OPERATION

FRICK® QUANTUM™
COMPRESSOR
CONTROL PANEL
Version 5.0x
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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 sub systems. 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.

Alarm - An alarm 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.
KEYPAD KEYS
Following is a list of the labeled keypad keys and the actions that occur when they are pressed:

[STOP] - Immediately stops the compressor. The compressor is stopped regardless of any other conditions.

[HOME] - Shows the Operating Status screen. This screen is an overview of the present readings, operating modes and operating status.

[MAIN] - Shows the Main Menu screen. This screen has the main selections for accessing information, setup of options, and setpoint entry.

[HELP] - Displays the on-line HELP. Information is shown for the operation of the compressor control panel.

[ALARM SILENCE] - Immediately silences a sounding alarm and turns off the alarm annunciation device that is connected to this panel.

[F1] - A function key that is only active when a screen indicates it as a selection key. Its function is dependent on what the screen indicates will occur.

[F2] - A function key that is only active when a screen indicates it as a selection key. Its function is dependent on what the screen indicates will occur.

[ENTER] - When changing data in a data entry field, this key will input the change.

[PREVIOUS SCREEN] - Shows the screen that was viewed previously to the current screen. Also is used to return to the previous set of screen keys when accessing different sets of screen key selections on the same screen.

[DELETE] - When changing a value in a data field, this key will delete the selected character.

Up Arrow [^] - When in the mode of changing setpoints, this arrow is used to go to the previous data entry field.

Down Arrow [v] - When in the mode of changing setpoints, this arrow is used to go to the next data entry field.

Right Arrow [>] - When in the mode of changing setpoints, this arrow is used to go to the next data entry field. When in the mode of changing a data entry field, this arrow is used to go to the next character.

Left Arrow [<] - When in the mode of changing setpoints, this arrow is used to go to the previous data entry field. When in the mode of changing a data entry field, this arrow is used to go to the previous character.

NUMERALS [0] - [9] - The numerical keys are used to enter a value in a data field.

DECIMAL [.] - The decimal point is used when entering a decimal value in a data field.

[+/-] - When changing a value in a data field, this key enters a negative (-) sign in the data field.
SCREEN KEYS

Most of the screens have screen keys that are graphically depicted. They describe or show a function that is recognized when the coinciding keypad key to the right of the screen is pressed. A set of screen command keys (i.e. Compressor Mode) have a title area to describe the command control. Following are descriptions of the commonly used screen keys:

[Change Setpoints] - When on a screen that has adjustable setpoint values, this positions the cursor at the first data entry field. (See To Change Setpoints for more information.)

[OK] - Available when in the mode of changing setpoints, this accepts all data changes. Available as a response to a message, this approves continuing.

[CANCEL] - Available when in the mode of changing setpoints, this rejects all data changes. Available as a response to a message, this disapproves continuing.

Arrows - Available when in the changing setpoints mode, they function the same as the panel keypad arrows.

[Increase Value] - Available when in the changing setpoints mode, this increases the selected setpoint by one unit each time it is pressed.

[Decrease Value] - Available when in the changing setpoints mode, this decreases the selected setpoint by one unit each time it is pressed.

[Up One] - Scrolls the data on the screen to show one more previous line of data.

[Down One] - Scrolls the data on the screen to show one more line of data.

[Page Up] - Scrolls the data on the screen to show the previous page of data.

[Page Down] - Scrolls the data on the screen to show the next page of data.

[Goto Start] – Scrolls the data on the screen to show the most recent data.

[Goto End] - Scrolls the data on the screen to show the oldest data.

[More…] - Available when the selections are on more than one screen. Used to go to the next selections.

[…Back] - Available when the selections are on more than one screen. Used to go back to the previous selections.

[Make Active] - Available when viewing a set of capacity control setpoints. This command will make the capacity control setpoints being viewed the active control setpoints. Only one set of capacity control setpoints can be active. Activating a set will deactivate any other.

[Enable] - Available to place the indicated control setpoints or option into usage.

[Disable] - Available to remove the usage of the indicated control setpoints or option.

TO CHANGE SETPOINTS

WARNING

The Quantum™ has the capability of being modified by the user/owner in order to obtain different performance characteristics. Any modification to the standard default settings may have a severe negative impact on the operation and performance of the equipment. Any modification to these control settings is the sole responsibility of the user/owner and Frick disclaims any liability for the consequences of these modifications. It is possible that the modification of these settings may cause improper operation and performance that results in property damage, personal injury or death. It is the responsibility of the user/owner to evaluate and assess the consequences of their actions prior to modifying the controls for this unit.

The setpoints define the operation and limits of the compressor unit and subsystems operation. Adjustable setpoints are setpoints that an operator can easily change by one unit each time it is pressed.

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.

1. From an adjustable setpoint screen, select the [Change Setpoints] key. This positions the cursor at the first data entry field. The selected data entry field can be identified by the black background and white text.

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

3. 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.

4. 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 [DELETE] key to erase it.

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

6. If the value is out of bounds, an error message box displays the proper value range. Press the [OK] key to acknowledge the error message. Re-enter the correct value.

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

8. When finished making any changes to the data on an adjustable setpoint screen press the [OK] key to accept all changes or press the [CANCEL] key to cancel all of the data changes.

Note: When the display units are selected to display in PSIG, then 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.
SCREEN DESCRIPTION - OPERATING STATUS

Also called the *Home* screen. The most important information about the compressor unit and the 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 the left side of this screen:

**COMPRESSOR DATA BOX:**

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

- **Status** - One of the following messages is shown:
  - Off
  - Starting
  - Running
  - Stopping 00:00
  - Slide Valve Too High
  - High Differential Pressure
  - Permissive Started

- **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 - The compressor remote command was sent. The compressor starting and stopping is through the serial Com-2 channel. 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.

  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 Control* screen.

  Pumpdown Delay - This message shows the remaining time in minutes for Pumpdown delay. If the compressor is in Pumpdown, the Pumpdown Delay will prevent the compressor from stopping until the delay time expires or the Suction Pressure falls below the *On when above* Pumpdown setpoint. This time delay is intended to provide enough time to remove the refrigerant gas.

  Note: While in Pumpdown, the delay time and the *On when above* setpoint can be overridden to force the compressor to stop by pressing the [Compressor Stop] screen command key again.

**COMPRESSOR ALARM STATUS BOX:**

The Alarm Status is displayed in the indented box below the Compressor status box. The status box is blank with no message if there are no alarms or shutdowns present.
One of the following messages could be shown:

**ALARM** - This message flashes when an alarm is present. An alarm 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.

An Alarm or Shutdown message indicates an Alarm or Shutdown point has been reached, or exceeded. Select the [Alarms/Shutdown] key from the Main Menu screen for details.

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.

**SETPOINT BOX:**

The following items are shown:

- **Setpoint** - This is the control setpoint maintained by the internal capacity control.
- **Actual** - The actual reading of the pressure or temperature that was chosen as the compressor control setpoint.

**STATUS BOX OF OIL LUBRATION DEVICES:**

The operating status is shown for the following devices:

- **Oil Pump** - (If a selected feature from Factory Setup) – 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 Factory Setup, 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 INDICATION BOX:**

The following items are shown:

- **Motor Amps** - The actual amps.
- **Full Load Amps** - The percentage of the drive motor full load amperage rating that the motor is currently using. % (FLA x SF)
- **Kilowatts** - est. or Kilowatts
- **Kilowatts - est.** - The estimated motor voltage times motor amps.
- **Kilowatts** - If Kilowatt monitoring was enabled in Panel Setup, the actual value of the kW Monitoring analog input is displayed instead of an estimated value.

**COMMUNICATIONS BOX:**

The Communication Ports Status is shown for Comm 1, Comm 2, and I/O Comm. One of the following messages is shown:

- Failed
- Off
- Active

The following information is shown on the right side of the Operating Status screen:

**CAPACITY CONTROL BOX:**

Shows what is presently controlling the Slide Valve and from what source it was initiated.

- **Status** - One of the following control modes is shown:
  - Suction Pressure Mode 1
  - Suction Pressure Mode 2
  - Process Temperature Mode 1
  - Process Temperature Mode 2
  - Discharge Pressure Mode 1
  - Discharge Pressure Mode 2
  - User Selectable Control Mode 1
  - User Selectable Control Mode 2

  **Note:** For safety reasons, even when in manual control, the control settings and safeties of the last control mode is active.

- **Source** - One of the following messages is shown:
  - Keypad - A Slide Valve command was sent from the panel keypad.
  - Remote-I/O - The status of the Process Mode Select input module (Input Module 19) forced Capacity Control to a different Mode. For this to occur, Input Module Capacity Control Selection must be enabled in Panel Setup.
  - Remote Comm. - A command was sent through the serial Com-2 channel that forced Capacity Control to a different control.
  - Schedule - The capacity is being controlled from the Setback Schedule and the active capacity control mode. The Mode 2 setpoints become active at the start time. At the stop time the mode 1 setpoints become active.
SENSOR INDICATION BOX:
The following sensors are displayed:

- **Suction** - Suction Pressure and Temp. are measured at the compressor inlet and the values are displayed along with the unit of measure.

- **Discharge** - Discharge Pressure and Temp. are measured at the compressor outlet and the values are displayed along with the unit of measure.

- **Oil** - Oil Pressure and Temp. are measured prior to entering the compressor and the values are displayed along with the unit of measure.

- **Filter Diff.** - 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** - Oil Separator Temp. value is displayed along with the unit of measure.

- **Leaving Process** - If Process Temperature Control Modes were enabled in Panel Setup, 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 oil pressure at the Balance Piston.

SLIDE VALVE and SLIDE STOP (or CAPACITY) STATUS BOX:
**Position** - The following values are shown:

- **Slide Valve or Capacity** is shown depending on the compressor model (Reference Compressor Model Differences)

- **Slide Valve** - The position is displayed as a percentage. This value indicates the mechanical position of the Slide Valve and does not indicate the percentage of compressor capacity.

- **Capacity** - The position is displayed as a percentage. This value indicates the mechanical position of the Capacity Control pistons and does not reflect the percentage of full load operation.

- **Slide Stop** (If applicable, reference Compressor Model Differences) - The position is displayed as a ratio (volume index (VI)).

**Mode** - The following are shown:

- **Slide Valve or Capacity** (Reference Compressor Model Differences) - One of the following is shown:
  - **Auto** (Automatic) - Capacity is being controlled from active Capacity Control setpoints at the panel.
  - **Manual** - A manual load or unload command was sent.
  - **Remote** - The Slide Valve or capacity is being controlled from a remote device.

- **Slide Stop** (If applicable, reference Compressor Model Differences) - One of the following is shown:
  - **Auto** (Automatic) - The movement of the Slide Stop is being controlled from internal logic at the panel.
  - **Manual** - A Slide Stop manual increase or decrease command was sent.

**Status** - The following are shown:

- **Slide Valve or Capacity** (Reference Compressor Model Differences) - One of the following could be shown:
  - **Load** - Indicates the compressor is loading and the Slide Valve or capacity value is increasing.
  - **Unload** - Indicates the compressor is unloading and the Slide Valve or capacity value is decreasing.
  - **Idle** - Indicates the Slide Valve or capacity is holding at the present position.

- **Slide Stop** (If applicable, reference Compressor Model Differences) - One of the following is shown:
  - **Increase** - Moving to a higher VI.
  - **Decrease** - Moving to a lower VI.
  - **Idle** - Not moving.

The following messages could be shown:

**At Maximum Load** -

- **Warm Up Load Inhibit 00:00** - The time period that the Slide Valve will be inhibited based on the Starting Period Before Slide Valve Will Load setpoint on the Slide Valve Setpoints screen.

- **Slide Valve Pulldown** - A message can appear stating in a percentage the amount that the Slide Valve has loaded. The message will appear as Stop Load - Slide Valve Pulldown. 5% as an example.

- **Stop Load** - If this message is shown, it indicates that the compressor is being prevented from further loading. The Stop Load setpoint that has been reached is shown next to the stop load message, i.e. **Stop Load** - **High Motor Amps**, this message indicates that the **High Motor Amps** Stop Load setpoint was reached and the compressor is being prevented from further loading. One of the following messages could be shown if the corresponding Stop Load setpoint is reached:
  - **High Motor Amps** - If the motor amps is greater than or equal to the **High Motor Amps** Stop Load setpoint, the unit is prevented from further loading until
the Motor Amps is less than this setpoint.

- **High Discharge Pressure** - If the Discharge Pressure is greater than or equal to the **High Discharge Pressure Stop Load** setpoint, the unit is prevented from further loading until the Discharge Pressure is less than this setpoint.

- **High Discharge Temperature** - If the Discharge Temp. is greater than or equal to the **High Discharge Temperature Stop Load** setpoint, the compressor is prevented from further loading until the Discharge Temp. is less than this setpoint.

- **Low Suction Pressure** - If the Suction Pressure is less than or equal to the **Low Suction Pressure Stop Load** setpoint, the unit is prevented from further loading until the Suction Pressure is greater than this setpoint.

- **High Suction Pressure** - If the Suction Pressure is greater than or equal to the **High Suction Pressure Stop Load** setpoint, the compressor is prevented from further loading until the Suction Pressure is less than this setpoint.

- **Low Process Temperature** - If the Process Temp. is less than or equal to the **Low Process Temperature Stop Load** setpoint, the compressor is prevented from further loading until the Process Temp. is greater than this setpoint.

- **Low Oil Flow** - The compressor configuration has a safety check that determined the Suction Pressure is greater than or equal to \(( (1.5 \times \text{oil pressure}) + 15 \text{ lb.} \text{ and (Slide Valve} \geq 48 \%))\), the compressor is prevented from further loading.

- **Separator Velocity** - This override prevents the Slide Valve from loading, to prevent oil carryover to the system due to high velocity of the refrigerant gas in the separator.

- **Low RPM** - This override prevents the Slide Valve from loading due to low RPM on an engine drive compressor.

- **High Manifold Pressure** - This override prevents the Slide Valve from loading due to high manifold pressure on an engine drive compressor.

**Forced Unload** - This message indicates that the unit has been forced to unload. The Force Unload setpoint that has been reached is shown next to the message, i.e. **Forced Unload** - **High Motor Amps**, this indicates that the **High Motor Amps Force Unload** setpoint was reached and the compressor has been forced to unload. One of the following messages could be shown if the corresponding Force Unload setpoint is reached:

- **High Motor Amps** - If the motor amps is greater than or equal to the **High Motor Amps Force Unload** setpoint, the compressor is forced to unload until the Motor Amps is less than 1% of this setpoint.

- **High Discharge Pressure** - If the Discharge Pressure is greater than or equal to the **High Discharge Pressure Force Unload** setpoint, the compressor is forced to unload until the Discharge Pressure is less than this setpoint.

- **High Discharge Temperature** - If the Discharge Temp. is greater than or equal to the **High Discharge Temperature Stop Load** setpoint, the compressor is forced to unload until the Discharge Temp. is less than this setpoint.

- **High Suction Pressure** - If the Suction Pressure is less than or equal to the **High Suction Pressure Force Unload** setpoint, the compressor is forced to unload until the Suction Pressure is greater than this setpoint.

- **High Suction Pressure** - If the Suction Pressure is greater than or equal to the **High Suction Pressure Force Unload** setpoint, the compressor is forced to unload until the Suction Pressure is less than this setpoint.

- **Low Suction Pressure** - If the Suction Pressure is less than or equal to the **Low Suction Pressure Force Unload** setpoint, the compressor is forced to unload until the Suction Pressure is greater than this setpoint.

- **Low Process Temperature** - If the Process Temp. is less than or equal to the **Low Process Temperature Force Unload** setpoint, the compressor is forced to unload until the Process Temp. is greater than this setpoint.

- **Low Oil Flow** - The compressor configuration has a safety check that determined the Suction Pressure is greater than or equal to \(( (1.5 \times \text{oil pressure}) + 10 \text{ lb.})\), the compressor is forced to unload until the Process Temp. is greater than this setpoint.

- **Separator Velocity** - The override forces the Slide Valve to unload due to high velocity of the refrigerant gas in the separator.

- **Stopping** - When stopping the compressor, if the **Stopping Period For Slide Valve Unload** setpoint is > 0, a Force Unload is issued on the Slide Valve Setpoints screen.

- **Low RPM** - The override forces the Slide Valve to unload due to low RPM on an engine drive compressor.

- **High Manifold Pressure** - This override forces the Slide Valve to unload due to high manifold pressure on an engine drive compressor.
SCREEN KEY DESCRIPTIONS

This section shows the major operating screens within the Quantum™ operating system. To the right of the following screen is a brief description of each of the keys. Some keys will call up other screens, while other keys will provide additional key selections, while keeping the same screen.

Note: Based upon the particular factory setup options for each compressor, it is possible that some of the actual compressor panel keys/screens will appear slightly different than those shown in this manual. The first example for this screen, shown below, represents what might be displayed for an RWBII variable VI unit.

OPERATING STATUS

Following are the screen key selections for the Operating Status screen:

[Menu] - shows the Main Menu screen.

[Compressor Mode] - The following are the Compressor Mode screen command keys:

[Remote] – Selects the compressor to be controlled by a remote device.

[Auto] - Selects the compressor to be controlled from the automatic cycling setpoints.

[Manual Start] - Places the compressor unit in the start mode for running.

[Manual Stop] - Stops the compressor unit.

Depending on the compressor model, either [Slide Valve Mode] or [Capacity Mode] is present (Reference Compressor Model Differences).

[Slide Valve Mode] - (If applicable, reference Compressor Model Differences). The following are the Slide Valve Mode screen command keys:

[Remote] – The Slide Valve loading and unloading is controlled by a remote device.

[Auto] - The Slide Valve loading and unloading is under automatic Capacity Control settings.

[Manual Load] - Sends a load signal for the duration the key is pressed.

[Manual Unload] - Sends an unload signal for the duration the key is pressed.

[Remote Slide Valve] - This key will appear if Slide Valve Position Control is enabled as a selectable option in Panel Setup. This key selects to control the Slide Valve based on the (4-20 ma) analog signal of the Remote Slide Valve Position input. The Slide Valve position control will screen as a Slide Valve %.
[Capacity Mode] - (If applicable, reference Compressor Model Differences) The following are the Capacity Mode screen command keys:

- **[Remote]** - The capacity loading and unloading is controlled by a remote device.
- **[Auto]** - The loading and unloading is under automatic Capacity Control settings.
- **[Manual Load]** - Sends a load signal for the duration the key is pressed.
- **[Manual Unload]** - Sends an unload signal for the duration the key is pressed.

[Slide Stop Mode] - (If applicable, reference Compressor Model Differences) The following are the Slide Stop mode screen command keys:

- **[Auto]** - The Slide Stop increase and decrease is under internal control that is based on the differential of the machines Suction Pressure and Discharge Pressure.
- **[Manual Increase]** - Sends an increase signal for the duration the key is depressed.
- **[Manual Decrease]** - Sends a decrease signal for the duration the key is depressed.

[Oil Pump Mode] - (If applicable) The following are the Oil Pump mode screen command keys:

- **[Auto]** - The Oil Pump is started and stopped under internal automatic control.
- **[Manual On]** - Places the Oil Pump in the run mode.
- **[Manual Off]** - Places the Oil Pump in the stop mode.

If dual pumps were enabled in Factory Setup, then a toggle key is provided, that changes which pump is the lead, or first pump to be turned on.

- **[Oil Lead Pump 1]** - Selects pump 1 to be the lead Oil Pump.
- **[Oil Lead Pump 2]** - Selects pump 2 to be the lead Oil Pump.

This screen represents a pictorial of the compressor configuration, and shows the most critical operational readings. It additionally shows the alarm/shutdown status, communications ID number, and basic factory information pertaining to the unit.
### Operating Status - 2

<table>
<thead>
<tr>
<th>Entered Process Temperature</th>
<th>Internal Panel Temperature</th>
<th>Compressor Superheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>-45.9°F</td>
<td>88.5°F</td>
<td>181.7°F</td>
</tr>
</tbody>
</table>

**Panel Heater**
- On or Off message is shown for the status of the Panel Heater. If the temperature sensor on the main processor board detects the temperature is less than or equal to 12 degrees C, the Panel Heater output is turned on. If the temperature is detected to be greater than 13 degrees C, the Panel Heater output is turned off. A temperature of 55 degrees F is attempted to be maintained.

**Power Up Time**
- The clock time when the Quantum™ program was started.

**Last Power Down**
- The clock time when the Quantum™ program was last stopped.

Following are the screen key selections for the Operating Status - 2 screen:

- **[Operating Status]** - Shows the Operating Status screen.
- **[Condenser Setpoints]** - Shows the Condenser Control screen. This key is shown if a type of Condenser Control was selected in Panel Setup.
- **[Compressor Sequence Setpoints]** - Shows the Compressor Sequence Control screen. This key is shown if Compressor Sequencing is enabled in Panel Setup.
- **[Compressor Interlock Setpoints]** - Shows the Compressor Interlock screen. This key is shown if Compressor Interlock is enabled from the Compressor Sequencing option in Panel Setup.
MAIN MENU - SCREEN KEY SET

The Main Menu screen provides a selection of screen keys to guide the operator through all the screens. The following are descriptions of each screen selection and a listing of further selections:

[Operating Status] - Shows the Operating Status screen.

[Alarms/Shutdowns] - Shows the Alarms / Shutdowns screen which shows in red text the current Failures, and the Date, and Time of the Failure. The following selections are available:

- [Clear Alarms]
- Alarms/Shutdowns History Screen
- Freeze Display
- Power Down Display

[Control Setup] - Shows the Control Setup menu screen. The following items are selections:

- Capacity Control Setpoints
- Compressor Safeties Setpoints
- Motor Control
- Oil Setpoints
- Slide Valve Setpoints (If applicable, reference Compressor Model Differences)
- Setback Schedule
- Options Setup
- Auxiliaries 3-8 (If applicable, see Panel Setup)
- Auxiliary Analog Temperatures and Pressures (If applicable, see Panel Setup)
- Pumpdown/DX Circuit Setup (If applicable, see Panel Setup)

[Security] - Shows the current security privilege level and if setpoints are allowed to be changed from the keypad. Security can be changed on this screen.

[Calibration] - Shows the Analog Calibration screen. From this screen the following calibrations can be selected:

- Pressure Transducer Ranges and Offsets
- Temperature Probe Types, Ranges and Offsets
- Calibrate Motor Current
- Calibrate Slide Valve and Slide Stop (If applicable, reference Compressor Model Differences)
- Calibrate Remote Control Setpoint (If applicable, see Panel Setup)
- Calibrate Slide Valve Position (If applicable)
- Calibrate Auxiliary Analog (If applicable, see Panel Setup)
- Kilowatt Monitor Calibration and Setup (If applicable, see Panel Setup)

[Panel Setup] - Shows the Panel Setup screen. This screen has the following menu items for setup:

- Change Current Time and Date
- Pressure Units
- Temperature Units
- Language
- Change Communications
- Capacity Control Options

[About...] - Shows the About screen. This screen shows the software version, the sales order number, copyright notification, main board information, analog board(s) information and digital board(s) information.

[Real Time] - Real Time Trending feature.

[History] – Historical Trending and data logging.

[Service Screen] - Selecting this key shows the Service Screen that provides tools for troubleshooting and setting up the Quantum™.
This screen is accessible from the **Main Menu** screen. When an alarm or shutdown is triggered, a red descriptive message shows on this screen. The date and time of the 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.

The following are the **Alarms/Shutdowns** screen selection keys:

- **[Clear Alarms]** - Selecting this key will clear all alarms and/or shutdowns from this screen. It also de-energizes the Alarm and Shutdown output modules to silence any alarm annunciation device.

- **[Alarms/Shutdown History]** - A full screen of failures is stored, along with the Last Fail Date/Time, and the Last Clear Date/Time of the failure. The stored data shows on the **Alarms/Shutdowns History** screen. The data is saved, even if there is a power outage. The last ten **Freeze** screens can be accessed from this screen.

- **[Power Down Display]** - This screen shows the **Operating Status** screen with the important values that were last saved to fast battery backup memory prior to a loss of power to the panel. This screen can be distinguished from the **Operating Status** screen by -- **POWER** in the screen title, and there are no screen keys. This screen can help the operator to identify the conditions and the date and time prior to a power loss.

**NOTE:** The **Power Down** screen will appear with invalid data when power is initially furnished to the unit.

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

1. Correct the conditions causing the alarm.
2. Press the **[ALARM SILENCE]** key. (This action may precede correcting the conditions causing the alarm). Or, go to step 3.
3. To clear or reset the **Alarms/Shutdowns** screen and turn off any alarm annunciation device, from the screen, press the **[Clear Alarms]** key. This will also clear the ALARM or SHUTDOWN message from the **Operating Status** screen.
4. If the conditions causing the alarm have not been corrected or a new fault has occurred, a new ALARM or SHUTDOWN message will appear. The Alarms/Shutdowns history screen keeps a record of the alarms and shutdowns. This information will help troubleshoot persistent operational problems.
5. The information on the **Freeze** screen can help the operator to identify the cause of a fault, which occurred when no one was present. The **Freeze** screen freezes the information of the **Operating Status** screen AT THE MOMENT OF A COMPRESSOR ALARM OR SHUTDOWN. The Freeze screen has the same appearance and contains the same information as the **Operating Status** screen. (For a description of the information presented by the **Freeze** screen, refer to the **Operating Status** screen). The **Freeze** screen will retain the information generated by an alarm or shutdown. The last nineteen alarms / shutdowns **Freeze** screens are saved. This data is saved during a power outage.

Refer to the **Alarms/Shutdowns Message** section for a list of all the possible alarms.

When a Shutdown occurs, the screen 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.
Alarms/Shutdowns History

[Freeze Display] – Accesses the Freeze screen. Use the arrow keys or the screen command keys on the Alarms/Shutdowns History screen to select an alarm or shutdown and then press this screen selection key to view its Freeze screen.

OPERATING STATUS -- FREEZE

This screen provides a snapshot of the values that were current at the time of the latest shutdown. The information on the Freeze screen can help the operator to identify the cause of a fault, which occurred when no one was present. The Freeze screen freezes the information of the Operating Status screen AT THE MOMENT OF A COMPRESSOR ALARM OR SHUTDOWN. The Freeze screen has the same appearance and contains the same information as the Operating Status screen. (For a description of the information presented by the Freeze screen, refer to the Operating Status screen). The Freeze screen will retain the information generated by an alarm or shutdown. The last ten alarms/shutdowns Freeze screens are saved. This data is saved during a power outage.
The Control Setup screen is accessible from the Main Menu screen. The following are the Control Setup screen selections:

- **Capacity Control** - Shows a screen with selections for the Capacity Control setpoints that were enabled in Panel Setup. Only two types of Capacity Control setpoints can be enabled in Panel Setup. Only one Capacity Control mode can be active. The message Active - Current Capacity Control displays at the selected Capacity Control mode.

- **Compressor Safeties** - Shows a screen with selections to the compressor safeties displays is shown.

- **Motor Setpoints** - Pressing this key will display the Motor Control screen.

- **Oil Setpoints** - Pressing this key will display the Oil Setpoints screen.

- **Slide Valve Setpoints** (If applicable) - Pressing this key will display the Slide Valve Setpoints screen.

- **Setback Setpoints** - Pressing this key will display the Setback Setpoints screen.

- **More Control Setup** - Shows a screen with selections to other screens of enabled options.

- **[Setback Setpoints]** - Pressing this key will display the Setback Setpoints screen.

- **[Options Setup]** - Shows a screen with selections to other screens of enabled options.

- **[Additional Auxiliaries]** - Shows the Auxiliaries Setup screen for the digital input auxiliaries 3-8 setpoints. (If applicable, see Panel Setup)

- **[Auxiliary Analog]** - Shows the Auxiliary Analog screen for setup of the Auxiliary Analog Temperatures and Pressures. (If applicable, see Panel Setup)

- **[Pumpdown/DX Circuit]** - (If applicable, see Panel Setup)

- **[PID Setup]** - (If applicable, see Panel Setup)

- **[Digital Output #18 Control]** - (If applicable, see Panel Setup)
The Capacity Control selections that were enabled in Panel Setup, are shown. Only two types of Capacity Controls can be enabled in Panel Setup. Each type of Capacity Control has a Mode 1 and a Mode 2 setpoint screen.

The following is a list of all the different Capacity Control setpoint screens:

- Suction Pressure Mode 1
- Suction Pressure Mode 2
- Process Temperature Mode 1
- Process Temperature Mode 2
- Discharge Pressure Mode 1
- Discharge Pressure Mode 2
- User Selectable Control Mode 1
- User Selectable Control Mode 2

Following is an example of a Capacity Control setpoint screen:

**Suction Pressure Control**

The following setpoints are required for each of the Capacity Control setpoint screens:

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

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.

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

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

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

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

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

<table>
<thead>
<tr>
<th>Proportional Distance Actual Reading is From Setpoint</th>
<th>Output Pulsed On (seconds)</th>
<th>Output Off (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>1/4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>1/2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3/4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

**Upper Cycle Time** - 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.

**Lower Cycle Time** - 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.

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

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

**Start Time 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 Time 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.

The following setpoints are required for separate entry into each of the control setpoint screens listed above:

**Low Suction Pressure Stop Load** - If the Suction Pressure is less than or equal to this setpoint, the compressor will be prevented from further loading until the Suction Pressure is greater than this setpoint. This setpoint helps avoid forced unloading.

**Low Suction Pressure Force Unload** - If the Suction Pressure is less than or equal to this setpoint, the compressor will be forced to unload until the Suction Pressure is greater than this setpoint. This setpoint helps avoid the low Suction Pressure alarm and shutdown.

**Low Suction Pressure Alarm** - If the Suction Pressure is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**Low Suction Pressure Shutdown** - If the Suction Pressure is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**Low Suction Pressure Alarm Time Delay** - The minimum time in seconds that the Suction Pressure is less than or equal to the low Suction Pressure alarm setpoint before notification of the alarm.

**Low Suction Pressure Shutdown Time Delay** - The minimum time in seconds that the Suction Pressure is less than or equal to the low Suction Pressure shutdown setpoint before the compressor will shut down.

The following special key is on this screen:

**[Make Active]** - Selecting this key, switches the active control mode to the Capacity Control setpoints being viewed. Only one Capacity Control mode can be active.

The following special toggle key is on a **Suction Pressure Control Mode** screen:

**[Change To Temp.]** - Changes the Capacity Control setpoint and actual reading along with the autocycle setpoints to display as temperature values. The Proportional and Dead Bands are displayed as temperatures but can not be changed unless they are displayed as pressures.

**[Change To Pressure]** - Changes the Capacity Control setpoint and actual reading along with the autocycle setpoints to display as pressure values.

The following setpoints are required for separate entry into this control setpoint screen:

**Low Process Temperature Stop Load** - If the Process Temperature is less than or equal to this setpoint, the compressor will be prevented from further loading until the Process Temperature is...
greater than this setpoint. This setpoint helps avoid forced unloading.

**Low Process Temperature Force Unload** - If the Process Temperature is less than or equal to this setpoint, the compressor will be forced to unload until the Process Temperature is greater than this setpoint. This setpoint helps avoid the low Process Temperature alarm or shutdown.

**Low Process Temperature Alarm** - If the Process Temperature is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**Low Process Temperature Shutdown** - If the Process Temperature is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**Low Process Temperature Alarm Delay** - The minimum time in seconds that the Process Temperature is less than or equal to the low Process Temperature alarm setpoint before notification of the alarm.

**Low Process Temperature Shutdown Delay** - The minimum time in seconds that the Process Temperature is less than or equal to the low Process Temperature shutdown setpoint before the compressor will shut down.

### Process Temperature Control

![Process Temperature Control Diagram](image)

**Capacity Control Setpoint** - 40.0°F

<table>
<thead>
<tr>
<th>Upper</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.0°F</td>
<td>15.0°F</td>
</tr>
<tr>
<td>1.0°F</td>
<td>1.0°F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Start</th>
<th>Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>45.0°F</td>
<td>36.0°F</td>
</tr>
<tr>
<td>1 Min</td>
<td>1 Min</td>
</tr>
</tbody>
</table>

**Low Suction Pressure**

- **Stop Load**: 10.0 PSIG
- **Force Unload**: 5.0 PSIG

**Low Process Temperature**

- **Alarm**: 34.0°F
- **Shutdown**: 0.0 PSIG

- **Delay**: 3 Sec
User Selectable Control Setup

Selecting User Selectable Mode allows the operator to select from a menu of analog inputs (channels) that they may want to use to control the Slide Valve rather than Suction Pressure, Process Temperature or Discharge Pressure.

The following setpoints are on this control setpoint screen:

[Change Enable] - Pressing this key will cause the User Selectable Control Mode to toggle between:
  - Enabled
  - Disabled

[Change Setpoints] - Pressing this key will highlight the box beside Control Channel. The user can set this value based upon the following channels for analog board 1:
  - Discharge Temperature (channel 2)
  - Process Temperature (channel 5)
  - Discharge Pressure (channel 8)
  - Suction Pressure (channel 9)
  - System Discharge Press. (channel 11)
  - Remote Slide Valve Pos. (channel 13)
  - Slide Valve Position (channel 14)
  - Motor Amps (channel 16)

The following channels are available as selections for analog board 2 (optional):
  - Entering Process Temp. (channel 20)
  - Analog Auxiliary # 1 (channel 21)
  - Analog Auxiliary # 2 (channel 22)
  - Analog Auxiliary # 3 (channel 23)
  - Analog Auxiliary # 4 (channel 24)
  - Analog Auxiliary # 5 (channel 25)
  - Analog Auxiliary # 6 (channel 26)
  - Analog Auxiliary # 7 (channel 27)
  - Analog Auxiliary # 8 (channel 28)
  - Analog Auxiliary # 9 (channel 29)
  - Analog Auxiliary # 10 (channel 30)

NOTE: If using channels 21 - 30, the input must be configured, including the units, before the mode can be set up.

[Change Action] - Pressing this key will cause the Action selection to toggle between:
  - Forward - The Slide Valve will load, and the compressor can be set to start at values greater than the setpoints.
  - Reverse - The Slide Valve will load, and the compressor can be set to start at values less than the setpoints.
Compressor Safeties are important for the safe operation of the compressor. The following setpoint screens can be accessed from this screen:

- Discharge Safeties
- Suction Safeties
- Entering Process Safeties (If applicable)

The following safety setpoint is on this screen:

- **High Level Shutdown Delay** - The time in seconds to delay after the High Liquid Level input is energized before the compressor will shut down.
- **Oil Level Delay** - The time that must elapse before the low oil level shutdown can be initiated.

**Discharge Safeties**

The following Discharge Temperature setpoints are on this control setpoint screen:

- **High Discharge Temperature Stop Load** - If the Discharge Temperature is greater than or equal to this setpoint, the compressor will be prevented from further loading until the Discharge Temperature is less than this setpoint. This setpoint helps avoid forced unloading.
- **High Discharge Temperature Force Unload** - If the Discharge Temperature is greater than or equal to this setpoint, the compressor will be forced to unload until the Discharge Temperature is less than this
setpoint. This setpoint helps avoid the high Discharge Temperature alarm or shutdown.

**High Discharge Temperature Alarm** - If the Discharge Temperature is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**High Discharge Temperature Shutdown** - If the Discharge Temperature is greater than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**High Discharge Temperature Alarm Delay** - The minimum time in seconds that the Discharge Temperature is greater than or equal to the high Discharge Temperature alarm setpoint before notification of the alarm.

**High Discharge Temperature Shutdown Delay** - The minimum time in seconds that the Discharge Temperature is greater than or equal to the high Discharge Temperature shutdown before the compressor will shut down.

**Starting Differential Pressure below** - If the Differential Pressure (the result from subtracting Suction Pressure from Discharge Pressure) is greater than or equal to this setpoint, when the compressor is starting, a start inhibit will be applied. This can prevent excessive torque on the motor at startup.

If Dual Discharge Control has been enabled in Factory Setup, the following Discharge Pressure setpoints will be necessary for High Discharge Pressure Mode 2 in addition to High Discharge Pressure Mode 1:

**High Discharge Pressure Stop Load** - If the Discharge Pressure is greater than or equal to this setpoint, the compressor will be prevented from further loading until the Discharge Pressure is less than this setpoint. This setpoint helps avoid forced unloading.

**High Discharge Pressure Force Unload** - If the Discharge Pressure is greater than or equal to this setpoint, the compressor will be forced to unload until the Discharge Pressure is less than this setpoint. This setpoint helps avoid the high Discharge Pressure alarm or shutdown.

**High Discharge Pressure Alarm** - If the Discharge Pressure is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**High Discharge Pressure Shutdown** - If the Discharge Pressure is greater than or equal to this setpoint, for the shutdown time delay, the compressor will be shut down.

**High Discharge Pressure Alarm Delay** - The minimum time in seconds that the Discharge Pressure is greater than or equal to the high Discharge Pressure alarm setpoint before notification of the alarm.

**High Discharge Pressure Shutdown Delay** - The minimum time in seconds that the Discharge Pressure is greater than or equal to the high Discharge Pressure shutdown setpoint before the compressor will shut down.

If Dual Discharge Control has been enabled in Factory Setup, Enabled will be shown at the control setpoints that are currently active. The Enabled mode will follow the current active Capacity Control mode.

**Suction Safeties**

The following Suction Pressure setpoints are on this control setpoint screen:

**High Suction Pressure Stop Load** - If the Suction Pressure is greater than or equal to this setpoint, the compressor will be prevented from further loading until the Suction Pressure is less than this setpoint. This setpoint helps avoid forced unloading.
High Suction Pressure Force Unload - If the Suction Pressure is greater than or equal to this setpoint, the compressor will be forced to unload until the Suction Pressure is less than this setpoint. This setpoint helps avoid a high Suction Pressure alarm or shutdown.

High Suction Pressure Alarm - If the Suction Pressure is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

High Suction Pressure Shutdown - If the Suction Pressure is greater than or equal to this setpoint, for the shutdown time delay, the compressor will be shut down.

**Entering Process Safeties**

<table>
<thead>
<tr>
<th>Entering Process Temperature</th>
<th>Low</th>
<th>Alarm</th>
<th>High</th>
<th>Shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Entering Process Temperature Alarm Delay</td>
<td>0 Sec</td>
<td>0 Sec</td>
<td>0 Sec</td>
<td>0 Sec</td>
</tr>
<tr>
<td>Low Entering Process Temperature Shutdown Delay</td>
<td>0 Sec</td>
<td>0 Sec</td>
<td>0 Sec</td>
<td>0 Sec</td>
</tr>
</tbody>
</table>

This screen is shown if the Entering Process Temperature option was enabled in Panel Setup. This reading is useful for monitoring the temperature of what is being processed.

The following Entering Process Temperature setpoints are on this control setpoint screen:

Low Entering Process Temperature Alarm - If the Entering Process Temperature is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

Low Entering Process Temperature Shutdown - If the Entering Process Temperature is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

Low Entering Process Temperature Alarm Delay - The minimum time in seconds that the Entering Process Temperature is less than or equal to the low Entering Process Temperature alarm setpoint before notification of the alarm.

Low Entering Process Temperature Shutdown Delay - The minimum time in seconds that the Entering Process Temperature is less than or equal to the low Entering Process Temperature shutdown setpoint before the compressor will shut down.

High Entering Process Temperature Alarm - If the Entering Process Temperature is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

High Entering Process Temperature Shutdown - If the Entering Process Temperature is greater than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

High Entering Process Temperature Alarm Delay - The minimum time in seconds that the Entering Process Temperature is greater than or equal to the high Entering Process Temperature alarm setpoint before notification of the alarm.

High Entering Process Temperature Shutdown Delay - The minimum time in seconds that the Entering Process Temperature is greater than or equal to the high Entering Process Temperature shutdown setpoint before the compressor will shut down.
Motor Control

The following information should be recorded from the motor nameplate:

- Motor Amps
- Volts
- Service Factor - Note: Not required if using RAM DBS.
- Horse Power
- CT Factor - The Current Transformer Factor is printed on the current transformer in the compressor motor starter. Note: Not required if using RAM DBS.

To verify that the CT has been sized properly, use the following equation:

\[
CTF = FLA \times SF \times 1.1 = \text{Recommended CT} \quad \text{(Round up to next highest 100 Amps)}
\]

**EXAMPLE:**

- FLA = 182 Amps
- SF = 1.0
- CTF = \((182 \times 1.0 \times 1.1) = 200.2 > \) Round up to 300 [use 300:5 CT]

The following setpoints are required for safe motor operation:

**Recycle delay** - Each time the compressor is started, this value will be loaded into the Recycle Delay timer. This time must elapse prior to allowing the compressor to restart. The timer will time 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.

**NOTE:** Consult Motor Manufacturer for the recommended duration of the Recycle Delay.

The following setpoints are required for Motor Amps load control:

**High Motor Amps Stop Load** - The compressor slide valve will be prevented from loading until the Motor Amps is less than this setpoint.

**TYPICAL SETTING:** Motor Amps Stop Load = FLA \times 100%

**High Motor Amps Force Unload** - When the Motor Amps is greater than or equal to this setpoint, the compressor Slide Valve will be forced to unload until the Motor Amps has dropped by greater than 1% of this setpoint. For example, if this setpoint were 115 amps, then Force Unload = 115 \times .01 = 1.15 amps. This means that the Slide Valve will be forced to unload until the Motors Amps has dropped by 1.15 amps.

**TYPICAL SETTING:** Motor Amps Force UnLoad = FLA \times 105%

**High Motor Amps Alarm** - If the Motor Amps is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**High Motor Amps Shutdown** - If the Motor Amps is greater than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**High Motor Amps Alarm Delay** - The minimum time in seconds that the Motor Amps is greater than or equal to the High Motor Amps Alarm setpoint before notification of the alarm.

**High Motor Amps Shutdown Delay** - The minimum time in seconds that the Motor Amps is greater than or equal to the High Motor Amps Shutdown setpoint before the compressor will shut down.

**Low Motor Amps Shutdown** - This setpoint is used to determine if the coupling has broken. If the Motor...
Amps is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

Low Motor Amps Shutdown Delay – The minimum time in seconds that the Motor Amps is less than or equal to the Low Motor Amps Shutdown setpoint before the compressor will shut down.

Forced Unload Load Inhibit Delay – (If applicable, reference Appendix C). Once a Force Unload condition is cleared, this is the amount of time in seconds that the compressor is inhibited from loading.

The following special selections are on this screen:

Clear Remaining Delay – This selection will cause a message box to appear saying WARNING!!! This may cause damage to the motor, Continue?. Select the [OK] key to clear the Recycle Delay time or select the [Cancel] key to void clearing this timer.

Power Fail Restart – This section is available if this option was enabled in Panel Setup. This selection displays the Power Failure Restart screen. This screen has the following setpoint:

Time after power allowing restart – The number of hours and minutes that the compressor is allowed to restart in its previous mode after a power loss can be changed.

DBS Motor Starter – This selection is available if this feature was selected in Factory Setup. This selection displays the RAM DBS Motor Starter screen.

VariSpeed Setup – This selection is available if this feature was selected in Factory Setup.

VFD Drive Setup – This selection is available if this feature was selected in Factory Setup.

This is the VariSpeed Setup screen. It will show the pertinent information that applies to the VariSpeed drive (similar to the Operating Status screen for the compressor).

In addition to the basic operating information, both the Fault and Warning (or Alarm / Shutdown) information can be viewed here. There is also a box labeled Comm3: which will show whether the communications to the VariSpeed Drive is functioning properly or not. A successfully communicating system will show Active, while a non-communication situation will be shown as Failed.
Hardware Signals

4 – 20 mA analog output – Signal from the Quantum™ to provide the speed setpoint to the VFD controller. The VFD’s controller and hardware will need to be configured to the minimum and maximum desired speed. The minimum speed will vary depending on compressor type, consult the factory for application assistance.

4 – 20 mA analog input – Analog input channel on the Quantum™ to monitor the actual RPM’s of the drive. This signal is for monitoring purposes only.

Setpoints related to the VFD speed control output:

Maximum output – Setpoint used to select the maximum operating speed of the VFD. Selectable from 1-100% of the Quantum™’s 4-20 mA signal.

Minimum output – Setpoint used to select the minimum operating speed of the VFD. Selectable from 1-100% of the Quantum™’s 4-20 mA signal.

Rate of change - Setpoint used to adjust the speed changes sent to the VFD based on the capacity control. Selectable from .1-25% of the 4-20 mA signal.

Cycle Time – Setpoint used in conjunction with the Rate of change setpoint to adjust the time between speed changes sent to the VFD. Selectable from 1-30 seconds.

Slide Valve Position to begin Speed Increase – The Slide Valve position that must be obtained before the VFD will begin increasing speed. Selectable from 0-100% of the compressors Slide Valve position. This setpoint is used in conjunction with the Slide Valve Position to begin Speed Increase.

Drive Output at Max SV position – The desired speed of the VFD when the compressors Slide Valve position reaches 100%. This setpoint is selectable from 1-100% of the Quantum™’s 4-20 mA signal and is used in conjunction with the Slide Valve Position to begin Speed Increase.

NOTE: See Electric, VFD, Engine, Turbine flowchart for further information.
Hardware Signals

4 - 20 mA analog output – Signal from the Quantum™ to provide the speed setpoint to the speed governing device. The speed governing device's controller (i.e. Electronic Governor) and hardware will need to be configured to the minimum and maximum desired speed. The minimum speed will vary depending on compressor type, consult the factory application assistance.

4 - 20 mA analog input – Analog input channel on the Quantum™ to monitor the actual RPM's of the drive. This signal can be sent to the Quantum™ from the speed-governing device if available or generated from a magnetic pickup located on the flywheel teeth wired to a frequency to 4-20 mA converter.

Manifold Pressure (Engine only) – Pressure signal required from the engine to detect and respond to overload conditions.

Setpoints related to the Engine speed control output:

<table>
<thead>
<tr>
<th>Setpoint Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle Speed</td>
<td>0.0</td>
</tr>
<tr>
<td>Low RPM</td>
<td>1100 RPM</td>
</tr>
<tr>
<td>Force Unload</td>
<td>1075 RPM</td>
</tr>
<tr>
<td>Alarm</td>
<td>700 RPM, 1900 RPM</td>
</tr>
<tr>
<td>Delay</td>
<td>30 Sec, 1 Sec, 3 Sec</td>
</tr>
<tr>
<td>Shutdown</td>
<td>600 RPM, 2000 RPM</td>
</tr>
<tr>
<td>Maximum Percentage</td>
<td>100.0</td>
</tr>
<tr>
<td>Minimum Percentage</td>
<td>99.0</td>
</tr>
<tr>
<td>Rate of Change</td>
<td>0.1</td>
</tr>
<tr>
<td>Cycle Time</td>
<td>1 Sec</td>
</tr>
<tr>
<td>Slide Valve Position to begin Speed Increase</td>
<td>8.0 %</td>
</tr>
</tbody>
</table>

Slide Valve Position to begin Speed Increase – The Slide Valve position which must be obtained before the speed will begin to increase. Selectable from 0-100% of the compressors Slide Valve position. This setpoint is used in conjunction with the Drive Output at Max SV position.

Drive Output at Max SV position – The desired speed of the engine/turbine when the Slide Valve position reaches 100%. This setpoint is selectable from 1-100% of the Quantum™’s 4-20 mA signal and is used in conjunction with the Slide Valve Position to begin Speed Increase.

High RPM Alarm - If the RPM is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

High RPM Shutdown - If the RPM is greater than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

High RPM Alarm Delay - The minimum time in seconds that the RPM is greater than or equal to the High RPM alarm setpoint before notification of the alarm.

High RPM Shutdown Delay - The minimum time in seconds that the RPM is greater than or equal to the High RPM shutdown setpoint before the compressor will shut down.

Low RPM Stop Load - If the RPM is less than or equal to this setpoint, the compressor will be prevented from further loading until the RPM is greater than this setpoint. This setpoint helps avoid forced unloading.

Low RPM Force Unload - If the RPM is less than or equal to this setpoint, the compressor will be forced to unload until the RPM is greater than this setpoint. This setpoint helps avoid a low RPM alarm or shutdown.
High RPM Alarm - If the RPM is greater than or equal to this setpoint, an alarm occurs.

High RPM Shutdown - If the RPM is greater than or equal to this setpoint, the compressor will shut down.

High RPM Alarm Delay - The minimum time in seconds that the RPM is greater than or equal to the High RPM alarm setpoint before notification of the alarm.

High RPM Shutdown Delay - The minimum time in seconds that the RPM is greater than or equal to the High RPM shutdown setpoint before the compressor will shut down.

Low RPM Stop Load - If the RPM is less than or equal to this setpoint, the compressor will be prevented from further loading until the RPM is greater than this setpoint. This setpoint helps avoid forced unloading.

Low RPM Force Unload - If the RPM is less than or equal to this setpoint, the compressor will be forced to unload until the RPM is greater than this setpoint. This setpoint helps avoid a low RPM alarm or shutdown.

Low RPM Alarm - If the RPM is less than or equal to this setpoint, an alarm occurs.

Low RPM Shutdown - If the RPM is less than or equal to this setpoint, the compressor will shut down.

Low RPM Alarm Delay - The minimum time in seconds that the RPM is less than or equal to the Low RPM alarm setpoint before notification of the alarm.

Low RPM Shutdown Delay - The minimum time in seconds that the RPM is less than or equal to the Low RPM shutdown setpoint before the compressor will shut down.

Confirmed Running (RPM) - The value that the RPM is greater than or equal to consider the compressor running.

Starting Maximum Delay - The time delay required for the Slide Valve to unload below the Highest Slide Valve position to allow starting the compressor setpoint and the engine RPM's to reach the confirmed running RPM's setpoint.

NOTE: See Electric, VFD, Engine, Turbine flowchart for further information.

This screen is available if a RAM DBS motor starter has been set up for use with the Quantum™. The DBS accelerates the motor in a smooth, stepless motion, therefore it reduces supply voltage dip during motor start, and mechanical shock on the compressor. Reference the DBS Operator's Guide and Instruction Manual or contact RAM Industries Inc., in Leesport, Pennsylvania at 800-220-8697 with any further questions concerning the setup and operation of the RAM DBS.

The current system conditions of the RAM DBS are displayed for monitoring. The Time Till Start value will also be displayed on both the Motor Control screen and this screen. This value and the current Recycle Delay timer must be zero prior to allowing the compressor to restart. These timers are intended to prevent damage to the motor from successive restarts. Both timers can be cleared by pressing the [Clear Remaining Delay] key on the Motor Control screen. The Time Till Start is read from the RAM DBS.

The following RAM DBS setpoints are modifiable from this screen:
- Locked Rotor Current
- Stall Time
- Jam Current Level

This screen is available if a RAM DBS motor starter has been set up for use with the Quantum™. The DBS accelerates the motor in a smooth, stepless motion, therefore it reduces supply voltage dip during motor start, and mechanical shock on the compressor. Reference the DBS Operator’s Guide and Instruction Manual or contact RAM Industries Inc., in Leesport, Pennsylvania at 800-220-8697 with any further questions concerning the setup and operation of the RAM DBS.

The current system conditions of the RAM DBS are displayed for monitoring. The Time Till Start value will also be displayed on both the Motor Control screen and this screen. This value and the current Recycle Delay timer must be zero prior to allowing the compressor to restart. These timers are intended to prevent damage to the motor from successive restarts. Both timers can be cleared by pressing the [Clear Remaining Delay] key on the Motor Control screen. The Time Till Start is read from the RAM DBS.

The following RAM DBS setpoints are modifiable from this screen:
- Locked Rotor Current
- Stall Time
- Jam Current Level
Low RPM Alarm - If the RPM is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

Low RPM Shutdown - If the RPM is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

Low RPM Alarm Delay - The minimum time in seconds that the RPM is less than or equal to the Low RPM alarm setpoint before notification of the alarm.

Low RPM Shutdown Delay - The minimum time in seconds that the RPM is less than or equal to the Low RPM shutdown setpoint before the compressor will shut down.

Confirmed Running (RPM) - The value that the RPM is greater than or equal to consider the compressor running.

Starting Maximum Delay - The time delay required for the Slide Valve to unload below the Highest Slide Valve position to allow starting the compressor setpoint and the engine RPM's to reach the confirmed running RPM's setpoint.

NOTE: See Electric, VFD, Engine, Turbine flowchart for further information.

**Turbine**

| Stop Load | 1100 RPM |
| Force Unload | 1875 RPM |
| Alarm | 790 RPM |
| Delay | 30 Sec |
| Shutdown | 630 RPM |
| Delay | 30 Sec |

| Maximum Percentage | 100.0 % |
| Minimum Percentage | 0.0 % |
| Rate of Change | 8.1 % |
| Cycle Time | 1 Sec |

Hardware Signals

4 – 20 mA analog output – Signal from the Quantum™ to provide the speed setpoint to the speed governing device. The speed governing device's controller (i.e. Electronic Governor) and hardware will need to be configured to the minimum and maximum desired speed. The minimum speed will vary depending on compressor type, consult the factory application assistance.

4 – 20 mA analog input – Analog input channel on the Quantum™ to monitor the actual RPM's of the drive. This signal can be sent to the Quantum™ from the speed-governing device if available or generated from a magnetic pickup located on the flywheel teeth wired to a frequency to 4-20 mA converter.

Setpoints related to the Turbine speed control output:

Maximum output – Setpoint used to select the minimum operating speed. Selectable from 1-100% of the Quantum™'s 4-20 mA signal.

Rate of change - Setpoint used to adjust the speed changes sent to the VFD based on the capacity control requirements. Selectable from .1-25% of the 4-20mA signal.

Cycle Time – Setpoint used in conjunction with the Rate of change setpoint to adjust the time between speed changes sent to the VFD. Selectable from 1-30 seconds.

Slide Valve Position to begin Speed Increase – The Slide Valve position that must be obtained before the speed will begin to increase. Selectable from 0-100% of the compressors Slide Valve position. This setpoint is used in conjunction with the Drive Output at Max SV position.

Drive Output at Max SV position – The desired speed of the engine/turbine when the Slide Valve position reaches 100%. This setpoint is selectable from 1-100% of the Quantum™'s 4-20 mA signal and is used in conjunction with the Slide Valve Position to begin Speed Increase.
• Jam Run Delay
• Service Factor
• Current Unbalance Alarm Level
• Current Unbalance Alarm Delay
• RTD Temperature Alarm Level
• RTD Temperature Alarm Delay

Alarms and trips (shutdowns) that are recorded by the DBS are shown on the RAM DBS Motor Starter screen but must be cleared from the Alarms / Shutdowns screen.

The following special selections are on these two screens:

[Fault History] – This selection displays the RAM DBS Motor Starter screen with the fault history of the RAM DBS system. This information is read directly from the system.

[Load Factory Setpoints] – This selection will reload the RAM DBS factory default settings.

[Clear Fault History] – This selection will clear the fault history at the RAM DBS system.

RAM DBS Motor Starter – FAULT HISTORY

<table>
<thead>
<tr>
<th>Last Trip Condition</th>
<th>: No Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last Trip Current</td>
<td>: 0 Amps</td>
</tr>
<tr>
<td>Last Trip HeatSink Temperature</td>
<td>: 32 F</td>
</tr>
<tr>
<td>Last Trip RTD Temperature</td>
<td>: 32 F</td>
</tr>
<tr>
<td>Last Trip Current Step</td>
<td>: 0 Amps</td>
</tr>
<tr>
<td>Last Trip Bypass Delay Time</td>
<td>: 0 Sec</td>
</tr>
<tr>
<td>Last Run Time</td>
<td>: 00:00</td>
</tr>
<tr>
<td>Total Number of Starts</td>
<td>: 8</td>
</tr>
<tr>
<td>Total Run Time</td>
<td>: 00:00</td>
</tr>
<tr>
<td>Total No. of Jam Trips</td>
<td>: 0</td>
</tr>
<tr>
<td>Total No. of Short Circuit Trips</td>
<td>: 0</td>
</tr>
<tr>
<td>Total No. of Phase Loss Trips</td>
<td>: 0</td>
</tr>
<tr>
<td>Total No. of Phase Reversal Trips</td>
<td>: 0</td>
</tr>
<tr>
<td>Total No. of Current Unbalance Alarms</td>
<td>: 0</td>
</tr>
<tr>
<td>Total No. of Current Unbalance Temperature Trips</td>
<td>: 0</td>
</tr>
<tr>
<td>Total No. of RTD Overtemperature Trips</td>
<td>: 0</td>
</tr>
<tr>
<td>Maximum RTD Overloads Trips</td>
<td>: 0</td>
</tr>
<tr>
<td>Maximum RTD Temperature</td>
<td>: 32 F</td>
</tr>
</tbody>
</table>

[Clear Fault History]
The following oil separator setpoints are on this screen:

**Low Oil Separator Temperature Alarm** - If the Oil Separator Temperature is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**Low Oil Separator Temperature Shutdown** - If the Oil Separator Temperature is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**Low Oil Separator Temperature Alarm Delay** - The minimum time in seconds that the Oil Separator Temperature is less than or equal to the Low Oil Separator Temperature Alarm setpoint before notification of the alarm.

**Low Oil Separator Temperature Shutdown Delay** - The minimum time in seconds that the Oil Separator Temperature is less than or equal to the Low Oil Separator Shutdown setpoint before the compressor will shut down.

**Oil Heater Off Above** - While the compressor is not running, the Oil Separator heater(s) will be turned off if the temperature is greater than or equal to this setpoint; however, if the temperature is 1 °C below this setpoint the Oil Separator heater(s) will be turned on. If the compressor is running, the oil heater(s) are turned off.

The following oil setpoints are on this screen:

**High Oil Temperature Alarm** - If the Oil Temperature is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**High Oil Temperature Shutdown** - If the Oil Temperature is greater than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**High Oil Temperature Alarm Delay** - The minimum time in seconds that the Oil Temperature is greater than or equal to the High Oil Temperature Alarm setpoint before notification of the alarm.

**High Oil Temperature Shutdown Delay** - The minimum time in seconds that the Oil Temperature is greater than or equal to the High Oil Temperature Alarm setpoint before the compressor will shut down.

**Low Oil Temperature Alarm** - If the Oil Temperature is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**Low Oil Temperature Shutdown** - If the Oil Temperature is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**Low Oil Temperature Alarm Delay** - The minimum time in seconds that the Oil Temperature is less than or equal to the Low Oil Separator Alarm setpoint before notification of the alarm.

**Low Oil Temperature Shutdown Delay** - The minimum time in seconds that the Oil Separator Temperature is less than or equal to the Low Oil Separator Shutdown setpoint before the compressor will shut down.

The following displayed Oil Setpoints can not be modified:

**Low Oil Pressure Alarm** - If the Oil Pressure is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**Low Oil Pressure Shutdown** - If the Oil Pressure is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.
**Low Oil Pressure Alarm Delay** - The minimum time in seconds that the Oil Pressure is less than or equal to the Low Oil Pressure Alarm setpoint before notification of the alarm.

**Low Oil Pressure Shutdown Delay** - The minimum time in seconds that the Oil Pressure is less than or equal to the Low Oil Pressure Shutdown setpoint before the compressor will shut down.

**Low Oil Pressure Alarm and Shutdown** - Is determined by the type of pump and its running mode, and from the pressure differential of the Oil Pressure reading above or below the Discharge Pressure reading.

The following tables show the setup of the Oil Setpoints that can not be modified:

**Running Full Lube Pump and Running Cycling Pump Oil Pressure - Discharge Pressure = Oil Pressure Differential**

<table>
<thead>
<tr>
<th>Oil Pressure Differential</th>
<th>Alarm</th>
<th>Shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Delay</td>
<td>10 PSID</td>
<td>5 PSID</td>
</tr>
<tr>
<td></td>
<td>30 sec.</td>
<td>10 sec.</td>
</tr>
</tbody>
</table>

Other Manufacture’s Compressor Pump (Full Lube) Oil Pressure - Discharge Pressure = Oil Pressure Differential

<table>
<thead>
<tr>
<th>Oil Pressure Differential</th>
<th>Alarm</th>
<th>Shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Delay</td>
<td>25 PSID</td>
<td>20 PSID</td>
</tr>
<tr>
<td></td>
<td>5 sec.</td>
<td>5 sec.</td>
</tr>
</tbody>
</table>

**Prelube Pump and Not Running Cycling Pump Discharge Pressure - Oil Pressure = Oil Pressure Differential**

<table>
<thead>
<tr>
<th>RWBII</th>
<th>Alarm</th>
<th>Shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Pressure Differential</td>
<td>25 PSID</td>
<td>30 PSID</td>
</tr>
<tr>
<td>Time Delay</td>
<td>30 sec.</td>
<td>10 sec.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RXF and RXB</th>
<th>Alarm</th>
<th>Shutdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Pressure Differential</td>
<td>35 PSID</td>
<td>40 PSID</td>
</tr>
<tr>
<td>Time Delay</td>
<td>30 sec.</td>
<td>10 sec.</td>
</tr>
</tbody>
</table>

Additionally a safety check is made for low oil flow that will stop the compressor from loading or force the compressor to unload. This check is made only for a RWB with prelube or a RXB with no pump:

- If \( \text{Oil Pressure} \leq (1.5 \times \text{Suction Pressure}) + 10 \text{ lb.} \) then the compressor will be forced to unload to 50% slide valve. If this condition is reached the message **Forced Unload - Low Oil Flow** is shown on the **Operating Status** screen.

- If \( \text{Oil pressure} \leq ((1.5 \times \text{suction pressure}) + 15 \text{ lb.}) \) and \( \text{(Slide Valve} \geq 48\%) \) then the compressor will be prevented from further loading. If this condition is reached the message **Stop Load - Low Oil Flow** is shown on the **Operating Status** screen.

**NOTE:** Refer to **OIL SAFETY LOGIC Flowchart** for more information.

The following special selections are on this screen:

- **[Main Oil Injection]** - This selection is only available if Main Oil Injection was enabled in Factory Setup. The following Oil Setpoints are on this screen:
  
  - **On at Discharge Temperature** - If the high stage compressor is running and the Discharge Temperature is greater than or equal to this setpoint, for the time delay, the Main Oil Injection Discharge Temperature output on digital board #2 is energized
  
  - **On at Discharge Temperature Delay** - The minimum time in seconds that the Discharge Temperature is less than or equal to the **On at Discharge Temperature** setpoint before the Main Oil Injection Discharge Temperature output on digital board #2 is energized.

- **[Liquid Injection]** - This selection is only available if the compressor has Liquid Injection oil cooling and it was enabled through Factory Setup. This selection displays the **Liquid Injection Cooling** screen. Liquid Injection controls the supply of liquid refrigerant to the compressor. Liquid Injection is off (the solenoid is closed) if the compressor is off.

This screen has the following setpoints:

- **Oil Temperature On at** - While the compressor is running, if the Oil Temperature equals or exceeds this setpoint, for the delay time, the Liquid Injection output will be energized or turned on to open a liquid valve. If the output is energized it will be de-energized or turned off, if the Oil Temperature is 1 °C below this setpoint.

- **Oil Temperature Delay** - The minimum time in seconds that the Oil Temperature is greater than or equal to the **Oil Temperature On at** setpoint when the compressor is running, before the Liquid Injection output is turned on.

**Filter Pressure Setpoints** screen. The filter value equals the Filter Pressure reading minus the Oil Pressure reading, with only one exception; if the pump is a Prelube and Liquid Injection is enabled; then, the Filter Pressure value equals the Discharge Pressure reading minus the Oil Pressure reading.
### Main Oil Injection Setpoints

<table>
<thead>
<tr>
<th>Parameter</th>
<th>On at</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge Temperature</td>
<td>180.8 F</td>
<td>5 Sec</td>
</tr>
</tbody>
</table>

**NOTE:** Only when compressor is running

### Liquid Injection Cooling Setpoints

<table>
<thead>
<tr>
<th>Parameter</th>
<th>On at</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Temperature</td>
<td>122.8 F</td>
<td>5 Sec</td>
</tr>
</tbody>
</table>

**NOTE:** Only when compressor is running
This screen has the following setpoints:

**High Filter Pressure Alarm** - If the Filter Pressure is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

**High Filter Pressure Shutdown** - If the Filter Pressure is greater than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

**High Filter Pressure Alarm Delay** - The minimum time in seconds that the Filter Pressure is greater than or equal to the High Filter Pressure Alarm setpoint before notification of the alarm.

**High Filter Pressure Shutdown Delay** - The minimum time in seconds that the filter pressure is greater than or equal to the High Filter Pressure Shutdown setpoint before the compressor will shut down.

**Overview of the Oil Pump Operation**

A Prelube Pump is turned on if the Slide Valve is too high. While the compressor is running the Prelube Pump is turned off. A Full Time Pump is always turned on while the compressor is starting and running. The Cycling Pump is cycled on and off while the compressor is running in response to the pressure differential calculation. The differential equals the Discharge Pressure reading minus the Suction Pressure reading. The pump is turned on if \[\text{Discharge} - (1.4 \times \text{Suction}) < 35\]. The pump is turned off if \[\text{Discharge} - (1.4 \times \text{Suction}) > 45\].

During the compressor stop cycle, the Oil Pump is used for a postlube operation that is performed to help unload the Slide Valve. During the postlube, the Oil Pump will be turned on for five (5) minutes or until the Slide Valve is unloaded to or below the Highest Slide Valve position to allow starting the compressor setpoint. The compressor can not be restarted unless the Slide Valve is less than 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 Unload Failure - Alarm is issued.

Dual Pumps are enabled in Factory Setup. The lead pump is the pump selected to be the first pump to run. If the lead pump has a pump auxiliary failure, an alarm message is issued and the other pump will be turned on. If the compressor has a Low Oil Pressure Alarm failure, the second pump will be turned on; then after a 30 seconds delay, the lead pump will be turned off. If while the compressor is running the second pump has an auxiliary failure or low Oil Pressure is encountered, a shutdown message and action is issued.
The **Slide Valve Setpoints** screen is shown if it applies to this compressor model (Reference **Compressor Model Differences**). The following Slide Valve setpoints are on this control setpoint screen:

- **Highest Slide Valve Position to allow Compressor Start** - If the Slide Valve is above this Slide Valve position the compressor will not be allowed to start.

- **Starting Period before Slide Valve will load** – The amount of time, in seconds, after the compressor starts, that the Slide Valve will not load. This timeout period is displayed on the Operator Status screen as a *Stop Load Starting Inhibit* message with time to expire.

- **Stopping Period Slide Valve Unload** – This setpoint comes in to play if the value is > zero and the [Compressor Manual Stop] button is pressed. The compressor will not stop, but will enter a stopping mode in which the Slide Valve is given a Force Unload until it is below the **Highest Slide Valve Position To Allow Starting The Compressor** setpoint before stopping –OR- the timeout period expires.

  **NOTE:** If the [Stop Button] is pressed again for a second time, the compressor will stop.

- **Minimum Slide Valve Position when in Autocycle** - If automatic cycling (autocycle) is active, this is the Slide Valve position a running compressor will not unload below. This setpoint is useful for pumping down the refrigerant in a system.

**Note the warning that says:**  
**CAUTION: High settings may cause motor overload trip.**  
**Note:** During the compressor stopping, the Slide Valve unload solenoid remains energized until the Slide Valve is unloaded to or below the **Highest Slide Valve**


The **Slide Valve Setpoints** screen is shown if it applies to this compressor model (Reference **Compressor Model Differences**). The following Slide Valve setpoints are on this control setpoint screen:

- **Highest Slide Valve Position to allow Compressor Start** - If the Slide Valve is above this Slide Valve position the compressor will not be allowed to start.

- **Starting Period before Slide Valve will load** – The amount of time, in seconds, after the compressor starts, that the Slide Valve will not load. This timeout period is displayed on the Operator Status screen as a *Stop Load Starting Inhibit* message with time to expire.

- **Stopping Period Slide Valve Unload** – This setpoint comes in to play if the value is > zero and the [Compressor Manual Stop] button is pressed. The compressor will not stop, but will enter a stopping mode in which the Slide Valve is given a Force Unload until it is below the **Highest Slide Valve Position To Allow Starting The Compressor** setpoint before stopping –OR- the timeout period expires.

  **NOTE:** If the [Stop Button] is pressed again for a second time, the compressor will stop.

- **Minimum Slide Valve Position when in Autocycle** - If automatic cycling (autocycle) is active, this is the Slide Valve position a running compressor will not unload below. This setpoint is useful for pumping down the refrigerant in a system.

**Note the warning that says:**  
**CAUTION: High settings may cause motor overload trip.**  
**Note:** During the compressor stopping, the Slide Valve unload solenoid remains energized until the Slide Valve is unloaded to or below the **Highest Slide Valve**


The Hot Gas Bypass and Slide Valve Setpoints digital outputs are displayed on the Slide Valve setpoints screen if it applies to this compressor model (Reference **Compressor Model Differences**) and if Hot Gas Bypass/SV Setpoint was enabled in Panel Setup. The on or off status of the outputs and the setpoint will be shown. The following outputs are used as an indicator of a Slide Valve position:

- **Hot Gas Bypass/SV Setpoint** - This output is intended to be used for either Hot Gas Bypass control or as an indication of a Slide Valve position.

  - **Slide Valve Setpoint 1**
  - **Slide Valve Setpoint 2**

  The following setpoint for the digital output is provided:

  - **On when below**

    The digital output is turned on when the Slide Valve position is below this setpoint and turned off when the Slide Valve position equals or exceeds this setpoint.

**Note:** These setpoints are active only when the compressor is running.

The following special selection is on this screen:

- **[Economizer Setpoints]** - Shows the **Economizer Setup** screen, shown on the following page.
The following setpoints are shown on this screen:

**On when above** - The Economizer digital output (module 11 on digital board #1) is turned on when the Slide Valve position is greater than this setpoint.

**Off when below** - The Economizer digital output (module 1 on digital board #1) is turned off when the Slide Valve position goes below this setpoint.

### Fixed Economizer Pressure

- **Fixed Economizer Pressure** -
  - **60.0 PSIG**

### Economizer Pressure Input

- **Economizer Pressure Input**: DISABLED

**NOTE**: Only when compressor is running

**Fixed Economizer Pressure** -

**Economizer Pressure Input** - Shows the current state of the input. A toggle key is provided to change from Disabled to Enabled.

**Note**: These setpoints are active only when the compressor is running.
Setback is another set of Capacity Control setpoints (Mode 2) that is initiated and removed by time of day. Setback can be used to save energy. At night or on weekends, when room doors are kept closed, a higher temperature can be set to reduce energy consumption.

This screen shows a time schedule. Two different start and stop times can be entered for each day of the week. The Setback Schedule is only effective if the compressor is in automatic. The Setback Schedule must be activated to switch the presently active Capacity Control mode to the Mode 2 (setback) setpoints at the start time. At the stop time, the control mode is returned to the Mode 1 (normal) setpoints. An entry of 00:00 will void the time entry field. If setback is required at midnight (00:00) use 00:01.

The following are descriptions of the setpoints:

- **Start** - time of day to switch to the Mode 2 (setback) setpoints of the active Capacity Control.
- **Stop** - time of day to return to the Mode 1 (normal) setpoints of the active Capacity Control.
The second Control Setup screen is accessible by pressing the [More...] key on the main Control Setup screen. The following are the second group of Control Setup screen selections:

[Options Setup] - Pressing this key will show a screen with available option selections.

[Additional Auxiliaries] - Pressing this key will show a screen that will allow setup of Auxiliaries 3 - 8.

[Auxiliary Analog] - Pressing this key will show a screen that will allow setup of Auxiliary Analogs (temperature and pressure).

[DX Circuit Setup] - Pressing this key will show a screen that will allow setup of Pumpdown/DX Circuit.

[PID Setup] - Shows a screen with PID setups.
Options that were enabled in **Panel Setup** are shown. The following screens are possible:

- **Condenser Control** (If applicable, see **Panel Setup**)
- **Compressor Sequence Control or Compressor Interlock** (If applicable, see **Panel Setup**)
- **Input Module Capacity Control Selection** (If applicable, see **Panel Setup**)
- **Auxiliary Setup** - Shows the **Auxiliary Setup** screen for the analog auxiliaries 1-2 setpoints. (If applicable, see **Panel Setup**)
- **Suction Pull Down** (If applicable, see **Panel Setup**)

---

<table>
<thead>
<tr>
<th>Options Setup</th>
<th>Condenser Control</th>
<th>Condenser Setpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Compressor Interlock</td>
<td>Compressor Interlock Setpoints</td>
</tr>
<tr>
<td></td>
<td>Input Module Capacity Control Selection</td>
<td>Input Module Setpoints</td>
</tr>
<tr>
<td></td>
<td>Auxiliary Setup</td>
<td>Auxiliary Input Setup</td>
</tr>
<tr>
<td></td>
<td>Pull Down</td>
<td>Pull Down</td>
</tr>
</tbody>
</table>

**Options Setup**

---

**S90-010 O                                   FRICK QUANTUM™ COMPRESSOR CONTROL PANEL**

**Page 40                                                                            OPERATION**
### Auxiliary Setup

<table>
<thead>
<tr>
<th>Auxiliary</th>
<th>Type</th>
<th>Checked</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary 3</td>
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<tr>
<td>Auxiliary 4</td>
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</tr>
<tr>
<td>Auxiliary 5</td>
<td>DISABLED</td>
<td>DISABLED</td>
<td>5 Sec</td>
</tr>
<tr>
<td>Auxiliary 6</td>
<td>DISABLED</td>
<td>DISABLED</td>
<td>5 Sec</td>
</tr>
<tr>
<td>Auxiliary 7</td>
<td>DISABLED</td>
<td>DISABLED</td>
<td>5 Sec</td>
</tr>
<tr>
<td>Auxiliary 8</td>
<td>DISABLED</td>
<td>DISABLED</td>
<td>5 Sec</td>
</tr>
</tbody>
</table>

The Auxiliaries #3 - #8 are programmable digital inputs on Digital I/O Board #2. These additional auxiliaries have the same settings as Auxiliary #1 and #2 (See Auxiliary Setup Screen). In addition to these settings there is a toggle key that changes between the following selections:

**[Auxiliary x Disable]** - This key is provided if this feature is disabled for this auxiliary. x is used here to refer to the auxiliary (3-8) that has been selected for setup.

**[Auxiliary x Enable]** - This key is provided if this feature is enabled. x is used here to refer to the auxiliary (3-8) that has been selected for setup.
### Auxiliary Analog (Temperatures & Pressures)

<table>
<thead>
<tr>
<th>Auxiliary Analog</th>
<th>Fri 2 Apr 2004 14:52:26</th>
<th>Change Auxiliary Analog 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Auxiliary Analog 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Shutdown</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Low Shutdown</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>High Alarm</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Low Alarm</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Current Value</td>
<td>72.9 °F</td>
<td>Temperature Active</td>
</tr>
<tr>
<td><strong>Auxiliary Analog 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Shutdown</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Low Shutdown</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>High Alarm</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Low Alarm</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Current Value</td>
<td>103.4 °F</td>
<td>Temperature Active</td>
</tr>
<tr>
<td><strong>Auxiliary Analog 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Shutdown</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Low Shutdown</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>High Alarm</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Low Alarm</td>
<td>30.0 °F</td>
<td>Delay</td>
</tr>
<tr>
<td>Current Value</td>
<td>134.0 °F</td>
<td>Temperature Active</td>
</tr>
</tbody>
</table>

The Temperature/Pressure Monitoring Auxiliary Analogs #1 - #9 and the Side Load/Economizer analog inputs of Analog Board #2 are setup here. These analog auxiliaries can be used for either temperature or pressure monitoring. The switching of these to temperature or pressure analog readings is done in Factory Setup. This screen shows the current reading of the analog value.

This screen has the following setpoints:

- **High Shutdown** - If the analog reading is greater than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

- **High Shutdown Delay** - The time in seconds that the analog reading is greater than or equal to the analog shutdown before the compressor will shut down.

- **High Alarm** - If the analog reading is greater than or equal to this setpoint, for the alarm time delay, an alarm occurs.

- **High Alarm Delay** - The time in seconds that the analog reading is greater than or equal to the high analog alarm setpoint before notification of the alarm.

- **Low Alarm** - If the analog reading is less than or equal to this setpoint, for the alarm time delay, an alarm occurs.

- **Low Alarm Delay** - The time in seconds that the analog reading is less than or equal to the analog alarm setpoint before notification of the alarm.
Low Shutdown - If the analog reading is less than or equal to this setpoint, for the shutdown time delay, the compressor will shut down.

Low Shutdown Delay - The time in seconds that the analog reading is less than or equal to the analog shutdown setpoint before the compressor will shut down.

The following screen keys are used for each auxiliary analog to setup how the analog reading will be used:

[Change Setpoints] - Changes the alarm settings and delay seconds that produce either an alarm or a shutdown.

A toggle key is provided that changes when the failure is checked:

[Analog 1 Checked Always] - If the Analog 1 input module is presently checked When running, this screen key is shown so that the operator can change when it is checked to Always Active.

[Analog 1 Checked Running] - If the Analog 1 input module is presently checked Always Active, this screen key is shown so that the operator can change when it is checked to When running.

Pumpdown/DX Circuit

This screen is shown if Pumpdown/DX Circuit control was enabled in Panel Setup. Pumpdown provides for pumping down the refrigerant (removal of the refrigerant gas). For example, this can be used for removing the refrigerant from a shell and tube heat exchanger to prevent its standing water from freezing. When Pumpdown is enabled and the compressor is stopped the DX circuits digital outputs are de-energized but the compressor remains running for the delay period. The time remaining for Pumpdown is displayed on the Operating Status screen in the compressor status box. When the delay period times out, or the Suction Pressure falls below the On When Above setpoint, the compressor is turned off. To force a compressor that is in Pumpdown to stop, press the compressor stop screen command key again.

This screen has the following setpoints for Pumpdown:

On when above - After sending the compressor stop command, if the Suction Pressure reading is above this setpoint, Pumpdown will be invoked. In Pumpdown, the compressor will stay on to continue vaporizing the refrigerant.

Delay - The amount of time in minutes the compressor will Pumpdown before it is stopped.

This screen provides for the setup of the DX (direct expansion) circuits (DX Circuit #1 and DX Circuit #2). The settings will determine when to turn on and off these digital outputs. This screen shows the current status of the digital outputs.

This screen has the following Slide Valve setpoints for both DX Circuits:

Off when below - If the compressor is running and control was selected as and at proper Slide Valve position, then the DX Circuit output is off if the slide valve is below this setpoint.

On when above - If the compressor is running and control was selected as and at proper Slide Valve position, then the DX Circuit output is on if the Slide Valve is above this setpoint.

A toggle key is provided for each of the outputs to determine when the output is energized:

[Slide Valve Position] - The Slide Valve setpoints will be used to turn on and off this digital output, when the compressor is running.

[Always] - This output will always be turned on when the compressor is running.
The PID Setup screen is accessible by pressing the [PID Setup] key on the Control Setup screen.

Each Output channel can be designated to a tune a particular input signal by setting it up from the Analog Output Setup screen in Calibration.

The following are the PID Setup screen selections:

- [PID Setup] - A PID Setup button is provided for Output Channel 1, 2, 5 and 6.

This screen is accessible by pressing the [PID Setup] key on the PID Setup screen. The following are the PID Setup screen selections:

- [Change Setpoints] - A key is provided to change the following values:
  - SETPOINT - The value that you wish to control to.
  - Dead Band - If the Actual value is within this Deadband, plus or minus to the setpoint value, no control will occur. Control will only occur if the Actual is not within the limits of the Deadband.
Setting up a PID Channel

NOTE: The basic steps in setting up a device for PID control is:

1. Setup Input channel

   - First, decide which physical input channel you will be using. As an example, if you wanted to use Suction Pressure, look through the wiring diagram, and locate the Suction Pressure input channel number (channel 9). Note: If you wish to use an Auxiliary Analog channel, it will require being completely setup as its own channel before attempting the remainder of this procedure.

   - Although we are setting up the input parameters for the PID, we need to access the Output Setup to do this. Call up the Analog Output Setup screen. To locate this screen, from the Operating Status screen, press [Menu], then [Calibration], and answer the Warning message with [OK]. Next, press the [More...] key, then [Analog Out Calibration].

   - On this screen, you can assign the PID to either Analog 1 or 2 (Note: Analog Outputs 1 and 2 are reserved for physical analog board # 1, and Analog Outputs 5 and 6 are reserved for physical analog board # 2). For this example, Suction Pressure input channel is 9 and is located on analog board # 1, therefore, we are free to use either Analog Output 1 or 2. For this example, we will use Analog Output 1.

   - Press the [Analog 1 Out Calibration] key. Notice that a new screen appears. This is where you can assign a Top End Value, a Bottom End Value, and an Offset. The text at the bottom of this screen helps to define these fields. When finished entering data on
this screen, press the [Previous Screen] key.

3. **Setup PID parameters**

   - From the **Operating Status** screen, press the [Menu] key. Next press the [Capacity Control], then [More…]. Finally, press the [PID Setup] key.
   - On the **PID Setup** screen, press the key that is adjacent to the Analog channel that has already been set up, in this case, channel 1.
   - It is on this Setup screen that the remainder of the PID parameters are entered. For a detailed description of these parameters, refer to the **Overview to Tuning a PID Controller**.

**Note:** After having performed the above setup procedure, if any portion of step 1 or 2 must be changed, then repeat the entire procedure to ensure that all parameters are correct per the new settings. Also, be aware that each device that is utilized for PID control must also be properly calibrated.

### Overview to Tuning a PID Controller

The purpose of this section is to give some basic guidelines for tuning **Proportional**, **Integral**, and **Differential** gains of a PID controller. To tune a PID controller, it would be advantageous to hook the system up to some test equipment to allow you to record the appropriate variables. At the very least, the appropriate data will have to be monitored and recorded by hand from the system screen for subsequent evaluation and possible spreadsheet graphing.

#### Differential Gain

Once ready, set all gains to zero (**Proportional**, **Integral** and **Derivative**). If you suspect that you will not need differential control, then skip down to the paragraph that discusses the Proportional Gain. Otherwise, start by adjusting the Differential Gain. You cannot use Differential control alone the way that the software is coded, so set the Proportional Gain to some small value (one or less). Check to see how the system works. If it oscillates Proportional Gain, you should be able to cure it with Differential Gain. Start with about 100 times more Differential Gain than Proportional Gain. Now, start increasing the Differential Gain until you see oscillation, excessive noise, or excessive (more than 50%) overshoot. Note that the oscillation from too much Differential Gain is much faster than the oscillation for not enough Differential Gain. A good strategy is to push the Gain up until the system is on the verge of oscillation, then back the Gain off by a factor of two or four. At this point, your system will probably be responding very sluggishly, so it is time to tune the Proportional and Integral Gains.

#### Proportional Gain

If it isn't already, set the Proportional Gain to a starting value between 1 and 100. Your system will probably either show terribly slow performance, or it will oscillate. If you see oscillation, drop the Proportional Gain by factors of eight or ten until the oscillation stops. If you don't see oscillation, increase the Proportional Gain by factors of eight or ten until you start seeing oscillation or excessive overshoot. As with the Differential Controller, a good strategy is to tune right up to the point of too much overshoot, then reduce the Gain by a factor of two or four. Once you are close, fine-tune the Proportional Gain by factors of two until you like what you see.

#### Integral Gain

Once you have the Proportional Gain set, start increasing the Integral Gain. Your starting values will probably be from 0.0001 to 0.01. Here again, you want to find the range of Integral Gain that gives you reasonably fast performance, without too much overshoot, and without being too close to oscillation.

#### Proportional Only Control

There will be certain applications in which only proportional control is required for good performance. When this is the case, the Integral and Differential Gains can simply be set to zero, and the Proportional Gain set to a calculated value. An example will help clarify how the Proportional Gain can be calculated to produce predictable results:

Suppose you wish to control the Suction Pressure to a setpoint of 50 PSIA, and you want the output to be 100% when the measured value is 35 PSIA (and below), and you want the output to be 0% when the measured value is 50 PSIA (and above).

Let the term **PB** represent the Proportional Band, and **PG** represent the Proportional Gain that you wish to calculate. Also, let the term **R** represent the Range of the particular sensor. Then, if the input channel is set for 1-5 Vdc use \[ PG = \frac{1.25 \times R}{PB} \], if the input channel is set for 0-5 Vdc, use \[ PG = \frac{R}{PG} \]. In these examples, the Proportional Band is 15 (50 - 35). The Range of a Suction Pressure sensor is 0 - 200 PSIA. Therefore, \[ PG = \frac{1.25 \times 200}{15} = 16.66 \]. Since only integer values are used by the Quantum™ control for gain factors, 17 would be entered for the Proportional Gain. Because of this roundoff, the output will reach 100%, close to but not exactly at 35 PSIA.

In this example, the **Action** of the control loop should be set to **Reverse** (the further the measured value is below the Setpoint, the higher the Output). If the opposite is desired in a particular control loop (the further the measured value is above the Setpoint, the higher the Output), then the **Action** should be set to **Forward**.

**Where:** \[ R = \text{Sensor Range} \]
- Temp 922.5
- Suction 200
- Discharge 500

\[ PB = 1.25 \times R \]
\[ PG \]
The **Condenser Control** screen is shown if a type of **Condenser Control** was selected in **Panel Setup**. Only the setpoints of the selected Condenser Control will show. Sequence set points are based on the system Discharge Pressure, analog channel 11. An additional pressure sensor for system discharge is required. The discharge level the condensers are operating on has its own pressure to maintain. The control system maintains Discharge Pressure by sequencing the condenser devices. Digital control is used to turn on and off the condenser digital outputs. Analog control is used to vary the analog signal of the condenser analog output.

This setpoint is required for both Digital Control and Analog Control:

**Condenser Control Setpoint** - This is used to control the sequencing on and off of the condenser digital outputs and/or the signal strength of the condenser analog output.

A Digital Control data box is shown if digital control is selected. The status of the condenser outputs is shown:

- **On** - This output is energized.
- **Off** - This output is de-energized.
The digital control settings on this screen are useful for sequencing condenser fans and pumps. The following set points are required:

Upper Dead Band - A Discharge Pressure band above the Condenser Control setpoint at which the condenser digital outputs will neither be turned on or turned off.

Lower Dead Band - A Discharge Pressure band below the Condenser Control setpoint at which the condenser digital outputs will neither be turned on or turned off.

Upper Delay - The minimum time in seconds that the system Discharge Pressure must be at or above the Condenser Control setpoint plus the upper dead band before an output is turned on. This timer is used to allow the system to respond to the change in the amount of condensing. If the pressure falls below this pressure for any reason at any time, the start time delay will be reset to start counting again if needed.

Lower Delay - The minimum time in seconds that the system Discharge Pressure must be at or below the Condenser Control setpoint, minus the lower dead band before an output is turned off. This timer is used to allow the system to respond to the change in the amount of condensing. If the pressure rises above this pressure for any reason at any time, the start time delay will be reset to start counting again if needed.

Sequence Order - A number will indicate the order in which the condenser output is turned on. Sequencing starts from 1, and goes up in numerical order. Stopping of condenser devices is in reverse order of the starting. The number zero (0) should be entered to disable that device from being sequenced on. A condenser output that is given a zero (0) will be immediately turned off. The following condenser outputs require a setpoint for a sequence position:

- Condenser Output #1
- Condenser Output #2
- Condenser Output #3
- Condenser Output #4 - If digital control is selected, this output is sequenced using the digital control setpoints. When analog control is selected, the output is coupled with the analog output.

An Analog Control data box is shown if analog control is selected. The status of condenser output #4 is shown in the analog data box along with the relative percent value of the analog output signal.

The following analog control settings are required:

Upper Dead Band - A Discharge Pressure band above the Condenser Control setpoint at which the condenser analog output signal will neither be increased or decreased.

Lower Dead Band - A Discharge Pressure band below the Condenser Control setpoint at which the condenser analog output signal will be neither increased or decreased.

Response Time - A response time of 1 to 20 refers to the relative time in seconds it takes to raise the analog signal to its maximum output if the system Discharge Pressure is greater than or equal to the Condenser Control setpoint plus the analog control upper dead band. The response time is also used as the relative time in seconds it takes to lower the analog signal to its minimum output if the system Discharge Pressure is less than or equal to the Condenser Control setpoint minus the analog control lower dead band. A response time of 1, is the slowest and 20 is the fastest.

A toggle key is provided that changes when the condenser control is active:

- [Condenser Active Always] - Selects the Condenser Control to be active always even when the compressor is not running.
- [Condenser Active Running] - Selects the Condenser Control to be active only when the compressor is running.
- [Not Active] - Selects the Condenser Control to be currently not active.

Digital Condenser Control

The following is a description of the Condenser Control logic when only digital condenser control is enabled.

If the System Discharge Pressure is above the condenser control setpoint the following is repeated until all condenser outputs are turned on:

- If the System Discharge Pressure continues to rise and is greater than or equal to the Condenser Control setpoint plus the digital control upper dead band, then the next condenser output is turned on. When a condenser output is turned on, the upper delay time is used to set a timer that must time out before the next condenser output will be turned on.

If the System Discharge Pressure is below the Condenser Control setpoint the following is repeated until all condenser outputs are turned off:

- If the System Discharge Pressure continues to fall and is less than or equal to the Condenser Control setpoint minus the digital control lower dead band, then the last condenser output that is on, is turned off. When a condenser output is turned off, the lower delay time is used to set a timer that must time out before the next condenser output will be turned off.
Analog Condenser Control

The following is a description of the Condenser Control logic when only analog Condenser Control is enabled.

If the System Discharge Pressure is above the Condenser Control setpoint:

- If the System Discharge Pressure is greater than or equal to the Condenser Control setpoint plus the analog control upper dead band, then condenser output #4 is turned on (if it is not already on) and the analog output signal is increased using the response time.

If the System Discharge Pressure is below the Condenser Control setpoint:

- If the System Discharge Pressure continues to fall and is less than or equal to the Condenser Control setpoint minus the analog control lower dead band, then the analog output signal is decreased using the response time. When the signal reaches its minimum output, condenser output #4 is turned off.

Digital and Analog Condenser Control

The following is a description of the Condenser Control logic when digital and analog Condenser Control is enabled:

If the System Discharge Pressure is above the Condenser Control setpoint, the following is repeated until all condenser outputs are turned on:

- If the System Discharge Pressure is greater than the Condenser Control setpoint plus the Digital Control Upper Dead Band, the first output is turned on. If the System Discharge Pressure remains high for another Upper Delay period of time, the second output is turned on. This continues until all the available outputs are turned on, or the System Discharge Pressure drops below the Control Setpoint plus the Upper Deadband.
- In addition, after Condenser Output #4 is turned on, the analog output signal begins to increase. This continues as long as the System Discharge Pressure is greater than the Condenser Control setpoint plus the Analog Control Upper Dead Band. After Condenser Output #4 turns on, additional digital outputs will not turn on until the analog output signal reaches 100%. The rate at which the analog output signal increases, or decreases, is determined by the Response Time.

If the System Discharge Pressure is below the Condenser Control setpoint the following is repeated until all condenser outputs are turned off:

- If the System Discharge Pressure is less than the Condenser Control setpoint minus the Analog Control Lower Dead Band, the analog output begins to decrease. After the analog output signal reaches 0%, if the System Discharge Pressure has been less than the Condenser Control setpoint minus the Digital Control Lower Dead Band for the Lower Delay period of time, the last output is turned off. If the System Discharge Pressure remains low for another Lower Delay period of time, the second output is turned off. This continues until all the outputs are turned off, or the System Discharge Pressure rises above the Control Setpoint minus the Lower Deadband.
Compressor Sequence Control (MODE 1)

This screen is shown if the Sequence Mode 1 Compressor Sequencing option was selected in Panel Setup. For quick access to this screen there is a [Compressor Sequence Setpoints] screen key on the Operating Status -2 screen. This sequencing is intended for compressors that are operating to maintain the same Capacity Control setpoint. The settings on this screen are used to sequence the compressors when a compressor is in the remote start mode of operation and in remote Slide Valve mode and available to run i.e. not in shutdown (cutout) or Recycle Delay. This sequence control is only used for compressors with a variable Slide Valve and will work with existing Frick RWB, RXB, and RXF panels. Serial communication using the Com-1 port is used for this sequencing (drawing nos. 640A0042 and 640A0050).

The setpoints that are currently being used for Capacity Control are only shown here for referencing. These setpoints are taken from the active Capacity Control settings at the panel where Compressor Sequencing is activated. Current Value is the current reading or actual reading of the pressure or temperature process variable that was chosen as the Capacity Control method. Compressor Sequencing can be enabled from panel setup and entered on more than one panel. However, for proper control, only the Compressor Sequencing settings at one panel should be made active. The following describes how Compressor Sequencing uses the Capacity Control setpoints:

**Capacity Control** - This is the reading that the control sequence will attempt to maintain for the indicated process. This setpoint is used to control the loading and unloading of the compressors.

The Proportional Band setpoint determines a range of Capacity Control values where proportionally timed 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 current reading of the process variable 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 midway from setpoint, the output is on and off an equal amount of time. (See Cycle Time).

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

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

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

**Lower Dead Band** - A band, measured in the units of the Capacity Control setpoint, below the setpoint at which the compressor will neither load nor unload.
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 4 second period is selected, then the following will result:

<table>
<thead>
<tr>
<th>Proportional Distance</th>
<th>Output Pulsed On (Seconds)</th>
<th>Output Off (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>1/4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>1/2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3/4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Upper Cycle Time - 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.

Lower Cycle Time - 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.

Start - A compressor is started at this setpoint. This is the Start Autocycle setpoint of the active Capacity Control. A compressor is started at this setpoint during Compressor Sequencing.

Stop - A compressor is stopped at this setpoint. This is the Stop Autocycle setpoint of the active Capacity Control. A compressor is stopped at this setpoint during Compressor Sequencing.

The load limiting setpoints are used if no compressors are running and the equalized system is to be slowly pulled down to normal. These setpoints limit the compressor loading when starting the first compressor:

Slide Valve Position - the Slide Valve position set point that the control system will hold the Slide Valve until the duration timer has timed out.

Duration Time - the amount of time in minutes to hold the compressor at the Load Limiting Slide Valve Position setpoint. If load limiting is not desired, set this time to zero (0).

When the first compressor is started, the sequence will allow that compressor to load up to the Slide Valve Position setpoint and hold the compressor at this setpoint until the Duration Time has timed out or the current reading of the process variable falls below the Start setpoint.

The following set points are required for each compressor on the suction level:

(A - D) Compressor ID - A through D represent the sequence position. Any machine can be set for any sequence position. The letter determines the starting order of the compressors, position A is the first position. If the Start setpoint is maintained, the lead or first machine started, will always load up first and then the next sequence position on up as they are needed. The stopping of compressors is done in the reverse order of the starting. Each compressor must have a unique ID# entered at their control panel. A zero (0) disables or removes a compressor ID from being sequenced.

Unload Minimum Slide Valve Position - This is the Slide Valve position a compressor will be allowed to unload to. The compressors will unload to the minimum Slide Valve position for that machine, when the reading is below the Capacity Control lower deadband. This set point is only used if more than one compressor is running. When only one compressor is running it is allowed to fully unload. This set point can prevent short cycling of compressors in the unload sequence. Short cycling occurs when a compressor is stopped and the current reading quickly rises and an already running compressor is unable to compensate because it is running at full load, so a compressor is cycled back on very shortly after a compressor was stopped. A screw compressor has some minimum built-in capacity that cannot be shed, generally in the range of 10-15% of full load capacity, when the compressor is stopped the control system needs to compensate for this loss. If a compressor that is running at full load is allowed to unload to a minimum Slide Valve position, this compressor will then be able to compensate for the extra load that occurs when another compressor is stopped.

The computer will not unload a compressor below this set point during normal system operation. For example, if compressor A is running at 100% capacity and compressor B is running and has been unloaded to the minimum Slide Valve position, B is still contributing somewhat to the capacity. To take B off line would be to lose approximately 10% of the total capacity. If A was already loaded to 100% capacity, it would not be able to load to compensate for losing the 10% B dropped off. The current reading would rise and B would be cycled on again. If the current reading remains low (below the lower deadband) for the predetermined time (stop time delay), B will then stop. A will have sufficient reserve capacity to maintain the loss of B. The control of this set point is in percentage of Slide Valve, not compressor capacity. With some experimentation, it is possible to find the right value for the minimum Slide Valve position set points that neither under-compensate for the built-in capacity, resulting in short cycling of the compressors, nor over-compensates for the built-in capacity, resulting in inefficient operation (where the sum of the capacity of the compressors that are running is significantly less than the full load capacity of the next compressor in the unload sequence).

Start Time Delay - The minimum time in minutes that the current reading must be at or above the Start setpoint before a compressor will start. This timer helps prevent cycling compressors on and off due to short sudden changes in load within the system. If the current reading falls below the Start setpoint for any reason at any time, the start time delay will be reset to start counting again if needed. When a compressor is starting, the start time delays will be reset to start counting again if needed for a next compressor.
Stop Time Delay - The minimum time in minutes that the current reading must be at or below the Stop setpoint before a compressor will stop. This timer helps prevent cycling compressors on and off due to short sudden changes in load within the system. If the current reading rises above the Stop setpoint for any reason at any time, the stop time delay counter will be reset to start counting again if needed. When a compressor is stopping, the stop time delays will be reset to start counting again if needed for a next compressor.

Minimum Run Time - The minimum time in minutes that the compressor must run before it is allowed to stop. This time should be as long as the Recycle Delay time. If the compressor has run out its Recycle Delay time and is turned off it will still be available to run as soon as required.

A toggle key is provided for compressor sequencing:

[Activate] - Selects the compressor control to be currently active.
[De-Activate] - Selects the compressor control to be currently not active.

Note: Only 1 panel should have Compressor Sequencing active.

Compressor Sequence Status

The active Capacity Control setpoints and Capacity Control reading are only shown here for referencing.

The following data is displayed for each compressor to be sequenced:

Slide Valve % - The actual % reading of the Slide Valve position.

Slide Valve Status - One of the following could be shown:

- Load - Indicates the compressor is being told to load.
- Unload - Indicates the compressor is being told to unload
- Idle - Indicates the compressor is neither being told to load or unload.

Note: The displayed status does not necessarily reflect the current solenoid status.

Sequence Status - One of the following text strings could be shown:

- Off in Remote Start
- Off in Manual Start
- Off in Autocycle Start
- Off in Recycle Delay
- Shutdown
- Running in Remote Start
- Running in Manual Start
- Running in Autocycle Start
- Not Communicating
- Not in Remote Start
- Slide Valve not in Remote
- Unable to Start
- Starting

Compressor Sequence Overview (Mode 1)

The above settings are used to sequence the selected compressors. Only a compressor that is in both remote compressor mode and remote Slide Valve mode will be started, stopped, loaded or unloaded using this sequence control. If one of these compressors is failed, shutdown (cutout), in Recycle Delay, or unable to communicate, that compressor will be skipped and the next compressor in the sequence (if there is one) will be controlled.

Compressor Sequencing allows for staging the compressors in an energy efficient method and providing a smooth transition from one compressor to another, while also giving operator flexibility.

The deadband determines how quickly the system will respond to a change in the process. For an example, a booster compressor might have a deadband of 0.5 PSIG for a quicker response than the high stage compressor with a deadband of 1.0 PSIG.

The proportional band and the cycle time determine how smoothly the compressor loads or unloads, and can be used to prevent overshooting the process setpoint.

Lowering the Unload Minimum Slide Valve Position setpoint, or lengthening the Stop Time Delay, or lengthening the Minimum Run Time can be used to prevent a compressor from cycling off and on too quickly.

The refrigeration load refers to the demand for loading of compressors to reduce the rise in capacity that has resulted from an increased need for refrigeration in the plant. When the load rises this means the capacity has risen. When the load falls this means the capacity has fallen. Compressors need to load if the Current Value is greater than or equal to the Capacity Control setpoint plus the Upper Dead Band setpoint and they need to be unloaded if the Current Value is less than or equal to the Capacity Control setpoint minus the Lower Dead Band setpoint.

When starting a compressor, a start command is sent from the panel that has Compressor Sequencing activated to the selected compressor every 30 seconds for 3 minutes. Should the compressor not start in that time period, the sequence status message Unable to Start is shown. If this occurs, the next compressor in the sequence (if there is one) will be sent the start command when it’s Start Delay times out. The Unable to Start message will clear after a time delay. The time delay is based on the worst case situation which requires 3 minutes for each available compressor. If there are 4 compressors, the delay will be 12 minutes. When this message is cleared, the compressor is again available for sequencing.
The following is an example of sequencing compressors:

**On System Start-up** - The first available compressor in the order of A, B, C and D will start if the capacity is greater than or equal to the **Start** setpoint for it’s **Start Delay** time period. If A is not available then B will start when it’s **Start Delay** has timed out. If B is not available then C will start when it’s **Start Delay** has timed out. If C is not available then D will start when it’s **Start Delay** has timed out.

On an initial or cold start-up (no compressors are running) and **Load Limiting** has been enabled, then the first compressor started will load to the **Load Limiting Slide Valve Position** setpoint and remain there until the **Load Limiting Duration Time** has timed out or until the current reading of the process variable falls below the **Start** setpoint.

**Load Rises** - If the current reading continues to be greater than or equal to the **Capacity Control** setpoint plus the **Upper Dead Band** setpoint, then the first compressor in the order of A, B, C, and D that is running will be loaded to 100%, followed by the next running compressor in the sequencing. When at 100%, the load signal will be sent to that compressor every minute to insure the compressor remains fully loaded.

If all running compressors are loaded greater than 90% slide valve position, then the next available compressor in the order of A, B, C, and D will be started if the current reading of the process variable is greater than the **Start** setpoint for it’s **Start Delay** time.

**Load Falls** - If the current reading of the process variable falls to or below the **Stop** setpoint, then the last compressor in the order of A, B, C, and D that is running will be unloaded to its **Min. Slide Valve Position** setpoint, followed by the next running compressor in reverse sequencing. For example, if A and B are running, B is unloaded to it’s **Min. Slide Valve Position** setpoint and then A is unloaded to it’s **Min. Slide Valve Position** setpoint.

Only the last two running compressors may unload to their **Min. Slide Valve Position** setpoint while any other running compressor will remain loaded. If a running compressor drops below its **Min. Slide Valve Position** setpoint it will be given a load pulse every 15 seconds to bring it back to the **Min. Slide Valve Position**. If more than one compressor is running and the compressors have unloaded to their **Min. Slide Valve Position** setpoint, then the last compressor in the sequence will be stopped if the **Current Value** is less than the **Stop** setpoint for the **Stop Delay** time and the compressor has run for longer than it’s **Min. Run Time** setpoint.

If only one compressor is running, then this compressor may unload completely and stop when the current reading of the process variable is less than the **Stop** setpoint.
Compressor Sequence Control (MODE 2)

This screen is shown if the Compressor Sequencing Mode 2 option was selected in Panel Setup. This option is not applicable for standard Frick products. It is only available for Gram compressors. Compressor Sequencing setpoints are based on the suction level that the compressors to be sequenced are operating on. The compressors must be on the same suction level because each suction level has its own settings to maintain. The settings on this screen are used to sequence the compressors when a compressor is in the remote mode of operation and in remote Slide Valve mode and not in shutdown. This sequence control is only used for compressors with a variable Slide Valve. The panels selected for compressor sequence control mode 2 must be connected via the proper hardware connection.

Compressor Sequence Status
The active capacity control setpoints and Capacity Control reading are shown here for referencing.

The following data is displayed for this compressor:

**Sequence Control:**
- **Activated** - This compressor is being controlled from the Compressor Sequencing Mode 2 control logic.
- **De-Activated** - This compressor is not being controlled from the Compressor Sequencing Mode 2 control logic.

**Control Type:**
- **Master** - The panel is selected as the Master for compressor sequencing control. The Master is able to control one or more subsequent Slaves.
- **Slave** - This panel is selected as a Slave for compressor sequencing control. The Slaves will be controlled by the setpoint of the Master.

**Output Status** (Digital Board 2):
- **Start** (Output 1) - This output is energized to signal the next panel to start the compressor. This output is de-energized to signal the next panel to stop the compressor.

Slide Valve Pos. - The actual % reading of the Slide Valve position.

Slide Valve Status - One of the following could be shown:
- **Load** - Indicates the compressor is being told to load.
- **Unload** - Indicates the compressor is being told to unload.
- **Idle** - Indicates the compressor is neither being told to load or unload.

Sequence Status - One of the following text strings could be shown:
- Off in Remote Start
- Off in Manual Start
- Off in Autocycle Start
- Off in Recycle Delay
- Shutdown
- Running in Remote Start
- Running in Manual Start
- Running in Autocycle Start
- Not in Remote Start
- Slide Valve not in Remote
• **Capacity Up** (Output 2) - This output is energized to signal the next panel to load the compressor.

• **Capacity Down** (Output 3) - This output is energized to signal the next panel to unload the compressor.

• **Slide Valve > Minimum** (Output 8) - This output is energized to signal the previous panel that the Slave’s slide valve reading is above the *Minimum Capacity when Running* setpoint.

**Input Status** (Digital Board 2):

• **Start** (Input 5) - This input is energized to signal this panel to start the compressor. This input is de-energized to signal this panel to stop the compressor.

• **Capacity Up** (Input 6) - This input is energized to signal this panel to load the compressor.

• **Capacity Down** (Input 7) - This input is energized to signal this panel to unload the compressor.

• **Slide Valve > Minimum** (Input 4) - This input is energized to signal this panel that the Slide Valve reading of the next compressor is above that panel’s *Minimum Capacity when Running* setpoint.

The active capacity control setpoints are shown here for referencing. The active Capacity Control setpoints are taken from the Capacity Control settings at this panel. *Actual* is the current reading of the pressure or temperature that was chosen as the Capacity Control setpoint. For proper control, only one panel should be selected as the Master for compressor sequencing. The Master compressor sequence controller attempts to maintain the Capacity Control setpoint by loading and unloading in response to the following capacity control setpoints. The Slave compressor sequence controller is signaled from a previous panel to load or unload and then uses the following Capacity Control setpoints to determine when to pulse the panel’s local Slide Valve load and Slide Valve unload outputs. The signal for loading or unloading from the previous panel overrides the Slave’s Capacity Control settings that might be determining the opposite local Capacity Control. For example, the Slave’s local settings could indicate it should be loading but a signal from a previous panel could be telling it to unload. In this situation, the Slave will unload but it will pulse according to its local settings. The Slave’s local settings are used to determine pulse loading or unloading and if these settings don’t coincide with the Master’s settings, then improper pulsing can result. For good Capacity Control, it is important that each panel is properly setup. The following describes the compressor sequencing Capacity Control setpoints:

- **Capacity Control** - This is the reading which the Master compressor sequence controller will attempt to maintain. This setpoint at each panel is used to control the loading and unloading of the compressor.

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.

- **Upper Proportional Band** - A band, measured in the units of the Capacity Control setpoint, above the upper dead band, where proportional load control is used. If the actual reading rises into this proportional band, the load output will be pulsed as explained above in the description about proportional band. When in this band the Master compressor sequence controller will begin the process of starting the compressor.

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

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

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

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 4 second period is selected, then the following will result:

<table>
<thead>
<tr>
<th>Proportional Distance Actual Reading is From Setpoint</th>
<th>Output Pulsed On (seconds)</th>
<th>Output Off (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>1/4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>1/2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3/4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

- **Upper Cycle Time** - 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.

- **Lower Cycle Time** - 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.
The following setpoints are required for each compressor to be sequenced:

**Minimum Capacity when Running** - This is the slide valve position a compressor will continuously load to, when started. The compressor will not unload below this setpoint during normal system operation. The last compressor that was signaled to start will be the first compressor to unload to it's Minimum Capacity when Running setpoint. Once the compressor has unloaded to this capacity position, a previous compressor is then allowed to unload. When the Slide Valve is above this setpoint + 1, the Slave sequence controller energizes the Slide Valve > Minimum Capacity output.

**Minimum Capacity to Stop Next Compressor** - If this compressor unloads to or below this setpoint and the next compressor stop delay has timed out, then the Slave Start output signal is de-energized to tell the next compressor to stop. This compressor unloads to this capacity position after the next compressor is running at or below it’s Minimum Capacity when Running setpoint.

**Next Compressor Start Delay** - The minimum time in minutes that the actual capacity must be at or above the starting capacity control setting before the Master sequence controller will start it’s compressor. Also, the minimum time in minutes that a compressor must be at or above 98% slide valve position before the Slave Start output signal is energized to start the next compressor and the Capacity Up output signal is energized to tell the next compressor to load. This timer helps prevent cycling compressors on and off due to short sudden changes in load within the system. If the Master’s current reading falls below it’s Capacity Control setpoint plus the Upper Dead Band setpoint, the Master’s start time delay will be reset to start counting again. If a running compressor’s slide valve position falls below 98%, the start time delay for starting the next compressor will be reset to start counting again.

**Next Compressor Stop Delay** - The minimum time in minutes that a running compressor must be at or below the Minimum Capacity to Stop Next Compressor slide valve position before the Slave Start output is de-energized to signal the next compressor to stop. This is also the minimum time in minutes that the actual capacity must be at or below the Capacity Control setpoint minus the Lower Dead Band setpoint before the Master that has already unloaded the compressor to at or below its Minimum Capacity when Running setpoint + 1, will further unload the compressor to below its Minimum Slide Valve Position to Start setpoint, and then stop.

This timer helps prevent cycling compressors on and off due to short sudden changes in load within the system. If a running compressor’s Slide Valve position rises above the Minimum Capacity to Stop Next Compressor setpoint, the stop timer for stopping the next compressor will be reset to start counting again. And if the actual capacity rises above the Master’s stopping Capacity Control setting, the Master’s stop time delay counter will be reset to start counting again.

A toggle key is provided for compressor sequencing:

- **Compressor Sequencing De-Activate** - Selects to use compressor sequencing to control this compressor. The delay timers that are present when sequence control is activated won’t change by simply changing the setpoint. Sequence control must be de-activated and then activated again.

- **Compressor Sequencing Activate** - Selects to use compressor sequencing to control this compressor. The Digital Board 2 outputs 1 through 3 and 8, are turned off.

A toggle key is provided for control type:

- **Control Type Master** - Only one panel should be selected as the Master. The Master compressor sequence controller attempts to maintain it’s capacity control setpoint by being the first compressor to start and then loads and unloads in response to it’s Capacity Control setpoints and furthermore will signal the next panel (a Slave) to do likewise.

- **Control Type Slave** - The Slave compressor sequence controller is signaled from a previous panel to load or unload, and then uses it’s capacity control setpoints to determine when to pulse the panel’s local Slide Valve load and Slide Valve unload outputs.

**Compressor Sequence Overview (Mode 2)**

The above settings are used to sequence the compressors that have been setup for compressor sequence control mode 2. The panels selected for compressor sequence control mode 2 must be connected via the proper hardware connection. Only a compressor that is in both remote compressor mode and remote Slide Valve mode and not in shutdown, will be started, stopped, loaded or unloaded using this sequence control.

The refrigeration load refers to the demand for loading of compressors to reduce the rise in capacity that has resulted from an increased need for refrigeration in the plant. When the load rises this means the capacity has risen. When the load falls this means the capacity has fallen. Compressors need to load if the Master sequence controller’s capacity reading is above it’s Upper Dead Band setpoint plus the Capacity Control setpoint and compressors need to unload if the Master sequence controller’s capacity reading is below it’s Capacity Control setpoint minus the Lower Dead Band setpoint. During compressor sequencing, if the Capacity Up output (request to load the next compressor) is energized, then the Capacity Down output (request to unload the next compressor) is not energized; and likewise, if the Capacity Down output is energized, then the Capacity Up output is not energized.

If one of these compressors has been told to run but remains off due to remaining Recycle Delay time or other conditions preventing the compressor from running, then no sequencing will happen until the compressor is running or shutdown.

If one of these compressors is not in remote compressor mode or is not in remote Slide Valve mode or is in
shutdown, that compressor is not available to be sequenced. However, it will signal its Capacity Control requirements to the next compressor.

Because the next compressor is forced to load to the *Minimum Capacity when Running* setpoint, excess capacity could occur causing the previous compressor to adjust by unloading a little. If the load continues to rise then the previous compressor that unloaded to below 98% will load again to at or above 98% prior to signaling the next compressor to load.

The following is an example of sequencing compressors:

**On System Start-up** - The Master compressor will start if the capacity is greater than or equal to the *Upper Dead Band* plus the *Capacity Control* setpoint for the *Next Compressor Start Delay* time period. If the Master is not available to be sequenced, then the Master’s Start Slave output and Capacity Up output are energized. If the Slave with the Start Slave input and the Capacity Up input energized is not available to be sequenced, then the Slave’s Start Slave output and Capacity Up output are energized.

On an initial start-up of a compressor, the compressor started will load to the *Minimum Capacity when Running* setpoint and remain at or above this setpoint until stopping. A Slave sequence controller energizes the Slide Valve > Minimum Capacity output when the Slide Valve is above the *Minimum Capacity when Running* setpoint + 1.

**Load Rises** - If the *Actual* reading continues to be greater than or equal to the *Upper Dead Band* plus the *Capacity Control* setpoint at the Master sequence controller, then the first available compressor in the order the panels are wired, starting with the Master sequence control panel is selected to load to 100%, followed by the next compressor.

If the running compressor loads to at or above 98% Slide Valve position for the *Next Compressor Start Delay* time period, then the Start Slave output and Capacity Up output are energized.

**Load Falls** - If the *Actual* reading falls to or below the *Capacity Control* setpoint minus the *Lower Dead Band* setpoint at the Master sequence controller, then the last compressor that is running will be selected for unloading. If the Start Slave output is energized (indicating another compressor has been told to run) the Capacity Down output is energized. If the Start Slave output is not energized and the Capacity Down input is energized then this compressor is unloaded to its *Minimum Capacity when Running* setpoint. If the Start Slave output is energized and the Slide Valve > Minimum Capacity input is not energized (indicating the next compressor has been unloaded to at or below the *Minimum Capacity when Running* setpoint) then this compressor is unloaded to or below its *Minimum Capacity to Stop Next Compressor* setpoint. When the *Next Compressor Stop Delay* has timed out, then the Start Slave and Capacity Down outputs are de-energized.

A running compressor that is signaled to stop will unload to or below its *Highest Slide Valve Position to allow starting the compressor* setpoint and then will stop. The Master sequence controller is the last compressor to unload. The Master will unload the compressor to the *Minimum Capacity when Running* setpoint and if the Master’s stop delay has timed out, the Master will unload the compressor to its *Highest Slide Valve Position to allow starting the compressor* setpoint before stopping this compressor.

### COMPRESSOR SEQUENCE CONTROL - MODE 2 WIRING

<table>
<thead>
<tr>
<th>Grammatic 2502 Digital Board 2</th>
<th>Grammatic 1502</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1-1 Output 1</td>
<td>DI-4 Input 4</td>
</tr>
<tr>
<td>P1-2 Output 2</td>
<td>DI-5 Input 5</td>
</tr>
<tr>
<td>P1-3 +24 VDC Input</td>
<td>Gram +24 VDC Digital Supply</td>
</tr>
<tr>
<td>P1-5 Output 3</td>
<td>DI-6 Input 6</td>
</tr>
<tr>
<td>P1-6 Input 4</td>
<td>DI-2 Input 2</td>
</tr>
<tr>
<td>P2-1 Input 5</td>
<td>DO-7 Output 19</td>
</tr>
<tr>
<td>P2-2 Input 6</td>
<td>DO-8 Output 20</td>
</tr>
<tr>
<td>+24 VDC (Quantum™ Supply)</td>
<td>Digital Output Relay Common</td>
</tr>
<tr>
<td>P2-4 to +24 VDC Return (Quantum™ Supply)</td>
<td>No Connection</td>
</tr>
<tr>
<td>P2-5 Input 7</td>
<td>DO-9 Output 21</td>
</tr>
<tr>
<td>P2-6 Output 8</td>
<td>DO-10 Output 22</td>
</tr>
</tbody>
</table>

**Note:** Use ODCM-5, 5 V digital output modules and IDCM-5, 5 V digital input modules.
This screen is shown if the [Compressor Interlock] option of **Compressor Sequencing** was selected in **Panel Setup**. For quick access to this screen there is a [Compressor Interlock Setpoints] screen key on the **Operating Status -2** screen. Compressor interlocking is used to interlock the running of one high stage compressor with one booster compressor. This option should be selected and setup on the booster compressor and requires serial communication between the two compressors using the Com-1 port. Reference drawing nos. 640A0042 and 640A0050. These compressors are sequenced only if the compressor is in the remote start mode of operation and in remote Slide Valve mode and available to run i.e. not in shutdown (cutout) or Recycle Delay.

When Compressor Interlock is activated, the program checks the running status of the two compressors. When the booster is started, the program checks if the high stage machine is running. If it is not running, it is told to start. After the high stage is confirmed to be running, the booster will start. If the booster is running and the high stage compressor has a shutdown, the booster shuts down with a **Compressor Interlock Failure**. If the booster is stopped, both machines will stop.

This screen has the following setpoint:

**High Stage ID** – The Identification number of the high stage compressor.

A toggle key is provided for compressor sequencing:

- **[Activate]** - Selects the compressor control to be currently active.

- **[De-Activate]** - Selects the compressor control to be currently not active.
This screen is shown if the [Input Module Capacity Control Selection] was enabled in Panel Setup. These modes will only be selected when Capacity Control source is remote. The following control logic is concluded about input module 19 and 20:

When input module 19 is de-energized:
The enabled Capacity Control that is listed first on the Capacity Control screen will be the Capacity Control that will be made active using the following control logic:

- When input module 20 is not energized:
  Mode 1 is the active Capacity Control.
- When input module 20 is energized:
  Mode 2 is the active Capacity Control.

When input module 19 is energized:
If a second Capacity Control has been enabled, the enabled Capacity Control listed secondly on the Capacity Control screen will be the Capacity Control that will be made active using the following control logic:

- When input module 20 is not energized:
  Mode 1 is the active Capacity Control.
- When input module 20 is energized:
  Mode 2 is the active Capacity Control.

When this feature is enabled, these inputs force which Capacity Control is active, even if a different Capacity Control mode is selected somewhere else. Only if the Capacity Control mode was forced by these inputs will Remote-I/O be displayed for the Capacity Control source on the Operating Status screen. The [Make Active] key will not be available on a Capacity Control setpoint screen when this feature has been enabled.
This screen is shown if a type of [Auxiliary 1 and 2] control was selected in Panel Setup. The auxiliary digital input modules can be selected as an alarm or a shutdown when the auxiliary input is de-energized. The auxiliary can be checked either Always Active or When running.

- **Always Active** means that at anytime the input module is de-energized, the selected type of auxiliary will occur if the module remains de-energized for the length of the delay period.

- **When running** means that only when the compressor is running and the input module is de-energized, the selected type of auxiliary will occur if the module remains de-energized for the length of the delay period.

The following screen keys are used to setup how the auxiliary will function:

- **[Change Setpoints]** - Changes the number of seconds to delay prior to producing either an alarm or a shutdown.

A toggle key is provided that changes between the following types of auxiliary:

- **[Auxiliary 1 Type Alarm]** - If the Auxiliary 1 is presently a shutdown type of auxiliary this screen key is shown so that the operator can change the auxiliary to an alarm type.

- **[Auxiliary 1 Type Shutdown]** - If the Auxiliary 1 is presently an alarm type of auxiliary, this screen key is shown so that the operator can change the auxiliary to a shutdown type.

- **[Auxiliary 1 Checked Always]** - If the Auxiliary 1 input module is presently checked When running, this screen key is shown so that the operator can change when it is checked to Always Active.

- **[Auxiliary 1 Checked Running]** - If the Auxiliary 1 input module is presently checked Always Active, this screen key is shown so that the operator can change when it is checked to When running.

Note: If an Auxiliary 2 option was also selected, then the screen keys described above but labeled Auxiliary 2 are relevant to setting up the Auxiliary 2 input module.
This screen is shown if the Pull Down option was selected in Panel Setup. Pull Down is only valid when in Suction Pressure Capacity Control. With this option enabled, the Suction Pressure can be slowly lowered in steps from the Starting Suction Pressure setpoint to the Suction Pressure Capacity Control setpoint. Slowly walking the pressure down prevents rapid drops in system pressure that causes violent boiling of refrigerant in the system. When the Suction Pull Down feature is activated and the compressor is started, the Capacity Control setpoint is changed to the current Suction Pressure. After the Amount of Time setpoint has timed out the Capacity Control setpoint is changed again. The Capacity Control setpoint is reduced by the amount of the pressure band. The system steps down to this setpoint and stays there until the time-out period has again elapsed. Then the Capacity Control setpoint is reduced again. The Capacity Control setpoint changes regardless of whether the system is following it or not. The Suction Pressure Pull Down feature is re-activated every time the machine is started unless it is de-activated.

This screen has the following setpoints:

**Suction Pressure Reduction Step Pressure Band** - This is the amount of Suction Pressure that will be used to step down the system. This value is subtracted from the starting Suction Pressure to provide a Capacity Control setpoint. The Capacity Control setpoint continues to be calculated by subtracting the pressure band from the previously calculated Capacity Control setpoint until the Suction Pressure reading reaches the operator entered Capacity Control setpoint.

**Amount of Time** - This is the time in minutes the Suction Pressure is maintained at each step during Suction Pressure pull down.

**Pull Down using Slide Valve Position**

- **Slide Valve Position** - The percentage of travel that the Slide Valve is permitted to load upon Compressor starting, and thereafter determined by the Amount of Time setpoint. For example, if this setpoint is 5%, and the Amount of Time setpoint is 1 Minute, then the Slide Valve will be permitted to load 5% of its stroke every minute, until such time as the compressor has reached capacity. It would take 20 minutes for the Slide Valve to fully load to 100% at this rate. When the Slide Valve is not moving, the following message will be displayed on the Operating Status screen: *Stop Load - Slide Valve Pulldown: xx%* where xx is the Slide Valve Position percentage. Once capacity has been achieved, this function is ignored, until such time as the compressor is restarted.

- **Amount of Time** - The amount of time between when the Slide Valve is permitted to move. See Slide Valve Position description.

**Note:** It is recommended to use Suction Pull Down when using Suction Pressure Mode 1 or 2, for best results, use Slide Valve Pull Down.
This screen shows the setpoints for Vibration Monitoring (if applicable). Pressing the [More...] key will show the second screen of parameters. To change setpoints, press the [Change Setpoints] key, and scroll to the setpoint you wish to change.

For more information, refer to Frick® document E70-020 TB (PhD Vibration Monitoring System).
Security Setup can be setup to allow different operators different access rights to setpoints. If access is presently denied when an operator selects to [Change Setpoints] then a message box will appear prompting the operator to enter a password. If an operator has not changed any setpoint within the last 15 minutes, the access level will change to no access.

Three levels of access rights to changing setpoints is provided:

1. **Full Access** - allows an operator to change all setpoints and passwords. If a password is required, a level 1 password provides full access.

2. **Moderate Access** - allows an operator to change setpoints, but prevents changing safety setpoints and passwords.

3. **No Access** - prevents an operator from changing any setpoint or password.

To have full access requiring a password, enter a password other than zero for the full access entry. To have moderate access, enter a different password for the moderate access entry than the full access entry. If an operator does not know an entered password then they are prevented from changing any setpoints. To disable security, enter zero for both full and moderate access entries.

The following information about the current security access is shown:

- **Current Security Privilege Level:**
  1. No Access
  2. Moderate Access
  3. Full Access

- **Change Setpoints from Keypad:**
  1. Enabled
  2. Disabled

If a password exists, then selecting a screen key will cause a password entry box to appear. To change a password the operator must enter their password and accept it (OK) which will cause another password entry box to appear. It prompts the operator to enter the password for this access level. Accepting it will cause another password entry box to appear. It prompts the operator to reenter the password to verify it. Properly reentering the password will cause a message box to appear stating *Pass Number Changed*. Improperly reentering the password will cause a message box to appear stating *Bad Verify Pass Number Not Changed*.

The following screen keys are used to setup security:

- **[Change Full Access]** - Select this key to change the full access password. The operator can also enter the current password to acquire full access privilege without changing the password.

- **[Change Moderate Access]** - Select this key to change the moderate access password. The operator can also enter the current password to acquire moderate access privilege without changing the password.

- **[No Access]** - Select this key to change the current access privilege to no access. This cancels security access to the system. A password must be re-entered to gain security access after pressing this key.
CALIBRATION AND SETUP

Calibrations should be performed anytime one or more analog channels appear to be inaccurate, or whenever a new analog device or analog board is replaced or installed in the system. All analog calibrations should be checked on a regular basis to ensure proper operation of the system. This should be considered as part of the normal maintenance schedule, and will vary as to the frequency of the individual customers requirements. A good starting point would be to check all calibrations once per year. This time frame can then be modified as conditions warrant.

The calibration screens are accessed from the Main Menu screen, by pressing the [Calibration] key as shown below:

A warning message will be superimposed on the Main Menu screen, to alert the operator of the possible danger that they may be accessing. If the operator is in agreement with the warning, they should press [OK], otherwise press [Cancel] to return to the regular Main Menu screen. The following is the content of the message:

!!! Warning Entering Calibration Screens !!!
You are attempting to modify critical system control settings. Any modifications of these settings may have a significant impact on the operation and performance of the pertinent equipment. By undertaking to modify these settings, you are assuming all responsibility for those actions. At the very minimum, prior to any such action, you should have thoroughly read and understood all manuals and literature accompanying the unit. IMPROPER CONTROL SETTINGS MAY CREATE AN OPERATING CONDITION WHERE THERE IS THE POTENTIAL OF PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.

### calibration Screens

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm Summary, Alarm History, Freeze Display</td>
<td>Alarms/Shutdowns</td>
</tr>
<tr>
<td>Capacity Control, Discharge, Motor, Oil, Slide Valve, Options, Setback Schedule</td>
<td>Control Setup</td>
</tr>
<tr>
<td>Setup of passwords and security levels</td>
<td>Security</td>
</tr>
<tr>
<td>Pressure and Temperature Offsets, Motor Current, Calibrate Slide Valve and Slide Stop</td>
<td>Calibration</td>
</tr>
<tr>
<td>Change Date, Time, Pressure and Temperature Units, Communication, Language, Selectable Options, Misc.</td>
<td>Panel Setup</td>
</tr>
<tr>
<td>Next screen of Main Menu selections</td>
<td>More...</td>
</tr>
<tr>
<td>Version Information about program</td>
<td>About...</td>
</tr>
</tbody>
</table>

A warning message will be superimposed on the Main Menu screen, to alert the operator of the possible danger that they may be accessing. If the operator is in agreement with the warning, they should press [OK], otherwise press [Cancel] to return to the regular Main Menu screen.
Analog Calibration

The following analog calibration selection keys are shown:

[Pressure Calibration] - Change Pressure Transducer Ranges and Offsets

[Temperature Calibration] - Change Temp. Probe Types, Ranges and Offsets

[Motor Current Calibration] - Calibrate Motor Current (Not applicable if using a RAM DBS Motor Starter)

[Slide Valve/Slide Stop Calibration] - Calibrate Slide Valve and Slide Stop (If applicable, reference Compressor Model Differences)

[Remote Control Calibration] - Calibrate Remote Control Setpoint (If applicable, see Panel Setup)

[Slide Valve Calibration] - Calibrate Slide Valve Position (If applicable, see Panel Setup)

[Auxiliary Analog Calibration] - Calibrate Auxiliary Analog (If applicable, see Panel Setup)

[Kilowatt Monitor Calibration] - Kilowatt Monitor Calibration and Setup (If applicable, see Panel Setup)

[Analog Out Calibration] - Calibrate the Analog Outputs (If applicable, see Panel Setup)

[Drive RTD Calibration] - Allows offsets to be entered for the RTD devices used for vibration/temperature monitoring (If applicable, see Panel Setup).
This screen shows a picture of a pressure gauge, current pressure readings are shown below the gauge for:

- Oil Injection Pressure (If applicable)
- Suction
- Discharge
- Oil
- Filter (If applicable)
- System Discharge (Required for Condenser Control)
- Balance Piston (If applicable)

A screen key exists for each of the displayed pressure readings. When a pressure calibration key is pressed, the identification of the pressure transducer and its settings are shown. It is at this time that the gauge will also show the current reading. Select the [Calibration Setpoints] key to modify the present calibration, see the screen shown below. The Setting for the Current Value is blank until a pressure for calibration is selected from the screen keys.

**Note:** The measurement range of transducers is usually given in PSIA. If another pressure unit has been selected in Panel Setup, the operator can temporarily change the pressure units in Panel Setup to use PSIA, then enter the PSIA ranges for all the transducers and finish by returning the pressure units in Panel Setup to the prior selection.
Temperature Calibration

This screen shows a thermometer and the current temperature readings for:

- Suction
- Discharge
- Oil
- Separator
- Leaving Process (If Process Temperature Capacity Control was enabled)
- Entering Process (If applicable, see Panel Setup)

The Setting for the Current Value is blank until a temperature for calibration is selected from the screen keys. A screen key exists for each of the displayed temperature readings. When a temperature calibration is selected, the identification of the temperature measurement sensor and its settings are shown. It is at this time that the thermometer will also show the current reading. Select the [Calibration Setpoints] screen key to modify the present calibration.

Calibrate Motor Current

This screen shows the current reading of the motor amps. Select the [Calibration Setpoints] screen key to modify what should be shown as the current reading.

Note: The motor current must be calibrated while the compressor is running and preferably with the compressor loaded.
The **Calibrate Slide Stop** screen is shown if it applies to the compressor model (Reference *Compressor Model Differences*). It shows a pictorial representation of a Slide Valve and Slide Stop. The Slide Valve and Slide Stop status information, the Motor Amps reading, and the Suction, Discharge, and Oil Pressure readings are shown here for quick reference. The screen heading and the high-lighted heading in the table, both depict what is presently selected to be calibrated. The Slide Stop should be calibrated prior to calibrating the Slide Valve. Calibrating the Slide Stop requires setting the minimum and maximum Slide Stop. The minimum Slide Stop value represents the furthest most position the Slide Stop can be decreased to. The maximum Slide Stop value represents the furthest position the Slide Stop can be increased to. The current reading is the reading that changes when increasing or decreasing the Slide Stop. An invalid reading is indicative of the need to calibrate. The volts reading corresponds to the metered voltage that is measured when the Slide Stop is at the displayed position. The screen keys are positioned in the order they should be used. (The RWB model 355 and 283 are exceptions to this sequence order. With these the **[Decrease Slide Stop]** should precede the **[Unload Slide Valve]**). The following keys are provided:

- **[Unload Slide Valve]** - The initial selection of this key will cause the Slide Valve position to continuously unload. Selecting this key again will stop the Slide Valve at the current position. The Slide Valve position should be unloaded until it does not interfere with decreasing the Slide Stop.

- **[Decrease Slide Stop]** - The initial selection of this key will cause the Slide Stop to continuously decrease. Selecting this key again will stop the Slide Stop at the current position. To decrease the Slide Stop to the minimum point, it is necessary that the Slide Valve position be decreased until the Slide Stop will no longer decrease.

- **[Set Minimum Point]** - This key should be selected when the Slide Stop is at the minimum position or lowest voltage reading. The minimum Slide Stop value of 2.2 will then be set as the current Slide Stop value.

- **[Increase Slide Stop]** - The initial selection of this key will cause the Slide Stop to continuously increase. Selecting this key again will stop the Slide Stop at the current position.

- **[Set Maximum Point]** - This key should be selected when the Slide Stop is at the maximum position or highest voltage reading. The maximum Slide Stop value of 5.0 will then be set as the current Slide Stop value.

- **[Slide Valve Calibration]** - Shows the Slide Valve calibration screen.
This screen is shown if it applies to the compressor model (Reference Compressor Model Differences). This screen shows a pictorial representation of a Slide Valve and Slide Stop. Reference the picture of the **Calibrate Slide Stop** screen. The Slide Valve and Slide Stop status information, the Motor Amps reading, and the Suction, Discharge, and Oil Pressure readings are shown here for quick reference. The screen heading and the high-lighted heading in the table, both depict what is presently selected to be calibrated. The minimum Slide Valve value represents the furthest position the Slide Valve can be unloaded to and is always set at 0%. The maximum Slide Valve value represents the furthest position Slide Valve can be loaded to and is always set at 100%. The current reading is the reading that changes when increasing or decreasing the Slide Valve. An invalid current reading is indicative of the need to calibrate. The volts reading corresponds to the metered voltage that is measured when the Slide Valve is at the displayed position. The screen keys are positioned in the order they should be used. The following keys are provided:

**[Decrease Slide Stop]** - The initial selection of this key will cause the Slide Stop to continuously decrease. Selecting this key again will stop the Slide Stop at the current position. For proper calibration of the Slide Valve, the Slide Stop should be decreased to the minimum point.

**[Unload Slide Valve]** - The initial selection of this key will cause the Slide Valve to continuously unload. Selecting this key again will stop the Slide Valve at the current position.

**[Set Minimum Point]** - This key should be selected when the Slide Valve is at the furthermost unload position or lowest voltage reading. The minimum Slide Valve value of 0% will then be set as the current Slide Valve value.

**[Load Slide Valve]** - The initial selection of this key will cause the Slide Valve to continuously load. Selecting this key again will stop the Slide Valve at the current position.

**[Set Maximum Point]** - This key should be selected when the Slide Valve is at the furthermost load position or highest voltage reading. The maximum Slide Valve value of 100% will then be set as the current Slide Valve value.

**[Slide Stop Calibration]** - Shows the Slide Stop Calibration screen.

**Note:** If a force unload, or a stop load condition is present as shown on the Operating Status screen, this will interfere with the proper calibration.
Remote Control Calibration

Remote Setpoint Incoming

<table>
<thead>
<tr>
<th>Top End Value (Slide)</th>
<th>Bottom End Value (Slide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction Pressure</td>
<td>30.0 Hg</td>
</tr>
<tr>
<td>Process Temp.</td>
<td>32.0 °F</td>
</tr>
<tr>
<td>Current Value</td>
<td>27.9 Hg</td>
</tr>
<tr>
<td>Offset</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Remote Setpoint Outgoing

<table>
<thead>
<tr>
<th>Top End Value (Slide)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction Pressure</td>
</tr>
<tr>
<td>Process Temp.</td>
</tr>
</tbody>
</table>

NOTE: Current Value based on current control mode

This screen will show if the Remote Control Setpoint was enabled in Panel Setup. This screen is used to calibrate the analog signal of the Remote Control Setpoint input and the Remote Control Setpoint output. The Remote Setpoint Incoming is used to calibrate the analog signal of the Remote Control Setpoint input. Enabling [Remote Setpoint] from the Selectable Options on the Panel Setup screen, selects the Remote Setpoint Incoming as the capacity control setpoint. The active Capacity Control mode is shown because the current value is based on this control value. The Remote Setpoint Outgoing is used to calibrate the analog signal of the Remote Control Setpoint output. The Remote Setpoint Outgoing is the corresponding calibrated output signal of the current active Capacity Control setpoint.

Calibrate Slide Valve Position

Input Position

| 28.6 % | 1.2 % |

Actual Position

| 28.6 % |

Offset = 0.00

Dead Band

| 1.0 % |

This screen will show if Slide Valve Position Control was enabled in Panel Setup. This screen is used to calibrate the analog signal of the Remote Slide Valve Position input. Selecting [Remote Slide Valve] from the Slide Valve mode screen command keys on the Operating Status screen, selects a remote (4-20 ma) signal to control the Slide Valve.
### Calibrate Level Position

This screen will show if YORK S-7 was enabled as the compressor type in Panel Setup. This screen is used to calibrate the analog signal of the level input. Channel 13 on analog board 1 is used to monitor the liquid level.

**Note:** Outputs 9 & 10 are used as Level Control (9 = Increase, 10 = decrease). When YORK S-7 is selected as Compressor Model, these output assignments will change to (9 = Liquid Injection, 10 = High Level).

### Calibrate Auxiliary Analog

<table>
<thead>
<tr>
<th>72.9 PSIG</th>
<th>Auxiliary Analog 1</th>
<th>Auxiliary Analog 1 Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>103.4 PSIG</td>
<td>Auxiliary Analog 2</td>
<td>Auxiliary Analog 2 Calibration</td>
</tr>
<tr>
<td>134.8 PSIG</td>
<td>Auxiliary Analog 3</td>
<td>Auxiliary Analog 3 Calibration</td>
</tr>
<tr>
<td>164.5 PSIG</td>
<td>Auxiliary Analog 4</td>
<td>Auxiliary Analog 4 Calibration</td>
</tr>
<tr>
<td>195.6 PSIG</td>
<td>Auxiliary Analog 5</td>
<td>Auxiliary Analog 5 Calibration</td>
</tr>
<tr>
<td>225.5 PSIG</td>
<td>Auxiliary Analog 6</td>
<td>Auxiliary Analog 6 Calibration</td>
</tr>
</tbody>
</table>

...
Calibrate Auxiliary Analog (Pressure)

This screen will show if Auxiliary Analog Temperatures and Pressures was enabled in Panel Setup. This screen is shown for the Auxiliary Analog Inputs. These inputs are switched to either temperature, pressure or other in Factory Setup mode. The actual value of the auxiliary analogs are displayed on the Auxiliary Analog Temperatures and Pressures screens that are accessed from Control Setup.

Current Value

Offset = 0.00
1:500dc

Auxiliary Analog 1

0.0 Hg

38.0 Hg

Fri 02 Apr 2004
10:15:57

Calibration Setpoints
### Analog Output Setup

The screens on this page are used to assign physical analog input channels to an analog output.

<table>
<thead>
<tr>
<th>Input Channel to Output</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Output 1</td>
<td>1</td>
<td>100.0°F</td>
</tr>
<tr>
<td>Analog Output 2</td>
<td>1</td>
<td>100.0°F</td>
</tr>
<tr>
<td>Analog Output 3</td>
<td>14</td>
<td>1.1 x</td>
</tr>
<tr>
<td>Analog Output 5</td>
<td>21</td>
<td>30.0 Hg</td>
</tr>
<tr>
<td>Analog Output 6</td>
<td>21</td>
<td>30.0 Hg</td>
</tr>
</tbody>
</table>

**Note:** If re-transmitting any analog channels, ensure that they are properly configured before doing analog setup.
Analog Output Setup

Use this screen only if the analog output signal needs calibration and it cannot be calibrated at the device.

The Quantum’s analog outputs have a range of approximately 0 to 25 mA, but most devices that are being controlled by the Quantum require a signal that varies between 4 and 20 mA. To restrict the analog outputs to the proper values, each of the outputs must be calibrated before they can be used. Every output channel has a Top End and a Bottom End setpoint that are used for calibration. Both values can be set from 0% to 100%. The output channel’s maximum value is represented by 100% and its minimum value is represented by 0%. To calibrate the channel the Top End percentage is decreased until the maximum output for the channel is limited to 20 mA. Also, the Bottom End percentage is increased until the minimum output for the channel is 4 mA.

Below is a step by step procedure for calibrating one analog output.

1. Make sure that the PID control for that output channel is disabled.
2. Set up a meter to read the channel’s output value in milliamps.
3. Go to the Analog Output Calibration page for the output that is being calibrated.
4. Press the [Set Output to Top End] key and the output value should jump to 100%.
5. Press the [Calibrate Top End] key.
6. Check that the Rate of Change value is 10.00. If it is not, press the [Select Rate of Change] key until it is displayed as 10.00.
7. If the channel’s output is greater than 20 mA press the [Decrease Top End] button. If the channel’s output is less than 20 mA, press the [Increase Top End] key. Use these keys to find the output value closest to 20 mA.
8. Press the [Select Rate of Change] key once to decrease the Rate of Change to 1.00.
9. Use the [Increase Top End] key and the [Decrease Top End] key to again find the value closest to 20 mA.
10. Repeat steps 8 and 9 for Rate of Change values of 0.1 and 0.01 to bring the output value as close as possible to 20 mA.
11. Press the [Previous Screen] key.
12. Press the [Set Output to Bottom End] key and the output value should drop to 0%.
13. Press the [Calibrate Bottom End] key.
14. Check that the Rate of Change value is 10.00. If it is not, press the [Select Rate of Change] key until it is displayed as 10.00.
15. If the channel’s output is greater than 4 mA, press the [Decrease Bottom End] key. If the channel’s output is less than 4 mA, press the [Increase Bottom End] key. Use these keys to find the output value closest to 4 mA.
16. Press the [Select Rate of Change] key once to decrease the Rate of Change to 1.00.
17. Use the [Increase Bottom End] key and the [Decrease Bottom End] key to again find the value closest to 4 mA.
18. Repeat steps 16 and 17 for Rate of Change values of 0.1 and 0.01 to bring the output value as close as possible to 4 mA.
19. Press the [Previous Screen] key.
20. Press the [Standard Output Control] key to allow the output to return to standard control.
21. If the output channel is being used for PID control, re-enable the PID.
Kilowatt Monitor Calibration

This screen will show if Kilowatt Monitor Calibration and Setup was enabled in Panel Setup. This screen is shown for calibrating the Kilowatt input. The current value of the kW Monitoring analog input is displayed on the Operating Status screen.

Drive RTD Calibration

This screen will show if Kilowatt Monitor Calibration and Setup was disabled in Panel Setup, and the necessary PhD channels have been properly setup. This screen is shown for calibrating the compressor motor shaft and stator temperatures. The current value of each of these devices is displayed here, along with the capability of adjusting each of the device offsets.
The current setup is shown here. The following Panel Setup screens can be selected:

- Change Current Time and Date
- Pressure Units -- PSIA, PSIG, or SI
- Temperature Units -- degrees Fahrenheit or Celsius
- Language -- English, Danish, German, Spanish, French
- Change Communications
- Capacity Control Options
- Selectable Options

### Change Current Time and Date

<table>
<thead>
<tr>
<th>Panel Setup</th>
<th>Mon 05 Apr 2004 10:45:44</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change Current Time and Date</td>
<td>Current: Mon 05 Apr 2004 10:45:44</td>
</tr>
</tbody>
</table>

This screen allows the user to enter the current date and time. It is very important to ensure that the date/time is kept accurate, as many maintenance related features are based on this accuracy.

The following screen keys are provided:

- [Increase Minutes]
- [Increase Hours]
- [Increase Day]
- [Increase Month]
- [Increase Year]
- [Decrease Year]
### Pressure Units -- PSIA, PSIG, or SI

This screen allows the user to change the units that pressures will be displayed in. The default is PSIG.

The following screen keys are provided:

- [Change to PSIA]
- [Change to PSIG]
- [Change to BarA] (Bar Absolute)
- [Change to Bar] (Bar Gauge)
- [Change to KPAA] (KPA Absolute)

### Temperature Units -- Degrees Fahrenheit or Celsius

This screen allows the user to change the units that temperatures will be displayed in. The default is Celsius.

The following screen keys are provided:

- [Change to Fahrenheit]
- [Change to Celsius]
This screen allows the user to change the displayed language. The default is English.

The following screen keys are provided:

[Change to English]
[Change to Danish]
[Change to German]
[Change to Spanish]
[Change to French]
[Change to Other lang.]
[Change to Other lang.]

The following screen selections are provided:

[Change Setpoints] - Select this key to change the panel ID number.

[Change to 2400 Baud] - A toggle key that changes between the baud rates of 1200, 2400, 4800, 9600, 19200, 38400, 76800, and 115200 is provided for the Comm. 1 setup.

[Change to 19200 Baud] - A toggle key that changes between the baud rates of 1200, 2400, 4800, 9600,
19200, 38400, 76800, and 115200 is provided for the Comm. 2 setup.

[YORK ISN.] - This is a toggle key that provides a method of selecting one protocol to communicate to the panel. This key changes between enabling A-B (Allen-Bradley), ModBus, York ISN, or Frick communication protocol. For further setup see the S90-010 CS (Communications Setup) manual.

[Comm. 2 Advanced] - This key selection will appear only if Modbus has been selected as the communications Protocol.

[Detect I/O Boards] - 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 was detected.

**Capacity Control Options**

This screen shows the Capacity Control selections that are possible. Only two types of Capacity Controls can be enabled at the same time. A control mode that is currently the active Capacity Control mode can not be disabled unless another Capacity Control mode has been enabled. The other enabled Capacity Control is made active, when disabling the current one, so active Capacity Control setpoints can always be viewed and modified. On the screen shown here, in order to enable either Suction Pressure Control Mode or Discharge Pressure Control Mode, then one of the currently enabled Control Modes (Process Temperature, or User Selectable Control Mode) would need to be disabled.

The following Capacity Control modes are provided as selections:

- Suction Pressure Control Modes
- Process Temperature Control Modes
- Discharge Pressure Control Modes
- User Selectable Control Modes

The following selection key is provided:

[Enable Mode] - This key is provided if the control is disabled.

[Disable Mode] - This key is provided if the control is enabled.

[Setup] - This key will cause the User Selectable Control Setup screen to appear.
The operator will only see the setpoints that are relevant to their plant by enabling or disabling options and selecting options from this screen. Reference the Quantum™ drawings for proper setup of options. Screen setup features are also selected from this screen. The present setup is shown. Following are the options that can be selected:

**Auxiliary 1 and 2** - This provides for selecting these auxiliary digital input modules to be used as an alarm or a shutdown when the auxiliary input is de-energized. For further setup, see the **Auxiliary Setup** screen. A toggle key is provided that changes between the following selections:

- [Disable]
- [Auxiliary 1]
- [Auxiliary 2]
- [Auxiliary 1 and 2]

**Power Failure Restart** - In the event of a plant shutdown, this option will cause the compressors to restart at different times. This is to prevent a situation where all of the compressors restart simultaneously and heavily tax the plant’s power system. If this option is enabled, a **[Power Failure Restart]** key is shown on the Motor Control Setpoint screen. On the **Power Failure Restart** page, the period of time is specified that the compressor will remain off after power-up. A toggle key is provided that changes between the following selections:

- [Enable] - This key is provided if the control is disabled.
- [Disable] - This key is provided if the control is enabled.

**Compressor Sequencing** - A toggle key is provided that changes between the following selections:

- [Sequence Mode 1] - This key is provided to select a method of sequencing compressors using serial communication. This is an adaptation of the Lead-Lag option used in other Frick panels. For further setup, see the **Compressor Sequence Control (Mode 1)** screen.
- [Sequence Mode 2] - This key is provided to select a method of sequencing compressors using digital inputs and outputs. For further setup, see the **Compressor Sequence Control (Mode 2)** screen.
- [Compressor Interlock] - This key is provided to select a method of sequencing a High Stage compressor with a Booster compressor using serial communication. For further setup, see the **Compressor Interlock** screen.
- [Disable] - This key is provided if this feature is enabled.

**Condenser Control** - This provides a method for stepping on and off condenser digital outputs and varying the Condenser Analog output signal. For further setup, see the **Condenser Control** screen. A toggle key is provided that changes between the following selections:

<table>
<thead>
<tr>
<th>Selectable Options</th>
<th>Disable</th>
<th>[Setpoint]</th>
<th>Enable</th>
<th>Sequence</th>
<th>Mode 1</th>
<th>More . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxiliary 1 and 2</td>
<td>DISABLED</td>
<td>[Auxiliary 1]</td>
<td>ENABLE</td>
<td>AUXILIARY 1</td>
<td>AUXILIARY 1</td>
<td>AUXILIARY 1</td>
</tr>
</tbody>
</table>
[Digital] - This key selects control of the condenser digital outputs.

[Analog] - This key selects control of the condenser analog output.

[Digital Analog] - This key selects control of the condenser digital outputs and the condenser analog output.

[Disable] - This key is provided to disable Condenser Control.

Suction Pressure Pull Down - With this option enabled, the Suction Pressure can be slowly lowered in steps from the Starting Suction Pressure setpoint to the Suction Pressure Capacity Control setpoint. Slowly walking the pressure down prevents rapid drops in system pressure that causes violent boiling of refrigerant in the system. A toggle key is provided that changes between the following selections:

[Enable] - This key is provided if the control is disabled.

[Disable] - This key is provided if the control is enabled.

---

### Selectable Options (Page 2)

<table>
<thead>
<tr>
<th>Selectable Options</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Gas Bypas/SV Setpoint</td>
<td>DISABLED</td>
</tr>
<tr>
<td>Auxiliaries 3-8</td>
<td>DISABLED</td>
</tr>
<tr>
<td>Pumpdown/DX Circuit</td>
<td>DISABLED</td>
</tr>
<tr>
<td>Kilowatt Monitor Calibration and Setup</td>
<td>DISABLED</td>
</tr>
<tr>
<td>Auxiliary Analog Temperatures and Pressures</td>
<td>DISABLED</td>
</tr>
<tr>
<td>Entering Process Temperature</td>
<td>DISABLED</td>
</tr>
<tr>
<td>More Selectable Options</td>
<td>More...</td>
</tr>
</tbody>
</table>

The operator will only see the setpoints that are relevant to their plant by enabling or disabling options and selecting options from this screen. Reference the Quantum® drawings for proper setup of options. Screen setup features are also selected from this screen. The present setup is shown. Following are the options that can be selected:

**Hot Gas Bypas/SV Setpoint** - This option is available if it applies to the compressor model (Reference Compressor Model Differences). This feature is provided to turn on up to three digital outputs based on an entered Slide Valve position setpoint. For further setup, see the Slide Valve Setpoints screen. A toggle key is provided that changes between the following selections:

[Hot Gas Enable] - This key is provided if the control is disabled.

[Hot Gas Disable] - This key is provided if the control is enabled.

**Auxiliaries 3-8** - This provides for selecting additional (more than 2) auxiliary digital input modules to be used as an alarm or a shutdown when the auxiliary input is de-energized. For further setup, see the **Auxiliaries 3-8 Setup** screen. A toggle key is provided that changes between the following selections:

[Auxiliary Inputs Enable] - This key is provided if this feature is disabled.

[Auxiliary Inputs Disable] - This key is provided if this feature is enabled.

**Pumpdown/DX Circuit** - This option is available if it applies to the compressor model (Reference Compressor Model Differences). This provides for setup of the DX (direct expansion) circuits (DX Circuit #1 and DX Circuit #2). Settings will determine when these digital outputs are turned on and off. For further setup, see the **Pumpdown/DX Circuit Setup** screen. A toggle key is provided that changes between the following selections:

[Enable] - This key is provided if this feature is disabled.

[Disable] - This key is provided if this feature is enabled.
Kilowatt Monitor Calibration and Setup - This provides for using the kW Monitoring analog channel 16. If Kilowatt monitoring is enabled, the current value of the kW Monitoring analog input is displayed on the Operating Status screen. For further setup, see the Kilowatt Monitor Calibration screen. A toggle key is provided that changes between the following selections:

[Kilowatt Monitor Enable] - This key is provided if this feature is disabled.

[Kilowatt Monitor Disable] - This key is provided if this feature is enabled.

Auxiliary Analog Temperature and Pressures - This provides for using from one up to ten analog input auxiliaries to monitor either temperature, pressure or other readings. For further setup see the Auxiliary Analog Temperatures & Pressures screen and the Calibrate Auxiliary Analog screen. A toggle key is provided that changes between the following selections:

[Analog Auxiliaries Enable] - This key is provided if this feature is disabled.

[Analog Auxiliaries Disable] - This key is provided if this feature is enabled.

Entering Process Temperature - This provides for using the Entering Process Temperature analog channel 4. If this is enabled, the current value of the Entering Process Temperature analog input is displayed on the Operating Status screen. For further setup, see the Temperature Calibration screen and the Entering Process Safeties screen. A toggle key is provided that changes between the following selections:

[Entering Process Enable] - This key is provided if this feature is disabled.

[Entering Process Disable] - This key is provided if this feature is enabled.

Selectable Options (Page 3)

<table>
<thead>
<tr>
<th>Selectable Options</th>
<th>Slide Valve Position Control</th>
<th>Remote Control Setpoint</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DISABLED</td>
<td>DISABLED</td>
</tr>
</tbody>
</table>

Slide Valve Position Control - This option is available if it applies to the compressor model (Reference Compressor Model Differences). This provides for using the Remote Slide Valve Position analog channel 13. The remote (4-20 ma) input signal to this channel can be used 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. A toggle key is provided that changes between the following selections:

[Slide Valve Position Enable] - This key is provided if this feature is disabled.

Remote Control Setpoint - This provides for using the Remote Control Setpoint analog input (channel 12) and the Remote Control Setpoint analog output (channel 4) 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. A toggle key is provided that changes between the following selections:

[Remote Setpoint Enable] - This key is provided if this feature is enabled.
[Remote Setpoint Disable] - This key is provided if this feature is enabled.

Permissive Start – The input used for this feature is Module 17 on the Digital I/O Board 2. If Permissive Start is enabled in Panel Setup, and there is no input signal present at module 17 of digital board 2, then the abbreviated message Prmsv Strt/No Input will flash once in the compressor status box of the Operating Status screen.

[Always] – This input must be energized to start the compressor. And if the compressor is running and this input is de-energized, the compressor is stopped.

[Starting] – This input needs to be energized only to start the compressor.

[Disable] – This key is provided to disable this feature.

Remote Enable Energized when in – The output for channel 2, board 2 (Remote Enable) will be energized when the Compressor Mode has been set for Remote operation and one of the following parameters have been selected:

- Remote Start and Remote Slide Valve
- Remote Start and Remote Slide Valve (4-20 mA)
- Remote Start Only

Digital Board 2 Module 1 Configuration –

Run Hours - The [Change Setpoints] key is provided to change the number of hours the compressor ran.

Power Assist - This provides for using the Power Assist digital output to get hot gas to the check valve when the compressor is stopped. A key is provided for Power Assist Setup that further provides a toggle key that changes between the following selections:

[Enable] - This key is provided if this feature is disabled.

[Disable] - This key is provided if this feature is enabled.

A [Change Setpoints] key is provided to change the number of seconds that the power assist output is energized after the compressor is stopped.

- Change Screen Settings - The following key is provided:
  - [Screen Setup] - Shows a screen for changing the screen settings.
The following selections are provided:

**[Standard Screen]** - The Frick® Blue screen color is used.

**[Mono Screen]** - A gray screen color is used.

**[Blue Screen]** - A blue screen color is used.

**[Lighten]** - The screen color (hue) is lightened, this does not change the screen intensity.

**[Darken]** - The screen color (hue) is darkened, this does not change the screen intensity.

**ScreenSaver** - A toggle key is provided:

**[Disable]** - Disables the screen saver.

**[Enable]** - Enables the screen saver. When there is no keypad activity at the panel, this screen saver will turn off the backlight until a key is pressed. The screen saver increases the life of the backlight.

**[Change Setpoints]** - Select to change the Minutes until screen saver setpoint.
REAL TIME TRENDING

Real time trending saves 900 recordings of the data items from the Operating Status screen. The data is stored in RAM memory. RAM memory is volatile memory and all information is lost if the power to the panel is lost. The data can be selected to be saved as frequently as once a second.

The following setpoint is provided:

Real time recording interval – The time interval in seconds that defines how often the trending data values are recorded.

The following screen command keys are provided:

[Data Log View] – Accesses the Real Time Trending screen for viewing the data in a tabular format.

[Trending View] – Accesses the Real Time Trending screen for viewing the data in a graphical format.

The data items to be viewed are selected from either the Data Log View or Trending View screen. The recorded data of a pressure or a temperature reading can be added or removed from what is currently displayed. Up to eight separate channels can be viewed at a time in any order. The screen command keys are used to select what data and time period to view. The Data Log View screen shows (hg) values in parenthesis. The Trending View screen automatically scales to include all the data. The time period to view is selected from the Data Log View screen.

The following screen command key is provided for both the Data Log View and the Trending Log View:

[Select Data] – Changes the screen command keys to the following selections of data to show:

- Suction Temperature
- Discharge Temperature
- Oil Temperature
- Separator Temperature
- Leaving Process
- Oil Pressure
- Filter Pressure
- Discharge Pressure
- Suction Pressure
- Balance Piston
- System Discharge
- Remote Setpoint
- Remote Position
- Slide Valve
- Slide Stop
- Motor Current
- Entering Temperature
- 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
- Oil Injection
- Kilowatt Monitor
- Analog 1 Out
- Analog 2 Out
- Slide Valve Out
- Setpoint Out
- Drive Out
- Condenser Out

A toggle key is provided for each of the data selections:

[Show] - Selects the data to be shown.

[Remove] – Removes this data from being shown.
### REAL TIME TRENDING SCREEN (Data Log View)

<table>
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<tr>
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<td>150.0</td>
<td>76.1</td>
</tr>
</tbody>
</table>
History trending saves 2000 recordings of the data items from the Operating Status screen. History data is stored in Flash memory. Flash memory is non-volatile and all information is retained even if the power to the panel is lost. The frequency at which the data is saved can be selected.

The following setpoint is provided:

**History recording interval** – The time interval in minutes that defines how often the trending data values are recorded. The time interval ranges from 1 minute up to 60 minutes.

The following screen command keys are provided:

- [Data Log View] – Accesses the History Trending screen for viewing the data in a tabular format.
- [Trending View] – Accesses the History Trending screen for viewing the data in a graphical format.
- [Operating Status View] – Accesses the History Trending screen for viewing the data as it was on the Operating Status screen format.

The History Trending data is viewed the same as the Real Time Trending data except that only 2000 records are saved and at a minimum time interval of every 1 minute. Reference the Real Time Trending screens for a description of the Trending screens.
This screen has been provided to help the service technician. It can be accessed from the Service Screen. From here, the technician can view communication data that is transferred in and out of the Comm-2 port or the on/off status of each channel of a digital board. Select the [Show Comms] screen key to view a screen that is a snapshot of the data transfer from the Comm-1 and Comm-2 communication ports. There are screen key selections to access the separate screens for each of the digital boards that are present. Digital values are shown as ON or OFF.

This screen has been provided to help the service technician. They can be accessed from the service screen. From here, the technician can view communication data that is transferred in and out of the Comm-2 port or the raw data from an analog board. Select the [Show Comms] screen key to view a screen that is a snapshot of the data transfer from the Comm-1 and Comm-2 communication ports. There are screen key selections to access the separate screens for each of the analog boards that are present. Analog values are converted from binary to show volts. The error factor is ± .05 volts.
Scheduled Maintenance

This screen has been provided to help the service technician and can be accessed from the service screen. From here, the technician can view up to six (6) user definable maintenance schedules (fifteen if Other compressor type). Each of the 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 define up to fifteen 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, an alarm will be generated alerting the user with an alarm message which 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.

Once the alarm has occurred, the values for the row that the alarm occurred in 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.

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.

A toggle key is provided for each of the data selections:

[Change Setpoints] - Pressing this key will highlight the top box of the center column. Values in the range of 0 - 11000 (hours) may be entered in the Service Every column (values of 10% of the IOM values 0-999999, if other compressor type). Use the arrow keys on the keypad to maneuver to the remaining selectable boxes. Values in the Next Scheduled At column are in the range of 0 - 999999 (hours).

[Text Change Up One] – Pressing this key causes the box above the highlighted one in the Maintenance Required column to become highlighted. Pressing this key when the top box is already selected has no affect.

[Text Change Down One] – Pressing this key causes the box below the highlighted one in the Maintenance Required column to become highlighted. Pressing this key when the bottom box is already selected has no affect.

[Change Text] – Upon using the [Text Change Up One] or [Text Change Down One] keys to highlight a box in the Required Maintenance column, pressing this key allows the operator to change the name of text within the box. An alphanumeric keypad screen (see Alpha Select screen on the next page) will replace the current screen. The user may type in a custom name up to 20 characters long.
This screen is used for changing alphanumeric text. A toggle key is provided that displays different sets of alphanumeric text that correspond to the keys on the panel keypad. Pressing a key that is graphically displayed on the screen will enter the alphanumeric shown on the graphical key. The existing [Delete] key on the panel keypad is always available when changing text.

A toggle key is provided that changes between the following sets of alphanumeric text selections:

- **[Character Set 1]** – This selection displays the letters of the alphabet in upper case.
- **[Character Set 2]** – This selection displays the letters of the alphabet in lower case.
- **[Special Character]** – This selection displays special characters such as # and %.
- **[Keypad]** – This selection displays numerals (as shown in the example above).
OPERATION OVERVIEW

Initial Setup Procedure:

1. Factory Setup 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. Panel Setup is performed to setup panel features and options, which can later be changed by an operator. Features such as the panel time, and screen color 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. From Control Setup, enter and setup the control settings.

5. From Security Setup, establish the desired access rights of the operators.

6. The Operating Status screens 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.
- 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.

<table>
<thead>
<tr>
<th>Input</th>
<th>%Capacity</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-Step Input 4</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-Step Input 5</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-Step Input 4</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-Step Input 5</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td></td>
</tr>
</tbody>
</table>

• 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 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.

The Hot Gas Bypass/SV Setpoint option can be used. This option, which is enabled in Panel Setup, is not available for all compressor models (Reference Compressor Model Differences). Three digital outputs are provided that signal when the Slide Valve has reached preset positions. For further setup, see the Slide Valve Setpoints screen.

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.
Alarms/Shutdowns Messages

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.

Following is the alphabetical listing of all the possible alarms:

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

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

**Auxiliary #1 Alarm** - The Auxiliary #1 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

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

**Auxiliary #2 Alarm** - The Auxiliary #2 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

**Auxiliary #2 Shutdown** - The Auxiliary #2 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

**Auxiliary #3 Alarm** - The Auxiliary #3 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

**Auxiliary #3 Shutdown** - The Auxiliary #3 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

**Auxiliary #4 Alarm** - The Auxiliary #4 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

**Auxiliary #4 Shutdown** - The Auxiliary #4 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

**Auxiliary #5 Alarm** - The Auxiliary #5 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

**Auxiliary #5 Shutdown** - The Auxiliary #5 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

**Auxiliary #6 Alarm** - The Auxiliary #6 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

**Auxiliary #6 Shutdown** - The Auxiliary #6 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

**Auxiliary #7 Alarm** - The Auxiliary #7 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

**Auxiliary #7 Shutdown** - The Auxiliary #7 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

**Auxiliary #8 Alarm** - The Auxiliary #8 input module has been setup to indicate an alarm when it is de-energized and it became de-energized.

**Auxiliary #8 Shutdown** - The Auxiliary #8 input module has been setup to indicate a shutdown when it is de-energized and it became de-energized.

**Balance Piston Failure Shutdown** - Balance piston control was enabled in Factory Setup. There are three (3) conditions that will cause a **Balance Piston Failure Shutdown**:

1. 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.

2. 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.

3. If the Balance Piston output module (digital output module 12) is energized, then Balance Piston pressure must be within 20lb. of Oil Pressure.

**Compressor Aux. Failure** - 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 Interlock Failure** - This shutdown message is issued if while the compressor is running the Compressor Auxiliary input module becomes de-energized for 5 seconds.

**Compressor Starting Failure - Aux.** - This shutdown message is displayed if after 30 seconds from sending the compressor start command, the compressor auxiliary input module is still not energized.

**Compressor 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.

**Compressor Stopping Failure - Aux.** - 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.

**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.

**Compressor Unable to Unload - Alarm** - While stopping the compressor or the compressor is off, the Slide Valve position has not unloaded below the Highest Slide Valve Position to allow starting the compressor.

**DBS Alarm** - The RAM DBS Motor Starter is responding that it has an alarm condition.

**DBS Trip** - The RAM DBS Motor Starter is responding that it has a shutdown condition.

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

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

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

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

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

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

**Discharge Pressure Sensor Fault** - This shutdown message is issued if the Discharge Pressure reading was out of range for its sensor.

**Discharge Temperature Saturation Alarm** - This alarm applies if Superheat has been enabled. When running, an alarm will occur if TDsat plus setpoint temperature is greater than the Discharge Temperature for the setpoint time.

**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 Sensor Fault** - This shutdown message is issued if the Discharge Temperature reading was out of range for its sensor.

**False Start Failure - Aux.** - 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 Start 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 Alarm** - The Auxiliary Analog #1 value was greater than or equal to the high Auxiliary Analog #1 alarm setpoint for its time delay.

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

**High Auxiliary Analog #2 Alarm** - The Auxiliary Analog #2 value was greater than or equal to the high Auxiliary Analog #2 alarm setpoint for its time delay.

**High Auxiliary Analog #2 Shutdown** - The Auxiliary Analog #2 value was greater than or equal to the high Auxiliary Analog #2 shutdown setpoint for its time delay.

**High Auxiliary Analog #3 Alarm** - The Auxiliary Analog #3 value was greater than or equal to the high Auxiliary Analog #3 alarm setpoint for its time delay.

**High Auxiliary Analog #3 Shutdown** - The Auxiliary Analog #3 value was greater than or equal to the high Auxiliary Analog #3 shutdown setpoint for its time delay.

**High Auxiliary Analog #4 Alarm** - The Auxiliary Analog #4 value was greater than or equal to the high Auxiliary Analog #4 alarm setpoint for its time delay.

**High Auxiliary Analog #4 Shutdown** - The Auxiliary Analog #4 value was greater than or equal to the high Auxiliary Analog #4 shutdown setpoint for its time delay.

**High Auxiliary Analog #5 Alarm** - The Auxiliary Analog #5 value was greater than or equal to the high Auxiliary Analog #5 alarm setpoint for its time delay.

**High Auxiliary Analog #5 Shutdown** - The Auxiliary Analog #5 value was greater than or equal to the high Auxiliary Analog #5 shutdown setpoint for its time delay.

**High Auxiliary Analog #6 Alarm** - The Auxiliary Analog #6 value was greater than or equal to the high Auxiliary Analog #6 alarm setpoint for its time delay.

**High Auxiliary Analog #6 Shutdown** - The Auxiliary Analog #6 value was greater than or equal to the high Auxiliary Analog #6 shutdown setpoint for its time delay.

**High Auxiliary Analog #7 Alarm** - The Auxiliary Analog #7 value was greater than or equal to the high Auxiliary Analog #7 alarm setpoint for its time delay.

**High Auxiliary Analog #7 Shutdown** - The Auxiliary Analog #7 value was greater than or equal to the high Auxiliary Analog #7 shutdown setpoint for its time delay.

**High Auxiliary Analog #8 Alarm** - The Auxiliary Analog #8 value was greater than or equal to the high Auxiliary Analog #8 alarm setpoint for its time delay.

**High Auxiliary Analog #8 Shutdown** - The Auxiliary Analog #8 value was greater than or equal to the high Auxiliary Analog #8 shutdown setpoint for its time delay.
High Auxiliary Analog #9 Alarm - The Auxiliary Analog #9 value was greater than or equal to the high Auxiliary Analog #9 alarm setpoint for its time delay.

High Auxiliary Analog #9 Shutdown - The Auxiliary Analog #9 value was greater than or equal to the high Auxiliary Analog #9 shutdown setpoint for its time delay.

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

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

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 Economizer Alarm - The Auxiliary Analog #10 value was greater than or equal to the high Auxiliary Analog #10 alarm 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 Entering Process Temperature Alarm - The Entering Process Temperature was greater than or equal to the High Entering Process Temperature Alarm 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 Liquid Level Shutdown - The corresponding input module was de-energized.

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

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

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

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

High Oil Filter Pressure Alarm - The Oil Filter Pressure was greater than or equal to the High Filter Pressure Alarm 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 Temperature Alarm - The Oil Temperature was greater than or equal to the High Oil Temperature Alarm 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 RPM Alarm - This alarm applies if Engine or Turbine Drive was enabled. If the RPM's of the motor exceeds this setpoint, an alarm will occur.

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.

Hi Suction Pressure Alarm - The Suction Pressure was greater than or equal to the active Hi Suction Pressure Alarm setpoint for its time delay.

Hi Suction Pressure Shutdown - The Suction Pressure was greater than or equal to the active Hi Suction Pressure Shutdown 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.

Liquid Slug Alarm - This alarm is triggered off of a sudden decrease in Discharge Temperature that is greater than the Liquid Slug Alarm setpoint for a five (5) second period. That is, if the Discharge Temperature is 130 degrees F, and the Liquid Slug Alarm 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 an alarm condition.

Liquid Slug Shutdown - This shutdown is triggered off of a sudden decrease in Discharge Temperature that is greater than the Liquid Slug 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.

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

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

Low Auxiliary Analog #2 Alarm - The Auxiliary Analog #2 value was less than or equal to the low Auxiliary Analog #2 alarm setpoint for its time delay.

Low Auxiliary Analog #2 Shutdown - The Auxiliary Analog #2 value was less than or equal to the low Auxiliary Analog #2 shutdown setpoint for its time delay.

Low Auxiliary Analog #3 Alarm - The Auxiliary Analog #3 value was less than or equal to the low Auxiliary Analog #3 alarm setpoint for its time delay.

Low Auxiliary Analog #3 Shutdown - The Auxiliary Analog #3 value was less than or equal to the low Auxiliary Analog #3 shutdown setpoint for its time delay.

Low Auxiliary Analog #4 Alarm - The Auxiliary Analog #4 value was less than or equal to the low Auxiliary Analog #4 alarm setpoint for its time delay.
Low Auxiliary Analog #4 Shutdown - The Auxiliary Analog #4 value was less than or equal to the low Auxiliary Analog #4 shutdown setpoint for its time delay.

Low Auxiliary Analog #5 Alarm - The Auxiliary Analog #5 value was less than or equal to the low Auxiliary Analog #5 alarm setpoint for its time delay.

Low Auxiliary Analog #5 Shutdown - The Auxiliary Analog #5 value was less than or equal to the low Auxiliary Analog #5 shutdown setpoint for its time delay.

Low Auxiliary Analog #6 Alarm - The Auxiliary Analog #6 value was less than or equal to the low Auxiliary Analog #6 alarm setpoint for its time delay.

Low Auxiliary Analog #6 Shutdown - The Auxiliary Analog #6 value was less than or equal to the low Auxiliary Analog #6 shutdown setpoint for its time delay.

Low Auxiliary Analog #7 Alarm - The Auxiliary Analog #7 value was less than or equal to the low Auxiliary Analog #7 alarm setpoint for its time delay.

Low Auxiliary Analog #7 Shutdown - The Auxiliary Analog #7 value was less than or equal to the low Auxiliary Analog #7 shutdown setpoint for its time delay.

Low Auxiliary Analog #8 Alarm - The Auxiliary Analog #8 value was less than or equal to the low Auxiliary Analog #8 alarm setpoint for its time delay.

Low Auxiliary Analog #8 Shutdown - The Auxiliary Analog #8 value was less than or equal to the low Auxiliary Analog #8 shutdown setpoint for its time delay.

Low Auxiliary Analog #9 Alarm - The Auxiliary Analog #9 value was less than or equal to the low Auxiliary Analog #9 alarm setpoint for its time delay.

Low Auxiliary Analog #9 Shutdown - The Auxiliary Analog #9 value was less than or equal to the low Auxiliary Analog #9 shutdown setpoint for its time delay.

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

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

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

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

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

Low Process Temperature Alarm - Process Temperature was the active Capacity Control and the Process Temperature was less than or equal to the Low Process Temperature Alarm setpoint for its time delay. This Process Temperature is the Leaving Process Temperature.

Low Process Temperature Shutdown - Process Temperature was the active Capacity Control and the Process Temperature was less than or equal to the Low Process Temperature Shutdown setpoint for its time delay. This Process Temperature is the Leaving Process Temperature.

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

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 Suction Pressure Alarm - The Suction Pressure was less than or equal to the active Low Suction Pressure Alarm setpoint for its time delay.

Low Suction Pressure Shutdown - The Suction Pressure was less than or equal to the active Low Suction Pressure Shutdown setpoint for its time delay.

Maintenance - Alarm - This alarm is generated from the Maintenance Schedule. It indicates that the amount of hours in the Service Every column has been exceeded. The alarm name may be custom named by the operator. This is purely an informational maintenance alarm, and there is no shutdown associated it.

Missing Oil Pressure Alarm - 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 Pump Auxiliary input module de-energized. This indicates Dual Pump Control and Pump #1 is the lead pump.

Oil Pump #1 Aux. Failure 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 Aux. Alarm - 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 Aux. Failure 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.

Oil Temperature Sensor Fault - This shutdown message is issued if the Oil Temperature reading was out of range for its sensor.

Opposite Shaft Side Drive Vibration Alarm - 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 Side Drive Vibration Alarm, for the period of time as set for the Opposite Shaft Side Drive Vibration Alarm Delay, an Alarm will be generated.

Opposite Shaft Side Drive Vibration Shutdown - 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 Side Drive Vibration Shutdown, for the period of time as set for the Opposite Shaft Side Drive Vibration Shutdown Delay, a Shutdown will be generated.

Opposite Shaft Side Drive Temperature Alarm - If the Opposite Shaft Side Drive Temperature sensor registers a reading that is higher than the value that has been set for the Opposite Shaft Side Drive Temperature Alarm Delay, an Alarm will be generated.

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

Shaft Side Drive Temp. Alarm - If the Shaft Side Drive Temperature sensor registers a reading that is higher than the value that has been set for the Shaft Side Drive Temperature Alarm, for the period of time as set for the Shaft Side Drive Temperature Alarm Delay, an Alarm will be generated.

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

Starting Failure - 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 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.

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

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

Suction Pressure Sensor Fault - This shutdown message is issued if the Suction Pressure reading was out of range for its sensor.

VariSpeed Communications Alarm - If VariSpeed option if enabled and the Comms communication has failed, this alarm is shown.
OIL SAFETY LOGIC
Part 1: Missing Oil Pressure

A

\[ P_{oil} < [1.1 \times P_{suct}] + 15 \]

\( t_1 + 1 \)

Yes

ALARM

\( t_1 > 25 \text{ sec.} \)

\( t_1 > 2 \text{ min.} \)

CUT OUT

No

Reset \( t_1 = 0 \)

B

OIL SAFETY LOGIC
Part 2: Insufficient Main Oil Pressure During Low Differential

A

\[ P_{oil} < P_{suct} \]

\( t_2 + 1 \)

Yes

CUT OUT

\( t_2 > 25 \text{ sec.} \)

No

Reset \( t_2 = 0 \)

B

B

\[ P_{oil} > [1.5 \times P_{suct}] + 15 \]

\( t_3 + 1 \)

Yes

Allow Load

No

Reset \( t_3 = 0 \)

\( t_3 > 3 \text{ min.} \)

CUT OUT

\( Sv < 40\% \)

\( Sv > 50\% \)

\( t_3 + 1 \)

Yes

Inhibit Load

Force Unload

Insufficient Main Oil Pressure Shutdown

No
OIL SAFETY LOGIC
Part 3: Oil Circuit Pressure Drop

C

P_{disch} - P_{oil} > 25

\text{Yes} \rightarrow t_4 + 1

\text{Yes} \rightarrow \text{ALARM}

\text{No} \rightarrow \text{Reset} \ t_4 = 0

\text{Yes} \rightarrow \text{ALARM}

\text{No} \rightarrow D

D

C

P_{disch} - P_{oil} > 30

\text{Yes} \rightarrow t_5 + 1

\text{Yes} \rightarrow \text{CUT OUT}

\text{No} \rightarrow \text{Reset} \ t_5 = 0

\text{Yes} \rightarrow \text{CUT OUT}

\text{No} \rightarrow D
OIL SAFETY LOGIC
Part 4: Oil Pressure Filter Drop

Note: Frick® Only – when filter pressure transducer is available
OIL PUMP STARTING LOGIC
(Frick No Pump)

Key

**Differential Pressure**
- \( = 0 \) if Discharge > Oil
- \( = \text{Oil} – \text{Discharge} \) if Oil is greater than Discharge

**Differential Setpoint**
- \( = 0 \) if pump type is Prelube or No Pump
- \( = 5 \) for Cycling or Demand Pump
- \( = 20 \) for Full Time pumps

**Slide Valve Setpoint**
- Highest Allowable Slide Valve position to start (10% default)

**Delay Timer**
- \( = 15 \) sec. for Prelube pumps
- \( = 5 \) sec. for Cycling, Demand and Full Time
- \( = 0 \) sec. for No pump

**Pump Status**
- if Prelube - - Pump is Off
- if Full Time - - Pump is On
- if Cycling or Demand
  - Pump is Off if \( [\text{Discharge} – (1.4 \times \text{Suction})] > 45 \)
  - Pump is On if \( [\text{Discharge} – (1.4 \times \text{Suction})] < 35 \)

A is from the main program loop
B is to the main program loop
### OIL PUMP STARTING LOGIC
(Frick Full Lube)

<table>
<thead>
<tr>
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<td><strong>Differential Pressure</strong> = 0 if Discharge &gt; Oil</td>
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<td>= Oil – Discharge if Oil is greater than Discharge</td>
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<tr>
<td><strong>Differential Setpoint</strong> = 0 if pump type is Prelube or No Pump</td>
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<tr>
<td>= 5 for Cycling or Demand Pump</td>
</tr>
<tr>
<td>= 20 for Full Time pumps</td>
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<tr>
<td><strong>Slide Valve Setpoint</strong> = Highest Allowable Slide Valve position to start (10% default)</td>
</tr>
<tr>
<td><strong>Delay Timer</strong> = 15 sec. for Prelube pumps</td>
</tr>
<tr>
<td>= 5 sec. for Cycling, Demand and Full Time</td>
</tr>
<tr>
<td>= 0 sec. for No pump</td>
</tr>
<tr>
<td><strong>Pump Status</strong> = if Prelube - - Pump is Off</td>
</tr>
<tr>
<td>= if Full Time - - Pump is On</td>
</tr>
<tr>
<td>= if Cycling or Demand</td>
</tr>
<tr>
<td>-- Pump is Off if [Discharge – (1.4 * Suction)] &gt; 45</td>
</tr>
<tr>
<td>-- Pump is On if [Discharge – (1.4 * Suction)] &lt; 35</td>
</tr>
</tbody>
</table>

A is from the main program loop

B is to the main program loop

---

**A**

Compressor Start Signal Given

Is Slide Valve position < Setpoint?

---

No

Pump On

---

Yes

Is Oil Logging Enabled?

---

Yes

Is Oil Logging Delay > Oil Log Setpoint?

---

Yes

Shutdown

---

No

---

Compressor On

Pump On

---

---

B
OIL PUMP STARTING LOGIC
(Demand Pump)

Key

<table>
<thead>
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<th>Description</th>
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<td>Oil – Discharge if Oil is greater than Discharge</td>
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<tr>
<td>Differential Setpoint</td>
<td>0 if pump type is Prelube or No Pump</td>
</tr>
<tr>
<td></td>
<td>5 for Cycling or Demand Pump</td>
</tr>
<tr>
<td></td>
<td>20 for Full Time pumps</td>
</tr>
<tr>
<td>Slide Valve Setpoint</td>
<td>Highest Allowable Slide Valve position to start (10% default)</td>
</tr>
<tr>
<td>Delay Timer</td>
<td>15 sec. for Prelube pumps</td>
</tr>
<tr>
<td></td>
<td>5 sec. for Cycling, Demand and Full Time</td>
</tr>
<tr>
<td></td>
<td>0 sec. for No pump</td>
</tr>
<tr>
<td>Pump Status</td>
<td>if Prelube - - Pump is Off</td>
</tr>
<tr>
<td></td>
<td>if Full Time - - Pump is On</td>
</tr>
<tr>
<td></td>
<td>if Cycling or Demand</td>
</tr>
<tr>
<td></td>
<td>-- Pump is Off if ([\text{Discharge} - (1.4 \times \text{Suction})] &gt; 45)</td>
</tr>
<tr>
<td></td>
<td>-- Pump is On if ([\text{Discharge} - (1.4 \times \text{Suction})] &lt; 35)</td>
</tr>
</tbody>
</table>

A is from the main program loop
B is to the main program loop
Quantum™ Automatic Capacity Control
(Electric, VFD, Engine, Turbine) Version 5.0x

Is capacity Increasing?

Yes

- Energize Load Solenoid
- De-Energize Unload Solenoid

No

Is the drive a constant electric?

Yes

- Is there a Stop Load or a Force Unload Condition?

Yes

- Force Unload:
  - De-Energize Load Solenoid
  - Energize Unload Solenoid
  - Reduce the Drive Output by 2 x Rate of Change*
  - Force Unload: Hold Drive Output at current Value

- Load:
  - Energize Load Solenoid
  - De-Energize Unload Solenoid

No

No

Step Load:
- De-Energize Load Solenoid
- De-Energize Unload Solenoid
- Hold Drive Output at current Value

**VFD, Engine, Turbine Setpoints**

- Speed Control:
  - Max Output (1% - 100%)
  - Min Output (0% - 100%)
  - Rate of Change (0.1% - 25%)
  - Cyle Time (0 - 30 sec.)
  - Idle (0% - 100%)

- Slide Valve Control:
  - Slide Valve Positive to Begin Drive
    Increase (0% - 100%) [SV Begin]
    Drive Output at Max Slide Valve Position (0% - 100%) [SV Max]

*VFD, Engine, Turbine Setpoints

**Slide Valve Only Force Unloads**

- VI OverRide
- Differential Pressure
- Stopping
- Low RPM
- Manifold Pressure

***Slide Valve Setpoints***

- Highest Slide Valve Position to allow starting the compressor (0% - 100%)
Quantum™ Automatic Capacity Control  
(Electric, VFD, Engine, Turbine) Version 5.0x

**VFD, Engine, Turbine Setpoints**
- Speed Control:
  - Max Output (1% - 100%)
  - Min Output (0% - 100%)
  - Rate of Change (0.1% - 25%)
  - Cycle Time (0 - 30 sec.)
  - Idle (0% - 100%)
- Slide Valve Control:
  - Slide Valve Positive to Begin Drive Increase (0% - 100%) [SV Begin]
  - Drive Output at Max Slide Valve Position (0% - 100%) [SV Max]

**Slide Valve Only Force Unloads**
- VI OverRide
- Differential Pressure
- Stopping
- Low RPM
- Manifold Pressure

**Slide Valve Setpoints**
- Highest Slide Valve Position to allow starting the compressor (0% - 100%)
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