration is selected, it is important to realize that the lead wire resistance in series with the RTD probe directly affects the accuracy of the temperature reading. The error is an offset in degrees and is constant throughout the RTD temperature range.

Approximate Temperature Error $\frac{\text{R Lead}}{\Delta \text{ RTD}}$ (Degrees)

RTD = Resistance change per $^{o}$F of the RTD.

Resistance of Copper Wire per 1000 feet used for R Lead.

| | |
|---|---|
| 24 Gauge | 25.67 Ohms |
| 22 Gauge | 16.14 Ohms |
| 20 Gauge | 10.15 Ohms |
| 18 Gauge | 6.38 Ohms |
| 16 Gauge | 4.02 Ohms |
| 14 Gauge | 2.52 Ohms |
| 12 Gauge | 1.59 Ohms |
| 10 Gauge | 0.99 Ohms |

| RTD PROBE | RTD |
|---|---|
| 100 Ohm Platinum | .215 Ohms/$^{o}$F |
| 120 Ohm Nickel | .585 Ohms/$^{o}$F |
| 10 Ohm Copper | .023 Ohms/$^{o}$F |

Example:
A 100 Ohm Platinum RTD is mounted 100 feet from the system. The wire selected is 18 Gauge with:

$R_{\text{Lead}}$ = 100 feet x 6.38 Ohms/1000 feet.

$R_{\text{Lead}}$ Total = $\frac{100 \times 6.38}{1000}$ = .638 Ohms

Multiply by (2) to include both leads - 1.276 Ohms

Temp. Error - $\frac{1.276}{.215} = 5.93^{o}\text{F}$

NOTE

Systems using copper probes are highly sensitive to lead resistance due to the low resistance of the probe. The three-wire configuration is recommended whenever utilizing copper RTDs.

The three-wire configuration eliminates most of the temperature errors caused by the lead wire resistance, by adding the resistance of one lead wire in opposite legs of the bridge and therefore cancelling out these effects.

In the three-wire hook-up, special care should be taken to equalize the length and size of the RTD+ and the RTD– leads.

2.9 INPUT WIRING INSTRUCTIONS

The signal input leads should be physically isolated from wires carrying relay contact, coil current or any other source of high current or voltage transients. The signal input leads should be twisted along the run from the RTD to the systems input screw terminals. If shielded leads are used, the shield should be grounded only at the system end to the chassis ground and in turn to a solid earth ground.

Two amp shutdown relay contacts for each point are accessible at terminals at the back of each module. Either one or two relays will be available for single and dual setpoints respectively. The shutdown relay contacts may be either normally open or normally closed, depending on the position of the "screw switch" on the alarm board.

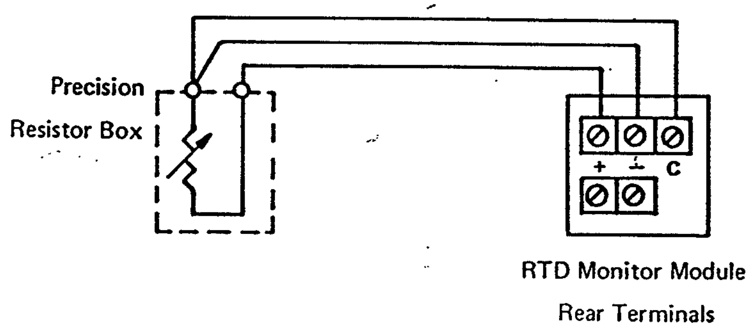
The shutdown relays be grouped by jumpering like terminals together. If this is done, it is necessary to ensure that all screw switches are in the normally open (N.O.) position.

3.0 SYSTEM ACCURACY VERIFICATION

The Ronan X84 Monitoring System should perform within its rated accuracy as calibrated at the factory for an indefinite period of time. However, periodic tests should be made to verify the system is functioning properly. The best way to perform an accuracy test is to simulate an accurate RTD connected to the terminals at the rear of the monitor modules. This can be done with a precision resistor box (0.02% resistors or better) for RTD points.

3.1 RTD ACCURACY TESTS

The three-wire connection, as shown in Figure 3-1 should be used for calibration of RTD points.




(Figure 3-1)

Before depressing the INPUT-SETPOINT switch on the module to be tested, ensure that the indication on the master module panel meter is +32°F (0°C). The ZERO control on the master module front panel should be used to adjust the meter zero with no module switches depressed.

After adjusting the master module zero to +32°F (0°C) set the precision resistor box to the correct RTD value at +32°F (0°C). (Platinum = 100.0 Ohms, Nickel = 120.0 Ohms, Copper = 10.00 Ohms).

Set the TEMP-SETPOINT switch of the module under test to the TEMP position. The panel meter should indicate +32°F ± 1°F (0°C ± 1°C). The ZERO control at the RTD monitor module front panel may be used to adjust the display to zero. The RTD monitor gain may be checked by simulating the RTD at an elevated temperature e.g., +500°F for platinum (198.98 Ohms), +470° for nickel (358 Ohms) and 300°F for copper (16.27 Ohms). Set the resistor box (see Installation Section for two wire versus three-wire connection information) to the specific value required and observe the digital panel meter when the TEMP-SETPOINT switch is set to the TEMP position. The temperature corresponding to the RTD value ± 2°F should be displayed on the panel meter.

## 4.0 GENERAL

All Ronan X84 systems have been subjected to a minimum of eight hours of burn-in time, after which they are rechecked to assure compliance with the published specifications.

## 4.1 TEST VERIFICATION

With power applied, the TEST button may be depressed, and should place all "normal" modules into the flashing condition and actuate the horn. Modules already in alarm are unaffected by the test. The digital meter on the master module should display all 8's when the TEST button is depressed (The ± 1 digit does not illuminate in the TEST mode).

## 4.2 ACKNOWLEDGE VERIFICATION

Depressing the ACK (acknowledge) pushbutton will silence the horn and change all flashing alarm points to a normal out condition unless an actual alarm occurs, in which case the flashing light on the point in alarm will go steady.

## 4.3 TEST/ACK VERIFICATION

Since normal operation of the system occurs when no alarm condition exists, it is impossible to observe the "steady" alarm condition during test, since the modules return to their "off" state upon "ACK". By maintaining the TEST button depressed, and then depressing "ACK", all modules should go to the steady state and remain there until "TEST" is released. The "TEST" button is inoperative unless the SHUTDOWN BYPASS switch is depressed.

## 4.4 SHUTDOWN VERIFICATION

The shutdown relays on the monitor boards function in a "latching" or "non-latching" mode. When a relay is operating in the "latching" mode it switches into the alarm condition when an alarm exists, even if momentarily and remains in the alarm condition until the system ACK pushbutton is depressed and the input is normal. When in the "non-latching" mode, the shutdown relay follows the alarm condition directly and can return to normal before the system "ACK" pushbutton is depressed. The shutdown functions can be verified by performing the following:

Test sequence:

1. Depress the SHUTDOWN BYPASS button.
2. Momentarily press the TEST button.
3. Release the SHUTDOWN BYPASS button (do not press ACK). The shutdown relays should now be in the alarm condition.
4. Momentarily depress the ACK button. This returns the system back to normal.

NOTE: The shutdown relays must be in the latching mode of operation before they can be tested per the above sequence.

The shutdown relay operation can also be tested on any one channel by adjusting the SETPOINT value below (above for low setpoint operation) the input value. Both latching and non-latching relay operation are tested by this method. Return the setpoint reading to its normal value when the shutdown testing is completed.

## 4.5 ALARM MODULE VERIFICATION - Single Setpoint Module

Proper operation of the single setpoint module may be verified after the sensor wiring has been connected to the monitor system.

Step 1: Remove the alarm module from the chassis and examine the position of the screw switch marked "HI-LO" alarm limit. Select the desired operating mode from the Single Setpoint Module - Operating Options Table and position the screw switch accordingly. Reinstall the alarm module.

Step 2: Verify operation of the module by adjusting the setpoint to simulate an alarm condition in the mode of operation selected. For example: With the screw switch in the HIGH position, the setpoint temperature should be adjusted higher than the operating temperature to start the test procedure. Adjust the setpoint downward through the operating temperature. The alarm window will flash, the horn will sound and the shutdown relay, if provided, will actuate. Depressing the ACK push-button will change the alarm window to steady on and silence the horn.

NOTE: Depress the SHUTDOWN BYPASS switch if it is desirable to not switch over the shutdown relays into the alarm condition.

## 4.6 ALARM MODULE VERIFICATION - Dual Setpoint Module

Proper operation of the dual setpoint module may be verified after the input wiring has been connected to the system.

Step 1: Remove the alarm module from the chassis and examine the position of the screw switches marked Channel A and Channel B. Select desired operating mode from the Dual Setpoint Module Operating Options Table and position the two screw switches accordingly. Reinstall the alarm module.

Step 2: Verify operation of the module by adjusting the setpoints individually to simulate the alarm conditions possible in the mode of operation selected. For example: With both screw switches set in the HIGH position, both Setpoint A and Setpoint B should be initially adjusted higher than the operating temperature. Setpoint B must be a set higher than Setpoint A. Adjust Setpoint A downward through the operating temperature. The alarm window will flash slowly, the horn will blow and the A output shutdown relay, if supplied, will activate. On acknowledging the horn by depressing the ACK pushbutton, the alarm window will go to steady on. Now adjust Setpoint B downward through the operating temperature. The alarm window will flash with a fast galloping flash rate, the horn will sound, and shutdown Relay B, if provided, will actuate. Depress the ACK pushbutton to silence the horn and the alarm window will go to a steady rapid flash.

Proper operation of each of the operating modes can be verified using a similar procedure by moving the setpoints to simulate alarm conditions. Depress the SHUTDOWN BYPASS switch if it is desirable to not switch over the shutdown relays into the alarm condition.

NOTE

**Special systems may not follow the standard sequence of operation or may not provide all the functions outlined above. Refer to specific system drawings for detailed operation of special systems.**

### 4.6.1 TRIP-POINT CALIBRATION

Set one (only) alarm module switch to the "SETPOINT" position. Adjust the setpoint potentiometer on the alarm module up or down, as required, while reading the setpoint temperature on the meter.

### 4.6.2 TEMPERATURE INDICATION

Place the switch on the monitor module into the "TEMP" position, and observe the temperature on the meter.

NOTE: Should the meter show erratic readings, release the switch and re-examine the sensor wiring.

Common causes are:

1. No sensor connected and shipping resistor removed.
2. RTD+ and RTD– lead reversed or crossed with other RTD.
3. Wrong common lead to RTD terminals.

SINGLE SET POINT MODULE – OPERATING OPTIONS

| Operating Mode and Monitoring Application | Alarm Module Screw Switch Position | Flashing Alarm Window | Shutdown Relay Actuates |
|---|---|---|---|
| Rising Temperature Setpoint High | High | Yes | If Provided |
| Falling Temperature Setpoint Low | Low | Yes | If Provided |

## DUAL SETPOINT MODULE – OPERATING OPTIONS

<table>
<tr><th rowspan="2">Operating Mode<br>and Monitoring Application</th><th colspan="2">Alarm Module<br>Screw Switch Position</th><th colspan="2">Flashing Rate<br>In Alarm</th><th colspan="2">Shutdown Relay<br>Output Sequence</th></tr>
<tr><th>Channel A</th><th>Channel B</th><th>Setpoint A</th><th>Setpoint B</th><th>A</th><th>B</th></tr>
<tr><td>A Setpoint High<br>B Setpoint Higher</td><td>High</td><td>High</td><td>Slow</td><td>Galloping Fast</td><td>1st</td><td>2nd</td></tr>
<tr><td>Falling Temperatures<br>A Setpoint Low<br>B Setpoint Lower</td><td>Low</td><td>Low</td><td>Slow</td><td>Galloping Fast</td><td>1st</td><td>2nd</td></tr>
<tr><td>Temperature Span<br>A Setpoint Higher than Operating Temperatures<br><br>B Setpoint Lower than Operating Temperature</td><td>High</td><td>Low</td><td>Slow</td><td>Galloping Fast</td><td rowspan="2" colspan="2">Either Output May be First</td></tr>
<tr><td>Temperature Span<br>A Setpoint Lower than Operating Temperature<br><br>B Setpoint Higher than Operating Temperature</td><td>Low</td><td>High</td><td>Slow</td><td>Galloping Fast</td></tr>
</table>

### CAUTION

Both A and B Setpoints must retain their positions relative to the operating temperature and to each other as explained in the Monitoring Applications column above. Crossing over of setpoints will not damage the equipment, however the alarm information will be confusing and shutdown outputs will not be in sequence.

## 5.0 CALIBRATION

### 5.1 RTD MONITOR MODULE CALIBRATION

**CAUTION**

**During the following tests the monitor setpoint voltages will most likely be exceeded causing an alarm condition. To exclude any shutdowns created by test conditions, the Shutdown Bypass Switch on the master module may be depressed for the duration of the calibration period.**

The RTD monitor circuit can be calibrated by constructing a test circuit as shown in Figure 3.1. In order to achieve maximum accuracy in use, the approximate resistance of the RTD leads should be simulated in each of the leads from the precision resistance box. **Ensure that the DPM on the master module indicates +32°F (0°C) with none of the systems TEMP/SETPOINT switches depressed. If the following tests indicate that an adjustment to the RTD amplifier needs to be made, an extender board should be used to make the gain potentiometer accessible while the measurement is being made. Adjust the precision resistor box to the correct RTD value at 32°F (0°C) and depress the TEMP/SETPOINT switch to the TEMP position. The DPM should indicate +32°F (0°C).** The monitor amplifier zero control is accessible at its front panel, if an adjustment is required. To test the monitor amplifier gain, set the resistance box to an equivalent RTD value at any temperature within the range of the system. (Table 5-1 lists RTD resistance values at some selected temperature). When the TEMP/SETPOINT switch is set to the TEMP position, the DPM should indicate the correct temperature ±2°.

| | RTD | | |
|---|---|---|---|
| Temperature | Platinum | Nickel | Copper |
| −80°F | 75.12 Ohm | | |
| +40°F | 101.76 Ohm | 122.98 Ohm | 10.19 Ohm |
| +70°F | 108.33 Ohm | 135.17 Ohm | 10.89 Ohm |
| +170°F | 130.00 Ohm | 179.49 Ohm | 13.23 Ohm |
| +250°F | 147.09 Ohm | 219.70 Ohm | 15.10 Ohm |
| +400°F | 178.49 Ohm | 309.04 Ohm | |
| +500°F | 198.98 Ohm | 380.57 Ohm | |

(Table 5-1)

RTD Values Versus Temperature

The gain of any monitor should rarely need to be re-calibrated and if the gain of a tested channel appears to need adjustment, test a number of channels first to determine if the gain adjustment might need to be performed in the master module. (All channels out of tolerance high or low by the same amount.) There will be gross accuracy errors on all channels if the linearizing board in the master module is unplugged or malfunctioning.

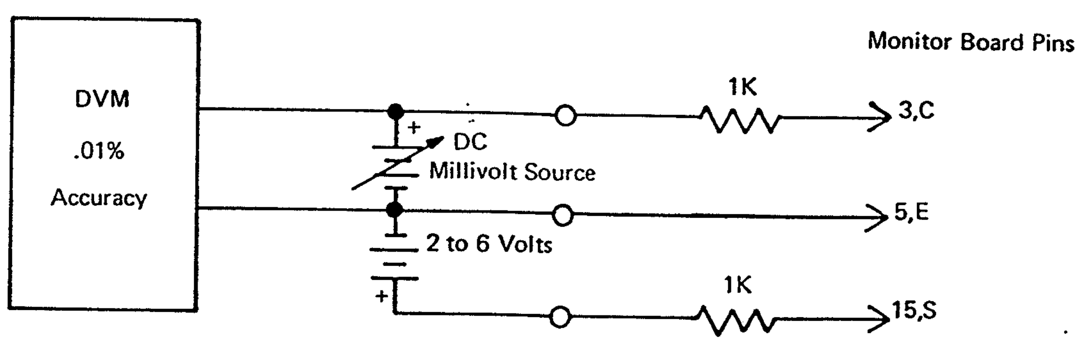
## 2 MASTER MODULE CALIBRATION

If it is determined that the master module needs calibration, it may be adjusted by the following procedure. Use an extender board to gain access to the calibration potentiometers along the left hand side of the master module. Set the DPM °F – °C switch to the °C position and adjust the front panel zero control to read 0°C. The sign indicator should blink between + and –.

The master module zero is now calibrated. If the readings are still incorrect, a gain calibration must be performed. To do this, replace one of the monitor boards with an extender board. The monitor board will not be used in this procedure and may be set aside. Construct the test circuit shown in Figure 5-1 to inject a voltage into the system. Unplug all linearizer boards from the master module. Set the master module to read °F.

The X84 system carries an elevated zero of +1.000 volts into the master module, i.e., with an input of +1.000V the DPM indication is 0°C or +32°F. The sensitivity of the master module is two millivolts per digit with all linearizer boards unplugged and the °C – °F switch in the °F position. Monitor the +1V reference at TP3 with a ± 0.02%, or better, accurate digital volt meter (DVM). Adjust potentiometer R5, if necessary, for a reading of +1.000 ± .0002V. Set the mv source of Figure 5-1 to +1.000V and readjust the front panel ZERO control, if necessary, for a reading of +32F on the DPM. Set the mv source of Figure 5-1 to +3.000V.

The master module DPM should read +1032F. Potentiometer R26 may be adjusted, if necessary, to obtain this reading. The master module should now be calibrated.




(Figure 5-1)
Equipment required and test configuration used for calibration of master module.

## 6.0 THEORY OF OPERATION

### 6.1 GENERAL DESCRIPTION

The Ronan X84 system is designed to continuously monitor from one to seventy RTD inputs with single or dual setpoint alarms on each input. The status or temperature of any sensor connected to the system can be selected and displayed on the digital panel meter on the master module. The master module provides linearization for the non-linear temperature sensors so that the digital panel meter indicates the sensor temperature directly and accurately.

Each sensor has a printed circuit board dedicated to its monitoring, containing signal conditioning and setpoint circuits (single or dual monitor board), and alarm logic circuits and shutdown relay(s) (single or dual alarm board). The monitor board amplifies the sensor output and routes the amplified signal to the setpoint circuit(s) and to a front panel "TEMP/SETPOINT" switch. The TEMP/SETPOINT switch is a two pole, momentary, three-position switch with a center "off" position. One of the poles on the switch connects to an analog data bus that goes to the master module analog input. This pole is switched in the TEMP position to the amplified sensor voltage and in the SETPOINT position to the setpoint voltage. The second pole on the switch is used to transmit a sensor identification signal to the master module which utilizes this information to select the correct linearization circuit.

The output of the setpoint comparator(s) activates the alarm circuitry which includes flashing lamps, a system horn buss driver and shutdown relay contacts. The lamp flashing sequences are explained in more detail in Section 7. Other inputs to the alarm circuit originate in the master module and consist of the test, acknowledge and reset (if required) signals from the pushbutton switches, the slow (F1) and fast (F2) flash signals and the SR signal. The SR signal is routed through the SHUTDOWN BYPASS switch and when this switch is depressed, inhibits the shutdown relay(s) from switching into the alarm condition.

The master module contains the pushbutton switches for the X84 system, the digital panel meter, signal conditioning for the selected input, linearization circuitry, flash generating circuits and voltage regulators required by the system. A DC-DC converter power supply is utiiized to provide the voltages required to run the master module.

Every monitor board, when selected by its front panel INPUT/SETPOINT switch applies an encoded voltage level to the "linearization bus". The monitor boards apply a unique signal for each type of RTD to the "linearization bus". The master module contains circuitry that recognizes when a sensor's output has been selected for display on the panel meter and selects the correct linearization board for the sensor (up to three different kinds of RTD's may be monitored by an X84 system with a single master module). Normally, there is no linearization code on the linearization bus (no point selected for read out on the panel meter) and no signal on the analog data bus. In this condition, an electronic switch connects the analog + input to +1V through a resistor. This "zero" voltage input to the master module results in a digital display of 0°C or +32°F.

Conformity to RTD's non-linear output function (linearization) is accomplished in the amplifier stage designated IC5 on the master module schematic (Drawing No. X84-1001). Curve fitting is accomplished by gain and offset changes in Amplifier IC5.

The signal input to the master module from a monitor board is scaled to 2MV/°F or 3.6 MV/°C, independent of the sensor type. The gain of Amplifier IC5, on a non-linearized segment is -0.5. The gain of IC4 is selected by the °F - °C switch and is either -1 or -0.5555 (°C). Thus the output to the digital panel meter is 1MV/°C or °F. An offset of +32MV (+32°F) referred to the output is also added to the signal at IC4 via the °F - °C switch in the °F position.

The slow and fast flash generator circuits are also contained on the master module circuit board. These are similar oscillator circuits utilizing CD4001 quad nor gates and oscillating at 1 Hz and 8 Hz. The 8 Hz oscillator is utilized for dual alarm flash or "first out" sequences.

The front panel pushbutton switch functions normally include SHUTDOWN BYPASS, °F - °C, TEST and ACKNOWLEDGE and may include RESET for special flash sequences.

The TEST, RESET and ACKNOWLEDGE pushbuttons control transistor switch circuits located on the master module which switch the respective system busses. These system busses are normally at +15V and are switched to V- (0V) when a switch is depressed. The pushbutton functions, TEST, ACKNOWLEDGE and RESET can be electronically effected by applying +24VDC to the rear terminals OTX, AX and RX respectively.

## 6.2 HORN RELAY

The horn relays are mounted at the rear of the master module. The normally open contacts are connected to the rear terminals X1 and X2.

## 6.3 SYSTEM POWER

The Ronan X80 Temperature Monitoring System operates from $24^{+6}_{-2}$ VDC which is connected to the V+ and V- terminals at the rear of the master module. The system is fused and is protected against a polarity reversal of the 24VDC supply. (Blows fuse if 24V supply is reversed). Alternately, an integral 115VAC power supply may be utilized for small systems.

## 7.0 DETAILED CIRCUIT DESCRIPTION

### 7.1 RTD MONITOR, SINGLE SETPOINT (Schematic X84-1005)

The single setpoint RTD monitor board includes a +15V reference supply, a differential amplifier with a bridge input, a setpoint circuit, alarm circuitry and a shutdown relay.

The reference voltage supply is formed by IC3 and associated components. Resistors R24, R25 and R26 form a voltage divider which provides the feedback into the regulating loop. The voltage at the junction of R25 and R26 is set to be the correct linearization code fo a specific kind of RTD monitor and is routed to the linearization code buss through switch S1. The reference supply output is 15V $\pm$ 6%.

The input bridge consists of resistors R5, R3, the RTD, R38 and the zero control R39. Resistor R1 is common to both legs of the bridge and is used to help elevate the inputs of the amplifier above zero volts. The components R6, R8, C1 and C2 provide input noise filtering. The gain of the RTD bridge and amplifier combination is dependent on the current through the RTD and the amplifier circuit gain. The gain control R12 affects the gain of the differential amplifier and is used to adjust for variations in reference supply voltages and resistor tolerances, so that all monitor amplifiers have the same output range with a given RTD. The gain determining components for the amplifier are R7, R11, R9, R10, R13 and the gain adjust pot. R12. The gain equation is:

$$\text{Gain} = \frac{R7 + R11}{R11} + \frac{2R7}{R12 + R13}$$

R7 = R10
R11 = R9

Amplifier IC2 has a zero offset of +1.00V at it's output, i.e., when an RTD input has a zero degree C value, the output of IC2-1 is 1V rather than zero volts. This 1V offset is removed in the master module at amplifier IC5 so that a zero degree C RTD value appears at the DPM as zero volts (+32MV, if °F, which is supplied at amplifier IC4 in the master module).

The amplifier output is routed to one of the contacts of switch S1, which can select this signal to be connected to the master module for readout on the DPM, and to the setpoint voltage comparator IC2. The comparator circuit compares the amplifier output voltage with the voltage at the arm of the SETPOINT control R20. For high setpoint operation, the output of the comparator is at +15V for normal inputs and goes to zero volts for an alarm condition. The output stage of the comparator is an open collector transistor utilizing R17 as a pull-up resistor to +15V.

The setpoint comparator provides an input to the alarm logic circuit consisting of IC4, IC5 and associated components. Alarm circuit components include a shutdown relay K1 and relay drive Q1, horn buss drive Q2 and lamp drive transistor Q3. Integrated circuit gates IC5A and B form an alarm flip-flop and gates IC5C and D form an acknowledge flip-flop. The outputs of Section A and C of the flip-flops are normally high, Section B and D are normally low. The alarm flip-flop is set when a high (+15V) signal is applied to IC5, Pin 1 (Section A is now low and Section B is high). IC5B, when high, turns on the horn buss drive Q2 causing the system horn to sound and turns on the lamp drive transistor Q3 through R30 and CR6.

When the lamp drive signal is applied through R30, the lamp is caused to flash by the F1 signal which pulls down the junction of R30 and CR6 at the flash rate.

The acknowledge flip-flop is set when an acknowledge signal is received at IC5C, Pin 8. The acknowledge flip-flop resets IC5, Section B (and Section A if the input condition is normal) causing the horn buss drive to turn off and the slow flash drive to be removed from R30. If the alarm signal is still present, the output of IC5D provides current to the lamp drive transistor Q3 through R35 causing the lamps to be continuously illuminated. A normal input signal condition resets IC5A and the acknowledge flip-flop. Table 7-1 shows the states of IC5A, B, C and D as they relate to the alarm, test and acknowledge signals.

The shutdown relay can be either normally energized (R40 installed) or normally de-energized (R41 installed). Also, the shutdown circuitry can be configured so that the relay is "non-latching" and follows the alarm input directly or it can be made to "latch" in on an alarm and remair in the alarm condition until the input is normal and the system has been acknowledged. Diode CR1 is installed for "latching" relay operation. The SR signal from the SHUTDOWN BYPASS switch or the master module enters this card at connector pins 12 and N and is applied to one of the inputs of the gate IC4. When the SR signal is not present, the gate is disabled and the relay cannot be made to switchover into the alarm condition.

| ALARM CONDITION | ACK | TEST | IC5A | IC5B | IC5C | IC5D | LAMP | SD RELAY | HORN |
|---|---|---|---|---|---|---|---|---|---|
| Normal | Normal | Normal | High | Low | High | Low | Off | Normal | Off |
| Alarm | Normal | Normal | Low | High | High | Low | Flashing | Alarm | On |
| Alarm | Ack. | Normal | Low | Low | Low | High | Steady | Alarm | Off |
| Normal | Ack. | Normal | High | Low | High | Low | Off | Normal | Off |
| Normal | Normal | Depressed | Low | High | High | Low | Flashing | Normal Bypassed | On |
| Normal | Ack. | Normal | High | Low | High | Low | Off | Normal | Off |

(Table 7-1)

## 7.2 DUAL CHANNEL MONITOR MODULE (Schematic X84-1007)

The dual channel alarm module contains two channels of amplification; setpoint monitoring and logic circuitry each of which is virtually identical to the circuits described for the single setpoint alarm module. Both channels utilize the same reference voltage supply IC1 and horn buss drive Q3. For a technical description of this circuitry, refer to Section 7.1.

## 7.3 DUAL SETPOINT ALARM MODULE (Schematic X84-1004)

The dual setpoint alarm module contains the RTD amplifier and setpoint circuitry of the single setpoint module (Section 7.1) plus a second identical setpoint.

The second setpoint circuit utilizes IC6B, the SETPOINT control R37, resistors R11, R52, R50, R51 and C3. Either setpoint can be selected for display on the master module DPM by the two position toggle switch S1, while holding the momentary switch S2, in the setpoint position.

The digital logic circuitry for each setpoint is similar to that for the single setpoint module plus some additional gating circuits to derive the several different lamp flash rates of the dual setpoint module. The steady lamp signal is provided by IC1D (acknowledged setpoint A alarm) in a similar manner to that of the single setpoint module. The triple input "AND" gates IC4A, IC4B and IC4C respectively, provide the slow flash, mixed rate or "galloping" flash and the fast flash signals. Table 7-2 shows the states of IC1 and IC5 as they relate to the alarm, test and acknowledge signals.

| ALARM CONDITION | | IC1 | | | | IC5 | | | | | SD RELAY | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.P.A. | S.P.B. | A | B | C | D | A | B | C | D | LAMP | A | B | HORN |
| Normal | Normal | High | Low | High | Low | High | Low | High | Low | Off | Normal | Normal | Off |
| Alarm | Normal | Low | High | High | Low | High | Low | High | Low | Slow Flash | Alarm | Normal | On |
| Ack. | Normal | Low | Low | Low | High | High | Low | High | Low | On Steady | Alarm | Normal | Off |
| Ack. | Alarm | Low | Low | Low | High | Low | High | High | Low | Mixed Flash | Alarm | Alarm | On |
| Ack. | Ack. | Low | Low | Low | High | Low | Low | Low | High | Fast Flash | Alarm | Alarm | Off |
| Ack. | Normal | Low | Low | Low | High | High | Low | High | Low | Steady | Alarm | Normal | Off |
| Normal | Normal | High | Low | High | Low | High | Low | High | Low | Off | Normal | Normal | Off |
| Alarm | Alarm | Low | High | High | Low | Low | High | High | Low | Mixed Flash | Alarm | Alarm | On |
| Ack. | Ack. | Low | Low | Low | High | Low | Low | Low | High | Fast Flash | Alarm | Alarm | Off |
| Test | Test | Low | High | High | Low | Low | High | High | Low | Mixed Flash | Normal | Normal | On |
| Ack. | Ack. | High | Low | High | Low | High | Low | High | Low | Off | Normal | Normal | Off |

(Table 7-2)

## 7.4 ISOLATED TRANSMITTER (Schematic X80-1019)

The isolated transmitter board includes a DC-DC converter, that supplies isolated power for the circuitry, a transformer coupled signal path isolator and a current output amplifier with zero and span controls.

The DC-DC converter circuit consists of transformer T1, transistors Q1 and Q2 and the associated resistors on the primary side. The circuit oscillates at about 12 kHz in a self-saturating mode of oscillation. An unregulated DC voltage is obtained through the transformer secondary winding 7-8-9, rectifiers CR2, CR3, CR4, CR5 and filter capacitors C4 and C5. Positive and negative regulated 6V supplies are formed by R6, CR6, Q3 and R7, CR7 and Q4.

The input signal is a relatively high level analog signal from the monitor amplifier output. The analog input signal is "chopped" by field-effect transistors (FET's) Q5 and Q6 and applied to the primary of T2. The switch drive signals are obtained from winding 10-11-12 of transformer T1. At the secondary of transformer T2, the DC signal is restored by the synchronous demodulator consisting of FET switches Q7, Q8 and the filter C6, R15 and C7. The restored DC signal is applied to the non-inverting amplifier stage IC1 and associated components. The zero control R11, functions in this stage and has a nominal span of plus/minus 10% of range at the output. Resistors R10, R12, R29, R30, R31, R32 and R33 are factory selected depending on the input span of the monitored point.

Amplifier IC2 and its associated components form a current output stage with the span control, R28 included. Transistor Q10 is driven by IC2 through the source follower Q9. When a positive voltage is applied to terminal 3 of IC2, the base of Q10 is driven positive and an increased current will flow from collector to emitter of Q10. This current flows through R30 in parallel with R28, R29 and R33 (Also, R31 or R32 may be connected in parallel through J1 or J2). The current will increase through Q10 until the voltage at the junction of R29 and R33, which is fed back to pin 2 of IC2, becomes equal to the signal at pin 3 of IC2 achieving a balance and the current through Q10 stabilizes at this value. The collector of Q10 is connected to the negative output terminal. When a current path (the load resistance) is connected across terminals 3 and 4, current flows from the plus unregulated supply through the load and Q10 to establish the correct feedback voltage. The strong amount of feedback control in this circuit forces a constant current to flow through the load, independent of the load value within the range of the transmitter.

The X80 isolated transmitter has three output current spans. With neither J1 nor J2 installed, the output current span is 1 to 5 Ma. The installation of J1 increases the output span to 4 to 20 Ma. The installation of J2 increases the output span to 10 to 50 Ma.

## 7.5 MASTER MODULE (Schematic X84-1001)

### 7.5.1 POWER SUPPLIES

The master module contains a DC-DC converter that operates from a nominal 24V power supply. The DC-DC converter supplies the several unregulated voltages that are used to power the master module circuits. The converter is a magnetically coupled, self-saturating oscillator consisting of Q10, Q13, transformer T1 and associated components. Assume the operating condition where Q10 is turned on and Q13 is turned off. Transistor Q10 draws current from V+ through winding 1-2 of T1. This current flow causes voltages to be induced into all of the other windings on the transformer until the transformer becomes saturated. The voltage across winding 10-11 when transistor Q10 is turning on is polarized so that current flows from terminal 11, through the base-emitter junctions of Q10, through CR17 and R73 to terminal 10 of the transformer. When the transformer saturates, the flux field begins to collapse causing polarity reversals of the voltages in all the secondary windings. The current in winding 10-11 will now flow through the base-emitter junction of Q13, R73 and CR16. Transistor Q13 now turns on drawing current through winding 2-3 and a full cycle is completed when the transformer again saturates and the flux field begins to reverse again.

The voltage at winding 4-5-6 is full wave rectified by CR15 and CR14 and regulated to +6V by IC12. The voltage at the cathodes of CR10 and CR12 is regulated by the IC regulator IC1 to +12V. A precision 1V reference is supplied by the reference zener CR6, amplifier IC10 and associated components. The amplifier IC3 utilizes the 6.2V reference zener to make a stable 12V regulator whose output is at the emitter of Q12. The front panel ZERO control is in the feedback path of this amplifier and adjusts the -12V to the value required to obtain the correct zero indication on the DPM.

### 7.5.2 FLASH CIRCUIT OSCILLATORS

Integrated circuit IC7 is a quad, two-input nor gate used as two astable oscillator circuits, that generate the slow and fast flash signals used in the X84 system The two circuits are identical, except for the frequency determining components R11, R18, C5 and C9. Sections A and B of IC7, along with R1 and C5, comprise the fast flash oscillator circuit. This circuit sustains oscillations in the following manner: When pin 4 of IC7A is low, pin 3 of IC7B is high and the capacitor C3 is charging to the low potential (V–) through R11. When the voltage at the junction of R11 and C5 reaches the transfer voltage point of inverter Section A, pin 4 goes high (to +12V and pin 3 goes low. Capacitor C5 now charges through R11 to the +12V level at pin 4 on this half-cycle. Again, when the voltage at the junction of R11 and C5 reaches the transfer voltage point of inverter A, pin 4 goes low, pin 3 goes high and the cycle repeats itself. The inverter Section B drives the high current gain switch Q4 which pulls the systems' fast flash buss to V– at the fast flash rate. The slow flash circuit consisting of IC7C and IC7D, R18 and C9 functions in an identical manner to that described for the fast flash circuit. The time constant of R18 and C9 is longer so that the circuit oscillates at about 1 Hz.

### 7.5.3 SWITCH INTERFACE CIRCUITS

The front panel pushbutton switches TEST, ACKNOWLEDGE and RESET are routed to the X84 buss system through transistor switch circuits. The three transistor switch circuits are identical and only the TEST pushbutton will be described in detail. One pole of the test pushbutton, in the depressed position, connects V+ through R21 and R41 to the base of Q6. Transistor Q6 then pulls the test buss down to 0V (V–), which initiates the test function on the alarm modules. The test buss is pulled up to +15V when the TEST pushbutton is in its normal position. Capacitors C12 and C13 provide transient noise filtering. Capacitor C21 supplies current momentarily to the ACK transistor Q7, upon power turn-on to provide a temporary acknowledge signal to prevent points in normal condition from alarming.

The voltage V+, is routed to the TEST pushbutton through the SHUTDOWN BYPASS switch when in the BYPASS position. Therefore, the system cannot be tested unless the SHUTDOWN BYPASS switch is depressed.

### 7.5.4 HORN DRIVER

When any of the alarm boards in the X84 system are in an unacknowledged alarm or test condition, the system horn buss is pulled down to 0V (V–). This signal enters the master module at connector pin 21 and pulls down the junction of R59 and R57 turning off transistor Q9. With Q9 off, base current is supplied to Q8 through R55, turning Q8 on and energizing the horn relay mounted at the rear of the master module.

7.5.5 $^{o}$F – $^{o}$C SWITCH

The $^{o}$F – $^{o}$C pushbutton switch changes gains of the master module amplification circuits and causes an "F" or "C" to be displayed at the far right position of the display. The gain of amplifier IC4 is -.555 with the $^{o}$F - $^{o}$C switch in the $^{o}$C position. The gain is the ratio of R27 plus R26 to R30. In the $^{o}$F position, R30 is paralleled with R31, increasing the gain of IC4 to -1. Also, in the $^{o}$F position, R28 and R29 are connected to the summing junction of IC4 and add an offset voltage equal to 32$^{o}$F.

7.5.6 INPUT BUFFER AND LINEARIZATION AMPLIFIERS

The amplifier IC6, is used as a high impedance input buffer with a gain of +1. It's input is connected to the systems' analog signal buss which brings the amplified RTD signal from any input module to the master module. When no input or setpoint is selected for readout, the field-effect transistor switch Q1 is turned on connecting the input of IC6 to +1.000 volts (equivalent zero degrees C input value) the linearization code buss enters the master module at connector pin 24 and is applied to the high impedance buffer, IC3. The output of IC3 goes to the linearizer board(s) plugged into connectors J2 and (or) J3 and to the comparator IC2 which controls switch Q1. The output (at pin 6) of comparator IC2 is normally at +11V and swings to -11V when any of the systems inputs or setpoints is selected for display.

Linearization is accomplished by gain and offset changes in amplifier IC5. IC5 has a gain of -.5 over a non-linearized segment and its gain is caused to increase or decrease by linearizer circuit over all other segments. Resistor R33 removes the elevated zero of the signals coming from the monitor modules. When the front panel ZERO control is adjusted, the -12V is caused to change which modifies the zero voltage value through R33.

7.5.7 DIGITAL PANEL METER

The analog to digital conversion is accomplished by two integrated circuits on the master module board IC1 and IC9. Integrated circuit IC1 contains the control logic, display multiplexing circuitry and switches for controlling the states of the analog circuits in IC9. The conversion system uses the dual slope method and is divided into three time periods: an auto-zero period, a signal integrate period and a reference integrate period. Capacitor C2 is the integration capacitor and C3 is the auto zero capacitor. Two of the gates of IC8 are used with R4, R25, R24 and C6 to make a 10 kHz clock oscillator for the converter.

The display board (Schematic X84-1002) contains two binary coded decimal (BCD) to 7-segment decoders connected in parallel, current limiting resistor networks RN1 and RN2, displays DP1 through DP5 and display drivers Q1 through Q4.

### 7.5.8 OPTIONAL 115VAC POWER SUPPLY (Schematic X84B14)

The optional power supply operates from 115/220VAC, 60 Hz and mounts inside the master module. The X84 system, when utilizing this internal power supply, is limited to ten monitored points. Larger systems must use an external 24VDC power supply.

Transformer T1, will operate from 115VAC, 60 Hz (pin 4 connected to pin 6 and pin 5 connected to pin 7) or from 220VAC, 60 Hz (pin 5 connected to pin 6). The secondary voltage is full wave rectified by two of the diodes in U1 and filtered by capacitor C1. The unregulated 24V output is applied to the DC power input pins of the master module circuit board.

## 7.6 LINEARIZER BOARD (Schematic X84-1003)

The RTD temperature ranges over which the X84 system functions are divided into nine segments by the linearizer board. For eight of the segments, the effective gain of amplifier IC5 on the master module is caused to be increased or decreased by the linearizer board. The gain of the master module is decreased somewhat by each segment for nickel RTDs' and increased by each segment for platinum RTDs'. In order to be active, a linearizer board needs to be enabled by a signal at the linearization code input at connector, pin 1. This signal is applied to two comparators packaged in IC4, a "low" and a "high" comparator. A signal between the "low" and "high" comparator trip points will enable the linearizer board. The low trip value is set at the junction of R31 and R32 and the high trip value is set at the junction of R33 and R34. The platinum RTD linearizer is enabled for a linearization signal of +.4V $\pm$ 25% and the nickel RTD linearizer is enabled for a linearization signal of +.8V $\pm$ 25%.

Each of the comparators packaged in IC1 and IC2 initiates a linearization segment when the voltage at its "+" input equals the voltage at its "–" input. The amplified RTD signal enters the linearizer card at connector, pin 8 and is applied across eight voltage dividers whose other ends are connected to -12V. The functions of the components that are utilized at the first break point will be described in detail, the remaining seven break points function in an identical manner.

The first gain modifying segment is initiated when the voltage at the junctions of R2 and R10 equals 0V (This voltage is negative when the signal input is below the break value). The voltage at the junctions of R2 and R10 is applied to pin 5 of IC1 and causes the output at comparator A2 to switch from -12V to 0V. This 0V potential is applied to the gate of the field, effect transistor switch Q1, allowing Q1 to turn on and connect R20 to the summing junction of IC3 for nickel RTDs', or to the summing junction of IC5 on the master module for platinum RTDs'. As the input signal increases above the break point value, a current proportional to the signal flows through R20 into the summing junction of IC3 or IC5 on the master module board.

## 8.0 PARTS LIST - X84 MASTER MODULE, X84-100

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 1 | 1 | | X84-1001C | Printed Circuit Board | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | 3 | R56,68,71 | RC07GF100J | Resistor, ¼W, 5%, 10 Ohm | A. B. |
| 5 | 1 | R23 | RC07GF470J | Resistor, ¼W, 5%, 47 Ohm | A. B. |
| 6 | 1 | R67 | RC07GF101J | Resistor, ¼W, 5%, 100 Ohm | A. B. |
| 7 | 1 | R72 | RC07GF221J | Resistor, ¼W, 5%, 220 Ohm | A. B. |
| 8 | 2 | R74,75 | RC07GF150J | Resistor, ¼W, 5%, 15 Ohm | A. B. |
| 9 | 4 | R21,43,49,60 | RC07GF102J | Resistor, ¼W, 5%, 1K | A. B. |
| 10 | 1 | R2 | RC07GF222J | Resistor, ¼W, 5%, 2.2K | A. B. |
| 11 | 8 | R3,24,41,42, 47,48,53,58 | RC07GF472J | Resistor, ¼W, 5%, 4.7K | A. B. |
| 12 | 11 | R12,35,36,38, 39,45,55,57,59, 65,76 | RC07GF103J | Resistor, ¼W, 5%, 10K | A. B. |
| 13 | | | | | |
| 14 | 3 | R37,44,46 | RC07GF153J | Resistor, ¼W, 5%, 15K | A. B. |
| 15 | 5 | R7,13,15,40, 66 | RC07GF473J | Resistor, ¼W, 5%, 47K | A. B. |
| 16 | 1 | R17 | RC07GF334J | Resistor, ¼W, 5%, 330K | A. B. |
| 17 | | | | | |
| 18 | 4 | R6,10,11,19 | RC07GF684J | Resistor, ¼W, 5%, 680K | A. B. |
| 19 | 1 | R18 | RC07GF225J | Resistor, ¼W, 5%, 2.2M | A. B. |
| 20 | 1 | R14 | RC07GF226J | Resistor, ¼W, 5%, 22M | A. B. |
| 21 | | | | | |
| 22 | 1 | R54 | RC32GF100J | Resistor, 1W, 5%, 10 Ohm | A. B. |
| 23 | 1 | R73 | RC42GF680J | Resistor, 2W, 5%, 680 Ohm | A. B. |
| 24 | | | | | |
| 25 | 5 | R22,61,62,63, 64 | | Not Used | |
| 26 | 1 | R20 | | Not Normally Used | |
| 27 | 1 | R52 | RN55C7320 | Resistor, 1/8W, 1%, 732 Ohm | Mepco |
| 28 | 2 | R9,50 | RN55C1911 | Resistor, 1/8W, 1%, 1.91K | Mepco |
| 29 | 1 | R8 | RN55C7681 | Resistor, 1/8W, 1%, 7.68K | Mepco |
| 30 | | | | | |
| 31 | 1 | R51 | RN55C1022 | Resistor, 1/8W, 1%, M. F., 10.2K | Mepco |
| 32 | 1 | R70 | RN55C1242 | Resistor, 1/8W, 1%, M. F., 12.4K | Mepco |
| 33 | | | | | |
| 34 | 1 | R69 | RN55C2262 | Resistor, 1/8W, 1%, M. F., 22.6K | Mepco |
| 35 | 1 | R25 | RN55C8062 | Resistor, 1/8W, 1%, M. F., 80.6K | Mepco |
| 36 | 1 | R16 | RN55C2263 | Resistor, 1/8W, 1%, M. F., 226K | Mepco |
| 37 | 2 | R28,29 | RN55C1823 | Resistor, 1/8W, 1%, M. F., 182K | Mepco |
| 38 | | | | | |
| 39 | | | | | |
| 40 | 1 | R27 | EI-17 995 Ohm ± 0.1% | Resistor, W.W., 995 Ohm ± 0.1% | Elliott, Jordan |

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 41 | 1 | R30 | EI-17 1.8K ± 0.05% | Resistor, W. W., 1.8K ± 0.05% | Elliott, Jordan |
| 42 | 1 | R31 | EI-17 2.25K ± 0.05% | Resistor, W. W., 2.25K ± 0.05% | Elliott, Jordan |
| 43 | 1 | R32 | EI-17 5.0K ± 0.05% | Resistor, W. W., 5.0K ± 0.05% | Elliott, Jordan |
| 44 | 1 | R34 | EI-17 10.0K ± 0.1% | Resistor, W. W., 10.0K ± 0.1% | Elliott, Jordan |
| 45 | 1 | R33 | EI-17 120K ± 0.1% | Resistor, W. W., 120K ± 0.1% | Elliott, Jordan |
| 46 | 1 | C6 | DM15-471J | Capacitor, D. Mica, 470 pfd | Arco |
| 47 | 1 | C26 | 5GA-D10 | Capacitor, Disc., .001 mfd | Sprague |
| 48 | 1 | C22 | TG-S10 | Capacitor, Disc., .01 mfd | Sprague |
| 49 | 2 | C16,23 | TGL-S50 | Capacitor, Disc., .05 mfd | Sprague |
| 50 | 6 | C7,8,15,17,29, 30 | 198D685X9035K1 | Capacitor, Tantalum 6.8 mfd/35V | Sprague |
| 51 | 6 | C5,11,12,13, 14, 20 | C280AE/A100K | Capacitor, Polyester .1 mfd | Mepco |
| 52 | 1 | C9 | C280AE/A220K | Capacitor, Polyester .22 mfd | Mepco |
| 53 | 3 | C24,25,27 | ET100X063A3 | Capacitor, Electrolytic 10 mfd/63V | Mepco |
| 54 | 1 | C21 | ET470X040A5 | Capacitor, Electrolytic 47 mfd/40V | Mepco |
| 55 | 1 | C18 | ET151X025A6 | Capacitor, Electrolytic 150 mfd/25V | Mepco |
| 56 | 2 | C1,3 | C280MAH/A1M | Capacitor, Polyester 1 mfd | Mepco |
| 57 | 1 | C2 | 71-334A10 | Capacitor, Polycarbonate .33 mfd | Texas Cap. Co. |
| 58 | | | | | |
| 59 | 3 | C4,10,19 | | Not Used | |
| 60 | 1 | CR2 | 1N457 | Diode, Low Leakage | Fairchild |
| 61 | 10 | CR1,5,9,10,11, 12,13,16,17,18 | 1N4148 | Diode, Signal 1N4148 | Fairchild |
| 63 | 2 | CR14,15 | 1N4934 | Diode, Rectifier | Motorola |
| 64 | 1 | CR6 | 1N827A | Diode, Reference 6.2V | Motorola |
| 65 | 2 | CR7,8 | 1N4005 | Diode, Rectifier | Motorola |
| 66 | 1 | Q1 | 2N4392 | Field-Effect Transistor | Motorola |
| 67 | 2 | Q10,13 | MJE243 | Transistor, NPN | Motorola |
| 68 | 8 | Q2,3,4,5,6,7,8,9 | 92PU01A | Transistor, NPN | National |
| 69 | 1 | Q12 | PN4249 | Transistor, PNP | Fairchild |
| 70 | 1 | Q11 | | Not Used | |
| 71 | 1 | | 3428-2002 | Connector | 3M |
| 72 | 1 | IC12 | 7806UC | Voltage Regulator, +6V | Fairchild |
| 73 | 1 | IC11 | 78M12UC | Voltage Regulator, +12V | Fairchild |
| 74 | 4 | IC2,5,10,13 | LM307N | Op-Amp | National |
| 75 | 2 | | 2VH10/1AK5 | Connector | Viking |
| 76 | 2 | IC4,6 | μA714HC | Precision Op-Amp | Fairchild |
| 77 | 1 | IC3 | LF355N | Bi-Fet Op-Amp | National |
| 78 | 2 | IC7,8 | CD4001BE | Quad 2-Input Nor Gate | RCA |
| 79 | | | | | |
| 80 | 1 | IC1 | ICL7103CPI | 4½ Digit Digital Processor | Intersil |

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 81 | 1 | IC9 | ICL8052A | A/D Converter Analog Proc. | Intersil |
| 82 | 1 | R5 | 89PR200 Ohm | Potentiometer, Cermet 15T | Beckman |
| 83 | 1 | R1 | 89PR5K | Potentiometer, Cermet 15T | Beckman |
| 84 | 1 | R4 | 89PR50K | Potentiometer, Cermet 15T | Beckman |
| 85 | 1 | R26 | 72PR20 Ohm | Potentiometer, Cermet 1T | Beckman |
| 86 | 1 | LED1 | 550-0405 | Light Emitting Diode | Dialight |
| 87 | 1 | T1 | X80B12B | Transformer | Mag. Devices |
| 88 | 1 | SW1 | 205CS75-877 | Pushbutton Sw, 4 Sta. | Switchcraft |
| 89 | 1 | | | Jumpers: JR1 (Norm Used) ☐<br>JR2 (Used with DPM) ☐<br>JR3 (Norm Used) ☐<br>JR4 (Not Used with Ext. S.D. Bypass Sw.) ☐ | |
| 90 | 2 | J2,3 | | 10 Pin P. C. Connector | |

## PARTS LIST - X84 DISPLAY BOARD, X84-101

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 1 | 1 | | X84-1002 | Printed Circuit Board | |
| 2 | 1 | | X80A11 | Cable with Connectors | 3M |
| 3 | | | | | |
| 4 | 2 | R3,4 | RC07GF152J | Resistor, ¼W, 5%, 1.5K | A. B. |
| 5 | | | | R3 - One Digit to Right of Dec. Point □ | |
| 6 | | | | R4 - Two Digits to Right of Dec. Point □ (Items 5 and 6 Optional) | |
| 7 | | | | R3, R4 Not Used (Standard) □ | |
| 8 | | | | | |
| 9 | 2 | R1,2 | RC07GF472J | Resistor, ¼W, 5%, 4.7K | A. B. |
| 10 | 1 | RN1 | 899-3 120 Ohm | Resistor, Network 120 Ohm | Beckman |
| 11 | 1 | RN2 | 899-3 680 Ohm | Resistor, Network 680 Ohm | Beckman |
| 12 | 2 | IC1,2 | CD4511BE | Latch, Bcd. to 7-Segment Decoder | RCA |
| 13 | 4 | DP1,2,3,4 | FND560 | Common Cathode, 7-Segment LED Display | Fairchild |
| 14 | 1 | DP5 | FND561 | LED Display ± 1 | Fairchild |
| 15 | 4 | Q1,2,3,4 | 2N3569 to 105 pkg. | Transistor, NPN | Fairchild |

## PARTS LIST - X84 RTD LINEARIZER SYSTEM, X84-200

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 1 | 1 | | X84-1003 | Printed Circuit Board | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | 2 | R1,35 | RC07GF470J | Resistor, ¼W, 5%, 47 Ohm | A. B. |
| 5 | 1 | R18 | RC07GF472J | Resistor, ¼W, 5%, 4.7K | A. B. |
| 6 | 1 | R19 | RC07GF273J | Resistor, ¼W, 5%, 27K | A. B. |
| 7 | 1 | RP1 | 898-3-33K | Resistor Network, 33K | Beckman |
| 8 | | | | | |
| 9 | | | | | |
| 10 | 1 | R28 | RN55C1002 | Resistor, 1/8", 1%, 10K | Mepco |
| 11 | 2 | R31,33 | RN55C2372 | Resistor, 1/8", 1%, 23.7K | Mepco |
| 12 | 8 | R10,11,12, 13,14,15,16, 17 | RN55C4992 | Resistor, 1/8", 1%, 49.9K | Mepco |
| 13 | | | | | |
| 14 | 1 | R30 | RN55C9091 | Resistor, 1/8", 1%, 9.09K | Mepco |
| 15 | | | | | |
| 16 | | | | | |
| 17 | | | | | |
| 18 | | | | | |
| 19 | | | | | |
| 20 | | | | | |
| 21 | | Resistors are RN55C, 1% | | | |
| 22 | | | | | |
| 23 | | | | | |
| 24 | | | | | |
| 25 | | | | | |
| 26 | | | | | |
| 27 | | | | | |
| 28 | | | | | |
| 29 | 1 | R29 | 89PR2K | Potentiometer, Cermet 2K | Beckman |
| 30 | | | | | |

| | −100 | −120 |
|---|---|---|
| R2 | 4.12K | 4.12K |
| R3 | 5.23K | 4.75K |
| R4 | 6.19K | 5.36K |
| R5 | 7.15K | 6.04K |
| R6 | 8.06K | 6.65K |
| R7 | 9.09K | 7.5K |
| R8 | 10K | 8.45K |
| R9 | 10.7K | 9.53K |
| R20 | 464K | 97.6K |
| R21 | 365K | 90.9K |
| R22 | 267K | 133K |
| R23 | 499K | 127K |
| R24 | 392K | 147K |
| R25 | 226K | 124K |
| R26 | 249K | 127K |
| R27 | 324K | 110K |
| | | |
| | | |
| R32 | 604 | 1.24K |
| R34 | 1.02K | 2.15K |
| JPRS | J2,3 | J1,2 |
| | | |

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 31 | 2 | CR1,2 | 1N4148 | Diode Signal | Fairchild |
| 32 | | | | | |
| 33 | 2 | IC1,2 | LM339N | Quad Comparator | National |
| 34 | 1 | IC4 | LM358N | Dual Op-Amp | National |
| 35 | 1 | IC3 | µA714HC | Prec. Op-Amp | Fairchild |
| 36 | | | | | |
| 37 | 8 | Q1,2,3,4,5, 6,7,8 | 2N4093 | Transistor, Field-Effect | Motorola |
| 38 | | | | | |
| 39 | 3 | C1,2,3 | 198D685X9035K1 | Capacitor, Tant 6.8/35V | Sprague |
| 40 | 8 | C5,6,7,8, 9,10,11,12 | 198D225X9035K1 | Capacitor, Tant 2.2/35V | Sprague |
| 41 | 2 | C4,13 | TG-S20 | Capacitor, Ceram Disc., .02 mfd | Sprague |
| 42 | | | | | |
| 43 | | | | | |
| 44 | | | | | |
| 45 | | | | | |

# PARTS LIST - RTD MONITOR, SINGLE INPUT, SINGLE SETPOINT, X84-300

| Item | Qty | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 1 | 1 | | X84-1005 | Printed Circuit Board | |
| 2 | 1 | | X80B118 | Bracket | Ronan |
| 3 | 1 | | | Lamp Holder | Ronan |
| 4 | 1 | R23 | RC07GF100J | Resistor, ¼W, 5%, 10 Ohm | A. B. |
| 5 | 1 | R21 | RC07GF271J | Resistor, ¼W, 5%, 270 Ohm | A. B. |
| 6 | 2 | R36,42 | RC07GF102J | Resistor, ¼W, 5%, 1K | A. B. |
| 7 | 1 | R22 | RC07GF682J | Resistor, ¼W, 5%, 6.8K | A. B. |
| 8 | 3 | R6,8,14 | RC07GF103J | Resistor, ¼W, 5%, 10.0K | A. B. |
| 9 | | | | | |
| 10 | 4 | R17,18,29, 35 | RC07GF273J | Resistor, ¼W, 5%, 27K | A. B. |
| 11 | | | | | |
| 12 | 1 | R40 | | 18K Use for Norm. Energized Relay ☐ | |
| 13 | 1 | R41 | | 18K Use for Norm. Non-Energized Relay ☐ (Items 12 and 13 One Only Used) | |
| 14 | | | | | |
| 15 | 1 | R30 | RC07GF683J | Resistor, ¼W, 5%, 68K | A. B. |
| 16 | 4 | R27,28,31, 32 | RC07GF104J | Resistor, ¼W, 5%, 100K | A. B. |
| 17 | 1 | R34 | RC07GF394J | Resistor, ¼W, 5%, 390K | A. B. |
| 18 | 2 | R19,33 | RC07GF564J | Resistor, ¼W, 5%, 560K | A. B. |
| 19 | 1 | R16 | RC07GF106J | Resistor, ¼W, 5%, 10M | A. B. |
| 20 | | | | | |
| 21 | | | | | |
| 22 | 1 | R1 | RN55C2000 | Resistor, 1/8W, 1%, M.F., 200 Ohm | Mepco |
| 23 | 1 | R15 | RN55C2431 | Resistor, 1/8W, 1%, M.F., 2.43K | Mepco |
| 24 | 1 | R24 | RN55C1582 | Resistor, 1/8W, 1%, M.F., 15.8K | Mepco |
| 25 | 1 | R38 | RN55C2152 | Resistor, 1/8W, 1%, M.F., 21.5K | Mepco |
| 26 | 1 | R37 | RN55C4872 | Resistor, 1/8W, 1%, M.F., 48.7K | Mepco |
| 27 | | | | | |
| 28 | 2 | R7,10 | RN55C1003 | Resistor, 1/8W, 1%, M.F., 100K | Mepco |
| 29 | | | | | |
| 30 | | | | | |
| 31 | | | | | |
| 32 | | | | | |
| 33 | | | | | |
| 34 | | | | | |
| 35 | | | | | |
| 36 | | | | | |
| 37 | | | | | |
| 38 | | | | | |
| 39 | | | | | |
| 40 | | | | | |
| 41 | | | | | |
| 42 | | | | | |

| | X84-300-10 | X84-300-100 | X84-300-120 | |
|---|---|---|---|---|
| R3 | 11 | 36.5 | 95.3 | RN55C |
| R4 | 11 | NOT USED | NOT USED | RN55C |
| R5 | 3.16K | 21.5K | 21.5K | RN55C |
| R2 | 3.74K | NOT USED | NOT USED | RN55C |
| R25 | 11.8K | 13.7K | 12.7K | RN55C |
| R26 | 2.43K | 806 | 1.62K | RN55C |
| R9,11 | 6.81K | 9.53K | 19.1K | RN55C |
| R13 | 29.4K | 37.4K | 53.6K | RN55C |
| R20 | 5K POT | 10K POT | 10K POT | 89PR |

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 43 | | | | | |
| 44 | | | | | |
| 45 | | | | | |
| 46 | 1 | R39 | 89PR50 | Potentiometer, Cermet 50 Ohm | Beckman |
| 47 | 1 | R12 | 72P100K | Potentiometer, Cermet 100K | Beckman |
| 48 | | | | | |
| 49 | 1 | C7 | DM15-391J | Capacitor, D. Mica, 390 pfd | Arco |
| 50 | 2 | C8,10 | TG-S10 | Capacitor, Ceram Disc., .01 mfd | Sprague |
| 51 | 7 | C1,2,3,4,5,6,9 | 198D685X9035K1 | Capacitor, Tant., 6.8 mfd/35 | Sprague |
| 52 | | | | | |
| 53 | 1 | CR3 | 1N4005 | Diode, Rectifier | Fairchild |
| 54 | 5 | CR2,4,5,6,7 | 1N4148 | Diode, Signal | Fairchild |
| 55 | | | | | |
| 56 | 1 | CR1 | | Diode, Signal, 1N4148 Use for "Latching" Relay ☐ | |
| 57 | | | | | |
| 58 | 1 | Q2 | 92PU01A | Transistor, NPN | National |
| 59 | 2 | Q1,3 | 92PU45A | Transistor, NPN | National |
| 60 | | | | | |
| 61 | 1 | IC3 | μA723C | Precision Voltage Reg. | Fairchild |
| 62 | 1 | IC1 | LM358N | Dual Op-Amp | National |
| 63 | 1 | IC2 | LM393AN | Dual Comparator | National |
| 64 | 1 | IC4 | CD4093BE | Quad 2-Input Nand Gate | RCA |
| 65 | 1 | IC5 | CD4001BE | Quad 2-Input Nor Gate | RCA |
| 66 | | | | | |
| 67 | 1 | K1 | R50-E0035-1 | DPDT Relay | P & B |
| 68 | | | | | |
| 69 | 1 | S1 | 7205SD9AB | Switch DPDT with Center Off | C & K |
| 70 | | | | | |
| 71 | 2 | | | Screwswitch: HI ☐ N.O. ☐ | |
| 72 | | | | LO ☐ N.C. ☐ | |
| 73 | | | | | |
| 74 | | | | | |
| 75 | | | | | |

## RTD MONITOR, DUAL INPUT, SINGLE SETPOINT, X84-302

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 1 | 1 | | X84-1007 | Printed Circuit Board | |
| 2 | 1 | | X80B118 | Bracket | Ronan |
| 3 | 1 | R21 | RC07GF100J | Resistor, ¼W, 5%, 10 Ohm | A. B. |
| 4 | 1 | R1 | RC07GF101J | Resistor, ¼W, 5%, 100 Ohm | A. B. |
| 5 | 2 | R47,72 | RC07GF102J | Resistor, ¼W, 5%, 1K | A. B. |
| 6 | 1 | R2 | RC07GF682J | Resistor, ¼W, 5%, 6.8K | A. B. |
| 7 | 6 | R8,10,17,19, 25,36 | RC07GF103J | Resistor, ¼W, 5%, 10K | A. B. |
| 8 | | | | | |
| 9 | 8 | R48,49,50,51, 59,63,64,67 | RC07GF273J | Resistor, ¼W, 5%, 27K | A. B. |
| 10 | | | | | |
| 11 | 4 | R57,61,62,66 | RC07GF683J | Resistor, ¼W, 5%, 68K | A. B. |
| 12 | 4 | R52,53,58,65 | RC07GF104J | Resistor, ¼W, 5%, 100K | A. B. |
| 13 | 3 | R54,56,60 | RC07GF564J | Resistor, ¼W, 5%, 560K | A. B. |
| 14 | 1 | R55 | RC07GF394J | Resistor, ¼W, 5%, 390K | A. B. |
| 15 | 2 | R35,43 | RC07GF106J | Resistor, ¼W, 5%, 10M | A. B. |
| 16 | 2 | R11,20 | RN55C2000 | Resistor, 1%, M. Film, 200 Ohm | Mepco |
| 17 | 1 | R22 | RN55C1581 | Resistor, 1%, M. Film, 15.8K | Mepco |
| 18 | 2 | R5,14 | RN55C2152 | Resistor, 1%, M. Film, 21.5K | Mepco |
| 19 | | | | | |
| 20 | 2 | R34,42 | RN55C2431 | Resistor, 1%, M. Film, 2.43K | Mepco |
| 21 | | | | | |
| 22 | 2 | R29,38 | RN55C4872 | Resistor, 1%, M. Film, 48.7K | Mepco |
| 23 | 4 | R26,33,37,46 | RN55C1003 | Resistor, 1%, M. Film, 100K | Mepco |
| 24 | | | | | |
| 25 | | | | | |
| 26 | 2 | R9,18 | 89PR50 | Potentiometer, Cermet 50 Ohm | Beckman |
| 27 | | | | | |
| 28 | 2 | R28,41 | 72P100K | Potentiometer, Cermet 100K (1 turn) | Beckman |
| 29 | | | | | |
| 30 | | | | | |

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 31 | | | | | |
| 32 | | | | | |
| 33 | | | | | |
| 34 | | | | | |
| 35 | | | | | |
| 36 | | | | | |
| 37 | | | | | Resistors are |
| 38 | | | | | RN55C, 1% |
| 39 | | | | | |
| 40 | | | | | |
| 41 | | | | | |
| 42 | | | | | |
| 43 | | | | | |
| 44 | | | | | |
| 45 | | | | | |

| | X84-302-10 | X84-302-100 | X84-302-120 |
|---|---|---|---|
| R3,12 | 3.74K | NOT USED | NOT USED |
| R6,15 | 11 | 36.5 | 95.3 |
| R4,13 | 3.16K | 21.5K | 21.5K |
| R7,16 | 11 | NOT USED | NOT USED |
| R27,30,40,45 | 6.81K | 9.53K | 19.1K |
| R31,44 | 59K | 100K | 127K |
| R23 | 11.8K | 13.7K | 12.7K |
| R24 | 2.43K | 806 | 1.62K |
| R32,39 | 5K POT | 10K POT | 10K POT |

Resistance Table

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 46 | 1 | C1 | DM15-391J | Capacitor, D. Mica, 390 pfd | Arco |
| 47 | 3 | C12,14,15 | TG-S10 | Capacitor, Ceram Disc., .01 mfd | Sprague |
| 48 | 12 | C2,3,4,5,6,7,8, 9,10,11,13,16 | 198D685X9035K1 | Capacitor, Tant., 6.8 mfd/35V | Sprague |
| 49 | | | | | |
| 50 | 1 | CR1 | 1N4005 | Diode, Rectifier 1N4005 | Fairchild |
| 51 | 9 | CR2,4,5,6,7, 9,10,11,12 | 1N4148 | Diode, Signal 1N4148 | Fairchild |
| 52 | | | | | |
| 53 | 1 | CR3 | 1N4148 For "Latching" Relay | Diode, Signal 1N4148 | Fairchild |
| 54 | 1 | CR8 | 1N4148 for "Latching" Relay | Diode, Signal 1N4148 | Fairchild |
| 55 | | | | | |
| 56 | 2 | R68,70 | RC07GF183J | 18K Use for Norm Energized Relay □ | |
| 57 | 2 | R69,71 | RC07GF183J | 18K Use for Norm Non-Energized Relay □ (Items 56 and 57 - One Pair (Only) Used) | |
| 58 | | | | | |
| 59 | | | | | |
| 60 | 1 | | X80B35 | Lamp Holder - Dual Window Version | Ronan |
| 61 | 1 | Q3 | 92PU01A | Transistor, NPN | National |
| 62 | 4 | Q1,2,4,5 | 92PU45A | Transistor, NPN | National |
| 63 | 1 | IC1 | µA723C | Prec. Voltage Reg. µA723C | Fairchild |
| 64 | 2 | IC2,3 | LM358N | Dual Op-Amp LM358N | National |
| 65 | 1 | IC4 | LM393AN | Dual Comparator LM393AN | National |

| Item | Qty. | Code | Part No. | Description | Vendor |
| --- | --- | --- | --- | --- | --- |
| 66 | 1 | IC5 | CD4093BE | Quad 2-Input Nand Gate (Schmitt Trigger) | RCA |
| 67 | 2 | IC6,7 | CD4001BE | Quad 2-Input Nor Gate | RCA |
| 68 | 1 | IC8 | CD4049UB | Hex Inverter | RCA |
| 69 | 2 | K1,2 | R50-E0035-1 | DPDT Relay | P & B |
| 70 | | | | | |
| 71 | 2 | S1,2 | 7205SD9AB | Switch, DPDT Momentary with Center Off | C & K |
| 72 | | | | | |
| 73 | 4 | | | Screwswitch: CH 1: HI ☐ LO ☐; CH 2: HI ☐ LO ☐ (Alarm)<br>CH 1: N.O. ☐ N.C. ☐; CH 2: N.O. ☐ N.C. ☐ (Relay Contacts) | |

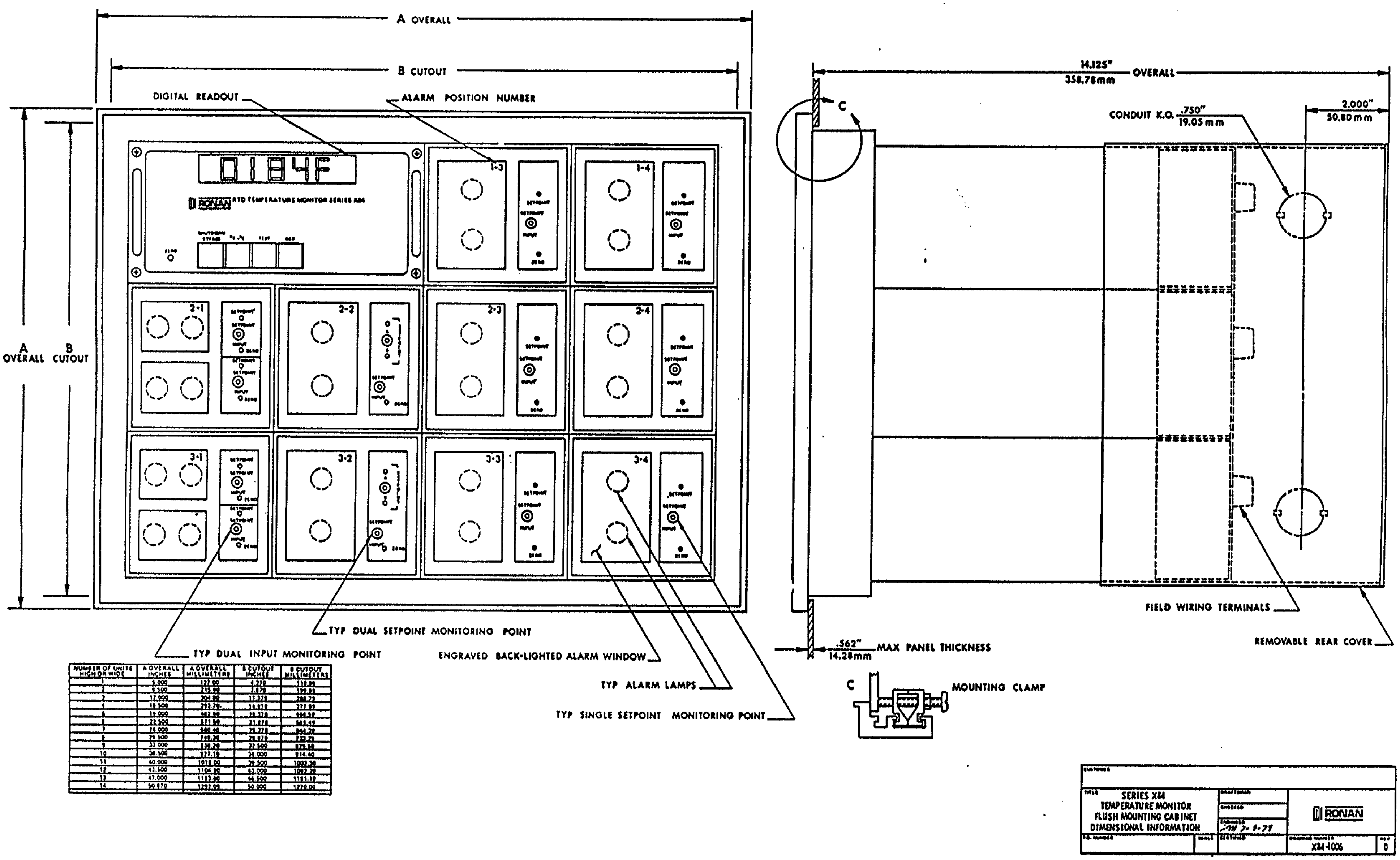
## RTD MONITOR, SINGLE INPUT, DUAL SETPOINT, X84-400

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 1 | 1 | | X84-1004 | Printed Circuit Board | |
| 2 | 1 | | X80B118 | Bracket | Ronan |
| 3 | 1 | | | Lamp Holder | Ronan |
| 4 | 1 | R25 | RC07GF100J | Resistor, ¼W, 5%, 10 Ohm | A. B. |
| 5 | 1 | R21 | RC07GF101J | Resistor, ¼W, 5%, 100 Ohm | A. B. |
| 6 | | | | | |
| 7 | 1 | R43 | RC07GF272J | Resistor, ¼W, 5%, 2.7K | A. B. |
| 8 | 1 | R26 | RC07GF682J | Resistor, ¼W, 5%, 6.8K | A. B. |
| 9 | 3 | R17,35,57 | RC07GF103J | Resistor, ¼W, 5%, 10K | A. B. |
| 10 | | | | | |
| 11 | 6 | R2,3,4,7,27, 28 | RC07GF183J | Resistor, ¼W, 5%, 18K | A. B. |
| 12 | | | | | |
| 13 | 2 | R5,48 | | 18K Use for Norm Energized Relay □ | A. B. |
| 14 | 2 | R6,47 | | 18K Use for Norm Non-Energized Relay □ (Items 13 and 14 - One Pair Only Used) | |
| 15 | 4 | R10,12,49, 50 | RC07GF273J | Resistor, ¼W, 5%, 27K | A. B. |
| 16 | 4 | R8,29,42,46 | RC07GF104J | Resistor, ¼W, 5%, 100K | A. B. |
| 17 | 6 | R38,39,40 41,44,45 | RC07GF224J | Resistor, ¼W, 5%, 220K | A. B. |
| 18 | 1 | R31 | RC07GF394J | Resistor, ¼W, 5%, 390K | A. B. |
| 19 | 3 | R9,30,32 | RC07GF564J | Resistor, ¼W, 5%, 560K | A. B. |
| 20 | 2 | R13,51 | RC07GF106J | Resistor, ¼W, 5%, 10 Meg | A. B. |
| 21 | | | | | |
| 22 | | | | | |
| 23 | 1 | R1 | RN55C2000 | Resistor, 1/8W, 1%, M.F., 200 Ohm | Mepco |
| 24 | 2 | R14,52 | RN55C2431 | Resistor, 1/8W, 1%, M.F., 2.43K | Mepco |
| 25 | 1 | R24 | RN55C1582 | Resistor, 1/8W, 1%, M.F., 15.8K | Mepco |
| 26 | 1 | R56 | RN55C2152 | Resistor, 1/8W, 1%, M.F., 21.5K | Mepco |
| 27 | 2 | R11,15 | RN55C4872 | Resistor, 1/8W, 1%, M.F., 48.7K | Mepco |
| 28 | 2 | R36,55 | RN55C1003 | Resistor, 1/8W, 1%, M.F., 100K | Mepco |
| 29 | | | | | |
| 30 | | | | | |

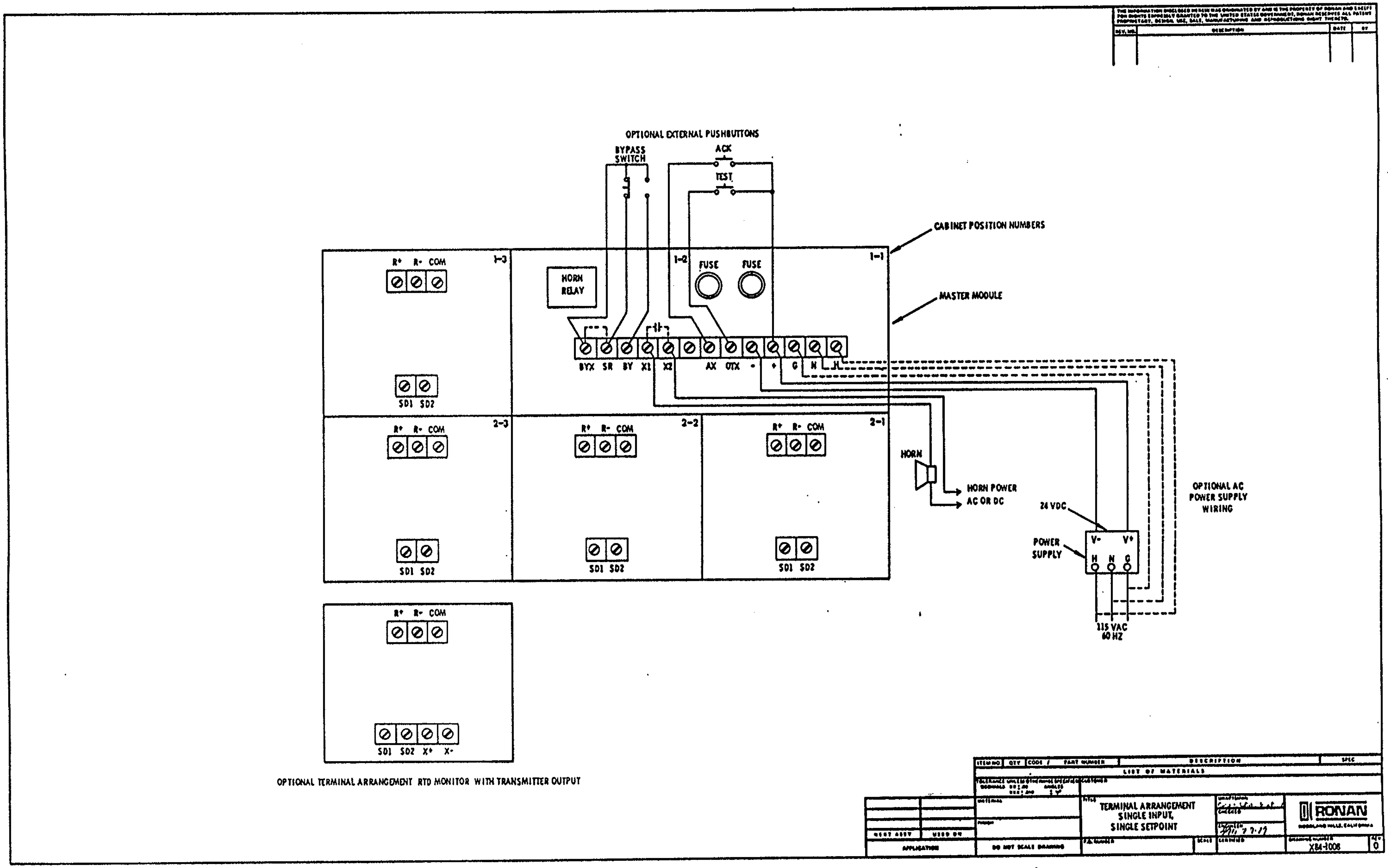
| Item | Code | X84-400-10 | X84-400-100 | X84-400-120 | Vendor |
|---|---|---|---|---|---|
| 31 | | | | | |
| 32 | | | | | |
| 33 | R18 | 11 | 36.5 | 95.3 | RN55C |
| 34 | R19 | 11 | NOT USED | NOT USED | RN55C |
| 35 | R16 | 3.16K | 21.5K | 21.5K | RN55C |
| 36 | R58 | 3.74K | NOT USED | NOT USED | RN55C |
| 37 | R23 | 11.8K | 13.7K | 12.7K | RN55C |
| 38 | R22 | 2.43K | 806 | 1.62K | RN55C |
| 39 | R53,54 | 6.81K | 9.53K | 19.1K | RN55C |
| 40 | R34 | 29.4K | 37.4K | 53.6K | RN55C |
| 41 | R20,37 | 5K POT | 10K POT | 10K POT | 89PR |
| 42 | | | | | |
| 43 | | | | | |
| 44 | | | | | |
| 45 | | | | | |

| Item | Qty. | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 46 | 1 | R59 | 89PR50 | Potentiometer, Cermet 50 Ohm | Beckman |
| 47 | 1 | R33 | 72P100K | Potentiometer, Cermet 100K | Beckman |
| 48 | | | | | |
| 49 | 1 | C7 | DM15-391J | Capacitor, D. Mica., 390 pfd | Arco |
| 50 | 4 | C1,8,12,13 | TG-S10 | Capacitor, Ceram. Disc., .01 mfd | Sprague |
| 51 | 9 | C2,3,4,5,6,8, 9,10,11 | 198D685X9035K1 | Capacitor, Tant., 6.8 mfd/35 | Sprague |
| 52 | | | | | |
| 53 | 1 | CR6 | 1N4005 | Diode, Rectifier | Fairchild |
| 54 | 7 | CR1,2,3,4,7, 8,9 | 1N4148 | Diode, Signal | Fairchild |
| 55 | | | | | |
| 56 | 2 | CR5,10 | | Diode, Signal, 1N4148 Use for "Latching" Relay ☐ | |
| 57 | | | | | |
| 58 | 1 | Q2 | 92PU01A | Transistor, NPN | National |
| 59 | 3 | Q1,3,4 | 92PU45A | Transistor, NPN | National |
| 60 | | | | | |
| 61 | 1 | IC3 | μA723C | Precision Voltage Reg. | Fairchild |
| 62 | 1 | IC7 | LM358N | Dual Op-Amp | National |
| 63 | 1 | IC6 | LM393AN | Dual Comparator | National |
| 64 | 2 | IC2,8 | CD4093BE | Quad 2-Input Nand Gate | RCA |
| 65 | 2 | IC1,5 | CD4001BE | Quad 2-Input Nor Gate | RCA |

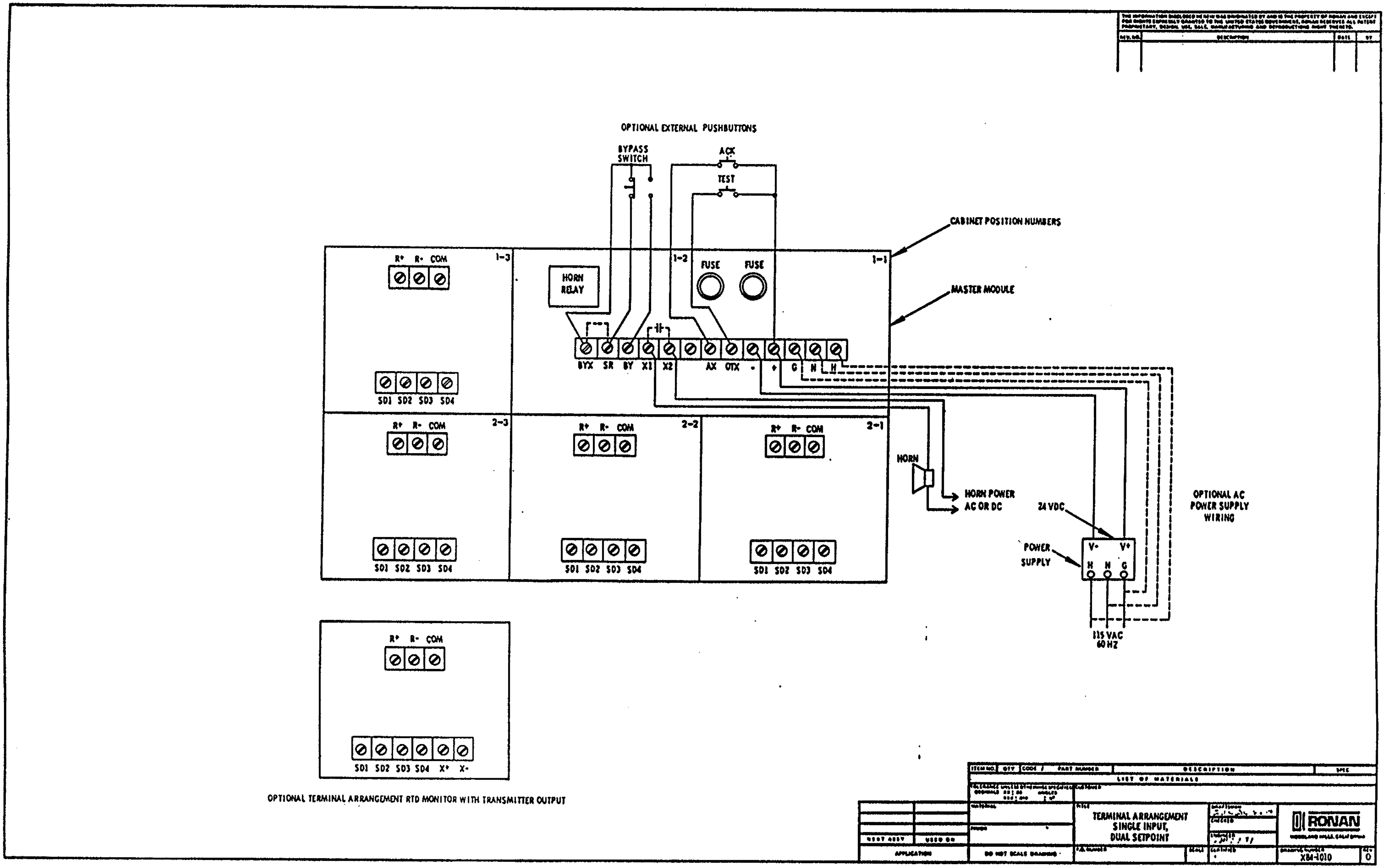
| Item | Qty | Code | Part No. | Description | Vendor |
|---|---|---|---|---|---|
| 66 | 1 | IC4 | CD4073BE | Triple 3-Input And Gate | RCA |
| 67 | | | | | |
| 68 | 2 | K1,2 | R50-E0035-1 | DPDT Relay | P & B |
| 69 | | | | | |
| 70 | 1 | S2 | 7205SD9AB | Switch DPDT with Center Off | C & K |
| 71 | 1 | S1 | 7101SD9AB | Switch SPDT | C & K |
| 72 | | | | | |
| 73 | 4 | | | Screwswitch: HI ☐ N. O. ☐ / LO ☐ N. C. ☐ (A)<br>HI ☐ N. O. ☐ / LO ☐ N. C. ☐ (B) | |

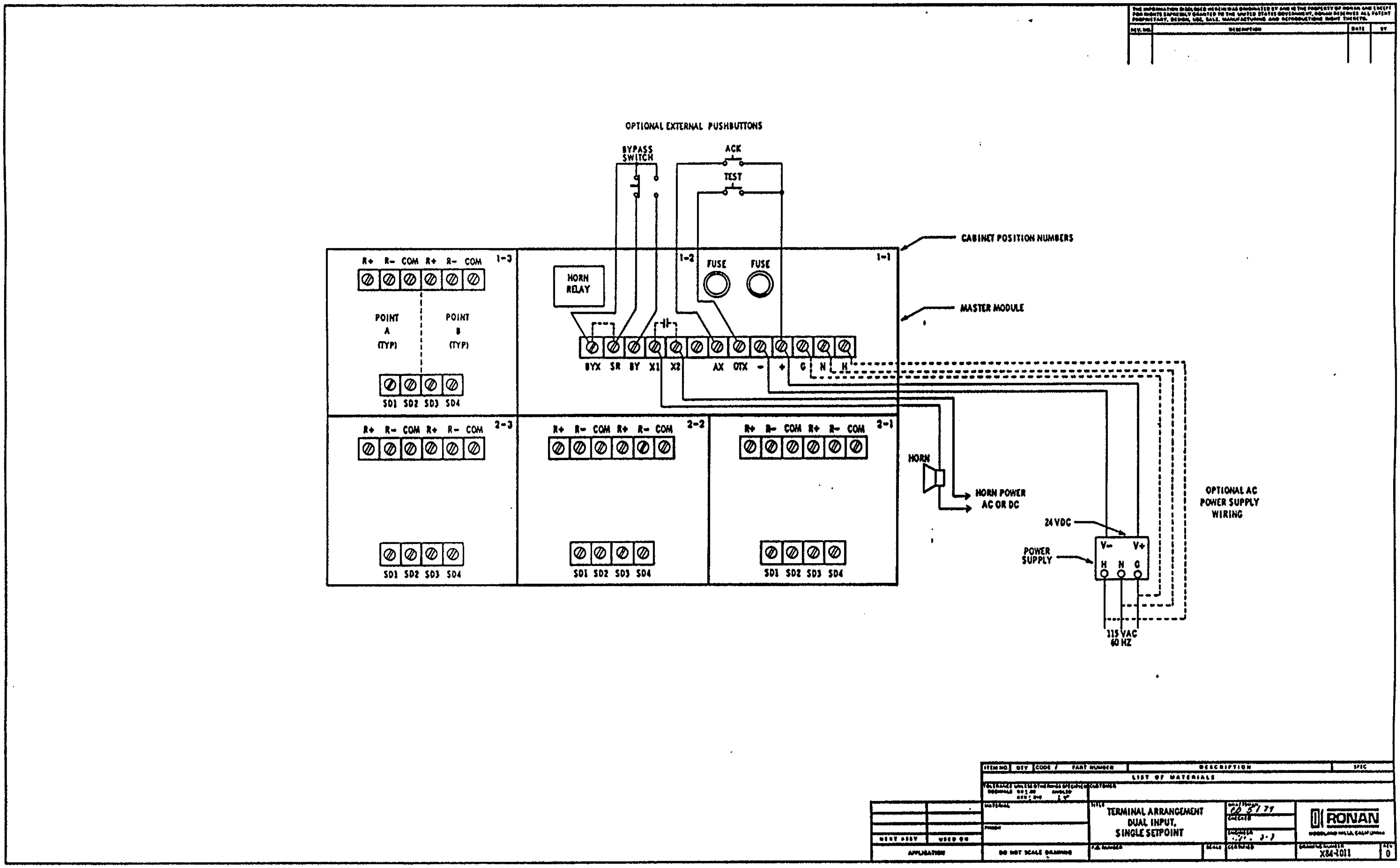


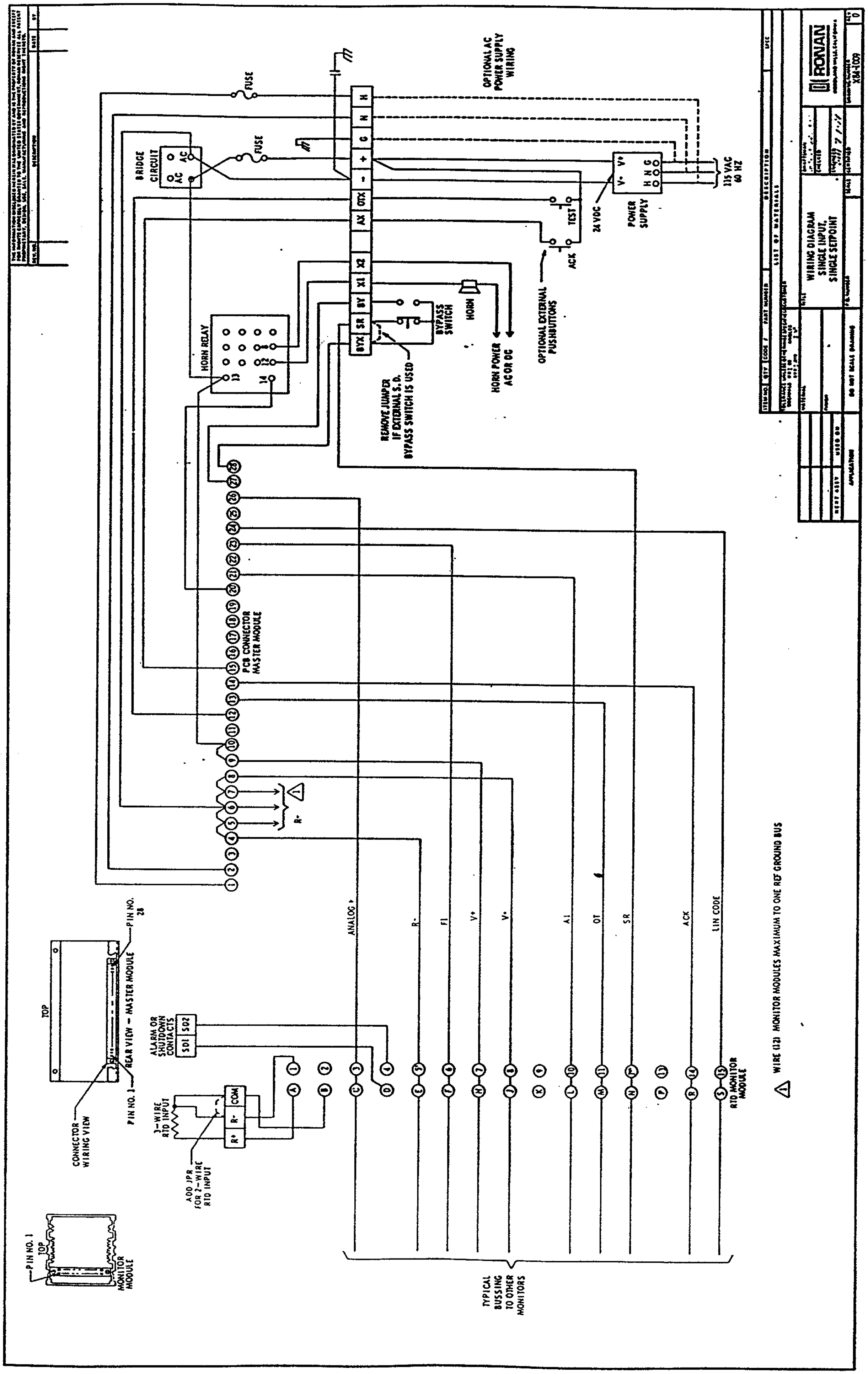

| NUMBER OF UNITS HIGH OR WIDE | A OVERALL INCHES | A OVERALL MILLIMETERS | B CUTOUT INCHES | B CUTOUT MILLIMETERS |
|---|---|---|---|---|
| 1 | 5.000 | 127.00 | 4.370 | 110.99 |
| 2 | 8.500 | 215.90 | 7.870 | 199.89 |
| 3 | 12.000 | 304.80 | 11.370 | 288.79 |
| 4 | 15.500 | 393.70 | 14.870 | 377.69 |
| 5 | 19.000 | 482.60 | 18.370 | 466.59 |
| 6 | 22.500 | 571.50 | 21.870 | 555.49 |
| 7 | 26.000 | 660.40 | 25.370 | 644.39 |
| 8 | 29.500 | 749.30 | 28.870 | 733.29 |
| 9 | 33.000 | 838.20 | 32.500 | 825.50 |
| 10 | 36.500 | 927.10 | 36.000 | 914.40 |
| 11 | 40.000 | 1016.00 | 39.500 | 1003.30 |
| 12 | 43.500 | 1104.90 | 43.000 | 1092.20 |
| 13 | 47.000 | 1193.80 | 46.500 | 1181.10 |
| 14 | 50.870 | 1292.09 | 50.000 | 1270.00 |

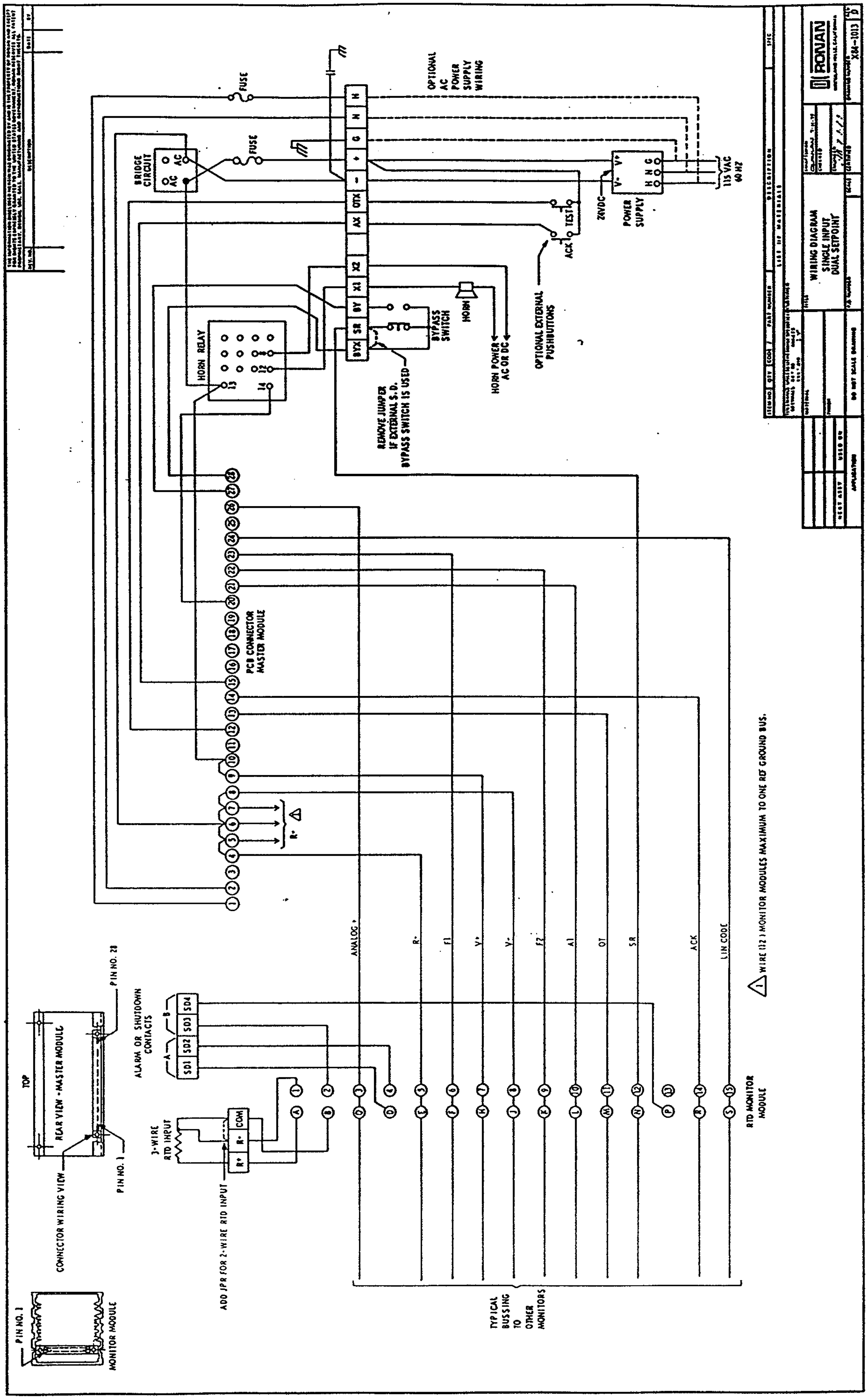


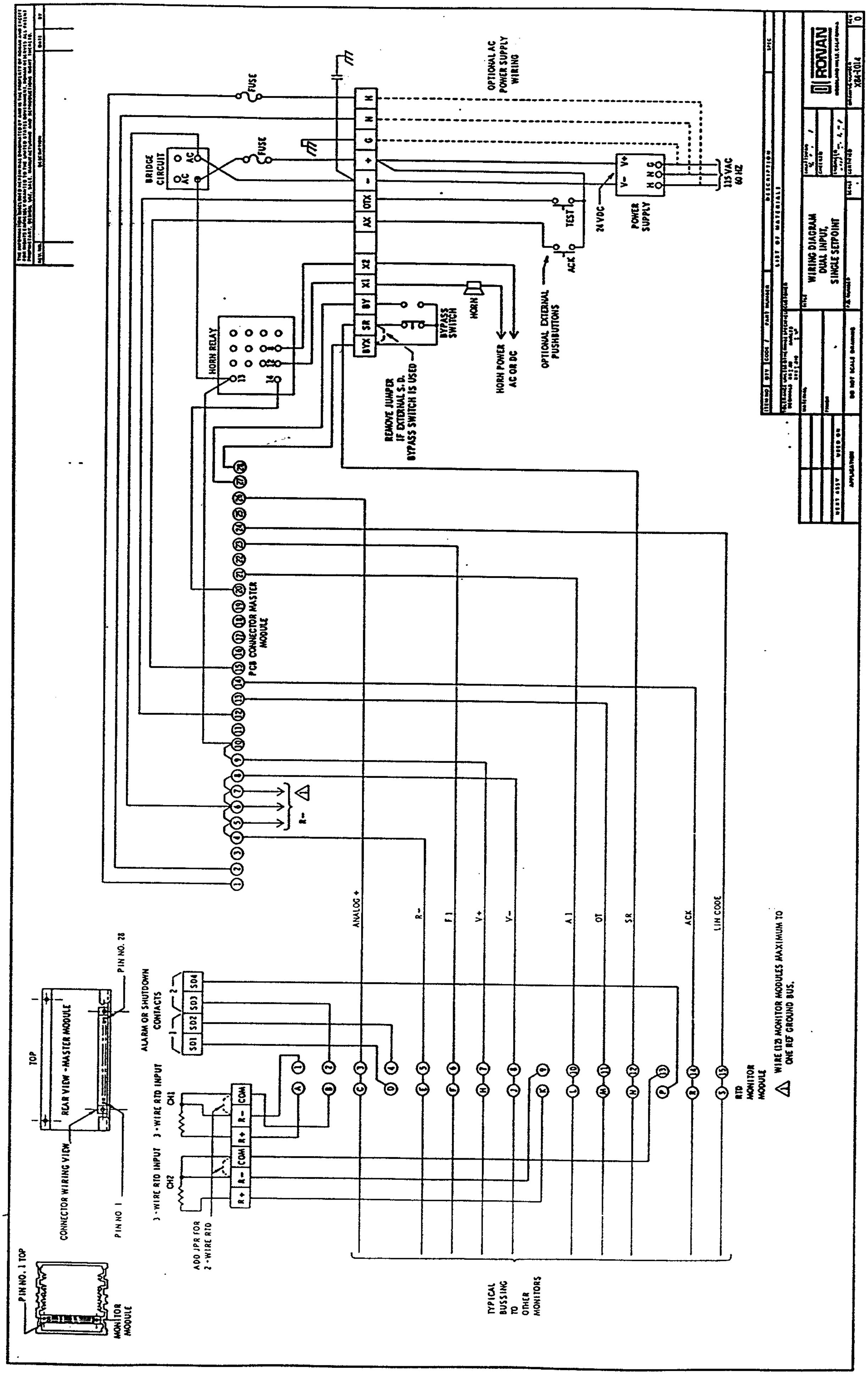
OPTIONAL EXTERNAL PUSHBUTTONS
BYPASS SWITCH
ACK
TEST
CABINET POSITION NUMBERS
MASTER MODULE
HORN RELAY
FUSE
FUSE
1-1
1-2
1-3
2-1
2-2
2-3
BYX SR BY X1 X2 AX OTX - + G N H
R+ R- COM
SD1 SD2
HORN
HORN POWER AC OR DC
24 VDC
POWER SUPPLY
V- V+
H N G
115 VAC 60 HZ
OPTIONAL AC POWER SUPPLY WIRING
SD1 SD2 X+ X-
OPTIONAL TERMINAL ARRANGEMENT RTD MONITOR WITH TRANSMITTER OUTPUT
LIST OF MATERIALS
TERMINAL ARRANGEMENT SINGLE INPUT, SINGLE SETPOINT
RONAN
X84-1008
DO NOT SCALE DRAWING
APPLICATION

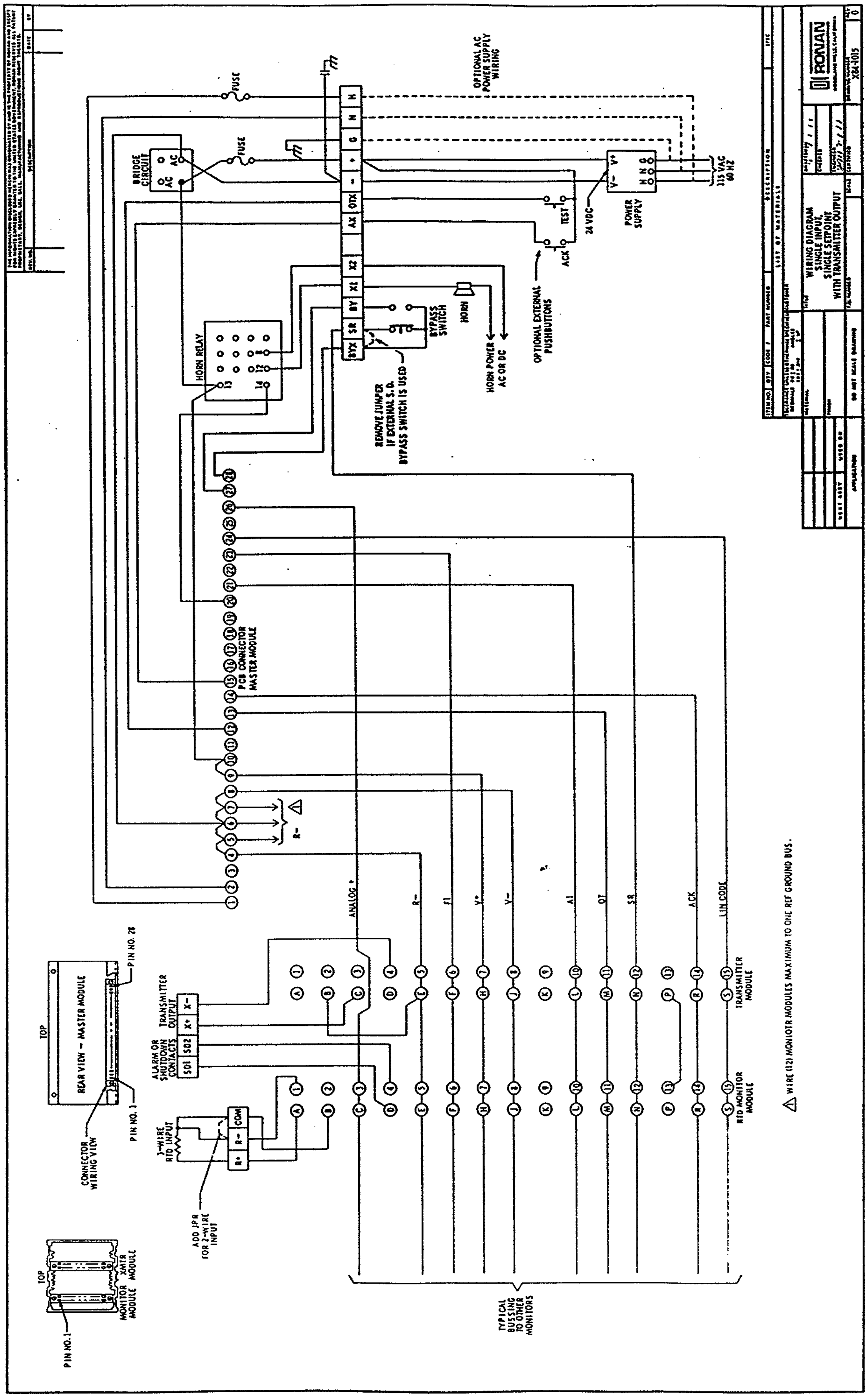

OPTIONAL EXTERNAL PUSHBUTTONS
BYPASS SWITCH
ACK
TEST
CABINET POSITION NUMBERS
MASTER MODULE
HORN RELAY
FUSE
FUSE
1-1
1-2
1-3
2-1
2-2
2-3
BYX SR BY X1 X2 AX OTX - + G N H
R+ R- COM
SD1 SD2 SD3 SD4
HORN
HORN POWER AC OR DC
24 VDC
POWER SUPPLY
V- V+
H N G
115 VAC 60 HZ
OPTIONAL AC POWER SUPPLY WIRING
SD1 SD2 SD3 SD4 X+ X-
OPTIONAL TERMINAL ARRANGEMENT RTD MONITOR WITH TRANSMITTER OUTPUT
LIST OF MATERIALS
TERMINAL ARRANGEMENT SINGLE INPUT, DUAL SETPOINT
RONAN
X84-1010
0
DO NOT SCALE DRAWING
APPLICATION
NEXT ASSY
USED ON

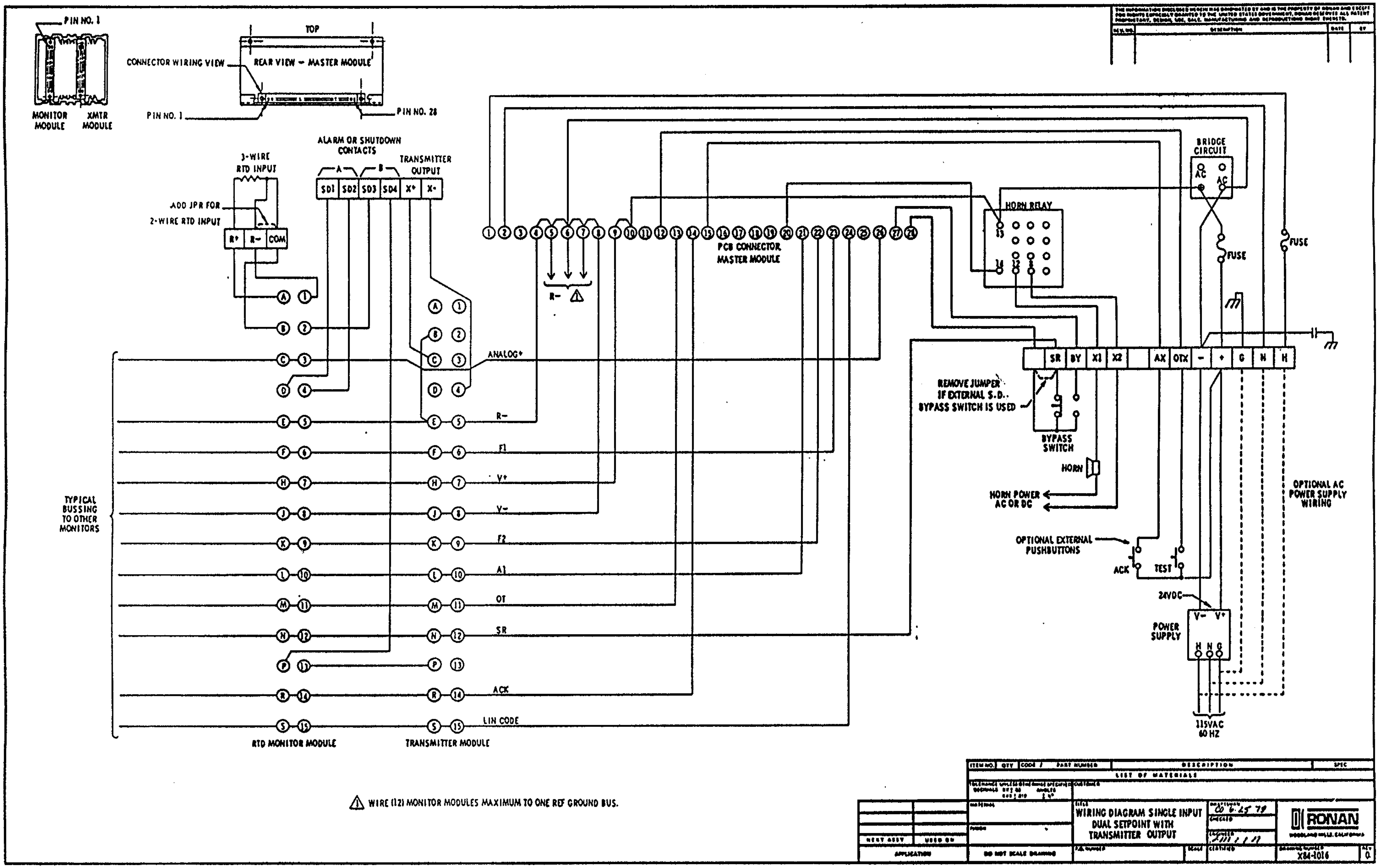

OPTIONAL EXTERNAL PUSHBUTTONS
BYPASS SWITCH
ACK
TEST
CABINET POSITION NUMBERS
MASTER MODULE
1-1
1-2
1-3
2-1
2-2
2-3
HORN RELAY
FUSE
FUSE
BYX SR BY X1 X2 AX OTX - + G N H
R+ R- COM R+ R- COM
POINT A (TYP)
POINT B (TYP)
SD1 SD2 SD3 SD4
HORN
HORN POWER AC OR DC
OPTIONAL AC POWER SUPPLY WIRING
24 VDC
POWER SUPPLY
V- V+
H N G
115 VAC 60 HZ
LIST OF MATERIALS
TERMINAL ARRANGEMENT
DUAL INPUT,
SINGLE SETPOINT
DO NOT SCALE DRAWING
APPLICATION
RONAN
X84-1011
0

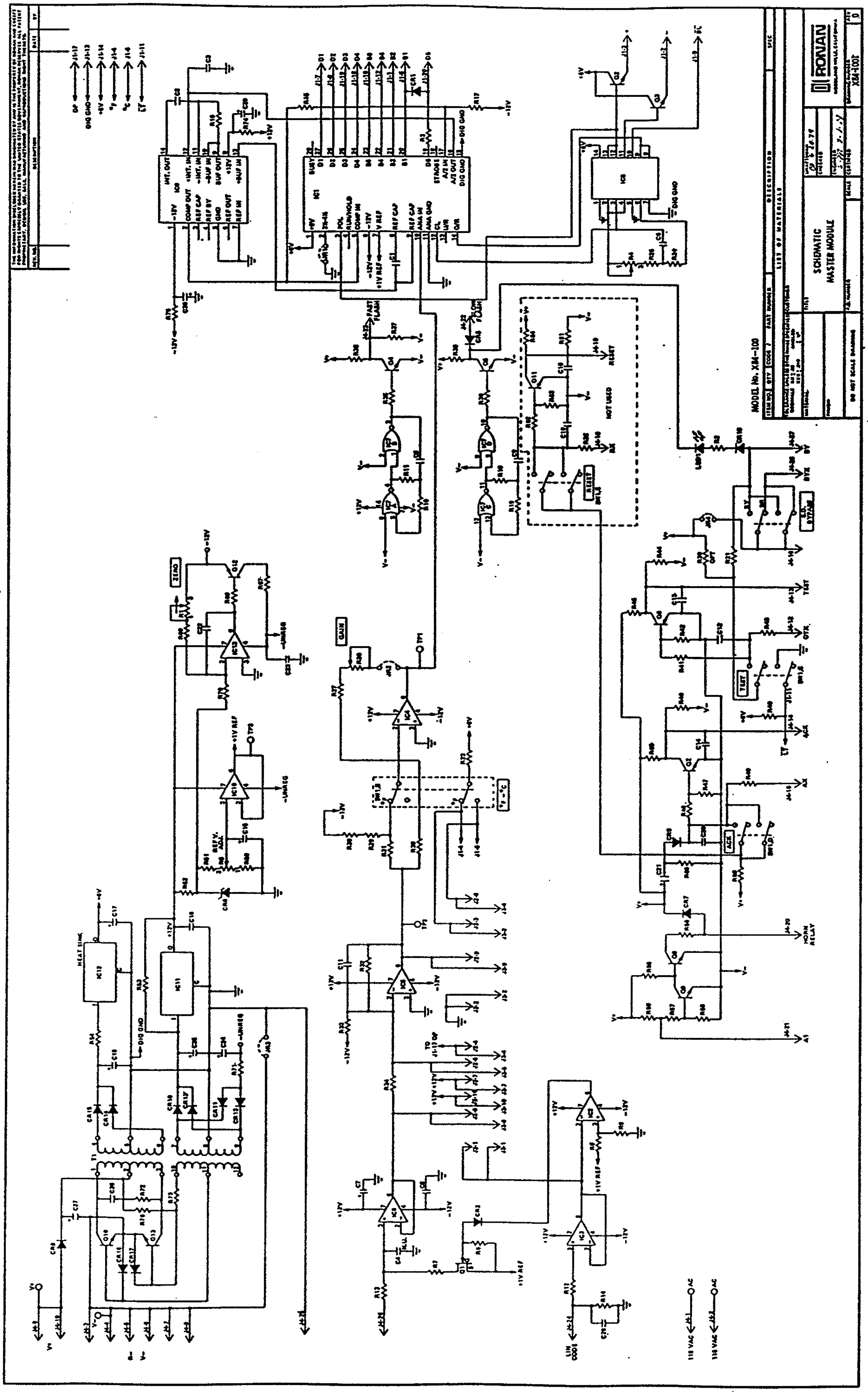

WIRING DIAGRAM
SINGLE INPUT,
SINGLE SETPOINT
RONAN
OPTIONAL AC
POWER SUPPLY
WIRING
FUSE
BRIDGE
CIRCUIT
AC
H
N
G
+
−
OTX
AX
X2
X1
BY
SR
BYX
TEST
ACK
24 VDC
POWER
SUPPLY
115 VAC
60 HZ
OPTIONAL EXTERNAL
PUSHBUTTONS
HORN
HORN POWER
AC OR DC
BYPASS
SWITCH
REMOVE JUMPER
IF EXTERNAL S.D.
BYPASS SWITCH IS USED
HORN RELAY
PCB CONNECTOR
MASTER MODULE
R−
ANALOG +
FI
V+
V−
AI
OT
SR
ACK
LIN CODE
WIRE (12) MONITOR MODULES MAXIMUM TO ONE REF GROUND BUS
RTD MONITOR
MODULE
ALARM OR
SHUTDOWN
CONTACTS
SD1
SD2
3-WIRE
RTD INPUT
COM
R−
R+
ADD JPR
FOR 2-WIRE
RTD INPUT
TOP
REAR VIEW − MASTER MODULE
PIN NO. 28
PIN NO. 1
CONNECTOR
WIRING VIEW
MONITOR
MODULE
TYPICAL
BUSSING
TO OTHER
MONITORS

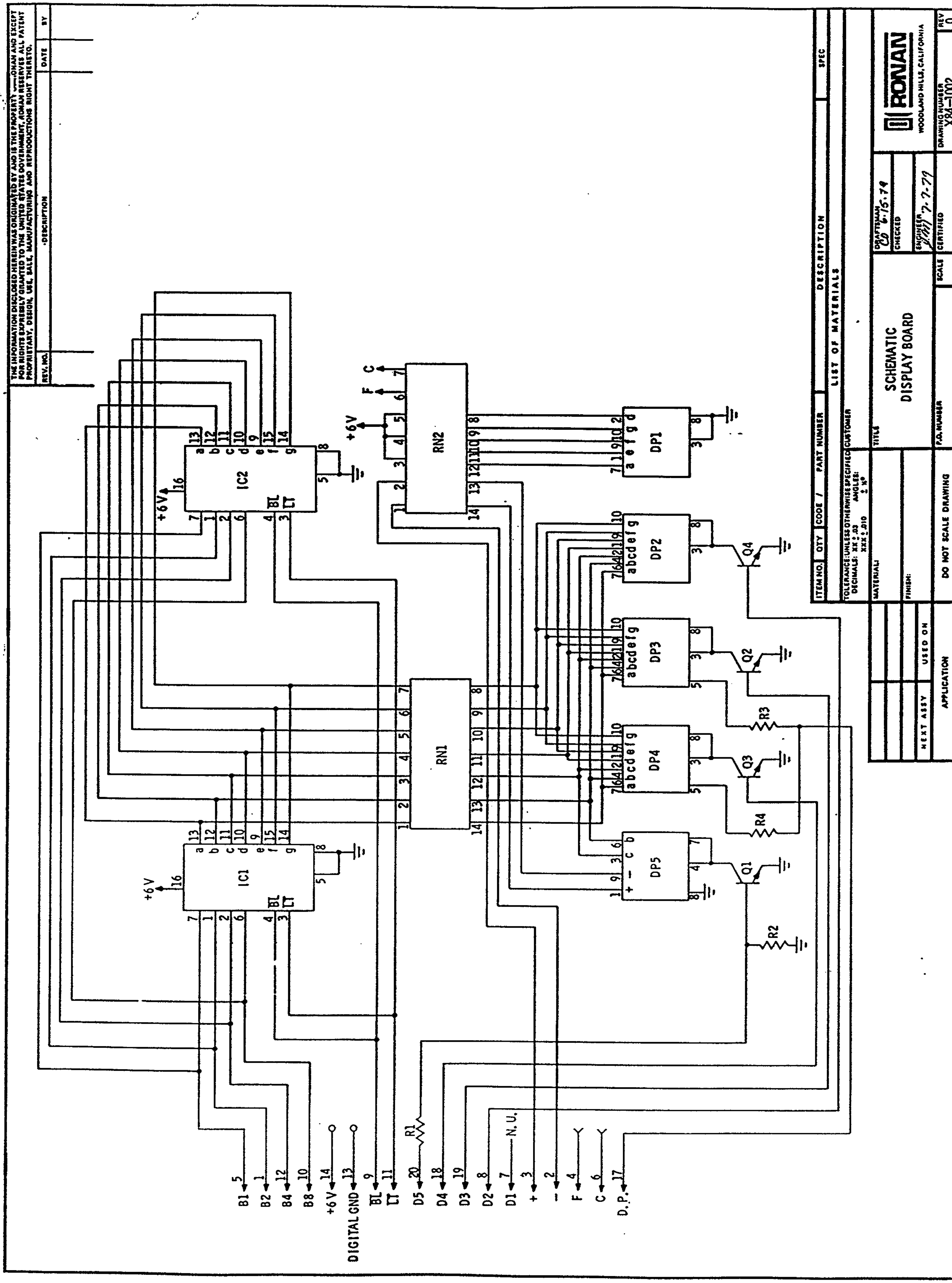

WIRING DIAGRAM
SINGLE INPUT
DUAL SETPOINT
RONAN
X84-1013
BRIDGE CIRCUIT
FUSE
FUSE
OPTIONAL AC POWER SUPPLY WIRING
115 VAC 60 HZ
POWER SUPPLY
24VDC
TEST
ACK
OPTIONAL EXTERNAL PUSHBUTTONS
HORN
BYPASS SWITCH
HORN POWER AC OR DC
REMOVE JUMPER IF EXTERNAL S.D. BYPASS SWITCH IS USED
HORN RELAY
PCB CONNECTOR MASTER MODULE
ANALOG +
R-
F1
V+
V-
F2
A1
OT
SR
ACK
LIN CODE
WIRE (12) MONITOR MODULES MAXIMUM TO ONE REF GROUND BUS.
ALARM OR SHUTDOWN CONTACTS
3-WIRE RTD INPUT
ADD JPR FOR 2-WIRE RTD INPUT
RTD MONITOR MODULE
TYPICAL BUSSING TO OTHER MONITORS
REAR VIEW - MASTER MODULE
TOP
PIN NO. 28
PIN NO. 1
CONNECTOR WIRING VIEW
MONITOR MODULE

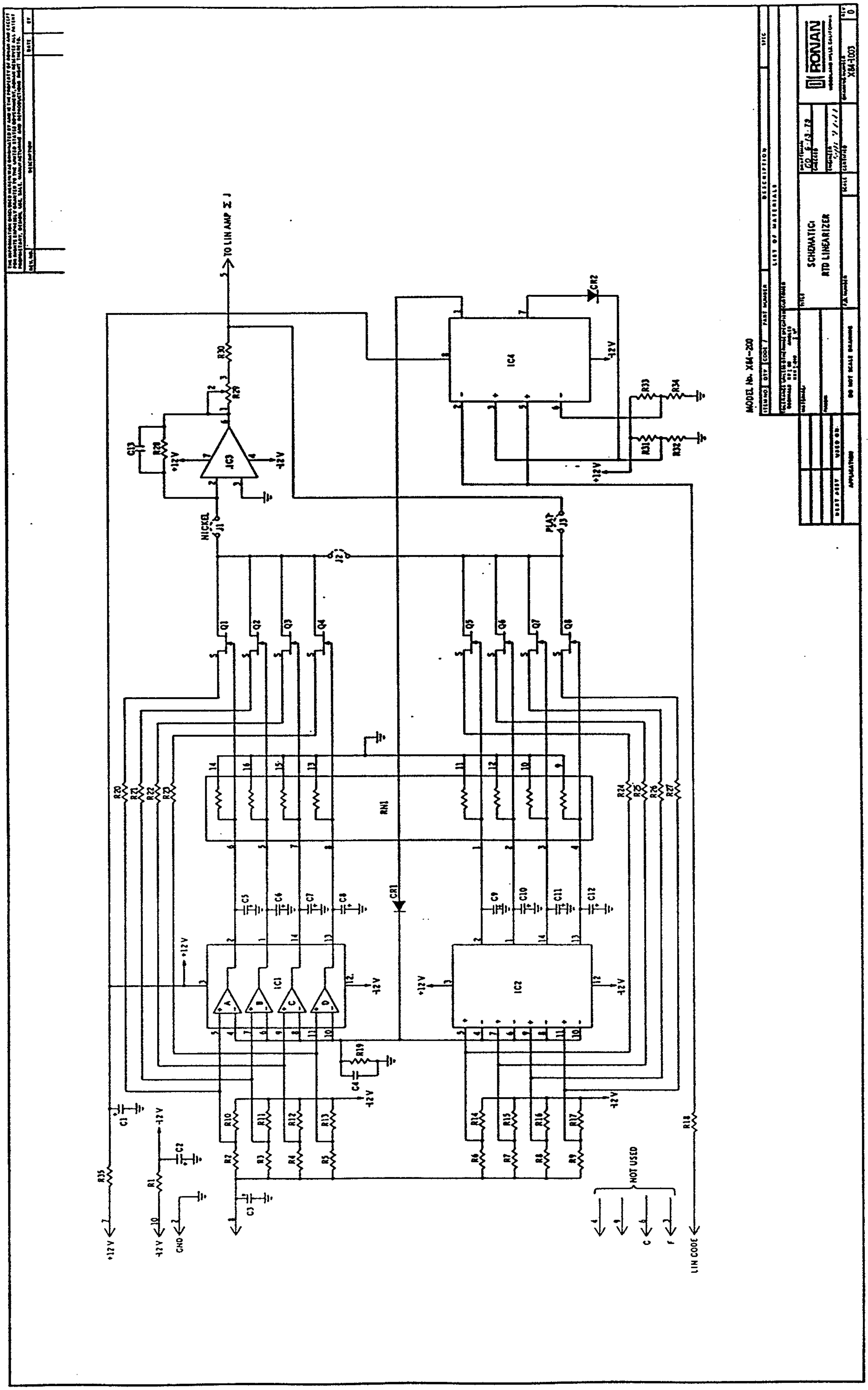

WIRING DIAGRAM
DUAL INPUT,
SINGLE SETPOINT
RONAN
X84-1014
OPTIONAL AC POWER SUPPLY WIRING
FUSE
BRIDGE CIRCUIT
HORN RELAY
BYPASS SWITCH
HORN
HORN POWER AC OR DC
OPTIONAL EXTERNAL PUSHBUTTONS
REMOVE JUMPER IF EXTERNAL S.D. BYPASS SWITCH IS USED
TEST
ACK
24 VDC
POWER SUPPLY
115 VAC 60 HZ
PCB CONNECTOR MASTER MODULE
ANALOG +
R−
F1
V+
V−
A1
OT
SR
ACK
LIN CODE
ALARM OR SHUTDOWN CONTACTS
3-WIRE RTD INPUT CH1
3-WIRE RTD INPUT CH2
ADD JPR FOR 2-WIRE RTD
RTD MONITOR MODULE
WIRE (12) MONITOR MODULES MAXIMUM TO ONE REF GROUND BUS.
TYPICAL BUSSING TO OTHER MONITORS
REAR VIEW - MASTER MODULE
TOP
PIN NO. 28
PIN NO. 1
CONNECTOR WIRING VIEW
PIN NO. 1 TOP
MONITOR MODULE

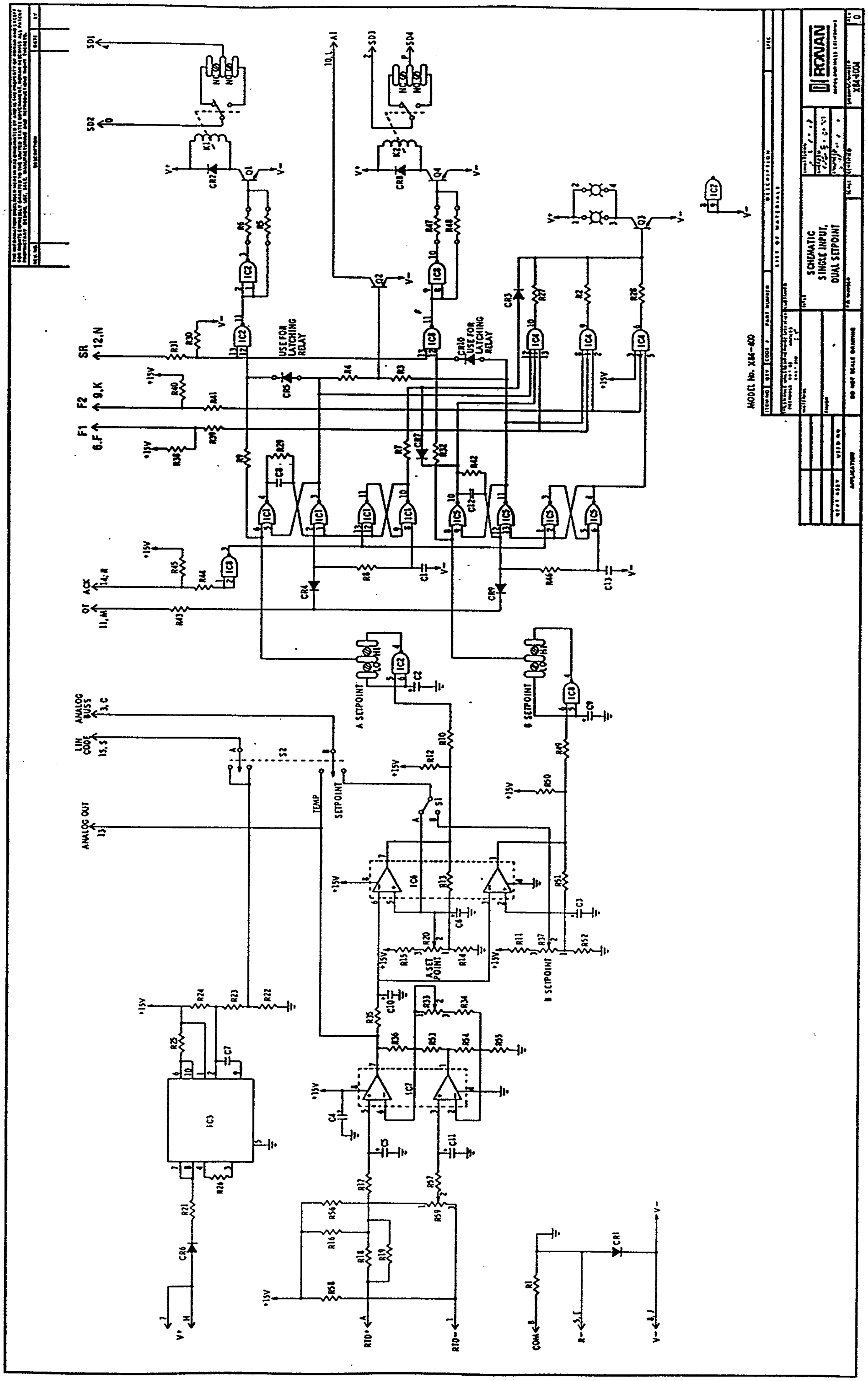

FUSE
OPTIONAL AC POWER SUPPLY WIRING
BRIDGE CIRCUIT
AC
HORN RELAY
POWER SUPPLY
24 VDC
115 VAC 60 HZ
TEST
ACK
OPTIONAL EXTERNAL PUSHBUTTONS
HORN
HORN POWER AC OR DC
BYPASS SWITCH
REMOVE JUMPER IF EXTERNAL S.D. BYPASS SWITCH IS USED
PCB CONNECTOR MASTER MODULE
ANALOG +
R-
F1
V+
V-
A1
OT
SR
ACK
LIN CODE
TRANSMITTER MODULE
RTD MONITOR MODULE
TRANSMITTER OUTPUT
ALARM OR SHUTDOWN CONTACTS
3-WIRE RTD INPUT
ADD JPR FOR 2-WIRE INPUT
REAR VIEW - MASTER MODULE
TOP
PIN NO. 28
PIN NO. 1
CONNECTOR WIRING VIEW
MONITOR MODULE
XMTR MODULE
TYPICAL BUSSING TO OTHER MONITORS
WIRE (12) MONIOTR MODULES MAXIMUM TO ONE REF GROUND BUS.
WIRING DIAGRAM SINGLE INPUT, SINGLE SETPOINT WITH TRANSMITTER OUTPUT
RONAN

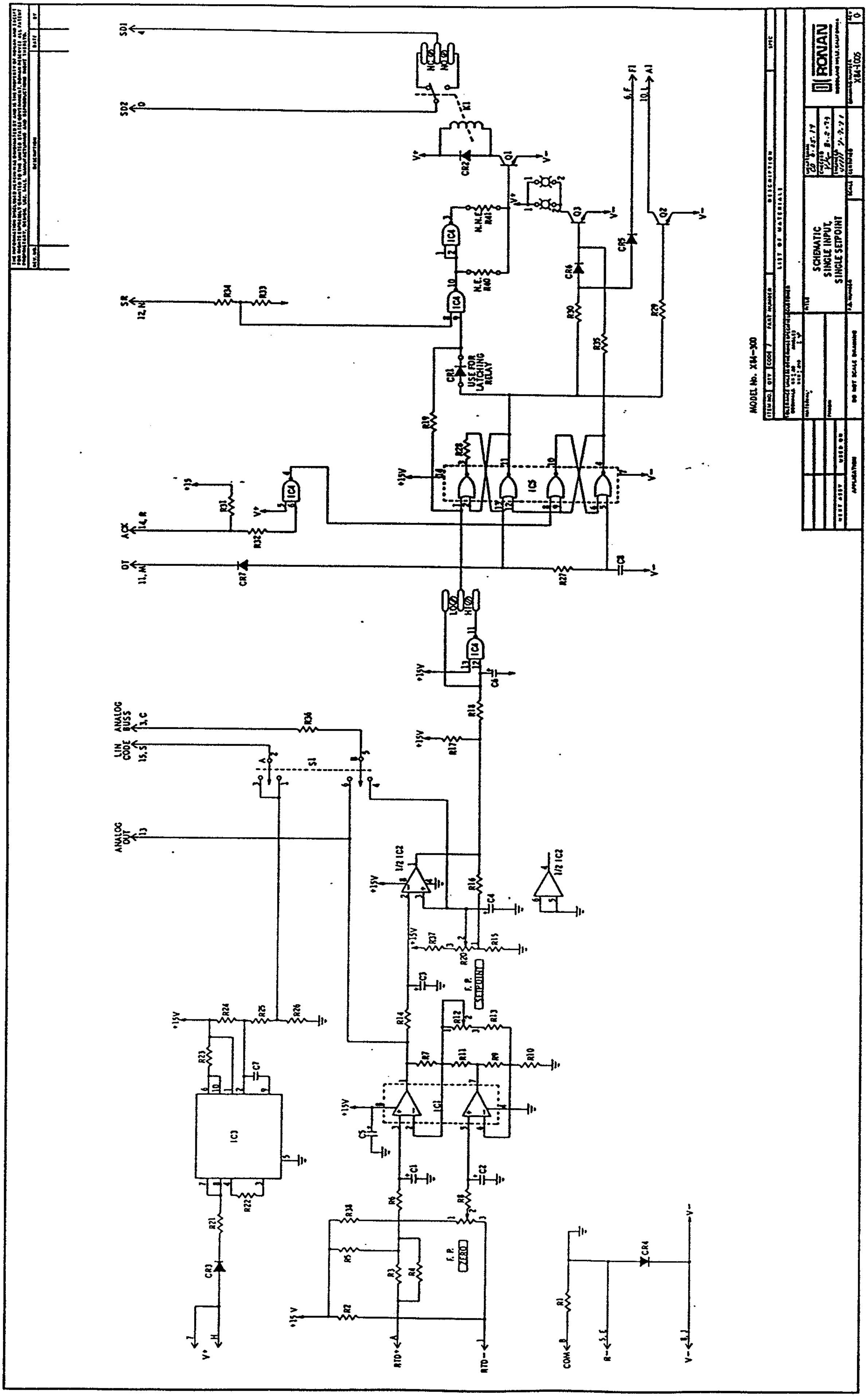

PIN NO. 1
MONITOR MODULE
XMTR MODULE
CONNECTOR WIRING VIEW
TOP
REAR VIEW – MASTER MODULE
PIN NO. 1
PIN NO. 28
3-WIRE RTD INPUT
ADD JPR FOR 2-WIRE RTD INPUT
R+ R– COM
ALARM OR SHUTDOWN CONTACTS
A B
SD1 SD2 SD3 SD4
TRANSMITTER OUTPUT
X+ X–
PCB CONNECTOR MASTER MODULE
R–
HORN RELAY
BRIDGE CIRCUIT
AC AC
FUSE
FUSE
SR BY X1 X2 AX OTX – + G N H
REMOVE JUMPER IF EXTERNAL S.D. BYPASS SWITCH IS USED
BYPASS SWITCH
HORN
HORN POWER AC OR DC
OPTIONAL EXTERNAL PUSHBUTTONS
ACK
TEST
24VDC
POWER SUPPLY
V– V+
H N G
115VAC 60 HZ
OPTIONAL AC POWER SUPPLY WIRING
TYPICAL BUSSING TO OTHER MONITORS
ANALOG+
R–
F1
V+
V–
F2
A1
OT
SR
ACK
LIN CODE
RTD MONITOR MODULE
TRANSMITTER MODULE
WIRE (12) MONITOR MODULES MAXIMUM TO ONE REF GROUND BUS.
LIST OF MATERIALS
WIRING DIAGRAM SINGLE INPUT DUAL SETPOINT WITH TRANSMITTER OUTPUT
RONAN
X84-1016
DO NOT SCALE DRAWING
APPLICATION

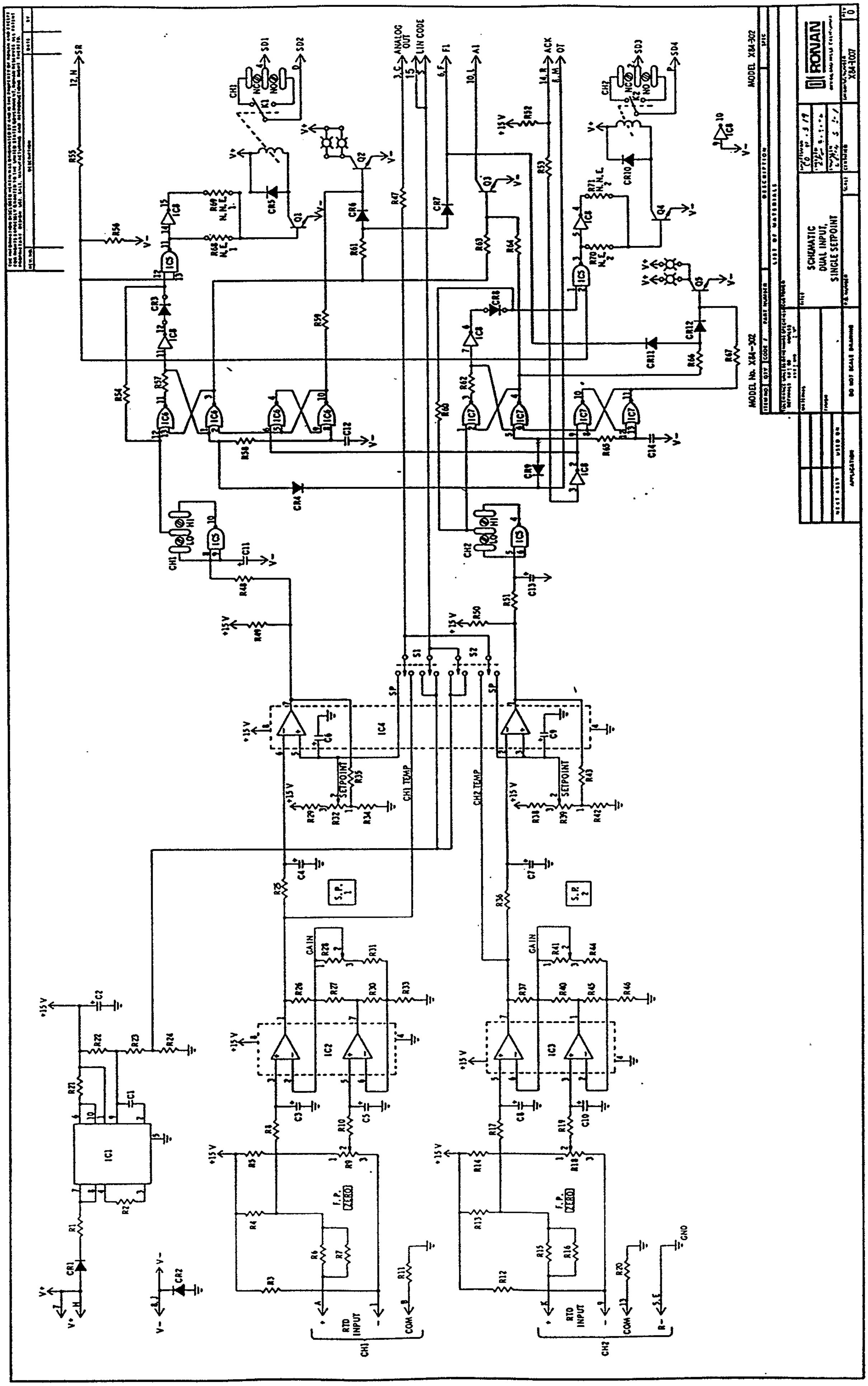

SCHEMATIC
MASTER MODULE
MODEL No. X84-100
RONAN
X84-100
LIST OF MATERIALS
NOT USED
HEAT SINK


SCHEMATIC
DISPLAY BOARD
RONAN
WOODLAND HILLS, CALIFORNIA
DRAWING NUMBER X84-1002
REV 0
LIST OF MATERIALS
ITEM NO.
QTY
CODE / PART NUMBER
DESCRIPTION
SPEC
DO NOT SCALE DRAWING
APPLICATION
NEXT ASSY
USED ON
MATERIAL
FINISH
DRAFTSMAN
CHECKED
ENGINEER
CERTIFIED
SCALE
TITLE
CUSTOMER
REV. NO.
DESCRIPTION
DATE
BY
IC1
IC2
RN1
RN2
DP1
DP2
DP3
DP4
DP5
Q1
Q2
Q3
Q4
R1
R2
R3
R4
+6V
B1
B2
B4
B8
DIGITAL GND
BL
LT
D5
D4
D3
D2
D1
N. U.
D.P.


SCHEMATIC: RTD LINEARIZER
MODEL No. X64-200
RONAN
TO LIN AMP Σ J
NICKEL
PLAT
NOT USED
LIN CODE
+12 V
-12 V
GND
RN1
IC1
IC2
IC3
IC4
CR1
CR2
DO NOT SCALE DRAWING
LIST OF MATERIALS


SCHEMATIC
SINGLE INPUT,
DUAL SETPOINT
MODEL No. X84-400
ROWAN
USE FOR LATCHING RELAY
A SETPOINT
B SETPOINT
ANALOG OUT
ANALOG BUSS
LIN CODE
TEMP
SETPOINT
RTD+
RTD-
COM
V+
V-


SCHEMATIC
SINGLE INPUT,
SINGLE SETPOINT
RONAN
MODEL No. X84-300
USE FOR LATCHING RELAY
ANALOG OUT
ANALOG BUSS
LIN CODE
F.P. SETPOINT
F.P. ZERO
DO NOT SCALE DRAWING


SCHEMATIC
DUAL INPUT,
SINGLE SETPOINT
MODEL X84-302
MODEL No. X84-302
RONAN
X84-1007
DO NOT SCALE DRAWING
RTD INPUT
CH1
CH2
COM
SETPOINT
GAIN
CH1 TEMP
CH2 TEMP
ANALOG OUT
LIN CODE