Form S90-021 O (MAY 2007)
OPERATION - ADVANCED
File: SERVICE MANUAL - SECTION 90
Replaces: S90-021 O/JUN 2005
Dist: 3, 3a, 3b, 3c

OPERATION – ADVANCED
(SESSION LEVEL 1)

FRICK® QUANTUM™ LX COMPRESSOR CONTROL PANEL
Version 6.5x

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OVERVIEW OF OPERATOR INTERFACE

The compressor unit is controlled by a computer based machine control system. The controller continuously monitors the conditions and operation of the compressor unit and the various subsystems. It also directs the operation of components.

The panel user interface is designed to allow an operator to efficiently access and control the operation of the compressor unit and subsystems. The control panel screen is used to display graphic screens. By pressing a key on the keypad, the labeled or described function is recognized by the control processor.

The following information is presented to help the operator interact with the graphic screens and the Quantum™ compressor control panel. This manual is intended to describe all presently available features for the compressors listed in *Compressor Model Differences*. Reference this section for the differences of the compressor models that will apply to the displayed data and the setup and setpoint entry. **If applicable** is used throughout this manual to indicate when something might apply. This is because of the compressor model (see *Compressor Model Differences*) or because this feature or option was selected from a setup.

COMMON TERMINOLOGY

Shutdown - A critical safety limit has been reached or exceeded and the compressor has been shutdown.

Warning - A Warning setpoint has been reached or exceeded. The compressor will continue to run if running.

Manual - The device is being controlled from direct commands or keys at the local controller.

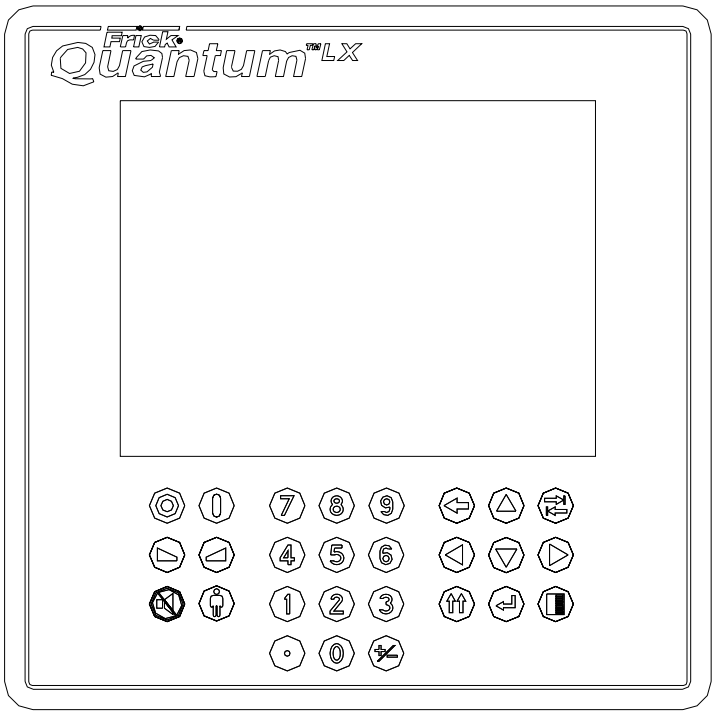
Auto (Automatic) - The device is being controlled from setpoints at the local controller.

Remote - The device is being controlled by a remote controller.

OPERATOR ACCESS

Operator access to this system is through various screens. A screen is the physical representation of data on the display. Icons have been used to help an operator quickly identify functions. An icon is a small, graphic symbol representation. Each screen has a title area. The title is descriptive of the screen. The current day; date and time, is shown in this title area. The day of the week; Sunday through Saturday (Sun. - Sat.) is displayed. The month of the year from January to December (Jan. - Dec.) is displayed. The day of the month from 1 to 31 and the year from 0001 to 9999 are displayed. The time displayed is the actual time in 24 hours (military) format. The hours, minutes, and seconds are displayed. The labeled keys on the panel keypad provide quick access to the operator's needs. By pressing a labeled key on the keypad, the corresponding function is recognized. Most of the screens have screen keys that describe or show a function that is recognized when the coinciding keypad key to the right of the screen is pressed. The screen keys provide access to other screens or commands. For easier viewing, related information is separated into boxes. The setup and setpoint entry is separated into logical control components. Setup selection of features and options have been provided to prevent the operator from unnecessary viewing and entering of unused control settings. The required control settings are clearly presented. To further assist the operator, on-line help is provided. Some selections appear faded to indicate that this feature is unavailable. A feature can be unavailable because of setup selections such as the compressor model. Some selections appear faded to indicate that this feature might be available in a future software release.

KEYS AND KEY FUNCTIONS

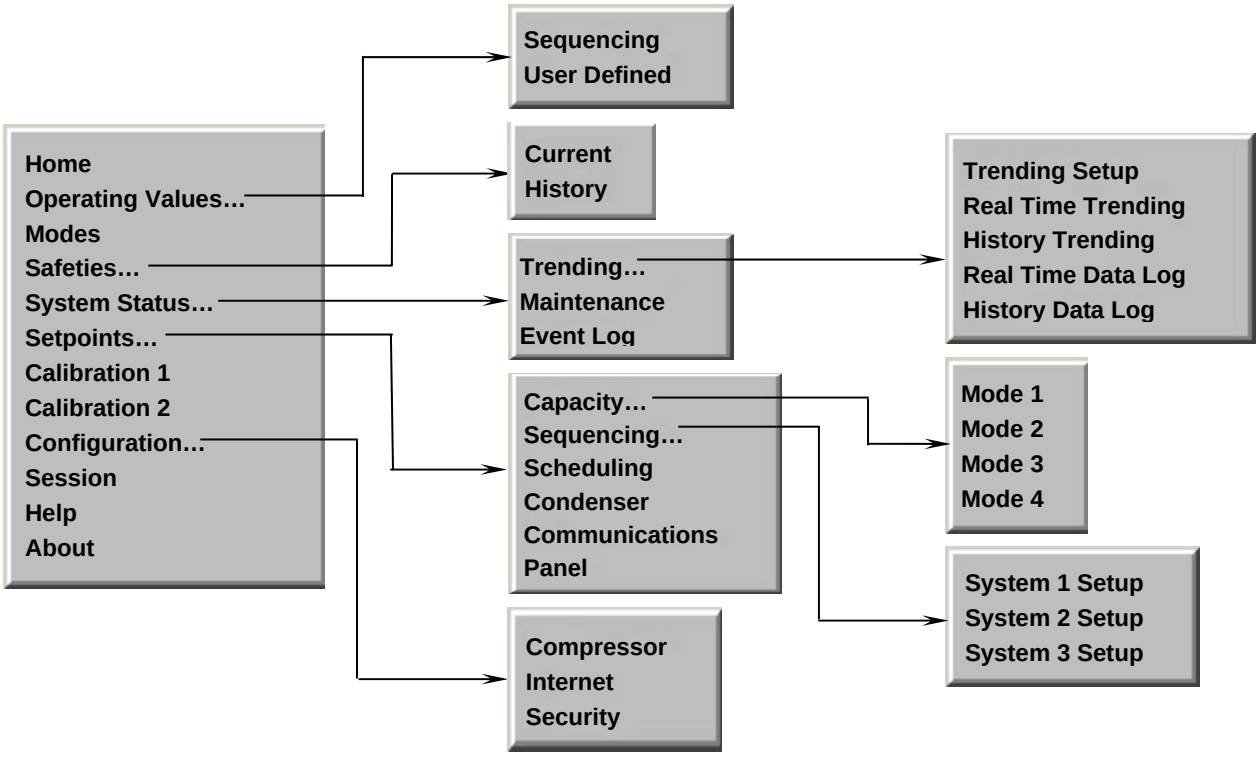


The following is a list of the labeled keypad keys and the actions that occur when they are pressed:

Key	Function
	[STOP] - When the compressor is running in *Manual Mode*, pressing this key immediately stops the compressor by placing it into Stop Mode. The compressor is stopped regardless of any other conditions.
	[START] - When in Manual Mode, this key places the compressor unit into the Start Mode for running.
	[INCREASE VALUE] - Increases Capacity.
	[DECREASE VALUE] - Decreases Capacity.
	[ALARM SILENCE] - Immediately silences a sounding alarm and turns off the alarm annunciation device that is connected to this panel.
	[MANUAL] - Changes the compressor mode from its current mode to its previous mode.
7 8 9 4 5 6 1 2 3 0	**NUMERALS [0] - [9]** - The numerical keys are used to enter a value in a data field.
	DECIMAL [.] - This key is used when entering a decimal value in a data field.
	[+/-] - When changing a value in a data field, this key toggles the value between negative and positive.

Key	Function
	[BACKSPACE] - Pressing this key will cause the current location of the cursor to backup one position per key depression. When changing a value in a data field, this key will delete the selected character.
	[UP ARROW] - Provides upward navigation within the *MAIN MENU* window.
	[TAB] - When in the mode of changing setpoints, pressing this key will cause the cursor to jump to the next data entry field.
	[LEFT ARROW] - When in the mode of changing setpoints, this key is used to go to the previous data entry field. When the *MAIN MENU* is shown, pressing this key will cancel the window.
	[DOWN ARROW] - Provides downward navigation within the *MAIN MENU* window.
	[RIGHT ARROW] - When in the mode of changing a data entry field, this key is used to go to the next character.
	[ENTER] - When changing data in a data entry field, this key will accept the change. This key is also used to select items on Menu Windows.
	[SUBMIT] - After changing a setpoint value, Use this key to enter (submit) the change.
	[MENU] - Shows the ***MAIN MENU*** window. This window shows the main selections for accessing information, setup of options, and setpoint entry.

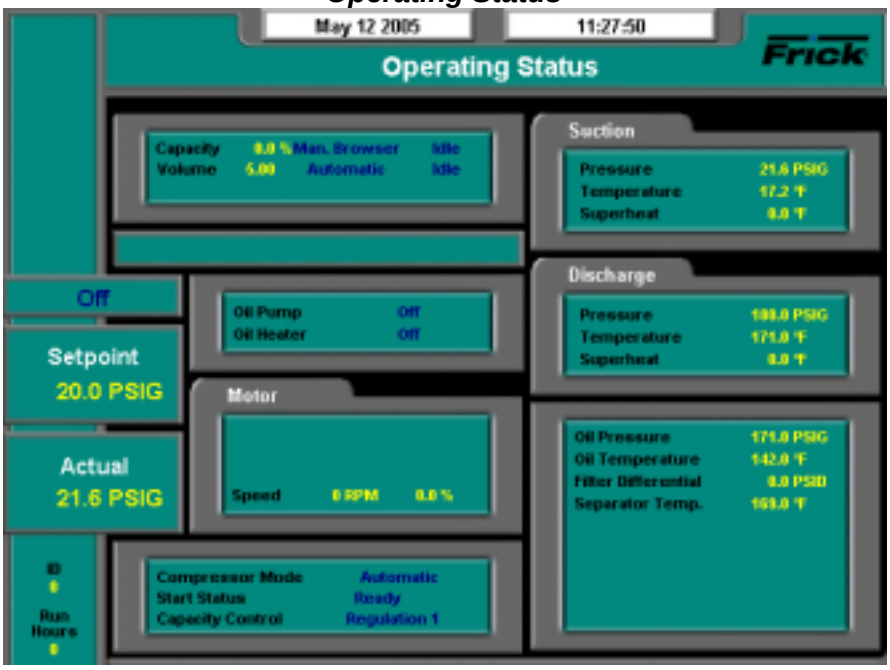
MENU STRUCTURE



The above graphic represents the menu structure, or tree, of the Quantum™-LX screens. Use this tree when accessing the various screens. When this document is viewed electronically, passing the mouse pointer over each of the above names, and then clicking on it, will take you directly to the page with that screen. Please note that this screen list is complete, and that certain screens may not be available as shown here, depending upon the enabled options.

OPERATING DISPLAY SCREENS

Operating Status



SCREEN NAME: ***Operating Status*** or Home.

ACCESSING: → **Home**

DESCRIPTION: This is the default screen. When power is applied, this screen will appear. Also called the ***Home*** screen. The most important information about the compressor and the applicable subsystems operation is displayed here. This screen is shown when power is first turned on and when a key is pressed after the screen saver has turned off the backlight. The ***Operating Status*** screen is continuously updated and provides a variety of information with regard to the current condition and performance of the compressor unit and subsystem.

The following information is shown on this screen:

DATE - The actual date will be displayed in this box. The date must first be set correctly on the ***Configuration*** screen. Once set, the date will be automatically adjusted for at the end of each month, much like the calendar feature of most modern watches. The primary use of the date feature is to provide a date stamp for Warnings and Shutdowns. (See also TIME)

TIME - The actual time will be displayed in this box. The time must first be set correctly on the ***Configuration*** screen. The time will also need to be adjusted for those locations which observe Daylight Savings Time. The primary use of the time feature is to provide a time stamp for Warnings and Shutdowns. (See also Date)

SCREEN TITLE - This is the title for the screen that is showing. Each screen will have a title. The Quantum™ LX manuals will extensively refer to screens by these names. When referred to in these manuals, screen names will be shown in bold italic print, such as ***Operating Status***.

COMPRESSOR MODEL - This is actually a rotating marquee. It will alternately display the model name of the compressor (such as RWF) and will then rotate to show Frick®.

COMPRESSOR RUN STATUS -

- Off
- Running
- Starting
- Stopping
- Stopping - High Capacity
- Stopping - Pumpdown

PROCESS SETPOINT VALUE - This is the control setpoint maintained by the internal capacity control.

PROCESS ACTUAL VALUE - The actual reading of the pressure or temperature that was chosen as the compressor control setpoint.

ID - The value shown here is the number that has been assigned to this particular unit on the ***Communications Setup*** screen.

RUN HOURS – The value shown here is the total number of hours that the compressor has been actually running, since the last start.

CAPACITY/VOLUME CONTROL BOX - Shows what is presently controlling the Slide Valve and from what source it was initiated. The following sources may be shown:

Capacity:

- Manual
- Automatic
- Remote -- Communications
- Remote -- IO
- Remote -- 4-20 Input
- Remote -- Sequencing

VOLUME:

- Manual
- Automatic

WARNING/SHUTDOWNS STATUS BOX - The Warning/Shutdowns Status is displayed in the indented box below the Capacity/Volume status box. This status box is blank with no message if there are no warnings or shutdowns present.

One of the following messages could be shown:

WARNING - This message flashes when a warning is present. A warning is a condition that requires operator acknowledgement and allows the compressor to continue to run if it is running.

SHUTDOWN - This message flashes when a shutdown is present. A shutdown is a condition that requires an operator to acknowledge it and causes the compressor to shut down. If the compressor cannot be stopped, it is minimally run in a protected state.

A Warning or Shutdown message indicates a Warning or Shutdown point has been reached, or exceeded.

When a Shutdown occurs, the display backlight will flash on and off to alert an operator of the shutdown. This visual alarm will help get the attention of the operator in a noisy engine room environment where audible alarms may not be heard. Pressing any key on the keypad will clear the flashing backlight.

OIL LUBRICATION DEVICE STATUS BOX - The operating status is shown for the following devices:

Oil Pump - (If selected in the *Configuration*) – The *On* or *Off* message is shown for the status of the oil pump. The Manual or Auto message is shown to indicate the position of the HAND-OFF-AUTO switch. If dual pump control was enabled in *Configuration*, the lead pump (either Oil Pump 1 or Oil Pump 2) is shown.

Oil Heater - The On or Off message is shown for the status of the oil separator heater(s).

MOTOR STATUS BOX - The following items are shown:

Motor Amps - The actual amps.

%FLA - The percentage of the drive motor full load amperage rating that the motor is currently using. % (FLA x SF)
Kilowatts - This is the estimated value of the kilowatt usage of the compressor motor. It is based on the calculation of Motor Amps * Volts * 3^2 / 1000.

Recycle Delay - This message shows the remaining time in minutes for Recycle Delay. If the compressor has started and shuts down within the recycle time delay setpoint period, the Recycle Delay will prevent the compressor from starting until the delay time expires. This time delay is intended to prevent damage to the compressor motor from successive restarts.

Note: The remaining recycle delay time can be cleared from the ***Motor*** screen

COMPRESSOR STATUS BOX - Shows the present operating status of the compressor and from what source it has been initiated:

Compressor Mode - One of the following messages is shown:

- **Manual** - A compressor manual start or stop command was sent.
- **Automatic** - The compressor auto command was sent. The compressor starting and stopping is being controlled from automatic cycling control setpoints at the panel. The automatic cycling control setpoints of the active capacity control are used.
- **Remote -- Communications** - The compressor remote communications command was sent. The compressor starting and stopping is through the serial Com-2 channel.
- **Remote -- IO -** The compressor remote I/O command was sent.
- **Remote -- Sequencing -** The compressor remote sequencing command was sent.

Note: If there is a shutdown in response to a safety setting, a compressor in *Remote* or *Automatic* mode is placed into *Manual* mode requiring operator intervention.

Start Status - One of the following messages is shown:

- Ready
- Start Inhibit In Shutdown

- Start Inhibit In Recycle Delay
- Start Inhibit High Discharge Temp.
- Start Inhibit High Oil Temperature
- Start Inhibit Low Separator Temperature
- Start Inhibit Slide Valve Too High
- Start Inhibit Still In Prelube
- Start Inhibit High Suction Pressure
- Start Inhibit High Suction/Discharge Differential Start Inhibit Permissive Start
- Start Inhibit Digital Auxiliaries
- Power Fail Restart

Capacity Control - One of the following messages is shown:

- Regulation 1
- Regulation 2
- Regulation 3
- Regulation 4

SUCTION PRESSURE & TEMPERATURE BOX - The following sensor information is displayed:

Suction Pressure - Is measured at the compressor inlet and the value is displayed along with the unit of measure.

Suction Temperature - Is measured at the compressor inlet and the value is displayed along with the unit of measure.

Superheat - The temperature of the gas at saturation temperature for a given period of time.

DISCHARGE PRESSURE & TEMPERATURE BOX - The following sensor information is displayed:

Discharge Pressure - Is measured at the compressor outlet and the value is displayed along with the unit of measure.

Discharge Temperature - Is measured at the compressor outlet and the value is displayed along with the unit of measure.

Superheat - Superheat is the term used to describe the difference between the *vapor point* (ie., the temperature at which the refrigerant evaporates at a given pressure) and the actual temperature of the refrigerant exiting the evaporator coil.

OTHER PRESSURES AND TEMPERATURE BOX - The following sensor information is displayed:

Oil Pressure - Is measured prior to entering the compressor and the value is displayed along with the unit of measure.

Oil Temperature - Is measured prior to entering the compressor and the value is displayed along with the unit of measure.

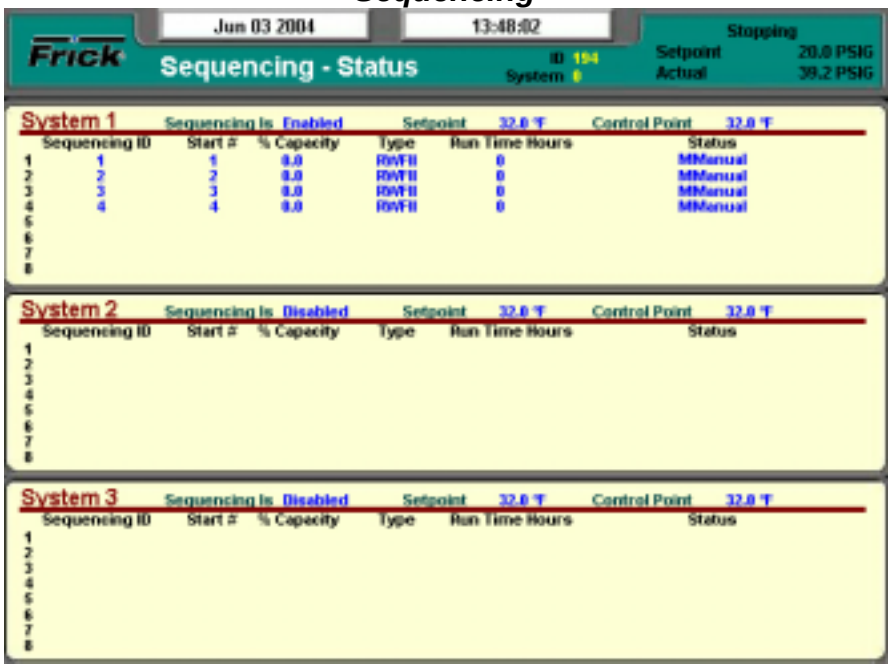
Filter Differential - If applicable, pressure drop across the oil filter. The main oil injection oil filter pressure drop value (differential) is displayed along with the unit of measure.

Separator Temperature - The Oil Separator Temperature value is displayed along with the unit of measure.

Process Temperature - If applicable, the Leaving Process Temperature value is displayed along with the unit of measure.

Balance Piston - If applicable, the Balance Piston pressure reading is displayed along with the unit of measure. This reading is a measurement of the presence at the Balance Piston.

Sequencing



SCREEN NAME: ***Sequencing***.

ACCESSING: → **Operating Values…** → **Sequencing**

DESCRIPTION: This screen will be available if Sequencing is enabled in ***Compressor*** configuration. This is strictly a status screen, no values can be changed from here.

The following is a description of the Sequencing strategy:

Start/Stop

System Setup:

- Control Input – Suction Pressure
- Control Direction – Forward
- High Stage Link – Disabled

Start Procedure

Before starting a compressor, the master must determine that all the running compressors are loaded and that the *Suction Pressure* has risen to a point where an additional compressor is needed.

First, the master checks that either no compressors are running or all the running compressors average 90% capacity. If a running compressor is at less than 90% capacity but is in a Load Inhibit or Force Unload condition, for the purposes of this calculation it is assumed to be at 90% capacity.

If all the running compressors are loaded the master next begins comparing its *Suction Pressure* to the Autocycle Start setpoint. When the Suction Pressure rises above the Start setpoint, the start timer is initiated. If the start timer reaches the Autocycle Start Delay setpoint time and the Suction Pressure has remained above the Start setpoint for the entire time, the master attempts to start an additional compressor. If the Autocycle Start Delay setpoint is 0 minutes, the master still waits 15 seconds before starting a compressor.

To determine which compressor to start, the master first sorts all the compressors in the system based on their start number, low to high. If two compressors have the same start number, the first one on the list remains ahead of the second. Next, the master starts at the top of the list and works down through list until it finds a compressor that is available to run. To be deemed available, a compressor must have good sequencing communications and its Compressor Mode and Capacity Mode must be set as Remote Sequencing. In addition the compressor must be off, and it cannot be in a Start Inhibit condition except for the Start Inhibit Slide Value Too High condition. The compressor with the lowest start number that also meets these conditions is then sent a start command. If no compressors are currently available to start, the master will continue checking until one becomes available or until the Suction Pressure drops below the Start setpoint.

After a compressor has been sent a start command, the master waits for that compressor to reach a Running state. If 3 minutes passes and the compressor has not yet begun to run, the master sends it a stop command. This compressor is then flagged as Unable to Start for 1 hour. After that time the master may again try to restart the compressor if additional capacity is needed. After a compressor begins running or after one fails to start and is sent a

stop command, the master can begin the process of starting another compressor.

Stop Procedure

If the *Suction Pressure* drops to a point where one of the running compressors is no longer needed, the master will stop the last compressor in the sequence list.

When the *Suction Pressure* drops below the Autocycle Stop setpoint, the stop timer is initiated. If the stop timer reaches the Autocycle Stop Delay setpoint time and the *Suction Pressure* has remained below the Stop setpoint for the entire time, the master attempts to stop one of the running compressors. If the Autocycle Stop Delay setpoint is 0 minutes, the master still waits 15 seconds before stopping a compressor.

To select the compressor to stop, the master also sorts all the compressors in the system according to their start number. Then the master starts at the bottom of the list and works up, looking for a running compressor that can be stopped. To be selected a compressor must have good sequencing communications and its Compressor Mode and Capacity Mode must be set as Remote Sequencing. In addition, the compressor's run time must be greater than the compressor's Minimum Run Time setpoint. If the Minimum Run Time setpoint is 0 minutes, a compressor can also be stopped if it is still in Starting mode. The compressor with the highest start number that meets these conditions is sent a stop command. If no compressors are currently available to stop, the master will continue checking until one becomes available or until the *Suction Pressure* rises above the Stop setpoint.

After a compressor has been sent a stop command, the master waits for that compressor to go to off. If 3 minutes passes and the compressor has not yet turned off, the master then flags this compressor as Unable to Stop for 1 hour. After that time the master may again try to stop the compressor. After a compressor goes to off or after one fails to stop within 3 minutes, the master can begin the process of stopping another compressor.

Load/Unload

System Setup:

Control Input – Suction Pressure
Control Direction – Forward
High Stage Link – Disabled

Load Procedure

If the master compressor's Suction Pressure is above the Capacity Control setpoint, the master calculates the increase in capacity that is required. The calculation is as follows:

Difference = Suction Pressure – (Capacity Control Setpoint + Upper Dead Band)

If the Difference is less than the Upper Proportional Band:

Capacity Change = (Difference / Upper Proportional Band) * Upper Cycle Time

If the Difference is greater than the Upper Proportional Band:

Capacity Change = Upper Cycle Time

After the capacity increase has been calculated, the master then finds the compressor whose capacity should be changed. To make this determination, the master sorts all the compressors based on their start number. Beginning at the compressor with the lowest start number, the master finds the first compressor on the list that is running but is not at its maximum capacity. A compressor is at maximum capacity if it is at 100 percent capacity or if it is in a Load Inhibit or Force Unload condition.

If the selected compressor is running the Quantum LX software, the capacity increase is added to the compressor's current capacity. This new value is then sent to the compressor as its Capacity Command, and that compressor will try to increase its capacity to match the Command value.

If the selected compressor is controlled by a Quantum 1-4 or a Plus panel, the capacity increase is interpreted as the time period for a load pulse and is sent to the compressor as a load command. The slave compressor will then turn on its load output for the given number of seconds.

Unload Procedure

If the master compressor's *Suction Pressure* is below the Capacity Control setpoint, the master calculates the decrease in capacity that is required. The calculation is as follows:

Difference = (Capacity Control Setpoint - Upper Dead Band) – Suction Pressure

If the Difference is less than the Lower Proportional Band:

Capacity Change = (Difference / Lower Proportional Band) * Lower Cycle Time

If the Difference is greater than the Lower Proportional Band:

Capacity Change = Lower Cycle Time

After the capacity decrease has been calculated, the master then finds the compressor whose capacity should be changed. To make this determination, the master sorts all the compressors based on their start number. Beginning at the compressor with the highest start number, the master finds the last compressor on the list that is running and whose capacity is above its Minimum Capacity setpoint. If two compressors are currently running at or below their Minimum Capacity setpoints, the master will not allow any additional

compressors to unload. This will allow the Suction Pressure to continue to drop and will cause the master to turn off one of the unloaded compressors. If the master sees that only one compressor is running in its system, it will continue to unload the compressor down to the master's Automatic Capacity Mode Minimum Slide Valve Position setpoint.

If the selected compressor is running the Quantum LX software, the capacity decrease is subtracted from the compressor's current capacity. This new value is then sent to the compressor as its Capacity Command, and that compressor will try to decrease its capacity to match the Command value.

If the selected compressor is controlled by a Quantum 1-4 or a Plus panel, the capacity decrease is interpreted as the time-period for an unload pulse and is sent to the compressor as an unload command. The slave compressor will then turn on its unload output for the given number of seconds.

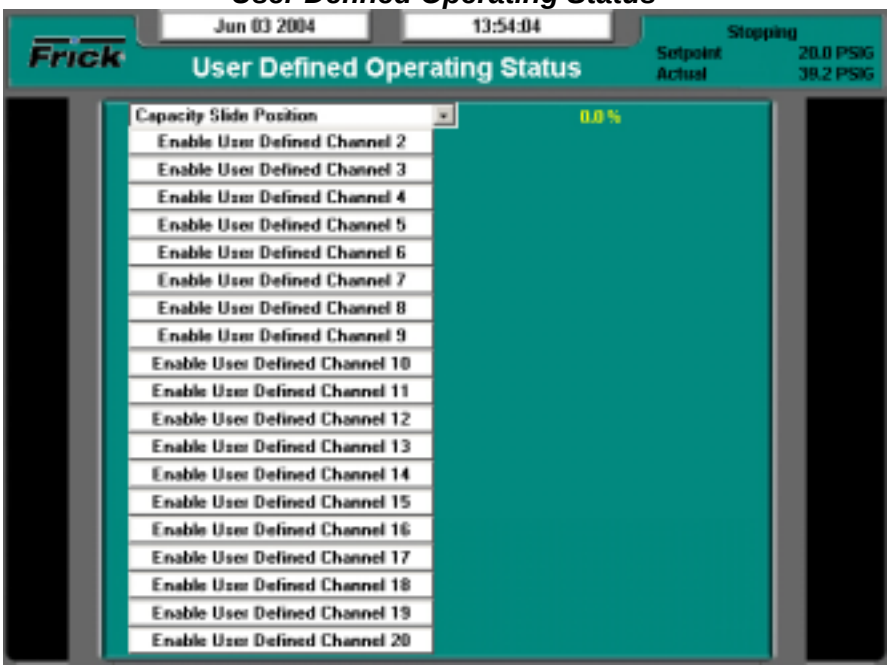
High Stage/Booster

The High Stage System Link setpoint is provided to tie a system of Booster compressors to a system of High Stage compressors. For example, if the Booster compressors are setup on System #1 and the High Stage Compressors are on System #2, the High Stage System Link setpoint from System #1 would be set as ***System 2***.

When the Booster System's master wants to start the first Booster compressor, it first checks that a Booster compressor is available to run and then sends a signal to the High Stage System's master telling it to start a High Stage compressor. If all the High Stage compressors are off, the High Stage System's master will start its first compressor, regardless of what the High Stage Control Input is reading. When the Booster System's master observes that a High Stage compressor is running, it will allow a Booster compressor to start.

After the first High Stage compressor begins to run, compressors in both systems will cycle on and off as their Control Inputs move up and down. The only stipulation to the control strategy is that one High Stage compressor must always remain on as long as at least one Booster compressor is running. If all the Booster compressors turn off, the High Stage compressor can then turn off as well.

User Defined Operating Status



SCREEN NAME: ***User Defined Operating Status***.

ACCESSING: → **Operating Values…** → **User Defined**

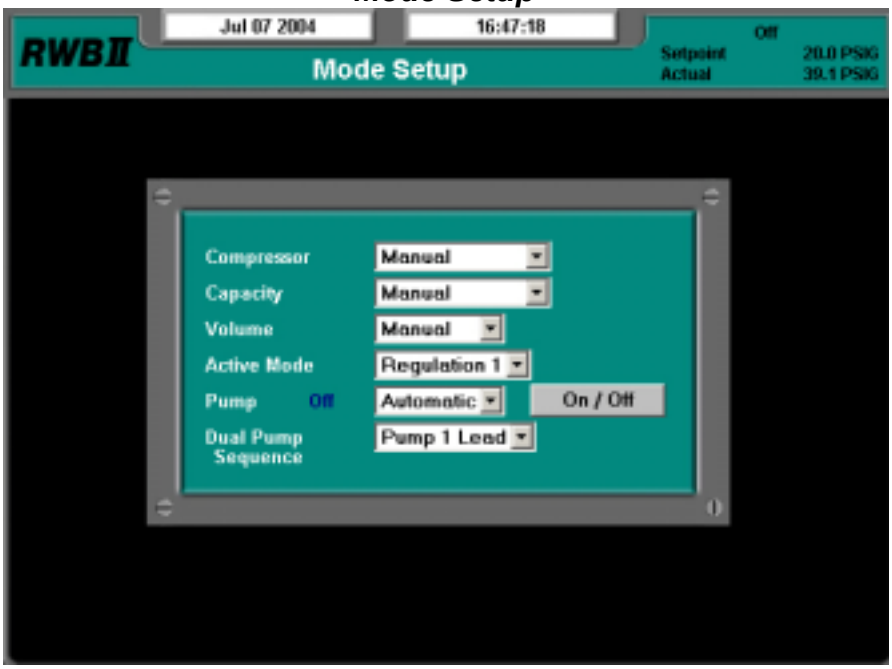
DESCRIPTION: The purpose of this screen is to allow the user to assign additional analog channels to be more readily viewable. Since the main ***Operating Status*** (Home) screen is capable of only showing a limited number of pre-assigned analog values, it may be desirable for the user to have a method of viewing additional information that they can select, on a common screen. They may even select values that are already being displayed on the ***Operating Status*** screen, as well as values that are not shown there.

As an example of how this screen works, assume that in addition to the data that is shown on the ***Operating Status*** screen, the user would like to monitor the Capacity Slide Position, Suction Pressure and Motor Current. Notice that both the Suction Pressure and the Motor Current are already shown on the ***Operating Status*** screen, but the user would also like to see Capacity Slide Position on the same screen as these other two. In order to set this screen up this way, the user would highlight the Enable User Defined Channel 1 (or whatever channel they wish to use), by pressing the **[Tab]** key. Once the box is highlighted, use the **[Enter]** key to cause the possible settings for the channel to appear. Use the arrow keys to scroll through the list. When the selection that you want to use has been highlighted, press the **[Enter]** key to select it. Once selected, a value will appear to the right of the list, which corresponds to the analog value for that channel.

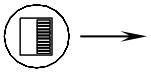
The following selections may be shown on this screen:

- Capacity slide position
- Volume slide position
- Suction pressure
- Discharge pressure
- Oil pressure (Compressor)
- Main Oil Injection pressure
- Economizer pressure
- Filter pressure
- Intermediate pressure
- Balance piston pressure
- System discharge pressure
- Suction temperature
- Discharge temperature
- Oil temperature compressor
- Oil separator temperature
- Process/Brine temperature leaving
- Process/Brine temperature entering
- Motor Current
- RPM
- User defined analog inputs #1 - #20
- Compressor Vibration - Suction
- Compressor Vibration - Discharge
- Motor Vibration - Shaft Side
- Motor Vibration - Opposite Shaft Side
- None

Mode Setup



SCREEN NAME: ***Mode Setup***.

ACCESSING:  **Mode**

DESCRIPTION: The purpose of this screen is to allow the user to assign operational states (such as manual or automatic) to the various modes shown on the screen.

The following pull-down menus are shown here:

Compressor:

- Manual
- Automatic
- Remote -- Communications
- Remote -- IO
- Remote -- Sequencing

Capacity:

- Manual
- Automatic
- Remote -- Communications
- Remote -- IO
- Remote -- 4-20 Input
- Remote -- Sequencing

Volume:

- Manual
- Automatic

Active Mode:

- Regulation 1
- Regulation 2
- Regulation 3
- Regulation 4

Pump (if enabled):

A Pump On/Off indicator (blue text) is provided here to alert the user as to the actual status of the Oil Pump (if applicable). A drop down menu is also provided, and there are two states that can be selected for oil pump operation, they are:

- Manual
- Automatic

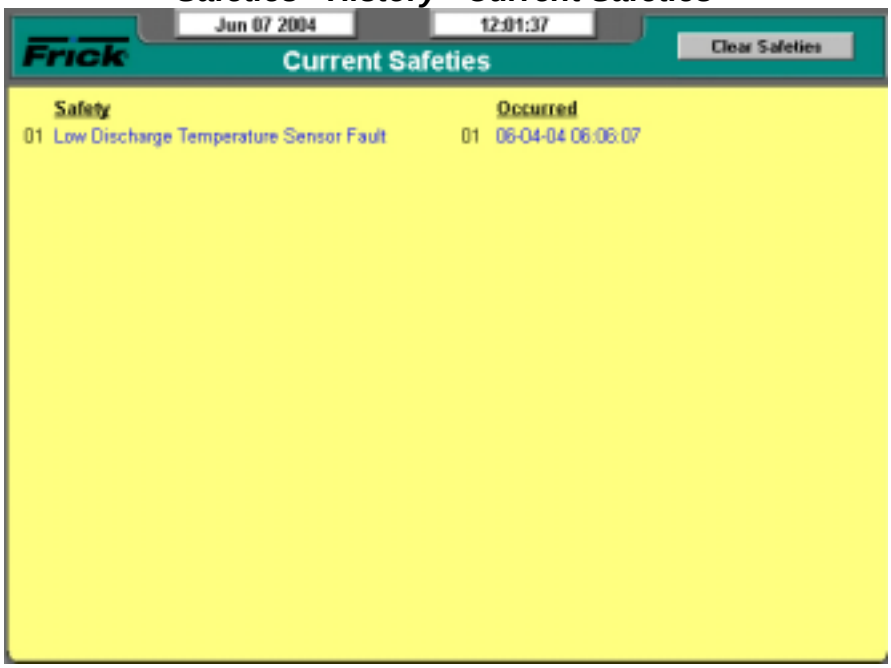
In Manual mode, the user has control over the running of the pump. To run the pump, simply observe the blue text indicator to ensure that the pump is not already running, and if not, then press the **[On/Off]** toggle button. The blue text indicator will change from *Off* to *On*. To stop the pump, press the toggle button again, and the pump indicator will change to *Off*.

If the pump is set to Automatic mode, the Quantum™ LX software program is controlling the pump operation. In this mode, if the toggle key is pressed, the mode will be changed from Automatic to Manual Mode, and the current state of the pump (digital output 3) will toggle also.

Dual Pump Sequence (if enabled):

- Pump 1 Lead
- Pump 2 Lead

Safeties - History - Current Safeties



SCREEN NAME: ***Current Safeties***.

ACCESSING: → **Safeties…** → **Current**

DESCRIPTION: The ***Current Safeties*** screen shows the Warnings and Shutdowns that have recently occurred (up to 50). When a warning or shutdown is triggered, a blue descriptive message shows on this screen. The date and time of the warning or shutdown occurrence is shown to the right of its description. The most recent message will appear on the top line of the screen with the oldest appearing at the bottom. When a Warning or Shutdown is logged to this screen, it will also be logged to the ***Safety History*** screen.

The following ***Current Safeties*** screen key is provided:

[Clear Safeties] - Selecting this key will clear all warnings and/or shutdowns from this screen. It also de-energizes the Warning and Shutdown output modules (digital outputs 23 and 24) to silence any warning annunciation device. This will also place a date/time stamp for the corresponding entry on the ***Safety History*** screen showing that the particular Warning or Shutdown was cleared. Clearing the entry on the ***Current Safeties*** screen, will not clear it from the ***Safety History*** screen.

To resume normal operation it will be necessary to go through the following steps:

1. Correct the condition(s) causing the warning.

2. Press the **[ALARM SILENCE]** key. (This action may precede correcting the condition(s) causing the warning). Or, go to step 3.

3. To clear or reset the ***Warnings/Shutdowns*** screen and turn off any warning annunciation device, from the screen, press the **[Clear Safeties]** key. This will also clear the WARNING or *SHUTDOWN* message from the ***Operating Status*** screen.

4. If the conditions causing the warning have not been corrected or a new fault has occurred, a new *WARNING* or *SHUTDOWN* message will appear. The ***Safety History*** screen keeps a record of the warnings and shutdowns. This information will help troubleshoot persistent operational problems.

Refer to the *Warnings/Shutdowns Message* section for a list of all the possible conditions.

When a Shutdown occurs, the screen backlight will flash on and off to alert an operator of the shutdown. This visual indication will help get the attention of the operator in a noisy engine room environment where audible alarms may not be heard. Pressing any key on the keypad will clear the flashing backlight.

Safeties - History - Safety History

	Safety		Occurred	Cleared
01	Low Discharge Temperature Sensor Fault	01	06-04-04 06:06:07	
02	Stopping Failure - Motor Amps	02	06-03-04 14:55:38	06-03-04 15:07:16
03	Oil Pump 1 Auxiliary Warning	03	06-03-04 13:35:59	06-03-04 14:31:37
04	Low Oil Pressure Shutdown	04	06-03-04 13:23:26	06-03-04 14:31:37
05	Low Oil Pressure Warning	05	06-03-04 13:18:26	06-03-04 14:31:37
06	Oil Level Shutdown	06	06-03-04 13:13:26	06-03-04 14:31:37
07	Stopping Failure - Motor Amps	07	06-03-04 13:08:34	06-03-04 14:31:37
08	False Running Failure – Motor Amps	08	06-03-04 13:08:27	06-03-04 14:31:37
09	False Running Failure – Motor Amps	09	06-03-04 13:06:04	06-03-04 14:31:37
10	Stopping Failure - Motor Amps	10	06-03-04 13:00:36	06-03-04 14:31:37
11	False Running Failure – Motor Amps	11	06-03-04 13:00:32	06-03-04 14:31:37
12	Low Oil Pressure Shutdown	12	06-03-04 12:23:41	06-03-04 14:31:37
13	Low Oil Pressure Warning	13	06-03-04 12:18:41	06-03-04 14:31:37
14	Oil Level Shutdown	14	06-03-04 12:13:41	06-03-04 14:31:37
15	Stopping Failure - Motor Amps	15	06-03-04 12:08:46	06-03-04 14:31:37
16	False Running Failure – Motor Amps	16	06-03-04 12:08:40	06-03-04 14:31:37
17	Low Oil Pressure Shutdown	17	06-03-04 11:48:48	06-03-04 14:31:37
18	Low Oil Pressure Warning	18	06-03-04 11:43:48	06-03-04 14:31:37
19	Stopping Failure - Motor Amps	19	06-03-04 11:38:55	06-03-04 14:31:37
20	Oil Level Shutdown	20	06-03-04 11:38:48	06-03-04 14:31:37
21	Stopping Failure - Motor Amps	21	06-03-04 11:32:49	06-03-04 11:33:35
22	Stopping Failure - Motor Amps	22	06-03-04 11:32:08	06-03-04 11:32:43
23	Low Oil Pressure Shutdown	23	06-03-04 10:58:29	06-03-04 11:32:02
24	Low Oil Pressure Warning	24	06-03-04 10:53:29	06-03-04 11:32:02

SCREEN NAME: ***Safety History***.

ACCESSING: → **Safeties…** → **History**

DESCRIPTION: The ***Safety History*** screen shows the warnings and shutdowns that have recently occurred (up to 50 maximum). When a warning or shutdown is triggered, a blue descriptive message shows on this screen. The date and time of the warning or shutdown occurrence is shown to the right of its description, followed by the date and time that the safety was cleared (if applicable, from the ***Current Safeties*** screen). The most recent message will appear on the top line of the screen with the oldest appearing at the bottom.

System Status -Trending - Trending Setup

SCREEN NAME: ***Trending Setup***.

ACCESSING: → **System Status…** → **Trending…** → **Trending Setup**

DESCRIPTION: This is the Trending Setup screen. Up to eight channels can be monitored in real time fashion (as the values are changing), and up to eight channels monitored as a history (long after they have happened).

The following setpoints are provided:

Real Time Recording Interval – The time interval that defines how often the trending data values are recorded.

History Recording Interval – The time interval that defines how often the trending data values are recorded.

To program this screen with the data you wish to trend, the user would highlight the Enable Real Time Trend Channel 1 (or whatever channel they wish to use), by pressing the **[Tab]** key. Once the box is highlighted, use the **[Enter]** key to cause the possible settings for the channel to appear. Use the arrow keys to scroll through the list. When the selection that you want to use has been highlighted, press the **[Enter]** key to select it. Once selected, the value for this channel will be automatically trended and shown on the Real Time Trending graph (or History Trending Graph), as well as on the Real Time Trending Data Log (Or History Trending Data Log).

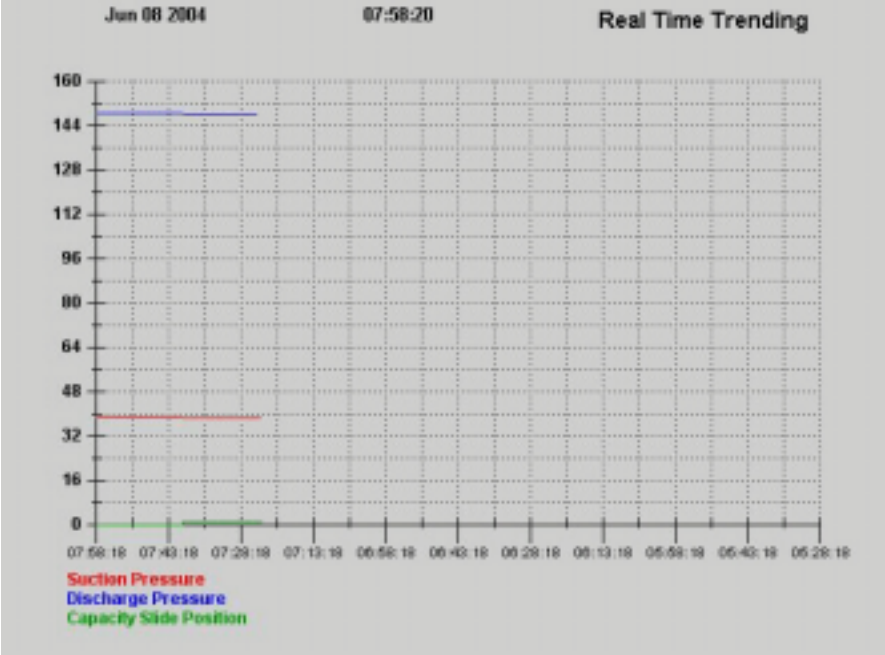
The following list is the selectable values that may be shown on this screen:

- Capacity slide position
- Volume slide position
- Suction pressure
- Discharge pressure
- Oil pressure (Compressor)
- Main Oil Injection pressure
- Economizer pressure
- Filter pressure
- Intermediate pressure
- Balance piston pressure
- System discharge pressure
- Suction temperature
- Discharge temperature
- Oil temperature compressor
- Oil separator temperature
- Process/Brine temperature leaving
- Process/Brine temperature entering
- Motor Current
- RPM
- User defined analog inputs #1 - #20
- Compressor Vibration - Suction
- Compressor Vibration - Discharge
- Motor Vibration - Shaft Side
- Motor Vibration - Opposite Shaft Side
- None

The following screen command keys are provided:

Download Data Trending Files -

System Status -Trending - Real Time Trending

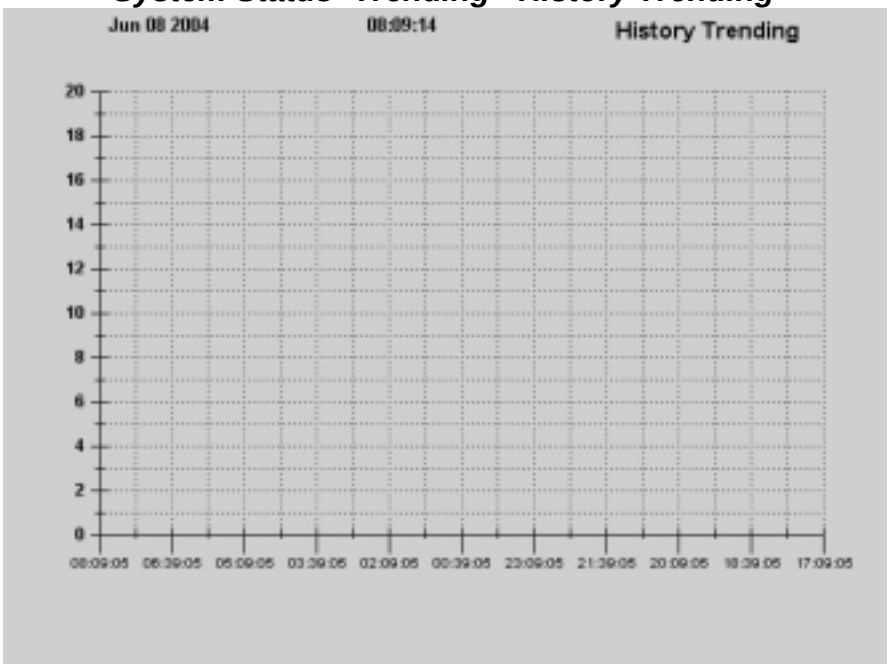


SCREEN NAME: ***Real Time Trending***

ACCESSING: → **System Status…** → **Trending…** → **Real Time Trending**

DESCRIPTION: This is the ***Real Time Trending*** screen. This screen will display in a graphical chart format, the data values as selected on the ***Real Time Trending Setup*** screen. Each of the possible eight selectable channels will be shown at the bottom of the screen, each in a different color. The color data values displayed in the chart, correspond to the matching color of the trending channels at the bottom of the screen.

System Status -Trending - History Trending

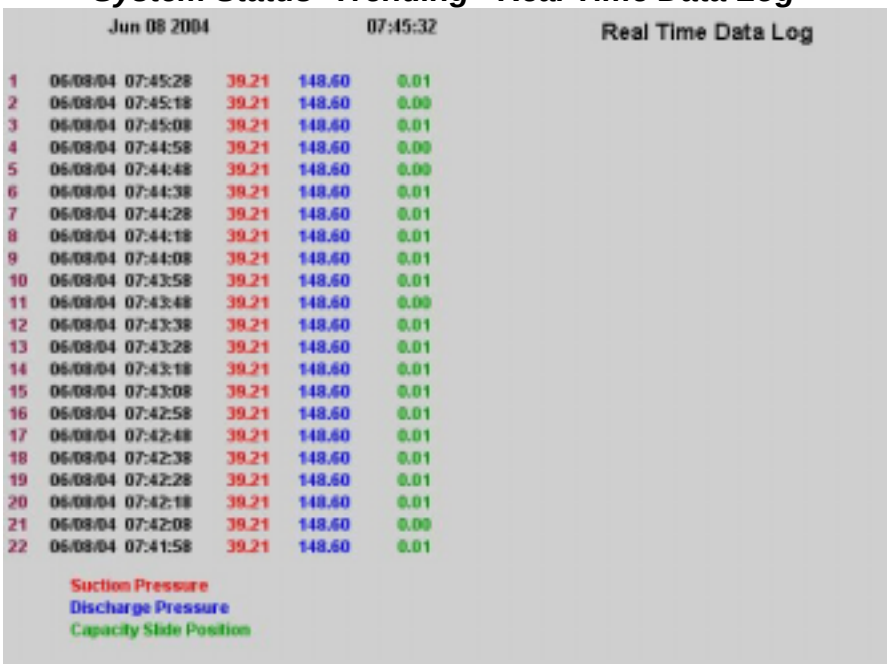


SCREEN NAME: ***Real Time Trending***

ACCESSING: → **System Status…** → **Trending…** → **History Trending**

DESCRIPTION: This is the ***History Trending*** screen. It is accessible from the *Main Menu* by pressing *System Status…*, then *Trending*, and finally *History Trending*. This screen will display in a graphical chart format, the data values as selected on the ***Real Time Trending Setup*** screen. Each of the possible eight selectable channels will be shown at the bottom of the screen, each in a different color. The color data values displayed in the chart, correspond to the matching color of the trending channels at the bottom of the screen.

System Status -Trending - Real Time Data Log

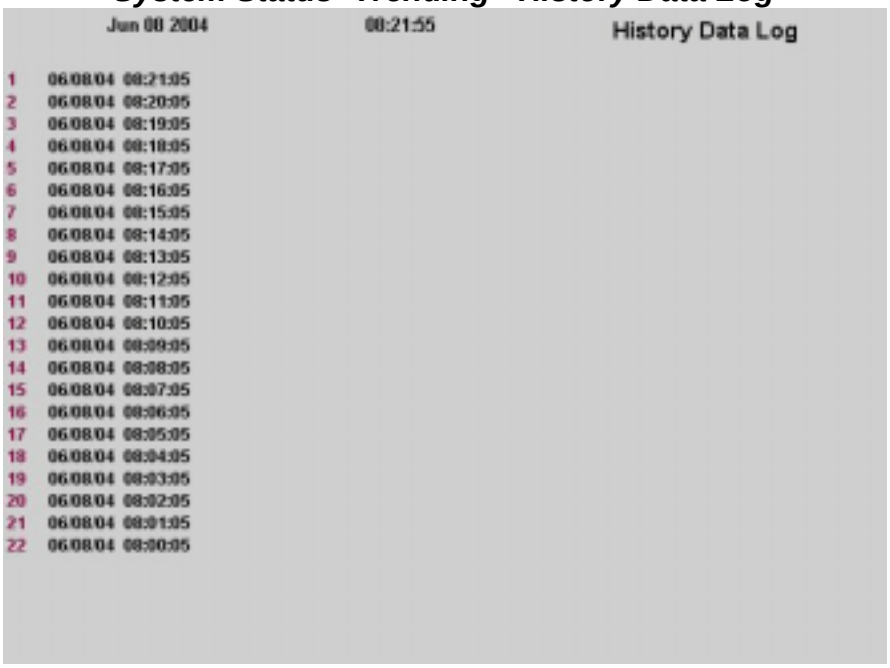


SCREEN NAME: ***Real Time Data Log***.

ACCESSING: → **System Status…** → **Trending…** → **Real Time Data Log**

DESCRIPTION: This screen will display in a tabular format, the numerical data values as selected on the ***Real Time Trending Setup*** screen. Each of the possible eight selectable channels will be shown at the bottom of the screen, each in a different color. The color data values displayed in the chart, correspond to the matching color of the trending channels at the bottom of the screen.

System Status -Trending - History Data Log

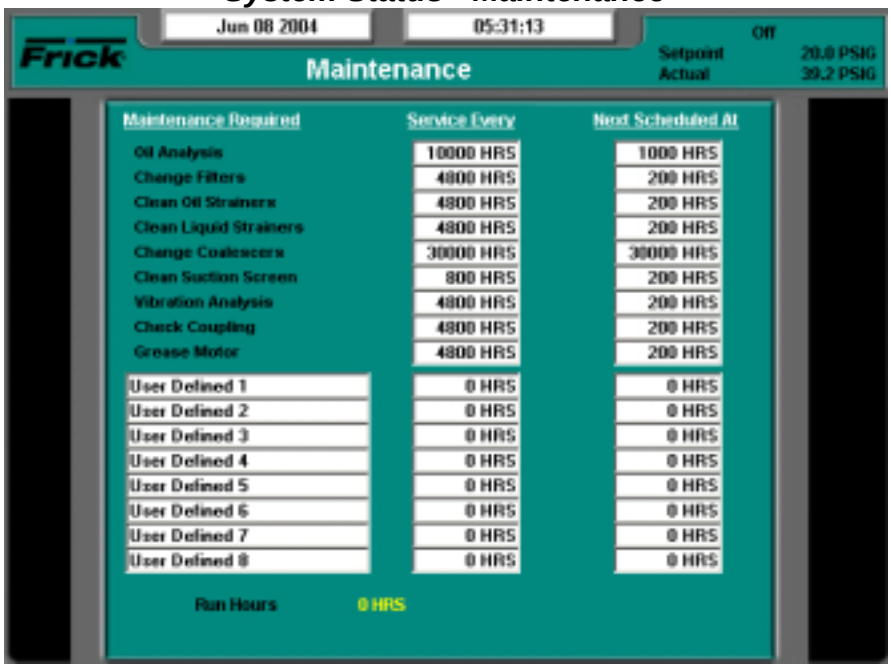


SCREEN NAME: ***History Data Log***.

ACCESSING: → **System Status…** → **Trending…** → **History Data Log**

DESCRIPTION: This screen will display in a tabular format, the numerical data values as selected on the ***Real Time Trending Setup*** screen. Each of the possible eight selectable channels will be shown at the bottom of the screen, each in a different color. The color data values displayed in the chart, correspond to the matching color of the trending channels at the bottom of the screen.

System Status - Maintenance



SCREEN NAME: ***Maintenance***.

ACCESSING: → **System Status…** → **Maintenance**

DESCRIPTION: Using this screen, the user can view up to nine (9) pre-programmed maintenance schedules, as well as eight (8) user definable maintenance schedules. Each of the user defined schedules may be custom named. This screen is based upon the Maintenance Schedule that is provided in the IOM manual for the specific compressor package.

The usage of this screen is that the user can assign up to seventeen different areas of compressor operation that they would like to schedule routine maintenance for. As an example, the above screen shows a row labeled as *Oil Analysis*. The next column (Service Every) on the same row has a value of 10000 Hrs. The last column (Next Scheduled At) of this row has a value of 1000 Hrs. When the compressor is running, this time value is being clocked. After 1000 hours of compressor run time, a message will be generated and placed on the ***Event Log*** screen. This particular message will read *Maintenance -- Oil Analysis*. This is to notify the operator that it is time to have the Oil checked. At this point, the operator should notify the proper maintenance personnel that the appropriate maintenance be performed. The user should access the Event Screen on a regular basis (perhaps once per week) to review the information provided there.

Once the message has been entered in the ***Event Log,*** the values for the row will be automatically updated, with new values as predetermined by an internal programmed maintenance schedule, based upon the type of compressor. The values for the *Next Scheduled at* column are based upon the Compressor Run Time hours (shown at the bottom of this screen).

At the bottom of the left most column is the user defined *Maintenance Required* column. This is where custom names may be entered for the various items that the user would like to track.

Modifying numerical values

To modify any of the numerical boxes on this screen, simply use the **[Tab]** key to scroll down the lists, or the **[Left Arrow]** key to scroll up the lists. When the box that you wish to change is highlighted, you may enter the new value using the numerical keys, then press the **[Enter]** key to accept the value.

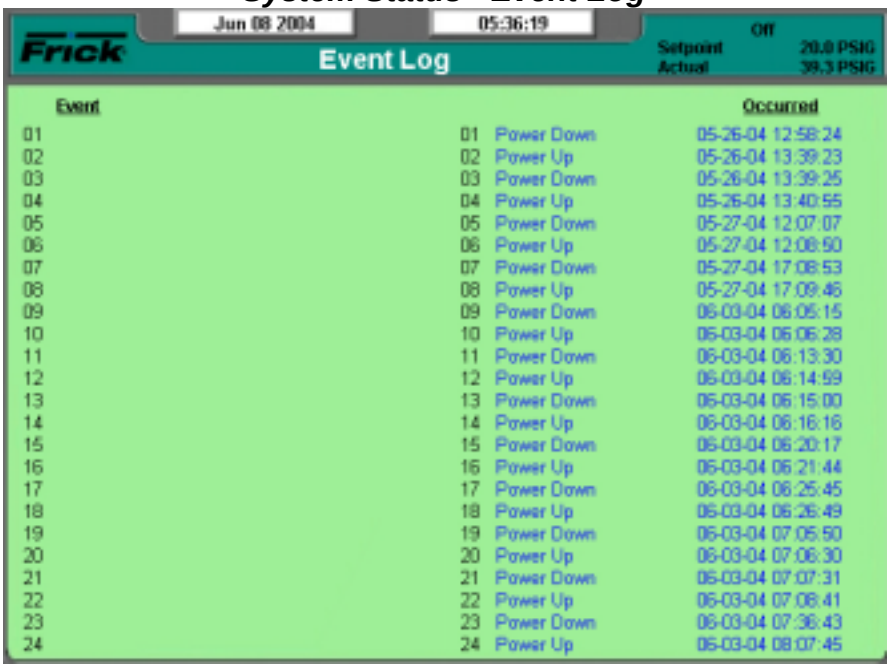
Modifying Text (User Defined) Boxes

To modify any of the text boxes on this screen, simply use the **[Tab]** key to scroll down the lists, or the **[Left Arrow]** key to scroll up the lists. When the box that you wish to change is highlighted, use the **[Up Arrow]** key. A new screen (***Alpha***) showing a numerical keypad will appear. Refer to the ***Alpha*** screen description for information on entering text messages. Press the **[Enter]** key to accept the text. The user may type in a custom name up to 20 characters long.

The following additional information is provided on this screen:

Run Hours - The value shown here are the total number of hours that the compressor motor has actually been in the running state. This value can be reset (or changed to any value from 0 to 1,000,000 Hours) from the ***Panel*** screen.

System Status - Event Log



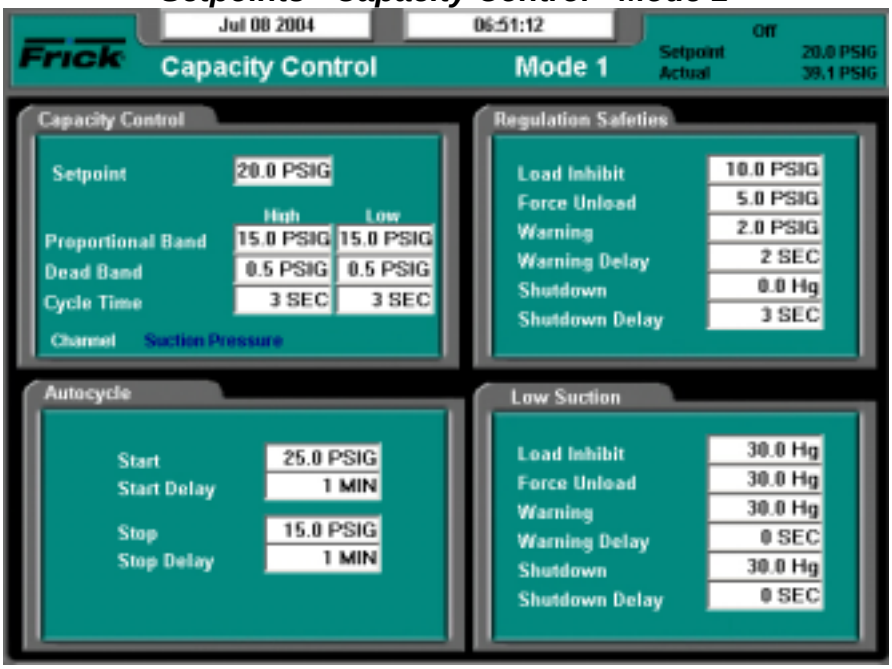
SCREEN NAME: ***Event Log***.

ACCESSING: → **System Status…** → **Event Log**

DESCRIPTION: This screen is used to log certain messages and events that are generated through normal unit operation. Occurrences such as normal power up and power down sequences, as well as all maintenance schedule messages (see the ***Maintenance*** screen for more information on these messages).

The messages that appear on this screen cannot be cleared, they will be stored indefinitely. The user can use the arrow keys on the keypad to scroll down through the list.

Setpoints - Capacity Control - Mode 1



SCREEN NAME: ***Capacity Control***.

ACCESSING: → **Setpoints…** → **Capacity…** → **Mode1**

DESCRIPTION: The Mode 1 and Mode 2 screens are identical in appearance. All setpoints having to do with Capacity Control, Autocylce, Regulation Safeties and Low Suction are found here.

CAPACITY CONTROL - The following setpoint boxes are provided:

Setpoint - This setpoint is used to control the loading and unloading of the compressor when the Slide Valve Position is in the Automatic (AUTO) mode.

Proportional Band High - A band, measured in the units of the Capacity Control setpoint, above the *Dead Band High*, where proportional load control is used. If the actual reading rises into this proportional band, the load output will be pulsed as explained below in the description about proportional band.

Proportional Band Low - A band, measured in the units of the Capacity Control setpoint, below the *Dead Band Low*, where proportional unload control is used. If the actual reading falls into this proportional band, the unload output will be pulsed as explained below in the description about proportional band.

A Note About Proportional Band: The Proportional Band setpoint determines a range of Capacity Control values where pulsed output is used. Beyond the proportional band the output is continuously energized. The length of time the output will be pulsed on is proportional to the distance the actual reading is from the Capacity Control setpoint. The further the distance from setpoint, the longer the output is pulsed on and the shorter the output is off. The closer the distance to setpoint, the shorter the output is pulsed on and the longer the output is off. If the actual reading is midpoint from setpoint, the output is on and off an equal amount of time.

Dead Band High - A band, measured in the units of the Capacity Control setpoint, above the setpoint at which the compressor will neither load nor unload.

Dead Band Low - A band, measured in the units of the Capacity Control setpoint, below the setpoint at which the compressor will neither load nor unload.

Cycle Time High - This setpoint determines the amount of time in seconds that the load output is on and off, when in the upper proportional band. Refer to the above description about cycle time.

Cycle Time Low - This setpoint determines the amount of time in seconds that the unload output is on and off, when in the lower proportional band. Refer to the above description about cycle time.

A Note About Cycle Time: The Cycle Time setpoint determines the amount of time the output is on and off, when in the proportional band. At the completion of the cycle time, the

actual reading and necessary response is re-evaluated. If a four-second period has been selected, then the following will result:

Proportional Distance Actual Reading is From Setpoint	Output Pulsed On (sec)	Output Off (sec)
0	0	4
1/4	1	3
1/2	2	2
3/4	3	1
1	4	0

The following status indicator is provided:

Channel - Shows which analog channel is being used to control this mode. The possible states of this indicator are:

- Capacity slide position
- Volume slide position
- Suction pressure
- Discharge pressure
- Oil pressure (Compressor)
- Main Oil Injection pressure
- Economizer pressure
- Filter pressure
- Intermediate pressure
- Balance piston pressure
- System discharge pressure
- Suction temperature
- Discharge temperature
- Oil temperature compressor
- Oil separator temperature
- Process/Brine temperature leaving
- Process/Brine temperature entering
- Motor Current
- RPM
- User defined analog inputs #1 - #20

AUTOCYCLE - The following setpoint boxes are provided:

Start - The compressor is started at this setpoint when it is under automatic control.

Start Delay - The minimum time in minutes that the actual Capacity Control value must equal or exceed the start autocycle (automatic cycling) setpoint before the compressor will start. This timer helps prevent cycling a compressor on and off due to short or sudden changes in load within the refrigeration system.

Stop- The compressor is stopped at this setpoint when it is under automatic control.

Stop Delay - The minimum time in minutes that the actual Capacity Control value must equal or exceed the stop autocycle (automatic cycling) setpoint before the compressor will stop. This timer helps prevent cycling a compressor on and off due to short or sudden changes in load within the refrigeration system.

REGULATION SAFETIES - The following setpoint boxes are provided**:**

- Load Inhibit
- Force Unload
- Warning
- Warning Delay
- Shutdown
- Shutdown Delay

Each of the four Regulation Modes has a set of Regulation Safeties and Low Suction Safeties. Additionally, each also has a Control Channel and is configured with a Control Direction of either *Forward* or *Reverse*. The Regulation Safety Setpoints monitor the Control Channel for their Regulation Mode.

If the Control Direction for a Regulation Mode is set to *Forward*, its Regulation Safeties are activated as the Control Channel's value drops below the Regulation Safety Setpoints.

Example:

Control Channel = Process Temperature
Control Direction = Forward
Regulation Safety Warning Setpoint = 35.0 F

Note: For the above conditions a Regulation Warning will occur if the Process Temperature drops below 35.0 F.

If the Control Direction for a Regulation Mode is set to Reverse, its Regulation Safeties are activated as the Control Channel's value rises above the Regulation Safety Setpoints.

Example:

Control Channel = Discharge Pressure
Control Direction = Reverse
Regulation Safety Load Inhibit Setpoint = 170.0 PSIG

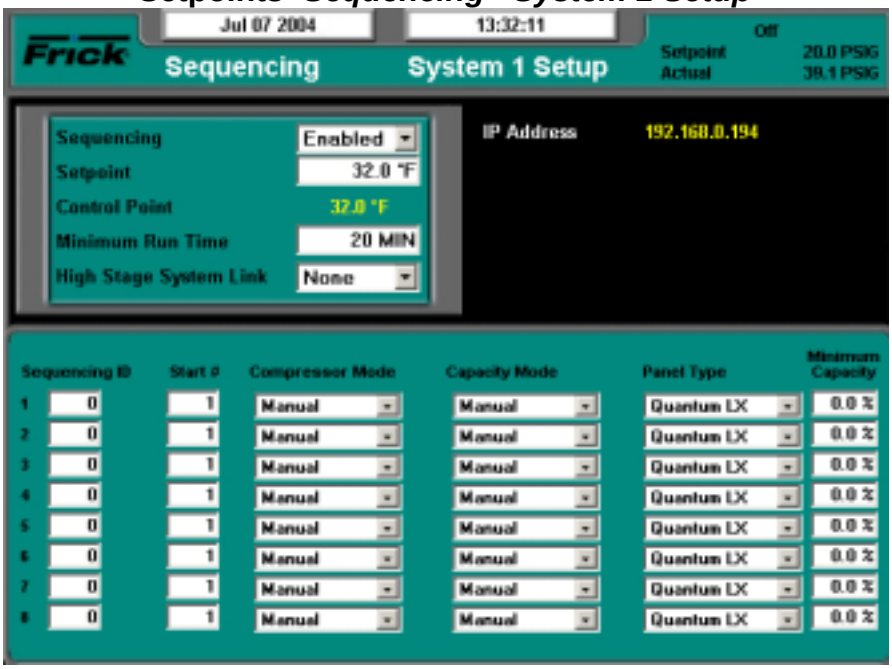
Note: For the above conditions a Regulation Load Inhibit condition will occur if the Discharge Pressure rises above 170.0 PSIG.

If a Regulation Mode's Control Channel is set to *Suction Pressure*, and its Control Direction is set to *Forward*, then both the Regulation Safeties and the Low Suction Safeties are checking for the same conditions. In this case, it is recommended that one group of safeties be set lower than the other group so that only one group will be actively monitoring the channel. Otherwise, duplicate Warning and Shutdown messages would be shown that could be confusing.

LOW SUCTION - The following setpoint boxes are provided:

- Load Inhibit
- Force Unload
- Warning
- Warning Delay
- Shutdown
- Shutdown Delay

Setpoints -*Sequencing - System 1 Setup*



SCREEN NAME: ***Sequencing - System 1 Setup***.

ACCESSING: → **Setpoints…** → **Sequencing…** → **System 1 Setup**

DESCRIPTION: This screen will be available if Sequencing is enabled in ***Compressor*** configuration. The screen shown here represents System 1. There are additionally a System 2 and a System 3 setup screen, which are not discussed further here, as all three screens show the same layout, although they may get setup using differently, using different capacity modes for example. Use these screens to setup all of the necessary operating parameters for performing compressor sequencing. The information from these three screens will be shown on the ***Sequencing Status*** screen.

The following pull-down menus and setpoint boxes are shown here:

Sequencing - Use this menu to set the current condition of System 1:

- **Disabled** - The compressors that are listed on this screen will not run as part of the sequencing scheme (System 1 will be ignored).
- **Enabled** - The compressors that are listed on this screen will run when called for as part of the sequencing scheme (System 1 will be included).

Setpoint - Use this setpoint box to set the value that you wish all compressors within this System to maintain.

Control Point - This is the actual value for the capacity control (as measured from the Master compressor). The master compressor is the unit with the lowest number shown on the Start # list. It is to this value that the compressors will attempt to maintain. This is strictly a displayed value, and cannot be changed here (it is based off of the Setpoint box directly above it).

Minimum Run Time - This is the minimum amount of time that each compressor within this system will run, when called upon to do so.

High Stage System Link - The High Stage System Link setpoint is provided to tie a system of Booster compressors to a system of High Stage compressors.

IP Address - Each compressor will have a different IP Address. This value should be entered by the network or LAN administrator, and will be shown here. Use the last three digits of this number for setting the Sequencing ID number for each compressor within the system. For example, from the IP shown on this screen, use 194 to enter into one of the eight Sequencing ID boxes at the left of the screen. This will identify which compressor is being communicated to with sequencing instructions.

There are eight rows of setpoint boxes shown at the bottom of this screen. These rows correspond to up to eight different compressors, which combined will make up this system. The user may program as few or as many of these rows as their situation requires:

Sequencing ID - Enter the last three digits of the IP Address here. This will identify each of the possible eight compressors to the Master.

Start # - Use the values of 1 - 8 here. The lowest number will identify which compressor is to be the Master. If the Master is for some reason turned off, the next lowest numbered compressor will become the Master, and so on.

Compressor Mode -

- Manual
- Automatic
- Remote Comm
- Remote IO
- Remote Seq.

Capacity Mode -

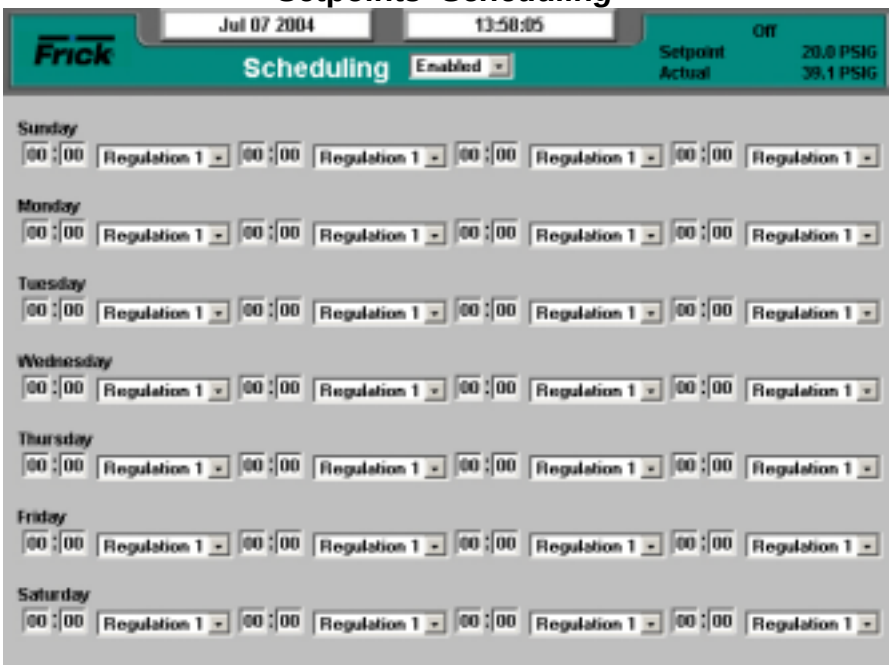
- Manual
- Automatic
- Remote Comm
- Remote 4-20
- Remote IO

Panel Type - Set this pull-down for the type of controller on each of the associated compressors. If the panel type is the Quantum / Plus version, then use the Panel ID for these units as the Sequencing ID. Ensure that the ID numbers are all different. The two selections are:

- Quantum LX
- Quantum / Plus

Minimum Capacity -

Setpoints -*Scheduling*



SCREEN NAME: ***Scheduling***.

ACCESSING: → **Setpoints...** → **Scheduling**

DESCRIPTION: Scheduling allows the user to program up to four different operating schedules for each day of the week. This can be a great way to save energy. At night or on weekends and holidays, or even over lunch periods when room doors are kept closed, or production is minimized, a higher temperature can be set to reduce energy consumption.

This screen shows a time schedule. Up to four different modes can be entered for each day of the week. The Schedule is only effective if the compressor is in automatic.

Notice that there are four columns of Hour/Minute entries, each followed by a Regulation mode (1 - 4). Use the left most column (on the row for the day of the week that you wish to schedule) to enter the time of day that you would like the compressor to switch form it's normal operating mode, into the scheduled mode. When that time of day arrives, whatever mode the compressor WAS running in, will be switched over to the scheduled (Regulation 1 -4) mode. This mode will then be the active running mode, and will continue to be the active mode until the time in the following column is reached. If the time in the next column is 00:00, it will be skipped.

The Schedule must be activated to switch the presently active Regulation mode to the *Scheduling* regulation mode at the assigned time. An entry of 00:00 will void the time entry field. If setback is required at midnight (00:00) use 00:01.

The following drop down menu is provided:

Scheduling

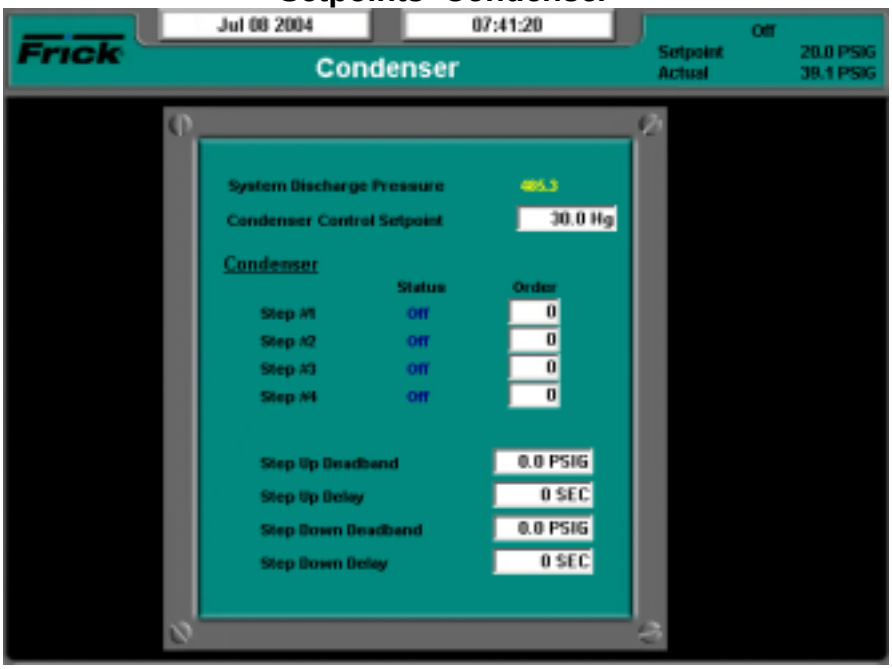
- Enabled - The user programmed Schedule will be followed.
- Disabled - The Quantum™ LX will ignore any schedule that may have been set.

The following are descriptions of the setpoints:

Time Column - The time of day that you want to switch to the Scheduled regulation setpoints of the active capacity control.

Mode Column - Set this to the Regulation Mode (1 - 4) that you want to run at the assigned time.

Setpoints -*Condenser*



SCREEN NAME: ***Condenser***.

ACCESSING: → **Setpoints…** → **Condenser**

DESCRIPTION: If *Condenser* is enabled, this screen allows the end user to enter and view the basic operating parameters related to condenser operation.

Setpoints -Communications

SCREEN NAME: ***Communications*** configuration.

ACCESSING: → **Setpoints…** → **Communications**

DESCRIPTION: This screen is used to set the compressor ID number, and the parameters for each of the three communications channels, as well as to show the status of the internal I/O board status.

The following setpoints are provided:

Compressor ID - A number that is used by an external communications application, to converse to individual compressors. On interconnected systems, this number must be unique. Valid values are from 0 - 99.

Comm1 - (Setup parameter definitions for Comm1, 2, and 3 are identical) Communications related information for the communications ports:

Status - Shows the current communications status of the port. The possible messages are:

- **Off** - No communications are currently taking place. NOTE: A delay of 15 seconds or more of inactive communications (time between valid responses) will cause this message to display.
- **Active** - Valid communications are actively occurring.
- **Failed** - An invalid command was received by the port. This could be due to a bad checksum value, a wiring issue, or hardware problem at either the transmitting (host) or receiving (Quantum™ LX) end.

Baud Rate - Allows for the following selections:

- 1200
- 2400
- 4800
- 9600
- 19200
- 38400
- 57600
- 115200

Data Bits - Allows for the following selections:

- 7
- 8

Stop Bits - Allows for the following selections:

- 1
- 2

Parity - Allows for the following selections:

- None
- Even
- Odd

RS-485 Connection - Allows for the following selections:

- No
- Yes

Protocol - Allows for the following selections:

- None
- Frick

- ModBus ASCII
- ModBus RTU
- AB DF1 Full Duplex
- AB DF1 Half Duplex
- DBS Motor Starter
- Vyper

Map File - Allows for the following selections:

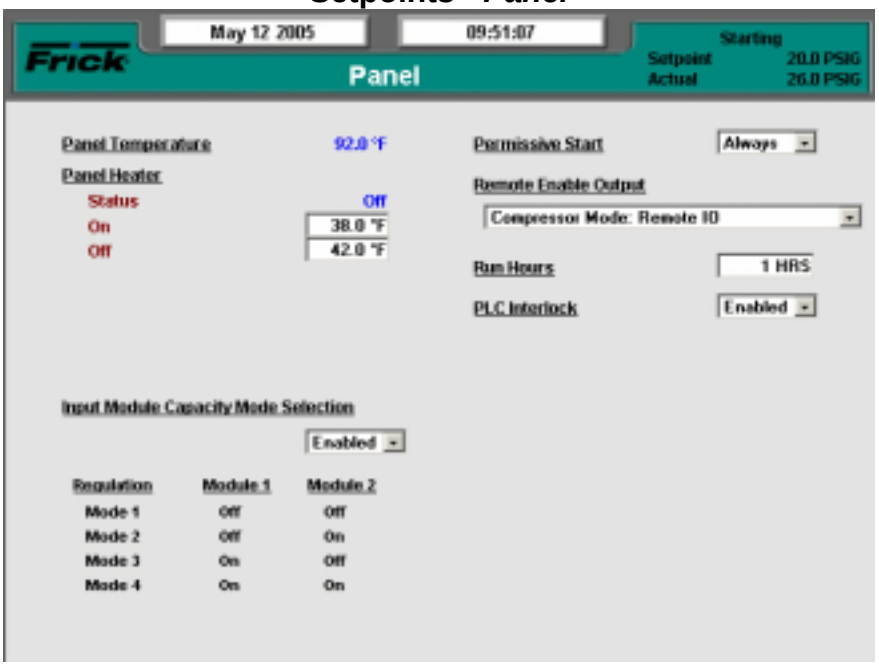
- No
- Yes

I/O Comms - A status indicator is provided to show the current state of the internal communications of the I/O boards. The possible displayed states are:

- Off
- Active
- Failed

Select this key to detect all connected Analog and Digital boards. If a board has been removed, a communication error shutdown will be issued until this key is selected. Reference the ***About*** screen to view what has been detected.

Setpoints - *Panel*



SCREEN NAME: ***Panel*** configuration.

ACCESSING: → **Setpoints…** → **Panel**

DESCRIPTION: This screen is used to view and set basic compressor operational values.

The following information is provided:

Panel Temperature - The main processor board is equipped with a temperature sensor. The panel has an operational temperature range that should be maintained. The operational temperature range is documented in the specifications document.

Panel Heater - A Status message is showing the current state of the Panel Heater:

- **Off** - Panel Heater is Off
- **On** - Panel Heater is On

Whether the Panel Heater is On or Off is determined by the setting of the following two setpoints:

- **On** - If the sensor on the main processor board detects that the temperature is less than or equal to this setpoint, the Panel Heater output is turned on.
- **Off** - If the sensor on the main processor board detects that the temperature is greater than or equal to this setpoint, the Panel Heater output is turned off.

The following pull-down boxes are provided:

Permissive Start -

Remote Enable Output -

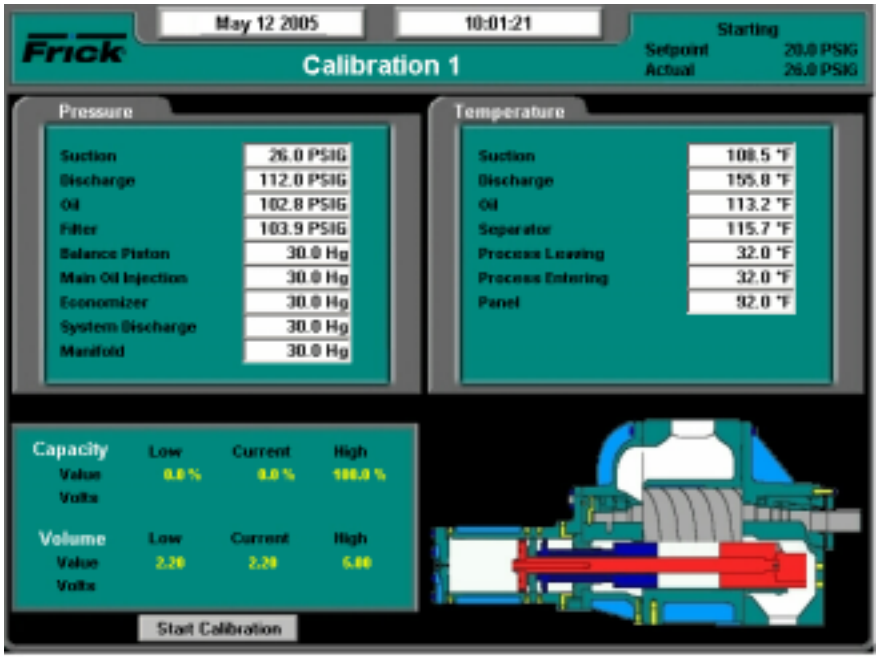
Run Hours -

PLC Interlock -

Input Module Capacity Mode Selection -

- Disabled
- Enabled

Calibration 1



SCREEN NAME: ***Calibration 1***.

ACCESSING: → **Calibration 1**

DESCRIPTION: This screen is used to view and set calibration values.

This screen should be used anytime a sensor is found to be out of calibration. The recommended practice for adjusting the calibration reading is to first determine which sensor(s) need to be calibrated. Once this is determined, you must know the actual reading that the sensor should be showing, This can be accomplished by comparing the displayed reading shown here, with the actual value using a separate measurement device, such as a Digital Volt Meter, or temperature probe, etc. Determine the difference between what the screen reading for the sensor is, and what the reading of the separate device shows. As an example, assume that the Suction Temperature on this screen reads 120° F, but a separate device is showing a reading of 123° F. Highlight the setpoint box for Suction Temperature, and enter the value of 123. The new reading will now read 123, and should match your separate reading.

The following fields are provided:

Pressure - The following sensor values are displayed along with the unit of measure:

Suction Pressure - This value is measured at the compressor inlet .

Discharge Pressure - This value is measured at the compressor outlet.

Oil Pressure - This value is measured prior to entering the compressor.

Filter (Differential) - If applicable, shows the pressure drop across the oil filter. The main oil injection oil filter pressure drop value (differential) is displayed along with the unit of measure.

Balance Piston - If applicable, the Balance Piston pressure reading is displayed along with the unit of measure. This reading is a measurement of the presence at the Balance Piston.

Main Oil Injection -

Economizer -

System Discharge -

Temperature - The following sensor values are displayed along with the unit of measure:

Suction Temperature - This value is measured at the compressor inlet.

Discharge Temperature - This value is measured at the compressor outlet.

Oil Temperature - This value is measured prior to entering the compressor.

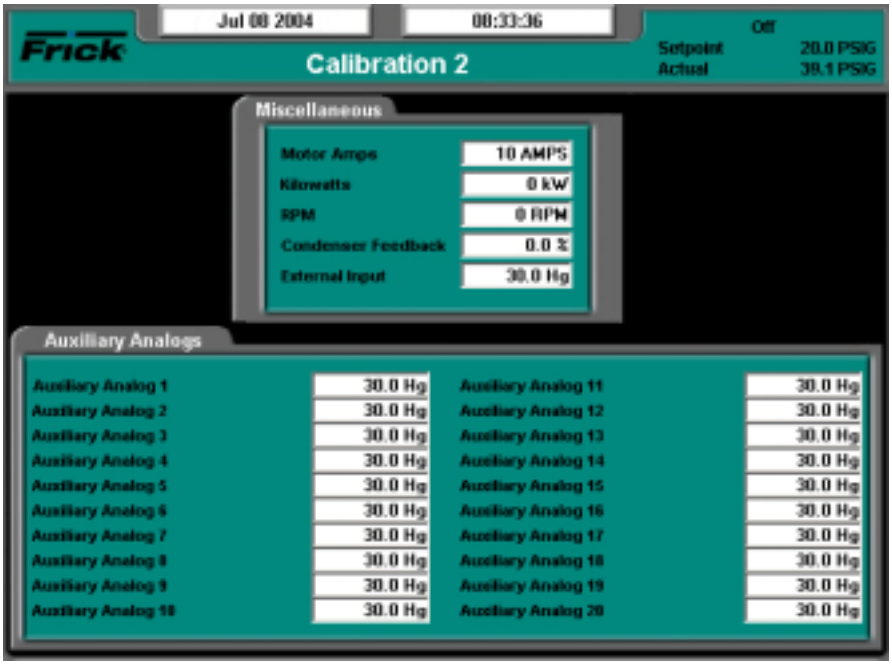
Separator Temp. - Oil Separator Temperature value is displayed.

Process Leaving - If *Process Temperature Control Modes* were enabled in Panel Setup, the Leaving Process Temperature value is displayed.

Process Entering - If *Process Temperature Control Modes* were enabled in Panel Setup, the Leaving Process Temperature value is displayed.

Panel - This reading is measured on the Quantum™ LX controller itself, and shows the actual board temperature value.

Calibration 2



SCREEN NAME: ***Calibration 2***.

ACCESSING: → **Calibration 2**

DESCRIPTION: This screen is used to view and set calibration values.

This screen should be used anytime a sensor is found to be out of calibration. The recommended practice for adjusting the calibration reading is to first determine which sensor(s) need to be calibrated. Once this is determined, you must know the actual reading that the sensor should be showing, This can be accomplished by comparing the displayed reading shown here, with the actual value using a separate measurement device, such as a Digital Volt Meter, or temperature probe, etc. Determine the difference between what the screen reading for the sensor is, and what the reading of the separate device shows. As an example, assume that the Suction Temperature on this screen reads 120° F, but a separate device is showing a reading of 123° F. Highlight the setpoint box for Suction Temperature, and enter the value of 123. The new reading will now read 123, and should match your separate reading.

The following fields are provided:

Miscellaneous - The following sensor values are displayed along with the unit of measure:

Motor Amps - This value is measured directly at the Channel 16 input of analog board 1.

Kilowatts -

RPM -

Condenser Feedback -

External Input -

Auxiliary Analogs - The following sensor values are displayed along with the unit of measure:

Auxiliary Analog 1 -

Auxiliary Analog 2 -

Auxiliary Analog 3 -

Auxiliary Analog 4 -

Auxiliary Analog 5 -

Auxiliary Analog 6 -

Auxiliary Analog 7 -

Auxiliary Analog 8 -

Auxiliary Analog 9 -

Auxiliary Analog 10 -

Auxiliary Analog 11 -

Auxiliary Analog 12 -

Auxiliary Analog 13 -

Auxiliary Analog 14 -

Auxiliary Analog 15 -

Auxiliary Analog 16 -

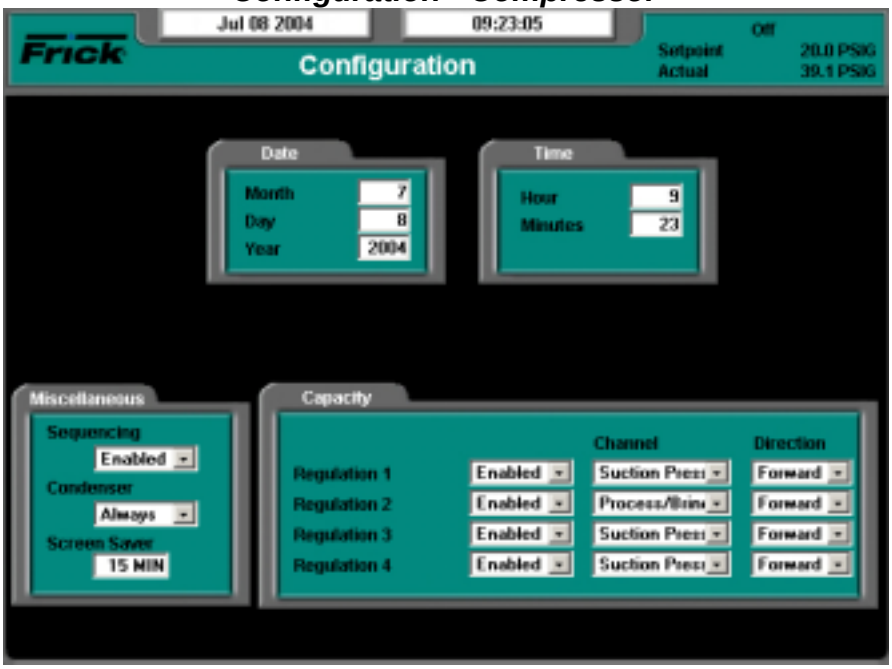
Auxiliary Analog 17 -

Auxiliary Analog 18 -

Auxiliary Analog 19 -

Auxiliary Analog 20 -

Configuration - Compressor



SCREEN NAME: ***Compressor*** configuration.

ACCESSING: → **Configuration…** → **Compressor**

DESCRIPTION: This screen is used to view and set basic compressor operational values. It is from this screen that most of the compressors operating characteristics are set.

The following drop-down menus are provided:

Date:

- Month (1 - 12)
- Day (1 - 31)
- Year (2000 - 2050)

Time:

- Hour (0 - 23)
- Minutes (0 - 59)

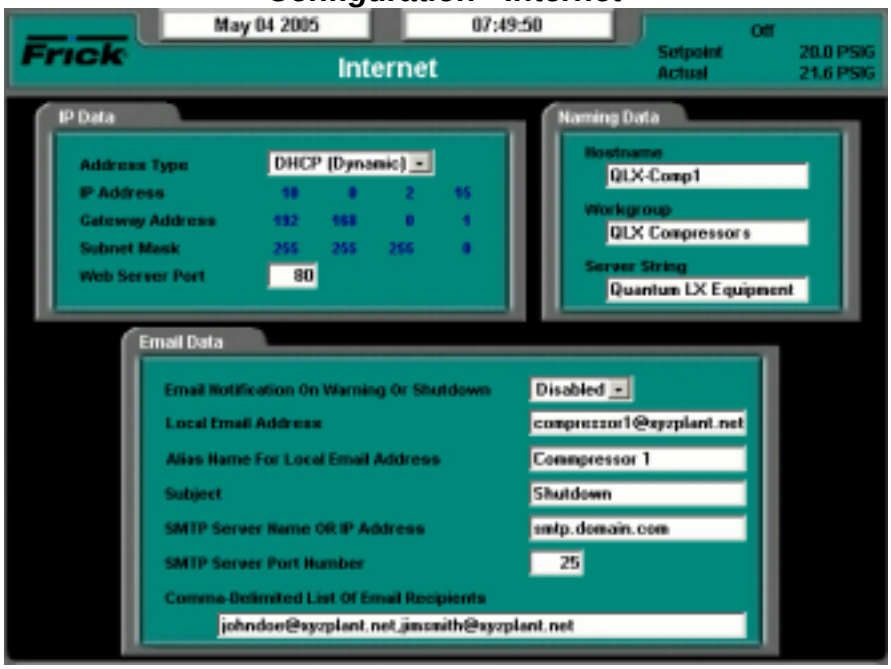
Miscellaneous:

- Sequencing
  - Disabled
  - Enabled
- Condenser
  - Disabled
  - Running
  - Always
- Screen Saver (0 - 60 Min.)

Capacity:

- Regulation 1, 2, 3 and 4
  - Disabled
  - Enabled
- Channel
  - Capacity slide position
  - Volume slide position
  - Suction pressure
  - Discharge pressure
  - Oil pressure (Compressor)
  - Main Oil Injection pressure
  - Economizer pressure
  - Filter pressure
  - Intermediate pressure
  - Balance piston pressure
  - System discharge pressure
  - Suction temperature
  - Discharge temperature
  - Oil temperature compressor
  - Oil separator temperature
  - Process/Brine temperature leaving
  - Process/Brine temperature entering
  - Motor Current
  - RPM
  - User defined analog inputs #1 - #20
- Direction
  - Forward
  - Reverse

Configuration - Internet



SCREEN NAME: ***Internet*** configuration.

ACCESSING: → **Configuration…** → **Internet**

DESCRIPTION: This screen is used to view and set basic internet operational values. It is from this screen that all internet and e-mail based operating characteristics are set. **NOTE:** A valid internet account and connection must be available for this feature to function. Refer to S90-020 CS for additional information.

The following fields are provided:

IP Data

Address Type - The following drop-down menu is provided:

- Fixed (Static)
- DHCP)Dynamic)

This should be set by the network or LAN administrator.

IP Address - Four setpoint boxes are provided here. The network or LAN administrator will enter the numerical IP address for this specific compressor unit.

Gateway Address - Four setpoint boxes are provided here. The network or LAN administrator will enter the numerical Gateway address.

Web Server Port - One setpoint box is provided here. The network or LAN administrator will enter the numerical address for this Web port.

Naming Data

NOTE: The IP Address Type must be set to DHCP (Dynamic) for this section to work.

Host Name – Enter here a distinct name that you wish to be able to identify this particular compressor by (for example; Unit1).

Work Group – All of the Quantum™ LX units within a network may be grouped into different categories. These categories could be unit locations, or perhaps categorized by unit function.

Server String – This is a comment area that can be used in conjunction with the Host Name.

Email Data

Email Notification On Alarm or Shutdown - For the E-mail notification feature to work, it must be enabled (it is disabled as a default). The following drop-down menu is provided:

- Disabled
- Enabled

Local Email Address - Use this setpoint box to enter a valid E-mail address that has been assigned to the internet account.

Alias Name For Local Email Address - Enter here a custom name to identify more clearly the local Email address. When a message is sent to all recipients, this is the name that will appear in the Email *FROM* column.

Subject - Enter here a custom subject that you would like to have appear when a message failure is sent. When a message is sent to all recipients, this is the wording that will appear in the Email *SUBJECT* column.

SMTP Server Name OR IP Address - SMTP stands for **S**imple **M**ail **T**ransfer **P**rotocol. This should be set by the network or LAN administrator.

SMTP Server Port Number - This value is in almost all cases going to be 25. This should be set by the network or LAN administrator.

Comma-Delimited List of Email Recipients - This is simply the list of the Email addresses that you would like to have any messages sent to.

Configuration - Security

SCREEN NAME: ***Security*** configuration.

ACCESSING: → **Configuration…** → **Security**

DESCRIPTION: This screen allows the user/supervisor to set the various levels of password protection. The Security screen shown above can only be modified at the Quantum™ LX control panel via the keypad.

The various levels are:

- **Level 0** - Also known as the BASIC level. This level is not shown on the Security screen, as it is the lowest level of system access, and as such, does not require a password to activate. This is the default level, and provides access to only the very basics of machine operation.

- **Level 1** - Also known as the ADVANCED level. This requires a password to set. Only those users who are authorized with the password may enter this level. It provides greater access than Level 0 (BASIC). The valid entry range is zero (0) to 5000.

To set the password protection for the each level, use the keypad to highlight the box beside the level that you wish to change. Set the level to either zero (0) or one (1), and enter the appropriate password for that level in the next box The valid range for password entry is -999999 to 999999.

NOTE: It is highly recommended that the supervisor documents this password and stores it in a safe place. If the password is ever forgotten, it can only be corrected by calling the factory.

Session

SCREEN NAME: ***Session***.

ACCESSING: → **Session**

DESCRIPTION: This screen allows the user/supervisor to access the various available user levels. This is also where the user can select the language, pressure units, temperature units and date format.

The following Setpoints may be changed:

User Level - One of two possible levels may be accessed here. Level one (0) is also referred to as the BASIC level, and requires no password. Level one (1) is referred to as ADVANCED, and requires a password.

Password - The factory default password for Level 1 is ***10***. It is recommended that the supervisor change this factory assigned password to a custom password, much like a PIN (Personal Identification Number). Write the new password down in a secure location, and ensure that the password is known by only those individuals (users) that you wish to have access to the associated level. The user must match the password for the particular level that they wish to access. **Note:** Level 0 (Basic) does not require a password.

The following pull-down menus have been provided:

Language - You may choose from the following list:

- English
- French
- Chinese
- Portuguese

Pressure Units - You may choose from the following list:

- Kpaa
- Bar
- BarA
- PSIA
- PSIG/hg

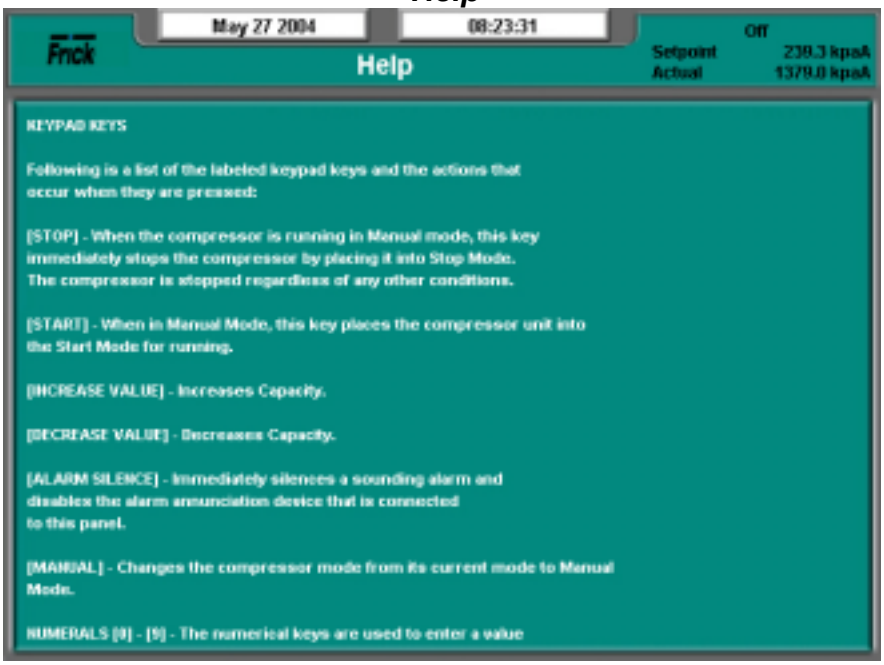
Temperature Units - You may choose from the following list:

- Celcius
- Fahrenheit

Date Format - You may choose from the following list:

- US
- Europe

Help



SCREEN NAME: ***Help***.

ACCESSING: → **Help**

DESCRIPTION: This screen provides the user with specific information as to the function of all keypad keys, as well as all screen keys, and changing Setpoints.

KEYPAD KEYS

This screen provides a written description for each of the keys on the keypad. Refer to page 4 for more information.

SCREEN KEYS

TO CHANGE THE ADJUSTABLE SETPOINTS

The adjustable setpoints define the operation and limits of the compressor unit and subsystems operation. Adjustable Setpoints are stored in EEPROM (non-volatile memory) and are easily changed in the field.

NOTE: Adjustable Setpoints are not lost after power is interrupted. However, we suggest that a list of Adjustable Setpoints be recorded and stored safely to facilitate reentry, in case there is a need to return to the original settings.

The **[TAB]** key is used to maneuver around the screen.

Use the arrow keys to move the cursor to the data entry field to be modified.

Having selected the setpoint to be changed, the numerical keys and the decimal key may be used to enter the new setpoint. Typing a new value will completely erase the old value.

To remove a typing mistake, the left and right arrow key can be used to position the cursor on the mistake and then use the **[BACKSPACE]** key to erase it.

Press the **[ENTER]** key to input the new data in the data entry field.

If the value is out of bounds, an error message box shows and displays the proper value range. Press the **[OK]** key to acknowledge that you saw the error message. Re-enter the correct value.

Pressing the **[Enter]** key inputs the new setpoint and selects the next data entry field.

When finished making any changes to the data on an adjustable setpoint, press the **[SUBMIT]** key to accept all changes or select another screen to cancel all of the data changes.

Note: When the display units are selected to display in PSIG, an entry of a pressure value above 29.7 is assumed to be PSIG, an entry less than or equal to 29.7 will cause a message box to appear after pressing the **[ENTER]** key. This message prompts the operator to select the unit of measure. The operator must select either the **[HG]** or the **[PSIG]** key.

To resume normal operation it will be necessary to go through the following steps:

Correct the conditions causing the alarm.

Press the **[ALARM SILENCE]** key. (This action may precede correcting the conditions causing the alarm).

To clear or reset the Warnings/Shutdowns, from the ***Current Safeties*** screen press the **[Clear Safeties]** key. This will also clear the WARNING or SHUTDOWN message from the ***Operating Status*** screen.

If the conditions causing the fault have not been corrected or a new fault has occurred, a new WARNING or SHUTDOWN message will appear. The Warning/Shutdowns history screen keeps a record of the warnings and shutdowns. This information will help troubleshoot persistent operational problems.

About

SCREEN NAME: ***About***.

ACCESSING: → **About**

DESCRIPTION: The ***About*** screen shows all microprocessor-based circuit boards that have been detected by the Quantum™ LX, as well other related software information.

The following information is shown here:

Linux Kernel - The Quantum™ LX controller runs on a Linux programming architecture (rather than Microsoft Windows). This is the software version number for the main Linux Kernel (or program).

York Quantum Software - This is the version of the software program that does the actual control of the compressor. It runs in the Linux environment.

Sales Order - A six digit numerical value that has been assigned to a specific compressor package by Frick Company. It is very important to have this number available when calling the factory for assistance or parts ordering.

Item - This is actually an extension of the Sales Order number. It would potentially be used for a multiple compressor site, where the same Sales Order number was assigned for all compressors. The Item Number would be different for each compressor.

Analog Boards - Shows all analog boards that were detected through communications at the last power up. If a board is detected, the software version of the program running on that board (with date of the software) will be shown.

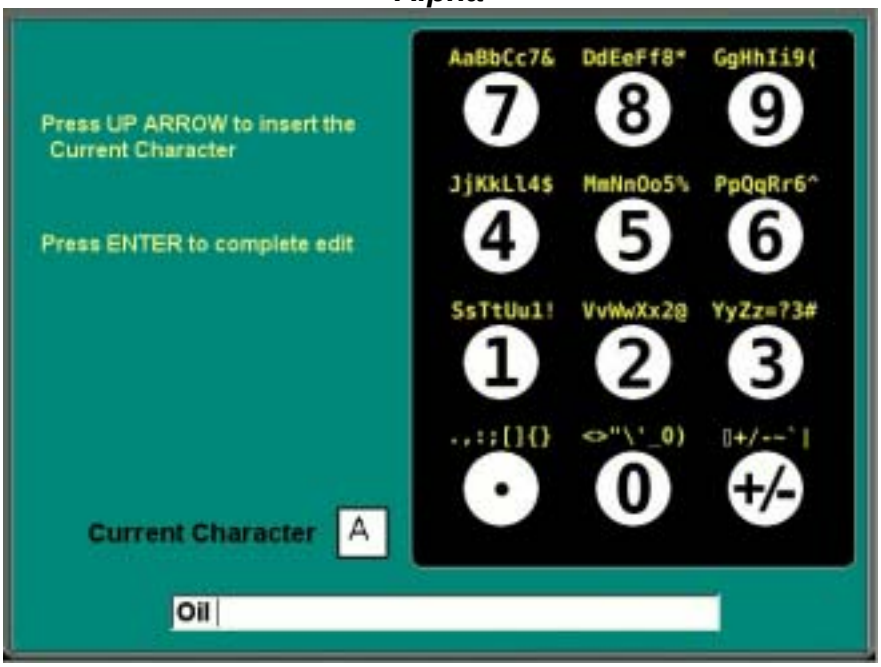
Digital Boards - Shows all digital boards that were detected through communications at the last power up. If a board is detected, the software version of the program running on that board (with date of the software) will be shown.

IO Boards - Shows all other I/O boards that were detected through communications at the last power up. If a board is detected, the software version of the program running on that board (with date of the software) will be shown.

Drive Controller - Shows motor or engine drive controllers that were detected through communications at the last power up. If a board is detected, the software version of the program running on that board (with date of the software) will be shown.

MISCELLANEOUS SCREENS

Alpha



The ***Alpha*** screen shows a graphic representation of the Quantum™-LX numerical keypad. It is accessible from any screen that allows the user to enter alpha/numeric data, such as the ***Maintenance*** screen, for example. The symbols that appear above each key on this screen, are the possible combinations of symbols that are associated with the digital portion of the key. As an example, by pressing the number 7 on the keypad will cause an alpha ***A*** to appear in the *Current Character* box. Pressing the number 7 again will cause the capital ***A*** to be replaced with a small ***a*** (this is the next letter in the line above the numeral 7). Continuing to press the 7 key will cycle through the remaining letters above the key, and then start over.

As a example, suppose that you wanted to modify the text line in the screen example shown above. You want to change the line from reading *Oil*, to *Low Oil 2*. The first thing you would do, is to use the **[Left Arrow]** key on the keypad, to position the cursor (blinking vertical line), to the far left side of the text. Press the number **[4]** key (notice that the capital ***L***, for ***L***ow, is one of the symbols in the line right above the numeral **[4]** key). A capital ***J*** will appear in the *Current Character* box. Continue press the numeral **[4]** until the capital ***L*** appears there. Now press the **[Up Arrow]** key, and notice that the ***L*** has been placed on the text line in the first position. Next press the numeral **[5]** key on the keypad, and continue pressing it until the small ***o*** appears in the *Current Character* box. Press the **[Up Arrow]** key to place the ***o*** on to the text line. Now to finish the word Low, press the **[2]** key until the small ***w*** appears in the Current Character box, then press the **[Up Arrow]**. This will complete the word Low, but we need to add a space after it. The symbol for a space is ‾, which is located above the **[+/-]** key. Press the [+/-] key, until the Current Character box contains nothing (the ‾ does not appear) then press the **[Up Arrow]** key to enter it on the text line. Finally, use the **[Right Arrow]** key, to move the blinking cursor to the right of the word *Oil*, and press the [Up Arrow] key again to enter the space (since the space was the last character entered, it can continue to be placed as many times as you would like on the line by pressing the **[Up Arrow]** key). After entering the space, press the numeral **[2]** key until the digit *2* appears in the *Current Character* box, then press the **[Up Arrow]** key. When you are satisfied with the changes that you have made, press the **[Enter]** key to accept them, and you will be returned to the previous screen.

With a little practice, the process for entering custom text will become more understandable.

OPERATION OVERVIEW

Initial Setup Procedure

1. Compressor Configuration should be performed by a Factory Representative or Distributor to setup the customer specific control features which should not need to be changed by operators.

2. *Configuration* is performed to setup panel features and options, which can later be changed by an operator. Features such as the panel time, and screen saver are changed here. Options such as Condenser Control are enabled here. The operator can avoid viewing and entering settings of unused controls by keeping unused options disabled.

3. Calibrate the control devices.

4. Enter and setup all control settings.

5. Establish the desired access rights of the operators.

6. The ***Operating Status*** screen now provide quick access to the most important information and controls of the compressor unit and the subsystems.

Compressor Start-Up Procedure

- Starting is shown for the Compressor status on the ***Operating Status*** screen.

- All the safeties are checked. If any shutdown condition is present the corresponding alarm message is shown and the compressor is prevented from starting.

- If the compressor type has been set to ***Other Compressor***:

    - The oil lubrication is checked. A Prelube pump needs a 5 lb. oil pressure differential to allow the compressor to start. A full time pump needs a 20 lb. Oil Pressure differential to allow the compressor to start. Other compressor manufacture's Oil Pumps needs a 30 lb. Oil Pressure differential to allow the compressor to start. If one of these conditions is not present an alarm message is issued and the compressor is prevented from starting.

- The Slide Valve position is checked to see if it is less than or equal to the *Highest Slide Valve Position to allow starting the compressor* setpoint. If the Slide Valve position is higher than this, the compressor is prevented from starting.

- If none of the above conditions has prevented the compressor from starting, a timer delay is started that requires the starting conditions to remain satisfied for a period of five seconds for all compressor model types except **[Other Compressor Manuf.]**. The *Other* compressor model type uses a 20 seconds delay. After the time delay the compressor and the Recycle Delay timer are started.

- If within 30 seconds, the Compressor Start Auxiliary input has not been energized, or Motor Current is not detected, then an alarm message is issued and the compressor is shut down.

- When the compressor begins running, the Oil Pressure values are in a state of change. For a period of 10 seconds after the compressor status switches to *Running*, the low Oil Pressure alarm and shutdown safeties are ignored.

Compressor Stopping Procedure

During the compressor stopping, the Slide Valve unload solenoid remains energized until the Slide Valve is unloaded to or below the *Highest slide valve position to allow starting the compressor* setpoint. If the Slide Valve does not unload below this setpoint within 5 minutes, the alarm message *Compressor Unable to Unload - Alarm* is issued.

Setup For Automatic Control

In order to operate a compressor at peak efficiency, under full load and part load conditions complex control sequences must be used. In order to obtain the efficiencies, Automatic Control is almost mandatory. Automatic control of the Slide Stop and Slide Valve increases the compressor efficiency over a wide operating range. The following steps (which are relevant) should be taken to control in Automatic:

- The compressor should be in automatic (automatic cycling) so the compressor will start and stop according to the Autocycle setpoints.

- The Oil Pump should be in auto because it's operation coincides with that of the compressor.

- The Slide Valve and the Slide Stop should be in Automatic so they are controlled by setpoints and internal control logic.

Note: If there is a shutdown in response to a safety setting, a compressor in *Automatic* mode is placed into *Manual* mode requiring operator intervention.

Remote Control Of The Compressor

The following digital outputs and inputs (on Digital Board 2) have been provided that can be used to control the compressor from another controller such as a PLC:

- (Module 1) - **Ready to Run** - This output is energized while the compressor is not shutdown and the Recycle Delay has timed out.

- (Module 2) - **Remote Enabled** - This output is energized while the compressor is in Remote Start mode.

- (Module 3) - **Remote Start / Run / Stop** - If the compressor is in Remote Start mode with no Recycle Delay time and this input is energized, the compressor is started. If this input is

energized and the compressor is started, it will continue to run. If this input is de-energized, the compressor is stopped.

- (Module 4) - **Remote Load or Remote C.C step 1 for step units**
  - Remote Load - If the Slide Valve is in Remote Mode and this input is energized, the Slide Valve load solenoid will be energized provided there are no safety overrides preventing loading.
  - Remote C.C step 1 for step units - If the Capacity Mode is in Remote this input is used to step on and off capacity according to the Remote Capacity Control chart.
- (Module 6) - **Remote Unload or Remote C.C step 2 for step units**
  - Remote Unload - If the Slide Valve is in remote and this input is energized, the Slide Valve unload solenoid will be energized.
  - Remote C.C step 2 for step units - If the Capacity Mode is in Remote this input is used to step on and off capacity according to the Remote Capacity Control chart.

Remote Capacity Control Chart

nput \ %Capacity	**25**	**50**	**75**	**100**
3-Step Input 4		OFF	OFF	ON
3-Step Input 5		OFF	ON	ON
4-Step Input 4	OFF	ON	OFF	ON
4-Step Input 5	OFF	OFF	ON	ON

- Recycle Delay (If compressor is off) - This output is energized while the remaining time in minutes for Recycle Delay is greater than zero (0). Recycle delay time is the time that must elapse prior to allowing the compressor to restart. This timer times out while the compressor is running or stopped since the Recycle Delay is a start-to-start protection. The Recycle Delay time is intended to prevent damage to the motor from successive restarts. For further setup see the ***Motor Control Setpoints*** screen
- Sequence Input (If compressor is on) – Reports the status of Stop Load or Force Unload (See Slide Valve and Slide Stop Status box for further details).

The *Hot Gas Bypas* option can be used. This option, is not available for all compressor models (Reference S90-020 M; *Compressor Model Differences*).

The Remote Control Setpoint option can be used. This option, which is enabled in Panel Setup, is not available for all compressor models (Reference *Compressor Model Differences*). This uses the Remote Control Setpoint analog input and the Remote Control Setpoint analog output for Capacity Control of compressors. For further setup see the ***Calibrate Remote Control Setpoint*** screen and the **[Remote Setpoint]** command key from the Slide Valve Mode screen command keys on the ***Operating Status*** screen.

The Remote Slide Valve Position option can be used. This option which is enabled in Panel Setup is not available for all compressor models (Reference *Compressor Model Differences*). This uses a (4-20 ma) input signal to the Remote Slide Valve Position analog input (Channel #13 on Analog Board #1) to control the Slide Valve. For further setup see the ***Calibrate Slide Valve Position*** screen and the **[Remote Slide Valve]** command key from the Slide Valve Mode screen command keys on the ***Operating Status*** screen.

The Slide Valve Position \ Capacity analog output can be used to determine the present Slide Valve position % or Capacity % dependent on the compressor model (Reference *Compressor Model Differences*). A (4-20 ma) output signal to the Slide Valve Position \ Capacity analog output (Channel #3 on Analog Board #1) corresponds to the present (%) value displayed on the ***Operating Status*** screen.

ASCII communication to the Com-2 port can be used (reference S90-010 CS Communications Setup manual). A compressor should be in both Remote Compressor Mode and Remote Slide Valve or Capacity Mode for Remote Control.

Note 1: If the compressor is in *Remote* mode and communication through the communication port has not occurred for 5 minutes, then the compressor is placed into *Automatic* mode and the Slide Valve is placed into *Auto* mode.

Note 2: If there is a shutdown in response to a safety setting, a compressor in *Remote* mode is placed into *Manual* mode requiring operator intervention.

Warnings/Shutdowns Messages

When a Shutdown occurs, the display backlight will flash on and off to alert an operator of the shutdown. This visual warning will help get the attention of the operator in a noisy engine room environment where audible alarms may not be heard. Pressing any key on the keypad will clear the flashing backlight.

NOTE: refer to S100-200/210 IOM for further Vyper message details.

Following is the alphabetical listing of all the possible conditions:

Analog Board 1 Communications Shutdown - It has been detected that the program is no longer able to communicate to Analog Board 1.

Analog Board 2 Communications Shutdown - It has been detected that the program is no longer able to communicate to Analog Board 2.

Auxiliary Input 1-20 Shutdown - The Auxiliary #1-20 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

Auxiliary Input 1-20 Warning - The Auxiliary #1-20 input module has been setup to indicate a warning when it is de-energized and it became de-energized.

Balance Piston 1 Shutdown - Balance piston control has been enabled. This shutdown will occur if the difference between Discharge Pressure and Suction Pressure is less than 60 lb. and the Balance Piston output module (digital output module 12) is de-energized, then the Balance Piston pressure must be 1.1 times Suction Pressure plus or minus 15 lb.

Balance Piston 2 Shutdown - Balance piston control has been enabled. This shutdown will occur if the difference Discharge Pressure and Suction Pressure is greater than or equal to 60 lb. and the Balance Piston output module (digital output module 12) is de-energized, then the Balance Piston pressure must be 50 lb. below Discharge Pressure plus or minus 15 lb.

Balance Piston 3 Shutdown - Balance piston control has been enabled. This shutdown will occur if the Balance Piston output module (digital output module 12) is energized, then Balance Piston pressure must be within 20lb. of Oil Pressure.

Compressor Auxiliary Shutdown - This shutdown message is issued if while the compressor is running, the Compressor Auxiliary input module, which receives feedback from the motor starter, becomes de-energized.

Compressor Capacity Unload Warning - While stopping the compressor or if the compressor is off, this indicates that the Slide Valve position has not unloaded below the *Highest Slide Valve Position to allow starting the compressor* setpoint.

DBS Communication Failure Warning – It has been detected that the program is no longer able to communicate to a RAM DBS Motor Starter.

DBS - Communication Failure Shutdown - It has been detected that the program is no longer able to communicate to a RAM DBS Motor Starter.

DBS - Current Unbalance – Either the current between two phases has exceeded the setpoint value longer than the time delay setpoint, or there is a voltage unbalance between phases, or the SCR operation is abnormal.

DBS - Heatsink Over-temperature – Either the temperature of the heat sink has exceeded the maximum safe operating temperature of 85 deg. C. or heat sink cable connection P2 is loose.

DBS – Jam – The current exceeded the Jam Trip level set point longer than the time delay set point while in the RUN state.

DBS - Phase Loss – This will occur if there is a loss of at least one phase of supply voltage or the loss of at least one phase of current feedback.

DBS - Phase Reversal – Either there is an incorrect phase order at the DBS chassis input terminals, or the control power was applied before the three phase power.

DBS - RTD Overtemperature –The RTD temperature sensor is out of range.

DBS - RTD Temperature – The RTD temperature sensor is out of range.

DBS - Short Circuit – The current exceeded 800% of FLA set point while the motor was starting.

DBS - Shorted SCR – This failure may occur if there is a defective SCR or a defective bypass contactor. It may also occur if the motor is disconnected. Also, inspect the main contacts of the bypass contactor.

DBS - Thermal Overload – Either the calculated thermal capacity of the motor exceeded 100% of limit, or the motor is "short-cycling".

Digital Board 1 Communications Shutdown - It has been detected that the program is no longer able to communicate to Digital Board 1.

Digital Board 1 Reset - If a reset of Digital Board 1 occurs, a shutdown will result to prevent the motor from restarting.

Digital Board 2 Communications Shutdown - It has been detected that the program is no longer able to communicate to Digital Board 2.

Digital Board 2 Reset - If a reset of Digital Board 2 occurs, a shutdown will result to prevent the motor from restarting.

Discharge Temperature Saturation Shutdown - This Shutdown applies if Superheat has been enabled. When running, a shutdown will occur if TDsat plus setpoint temperature is greater than the Discharge Temperature for the setpoint time.

Discharge Temperature Saturation Warning - This warning applies if Superheat has been enabled. When running, a warning will occur if TDsat plus setpoint temperature is greater than the Discharge Temperature for the setpoint time.

False Running Failure -- Compressor Confirmed Running Input - This shutdown message is issued if while the compressor is off the compressor auxiliary is energized. While this condition is present, the Oil Pump (if available) is on, and Liquid Injection (if available) is allowed on and the Slide Valve is unloaded to 0% to safeguard the compressor.

False Running Failure -- Motor Amps - This shutdown message is issued if while the compressor is off, the Motor Current reading is above the *Low Motor Amps Shutdown* setpoint. While this condition is present, the Oil Pump (if available) is on, and Liquid Injection (if available) is allowed on and the Slide Valve is unloaded to 0% to safeguard the compressor.

High Auxiliary Analog 1-20 Shutdown - The Auxiliary Analog #1-20 value was greater than or equal to the high Auxiliary Analog #1-20 shutdown setpoint for its time delay.

High Auxiliary Analog 1-20 Warning - The Auxiliary Analog #1-20 value was greater than or equal to the high Auxiliary Analog #1-20 warning setpoint for its time delay.

High Compressor Vibration Shutdown - Suction - If the Suction End Compressor Vibration sensor registers a reading that is higher than the value that has been set for the *Suction End High Shutdown*, for the period of time as set for the *Suction End High Shutdown Delay*, a Shutdown will be generated.

High Compressor Vibration Warning - Suction - If the Suction End Compressor Vibration sensor registers a reading that is higher than the value that has been set for the *Suction End High Warning*, for the period of time as set for the *Suction End High Warning Delay*, a Warning will be generated.

High Compressor Vibration Shutdown - Discharge - If the Discharge End Compressor Vibration sensor registers a reading that is higher than the value that has been set for the *Discharge End High Shutdown*, for the period of time as set for the *Discharge End High Shutdown Delay*, a Shutdown will be generated.

High Compressor Vibration Warning - Discharge - If the Discharge End Compressor Vibration sensor registers a reading that is higher than the value that has been set for the *Discharge End High Warning,* for the period of time as set for the *Discharge End High Warning Delay*, a warning will be generated.

High Discharge Pressure Shutdown – The Discharge Pressure was greater than or equal to the active *High Discharge Pressure Shutdown* setpoint for its time delay.

High Discharge Pressure Warning – The Discharge Pressure was greater than or equal to the active *High Discharge Pressure Warning* setpoint for its time delay.

High Discharge Pressure Shutdown -- Dual Discharge Mode 1 - The Discharge Pressure was greater than or equal to the active *High Discharge Pressure Shutdown* setpoint for its time delay.

High Discharge Pressure Warning -- Dual Discharge Mode 1 - The Discharge Pressure was greater than or equal to the active *High Discharge Pressure Warning* setpoint for its time delay.

High Discharge Pressure Shutdown -- Dual Discharge Mode 2 - The Discharge Pressure was greater than or equal to the active *High Discharge Pressure Shutdown* setpoint for its time delay.

High Discharge Pressure Warning -- Dual Discharge Mode 2 - The Discharge Pressure was greater than or equal to the active *High Discharge Pressure Warning* setpoint for its time delay.

High Discharge Pressure Sensor Fault - This shutdown message is issued if the Discharge Pressure reading was to the upper or maximum range (out of range) for its sensor.

High Discharge Temperature Shutdown - The Discharge Temperature was greater than or equal to the *High Discharge Temperature Shutdown* setpoint for its time delay.

High Discharge Temperature Warning - The Discharge Temperature was greater than or equal to the *High Discharge Temperature Warning* setpoint for its time delay.

High Economizer Shutdown - The Auxiliary Analog #10 value was greater than or equal to the high Auxiliary Analog #10 shutdown setpoint for its time delay.

High Economizer Warning - The Auxiliary Analog #10 value was greater than or equal to the high Auxiliary Analog #10 warning setpoint for its time delay.

High Entering Process Temperature Shutdown - The Entering Process Temperature was greater than or equal to the *High Entering Process Temperature Shutdown* setpoint for its time delay.

High Entering Process Temperature Warning - The Entering Process Temperature was greater than or equal to the *High Entering Process Temperature Warning* setpoint for its time delay.

High Limit Discharge Pressure Shutdown - The Discharge Pressure was greater than or equal to the active *High Discharge Pressure Shutdown* setpoint for its time delay.

High Limit Discharge Temperature Shutdown - The Discharge Temperature was greater than or equal to the active *High Discharge Temperature Shutdown* setpoint for its time delay.

High Liquid Level Shutdown - The corresponding input module was de-energized.

High Manifold Pressure Shutdown - This shutdown applies if Engine Drive was enabled. When the Manifold Pressure exceeds this setpoint, an alarm will occur.

High Manifold Pressure Warning - This warning applies if Engine Drive was enabled. When the Manifold Pressure exceeds this setpoint, a warning will occur.

High Motor Current Shutdown - The motor amps was greater than or equal to the *High Motor Amps Shutdown* setpoint for its time delay.

High Motor Current Warning - The Motor Amps was greater than or equal to the *High Motor Amps Warning* setpoint for its time delay.

High Motor Stator #1 Temperature Warning – If Motor Stator #1 temperature sensor registers a reading that is higher than the value that has been set for the *Motor Stator #1 Temp. Warning*, for the period of time as set for the *Motor Stator #1 Temp. Warning Delay*, a warning will be generated.

High Motor Stator #1 Temperature Shutdown – If Motor Stator #1 temperature sensor registers a reading that is higher than the value that has been set for the *Motor Stator #1 Temp. Shutdown*, for the period of time as set for the *Motor Stator #1 Temp. Shutdown Delay*, a Shutdown will be generated.

High Motor Stator #2 Temperature Warning – If Motor Stator #2 temperature sensor registers a reading that is higher than the value that has been set for the *Motor Stator #2 Temp. Warning*, for the period of time as set for the *Motor Stator #2 Temp. Warning Delay*, a warning will be generated.

High Motor Stator #2 Temperature Shutdown – If Motor Stator #2 temperature sensor registers a reading that is higher than the value that has been set for the *Motor Stator #2 Temp. Shutdown*, for the period of time as set for the *Motor Stator #2 Temp. Shutdown Delay*, a Shutdown will be generated.

High Motor Stator #3 Temperature Warning – If Motor Stator #3 temperature sensor registers a reading that is higher than the value that has been set for the *Motor Stator #3 Temp. Warning*, for the period of time as set for the *Motor Stator #3 Temp. Warning Delay*, a warning will be generated.

High Motor Stator #3 Temperature Shutdown – If Motor Stator #3 temperature sensor registers a reading that is higher than the value that has been set for the *Motor Stator #3 Temp. Shutdown*, for the period of time as set for the *Motor Stator #3 Temp. Shutdown Delay*, a Shutdown will be generated.

High Motor Temperature Warning - Shaft Side – The motor has temperature sensors that monitor the Shaft Side bearing. If the temperature of this bearing exceeds the *Shaft Side High Warning* setpoint, for a period of time exceeding the *Shaft Side High Warning Delay* setpoint, this Warning will occur. The default values for these setpoints are 203° F and a delay of 5 seconds.

High Motor Temperature Warning - Opposite Shaft Side – The motor has temperature sensors that monitor the Opposite Shaft Side bearing. If the temperature of this bearing exceeds the *Opposite Shaft Side High Warning* setpoint, for a period of time exceeding the *Opposite Shaft Side High Warning Delay* setpoint, this Warning will occur. The default values for these setpoints are 203° F and a delay of 5 seconds.

High Motor Temperature Shutdown - Shaft Side – The motor has temperature sensors that monitor the Shaft Side bearing. If the temperature of this bearing exceeds the *Shaft Side High Shutdown* setpoint, for a period of time exceeding the *Shaft Side High Shutdown Delay* setpoint, this Shutdown will occur. The default values for these setpoints are 221° F and a delay of 5 seconds.

High Motor Temperature Shutdown - Opposite Shaft Side – The motor has temperature sensors that monitor the Opposite Shaft Side bearing. If the temperature of this bearing exceeds the *Opposite Shaft Side High Shutdown* setpoint, for a period of time exceeding the *Opposite Shaft Side High Shutdown Delay* setpoint, this Shutdown will occur. The default values for these setpoints are 221° F and a delay of 5 seconds.

High Motor Vibration Shutdown - Opposite Shaft Side - If the Opposite Shaft Side Drive Vibration sensor registers a reading that is higher than the value that has been set for the *Opposite Shaft High Shutdown*, for the period of time as set for the *Opposite Shaft High Shutdown Delay*, a Shutdown will be generated.

High Motor Vibration Warning - Opposite Shaft Side - If the Opposite Shaft Side Drive Vibration sensor registers a reading that is higher than the value that has been set for the *Opposite Shaft High Warning*, for the period of time as set for the *Opposite Shaft High Warning Delay*, a warning will be generated.

High Motor Vibration Shutdown - Shaft Side - If the Shaft Side Drive Vibration sensor registers a reading that is higher than the value that has been set for the *Shaft Side High Shutdown*, for the period of time as set for the *Shaft Side High Shutdown Delay*, a Shutdown will be generated.

High Motor Vibration Warning - Shaft Side - If the Shaft Side Drive Vibration sensor registers a reading that is higher than the value that has been set for the *Shaft Side High Warning*, for the period of time as set for the *Shaft Side High Warning Delay*, a warning will be generated.

High Oil Filter Pressure Warning - The Oil Filter Pressure was greater than or equal to the *High Filter Pressure Warning* setpoint for its time delay.

High Oil Filter Pressure Shutdown - The Oil Filter Pressure was greater than or equal to the *High Filter Pressure Shutdown* setpoint for its time delay.

High Oil Pressure Sensor Fault - This shutdown message is issued if the Oil Pressure reading was to the upper or maximum range (out of range) for its sensor.

High Oil Pressure Shutdown – The Oil Pressure was greater than or equal to *the High Oil Pressure Shutdown* setpoint for its time delay.

High Oil Temperature Shutdown - The Oil Temperature was greater than or equal to *the High Oil Temperature Shutdown* setpoint for its time delay.

High Oil Temperature Warning - The Oil Temperature was greater than or equal to the *High Oil Temperature Warning* setpoint for its time delay.

High RPM Shutdown - This shutdown applies if Engine or Turbine Drive was enabled. If the RPM's of the motor exceeds this setpoint, a shutdown will occur.

High RPM Warning - This warning applies if Engine or Turbine Drive was enabled. If the RPM's of the motor exceeds this setpoint, a warning will occur.

High Suction Pressure Shutdown - The Suction Pressure was greater than or equal to the active *High Suction Pressure Shutdown* setpoint for its time delay.

High Suction Pressure Warning - The Suction Pressure was greater than or equal to the active *High Suction Pressure Warning* setpoint for its time delay.

Insufficient Main Oil Pressure Shutdown - The Slide Valve is greater than 50% and the Oil Pressure (PSIA) is less than or equal to the Suction Pressure (PSIA) multiplied by 1.5 and then added to 15.0.

Kobe High Oil Pressure Shutdown – If the compressor type is set to Other Manufacturer (Kobe), the oil pump type is set to Demand and if Oil Pressure rises above 325 PSIA for more than 5 seconds this shutdown will occur. This shutdown is only active when the compressor is running and is also not checked for the first 90 seconds after the compressor starts.

Kobe Low Oil Differential 1 Shutdown – If the compressor type is set to Other Manufacturer (Kobe), the oil pump type is set to Demand and if the differential between Oil Pressure and Suction Pressure is less than 50 PSI for 5 seconds this shutdown will occur. This shutdown is only active when the compressor is running and is also not checked for the first 90 seconds after the compressor starts.

Kobe Low Oil Differential 2 Shutdown – If the compressor type is set to Other Manufacturer (Kobe), the oil pump type is set to Demand and the differential between Oil Pressure and Suction Pressure is less than Suction Pressure times 0.8 for 5 seconds this shutdown will occur. This shutdown is only active when the compressor is running and is also not checked for the first 90 seconds after the compressor starts.

Liquid Slugging Shutdown - This shutdown is triggered off of a sudden decrease in Discharge Temperature that is greater than the Liquid Slugging Shutdown setpoint for a five (5) second period. That is, if the Discharge Temperature is 130 degrees F, and the Liquid Slug Shutdown setpoint is 20 degrees F, then a sudden drop in Discharge Temperature from 130 to 110 degrees F within a five second period will generate a shutdown condition.

Liquid Slugging Warning - This warning is triggered off of a sudden decrease in Discharge Temperature that is greater than the Liquid Slug Warning setpoint for a five (5) second period. That is, if the Discharge Temperature is 130 degrees F, and the Liquid Slugging Warning setpoint is 10 degrees F, then a sudden drop in Discharge Temperature from 130 to 120 degrees F within a five second period will generate a warning condition.

Low Auxiliary Analog 1-20 Shutdown - The Auxiliary Analog #1-20 value was less than or equal to the low Auxiliary Analog #1-20 shutdown setpoint for its time delay.

Low Auxiliary Analog 1-20 Warning - The Auxiliary Analog #1-20 value was less than or equal to the low Auxiliary Analog #1-20 warning setpoint for its time delay.

Low Discharge Pressure Sensor Fault - This shutdown message is issued if the Discharge Pressure reading was to the lower or minimum range (out of range) for its sensor.

Low Discharge Temperature Sensor Fault - This shutdown message is issued if the Discharge Temperature reading was to the lower or minimum range (out of range) out of range for its sensor.

Low Economizer Shutdown - The Auxiliary Analog #10 value was less than or equal to the low Auxiliary Analog #10 shutdown setpoint for its time delay.

Low Economizer Warning - The Auxiliary Analog #10 value was less than or equal to the low Auxiliary Analog #10 warning setpoint for its time delay.

Low Entering Process Temperature Shutdown - The Entering Process Temperature was less than or equal to the *Low Entering Process Temperature Shutdown* setpoint for its time delay.

Low Entering Process Temperature Warning - The Entering Process Temperature was less than or equal to the *Low Entering Process Temperature Warning* setpoint for its time delay.

Low Main Oil Injection Pressure Shutdown - This shutdown can occur if Oil Injection was enabled. The Oil Injection Pressure (channel 15, Analog Board 2) must greater than or equal to the Suction Pressure times 1.5, plus the setpoint to be in the safe condition, otherwise this shutdown will occur.

Low Motor Current Shutdown - This shutdown message is issued if, while the compressor was running, the Motor Amps reading was less than or equal to the *Low Motor Amps Shutdown* setpoint.

Low Oil Pressure Sensor Fault - This shutdown message is issued if the Oil Pressure reading was to the lower minimum range (out of range) for its sensor.

Low Oil Pressure Shutdown - The compressor was running. Either the Oil Pressure of a running pump was less than or equal to the *Low Oil Pressure Shutdown*

setpoint, or the Oil Pressure of a not running pump was less than or equal to the *Low Oil Pressure Shutdown* setpoint for its time delay.

Low Oil Pressure Warning - The compressor was running. Either the Oil Pressure of a running pump was less than or equal to the *Low Oil Pressure Warning* setpoint, or the Oil Pressure of a not running pump was less than or equal to the *Low Oil Pressure Warning* setpoint for its time delay.

Low Oil Temperature Sensor Fault - This shutdown message is issued if the Oil Temperature reading was to the lower or minimum range (out of range) for its sensor.

Low Oil Temperature Shutdown - The Oil Temperature was less than or equal to the *Low Oil Temperature Shutdown* setpoint for its time delay.

Low Oil Temperature Warning - The Oil Temperature was less than or equal to the *Low Oil Temperature Warning* setpoint for its time delay.

Low RPM Shutdown - This shutdown applies if Engine or Turbine Drive was enabled. If the RPM's of the motor drops below this setpoint, a shutdown will occur.

Low RPM Warning - This warning applies if Engine or Turbine Drive was enabled. If the RPM's of the motor drops below this setpoint, a warning will occur.

Low Separator Temperature Sensor Fault - This shutdown message is issued if the Separator Temperature reading was to the lower or minimum range (out of range) for its sensor.

Low Separator Temperature Shutdown - The Oil Separator Temperature was less than or equal to the *Low Oil Separator Temperature Shutdown* setpoint for its time delay.

Low Separator Temperature Warning - The Oil Separator Temperature was less than or equal to the *Low Oil Separator Temperature Warning* setpoint for its time delay.

Low Suction Pressure Sensor Fault - This shutdown message is issued if the Suction Pressure reading was to the lower or minimum range (out of range) for its sensor.

Low Suction Shutdown -- Regulation Mode 1 - When running in Regulation Mode 1, if the Suction Pressure was less than or equal to the active Regulation Mode 1 *Low Suction Shutdown* setpoint for its time delay.

Low Suction Warning -- Regulation Mode 1 - When running in Regulation Mode 1, if the Suction Pressure was less than or equal to the active Regulation Mode 1 *Low Suction Warning* setpoint for its time delay.

Low Suction Shutdown -- Regulation Mode 2 - When running in Regulation Mode 2, if the Suction Pressure was less than or equal to the active Regulation Mode 2 *Low Suction Shutdown* setpoint for its time delay.

Low Suction Warning – Regulation Mode 2 - When running in Regulation Mode 2, if the Suction Pressure was less than or equal to the active Regulation Mode 2 *Low Suction Warning* setpoint for its time delay.

Low Suction Shutdown -- Regulation Mode 3 - When running in Regulation Mode 3, if the Suction Pressure was less than or equal to the active Regulation Mode 3 *Low Suction Shutdown* setpoint for its time delay.

Low Suction Warning -- Regulation Mode 3 - When running in Regulation Mode 3, if the Suction Pressure was less than or equal to the active Regulation Mode 3 *Low Suction Warning* setpoint for its time delay.

Low Suction Shutdown – Regulation Mode 4 - When running in Regulation Mode 4, if the Suction Pressure was less than or equal to the active Regulation Mode 4 *Low Suction Shutdown* setpoint for its time delay.

Low Suction Warning – Regulation Mode 4 - When running in Regulation Mode 4, if the Suction Pressure was less than or equal to the active Regulation Mode 4 *Low Suction Warning* setpoint for its time delay.

Missing Oil Pressure Shutdown A - The Oil Pressure (PSIA) is less than the Suction Pressure (PSIA) multiplied by 1.1 and then added to 15.0, then delayed by 2 min.

Missing Oil Pressure Shutdown B - The Oil Pressure (PSIA) is less than the Suction Pressure (PSIA) added to 15.0, then delayed by 25 sec.

Missing Oil Pressure Warning - The Oil Pressure (PSIA) is less than the Suction Pressure (PSIA) multiplied by 1.1 and then added to 15.0, then delayed by 25 sec.

Oil Level Shutdown - The corresponding input module for low Oil Level was de-energized for five (5) minutes.

Oil Log Shutdown - Oil log was enabled and the Compressor has not started and the Oil Pump has already run for the fail delay time.

Oil Pump Auxiliary Failure - While starting the Oil Pump, the Oil Pump Auxiliary input module did not energize within five (5) seconds, or, while the Oil Pump was running, the Oil Pump Auxiliary input module de-energized.

Oil Pump 1 Auxiliary Warning - While starting Oil Pump #1, the Oil Pump #1 Auxiliary input module did not energize within five (5) seconds, or, while this Oil Pump was running, the Oil Pump #1 Auxiliary input module de-energized. This indicates Dual Pump Control and *Pump #1* is the lead pump.

Oil Pump 1 Auxiliary Shutdown - While starting Oil Pump #1, the Oil Pump #1 Auxiliary input module did not energize within five (5) seconds, or, while this Oil Pump was running, the Oil Pump #1 Auxiliary input module de-energized. This indicates Dual Pump Control and *Pump #1* is the last pump to start.

Oil Pump 2 Auxiliary Warning - While starting Oil Pump #2, the Oil Pump #2 Auxiliary input module did not energize within five (5) seconds, or, while this Oil Pump was running the Oil Pump #2 Auxiliary input module de-energized. This indicates Dual Pump Control and *Pump #2* is the lead pump.

Oil Pump 2 Auxiliary Shutdown - While starting Oil Pump #2, the Oil Pump auxiliary input module did not energize within five (5) seconds, or, while the Oil Pump was running, the Oil Pump auxiliary input module de-energized. This indicates Dual Pump Control and *Pump #2* is the last pump to start.

Process Stopped - Check Event Log for Details – One of the control program subroutine processes has stopped functioning and a message has been entered into the event log. This is a Warning message.

Regulation Mode 1 Shutdown – When the selected regulation control process for Regulation Mode 1 has exceeded it's setpoint for the delay period, a Shutdown occurs.

Regulation Mode 1 Warning – When the selected regulation control process for Regulation Mode 1 has exceeded it's setpoint for the delay period, a Warning occurs.

Regulation Mode 2 Shutdown – When the selected regulation control process for Regulation Mode 2 has exceeded it's setpoint for the delay period, a Shutdown occurs.

Regulation Mode 2 Warning – When the selected regulation control process for Regulation Mode 2 has exceeded it's setpoint for the delay period, a Warning occurs.

Regulation Mode 3 Shutdown – When the selected regulation control process for Regulation Mode 3 has exceeded it's setpoint for the delay period, a Shutdown occurs.

Regulation Mode 3 Warning – When the selected regulation control process for Regulation Mode 3 has exceeded it's setpoint for the delay period, a Warning occurs.

Regulation Mode 4 Shutdown – When the selected regulation control process for Regulation Mode 4 has exceeded it's setpoint for the delay period, a Shutdown occurs.

Regulation Mode 4 Warning - When the selected regulation control process for Regulation Mode 4 has exceeded it's setpoint for the delay period, a Warning occurs.

Sequencing Slide Valve Failure Shutdown – When in sequencing mode, if the controlling compressor fails to properly load the Slide Valve, a shutdown occurs, and control moves to the next compressor.

Start Failure Shutdown For Engine And Turbine - This message may be issued if Engine or Turbine was enabled, and the start delay period to get to a running condition has expired.

Starting Failure - Low Motor Amps - This shutdown message is displayed if after 30 seconds from sending the compressor start signal, the Motor Amps reading is not greater than the *Low Motor Amps Shutdown* setpoint.

Starting Failure - No Compressor Auxiliary - This shutdown message is displayed if after 450 seconds from sending the compressor start command, the compressor auxiliary input module is still not energized.

Starting Low Oil Pressure Shutdown – This safety is active if the compressor type is set to Other Manufacturer, Other Manufacturer (Kobe) or Other Manufacturer (Mycom) and the oil pump type is set to Full Time. When the compressor is starting, if Oil Pressure does not rise above Discharge Pressure plus the Low Oil Pressure Shutdown setpoint plus 10 PSI within 30 seconds this shutdown will occur. The default value for the Low Oil Pressure Shutdown setpoint is 20 PSI.

Starting Superheat Shutdown - This message may be issued if Superheat was enabled. A shutdown will occur if TDsat plus temperature setpoint is greater than the Separator temperature.

Stopping Failure - Compressor Auxiliary - This shutdown message is issued if while stopping the compressor, after 8 seconds from the compressor stop command, the compressor auxiliary is energized. While this condition is present, the Oil Pump (if available) is on and Liquid Injection (if available) is allowed on and the Slide Valve is unloaded to 0% to safeguard the compressor.

Stopping Failure - Motor Amps - This shutdown message is issued if while stopping the compressor, after 12 seconds from the compressor stop command, the Motor Current reading is above the *Low Motor Amps Shutdown* setpoint. While this condition is present, the Oil Pump (if available) is on, and Liquid Injection (if available) is allowed on and the Slide Valve is unloaded to 0% to safeguard the compressor.

Vyper - Interface Board Power Supply - This fault is set on every power-up. It is immediately cleared, and logged in the fault history to record the occurrence of the power loss.

Vyper Communications Failure Warning - If Vyper option is enabled and the Comms communication has failed, this warning is shown.

Vyper - Interface Board to Panel Communications Loss - This fault occurs when the Frick Interface Board loses communications from the Quantum™ LX Control Panel, meaning it has not received any data for a period of fifteen seconds. It is only applicable in automatic mode.

Vyper - Interface Board Motor Current > 15% - This fault occurs whenever the Vyper™ is running and a motor current of less than 10 % FLA is detected for at least twenty-five continuous seconds. This fault is only checked when the Run Acknowledge output is engaged. Therefore, it is NOT checked during STANDBY, which prevents this fault from occurring during STANDBY.

Vyper - Interface Board Run Signal - This fault occurs if the Run Signal from the Quantum Control Panel is high, but the speed command being sent over the RS-485 communications link is zero. It may also occur if the Run Signal is low, but the speed command is not zero. Both

conditions must be present for five seconds before the fault is set, and are only applicable in automatic mode.

Vyper – Initialization - At power-up, all the boards go through a process called initialization. At this time, memory locations are cleared, jumper positions are checked, and serial communications links are established.

Vyper - Stop Contacts - This fault occurs if the No Fault signal from the Vyper™ is low. It indicates a fault is present at the Vyper™ or the Harmonic Filter, but the communications data contains no Vyper™ fault data for twenty seconds. The Frick Interface Board will send Initialize data requests while this fault is active.

Vyper - Harmonic Filter Logic Board Or Communications – This fault occurs if the No Fault signal from the Vyper™ is low, indicating a fault is present at the Vyper™ or the Harmonic Filter, but the communications data contains no Harmonic Filter fault data for twenty seconds. The Frick Interface Board will send Initialize data requests while this fault is active.

Vyper - Harmonic Filter High Total Demand Distortion – This shutdown indicates that the filter is not operating correctly or the input current to the Vyper™ / filter system is not sinusoidal. This fault occurs when any of the three phases of Total Demand Distortion is greater than 25.0 %, for forty-five continuous seconds while the Vyper™ is running.

Vyper - Harmonic Filter Input Frequency Out of Range (Warning Only) - The Harmonic Filter monitors the line frequency on its inputs. If this frequency is out of range, it will cease filtering, and set a bit in the communications packet. This warning is indicated whenever this bit is set.

Vyper - High Phase A Inverter Baseplate Temp. – A thermistor sensor is located inside the IGBT Module on the Vyper™ power unit. If at anytime this thermistor detects a temperature of 175°F (79°C) or higher of the Phase A Inverter, a shutdown will occur. The cooling fans and coolant pump on the Vyper™ will continue to run after the shutdown, until the thermistor temperature has dropped to below 165°F (74°C). This shutdown requires a manual reset via the Reset push button on the Vyper™ logic board.

Vyper - High Phase B Inverter Baseplate Temp. – A thermistor sensor is located inside the IGBT Module on the Vyper™ power unit. If at anytime this thermistor detects a temperature of 175°F (79°C) or higher of the Phase B Inverter, a shutdown will occur. The cooling fans and coolant pump on the Vyper™ will continue to run after the shutdown, until the thermistor temperature has dropped to below 165°F (74°C). This shutdown requires a manual reset via the Reset push button on the Vyper™ logic board.

Vyper - High Phase C Inverter Baseplate Temp. – A thermistor sensor is located inside the IGBT Module on the Vyper™ power unit. If at anytime this thermistor detects a temperature of 175°F (79°C) or higher of the Phase C Inverter, a shutdown will occur. The cooling fans and coolant pump on the Vyper™ will continue to run after the shutdown, until the thermistor temperature has dropped to below 165°F (74°C). This shutdown requires a manual reset via the Reset push button on the Vyper™ logic board.

Vyper - Low Phase A Inverter Baseplate Temp. – The phase A heatsink temperature and the inverter module base plate temperature are compared to a lower limit of 37°F. If the inverter module base plate temperature falls below this limit the unit will trip and the Quantum™ LX Panel will display this message. In addition, if both the inverter and converter temperatures fall below the 37°F limit, the unit will trip and the fan(s) and water pump will be energized.

Vyper - Low Phase B Inverter Baseplate Temp. – The phase B heatsink temperature and the inverter module base plate temperature are compared to a lower limit of 37°F. If the inverter module base plate temperature falls below this limit the unit will trip and the Quantum™ LX Panel will display this message. In addition, if both the inverter and converter temperatures fall below the 37°F limit, the unit will trip and the fan(s) and water pump will be energized.

Vyper - Low Phase C Inverter Baseplate Temp. – The phase C heatsink temperature and the inverter module base plate temperature are compared to a lower limit of 37°F. If the inverter module base plate temperature falls below this limit the unit will trip and the Quantum™ LX Panel will display this message. In addition, if both the inverter and converter temperatures fall below the 37°F limit, the unit will trip and the fan(s) and water pump will be energized.

Vyper - High Phase A Instantaneous Current – Phase A of the output line to the motor is monitored via a current transformer within the drive. The unit's Phase A of instantaneous output current is compared to a prescribed limit which is contained in the hardware. If the peak current limit is exceeded, the unit will trip and the Quantum™ LX Panel will display this message.

Vyper - High Phase B Instantaneous Current – Phase B of the output line to the motor is monitored via a current transformer within the drive. The unit's Phase B of instantaneous output current is compared to a prescribed limit which is contained in the hardware. If the peak current limit is exceeded, the unit will trip and the Quantum™ LX Panel will display this message.

Vyper - High Phase C Instantaneous Current – Phase C of the output line to the motor is monitored via a current transformer within the drive. The unit's Phase C of instantaneous output current is compared to a prescribed limit which is contained in the hardware. If the peak current limit is exceeded, the unit will trip and the Quantum™ LX Panel will display this message.

Vyper - Phase A Gate Driver – The unit's phase bank assembly shall contain one IGBT gate driver control board. This board monitors the saturation voltage drop across the Phase A Gate Driver while gated on. If the IGBT's Phase A Gate Driver saturation voltage exceeds the prescribed limit, the gate driver will make the determination that a short circuit is present. This in turn shall cause the unit to trip and the Quantum™ LX Panel shall display this message. If the driver board's power supply voltage falls below the permissible limit, this same message shall be generated.

Vyper - Phase B Gate Driver – The unit's phase bank assembly shall contain one IGBT gate driver control board. This board monitors the saturation voltage drop across the Phase B Gate Driver while gated on. If the IGBT's Phase B Gate Driver saturation voltage exceeds the prescribed limit, the gate driver will make the determination that a short circuit is present. This in turn shall cause the unit to trip and the Quantum™ LX Panel shall display this message. If the driver board's power supply voltage falls below the permissible limit, this same message shall be generated.

Vyper - Phase C Gate Driver – The unit's phase bank assembly shall contain one IGBT gate driver control board. This board monitors the saturation voltage drop across the Phase C Gate Driver while gated on. If the IGBT's Phase C Gate Driver saturation voltage exceeds the prescribed limit, the gate driver will make the determination that a short circuit is present. This in turn shall cause the unit to trip and the Quantum™ LX Panel shall display this message. If the driver board's power supply voltage falls below the permissible limit, this same message shall be generated.

Vyper - Single Phase Input Power – The Vyper's SCR Trigger Control board contains circuitry that checks the three-phase mains for the presence of all three line voltages. If all line voltages are not present, the unit will trip and the Quantum™ LX Panel will display this message.

Vyper - 105% Motor Current Overload – The Vyper™ Logic Board generates this shutdown by reading the current from the 3 output current transformers. The shutdown is generated when the Vyper™ Logic board has detected that the highest of the three output phase currents has exceeded 105% of the programmed 100% full load amps (FLA) value for more than 40 seconds. If this is detected, the unit will trip and the Quantum™ LX panel will display the fault message.

Vyper - High DC Bus Voltage – The DC link overvoltage trip level is determined by hardware on the logic board and it is designed to trip the unit at 745 +/- 17 VDC for both 60 and 50 Hz VSD's. If the DC bus current exceeds this level, the unit will trip and the Quantum™ LX Panel will display this message.

Vyper - Logic Board Power Supply – The various DC power supplies which power the Logic Board are monitored via hardware located on the Logic Board. If any of these power supplies fall outside their allowable limits, the unit will trip and the Quantum™ LX Panel will display the fault message.

Vyper - Low DC Bus Voltage – The DC link under voltage trip level must be set at 500 VDC for 60 Hz and 414 VDC for 50 Hz VSD's. If the DC link drops below this level, the unit will trip, and the Vyper™ Logic Board will initiate a system shutdown.

Vyper - DC Bus Voltage Imbalance – The 1/2 DC link voltage magnitude must remain within ± 88 VDC of the total DC link voltage divided by two for both 60 and 50 Hz VSD's. If the 1/2 DC link magnitude exceeds the ± 88 volt window, the unit will trip and the Quantum™ LX will display this message.

Vyper - High Internal Ambient Temperature – The logic board contains a temperature sensor which monitors the unit's internal ambient temperature. The magnitude of the unit's internal temperature is compared to a limit of 145°F. If this limit is exceeded the unit will trip and the Quantum™ LX panel will display this message. The fan(s) and water pump remain energized until the internal temperature drops below 137°F. The fan(s) and water pump will be de-energized when the internal temperature drops below 137°F.

Vyper - High Inverter Baseplate Temperature – A thermistor sensor is located inside the IGBT Module on the Vyper™ power unit. If at anytime this thermistor detects a temperature of 175°F (79°C) or higher, a shutdown will occur. The cooling fans and coolant pump on the Vyper™ will continue to run after the shutdown, until the thermistor temperature has dropped to below 165°F (74°C). This shutdown requires a manual reset via the Reset push button on the Vyper ™ logic board.

Vyper - Logic Board Processor – This shutdown is generated if a communications problem occurs between the two microprocessors on the Vyper™ Logic Board. If this shutdown occurs, replace the Vyper™ Logic board.

Vyper - Run Signal – Upon receipt of either of the two run commands, a 5-second timer will start. If the missing run signal is not asserted within the 5-second window, the unit will trip and the Quantum™ LX panel will display this message.

Vyper - High Converter Heatsink Temperature – A thermistor sensor is located behind the last SCR/Diode block on the copper chill plate of the Vyper™ Power Unit. If at anytime this thermistor detects a temperature of 170°F (76°C) or higher, a shutdown will occur. The cooling fans and coolant pump on the Vyper™ will continue to run after the shutdown, until the thermistor temperature has dropped to below 160°F (71°C). This shutdown requires a manual reset via the Reset push button on the Vyper™ Logic board.

Vyper - Invalid Current Scale Selection – The J1 connector on the Vyper™ Logic board contains jumpers along with wires from the output CTs. Since the part number of the Logic board is the same on all horsepower sizes, the jumpers tell the logic board the size of the Vyper™ being employed in order to properly scale the output current. If the jumper configuration is found by the Logic board to be invalid, the system will be shut down and the above message will be generated.

Vyper - Low Inverter Baseplate Temperature – The phase bank assembly heatsink temperature and the inverter module base plate temperature are compared to a lower limit of 37°F. If the inverter module base plate temperature falls below this limit the unit will trip and the Quantum™ LX Panel will display this message.

Vyper - Serial Communication – When requesting Status data, the response data from the Vyper™ includes a bit that indicates whether communications were lost from

the Frick Interface Board to the Vyper™. If this bit is high for 22 consecutive seconds, this fault occurs. This fault also occurs whenever a receive, timeout, or checksum fault is detected on the Vyper™ communications, for twenty continuous seconds. While this fault is active, the Frick Interface Board will send Initialize data requests in order to reestablish the communications link. All serial input data is also cleared.

Vyper - Precharge Lockout – If the Vyper™ fails to meet the precharge criteria, then the precharge circuit will wait for a period of 10 seconds. During this time, the unit's cooling fans and coolant pump remain energized in order to cool the input SCR's. Following this 10-second cool-down period, precharge will again be initiated. The unit will attempt to meet the precharge criteria three consecutive times. If the Vyper™ fails to meet the precharge criteria on three consecutive tries, the Vyper™ will shut down, lock out, and display this message. In order to initiate precharge again, the Quantum™ LX panel's compressor switch must first be placed into the STOP/RESET position.

Vyper - Low Converter Heatsink Temperature – The phase bank assembly heatsink temperature and the inverter module base plate temperature are compared to a lower limit of 37°F. If the inverter base plate temperature or the converter heat sink temperature falls below 37°F, this message will be displayed. In addition, if both temperatures fall below the 37°F limit, the unit will trip and the fan(s) and water pump will be energized.

Vyper - Current Imbalance – When the average of the three output phase currents exceeds 80% of the 100% Job FLA, the % Output Current Imbalance is calculated using the following equation: $[(I_a-I_{ave}) + (I_b-I_{ave}) + (I_c-I_{ave}) / \{2\}\{I_{ave}\}] [100]$: $I_{ave} = \{I_a + I_b + I_c\}/3$. If the % Imbalance exceeds 30% continuously for 45 seconds the unit shall trip and the Quantum™ LX panel shall display this message. The imbalance fault is disabled when the average of the three output phase currents drops below 80% FLA.

Vyper - Precharge / DC Bus Voltage Imbalance – The 1/2 DC link voltage magnitude will remain within ± 88VDC of the total DC link voltage divided by two during the precharge interval for both the 60 and 50 Hz VSD's. If not, the Quantum™ LX panel will display this message. The definition for this fault is identical to "VSD - DC Bus Voltage Imbalance", except that the fault has occurred during the precharge period which begins during prelube.

Vyper - Precharge / High DC Bus Voltage – The DC link voltage will reach at least 500 VDC within 20 seconds after the precharge signal has been asserted on the 60 Hz VSD and at least 414 VDC within 20 seconds on the 50 Hz VSD. If not, the Quantum™ LX panel will display this message.

Vyper - Precharge / Low DC Bus Voltage – This fault has two different timing events. First, the DC Bus voltage must be equal to or greater than 50 VDC for 60 Hz (41 VDC for 50 HZ) 4 seconds after precharge has begun. Second, the DC Bus voltage must be equal to or greater than 500 VDC for 60 Hz (414 VDC for 50 HZ) 20 seconds after precharge has begun. The unit is shut down and this message is generated if any of these conditions are not met.

Vyper - Harmonic Filter High DC Bus Voltage – The harmonic filter's DC link voltage is continuously monitored and if the level exceeds a range of 822 to 900 VDC, a Filter Bus Over-Voltage shutdown is initiated.

Vyper - Harmonic Filter High Phase C Current – The unit's three phases of instantaneous output current are compared to a prescribed limit, which is contained in the hardware. If the Phase C signal exceeds the prescribed limit, the filter will be inhibited from operating by inhibiting the Current Regulator Run signal for five to six input line voltage. If the Phase C signal exceeds the prescribed threshold three times in 60 line cycles, the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter High Phase B Current – The unit's three phases of instantaneous output current are compared to a prescribed limit, which is contained in the hardware. If the Phase B signal exceeds the prescribed limit, the filter will be inhibited from operating by inhibiting the Current Regulator Run signal for five to six input line voltage. If the Phase B signal exceeds the prescribed threshold three times in 60 line cycles, the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter High Phase A Current – The unit's three phases of instantaneous output current are compared to a prescribed limit, which is contained in the hardware. If the Phase A signal exceeds the prescribed limit, the filter will be inhibited from operating by inhibiting the Current Regulator Run signal for five to six input line voltage. If the Phase A signal exceeds the prescribed threshold three times in 60 line cycles, the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter Phase Locked Loop – This shutdown indicates that a circuit called a "phase locked loop" on the Filter Logic board has lost synchronization with the incoming power line for a period of time.

Vyper - Harmonic Filter Logic Board Power Supply – This shutdown indicates that one of the low voltage power supplies on the Filter Logic board have dropped below their permissible operating voltage range.

Vyper - Harmonic Filter Precharge / High DC Bus Voltage – The DC link voltage will reach at least 525 VDC within 5 seconds after the precharge relay is pulled in on the 60 Hz 519 filter and at least 425 VDC within 5 seconds on the 50 Hz 519 filter. If not, the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter Precharge / Low DC Bus Voltage – The DC link voltage will reach at least 50 VDC within 100 msec after the precharge relay has been pulled in on the 60 Hz 519 filter and at least 41 VDC within 100 msec on the 50 Hz 519 filter. If not, the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter DC Current Transformer 1 – During initialization, the output voltage of DC Current Transformer 1 which sense the filter's input current will be monitored and compared against a level of ± 147 mv (± 6010 A to D

counts). If the offset error falls outside this range, the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter DC Current Transformer 2 – During initialization, the output voltage of DC Current Transformer 2 which sense the filter's input current will be monitored and compared against a level of ± 147 mv (± 6010 A to D counts). If the offset error falls outside this range, the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter High Baseplate Temp. – The unit contains one heatsink assembly for the 305 Hp. The Filter's power module base plate temperature will feed the Harmonic Filter Logic board. This temperature is compared in software to a limit of 79°C and if this limit is exceeded, the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter Low DC Bus Voltage – The DC link voltage magnitude should remain within -80 VDC of the bus voltage setpoint determined from the peak input voltage. If the DC link voltage magnitude falls outside this range for 100 msec the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter DC Bus Voltage Imbalance – The 1/2 DC link voltage magnitude will remain within ± 50VDC of the total DC link voltage divided by two during the precharge interval for both 60 and 50 Hz 519 filters. If not, the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter 110% Input Current Overload – The overload threshold and timer functions reside in software on the Harmonic Filter's Logic board. The unit's three phases of RMS output current are compared to the overload threshold magnitude. If this threshold is exceeded for 40 seconds the unit will trip and the Quantum™ LX panel will display this message.

Vyper - Harmonic Filter Run Signal – When a digital run command is received at the filter logic board from the Vyper™ Logic board, a 1/10 second timer is begun. A redundant run command must also occur on the serial data link from the Vyper™ Logic board before the timer expires. If not, the Vyper™ will be shut down and this Fault message will be displayed.

Vyper - Interface Board NovRAM Failure – The integrity of the NovRAM is verified on every power-up. A known value is written to a specified location in NovRAM, read back from that location, and compared to the value originally written. If the two values do not match, the NovRAM Failure fault is displayed.

Vyper - Harmonic Filter Serial Communication – When requesting Status data, the response data from the Harmonic Filter includes a bit that indicates whether communications were lost from the Vyper™ to the Harmonic Filter. If this bit is high for twenty consecutive seconds, this warning is indicated. This warning is also indicated whenever a receive, timeout, or checksum fault is detected on the Harmonic Filter communications, for twenty continuous seconds.

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