YORK	SERVICE BULLETIN	
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SUBJECT: MICROCOMPUTER CONTROL CENTER (YK CENTRIFUGAL CHILLER) - EPROM VERSION C.02F.16 & C.02T.16

On/about June 1997, the subject units will be equipped with eprom version C.02F.16 (P/N 031-01431-002). Version C.02T.16 (P/N 031-01431-003) will be available for Remote Chiller Communications applications. These eproms have the following operational enhancements that revise Service Manual 160.49-M2 as follows:

OIL PUMP VARIABLE SPEED DRIVE

On the new style "D" YK chillers, the oil pump is driven by a small Variable Speed Drive (VSD). This eprom supports both Variable Speed Oil Pump applications and fixed speed oil pump applications. It can be used in existing chillers that are not equipped with the oil pump Variable Speed Drive.

The Microcomputer Control Center maintains desired system oil pressure by controlling the speed of the oil pump. The speed at which the oil pump runs is determined by the VSD output frequency. The Micro Board applies a speed command to the oil pump VSD to control the output frequency. The speed command is in the form of a Pulse Width Modulation (PWM) signal as explained below.

During the Pre-lube period and the first 15 seconds of compressor run, the program operates the oil pump VSD over a range of 25Hz to 60Hz to maintain the oil pressure to 45 PSID. Thereafter, it operates the VSD over this range to maintain the oil pressure to the programmed **OIL PRESSURE SETPOINT** (20 to 45 PSID).

As with the fixed speed oil pump application, 13 seconds after a chiller start is initiated, the oil pump is turned on by a run signal from Relay Board TB3-29 (ref fig 1). This energizes new Relay 3R (instead of the oil pump contactor as was previously done in the fixed speed oil pump application). The closing of 3R contacts applies a GROUND connection from Power Supply Board J5-1 to the RUN input of the VSD. This starts the oil pump. The Micro Board applies a speed command from J10-2 (through the Refrigerant Level Control Board) to the VSD "PWM" input that ramps the VSD output frequency from 25Hz to whatever frequency is required (up to a maximum of 60Hz) to achieve the 45 PSID target oil pressure. The target oil pressure remains 45 PSID throughout the pre-lube period and during the first 15 seconds of compressor run. While this

target is in effect, "**OIL PRESSURE=XX.XPSID;TARGET=XX.XPSID**" is displayed when the OIL PRESSURE display key is pressed. As with the previous fixed speed oil pump application, the compressor is started 50 seconds after the the chiller start was initiated.

If either of the following conditions occur, a safety shutdown is initiated and "**DAY-TIME-HIGH OIL FLOW**" is displayed.

a.) If the oil pressure is < 40.0 PSID for 5 continuous seconds during the last 10 seconds of the compressor pre-lube or during the first 15 seconds of SYSTEM RUN.

b.) If the oil pressure is < the programmed **OIL PRESSURE SETPOINT** and the speed command is at 60Hz for 5 continuous seconds, anytime after the first 30 seconds of SYSTEM RUN.

The "**DAY-TIME-HIGH OIL FLOW**" safety checks are not performed during MANUAL SPEED control.

All other oil pressure safety shutdown thresholds are the same as with the fixed speed oil pump applications. For both fixed speed and variable speed oil pump applications, the shutdown threshold for "**DAY-TIME-HIGH OIL PRESSURE**" is now 90 PSID. In previous eprom versions, this threshold was 125 PSID for the first 7 minutes of compressor operation and 60 PSID thereafter. Refer to explanation in separate category below.

After the compressor has been running for 15 seconds, the target oil pressure becomes the **OIL PRESSURE SETPOINT**" (20 to 45 PSID) that has been programmed by the Service Technician using procedure below under "PROGRAMMING". The Micro Board then applies a speed command to the VSD that changes the VSD output frequency as required to achieve this oil pressure. This programmed **OIL PRESSURE SETPOINT** is the target oil pressure for the remainder of "SYSTEM RUN" and through "SYSTEM COASTDOWN", unless changed. While this target is in effect, "**OIL PRESSURE=XX.XPSID;SETP=XX.XPSID**" is displayed when the oil pressure key is pressed.

During oil pump operation, the actual oil pressure and the frequency the VSD is commanded to be running can be monitored with the DISPLAY DATA key. One of the scrolled messages is "**OIL PUMP VSD=XXXHZ;PRS=XX.XPSID**".

The Micro Board controls the VSD output frequency by applying a Pulse Width Modulation (PWM) speed command signal to the VSD (ref fig 2). The signal is applied every 0.7 seconds. Within the 0.7 second period, the duration of time that the signal is "low" (0vdc), determines the VSD output frequency between 25 to 60Hz. If it remains "high" (+12vdc) for the entire 0.7 second period, it is commanding the VSD to output a frequency of 25Hz. If it is low for the entire 0.7 second period, it is telling the VSD to output a frequency of 60Hz. Frequencies between these extremes are achieved by driving the signal low for a proportionate amount of time within the 0.7 second period. For example, if the signal is low for 50%

(0.35 seconds) of the 0.7 second period, it would be commanding the VSD to operate at a frequency that is halfway between 25 and 60Hz, or 42.5Hz. The resolution, or smallest increment of change is 0.01 seconds. This allows the output frequency to be changed in 0.5 Hz steps. The formula provided in fig 2 can be used to calculate the output frequency for a given PWM signal.

The entire oil pump run time is divided into "OIL PRESSURE CONTROL PERIODS". They run consecutively and continously; when the first one ends, the next one begins. This repeats until the oil pump is shutdown. The duration of the periods are determined by the **OIL PRS CTRL PERIOD SETPOINT**", programmed by the Service Technician using instructions below under "PROGRAMMING". This setpoint is programmed in multiples of 0.3 seconds over the range of 0.3 to 2.7 seconds, by programming a "MULTIPLIER" value of 1 thru 9. The program multiplies this value by 0.3 to produce periods over the range of 0.3 to 2.7 seconds. This multiplier value also determines the magnitude of output frequency correction when the error between the actual oil pressure and the oil pressure setpoint is > $\pm$6 PSID. The programmed value (1 thru 9) is multiplied by 0.5Hz to provide greater frequency change to more quickly correct the oil pressure. If the error is < $\pm$ 6 PSID, the output frequency is increased or decreased 0.5Hz. At the end of each period, the actual oil pressure is compared to the programmed **OIL PRESSURE SETPOINT** and the Micro Board changes the VSD frequency as required per the following:

If actual oil pressure is:

a.) >(setpoint + 0.5 PSID) & $\leq$(setpoint + 6 PSID), decrease output frequency 0.5Hz.

b.) >(setpoint + 6 PSID), decrease output frequency 0.5Hz x Control Period Multiplier.

c.) <(setpoint - 0.5 PSID) & $\geq$(setpoint - 6 PSID), increase output frequency 0.5Hz.

d.) <(setpoint - 6 PSID), increase output frequency 0.5Hz x Control Period multiplier.

The oil pump VSD is equipped with a set of normally open relay contacts that are driven closed as long as all the VSD internal protection circuits are satisfied. They open anytime its internal protection has initiated a drive shutdown. The contacts remain open until the internal protection circuits permit the drive to run. They will automatically close on all drive initiated shutdowns except if the drive experiences a short circuit on the output; this requires the drive be manually reset by the removal and restoration of AC power (460, 230, 208 vac, etc) to the drive. The opening of these contacts initiate a chiller CYCLING shutdown. While the contacts are open, "DAY-TIME-OIL PUMP DRIVE - AUTOSTART" is displayed on the Microcomputer Control Center display and the chiller is prevented from starting. The closed contacts apply 115vac to Digital Input Board input TB1-70. Refer to fig 1.

Since this eprom version can be used on chillers that are equipped with the oil pump VSD and those that are not, VSD oil pump control must be enabled or disabled, as appropriate, and the associated

setpoints programmed using the "PROGRAMMING" procedure below.

MANUAL SPEED CONTROL

The oil pump speed can be manually controlled using the Pre-Rotation Vanes OPEN, CLOSE, HOLD or AUTO keys in SERVICE mode. Manual pump speed control must be selected using the procedure below.

After the pump has been turned on with the "MANUAL OIL PUMP" key, the "OPEN" and "CLOSE" keys can be used to increase or decrease the oil pump VSD output frequency over the range of 25Hz to 60Hz. Each time the "OPEN" key is pressed, the frequency is increased 0.5Hz. Each time the "CLOSE" key is pressed, the frequency is decreased 0.5Hz. If the AUTO key is pressed, automatic operation as described above is resumed.

A special feature allows the oil pump VSD to be driven to a specific pre-determined frequency. This permits service analysis of oil pressure at various oil pump speeds. This frequency is programmed as the "**OIL PUMP VSD FREQUENCY=XX HZ**" setpoint in the "PROGRAMMING" procedure below. If the "HOLD" key is pressed, the VSD output goes to this frequency.

During manual operation, the DISPLAY DATA key can be used to monitor the oil pump VSD frequency and system oil pressure. One of the scrolled messages is "**OIL PUMP VSD FREQ=XX.XHZ;PRS=XX.XPSID**".

As on fixed speed oil pump applications, after the pump is manually turned on, it is automatically turned off after 10 minutes, if not manually terminated earlier.

To enable the keypad PRV Service keys for manual oil pump speed control, perform the following:

1.) This procedure assumes variable speed drive oil pump operation has been selected using the procedure below under "PROGRAMMING".
2.) Using ACCESS CODE 1 3 8 0, enter PROGRAM mode. "PROGRAM MODE SELECT SETPOINT" is displayed.
3.) Press OPTIONS key.
4.) Use the ADVANCE DAY/SCROLL key to scroll to the message "MANUAL CONTROL = X (0=VANES,1=LVL,2=OP)".
5.) Press the 2 key.
6.) Press ENTER key.
7.) Press PROGRAM key to exit.

It can be confirmed that manual oil pump speed control has been enabled by pressing the "DISPLAY DATA" key. The first scrolled message will be **"MANUAL OIL PUMP SPEED CONTROL ALLOWED"**.

OIL HEATER OPERATION

On chillers equipped with the oil pump Variable Speed Drive, the oil heater is controlled by the Microcomputer Control Center program; not by the heater thermostat. The heater is turned on and off to maintain the oil temperature to a value 50 degrees F above the condenser saturation temperature. This is the target value. When the temperature falls to 4 degrees F or greater below the target, the heater is turned on. It is turned off when it increases to 3 degrees F above the target value. The heater is not turned on when the compressor is operating.

If the calculated target value is greater than 160 degrees F, the target defaults to 160 degrees F. If the calculated target value is less than 110 degrees F, it defaults to 110 degrees F.

The heater is operated by Relay Output Board terminal TB3-34. On chillers not equipped with the oil pump VSD, this terminal operates the Vent Line Solenoid. Selecting oil pump VSD operation below under "PROGRAMMING" enables this output for heater operation; disabling oil pump VSD operation enables this output for Vent Line Solenoid operation.

To prevent overheating the oil in the event of a control center component failure, the oil heater thermostat 1HTR, set to open at 180 deg. F, is wired in series with the heater contactor 1M.

PROGRAMMING

This eprom version can be used in chillers that are equipped with the oil pump Variable Speed Drive and those that are equipped with the fixed speed oil pump. If the chiller is equipped with the oil pump VSD, VSD oil pump application must be selected below. If the chiller is not equipped with the oil pump VSD, fixed speed oil pump application must be selected. If VSD oil pump application is selected, additional VSD setpoints, as described above, must be entered. Also, the "STANDBY LUBRICATION" feature, as described below, can be enabled or disabled in this procedure.

If VSD oil pump application is selected, the oil heater will be controlled as described under **OIL HEATER OPERATION** below and the program is configured to operate the chiller without the Liquid Line (2SOL), Vent Line (3SOL), and High Speed Thrust (4SOL) solenoid valves as described below under **SOLENOID VALVES** (these devices have been removed on style "D" YK chillers). If Fixed Speed oil pump application is selected, the program operates these devices in the same way as previous eprom versions.

1.) Using ACCESS CODE 1 3 8 0, enter PROGRAM mode.
"PROGRAM MODE, SELECT SETPOINT" is displayed.
2.) Press OIL PRESSURE key.

"VSD OIL PUMP INSTALLED = 0 (0=NO;1=YES)" is displayed.

3.) Using ENTRY keys, press "1" if chiller is equipped with the oil pump variable speed drive. Press "0" if this is a fixed speed oil pump application.

4.) Press ENTER key.

5.) Press ADVANCE DAY/SCROLL key.
"ENABLE STANDBY LUBE = 0 (0=NO;1=YES) is displayed.

6.) Using ENTRY keys, press "1" if the STANDBY LUBRICATION feature, as described below, is desired. Otherwise, press "0".

7.) Press ENTER key.

8.) If FIXED SPEED oil pump application was selected, by entering "0" in step 2.) above, press PROGRAM key to exit. Otherwise, press ADVANCE DAY/SCROLL key.
"OIL PRS CTRL PERIOD = __ X 0.3 SECONDS" is displayed.

9.) Using ENTRY keys, enter desired value "1" through "9". Recommended value "3" will provide correct operation in most applications. If the CANCEL key is pressed, default value "3" is displayed.

10.) Press ENTER key.

11.) Press ADVANCE DAY/SCROLL key.
"OIL PRESSURE SETPOINT = XXPSID" is displayed.

12.) Using ENTRY keys, enter desired value between "20" and "45" PSID. Recommended value "35" will provide correct operation in most applications. If CANCEL key is pressed, default value "35" is displayed.

13.) Press ENTER key.

14.) Press ADVANCE DAY/SCROLL key.
"OIL PUMP VSD FREQUENCY = XX Hz" is displayed.

15.) Using ENTRY keys, enter desired value between "25" and "60" Hz. If CANCEL key is pressed, default value "25" is displayed.

16.) Press ENTER key.

17.) Press PROGRAM key to exit.

DIAGNOSTIC SOFTWARE - DIGITAL OUTPUTS

If Variable Speed Oil Pump operation has been enabled in the "PROGRAMMING" procedure above, the oil heater on/off output from the Relay Board and the oil pump VSD frequency control output from the MICRO BOARD can be manually controlled using the DIGITAL OUTPUTS portion of DIAGNOSTIC SOFTWARE. The following messages are displayed:

"OUTPUT--OIL HEATER--1, 9 MORE"
"OUTPUT--VSD OIL PUMP PULSE--1, 9 MORE"

Manual control of these outputs is the same as manual control of all other outputs using the DIGITAL OUTPUTS section of DIAGNOSTIC SOFTWARE. The output is driven high (+12vdc) when the "1" key is pressed. It is driven low (<1vdc) when the "0" key is pressed. When the "0" key is pressed, "0" is displayed in place of "1". Refer to instructions in Service Manual 160.49-M2, section 5.

If Variable Speed Oil Pump operation is not selected, these messages are replaced by:

"OUTPUT--VENT LINE--1, 9 MORE"
"OUTPUT--HI SPEED THRUST SOL--1, 9 MORE"

MICRO BOARD

The circuit that provides the VSD PWM speed command output from Micro Board J10-2 is not present on Micro Board part number 031-01065-001. This Micro Board has been revised to include these circuits and the part number has been changed to 031-01065-002. Micro Board part number 031-01065-002 is required on all variable speed drive oil pump applications.

STANDBY LUBRICATION

To maintain oil seal integrity while the chiller is shutdown, the oil pump is turned on for 2 minutes every 24 hours if the chiller has not run in the past 24 hours. While the pump is running, "**STANDBY LUBE IN PROCESS - X.X MIN LEFT**" is displayed. If a Variable Speed Drive oil pump is applied, the operating oil pressure will be the oil pressure setpoint programmed by the Service Technician.

To prevent oil pump damage due to low oil level, if at least 15 PSID of oil pressure is not achieved within 30 seconds of turning on the oil pump, the cycle is terminated and "**STANDBY LUBE LOCKOUT - CHECK OIL LEVEL**" is displayed when the STATUS key is pressed. No more standby lubrications will be performed until the WARNING RESET key is pressed in SERVICE mode, at which point another cycle will be attempted. Starting the chiller also resets this lockout.

These standby lubrication cycles are enabled or disabled by the Service Technician using the Variable Speed Oil Pump selection procedure described above. It is recommended that the standby lubrication be enabled on chillers that remain shutdown for periods of 24 hours or greater.

Standby lubrication cycles will not be performed if either oil pressure transducer is out of range (HOP $\leq$ 6.8 PSIG; LOP $\leq$ 0 PSIG). This assures that standby lubrication cycles will not be performed until the chiller has been charged with refrigerant and chiller commissioning has been completed.

COMPRESSOR BACKSPIN ELIMINATION

To eliminate compressor backspin at chiller shutdown, the pre-rotation vanes are driven fully closed prior to shutting down the chiller on certain CYCLING shutdowns. This is not performed on

safety shutdowns because the time required for the vanes to close could cause chiller damage. Also, this is not performed on operator initiated shutdowns at the front panel Start/Run/Stop-Reset switch because these could be emergency shutdowns.

When one of the below listed shutdown commands are received, the vanes are driven fully closed. During the vanes closure, "SYSTEM SHUTTING DOWN - VANES CLOSING" is displayed. When the vane motor switch closes (indicating the vanes have fully closed) or 210 seconds from start of vane closure have elapsed, the start signal is removed from the starter and "SYSTEM COASTDOWN" begins. This operation is performed on the following shutdowns:

1.) Low Water Temp
2.) Multi-Unit Sequence (TB2-9)
3.) Internal Time Clock
4.) Remote/Local Cycling (TB2-13)
5.) Remote Stop (TB2-8)
6.) Remote Stop from ISN 4500 BAS (RS-485 serial port)

OIL PUMP OPERATION AFTER POWER FAILURES

If a power failure occurs while the chiller is running, the duration of the power failure determines whether a "SYSTEM COASTDOWN" (post-lube) is performed when power is restored.

If the power failure is less than 2 minutes in duration, a standard 2.5 minute "SYSTEM COASTDOWN" operation is performed when power is restored. During the "SYSTEM COASTDOWN", the oil pump runs. If configured for AUTO-RESTART AFTER POWER FAILURE, a SYSTEM COASTDOWN is performed prior to the chiller automatically restarting.

If the power failure is greater than 2 minutes in duration, there is no 2.5 minute "SYSTEM COASTDOWN" with oil pump operation performed when power is restored.

SOLENOID VALVES

Style "D" YK chillers are not equipped with the following solenoid valves:

1.) Liquid line solenoid valve (2SOL)
2.) Vent line solenoid valve (3SOL)
3.) High speed thrust solenoid valve (4SOL)

When Variable Speed Oil Pump application is selected in the "PROGRAMMING" procedure in the "OIL PUMP VARIABLE SPEED DRIVE" section above, the program is configured to operate the chiller without these solenoid valves. When Fixed Speed Oil pump application is selected, the program operates these solenoid valves in the same way as previous eprom versions.

HIGH OIL PRESSURE SAFETY SHUTDOWN THRESHOLD

In previous eprom versions, the safety shutdown threshold for **DAY-TIME-HIGH OIL PRESSURE** was 125 PSID for the first 7 minutes of compressor operation and 60 PSID thereafter. The threshold is now 90 PSID, regardless of how long the compressor has been running. This new operation applies to both fixed speed and variable speed oil pump applications.

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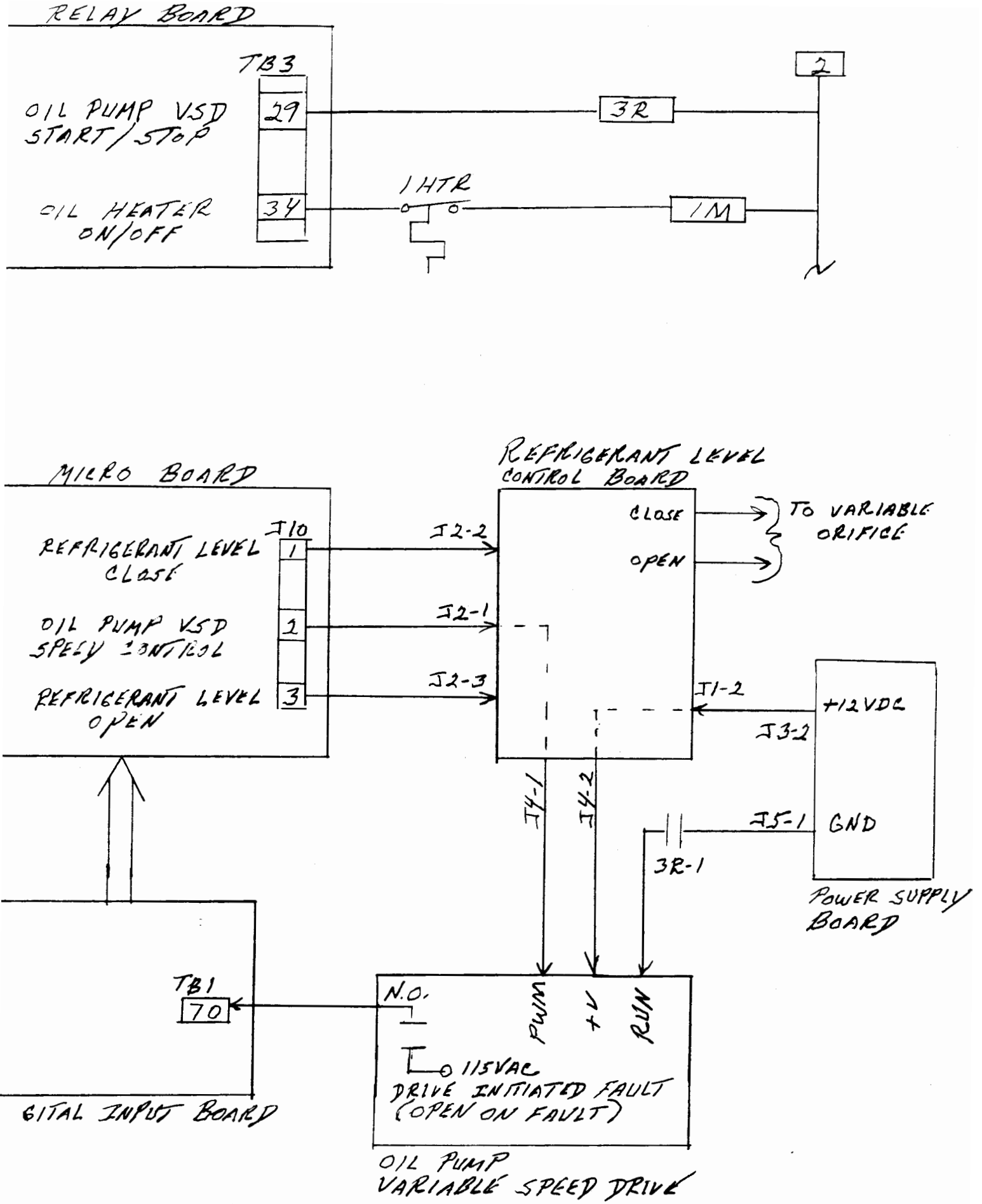
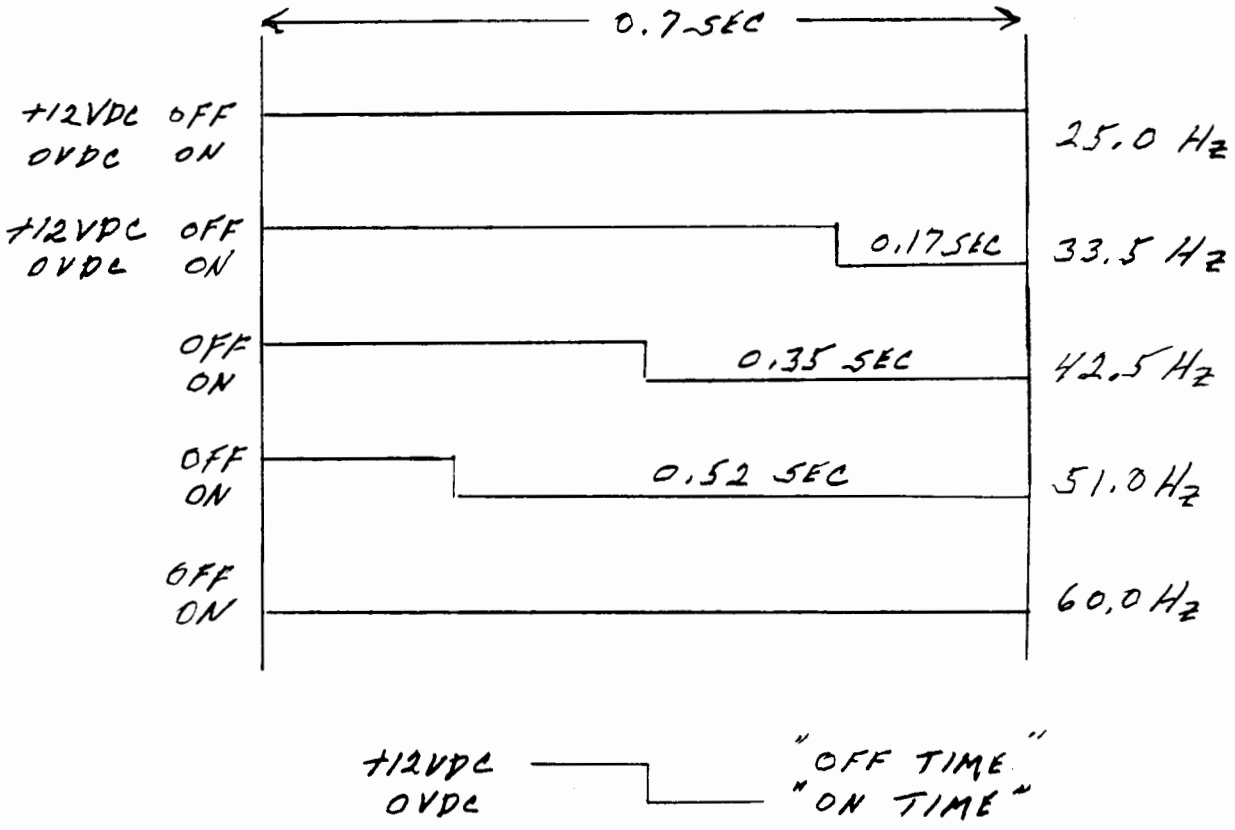

RELAY BOARD
TB3
OIL PUMP VSD START/STOP
29
3R
2
OIL HEATER ON/OFF
34
1HTR
1M
MICRO BOARD
REFRIGERANT LEVEL CONTROL BOARD
J10
REFRIGERANT LEVEL CLOSE
1
J2-2
CLOSE
TO VARIABLE ORIFICE
OPEN
OIL PUMP VSD SPEED CONTROL
2
J2-1
REFRIGERANT LEVEL OPEN
3
J2-3
J1-2
+12VDC
J3-2
J4-1
J4-2
J5-1
GND
3R-1
POWER SUPPLY BOARD
TB1
70
N.O.
PWM
+V
RUN
115VAC
DRIVE INITIATED FAULT (OPEN ON FAULT)
GITAL INPUT BOARD
OIL PUMP VARIABLE SPEED DRIVE

FIG. 1

OIL PUMP VARIABLE SPEED DRIVE

PULSE WIDTH MODULATION (PWM) SPEED CONTROL SIGNAL



TO CALCULATE FREQUENCIES BETWEEN THE ABOVE:

OUTPUT FREQ IN H_z = (ON TIME IN SECONDS / 0.02) + 25

SMALLEST INCREMENT OF CHANGE = 0.010 SEC ; 0.5 H_z

FIG. 2