YORK®

CodePak

CENTRIFUGAL LIQUID CHILLERS

SERVICE INSTRUCTIONS	Supersedes: Form 160.45-M2 (490)	790	Form 160.45-M2

FOR QUALIFIED SERVICE PERSONNEL ONLY

MICROCOMPUTER CONTROL CENTER
PART NO. 031-00846
FOR
MODEL YTAI AI BI THRU YT L6 X6 F2
AND
MODEL YTAI AI BI THRU YT L3 X3 E2
TURBO - MODULATOR FACTORY PACKAGED SYSTEM

COOLING AND HEAT RECOVERY UNITS

150 THRU 1000 TONS

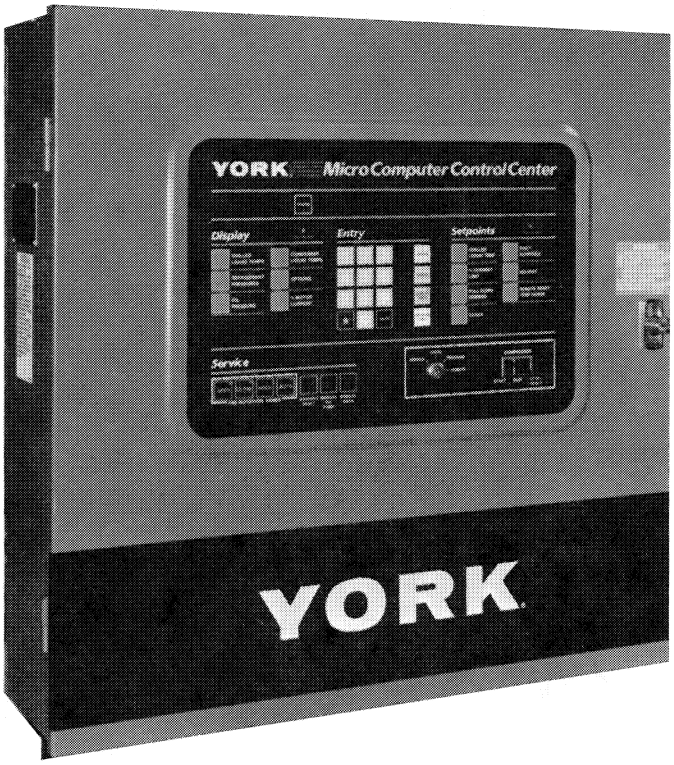


TABLE OF CONTENTS

	PAGE	
INTRODUCTION	3	**SECTION 1**
THEORY OF OPERATION	3-7	**SECTION 2**
COMPONENT DESCRIPTIONS	7-9	**SECTION 3**
DIGITAL INPUT BOARD	9-10	SECTION 4
ANALOG INPUT BOARD	10-43	SECTION 5
RELAY OUTPUT BOARD	43-46	SECTION 6
POWER SUPPLY BOARD	47-48	SECTION 7
MICRO BOARD	45-59	SECTION 8
DISPLAY	59	SECTION 9
FIBER OPTIC INTERFACE BOARD	59-62	SECTION 10
REMOTE CURRENT LIMITER TEMPERATURE BOARD	63-66	**SECTION 11**
SYSTEM CALIBRATION PROCEDURES	67-69	**SECTION 12**
TESTING WITH DIAGNOSTIC SOFTWARE	69-71	**SECTION 13**
TROUBLE SHOOTING	71-87	**SECTION 14**
SERVICE BULLETINS	88-97	**SECTION 15**

IMPORTANT

This instruction is intended to be used by certified (Qualified) Service personnel who have been instructed to service the Microcomputer control center. **Do not attempt to service this control center if you are not qualified.**

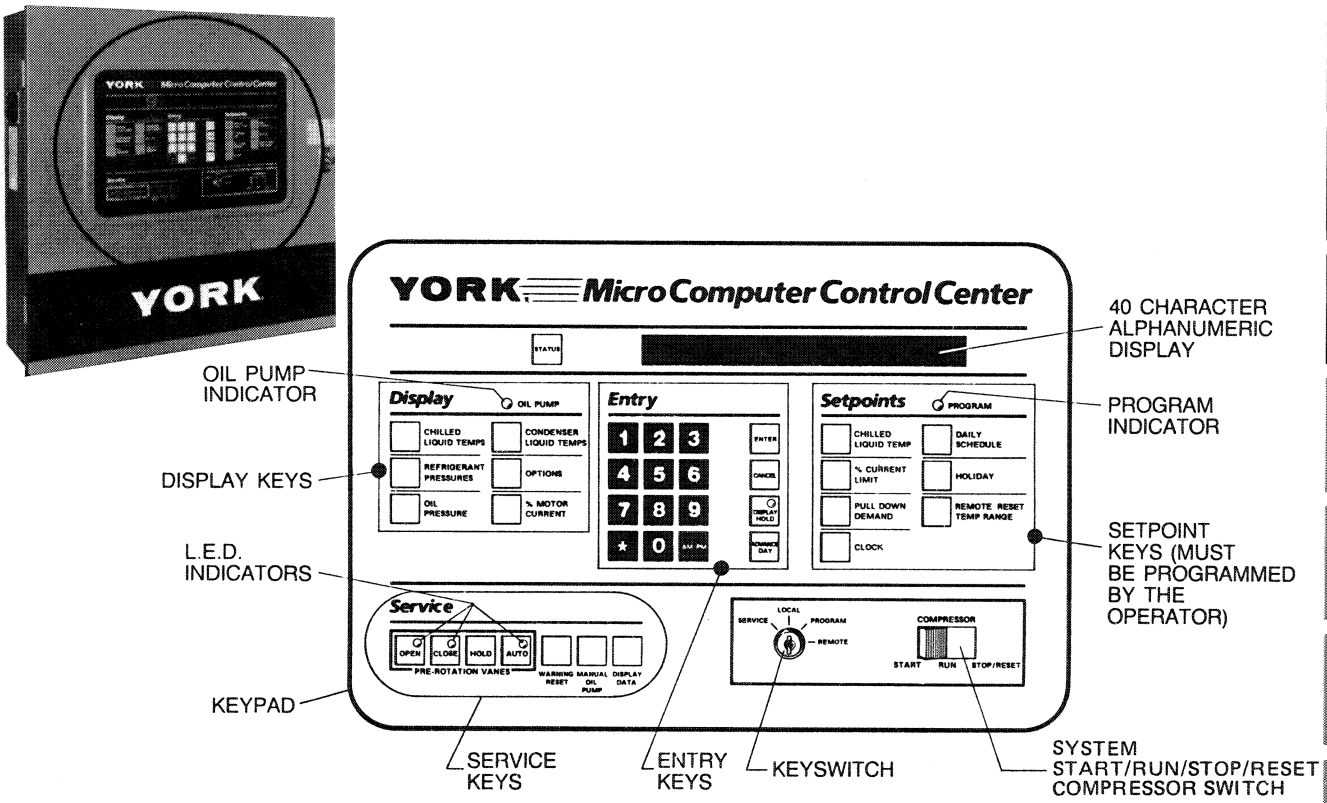


FIG. 1 – CONTROL CENTER WITH KEYPAD IDENTIFICATIONS

SECTION 1
INTRODUCTION

This instruction is a description of the electronic operation, functional description of components and trouble shooting of the microcomputer control center used to control the operation of a Codepak Centrifugal Liquid Chiller. This control center utilizes a solid state starter or a electro-mechanical starter or a Turbo-Modulator.

The microcomputer control center installation, operation, and display messages are described in Form 160.45-NO1 and 160.45 O1.1. That instruction is basically for the operator of the Codepak Liquid Chiller and does not include the technical operation of the control center, but should be used with this instruction by the field service technician qualified to perform the necessary service when needed.

This instruction should be read thoroughly before servicing the micro computer control center.

SECTION 2
THEORY OF OPERATION

OVERVIEW

The York microcomputer control panel is a microprocessor based control system for centrifugal chillers. It controls the leaving chilled water temperature via pre-rotation vane control and has the ability to limit motor current via control of the pre-rotation vanes. Further, it is compatible with turbo-modulator, solid state starter and electro-mechanical starter applications.

A front panel mounted tactile touch key pad allows the operator to display system operating parameters on a 40 character alphanumeric display that is an inherent part of the key pad. These parameters are:

- chilled liquid temperatures
- refrigerant pressures
- differential oil pressure
- condenser liquid temperatures

- % motor current
- saturation temperatures
- discharge temperature
- oil temperature
- purge pressure

The system setpoints are operator entered on the front panel key pad. These setpoints can also be displayed on the 40 character alphanumeric display. The system setpoints are:

- chilled liquid temperatures (LCWT)
- % current limit
- pulldown demand limit
- clock (time-of-day)
- daily schedule (7 day time-clock programming)
- holiday
- remote reset temperature range

The cause of all system shutdowns (safety or cycling) is preserved in the micro's memory for subsequent viewing on the key pad display. Moreover, the operator is continually advised of system operating conditions by various background and warning messages. Finally, the key pad contains special service keys for use by the serviceman when performing system troubleshooting.

The microcomputer control panel is compatible with most energy management systems (EMS) in use today. The standard design allows for the following EMS interface:

- remote start
- remote stop
- remote LCWT setpoint (PWM signal)
- remote current limit setpoint (PWM signal)
- "ready to start" status contacts
- safety shutdown status contacts
- cycling shutdown status contacts

As an enhancement to the above standard EMS features, the customer may purchase optional plug-in PC boards that allow for remote LCWT setpoint and remote current limit setpoint interface in the following format:

- 4-20 MA
- 0-10 Vdc
- contact closures

SYSTEM ARCHITECTURE

The microprocessor and supporting digital logic circuits are contained on a single PC board known as the **micro board.** All system operating decisions are made on this board; such as when to open or close the vanes (except with Turbo-Modulator applications), when to operate purge and vent line solenoids, when to run the oil pump, when to shutdown on safety shutdowns, etc. Therefore, all system inputs and outputs must pass through this board. However, since the micro's digital logic is ±5 Vdc or +12 Vdc the 115 vac inputs must be signal conditioned prior to application to the micro board. Similarily, the +12 Vdc outputs must be relay isolated in order to drive the system 115 vac relays and solenoids. These functions are performed by the digital input board and relay output-board respectively.

The **digital input board** accepts 115 vac inputs from system relays and external devices such as chilled water pump interlocks, local/remote cycling devices, EMS, purge float switches and vane motor switch, etc. These 0 vac/115 vac input signals are converted to 0 Vdc/+5 Vdc logic level signals for use by the micro board. The output of the digital input board is interfaced directly to the micro board.

The micro board output interfaces directly to the **relay output board.** The +12 Vdc logic level outputs of the micro board energize or de-energize DC relays on the relay output board. The contacts of these relays energize or de-energize the system 115 vac solenoids and relays. Also, the EMS remote status contacts are located on this board.

System pressures are sensed by pressure transducers. System temperatures are sensed by thermistors. The transducers and thermistors are input to the **analog input board** where these analog signals are serially transmitted (multiplexed) to the micro board. On the micro board these analog signals are converted to digital words for comparison to stored safety threshold values. If these pressures or temperatures exceed the stored threshold values, the micro would shutdown the system. The leaving chilled water temperature (LCWT) thermistor, however, does not connect to the analog input board. It interfaces directly to the micro board where this analog signal is converted to a digital word for subsequent use in LCWT control.

APPLICATIONS

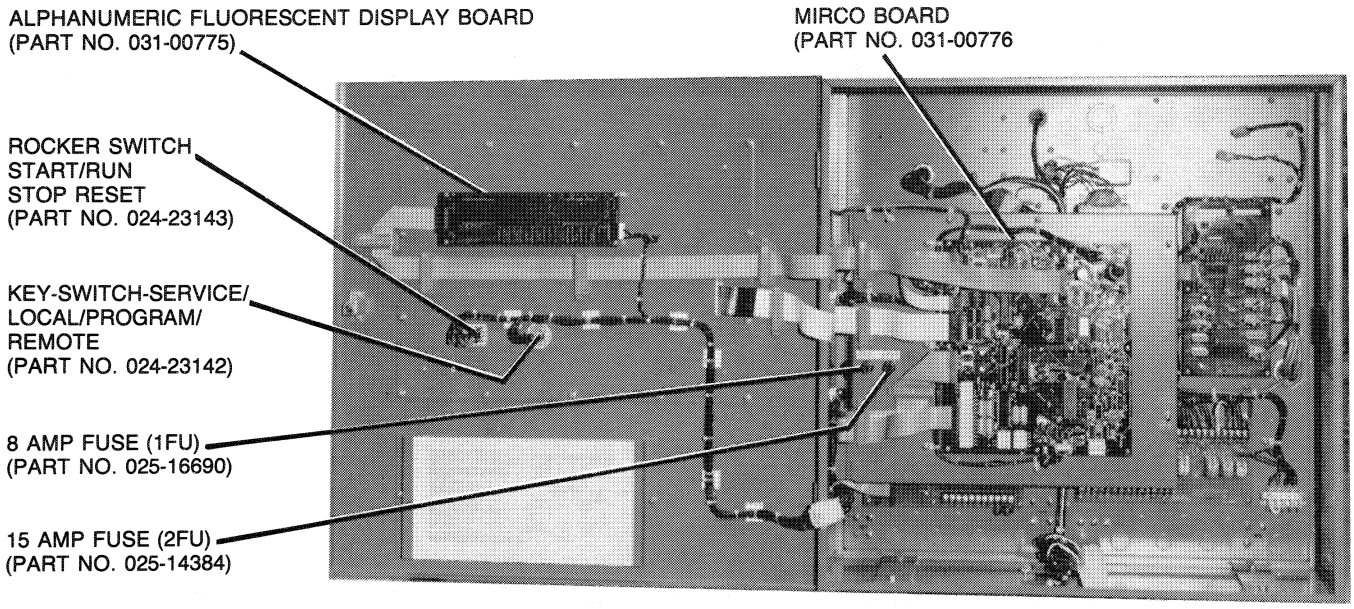
The microcomputer control panel is used on electro-mechanical or solid state starter, and Turbo-Modulator applications.

When the control panel is used on **electro-mechanical starter** applications, it performs both LCWT and current limit control. A CM-1A current module is provided to perform the compressor motor overload function. Further, the CM-1A also provides current limit control as a backup to the control panel.

When the control panel is used on **solid state starter** applications, it performs both LCWT and current limit

control. The solid state starter performs the compressor motor overload function and also current limit control as a backup to the control panel.

When the control panel is used on **Turbo-Modulator** applications, it performs neither LCWT control nor current limit control. These functions are performed by the Turbo-Modulator. However, the setpoints for both of these functions are entered at the microcomputer control panel key pad. Therefore, an interface between the control panel and turbo-modulator is required. This is provided by a fiber-optic cable interface from the control panel to the **fiber-optic interface board** in the Turbo-Modulator logic box. The fiber-optic interface board conditions the fiber-optic signal and provides an analog LCWT and current limit setpoint to the Turbo-Modulator capacity board.



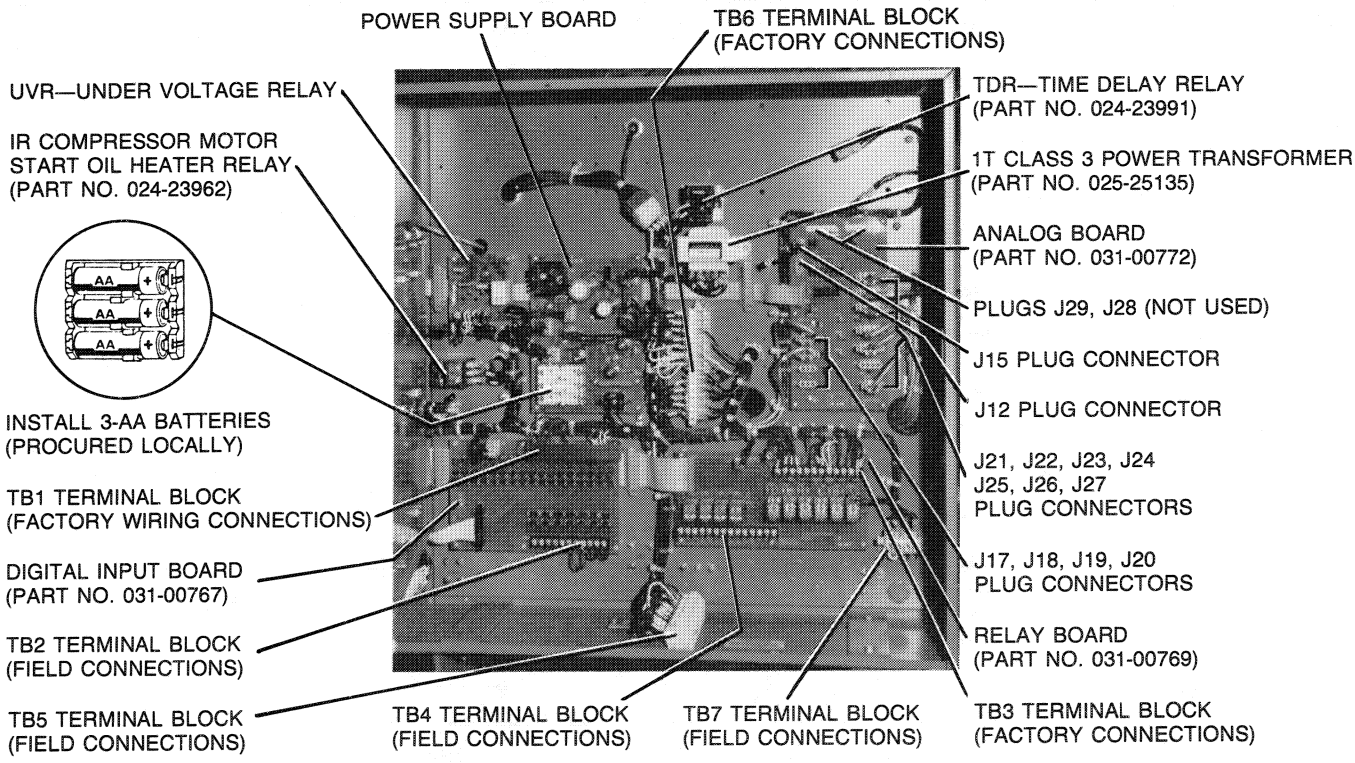


FIG. 2 – MICRO COMPUTER CONTROL CENTER. COMPONENT IDENTIFICATION.

MICRO COMPUTER CONTROL CENTER BLOCK DIAGRAM

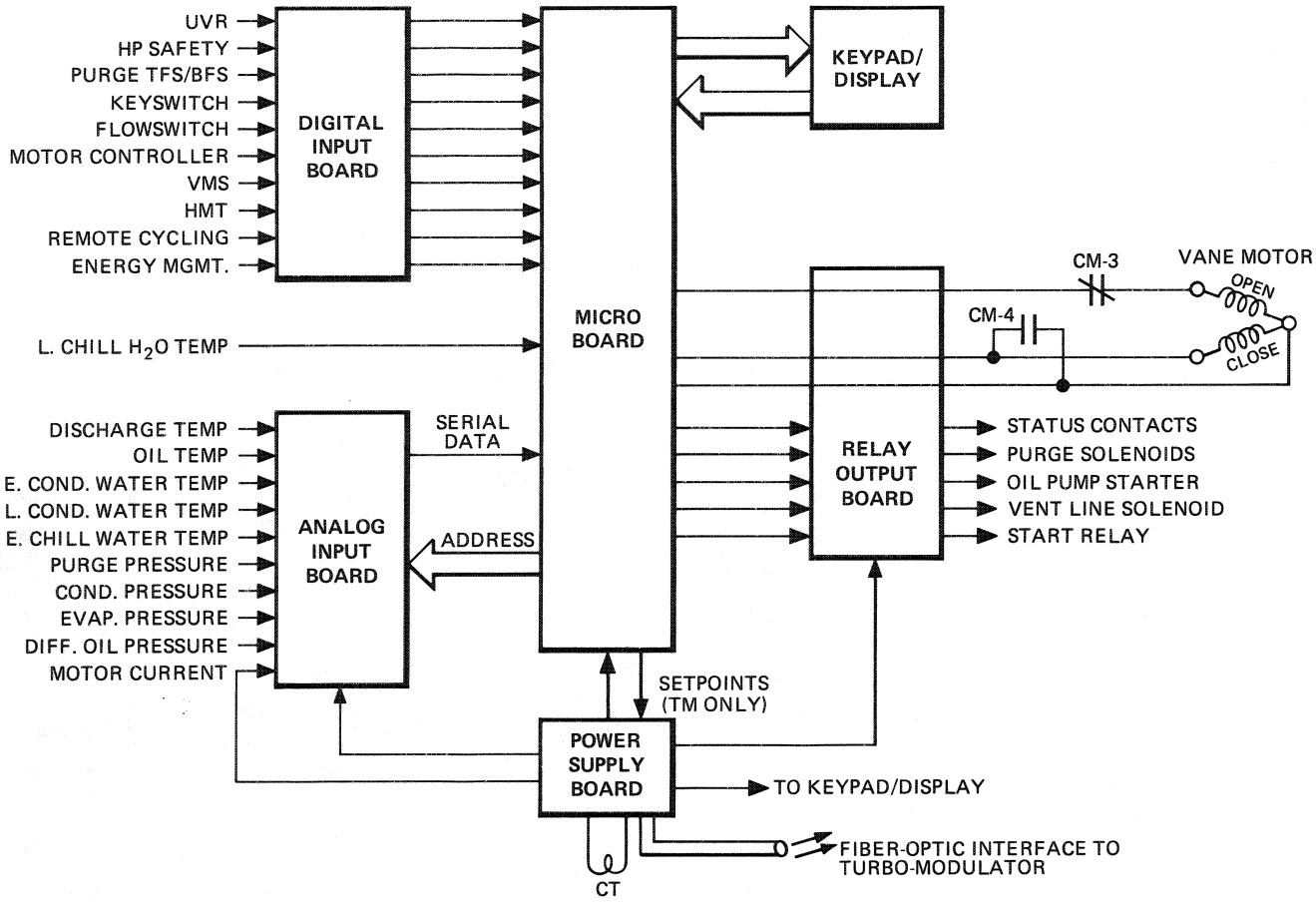


FIG. 3 – MICRO COMPUTER CONTROL CENTER BLOCK DIAGRAM

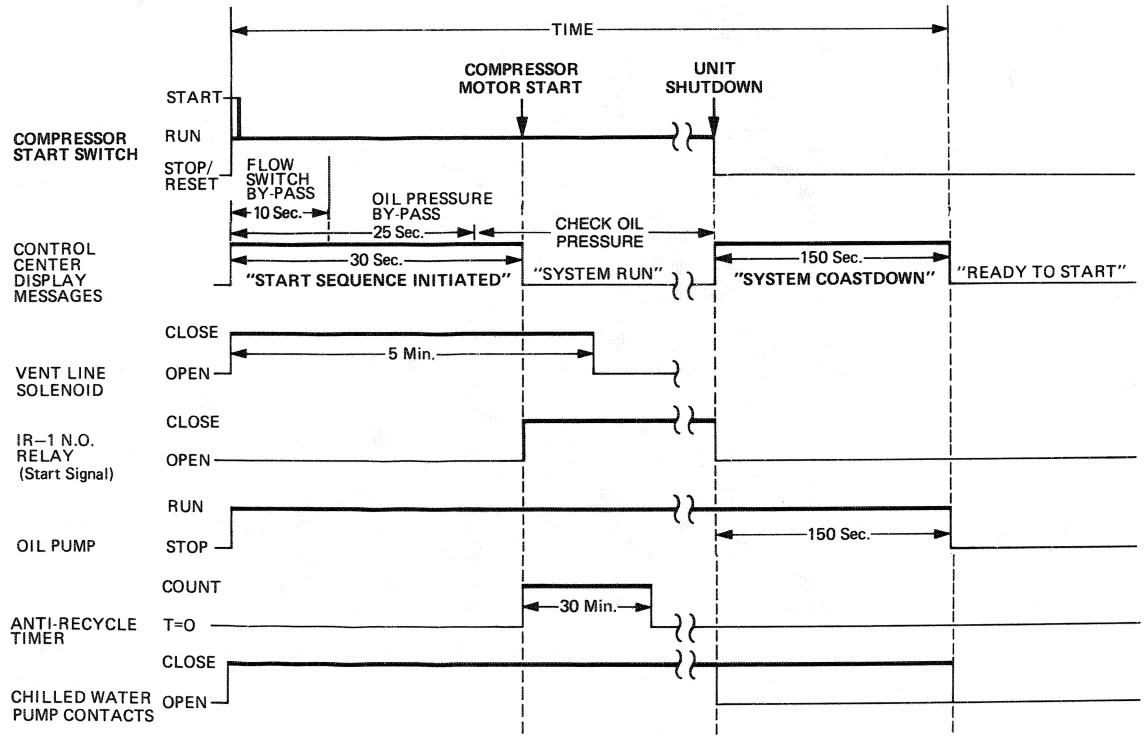


FIG. 4 – CODEPAK CHILLER STARTING SEQUENCE & SHUTDOWN SEQUENCE

SECTION 3
COMPONENT DESCRIPTIONS

SECTION 4
DIGITAL INPUT BOARD

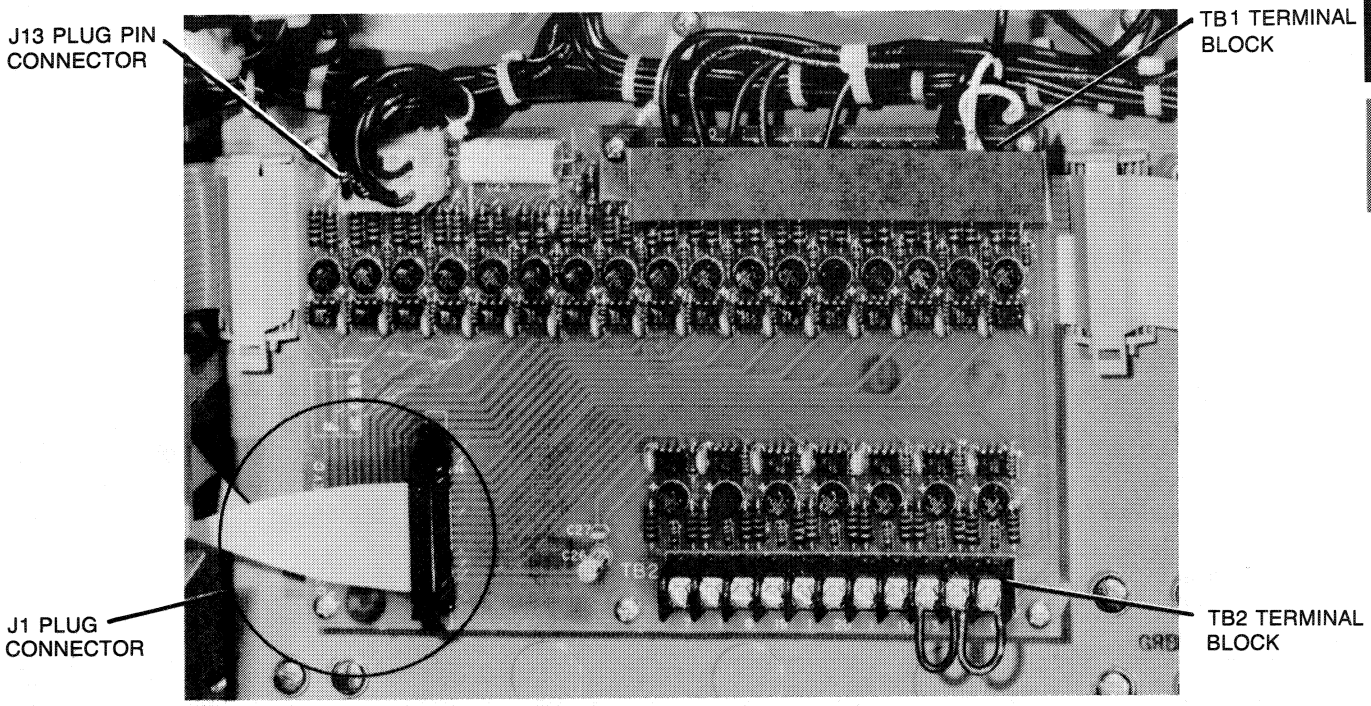


FIG. 5 – DIGITAL INPUT BOARD

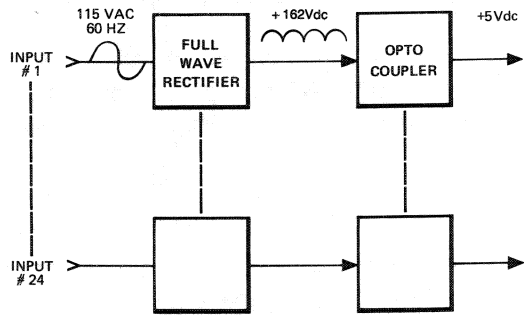


FIG. 6 – DIGITAL INPUT BOARD SIMPLIFIED BLOCK DIAGRAM

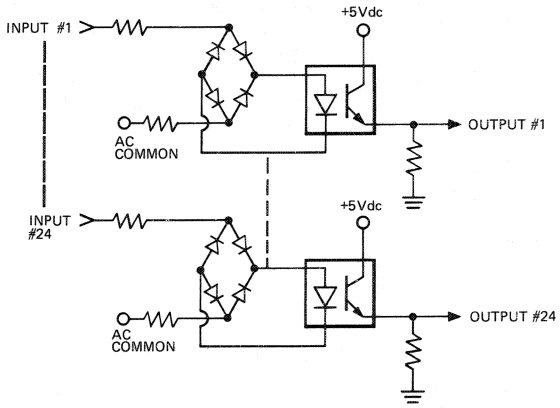


FIG. 7 – DETAILED SCHEMATIC REPRESENTATION DIGITAL INPUT-BOARD

DIGITAL INPUT BOARD (Ref. Fig. 5, 6, 7 & 8)

The Digital Input Board converts 115VAC signals to +5Vdc logic level signals for use by the micro board.

When the digital input device in question closes, the 115VAC input is applied to a full wave rectifier. This unfiltered DC is then applied to an opto-coupler that turns on and allows the full +5Vdc to be dropped across the output resistor. In summary, the input switch closure supplies a 115 VAC input which produces a +5Vdc output; an open input produces a 0Vdc output.

Terminal Strip TB2 is provided on the Digital Input Board for interfacing external customer signals (flow switch, multi-unit sequence, etc.). The signal input terminals are grouped together (according to function) with a 115 VAC power source terminal (1). The power source terminal (1) supplies source voltage for externally located relay contacts — such as: the chilled water pump interlock/flow switch terminal (12) located adjacent to a terminal (1). Since terminal (1) is internally connected to 115VAC on the **Digital Input Board,** the flow switch contacts would be connected between (12) and (1). When the flow switch contacts close, 115 VAC is applied to input terminal (12) causing the **Digital Input Board** output J1-19 to transition from 0Vdc to +5Vdc. The output will remain at +5Vdc as long as the flow switch is closed.

Terminal strip TB1 is provided for interfacing York supplied components that are located on the chiller (purge float switches, vane motor switch, high pressure safety switch, low evaporator pressure, (Brine units only), LWT (T-M only).

Multi-pin plug connector J13 is provided for interfacing control panel mounted components (keyswitch, motor controller, undervoltage relay, start/stop switch).

Refer to **Digital input board inputs and outputs** page in this instruction for details of each input signal.

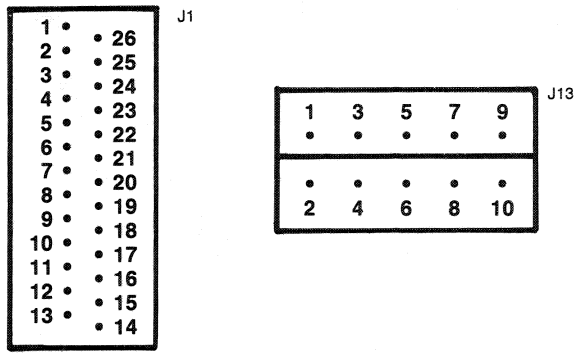


FIG. 8 – DIGITAL INPUT BOARD-PIN IDENTIFICATION

DIGITAL INPUT BOARD - INPUTS

J13 — Multi-pin plug connector.

J13-1 — Keyswitch SERVICE position input. 115 VAC when switch is in SERVICE position.

J13-2 — Compressor switch START position input. 115 VAC when switch in START position.

J13-3 — Keyswitch PROGRAM position input. 115 VAC when switch is in PROGRAM position.

J13-4 — Compressor switch STOP position input. 115 VAC when switch is in STOP position.

J13-5 — Keyswitch REMOTE position input. 115 VAC when switch is in REMOTE position.

J13-6 — Motor controller contacts (CM-6, N.C.) input. From Current Moduler York Solid State Starter, or Turbo-Modulator. 0 VAC when motor controller has initiated a shutdown. When motor controller has reset, input goes to 115 VAC. Typically, the motor controller device must be manually reset to clear this signal. However, the following motor controller shutdowns do not require an external reset:

Turbo-Modulator — PF, HA, FLTH
Solid State Starter — Single Phase, Phase Rotation, Current Fault, Power Fault
CM-1A — Power Fault (Electro-Mechanical Starter)

When the motor controller device has detected a "Power Fault", the motor controller contacts will open and reclose in less than 3 seconds. any reclosure in less than 3 seconds will be interpreted by the control panel as a power fault. Power fault shutdowns do not require an external reset before restarting chiller; the chiller automatically restarts.

J13-7 — Unused Pin

J13-8 — High Motor Temp (HMT) safety input. 115 VAC when HMT safety has sensed a compressor motor overtemperature condition. (Hermetic units only).

J13-9 — Keyswitch wiper input. This pin is internally connected to 115 VAC on the Digital Input Board.

J13-10 — Undervoltage relay contacts input. 115 VAC when UVR has detected low voltage condition . . . 90 VAC. Undervoltage relay resets when control power rises to 101 VAC.

TB1 — Terminal Block

TB1-71 — Purge top float switch input. 0VAC when purge tank fill cycle has been completed.

TB1-70 — Purge bottom float switch input. 115 VAC when purge tank has emptied.

TB1-32 — High pressure safety input. This function is provided by a pressure control mounted on the condenser shell. 115 VAC when condenser pressure rises to 15 PSIG (29.7 PSIA). High pressure safety device resets when condenser pressure falls to 9 PSIG (23.7 PSIA).

TB1-18 — Vane motor switch input. 115 VAC when vanes are fully closed.

TB1-11 — Unused terminal on electro-mechanical and solid state starter applications. Low Water Temp (LWT) input on Turbo-Modulator applications. 0VAC when Turbo-Modulator capacity board senses a LCWT of 4°F below the temp setpoint.

TB1-10 — Low evaporator pressure safety input on brine applications only. 0 VAC when external LEP safety device senses a low pressure situation. The actual trip setting of the safety device is determined by the specific application.

TB1-1 — 115 VAC input from control panel AC power.

TB1-2 — 115 VAC neutral input from control panel AC power.

TB2 — Terminal Block

TB2-7 — Remote start input from external Energy Management System (EMS). Input designed to accept 115 VAC from external field supplied contacts to start compressor. Input will only be accepted if control panel is in REMOTE mode and panel compression switch is in RUN mode. Refer to Fig. 9. This signal need only be a momentary or constant signal to initiate a start.

TB2-1 — Connected to 115 VAC on Digital Input Board. Source voltage for remote start and remote stop inputs. Refer to Fig. 9 below.

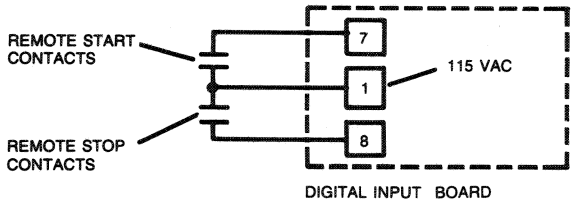


FIG. 9 - REMOTE START AND STOP INPUTS

TB2-8 — Remote stop input from external Energy Management System (EMS). Input designed to accept 115 VAC from external field supplied contacts to stop compressor. Input will only be accepted if control panel is in REMOTE mode and panel compressor switch is in RUN mode. Refer to Fig. 9. This signal must be a maintained signal to provide a stop function.

TB2-19 — Remote LCWT setpoint from external Energy Management System (EMS). Signal is a 1-11 SEC. Pulse Width Modulated (PWM) signal as follows: A 1 second application of 115 VAC corresponds to the control panel operator programmed **Chilled Liquid Temp** setpoint . . . An 11 second application of 115 VAC corresponds to the maximum allowable remote reset value, 10°F or 20°F (Refer to description of **Remote Reset Temp Range**). All settings between 1 sec. and 11 sec. are linearly scaled. Refer to Fig. 10 below. Input will only be accepted if control panel is in REMOTE mode. Calculate the setpoint as follows:

$$^{\circ}F\ Offset = \frac{(Pulse\ Width - 1)\ (Remote\ Reset\ Temp\ Range)}{10}$$

Setpoint = Keypad Entered Setpoint + °F Offset

TB2-1 — Connected to 115 VAC on Digital Input Board. Source voltage for remote LCWT setpoint (PWM signal) and remote current limit setpoint (PWM signal). Refer to Fig. 10 below.

SECTION 4

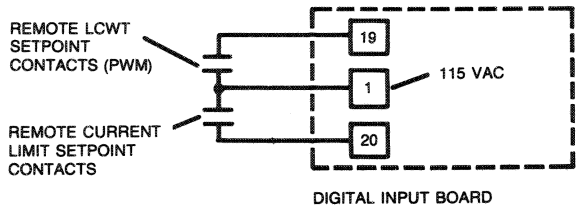


FIG. 10 - REMOTE LCWT & CURRENT LIMIT SETPOINT INPUTS (PWM)

TB2-20 — Remote current limit setpoint from external Energy Management System (EMS). Signal is a 1-11 sec. Pulse Width Modulated (PWM) signal as follows: A 1 second application of 115 VAC corresponds to a setting of 100% FLA . . . an 11 second application of 115 VAC corresponds to a setting of 40% FLA. All settings between 1 sec. and 11 sec. are linearly scaled. Input will only be accepted when control panel is in REMOTE mode. Refer to Fig. 10 above. Calculate the setpoint as follows:

Setpoint = 100% [(Pulsewidth - 1) 6%]

TB2-1 — Connected to 115 VAC on Digital Input Board. Source voltage for chilled water pump interlock/flow switch inputs. Refer to Fig. 11 below.

TB2-12 — Chilled water pump interlock or flow switch contacts input. 115 VAC when interlock or water flow is established. This condition is a prerequisite to running the compressor. Refer to Fig. 11 below.

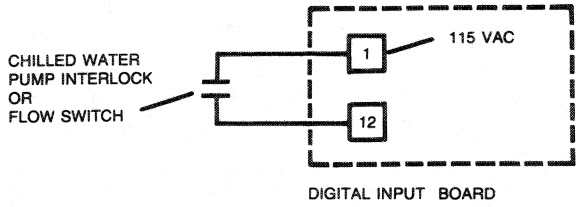
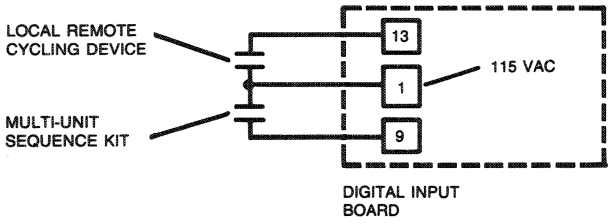
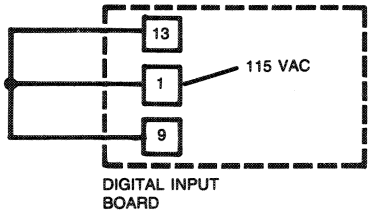


FIG. 11 - CHILLED WATER PUMP INTERLOCK OR FLOW SWITCH CONTACTS



DETAIL A



NO LOCAL OR REMOTE CYCLING OR MULTI UNIT SEQUENCE

DETAIL B

FIG. 12 – LOCAL REMOTE CYCLE DEVICE & MULTI-UNIT SEQUENCE KIT INPUTS

TB2-1 — Connected to 115 VAC on digital input board. Source voltage for Local/Remote Cycling Device Input and multi-unit sequence input. Refer to Fig. 12 (Details A & B)

TB2-9 — Multi-unit sequence kit input. 115 VAC when sequence kit enables the compressor to run. If no multi-unit sequence kit is provided, this input must be jumpered as shown below. Compressor switch must be in RUN position to enable input. Refer to Fig. 12 (Details A & B)

DIGITAL INPUT BOARD — OUTPUTS

All outputs are +5Vdc in the active state. In other words, a 115 VAC input signal causes a +5Vdc output level on the corresponding board output. A 0VAC input causes a 0Vdc output. All outputs interface to the micro board via ribbon cable.

J1-1 - Vane Motor Switch
2 - HP Safety
3 - Purge Bottom Float Switch
4 - Purge Top Float Switch
5 - Undervoltage Relay
6 - High Motor Temp (Hermetric units only)
7 - Motor Controller
8 - Stop (Local)
9 - Start (Local)
10 - Keyswitch-Remote
11 - Keyswitch-Program
12 - Keyswitch-Service
13 - 5V Return
14 - +5V Regulated
15 - Remote Start
16 - Remote Stop
17 - Remote LCWT Setpoint
18 - Remote Current Limit Setpoint
19 - Flow Switch
20 - Local/Remote Cycling Device
21 - Multi-Unit Sequence
22 - Not Used
23 - Not Used
24 - Spare
25 - LEP
26 - LWT

SECTION 5
ANALOG INPUT BOARD

(Ref. Figs. 13, 14 & Tables 1 through 5)

The **Analog Input Board** receives DC voltages from pressure transducers and temperature thermistors (except LCWT) and transmits them serially to the **micro board.** These voltages are analogous to system pressures and temperatures.

The technique used is called analog multiplexing. An analog multiplexer (MUX) IC Chip takes parallel analog inputs and transmits them serially, in a defined sequence, to the micro board. The sequence, or order in which they exit the MUX Chip, is determined by commands in the form of "Address" commands. Each analog input has a unique identification, or address. This address is a number 0 thru 15 and is expressed in Binary form. Therefore, when the **micro board** sends an address to the **analog board,** the analog input with that address will be output from the **analog board.** See Fig. 14.

The inputs are sent to the **micro board** in input ordered sequence (i.e. micro board addresses input no. 3, then no. 4, then no. 5 etc.). Note that inputs 0 thru 2 and 9 and 14 are not addressed by the **micro board** because they are unused inputs. (Refer to Table 1)

Inputs no. 3 thru 7 are temperature sensing thermistors. Refer to Tables 2 thru 4 (temp. vs. volts charts) to determine the correct thermistor voltage output for a given temperature. Input no. 8 is motor current. For electro-mechanical starter and solid state starter applications. Motor current is provided by a CT located in Phase "A" of the motor wiring. The CT feeds the power supply board where the signal is conditioned to provide a linear 0-4 Vdc output to the analog board. Further, this signal is calibrated (using R4), on the power supply board to provide a +4Vdc signal @ 100% FLA. For Turbo-Modulator applications, the motor current value is provided by the Turbo-Modulator Logic Board. Pot R9 on the power

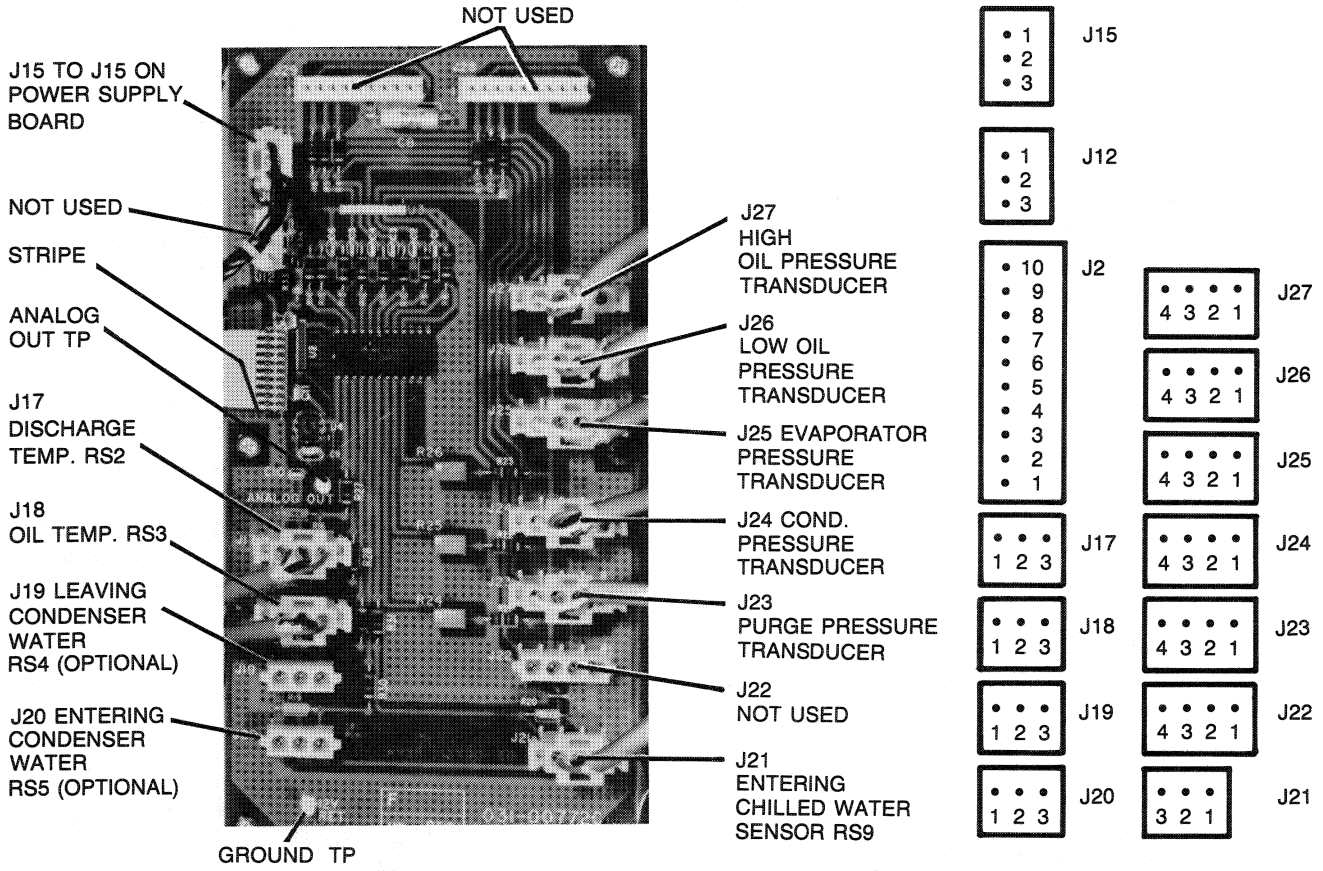


FIG. 13 – ANALOG INPUT BOARD COMPONENTS ANALOG INPUT BOARD PIN IDENTIFICATION

supply board is used to calibrate the signal for +4Vdc @ 100% FLA. Finally, inputs no. 10 thru 15 (except 14) are pressure sensing transducers. Refer to "ANALOG INPUT BOARD-INPUTS" section to determine the correct transducer output voltage for a given pressure.

The "Analog Input Board Inputs & Outputs" Instruction provides details of the inputs and outputs. See pages 12 thru 14.

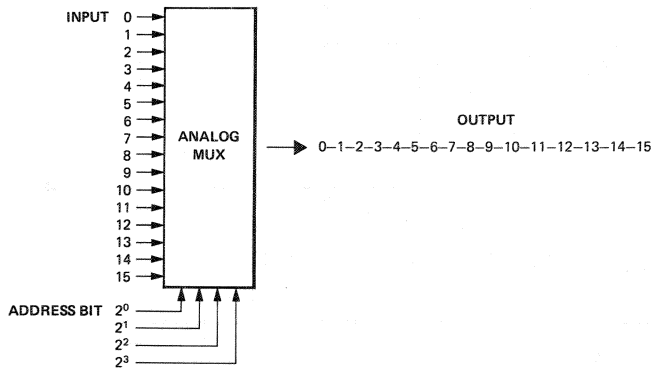


FIG. 14 – ANALOG INPUT BOARD SIMPLIFIED BLOCK DIAGRAM

TABLE 1 – BINARY ADDRESS FOR ANALOG INPUT BOARD

JACK NO.	INPUT NO.	BINARY ADDRESS $2^3\ 2^2\ 2^1\ 2^0$	FUNCTION
–	0	0 0 0 0	NOT USED
–	1	0 0 0 1	NOT USED
–	2	0 0 1 0	NOT USED
J21	3	0 0 1 1	ENTERING CHILL WATER TEMP.
J20	4	0 1 0 0	ENTERING COND. WATER TEMP.
J19	5	0 1 0 1	LEAVING COND. WATER TEMP.
J18	6	0 1 1 0	OIL TEMP.
J17	7	0 1 1 1	DISCHARGE TEMP.
J15	8	1 0 0 0	MOTOR CURRENT
J12	9	1 0 0 1	NOT USED
J26	10	1 0 1 0	OIL PRESSURE (LOW SIDE)
J25	11	1 0 1 1	EVAP. PRESSURE
J24	12	1 1 0 0	COND. PRESSURE
J23	13	1 1 0 1	PURGE PRESSURE
J22	14	1 1 1 0	NOT USED
J27	15	1 1 1 1	OIL PRESSURE (HIGH SIDE)

SECTION 5

ANALOG INPUT BOARD - INPUTS

J2-1 - 12V Ret
2 - 12V Ret
3 - -12Vdc reg.
4 - Not Used
6 - Address Bit "A" (2^0) from Micro Board. +12Vdc = LOGIC 1 STATE
7 - Address Bit "B" (2^1) from Micro Board. +12Vdc = LOGIC 1 STATE
8 - Address Bit "D" (2^3) from Micro Board. +12Vdc = LOGIC 1 STATE
9 - Address Bit "C" (2^2) from Micro Board. +12Vdc = LOGIC 1 STATE
10 - "Mux Inhibit" Bit Input - Not Used

J12-1 - Not Used
2 - Not Used
3 - Not Used

J15-1 - 12V Ret.
2 - +12Vdc
3 - CT Output Signal — full wave rectified output of motor current CT. Adjusted for 4 Vdc at 100% FLA by R4 on power supply board. On Turbo-Modulator applications use R9 on power supply board.

J17-1 - SHLD
2 - +12Vdc
3 - Discharge temp thermistor input. 0-5 Vdc input as measured to ground (J15-1). Refer to Table 5 (Temp vs. Voltage)

J18-1 - SHLD
2 - +12Vdc
3 - Oil temp thermistor input. 0-5 Vdc input as measured to ground (J15-1). Refer to Table 5 (Temp vs. Voltage)

J19-1 - SHLD
2 - +12Vdc
3 - Leaving condenser water temp thermistor input. 0-5 Vdc input as measured to ground (J15-1). Refer to Table 4 (Temp vs. Voltage). This function is optional.

J20-1 - SHLD
2 - +12Vdc
3 - Entering chilled water temp thermistor input. 0-5 Vdc as measured to ground (J15-1).

J21-1 - SHLD
2 - +12Vdc
3 - Entering chilled water temp thermistor input. 0-5 Vdc input as measured to ground (J15-1). Refer to Table 3. (Temp vs. Voltage).

J22-1 - SHLD
2 - 12V Ret
3 - +12Vdc
4 - Not Used

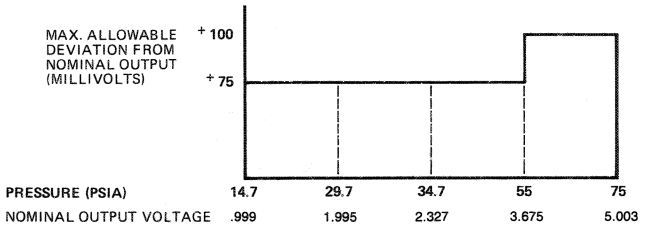


FIG. 15 – PURGE & OIL PRESSURE (HIGH SIDE) TRANSDUCERS – YORK P/N 025-25127-004

J23-1 - SHLD
2 - 12V Ret
3 - +12Vdc
4 - Purge Pressure Transducer Input. .999-5.003 Vdc transducer output [as measured to ground (J23-2)] corresponds to 14.7 PSIA - 75 PSIA transducer input. To calculate the transducer output voltage vs. a given input pressure, use the following formula: (Ref. Fig. 15)

To Solve For V:

$$V = \frac{P + .345}{15.06}$$

Where: P = Pressure in PSIA
V = Volts DC

To Solve For P:

$$P = 15.06 \times V - .345$$

when reading pressures 14.7 PSIA thru 54.9 PSIA, the tolerance of the transducer output is ± 75 MV. When reading pressures 55 PSIA thru 75 PSIA, the tolerance of the transducer output is ± 100 MV.

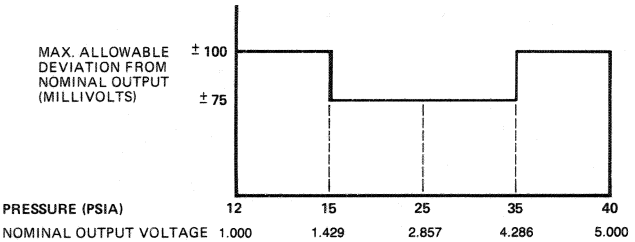


FIG. 16 – CONDENSER TRANSDUCER – YORK P/N 025-25127-001

J24-1 - SHLD
2 - 12V Ret
3 - +12Vdc
4 - Condenser pressure transducer input. 1-5 Vdc transducer output [as measured to ground (J24-2)] corresponds to 12.0 PSIA - 40 PSIA transducer input. To calculate the

transducer output voltage vs. a given input pressure, use the following formula: (Fig. 16)

To Solve For V:

$$V = \frac{P-5}{7}$$

Where: P = Pressure in PSIA
V = Volts dc

To Solve for P:

$$P = 7 \times V + 5$$

when reading pressures 12.0 PSIA thru 14.9 PSIA and 35 PSIA thru 40 PSIA, the tolerance of the transducer output is ± 100 MV. When reading pressures 15 PSIA thru 34.9 PSIA, the tolerance of the transducer output is = 75 MV.

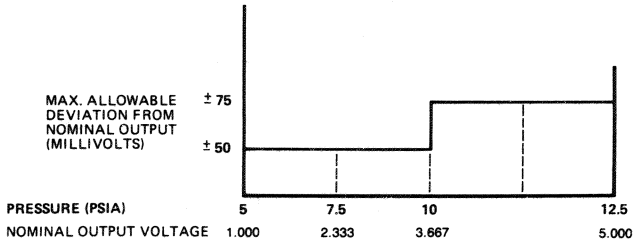


FIG. 17 – EVAPORATOR TRANSDUCER – YORK P/N 025-25127-002

J25-1 - SHLD
2 - 12V Ret
3 - +12Vdc

J25-4 - Evaporator pressure transducer input. 1-5 Vdc transducer output [as measured to ground (J25-2)] corresponds to 5 PSIA - 12.5 PSIA transducer input. To calculate the transducer output voltage vs. a given input pressure, use the following formula:

To Solve For V:

$$V = \frac{P - 3.125}{1.875}$$

Where: P = Pressure In PSIA
V = Volts dc

To Solve For P:

$$P = 1.875 \times V + 3.125$$

when reading pressures 5.0 PSIA thru 9.9 PSIA, the tolerance of the transducer output is ± 50 MV. When reading pressures 10 PSIA thru 12.5 PSIA, the tolerance of the transducer output is ± 75 MV.

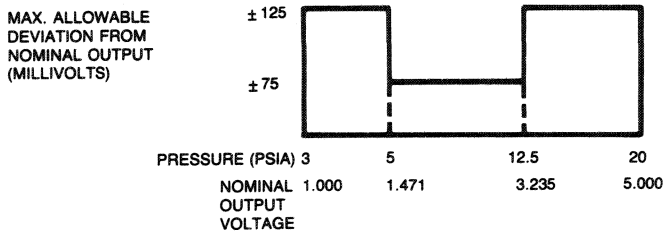


FIG. 18 – OIL PRESSURE (LOW SIDE) TRANSDUCER YORK P/N 025-25127-003

SECTION 5

J26-1 - SHLD
2 - 12V Ret
3 - +12Vdc
4 - Oil pressure transducer input (PRV Input Point - Low side). 1-5 Vdc transducer output [as measured to ground (J26-2)] corresponds to 3-20 PSIA transducer input.

To calculate the transducer output voltage vs. a given input pressure; use the following formula: (Refer to Fig. 18)

To Solve For V:

$$V = \frac{P + 1.25}{4.25}$$

Where: P = Pressure In PSIA
V = Volts dc

To Solve For P:

$$P = 4.25 \times V - 1.25$$

when reading Pressures 5-12.5 PSIA, the tolerance of the transducer output is ± 75 MV. When reading pressures 3-5 PSIA and 12.5-20 PSIA, the tolerance of the transducer is ± 125 MV.

Note that the oil pressure is being monitored at both the oil filter discharge points (Analog Board J27) and PRV Inlet Point (Analog Board J26). The microprocessor subtracts the two values and displays "Differential Oil Pressure" as follows:

Oil Filter Discharge P - PRV Inlet P = PSID

OIL PRESSURE (HIGH SIDE) TRANSDUCER

J27-1 - SHLD
2 - 12V Ret
3 - + 12V
4 - Oil pressure transducer input (oil filter discharge - high side) 0.999 - 5.003 Vdc transducer output [as measured to ground (J27-2)] corresponds to 14.7-75 PSIA transducer input. To calculate the transducer output voltage vs. a given input pressure, use the following formula: (Ref. Fig. 15).

To Solve For V:

$$V = \frac{P + .345}{15.06}$$

Where: P = Pressure In PSIA
V = Volts dc

To Solve For P:

$$P = 15.06 \times V - .345$$

when reading pressures 14.7 PSIA thru 54.9 PSIA, the tolerance of the transducer output is ± 75 MV. When reading pressures 55 PSIA thru 75 PSIA, the tolerance of the transducer output is ± 100 MV.

Note that the oil pressure is being monitored at both the oil filter discharge point (Analog Board J27) and PRV inlet point (Analog Board J26). The microprocessor subtracts the two values and displays "Differential Oil Pressure" as follows:

Oil Filter Discharge P - PRV Inlet P = PSID

J28 - Not Used

J29 - Not Used

ANALOG INPUT BOARD - OUTPUTS

J2-5 - MUX Analog output. O-5 Vdc multiplexed analog serial data output. The following addresses produce the following outputs:

BINARY ADDRESS	OUTPUT
0000_2	Input Channel 0 — Not Used
0001_2	Input Channel 1 — Not Used
0010_2	Input Channel 2 — Not Used
0011_2	Input Channel 3 — Entering chilled water temp thermistor
0100_2	Input Channel 4 — Entering condenser water temp thermistor
0101_2	Input Channel 5 — Leaving condensor water temp thermistor
0110_2	Input Channel 6 — Oil Temp Thermistor
0111_2	Input Channel 7 — Discharge Temp Thermistor
1000_2	Input Channel 8 — Motor current from CT (via power supply board)
1001_2	Input Channel 9 — Not Used
1010_2	Input Channel 10 — Oil Pressure Transducer (Low Side)
1011_2	Input Channel 11 — Evaporator Pressure Transducer
1100_2	Input Channel 12 — Condenser Pressure Transducer
1101_2	Input Channel 13 — Purge Pressure Transducer
1110_2	Input Channel 14 — Not Used
1111_2	Input Channel 15 — Oil Pressure Transducer (High Side)

TABLE 2 — LEAVING CHILLED WATER TEMP.

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)
710	9.98	0.36	960	20.05	0.48	1210	27.95	0.61
715	10.22	0.36	965	20.23	0.48	1215	28.09	0.61
720	10.45	0.36	970	20.40	0.49	1220	28.24	0.61
725	10.68	0.36	975	20.57	0.49	1225	28.39	0.61
730	10.91	0.37	980	20.74	0.49	1230	28.54	0.62
735	11.14	0.37	985	20.91	0.49	1235	28.68	0.62
740	11.36	0.37	990	21.08	0.50	1240	28.83	0.62
745	11.59	0.37	995	21.25	0.50	1245	28.98	0.62
750	11.81	0.38	1000	21.42	0.50	1250	29.12	0.63
755	12.03	0.38	1005	21.58	0.50	1255	29.27	0.63
760	12.26	0.38	1010	21.75	0.51	1260	29.42	0.63
765	12.47	0.38	1015	21.92	0.51	1265	29.56	0.63
770	12.69	0.39	1020	22.08	0.51	1270	29.71	0.64
775	12.91	0.39	1025	22.24	0.51	1275	29.86	0.64
780	13.12	0.39	1030	22.41	0.52	1280	30.00	0.64
785	13.34	0.39	1035	22.57	0.52	1285	30.15	0.64
790	13.55	0.40	1040	22.73	0.52	1290	30.30	0.65
795	13.76	0.40	1045	22.89	0.52	1295	30.44	0.65
800	13.97	0.40	1050	23.05	0.53	1300	30.59	0.65
805	14.18	0.40	1055	23.21	0.53	1305	30.74	0.65
810	14.38	0.41	1060	23.37	0.53	1300	30.64	0.65
815	14.59	0.41	1065	23.53	0.53	1305	30.77	0.65
820	14.79	0.41	1070	23.69	0.54	1310	30.90	0.66
825	15.00	0.41	1075	23.38	0.54	1315	31.05	0.66
830	15.20	0.42	1080	24.01	0.54	1320	31.16	0.66
835	15.40	0.42	1085	24.16	0.54	1325	31.29	0.66
840	15.60	0.42	1090	24.32	0.55	1330	31.42	0.67
845	15.80	0.42	1095	24.47	0.55	1335	31.55	0.67
850	15.99	0.43	1100	24.63	0.55	1340	31.68	0.67
855	16.19	0.42	1105	24.78	0.55	1345	31.81	0.67
860	16.38	0.43	1110	24.94	0.56	1350	31.94	0.68
865	16.58	0.43	1115	25.05	0.56	1355	32.07	0.68
870	16.77	0.44	1120	25.25	0.56	1360	32.20	0.68
875	16.96	0.44	1125	25.40	0.56	1365	32.33	0.68
880	17.15	0.44	1130	25.55	0.57	1370	32.46	0.69
885	17.34	0.44	1135	25.70	0.57	1375	32.58	0.69
890	17.53	0.45	1140	25.85	0.57	1380	32.71	0.69
895	17.72	0.45	1145	26.01	0.57	1385	32.84	0.69
900	17.90	0.45	1150	26.16	0.58	1390	32.97	0.70
905	18.09	0.45	1155	26.31	0.58	1395	33.09	0.70
910	18.27	0.46	1160	26.46	0.58	1400	33.22	0.70
915	18.45	0.46	1165	26.61	0.58	1405	33.35	0.70
920	18.63	0.46	1170	26.76	0.59	1410	33.47	0.71
925	18.81	0.46	1175	26.91	0.59	1415	33.60	0.71
930	18.99	0.47	1180	27.06	0.59	1420	33.72	0.71
935	19.17	0.47	1185	27.20	0.59	1425	33.85	0.71
940	19.35	0.47	1190	27.35	0.60	1430	33.97	0.72
945	19.53	0.47	1195	27.50	0.60	1435	34.10	0.72
950	19.70	0.48	1200	27.65	0.60	1440	34.22	0.72
955	19.88	0.48	1205	27.80	0.61	1445	34.35	0.72

SECTION 5

TABLE 2 — LEAVING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)
1450	34.47	0.73	1700	40.35	0.85	1950	45.63	0.98
1455	34.60	0.73	1705	40.46	0.85	1955	45.73	0.98
1460	34.72	0.73	1710	40.57	0.86	1960	45.83	0.98
1465	34.84	0.73	1715	40.68	0.86	1965	45.93	0.98
1470	34.97	0.74	1720	40.79	0.86	1970	46.03	0.99
1475	35.09	0.74	1725	40.90	0.86	1975	46.13	0.99
1480	35.21	0.74	1730	41.01	0.87	1980	46.23	0.99
1485	35.33	0.74	1735	41.12	0.87	1985	46.33	0.99
1490	35.45	0.75	1740	41.23	0.87	1990	46.43	1.00
1495	35.58	0.75	1745	41.34	0.87	1995	46.53	1.00
1500	35.70	0.75	1750	41.45	0.88	2000	46.62	1.00
1505	35.82	0.75	1755	41.56	0.88	2005	46.72	1.00
1510	35.94	0.76	1760	41.66	0.88	2010	46.82	1.01
1515	36.06	0.76	1765	41.77	0.88	2015	46.92	1.01
1520	36.18	0.76	1770	41.88	0.89	2020	47.02	1.01
1525	36.30	0.76	1775	41.99	0.89	2025	47.11	1.01
1530	36.42	0.77	1780	42.10	0.89	2030	47.21	1.02
1535	36.54	0.77	1785	42.21	0.89	2035	47.31	1.02
1540	36.66	0.77	1790	42.31	0.90	2040	47.40	1.02
1545	36.78	0.77	1795	42.42	0.90	2045	47.50	1.02
1550	36.90	0.78	1800	42.53	0.90	2050	47.60	1.03
1555	37.02	0.78	1805	42.63	0.90	2055	47.69	1.03
1560	37.13	0.78	1810	42.74	0.91	2060	47.79	1.03
1565	37.25	0.78	1815	42.85	0.91	2065	47.89	1.03
1570	37.37	0.79	1820	42.95	0.91	2070	47.98	1.04
1575	37.49	0.79	1825	43.06	0.91	2075	48.08	1.04
1580	37.60	0.79	1830	43.16	0.92	2080	48.17	1.04
1585	37.72	0.79	1835	43.27	0.92	2085	48.27	1.04
1590	37.84	0.80	1840	43.37	0.92	2090	48.36	1.05
1595	37.95	0.80	1845	43.48	0.92	2095	48.46	1.05
1600	38.07	0.80	1850	43.58	0.93	2100	48.55	1.05
1605	38.19	0.80	1855	43.69	0.93	2105	48.64	1.05
1610	38.30	0.81	1860	43.79	0.93	2110	48.74	1.06
1615	38.42	0.81	1865	43.90	0.93	2115	48.83	1.06
1620	38.53	0.81	1870	44.00	0.94	2120	48.93	1.06
1625	38.65	0.81	1875	44.10	0.94	2125	49.02	1.06
1630	38.76	0.82	1880	44.21	0.94	2130	49.11	1.07
1635	38.88	0.82	1885	44.31	0.94	2135	49.21	1.07
1640	38.99	0.82	1890	44.41	0.95	2140	49.30	1.07
1645	39.11	0.82	1895	44.52	0.95	2145	49.39	1.07
1650	39.22	0.83	1900	44.62	0.95	2150	49.48	1.08
1655	39.33	0.83	1905	44.72	0.95	2155	49.58	1.08
1660	39.45	0.83	1910	44.82	0.96	2160	49.67	1.08
1665	39.56	0.83	1915	44.92	0.96	2165	49.67	1.08
1670	39.67	0.84	1920	45.03	0.96	2170	49.85	1.09
1675	39.79	0.84	1925	45.13	0.96	2175	49.95	1.09
1680	39.90	0.84	1930	45.23	0.97	2180	50.04	1.09
1685	40.01	0.84	1935	45.33	0.97	2185	50.13	1.09
1690	40.12	0.85	1940	45.43	0.97	2190	50.22	1.10
1695	40.23	0.85	1945	45.53	0.97	2195	50.31	1.10

TABLE 2 — LEAVING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)
2200	50.40	1.10	2450	54.73	1.23	2700	58.68	1.35
2205	50.49	1.10	2455	54.81	1.23	2705	58.75	1.35
2210	50.58	1.11	2460	54.89	1.23	2710	58.83	1.36
2215	50.67	1.11	2465	54.97	1.23	2715	58.90	1.36
2220	50.76	1.11	2470	55.05	1.24	2720	58.98	1.36
2225	50.85	1.11	2475	55.14	1.24	2725	59.05	1.36
2230	50.94	1.12	2480	55.22	1.24	2730	59.13	1.37
2235	51.03	1.12	2485	55.30	1.24	2735	59.20	1.37
2240	51.12	1.12	2490	55.38	1.25	2740	59.28	1.37
2245	51.21	1.12	2495	55.46	1.25	2745	59.35	1.37
2250	51.30	1.13	2500	55.54	1.25	2750	59.43	1.38
2255	51.39	1.13	2505	55.62	1.25	2755	59.50	1.38
2260	51.48	1.13	2510	55.71	1.26	2760	59.58	1.38
2265	51.57	1.13	2515	55.79	1.26	2765	59.65	1.38
2270	51.65	1.14	2520	55.87	1.26	2770	59.73	1.39
2275	51.74	1.14	2525	55.95	1.26	2775	59.80	1.39
2280	51.83	1.14	2530	56.03	1.27	2780	59.87	1.39
2285	51.92	1.14	2535	56.11	1.27	2785	59.95	1.39
2290	52.01	1.15	2540	56.19	1.27	2790	60.02	1.40
2295	52.09	1.15	2545	56.27	1.27	2795	60.10	1.40
2300	52.18	1.15	2550	56.35	1.28	2800	60.17	1.40
2305	52.27	1.15	2555	56.43	1.28	2805	60.24	1.40
2310	52.35	1.16	2560	56.51	1.28	2810	60.32	1.41
2315	52.44	1.16	2565	56.59	1.28	2815	60.39	1.41
2320	52.53	1.16	2570	56.66	1.29	2820	60.46	1.41
2325	52.61	1.16	2575	65.74	1.29	2825	60.53	1.41
2330	52.70	1.17	2580	56.82	1.29	2830	60.61	1.42
2335	52.79	1.17	2585	56.90	1.29	2835	60.68	1.42
2340	52.87	1.17	2590	56.98	1.30	2840	60.75	1.42
2345	52.96	1.17	2595	57.06	1.30	2845	60.83	1.42
2350	53.04	1.18	2600	57.14	1.30	2850	60.90	1.43
2355	53.13	1.18	2605	57.21	1.30	2855	60.97	1.43
2360	53.22	1.18	2610	57.29	1.31	2860	61.04	1.43
2365	53.30	1.18	2615	57.37	1.31	2865	61.11	1.43
2370	53.39	1.19	2620	57.45	1.31	2870	61.19	1.44
2375	53.47	1.19	2625	57.53	1.31	2875	61.26	1.44
2380	53.56	1.19	2630	57.60	1.32	2880	61.33	1.44
2385	53.64	1.19	2635	57.68	1.32	2885	61.40	1.44
2390	53.72	1.20	2640	57.76	1.32	2890	61.47	1.45
2395	53.81	1.20	2645	57.48	1.32	2895	61.55	1.45
2400	53.89	1.20	2650	57.91	1.33	2900	61.62	1.45
2405	53.98	1.20	2655	57.99	1.33	2905	61.69	1.45
2410	54.06	1.21	2660	58.07	1.33	2910	61.76	1.46
2415	54.14	1.21	2665	58.14	1.33	2915	61.83	1.46
2420	54.23	1.21	2670	58.22	1.34	2920	61.90	1.46
2425	54.31	1.21	2675	58.30	1.34	2925	61.97	1.46
2430	54.39	1.22	2680	58.37	1.34	2930	62.04	1.47
2435	54.48	1.22	2685	58.45	1.34	2935	62.11	1.47
2440	54.56	1.22	2690	58.53	1.35	2940	62.19	1.47
2445	54.64	1.22	2695	58.60	1.35	2945	62.26	1.47

TABLE 2 — LEAVING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)
2950	62.33	1.48	3200	65.75	1.60	3450	69.00	1.73
2955	62.40	1.48	3205	65.81	1.60	3455	69.07	1.73
2960	62.47	1.48	3210	65.88	1.61	3460	69.13	1.73
2965	62.54	1.48	3215	65.94	1.61	3465	69.20	1.73
2970	62.61	1.49	3220	66.01	1.61	3470	69.26	1.74
2975	62.68	1.49	3225	66.08	1.61	3475	69.32	1.74
2980	62.75	1.49	3230	66.14	1.62	3480	69.39	1.74
2985	62.82	1.49	3235	66.21	1.62	3485	69.45	1.74
2990	62.89	1.50	3240	66.28	1.62	3490	69.52	1.75
2995	62.96	1.50	3245	66.34	1.62	3495	69.58	1.75
3000	63.03	1.50	3250	66.41	1.63	3500	69.64	1.75
3005	63.10	1.50	3255	66.47	1.63	3505	69.71	1.75
3010	63.17	1.51	3260	66.54	1.63	3510	69.77	1.76
3015	63.23	1.51	3265	66.61	1.63	3515	69.84	1.76
3020	63.30	1.51	3270	66.67	1.64	3520	69.90	1.76
3025	63.37	1.51	3275	66.74	1.64	3525	69.96	1.76
3030	63.44	1.52	3280	66.80	1.64	3530	70.03	1.77
3035	63.51	1.52	3285	66.87	1.64	3535	70.09	1.77
3040	63.58	1.52	3290	66.93	1.65	3540	70.15	1.77
3045	63.65	1.52	3295	67.00	1.65	3545	70.22	1.77
3050	63.72	1.53	3300	67.06	1.65	3550	70.28	1.78
3055	63.79	1.53	3305	67.13	1.65	3555	70.34	1.78
3060	63.85	1.53	3310	67.19	1.66	3560	70.41	1.78
3065	63.92	1.53	3315	67.26	1.66	3565	70.47	1.78
3070	63.99	1.54	3320	67.33	1.66	3570	70.53	1.79
3075	64.06	1.54	3325	67.39	1.66	3575	70.60	1.79
3080	64.13	1.54	3330	67.46	1.67	3580	70.66	1.79
3085	64.20	1.54	3335	67.52	1.67	3585	70.72	1.79
3090	64.26	1.55	3340	67.59	1.67	3590	70.79	1.80
3095	64.33	1.55	3345	67.65	1.67	3595	70.85	1.80
3100	64.40	1.55	3350	67.72	1.68	3600	70.91	1.80
3105	64.47	1.55	3355	67.78	1.68	3605	70.98	1.80
3110	64.54	1.56	3360	67.85	1.68	3610	71.04	1.81
3115	64.60	1.56	3365	67.91	1.68	3615	71.10	1.81
3120	64.67	1.56	3370	67.97	1.69	3620	71.17	1.81
3125	64.74	1.56	3375	68.04	1.69	3625	71.23	1.81
3130	64.81	1.57	3380	68.10	1.69	3630	71.29	1.82
3135	64.87	1.57	3385	68.17	1.69	3635	71.36	1.82
3140	64.94	1.57	3390	68.23	1.70	3640	71.42	1.82
3145	65.01	1.57	3395	68.30	1.70	3645	71.48	1.82
3150	65.03	1.58	3400	68.36	1.70	3650	71.55	1.83
3155	65.14	1.58	3405	68.43	1.70	3655	71.61	1.83
3160	65.21	1.58	3410	68.49	1.71	3660	71.67	1.83
3165	65.28	1.58	3415	68.56	1.71	3665	71.74	1.83
3170	65.34	1.59	3420	68.62	1.71	3670	71.80	1.84
3175	65.41	1.59	3425	68.68	1.71	3675	71.86	1.84
3180	65.48	1.59	3430	68.75	1.72	3680	71.92	1.84
3185	65.55	1.59	3435	68.81	1.72	3685	71.99	1.84
3190	65.61	1.60	3440	68.88	1.72	3690	72.05	1.85
3195	65.68	1.60	3445	68.94	1.72	3695	72.11	1.85

TABLE 2 — LEAVING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)
3700	72.18	1.85	3800	73.44	1.90	3900	74.70	1.95
3705	72.24	1.85	3805	73.50	1.90	3905	74.76	1.95
3710	72.30	1.86	3810	73.56	1.91	3910	74.83	1.96
3715	72.37	1.86	3815	73.63	1.91	3915	74.89	1.96
3720	72.43	1.86	3820	73.69	1.91	3920	74.95	1.96
3725	72.49	1.86	3825	73.75	1.91	3925	75.02	1.96
3730	72.56	1.87	3830	73.82	1.92	3930	75.08	1.97
3735	72.62	1.87	3835	73.88	1.92	3935	75.14	1.97
3740	72.68	1.87	3840	73.94	1.92	3940	75.21	1.97
3745	72.74	1.87	3845	74.00	1.92	3945	75.27	1.97
3750	72.81	1.88	3850	74.07	1.93	3950	75.33	1.98
3755	72.87	1.88	3855	74.13	1.93	3955	75.40	1.98
3760	72.93	1.88	3860	74.19	1.93	3960	75.46	1.98
3765	73.00	1.88	3865	74.26	1.93	3965	75.52	1.98
3770	73.06	1.89	3870	74.32	1.94	3970	75.59	1.99
3775	73.12	1.89	3875	74.38	1.94	3975	75.65	1.99
3780	73.19	1.89	3880	74.45	1.94	3980	75.71	1.99
3785	73.25	1.89	3885	74.51	1.94	3985	75.78	1.99
3790	73.31	1.90	3890	74.57	1.95	3990	75.84	2.00
3795	73.37	1.90	3895	74.64	1.95	3995	75.90	2.00
						4000	75.97	2.00

SECTION 5

TABLE 3 — ENTERING CHILLED WATER TEMP.

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)	ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
199	10.066	0.9692	17981.75	224	14.645	1.0913	15793.64
200	10.250	0.9741	17883.70	225	14.825	1.0962	15716.25
201	10.434	0.9790	17786.62	226	15.006	1.1011	15639.55
202	10.617	0.9839	17690.51	227	15.186	1.1060	15563.52
203	10.801	0.9888	17595.35	228	15.366	1.1108	15488.17
204	10.985	0.9937	17501.12	229	15.546	1.1157	15413.47
205	11.169	0.9985	17407.81	230	15.725	1.1206	15339.42
206	11.353	1.0034	17315.42	231	15.904	1.1255	15266.02
207	11.537	1.0083	17223.91	232	16.082	1.1304	15193.25
208	11.721	1.0132	17133.29	233	16.260	1.1352	15121.11
209	11.905	1.0181	17043.54	234	16.438	1.1401	15049.58
210	12.088	1.0229	16954.64	235	16.615	1.1450	14978.67
211	12.272	1.0278	16866.59	236	16.791	1.1499	14908.36
212	12.455	1.0327	16779.38	237	16.968	1.1548	14838.64
213	12.639	1.0376	16692.98	238	17.143	1.1597	14769.51
214	12.822	1.0425	16607.29	239	17.318	1.1646	14700.96
215	13.005	1.0474	16522.60	240	17.493	1.1694	14632.98
216	13.188	1.0522	16438.60	241	17.667	1.1743	14565.56
217	13.371	1.0571	16255.37	242	17.841	1.1792	14498.71
218	13.554	1.0620	16272.91	243	18.014	1.1841	14432.40
219	13.726	1.0669	16191.20	244	18.186	1.1890	14366.64
220	13.018	1.0718	16110.24	245	18.358	1.1938	14301.42
221	14.100	1.0767	16030.01	246	18.530	1.1987	14236.73
222	14.282	1.0815	15950.51	247	18.700	1.2036	14172.57
223	14.463	1.0864	15871.72	248	18.870	1.2085	14108.92

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
249	19.040	1.2134	14045.79
250	19.208	1.2182	12983.16
251	19.376	1.2231	13921.93
252	19.544	1.2280	13859.40
253	19.710	1.2329	13798.25
254	19.876	1.2378	13737.59
255	20.042	1.2427	13677.40
256	20.206	1.2476	13617.68
257	20.370	1.2524	13448.43
258	20.523	1.2573	13499.64
259	20.695	1.2622	13441.31
260	20.856	1.2671	13383.42
261	21.016	1.2720	13325.98
262	21.176	1.2769	13268.98
263	21.335	1.2817	13212.41
264	21.493	1.2866	13156.27
265	21.650	1.2915	13100.56
266	21.806	1.2964	13045.27
267	21.961	1.3013	12990.39
268	22.115	1.3062	12035.92
269	22.269	1.3110	12881.85
270	22.421	1.3159	12828.19
271	22.572	1.3208	12774.93
272	22.723	1.3257	12722.06
273	22.872	1.3306	12669.57
274	23.020	1.3354	12617.47
275	23.168	1.3403	12565.75
276	23.314	1.3452	12514.40
277	23.459	1.3501	12463.43
278	23.603	1.3550	12412.82
279	23.746	1.2599	12362.58
280	23.888	1.3647	12312.69
281	24.029	1.3696	12263.17
282	24.169	1.3745	12213.99
283	24.308	1.3794	12165.16
284	24.445	1.3843	12116.68
285	24.581	1.3892	12068.53
286	24.716	1.3940	12020.73
287	24.850	1.3989	11973.26
288	24.982	1.4038	11926.11
289	25.114	1.4087	11879.30
290	25.244	1.4136	11832.81
291	25.373	1.4185	11786.64
292	25.500	1.4233	11740.78
293	25.626	1.4282	11695.24
294	25.751	1.4331	11650.01
295	25.875	1.4380	11605.09
296	25.997	1.4429	11560.47
297	26.118	1.4478	11516.15
298	26.238	1.4526	11472.13
299	26.356	1.4575	11428.40
300	26.472	1.4624	11384.97
301	26.588	1.4673	11341.82
302	26.702	1.4722	11298.97
303	26.814	1.4771	11256.39
304	26.925	1.4819	11214.10
305	27.034	1.4868	11172.08
306	27.142	1.4917	11130.34
307	27.249	1.4966	11088.87
308	27.354	1.5015	11047.67
309	27.457	1.5063	11006.74
310	27.559	1.5112	10966.07
311	27.660	1.5161	10925.66
312	27.758	1.5210	10885.52
313	27.855	1.5259	10845.63
314	27.951	1.5308	10805.99
315	28.045	1.5356	10766.61
316	28.137	1.5404	10727.47
317	28.228	1.5454	10688.59
318	28.317	1.5503	10649.95
319	28.404	1.5552	10611.55
320	28.490	1.5601	10573.39
321	28.573	1.5649	10535.47
322	28.656	1.5698	10497.79
323	28.736	1.5747	10460.33
324	28.815	1.5796	10423.12
325	28.891	1.5845	10386.13
326	28.966	1.5894	10349.36
327	29.040	1.5942	10312.83
328	29.111	1.5991	10276.51
329	29.181	1.6040	10240.42
330	29.249	1.6089	10204.55
331	29.315	1.6138	10168.89
332	29.379	1.6187	10133.45
333	29.441	1.6235	10098.22
334	29.501	1.6284	10063.20
335	29.559	1.6333	10028.39
336	29.616	1.6382	9993.79
337	29.670	1.6431	9959.40
338	29.723	1.6427	9825.21
339	29.773	1.6528	9891.22
340	29.822	1.6577	9857.43
341	29.868	1.6626	9823.84
342	31.011	1.6675	9790.45
343	31.124	1.6724	9757.25
344	31.236	1.6772	9724.24
345	31.348	1.6821	9691.43
346	31.460	1.6870	9658.81
347	31.571	1.6919	9626.37
348	31.683	1.6968	9594.12
349	31.794	1.7017	9562.06
350	31.906	1.7065	9530.18
351	32.017	1.7114	9498.48
352	32.128	1.7163	9466.96
353	32.239	1.7212	9435.63
354	32.349	1.7261	9404.46
355	32.460	1.7310	9373.48
356	32.570	1.7358	9342.67
357	32.681	1.7407	9312.03
358	32.791	1.7456	9281.80

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
359	32.901	1.7505	9251.26
360	33.011	1.7554	9221.13
361	33.120	1.7603	9191.17
362	33.230	1.7651	9161.38
363	33.339	1.7700	9131.75
364	33.449	1.7749	9102.28
365	33.558	1.7798	9072.97
366	33.667	1.7847	9043.82
367	33.776	1.7896	9014.84
368	33.884	1.7944	8986.01
369	33.993	1.7993	8957.34
370	34.101	1.8042	8928.82
371	34.210	1.8091	8900.45
372	34.318	1.8140	8872.24
373	34.426	1.8188	8844.18
374	34.534	1.8237	8816.27
375	34.641	1.8286	8788.51
376	34.749	1.8335	8760.90
377	34.856	1.8384	8733.43
378	34.964	1.8433	8706.11
379	35.071	1.8481	8678.94
380	35.178	1.8530	8651.91
381	35.285	1.8579	8625.01
382	35.392	1.8628	8598.26
383	35.498	1.8677	8571.65
384	35.605	1.8726	8545.18
385	35.711	1.8774	8518.85
386	35.817	1.8823	8492.65
387	35.923	1.8872	8466.59
388	36.029	1.8921	8440.67
389	36.135	1.8970	8414.87
390	36.241	1.9019	8389.21
391	36.346	1.9067	8363.68
392	36.452	1.9116	8338.28
393	36.557	1.9165	8313.01
394	36.662	1.9214	8287.87
395	36.767	1.9263	8262.86
396	36.872	1.9312	8237.97
397	36.977	1.9360	8213.21
398	37.081	1.9409	8188.57
399	37.186	1.9458	8164.06
400	37.290	1.9507	8139.67
401	37.394	1.9556	8115.40
402	37.499	1.9604	8091.25
403	37.602	1.9653	8067.22
404	37.706	1.9702	8043.32
405	37.810	1.9751	8019.53
406	37.914	1.9800	7995.85
407	38.017	1.9849	7972.30
408	38.120	1.9897	7948.85
409	38.223	1.9946	7925.53
410	38.326	1.9995	7902.32
411	38.429	2.0044	7879.22
412	38.432	2.0093	7856.23
413	38.635	2.0142	7833.35

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
414	38.737	2.0190	7810.59
415	38.840	2.0239	7787.93
416	38.942	2.0288	7765.39
417	39.044	2.0337	7742.95
418	39.146	2.0486	7720.62
419	39.248	2.0435	7698.39
420	39.350	2.0483	7676.28
421	39.451	2.0532	7654.26
422	39.553	2.0581	7632.36
423	39.654	2.0630	7610.55
424	39.756	2.0679	7588.85
425	39.857	2.0728	7567.25
426	39.958	2.0776	7545.75
427	40.059	2.0825	7524.36
428	40.159	2.0874	7503.06
429	40.260	2.0923	7481.86
430	40.360	2.0972	7460.76
431	40.461	2.1021	7439.76
432	40.561	2.1069	7418.86
433	40.661	2.1118	7398.05
434	40.761	2.1167	7377.34
435	40.861	2.1216	7356.73
436	40.961	2.1265	7336.21
437	41.061	2.1313	7315.78
438	41.160	2.1362	7295.45
439	41.260	2.1411	7275.21
440	41.359	2.1460	7255.06
441	41.458	2.1509	7235.00
442	41.557	2.1558	7215.04
443	41.656	2.1606	7195.16
444	41.755	2.1655	7175.37
445	41.853	2.1704	7155.68
446	41.952	2.1753	7136.07
447	42.050	2.1802	7116.55
448	42.149	2.1851	7097.11
449	42.247	2.1899	7077.77
450	42.345	2.1948	7058.51
451	42.443	2.1997	7039.33
452	42.541	2.2046	7020.24
453	42.638	2.2095	7001.23
454	42.736	2.2144	6982.31
455	42.834	2.2192	6963.47
456	42.931	2.2241	6944.72
457	43.028	2.2290	6926.04
458	43.125	2.2339	6907.45
459	43.222	2.2388	6888.94
460	43.319	2.2437	6870.51
461	43.416	2.2485	6852.16
462	43.513	2.2534	6833.89
463	43.609	2.2583	6815.69
464	43.706	2.2632	6797.58
465	43.802	2.2681	6779.54
466	43.898	2.2729	6761.59
467	43.994	2.2778	6743.70
468	44.090	2.2827	6725.90

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
469	44.186	2.2876	6708.17
470	44.282	2.2925	6690.52
471	44.378	2.2974	6672.94
472	44.473	2.3022	6655.44
473	44.569	2.3071	6638.01
474	44.664	2.3120	6620.65
475	44.759	2.3169	6603.37
476	44.854	2.3218	6586.16
477	44.949	2.3267	6569.02
478	45.044	2.3315	6551.95
479	45.139	2.3364	6534.96
480	45.233	2.3413	6518.04
481	45.328	2.3462	6501.18
482	45.422	2.3511	6484.40
483	45.517	2.3560	6467.68
484	45.611	2.3608	6451.04
485	45.705	2.3657	6434.46
486	45.799	2.3706	6417.96
487	45.893	2.3755	6401.52
488	45.986	2.3804	6385.14
489	46.080	2.3853	6368.84
490	46.174	2.3901	6352.60
491	46.267	2.3950	6336.43
492	46.360	2.3999	6320.32
493	46.454	2.4048	6304.28
494	46.547	2.4197	6288.30
495	46.640	2.4146	6272.39
496	46.733	2.4194	6256.54
497	46.825	2.4243	6240.76
498	46.918	2.4292	6225.04
499	47.011	2.4341	6209.38
500	47.103	2.4390	6193.79
501	47.196	2.4438	6178.26
502	47.288	2.4487	6162.79
503	47.380	2.4536	6147.38
504	47.472	2.4585	6132.03
505	47.564	2.4634	6116.75
506	47.656	2.4683	6101.52
507	47.748	2.4731	6086.35
508	47.839	2.4780	6071.25
509	47.931	2.4829	6056.20
510	48.022	2.4878	6041.21
511	48.114	2.4927	6026.28
512	48.205	2.4976	6011.41
513	48.296	2.5024	5996.60
514	48.387	2.5073	5981.85
515	44.785	2.1225	5967.15
516	48.569	2.5171	5952.51
517	48.659	2.5220	5937.92
518	48.750	2.5269	5923.40
519	48.841	2.5317	5908.93
520	48.931	2.5366	5894.51
521	49.021	2.5415	5880.15
522	49.111	2.5464	5865.84
523	49.202	2.5513	5851.59
524	49.292	2.5562	5837.40
525	49.382	2.5610	5823.26
526	49.471	2.5659	5809.17
527	49.561	2.5708	5795.13
528	49.651	2.5757	5781.15
529	49.740	2.5806	5767.22
530	49.830	2.5854	5753.35
531	49.919	2.5903	5739.52
532	50.008	2.5952	5725.75
533	50.097	2.6001	5712.03
534	50.186	2.6050	5698.37
535	50.275	2.6099	5684.75
536	50.364	2.6147	5671.18
537	50.453	2.6196	5657.67
538	50.542	2.6245	5644.20
539	50.630	2.6294	5630.79
540	50.719	2.6343	5617.42
541	50.807	2.6392	5604.10
542	50.895	2.6440	5590.84
543	50.984	2.6489	5577.62
544	51.072	2.6538	5564.45
545	51.160	2.6587	5551.33
546	51.248	2.6636	5538.25
547	51.335	2.6685	5525.23
548	51.423	2.6733	5512.25
549	51.511	2.6782	5499.32
550	51.598	2.6831	6586.44
551	51.686	2.6880	5473.60
552	51.773	2.6929	5460.81
553	51.860	2.6978	5448.07
554	51.948	2.7026	5435.37
555	52.035	2.7075	5422.72
556	52.122	2.7124	5410.11
557	52.209	2.7173	5397.55
558	52.295	2.7222	5385.04
559	52.382	2.7271	5372.57
560	52.469	2.7319	5360.14
561	52.555	2.7368	5347.76
562	52.642	2.7417	5335.42
563	52.728	2.7466	5323.13
564	52.814	2.7515	5310.87
565	52.901	2.7563	5298.67
566	52.987	2.7612	5286.50
567	53.073	2.7661	5274.38
568	53.159	2.7710	5262.30
569	53.244	2.7759	5250.27
570	53.330	2.7808	5238.28
571	53.416	2.7856	5226.32
572	53.501	2.7905	5214.41
573	53.587	2.7954	5202.55
574	53.672	2.8003	5190.72
575	53.758	2.8052	5178.93
576	53.843	2.8101	5167.19
577	53.928	2.8149	5155.49
578	54.013	2.8198	5143.82

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
579	54.098	2.8247	5132.20
580	54.183	2.8296	5120.62
581	54.268	2.8345	5109.07
582	54.353	2.8394	5097.57
583	54.437	2.8442	5086.11
584	54.522	2.8491	5074.68
585	54.606	2.8540	5063.30
586	54.691	2.8589	5051.95
587	54.775	2.8638	5040.64
588	54.859	2.8687	5029.38
589	54.948	2.8735	5018.14
590	55.027	2.8784	5006.95
591	55.111	2.8833	4995.80
592	55.195	2.8882	4984.68
593	55.279	2.8931	4973.60
594	55.363	2.8979	4962.56
595	55.447	2.9028	4951.55
596	55.530	2.9077	4940.58
597	55.614	2.9126	4929.65
598	55.697	2.9175	4918.76
599	55.781	2.9224	4907.90
600	55.864	2.9272	4897.08
601	55.947	2.9321	4886.29
602	56.030	2.9370	4875.54
603	56.113	2.9419	4864.83
604	56.196	2.9468	4854.15
605	56.279	2.9517	4843.50
606	56.362	2.9565	4832.90
607	56.445	2.9614	4822.32
608	56.527	2.9663	4811.78
609	56.610	2.9712	4801.28
610	56.692	2.9761	4790.81
611	56.775	2.9810	4780.37
612	56.857	2.9858	4769.97
613	56.939	2.9907	4759.60
614	57.021	2.9956	4749.27
615	57.104	2.0005	4738.97
616	57.186	3.0054	4728.71
617	57.268	3.0103	4718.47
618	57.350	3.0151	4708.27
619	57.431	3.0200	4698.11
620	57.513	3.0249	4687.97
621	57.595	3.0298	4677.87
622	57.676	3.0347	4667.80
623	57.758	3.0396	4657.76
624	57.839	3.0444	4647.76
625	57.921	3.0493	4637.79
626	58.002	3.0542	4627.85
627	58.083	3.0591	4617.94
628	58.165	3.0640	4608.06
629	58.246	3.0688	4598.21
630	58.327	3.0737	4588.40
631	58.408	3.0786	4578.62
632	58.489	3.0835	4568.86
633	58.569	3.0884	4559.14
634	58.650	3.0933	4549.45
635	58.731	3.0981	4539.79
636	58.811	3.1030	4530.16
637	58.892	3.1079	4520.56
638	58.972	3.1128	4510.99
639	59.053	3.1177	4501.45
640	59.133	3.1226	4491.94
641	59.213	3.1274	4482.46
642	59.294	3.1323	4473.01
643	59.374	3.1372	4463.59
644	59.454	3.1421	4454.20
645	59.534	3.1470	4444.84
646	59.614	3.1519	4435.50
647	59.694	3.1567	4426.20
648	59.773	3.1616	4416.92
649	59.853	3.1665	4407.68
650	59.933	3.1714	4398.46
651	60.012	3.1763	4389.27
652	60.092	3.1812	4380.10
653	60.171	3.1860	4370.97
654	60.251	3.1909	4361.86
655	60.330	3.1958	4352.79
656	60.410	3.2007	4343.73
657	60.489	3.2056	4334.71
658	60.568	3.2104	4325.72
659	60.647	3.2153	4316.75
660	60.726	3.2202	4307.81
661	60.805	3.2251	4298.89
662	60.884	3.2300	4290.00
663	60.963	3.2349	4281.14
664	61.042	3.2397	4272.31
665	61.120	3.2446	4263.50
666	61.199	3.2495	4254.72
667	61.278	3.2544	4245.97
668	61.356	3.2593	4237.24
669	61.435	3.2642	4228.54
670	61.513	3.2690	4219.86
671	61.591	3.2739	4211.21
672	61.670	3.2788	4202.59
673	61.748	3.2837	4193.99
674	61.826	3.2886	4185.42
675	61.904	3.2935	4176.87
676	61.982	3.2983	4168.35
677	62.060	3.3032	4159.85
678	62.138	3.3081	4151.38
679	62.216	3.3130	4142.93
680	62.294	3.3179	4134.51
681	62.372	3.3228	4126.11
682	62.449	3.3276	4117.74
683	62.527	3.3325	4109.39
684	62.605	3.3374	4101.07
685	62.682	3.3423	4092.77
686	62.760	3.3472	4084.49
687	62.837	3.3521	4076.24
688	62.915	3.3569	4068.01

SECTION 5

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
689	62.992	3.3618	4059.81
690	63.069	3.3667	4051.63
691	63.146	3.3716	4043.47
692	63.224	3.3765	4035.34
693	63.301	3.3813	4027.23
694	63.378	3.3862	4019.15
695	63.455	3.3911	4011.08
696	63.532	3.3960	4003.05
697	63.609	3.4009	3995.03
698	63.685	3.4058	3987.04
699	63.762	3.4106	3979.07
700	63.839	3.4155	3971.12
701	63.916	3.4204	3963.19
702	63.992	3.4253	3955.29
703	64.069	3.4302	3947.41
704	64.145	3.4351	3939.56
705	64.222	3.4399	3931.72
706	64.298	3.4448	3923.91
707	64.375	3.4497	3916.12
708	64.451	3.4546	3908.35
709	64.527	3.4595	3900.60
710	64.604	3.4644	3892.88
711	64.680	3.4692	3885.18
712	64.756	3.4741	3877.50
713	64.832	3.4790	3869.84
714	64.908	3.4839	3862.20
715	64.984	3.4888	3854.58
716	65.060	3.4937	3846.99
717	65.136	3.4985	3839.41
718	65.212	3.5034	3831.86
719	65.287	3.5083	3824.33
720	65.363	3.5132	3816.81
721	65.439	3.5181	3809.32
722	65.515	3.5229	3801.85
723	65.590	3.5278	3794.41
724	65.666	3.5327	3786.98
725	65.741	3.5376	3779.57
726	65.817	3.5425	3772.18
727	65.892	3.5474	3764.81
728	65.968	3.5522	3757.47
729	66.043	3.5571	3750.14
730	66.118	3.5620	3742.83
731	66.193	3.5669	3735.55
732	66.269	3.5718	3728.28
733	66.344	3.5767	3721.03
734	66.419	3.5815	3713.81
735	66.494	3.5864	3706.60
736	66.569	3.5913	3699.41
737	66.644	3.5962	3692.24
738	66.719	3.6011	3685.10
739	66.794	3.6060	3677.97
740	66.869	3.6108	3670.86
741	66.944	3.6157	3663.77
742	67.018	3.6206	3656.69
743	67.093	3.6255	3649.64
744	67.168	3.6304	3642.61
745	67.243	3.6353	3635.59
746	67.317	3.6401	3628.60
747	67.392	3.6450	3621.62
748	67.466	3.6499	3614.66
749	67.541	3.6548	3607.72
750	67.615	3.6597	3600.80
751	67.690	3.6646	3593.89
752	67.764	3.6694	3587.01
753	67.839	3.6743	3580.14
754	67.913	3.6792	3573.30
755	67.987	3.6841	3566.47
756	68.061	3.6890	3559.65
757	68.136	3.6938	3552.86
758	68.210	3.6987	3546.08
759	68.284	3.7036	3539.32
760	68.358	3.7085	3532.58
761	68.432	3.7134	3525.86
762	68.506	3.7183	3519.16
763	68.580	3.7231	3512.47
764	68.654	3.7280	3505.80
765	68.728	3.7329	3499.15
766	68.802	3.7378	3492.51
767	68.876	3.7427	3485.89
768	68.950	3.7476	3479.29
769	69.023	3.7524	3472.71
770	69.097	3.7573	3466.14
771	69.171	3.7622	3459.60
772	69.244	3.7671	3453.06
773	69.318	3.7720	3446.55
774	69.392	3.7769	3440.05
775	69.465	3.7817	3433.57
776	69.539	3.7866	3427.10
777	69.612	3.7915	3420.65
778	69.686	3.7964	3414.22
779	69.759	3.8013	3407.81
780	69.833	3.8062	3401.41
781	69.906	3.8110	3395.03
782	69.980	3.8159	3388.66
783	70.053	3.8208	3382.31
784	70.126	3.8257	3375.98
785	70.200	3.8306	3369.66
786	70.273	3.8354	3363.36
787	70.346	3.8403	3357.07
788	70.419	3.8452	3350.80
789	70.492	3.8501	3344.55
790	70.566	3.8550	3338.31
791	70.639	3.8599	3332.09
792	70.712	3.8647	3325.89
793	70.785	3.8696	3319.69
794	70.858	3.8745	3313.52
795	70.931	3.8794	3307.36
796	71.004	3.8843	3301.22
797	71.077	3.8892	3295.09
798	71.150	3.8940	3288.98

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
799	71.223	3.8989	3282.88
800	71.295	3.9038	3276.80
801	71.368	3.9087	3270.73
802	71.441	3.9136	3264.68
803	71.514	3.9185	3258.64
804	71.587	3.9233	3252.62
805	71.659	3.9282	3246.61
806	71.732	3.9331	3240.62
807	71.805	3.9380	3234.64
808	71.878	3.9429	3228.68
809	71.950	3.9378	3222.73
810	72.023	3.9526	3216.80
811	72.095	3.9575	3210.88
812	72.168	3.9624	3204.98
813	72.241	3.9673	3199.09
814	72.313	3.9722	3193.21
815	72.386	3.9771	3187.35
816	72.458	3.9819	3181.51
817	72.531	3.9868	3175.67
818	72.603	3.9917	3169.86
819	72.676	3.9966	3164.05
820	72.748	4.0015	3158.26
821	72.820	4.0063	3152.49
822	72.893	4.0112	3146.73
823	72.965	4.0161	3140.98
824	73.038	4.0210	3135.25
825	73.110	4.0259	3129.53
826	73.182	4.0308	3123.83
827	73.254	4.0356	3118.13
828	73.327	4.0405	3112.46
829	73.399	4.0454	3106.79
830	73.471	4.0503	3101.14
831	73.543	4.0552	3095.51
832	73.616	4.0601	3089.88
833	73.688	4.0649	3084.27
834	73.760	4.0698	3078.68
835	73.832	4.0747	3073.10
836	73.904	4.0796	3067.53
837	73.976	4.0845	3061.97
838	74.049	4.0894	3056.43
839	74.121	4.0942	3050.90
840	74.193	4.0991	3045.38
841	74.265	4.1040	3039.88
842	74.337	4.1089	3034.39
843	74.409	4.1138	3028.91
844	74.481	4.1187	3023.45
845	74.553	4.1235	3018.00
846	74.625	4.1284	3012.56
847	74.697	4.1333	3007.13
848	74.769	4.1382	3001.72
849	74.841	4.1431	2996.32
850	74.913	4.1479	2990.93
851	74.985	4.1528	2985.56
852	75.057	4.1577	2980.20
853	75.128	4.1626	2974.85
854	75.200	4.1675	2969.51
855	75.272	4.1724	2964.19
856	75.344	4.1772	2958.88
857	75.416	4.1821	2953.58
858	75.488	4.1870	2948.29
859	75.560	4.1919	2943.01
860	75.632	4.1968	2937.75
861	75.703	4.2017	2932.50
862	75.775	4.2065	2927.26
863	75.847	4.2114	2922.04
864	75.919	4.2163	2916.82
865	75.991	4.2212	2911.62
866	76.062	4.2261	2906.43
867	76.134	4.2310	2901.26
868	76.206	4.2358	2896.09
869	76.278	4.2407	2890.94
870	76.349	4.2456	2885.79
871	76.421	4.2505	2880.66
872	76.493	4.2554	2875.55
873	76.565	4.2603	2870.44
874	76.636	4.2651	2865.34
875	76.708	4.2700	2860.26
876	76.780	4.2749	2855.19
877	76.852	4.2798	2850.13
878	76.923	4.2847	2845.08
879	76.995	4.2896	2840.04
880	77.067	4.2944	2835.02
881	77.138	4.2993	2830.00
882	77.210	4.3042	2825.00
883	77.282	4.3091	2820.01
884	77.353	4.3140	2815.03
885	77.425	4.3188	2810.06
886	77.497	4.3237	2805.10
887	77.569	4.3286	2800.16
888	77.640	4.3335	2795.22
889	77.712	4.3384	2790.30
890	77.784	4.3433	2785.38
891	77.855	4.3481	2780.48
892	77.927	4.3530	2775.59
893	77.999	4.3579	2770.71
894	78.070	4.3628	2765.84
895	78.142	4.3677	2760.98
896	78.214	4.3726	2756.13
897	78.285	4.3774	2751.30
898	78.357	4.3823	2746.47
899	78.429	4.3872	2741.66
900	78.500	4.3921	2736.85
901	78.572	4.3970	2732.06
902	78.644	4.4019	2727.27
903	78.715	4.4067	2722.50
904	78.787	4.4116	2717.74
905	78.859	4.4165	2712.99
906	78.930	4.4214	2708.25
907	79.002	4.4263	2703.52
908	79.074	4.4312	2698.80

SECTION 5

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
909	79.146	4.4360	2694.09
910	79.217	4.4409	2689.39
911	79.289	4.4458	2684.70
912	79.361	4.4507	2680.02
913	79.432	4.4556	2675.35
914	79.504	4.4604	2670.69
915	79.576	4.4653	2666.04
916	79.648	4.4708	2661.41
917	79.719	4.4751	2656.78
918	79.791	4.4800	2652.16
919	79.863	4.4849	2647.55
920	79.935	4.4897	2642.96
921	80.006	4.4946	2638.37
922	80.078	4.4995	2633.79
923	80.150	4.5044	2629.22
924	80.222	4.5093	2624.66
925	80.294	4.5142	2620.12
926	80.365	4.5190	2615.58
927	80.437	4.5239	2611.05
928	80.509	4.5288	2606.53
929	80.581	4.5337	2602.02
930	80.653	4.5386	2597.52
931	80.724	4.5435	2593.03
932	80.796	4.5483	2588.55
933	80.868	4.5532	2584.08
934	80.940	4.5581	2579.62
935	81.012	4.5630	2575.17
936	81.084	4.5679	2570.73
937	81.156	4.5728	2566.30
938	81.228	4.5776	2561.88
939	81.300	4.5825	2557.46
940	81.372	4.5874	2553.06
941	81.444	4.5923	2548.66
942	81.516	4.5972	2544.28
943	81.588	4.6021	2539.90
944	81.660	4.6069	2535.54
945	81.732	4.6118	2531.18
946	81.804	4.6167	2526.83
947	81.876	4.6216	2522.49
948	81.948	4.6265	2518.16
949	82.020	4.6313	2513.84
950	82.092	4.6362	2509.53
951	82.164	4.6411	2505.23
952	82.236	4.6460	2500.93
953	82.308	4.6509	2496.65
954	82.380	4.6558	2492.37
955	82.452	4.6606	2488.11
956	82.525	4.6655	2483.85
957	82.597	4.6704	2479.60
958	82.669	4.6753	2475.36
959	82.741	4.6802	2471.13
960	82.813	4.6851	2466.91
961	82.886	4.6899	2462.69
962	82.958	4.6948	2458.49
963	83.030	4.6997	2454.29
964	83.103	4.7046	2450.11
965	83.175	4.7095	2445.93
966	83.247	4.7144	2441.76
967	83.320	4.7192	2437.60
968	83.392	4.7241	2433.44
969	83.464	4.7290	2429.30
970	83.537	4.7339	2425.17
971	83.609	4.7388	2421.04
972	83.682	4.7437	2416.92
973	83.754	4.7485	2412.81
974	83.827	4.7534	2408.71
975	83.899	4.7583	2404.62
976	83.972	4.7632	2400.53
977	84.045	4.7681	2396.45
978	84.117	4.7729	2392.39
979	84.190	4.7778	2388.33
980	84.262	4.7827	2384.28
981	84.335	4.7876	2380.23
982	84.408	4.7925	2376.20
983	84.480	4.7974	2372.17
984	84.553	4.8022	2368.15
985	84.626	4.8071	2364.14
986	84.699	4.8120	2360.14
987	84.772	4.8169	2356.15
988	84.844	4.8218	2352.16
989	84.917	4.8267	2348.18
990	84.990	4.8315	2344.21
991	85.063	4.8364	2340.25
992	85.136	4.8413	2336.30
993	85.209	4.8462	2332.35
994	85.282	4.8511	2328.41
995	85.355	4.8560	2324.48
996	85.428	4.8608	2320.56
997	85.501	4.8657	2316.65
998	85.574	4.8706	2312.74
999	85.647	4.8755	2308.84
1000	85.720	4.8804	2304.95
1001	85.794	4.8853	2301.07
1002	85.867	4.8901	2297.19
1003	85.940	4.8950	2293.32
1004	86.013	4.8999	2289.46
1005	86.087	4.9048	2285.61
1006	86.160	4.9097	2281.77
1007	86.233	4.9146	2277.93
1008	86.307	4.9194	2274.10
1009	86.380	4.9243	2270.28
1010	86.454	4.9292	2266.47
1011	86.527	4.9341	2262.66
1012	86.601	4.9390	2258.86
1013	86.674	4.9438	2255.07
1014	86.748	4.9487	2251.29
1015	86.821	4.9536	2247.51
1016	86.895	4.9585	2243.74
1017	86.969	4.9634	2239.98
1018	87.042	4.9683	2236.22

TABLE 3 — ENTERING CHILLED WATER TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
1019	87.116	4.9731	2232.48
1020	87.190	4.9780	2228.74
1021	87.264	4.9829	2225.01
1022	87.337	4.9878	2221.28
1023	87.411	4.9927	2217.56

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
194	32.161	0.9448	9430.82
195	32.344	0.9497	9378.19
196	32.526	0.9546	9326.10
197	32.708	0.9595	9274.54
198	32.890	0.9644	9223.50
199	33.071	0.9692	9172.97
200	33.251	0.9741	9122.95
201	33.431	0.9790	9073.43
202	33.611	0.9839	9024.40
203	33.790	0.9888	8975.85
204	33.969	0.9937	8927.79
205	34.147	0.9985	8880.19
206	34.325	1.0034	8833.05
207	34.502	1.0083	8786.38
208	34.678	1.0132	8740.15
209	34.855	1.0181	8694.36
210	35.030	1.0229	8649.01
211	35.206	1.0278	8604.10
212	35.380	1.0327	8559.61
213	35.555	1.0376	8515.53
214	35.728	1.0425	8471.87
215	35.902	1.0474	8428.62
216	36.075	1.0522	8385.77
217	36.247	1.0571	8343.31
218	36.419	1.0620	8301.24

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
219	36.590	1.0669	8259.56
220	36.761	1.0718	8218.26
221	36.932	1.0767	8177.34
222	37.102	1.0815	8136.78
223	37.272	1.0864	8096.59
224	37.441	1.0913	8056.75
225	37.610	1.0962	8017.28
226	37.778	1.1011	7978.15
227	37.946	1.1060	7939.37
228	38.113	1.1108	7900.93
229	38.280	1.1157	7862.82
230	38.446	1.1206	7825.05
231	38.612	1.1255	7787.60
232	38.778	1.1304	7750.48
233	38.943	1.1353	7713.68
234	39.108	1.1401	7677.19
235	39.272	1.1450	7641.02
236	39.436	1.1499	7605.15
237	39.599	1.1548	7569.58
238	39.762	1.1597	7534.32
239	39.925	1.1646	7499.35
240	40.087	1.1694	7464.67
241	40.248	1.1743	7430.28
242	40.410	1.1792	7396.18
243	40.570	1.1841	7362.35

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
244	40.731	1.1890	7328.81
245	40.890	1.1938	7295.54
246	41.050	1.1987	7262.54
247	41.209	1.2036	7229.80
248	41.368	1.2085	7197.34
249	41.526	1.2134	7165.13
250	41.684	1.2183	7133.18
251	41.841	1.2231	7101.49
252	41.998	1.2280	7070.05
253	42.154	1.2329	7038.85
254	42.311	1.2378	7007.91
255	42.466	1.2427	6977.20
256	42.622	1.2476	6946.74
257	42.776	1.2524	6916.52
258	42.931	1.2573	6886.53
259	43.085	1.2622	6856.77
260	43.239	1.2671	6827.24
261	43.392	1.2720	6797.94
262	43.545	1.2769	6768.86
263	43.697	1.2817	6740.00
264	43.849	1.2866	6711.36
265	44.001	1.2915	6682.94
266	44.152	1.2964	6654.74
267	44.303	1.3013	6626.74
268	44.454	1.3062	6598.96
269	44.604	1.3110	6571.38
270	44.753	1.3159	6544.00
271	44.903	1.3208	6516.83
272	45.051	1.3257	6489.86
273	45.200	1.3306	6463.08
274	45.348	1.3354	6436.51
275	45.496	1.3403	6410.12
276	45.643	1.3452	6383.93
277	45.790	1.3501	6357.93
278	45.937	1.3550	6332.11
279	46.083	1.3599	6306.48
280	46.229	1.3647	6281.03
281	46.374	1.3696	6255.77
282	46.520	1.3745	6230.68
283	46.664	1.3794	6205.77
284	46.809	1.3843	6181.04
285	46.953	1.3892	6156.48
286	47.096	1.3940	6132.09
287	47.240	1.3989	6107.88
288	47.382	1.4038	6083.83
289	47.525	1.4087	6059.95
290	47.667	1.4136	6036.23
291	47.809	1.4185	6012.68
292	47.950	1.4233	5989.29
293	48.091	1.4282	5966.05
294	48.232	1.4331	5942.98
295	48.373	1.4380	5920.06
296	48.513	1.4429	5897.30
297	48.652	1.4478	5874.69
298	48.792	1.4526	5852.24
299	48.931	1.4575	5829.93
300	49.069	1.4624	5807.77
301	49.207	1.4673	5785.77
302	49.345	1.4722	5763.90
303	49.483	1.4771	5742.18
304	49.620	1.4819	5720.61
305	49.757	1.4868	5699.17
306	49.894	1.4917	5677.88
307	50.030	1.4966	5656.73
308	50.166	1.5015	5635.71
309	50.301	1.5063	5614.83
310	50.437	1.5112	5594.08
311	50.572	1.5161	5573.47
312	50.706	1.5210	5552.99
313	50.840	1.5259	5532.64
314	50.974	1.5308	5512.42
315	51.108	1.5356	5492.33
316	51.241	1.5405	5472.37
317	51.374	1.5454	5452.53
318	51.507	1.5503	5432.82
319	51.639	1.5552	5413.23
320	51.771	1.5601	5393.77
321	51.903	1.5649	5374.42
322	52.034	1.5698	5355.20
323	52.165	1.5747	5336.09
324	52.296	1.5796	5317.11
325	52.426	1.5845	5298.24
326	52.556	1.5894	5279.49
327	52.686	1.5942	5260.85
328	52.816	1.5991	5242.32
329	52.945	1.6040	5223.91
330	53.074	1.6089	5205.61
331	53.202	1.6138	5187.42
332	53.330	1.6187	5169.34
333	53.458	1.6235	5151.37
334	53.586	1.6284	5133.51
335	53.713	1.6333	5133.51
336	53.841	1.6382	5098.10
337	53.967	1.6431	5080.55
338	54.094	1.6479	5063.11
339	54.220	1.6528	5045.77
340	54.346	1.6577	5028.54
341	54.472	1.6626	5011.40
342	54.597	1.6675	4994.37
343	54.722	1.6724	4977.43
344	54.847	1.6772	4960.60
345	54.971	1.6821	4943.86
346	55.095	1.6870	4927.21
347	55.219	1.6919	4910.67
348	55.343	1.6968	4894.22
349	55.466	1.7017	4877.86
350	55.590	1.7065	4861.60
351	55.712	1.7114	4845.43
352	55.835	1.7163	4829.35
353	55.957	1.7212	4813.36

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
354	56.079	1.7261	4797.47
355	56.201	1.7310	4781.66
356	56.322	1.7358	4765.94
357	56.444	1.7407	4750.31
358	56.565	1.7456	4734.77
359	56.685	1.7505	4719.32
360	56.806	1.7554	4703.95
361	56.926	1.7603	4688.66
362	57.046	1.7651	4673.46
363	57.165	1.7700	4658.35
364	57.285	1.7749	4643.31
365	57.404	1.7798	4628.36
366	57.523	1.7847	4613.50
367	57.642	1.7896	4598.71
368	57.760	1.7944	4584.00
369	57.878	1.7993	4569.37
370	57.996	1.8042	4554.83
371	58.114	1.8091	4540.36
372	58.231	1.8140	4525.97
373	58.348	1.8188	4511.65
374	58.465	1.8237	4497.42
375	58.582	1.8286	4483.25
376	58.698	1.8335	4469.17
377	58.815	1.8384	4455.16
378	58.931	1.8433	4441.22
379	59.046	1.8481	4427.36
380	59.162	1.8530	4413.57
381	59.277	1.8579	4399.85
382	59.392	1.8628	4386.20
383	59.507	1.8677	4372.63
384	59.622	1.8726	4359.13
385	59.736	1.8774	4345.69
386	59.850	1.8823	4332.33
387	59.964	1.8872	4319.03
388	60.078	1.8921	4305.81
389	60.191	1.8970	4292.65
390	60.305	1.9019	4279.56
391	60.418	1.9067	4266.54
392	60.531	1.9116	4253.58
393	60.643	1.9165	4240.69
394	60.756	1.9214	4227.86
395	60.868	1.9263	4215.10
396	60.980	1.9312	4202.41
397	61.092	1.9360	4189.78
398	61.203	1.9409	4177.21
399	61.315	1.9458	4164.70
400	61.426	1.9507	4152.26
401	61.537	1.9556	4139.88
402	61.648	1.9604	4127.56
403	61.758	1.9653	4115.31
404	61.869	1.9702	4103.11
405	61.979	1.9751	4090.97
406	62.089	1.9800	4078.90
407	62.199	1.9849	4066.88
408	62.308	1.9897	4054.92
409	62.418	1.9946	4043.02
410	62.527	1.9995	4031.18
411	62.636	2.0044	4019.40
412	62.745	2.0093	4007.67
413	62.854	2.0142	3996.00
414	62.962	2.0190	3984.39
415	63.071	2.0239	3972.83
416	63.179	2.0288	3961.33
417	63.287	2.0337	3949.88
418	63.395	2.0386	3938.49
419	63.502	2.0435	3927.16
420	63.610	2.0483	3915.87
421	63.717	2.0532	3904.64
422	63.824	2.0581	3893.47
423	63.931	2.0630	3882.34
424	64.038	2.0679	3871.27
425	64.144	2.0728	3860.26
426	64.251	2.0776	3849.29
427	64.357	2.0825	3838.37
428	64.463	2.0874	3827.51
429	64.569	2.0923	3816.70
430	64.675	2.0972	3805.93
431	64.781	2.1021	3795.22
432	64.886	2.1069	3784.56
433	64.992	2.1118	3773.94
434	65.097	2.1167	3763.38
435	65.202	2.1216	3752.86
436	65.307	2.1265	3742.39
437	65.411	2.1313	3731.97
438	65.516	2.1362	3721.60
439	65.620	2.1411	3711.28
440	65.725	2.1460	3701.00
441	65.829	2.1509	3690.77
442	65.933	2.1558	3680.58
443	66.037	2.1606	3670.44
444	66.140	2.1655	3660.35
445	66.244	2.1704	3650.30
446	66.347	2.1753	3640.30
447	66.451	2.1802	3630.34
448	66.554	2.1851	3620.43
449	66.657	2.1899	3610.56
450	66.760	2.1948	3600.73
451	66.863	2.1997	3590.95
452	66.965	2.2046	3581.21
453	67.068	2.2095	3571.52
454	67.170	2.2144	3561.86
455	67.273	2.2192	3552.25
456	67.375	2.2241	3542.68
457	67.477	2.2290	3533.16
458	67.579	2.2339	3523.67
459	67.681	2.2388	3514.23
460	67.782	2.2437	3504.83
461	67.884	2.2485	3495.47
462	67.985	2.2534	3486.15
463	68.087	2.2583	3476.87

SECTION 5

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
464	68.188	2.2632	3467.63
465	68.289	2.2681	3458.43
466	68.390	2.2729	3449.26
467	68.491	2.2778	3440.14
468	68.592	2.2827	3431.06
469	68.693	2.2876	3422.02
470	68.793	2.2925	3413.01
471	68.894	2.2974	3404.04
472	68.994	2.3022	3395.11
473	69.095	2.3071	3386.22
474	69.195	2.3120	3377.37
475	69.295	2.3169	3368.55
476	69.395	2.3218	3359.77
477	69.495	2.3267	3351.03
478	69.595	2.3315	3342.33
479	69.695	2.3364	3333.66
480	69.795	2.3413	3325.02
481	69.894	2.3462	3316.43
482	69.994	2.3511	3307.86
483	70.093	2.3560	3299.34
484	70.193	2.3608	3290.85
485	70.292	2.3657	3282.39
486	70.391	2.3706	3273.97
487	70.490	2.3755	3265.58
488	70.589	2.3804	3257.23
489	70.688	2.3853	3248.91
490	70.787	2.3901	3240.63
491	70.886	2.3950	3232.38
492	70.985	2.3999	3224.16
493	71.084	2.4048	3215.98
494	71.182	2.4097	3207.83
495	71.281	2.4146	3199.71
496	71.379	2.4194	3191.63
497	71.478	2.4243	3183.58
498	71.576	2.4292	3175.56
499	71.675	2.4341	3167.57
500	71.773	2.4390	3159.62
501	71.871	2.4438	3151.69
502	71.969	2.4487	3143.80
503	72.067	2.4536	3135.94
504	72.165	2.4585	3128.11
505	72.263	2.4634	3120.31
506	72.361	2.4683	3112.55
507	72.459	2.4731	3104.81
508	72.557	2.4780	3097.10
509	72.655	2.4829	3089.43
510	72.753	2.4878	3081.78
511	72.851	2.4927	3074.17
512	72.948	2.4976	3066.58
513	73.046	2.5024	3059.03
514	73.144	2.5073	3051.50
515	73.241	2.5122	3044.00
516	73.339	2.5171	3036.53
517	73.436	2.5220	3029.09
518	73.534	2.5269	3021.68
519	73.631	2.5317	3014.30
520	73.729	2.5366	3006.95
521	73.826	2.5415	2999.62
522	73.924	2.5464	2992.32
523	74.021	2.5513	2985.05
524	74.118	2.5562	2977.81
525	74.216	2.5610	2970.60
526	74.313	2.5659	2963.41
527	74.410	2.5708	2956.25
528	74.507	2.5757	2949.12
529	74.605	2.5806	2942.01
530	74.702	2.5854	2934.94
531	74.799	2.5903	2927.88
532	74.896	2.5952	2920.86
533	74.994	2.6001	2913.86
534	75.091	2.6050	2906.89
535	75.188	2.6099	2899.94
536	75.285	2.6147	2893.02
537	75.382	2.6196	2886.13
538	75.479	2.6245	2879.26
539	75.577	2.6294	2872.41
540	75.674	2.6343	2865.60
541	75.771	2.6392	2858.80
542	75.868	2.6440	2852.03
543	75.965	2.6489	2845.29
544	76.063	2.6538	2838.57
545	76.160	2.6587	2831.88
546	76.257	2.6636	2825.21
547	76.354	2.6685	2818.57
548	76.451	2.6733	2811.95
549	76.549	2.6782	2805.35
550	76.646	2.6831	2798.78
551	76.743	2.6880	2792.23
552	76.841	2.6929	2785.71
553	76.938	2.6978	2779.20
554	77.035	2.7026	2772.73
555	77.133	2.7075	2766.27
556	77.230	2.7124	2759.84
557	77.327	2.7173	2753.44
558	77.425	2.7222	2747.05
559	77.522	2.7271	2740.69
560	77.620	2.7319	2734.35
561	77.717	2.7368	2728.03
562	77.815	2.7417	2721.74
563	77.913	2.7466	2715.47
564	78.010	2.7515	2709.22
565	78.108	2.7563	2702.99
566	78.206	2.7612	2696.79
567	78.303	2.7661	2690.60
568	78.401	2.7710	2684.44
569	78.499	2.7759	2678.30
570	78.579	2.7808	2672.18
571	78.695	2.7856	2666.09
572	78.793	2.7905	2660.01
573	78.891	2.7954	2653.96

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
574	78.989	2.8003	2647.92
575	79.087	2.8052	2641.91
576	79.185	2.8101	2635.92
577	79.283	2.8149	2629.95
578	79.382	2.8198	2624.00
579	79.480	2.8247	2618.07
580	79.578	2.8296	2612.16
581	79.677	2.8345	2606.27
582	79.775	2.8394	2600.41
583	79.874	2.8442	2594.56
584	79.973	2.8491	2588.73
588	80.056	2.8687	2565.62
589	80.147	2.8735	2559.89
590	80.237	2.8784	2554.18
591	80.328	2.8833	2548.49
592	80.481	2.8882	2542.82
593	80.509	2.8931	2537.17
594	80.599	2.8979	2531.53
595	80.689	2.9028	2525.92
596	80.779	2.9077	2520.32
597	80.869	2.9126	2514.75
598	80.959	2.9175	2509.19
599	81.049	2.9224	2503.65
600	81.139	2.9272	2498.13
601	81.229	2.9321	2492.63
602	81.319	2.9370	2487.14
603	81.408	2.9419	2481.68
604	81.498	2.9468	2476.23
605	81.587	2.9517	2470.80
606	81.677	2.9565	2465.39
607	81.766	2.9614	2459.99
608	81.856	2.9663	2454.62
609	81.945	2.9712	2449.26
610	82.034	2.9761	2443.92
611	82.123	2.9810	2438.60
612	82.213	2.9858	2433.29
613	82.302	2.9907	2428.00
614	82.391	2.9956	2422.73
615	82.479	3.0005	2417.48
616	82.568	3.0054	2412.24
617	82.657	3.0103	2407.02
618	82.746	3.0151	2401.81
619	82.834	3.0200	2396.63
620	82.923	3.0249	2391.46
621	83.012	3.0298	2386.31
622	83.100	3.0347	2381.17
623	83.188	3.0396	2376.05
624	83.277	3.0444	2370.95
625	83.365	3.0493	2365.86
626	83.453	3.0542	2360.79
627	83.541	3.0591	2355.73
628	83.630	3.0640	2350.69
629	83.718	3.0688	2345.67
630	83.806	3.0737	2340.66
631	83.893	3.0786	2335.67
632	83.981	3.0835	2330.70
633	84.069	3.0884	2325.74
634	84.157	3.0933	2320.80
635	84.244	3.0981	2315.87
636	84.332	3.1030	2310.96
637	84.420	3.1079	2306.06
638	84.507	3.1128	2301.18
639	84.595	3.1177	2296.31
640	84.682	3.1226	2291.46
641	84.769	3.1274	2286.62
642	84.856	3.1323	2281.80
643	84.944	3.1372	2277.00
644	85.031	3.1421	2272.21
645	85.118	3.1470	2267.43
646	85.205	3.1519	2262.67
647	85.292	3.1567	2257.92
648	85.379	3.1616	2253.19
649	85.466	3.1665	2248.47
650	85.552	3.1714	2243.77
651	85.639	3.1763	2239.08
652	85.726	3.1812	2234.41
653	85.812	3.1860	2229.75
654	85.899	3.1909	2225.10
655	85.985	3.1958	2220.47
656	86.072	3.2007	2215.85
657	86.158	3.2056	2211.25
658	86.245	3.2104	2206.66
659	86.331	3.2153	2202.09
660	86.417	3.2202	2197.53
661	86.503	3.2251	2192.98
662	86.589	3.2300	2188.45
663	86.675	3.2349	2183.93
664	86.761	3.2397	2179.42
665	86.847	3.2446	2174.93
666	86.933	3.2495	2170.45
667	87.019	3.2544	2165.98
668	87.105	3.2593	2161.53
669	87.190	3.2642	2157.09
670	87.276	3.2690	2152.66
671	87.361	3.2739	2148.25
672	87.447	3.2788	2143.85
673	87.532	3.2837	2139.47
674	87.618	3.2886	2135.09
675	87.703	3.2935	2130.73
676	87.789	3.2983	2126.38
677	87.874	3.3032	2122.05
678	87.959	3.3081	2117.73
679	88.044	3.3130	2113.42
680	88.129	3.3179	2109.12
681	88.214	3.3228	2104.84
682	88.299	3.3276	2100.57
683	88.384	3.3325	2096.31
684	88.469	3.3374	2092.06
685	88.554	3.3423	2087.83
686	88.639	3.3472	2083.61

SECTION 5

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
687	88.723	3.3521	2079.40
688	88.808	3.3569	2075.20
689	88.893	3.3618	2071.02
690	88.977	3.3667	2066.84
691	89.062	3.3716	2062.68
692	89.146	3.3765	2058.53
693	89.231	3.3813	2054.40
694	89.315	3.3862	2050.27
695	89.399	3.3911	2046.16
696	89.484	3.3960	2042.06
697	89.568	3.4009	2037.97
698	89.652	3.4058	2033.89
699	89.736	3.4106	2029.83
700	89.820	3.4155	2025.77
701	89.904	3.4204	2021.73
702	89.988	3.4253	2017.70
703	90.072	3.4302	2013.68
704	90.156	3.4351	2009.67
705	90.240	3.4399	2005.68
706	90.323	3.4448	2001.69
707	90.407	3.4497	1997.72
708	90.491	3.4546	1993.75
709	90.574	3.4595	1989.80
710	90.658	3.4644	1985.86
711	90.741	3.4692	1981.93
712	90.825	3.4741	1978.01
713	90.908	3.4790	1974.11
714	90.991	3.4839	1970.21
715	91.075	3.4888	1966.32
716	91.158	3.4937	1962.45
717	91.241	3.4985	1958.59
718	91.324	3.5034	1954.73
719	91.407	3.5083	1950.89
720	91.490	3.5132	1947.06
721	91.573	3.5181	1943.24
722	91.656	3.5229	1939.43
723	91.739	3.5278	1935.63
724	91.822	3.5327	1931.84
725	91.905	3.5376	1928.06
726	91.988	3.5425	1924.29
727	92.070	3.5474	1920.53
728	92.153	3.5522	1916.78
729	92.236	3.5571	1913.05
730	92.318	3.5620	1909.32
731	92.401	3.5669	1905.60
732	92.483	3.5718	1901.90
733	92.566	3.5767	1898.20
734	92.648	3.5815	1894.51
735	92.731	3.5864	1890.84
736	92.813	3.5913	1887.17
737	92.895	3.5962	1883.51
738	92.977	3.6011	1879.87
739	93.059	3.6060	1876.23
740	93.142	3.6108	1872.60
741	93.224	3.6157	1868.98
742	93.306	3.6206	1865.38
743	93.388	3.6255	1861.78
744	93.470	3.6304	1858.19
745	93.551	3.6353	1854.61
746	93.633	3.6401	1851.04
747	93.715	3.6450	1847.48
748	93.797	3.6499	1843.93
749	93.879	3.6548	1840.39
750	93.960	3.6597	1836.86
751	94.042	3.6646	1833.34
752	94.123	3.6694	1829.83
753	94.205	3.6743	1826.33
754	94.286	3.6792	1822.83
755	94.368	3.6841	1819.35
756	94.449	3.6890	1815.87
757	94.531	3.6938	1812.41
758	94.612	3.6987	1808.95
759	94.693	3.7036	1805.50
760	94.775	3.7085	1802.07
761	94.856	3.7134	1798.64
762	94.937	3.7183	1795.22
763	95.018	3.7231	1791.80
764	95.099	3.7280	1788.40
765	95.180	3.7329	1785.01
766	95.261	3.7378	1781.62
767	95.342	3.7427	1778.25
768	95.423	3.7476	1774.88
769	95.504	3.7524	1771.52
770	95.585	3.7573	1768.17
771	95.665	3.7622	1764.83
772	95.746	3.7671	1761.50
773	95.827	3.7720	1758.18
774	95.908	3.7769	1754.86
775	95.988	3.7817	1751.55
776	96.069	3.7866	1748.26
777	96.149	3.7915	1744.97
778	96.230	3.7964	1741.69
779	96.310	3.8013	1738.41
780	96.391	3.8062	1735.15
781	96.471	3.8110	1731.89
782	96.551	3.8159	1728.65
783	96.632	3.8208	1725.41
784	96.712	3.8257	1722.18
785	96.792	3.8306	1718.95
786	96.872	3.8354	1715.74
787	96.952	3.8403	1712.53
788	97.033	3.8452	1709.33
789	97.113	3.8501	1706.14
790	97.193	3.8550	1702.96
791	97.273	3.8599	1699.79
792	97.353	3.8647	1696.62
793	97.433	3.8696	1693.46
794	97.512	3.8745	1690.31
795	97.592	3.8794	1687.17
796	97.672	3.8843	1684.04

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
797	97.752	3.8892	1620.91
798	97.832	3.8940	1677.79
799	97.911	3.8989	1674.68
800	97.991	3.9038	1671.58
801	98.071	3.9087	1668.49
802	98.150	3.9136	1665.40
803	98.230	3.9185	1662.32
804	98.309	3.9233	1659.25
805	98.389	3.9282	1656.18
806	98.468	3.9331	1653.13
807	98.548	3.9380	1650.08
808	98.627	3.9429	1647.03
809	98.706	3.9478	1644.00
810	98.786	3.9526	1640.97
811	98.865	3.9575	1637.96
812	98.944	3.9624	1634.94
813	99.023	3.9673	1631.94
814	99.102	3.9722	1628.94
815	99.181	3.9771	1625.95
816	99.261	3.9819	1622.97
817	99.340	3.9868	1620.00
818	99.419	3.9917	1617.03
819	99.498	3.9966	1614.07
820	99.577	4.0015	1611.11
821	99.655	4.0063	1608.17
822	99.734	4.0112	1605.23
823	99.813	4.0161	1602.30
824	99.892	4.0210	1599.37
825	99.971	4.0259	1596.46
826	100.050	4.0308	1593.55
827	100.128	4.0356	1590.64
828	100.207	4.0405	1587.75
829	100.286	4.0454	1584.86
830	100.364	4.0503	1581.98
831	100.443	4.0552	1579.10
832	100.521	4.0601	1576.23
833	100.600	4.0649	1573.37
834	100.678	4.0698	1570.52
835	100.757	4.0747	1567.67
836	100.835	4.0796	1564.83
837	100.914	4.0845	1561.99
838	100.992	4.0894	1559.16
839	101.070	4.0942	1556.34
840	101.149	4.0991	1553.53
841	101.227	4.1040	1550.72
842	101.305	4.1089	1547.92
843	101.383	4.1138	1545.13
844	101.462	4.1187	1542.13
845	101.540	4.1235	1539.56
846	101.618	4.1284	1536.79
847	101.696	4.1333	1534.02
848	101.774	4.1382	1531.26
849	101.852	4.1431	1528.50
850	101.930	4.1479	1525.75
851	102.008	4.1528	1523.01
852	102.086	4.1577	1520.28
853	102.164	4.1626	1517.55
854	102.242	4.1675	1514.83
855	102.320	4.1724	1512.11
856	102.398	4.1772	1509.40
857	102.475	4.1821	1506.70
858	102.553	4.1870	1504.00
859	102.631	4.1919	1501.31
860	102.709	4.1968	1498.63
861	102.786	4.2017	1495.95
862	102.864	4.2065	1493.28
863	102.942	4.2114	1490.61
864	103.019	4.2163	1487.95
865	103.097	4.2212	1485.30
866	103.174	4.2261	1482.65
867	103.252	4.2310	1480.01
868	103.329	4.2358	1477.37
869	103.407	4.2407	1474.74
870	103.484	4.2456	1472.12
871	103.562	4.2505	1469.50
872	103.639	4.2554	1466.89
873	103.716	4.2603	1464.29
874	103.794	4.2651	1461.69
875	103.871	4.2700	1459.10
876	103.948	4.2749	1456.51
877	104.026	4.2798	1453.93
878	104.103	4.2847	1451.35
879	104.180	4.2896	1448.78
880	104.257	4.2944	1446.22
881	104.334	4.2993	1443.66
882	104.412	4.3042	1441.11
883	104.489	4.3091	1438.56
884	104.566	4.3140	1436.02
885	104.643	4.3188	1433.49
886	104.720	4.3237	1430.96
887	104.797	4.3286	1428.43
888	104.874	4.3335	1425.92
889	104.951	4.3384	1423.40
890	105.028	4.3433	1420.90
891	105.105	4.3481	1418.40
892	105.182	4.3530	1415.90
893	105.259	4.3579	1413.41
894	105.335	4.3628	1410.93
895	105.412	4.3677	1408.45
896	105.489	4.3726	1405.98
897	105.566	4.3774	1403.51
898	105.643	4.3823	1401.05
899	105.719	4.3872	1398.59
900	105.796	4.3921	1396.14
901	105.873	4.3970	1393.70
902	105.949	4.4019	1391.26
903	106.026	4.4067	1388.82
904	106.103	4.4116	1386.39
905	106.179	4.4165	1383.97
906	106.256	4.4214	1381.55

SECTION 5

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
907	106.332	4.4263	1379.14
908	106.409	4.4312	1376.73
909	106.485	4.4360	1374.33
910	106.562	4.4409	1371.93
911	106.638	4.4458	1369.54
912	106.715	4.4507	1367.15
913	106.791	4.4556	1364.77
914	106.868	4.4604	1362.39
915	106.944	4.4653	1360.02
916	107.021	4.4702	1357.65
917	107.097	4.4751	1355.29
918	107.173	4.4800	1352.94
919	107.250	4.4849	1350.59
920	107.326	4.4897	1348.24
921	107.402	4.4946	1345.90
922	107.478	4.4995	1343.57
923	107.555	4.5044	1341.24
924	107.631	4.5093	1338.91
925	107.707	4.5142	1336.59
926	107.783	4.5190	1334.28
927	107.859	4.5239	1331.97
928	107.936	4.5288	1329.66
929	108.012	4.5337	1327.36
930	108.088	4.5386	1325.07
931	108.164	4.5435	1322.78
932	108.240	4.5483	1320.49
933	108.316	4.5532	1318.21
934	108.392	4.5581	1315.93
935	108.468	4.5630	1313.66
936	108.544	4.5679	1311.40
937	108.620	4.5728	1309.14
938	108.696	4.5776	1306.88
939	108.772	4.5825	1304.63
940	108.848	4.5874	1302.38
941	108.924	4.5923	1300.14
942	109.000	4.5972	1297.90
943	109.076	4.6021	1295.67
944	109.152	4.6069	1293.44
945	109.227	4.6118	1291.22
946	109.303	4.6167	1289.00
947	109.379	4.6216	1286.79
948	109.455	4.6265	1284.58
949	109.531	4.6313	1282.38
950	109.607	4.6362	1280.18
951	109.682	4.6411	1277.98
952	109.758	4.6460	1275.79
953	109.834	4.6509	1273.61
954	109.910	4.6558	1271.43
955	109.985	4.6606	1269.25
956	110.061	4.6655	1267.08
957	110.137	4.6704	1264.91
958	110.212	4.6753	1262.75
959	110.288	4.6802	1260.59
960	110.364	4.6851	1258.44
961	110.439	4.6899	1256.29
962	110.515	4.6948	1254.14
963	110.590	4.6997	1252.00
964	110.666	4.7046	1249.86
965	110.742	4.7095	1247.73
966	110.817	4.7144	1245.61
967	110.893	4.7192	1243.48
968	110.968	4.7241	1241.36
969	111.044	4.7290	1239.25
970	111.119	4.7339	1237.14
971	111.195	4.7388	1235.04
972	111.270	4.7437	1232.94
973	111.346	4.7485	1230.84
974	111.421	4.7434	1228.75
975	111.497	4.7583	1226.66
976	111.572	4.7632	1224.57
977	111.648	4.7681	1222.50
978	111.723	4.7729	1220.42
979	111.798	4.7778	1218.35
980	111.874	4.7827	1216.28
981	111.949	4.7876	1214.22
982	112.025	4.7925	1212.16
983	112.100	4.7974	1210.11
984	112.175	4.8022	1208.06
985	112.251	4.8071	1206.01
986	112.326	4.8120	1203.97
987	112.401	4.8169	1201.93
988	112.477	4.8218	1199.90
989	112.552	4.8267	1197.87
990	112.627	4.8315	1195.84
991	112.703	4.8364	1193.82
992	112.778	4.8413	1191.81
993	112.853	4.8462	1189.79
994	112.928	4.8511	1187.79
995	113.004	4.8560	1185.78
996	113.079	4.8608	1183.78
997	113.154	4.8657	1181.78
998	113.229	4.8706	1179.79
999	113.305	4.8755	1177.80
1000	113.380	4.8804	1175.82
1001	113.455	4.8853	1173.84
1002	113.530	4.8901	1171.86
1003	113.605	4.8950	1169.89
1004	113.681	4.8999	1167.92
1005	113.756	4.9048	1165.95
1006	113.831	4.9097	1163.99
1007	113.906	4.9146	1162.03
1008	113.981	4.9194	1160.08
1009	114.056	4.9243	1158.13
1010	114.132	4.9292	1156.18
1011	114.207	4.9341	1154.24
1012	114.282	4.9390	1152.31
1013	114.357	4.9438	1150.37
1014	114.432	4.9487	1148.44
1015	114.507	4.9536	1146.51
1016	114.582	4.9585	1144.59

TABLE 4 — ENTERING AND LEAVING CONDENSER WATER (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
1017	114.657	4.9634	1142.67
1018	114.732	4.9683	1140.76
1019	114.808	4.9731	1138.85
1020	114.883	4.9780	1136.94
1021	114.958	4.9829	1135.03
1022	115.033	4.9878	1133.13
1023	115.108	4.9927	1131.24

TABLE 5 — OIL DISCHARGE TEMP.

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
1	68.385	0.0024	3960845.20
2	68.903	0.0073	1319744.40
3	69.419	0.0122	791524.24
4	69.934	0.0171	565144.17
5	70.447	0.0220	439377.47
6	70.959	0.0269	359344.11
7	71.469	0.0317	303936.40
8	71.978	0.0366	263304.08
9	72.485	0.0415	232232.31
10	72.991	0.0464	207701.96
11	73.495	0.0513	187844.06
12	73.997	0.0562	171439.70
13	74.499	0.0610	157660.05
14	74.998	0.0659	145921.81
15	75.496	0.0708	135802.66
16	75.993	0.0757	126989.20
17	76.488	0.0806	119244.04
18	76.982	0.0854	112384.03
19	77.474	0.0903	106265.65
20	77.965	0.0952	100774.80
21	78.454	0.1001	95819.64
22	78.942	0.1050	91325.42
23	79.428	0.1099	87230.69
24	79.913	0.1147	83484.45
25	80.397	0.1196	80044.02
26	80.879	0.1245	76873.44
27	81.359	0.1294	73942.14
28	81.838	0.1343	71224.02
29	82.316	0.1392	68696.65
30	82.792	0.1440	66340.63
31	83.267	0.1489	64139.10
32	83.740	0.1538	62077.35
33	84.212	0.1587	60142.48
34	84.682	0.1636	58323.12
35	85.151	0.1685	56609.23
36	85.618	0.1733	54991.90
37	86.084	0.1782	53463.19
38	86.549	0.1831	52016.02
39	87.012	0.1880	50644.02
40	87.474	0.1929	49341.48
41	87.934	0.1978	48103.27
42	88.393	0.2026	46924.74
43	88.851	0.2075	45801.66
44	89.307	0.2124	44730.22
45	89.762	0.2173	43706.93
46	90.215	0.2222	42728.63
47	90.667	0.2271	41792.40
48	91.118	0.2319	40895.59
49	91.567	0.2368	40035.76
50	92.014	0.2417	39210.68
51	92.461	0.2466	38418.27
52	92.906	0.2515	37656.63
53	93.349	0.2563	36924.01
54	93.791	0.2612	36218.78
55	94.232	0.2661	35539.42
56	94.672	0.2710	34884.55
57	95.110	0.2759	34252.86
58	95.546	0.2808	33643.14
59	95.982	0.2856	33054.27
60	96.416	0.2905	32485.19
61	96.848	0.2954	31934.92
62	97.280	0.3003	31402.55
63	97.709	0.3052	30887.21
64	98.138	0.3101	30388.10
65	98.565	0.3149	29904.47
66	98.991	0.3198	29435.61
67	99.415	0.3247	28980.85
68	99.839	0.3296	28539.56
69	100.260	0.3345	28111.16
70	100.681	0.3394	27695.09
71	101.100	0.3442	27290.82
72	101.518	0.3491	26897.85
73	101.934	0.3540	26515.73
74	102.349	0.3589	26144.01
75	102.763	0.3638	25782.26
76	103.176	0.3687	25430.10
77	103.587	0.3735	25087.15
78	103.997	0.3784	24753.04
79	104.405	0.3833	24427.45
80	104.813	0.3882	24110.05
81	105.218	0.3931	23800.53
82	105.623	0.3979	23498.61
83	106.026	0.4028	23204.01
84	106.428	0.4077	22916.46
85	106.829	0.4126	22635.72
86	107.229	0.4175	22361.55
87	107.627	0.4224	22093.72
88	108.024	0.4272	21832.01
89	108.419	0.4321	21576.21
90	108.814	0.4370	21326.13
91	109.207	0.4419	21081.58
92	109.598	0.4468	20842.37
93	109.989	0.4517	20608.33
94	110.378	0.4565	20379.30
95	110.766	0.4614	20155.12
96	111.153	0.4663	19935.63
97	111.538	0.4712	19720.69
98	111.922	0.4761	19510.16
99	112.305	0.4810	19303.90
100	112.687	0.4858	19101.79
101	113.067	0.4907	18903.71
102	113.446	0.4956	18709.52
103	113.824	0.5005	18519.13
104	114.201	0.5054	18332.41
105	114.576	0.5103	18149.27

TABLE 5 — OIL AND DISCHARGE TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
106	114.951	0.5151	17969.60
107	115.324	0.5200	17793.30
108	115.695	0.5249	17620.28
109	116.066	0.5298	17450.46
110	116.435	0.5347	17283.73
111	116.803	0.5396	17120.02
112	117.170	0.5444	16959.25
113	117.536	0.5493	16801.34
114	117.900	0.5542	16646.21
115	118.263	0.5591	16493.79
116	118.625	0.5640	16344.01
117	118.986	0.5688	16196.79
118	119.346	0.5737	16052.09
119	119.704	0.5786	15909.83
120	120.061	0.5835	15769.95
121	120.417	0.5884	15632.39
122	120.772	0.5933	15497.09
123	121.126	0.5981	15364.00
124	121.478	0.6030	15233.07
125	121.830	0.6079	15104.25
126	122.180	0.6128	14977.47
127	122.528	0.6177	14852.70
128	122.876	0.6226	14729.89
129	123.223	0.6274	14608.99
130	123.568	0.6323	14489.95
131	123.912	0.6372	14372.74
132	124.255	0.6421	14257.31
133	124.597	0.6470	14143.63
134	124.938	0.6519	14031.64
135	125.278	0.6567	13921.33
136	125.616	0.6616	13812.64
137	125.953	0.6665	13705.54
138	126.290	0.6714	13600.00
139	126.625	0.6763	13495.99
140	126.958	0.6812	13393.47
141	127.291	0.6860	13292.40
142	127.623	0.6909	13192.77
143	127.953	0.6958	13094.53
144	128.283	0.7007	12997.66
145	128.611	0.7056	12902.14
146	128.938	0.7104	12807.92
147	129.264	0.7153	12714.99
148	129.589	0.7202	12623.33
149	129.127	0.2512	12532.89
150	130.235	0.7300	12443.67
151	130.556	0.7349	12355.63
152	130.877	0.7397	12268.76
153	131.196	0.7446	12183.02
154	131.514	0.7495	12098.40
155	131.831	0.7544	12014.88
156	132.147	0.7593	11932.43
157	132.462	0.7642	11851.03
158	132.776	0.7690	11770.67
159	133.089	0.7739	11691.32
160	133.401	0.7788	11612.97
161	133.711	0.7837	11535.59
162	134.021	0.7886	11459.17
163	134.329	0.7935	11383.70
164	134.636	0.7983	11309.14
165	134.943	0.8032	11235.49
166	135.248	0.8081	11162.73
167	135.552	0.8130	11090.85
168	135.855	0.8179	11019.82
169	136.157	0.8228	10949.64
170	136.458	0.8276	10880.29
171	136.758	0.8325	10811.75
172	137.057	0.8374	10744.00
173	137.355	0.8423	10677.05
174	137.652	0.8472	10610.86
175	137.947	0.8521	10545.44
176	138.242	0.8569	10480.76
177	138.536	0.8618	10416.81
178	138.828	0.8667	10353.58
179	139.120	0.8716	10291.06
180	139.410	0.8765	10229.24
181	139.700	0.8813	10168.10
182	139.988	0.8862	10107.64
183	140.276	0.8911	10047.84
184	140.562	0.8960	9988.69
185	140.848	0.9009	9930.18
186	141.132	0.9058	9872.31
187	141.416	0.9106	9815.05
188	141.698	0.9155	9758.40
189	141.980	0.9204	9702.36
190	142.260	0.9253	9646.91
191	142.540	0.9302	9592.03
192	142.818	0.9351	9537.74
193	143.096	0.9399	9484.00
194	143.372	0.9448	9430.82
195	143.648	0.9497	9378.19
196	143.922	0.9546	9326.10
197	144.196	0.9595	9274.54
198	144.468	0.9644	9223.50
199	144.740	0.9692	9172.97
200	145.010	0.9741	9122.95
201	145.280	0.9790	9073.43
202	145.549	0.9839	9024.40
203	145.816	0.9888	8975.85
204	146.083	0.9937	8927.79
205	146.349	0.9985	8880.19
206	146.614	1.0034	8833.05
207	146.878	1.0083	8786.38
208	147.141	1.0132	8740.15
209	147.403	1.0181	8694.36
210	147.664	1.0229	8649.01
211	147.924	1.0278	8604.10
212	148.183	1.0327	8559.61
213	148.441	1.0376	8515.53
214	148.698	1.0425	8471.87
215	148.955	1.0474	8428.62

TABLE 5 — OIL DISCHARGE TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
216	149.210	1.0522	8385.77
217	149.465	1.0571	8343.31
218	149.718	1.0620	8301.24
219	149.971	1.0669	8259.56
220	150.223	1.0718	8218.26
221	150.474	1.0767	8177.34
222	150.724	1.0815	8136.78
223	150.973	1.0864	8096.59
224	151.221	1.0913	8056.75
225	151.468	1.0962	8017.28
226	151.714	1.1011	7978.15
227	151.960	1.1060	7939.37
228	152.204	1.1108	7900.93
229	152.448	1.1157	7862.82
230	152.691	1.1206	7825.05
231	152.933	1.1255	7787.60
232	153.174	1.1304	7750.48
233	153.414	1.1353	7713.68
234	153.653	1.1401	7677.19
235	153.892	1.1450	7641.02
236	154.129	1.1499	7605.15
237	154.366	1.1548	7569.58
238	154.601	1.1597	7534.32
239	154.836	1.1646	7499.35
240	155.070	1.1694	7464.67
241	155.304	1.1743	7430.28
242	155.536	1.1792	7396.18
243	155.768	1.1841	7362.35
244	155.998	1.1890	7328.81
245	156.228	1.1938	7295.54
246	156.457	1.1987	7262.54
247	156.685	1.2036	7229.80
248	156.912	1.2085	7197.34
249	157.139	1.2134	7165.13
250	157.364	1.2183	7133.18
251	157.589	1.2231	7101.49
252	157.813	1.2280	7070.05
253	158.036	1.2329	7038.85
254	158.259	1.2378	7007.91
255	158.480	1.2427	6977.20
256	158.701	1.2476	6946.74
257	158.921	1.2524	6916.52
258	159.140	1.2573	6886.53
259	159.358	1.2622	6856.77
260	158.576	1.2671	6827.24
261	159.792	1.2720	6797.94
262	160.008	1.2769	6768.86
263	160.223	1.2817	6740.00
264	160.438	1.2866	6711.36
265	160.651	1.2915	6682.94
266	160.864	1.2964	6654.74
267	161.076	1.3013	6626.74
268	161.287	1.3062	6598.96
269	161.497	1.3110	6571.38
270	161.707	1.3159	6544.00
271	161.916	1.3208	6516.83
272	162.124	1.3257	6489.86
273	162.331	1.3306	6463.08
274	162.538	1.3354	6436.51
275	162.743	1.3403	6410.12
276	162.948	1.3452	6383.93
277	163.153	1.3501	6357.93
278	163.356	1.3550	6332.11
279	163.559	1.3599	6306.48
280	163.761	1.3647	6281.03
281	163.962	1.3696	6255.77
282	164.163	1.3745	6230.68
283	164.363	1.3794	6205.77
284	164.562	1.3843	6181.04
285	164.760	1.3892	6156.48
286	164.958	1.3940	6132.09
287	165.155	1.3989	6107.88
288	165.351	1.4038	6083.83
289	165.546	1.4087	6059.95
290	165.741	1.4136	6036.23
291	165.935	1.4185	6012.68
292	166.128	1.4233	5989.29
293	166.321	1.4282	5966.05
294	166.513	1.4331	5942.98
295	166.704	1.4380	5920.06
296	166.894	1.4429	5897.30
297	167.084	1.4478	5874.69
298	167.273	1.4526	5852.24
299	167.461	1.4575	5829.93
300	167.649	1.4624	5807.77
301	167.836	1.4673	5785.77
302	168.022	1.4722	5763.90
303	168.208	1.4771	5742.18
304	168.393	1.4819	5720.61
305	168.577	1.4868	5699.17
306	168.761	1.4917	5677.88
307	168.944	1.4966	5656.73
308	169.126	1.5015	5635.71
309	169.308	1.5063	5614.83
310	169.489	1.5112	5594.08
311	169.669	1.5161	5573.47
312	169.848	1.5210	5552.99
313	170.027	1.5259	5532.64
314	170.206	1.5308	5512.42
315	170.383	1.5356	5492.33
316	170.560	1.5405	5472.37
317	170.737	1.5454	5452.53
318	170.913	1.5503	5432.82
319	171.088	1.5552	5413.23
320	171.262	1.5601	5393.77
321	171.436	1.5649	5374.42
322	171.609	1.5698	5355.20
323	171.782	1.5747	5336.09
324	171.954	1.5796	5317.11
325	172.125	1.5845	5298.24

TABLE 5 — OIL AND DISCHARGE TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
326	172.296	1.5894	5279.49
327	172.466	1.5942	5260.85
328	172.636	1.5991	5242.32
329	172.804	1.6040	5223.91
330	172.973	1.6089	5205.61
331	173.140	1.6138	5187.42
332	173.307	1.6187	5169.34
333	173.474	1.6235	5151.37
334	173.640	1.6284	5133.51
335	173.805	1.6333	5115.75
336	173.970	1.6382	5098.10
337	174.134	1.6431	5080.55
338	174.298	1.6479	5063.11
339	174.461	1.6528	5045.77
340	174.623	1.6577	5028.54
341	174.785	1.6626	5011.40
342	174.946	1.6675	4994.37
343	175.107	1.6724	4977.43
344	175.267	1.6772	4960.60
345	175.426	1.6821	4943.86
346	175.585	1.6870	4927.21
347	175.744	1.6919	4910.67
348	175.902	1.6968	4894.22
349	176.059	1.7017	4877.86
350	176.216	1.7065	4861.60
351	176.372	1.7114	4845.43
352	176.528	1.7163	4829.35
353	176.683	1.7212	4813.36
354	176.837	1.7261	4797.47
355	176.991	1.7310	4781.66
356	177.145	1.7358	4765.94
357	177.298	1.7407	4750.31
358	177.450	1.7456	4734.77
359	177.602	1.7505	4719.32
360	177.754	1.7554	4703.95
361	177.905	1.7603	4688.66
362	178.055	1.7651	4673.46
363	178.205	1.7700	4658.35
364	178.354	1.7749	4643.31
365	178.503	1.7798	4628.36
366	178.652	1.7847	4613.50
367	178.799	1.7896	4598.71
368	178.947	1.7944	4584.00
369	179.094	1.7993	4569.37
370	179.240	1.8042	4554.83
371	179.386	1.8091	4540.36
372	179.531	1.8140	4525.97
373	179.676	1.8188	4511.65
374	179.821	1.8237	4497.42
375	179.965	1.8286	4483.25
376	180.108	1.8335	4469.17
377	180.251	1.8384	4455.16
378	180.394	1.8433	4441.22
379	180.536	1.8481	4427.36
380	180.677	1.8530	4413.57
381	180.818	1.8579	4399.85
382	180.959	1.8628	4386.20
383	181.099	1.8677	4372.63
384	181.239	1.8726	4359.13
385	181.378	1.8774	4345.69
386	181.517	1.8823	4332.33
387	181.656	1.8872	4319.03
388	181.794	1.8921	4305.81
389	181.931	1.8970	4292.65
390	182.068	1.9019	4279.56
391	182.205	1.9067	4266.54
392	182.341	1.9116	4253.58
393	182.477	1.9165	4240.69
394	182.612	1.9214	4227.86
395	182.747	1.9263	4215.10
396	182.882	1.9312	4202.41
397	183.016	1.9360	4189.78
398	183.150	1.9409	4177.21
399	183.283	1.9458	4164.70
400	183.416	1.9507	4152.26
401	183.549	1.9556	4139.88
402	183.681	1.9604	4127.56
403	183.812	1.9653	4115.31
404	183.944	1.9702	4103.11
405	184.074	1.9751	4090.97
406	184.205	1.9800	4078.90
407	184.335	1.9849	4066.88
408	184.465	1.9897	4054.92
409	184.594	1.9946	4043.02
410	184.723	1.9995	4031.18
411	184.852	2.0044	4019.40
412	184.980	2.0093	4007.67
413	185.108	2.0142	3996.00
414	185.235	2.0190	3984.39
415	185.362	2.0239	3972.83
416	185.489	2.0288	3961.33
417	185.615	2.0337	3949.88
418	185.741	2.0386	3938.49
419	185.867	2.0435	3927.16
420	185.992	2.0483	3915.87
421	186.117	2.0532	3904.64
422	186.242	2.0581	3893.47
423	186.366	2.0630	3882.34
424	186.490	2.0679	3871.27
425	186.614	2.0728	3860.26
426	186.737	2.0776	3849.29
427	186.860	2.0825	3838.37
428	186.982	2.0874	3827.51
429	187.105	2.0923	3816.70
430	187.227	2.0972	3805.93
431	187.348	2.1021	3795.22
432	187.470	2.1069	3784.56
433	187.591	2.1118	3773.94
434	187.711	2.7767	3763.38
435	187.832	2.1216	3752.86

SECTION 5

TABLE 5 — OIL DISCHARGE TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
436	187.952	2.1265	3742.39
437	188.071	2.1313	3731.97
438	188.191	2.1362	3721.60
439	188.310	2.1411	3711.28
440	188.429	2.1460	3701.00
441	188.547	2.1509	3690.77
442	188.666	2.1558	3680.58
443	188.784	2.1606	3670.44
444	188.901	2.1655	3660.35
445	189.019	2.1704	3650.30
446	189.136	2.1753	3640.30
447	189.253	2.1802	3630.34
448	189.369	2.1851	3620.43
449	189.486	2.1899	3610.56
450	189.602	2.1948	3600.73
451	189.717	2.1997	3590.95
452	189.833	2.2046	3581.21
453	189.948	2.2095	3571.52
454	190.063	2.2144	3561.86
455	190.178	2.2192	3552.25
456	190.292	2.2241	3542.68
457	190.407	2.2290	3533.16
458	190.521	2.2335	3523.67
459	190.634	2.2388	3514.23
460	190.748	2.2437	3504.83
461	190.861	2.2485	3495.47
462	190.974	2.2534	3486.15
463	191.087	2.2583	3476.87
464	191.200	2.2632	3467.63
465	191.312	2.2681	3458.43
466	191.424	2.2729	3449.26
467	191.536	2.2778	3440.14
468	191.648	2.2827	3431.06
469	191.759	2.2876	3422.02
470	191.870	2.2925	3413.01
471	191.982	2.2974	3404.04
472	192.092	2.3022	3395.11
473	192.203	2.3071	3386.22
474	192.314	2.3120	3377.37
475	192.424	2.3169	3368.55
476	192.534	2.3218	3359.77
477	192.644	2.3267	3351.03
478	192.753	2.3315	3342.33
479	192.863	2.3364	3333.66
480	192.972	2.3413	3325.02
481	193.081	2.3462	3316.43
482	193.190	2.3511	3307.86
483	193.299	2.3560	3299.34
484	193.408	2.3608	3290.85
485	193.516	2.3657	3282.39
486	193.624	2.3706	3273.97
487	193.732	2.3755	3265.58
488	193.840	2.3804	3257.23
489	193.948	2.3853	3248.91
490	194.056	2.3901	3240.63
491	194.163	2.3950	3232.38
492	194.271	2.3999	3224.16
493	194.378	2.4048	3215.98
494	194.485	2.4097	3207.83
495	194.592	2.4146	3199.71
496	194.698	2.4194	3191.63
497	194.805	2.4243	3183.58
498	194.912	2.4292	3175.56
499	195.018	2.4341	3167.57
500	195.124	2.4390	3159.62
501	195.230	2.4438	3151.69
502	195.336	2.4487	3143.80
503	195.442	2.4536	3135.94
504	195.548	2.4585	3128.11
505	195.653	2.4634	3120.31
506	195.759	2.4683	3112.55
507	195.864	2.4731	3104.81
508	195.970	2.4780	3097.10
509	196.075	2.4829	3089.43
510	196.180	2.4878	3081.78
511	196.285	2.4927	3074.17
512	196.390	2.4976	3066.58
513	196.495	2.5024	3059.03
514	196.599	2.5073	3051.50
515	196.704	2.5122	3044.00
516	196.809	2.5171	3036.53
517	196.913	2.5220	3029.09
518	197.018	2.5269	3021.68
519	197.122	2.5317	3014.30
520	197.226	2.5366	3006.95
521	197.330	2.5415	2999.62
522	197.434	2.5464	2992.32
523	197.539	2.5513	2985.05
524	197.643	2.5562	2977.81
525	197.747	2.5610	2970.60
526	197.850	2.5659	2963.41
527	197.954	2.5708	2956.25
528	198.058	2.5757	2949.12
529	198.162	2.5806	2942.01
530	198.266	2.5854	2934.94
531	198.369	2.5903	2927.88
532	198.473	2.5952	2920.86
533	198.576	2.6001	2913.86
534	198.680	2.6050	2906.89
535	198.784	2.6099	2899.94
536	198.887	2.6147	2893.02
537	198.991	2.6196	2886.13
538	199.094	2.6245	2879.26
539	199.197	2.6294	2872.41
540	199.301	2.6343	2865.60
541	199.404	2.6392	2858.80
542	199.508	2.6440	2852.03
543	199.611	2.6489	2845.29
544	199.715	2.6538	2838.57
545	199.818	2.6587	2831.88

TABLE 5 — OIL AND DISCHARGE TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
546	199.921	2.6636	2825.21
547	200.025	2.6685	2818.57
548	200.128	2.6733	2811.95
549	200.232	2.6782	2805.35
550	200.335	2.6831	2798.78
551	200.439	2.6880	2792.23
552	200.542	2.6929	2785.71
553	200.645	2.6978	2779.20
554	200.749	2.7026	2772.73
555	200.853	2.7075	2766.27
556	200.956	2.7124	2759.84
557	201.060	2.7173	2753.44
558	201.163	2.7222	2747.05
559	201.267	2.7271	2740.69
560	201.371	2.7319	2734.35
561	201.475	2.7368	2728.03
562	201.578	2.7417	2721.74
563	201.682	2.7466	2715.47
564	201.786	2.7515	2709.22
565	201.890	2.7563	2702.99
566	201.994	2.7612	2696.79
567	202.098	2.7661	2690.60
568	202.202	2.7710	2684.44
569	202.307	2.7759	2678.30
570	202.411	2.7808	2672.18
571	202.515	2.7856	2666.09
572	202.620	2.7905	2660.01
573	202.724	2.7954	2653.96
574	202.829	2.8003	2647.92
575	202.934	2.8052	2641.91
576	203.038	2.8101	2635.92
577	203.143	2.8149	2629.95
578	203.248	2.8198	2624.00
579	203.353	2.8247	2618.07
580	203.458	2.8296	2612.16
581	203.564	2.8345	2606.27
582	203.661	2.8394	2600.41
583	203.774	2.8442	2594.56
584	203.880	2.8491	2588.73
585	203.986	2.8540	2582.92
586	204.091	2.8589	2577.14
587	204.197	2.8638	2571.37
588	204.303	2.8687	2565.62
589	204.410	2.8735	2559.89
590	204.516	2.8784	2554.18
591	204.622	2.8833	2548.49
592	204.729	2.8882	2542.82
593	204.835	2.8931	2537.17
594	204.942	2.8979	2531.53
595	205.049	2.9028	2525.92
596	205.156	2.9077	2520.32
597	205.264	2.9126	2514.75
598	205.371	2.9175	2509.19
599	205.478	2.9224	2503.65
600	205.586	2.9272	2498.13

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
601	205.694	2.9321	2492.63
602	205.802	2.9370	2487.14
603	205.910	2.9419	2481.68
604	206.018	2.9468	2476.23
605	206.127	2.9517	2470.80
606	206.236	2.9565	2465.39
607	206.344	2.9614	2459.99
608	206.453	2.9663	2454.62
609	206.563	2.9712	2449.26
610	206.672	2.9761	2443.92
611	206.782	2.9810	2438.60
612	206.891	2.9858	2433.29
613	207.001	2.9907	2428.00
614	207.111	2.9956	2422.73
615	207.222	3.0005	2417.48
616	207.332	3.0054	2412.24
617	207.443	3.0103	2407.02
618	207.554	3.0151	2401.81
619	207.665	3.0200	2396.63
620	207.777	3.0249	2391.46
621	207.888	3.0298	2386.31
622	208.000	3.0347	2381.17
623	208.112	3.0396	2376.05
624	208.224	3.0444	2370.95
625	208.337	3.0493	2365.86
626	208.449	3.0542	2360.79
627	208.562	3.0591	2355.73
628	208.675	3.0640	2350.69
629	208.789	3.0688	2345.67
630	208.902	3.0737	2340.66
631	209.016	3.0786	2335.67
632	209.130	3.0835	2330.70
633	209.245	3.0884	2325.74
634	209.359	3.0933	2320.80
635	209.474	3.0981	2315.87
636	209.589	3.1030	2310.96
637	209.704	3.1079	2306.06
638	209.820	3.1128	2301.18
639	209.936	3.1177	2296.31
640	210.052	3.1226	2291.46
641	210.169	3.1274	2286.62
642	210.285	3.1323	2281.80
643	210.402	3.1372	2277.00
644	210.591	3.1421	2272.21
645	210.637	3.1470	2267.43
646	210.755	3.1519	2262.67
647	210.873	3.1567	2257.92
648	210.991	3.1616	2253.19
649	211.110	3.1665	2248.47
650	211.229	3.1714	2243.77
651	211.348	3.1763	2239.08
652	211.468	3.1812	2234.41
653	211.588	3.1860	2229.75
654	211.708	3.1909	2225.10
655	211.828	3.1958	2220.47

TABLE 5 — OIL DISCHARGE TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
656	211.949	3.2007	2215.85
657	212.070	3.2056	2211.25
658	212.192	3.2104	2206.66
659	212.313	3.2153	2202.09
660	212.435	3.2202	2197.53
661	212.558	3.2251	2192.98
662	212.680	3.2300	2188.45
663	212.804	3.2349	2183.93
664	212.927	3.2397	2179.42
665	213.051	3.2446	2174.93
666	213.175	3.2495	2170.45
667	213.299	3.2544	2165.98
668	213.424	3.2593	2161.53
669	213.549	3.2642	2157.09
670	213.674	3.2690	2152.66
671	213.800	3.2739	2148.25
672	213.926	3.2788	2153.85
673	214.053	3.2837	2139.47
674	214.180	3.2886	2135.09
675	214.307	3.2935	2130.73
676	214.435	3.2983	2126.38
677	214.563	3.3032	2122.05
678	214.691	3.3081	2117.73
679	214.820	3.3130	2113.42
680	214.949	3.3179	2109.12
681	215.078	3.3228	2104.84
682	215.208	3.3276	2100.57
683	215.338	3.3325	2096.31
684	215.469	3.3374	2092.06
685	215.600	3.3423	2087.83
686	215.732	3.3472	2083.61
687	215.863	3.3521	2079.40
688	215.996	3.3569	2075.20
689	216.128	3.3618	2071.02
690	216.261	3.3667	2066.84
691	216.395	3.3716	2062.68
692	216.529	3.3765	2058.53
693	216.663	3.3813	2054.40
694	216.798	3.3862	2050.27
695	216.933	3.3911	2046.16
696	217.068	3.3960	2042.06
697	217.204	3.4009	2037.97
698	217.341	3.4058	2033.89
699	217.478	3.4106	2029.83
700	217.615	3.4155	2025.77
701	217.753	3.4204	2021.73
702	217.891	3.4253	2017.70
703	218.029	3.4302	2013.68
704	218.168	3.4351	2009.67
705	218.308	3.4399	2005.68
706	218.448	3.4448	2001.69
707	218.588	3.4497	1997.72
708	218.729	3.4546	1993.75
709	218.871	3.4595	1989.80
710	219.012	3.4644	1985.86
711	219.155	3.4692	1981.93
712	219.297	3.4741	1978.01
713	219.440	3.3790	1974.11
714	219.584	3.4839	1970.21
715	219.728	3.4888	1966.32
716	219.873	3.4937	1962.45
717	220.018	3.4985	1958.59
718	220.164	3.5034	1954.73
719	220.310	3.5083	1950.89
720	220.456	3.5132	1947.06
721	220.603	3.5181	1943.24
722	220.751	3.5229	1939.43
723	220.899	3.5278	1935.63
724	221.048	3.5327	1931.84
725	221.197	3.5376	1928.06
726	221.346	3.5425	1924.29
727	221.496	3.5474	1920.53
728	221.647	3.5522	1916.78
729	221.798	3.5571	1913.05
730	221.950	3.5620	1909.32
731	222.102	3.5669	1905.60
732	222.255	3.5718	1901.90
733	222.408	3.5767	1898.20
734	222.562	3.5815	1894.51
735	222.716	3.5864	1890.84
736	222.871	3.5913	1887.17
737	223.026	3.5962	1883.51
738	223.182	3.6011	1879.87
739	223.338	3.6060	1876.23
740	223.495	3.6108	1872.60
741	223.653	3.6157	1868.98
742	223.811	3.6206	1865.38
743	223.970	3.6255	1861.78
744	224.129	3.6304	1858.19
745	224.289	3.6353	1854.61
746	224.449	3.6401	1851.04
747	224.610	3.6450	1847.48
748	224.771	3.6499	1843.93
749	224.933	3.6548	1840.39
750	225.096	3.6597	1836.86
751	225.259	3.6646	1833.34
752	225.423	3.6694	1829.83
753	225.587	3.6743	1826.33
754	225.752	3.6792	1822.83
755	225.918	3.6841	1819.35
756	226.084	3.6890	1815.87
757	226.251	3.6938	1812.41
758	226.418	3.6987	1808.95
759	226.586	3.7036	1805.50
760	226.755	3.7085	1802.07
761	226.924	3.7134	1798.64
762	227.093	3.7183	1795.22
763	227.264	3.7231	1791.80
764	227.435	3.7280	1788.40
765	227.606	3.7329	1785.01

TABLE 5 — OIL AND DISCHARGE TEMP. (CONT.)

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
766	227.779	3.7378	1781.62
767	227.951	3.7427	1778.25
768	228.125	3.7476	1774.88
769	228.299	3.7524	1771.52
770	228.474	3.7573	1768.17
771	228.649	3.7622	1764.83
772	228.825	3.7671	1761.50
773	229.002	3.7720	1758.18
774	229.179	3.7769	1754.86
775	229.357	3.7817	1751.55

ADC Number	Probe Temperature (Deg. F)	Probe Voltage (Volts)	Apparent Resistance (Ohms)
776	229.536	3.7866	1748.26
777	229.715	3.7915	1744.97
778	229.895	3.7964	1741.69
779	229.075	3.8013	1738.41
780	229.256	3.8013	1738.41
781	229.438	3.8110	1731.89
782	229.621	3.8159	1728.65
783	229.804	3.8208	1725.41
784	229.988	3.8257	1722.18

SECTION 6
RELAY OUTPUT BOARD

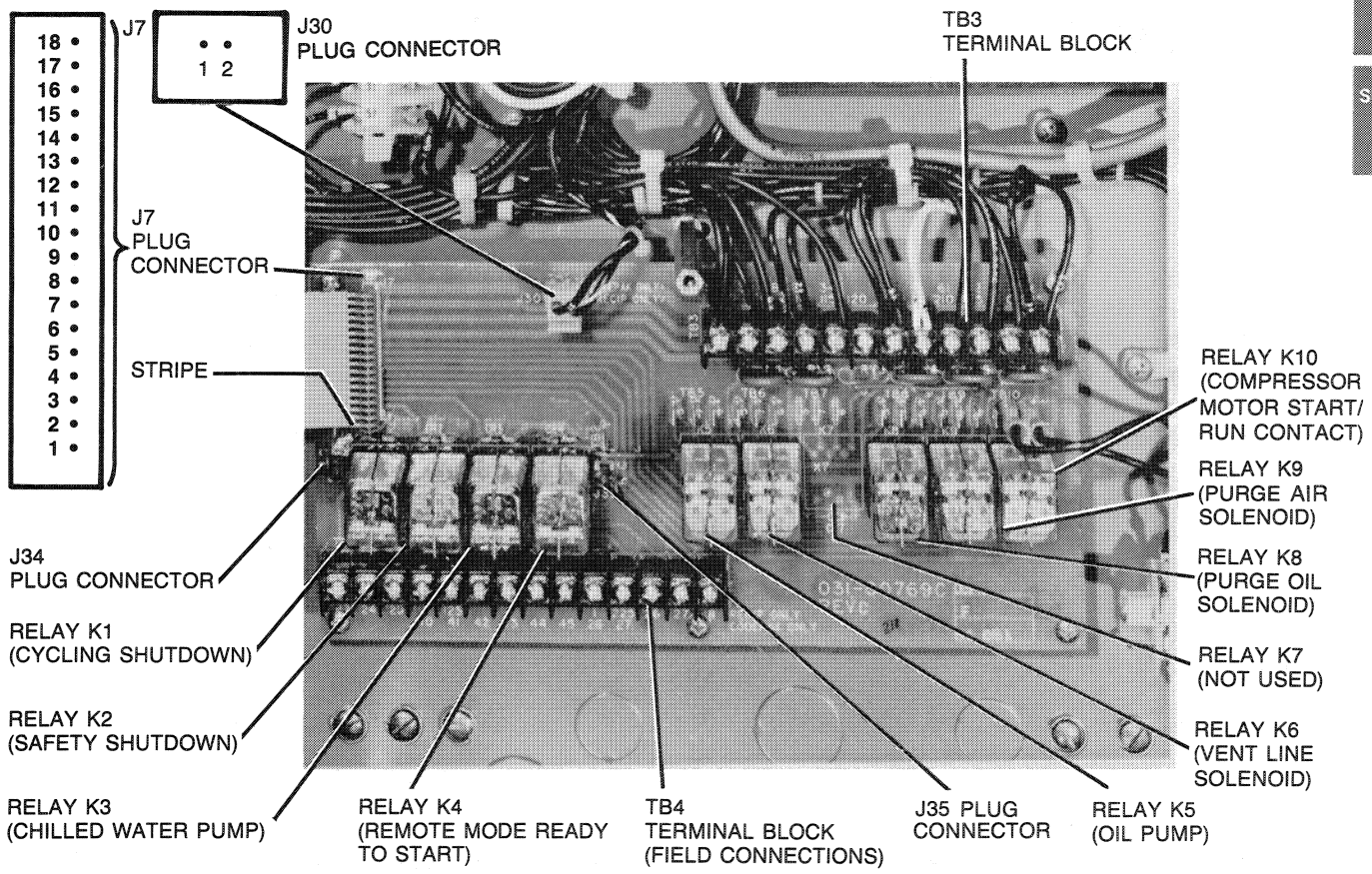


FIG. 19 – RELAY OUTPUT BOARD

RELAY OUTPUT BOARD (Ref. Fig. 19 & 20)

The relay output board allows the micro board to be interfaced to 115 VAC output signals. Nine board-mounted relays are driven by the micro board. One side of each relay coil is connected to + 12Vdc unregulated power. The other side of the coil is connected to the input connector J7. The micro board is connected to this connector and it drives the appropriate pin to ground potential when it want to energize a selected relay. The contacts (N.O.) of each relay are interfaced, via Terminal blocks TB3 and TB4, to various external relays and solenoids.

Terminal block TB3 is provided for interfacing system start relay, selected system safeties, system solenoids

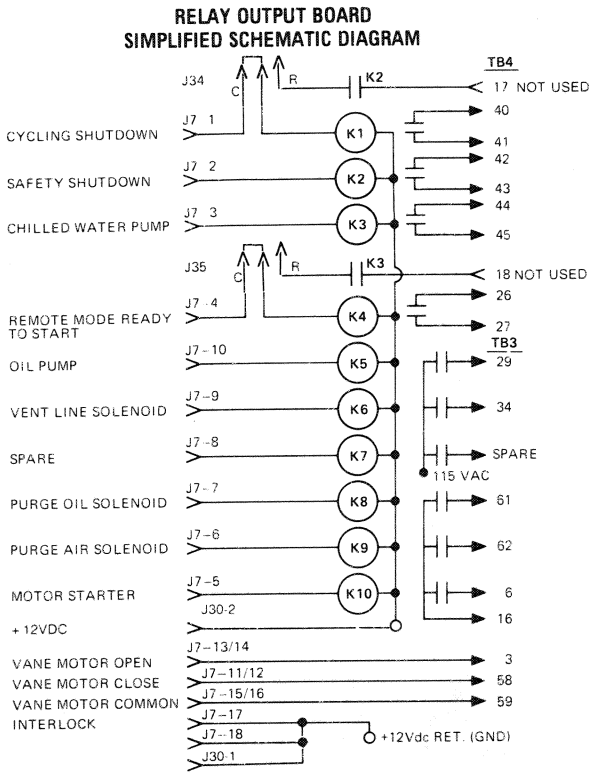


FIG. 20 – RELAY OUTPUT BOARD SIMPLIFIED SCHEMATIC DIAGRAM

and the vane motor. The water temperature control circuits that control the vane motor are located on the micro board. Triacs, mounted on the micro board, drive the vanes open or closed to control the LCWT to the "Chilled Liquid Temp" setpoint. These triacs are interfaced to the vane motor via the relay output board. This board is used only as an intermediary tie point (terminals 58, 59, 3) for the vane motor interface from the micro board. There are no active vane motor control components on the relay output board.

Terminal block TB4 is provided for field interface of selected system status contact closures.

This board is used in both the Centrifugal Chiller microcomputer control panel and the Reciprocating Chiller microcomputer control panel. To configure the board for the correct application, simply install the two-pin jumper plugs (J34 & J35) in the appropriate position . . . "R" (Reciprocating) or "C" (Centrifugal).

Refer to "Relay Output Board" Inputs as follows:

RELAY OUTPUT BOARD - INPUTS

All inputs are Logic Low (.1 Vdc) in the active state. In other words, a Logic Low input to this board causes the output relay contacts to close. A +12Vdc unregulated input causes the output relay contact to open. All inputs interface from the micro board.

Although the vane motor control circuitry is located on the micro board, the open, close and common wires pass thru the relay output relay board, using this board as an interface terminal point only.

J7- 1 — Cycling Shutdown
2 — Safety Shutdown
3 — Chilled Water Pump
4 — Remote Mode Ready to Start
5 — Motor Starter
6 — Purge Air Solenoid
7 — Purge Oil Solenoid
8 — Spare
9 — Vent Line Solenoid
10 — Oil Pump
11 — PRV Close
12 — PRV Close
13 — PRV Open
14 — PRV Open
15 — PRV Common
16 — PRV Common
17 — 12Vdc Return
18 — 12Vdc Return

J30- 1 — 12V Ret
2 — +12Vdc Unregulated

TB3- 1 — 115VAC Control Power
2 — 115VAC Neutral

RELAY OUTPUT BOARD - OUTPUTS

TB3-59 —PRV common.

TB3-3 —PRV motor open winding. 0VAC measured to TB7-59 when vanes are opening. Approx. 24VAC when vanes are holding or closing.

TB3-58 —PRV motor close winding. 0VAC measured to TB7-59 when vanes are closing. Approx. 24VAC when vanes are holding or opening.

TB3-29 —Oil pump starter contacts. 115VAC when micro board is commanding the oil pump to run.

TB3-34 —Vent line solenoid valve contacts. 115VAC when micro board is commanding the solenoid valve to open.

TB3-6 —Motor starter contacts. 115VAC when micro board is commanding the compressor motor to run and the motor controller contact is closed.

TB3-16 —Motor controller input. 115VAC when motor controller device is satisfied. Otherwise, 0VAC.

TB3-61 —Purge oil solenoid valve contacts. 115VAC when micro board is commanding the purge oil solenoid valve to energize and fill the purge canister. Valve de-energizes to empty the canister.

TB3-62 —Purge air exhaust solenoid valve contacts. 115VAC when micro board is commanding the air exhaust solenoid valve to energize and exhaust the non-condensables from the purge cannister.

TB4-40/41 —Cycling shutdown contacts. Dry closure N.O. contacts (rated for 115VAC; 2 AMPS) available for remote status indications. Contacts will close whenever chiller is shutdown on a "Cycling" shutdown. A "Cycling" shutdown is that which does not require a local manual reset at the control panel to restart the compressor; such as power failure (Automatic Restart Option), local/remote cycling device, low water temp, motor controller or multi-unit sequence kit. When shutdown control is satisfied, the system will restart automatically. The contacts open upon "Start Sequence Initiated" or when the compressor switch is placed in "Stop-Reset" position. Refer to FIG. 21.

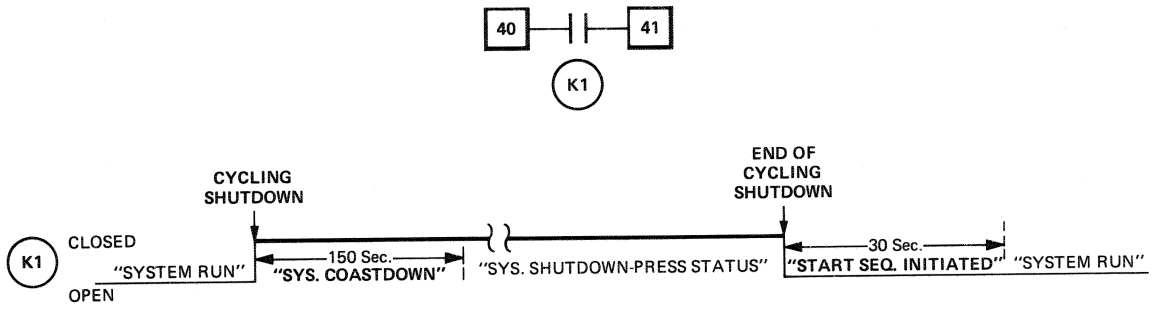


FIG. 21 – STATUS CONTACTS – CYCLING SHUTDOWN

TB4-42/43 —Safety shutdown contacts. Dry closure N.O. contacts (rated for 115VAC; 2 AMPS) available for remote status indications. Contacts will close whenever chiller is shutdown on a "safety" shutdown. A "safety" shutdown is that which requires a local manual reset at control panel to restart system; such as power failure (manual restart option), LEP, HOT, HDT, HMT (Hermetic Turbopaks), LOP, HOP, or HP. The contacts will open when the compressor switch is placed in "Stop-Reset" position. The system must be manually restarted. Refer to FIG. 22.

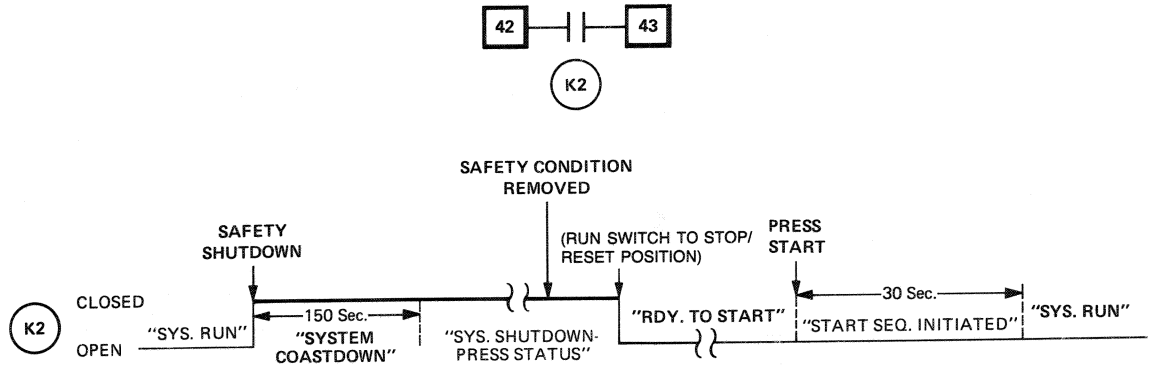


FIG. 22 – STATUS CONTACTS – SAFETY SHUTDOWN

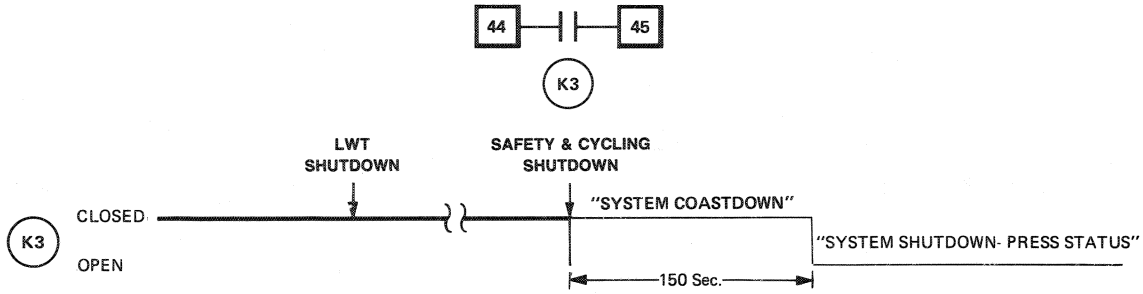


FIG. 23 – CHILLED WATER PUMP CONTACTS – CYCLING & SAFETY SHUTDOWNS

TB4-44/45 — Chilled water pump contacts. Dry closure N.O. contacts (rated for 115VAC; 2 AMPS) that can be used to start & stop the chilled water pump when the control panel is operating the chiller, i.e., the contacts close when the operator depresses the compressor start switch, or the programmed "start time" commands the chiller start sequence to be initiated. The contacts open when the programmed "stop time" (or an operator) commands the chiller to stop running or a remote stop is initiated or during a safety shutdown. Only LWT cycling shutdowns that occur between the programmed daily start and stop times will cause the contacts to remain closed, keeping the evaporator water pumps running. If any other cycling shutdown or a safety shutdown occurs, the contacts will open at the completion of system coastdown. Refer to FIG. 24.

TB4-26/27 — Remote mode ready to start contacts. Dry closure N.O. contact (115VAC, 2A). Available for remote status indication to an Energy Management System (EMS). The contacts will be closed if the keyswitch is in REMOTE mode and the compressor switch is in the RUN position and all safeties and cycling devices are satisfied. The contacts will open coincident with any safety or cycling device becoming unsatisfied or if the keyswitch is moved from the REMOTE position or if the compressor switch is moved to the STOP position. Refer to FIG. 24.

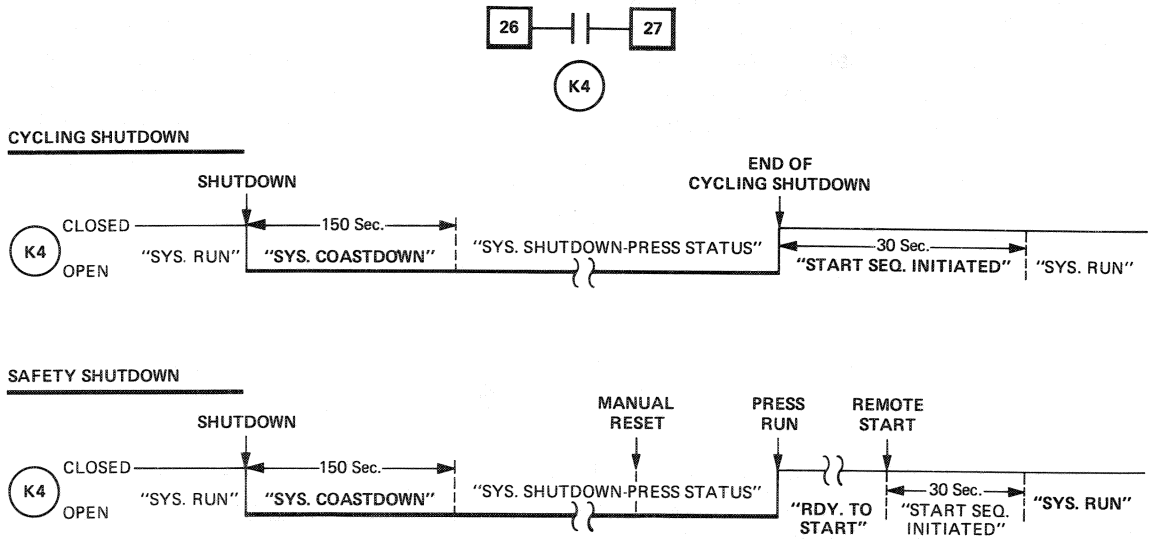
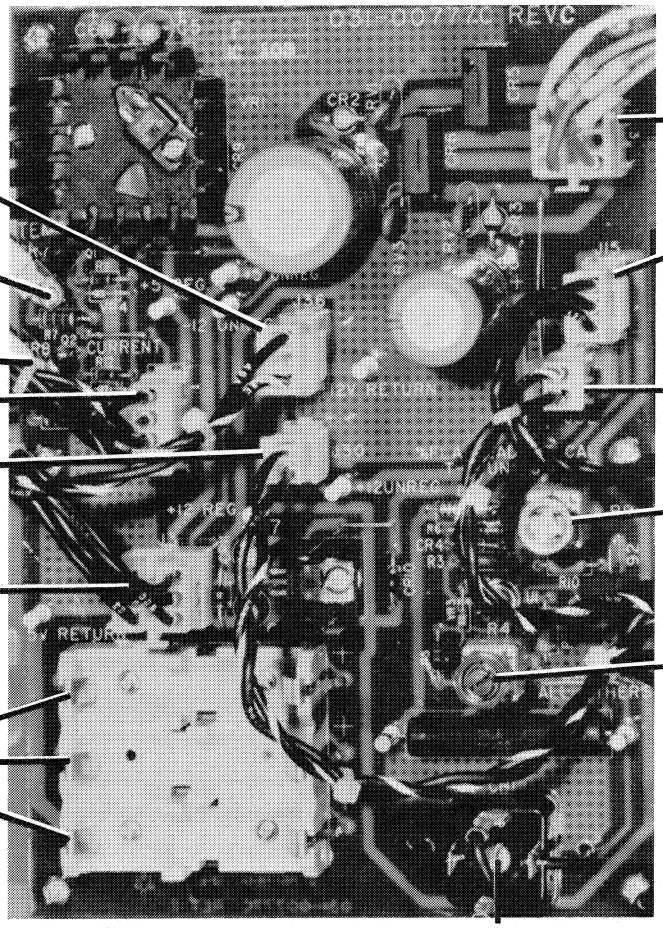
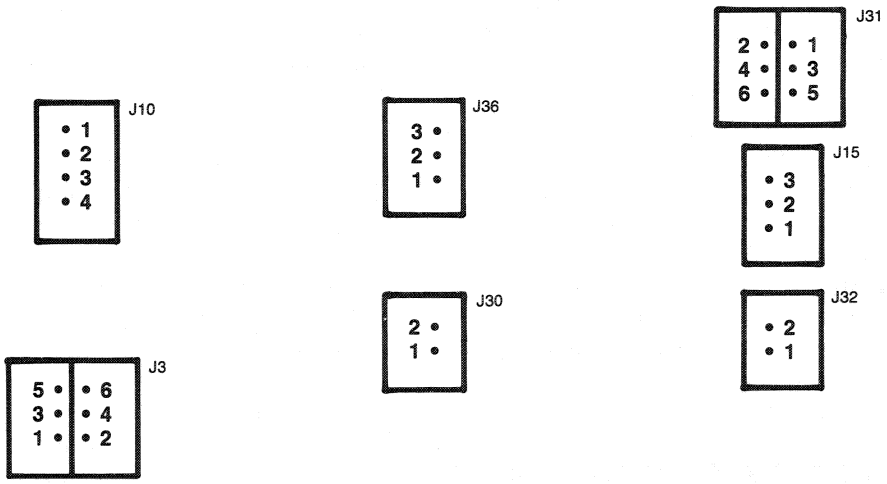


FIG. 24 – REMOTE MODE READY TO START CONTACTS

POWER SUPPLY BOARD



CONNECTIONS TO MOTOR TERMINAL BOX CT'S
(E-M OR SSS STARTER APPLICATIONS ONLY)



POWER SUPPLY BOARD—PIN IDENTIFICATION

FIG. 25 – POWER SUPPLY BOARD

SECTION 7

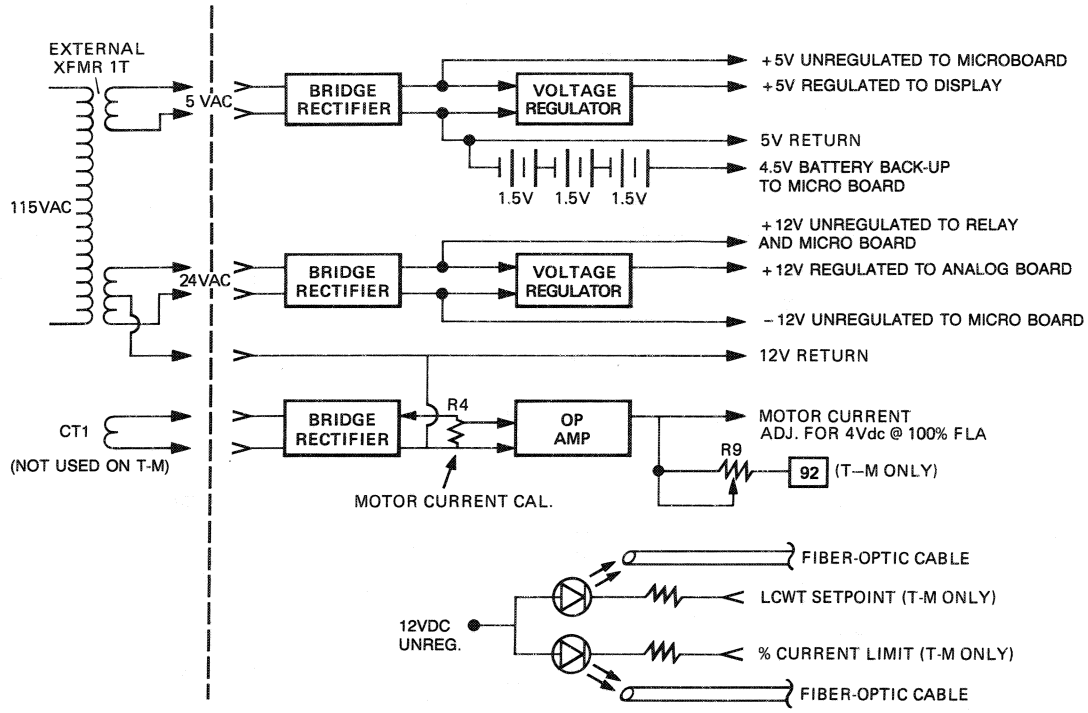


FIG. 26 – POWER SUPPLY BOARD OPERATIONAL DIAGRAM

POWER SUPPLY BOARD (Ref. Figs. 25 & 26)

This board provides the necessary operating voltages for all the PC boards in the microcomputer control panel. A step-down transformer (1T) provides two independent secondary windings . . . 5VAC and 24VAC. These windings feed two independent board mounted power supplies. First, a +5Vdc power supply provides both a regulated and unregulated output. Second, a 12Vdc power supply provides a +12Vdc regulated and unregulated outputs and a -12Vdc unregulated output.

Further, battery back-up DC power is provided to the micro board in the event of a power failure. Three each 1.5V AA alkaline batteries provide +4.5Vdc power to the micro board. the micro board uses this voltage to maintain the real-time clock (RTC) so that all programmed setpoints and the time of power failure will be "remembered" for subsequent display when system power has been restored, to illustrate: Any time power has been applied to the system, after a power failure, the following message will be displayed:

"MON 10:36 AM POWER FAILURE"

Motor current values are conditioned on the power supply board and provided to the analog input board (to be multiplexed to the micro board). On electro-mechanical and solid state starter units, a current transformer CT1, located in Phase 'A' of the motor power wiring feeds a bridge rectifier. The full wave rectified signal is then applied to an amplifier where it is conditioned to provide a 0-4Vdc output. Calibration potentiometer R4 is used to adjust the output signal for 4Vdc @ 100% FLA. On Turbo-Modulator units, wire 92 feeds a voltage proportional to motor current to R9 on the power supply board for calibration of the signal to 4Vdc @ 100% FLA.

The fiber-optic interface to the Turbo-Modulator is located on this board. It provides a means of interfacing "Chilled Liquid Temp" and "% Current Limit" setpoints from the Micro Panel Keypad to the Turbo-Modulator capacity board. Pulse-width modulated (PWM) signals are received from the **micro board** to drive two optical transmitters which in turn drive two fiber-optic cables that interface to the Turbo-Modulator. The optical transmitters emit a dim red light when current is conducted through them. This light is transmitted along the fiber-optic cable to the Turbo-Modulator where it is detected by an optical receiver.

The micro normally has the optical transmitters turned on (by driving the input to the optical transmitters, J10-1/J10-2, to ground potential). When the operator performs a keypad entry on the "Chilled Liquid Temp" or "% Current Limit" setpoints, the micro turns off the appropriate optical transmitter (by allowing the input to the optical transmitters, J10-1/J10-2, to float to +12Vdc regulated) for a period of 1-11 seconds as determined by the operator entered value. Refer to the description of **micro board** for additional details of this circuit.

SECTION 8
MICRO BOARD

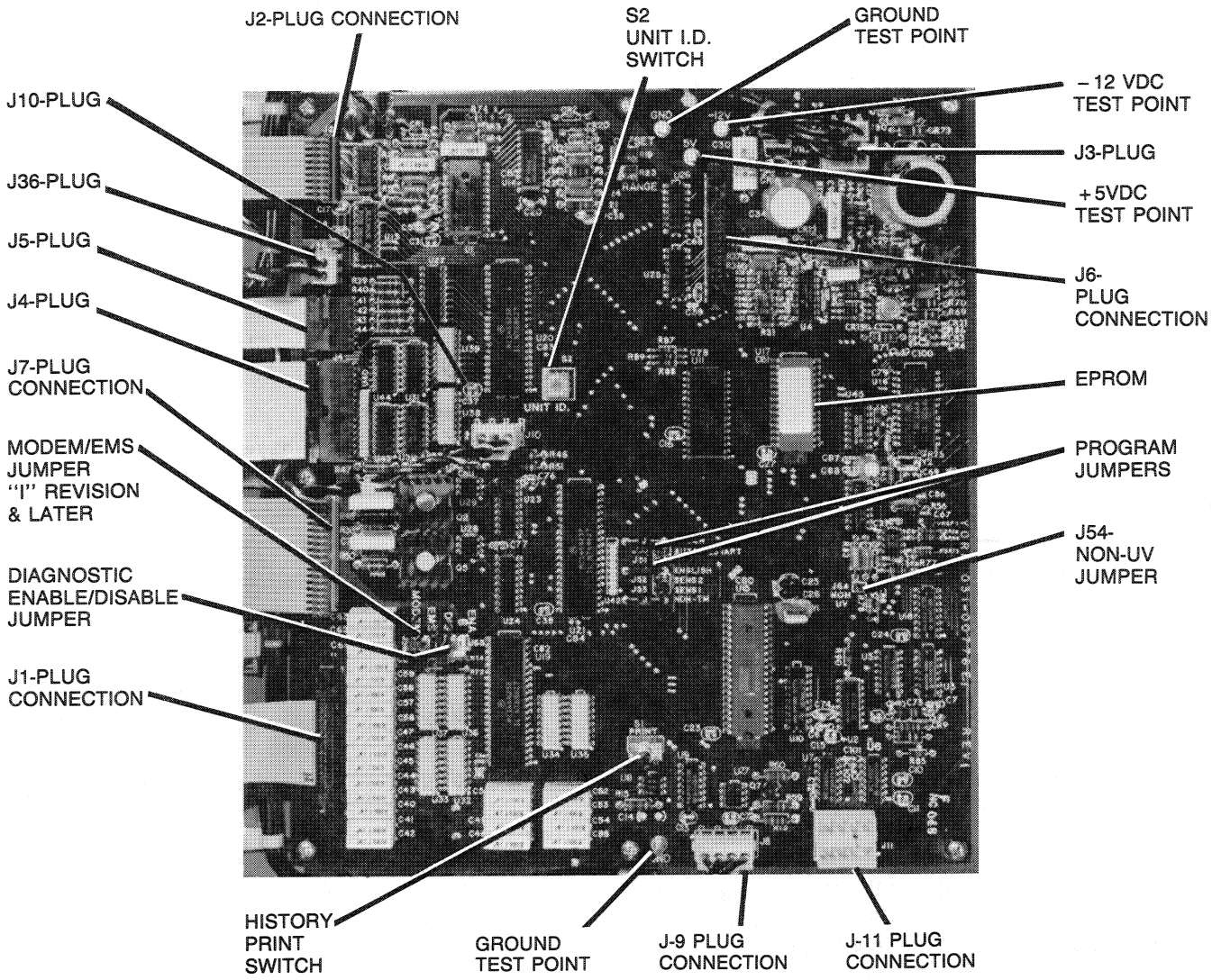


FIG. 27 – MICRO BOARD AND PIN IDENTIFICATION

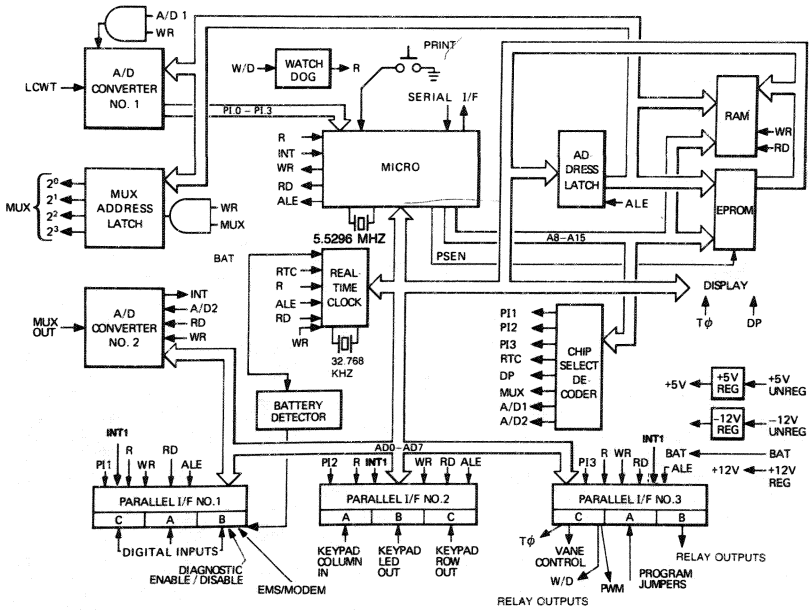


FIG. 28 – MICRO BOARD BLOCK DIAGRAM

MICRO BOARD (Ref. Fig. 27-31 and Table 1)

The micro board contains an INTEL 8031 single component 8-bit micro computer. An external RAM is provided for scratchpad memory and the operating program is stored in an external EPROM.

The analog to digital converter no. 1 (A/D1) receives the leaving chilled water temperature (LCWT) value directly from the LCWT thermistor. This 0-2Vdc analog signal is converted to a 12-bit BCD digital word. The 4-bit BCD output is loaded into the micro on data bus PI.0-P1.3. Three read cycles are required to load the complete 12-bit BCD word. Address bits **A0** and **A1** are used to select the low, middle and high order BCD bytes. These address bits are written into A/D No. 1 by chip select **A/D1** and the **WR** write pulse.

The analog to digital converter no. 2 (A/D2) receives the multiplexed analog output from the analog input board and converts this 0-5Vdc signal to a 10-bit binary word. The conversion is initiated by asserting chip select pulse **A/D2** and write pulse **WR.** Upon completion of the conversion, the analog to digital converter outputs the INTØ (Interrupt) pulse to the micro. The 10-bit word is transferred to the micro in two 8-bit bytes on the address/data bus AD0-AD7. The most significant byte is transferred with the coincident application of the chip select pulse **A/D2** and read pulse **RD.** The lease significant byte is then transferred by a second coincident application of **A/D2** and **RD.**

The MUX address latch chip latches and holds the addresses for the multiplexer that is located on the analog input board. The latch chip receives the 5-bit address on the address bus (A0-A4) from the micro. Each sequential address is written into the latch with the application of the write pulse **WR** and chip select pulse **MUX.** As each address is applied to the analog input board the multiplexer outputs the corresponding analog input (system temperature, pressure or motor current value) to the micro board where it is received by analog to digital converter no. 2 and subsequently converted to a word and supplied to the micro.

The parallel interface (PI) chips are bi-directional input/output devices that allow the micro to interface with external digital signals. Each chip has three 8-bit bi-directional ports that can be configured as inputs or outputs. An 8-bit address, supplied from the micro, configures each of the 24 ports as either an input or output and determines which of the three 8-bit ports are read or written-to during a read or write cycle. When the micro reads data from a PI, it applies an address along with an address latch enable pulse, **ALE,** the address is latched into the PI with the trailing edge of **ALE.** Data is then read from the PI when the micro applies the read **RD** pulse along with the chip enable pulse (**PI1, PI2,** or **PI3** depending on which chip is being read). When the micro is writing data to the PI, it applies an address along with an address latch enable

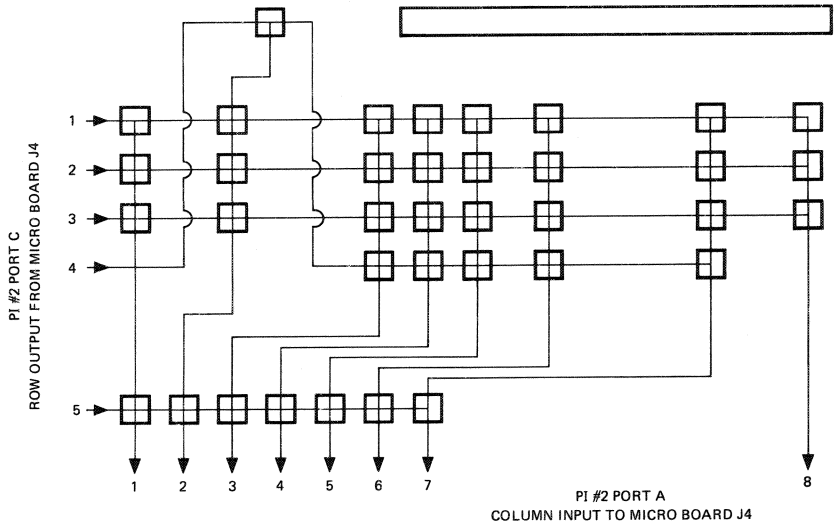
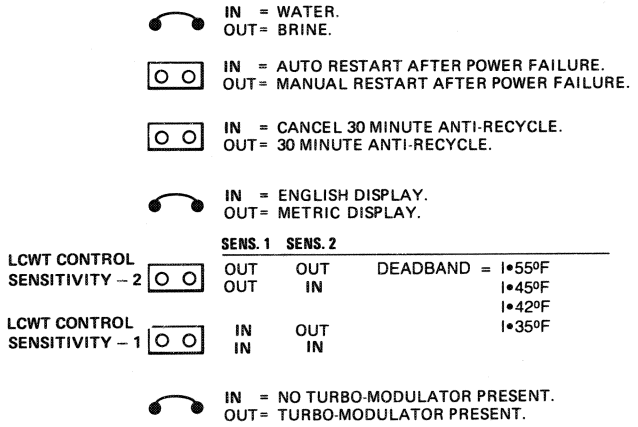


FIG. 29 – KEY PAD CONNECTION MATRIX

ALE pulse. The address is latched into the PI with the trailing edge of **ALE.** Data is then written to the PI when the micro applies the write **(WR)** pulse along with the chip enable pulse (PI1, PI2, or **PI3 depending on which chip is being written to). Parallel Inteface Chip No. 1** is always configured as an input and output. Port "B" is configured as an output and is connected to J5. It acts as a current sink for the keypad-mounted LED's; i.e. the anode of the LED's are connected to +12Vdc unregulated and the cathodes are individually connected to Port B. When the micro commands an LED to illuminate, it writes a logic one (1) to parallel interface no. 2 along with the correct address and the appropriate output at J5 goes to ground to illuminate the selected keypad LED. Ports "A" and "C" are connected to J4 and are used to read the keypad keys as follows: (refer to Fig. 29).

Port "C" is configured as an output port and is connected to the keypad keys rows 1 thru 5. Port "A" is configured as an input port and is connected to the keypad keys columns 1 thru 8. At regular intervals the micro reads the keypad keys by sequentially driving rows 1 thru 5 to ground (logic low). It then reads the 8-bit column output to determine if any keys are pressed. For example, then the micro strobes row 1, one side of all the keys in row 1 are placed at ground potential. The other side of each key is physically connected to +5Vdc via a pull up resistor located on the micro board. If no keys in row 1 are pressed, all 8 column input bits as read by parallel interface no. 2 Port "A" would be +5Vdc (logic high). If any key is pressed in row 1 then a connection is made between row 1 (ground) and the appropriate column output (+5Vdc). The resultant current flow produces a logic low at the appropriate column input bit which is then read by parallel interface no. 2 Port "A".



*CAUTION
NON-UV IN = DISABLED UNDERVOLTAGE RELAY
DIS ENA = DISABLED SOFTWARE DIAGNOSTIC
DIS ENA = ENABLES SOFTWARE DIAGNOSTIC
EMS MODEM = FOR FUTURE USE
EMS MODEM = ALLOWS OPERATION OF REMOTE PWM TEMPERATURE AND % CURRENT INPUTS. (I REV. AND LATER)

FIG. 30 — MICROBOARD PROGRAM JUMPERS

Parallel Interface No. 3 is configured as an input and output. Port "A" is configured as an input. Seven program jumpers are input to Port "A". When a jumper is installed, the input bit is at ground potential (logic low). With the jumper removed, the input bit is +5Vdc (logic high). Since the micro board is universal in application, the program jumpers are provided to configure it for unique applications (refer to Figure 28). The following is a detailed description of the program jumpers:

SECTION 8

a. **Water/Brine** — This wire jumper must be installed when the chiller is applied to the cooling of water. The keyboard adjustable LCWT setpoint range is 38°F to 70°F. The LWT cutout is 4°F below setpoint unless the LWCT setpoint is raised, then the LWT cutout is 36°F for 10 minutes to eliminate nuisance trips due to reset. If the LWCT setpoint is less than 40°F then the LWT cutout is 36°F.

   If the chiller is applied to the cooling of brine this jumper must be cut. The keyboard adjustable LCWT setpoint range is 10°F to 45°F. The LWT cutout is 4°F below the setpoint.

b. **Manual/Auto Restart After Power Failure** — This jumper plus must be installed when auto restart after power failure is desired. When installed, whenever the system experiences a 115VAC power failure to the panel and the compressor switch is in the Run position, the system will automatically start when power is restored. It must be removed when manual restart after power failure is desired.

c. **Cancel/Allow 30 Minute Anti-Recycle Timer** — This jumper plug must be installed to cancel the 30 minute anti-recycle timer. If the plug is removed, the chiller can be restarted at a minimum of 30 minute intervals. **Note: If this jumper was installed at any other time and left in position during operation of unit the warranty will be voided.**

d. **English/Metric Display** — If this wire jumper is installed, the system pressures are displayed in PSIA (Lbs/In² Absolute) and the system temperatures are displayed in °F degrees Fahrenheit. If this wire jumper is cut, the system pressures are displayed in KPa (kilo Pascals) and the system temperatures are displayed in °C (degrees Centigrade).

e. **LCWT Control Sensitivity 1 & 2** — These two plug-jumpers select the amount of vane control sensitivity. The sensitivity selected determines the magnitude of deadband. The deadband is inversely proportional to the sensitivity (i.e. the greater the sensitivity, the smaller the deadband). Tighter LCWT control is achieved with the higher sensitivity selected. However, if excessive vane "hunting" results, a lessor sensitivity must be selected.

f. **Turbo-Modulator Present/Not Present** — This wire jumper must be installed for solid-state starter or electro-mechanical starter applications. For Turbo-Modulator applications, the jumper must be removed. When removed, the LCWT is controlled by the Turbo-Modulator capacity board under setpoint control by the microprocessor and the LCWT setpoint is adjustable between 40°F to 60°F. The vanes cannot be controlled from the keypad and the vane control LED's (service keys) will not function. Also, the LWT shutdown signal from the Turbo-Modulator will then be monitored.

g. **Enable/Disable** — This board-mounted 3-pin plug allows the serviceman to enable or disable the software diagnostic routine. When the jumper is in the **enable** position, the micro uses the software diagnostic routine. When the jumper is in the **disable** position, the micro uses the chiller operating routine. Prior to placing the jumper in the **enable** position refer to "testing with diagnostic software" section of this book.

h. **Non-UV** — This jumper must be installed when the micro processor control center is not equipped with an under voltage relay board (031-00082-000). If the undervoltage relay board is installed in the control panel this jumper must be removed.

i. The EMS/MODEM jumper must be placed in **Modem** position to allow operation of the Remote PWM temperature and % current inputs.

Port "B" of **Parallel Interface No. 3** is configured as an output and is interfaced to the relay output board (J7) via relay drivers for the purpose of driving relays that control the following: Vent line solenoid, purge air solenoid, purge oil solenoid, oil pump starter, chilled water pump, cycling shutdown contacts and safety shutdown contact. When the micro commands any of these relays to energize it forces the appropriate Port "B" output to ground potential. Port "C" of **Parallel Interface No. 3** is configured as an output and is interfaced from J7. Bit 1 and Bit 5 are interfaced to the relay output board via relay drivers to drive the "motor starter" and "remote mode ready to start" relays. When the micro commands these relays to energize it forces the output to ground potential. Bit 7 is the input to the watchdog circuit. The watchdog circuit insures that the complete program is executed each program cycle. If this safeguard is not incorporated, it is possible that the program could land in an endless loop subroutine with the result that critical chiller safety parameters would be overlooked. At the beginning of each program cycle, Bit 8 is pulsed by the micro. This pulse starts a 2 second timer in the watchdog circuit. If another pulse is not received by the watchdog circuit before 2 seconds has elapsed, the watchdog circuit will output a "reset" (R) pulse to the micro. The micro then re-initialized the program and shuts down the chiller. If the compressor switch is in the **run** position and the anti-recycle timer has expired, the chiller will automatically restart.

Bit 0 of Port "C" of **Parallel Interface No. 3** is configured as an output and is interfaced to the power supply board via J10-3. This signal is the "% Current Limit" setpoint to the Turbo-Modulator. It is a 1-11 second pulse width modulated (PWM) signal corresponding to a 100% to 40% current limit setpoint (i.e. 1 second pulse = 100%; 11 second pulse = 40%). It is linear between 1-11 seconds. The micro normally

commands this signal to be low (0Vdc). However, when the operator performs a keyboard entry of the "% Current Limit" setpoint, this signal transitions to +12Vdc (regulated) for a period of 1-11 seconds as determined by the operator entered value. This signal is applied to the power supply board where it drives the fiber-optic interface to the Turbo-Modulator. The micro will only accept an operator entered setpoint update every 70 seconds when a Turbo-Modulator is applied. **Parallel Interface No. 3,** Port A, Bit 0 is configured as an output and is interfaced to the power supply board via J10-1. This signal is the "Chilled Liquid Temp" setpoint to the Turbo-Modulator. It is a 1-11 second pulse width modulated (PWM) signal corresponding to 40°F to 60°F LCWT setpoint (i.e. 1 second Pulse = 40°F; 11 second Pulse = 60°F). It is linear between 1-11 seconds. The micro normally commands this signal to be low (0Vdc). However, when the operator performs a keyboard entry of the "Chilled Liquid Temp" setpoint, this signal transitions to +12Vdc (regulated) for a period of 1-11 seconds as determined by the operator entered value. This signal is applied to the power supply board where it drives the fiber-optic interface to the Turbo-Modulator. The micro will only accept an operator entered setpoint update every 70 seconds when a Turbo-Modulator is applied.

Parallel Interface No. 3, Port C, bits 3 and 4 are interfaced to the relay output board via J7 to control the chiller pre-rotation vanes for LWCT and current limit control. The PRV motor "open" winding is connected to one side of a triac, that is controlled by Bit 3. The "closed" winding is connected to one side of a triac that is controlled by Bit 4. The other side of both triacs are connected to the "common" terminal of the PRV motor. When the micro commands the vanes to "open," it turns'on the "open" triac. This action causes the PRV motor "common" terminal to be shortened to the "open" winding causing the vanes to open. Similarly, to close the vanes the micro must turn-on the "close" triac. This action shorts the PRV "common" terminal to the "close" terminal causing the vanes to close.

Parallel Interface No. 2, Port C, bits 0, 1 and 2 are inputs from UNIT ID switch S2 on the Micro board (Rev I and later).

The **Real-Time Clock** (RTC) chip stores and updates the time-of-day and day-of-week setpoint parameters. It contains an internal RAM that is powered from the external DC power supply and the battery back-up source. The operator-entered system setpoints are stored here. Therefore, none of the system setpoints are lost during a power failure. The RTC also contains a 32.768 crystal oscillator that serves as a clock for RTC internal operations. Data is written into the RTC by first applying an address along with an address latch enable **(ALE)** pulse from the micro. The address is latched into the IRTC with the trailing edge of **ALE.** Data is written to the RTC when the micro applies the write **(WR)** pulse along with the chip enable **(RTC)** pulse. When the micro reads data from the RTC it applies an address along with an address latch enable **(ALE)** pulse. The address is latched into the RTC with the trailing edge of *ALE.* Data is then read from the RTC when the micro applies a read **(RD)** pulse along with the chip enable **(RTC)** pulse.

The **Chip Select Decoder** decodes the high-order address bits (A8-A15) from the micro. To illustrate, when the micro reads data from or writes data to the PI's, A/D converters, RTC, display and MUX address latch, it must supply a chip enable pulse along with the read or write pulse. This chip enable pulse is derived from the high-order address bits (A8-A15) that are decoded by the chip select decoder and subsequently applied to the appropriate chip during read and write cycles.

The micro utilizes an 8-bit bi-directional bus that transfers data to and from peripheral chips and transfer addresses to the peripheral chips. This bus is known as the address/data bus since it allows the transfer of both address and data. On the **block** diagram Fig. 28, it is identified as **AD0-AD7.** Because both address and data are transferred on the same bus, a method of demultiplexing (decoding) the bus must be employed. This is acccomplished with the **address latch** chip. The **address latch** chip receives both data and addresses from the address/data bus (AD0-AD7) and if the address latch enable **(ALE)** pulse is simultaneously applied from the micro, then the 8 address bits are transferred to the output and are known as **A0-A7** (low order address bits). If the **ALE** pulse is not applied with the address/data bits then the bits that are on the address/data but **(AD0-AD7)** will not be transferred to the external devices (RAM, EPROM, A/D No. 1 & MUX address latch) as address bits.

External program memory is provided by a 32k x 8 EPROM. Since the EPROM has 32k memory locations, the standard 8 address bits are insufficient to access a location greater than 255_{10}. Therefore, expanded memory addressing is employed by the micro to access memory locations greater than 255_{10}. To illustrate, when the micro fetches an instruction from the EPROM it supplies a 16-bit address; bits A0-A7 via **address latch** chip as previously described and bits A8-A15 on the expanded memory address bus. This 16-bit address is accomplished by the **PSEN** (Program Store Enable) pulse from the micro which causes the program instruction to be transferred from the EPROM onto the address/data bus (AD0-AD7) to the micro.

External scratchpad memory is provided by a 8k x 8 **RAM.**(Rev. I and later) The micro uses the same expanded memory addressing scheme that is used when addressing the EPROM. However, since the static RAM is a type of memory that can be written-to or read-from, **RD** (read) and **WR** (write) pulses are used instead of the **PSEN** pulse that was used with the EPROM. To illustrate, when the micro reads data from the RAM it applies a 16-bit address along with a **RD** pulse. The data

SECTION 8

in the specified location is then transferred along the address/data bus (AD0-AD7) to the micro. When the micro writes data to the RAM, it applies a 16-bit address along with a **WR** pulse. This causes the data that is on the AD0-AD7 bus to be written to the specified **RAM** location via the A0-A7 bus.

The **ENABLE/DISABLE** jumper plug on the micro board is used during execution of the service diagnostic routines. Refer to description of **service diagnostic** routines for details of the operation of **ENABLE/DISABLE** jumper.

The **EMS/MODEM** jumper plug on the micro board must be placed in **Modem** position to allow operation of the Remote PWM Temperature and % current inputs. A **low battery detector circuit** monitors the battery back-up voltage that is being supplied from the power supply board. If the battery voltage falls below +3.6Vdc, the **battery detector** circuit outputs a logic high signal to **parallel interface no. 1** Port "B" bit 4.

When the micro reads the PI, it will then display the following message and allow the system to continue to run:

"REPLACE BATTERY - REPROGRAM SETPOINTS"

The three AA alkaline batteries should be replaced as soon as possible to allow the programmed setpoints to be maintained in the event of a power failure. Additionally, neglecting to replace the batteries disables any further "status" messages to be displayed, such as EXCESS PURGE, WARNING-HIGH PURGE PRESSURE, etc.

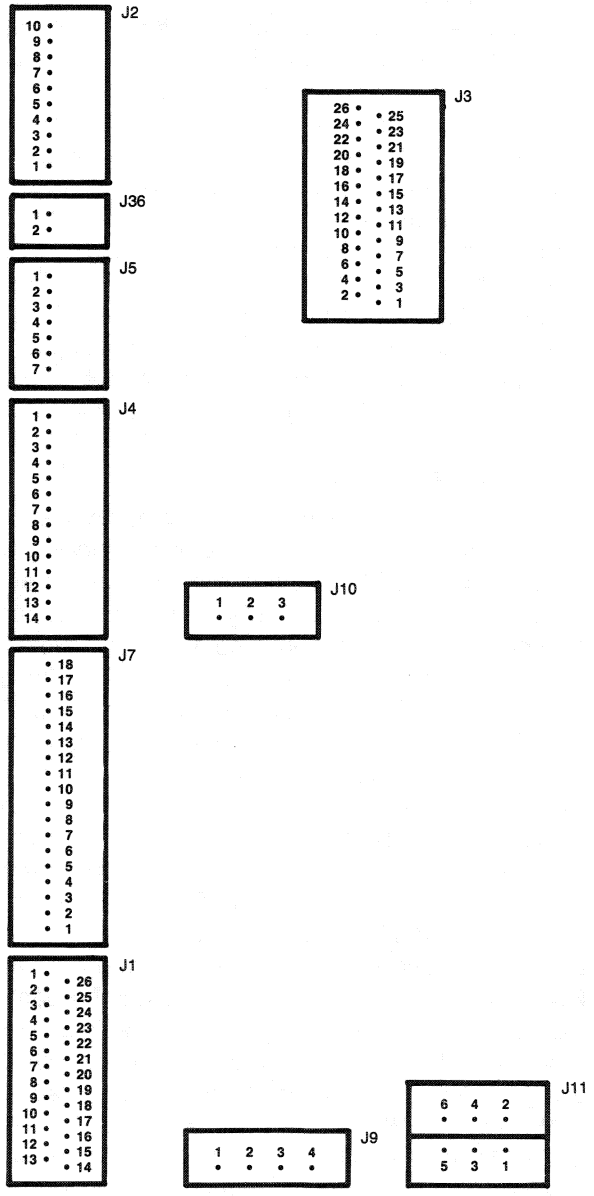


FIG. 31 – MICRO BOARD PLUG PIN IDENTIFICATION

MICRO BOARD - INPUTS (PLUG PIN NO'S.) (Refer to Fig. 31 for pin identification)

J1-26 — Low water temp safety (T-M application only). 0 Vdc when Turbo-Modulator has initiated an LWT shutdown.

J1-25 — Low evaporator pressure safety (Brine applications only). 0 Vdc when external LEP safety indicated a low pressure condition.

J1-24 — Spare

J1-23 — Not Used

J1-22 — Not Used

J1-21 — Multi-unit sequence. +5Vdc when sequence kit enables compressor to run; or when jumper is installed at input to digital input board.

J1-20 — Local/remote cycling device. +5Vdc when remote cycling device enables the compressor to run; or when jumper is installed at input to digital input board.

J1-19 — Chilled water pump interlock or flowswitch. +5Vdc when interlock or flowswitch enables compressor to run; or when jumper is installed at input to digital input board.

***J1-18** — Remote current limit setpoint (EMS). A 1-11 sec pulse width modulated (PWM) signal that is +5Vdc in the active state. Signal is only accepted every 60 seconds — any signal received at a rate greater than 1 signal/60 seconds will be ignored.

***J1-17** — Remote LCWT setpoint (EMS). A 1-11 sec Pulse Width Modulated (PWM) signal that is +5Vdc in the active state. Signal is only accepted every 60 seconds. Any signal received at a rate greater than 1 signal/60 seconds will be ignored.

J1-16 — Remote stop (EMS). +5Vdc when remote EMS has commanded the compressor to stop. This

must be a maintained signal to provide a stop function.

J1-15 — Remote start (EMS) +5Vdc when remote EMS has commanded the compressor to start. This signal need only be a momentary signal to initiate start.

J1-14 — +5Vdc reg. power supply

J1-13 — 5V ret.

J1-12 — Service. +5Vdc when keyswitch is in **SERVICE** mode.

J1-11 — Program. +5Vdc when keyswitch is in **PROGRAM** mode.

J1-10 — Remote. +5Vdc when keyswitch is in **REMOTE** mode.

J1-9 — Start. +5Vdc when compressor is in **START** mode.

J1-8 — Stop. +5Vdc when compressor is in **STOP** mode.

J1-7 — Motor controller. 0 Vdc when motor controller contacts are open indicating a motor controller shutdown.

J1-6 — High motor temp. +5Vdc when HMT safety indicates a high temperature condition.

J1-5 — Under voltage. 0 Vdc when under voltage relay detects a low voltage condition (90VAC).

J1-4 — Purge top float switch. +5Vdc when purge is in fill cycle; 0 Vdc when fill cycle is complete.

J1-3 — Purge bottom float switch. +5Vdc when purge tank has emptied.

J1-2 — High pressure. +5Vdc when condenser pressure rises to 15 PSIG (29.7 PSIA) as indicated by external HP safety. Returns to 0 Vdc when pressure falls to 9 PSIG (23.7 PSIA).

J1-1 — Vane motor switch. +Vdc when vanes are fully closed.

*This signal is normally sent from EMS once every 60-90 seconds. However, if a signal is not received within 30 minutes of the last signal received, the setpoint reverts to the control panel programmed setpoint.

J2

J2-1 — 12V ret.

J2-2 — 12V ret.

J2-3 — 12V regulated

J2-4 — Not Used

J2-5 — Analog input. 0-5Vdc multiplexed analog serial data.

J3

J3-1 — Battery input. +3.6 to +4.5 Vdc

J3-2 — +12Vdc regulated power supply input

J3-3 — +5Vdc unregulated power supply input

J3-4 — 12V ret.

J3-5 — 5V ret.

J3-6 — -12Vdc unregulated power supply input

J4

J4-7 — Keypad input, column 4; 0Vdc when a key in column 4 (**ENTRY** keys) is pressed. Otherwise, +5Vdc.

J4-8 — Keypad input, column 3; 0Vdc when a key in column 3 (**ENTRY** or **service** keys) is pressed. Otherwise, +5Vdc.

SECTION 8

J4-9 — Keypad input, column 2; 0Vdc when a key in column 2 (**DISPLAY** or **SERVICE** keys) is pressed. Otherwise4, +5Vdc.

J4-10 — Keypad input, column 1; 0Vdc when a key in column 1 (**DISPLAY** or **SERVICE** keys) is pressed. Otherwise, +5Vdc.

J4-11 — Keypad input, column 5; 0Vdc when a key in column 5 (**ENTRY** keys) is pressed. Otherwise, +5Vdc.

J4-12 — Keypad input, column 6; 0Vdc when a key in column 6 (**ENTRY** keys) is pressed. Otherwise, +5Vdc.

J4-13 — Keypad input, column 7; 0Vdc when a key in column 7 (**SETPOINTS** keys) is pressed. Otherwise, +5Vdc.

J4-14 — Keypad input, column 8; 0Vdc when a key in column 8 (**SETPOINTS** keys) is pressed. Otherwise, +5Vdc.

J8

J8-1 — Cardfile interface current loop serial port connector. Receiver for future use.

J8-2 — Cardfile interface current loop serial port connector. Receiver for future use.

J11

J11-3 — RCD (Received Data). RS232 serial data port for future printer or modem use.

J11-4 — DTR (Transmit Data). RS232 serial data port for future printer or modem use.

LCWT THERMISTOR

+12V — +12Vdc power supply input

SIGNAL — LCWT thermistor input. 0-2Vdc input as measured to GND. Refer to Table 6 (Temp. vs. Voltage Chart).

SHLD — Cable shield connection.

J36

J36-1 — 12V ret.

J36-2 — +12Vdc unregulated power supply input

MICRO BOARD OUTPUTS (PLUG PIN NO'S.) (REFER TO FIG. 31 FOR PLUG PIN IDENTIFICATION)

J2-6 — Address bit "A" (2^0) to analog board. +12 Vdc = LOGIC 1 STATE

J2-7 — Address bit "B" (2^1) to analog board. +12 Vdc = LOGIC 1 STATE

J2-8 — Address bit "D" (2^3) to analog board. +12 Vdc = LOGIC 1 STATE

J2-9 — Address bit "C" (2^2) to analog board. +12 Vdc = LOGIC 1 STATE

J2-10 — "MUX Inhibit" bit - not used

J4

J4-1 — +5Vdc return

J4-2 — Keypad output, row 1. This line is driven to GND when micro is scanning row 1. Otherwise +5Vdc.

J4-3 — Keypad output, row 2. This line is driven to GND when micro is scanning row 2. Otherwise +5Vdc.

J4-4 — Keypad output, row 3. This line is driven to GND when micro is scanning row 3. Otherwise +5Vdc.

J4-5 — Keypad output, row 4. This line is driven to GND when micro is scanning row 4. Otherwise +5Vdc.

J4-6 — Keypad output, row 5. This line is driven to GND when micro is scanning row 5. Otherwise +5Vdc.

J5

J5-1 — **PROGRAM** LED output. LED OFF = +12 Vdc unregulated with respect to GND. LED ON = approx 10% voltage drop from "OFF" state.

J5-2 — **OIL PUMP** LED output. Same as J5-1

J5-3 — **DISPLAY HOLD** LED output. Same as J5-1

J5-4 — **AUTO** LED output. Same as J5-1

J5-5 — **CLOSE** LED output. Same as J5-1

J5-6 — **OPEN** LED output. Same as J5-1

J5-7 — Common anode output. + 12Vdc unregulated output to all the anodes of **PROGRAM, OIL PUMP, DISPLAY HOLD, AUTO, CLOSE & OPEN** LED'S.

J6

J6-1 — "To" output. Control bit that is used to inititate the display self-test. Bit is GND for greater than 3 sec to initiate test. Otherwise +5Vdc.

J6-3 — CS (Chip Select) output. Control bit that is 0 Vdc to enable vacuum fluorescent display module to accept a character. Otherwise, +5Vdc.

J6-5 — RD (Read) output. Control bit that is 0 Vdc to read data from the vacuum fluorescent display module. Otherwise, +5Vdc. This bit is not used in this application.

J6-7 — "A" output. Not used.

J6-9 — WR (Write) output. Control bit that is 0 Vdc to write a character into the vacuum fluorescent display module. Otherwise, +5Vdc.

J6-11 — 2^0 bit output. ASCII that is +5Vdc in the active state. Otherwise, 0 Vdc.

J6-13 — 2^1 bit output. ASCII that is +5Vdc in the active state. Otherwise, 0 Vdc.

J6-15 — 2^2 bit output. ASCII that is +5Vdc in the active state. Otherwise, 0 Vdc.

J6-17 — 2^3 bit output. ASCII that is +5Vdc in the active

state. Otherwise, 0 Vdc.

J6-19 — 2^4 bit output. ASCII that is +5Vdc in the active state. Otherwise, 0 Vdc.

J6-21 — 2^5 bit output. ASCII that is +5Vdc in the active state. Otherwise, 0 Vdc.

J6-23 — 2^6 bit output. ASCII that is +5Vdc in the active state. Otherwise, 0 Vdc.

J6-25 — 2^7 bit output. ASCII that is +5Vdc in the active state. Otherwise, O Vdc.

J7

J7-1 — Cycling shutdown. 0 Vdc when panel is shutdown on a "Cycling" shutdown. Otherwise, +12 Vdc unreg. Refer to **RELAY OUTPUT BOARD - OUTPUTS** section (TB4-40/41) for details of "Cycling" shutdown.

J7-2 — Safety shutdown. 0 Vdc when panel is shutdown on a "Safety" shutdown. Otherwise, +12 Vdc unreg. Refer to **RELAY OUTPUT BOARD - OUTPUTS SECTION** (TB4-42/43) for details of "Safety" shutdown.

J7-3 — Chilled water pump. 0 Vdc when panel is commanding the chilled water pump to run. Otherwise, +12 Vdc unreg. Refer to **RELAY OUTPUT BOARD - OUTPUTS SECTION** (TB4-44/45) for details of "Chilled Water Pump" contacts.

J7-4 — Remote mode ready to start. 0 Vdc when all safeties and cycling devices are satisfied and the keyswitch is in the **REMOTE** mode. Otherwise, +12 Vdc unreg.

J7-5 — Motor starter. 0 Vdc when micro board is commanding the compressor motor to run. Otherwise, +12 Vdc unreg.

J7-6 — Purge air exhause solenoid. 0 Vdc when micro board is commanding the air exhaust solenoid valve to energize and exhaust the non-condensables from the purge cannister. Otherwise, + 12 Vdc.

J7-7 — Purge oil solenoid. 0 Vdc when micro board is commanding the purge oil solenoid valve to energize and fill the purge cannister. Otherwise, +12 Vdc unreg.

J7-8 — Spare

J7-9 — Vent line solenoid. 0 Vdc when micro board is commanding the vent line valve to open. Otherwise, +12 Vdc unreg.

J7-10 — Oil pump. 0 Vdc when micro board is commanding the oil pump to run. Otherwise, +12 Vdc unreg.

J7-11/12 — PRV motor close winding. 0-2 VAC (measured to J7-15) when vanes are being commanded to close. Approx. 24VAC when vanes are holding or opening.

J7-13/14 — PRV motor open winding. 0-2 VAC (measured to J7-15) when vanes are being commanded to open. 24VAC when vanes are holding or closing.

J7-15/16 — PRV common.

J7-17/18 — 12V return.

J8

J8-3 — Cardfile current loop serial port interface connector transmitter. For future use.

J8-4 — Cardfile current loop serial port interface connector transmitter. For future use.

J10 (USED ON TURBO-MODULATOR APPLICATIONS ONLY)

J10-1 — LCWT setpoint to Turbo-Modulator via power supply board. Signal is a 1-11 second Pulse Width Modulated (PWM) signal corresponding to a 40°F to 60°F LCWT setpoint. It is linear between 1-11 sec. Signal is normally low (0 Vdc) causing the fiber optic driver to be turned on. Every 60 seconds, the signal goes high (+5Vdc unreg.) to turn off fiber optic driver. The signal transitions to +5Vdc (unregulated) causing the fiber optic driver to turn off for the desired period (1-11 seconds) and at the completion of the desired period the signal then transitions back to 0 Vdc causing the fiber optic driver to again turn on.

J10-2 — Not Used

J10-3 — % current limit setpoint to Turbo-Modulator via power supply board. Signal is a 1-11 second Pulse Width Modulated (PWM) signal corresponding to a 100% to 40% current limit setpoint (i.e., 1 second pulse = 100%; 11 second pulse = 40%). It is linear between 1-11 seconds. Signal is normally low (0 Vdc) causing the fiber optic driver to turn on. Every 60 seconds, the signal goes high (+5Vdc unreg.) to turn off fiber optic driver. The signal transitions to +5Vdc (unregulated) causing the fiber optic driver to turn off for the desired period (1-11 seconds) and at the completion of the desired period the signal then transitions back to 0 Vdc causing the fiber optic driver to again turn on.

J11

J11-1 — TXD (Transmit Data). RS232 serial data port for future use.

J11-2 — DSR (Receive Data). RS232 serial data port for future use.

SECTION 9
DISPLAY

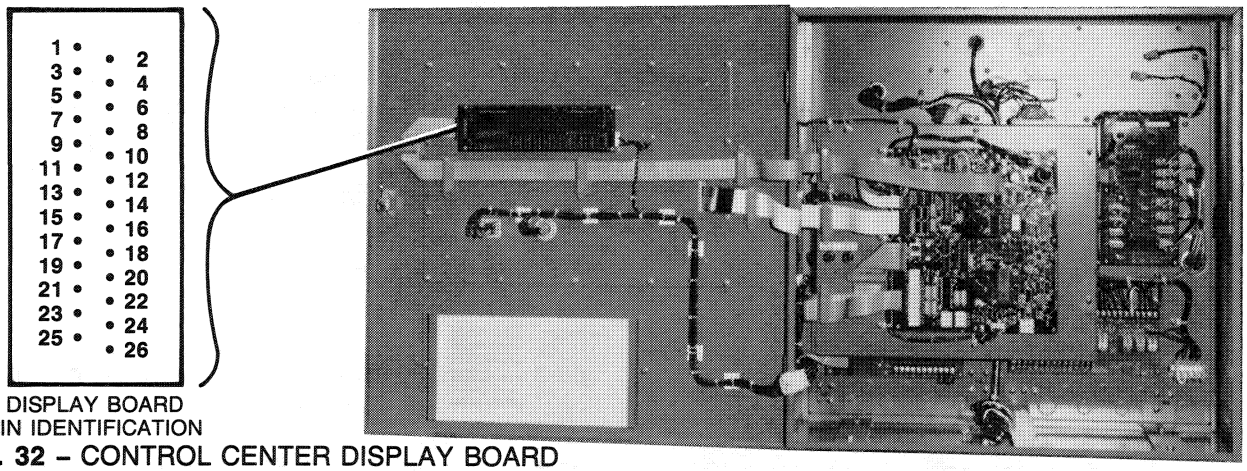


FIG. 32 – CONTROL CENTER DISPLAY BOARD

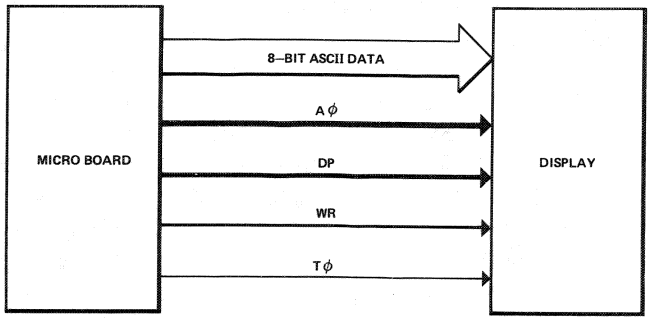


FIG. 33 – VACUUM FLUORESCENT DISPLAY BLOCK DIAGRAM

SECTION 9

DISPLAY (Ref. Fig. 32, 33 & 34)

The control panel display is a 40 character vacuum fluorescent dox matrix display. It receives a parallel 8-bit ASCII alphanumeric word from the micro board. Each 8-bit word represents a character. These words are stored, as a string, in the **RAM & EPROM** on the micro board. When the micro writes to the display, it provides the 8-bit ASCII word along with a **WR** pulse and the **DP** (chip select pulse). The least significant bit (LSB) of the address bus, A0, must also be driven low to allow the display to accept data from the micro board.

In addition to the alphanumeric data that is written to the display, command codes are also written to the display. These codes control the position of the cursor. When the micro writes a command code to the display it provides the code along with a **WR** and **DP** pulse. Also, the LSB of the address bus must be driven high to allow the display to accept a command code.

Forty characters can be simultaneously displayed. Each character is displayed on a 5 x 7 phosphor dot matrix (Fig. 34) A character generator interprets the ASCII word and illuminates the appropriate dots in the matrix to form the alphanumeric character.

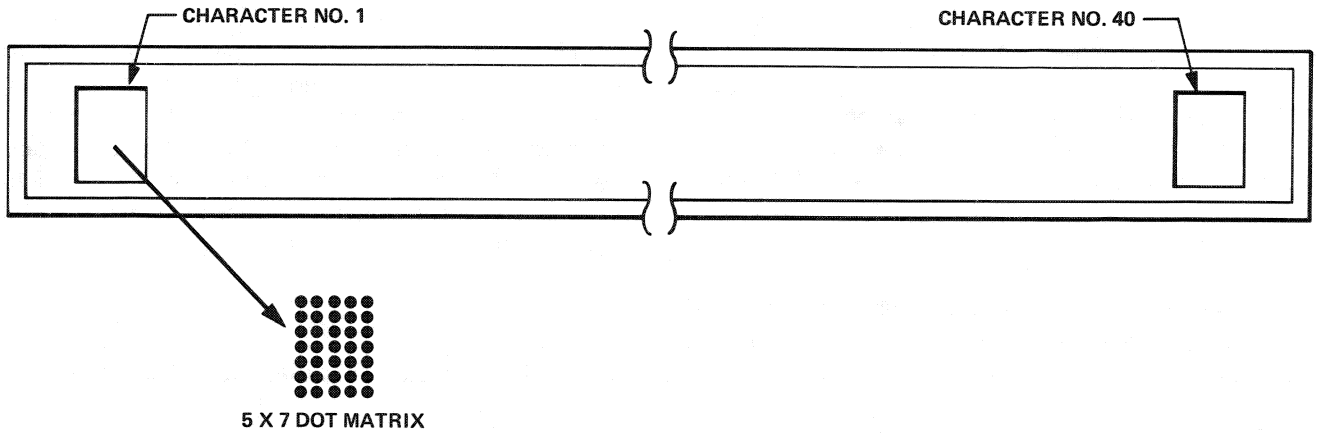


FIG. 34 – VACUUM FLUORESCENT DISPLAY

The display has a **self test** mode of operation. When in this mode, all alphabet letters, numerals 0-10, and puncuation marks are sequentially scrolled across the display at a rate of 1 character per second. This test is part of the **service diagnostic** routine. The micro board initiates (upon prompt from operator personnel) the self test by driving control line **TO** low for a period greater than 3 seconds. The self test will cease when **TO** is driven high.

SECTION 10
FIBER-OPTIC INTERFACE BOARD

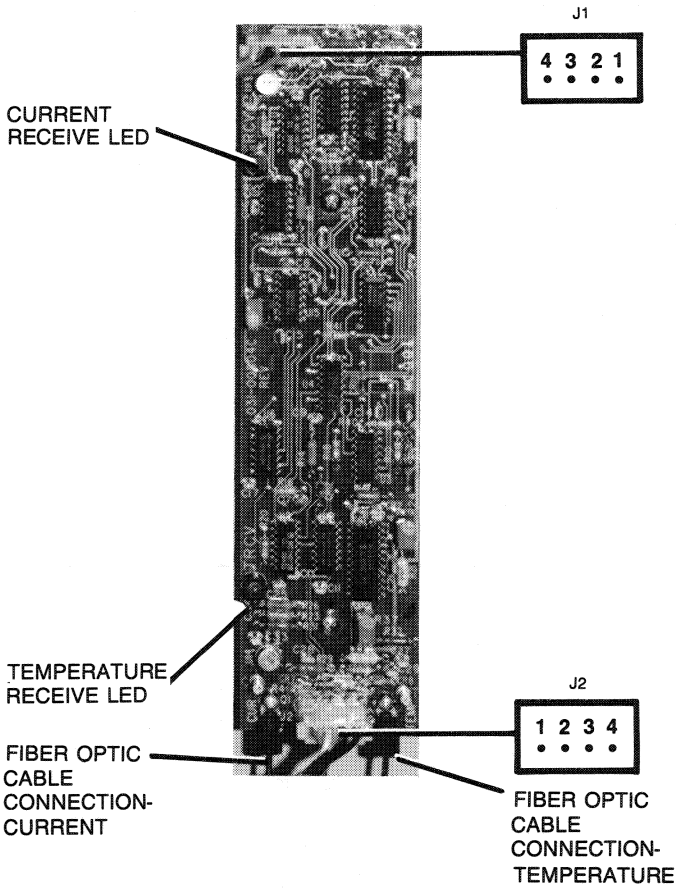


FIG. 35 – FIBRE-OPTIC INTERFACE BOARD

FIBER-OPTIC INTERFACE BOARD (Ref. Fig. 35) (Turbo-Modulator Applications Only)

The fiber-optic interface board receives the fiber-optic Pulse Width Modulated (PWM) **TEMP** and **CURRENT** setpoints from the micro control panel every 60 seconds and converts this setpoint data into analog signals that are applied to the Turbo-Modulator capacity board. The capacity board uses this data to control the Leaving Chilled Water Temperature (LCWT) and perform current limit functions (% current limit).

Refer to **"Inputs and Outputs"** section for details of the fiber-optic signals.

With the exception of the output circuit, both the **TEMP** and **CURRENT** circuits are identical. Therefore, only the **TEMP** circuit will be discussed. However, the differences in the output circuits will be explained.

The fiber-optic light is normally turned on. Once every minute the light is turned off for a period of 1-11 seconds. The duration of time that the light is extinguished is determined by the operator entered setpoint at the keypad. The range of operator entered values is 40°F-60°F LCWT corresponding to a PWM signal of 1-11 seconds (Ref. "Inputs and Outputs Section").

SECTION 9
SECTION 10

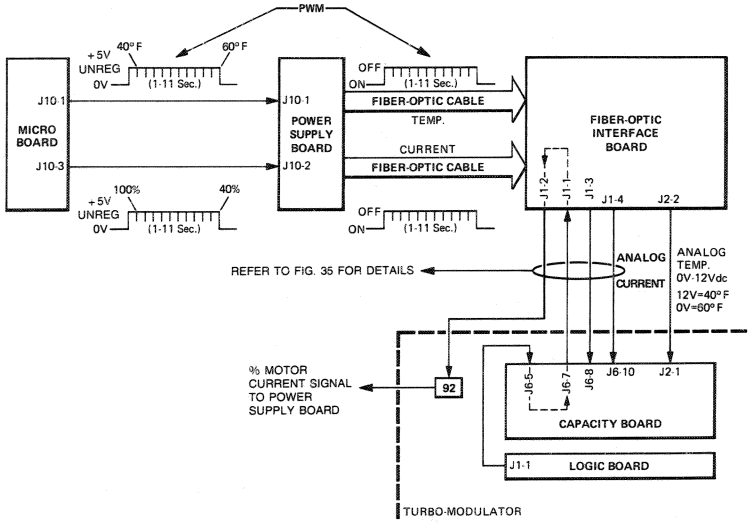


FIG. 36 – TURBO-MODULATOR SETPOINT INTERFACE (LCWT 80% CURRENT LIMIT)

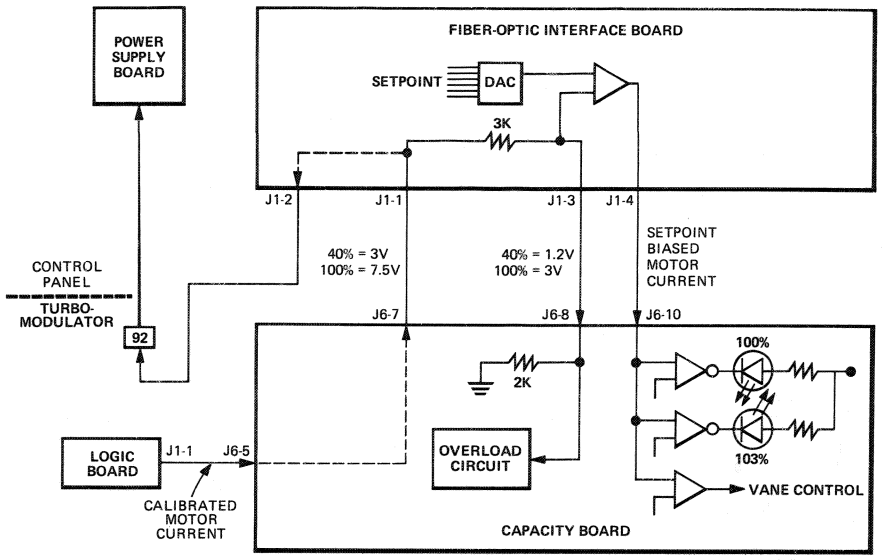


FIG. 37 – TURBO-MODULATOR SETPOINT INTERFACE (% CURRENT LIMIT DETAILS)

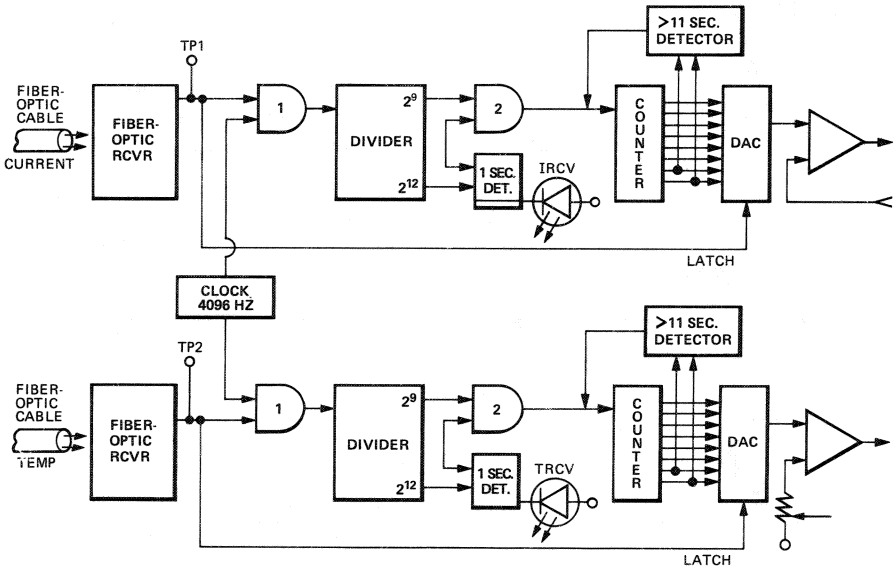
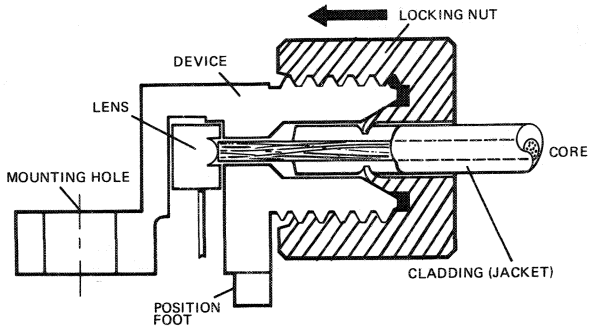


FIG. 38 – FIBER-OPTIC INTERFACE BOARD – BLOCK DIAGRAM

The fiber-optic light PWM signal is received by the **fiber-optic receiver** circuitry which converts it to a logic level voltage (Refer to Fig. 38). With the light turned on, the voltage at TP2 is 0Vdc; with the light extinguished the voltage at TP2 is + 12Vdc. This logic level signal is applied to an "AND" gate. If the level is + 12Vdc, the 4096 HZ clock pulses are enabled to the **divider** which divides the 4096 HZ by factors of 2^9 and 2^{12}. The 2^{12} ouput represents a count of 4096 which represents 1 second of PWM off-time. This 2^{12} output turns on the **1 Second Detector** which illuminates the **TRCV** lamp (temperature receive) and provides an enable for the 2^9 "AND" gate. Therefore, the **TRCV** lamp illuminates with a PWM pulse greater than 1 second and remains



TERMINATION INSTRUCTIONS:

1. **Strip** fiber jacket (cladding) back with razor blade or wire stripper to expose about 1/2" of bare fiber core. Avoid nicking the fiber core.

2. **Scribe** the fiber core completely around its circumference with a razor blade or similar tool to leave 1/8" of the core protruding beyond the jacket (actual tolerance for the bare fiber core is 0.100" to 0.180"). Break off core with fingers.

3. **Screw** back (loosen) connector locking nut. Insert terminated fiber into the connector until the core tip seats against the molded lens inside the device package. Screw connector locking nut down to a snug fit, locking the fiber in place.

FIG. 39 – FIBER-OPTIC CABLE TERMINATION

illuminated for the duration of the PWM pulse (if the pulse is 1 second in length the TRCV lamp will momentarily illuminate. If the pulse is 11 seconds the lamp would be illuminated for 10 seconds). The 2^9 **divider** output is applied to an "AND" gate that is enabled by the 1 second detector. The 2^9 output represents a count of 512_{10} therefore, for every 4096 HZ, the 2^9 port would output 8 HZ $\left(\frac{4096}{512} = 8\right)$. For every second of PWM, the 2^9 port would output 8 pulses.

These 8 pulses/second are applied thru the "AND" gate (provided that the PWM is greater than 1 second) to the **counter.** The **counter** counts the number of pulses applied to it. Since the "AND" gate no. 2 is not enabled until after 1 second of PWm, the maximum count will be 80_{10} (11 sec. - 1 sec. = 10 sec.; 10 sec. x 8 pulses = 80 pulses). This count is applied to the **DAC** where the digital word is converted to an analog value. The trailing edge of the PWM pulse latches the digital count into the **DAC** and the analog value is presented at the output. This analog value is applied to a buffer that provides an output range of 0-12Vdc (refer to "System Inputs and Outputs"). As a precaution against allowing the **counter** to increment above 80_{10} (caused by a PWM pulse greater than 11 seconds), the **greater than 11 second detector** will inhibit the counter. The 0-12 Vdc output is then applied to the Turbo-Modulator capacity board LCWT error circuits.

As previously stated, the **current** circuits operate identically to the **temp** circuits as explained above.However, the **current** output circuit differs (refer to Fig. 38). To explain, the Turbo-Modulator logic board outputs a signal that is calibrated to be 7.5Vdc when the compressor motor is drawing 100% FLA. This signal passes thru the capacity board to the fiber-optic interface board and back to the capacity board where it operates the overload circuit. This signal is also applied to the **power supply** board via terminal 92 in the Turbo-Modulator. At the **Power Supply** board the signal is then recalibrated and applied to the **Analog Input board.** The **setpoint biased motor current** value is derived from a summation of the calibrated motor current value and the keypad entered **% current limit** value. The setpoint biased motor current value is then applied to the capacity board to operate the 100%, 103% FLA indicator LED's and the vane control circuits to achieve current limit control. (Refer to "Inputs and Outputs").

This board interacts with the calibration of the Turbo-Modulator logic and capacity. Therefore, refer to the "System Calibration Procedures".

FIBER-OPTIC INTERFACE BOARD – INPUTS (Turbo-Modulator Only)

All Turbo-Modulator references in this manual refer to the Turbo-Modulator I not the new Turbo-Modulator II although some points are not changed, others are.

TEMP - Fiber-optic cable input from power supply board. Signal is a 1-11 second PWM light (RED) transmission. The light is normally on. It is turned off for a period of 1-11 seconds to indicate a setpoint of 40°F to 60°F (ie. 1 sec. = 40°F; 11 sec. =60°F). The signal is sent once every 60 seconds.

CURRENT - Fiber-optic cable input from power supply board. Signal is a 1-11 second PWM light (RED) transmission. The light is normally on. It is turned off for a period of 1-11 seconds to indicate a setpoint of 100% to 40% (ie. 1 sec. = 100%; 11 sec. = 40%). The signal is sent once every 60 seconds.

SECTION 10

J2-1 - +12Vdc power supply input from Turbo-Modulator.

J2-3 - -12Vdc power supply input from Turbo- Modulator.

J2-4 - Power supply (+12, -12) ground input from Turbo-Modulator.

J1-1 - Calibrated motor current input from Turbo-Modulator Capacity Board. With the motor drawing 100% FLA the voltage should be 7.5Vdc; with 40% FLA the voltage should be 3Vdc. To calculate the voltage between these extremes use the following formula:

$$7.5 \left(\frac{XX}{100}\right) = E_{J1\text{-}1}$$

Where XX = "% Motor Current" as read at display (Actual % of FLA that motor is conducting)

FIBER-OPTIC INTERFACE BOARD – OUTPUTS (T-M) Only)

J1-2 - Calibrated motor current output to power supply board via Terminal 92 in Turbo-Modulator. The voltages are the same as J1-1.

J1-3 - Part of calibrated motor current voltage divider circuit return path to Turbo-Modulator Capacity Board. With the motor drawing 100% FLA the voltage should be 3Vdc; with 40% FLA the voltage should be 1.2Vdc. To calculate the voltage between these extremes use the following formula:

$$3 \left(\frac{XX}{100} \right) = E_{J1-3}$$

Where XX = "% Motor Current" as read at display (Actual % of FLA that motor is conducting)

J1-4 - Setpoint biased motor current value to Turbo-Modulator Capacity Board. Calculate the voltage as follows:

$$I_{out} = (100 - XX)\ .02$$

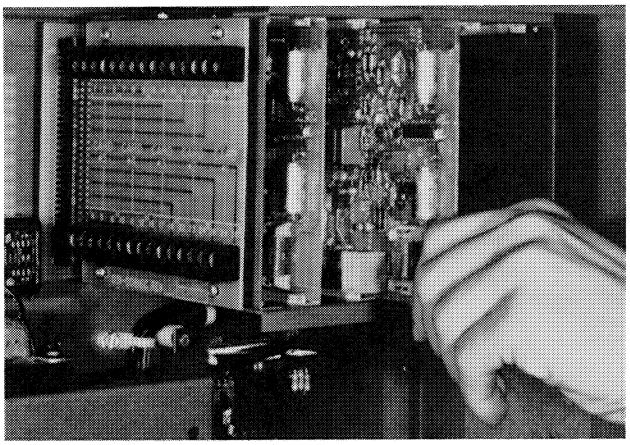
Where XX = % current limit Setpoint entered @ keypad.

$$E_{J1-4} = (I_{out} \times 1.5) + E_{J1-3}$$

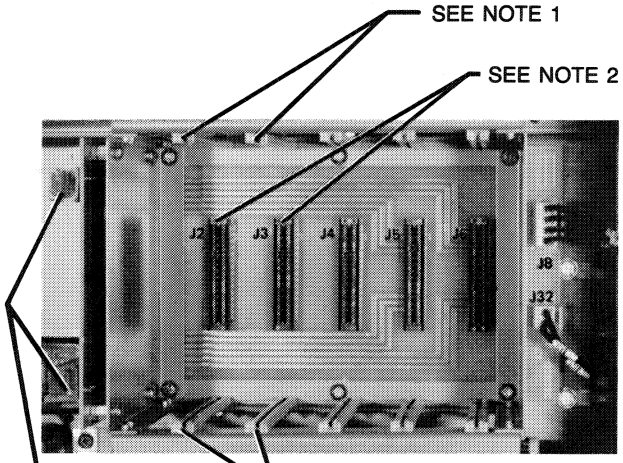
J2-2 - LCWT setpoint output to Turbo-Modulator Capacity Board. Signal is a 0-12Vdc analog voltage corresponding to a 60°F - 40°F setpoint (ie. 60°F = OV, 40°F = 12V). The resolution is 1.2Vdc output/second of PWM input as follows:

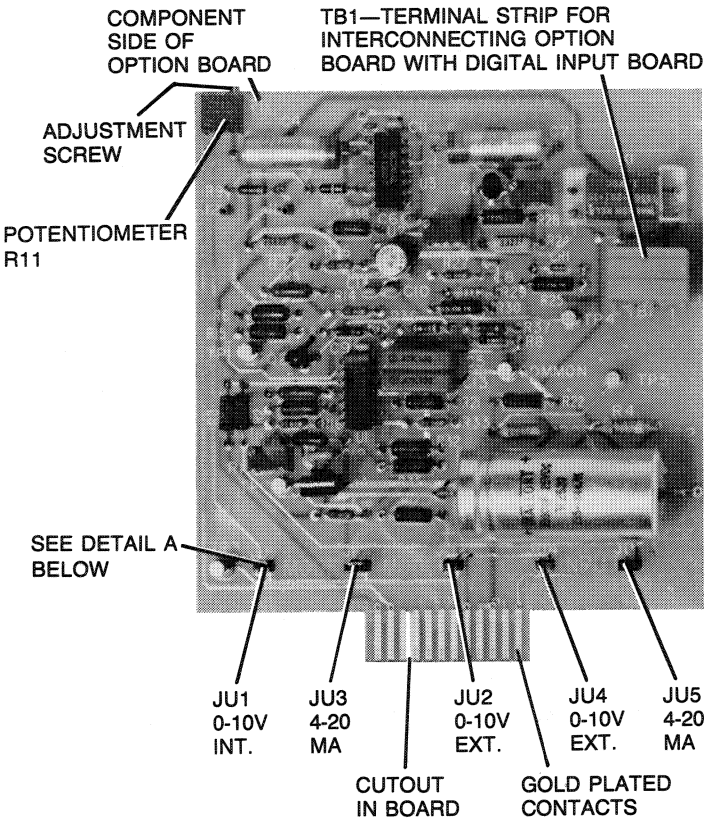
SETPOINT	PWM INPUT	OUTPUT(J2-2)
40°F	.1 Sec.	12 Vdc
41°F	1.5 Sec.	11.4 Vdc
42°F	2.0 Sec.	10.8 Vdc
43°F	2.5 Sec.	10.2 Vdc
44°F	3.0 Sec.	9.6 Vdc
45°F	3.5 Sec.	9.0 Vdc
46°F	4.0 Sec.	8.4 Vdc
47°F	4.5 Sec.	7.8 Vdc
48°F	5.0 Sec.	7.2 Vdc
49°F	5.5 Sec.	6.6 Vdc
50°F	6.0 Sec.	6.0 Vdc
51°F	6.5 Sec.	5.4 Vdc
52°F	7.0 Sec.	4.8 Vdc
53°F	7.5 Sec.	4.2 Vdc
54°F	8.0 Sec.	3.6 Vdc
55°F	8.5 Sec.	3.0 Vdc
56°F	9.0 Sec.	2.4 Vdc
57°F	9.5 Sec.	1.8 Vdc
58°F	10.0 Sec.	1.2 Vdc
59°F	10.5 Sec.	.6 Vdc
60°F	11.0 Sec.	0 Vdc

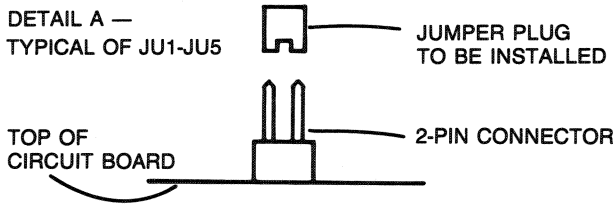
SECTION 11
REMOTE CURRENT LIMIT/LCWT SETPOINT BOARD



BOARD CARD FILE







NOTES:

1. Card edge guides used to slide option board into card file.
2. Option board to be installed into either connector J2 or connector J3 on the inside of the card file.

FIG. 40 – CARD FILE AND BOARDS

REMOTE CURRENT LIMIT/LCWT SETPOINT BOARD (Ref. Fig. 40)

The Remote Current Limit/LCWT Setpoint Board(s) (031-00814-000) allows the microcomputer control panel to accept a 4-20MA, 0-10Vdc or a contact closure remote setpoint from an Energy Management System (EMS). This board(s) slides into a card file (031-00827-000) that is field mounted in the upper right corner of the microcomputer control panel enclosure. Both the card file and the PC board(s) are Customer options. (For connection to energy management systems).

This board can accept either remote current limit setpoints or remote LCWT setpoints from an EMS. Therefore, if both of these remote setpoint capabilities are desired, two boards (031-00814-000) are required. They are installed in J2 and J3 of the card file. (If only one function is required, the board is installed in J2 or J3).

The EMS (supplied by others) applies a 4-20MA or 0-10Vdc or contact closure to the remote current limit/LCWT setpoint board. This board converts the remote signal to Pulse Width Modulation (PWM). The PWM pulse is applied to the appropriate input (TB2-19

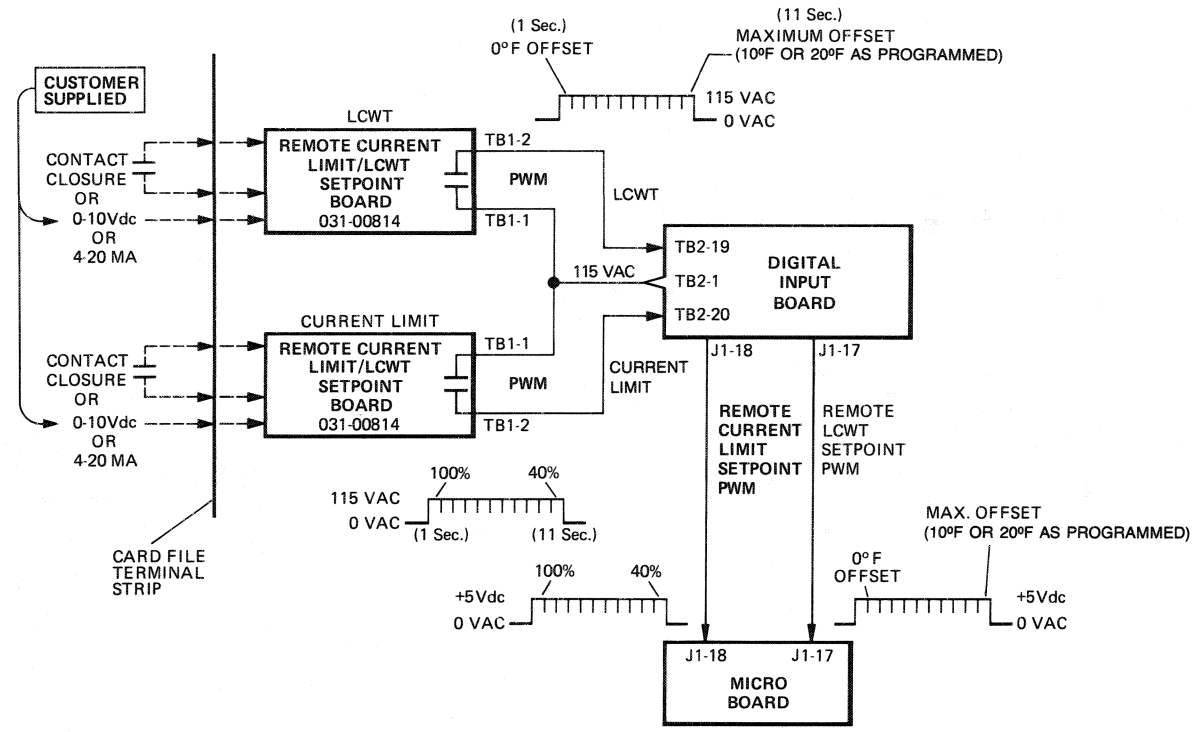


FIG. 42 – REMOTE CURRENT LIMIT/REMOTE LCWT SETPOINT CONFIGURATION

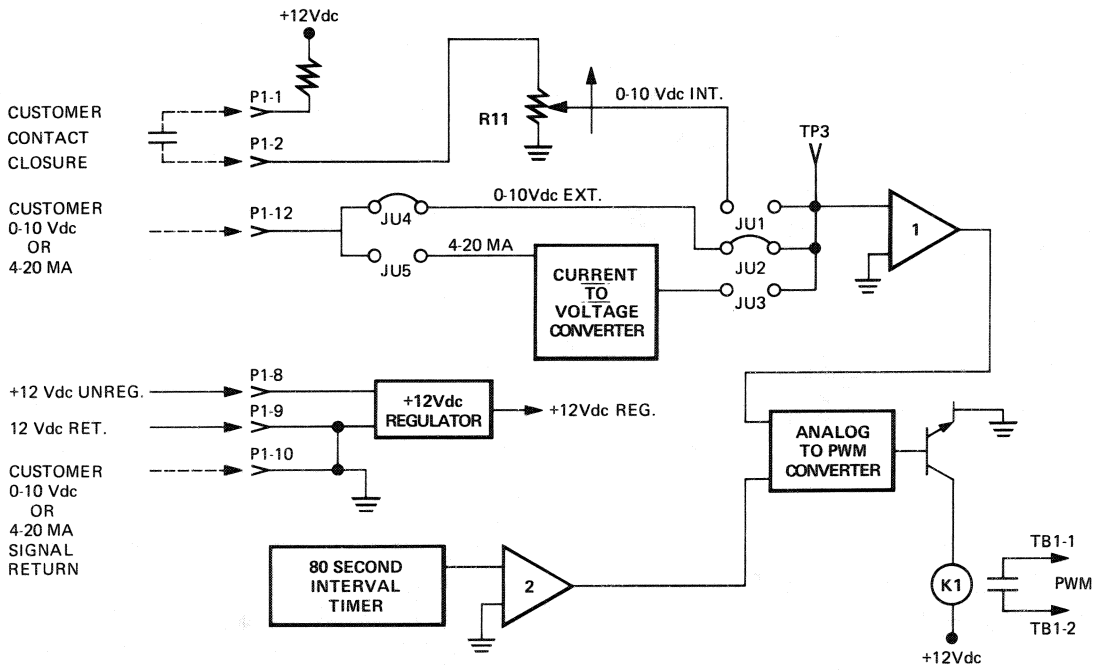


FIG. 42 – REMOTE CURRENT LIMIT/REMOTE LCWT SETPOINT BOARD SIMPLIFIED BLOCK DIAGRAM PART NO. 031-00814-000

for LCWT or TB2-20 for current limit) of the digital input board where the 115VAC PWM pulse is converted to + 5Vdc PWM pulse for use by the micro board. The length of the PWM pulse is 1-11 seconds. Refer to "Inputs & Outputs" section in this book for details of these signals. The board contains five 2-Pin connectors (JU1 thru JU5) that are used to configure the board for the desired input signal type. Two 2-pin jumper plugs

are provided with each board. These jumper plugs are installed on the 2-pin connectors as follows:

DESIRED INPUT	INSTALL JUMPERS ON:
4-20 MA	JU5 & JU3
0-10Vdc	JU4 & JU2
Contact Closure	JU1 & JU4

The **0-10Vdc Customer Input** is applied to the board @ J1-12 and passes thru JU4 and JU2 to amplifier no. 1 where it is conditioned for input to the analog to PWM converter. The 80 second interval timer assures a PWM pulse is only output at a rate of 1 pulse every 80 seconds. The micro board ignores pulses received at less than 60 second intervals. The PWM output drives relay K1 which is normally de-energized. When the PWM pulse is output, relay K1 is energized for a period of 1-11 seconds. This applies 115VAC to the digital input board for a period of 1-11 seconds. When the contacts open, OVAC is applied to the digital input board.

The **4-20MA Customer Input** is applied at J1-12 and passes thru JU5 to the "Current To Voltage Converter" where the 4-20MA signal is converted to a 0-10Vdc signal. This signal passes thru JU3 and then continues on the same path as discussed above.

The **"Contact Closure" Customer Input"** is applied at J1-1 & J1-2. When the contacts are open, 0Vdc is applied to JU1. When the contacts are closed, a voltage (0-10Vdc) corresponding to the setting of Pot R11 is applied to JU1. This signal passes thru JU1 and continues on the same path as discussed above.

REMOTE CURRENT LIMIT/LCWT SETPOINT BOARD (031-00814-000) – INPUTS

Since this board is installed in the card file, the field supplied 4-20MA, 0-10Vdc or contact closure inputs to this board connect to the card file. The field connection terminal strips are located on the left side of the card file. When the board is installed in the card file, all inputs are automatically connected to the board from the card file.

When a board is installed in J2 of the card file, the input connections are:

INPUT		CARD FILE TERMINAL
4-2MA	(+)	28
4-20MA	(-)	30
0-10Vdc	(+)	28
0-10Vdc	(-)	30
Contact Closure		25 & 26

When a board is installed in J3 of the card file, the input connections are:

INPUT		CARD FILE TERMINAL
4-20MA	(+)	22
4-20MA	(-)	24
0-10Vdc	(+)	22
0-10Vdc	(-)	24
Contact Closure		19 & 20

When this board is used for remote current limit setpoint, the following is an analysis of the input signals:

4-20MA - 4-20MA input corresponding to a 100% - 40% current limit setpoint (ie; 4MA = 100% setpoint. To calculate the setpoint for values between 4MA and 20MA use the following formula:

SETPOINT = 100% - [(MA SIGNAL - 4) 3.75%]

For example, an 8MA input would be calculated as follows:

SETPOINT = 100 - [(8 - 4) 3.75]
SETPOINT = 100 - [4 x 3.75]
SETPOINT = 100 - [15]
SETPOINT = 85%

0-10Vdc - 0-10Vdc input corresponding to a 100% - 40% current limit setpoint (ie; 0Vdc = 100% setpoint, 10Vdc = 40% setpoint). To calculate the setpoint for values between 0Vdc and 10Vdc use the following formula:

SETPOINT = 100% - [(DC VOLTAGE SIGNAL) 6%]

For example, a 4Vdc input would be calculated as follows:

SETPOINT = 100 - [4 x 6]
SETPOINT = 100 - 24
SETPOINT = 76%

CONTACT CLOSURE - When the customer supplied contacts are open, the input is 0Vdc which corresponds to a 100% setpoint. When the contacts are closed, the input is 0-10Vdc (100% - 40%) as determined by the setting of POT R11 (located on the front edge of the PC Board). To calculate the setpoint for values between 0Vdc and 10Vdc (as measured @ TP-3) use the above formula.

When this board is used for remote LCWT setpoint, the following is an analysis of the input signals:

4-20MA - a 4MA input corresponds to the control panel operator programmed "Chilled Liquid Temp" setpoint (0°F offset). A 20MA input corresponds to the maximum allowable "Chilled Liquid Temp" setpoint offset (10°F or 20°F as programmed). To calculate the setpoint for values between 4MA and 20MA use the following formula:

SECTION 11

$$°F\ OFFSET = \frac{(MA\ SIGNAL - 4)\ (REMOTE\ RESET\ TEMP\ RANGE)}{16}$$

$$SETPOINT = KEYPAD\ ENTERED\ SETPOINT + °F\ OFFSET$$

For example, if the programmed "Remote Reset Temp" range is 10°F and the programmed "Chilled Liquid Temp" is 45°F, a 12MA input would be calculated as follows:

$$°F\ OFFSET = \frac{(12 - 4)\ (10)}{16} = 5°F$$

$$SETPOINT = 45 + 5 = 50°F$$

0-10Vdc - A 0Vdc input corresponds to the control panel operator programmed "Chilled Liquid Temp" setpoint (0°F offset). A 10Vdc input corresponds to the maximum allowable "Chilled Liquid Temp" setpoint offset (10°F or 20°F as programmed). To calculate the setpoint for values between 0Vdc and 10Vdc use the following formula:

$$°F\ OFFSET = \frac{(DC\ VOLTAGE\ SIGNAL)\ (REMOTE\ RESET\ TEMP\ RANGE)}{10}$$

$$SETPOINT = KEYPAD\ ENTERED\ SETPOINT + °F\ OFFSET$$

For example, if the programmed "Remote Reset Temp" range is 10°F and the programmed "Chilled Liquid Temp" is 45°F, a 5Vdc input would be calculated as follows:

$$°F\ OFFSET = \frac{(5)\ (10)}{10} = 5°F$$

$$SETPOINT = 45 + 5 = 50°F$$

CONTACT CLOSURE = When the customer supplied contacts are open, the input is 0Vdc which corresponds to the control panel operator programmed "Chilled Liquid Temp" setpoint (0°F offset). When the contacts are closed the input is 0-10Vdc as determined by the setting of POT R11 (located on the front edge of the PC board). A 10Vdc input corresponds to the maximum allowable "Chilled Liquid Temp" setpoint offset (10°F or 20°F as programmed). To calculate the setpoint for values between 0Vdc and 10Vdc (as measured @ TP-3) use the above formula.

REMOTE CURRENT LIMIT/LCWT SETPOINT BOARD (031-00814-000)

When this board is used for remote current limit setpoint, the output is as follows:

TB1-1/2 - A relay contact closure Pulse Width Modulated (PWM) signal that is 1-11 seconds in length. A 1 second closure corresponds to a setting of 100% FLA. An 11 second closure corresponds to a setting of 40% FLA. All settings between 1 second and 11 seconds are linearly scaled. To calculate the setpoint for values between 1 second and 11 seconds use the following formula:

$$SETPOINT = 100\%\ [(PULSEWIDTH - 1)\ 6\%]$$

For example, a 4 second closure would be calculated as follows:

$$SETPOINT = 100 - [(4 - 1)\ 6]$$

$$SETPOINT = 100 - 18$$

$$SETPOINT = 82\%$$

When this board is used for remote LCWT setpoint, the output is as follows:

TB1-1/2 - A relay contact closure Pulse Width Modulation (PWM) signal that is 1-11 seconds in length. A 1 second closure corresponds to the control panel operator programmed "Chilled Liquid Temp" setpoint (0°F offset). An 11 second closure corresponds to the maximum allowable "Remote Reset Temp Range" value (10°F or 20°F). Refer to description of "Remote Reset Temp Range". All setting between 1 second and 11 seconds are linearly sealed. To calculate the setpoint for values between 1 second and 11 seconds use the following formulas:

$$°F\ OFFSET = \frac{(PULSEWIDTH - 1)\ (REMOTE\ RESET\ TEMP\ RANGE)}{10}$$

$$SETPOINT = KEYPAD\ ENTERED\ SETPOINT + °F\ OFFSET$$

For example, if the programmed "Remote Reset Temp Range" is 10°F and the programmed "Chilled Liquid Temp" is 45°F, a 5 second closure would be calculated as follows:

$$°F\ OFFSET = \frac{(5 - 1)\ (10)}{10}$$

$$°F\ OFFSET = \frac{(4)\ (10)}{10}$$

$$°F\ OFFSET = \frac{40}{10}$$

$$°F\ OFFSET = 4°F$$

$$SETPOINT = 45°F + 4°F$$

$$SETPOINT = 49°F$$

SECTION 12
SYSTEM CALIBRATION PROCEDURES

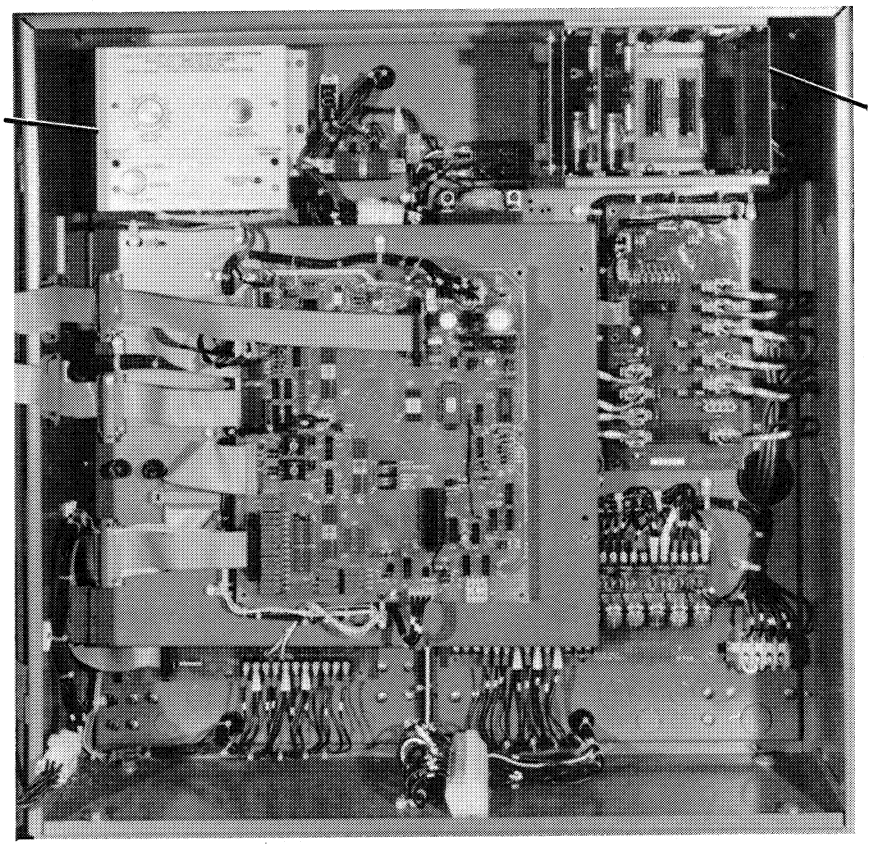


FIG. 43 – LOCATION OF CM-1A CURRENT MODULE IN THE MICRO COMPUTER CONTROL CENTER

ELECTRO-MECHANICAL STARTER APPLICATIONS

Control panels installed on chillers equipped with electro-mechanical starters contain a CM-1A current module. This module performs the compressor motor **overload** *and* **power fault** function. Further, it performs three phase **current limit** control @ 100% FLA and 104% FLA. However, these 100% and 104% current limit points are not biased by the keypad entered current limit setpoint. Specifically, the former % current limit setpoint pot that interfaced to the CM-1A has been replaced by a fixed value 3K OHM resistor that establishes a permanent 100% current limit setting to the CM-1A module. This current limit feature is retained as a contingency measure in the event of a software malfunction in the control panel.

The control panel monitors the motor current via a Current Transformer (CT1) in Phase "A" of the compressor motor wiring. This signal is calibrated on the power supply board to the full load amps of the chiller per the value listed on the sales order. The control panel uses the motor current signal to (a.) Display motor current as a percentage of full load amps and (b.) perform single phase current limit control @ 100% FLA and 104% FLA.

Since both the control panel and CM-1A module perform current limit control, it is essential that both be calibrated to the chiller full load amps. This calibration is performed at the factory. However, should it be necessary to perform this calibration in the field (as when the control panel power supply board or CM-1A current module is replaced) use the following procedure:

1. Using the keypad **% CURRENT LIMIT** key, enter a current limit setpoint of 100% FLA.
2. On the power supply board turn pot R4 fully counterclockwise.
3. Apply clamp-on ammeter to compressor motor power wires at L1 (Phase "A" motor current).
4. Run chiller to achieve 100% FLA (refer to sales order) as indicated by the clamp-on ammeter. Note that it may be necessary to manually operate the vanes to achieve 100% FLA. Further, if the CM-1A "100% CURRENT" LED is illuminated prior to the

clamp-on ammeter indicating 100% FLA then the CM-1A is inhibiting the chiller from reaching maximum load. To correct this simply move the slide bar on the variable resistors "RES" to a lower resistance value until the CM-1A "100% CURRENT" LED extinguishes.

5. With the chiller running @ 100% FLA, as indicated by the clamp-on ammeter, move the slide bars equally on variable resistors "RES" to achieve a voltage drop .90-1.05 Vdc across wires A & B (J16-13 & J16-14) of CM-1A module. The CM-1A module "100% CURRENT" LED should illuminate.
6. With the chiller running @ 100% FLA as indicated by the clamp-on ammeter, adjust power supply board POT **R4** clockwise until [the voltage at power supply board J15-3 to J15-1 (GND) equals 4.0 Vdc.] the control panel displays a **"% MOTOR CURRENT"** value of 100% FLA. Lock the POT.
7. The system is now calibrated. Recheck the calibration by running chiller up to 100% FLA (as indicated by the clamp-on ammeter). The following events should occur simultaneously as 100% FLA is reached:
   a.) CM-1A module "100% CURRENT" LED illuminates.
   b.) Control panel displays a "% MOTOR CURRENT" value of 100% FLA.

SOLID STATE STARTER APPLICATIONS

The York solid state starter performs the motor current **overload** *and* **power fault** function. It also performs three phase **current limit** at 100% FLA or 104% FLA. Therefore, the solid state starter must be calibrated to the chiller full load amps as per the value given in the sales order. These 100% FLA and 104% FLA factory adjusted current limit points are not biased by the keypad entered current limit setpoint. Specifically, the former % current limit setpoint POT that interfaced with the solid state starter has been replaced by a fixed value 3K OHM resister that establishes a permanent 100% current limit setting to the solid state starter. This current limit feature is retained as a contingency measure in the event of a software malfunction in the control panel.

The control panel monitors the motor current via a current transformer in Phase "A" of the compressor motor wiring. This signal is calibrated on the power supply board to the full load amps of the chiller per the value listed on the sales order. The control panel uses this motor current signal to (a.) Display motor current as a percentage of full load amps and (b.) perform current limit from 40% to 100%.

Since both the control panel and the solid state starter perform current limit control it is essential that both be calibrated to the chiller full load amps. This calibration is performed at the factory. However, should it be necessary to perform this calibration in the field, (as when the control panel power supply board of SSS logic board is replaced) use the following procedure:

1. Using the keypad **% CURRENT LIMIT** key, enter a current limit setpoint of 100% FLA.

2. On the power supply board turn POT **R4** fully counterclockwise.

3. Apply clamp-on ammeter to compressor motor power wires at L1 (Phase "A" motor current).

4. Run chiller to achieve 100% FLA (refer to sales order) as indicated by the clamp-on ammeter. Note that it may be necessary to manually operate the vanes to achieve 100% FLA. Further, if the solid state starter logic board "100% CURRENT" LED illuminates prior to the clamp-on ammeter indicating 100% FLA then the logic board is inhibiting the chiller from reaching maximum load. To correct this simply turn the logic board **"OVERLOAD"** POT clockwise until the SSS logic board "100% CURRENT" LED extinguishes.

5. With chiller running @ 100% FLA as indicated by the clamp-on ammeter, turn the SS logic board **"OVERLOAD"** POT counterclockwise until the logic board "100% CURRENT" LED just illuminates. Lock the POT.

6. With chiller running @ 100% FLA as indicated by the clamp-on ammeter, turn power supply board POT **R4** clockwise until the voltage @ power supply board J15-3 to J15-1 (GND) equals 4.0 Vdc and the control panel displays a "% MOTOR CURRENT" value of 100% FLA. Lock the POT.

7. The system is now calibrated. Recheck the calibration by running the chiller up to 100% FLA (as indicated by the clamp-on ammeter). The following events should occur simultaneously as 100% FLA is achieved:

   a.) SSS Logic Board "100% CURRENT" LED illuminates.

   b.) Control panel displays a "100% MOTOR CURRENT" value of 100% FLA.

TURBO-MODULATOR APPLICATIONS

When Turbo-Modulators are applied to chillers, the control panel does not perform current limit control or leaving chilled water temperature control. These functions are performed by the Turbo-Modulator.

The control panel does, however, read the compressor motor current value from the logic board and displays

it as a percentage of full load amps. Therefore, it is essential that the control panel be calibrated to the chiller full load amps. This calibration is performed at the factory. If it should become necessary to perform this calibration in the field (as when the control panel power supply board is replaced), use the following procedure:

1. Using the keypad **% CURRENT LIMIT** key, enter a current limit setpoint of 100% FLA.

2. Verify that the Turbo-Modulator logic board "CAL" POT is properly calibrated per "Turbo-Modulator Start-Up and Test Procedures" booklet page 32.

3. Run the chiller to achieve 100% FLA ("100% LED" on the Turbo-Modulator capacity board illuminates).

4. With chiller running @ 100% FLA, adjust control panel power supply board POT **R9** until the voltage @ power supply board J15-3 to J15-1 (GND) equals 4.0 Vdc and the control panel displays a **% MOTOR CURRENT**" value of 100% FLA. Lock and POT.

5. The system is now calibrated. Recheck the calibration by running chiller up to 100% FLA. The following events should occur simultaneously as 100% FLA is reached:

   a.) Turbo-Modulator capacity board "100%" LED illuminates.

   b.) Control panel displays a "% MOTOR CURRENT" value of 100% FLA.

To calibrate the "Leaving Chilled Water Temperature" perform the following procedure.

1. On Turbo-Modulator set diagnostic switches as follows:

T-M I BOARD	CAPACITY BOARD	T-M II LOGIC PCB
BRIDGE - ON RAMP - ON SYSTEM - AUTO GATES - AUTO	MODEL SWITCH - FIX VANE SELECT - AUTO	NO SWITCH TO SET

2. On the control panel keypad, enter a "% CURRENT LIMIT" setpoint of **100%.**

3. On the control panel keypad, enter the desired "Chilled Liquid Temp" setpoint.

4. Wait for system to stabilize and regulate leaving chilled water temperature.

5. Monitor "Chilled Liquid Temp" (Chilled Leaving) on keypad display. Adjust R8 on Turbo-Modulator capacity board until the "Chilled Liquid Temp" on display equals setpoint. Allow system to stabilize after each adjustment. (Adjust R8 CW to decrease LCWT; CCW to increase LCWT).

SECTION 13
TESTING

DIAGNOSTIC SOFTWARE - YORK MICRO-COMPUTER CONTROL CENTER

The diagnostic software consists of six tests. These tests are Ram test, A/D test, display test, keyboard test, digital input test, and digital output test. The diagnostic software is stored in the same memory as the operating program. To enable the diagnostic, turn the keypad keyswitch to **SERVICE** position and place the enable/disable jumper plug (on micro board) in the **ENABLE** position. To disable the diagnostic, turn the keypad keyswitch out of **SERVICE** position and place the enable/disable jumper plug in the **DISABLE** position. After the diagnostic is enabled, all further service technician interaction is done on the front panel keypad. When the diagnostic is enabled, the service technician is presented with a menu from which he can choose the test to be performed. The menu and six tests are described as follows:

CAUTION: Before performing this test, remove the jumper between terminals 24 and 25 on TB5 and press the manual trip button on 1M oil pump starter mounted on the condenser shell. This disables both the compressor motor and the oil pump starters. Upon completion of the test, replace the jumper between terms. 24 and 25 on TB5 and reset the 1M oil pump starter.

MENU

Upon entering the diagnostic software the technician will observe a menu from which one of the six tests may be chosen. Press **9** key to view all five tests. The tests may be chosen by selecting the numeric key listed with the test. The keys and tests are as follows:

0 — Ram test
1 — A/D test
2 — Display test
3 — Keyboard test
4 — Digital input test
5 — Digital output test

SECTION 12
SECTION 13

The numeric keys are located under "Entry" on the front of the control center.

RAM TEST

This test will check all ram locations in the system. The ram consists of three areas:

EXT — external ram
RTC — ram internal to the clock
INT — ram internal to the microcomputer

After the test is completed the display will show the three areas with either a pass or fail. A failed condition would indicate that the micro board should be replaced. Press any key after the test is over to return to the main menu.

A/D TEST

This test will allow the technician to select any of the analog input channels and display the voltage on that channel on the display. The display will show the voltage found on that channel in volts (0-5.000V). Upon entering this test the technician will be asked to push one of the six display function keys to select a group of analog channels; from here an individual channel may be selected. The analog channels associated with the display keys are as follows:

CHILLED LIQUID TEMPS
  ECWT — entering chilled water temp
  LCWT — leaving chilled water temp

REFRIGERANT PRESSURES
  PURG — purge pressure
  COND — condenser pressure
  EVAP — evaporator pressure

OIL PRESSURE
  LOP — low oil pressure
  HOP — high oil pressure

CONDENSER LIQUID TEMPS
  ECNWT — entering condenser water temp
  LCNWT — leaving condenser water temp

OPTIONS
  DISCGT — discharge temp sensor
OT — oil temp

% MOTOR CURRENT
  % FLA — motor current

After tests are completed press "*" to return to the main menu.

DISPLAY TEST

This test will make sure the display and the six led's on the keypad are functioning. Upon entering this test the technician will be instructed to push a key to start the test. Once the test has started the technician will see different characters scroll past on the display. Note that the six led's on the keypad should be illuminated. Any key may be pushed after the test has started to return to the main menu.

KEYPAD TEST

This test allows the service technician to make sure that all of the keys on the keypad are functioning. Upon entering this test the technician will be instructed to press any of the keys. Upon pressing any of the keys a description of that key will be displayed on the display to determine if the keypad is working correctly. To exit this routine and return to the main menu the "*" key must be pushed.

DIGITAL INPUT TEST

This test will monitor the digital input lines to the system and determine if the lines and their associated devices are functioning properly. A mnemonic for each line will be displayed with its associated state (1 if the line is high or 0 if the line is low). The lines monitored and their associated mnemonics are:

STOP — stop line
MOCON — motor controller
HMT — high motor temp
START — start line
TFS — top float switch
BFS — bottom float switch
HP — high pressure
VMS — vane motor switch
FLS — flow switch
BAT — battery back-up
SYSCY — remote/local cycling
MULCY — multi unit cycling
LEP — low evaporator pressure
LWT — low water temp
SERV — service keyswitch
REMC — remote control
PROG — program keyswitch
RSTRT — remote start switch
UVR — untervoltage relay
RSTOP — remote stop switch
RLCWT — remote LCWT set point
RCURR — remote current set point

DIGITAL OUTPUT TEST

This routine allows the technician to monitor and

change the state of the digital output lines. The technician will see an output line listed along with its present state (1 if the line is high or 0 if the line is low). At this time if the technician wishes to change the state of the line, press 1 to make the line high or 0 to make the line low. To leave this routine to return to the main menu press "*". The digital output lines monitored are:

SPARE	SAFETY SD
VENT LINE	CYCLING SD
PURGE AIR	MOTOR STARTER
PURGE OIL	PRV OPEN
OIL PUMP	PRV CLOSE
CHILLED WATER PUMP	EMS

SECTION 14
TROUBLESHOOTING

INTRODUCTION

The failures or problems that could be encountered in the microcomputer control center can be placed in seven major categories as follows:

- Digital Inputs
- Relay Outputs
- Keypad
- Analog Inputs
- EMI Noise
- Turbo-Modulator Setpoint Interface
- Remote Setpoint Interface (4-20MA, 0-10Vdcm, Contact Closure)

Each category requires a specific procedure to resolve the problem. These procedures direct the troubleshooter along the path that leads to the identification of the problem. The troubleshooter should understand the operation of the microcomputer control center and the function of each major component and PC board contained within the cabinet. Also the troubleshooter must understand the system interface and is able to utilize unit wiring diagrams to follow signal flow throughout the system.

Several levels of documentation are required for the troubleshooting process. The control center wiring diagram, supplied with every microcomputer control center is the top level document. It provides the overall wiring and configuration. Sections of this instruction provide the required lower levels. Specifically, block diagrams provide signal flow and simplified representations of PC board circuitry. The "Inputs and Outputs" of each board provide details of the required voltage levels at all connectors on the PC boards.

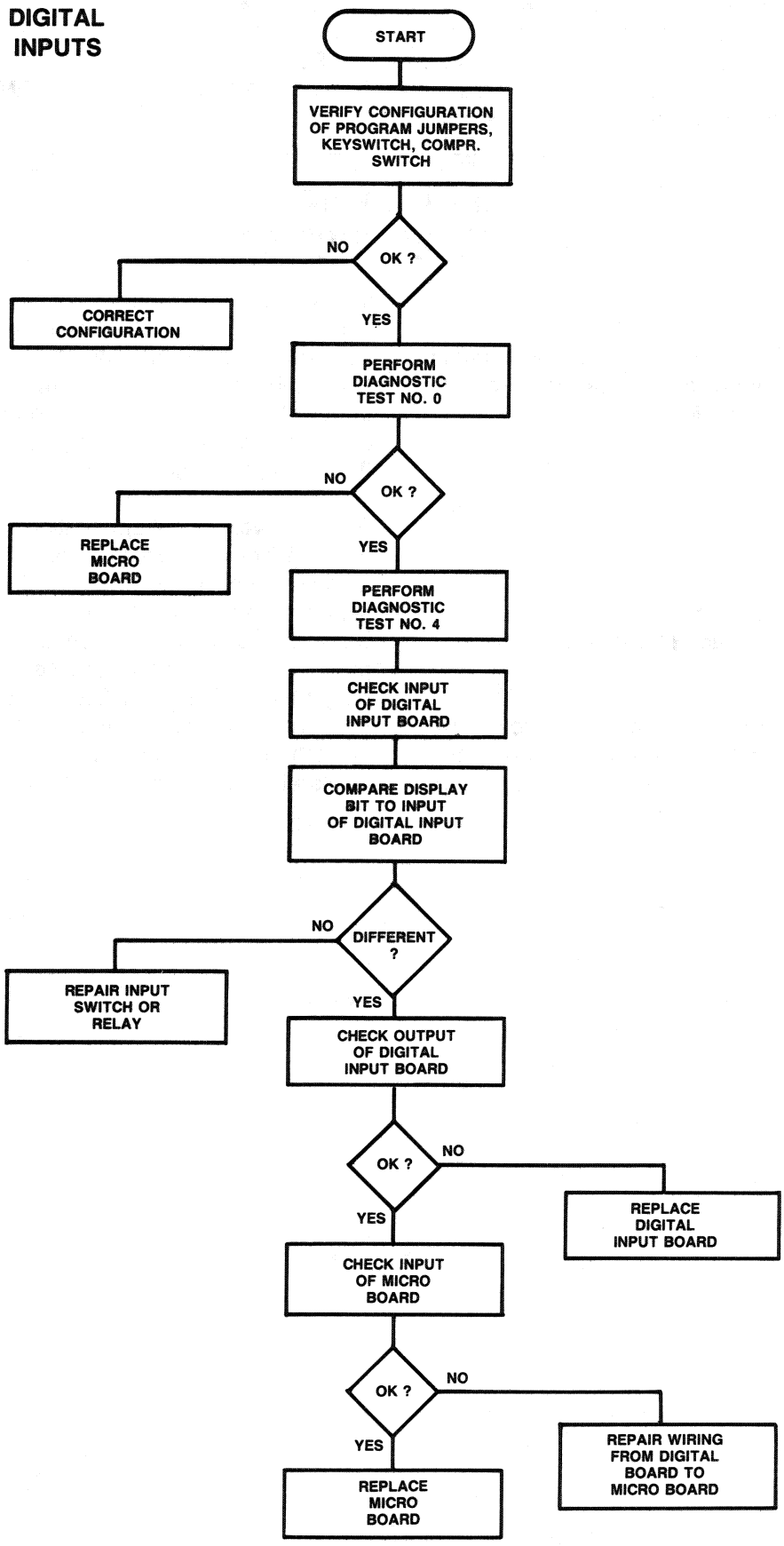
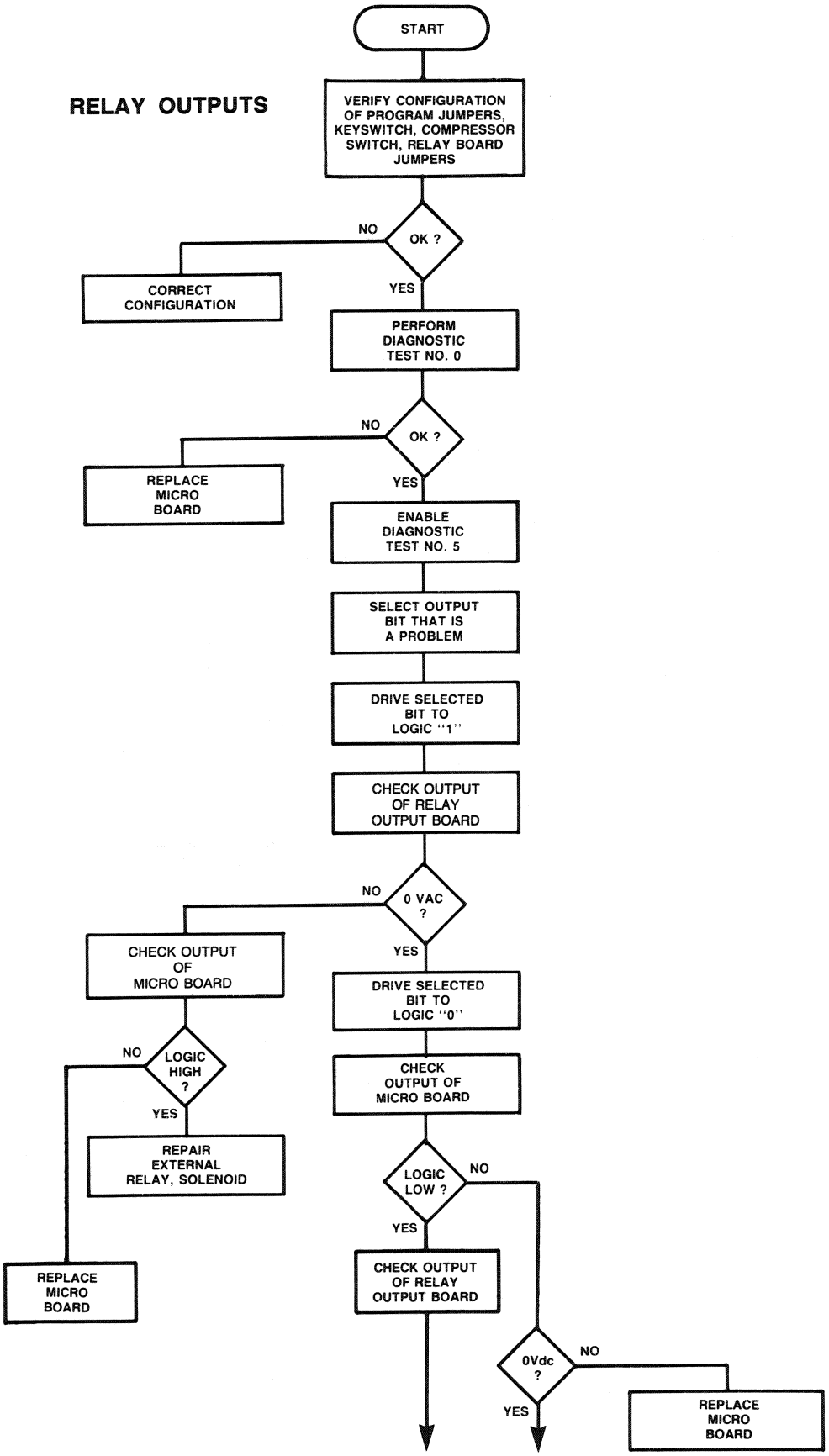


FIG. 44 — DIGITAL INPUTS TROUBLESHOOTING PROCEDURE

TROUBLESHOOTING PROCEDURES

RELAY OUTPUTS



Continued on page 74

FIG. 45 — RELAY OUTPUTS TROUBLESHOOTING PROCEDURE

Continued from page 73

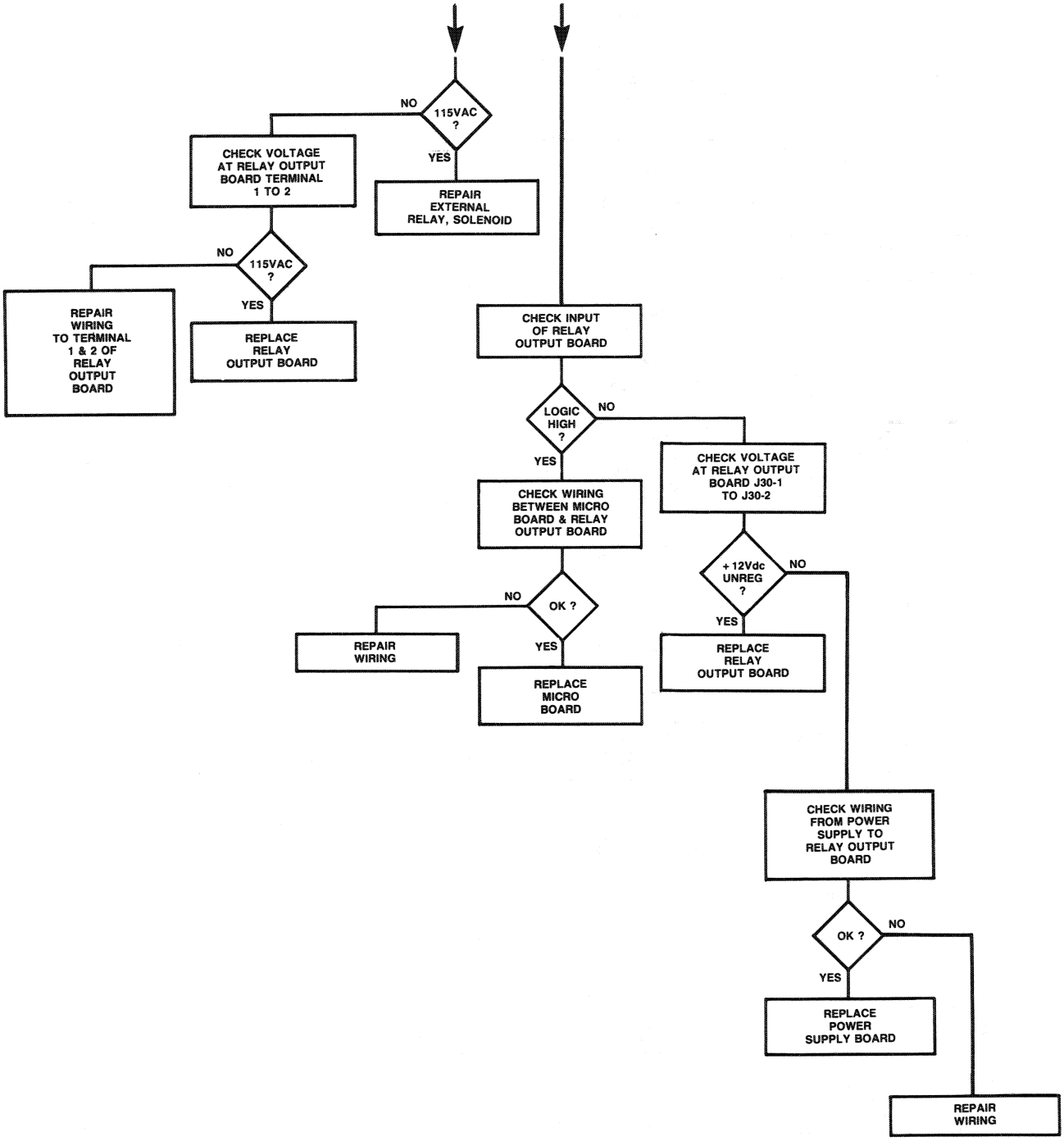


FIG. 45 — (CONTD.) RELAY OUTPUTS TROUBLESHOOTING PROCEDURE

TROUBLESHOOTING PROCEDURES

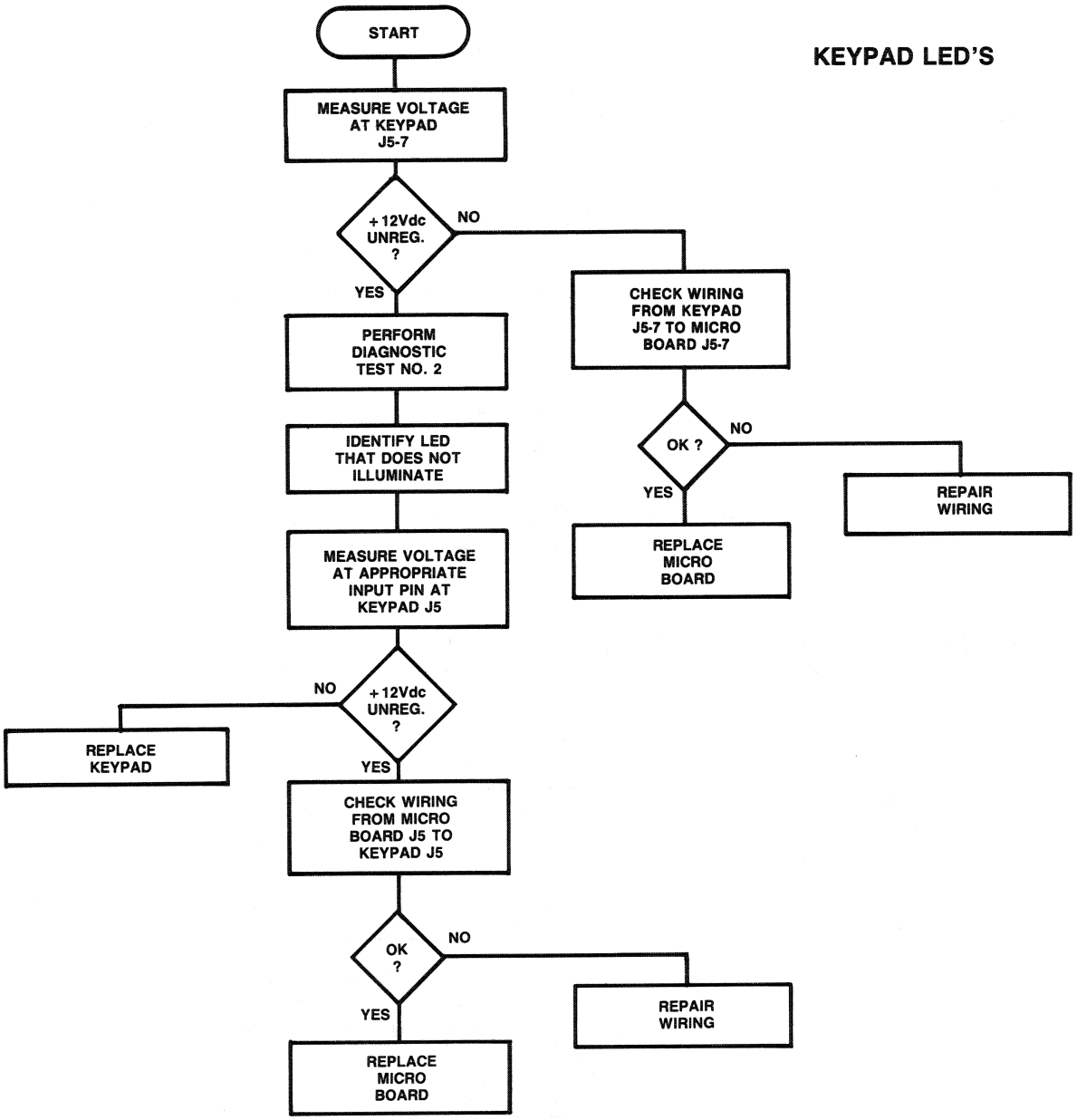


FIG. 46 — KEYPAD LED'S TROUBLESHOOTING PROCEDURE

SECTION 14

KEYPAD KEYS

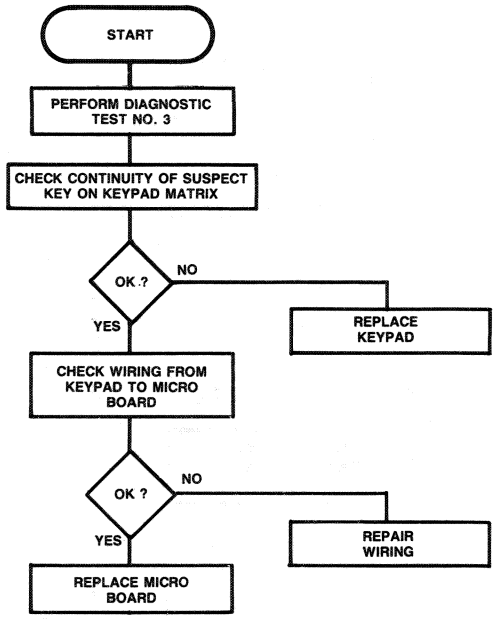


FIG. 47 — KEYPAD KEYS TROUBLESHOOTING PROCEDURE

KEYPAD DISPLAY

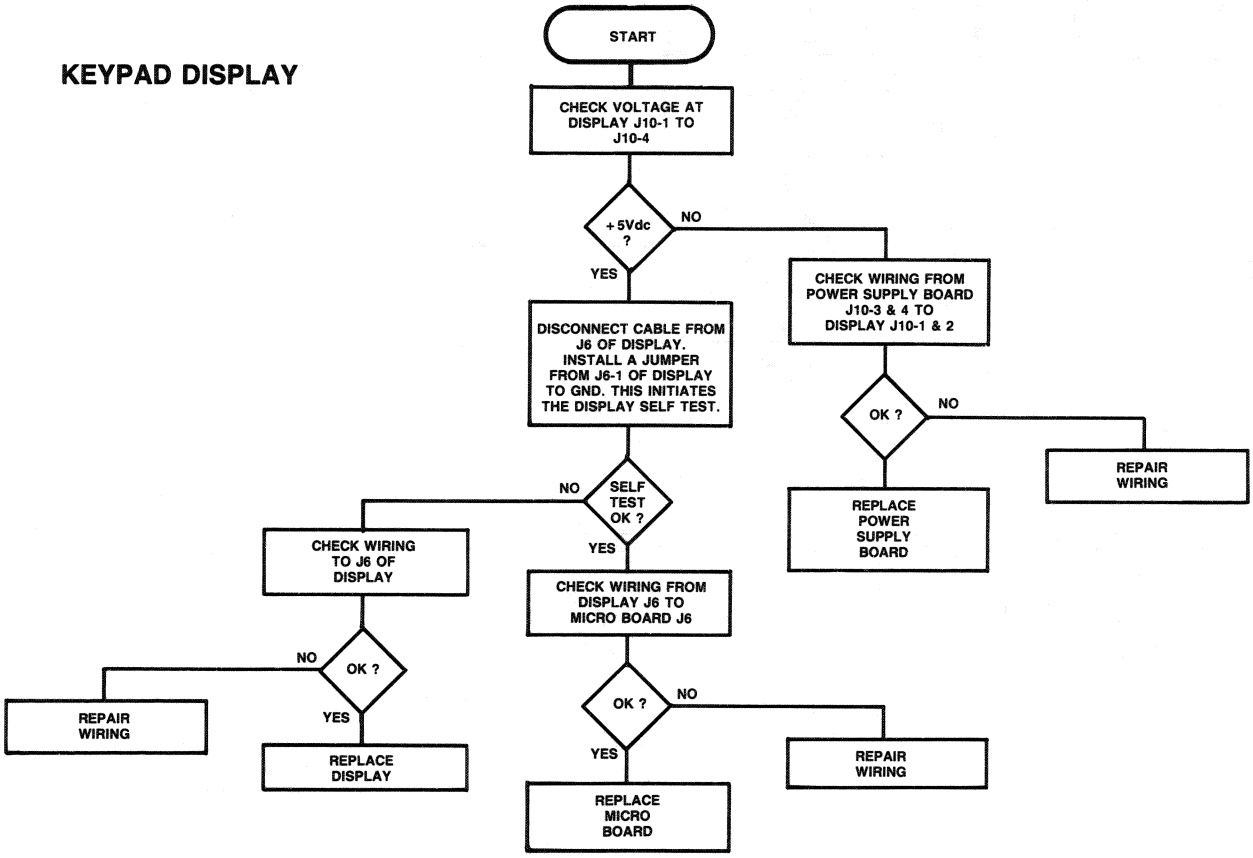
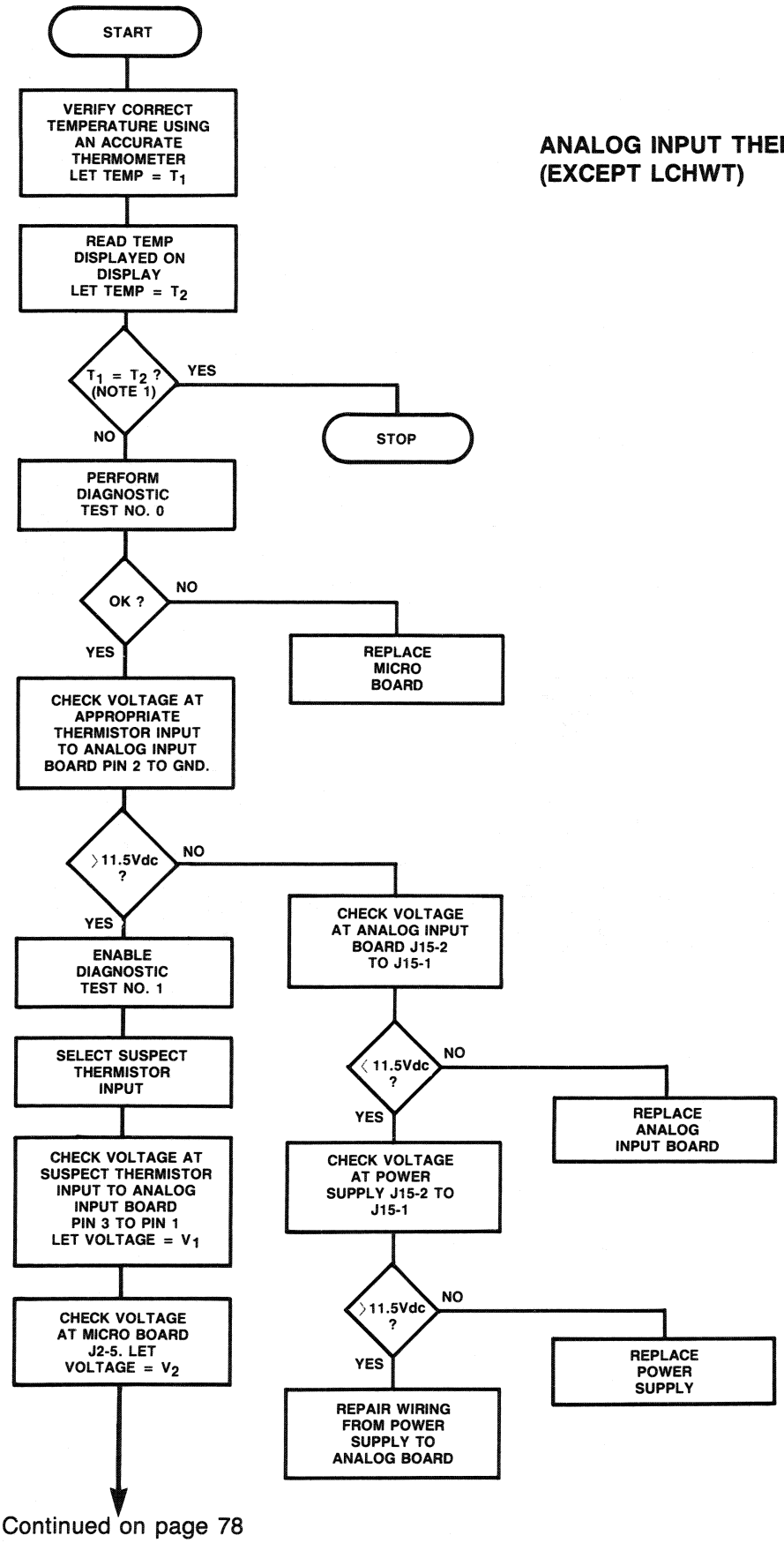


FIG. 48 — KEYPAD DISPLAY TROUBLESHOOTING PROCEDURE

TROUBLESHOOTING PROCEDURES

ANALOG INPUT THERMISTORS (EXCEPT LCHWT)

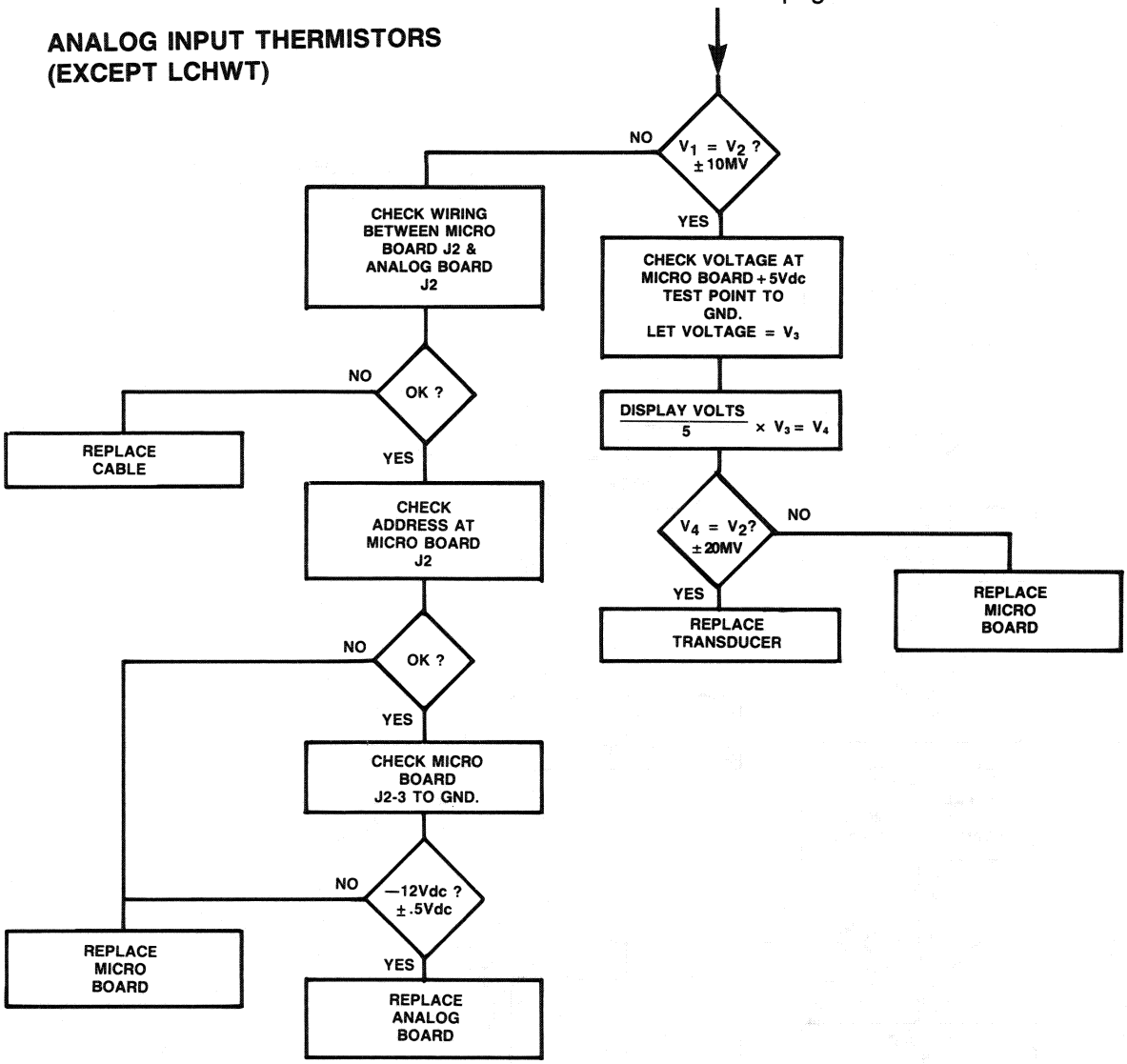


Continued on page 78

FIG. 49 — ANALOG INPUT THERMISTORS (EXCEPT LCHWT) TROUBLESHOOTING PROCEDURES

Continued from page 77

ANALOG INPUT THERMISTORS (EXCEPT LCHWT)



NOTE:

1. The worst case accuracy of the control panel temperature sensing circuits is as follows:

Entering chilled H_2O Entering condenser H_2O Leaving condenser H_2O	+.817°F;—.617°F
*Oil temperature	@ 100°F = +7.17°F;—5.97°F
*Discharge temperature	@ 180°F = +1.82°F;—1.87°F @ 220°F = +7.32°F;—5.76°F

The accepted accuracy of mercury-in-glass thermometers per ASHRAE standards is ±.50°F. Therefore, the worst case control panel display deviation from thermometer reference is as follows:

Entering chilled H_2O Entering condenser H_2O Leaving condenser H_2O	+1.317°F;—1.117°F
*Oil temperature	@ 100°F = +7.67°F;—6.47°F
*Discharge temperature	@ 100°F = +2.32°F;—2.37°F @ 220°F = +7.82°F;—6.26°F

*Below 100°F there is a significant deviation between displayed temperature and actual thermister temperatures. (Refer to 50.)

FIG. 49 — (CONTD.) ANALOG INPUT THERMISTORS (EXCEPT LCHWT) TROUBLESHOOTING PROCEDURES

TROUBLESHOOTING PROCEDURES

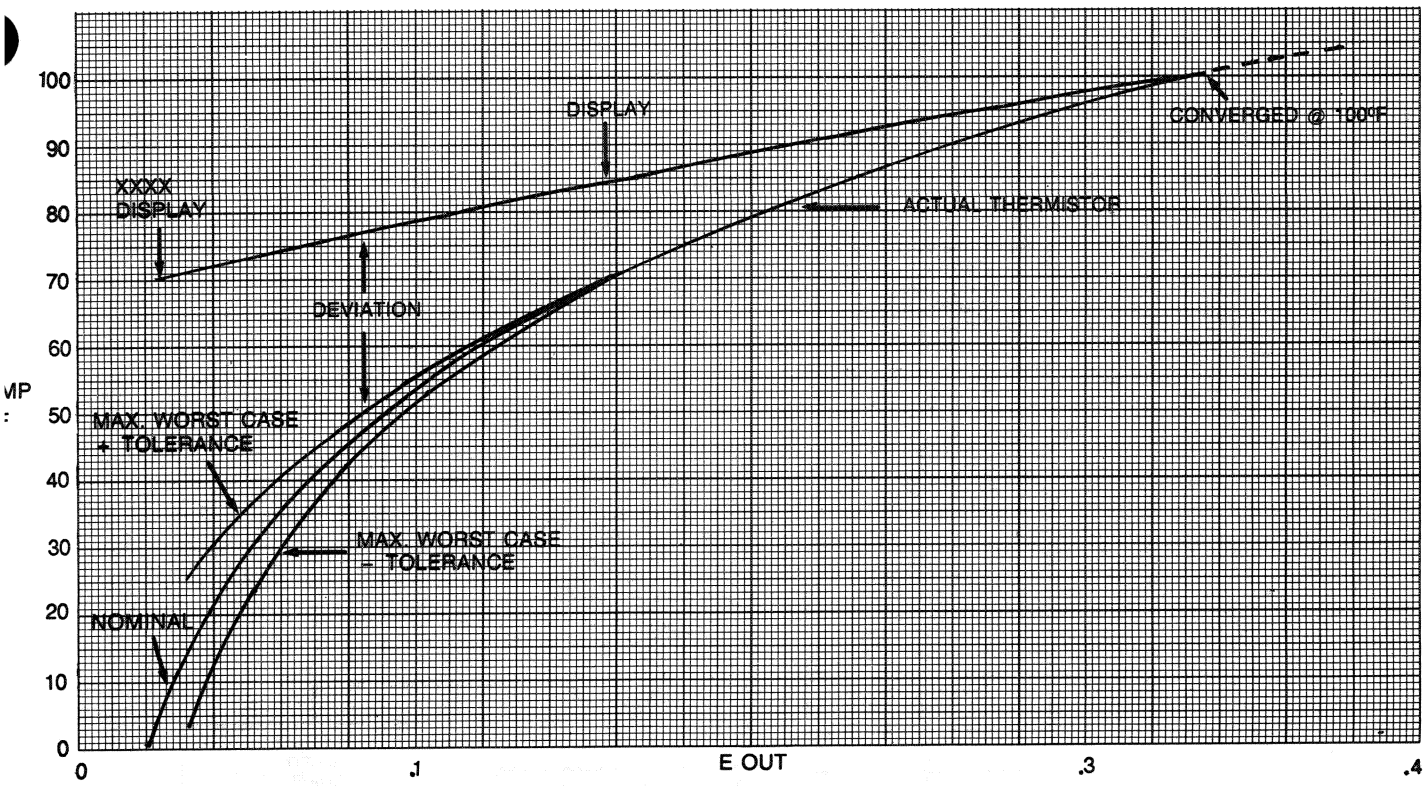
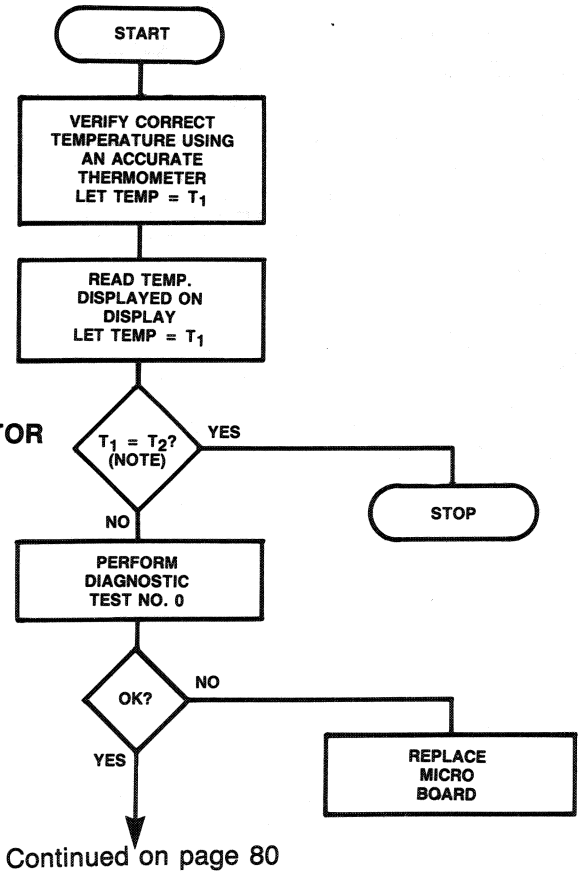


FIG. 50 — OIL & DISCHARGE TEMPS — SHOWING DIVIATION BETWEEN DISPLAY AND PROBE TEMPS BELOW 100°F

ANALOG INPUT THERMISTOR (LCHWT)



Continued on page 80

NOTE:

1. The worst case accuracy of the control panel leaving chilled water temperature (LCHWT) sensing circuits is +.793°F; — .593°F The accepted accuracy of mercury-in-glass thermometers per ASHRAE standards is ±.50°F. Therefore the worst case control panel display deviation from thermometer refrigerant is +1.293°F;—1.093°F.

SECTION 14

FIG. 51 — ANALOG INPUT — THERMISTOR (LCHWT) TROUBLESHOOTING PROCEDURES

Continued from page 79

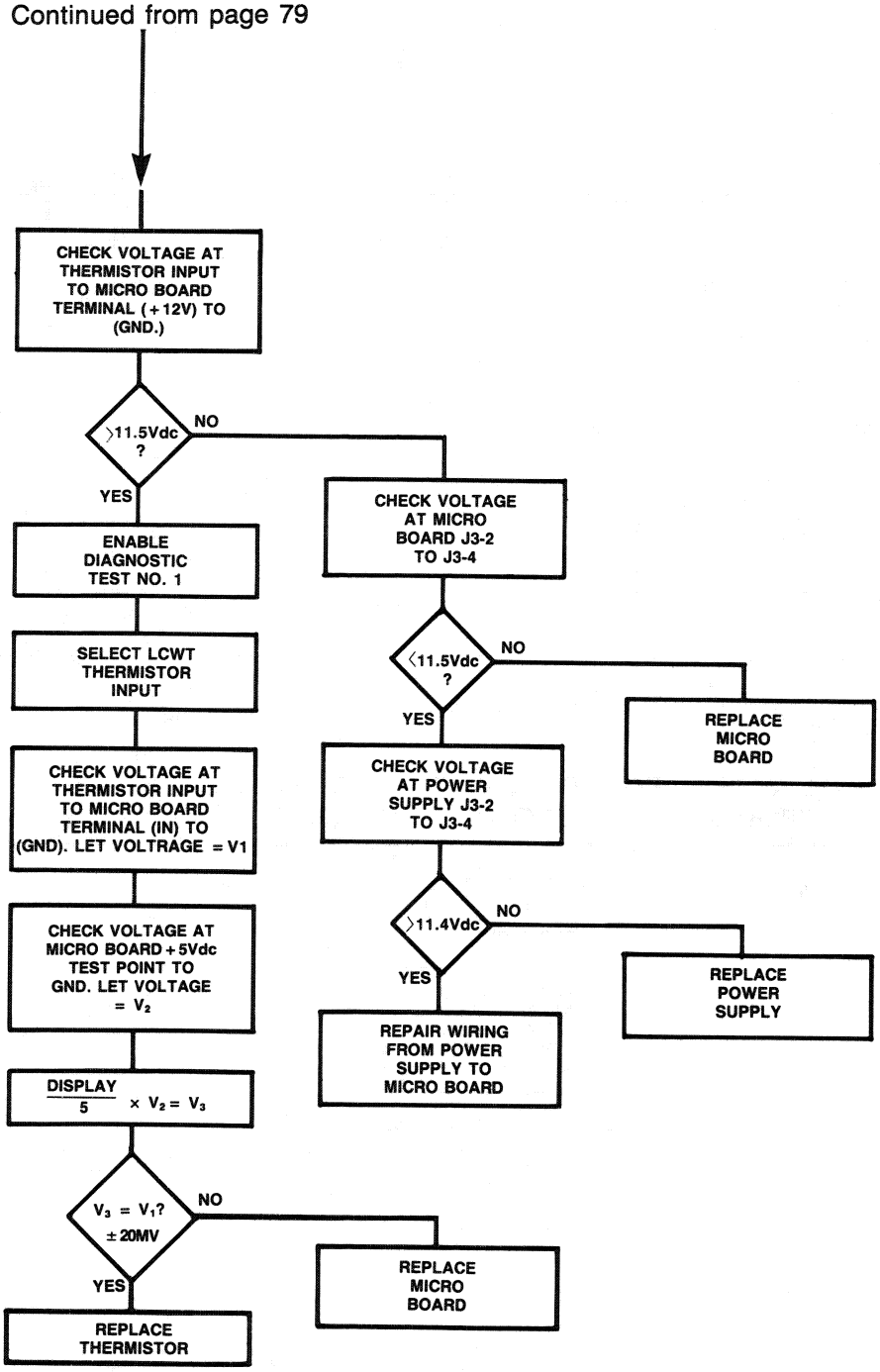
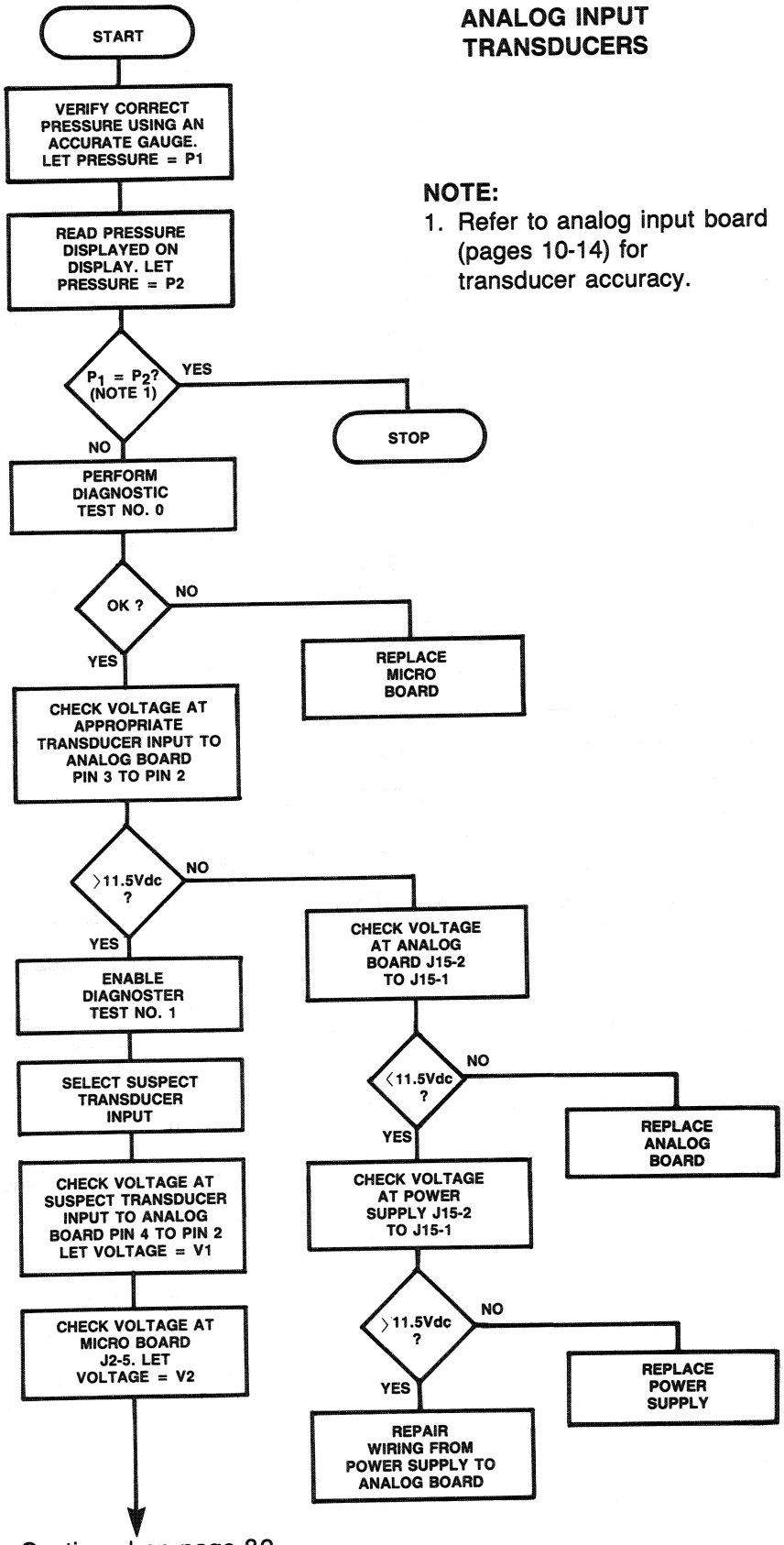


FIG. 51 — (CONTD.) ANALOG INPUT-THERMISTOR (LCHWT) TROUBLESHOOTING PROCEDURE

TROUBLESHOOTING PROCEDURES



Continued on page 82

SECTION 14

FIG. 52 — ANALOG INPUT-TRANSDUCERS TROUBLESHOOTING PROCEDURES

Continued from page 81

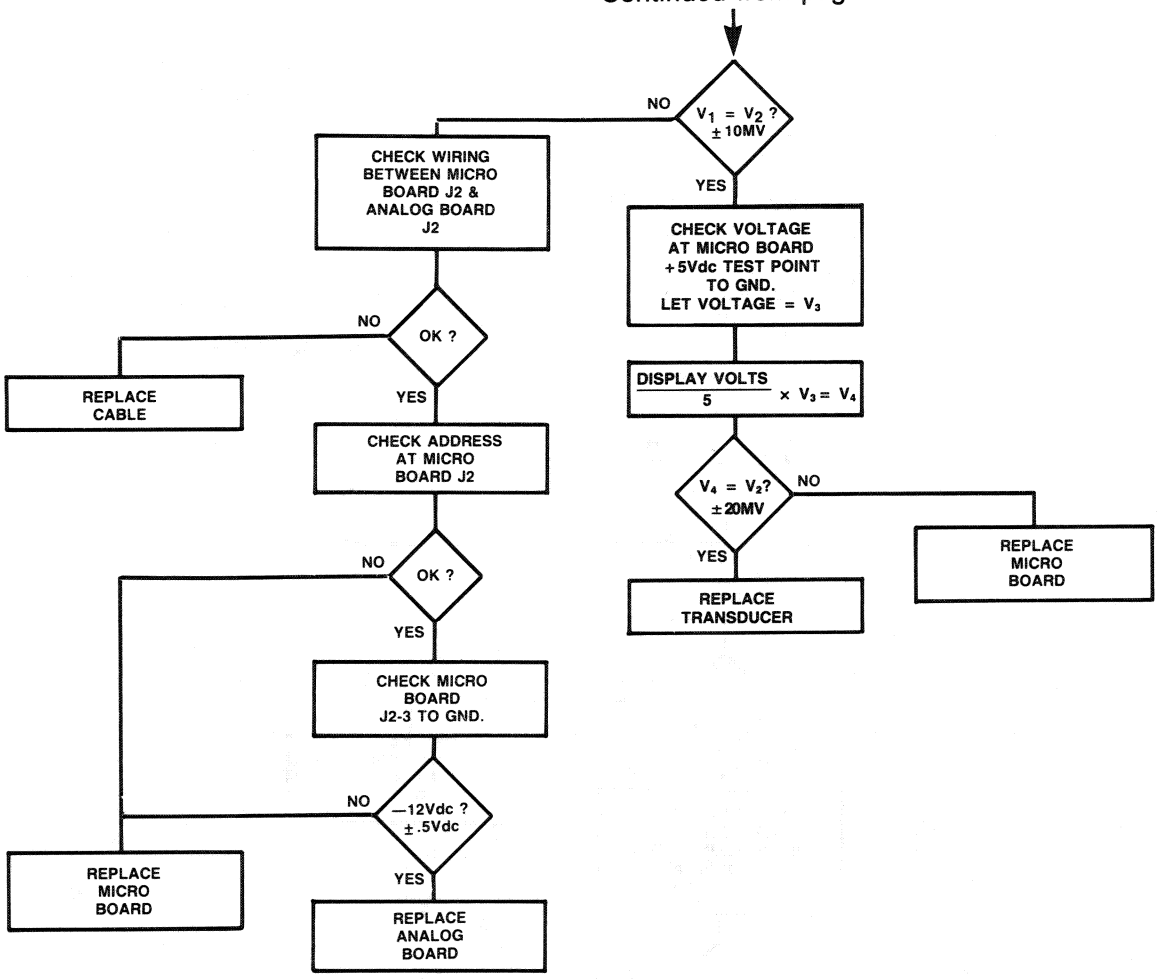


FIG. 52 — (CONTD.) ANALOG INPUT-TRANSDUCERS TROUBLESHOOTING PROCEDURES

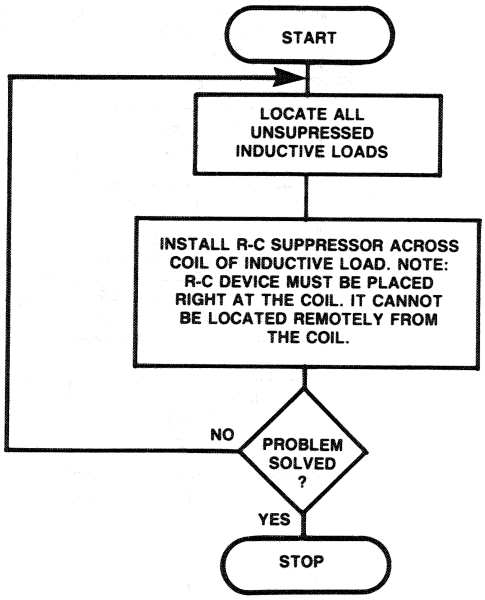
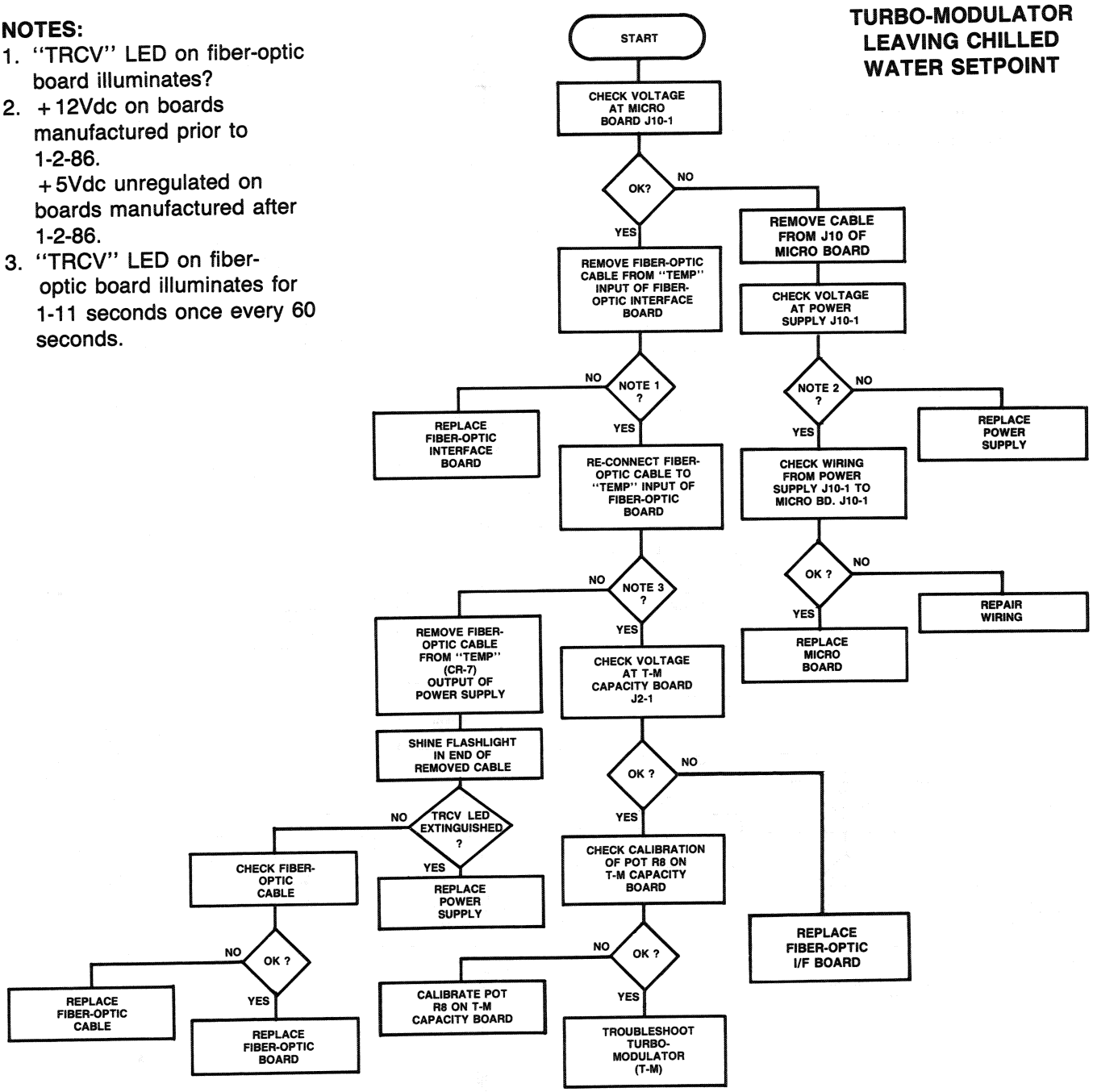


FIG. 53 — EMI NOISE TROUBLESHOOTING PROCEDURE

TROUBLESHOOTING PROCEDURES

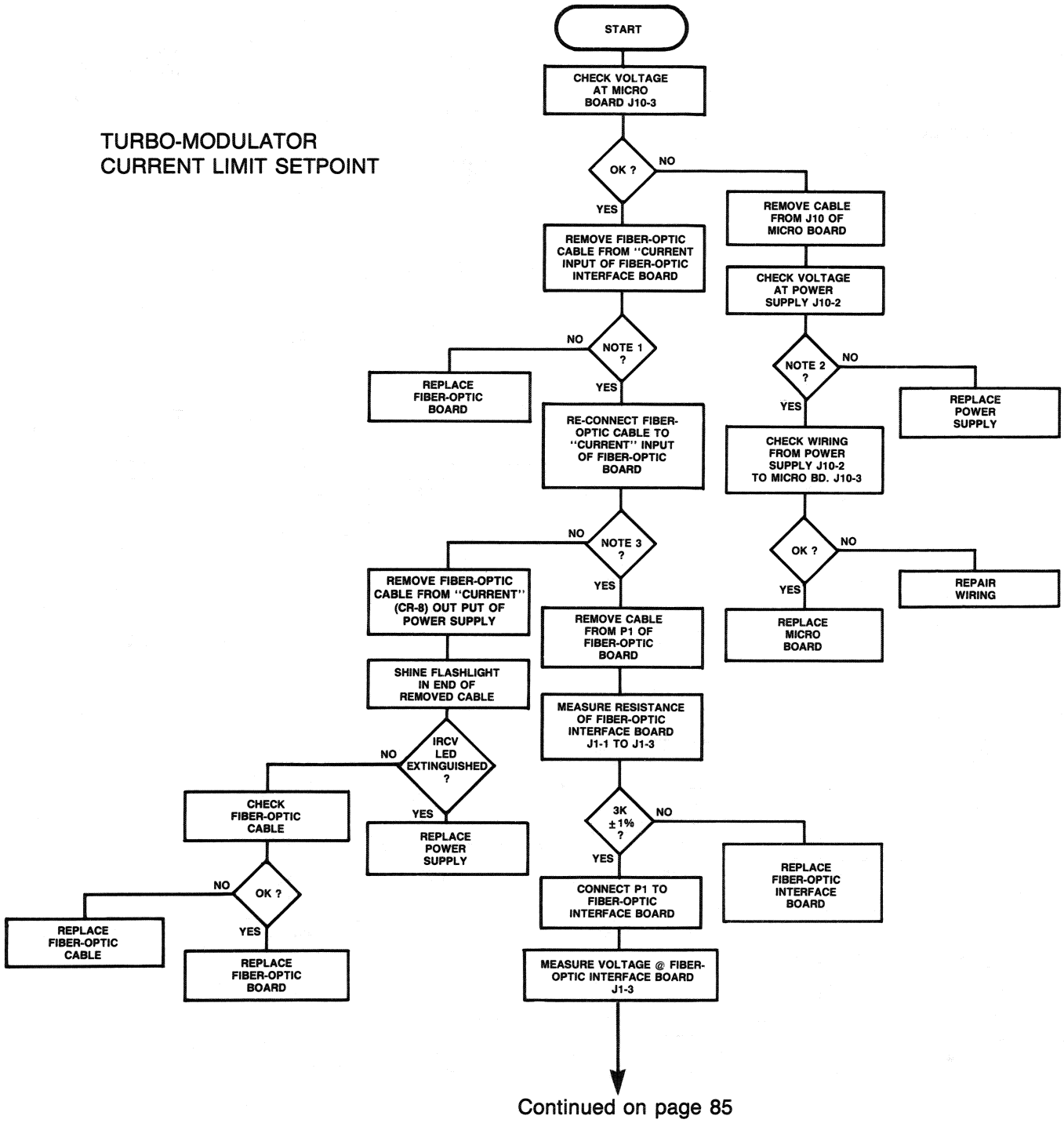
NOTES:
1. "TRCV" LED on fiber-optic board illuminates?
2. +12Vdc on boards manufactured prior to 1-2-86.
   +5Vdc unregulated on boards manufactured after 1-2-86.
3. "TRCV" LED on fiber-optic board illuminates for 1-11 seconds once every 60 seconds.



SECTION 14

FIG. 54 — TURBO-MODULATOR LEAVING CHILLED WATER (LCHWT) SETPOINT

TURBO-MODULATOR
CURRENT LIMIT SETPOINT

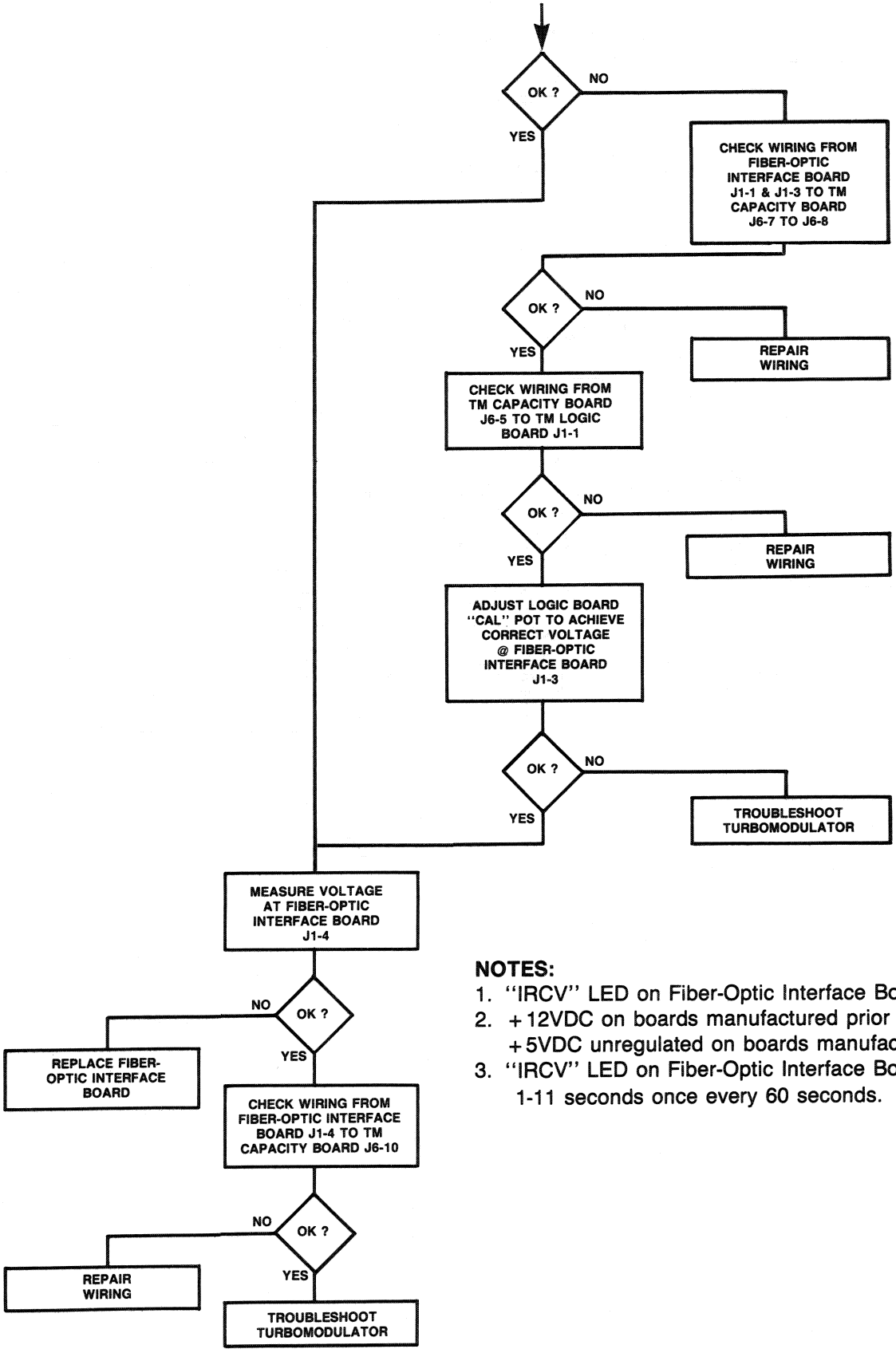


Continued on page 85

FIG. 55 — TURBO-MODULATOR CURRENT LIMIT SETPOINT

TROUBLESHOOTING PROCEDURES

Continued from page 84



NOTES:

1. "IRCV" LED on Fiber-Optic Interface Board illuminates?
2. +12VDC on boards manufactured prior to 1-2-86
   +5VDC unregulated on boards manufactured after 1-2-86
3. "IRCV" LED on Fiber-Optic Interface Board illuminates for 1-11 seconds once every 60 seconds.

SECTION 14

FIG. 55 — (CONTD.) TURBO-MODULATOR CURRENT LIMIT SETPOINT

REMOTE SETPOINT INTERFACE

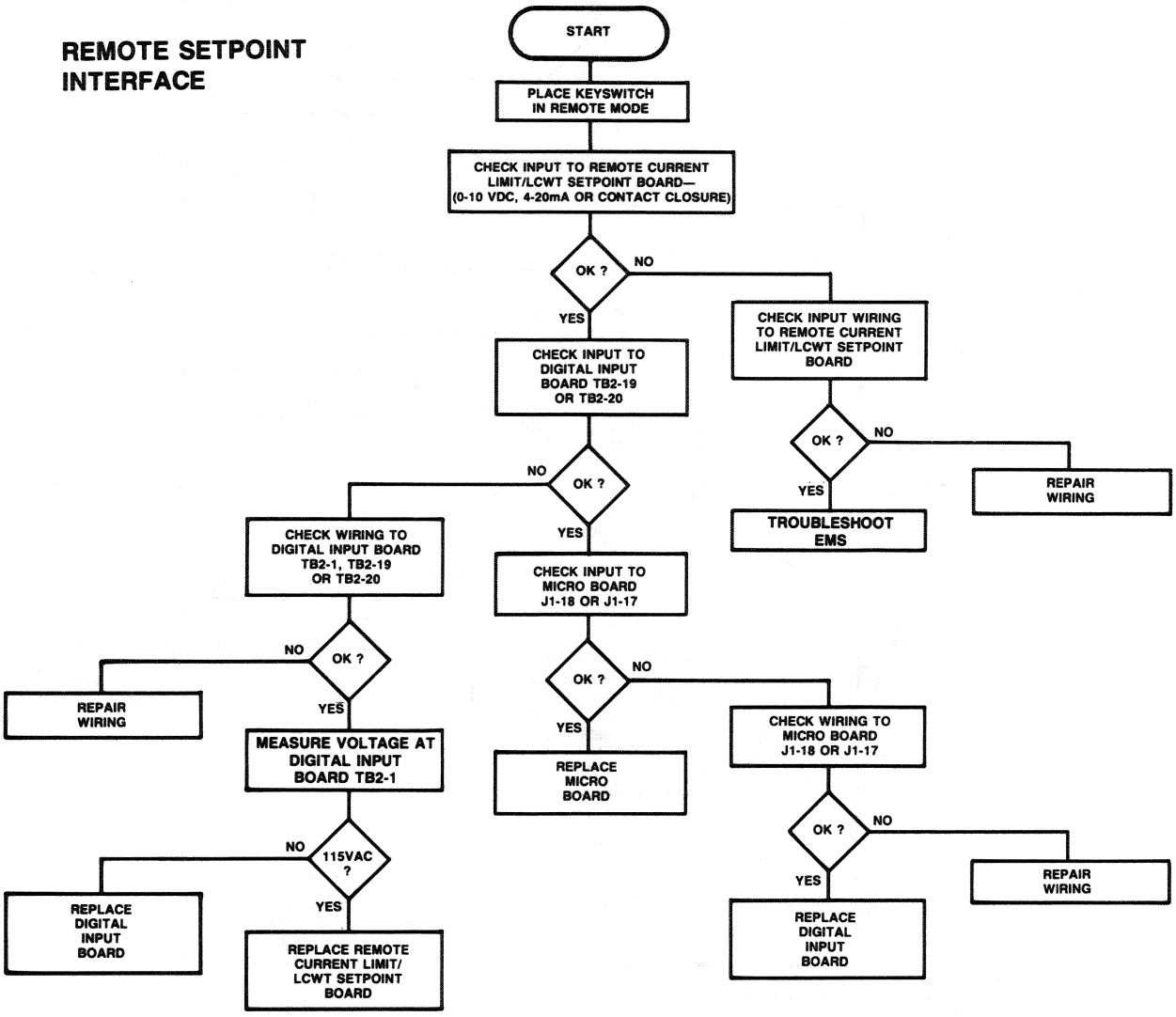


FIG. 56 — REMOTE SETPOINT INTERFACE

SECTION 15
SERVICE BULLETINS

The following information, previously published in service bulletins, is reproduced here for your convenience.

SAFETY WARNING TRANSDUCER INSTALLATION AND REMOVAL

Do Not, Under Any Circumstances, Install or Remove Recip. or Cent. Micro Panel Transducers with a "Strap Wrench".

Torque applied by a strap wrench on the transducer case will cause the case to turn before the body (See Fig. 1). This turning will misalign the internal locking tabs on the case and body causing pressure to leak around one of the internal "O" rings. When this happens, system pressure is applied to the top plate causing it to separate (blow away) from the case. In addition, the epoxy on the top plate will shatter spraying it in all directions.

When installing a transducer, as soon as the threads catch, turn it in the rest of the way with an open-end wrench (See Fig. 1) applied to the hex area on the body.

When removing a transducer, turn it out entirely with an open-end wrench (See Fig. 1) applied to the hex area on the body.

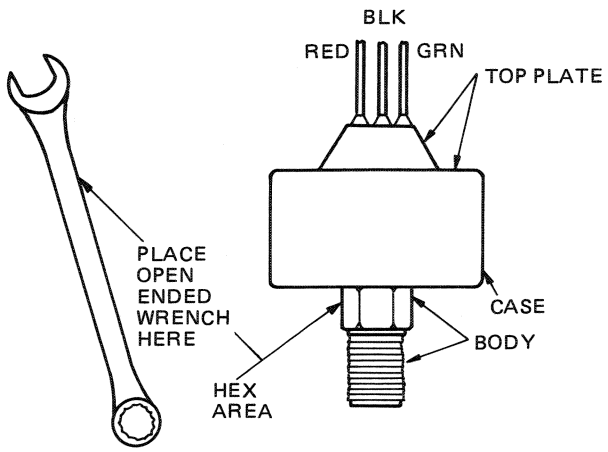


FIG. 1

SMART PANEL TESTING AND TROUBLE-SHOOTING

You will find below a list of problems and solutions. Some of the problems have several solutions. The solutions are not in any type of troubleshooting order unless otherwise stated.

PROBLEM: Voltage regulated power supply reads as follows:

+12V unregulated reads = OK
+12V regulated reads = less than +11.5V

SOLUTION: The problem is with one of the following on or with the analog P.C.B.:

NOTE: The regulator has an internal thermal protection "shut-off" circuit if it sees too much load current, such as a short circuit.

1. Transducers, Thermistor, or Analog P.C.B. itself check: disconnect J23, 24, 25, 26, 27 (transducers) and J17, 18, 19, 20 (thermistors) plugs one at a time, if the voltage is still low, unplug J15 (analog input P.C.B.). When your voltage rises (to +12V) to normal replace that defective part or analog P.C.B.

PROBLEM: Micro Panel is going off on Power Fault, especially at low load conditions.

SOLUTION: Relay K10 on the relay P.C.B. in the panel is not seated correctly. Perform the following:

1. Remove K10 from the socket & inspect the pins on the relay for possible humiseal or broken pins.
2. See that the pins in the socket (on the P.C.B.) are close/tight together. If not, push the pins together using a small instrument. Be careful, they are fragile.
3. Inset relay back in socket and install spring relay clamp and run.
4. If problem is still there, swap out K10 relay with another relay on the P.C.B. which is not being used.

5. Check [1] to [53] in panel to assure jumper is tight and in place.

6. If no jumper, check exterior safeties between [1] and [53]. Checked the safeties.

7. If the problem still exists, replace the relay P.C.B.

PROBLEM: Micro Panel is going down on Power Failure

SOLUTION: Check the U.V. relay (only on "I" Revision Micro P.C.B.'s)

1. Remove wire #14 at the U.V. relay. This takes the relay out of the circuit. Also on the Micro P.C.B. jumper out J54 (right hand corner).

2. If the problem goes away, the U.V. relay is the problem.

3. You can leave the U.V.R. disconnected and the jumper installed across J54 and leave the chiller on line.

"If problem still exists"

1. Suppressors missing (oil pump starter, 1 sol, 2 sol, 3 sol). The suppressor must be at the coil at the device.

2. Also install M.O.V.'s at the vane motor (X to 2 and X to 3).

"If problem still exists"

1. +5 Volt regulator is going to 0 Volts.

2. Check for shorts by disconnecting J1, J11 on Micro P.C.B. to see if the short goes away.

3. Replace Micro P.C.B.

"If problem still exists"

1. +5 Volts unregulated is not reaching the Micro P.C.B. (this voltage feeds the +5 Volts regulated on the Micro P.C.B.)

2. Check plug J3 to assure proper voltage and a tight connection.

"If problem still exists"

1. 115 Volt transformer opens up intermittently.

"If problem still exists"

1. Poor push-on connection on 1 FU fuse.

"If problem still exists"

1. Someone installed an additional relay inside of the Micro Panel. This will cause RFI/EMI problems. Do not install any relays or equipment inside the Micro Panel.

"If problem still exists"

1. Any 115 Volt relay installed/added to the outside of the Micro Panel but connected to the panel must have suppressors across the coil.

NOTE: Inside the Micro Panel on the door is a cloth bag containing extra suppressors. The suppressors must be located at the relay across the coil.

"If problem still exists"

1. Defective power supply P.C.B. (+5 Volt unregulated to Micro Panel).

"If problem still exists"

1. Transformer which feeds 115 Volts A.C. to the Micro Panel may have a defective/poor solder connection on the fused secondary.

2. The secondary of the 115 Volt A.C. control supply transformer must be grounded to the starter.

PROBLEM: P.R.V. motor does not open or close. P.R.V. motor itself opens when terminals △3 and △59 of elementary diagram jumpered (closing the "close on Temp. rise" contact). Also possible shorted M.O.V.'s on vane motor.

SOLUTION: Problem indicates defective Micro P.C.B. (most likely a defective triac on the Micro P.C.B.). Also replace shorted M.O.V.'s.

PROBLEM: Micro Panel reads Setpoint Override all the time. All setpoints are correct as programmed into the panel. Chiller runs OK.

SOLUTION:

1. Turn key switch to the program position and back to the local position. This will clear the read out.

2. Check to be sure the batteries are good and read above 3.6 Volts D.C. The batteries must be 1.5 Volts D.C. each, alkaline type (quantity 3).

PROBLEM: Micro Panel display scrambles. The read out display rolls from left to right changing from upper case letters to lower case letters to numbers to symbols.

SOLUTION: With display scrolling alphabet, numbers, and punctuation marks scrambling, perform the following:

1. Check the cable for any shorts. Ringout using a Simpson 260 analog meter.
2. Unplug the ribbon cable to the display; if it stops, replace Micro P.C.B.
3. Unplug the ribbon cable to the display; if it stays the same, replace the display.

PROBLEM: The vacuum fluorescent display fades in and out (bright to dull) on the Micro Panel.

SOLUTION:

1. Check to be sure all connections are good between power supply and the display. Use a Simpson 260 analog meter.
2. Check to assure the 5 Volts is constantly feeding the display. If not, replace the power supply.
3. If the 5 Volts is constant, replace the vacuum fluorescent display.

PROBLEM: An analog safety or cycling shutdown shown on the vacuum fluorescent display on the Micro Panel (high oil pressure transducer, low oil pressure transducer, evap. pressure transducer, condenser pressure transducer, entering chilled water thermistor, discharge temp., oil temp., motor current).

SOLUTION: Proceed step-by-step for this test.

1. Check all wiring connections and plugs.
2. Check to see that you have 12V going to the analog input P.C.B. If not, replace the power supply.
3. Check the 12V to the suspected defective component.
4. Check wiring to the suspected defective component (check with ohmmeter, Simpson #260).
5. If voltage from the component is OK, check its output to the Micro P.C.B. on J2-5 shown below.
6. Load diagnostic on Micro Panel display as outlined in the following steps, then select software test #1 (A/D test). Then select defective component and measure the output on J2-5. This voltage must be within ±2% as the voltage at the suspected component.
7. Put jumper in the enable position on the Micro P.C.B.
8. Put the key switch in the service position.
9. On page no. 69 under MENU in YORK Form No. 160.45-M2, select no. 1, which is the A/D test.
10. Choose whichever test you need to check your suspected defective component shown on page 70 under A/D test in YORK Form No. 160.45-M2.
11. Read the voltage on the display for your device which you are checking.
12. Check the input on the analog P.C.B. on whichever component you are checking.
13. Compare the voltages in steps 5 and 6. They must be the same.
14. Check the voltage at J2 on pins 6, 7, 8, and 9 on the analog input P.C.B.
15. Compare the voltage on J2 plug pins 6 thru 9 to Table no. 1 on page no. 11 in YORK Form No. 160.45-M2.

Example: Checking the entering chiller water temperature.

$$J2\text{-}6\ (2^0) = 1$$
$$J2\text{-}7\ (2^1) = 1$$
$$J2\text{-}8\ (2^3) = 0$$
$$J2\text{-}9\ (2^2) = 0$$

The voltage readings on J2 are either high or 1 (+12 VDC) or low or 0 (0 VDC) readings indicating binary numbers.

16. If the voltage is not within ±2%, you must check the address (refer to page #11, table #1).
17. If address is OK, replace analog P.C.B.

PROBLEM: Current fluctuates from 60-80%, the water temperature fluctuates from 44° to 46° (cycling every 1 to 2 minutes). This is on a Micro Panel with an Electro Mechanical Starter.

SOLUTION: Proceed step-by-step for this test.

1. Check the +12 Volt regulated power supply to assure a steady state.
2. Check the 5 Volt regulated supply on the Micro P.C.B.
3. Check the output of the leaving chilled water

thermistor (check rate of change to see if it follows your cycle time) must be linear.

NOTE: Use an ice bath or room temp. to check the thermistor if the chiller cannot be shut down.

If all of the above checks OK, proceed on

4. Jumper out the current module (with chiller running)
   a. Remove wire #59A from TB-7.
   b. Term. #(3) to # [57] (jumpered out CM-3)

5. If the problem still exists, replace the Micro P.C.B.

PROBLEM: A Non T-M/Chiller running at 65% of F.L.A. but the chiller would vary 62%-71% of F.L.A.

SOLUTION: Check the signal from CT1 which feeds into the power supply P.C.B. If the voltage at J15-3 (on power supply P.C.B.) is fluctuating, the problem is that the motor current buffer on the power supply is not steady. Replace the power supply P.C.B.

PROBLEM: Purge oil solenoid relay chatters. Purge will never cycle/fill.

SOLUTION:

1. Remove wires from (70) and (71)
2. Jumper (70) and (71) to 110 Volts and check that the system follows the voltage on the digital input P.C.B.

   J1-3 = must be +5 VDC
   J1-4 = must be +5 VDC

3. Remove the jumpers in step #2
   J1-3 & J1-4 = must be 0 VDC
4. If #2 and #3 are not as stated above, replace digital input P.C.B.
5. Jumper (70) to 110V AC (with (71) open). J1-3 must be +5 VDC and J1-4 must be 0 VDC.
6. Do the same in step #4 for (71) (with (70) open). J1-3 must be 0 VDC and J1-4 must be +5 VDC.
7. If #5 and #6 are not as stated, replace Micro Board.
8. Replace wires on (70) and (71)
9. Verify that when purge is full, (70) and (71) are 0 VAC.
10. Verify when purge is empty (70) and (71) are both 110 VAC. If #7 and #8 are not as stated, you have a float problem.

PROBLEM: The chiller constantly goes down on low oil pressure. The chiller will restart if the compressor switch is pushed to the stop/reset position and then back to the start position.

SOLUTION:

1. Check the level of the oil pump (must be 30 lbs), check the oil pump, it may be out of adjustment (too low), check to see that the oil heater is at 135°F, check to see if refrigerant is mixed with the oil, etc.
2. Replace both the high and low oil pressure transducers. This is due to one of the transducers intermittently cutting out.

PROBLEM: No readings on the Micro Panel Fluorescent display upon initial start-up.

SOLUTION: Fluorescent display is not seated in its socket, reseat display. Use extreme caution so you do not bend the pins on the display causing a poor/broken pin connection. This is usually found upon receiving the unit. We have found that this is due to our vendor not seating the display into its socket properly.

PROBLEM: Panel randomly shuts down chiller, usually on a different message each time, but always related to one of the sensors which connects to the analog board. If you happen to be at the chiller at the time of shutdown, you may find that all inputs except LCWT read XX.XX. The first conclusion you might reach could be that the analog board is faulty, since this board is common to all inputs except LCWT. However, our experience has been that this is caused by one of the transducers going bad. Because all the transducers and sensors share the same +12 VDC supply from the analog board, if one transducer or sensor shorts, it will load down the +12 VDC power supply, and the signal voltages from all the other transducers and sensors will drop to 0 volts as well.

SOLUTION: The easiest way to troubleshoot this problem requires that you be present when the system goes down and all sensors read XX.XX (except LCWT). While monitoring the +12 VDC on the analog board, one at a time, pull and then re-

insert each input connection to the analog board. When you pull the plug on the defective transducer or sensor, the supply will bounce back to +12 VDC and all other transducers and sensors will read correctly. Once you have isolated the defective device, replace just that transducer or sensor.

PROBLEM: Revision Level E or F Micro Boards having a problem with "Clock Defaulting". Refer to Form 160.45-M2(SB1).

SOLUTION: Make certain you have a 1.CS EPROM in the Micro P.C.B. If you do and still have the problem and you have a revision level "F" or lower Micro P.C.B., replace the Micro P.C.B. to correct your problem. When ordering, you will receive a current level Micro P.C.B. along with a current level EPROM.

PROBLEM: Intermittent shutdown on one of the following:

1. Flow Switch [1] and [12]
2. Remote cycle [13] and [1]
3. Multi-Unit [1] and [9]

Upon pressing on the digital input P.C.B., you will be able to cause one of the above shutdowns.

SOLUTION:

1. Poor/cold solder joint on TB-2 terminal strip on the digital input P.C.B. using a low wattage soldering iron & extreme care.
2. Check for a loose connection at the terminal strip or the jumper is not secure in the terminal strip.
3. Also check for intermittent flow switch or air in the water line.

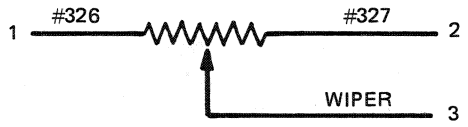
PROBLEM: Electro Mechanical or S.S.S. applications the chiller will not reach F.L.A.

SOLUTION: 100% L.E.D. on the S.S.S. and the current limit L.E.D. on the CM-1A is not calibrated properly. Adjust as needed to correct the problem. Refer to Form 160.45-M2, page #67.

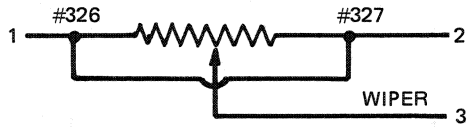
PROBLEM: On a T-M II application, the Micro Panel cannot be adjusted to read 100% F.L.A.

SOLUTION:

1. On Micro Panel check terminal [92] on power supply P.C.B. Terminal number [92] must be 7.5 VDC when chiller is at F.L.A.
2. Try to adjust F.L.A. pot on T-M II to read 7.5 VDC @ terminal [92] . Check wiring to pot and also proper wiring at the F.L.A. pot.



"CORRECT"



"INCORRECT"

3. If wiring to the pot and wiring at the pot is OK, replace T-M II logic P.C.B.
4. Adjust F.L.A. on T-M, then adjust R9 on the chiller panel power supply board.

PROBLEM: Incorrect purge operation due to top or bottom float switches sticking.

SOLUTION:

1. Tap canister using a piece of wood (2 x 4) to try and free float.
2. Replace float switch assembly if problem recurs.

PROBLEM: Excessive P.R.V. hunting.

SOLUTION:

1. Remove vane cover from P.R.V. and look for a resistor from 2 to ground or 3 to ground. If a resistor is between these terminals, remove and replace cover.

NOTE: DO NOT REMOVE M.O.V.'s

2. Check for oscillating (faulty) leaving chilled water thermistor with chiller shutoff.

PROBLEM: Adjusting of R8 (current limit) on the capacity P.C.B. in the T-M.

SOLUTION: Clarification of write-up in YORK form No. 160.45-M2, section #12, page #69, right-hand column, last paragraph should read as follows:

Monitored "chilled liquid temp." (chilled leaving) on keypad display. Adjust R8 on T-M capacity board until the "Chilled

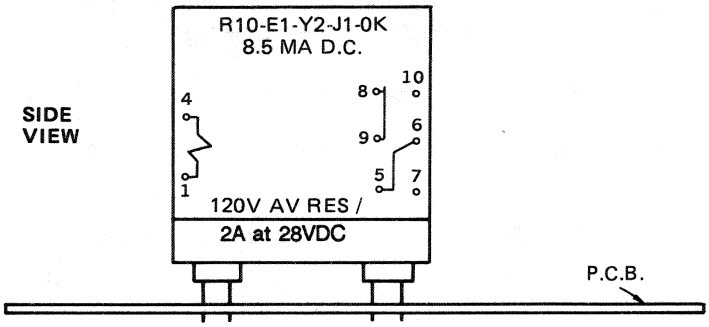
Liquid Temp." on display equals set point. Allow system to stabilize after each adjustment (adjust R8 CW to decrease LCWT; CCW to increase LCWT).

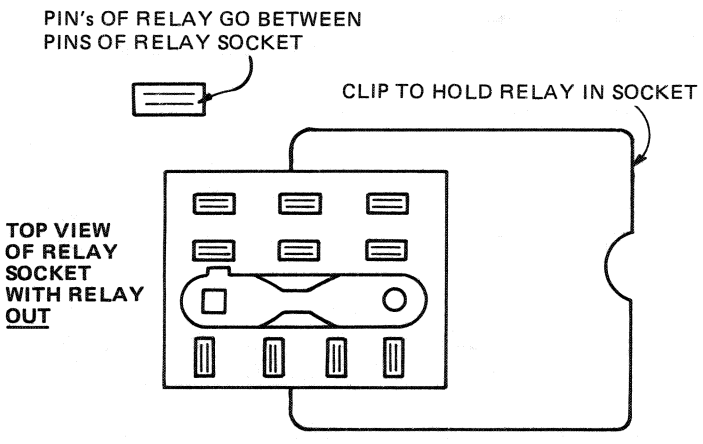
PROBLEM: When using the Weigh-Tronix IMP-24 printer, you experience only 2 or 2½ of the history printout instead of the last 4 cycling or safety shutdowns.

SOLUTION: Weigh-Tronix has changed its software on its new line of printers. The old software would allow you to receive the last 4 shutdowns, but the new printer only prints out the last 2 to 2½ of the history printout.

1. If you need all 4, use one of the other specified printers in Form 160.45-No.1.2.
2. If you only need, or can use, 2 or 2½ prints of history, you can use the Weigh-Tronix IMP-24 #2600 V1.0 model. We found this to be sufficient in most applications.

RELAY OUTPUT P.C.B.





NOTE: BE SURE THAT THE RELAY PIN'S ARE BETWEEN THE PINS IN THE RELAY SOCKET WHEN INSTALLING THE RELAYS. WE ARE FINDING THAT THE RELAY'S ARE BEING INSTALLED INCORRECTLY (RELAY PINS ARE BEING PUT ON THE OUTSIDE OF THE SOCKET PINS) THUS CAUSING INTERMITTENT PROBLEMS.

PROBLEM: When installing an EPROM into a Centrifugal Smart Panel, then re-applying power, the display reads:

SYSTEM RUN - SET POINT OVERRIDE

(Refer to YORK Form 160.45-N01, page 24)

SOLUTION:

1. Remove power from the Centrifugal Panel.
2. Install the new EPROM.
3. Re-apply power to the Centrifugal Panel.
4. Display will read:

   SYSTEM RUN - SET POINT OVERRIDE

5. Turn key switch to the Program Mode momentarily, then back to the Local Mode.
6. The above procedure will cure the problem.

PROBLEM: The Weigh-Tronix Printer used on the Centrifugal Micro Panel is printing very light characters and the characters get darker as it prints from left to right.

The printout numbers and letters are too close together making it difficult to read. The problem is with the single width characters only.

SOLUTION:

1. When ordering a new printer, you must spec-ify on your order that you need a 40 column print so Weigh-Tronix will install the proper software in the printer.
2. If you already have a Weigh-Tronix Printer which has the above problem, follow the return procedure below.

   a. Ask for **Bill Harris** at Weigh-Tronix.
   b. Phone Weigh-Tronix at **1-800-533-2088.**
   c. Send printer to:

      Weigh-Tronix
      100 Armstrong Drive
      P.O. Box 1000
      Fairmont, MN 56031-1000

   d. Include a return address label with the printer.
   e. Include the serial number of the printer.
   f. Tell them that you need a 40 column print fix for YORK. This is a chip revision level update to V1.1 and adding of a diode to the circuit.
   g. The repair will be N/C to YORK.

CENTRIFUGAL COMPRESSOR MICROCOMPUTER CONTROL PANEL - FIELD INSTALLED RELAYS/SOLENOIDS

Do not install any auxiliary relays or solenoids inside the Microcomputer Control Panel. These devices should be installed external to the control panel and include an RC noise suppressor at the coil of the device. The suppressors are supplied in a cloth bag inside every control panel.

The RFI/EMI generated by relays and solenoids can have a detrimental effect on the operation of the Micro. Typical symptoms would include nuisance shutdowns.

CENTRIFUGAL COMPRESSOR - VANE MOTOR RFI/EMI SUPPRESSION

The vane motor open and close windings represent inductive loads to the solid state starter and Microcomputer Control Panel. Any time the current through these windings is interrupted, the collapse of the magnetic field causes a spike that is inductively coupled to adjacent wires. This electrical noise can cause unexplained shutdowns in both the control panel and solid state starter.

To prevent this interference, the factory installs metal oxide varistors (MOVs) across the open winding (X-2) and close winding (X-3) of the vane motor. Note that the X-3 MOV is only necessary when a Microcomputer Control Panel is present.

At the time of chiller commissioning, remove the vane motor cover plate to expose the circular terminal strip. Make sure the MOVs are correctly installed. Reinstall cover plate.

DEFECTIVE CM-1 MODULES ON DUAL SHELL SMART PANEL EQUIPPED CENTRIFUGAL CHILLERS

The conduit nut has been occasionally coming loose inside the Purge Oil Solenoid Electrical Box. The nut falls and shorts out the push-on terminals on the Purge Oil Solenoid. This causes the CM-6 circuitry of the CM-1 (Current Module) to fail. The result will be a loss of the 115 VAC to terminal 16 of the Digital Input Board of the Smart Panel.

The visual indication that the CM-1 Module has failed will be that the display will say: "SYSTEM SHUTDOWN - PRESS STATUS". When "STATUS" is pressed, the display will indicate: "(DAY) (TIME) - MOTOR CONTROLLER - EXT. RESET". It will not be possible to start the chiller with this message.

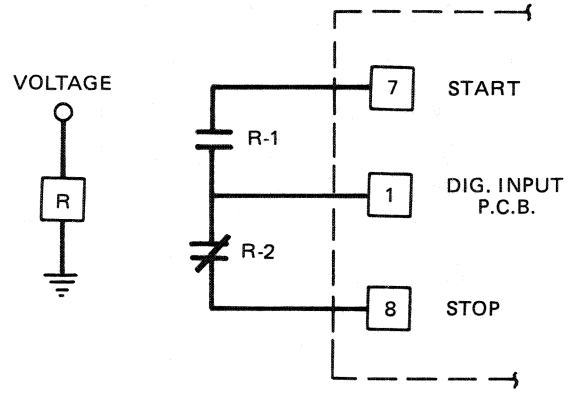
Anyone experiencing a CM-1 failure on Smart Panel equipped Centrifugal Chillers should check for a loose conduit nut before replacing the CM-1 Module. If this is the cause, replace the aluminum single-threaded nut with a steel one and insulate the push-on terminals with tape. This should assure that no future problems occur.

In addition, if you are on the job site with one of these chillers, it would be advisable to take a few minutes and check that the conduit nut is tight and to insulate the push-on terminals with tape.

CENTRIFUGAL SMART PANEL REMOTE START-STOP CONTACTS

There have been several questions on how the Remote start and Remote stop contacts are to be wired when using a Johnson, Honeywell, etc. system.

In YORK Form No. 160.45-M2, page 9, you will find one way of wiring the auxiliary sets of contacts. You will find below another method which you can use in the field.



PRESSURE CONVERSION CHART - R11

Enclosed is a pressure conversion chart that is helpful when operating the Microprocessor Control Center. It provides conversions from PSIA to PSIG for all R11 systems.

"FREON-11" SATURATION PROPERTIES—TEMPERATURE TABLE

TEMP.	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb)(°R)		TEMP.
°F	PSIA	PSIG	LIQUID v_f	VAPOR v_g	LIQUID $1/v_f$	VAPOR $1/v_g$	LIQUID h_f	LATENT h_{fg}	VAPOR h_g	LIQUID s_f	VAPOR s_g	°F
− 3	2.3544	25.1277*	0.010153	14.993	98.497	0.066699	7.488	84.121	91.609	0.017093	0.20130	− 3
− 2	2.4216	24.9908*	0.010160	14.605	98.421	0.068468	7.691	84.038	91.730	0.017536	0.20116	− 2
− 1	2.4904	24.8508*	0.010168	14.230	98.345	0.070275	7.894	83.956	91.850	0.017979	0.20102	− 1
0	2.5607	24.7076*	0.010176	13.866	98.268	0.072119	8.098	83.873	91.970	0.018421	0.20088	0
1	2.6327	24.5610*	0.010184	13.513	98.191	0.074003	8.301	83.790	92.091	0.018863	0.20075	1
2	2.7063	24.4112*	0.010192	13.171	98.115	0.075925	8.504	83.707	92.211	0.019303	0.20062	2
3	2.7816	24.2578*	0.010200	12.839	98.038	0.077887	8.707	83.624	92.332	0.019743	0.20049	3
4	2.8586	24.1011*	0.010208	12.517	97.961	0.079890	8.910	83.542	92.452	0.020181	0.20036	4
5	2.9373	23.9408*	0.010216	12.205	97.884	0.081933	9.114	83.459	92.572	0.020619	0.20023	5
6	3.0178	23.7770*	0.010224	11.902	97.807	0.084018	9.317	83.376	92.693	0.021056	0.20010	6
7	3.1000	23.6095*	0.010232	11.608	97.730	0.086145	9.521	83.293	92.814	0.021492	0.19998	7
8	3.1841	23.4383*	0.010240	11.323	97.653	0.088315	9.724	83.210	92.934	0.021927	0.19985	8
9	3.2700	23.2634*	0.010248	11.046	97.576	0.090528	9.928	83.127	93.055	0.022362	0.19973	9
10	3.3578	23.0847*	0.010257	10.778	97.498	0.092785	10.131	83.044	93.175	0.022795	0.19961	10
11	3.4475	22.9020*	0.010265	10.517	97.421	0.095087	10.335	82.961	93.296	0.023228	0.19949	11
12	3.5391	22.7155*	0.010273	10.263	97.344	0.097433	10.539	82.878	93.416	0.023660	0.19937	12
13	3.6327	22.5249*	0.010281	10.017	97.266	0.099826	10.742	82.795	93.537	0.024091	0.19925	13
14	3.7283	22.3303*	0.010289	9.7785	97.189	0.10226	10.946	82.712	93.658	0.024521	0.19914	14
15	3.8259	22.1316*	0.010297	9.5465	97.111	0.10475	11.150	82.628	93.778	0.024951	0.19903	15
16	3.9256	21.9286*	0.010306	9.3210	97.033	0.10728	11.354	82.545	93.899	0.025379	0.19891	16
17	4.0274	21.7214*	0.010314	9.1019	96.956	0.10987	11.558	82.462	94.020	0.025807	0.19880	17
18	4.1313	21.5099*	0.010322	8.8890	96.878	0.11250	11.762	82.379	94.140	0.026234	0.19869	18
19	4.2373	21.2940*	0.010331	8.6821	96.800	0.11518	11.966	82.295	94.261	0.026661	0.19859	19
20	4.3456	21.0736*	0.010339	8.4810	96.722	0.11791	12.170	82.212	94.382	0.027086	0.19848	20
21	4.4560	20.8487*	0.010347	8.2855	96.644	0.12069	12.374	82.128	94.502	0.027511	0.19837	21
22	4.5687	20.6192*	0.010356	8.0954	96.566	0.12353	12.578	82.045	94.623	0.027935	0.19827	22
23	4.6837	20.3851*	0.010364	7.9106	96.488	0.12641	12.783	81.961	94.744	0.028358	0.19817	23
24	4.8010	20.1462*	0.010372	7.7308	96.409	0.12935	12.987	81.878	94.864	0.028781	0.19806	24
25	4.9207	19.9026*	0.010381	7.5560	96.331	0.13235	13.191	81.794	94.985	0 029202	0.19796	25
26	5.0428	19.6541*	0.010389	7.3859	96.253	0.13539	13.396	81.710	95.106	0.029623	0.19787	26
27	5.1672	19.4006*	0.010398	7.2205	96.174	0.13850	13.600	81.626	95.227	0.030043	0.19777	27
28	5.2942	19.1422*	0.010406	7.0595	96.096	0.14165	13.805	81.542	95.347	0.030463	0.19767	28
29	5.4236	18.8786*	0.010415	6.9028	96.017	0.14487	14.009	81.458	95.468	0.030881	0.19758	29
30	5.5556	18.6100*	0.010423	6.7503	95.938	0.14814	14.214	81.374	95.588	0.031299	0.19748	30
31	5.6901	18.3361*	0.010432	6.6019	95.860	0.15147	14.419	81.290	95.709	0.031716	0.19739	31
32	5.8273	18.0569*	0.010441	6.4574	95.781	0.15486	14.624	81.206	95.830	0.032133	0.19730	32
33	5.9670	17.7723*	0.010449	6.3168	95.702	0.15831	14.828	81.122	95.950	0.032548	0.19721	33
34	6.1094	17.4823*	0.010458	6.1798	95.623	0.16182	15.033	81.038	96.071	0.032963	0.19712	34
35	6.2546	17.1868*	0.010466	6.0465	95.544	0.16539	15.238	80.953	96.192	0.033377	0.19703	35
36	6.4025	16.8857*	0.010475	5.9166	95.464	0.16902	15.443	80.869	96.312	0.033791	0.19694	36
37	6.5532	16.5789*	0.010484	5.7901	95.385	0.17271	15.648	80.784	96.433	0.034204	0.19686	37
38	6.7067	16.2664*	0.010493	5.6668	95.306	0.17647	15.853	80.700	96.553	0.034616	0.19677	38
39	6.8630	15.9480*	0.010501	5.5468	95.226	0.18029	16.059	80.615	96.674	0.035027	0.19669	39
40	7.0223	15.6238*	0.010510	5.4298	95.147	0.18417	16.264	80.530	96.794	0.035437	0.19660	40
41	7.1844	15.2936*	0.010519	5.3158	95.067	0.18812	16.469	80.445	96.915	0.035847	0.19652	41
42	7.3496	14.9574*	0.010528	5.2047	94.988	0.19214	16.675	80.361	97.035	0.036256	0.19644	42
43	7.5178	14.6150*	0.010537	5.0964	94.908	0.19622	16.880	80.276	97.156	0.036665	0.19636	43
44	7.6890	14.2664*	0.010545	4.9908	94.828	0.20037	17.086	80.190	97.276	0.037073	0.19628	44
45	7.8633	13.9115*	0.010554	4.8879	94.748	0.20459	17.291	80.105	97.396	0.037480	0.19621	45
46	8.0407	13.5502*	0.010563	4.7876	94.668	0.20887	17.497	80.020	97.517	0.037886	0.19613	46
47	8.2213	13.1825*	0.010572	4.6897	94.588	0.21323	17.702	79.935	97.637	0.038292	0.19606	47
48	8.4051	12.8083*	0.010581	4.5943	94.508	0.21766	17.908	79.849	97.757	0.038697	0.19598	48
49	8.5922	12.4274*	0.010590	4.5012	94.428	0.22216	18.114	79.764	97.877	0.039101	0.19591	49
50	8.7825	12.0399*	0.010599	4.4105	94.347	0.22673	18.320	79.678	97.998	0.039505	0.19584	50
51	8.9762	11.6456*	0.010608	4.3219	94.267	0.23138	18.526	79.592	98.118	0.039907	0.19577	51

*Inches of mercury below one atmosphere

"FREON-11" SATURATION PROPERTIES—TEMPERATURE TABLE

TEMP.	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb)(°R)		TEMP.
°F	PSIA	PSIG	LIQUID v_f	VAPOR v_g	LIQUID $1/v_f$	VAPOR $1/v_g$	LIQUID h_f	LATENT h_{fg}	VAPOR h_g	LIQUID s_f	VAPOR s_g	°F
52	9.1733	11.2444*	0.010617	4.2355	94.186	0.23610	18.732	79.506	98.238	0.040310	0.19570	52
53	9.3737	10.8362*	0.010626	4.1512	94.106	0.24089	18.938	79.420	98.358	0.040711	0.19563	53
54	9.5776	10.4211*	0.010635	4.0690	94.025	0.24576	19.144	79.334	98.478	0.041112	0.19556	54
55	9.7850	9.9988*	0.010645	3.9887	93.944	0.25071	19.350	79.248	98.598	0.041512	0.19549	55
56	9.9960	9.5693*	0.010654	3.9103	93.864	0.25573	19.556	79.162	98.718	0.041912	0.19542	56
57	10.210	9.133*	0.010663	3.8338	93.783	0.26083	19.763	79.075	98.838	0.042311	0.19536	57
58	10.429	8.688*	0.010672	3.7592	93.702	0.26602	19.969	78.989	98.958	0.042709	0.19529	58
59	10.650	8.237*	0.010681	3.6863	93.620	0.27128	20.176	78.902	99.078	0.043107	0.19523	59
60	10.876	7.778*	0.010691	3.6151	93.539	0.27662	20.382	78.816	99.198	0.043504	0.19517	60
61	11.105	7.311*	0.010700	3.5456	93.458	0.28204	20.589	78.729	99.317	0.043900	0.19511	61
62	11.338	6.836*	0.010709	3.4777	93.377	0.28754	20.795	78.642	99.437	0.044295	0.19505	62
63	11.575	6.354*	0.010719	3.4114	93.295	0.29313	21.002	78.555	99.557	0.044690	0.19499	63
64	11.816	5.864*	0.010728	3.3467	93.213	0.29880	21.209	78.468	99.676	0.045085	0.19493	64
65	12.061	5.366*	0.010737	3.2834	93.132	0.30456	21.416	78.380	99.796	0.045478	0.19487	65
66	12.309	4.859*	0.010747	3.2216	93.050	0.31040	21.623	78.293	99.916	0.045872	0.19481	66
67	12.562	4.345*	0.010756	3.1612	92.968	0.31633	21.830	78.205	100.035	0.046264	0.19475	67
68	12.819	3.822*	0.010766	3.1022	92.886	0.32235	22.037	78.118	100.154	0.046656	0.19470	68
69	13.080	3.291*	0.010775	3.0445	92.804	0.32846	22.244	78.030	100.274	0.047047	0.19464	69
70	13.345	2.752*	0.010785	2.9882	92.722	0.33465	22.451	77.942	100.393	0.047437	0.19459	70
71	13.614	2.204*	0.010795	2.9331	92.640	0.34094	22.658	77.854	100.512	0.047827	0.19454	71
72	13.887	1.647*	0.010804	2.8792	92.557	0.34731	22.866	77.766	100.631	0.048217	0.19448	72
73	14.165	1.081*	0.010814	2.8266	92.475	0.35378	23.073	77.678	100.751	0.048605	0.19443	73
74	14.447	0.507*	0.010823	2.7751	92.392	0.36034	23.280	77.589	100.870	0.048993	0.19438	74
75	14.733	0.037	0.010833	2.7248	92.310	0.36700	23.488	77.501	100.989	0.049381	0.19433	75
76	15.024	0.328	0.010843	2.6756	92.227	0.37375	23.696	77.412	101.108	0.049768	0.19428	76
77	15.319	0.623	0.010853	2.6275	92.144	0.38059	23.903	77.323	101.226	0.050154	0.19423	77
78	15.619	0.923	0.010862	2.5804	92.061	0.38754	24.111	77.234	101.345	0.050540	0.19419	78
79	15.924	1.228	0.010872	2.5344	91.978	0.39458	24.319	77.145	101.464	0.050925	0.19414	79
80	16.233	1.537	0.010882	2.4893	91.895	0.40172	24.527	77.056	101.583	0.051309	0.19409	80
81	16.546	1.850	0.010892	2.4453	91.812	0.40895	24.735	76.967	101.701	0.051693	0.19405	81
82	16.865	2.169	0.010902	2.4021	91.728	0.41629	24.943	76.877	101.820	0.052076	0.19400	82
83	17.188	2.492	0.010912	2.3600	91.645	0.42374	25.151	76.787	101.938	0.052459	0.19396	83
84	17.516	2.820	0.010922	2.3187	91.561	0.43128	25.359	76.698	102.057	0.052841	0.19391	84
85	17.848	3.152	0.010932	2.2783	91.477	0.43893	25.567	76.608	102.175	0.053222	0.19387	85
86	18.186	3.490	0.010942	2.2388	91.394	0.44668	25.776	76.518	102.293	0.053603	0.19383	86
87	18.529	3.833	0.010952	2.2001	91.310	0.45453	25.984	76.427	102.411	0.053983	0.19379	87
88	18.876	4.180	0.010962	2.1622	91.226	0.46250	26.192	76.337	102.529	0.054363	0.19375	88
89	19.229	4.533	0.010972	2.1251	91.142	0.47057	26.401	76.246	102.647	0.054742	0.19371	89
90	19.587	4.891	0.010982	2.0888	91.057	0.47874	26.610	76.156	102.765	0.055121	0.19367	90
91	19.950	5.254	0.010992	2.0532	90.973	0.48703	26.818	76.065	102.883	0.055499	0.19363	91
92	20.318	5.622	0.011002	2.0184	90.889	0.49543	27.027	75.974	103.001	0.055876	0.19359	92
93	20.691	5.995	0.011013	1.9844	90.804	0.50394	27.236	75.883	103.119	0.056253	0.19355	93
94	21.070	6.374	0.011023	1.9510	90.719	0.51256	27.445	75.791	103.236	0.056629	0.19352	94
95	21.454	6.758	0.011033	1.9183	90.635	0.52130	27.654	75.700	103.354	0.057005	0.19348	95
96	21.843	7.147	0.011044	1.8863	90.550	0.53015	27.863	75.608	103.471	0.057380	0.19345	96
97	22.238	7.542	0.011054	1.8549	90.465	0.53912	28.072	75.516	103.588	0.057755	0.19341	97
98	22.638	7.942	0.011064	1.8241	90.379	0.54820	28.281	75.424	103.706	0.058129	0.19338	98
99	23.044	8.348	0.011075	1.7940	90.294	0.55740	28.491	75.332	103.823	0.058502	0.19334	99
100	23.456	8.760	0.011085	1.7645	90.209	0.56672	28.700	75.240	103.940	0.058875	0.19331	100
101	23.873	9.177	0.011096	1.7356	90.123	0.57616	28.909	75.147	104.057	0.059248	0.19328	101
102	24.296	9.600	0.011106	1.7073	90.038	0.58572	29.119	75.055	104.174	0.059620	0.19325	102
103	24.724	10.028	0.011117	1.6795	89.952	0.59540	29.329	74.962	104.290	0.059991	0.19322	103
104	25.159	10.463	0.011128	1.6523	89.866	0.60521	29.538	74.869	104.407	0.060362	0.19319	104
105	25.599	10.903	0.011138	1.6256	89.780	0.61514	29.748	74.776	104.524	0.060732	0.19316	105
106	26.045	11.349	0.011149	1.5995	89.694	0.62519	29.958	74.682	104.640	0.061102	0.19313	106

*Inches of mercury below one atmosphere

"FREON-11" SATURATION PROPERTIES—TEMPERATURE TABLE

TEMP.	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb)(°R)		TEMP.
°F	PSIA	PSIG	LIQUID v_f	VAPOR v_g	LIQUID $1/v_f$	VAPOR $1/v_g$	LIQUID h_f	LATENT h_{fg}	VAPOR h_g	LIQUID s_f	VAPOR s_g	°F
107	26.497	11.801	0.011160	1.5739	89.608	0.63538	30.168	74.589	104.757	0.061471	0.19310	107
108	26.956	12.260	0.011170	1.5487	89.522	0.64569	30.378	74.495	104.873	0.061840	0.19307	108
109	27.420	12.724	0.011181	1.5241	89.435	0.65612	30.588	74.401	104.989	0.062208	0.19304	109
110	27.890	13.194	0.011192	1.4999	89.349	0.66669	30.798	74.307	105.105	0.062575	0.19301	110
111	28.367	13.671	0.011203	1.4763	89.262	0.67739	31.009	74.213	105.221	0.062942	0.19299	111
112	28.850	14.154	0.011214	1.4530	89.175	0.68822	31.219	74.118	105.337	0.063309	0.19296	112
113	29.339	14.643	0.011225	1.4302	89.088	0.69919	31.429	74.023	105.453	0.063675	0.19294	113
114	29.834	15.138	0.011236	1.4079	89.001	0.71029	31.640	73.929	105.569	0.064041	0.19291	114
115	30.336	15.640	0.011247	1.3860	88.914	0.72152	31.851	73.833	105.684	0.064406	0.19289	115
116	30.844	16.148	0.011258	1.3645	88.826	0.73289	32.061	73.738	105.800	0.064770	0.19286	116
117	31.359	16.663	0.011269	1.3434	88.739	0.74440	32.272	73.643	105.915	0.065134	0.19284	117
118	31.880	17.184	0.011280	1.3227	88.651	0.75605	32.483	73.547	106.030	0.065498	0.19281	118
119	32.408	17.712	0.011291	1.3024	88.564	0.76784	32.694	73.451	106.145	0.065861	0.19279	119
120	32.943	18.247	0.011303	1.2824	88.476	0.77977	32.905	73.355	106.260	0.066223	0.19277	120
121	33.484	18.788	0.011314	1.2629	88.388	0.79184	33.116	73.259	106.375	0.066585	0.19275	121
122	34.032	19.336	0.011325	1.2437	88.300	0.80406	33.328	73.162	106.490	0.066947	0.19273	122
123	34.587	19.891	0.011336	1.2249	88.211	0.81642	33.539	73.066	106.605	0.067308	0.19271	123
124	35.149	20.453	0.011348	1.2064	88.123	0.82893	33.751	72.969	106.719	0.067669	0.19269	124
125	35.718	21.022	0.011359	1.1882	88.034	0.84159	33.962	72.872	106.834	0.068029	0.19267	125
126	36.294	21.598	0.011371	1.1704	87.946	0.85440	34.174	72.774	106.948	0.068388	0.19265	126
127	36.877	22.181	0.011382	1.1529	87.857	0.86735	34.385	72.677	107.062	0.068747	0.19263	127
128	37.467	22.771	0.011394	1.1358	87.768	0.88046	34.597	72.579	107.176	0.069106	0.19261	128
129	38.064	23.368	0.011405	1.1189	87.679	0.89372	34.809	72.481	107.290	0.069464	0.19259	129
130	38.668	23.972	0.011417	1.1024	87.589	0.90714	35.021	72.383	107.404	0.069822	0.19257	130
131	39.280	24.584	0.011429	1.0861	87.500	0.92071	35.233	72.284	107.518	0.070179	0.19256	131
132	39.899	25.203	0.011440	1.0702	87.410	0.93443	35.446	72.186	107.631	0.070536	0.19254	132
133	40.525	25.829	0.011452	1.0545	87.321	0.94832	35.658	72.087	107.745	0.070892	0.19252	133
134	41.159	26.463	0.011464	1.0391	87.231	0.96237	35.870	71.988	107.858	0.071248	0.19251	134
135	41.801	27.105	0.011476	1.0240	87.141	0.97657	36.083	71.888	107.971	0.071604	0.19249	135
136	42.450	27.754	0.011488	1.0091	87.051	0.99094	36.296	71.789	108.084	0.071959	0.19248	136
137	43.106	28.410	0.011499	0.99456	86.960	1.0055	36.508	71.689	108.197	0.072313	0.19246	137
138	43.771	29.075	0.011511	0.98023	86.870	1.0202	36.721	71.589	108.310	0.072667	0.19245	138
139	44.443	29.747	0.011523	0.96615	86.779	1.0350	36.934	71.489	108.423	0.073021	0.19243	139
140	45.123	30.427	0.011536	0.95232	86.689	1.0501	37.147	71.388	108.535	0.073374	0.19242	140
141	45.810	31.114	0.011548	0.93873	86.598	1.0653	37.360	71.287	108.648	0.073727	0.19241	141
142	46.506	31.810	0.011560	0.92538	86.507	1.0806	37.574	71.186	108.760	0.074079	0.19239	142
143	47.210	32.514	0.011572	0.91226	86.415	1.0962	37.787	71.085	108.872	0.074431	0.19238	143
144	47.921	33.225	0.011584	0.89937	86.324	1.1119	38.001	70.983	108.984	0.074783	0.19237	144
145	48.641	33.945	0.011597	0.88670	86.232	1.1278	38.214	70.881	109.096	0.075134	0.19236	145
146	49.369	34.673	0.011609	0.87424	86.141	1.1439	38.428	70.779	109.207	0.075484	0.19235	146
147	50.105	35.409	0.011621	0.86200	86.049	1.1601	38.642	70.677	109.319	0.075835	0.19233	147
148	50.850	36.154	0.011634	0.84996	85.957	1.1765	38.856	70.574	109.430	0.076184	0.19232	148
149	51.603	36.907	0.011646	0.83813	85.864	1.1931	39.070	70.472	109.542	0.076534	0.19231	149
150	52.364	37.668	0.011659	0.82650	85.772	1.2099	39.284	70.368	109.653	0.076883	0.19230	150
151	53.133	38.437	0.011671	0.81507	85.680	1.2269	39.499	70.265	109.764	0.077231	0.19229	151
152	53.912	39.216	0.011684	0.80383	85.587	1.2440	39.713	70.161	109.874	0.077579	0.19228	152
153	54.698	40.002	0.011697	0.79278	85.494	1.2614	39.928	70.057	109.985	0.077927	0.19227	153
154	55.494	40.798	0.011709	0.78191	85.401	1.2789	40.142	69.953	110.096	0.078275	0.19227	154
155	56.298	41.602	0.011722	0.77122	85.308	1.2966	40.357	69.849	110.206	0.078622	0.19226	155
156	57.111	42.415	0.011735	0.76071	85.214	1.3146	40.572	69.744	110.316	0.078968	0.19225	156
157	57.933	43.237	0.011748	0.75037	85.121	1.3327	40.787	69.639	110.426	0.079314	0.19224	157
158	58.763	44.067	0.011761	0.74021	85.027	1.3510	41.003	69.533	110.536	0.079660	0.19223	158
159	59.603	44.907	0.011774	0.73021	84.933	1.3695	41.218	69.428	110.646	0.080006	0.19223	159
160	60.451	45.755	0.011787	0.72037	84.839	1.3882	41.433	69.322	110.755	0.080351	0.19222	160
161	61.309	46.613	0.011800	0.71070	84.745	1.4071	41.649	69.215	110.865	0.080695	0.19221	161

TRANSDUCERS for the CENTRIFUGAL SMART PANELS (NEW and OLD STYLES)

We are receiving phone calls from the field on replacement transducers which are D.O.A. Upon further investigation, we found that some field mechanics are using the New Micro Panel (Keyless Style) transducers on the Old Micro Panel (with Key Switch) and vice versa.

The New Micro Panel transducers operate on a +5 VDC supply while the Old Style Micro Panel operates on a +12 VDC supply.

NOTE: THE ABOVE TRANSDUCERS CAN NOT BE INTERCHANGED BETWEEN THE PANELS.

You will find below the part numbers for the Old and New Panels:

	OLD STYLE PANEL	NEW STYLE PANEL
COND.	= 025-25127-001	= 025-27517-001
EVAP.	= 025-25127-002	= 025-27517-002
L.O.P.	= 025-25127-003	= 025-27517-003
H.O.P. & PURGE	= 025-25127-004	= 025-27517-004

NOTES

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