Power$ync

Computerized Control Option for QSI-i Compressors

Instruction Manual

This manual contains important safety information and should be made available to all personnel who operate and/or maintain this product. Carefully read this manual before attempting to operate or perform maintenance on this equipment.

Manual No. 65097-P$1A

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- ♦ Safety Alert Symbols
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- ♦ Serial/Model Identification Plate

<u>Safety Alert Symbols</u>

IMPORTANT!

Throughout this manual we have identified key hazards. The following symbols identify the level of hazard seriousness:

DANGER!

This symbol identifies immediate hazards which will result in severe personal injury, death or substantial property damage.

DANGER!

This symbol identifies life threatening electrical voltage levels which will result in severe personal injury or death. All electrical work must be performed by a qualified electrician.

CAUTION!

This symbol identifies hot surfaces which could result in personal injury or property damage.

WARNING!

This symbol identifies hazards or unsafe practices which could result in personal injury, death or substantial property damage.

CAUTION!

Identifies hazards or unsafe practices which could result in minor personal injury or property damage.

NOTICE!

Identifies important installation, operation or maintenance information which is not hazard related.

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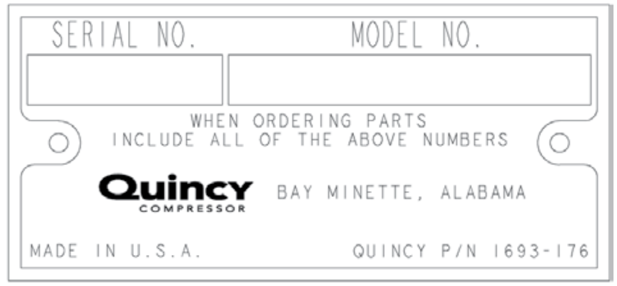
NOTICE!

Every effort has been taken to ensure complete and correct instructions have been included in this manual, however, possible product updates and changes may have occurred since this printing. Quincy Compressor reserves the right to change specifications without incurring any obligation for equipment previously or subsequently sold. Not responsible for typographical errors.

Spare Parts Ordering Information

Quincy Compressor maintains replacement parts for Quincy compressors and accessories. A repair parts list is shipped with all new machines. Order parts from your Authorized Quincy distributor. Use only genuine Quincy replacement parts. Failure to do so may void warranty.

Serial/Model Identification Plate



Reference to the machine MODEL, SERIAL NUMBER and DATE OF ORIGINAL START-UP must be made in all communication relative to parts orders. A model/serial number plate is located on the frame or in the upper right corner of the control panel door.

The serial/model information can be recorded here for quick reference:

Model #:________________________

Serial #: ________________________

Start-up date: ____________________

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Introduction

The Power$ync® control option equips Quincy QSI-i compressors with a variable capacity airend (Figure 1), a capacity control system comprised of electronic controls, control solenoids and lift valves and a computerized touch screen control panel (Figure 2).

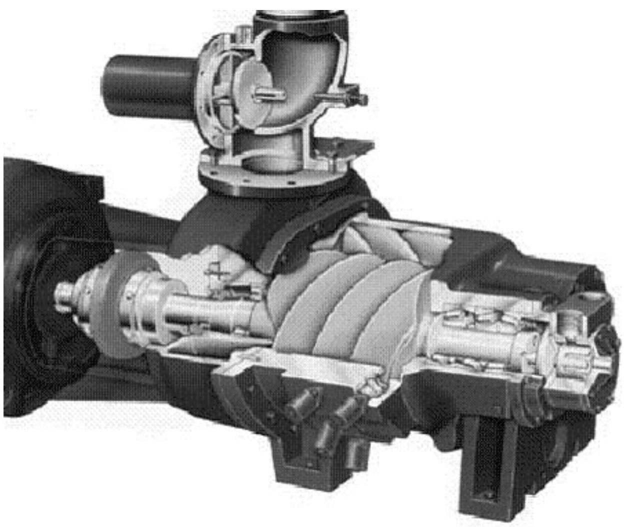

Figure 1. Variable Capacity Airend

Capacity Control System

The capacity control system consists of three groups: electronic controls, control solenoids and lift valves.

The electronic controls consist of the PLC and the HMI touch screen. The computer analyzes the compressed air system demand and sends signals to the PLC controlling the compressors response to those demands.

The control solenoids are a manifold of four four-way solenoid valves mounted on the compressor frame near the airend. When directed by the Power$ync computer, these valves open or close control valves which direct compressed air to open or close the lift valves located in the airend rotor bore.

The lift valves are four double-acting, pneumatic valves that open and close to return air to the suction housing prior to compression, controlling the effective length of the rotor compression area.

The Power$ync airend and controller have been designed to work together to provide the best full-load and part-load efficiencies available in the compressor industry.

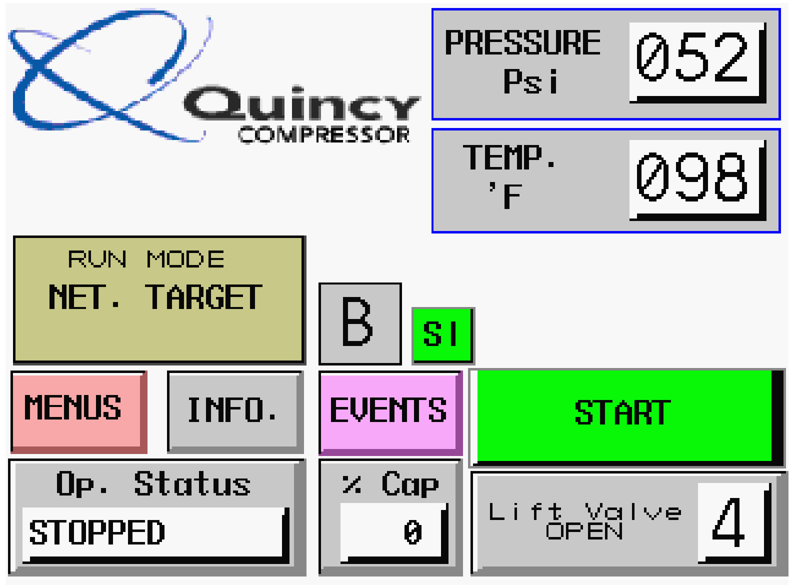

Figure 2. Touch Screen Control Panel (Main Screen)

Besides providing outstanding single machine efficiencies, Power$ync includes multi-machine control that uses logic based on system and compressor capacity demands to provide optimal utilization of your compressor equipment.

For applications that may be able to use base-load compressors without variable capacity control, the computerized controller can be ordered with standard QSI-i compressors and used in a network with other Power$ync compressors.

NOTICE!

Reference 'Fluid Carryover' (pages 22-23) for special considerations when using the computerized controller with standard QSI-i compressors.

NOTICE!

Reference 'Appendix A - PowerSync Gateway' (pages 32-39) for instructions on connecting a new QSI-i compressor with Power$ync to an existing network of older QSI compressors with Power$ync.

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Modes of Operation

Single Machine Modes

There are two modes of operation available for single Power$ync machine installations. They are: Continuous Run, Auto Dual.

- ♦ Continuous Run

Continuous Run mode uses an adjustable pressure deadband to match compressor output to system demand.

As the pressure rises above the full-load pressure setting, a signal is sent to open the lift valves. When the pressure rise indicates that the system demand is 50% of compressor capacity, Power$ync will open all four lift valves. If system demand continues to fall (and pressure continues to rise) the control will operate as load/unload control over the lower 50% of machine capacity. If the compressor loads and unloads a certain number of times over a preset time period, the control will switch to modulation control to stabilize system pressure. If the pressure rises to a point indicating no system demand, the control will close the inlet valve, unload the compressor and blow the reservoir down to atmospheric pressure. The compressor will continue to run in this unloaded state until system pressure drop indicates additional air demand. As the pressure drops from the upper (unload) setpoint, the control will begin loading and unloading the inlet valve. When pressure drop indicates that the system is again consuming more than 50% of the compressor's capacity, Power$ync will begin to use the lift valves to vary the compressor output.

Continuous Run control mode is best for systems with only brief periods during which there is no system demand. Systems with little or no compressed air storage capacity will also run better with a control scheme using a pressure deadband to moderate changes in loading levels.

- ♦ Auto Dual

Auto Dual mode operates identically to Continuous Run when responding to system demand. During periods of no system demand Auto Dual provides additional power savings by using a shutdown timer.

In Auto Dual mode, a shutdown timer will start and count down a preset waiting period when the compressor unloads. If there is no drop in system pressure during this waiting period, Power$ync will turn the compressor motor off and stand by, continuing to monitor system pressure. When demand returns to the system, the controller will restart the compressor to satisfy the air requirements.

Auto Dual mode is best utilized on systems with extended periods (usually half an hour or more) of no system demand. Adequate compressed air storage capacity and a reasonable pressure deadband will provide a very small continuous demand system with the power saving benefits associated with having the compressor turned off.

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Network Mode

Power$ync uses Network mode to control multiple compressor installations with relatively constant air demands and compressed air storage capacities of at least two gallon for every cubic foot of compressor capacity efficiently.

Using target pressure in applications with adequate air storage and minimum pressure drops, the control will maintain system pressure to within two or three pounds of the target pressure, thereby reducing power consumption at part load because system pressure does not have to climb through a pressure deadband to start a compressor. Target pressure will maintain a more steady pressure throughout the compressed air system.

Compressor installations using Network Mode can select from two methods of network operation: Target Pressure mode or D.B. (Deadband) mode. When operated in Network mode, Power$ync uses an average of all compressor discharge pressures of the active compressors to determine the network's proximity to the target pressure.

The Power$ync controller can be programmed with schedules and sequences so the compressors can efficiently meet system demand.

The speed with which the control responds to changes in system demand is determined by the rate at which the demand changes (i.e. if the system pressure moves away from the target pressure quickly, the control will react quickly and vice versa). All machines in a properly designed system are operated at the same pressure; therefore, there is no pressure differential requirement between machines on the network.

☞ NOTICE!

Network Mode is the most sophisticated control available for multiple machine applications. To gain full benefit of the features afforded by this mode of operation, a good understanding of the specific system into which the compressor is installed is required.

- ♦ Single Machine Installation
- ♦ Network Installation

Single Machine Installation

To install a single QSI-i Power$ync compressor connect the wiring between the disconnect and the compressor, connect the discharge piping to the air system, apply power and close the disconnect to provide power to the control.

All settings on Quincy QSI-i compressors with Power$ync are preset at the factory per the instructions on the order. If operating requirements have changed since the machine was ordered, Power$ync can be adjusted to the new parameters.

Network Installation

To form a network of compressors and utilize the multiple machine control capability built into the Power$ync software, the following items are needed:

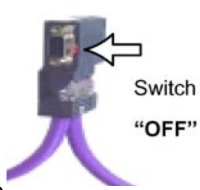
1) ProfiBus cable to properly connect machines. (Quincy part number 146780-100, -250, -500 or -1000 is recommended.)
2) ProfiBus connectors for each machine. (Quincy part number 146780-001)

NOTICE!

The maximum cable length between compressors in the network is 330 feet (100 meters).

When networking only 2 machines, the switch on the connectors must be in the ON position.

When networking more than 2 machines, the switch on the connectors that are on the end machines (first and last) must be in the ON position and the switch on all other connectors must be in the OFF position.



The following instructions demonstrate the proper procedure for connecting the cables to the connectors using a Siemens FastConnect stripping tool:

Holding the stripping tool in the right hand, measure the length to be stripped by holding the cable against the template on the side of the tool.

Mark the position using the index finger of the left hand and insert the cable into the tool (to the measured distance) and clamp the end of the cable in the stripping tool as shown.

Turn the tool in the direction of the arrow four to eight times (until the cable insulation is cut through).

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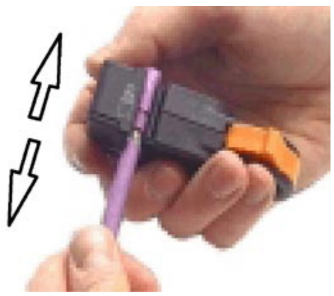
Keeping the tool closed, remove it from the cable. The cut insulation should remain in the tool. If the cut is poor, replace the blade cassette of the stripping tool.



Remove the protective layer from the cores of the cable.

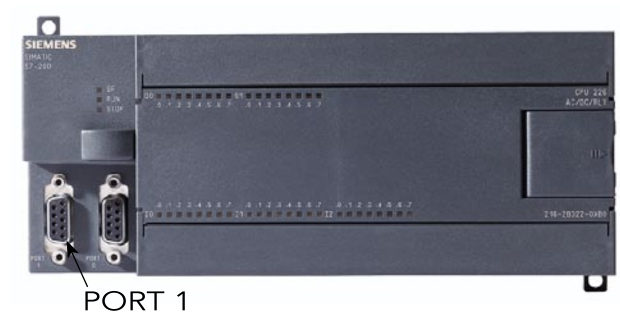
Loosen the screw of the strain relief on the connector, turn back the strain relief clamp and lift the contact cover.

Fit the incoming cable into the connector (contact cover labeled A1, B1) and press the contact cover down firmly.

If an outgoing cable is required (on machines in a network of more than two compressors), fit the outgoing cable into the connector (contact cover labeled A2, B2) and press the contact cover down firmly.

Turn the strain relief clamp back into position and tighten the screw.

Once the cables are properly installed in the connectors, plug the connectors into port 1 of the PLC.



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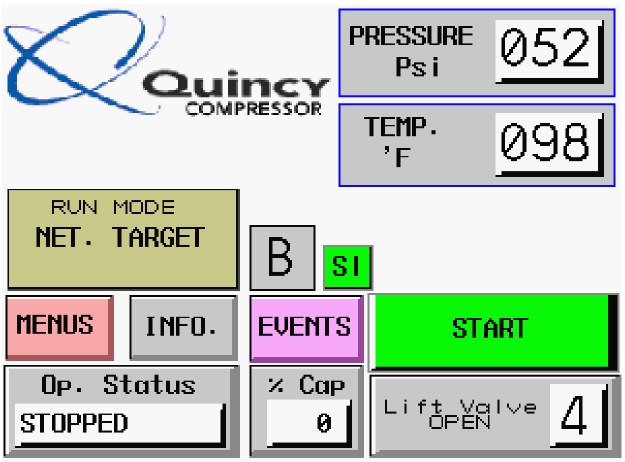
- ♦ Main Screen
- ♦ Setup & Configuration

Main Screen

When power is applied to the compressor, the HMI touch screen control panel will display the main screen:



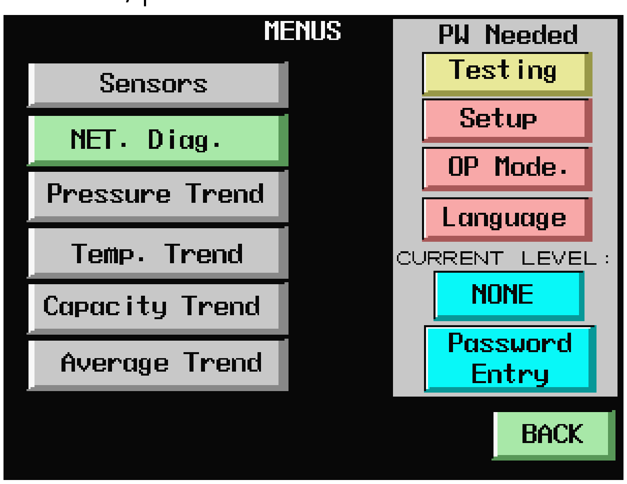
The main screen provides all of the commonly required information about the compressor operation: discharge pressure, airend discharge temperature, run mode, operation status, machine ID, network flag (master or slave), percent capacity (calculated based on the number of lift valves open) and the number of lift valves open.

Press the start button to start the compressor. The green start button will change to a red stop button when the compressor is running or in standby operation status.

Setup & Configuration

There are 3 other buttons on the main screen: MENUS, INFO, and EVENTS.

To view or change the configuration of the machine, press the MENUS button:



The BACK button at the bottom right hand side of this screen appears on all of the screens except the main screen. Press this button to return to the previous screen at any time. To return to the main screen, press the BACK button as many times as necessary.

Some menus require a password to gain access. There are 2 levels of password, a user level and a master level.

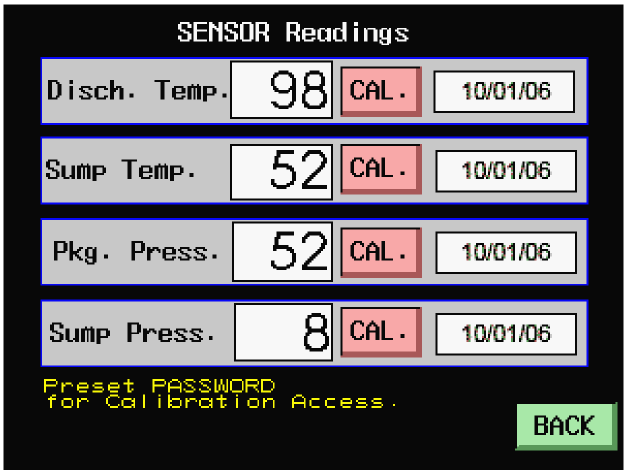
The menus in the gray zone on the right side of this screen (under PW Needed) require a password.

☞ NOTICE!

Only authorized Quincy service technicians are permitted to change settings requiring a master password.

The menus on the left side are informational displays and do not require a password to view.

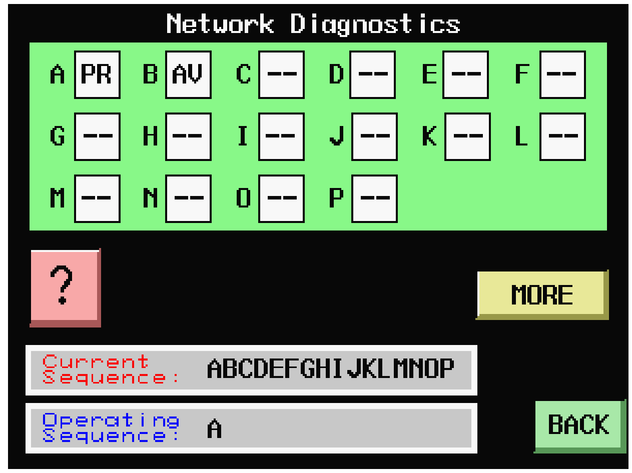
The Sensors menu displays the current sensor readings and the date that each sensor was last calibrated.



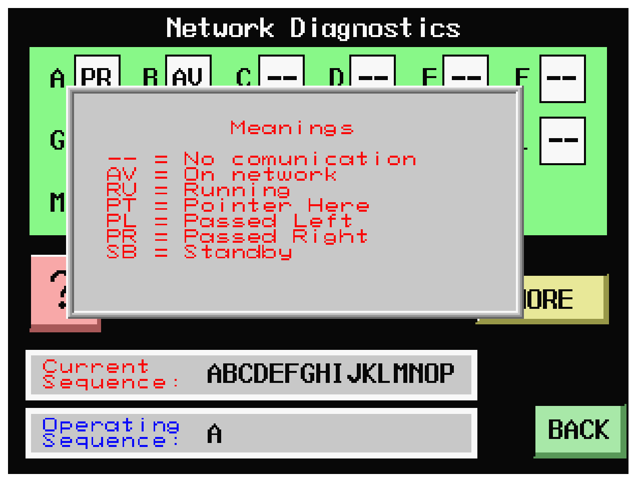
The CAL. button is used to calibrate the sensors and requires a master level password. Contact Quincy service.

Press the BACK button to return to the MENUS screen.

The Net. Diag. menu is used to check the communication status of networked compressors.



Press the question mark button for an explanation of the code displayed next to each compressor. Touch the gray pop-up window to remove it.



Current Sequence shows the sequence of compressors scheduled to run. Operating Sequence shows the actual compressors that are operating.

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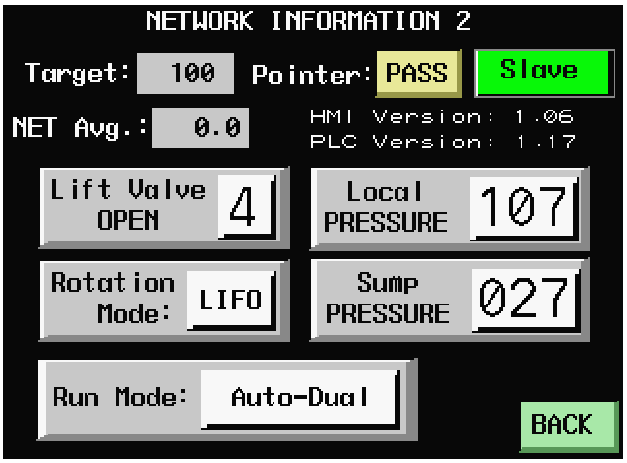
☞ NOTICE!

The compressors must be in Network mode for the Network Diagnostics screen to display valid data.

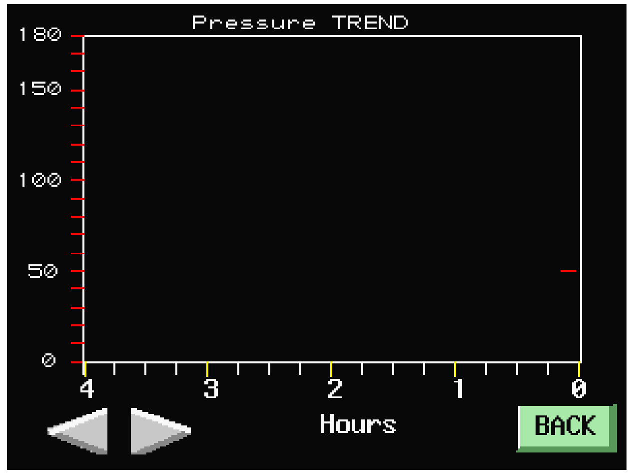
Press MORE to access the NETWORK INFORMATION 2 screen:



This screen shows target pressure, network average pressure, whether or not this compressor has the pointer in a network of compressors and master or slave network flag position for this compressor. It also displays the number of open lift valves, rotation mode, local pressure, sump pressure and run mode of the package as well as the software version of the HMI and the PLC.

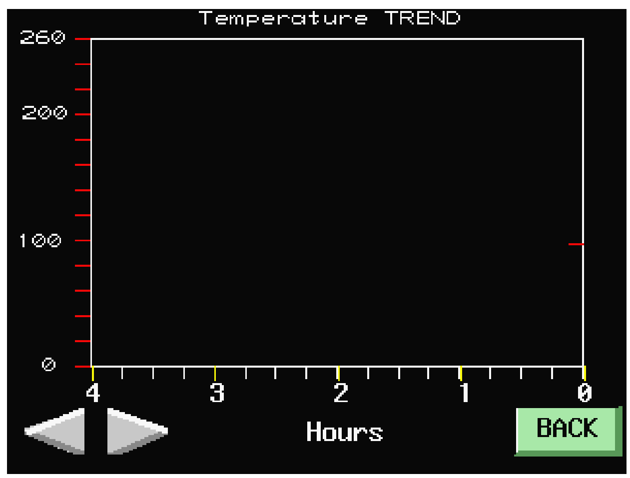
Press the BACK button until the MENUS screen is displayed.

Press the Pressure Trend button to view a graph of the package pressure at this compressor:



Press the BACK button to return to the MENUS screen.

Press the Temp Trend button view a graph of the airend discharge temperature at this compressor:



Press the BACK button to return to the MENUS screen.

Press the Capacity Trend button to view a graph of the calculated air capacity at this compressor:

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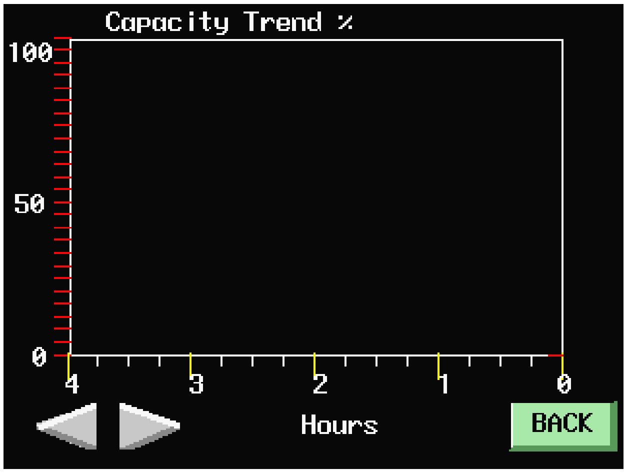
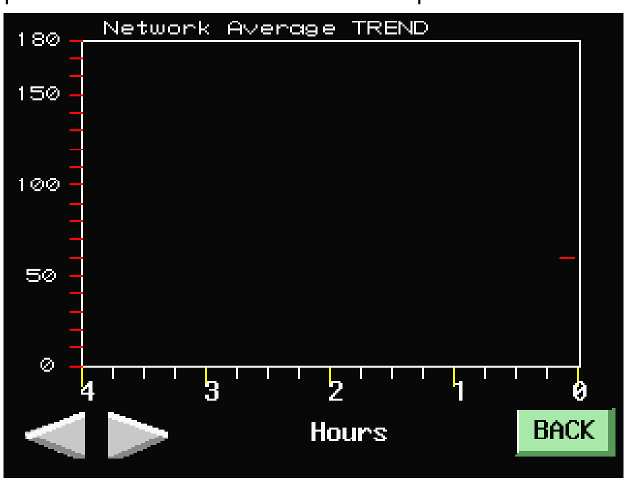


This calculation is based on the number of lift valves open and whether the compressor is loaded or unloaded.

Press the BACK button to return to the MENUS screen.

Press the Average Trend button to view a graph of the calculated average air pressure in a network of compressors:

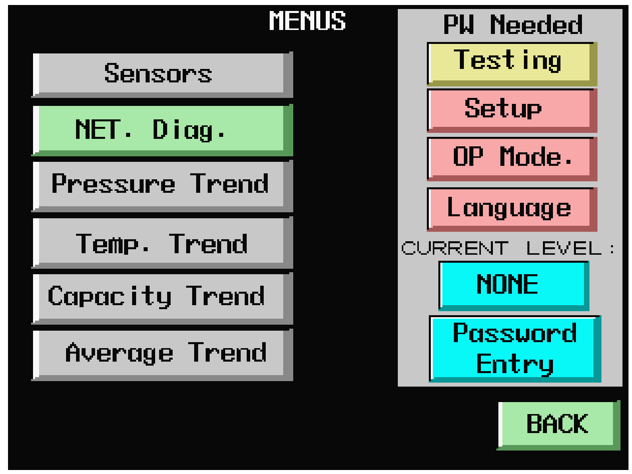


This calculation is based on the number of compressors running and is the average pressure based on this information (also referred to as network average pressure).

NOTICE!

Use the arrows in the bottom left hand corner of the trend screens to scroll the graphs left and right to view the trend curve up to a maximum of 129 hours.

Press the BACK button to return to the MENUS screen:

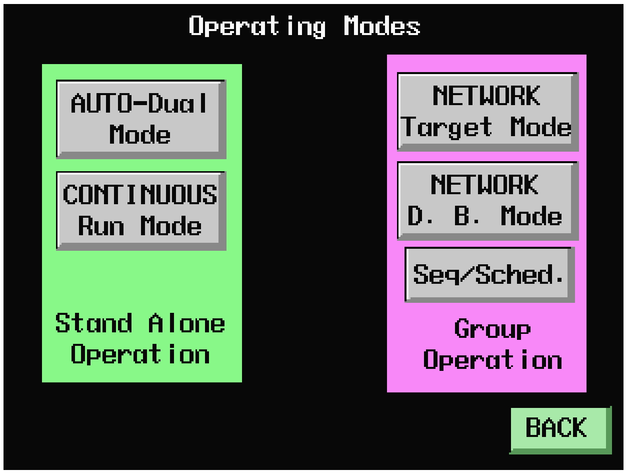


The Testing and Setup buttons are used for manufacturing setup and service, require a master password and are not covered in this manual.

The Op Mode and Language buttons require a user level password. Press the Password Entry button and enter user password 777.

Once the password is entered, the MENUS screen will display USER under current level.

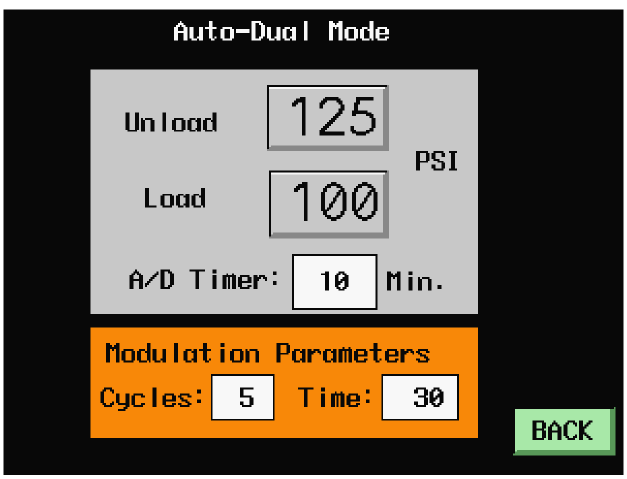
Press the OP Mode button to select one of the four available operating modes:



The compressor will immediately be set to the selected operating mode when one of these buttons is pressed.

Auto-dual is the most common mode for operating a single non-network compressor.

If auto-dual is desired, press the AUTO-Dual Mode button:

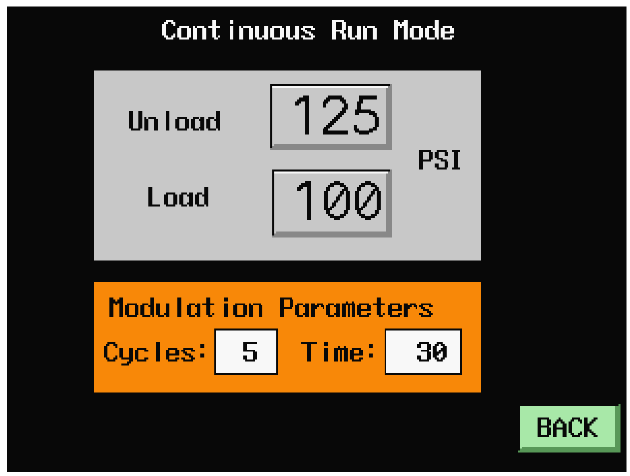


Set the desired Unload pressure, Load pressure, Auto-Dual Timer, and Modulation Parameters.

Press the BACK button once to return to the Operating Modes screen, twice to exit to the main screen.

Continuous run is a common mode for operating a single non-network compressor. This mode does not have a timer to shut the compressor down if it runs unloaded.

If continuous run is desired, press the CONTINUOUS Run Mode button at the Operating Modes screen:

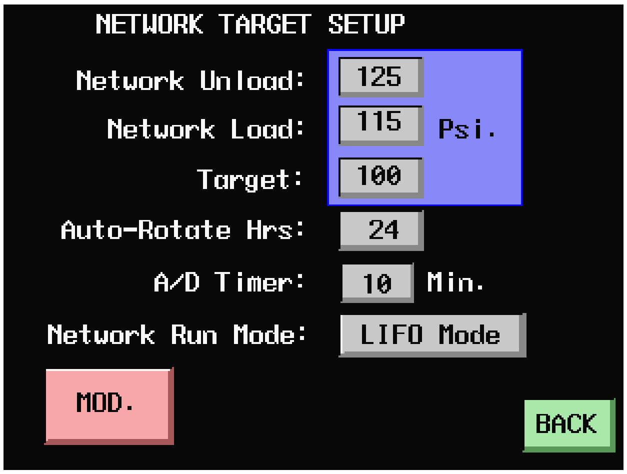


These settings are the same as AUTO-Dual Mode, except there is no timer setting in this continuous run mode.

Press the BACK button once to return to the Operating Modes screen, twice to exit to the main screen.

Network target mode is the most common mode for operating 2 or more networked compressors.

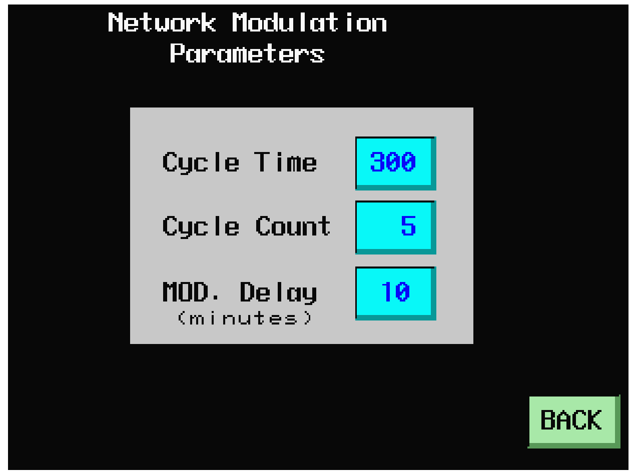
If network target mode is desired, press the NETWORK Target Mode button:



Set the Network Unload pressure, Network Load pressure, Target Pressure, Auto-Rotation Hours, Auto-Dual Timer, and Network Run Mode (press the gray box next to Network Run Mode to toggle from LIFO Mode to Auto-Rotate Mode). Reference page 24 for a detailed explanation of these settings.

All of the network settings are transmitted to all active compressors on the network.

To display the Network Modulation Parameters setup screen, press the MOD button:

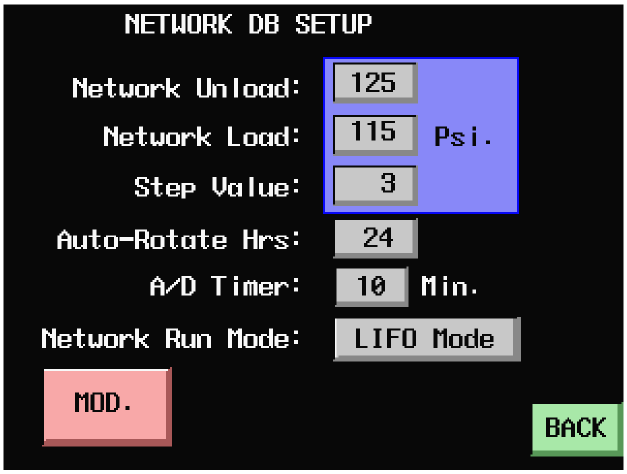


The MOD. Delay setting is the length of time that the compressor will be held in modulation if it goes into modulation because of rapid cycling.

Press the BACK button twice to return to the Operating Modes screen, three times to exit to the main screen.

NETWORK D. B. Mode uses a pressure range for operating 2 or more compressors that are networked together.

If network deadband mode is desired, press the NETWORK D. B. Mode button at the Operating Modes screen:



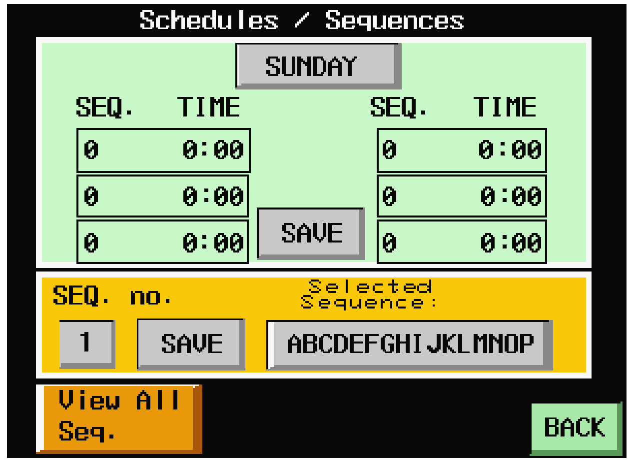
Set the Network Unload pressure, Network Load pressure, Step Value, Auto-Rotation Hours, Auto-Dual Timer, and Network Run Mode (press the gray box next to Network Run Mode to toggle from LIFO Mode to Auto-Rotate Mode). Reference page 24 for a detailed explanation of these settings.

All of the network settings are transmitted to all active compressors on the network.

The MOD button accesses the Network Modulation Parameters setup screen. These settings are the same as described on the previous page.

Press the BACK button once to return to the Operating Modes screen, twice to exit to the main screen.

To set the sequences and the schedules for the network, press the Seq/Sched button at the Operating Modes screen:



All of the network settings set here are transmitted to all active compressors on the network.

NOTICE!

It is recommended that this screen only be used on machines that have the Slave flag.

To set the network schedule & sequence, begin by selecting the day of the week for the selected sequence to begin. Press the gray button (labeled SUNDAY in the above figure) to scroll through the days of the week. When the desired day is displayed, press the first available space under the SEQ column. A keypad will appear. Enter a number from 1 to 9 to select the desired sequence. Press the first available hour location under the TIME column and enter a number from 0 to 23 to represent hours

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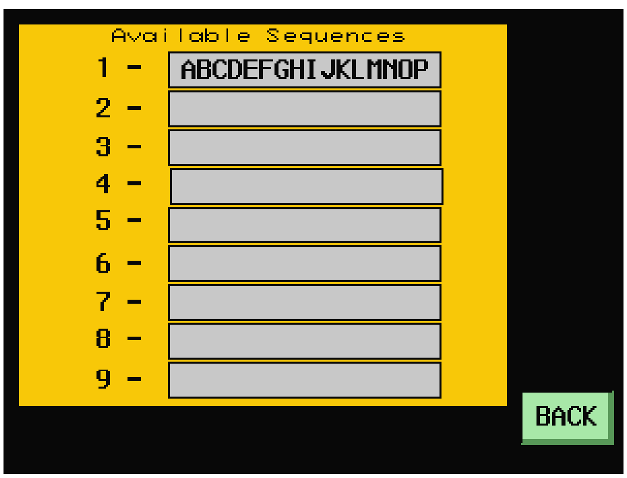
in a 24 hour format. (i.e.: 7 represents 7 am, 19 represents 7 pm.) Press the first available minute location under the TIME column. Enter a number from 0 to 59 to represent minutes. Press the SAVE button in the green area to save the settings.

To edit the sequence of the compressors in the schedule, press the gray button under SEQ until the sequence number to be edited appears. Press the gray area under Selected Sequence and a keypad will appear. Enter up to 16 machine ID letters in any order you wish.

NOTICE!

For proper operation, all compressors listed in a sequence must have valid compressor ID's.

To view all the available sequences and verify that all compressor ID's in the schedule are valid, press the View All Seq. button:

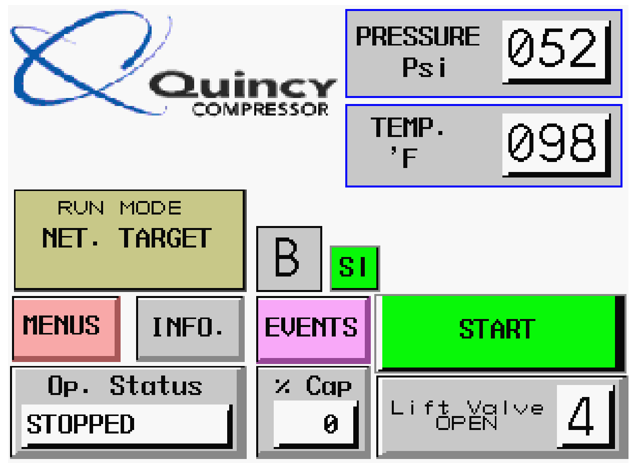


Sequence 1 shown here has all possible compressor ID's listed. If this sequence is scheduled, all the compressors will run in this order beginning at the scheduled time.

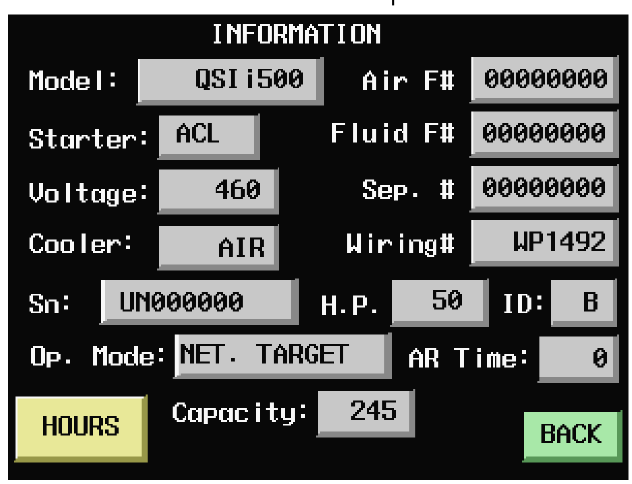
There are no other valid sequences scheduled. Press the BACK button once to return to the Schedules / Sequences display. Set the desired sequences and schedules as described in the preceding paragraphs.

If a sequence in the schedule does not contain all of the available compressors, the compressors not in the sequence will unload, time out and shutdown (go into standby mode). All of the available compressors not in the sequence will stay in standby mode until the compressor ID appears in a scheduled sequence.

Press the BACK button (as many times as required) to return to the main screen.



Press the INFO button to display basic information about the compressor:



Most of this information is self explanatory. If Auto-Rotate was selected in network mode, AR Time: is the time (in hours) remaining until the networked compressors Auto-Rotate.

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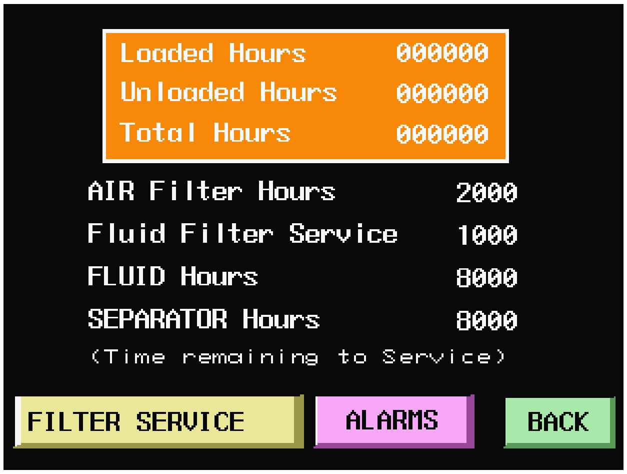
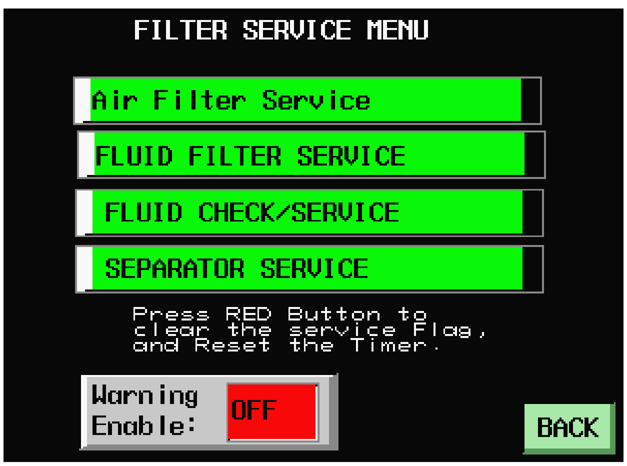
Press the HOURS button:



This screen displays the loaded, unloaded and total hours on the compressor as well as the remaining hours until service is required based on the service hours settings.

Press the FILTER SERVICE button:

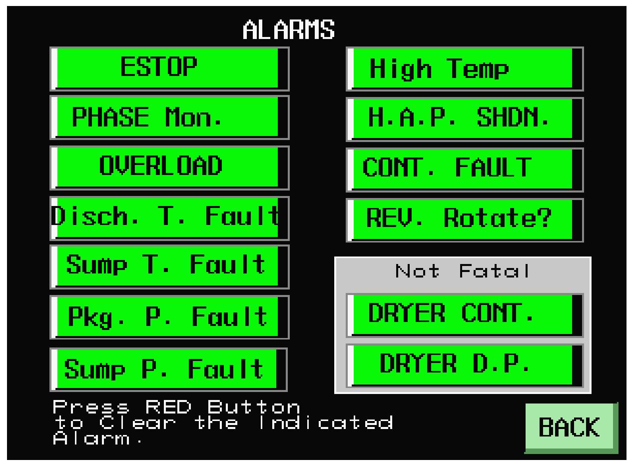


If service is required, the item needing service will appear in red. To clear the service flag and reset the timer once service has been performed, press the red button.

The separator and filters service flags are based on either a delta pressure sensor or a service timer. Fluid service is based on a service time setting and not on a sensor. A red OFF button in the gray area labeled Warning Enable indicates that the service for the filters and separator is based on the delta pressure sensor only. Press the Warning Enable button to toggle this setting ON or OFF.

Press the BACK button to return to the hours display screen.

Press the ALARMS button:



If the compressor shuts down unexpectedly, this display will show the cause of the shutdown in red. Correct the problem and press the red bar to reset the fault and allow the compressor to be restarted. If the bar does not turn green, the fault condition is still in effect and needs to be cleared (i.e.: unlock the E-stop button, reset the overload, etc.).

Press the BACK button (as many times as required) to return to the main screen.

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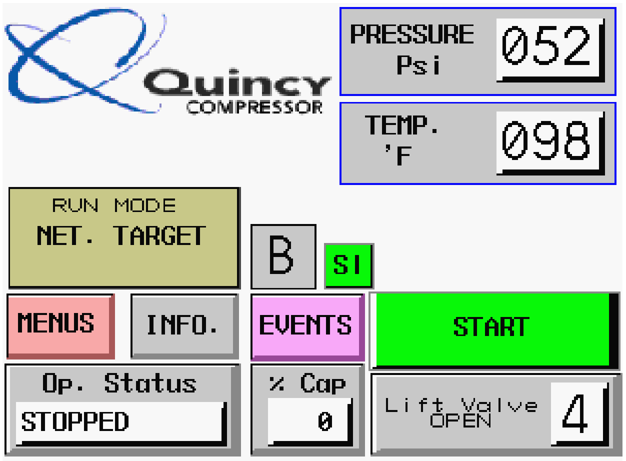
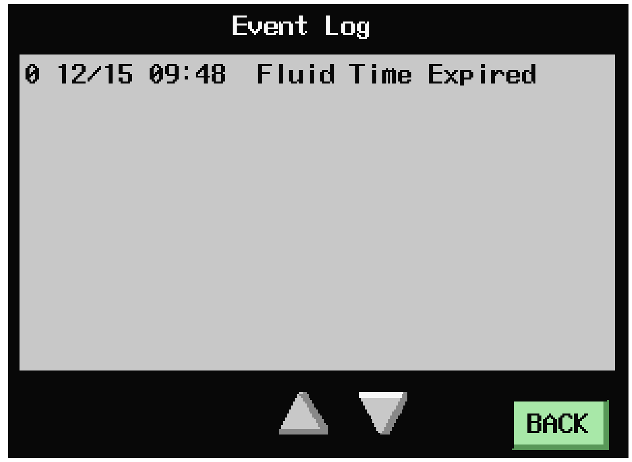


Press the EVENTS button:



The Event Log screen displays all of the service and shutdown events that have occurred on the compressor. Up to 200 events (with date and time) can be recorded. Press the up and down arrows to scroll through the events.

Press the BACK button to return to the main screen.

- ♦ Pressure Settings
- ♦ Fluid Carryover
- ♦ Sequencing and Scheduling
- ♦ Network Run Modes
- ♦ Network Operational Rules for Target Pressure Mode
- ♦ Network Operational Rules for D.B. Mode

Pressure Settings

Pressure measures how much the physical volume of ambient air has been reduced. (i.e.: If one cubic foot of sea level air is compressed to 15 psig, it will occupy 1/2 of a cubic foot. At 45 psig, it will occupy 1/4 of a cubic foot.) At plant operating pressures (around 100 psig) ambient air has been compressed to occupy slightly less than 1/8 of its original volume. Compressor output and consumption are measured in cubic feet of inlet air. As pressures rise in the reservoir, each of these inlet cubic feet occupies less volume.

Power$ync is factory set to operate efficiently for most compressed air systems. The pressure limits are based on the particular configuration. Quincy recommends using the factory setting for a while before making any changes. When changes are made, document the changes and the resulting system pressure and fluctuation to allow the compressor to be fine-tuned for a particular application.

The following pressure setting descriptions apply to single machines and to the base load machine in multiple machine applications:

Load pressure is the maximum pressure at which the machine will operate at full capacity. As demand for air drops, the pressure will rise to the unload pressure. At the unload pressure, all the lift valves will be open and the inlet valve will be closed (the compressor will not be compressing air).

Maximum load and unload pressures are determined by available motor horsepower and the pressure ratings of various components in the compressor package. This information can be found in the QSI-i Instruction Manual (Appendix B - Technical Data).

Minimum loaded pressure is based on the capability of the separation system to remove fluid from the discharge air stream. Most QSI-i compressors have minimum full load pressure set to 85 psig. (Reference ‘Fluid Carryover’ on pages 22-23.)

The differential between the load pressure and the unload pressure should not be less than 10 psig.

To determine proper pressure and differential settings, several factors must be considered:

- ♦ The pressure required in the plant air distribution system to maintain proper equipment performance - Many pneumatic tools and devices are rated to operate at a particular pressure. Operating them at a higher pressure increases the amount of air they consume. For maximum energy efficiency and performance, do not maintain more pressure in the system than required. Most systems will have some leaks. More air will pass through a leak at a higher pressure than at a lower pressure.

- ♦ The storage capacity of the distribution system - A distribution system with little or no storage capacity will operate better with a wider differential between load and unload pressure. Systems with at least one gallon of storage capacity per cubic foot of compressor capacity can reduce energy consumption by using a more narrow pressure differential. Adequate storage capacity also provides more consistent system pressure. The differential should initially be set at 15 psig. If system pressure remains steady throughout a typical work cycle, reduce the differential to 10 psig. If system pressure fluctuates greatly, increase the differential.

- ♦ The nature of air consumption within the system itself - A system subject to rapid, cyclic air consumption may require a wider differential than one with a steady air requirement. As with the other considerations, improvements in energy efficiency can be obtained by adjusting the pressure settings to maintain the lowest acceptable steady pressure.

Fluid Carryover

The process of compressing air in a fluid flooded rotary screw compressor creates a mix of liquid fluid, fluid aerosol, fluid vapor and air. Fluid carryover is the amount of fluid that reaches the compressed air distribution system.

Quincy Compressor takes the following design considerations into account to minimize the amount of fluid reaching the separator element under typical operating conditions:

- ♦ The air stream is directed around the inside wall of the reservoir to reduce the amount of liquid fluid reaching the separator element.
- ♦ The separator element(s) are designed to trap liquids (and aerosols) at the anticipated air velocities and return the trapped liquid to the reservoir.

Fluid carryover numbers are based on full load operating pressures. Pressure drops of 10 to 15 psig below full load pressure can double, triple or even quadruple the full load pressure carryover rate. At pressures between full load and minimum operating pressure, the separation system will be less efficient. At a point below minimum pressure, the separation system will become overloaded and no longer separate at all, causing discharge from the compressor to become a fluid fog.

The following paragraphs describe some factors which may affect fluid carryover when operating conditions are not typical.

- ♦ At a given level of saturation, the amount of fluid reaching the separator element varies inversely with the absolute pressure inside the reservoir - A maximum saturation point within the reservoir governs the amount of aerosol present. If the quantity of aerosol increases, tiny droplets collide and form larger droplets which become heavy enough for gravity to pull down to the liquid pool at the bottom of the reservoir. The distance between the droplets determines the maximum amount of fluid that remains in suspension on the wet side of the separation system.
- ♦ The differential pressure between the point on the airend where the fluid is returned and the pressure in the reservoir - Higher reservoir pressures reduce the amount of fluid reaching the separator element and increase the ability of the scavenge system to remove the collected fluid.
- ♦ Velocity of the compressed air in the airend discharge line and the reservoir - Velocities increase if pressure falls below the rated full load pressure of the compressor. Velocity through the separation system varies inversely with absolute pressure. (i.e.: Doubling absolute pressure cuts velocity in half.) Increased velocities can cause more fluid to be suspended inside the reservoir.
- ♦ Temperature in the compression area of the airend - Some fluids contain components which are volatile and may change from liquid to vapor at temperatures found in the compression area of an airend. This fluid vapor can pass through most filtration products and remain in the air stream. When these vapors reach cooler downstream temperatures (usually in the aftercooler or dryer), they condense back to liquid form.
- ♦ Compressor operating below normal operating temperature range - The temperature of the compressed air may be at or below the pressure dewpoint of the water vapor.
- ♦ Dirty separator elements - Part of the surface area is plugged causing increased velocities and pressure differential across the element (causing an increased cooling effect).

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- Ambient air temperature and relative humidity - On warm, humid days, if the operating temperature of the compressor is near the pressure dewpoint of the water vapor in the compressed air stream, air that is compressed to normal plant operating pressures can be at or near the saturation point when it leaves the airend. Any drop in temperature can result in water condensation.

- Temperature inside the reservoir is at the pressure dewpoint of the water vapor - When the pressure of a gas is reduced, heat energy is released, thereby cooling the gas. If the gas is water vapor, liquid water will form. As the compressed air stream crosses the separator element, its pressure is reduced by 1 psig or more and liquid water will form on the element. A wet separator element will pass more fluid than a dry one because the fluid travels across the element on the surface of the water without combining with other fluid droplets to form drops big enough to be affected by gravity.

- Compressor controls and plant air requirements - The two types of compressor controls generally used on rotary screw compressors are load/no load and variable intake capacity controls. A machine with load/no load controls operates between two pressure setpoints. The lower setpoint is usually 10 psig below maximum full load pressure. Using a standard 100 psig application, the separator element is subjected to compressed air pressures 8 to 10% below maximum full load pressure. Each cubic foot of inlet air is 8 to 10% larger than it would be at the upper setpoint, capable of carrying 8 to 10% more suspended fluid and is carrying this greater fluid load at velocities that are 8 to 10% higher than they would be at maximum full load pressure. As system demand drops, pressure begins to rise. Load/No load controls continue to deliver full capacity to the upper setpoint subjecting the separator element to its maximum fluid load. When the upper setpoint is reached, the inlet valve closes and most compressors relieve some or all of the pressure in the reservoir to lower the unloaded brake horsepower requirement. The media in the element now has a full load of fluid which begins to drain to the collection point where the scavenge system returns it to the airend. Since the reservoir pressure has been relieved, the rate at which the fluid is scavenged is reduced. Normal fluid carryover can be expected if all the fluid is scavenged before the compressor reloads. If the machine reloads too quickly, the liquid remaining in the bottom of the dry side of the separator element will be carried out of the element and downstream into the system. Compressors with modulating controls (including inlet valve modulation and various methods of rotor length control) begin at the maximum full load pressure setting and go up. At the lower pressure setpoint, the separator element is subjected to the full flow of the compressor. As the pressure rises, the amount of air entering the compressor is reduced until the maximum pressure setpoint is reached and inlet air is completely cut off. As system requirement falls and pressure rises, fewer units of inlet air go to the element and the units are smaller (higher pressure), travel at lower velocities and carry less fluid. Less fluid reaches the element, increased system pressure improves the efficiency of the scavenge system and the separator element is drying out.

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Sequencing and Scheduling

Sequencing refers to the order in which compressors in a network will be brought on and off line to satisfy system demand. Power$ync has a default sequence (in alphabetical order, beginning with A). Up to six sequences can be scheduled for each day. The number of sequences used depends on the load requirements of the compressed air system.

Scheduling refers to the time and day that a particular sequence is to be used. The goal of proper scheduling is to assign a sequence to a particular time to assure that the compressors running will be operating as close to full load as possible.

The target pressure method of control moves a control pointer through the sequence. The machine that the pointer starts at in the sequence depends on the system pressure at the time the compressors are started. If the machine that the pointer is at reaches full capacity and cannot maintain target pressure, the pointer passes to the next machine in the sequence. This continues (as demand requires) until all machines are running and the pointer is at the last machine in the sequence. If demand diminishes and system pressure starts to rise, the pointer moves backward through the sequence from right to left, as required to maintain target pressure.

Sequence and scheduling information should always be entered in a machine with the slave flag. When a sequence change occurs, a pressure drop can also occur while the pointer position is established. Therefore, it is recommended that sequence changes be made at a time when there is no demand.

In order to optimize energy savings, a load study to determine appropriate sequencing and scheduling should be done prior to ordering compressors.

Network Run Modes

LIFO

LIFO stands for last in, first out. This network run mode is recommended for both network modes of operation and is the recommended mode if the compressors in the network are different sizes. The largest capacity compressor should be BASE load.

The term LIFO refers to the order machines load up as the network average pressure drops. The last in will be the last compressor in the sequence. As the pressure rises the first one out will be the last compressor in the sequence.

Auto Rotation

Auto Rotation Network Run Mode is recommended for both network modes of operation when all the compressors in the network are the same size. This network run mode uses the auto-rotation hours to determine when to change the order of the sequence.

This mode uses sequence 1, therefore, sequence 1 should have valid compressor ID's in the network, for example ABC. Do not use the default A through P sequence. After the Auto-Rotation Hours reach zero, the compressor ID that is in the second position, B in this case, will be moved to the first position and the compressor that was in the first position, A in this case, will be moved to the last position.

The Auto-Rotation Hours will reset and the process will be repeated as long as the Network Run Mode is set for Auto Rotation.

Ensure that only sequence 1 is scheduled for use and is active. The auto-rotation time starts when this is activated on the HMI panel, not by the scheduler.

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Page updated 07/10/07.

Network Operational Rules for Target Pressure Mode

The following paragraphs describe the rules under which a network of compressors operates:

In a network of compressors, a pointer flag is passed from machine to machine. The compressor with the pointer flag is the only compressor in the network able to control its lift valves. This provides an order for the operation of the lift valves.

The pointer moves from one end of the active sequence to the other as the network tries to maintain the target pressure by opening or closing lift valves. The order of opening lift valves is started with the last machine in the sequence.

Example: In a network schedule with a sequence of AB; machine B is the last machine in the sequence. If the compressors are started in a system where the pressure is at or above the target pressure, the pointer will be at machine B, poised to start opening the lift valves. When all of the lift valves on machine B are open, the pointer passes to machine A.

Machine B is at 50% capacity with all four lift valves open. Machine B monitors the lift valves opening and closing on machine A. When and if machine A opens enough lift valves to represent the 50% capacity that B is still delivering, machine B will unload and begin to time out to shut down.

To explain further:

If machine B is a 500 CFM compressor and machine A is a 1000 CFM compressor. When machine A opens two lift valves, those two lift valves represent a capacity reduction of 250 CFM (25% of 1000). Machine B has all four lift valves open which also represents a capacity reduction of 250 CFM (50% of 500). Machine B will now unload, since when it unloads, it will cause another 250 CFM to be reduced in the system. If the CFM reduction is too large, machine A will close its two open two lift valves to restore up to 250 CFM back into the system and prevent machine B from loading back up or restarting.

If the sizes for machines A and B are reversed (machine B is a 1000 CFM compressor and machine A is a 500 CFM compressor), when machine B opens all of its lift valves, it represents a reduction of 500 CFM (50% of 1000). When machine B passes the pointer to machine A and machine A opens all of its lift valves, that represents a reduction of 250 CFM (50 % of 500). In this scenario, machine A does not provide enough reduction to equal the 500 CFM remaining in machine B, so machine B will not unload because that would drop 500 CFM out of the system and machine A does not have enough lift valves to make up the CFM.

In this case, machines A and B would both be running at 50% capacity and would remain this way if the air demand remained the same. If the air demand drops, causing the pressure to continue to rise, both machines would reach the network unload pressure and unload. When the pressure drops back to the network load pressure, the compressors will load.

For this reason, when developing a sequence for two or more compressors of different sizes in target pressure mode, the largest compressors should be at the beginning of the sequence and the smallest compressors should be at the end of the sequence. If all the compressors are the same size, the sequence order does not matter.

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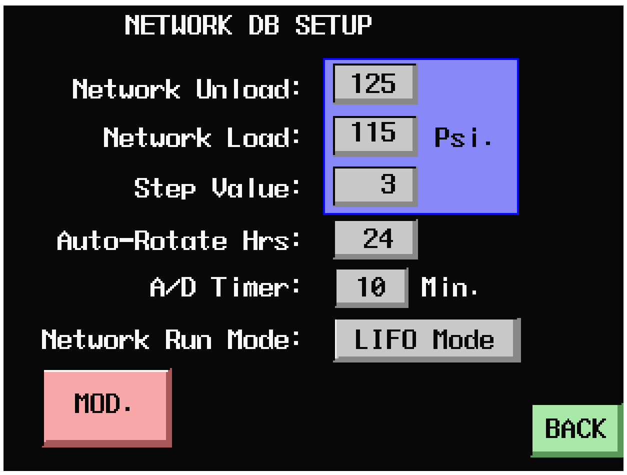
Network Operational Rules for D. B. Mode

D. B. mode refers to Deadband mode. As with target pressure mode, D. B. mode uses the average pressure of the active compressors in the network as the control reference. However, in this mode, each compressor operates in a pressure range instead of trying to maintain a target pressure. If the larger compressors in a network need to be at the end of the sequence, D. B. mode is recommended.



Shown here is the NETWORK DB SETUP screen. The Network Unload pressure and the Network Load pressure shown here are the pressure settings for the machine in the first position in the current sequence. The Step Value sets the Unload and Load pressures for all other machines in the sequence.

Example: With a sequence of ABC, machine A has an unload pressure setting of 125 and a load pressure setting of 115.

The Step Value for the compressors in the sequence is 3. Therefore, machine B has an unload pressure of 122 and a load pressure of 112 and machine C has an unload pressure 119 and a load pressure 109.

The pressure settings are not fixed by the compressor ID's but by the position of the machine in the sequence.

To explain further:

With these pressure settings, as the network average pressure climbs, the first machine to be affected is machine C. When the network average pressure is 110, a lift valve in machine C will open. If the network average pressure reaches 111, two lift valves in machine C will open. If the network average pressure reaches 118, all four lift valves in machine C will open and one lift valve in machine B will open. If the network average pressure reaches 119, machine C will unload and two lift valves in machine B will open.

If the network average pressure falls to 118, machine C will still be unloaded and machine B will have one lift valve open. The network average pressure must fall to 109 in order for machine C to load.

If the sequence is changed to BCA, machine B has pressure settings of 125 unload and 115 load. Machine C an unload pressure of 122 and a load pressure of 112 and machine A now has an unload pressure 119 and a load pressure 109.

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Probable Causes:	Corrective Action:
Failure to Start:	
Power Not Turned On	Turn power on by closing main disconnect switch or circuit breaker.
Blown Control Circuit Fuse	Replace fuse. Check for shorted out lift valve solenoid.
Power Failure	Check power supply & power supply cables.
Low Voltage	Check voltage at entrance meter and motor terminals and compare readings to locate the source of low voltage.
Faulty Transformer	Check secondary voltage on transformer fuses.
Set Up Memory Failure	Turn power off and back on. Contact an Authorized Quincy Service Technician to check for microprocessor failure or improper voltage from the DC power supply.
Safety Circuit Shutdown	Diagnose cause. Correct cause and restart compressor.
Emergency Stop Pressed	Reset Emergency Stop and start compressor. Check for failure of the HAT probe.
Loose Wire Connections	Check all wiring terminals for contact and tightness.
Thermal Overload Relay Tripped	Correct cause of overload condition, reset overload relay and press start button.
Contactor Not Engaging	Check control wire connections. Check for power to contactor coil. Check signal wires from contactor auxiliary contacts.

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Probable Causes:	Corrective Action:
Unscheduled Shutdown:	
Power Failure	Check power supply & power supply cables.
Discharge RTD Faulty or Disconnected Sump RTD Faulty or Disconnected	Check wire connections. If RTD performance is questionable, contact an Authorized Quincy Service technician.
Line Pressure Sensor Faulty Sump Pressure Sensor Faulty	Check wire connection of pressure sensor(s). Replace sensor(s).
Loose Wire Connections	Check all wire connections for tightness.
Motor Overload	Correct the cause of the overload condition, reset the overload relay.
Low Air Delivery:	
Lift Valves Not Closing	Contact an Authorized Quincy Service technician to check operation of lift valves and control solenoids.
Low Receiver Pressure:	
Excessive Demand - Exceeds Supply	Add additional compressors as needed.
Faulty Receiver Pressure Transducer	Contact an Authorized Quincy Service Technician.
High Discharge Air Temperature:	
Excessive Ambient Temperatures	Maximum ambient temperature is listed in QSI-i Instruction Manual - Appendix B. Ventilate room or relocate compressor.
Incorrect RTD Reading	Contact an Authorized Quincy Service Technician.
Excessive Fluid Consumption:	
	Read 'Fluid Carryover' on pages 22-23 of this manual.

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Probable Causes:	Corrective Action:
Fluid Coming Out Through the Blowdown Valve:	
	Read 'Fluid Carryover' on pages 22-23 of this manual.
Compressor Does Not Unload When There Is No Air Demand:	
Lift Valves Do Not Open	Check lift valve solenoids for proper operation. Check for air pressure to lift valve solenoid bank. Check for proper piping configuration to lift valves from solenoids.
Solenoid Valve Faulty	Repair or replace as necessary.
Communication between Power$ync controller and Solenoids Disrupted	Check wire connection and correct wiring.
Compressor does not Revert to Load when Service Line Pressure Drops to Low Limit of Modulation Range:	
Control Solenoid Valve Not Functioning	Check wires and connections to solenoid valve. Correct wiring and test solenoid. Replace if necessary.
Lift Valves Not Closing	Check air pressure from solenoid to lift valve. Check for proper piping configuration.
Lift Valve Solenoid Not Operating	Replace or repair solenoid as necessary. Check wire connections between controller and solenoid bank.

Probable Causes:	Corrective Action:
Network Communication Erratic or Non-Existent:	
Wrong Communication Cable	Must be Quincy part number #146780-*** Cable. Refer to 'Network Installation' on pages 8-9 for proper installation.
Communication Cable Connected Incorrectly	Refer to 'Network Installation' on pages 8-9 for proper installation.
Damage to the Communication Cable	Check for breaks or worn spots. Install new cable as required.
Machine ID Letters Are Not Correct	Correct machine ID letters - Reference Network Operational rules on pages 24-25.
Unit Not In Network Mode of Operation	Set all units to operate in network mode - Reference Mode of Operation menu on page 14.
Conflicting Instructions in the Sequence or Schedule	Check scheduling and sequence on each machine. Correct sequence and schedule data on machine A.
Cable Run Exceeds Maximum Distance	The maximum cable length between compressors in the network is 330 feet (100 meters). Reference Installation instructions on page 8.
Erroneous Displays:	
Low Incoming Voltage to the Power Supply	Check voltage from control transformer.
Incorrect Power Supply Adjustment	Contact an Authorized Quincy Service technician.

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- ♦ Introduction
- ♦ Functionality
- ♦ Setup
- ♦ Limitations

Introduction

The Power$ync Gateway controller is a dependent system controller that allows for inter-network operation between the current QSI-i generation of Power$ync compressors and legacy QSI Power$ync compressors.

Power$ync Gateway is a network translator which allows the PLC's and microprocessors to transverse each others communications protocol and allow for passage of network parameters.

Bandwidth limitations cause the Gateway to pass the bare minimum of information between the networks. Limiting the parameters that are passed through the gateway ensures the greatest possible compatibility between the networks.

The network bridge PLC establishes a parameter passage through the serial port on the microprocessor board on the old QSI Power$ync and the Profibus network of the new QSI-i Power$ync units.

The Gateway establishes control of the existing QSI Power$ync network based on the sequence of the new QSI-i Power$ync compressors.

From the QSI-i network pointer location, the Gateway allows for specific parameters to be passed from the new QSI-i network to the old QSI network. These parameters are manipulated to achieve the maximum control benefit to allow the compressors to load, unload, and time-out as the situation demands.

Functionality

The network bridge acts as a pathway to allow some of the necessary parameters to be passed from the new network to the DB9 serial port on the older network.

The serial port communicates by a RS232 protocol which is then converted to RS485.

The Power$ync Gateway reads this RS485 on Port 0 and allows for communication to the QSI-i network on Port 1.

DB9 RS232 to Power$ync Serial Cable Connection	
Pin number:	Attached to:
1	1
2	2
3	3
4	4
5	5
6	1
7	7
8	8
9	9

Pins 1 and 6 are jumpered together. All other pins are straight through.

The Gateway takes the current network sequence on the existing QSI network and represents it on the QSI-i network as a phantom compressor, P.

The phantom compressor has all of the states and properties of the entire QSI network of compressors that are active or in sequence.

In order for the QSI network to be available on the QSI-i network, compressor P must be in the sequence.

When P is called in active sequence, the Gateway passes the active parameter targets to the existing (QSI) Power$ync network to enable the currently loaded sequence.

The existing QSI network (compressor P) comes online as called by the sequence till the air demands are satisfied. If more air is needed, the Gateway passes the

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pointer to the right. The Gateway allows the pointer to pass to and from P as a normal compressor in the network. While the pointer is not at P, the Gateway manipulates the information passed to keep the compressors in the proper operation until the pointer allows for permission to modulate the lift valves.

If the pointer is to the left of P in the sequence, the target pressure that the Gateway passes to the compressors in the QSI network are low to allow the compressors to stay at minimum or time out.

If the pointer is to the right of P in the sequence, the target pressure that the Gateway passes is higher to prevent any unnecessary changes in the capacity of the compressors in the QSI network.

The Power$ync Gateway operates in Network Target Pressure mode only; network communication passed in other modes are incomplete and do not function.

No other operation modes are affected by the Gateway. Other operational modes are still available, but the networks will not share any data between the systems if set to operate in any other mode. Individual compressors may be operated in Auto-dual or Continuous Run, if needed, since they are not included in the active sequence in these modes.

Setup

The combined network setup procedure is similar to the original setup of each individual network.

Adding P to the active sequences of the QSI-i network allows the Gateway to be called for in system parameter pass.

The existing QSI network is a typical setup; no added parameters are necessary.

The new QSI-i Power$ync network supersedes the existing QSI Power$ync network and controls the system. The sequence from the new QSI-i network is the master sequence. It controls the actions of P and, thus, the pass of parameters to the existing QSI network.

This creates a system of two independent networks working together for a common goal.

A step by step Power$ync Gateway Network setup example is as follows:

Mount the Power$ync Gateway box in the desired location. It should be within ten feet (serial cable range) of the serial port on the QSI Power$ync controller board on compressor A.

Connect a serial cable into compressor A of the existing QSI network. Connecting to other compressors in the network will not ensure full network functionality.

Assign compressor id's to all compressors in the QSI network starting with A (i.e. if there are three compressors in the network they should be identified as A, B & C, four compressors would be identified as A, B, C & D, etc.).

Connect the Profibus cable to Port 1 of the mounted Gateway box. Do not connect to the serial data port (Port 0) until the proper sequence parameters have been established on the network.

Enter the desired sequences into the new QSI-i Power$ync compressors. Include P in any sequence where operation of the existing QSI network is desired.

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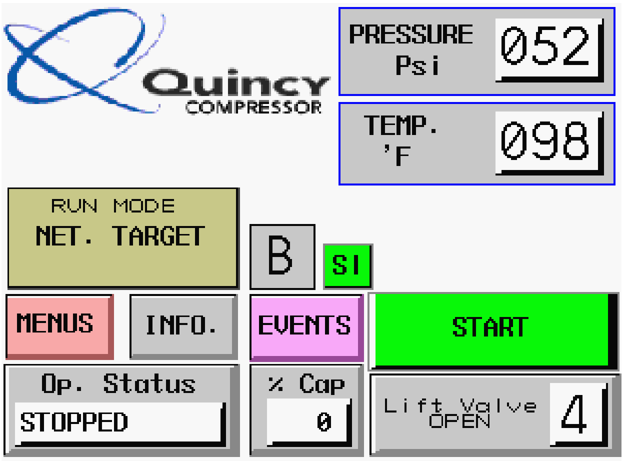
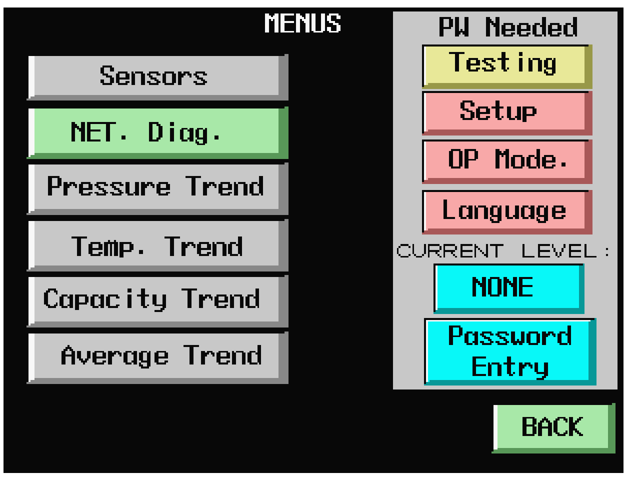
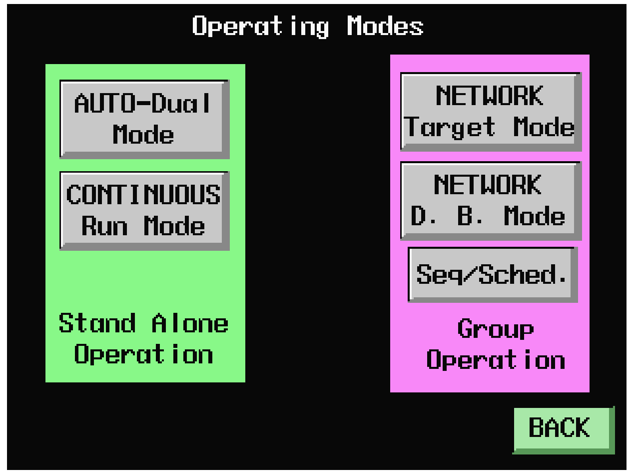
To enter a sequence, press MENUS at the main screen:



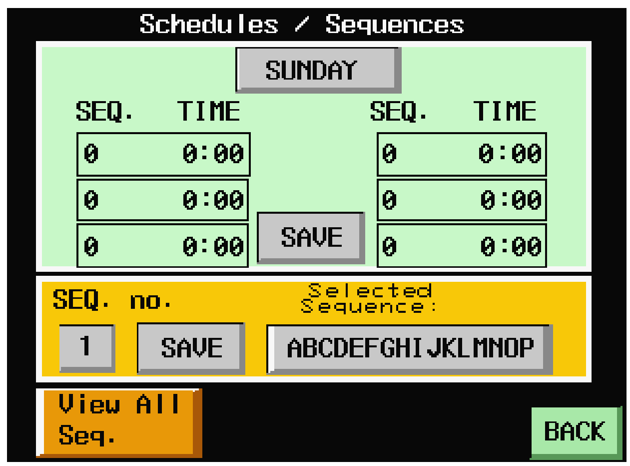


Press Password Entry and enter the user password (777).

Press OP Mode:



Press Seq/Sched. to access the schedules & sequences:



Enter the desired sequences. Reference pages 16-17 for instructions on entering

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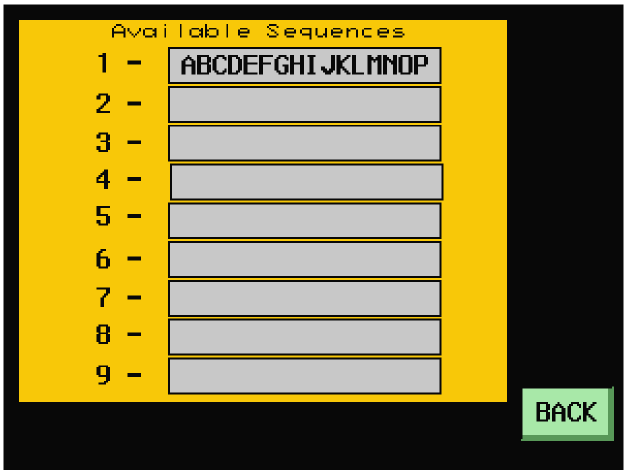
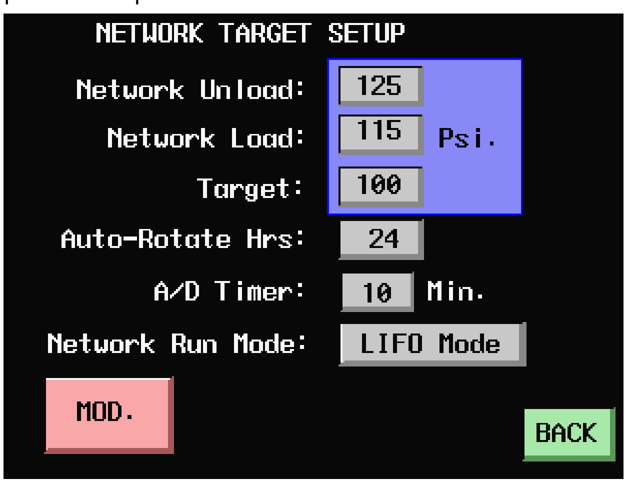
sequences. If the existing Power$ync network is to run, enter compressor P in the sequence. Save the sequence and schedules. Press View All Seq. to review the active sequences:

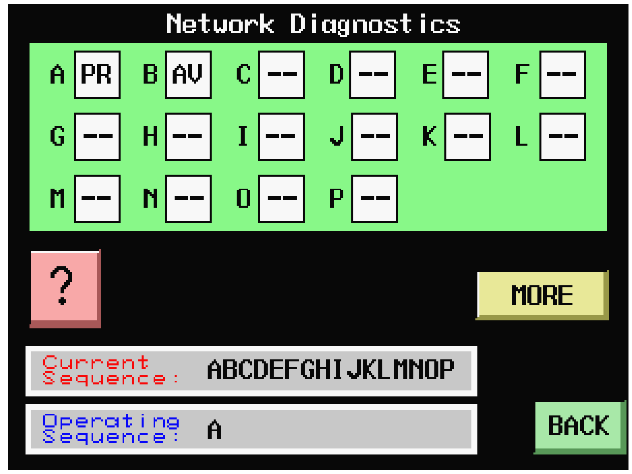


Press back twice to return to the Operating Modes screen and press NETWORK Target Mode to enter the desired network target pressure parameters for the network:

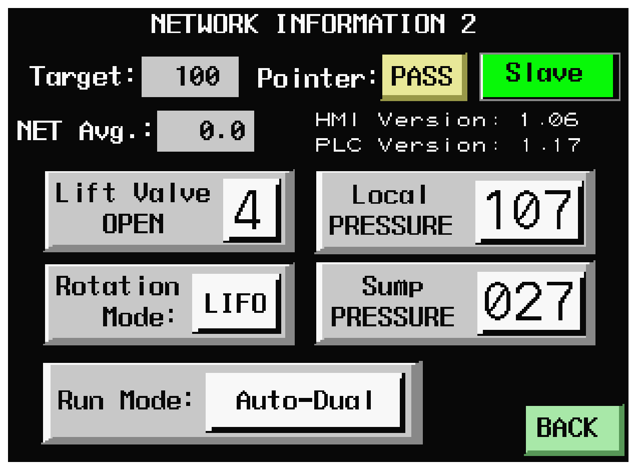


Enter the desired operating parameters for network operation. Remember, these parameters will be passed to the (old) QSI network.

Press back twice to return to the Menus screen and press Net. Diag. to verify the network parameters.



Confirm the current sequence and the operating sequence. Press MORE to verify the network target parameters.



Press BACK three times to return to the main screen.

Once the parameters are entered into the network system, plug the serial cable (from compressor A of the QSI network) into Port 0 on the Power$ync Gateway. Data can now transfer between the networks through the Gateway.

NOTICE!

If this connection is made and P is not in the sequence, the Gateway will send a target pressure of zero to the existing QSI network.

Start all of the compressors currently in the schedules and sequences. The compressors will timeout if not needed.

The networks should now be operating under common pressure mode. With the parameters for the existing QSI compressor network being passed from the new QSI-i compressors. The Gateway pointer and parameterization pass between the networks establishes control and proper operating sequence of the unified network.

Limitations

The Power$ync Gateway software is compatible with Power$ync QSI-i code version 1.16 and higher and QSI code version 1.45 and higher. If the current QSI network has an older version of Power$ync, it will need to be updated to install the Power$ync Gateway.

Communications response through the gateway is not a speedy process. The default baud rate of the Power$ync Gateway serial connection is 2400 baud to ensure the greatest compatibility amongst existing QSI Power$yncs. This is more than 75 times slower than the profibus side of the network communications. The more compressors there are in the existing QSI network, the slower the communication rotations will be.

The Power$ync Gateway operates in a limited function of the network capability; streamlined for Network Target Pressure Mode only. Other compressors in the network can run at different operational modes but there must be at least 1 compressor on the existing QSI network in network target mode to allow compressor P to show up in the active sequence on the new QSI-i network.

Compressor A of the QSI network must be under power at all times for the network communications to function properly. If power is removed from that compressor, the networks will not be able to communicate. Compressor A does not have to be running, or in network target mode, but it must be under power and connected to the network for the communications to work.

The importance of compressor placement in relation to airflow and pressure dynamics is magnified by the network bridge. For example: If compressors are installed in separate parts of a plant air system network, with one bank being closer to the main pressure reservoir than the other, pressure readings taken from the closer bank of compressors will be different than those at the compressors further down the line. The pressure drop and loss in pressure response will be greater the more pipe differential between the compressor banks. If any of this pressure loss transverses the gateway the differential effect may be magnified.

Normally, the data gap between compressor installations is averaged over all online and active compressors in the network which dilutes the pressure gap over the entire system.

However, due to the communications process of the Power$ync Gateway system, using the Gateway has a greater influence on pressure fluxuation.

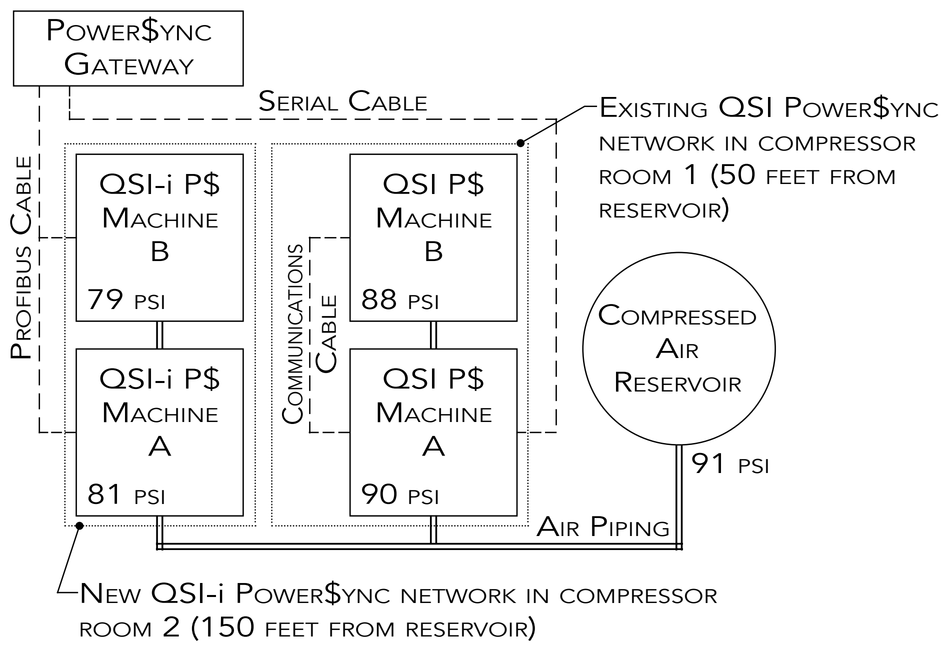
The Gateway works under the assumption that compressor P is one compressor, despite P representing a network of existing QSI compressors. This alters the resulting pressure calculations somewhat in terms of portraying accurate pressures used to determine pointer pass parameters.

Another problem is that the average pressure calculation only takes active compressors pressure readings into account. This causes a gap if the QSI-i and QSI compressors are at different pressures. The pointer pass parameters will cause issues that will need to be taken into account during system setup.

The primary goal of the entire system and each network is to maintain the desired target pressure. Carefully planned sequences can reduce unnecessary operation and increase system response on the network. The following paragraphs give examples of things to consider when using the Power$ync Gateway to connect a new QSI-i network to an existing QSI network.

The following examples will consider several setups and the pressure responses to each situation. In each setup, target air pressure will be achieved by the system, but some arrangements will cause unnecessary wear and tear on the compressors.

In the example system below, we assume a pressure drop similar to a typical setup. This example shows an existing QSI network of compressors and a recently installed QSI-i network of compressors attached to the same plant air reservoir and communicating through the Power$ync Gateway.



Notice the pressure drop across the units in relation to their location to the reservoir. The existing QSI Power$ync units are closer to the reservoir and thus have less of a pressure drop than the new QSI-i Power$ync units.

An examination of the parameter pass practice will show the best way to set up the system for efficient operation.

Assume the system is set up to follow sequence APB, with P representing the QSI

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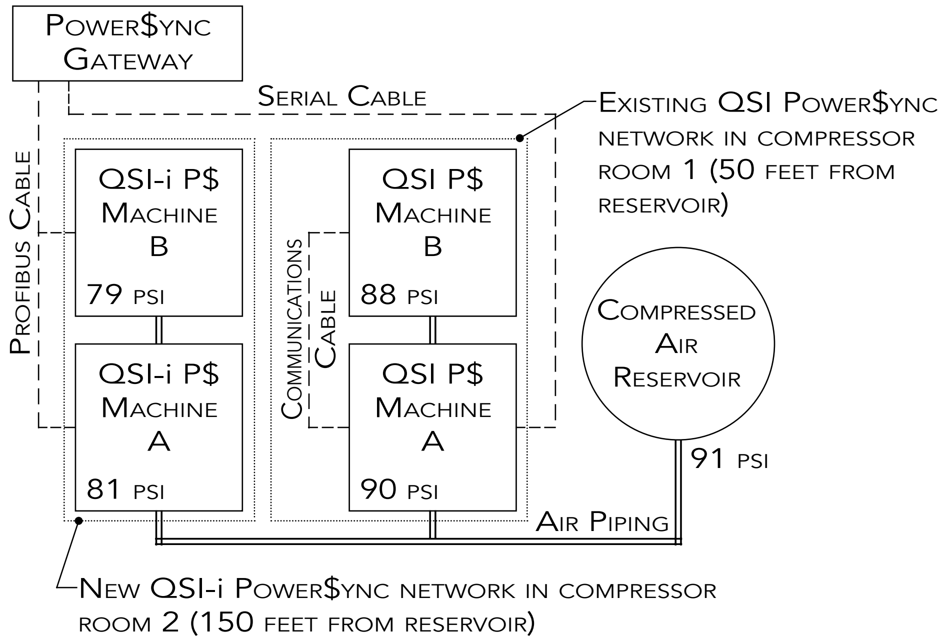

sequence AB (making the actual sequence A<AB>B), and that the system has a target pressure of 88 PSI.

Starting the sequence, A has the pointer and passes it to P once A has reached capacity.

The pointer pass parameter is controlled by the compressor with the pointer, so A passes the pointer to P. Since the pressure of P is greater than the target pressure, compressor P times out and passes the pointer back to A.

The problem created by this scenario is that the pointer will keep being passed back and forth between A and P, causing the compressors represented by P to keep unloading and timing out. This results in unnecessary wear on the compressors while the overall air demand on the system stays the same.

One solution is to use P as a baseload compressor (sequence PAB, i.e. <AB>AB). Since P is closer to the reservoir, it will have a more accurate target pressure. This

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sequence will also prevent the unnecessary pass of the pointer since the more accurate compressors are at the forefront of the system. However, this sequence fails to evenly rotate the compressors and will cause an additional load on the existing compressors.

A better solution would be to use sequence PAB, with A and B set to auto rotate. This setup will allow the compressors to achieve the desired air capacity and prevent unnecessary passing of the pointer back and forth in the system. P provides the bulk of the air needed to meet the demand, but if it cannot meet the demand, the gateway will pass the pointer to the next compressor. This compressor will probably exceed the necessary air demand of the system, but it will reserve bringing any additional compressors onto the network until it is necessary. Scaling back the sequence represented by P allows for the compressors to even the load out over the network.

If the desire is to utilize the newer QSI-i compressors, sequence ABP provides for A and B to be on equal footing for pointer pass transactions and only calls on compressor P if it is needed to maintain pressure.

The compressors further away from the reservoir will probably achieve a greater target pressure at the reservoir than necessary, but compressor P is called less frequently than in the original example of APB, preventing the loading, unloading and timing out cycle of APB.

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