Installation & Operation Manual

ESC 201 Electronic Module
JETKOOL Oil Cooling System

Copeland Screw Compressors
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1.0 Functions

1. Compressor Direct on Line Start Initialization
2. Compressor Part Winding Start Initialization
3. Compressor Sequencing Control
4. Compressor Rotation Control and Alarm
5. Compressor Short Cycle Prevention
6. Compressor Loader Start Delay
7. Compressor Direct on Line Run Proof
8. Compressor Inverter Run Proof
9. Discharge Temperature Control and Alarm
10. Motor Overload Control and Alarm
11. Oil Solenoid Control
12. Economizer Control
13. Oil Safety Control with Auto Reset and Alarm
14. Motor Phase Loss Protection
15. Oil Separator Level Control and Alarm
16. Dirty Oil Filter Alarm
17. Jet Kool Operation and Control
18. Critical Discharge Temperature Monitoring and Control
19. Liquid Injection Control
20. Low Discharge Temperature Monitoring and Control
21. Welded Contactor Protection
22. Alarm Logging with Retrieval
23. Echelon Communications Capability
24. RS-485 Communications Capability
25. Direct Compressor Operation via Com. Port

2.0 Features

1. Display Screen – 4 line, 20 Characters per Line
2. Programmable Functions and Alarms
3. Four Button Control
4. Language Selection; English, German, French, Italian, Portuguese, Spanish
5. Flashing Alarm Screens with Priority Levels
6. Input and Output Plug Terminals
7. One Amp Fuse Protection on 20VAC Power
8. 5 Amp Fuse Protection on Control Power
9. Horizontal or Vertical Mounting
10. Control Reset Button
11. Remote Control Reset
12. Automatic Configuration of Control and Power Voltages
13. Snap Track Mounting
14. L.E.D. Operational and Communication Lights
3.0 ESC 201 Description

The ESC 201 control is an upgraded version of the ESC 200 with added features and functions to further enhance and protect the Copeland screw compressor. The ESC 201 controls all compressor safety and operation functions through the use of a microprocessor and various types of sensors.

The control will interface with either mechanical or electronic pressure controlled systems. Safety functions requiring a compressor shutdown can be reset with a built-in reset button through the Echelon network or via a remote reset activated by an electronic pressure controller. Compressor alarms can be logged to an electronic pressure controller through the Echelon or 485 networks. A general alarm output is provided to activate a panel light, auxiliary alarm or relay. Internal permanent logging is provided on several functions to record a permanent record on critical functions. This log can be used to assist in troubleshooting or determining warranty. Log functions will record date, time of occurrence and cannot be erased except by the factory.

The ESC 201 will operate Copeland’s Screw compressors by several different starting methods, such as: frequency drives, direct on line and part winding start. Compressor starting, stopping and capacity control operations can be controlled directly from the electronic pressure controller or across the Echelon or 485 network without a controller output point.

Most compressor control functions are compressor model specific requiring configuration via the software by using the program buttons. Once the compressor has been selected, the applicable functions can be established as either manual or automatic reset. Certain functions are locked to specific compressor models and cannot be accessed through the software. Critical compressor functions will alarm and shut down the compressor causing a manual lockout or automatic reset sequence. If the alarm causes the maximum automatic resets, the compressor will be locked out requiring a manual reset. Non-critical alarm functions will generate an alarm notice allowing the compressor to remain operational.

A four line twenty character per line LCD screen displays compressor operational and control information, as well as, compressor notices and alarms. These screen functions can be displayed in six languages: English, German, Italian, Portuguese, Spanish and French. All control functions are programmed with four buttons located under the display screen.

Any ESC 201 can be selected as a master control through programming. The master control is used to perform all communications from the slave controls and/or the Echelon network. Master units are the only controls allowed to operate the Jet Kool function and configure the slave controls for their initial setup. The Master ESC 201 can become Echelon compatible by plugging in the “E” hardware into the master control board.

Snap track mounting provides easy mounting in the control panel. All low and control voltage connections are performed with plug-in connectors for easy installation. A button memory chip is utilized to retain control setting for each control.

4.0 General Operations

The compressor start sequence will be initiated when the ESC 201 receives a valid voltage input signal at (C1). The compressor output relays (C5, C6) will close and allow the compressor to start after all static input functions have been checked to be within acceptable
tolerances and all time delays have elapsed. Within the first 2 seconds of operation the ESC 201 will monitor for a valid phase sequence, rotation and run proof signal. If any of these functions do not return a valid signal the compressor will shut down and lockout requiring a manual reset. Once these valid signals are returned to the ESC, the oil solenoid will be energized within 2 seconds after start. After a 7 second delay from start the ESC will energize the loaders as required by the system controller in their proper sequence.

After the compressor is operational for more than 7 seconds the ESC will continue to monitor all safety functions until the next proper shutdown or alarm function occurs. The monitored safety functions consist of: Rotation, Run proof, Phase, Oil Flow, Oil Level, Motor Overload, and Discharge Temperature. Any alarm in these areas will cause a compressor shut down in the manual mode and/or automatic mode.

4.1 Manual Mode Operation
When operating in the manual operation mode any compressor shut down function will alarm and leave the compressor in a shut down state until the manual reset button is depressed. The manual reset can also be accomplished via the remote reset option. Rotation and run proof function are a mandatory manual mode operation. Oil flow, discharge temperature, motor overload, oil level, and phase monitoring can be set up in either manual or automatic mode.

4.2 Automatic Mode Operation
Automatic mode allows the compressor to be restarted automatically by the ESC with the strategy programmed for the individual function. Each functions automatic reset strategy will be described in the section of the manual pertaining to that function. Functions, which are allowed operation with the automatic resets are: oil flow, discharge temperature, motor overload, phase monitoring and oil level control.

5.0 ESC 201 Installation and Setup Procedures
Proper installation of the ESC 201 and setup of compressor parameters requires adhering to the following procedures. Programming of each compressor and the function parameter will change depending upon the compressor model and type. A default list of parameter can be found in section 5.4

5.1 ESC 201 Mounting procedures
The ESC 201 is provided with plastic snap track mounting. This snap track should be attached to the electrical back panel with tech screws or another type of fastener, which will provide secure mounting for the control.

Ample space must be provided around the control for safety and accessibility purposes to accommodate the removal of any wire, terminal plug or fuse and not hamper access to the manual reset button.

The ESC is provided with a UL required ground wire attached to the ESC electronic circuit board. All input functions reference a ground through terminals A7 and B7. This ground wire is the only ground source for the control and must be attached to the electrical back panel to insure proper operation of the ESC 201.
5.2 Electrical Wiring

Three Phase Wiring

Three-phase power is required from the load side of the compressor contactor or the compressor motor terminals, to the three phase connectors located on the right side of the ESC 201. **DO NOT CONNECT FROM THE LINE SIDE OF THE CONTACTOR.** This will cause a **WIRING FAULT ALARM** and prevent the ESC 201 from starting the compressor. This power must be supplied from the load side of the contactor to assure proper electrical protection to the system.

Shielded Cable Requirements

Located on the left side of board is a terminal plug with two terminals marked AC. These terminals are the connection points for the 20VAC transformer power. Also located on this plug are the two communication ports market (1+1-) and (2+2-). Shielded cable must be used to connect both the power and the communication ports. It is also recommended all input function wiring should utilize shielded cable from the input device to the ESC terminal point. Terminal points which require shielded cable are, terminals A1-A8, B1 to all other points may be wired using 16-gauge wire.

All shielded cable must be grounded at one end of the cable to the same source as the ESC ground. Shielded cable will provide protection against any possible electrical noise transmission across the input or network wiring to the ESC 201.

Communication Wiring

The ESC 201 is equipped with two communication ports (Comm.1 & Comm.2). These ports must be wired with shielded cable, one end of the shield connected to ground, to reduce to possibility of noise transmission across the networks. The ESC 201 has an optional alarm board. If used it must be wired with shielded cable and grounded. The master and slave boards are connected across the N2 network using the Comm.2 ports. In any prescribed group, a single master may be connected up to 11 slaves. More than one master can be used on a system where special control requirements exist.

Wiring Multiple Groups of Master and Slaves

When multiple master-slaves combinations are required the slaves must be daisy chain wired to the master on the Comm. 2 (N2) network as a group and isolated from other groups. The Comm. 2 network is utilized to communicate control information from the slaves to the master. Alarm boards are also daisy chain wired on the Comm. 2 network within the group. Alarm information is transmitted on the Comm. 2 network from the ESC 201 to its corresponding alarm board. *(Refer to section on alarm boards for detailed information on the operation of the alarm boards.)*

Communications back to the rack controller will be accomplished via the Comm.1 network. All ESC 201 controls must also be daisy chain wired on the Comm. 1 network back to the rack controller. When the Echelon network is enabled, the communication link will be accomplished by daisy chain wiring all the master controls, containing the Echelon Module, back to the Echelon terminal on the rack controller.

NOTE: See wiring diagrams located in the EXT/ECH ID Function section of this manual.
Terminating Jumpers

The ESC 201 is equipped with Comm. 1 and Comm. 2 terminating jumpers. These jumpers are located in the lower left corner on the board directly below the Comm. port terminal block. The Comm. 1 jumper must be placed across jumper pins (J5) on the last master control in the network. Example: When more than one master control is configured in a rack system, all the Comm. 1 ports on the master controls must be networked together with a signal shielded cable back to the rack controller. The last master control in the network must have the jumper in place on (J5). Comm. 2 (N2) network terminating jumper (J6) is located below the Comm. 1 jumper terminal (J5). This jumper should be place across this terminal on the last board in the Comm.2 network. This includes all ESC 201 and alarm boards connected on the Comm. 2 network.

Communications Protocol

Comm. 1 port has been provided to connect the master ESC controls to rack controller or other device capable of accepting 485 communications. An open protocol will be made available on request to allow other equipment suppliers to read the information from the ESC 201 controls.

5.3 Transformer Installation and wiring

Power Requirements

A 24-Volt, non-center tapped, A/C transformer is required to power the ESC 201. The ESC 201 maximum operating current with Jet Kool and Echelon is 760 mA. As a safety factor, a transformer should be selected with a 900 mA rating to operate one board. Multiple ESC 201 boards can be operated from a single transformer designed to handle the total power requirement. A power terminal block is provided on the left side of the ESC board to accommodate the A/C power and the communication wiring. This terminal block has two designated terminals for the 24 volts marked “AC”. **DO NOT CONNECT ANY POWER TO TERMINALS MARKED [1+, 1- OR 2+, 2-].** These are serial communication terminals and damage will occur to the ESC if power is applied to these terminals.

Wiring

Power wiring from the transformer to the ESC 201 must be wired using shielded cable, with one end of the shield grounded to the electrical panel back pan. Please refer to Appendix C for the proper transformer wiring and detailed electrical specifications.

Fuse

24V power is fused on the board with a 3A fuse located directly above the AC power connector.
5.4 ESC 201 Function Programming

The ESC 201 has the capability to operate all Copeland screw compressor functions. These functions must be programmed as applied to each compressor model and type, as well as, the function capability. Illustrated below are the operations to begin the programming mode. Once the programming mode has been initiated, the programmer must scroll through each function and set that function to the proper application for the compressor operation. The setup screen can be accessed from the main screen or the compressor operational screen by pressing any button.

Step #1

1. Press any button for setup screen

Step #2

1. Press SELECT button (4) to pick category
2. Press main (1) to return to main screen

Step #3

1. CONFIG will be flashing
2. Use NEXT button (4) to choose category
3. The chosen category will flash
4. Press the PICK button (1) to access category
5. Press END button (2) returns to last screen

5.5 ESC 201 Screen Displays

Listed below are screen displays, which will appear during the different modes of control operation.

Ready Screen

The ready screen will be displayed when the compressor is in a ready for operation state.

(1) Unit # - displays the assigned unit number as assigned in the comm. 2 network. Unit #1 will always be assigned as a master control.
(2) ESC 201 (X) – displays the model number and version of software that has been loaded into the control. Letters following the model number designates the version of software.
(3) Date – displays the programmed date.
(4) Time – displays the programmed time.
(5) JKV – displays the percentage the Jet Kool valve is open.
(6) JKT – displays the average discharge temperature of all compressors operated by Jet Kool on the comm. 2 network.

NOTE: Items numbers (5) & (6) will only be displayed on the master control. These items will show the current status of these functions, regardless of the master control compressor status.
Compressor Run Screen

Compressor run screen displays the operating status of the compressor during normal operations. The last display line of the master compressor run screen will display the current Jet Kool status. Jet Kool status will not be displayed on a slave control.

(1) Unit # - displays the assigned unit number as assigned in the comm. 2 network. Unit #1 will always be assigned as a master control.
(2) C - displayed when compressor is in operation.
(3) TRT – displays total run time of compressor.
(4) L1 – displayed when loader #1 is energized.
(5) L2 – displayed when loader #2 is energized.
(6) O – displayed when oil solenoid is energized.
(7) E – displayed when economizer solenoid is energized.
(8) CDT – displays compressor discharge temperature when PT1000 type temperature probe has been installed in compressor. Will not display when using PTC probe.
(9) DP – indicates either differential pressure or discharge pressure depending on the following enabled functions.
   1. DP - differential pressure when using analog oil flow switch and both discharge and suction transducers are connected to the ESC 201.
   2. DP - discharge pressure for all other operations when discharge transducer is connected to ESC 201.
(10) JKV – displays the percentage the Jet Kool valve is open.
(11) JKT – displays the average discharge temperature of all compressors operated by Jet Kool on the comm. 2 network.

Alarm Screen

When a compressor alarm has been generated the flowing type of display screen will replace the compressor run screen. The actual compressor alarm generated will be a flashing display on the screen. This alarm will remain displayed until the alarm has been cancelled by an ESC 201 reset function or by depressing the reset button.

Example #1

<table>
<thead>
<tr>
<th>CDT 210 F (1)</th>
<th>JKV (3) 100%</th>
<th>JKT (4) 180.0F</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Discharge Temperature (2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example #2

<table>
<thead>
<tr>
<th>Low Oil Flow (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JKV (3) 100%</td>
</tr>
<tr>
<td>JKT (4) 180.0F</td>
</tr>
</tbody>
</table>
The following are ESC 201 functions that require programming:

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>INITIAL DEFAULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Compressor Type</td>
<td>SHL 1-7500</td>
</tr>
<tr>
<td>2. Oil Cooling Mode</td>
<td>None</td>
</tr>
<tr>
<td>3. Jet Kool Target Temperature</td>
<td>180°F</td>
</tr>
<tr>
<td>4. Discharge Temperature Reset</td>
<td>Automatic</td>
</tr>
<tr>
<td>5. Motor Overload Reset</td>
<td>Automatic</td>
</tr>
<tr>
<td>6. Oil Flow Reset</td>
<td>Automatic</td>
</tr>
<tr>
<td>7. Oil Flow Sensor</td>
<td>Digital</td>
</tr>
<tr>
<td>8. Phase Protection Reset</td>
<td>Automatic</td>
</tr>
<tr>
<td>9. Pressure Transducer Type</td>
<td>Eclipse 500</td>
</tr>
<tr>
<td>10. Discharge Pressure Offset</td>
<td>Master Only</td>
</tr>
<tr>
<td>11. Suction Pressure Offset</td>
<td>Master Only</td>
</tr>
<tr>
<td>12. Discharge \ Suction Pressure</td>
<td>Read Only</td>
</tr>
<tr>
<td>13. Motor Overload Monitor</td>
<td>Enable</td>
</tr>
<tr>
<td>14. Phase Monitor</td>
<td>Enable</td>
</tr>
<tr>
<td>15. Critical Discharge Monitor</td>
<td>Enable</td>
</tr>
<tr>
<td>16. 7 Minute Time delay</td>
<td>Enable</td>
</tr>
<tr>
<td>17. Compressor Start Delay</td>
<td>0 Seconds</td>
</tr>
<tr>
<td>18. Temperature probe Type</td>
<td>PT1000</td>
</tr>
<tr>
<td>19. Discharge Temperature Offset</td>
<td>0</td>
</tr>
<tr>
<td>20. Refrigerant Type</td>
<td>None</td>
</tr>
<tr>
<td>21. Screen Contrast</td>
<td>7 Bars</td>
</tr>
<tr>
<td>22. Date &amp; Time</td>
<td>Current</td>
</tr>
<tr>
<td>23. Power Frequency</td>
<td>60 Hz</td>
</tr>
<tr>
<td>24. Jet Kool Temperature Source</td>
<td>Compressors</td>
</tr>
<tr>
<td>25. Language</td>
<td>English</td>
</tr>
<tr>
<td>26. Slaves on Line</td>
<td>Master Only</td>
</tr>
<tr>
<td>27. I.D. Network</td>
<td>1</td>
</tr>
<tr>
<td>28. EXT / ECH ID</td>
<td>1</td>
</tr>
<tr>
<td>29. N2 Network Mode</td>
<td>Slave</td>
</tr>
<tr>
<td>30. Control By:</td>
<td>Local</td>
</tr>
<tr>
<td>31. Alarms Boards</td>
<td>Disabled</td>
</tr>
<tr>
<td>32. Echelon</td>
<td>Disabled</td>
</tr>
<tr>
<td>33. Temperature</td>
<td>Fahrenheit</td>
</tr>
<tr>
<td>34. Pressure</td>
<td>PSI</td>
</tr>
<tr>
<td>35. Flow Rate</td>
<td>Gallons/Min</td>
</tr>
<tr>
<td>36. Date Format</td>
<td>Month/Day</td>
</tr>
</tbody>
</table>

Each of these functions will be covered in detail throughout the manual. Configuration setup mode allows the programmer to scroll through each of the 29 functions for configuration. The setup screen contains 3 shortcuts, allowing the programmer to directly access the network, time & date and language screens. These three modes will require more programming accessibility than the other 24 functions, eliminating a lengthy scroll process.
6.0 Frequency Inverter Operation

The compressor start sequence will be initiated when the ESC 201 receives a valid voltage input signal at (C1). The compressor output relay (C5) will close the inverter forward run relay, initiating the inverter start sequence and allowing the compressor to start. **NOTE: If a time delay can be programmed between the time the inverter receives a forward run signal and voltage output to the compressor, this delay must be set to zero seconds.** All static input functions must be verified as acceptable for the compressor to remain operational.

Inverter operation is determined automatically when the ESC senses a closure of the inverter run proof at (A4). A 5 VDC signal is sent from the ESC to a dry set of inverter run proof contacts provided by the inverter or a dry set of relay contacts operated by a voltage output from the inverter. The closure of either of these contacts will return a 5 VDC signal to the ESC indicating to the ESC it will be operating in the inverter mode. **NOTE: DO NOT APPLY A VOLTAGE SIGNAL ABOVE 5VDC TO TERMINAL (A4).**

The compressor signal (C5) will remain energized to the inverter forward run relay while run proof is being verified, permitting the inverter to reset automatically in the event of a fault. If the run proof is not verified during the first 5 seconds of start, the alarm will be issued displaying **“Run Proof Failure”** on the display. Functional operations such as: oil solenoid, loader solenoids and economizer solenoid will remain inactive until the run proof is verified. The compressor will remain operational for an additional 5 seconds waiting for the run proof to be verified. Once the 10 seconds has elapsed without a run proof or being switched into the by-pass mode, the compressor will be shut down requiring a manual restart.

If the inverter faults and the compressor is placed in the by-pass mode, the (direct on line) run proof will be indicated by the closure of the auxiliary contacts on the (direct on line) contactor. During this operation the ESC will perform the required phase operations previously performed by the inverter.

**NOTE:** If both DOL and inverter run proofs are closed together, the compressor will be shut down immediately, and a **“Dual Run Proof”** alarm will be displayed.

6.1 Inverter Fault Operation

Most inverters can be programmed to recognize faults, clear faults and perform automatic restarts, if the fault can be cleared. To prevent the ESC from locking out the compressor during inverter fault retries, the **INVERTER FAULT SCHEME** must be wired into the control circuit. This scheme consists of a N/C relay (IFR) in series with the control voltage signal input to (C4). The (IFR) relay coil is energized by the inverter fault output each time the inverter faults. When the inverter faults the (IFR) N/C contacts open, removing the voltage signal from (C4), placing the ESC 201 in the ready mode. Additional set of N/O contacts can be utilized on the IFR to place the inverter compressor into by-pass when IFR coil is energized. Example of this scheme is illustrated below.
7.0 Direct-on-Line Operation (DOL)

Compressors operated direct on line rely upon two voltage signals to determine this method of operation. A 115V run proof signal supplied to (C4) and the three-phase voltage signal supplied to right side of the ESC 201, labeled L1 {A}, L2 {B} and L3 {C}.

Two seconds after start, rotation will be verified allowing the oil solenoid to activate. Within this time all operational functions will commence in sequence. Five seconds after all functions have been verified as operational, the loaders will energize and the compressor will remain operational. If the run proof is not verified within 5 seconds from start, the compressor will be shut down and a "Run Proof Failure" alarm will be displayed. If the run proof is lost during operation the oil solenoid and loaders will be turned off immediately. After a five second delay the compressor will be shut down, unless the run proof has been reestablished, at which time the oil solenoid and loaders will be reactivated.

See Appendix A “Direct on Line”

NOTE: If both DOL and inverter run proofs are closed together, the compressor will be shut down immediately, and a “Dual Run Proof” alarm will be displayed.
8.0 Part Winding Start Operation

The ESC 201 has been designed to perform the part winding start operation with a primary start winding output (C5) and a secondary winding output (C6). The secondary winding output will energize ½ second after the primary winding output. Voltage monitoring for phase loss and phase symmetry will be accomplished from the primary start contactor.

Run proof verification must be accomplished with N/O auxiliary contacts on the primary and secondary contactors. These auxiliary contacts must be wired in series to terminal (C4). NOTE: Refer to section on “(DOL) Run Proof” for proper wiring procedures.

Two seconds after start, rotation will be verified allowing the oil solenoid to activate. Within this time all operational functions will commence in sequence. Five seconds after all functions have been verified as operational, the loaders will energize and the compressor will remain operational.

If the run proof is not verified within 5 seconds from start, the compressor will be shut down and a “Run Proof Failure” alarm will be displayed. If the run proof is lost during operation the oil solenoid and loaders will be turned off immediately. After a five second delay the compressor will be shut down, unless the run proof has been reestablished, at which time the oil solenoid and loaders will be reactivated.

See Appendix A “Part Winding Start”

9.0 Inverter Run Proof

When a frequency inverter operates a compressor, the inverter (due to time delays) must supply the run proof signal and other software configurations. The inverter is configured with a dry set of N/O contacts, which are used to return a 5 VDC signal back to the ESC 201 telling the ESC the compressor is operational. If these contacts are utilized by another device requiring a high voltage signal such as 110V or 230V, an isolation relay can be used with the same coil voltage. This relay can be used as the run proof to supply a signal back to the ESC 201.

Run proof set up is sensed automatically when the inverter run proof contacts closes the circuit to (A4) for inverter operation or the compressor contactor auxiliary closes the circuit to (C4) for direct on line operation. If the ESC 201 senses a closure at both (A4) and (C4) simultaneously the ESC is designed to fail and alarm “Dual Run Proofs”, locking out the compressor. All operational functions, such as oil solenoid and loaders; will remain inactive until a run proof is verified. If the run proof is not verified within 5 second from start, the ESC will alarm “Run Proof Failure” at the end of an additional 5 seconds. The run proof has not been confirmed the compressor will be shut down requiring a manual reset.

Depending upon the OEM and their methods of controlling inverter compressors, a by-pass scheme may be implemented before the compressor is locked out on the run proof alarm. A method of wiring an automatic by-pass can be found in section 6.1 “ Inverter Fault Scheme”. By pass run proof operation is discussed in section 9.1 “Direct On Line” run proof.

See Appendix A “Inverter”
9.1 Direct On Line (DOL) / By Pass Run Proof

Direct On Line run proof will automatically be configured when the compressor is started. If a DOL run proof is required, a voltage signal will appear at terminal C4, indicating a DOL run proof is required. This method of run proof sensing is utilized when compressors are operated direct on line or a by pass is required with an inverter compressor. A high voltage signal (110V or 230V) must be supplied from L1 through a compressor contactor auxiliary closure to (C4). A valid run proof signal must be verified before the ESC will activate the oil solenoid. After 5 seconds the ESC 201 will display the Alarm “Run Proof Failure” and at the end of 10 seconds the compressor will be shut down requiring a manual reset, if the run proof has not been confirmed. If the ESC 201 senses a closure at both (A4) and (C4) simultaneously, the ESC is designed to fail and alarm “Dual Run Proofs”, locking out the compressor.

See Appendix A “Part Winding Start”

10.0 Operational Functions

Operational functions consist of devices, which operate valves, and devices that are required to start and run the screw compressor. These devices incorporate the oil solenoid, loader solenoids, economizer solenoid, rotation switch, and oil level control. These devices do not require any configuration or programming. The operations for these devices are factory preset and cannot be altered.

10.1 Oil Solenoid Operation

The oil solenoid output relay (C9) will energize 2 seconds after the compressor start sequence has been initiated, allowing oil to flow to the compressor. During the 2 second-time interval, if either the rotation or run proof has not returned a signal to the ESC 201 the compressor will shut down requiring a manual reset. Any time the compressor stops, either normally or due to a fault the oil solenoid will close, preventing oil from flooding the compressor. The 2 second oil solenoid delay will also provide reduced loading during part-winding-start operation.

It is recommended that a solenoid coil light be mounted in the coil and wired in parallel indicating power has been applied to the solenoid coil. This provides the service technician visual proof the solenoid has been energized.

10.2 Capacity Control / Start Unloading

After the compressor start sequence has been initiated for a period of 5 seconds, the capacity control regulators [CR] will activate in accordance with the program prescribed by the ESC 201. These capacity control regulators are referred to as loaders, since they must be electrically energized to load the compressor. The electronic rack controller will perform the operation of controlling the loaders for the purpose of capacity control. The function of the ESC 201 is insure the loaders remain de-energized during start conditions and their sequence of operation conforms to Copeland’s prescribed operation. By insuring these capacity regulators remain de-energizer during start they will also perform the function of start unloading to assist in the part-winding-start operation.

The prescribed operation sequence for each model compressor is listed below.
“SHM2 & SHL2” Unloading sequence Loading sequence
“SHM1-5000 /6000”
“SHL1-4000 / 5000”
Step #1 CR1 de-energize (C7) CR2 energize
Step #2 CR2 de-energize (C8) CR1 energize

“All Others” Unloading sequence Loading sequence
Step #1 CR2 de-energize (C8) CR1 energize
Step #2 CR1 de-energize (C7) CR2 energize

Note: For the proper loader identification by model, refer to Appendix “B” in the rear of this manual.

When the loaders are wired in the correct sequence from the ESC 201 to the compressor capacity control regulator solenoid, the ESC will operate these solenoids in the proper order regardless of the input signal sequence from the rack controller. CR1 must be wired from (C7) and CR2 must be wired from (C8). The rack controller will supply a signal to energize either loader #1 (C2) or loader #2 (C3) based on the scheme setup by the rack controller manufacture. Different rack controllers have several types of logic to control capacity, which may conflict with the required sequence Copeland needs to insure a safe and efficient compressor operation. For this reason the ESC 201 will perform the proper loading and unloading sequence regardless of the demands set by the rack controller.

Operating voltage for the capacity control regulators is determined by the voltage input to terminals (C2 & C3). The voltage applied to these terminals will be sent out through terminals (C7 & C8) respectively. The ESC capacity control voltage limitations are from 90 – 250 VAC and 12 - 24 VDC

10.3 Rotation
Rotation determination is accomplished by 2 methods, a pressure switch and phase sequence. Both of these methods when used in conjunction will insure the proper rotation of the compressor. This function is a non-programmable function requiring only the proper installation and wiring of the devices used to determine rotation. Rotation can only be reset manually.

Pressure Switch
Compressor rotation verification is accomplished in two methods, both of which must be verified to continue operating the compressor after the 2 second start sequence. The primary method to detect reverse rotation is a switch mounted on the front of the compressor. This switch senses the pressure in the rotor chamber to determine the proper direction of rotation. The switch will close when the pressure rises above 20 PSI and opens at 10 PSI. The switch becomes an active part of the rotation control scheme after an elapsed starting time of 2 seconds. After this 2 second time delay the ESC will check the status of the switch to determine rotation. If the switch is closed, a 5 VDC signal is sent from terminal (A3) back to (A7), indicating the compressor is operating in the correct direction and allowing the compressor to remain operational. After the 2-second time delay and the ESC determines the switch is open, the compressor will be shut down and the alarm “Rotation Failure” will be displayed on the ESC screen.
Clearing this alarm will require a manual reset. The pressure switch is a high pressure rated switch designed specifically for this application. This switch requires the use of a vibration damper mounted between the compressor and the switch. If this switch or compressor is changed for any reason the old vibration damper can be utilized. Inspect the damper to determine that the internal filter has not been damaged. Do Not use the old vibration damper if is determined to be defective. To determine proper assembly of the rotation switch for each compressor type, refer to appendix B, figures 1 through 4.

**Phase**
The second method to determine rotation is by checking phase sequence. This check is determined with the ESC software utilizing the three phase input signal supplied from the phase terminals. When wired properly the software determines the proper rotation within ½ second from the initial start sequence. If the rotation is incorrect the compressor will be shut down and the ESC will display the alarm “Phase Rotation”. Follow the below listed phase sequence procedures to correct the fault.

**Phase Sequence Procedures**
During initial startup procedure, check for proper phasing of the ESC 201 to insure Phases [A, B, C] from either the compressor terminals or the load side of the contactor to the corresponding [A, B, C] phases on the ESC 201 are correctly wired. If the compressor is determined to be operating in the correct direction, with pressure gauges or visually on the open type compressors, and the “phase rotation” alarm shuts down the compressor, the phase wiring may be incorrect. This wiring correction can be accomplished by changing the position of any two wires on the ESC phase connector. WARNING! Make sure the compressor is operating in the correct direction before any wiring is altered.

**10.4 Economizer Solenoid**
Terminal (C11) is designated as the economizer output. This relay point will energize a solenoid to operate the economizer. The economizer output will energize 2 second after the initial compressor start.

The ESC 201 has an enhanced feature to monitor discharge temperatures on both the high and low extremes, providing the best protection possible to the compressor. The low discharge function may require disabling of the economizer to perform certain diagnostic checks on the system. To accomplish this check and others, it is important the economizer (C11) output be utilized with the compressor.

**10.5 Oil level Control**

**Installation**
The oil separator is fitted with a ¾” –16 UNJF-3A threaded female adapter to accept a male optical well assembly. The well permits the removal of the electronics without the loss of oil or refrigerant. The sensor well should be tightened by hand not to exceed a torque value of 15 ft-lbs.

**Operation**
The switch sends out a light beam that is refracted by the presents of oil. When the oil level falls below the optical sensor, light is no longer refracted opening the electronic contacts in the switch. In normal operation, a 5V DC signal is sent from the ESC 201 to the switch and returned to the ESC indicating a proper level in the oil separator. When the optical switch opens, the ESC 201 reads this signal as a low oil level and shuts down all compressors affected by the low oil function. When the ESC 201 is configured as a master, the oil level
control does not affect the compressor assigned to the master ESC. This compressor is allowed to remain in operation, to perform the oil return function return back to the separator, preventing a total rack shut down. The main oil protection for the compressor connected to the master ESC will be the oil flow switch. The compressor connected to the master ESC can be safely operated, since the oil level below the optical sensor is sufficient to operate one compressor. When the oil level returns to a level sensed by the optical sensor, a time delay of three minutes must occur before any compressors are allowed to restart. This three-minute time delay prevents the short cycling of a compressor due to a possible rapid drop in oil level.

Immediately after the optical level sensor sends a low oil level signal to the ESC 201 the compressors affected by the oil level sensor will shut down and a “Low Oil Level” alarm will be displayed on the ESC screen. The alarm will clear automatically once the oil level returns and the 3-minute time delay elapses.

Wiring

The white, signal wire, from the optical sensor must be wired to terminal (A2) on all ESC 201 controls. Accomplish this by wiring the optical sensor signal wire to the Master ESC 201 terminal (A2) and use a jumper wire to the slave ESC 201 controls. The optical sensor (5VDC) power must be supplied from terminal (B8) on the Master ESC 201. Do Not Jumper together these power supply terminals (B8) from the master to the slave boards. This may cause damage to either the optical sensor or the ESC 201 controls.

Optical Sensor Specifications

<table>
<thead>
<tr>
<th>Voltage</th>
<th>5VDC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current</td>
<td>45mA</td>
</tr>
<tr>
<td>Pressure Range</td>
<td>0-2500 PSI</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-40°F to 212°F</td>
</tr>
<tr>
<td>O-Ring size</td>
<td>#3-908</td>
</tr>
<tr>
<td>Housing Torque</td>
<td>15 ft-lbs Max.</td>
</tr>
</tbody>
</table>

10.6 Dirty Oil Filter

Each compressor is equipped with an oil filter. Located on the filter is a differential pressure switch, which reads the pressure drop across the filter assembly. This switch is set to alarm at 25 PSID. The dirty filter switch has 2 methods to indicate this alarm, a visual indicator located on the top of the switch that changes from green to red and the electrical indicator, which closes a set of contacts making a connection between terminals (A1) and (A7). When the ESC 201 receives this signal, an alarm, “Dirty Oil filter”, will be displayed on the ESC screen. Once the filter has been changed the manual reset button on the ESC must be pushed to clear the alarm.

The dirty oil filter function is not a compressor shut down function, it is only an alarm function.

10.7 Low Economizer Temperature

If the compressor discharge temperature is determined to be less than or equal to 35°F above the condensing temperature for a consecutive period of 30 minutes the ESC 201 will alarm “Low Discharge temperature”. The economizer output terminal (C11) will shutdown the economizer solenoid for a time period of five minutes. At the end of this 5-minute shutdown
the ESC 201 will check the discharge temperature to determine if the discharge temperature has risen to a value of at least 45°F above condensing. If not ESC 201 will permanently shutdown the economizer, requiring a manual reset and display the alarm “LOW ECO TEMP”.

If turning off the economizer solenoid does not raise the discharge temperature above the condensing temperature by 45°F the economizer output (C11) will be energized, placing the ECO back into operation, displaying the alarm, “Low Discharge Temperature”.

When the discharge temperature remains below the condensing temperature by at least 50°F the conditions exist to condense refrigerant at the outlet of the compressor. Low discharge temperature can be attributed in many cases to low super heat at the economizer inlet. The low discharge temperature will cause premature bearing damage resulting in compressor damage. The above function will protect the compressor from bearing damage caused by low super heat conditions at the economizer. When the “Low Discharge Temperature” alarm appears rather than “LOW ECO TEMP”, the low super heat or liquid can be coming from the compressor suction.

11.0 Programmable Operations

Many operational functions require a program change to insure the compressor or function has been configured to perform a specific operation. Follow steps 1 – 3 illustrated in section “5.0 ESC 201 Installation and Setup Procedures” to begin the programming steps for configuration setup.

Selecting Functions

Pick the “Config” category by pressing button #1. The first screen will be the “Compressor Model” screen. If this function selection is not correct, then follow the “Edit Functions” instruction below. If this selection is correct and you want to continue to the next function press the “next button”. This will place you in the “Oil Cooling Mode” selection screen. Each time you press the next button you will scroll forward to the next sequential function, or press the “Prev” button for the previous function. To return to the main menu, press the menu button and then the main button to return back to the Main Screen.

Editing Functions

If the correct function selection is not shown on the screen, then press the edit button and the function selections will begin to flash. Next, press either the (+) or (-) sign buttons to scroll forward or backwards through the function selections until the correct selection appears. When the correct selection is flashing on the screen, press the save button, “Saving” that selection in memory. To continue the programming procedure for other functions press the next button to move forward in the process. To return to the main menu, press the menu button and then the main button to return back to the Main Screen.

11.1 Compressor Type

Compressor choices are listed as follows: SHM2-3000, SHM2-3500, SHM2-4000, SHL2-2000, SHL2-2500, SHL2-3000, SHM1-5000, SHM1-6000, SHL1-4000, SHL1-5000, SHM1-7000, SHM1-8000, SHM1-9000, SHL1-6000, SHL1-7000, and SHL1-7500 in the Semi-Hermetic models. The open drive model numbers are listed as SDM1-0084, SDM1-0100, SDM1-0118, SDL1-0084, SDL1-0100, SDL1-0118, SDM1-0165, SDM1-0192, SDM1-0220, SDL1-0165, SDM1-0192, and SDM1-0220. Mandatory functions for the compressor will be initialized automatically when the compressor is selected. The correct compressor must be selected to insure the proper protection has been setup for that compressor. Items that are...
automatically setup by selecting the compressor type is; motor protection, 7-minute start delay, and analog oil flow requirements. The Factory default for the compressor type is “SHL1-7500”.

**Mode Programming**

Changing the compressor type is accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Compressor Type”, the (+/-) buttons will allow the programmer to scroll and select the required compressor. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

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### 11.2 Oil Cooling Mode

Oil cooling can be accomplished using several different methods. The normal methods consist of Jet Kool, None (Air Cooled, Water Cooled) or Liquid Injection. Factory default for this function is “None”.

**Jet Kool**

When Jet Kool is the method of oil cooling, the ESC control (designated as the master) must be setup in the oil-cooling mode as “Jet Kool”. Changing the oil cooling mode is accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Oil Cooling Mode”, the (+/-) buttons will allow the programmer to scroll and select “Jet Kool” as the oil cooling method. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

Section 11.20 “Jet Kool Temperature Source” explains the function setup procedures for the proper temperature probe. The ESC will read either the “Compressors” or the “Rack Sensor” as the temperature source to operate the Jet Kool control valve. The ESC 201 will display the Jet Kool temperature and the percentage the Jet Kool valve is open. Shown in this paragraph is an illustration of the master ESC operating screen in the Jet Kool Mode. The bottom display line shows the Jet Kool Valve “JKV %” and the Jet Kool Temperature “JKT °F or °C”. The JKT is an average of all compressor discharge temperatures when the ESC 201 is configured for “compressors” as the Jet Kool temperature source, or the discharge header temperature.

<table>
<thead>
<tr>
<th>Unit</th>
<th>C</th>
<th>L1</th>
<th>L2</th>
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<td>TRT</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDT 178.3F</td>
<td>DP 211.3</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JKV</td>
<td>28%</td>
<td>JKT</td>
<td>173.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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(Cx) ESC terminal number  Page 22 of 67  Preliminary Data Subject to change  ESC201C-4-23-02 4/22/02
when it is configured as “**Rack Sensor**”. When this function is configured for “compressors” the average temperature is taken only from the operating compressors. The compressor discharge temperature “CDT” is the temperature read in the discharge of each screw compressor. The only time the “JKT” and the “CDT” will read the same value is when a single compressor is in operation. The preferred method to operate the Jet Kool is using the “compressor” source rather than the “Rack Sensor” source. The “Rack Sensor” has been provided to upgrade or replace the old style Jet Kool controls with a single temperature sensor mounted on the discharge line, and the compressors are fitted with a PTC sensor rather than the PT1000 sensor.

A terminal block located in the upper left corner of the ESC board labeled “Jet Kool” is provided to connect the Jet Kool Valve using #18-2 shielded cable. Shielded cable is also recommended for the temperature sensor wires from the compressors and/or the rack sensor temperature probes. The desired discharge temperature can be set in **11.3 “Jet Kool Target Temperature”**.

**Liquid Injection**

Each ESC 201 has the capability to control the discharge temperature by using a liquid injection valve. This method of oil cooling is limited to a maximum of 10% of the compressor capacity. The target temperature for this function is preset to control the discharge at 190°F (88°C). After accessing the edit screen for “Oil Cooling Mode” the (+-) buttons will allow the programmer to scroll and select “Liquid Injection” as the oil cooling method. The liquid injection valve percentage open “LIV %” will be displayed on the bottom line of the ESC operational screen.

Each ESC 201 will control the liquid injection valve for the connected compressor. A terminal block located in the upper left corner of the ESC board labeled “Jet Kool” is provided to connect the liquid injection valve using #18-2 shielded cable. Shielded cable is also recommended for the temperature sensor wires from the compressors and/or the rack sensor temperature probes.

**None**

The third option for oil cooling is none. After accessing the edit screen for “Oil Cooling Mode” the (+-) buttons will allow the programmer to scroll and select “None” as the oil cooling method. This method is normally selected when either air cooled, water-cooled and no oil cooling is required. In the case of air and water-cooled oil coolers the preferred device is an oil temperature mixing valve to control discharge temperature. Details on these devices can be obtained by contacting the factory.

The last line of ESC display will be blank when the “None” option is selected for oil cooling.

**11.3 Jet Kool Target temperature**

Jet Kool Target Temperature can only be accessed if the Jet Kool oil cooling method has been selected. The target range can be set from 165°F (74°C) to 195°F (90°C). Factory default for this function is “180°F”.

<table>
<thead>
<tr>
<th>Unit</th>
<th>1</th>
<th>C</th>
<th>L1</th>
<th>L2</th>
<th>O</th>
<th>E</th>
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</thead>
<tbody>
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<td>30</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CDT 190.5F</td>
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<td>DP 211.3</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIV</td>
<td>46%</td>
<td></td>
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</tbody>
</table>
Temperature Programming

Changing the Jet Kool target temperature can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Jet Kool Target Temperature”, the (+-) buttons will allow the programmer to scroll and select this temperature between 165°F (74°C) and 195°F (90°C). Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.4 Discharge Temperature Reset

Discharge Temperature Reset allows the programmer to configure this function for either automatic or manual reset. The Manual Mode will shut down and lock out the compressor when the discharge temperature reaches 212°F (100°C), requiring an operator to manually reset the ESC 201, clearing the “High Discharge Temperature Alarm” restarting the compressor. The automatic mode will shut down the compressor when the discharge temperature reaches 212°F (100°C). When the discharge temperature falls below 183°F/84°C the “High Discharge Temperature Alarm”, will be cleared, restarting the compressor. When the compressor is reset automatically, the 7-minute short cycle delay (Section 11.13) will take precedence over the function to prevent compressor short cycling. Factory Default for this function is “Automatic”.

Mode Programming

Changing the discharge temperature reset can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Discharge Temperature Reset”, the (+-) buttons will allow the programmer to scroll and select between automatic and manual. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.5 Motor Overload Reset

Motor Overload Reset allows the programmer to configure this function for either automatic or manual reset. The Manual Mode will shut down and lock out the compressor when the motor thermostors exceed a temperature of 212°F (100°C), requiring an operator to manually reset the ESC 201, clearing the “Motor Overload Alarm”, restarting the compressor. The automatic mode will shut down the compressor when the motor temperature reaches 212°F (100°C), and as the motor temperature falls below the reset point, the “Motor Overload Alarm” will be cleared, restarting the compressor. When the compressor is reset automatically the 7-minute short cycle delay (Section 11.13) will take precedence over the function to prevent compressor short cycling. Factory default for this function is “Automatic”.

Mode Programming

Changing the discharge temperature reset can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Discharge Temperature Reset”, the (+-) buttons will allow the programmer to scroll and select between automatic and manual. Once the selection has been made, pressing the “Save” button will
save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.6 Oil Flow Reset
Oil flow reset permits the programmer to configure this function for either automatic or manual reset. The automatic or manual modes monitor the oil flow rate with either a digital or analog switch. These switches are described in section 7, “Oil Flow Sensors”. The oil flow reset mode is configured at the factory in the “Automatic Mode”.

Automatic Mode
When the reset mode is configured for automatic the compressor will be allowed to automatically restart 3 times, after an oil flow failure, before a manual lockout occurs. 5 – 6 seconds after the oil flow falls below the minimum requirements for safe operation the ESC 201 will shut down the compressor, displaying a “Low Oil Flow Alarm”. If 3 oil flow resets occur within a 10-minute consecutive period the ESC 201 will lock out the compressor, requiring a manual restart. This 10-minute timer is automatically reset back to “0” once an elapsed time of 10-minutes passes without an oil flow failure. During initial starting sequence the compressor will be allowed to operate for 20-seconds to establish the required oil flow. If the proper oil flow has not been established after the elapsed 20-seconds the compressor will be shut down in either the automatic or manual mode.

When the reset mode is configured for manual start the compressor is allowed to operate for a period of 15-seconds to establish oil flow. The compressor will be shut down if the oil flow falls below the minimum required flow rate. If after 15-seconds, a safe oil flow has not been established the compressor will be shut down and a “Low Oil Flow Alarm” will be displayed. Either depressing the reset button or activating the remote reset will accomplish restarting the compressor. This mode is primarily used in trouble shooting procedures.

Mode Programming
Changing the oil flow reset can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Oil Flow Reset ” the (+-) buttons will allow the programmer to scroll and select between automatic and manual. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.7 Oil Flow Sensor
2 types of oil flow sensors can be used to determine the proper oil flow requirements to the compressor. These consist of a “Digital” flow sensor, which opens an electrical circuit interrupting a signal back to the ESC 201, or the analog sensor, which reads the oil flow. Either switch has an established setting determining the minimum oil flow requirement to safely protect the compressor. Factory default for this function is “Digital”.

Digital Sensor
The digital sensor requires a differential pressure and a minimum oil flow to activate the switch. 2 different switches are required to operate the entire series of compressors. The SHM2-3000/3500/4000 to SHL2-2000/2500/3000 and SDM1-0084/0100/0118 to SDL1-0084/0100/0118 series of compressors operate with a minimum (discharge to suction) differential of 45 PSIG (3.06
Bars) and a minimum flow rate of 1.6 GPM’S (6 L/M). This switch is painted blue for identification purposes. All other compressors require a switch with higher flow requirements of 90PSIG (6 Bars) minimum (discharge to suction) differential and a minimum flow rate of 2.6 GPM’S (10 L/M). This switch is a brass or silver colored. The digital switch has a brass plunger, when lifted by the minimum oil pressure and flow combination, closes a contact, sending an electrical signal back to the ESC 201. If the contact is opened after the compressor reaches operational status, the ESC 201 will sense this as an unsafe state and alarm a “Low Oil Flow”, shutting down the compressor. Installation of the digital switch must be after the oil filter to prevent foreign particles from obstructing the switch.

**Analog Sensor**

Analog sensor is a wheel type flow device, which uses a magnetic pickup to count the number of wheel rotations, which is converted to a 0-10VDC signal that can be read by the ESC 201 and displayed in either gallons per minute or liters per minute. This sensor provides a greater range of operation while providing the proper oil safety protection for the compressor. If the oil flow falls below the minimum calculated oil flow rate for the present conditions, the ESC 201 will shut down the compressor and display “Low Oil Flow”. Installation of the analog switch must be after the oil filter to prevent foreign particles from obstructing the switch.

The analog oil sensor requires additional information from the system to determine the proper oil flow limitation. Information required consists of the discharge and suction pressures of the system to calculate differential pressure. The pressure transducers supplied by the pressure controller can be connected to the ESC 201 as the source for these pressures. If these pressures are not supplied to each ESC 201 the control will shut down the compressor on “Low Oil Flow”.

**Mode Programming**

Changing the oil flow sensor can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Oil Flow Sensor” the (+-) buttons will allow the programmer to scroll and select between digital and analog. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

**11.8 Phase Protection Reset**

Three phase protection has been provided to protect the compressor against loss of phase and phase symmetry. Normal panel mounted phase monitors only monitor power supplied to the equipment. The ESC 201 provides protection to each compressor, monitoring the power supplied through all electrical devices connected to the compressor motor. When the compressor start sequence begins, the ESC 201 will wait ½ second for the power to stabilize and then check for power on all 3 phases and the proper sequence between phases. This function can be configured for either automatic or manual reset. Factory default for this function is “Automatic”.

**Automatic Mode**

During the operation of the compressor, if power is lost to any phase, the compressor will be shut down immediately and the alarm “Phase Loss” will be displayed. The ESC 201 will wait 30-seconds and attempt a compressor restart. The ESC 201 will attempt 3 restarts with 30-second delays between starts. If power has not returned after the three restarts, the time delay between restarts will be increased to five minutes for two additional restarts. If all the automatic restarts fail the compressor will be locked out requiring a manual reset.
Manual Mode
When phase protection is configured in the manual mode and power is lost to any phase, the compressor will be shut down and locked off by the ESC 201, displaying the alarm “Phase Loss”. Restarting the compressor requires depressing the manual reset button on the ESC.

Mode Programming
Changing the phase protection reset can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Phase Loss Reset” the (+-) buttons will allow the programmer to scroll and select between automatic and manual. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.9 Pressure Transducer Type
The equipment discharge pressure will read from the equipment electronic pressure transducer. This pressure will be used to make calculations in several ESC 201 functions. Since several different type transducers are supplied the ESC 201 has the ability to read these transducers once they are configured. Factory Default for this function is “Eclipse 500”.

Mode Programming
Changing the discharge pressure transducer type can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Discharge Transducer Type” the (+-) buttons will allow the programmer to scroll and select between several different types listed below. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

Discharge Pressure Transducer Types

1. Eclipse 500 Lb
2. 4 – 20 ma 500 Lb
3. 0-10V 500 Lb
4. 1-6V 500 Lb
5. SA 500 Lb

11.10 Discharge Pressure Offset
The pressure transducer used for reading discharge pressure is a supplied component by the manufacture of the electronic pressure controller. This function is designed to allow the ESC 201 pressure reading to be calibrated to the electronic pressure controller transducer. The discharge pressure reading is used to calculate the low economizer function and the differential pressure between discharge and suction for the analog oil flow sensor.

Discharge pressure offset function can only be accessed when the ESC 201 is setup as a “Master Control”. The master control will send the discharge pressure values to the connected slaves. The discharge pressure value can be read in the slave ESC 201 under the “Discharge \ Suction Pressure” Function described under function 11.12
Mode programming
Changing the discharge pressure offset can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “discharge pressure offset”, the (+-) buttons will allow the programmer to scroll up and down to place a positive or negative value in the offset to correct the pressure value. Once the selection has been made, pressing the “Save” button will save the offset value and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.11 Suction Pressure Offset
The pressure transducer used for reading suction pressure is a supplied component by the manufacture of the electronic pressure controller. This function is designed to allow the ESC 201 pressure reading to be calibrated to the electronic pressure controller transducer. The suction pressure reading is used to calculate the differential pressure between discharge and suction for the analog oil flow sensor.

Suction pressure offset function can only be accessed when the ESC 201 is setup as a “Master Control”. The master control will send the suction pressure values to the connected slaves. The discharge pressure value can be read in the slave ESC 201 under the “Discharge \ Suction Pressure” Function described under function 11.12

Mode programming
Changing the suction pressure offset can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “suction pressure offset”, the (+-) buttons will allow the programmer to scroll up and down to place a positive or negative value in the offset to correct the pressure value. Once the selection has been made, pressing the “Save” button will save the offset value and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.12 Discharge \ Suction Pressure
This function can not be edited and is used to display the values read by the suction and discharge pressure transducers. This function displays the discharge and suction pressure values as determined by the discharge and suction pressure offsets. The slave ESC 201 receives these values from the master control across the Comm. 2 network.

11.13 Motor Overload Monitor
The motor thermistor will be read by the ESC 201 to determine if the motor temperature is within the limits set by the manufacture. If the motor temperature exceeds these limits the ESC 201 will shut down the compressor in either the automatic or manual mode.

This function is configured at the factory as “Enabled” when any Semi-Hermetic compressor is selected and “Disabled” when an open type is selected. Any time a Semi-Hermetic compressor is selected the motor overload configuration cannot be disabled.

Mode Programming
Changing the motor overload monitor can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Motor Overload Monitor”,

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the (+-) buttons will allow the programmer to scroll and select between Enable and Disable for the open type compressor only. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.14 Phase Monitor
The phase monitor function has the ability to be enabled or disabled depending on the application and power source requirements. *It is not recommended to disable this function*. Factory default for this function is “Enabled”.

Mode Programming
Changing the phase monitor can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Phase Monitor”, the (+-) buttons will allow the programmer to scroll and select between Enable and Disable for the open type compressor only. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.15 Critical Discharge Monitor
If the discharge temperature exceeds 200°F the loaders will be deactivated, relieving some of the load on the compressor. If the discharge temperature falls below 194°F, the Loaders will be automatically activated.

When the compressor remains in this critical discharge temperature range (200°F/100°C to 211°F/99°C) for 20 minutes the compressor will be shut down in the automatic restart mode. The compressor will restart and activate the loaders when the discharge temperature falls below 194°F/90°C.

When the compressor is in the critical discharge temperature range the display will change to “Critical Discharge Temperature”. While the compressor is in the critical discharge range, the screen will only display the discharge temperature and no other compressor data, (with the exception of the Jet Kool information if the compressor is configured as a “Master”). If the temperature continues to rise to the high discharge cutout temperature of 212°F/100°C, the screen will display “High Discharge Temperature” and the compressor will be shut down. When in the high discharge temperature automatic mode the compressor will remain off until the high discharge temperature reset point has been reached (approx 183°F/84°C), not the critical discharge temperature reset point at 194°F/90°C.

11.16 7-Minute Time Delay
This function prevents short cycling that can cause damage to large compressor motors. The SHM1-5000 to SHL1-7500 series compressor should not be cycled more than 7 times an hour. This function is designed to reduce the number of short cycle starts, preventing excessive overload conditions caused by short cycling. The factory default for the 7-minute start delay is “Enabled”.

The timer is a 7-minute start to start operation, permitting the compressor to start immediately if the compressor has been either shut down for 7-minutes or constantly on for 7-minutes. If the compressor shuts down and attempts an immediate restart, the ESC 201 will delay the start for a period of 30-seconds. After this 30-second delay, the compressor
will be allowed to start. If the compressor shuts down immediately for the second time, the ESC 201 will keep the compressor off for the remainder of the 7-minutes or (6 minutes and 30 seconds at that point). The compressor must be either “ON” for 7 minutes or “OFF” for 7 minutes for the sequence to start over again.

The last line of the ESC 201 display will flash and alternate between the Jet Kool information and the time remaining to start while in the starting countdown mode. The operator will know the exact time left before the compressor will start.

This function cannot be disabled on the SHM1-5000 to SHL1-7500 model compressors. The SHM2 to SHL2 model compressors is the only series that this function can be disabled but is not recommended.

**Mode Programming**

Changing the 7-minute time delay can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “7-Minute Time Delay” the (+-) buttons will allow the programmer to scroll and select between Enable and Disable for the SHM2 & SHL2 type compressors only. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

**11.17 Compressor Start Delay**

Compressor start delay function is designed to prevent excessive current inrush to equipment with multiple compressors. Most equipment with multiple compressors utilizes a microprocessor to sequence the compressors, preventing a large inrush of current. If an electronic failure occurs in the microprocessor, the compressors will lose sequence ability provided by the microprocessor. The “Compressor Start Delay” function will act as a fail-safe feature for this function. Factory default for this function is “0” seconds.

Each compressor can be programmed with an individual start time delay from 0 – 99 seconds. The programmer has the flexibility to program the compressor starts around their system parameters to insure system safety, preventing long delays during normal starts.

**Mode Programming**

Changing the compressor start delay can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Compressor Start Delay”, the (+-) buttons will allow the programmer to scroll from 0 to 99 seconds. Once the start time selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

**11.18 Temperature Probe Type**

Two different temperature probes can be used for discharge temperature protection. The PTC probe does not have the ability to be read for control and display purposes. The PT1000 probe can be read, allowing the ESC 201 to display the actual discharge temperature of each compressor. Factory default for probe type is “PT1000”.

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PTC
This probe has been used for many years as an on/off safety device monitored by many different types of electronic controls to simply supply a signal for shutting down and restarting the compressor within a temperature range. This probe can be identified by having either a metal flexible protection around the wire with the markings PTC 100 stamped into the probe housing or red rubber insulation with the markings PTC 100 stamped into the housing. PTC probe can be used with the ESC 201 for discharge temperature protection by simply selecting “PTC” in the temperature probe type setup. This probe does not have the ability to be read temperature, eliminating the possibility of displaying the discharge temperature.

PT1000
Due to enhanced capabilities of the ESC 201 to monitor and control several functions, the requirement of a readable probe was essential. To operate the Jet Kool, Critical Discharge Temperature, High Discharge Temperature and Low Discharge Temperature functions, the PT 1000 temperature must be used. The PT 1000 can be read for display purposes and to operate the above functions. A white insulated wire with a yellow shrink band labeled “PT1000” can identify this probe.

Mode Programming
Changing the temperature probe type can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Temperature Probe Type”, the (+) buttons will allow the programmer to scroll between PTC and PT1000. Once the proper selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.19 Discharge Temperature Offset
This function provides the ability to calibrate the PT1000 discharge temperature probe. The ability to calibrate the PT1000 can be accomplished in either a master or slave control.

Mode programming
Changing the discharge temperature offset can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “discharge temperature offset”, the (+) buttons will allow the programmer to scroll up and down to place a positive or negative value in the offset to correct the temperature value. Once the selection has been made, pressing the “Save” button will save the offset value and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.20 Refrigerant Type
Refrigerant type is extremely important to setup in the ESC 201, since a calculation must be performed using data in the pressure-temperature table for the refrigerants to calculate condensing conditions. Refrigerant types to select from are R-22, R404A, R507, R134a, R717 and None. Warning, if the correct refrigerant is not selected improper system operation will occur. Factory default for this function is “R22”. 

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Mode Programming
Changing the refrigerant type can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Refrigerant Type”, the (+-) buttons will allow the programmer to scroll and select between the refrigerant types. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.21 Screen Contrast
Screen contrast can be made lighter or darker to enhance the display if the ESC 201 is located in a light or dark area. By increasing or decreasing the number of bars displayed in the function configuration the contrast will become lighter or darker. Factory default for this function is “7 Bars”.

Mode Programming
Changing the screen contrast can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Screen Contrast”, the (+-) buttons will allow the programmer to increase or decrease a bar indicator from 1 – 10 bars. The more bars displayed the higher the contrast. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.22 Date & Time
The ESC 201 has an internal logging feature and the ability to tag alarms with the current time & date to be transmitted across the 485 network to other devices and controllers. It is important the correct Date & Time be entered into the ESC 201.

The display screen has a date format of 02/10/01 and a time format of 15:20:36. The time is displayed in Military Time (24 Hr Clock). Follow the instructions below to change the date & time. Factory default for this function is the “Current Date & Time”.

Mode Programming
Changing the Date & Time can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Date & Time”, the (+-) buttons will allow the programmer to scroll and change each group of the date or time. The NEXT button will advance the cursor to the next group to allow the programmer to use the (+-) buttons to change that group. Once the corrections have been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.
11.23 Power Frequency

The ESC 201 is capable of operating with either 50 or 60 Hz power. The frequency can be changed in the configuration mode to either 50 or 60 Hz by following the below procedures.

Mode Programming
Changing the power frequency can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Power Frequency” the (+-) buttons will allow the programmer to scroll between 50Hz and 60 Hz. Once the corrections have been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.24 Jet Kool Source

Jet Kool oil cooler requires the discharge temperature as the input control source for the Jet Kool system. This signal is read by the ESC 201 to operate the Jet Kool Valve (JKV 100). The discharge temperature can be obtained by reading the individual compressor discharge probes (PT1000 only) or a single probe mounted on the discharge header after the last compressor and before the oil separator. Factory default for this function is “Compressors”.

Compressors
When the ESC 201 is configured as “Compressors” in the Jet Kool Source mode, the individual compressor discharge probes (PT1000 only) are read and averaged to determine the overall rack discharge temperature. Any compressor in the averaging group that is not in operation will be eliminated from the calculation process. Any time multiple suction groups are used on a single discharge group with oil coolers supplying cool oil to the suction groups, the configuration mode must be “Compressors” and the PT1000 probe must be used as the sensor device.

Rack Sensor
If the ESC 201 is operating an existing Jet Kool oil cooler with a probe mounted on the discharge line, this probe can be used as long as the configuration mode has been set to “Rack Sensor”. If the system will not permit the use of the compressor probe, PT 1000 as the source, a rack sensor probe must be used as the source.

Mode Programming
Changing the Jet Kool temperature source can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Jet Kool Temperature Source”, the (+-) buttons will allow the programmer to scroll between Compressor and Rack Source. Once the corrections have been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.
11.25 Language

Six languages can be programmed as screen displays. These languages are English, German, French, Spanish, Portuguese and Italian. These languages can be accessed through the normal setup procedures found below in "Mode Programming" or by using a the following short-cut. Factory default for this function is “English”.

1. Main Screen - press any button to access the “Setup ESC” Screen.
2. Setup ESC Screen - press the select button and the “Config” will begin to flash.
3. Press the “Next” button to scroll to “language”
4. When the “Language” is flashing press the pick button.
5. The choose language screen will appear.
6. press the edit button to access the languages.
7. Press the (+-) buttons to scroll between the languages.
8. When the desired languages appears, press the save button.
9. Press the “Menu” button and then the “Main” button to return to the main screen.

Mode Programming
Changing the Language can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Language”, the (+-) buttons will allow the programmer to scroll between Languages. Once the corrections have been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.26 Slaves on Line

This function can only be read in the master control. When accessing this function the total number of slaves that are connect to the master on the Comm. 2 network will be listed by their ID numbers. This function can be used to determine if a problem exists with slaves communicating to the master. Accessing the “Netw ork” function on the setup screen will provide direct access to this function.

11.27 I.D. Network

The ESC 201 has the ability to communicate to a rack controller using an open protocol across the 485 network, and the N2 network between the Master ESC and the Slave ESC boards. The ESC 201 can be supplied with Echelon communications from the Master ESC to the rack controller. To identify the slave ESC boards each ESC must be programmed with an I.D. number. This I.D. Number must be set up in each ESC control. When multiple compressors are configured with a master, the Master ESC should be setup as # 1. The I.D. number range starts at 0 and ends at 12. The number 0 should be reserved for single compressor operations. Factory default for this function is “0”.

Mode Programming
Changing the I.D. Network source can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “I.D. Network”, the (+-) buttons will allow the programmer to scroll between number 0 and 12. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

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11.28 EXT / ECH ID

The ESC 201 has the capability to transmit alarms and operational data either directly across the Comm.1 or Echelon Networks. This feature eliminates the use of additional input boards and / or isolation relays to read the alarms generated by the ESC 201.

EXT

When this function is configured for EXT. (External) the rack controller will be able to communicate directly across the Comm. 1 network to the ESC 201, retrieving all the alarm and data logs. The manufacturer of the rack controller must provide the software to allow the rack controller to read the ESC 201 alarms and data. Protocol information to develop the software is available by contacting the factory.

ECH

If the ESC 201 is utilizing Echelon communications the alarms and data logs will be sent via the Echelon network. The information required to communicate across the Echelon network will be provided by the factory on request.

Mode Programming

Mode determination between the External or Echelon connections are determined by connecting the communication wires to either Comm.1 (RS-485) or Echelon ports. Do not connect cables to both Comm. 1 and the Echelon ports. EXT/ECH configuration requires a number from 1-31 in this field. This number is used to address the EXT/ECH function to identify the ESC 201 on the Comm. 1 (RS-485) network. All master controls in the Echelon network must have the ECHelon FUNCTION “Enabled” for the EXT/ECH function to operate properly. IMPORTANT: The default setting for the EXT/ECH ID is “1”. This function must be set to value greater than “0” or the slave boards will not communicate to the master ESC, causing problems with the Jet Kool, critical discharge temperature and economizing functions.

Do not enable the ECHELON FUNCTION on the slave controllers.

The EXT/ECH function should not be confused with the I.D. Network Function. When programming the I.D. Network, each Master ESC 201 will have slaves that are configured to communicate to that Master ESC 201 for control purposes. The master will always be designated as “1” in the I.D. Network (Function # 22) with slaves to follow as 2,3,4 in that group. Group #2 on the same equipment will have another master designated as “1” with its slaves to follow as 2,3,4,5 in that group, and so on with group #3.

Note: A control designated as a master with a “1” in the I.D. Network (#22) will also be designed with sequential number from 1 to 31 in the EXT/ECH ID (# 23). The First Control in the system will always have an I.D. Network as “1” with the EXT/ECH ID also as “1”. The first control in the second group will have an I.D. Network as “1” with the EXT/ECH ID as “5”.

Example: System with a total of 9 ESC 201 Controls configured with 3 groups with 4 Controls in the first group, 3 controls in the second group, and 2 controls in the third group, will be set up as follows:
<table>
<thead>
<tr>
<th>Control Number</th>
<th>I.D. Network</th>
<th>EXT/ECH ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Group #1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1 Master</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2 Slave</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3 Slave</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Group #2</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>1 Master</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>2 Slave</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Group #3</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>1 Slave</td>
<td>9</td>
</tr>
</tbody>
</table>

**Wiring Configuration**

For External Connection

**External Function Wiring**

External Function wiring for the Comm.1 & Comm. 2 ports should be configured according to the following procedure.

Comm. 1 (RS-485)

A shielded cable should be daisy chain connected from the rack controller comm. Port to all ESC 201 Comm.1 ports on the equipment.

Comm. 2 (RS-485)

A shielded cable should be daisy chain connected from the master ESC 201 Comm. 2 port to all the slave Comm. 2 ports in the same group.
Echelon Function Wiring
Echelon Function wiring for Echelon & Comm. 2 ports should be configured according to the following procedure. The Echelon hardware is a separate board mounted in the lower left corner of the ESC 201 master control. Terminals to connect the wiring for the Echelon are located on this daughter board. The Echelon daughter board plugs into the master ESC 201. If the master must be replaced for any reason the Echelon board must be moved to the new board.

Echelon
A shielded cable should be daisy chain connected from the rack controller Echelon port to all Master ESC 201 Echelon ports.

Comm. 2
A shielded cable should be daisy chain connected from the master ESC 201 Comm. 2 port to all the slave Comm. 2 ports in the same group.

Note: Make sure the Comm.1 (RS-485) ports are not wired to the Echelon Ports.

11.29 N2 network Mode
Three network mode selections are possible when configuring the ESC 201. This configuration must be properly set up to enable the logging of alarms and information back to the rack controller. Factory default for this function is “Slave”.

Master
The Master Mode is used when more than one ESC 201 is connected in the network or when Jet Kool oil cooling is required to be controlled. The master is the main communication device between the slaves and the rack controller for alarms and other information data. The master is also used to collect temperature data from the other compressors to calculate the system discharge temperature to operate the Jet Kool oil cooler. More than one master is possible to be set up on a large rack system where multiple Jet Kool oil coolers are used to control the different suction groups.
Slave
Slave units are wired in series to the master control using the N2 network. The Comm. 2 connector is labeled (2+, 2-) on the bottom 2 terminals of the 6 connector terminal plug, located on the left hand side of the ESC board. The slaves send the information collected from its compressor across the N2 network to the Master control.

Terminating Jumpers
Terminating jumpers are located on the ESC 201 for Comm.1 and Comm.2. The alarm boards are also equipped with a terminating jumper. The terminating jumper must be placed across the jumper pins on the last board in the network. The Comm.1 network is used to connect the ESC master controls to the equipment controller. The termination jumper on Comm. 1 must be in place on the last ESC 201 in that network. Comm.2 jumper is used on the N2 network with the slave and alarm boards. When the slaves are connected to the master the Comm. 2 terminating jumper must be in place on the last slave board or the last alarm board in that group.

NOTE: The slave and alarm terminating jumpers perform the same function. The last board in the network must the terminating jumper across the terminal pins. The Comm.1 & Comm.2 terminating jumpers are located on the lower left corner of the ESC 201, labeled respectively.

11.30 Control By:
The screw compressors have two methods to be controlled when using the ESC 201. These methods are LOCAL and ECHELON. The Default control is by the local function.

Local Control
The local method of control consists of wiring through a computerized system controller, which operates the compressors, and loaders using an electronic relay board. When the relay output is energized it sends an electrical signal through a series of electro-mechanical safety devices to the (C1) terminal on the ESC 201 board. The ESC 201 recognizes this signal to start the compressor and load the loaders. Any interruption in this (C1) signal will shut down the compressors.

Echelon Control
Echelon method to control the compressors and loaders eliminates the electronic relay board. The compressors and loaders are operated directly from the computerized system controller across the Echelon Network. Elimination of the output relay board will simplify the unit wiring and reduce the space requirements in the electrical panel. The (C1) input to the ESC 201 will also be required as a safety monitor. An electrical signal is required to be sent through an on-off switch to the standard high and low pressure safety switches, providing a mechanical back up to the compressor. If this signal to terminal (C1) is broken for any reason the compressor will be shut down.

11.31 Alarm Boards
ESC 201-alarm board mode must be configured as “Enabled” to communicate to the designated board for the ESC.
Mode Programming
Changing the alarm board mode can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Alarm Boards”, the (+-) buttons will allow the programmer to scroll between Enabled and Disabled. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.32 Echelon
An optional Echelon card can be installed on the lower left portion of the ESC 201. This card incorporates the hardware and software to provide Echelon communications. The Echelon card is only required on the ESC 201 master control. Information from the slave units will be transmitted across the N2 network to the Echelon card and back to the equipment controller. When using Echelon communication, the Echelon mode must be enabled. The factory default for this function is “Disabled”.

Mode Programming
Changing the Echelon Mode can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Echelon”, the (+-) buttons will allow the programmer to scroll between enabled and disabled. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.33 Temperature
The screen display for temperature can be changed from Fahrenheit to Centigrade. The factory default for this function is “Fahrenheit”.

Mode Programming
Changing the temperature units can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Temperature”, the (+-) buttons will allow the programmer to scroll between Fahrenheit and Centigrade. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.
11.34 Pressure
The screen display for Pressure can be changed from PSI to Bars. The factory default for this function is “PSI”.

Mode Programming
Changing the pressure units can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Pressure” the (+-) buttons will allow the programmer to scroll between PSI and Bars. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.35 Flow Rate
The screen display for Flow Rate can be changed from Gallons/Min to Liters/Min. The factory default for this function is “Gallons/Min”.

Mode Programming
Changing the flow rate can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Flow Rate”, the (+-) buttons will allow the programmer to scroll between Gallons/Min and Liters/Min. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

11.36 Date Format
The date format on the screen display can be changed to accommodate the U.S. format and the European Format. The U.S. Format is displayed as “Month/Day”, while the European is “Day/Month”. The factory default for this function is “Month/Day”.

Mode Programming
Changing the date format can be accomplished by following steps 1-3 in section 5.0 to obtain the category selection screen, then follow the instruction found in section “11.0 Programmable Operations”. After accessing the edit screen for “Date Format”, the (+-) buttons will allow the programmer to scroll between Month/Day and Day/Month. Once the selection has been made, pressing the “Save” button will save the selection and return the programmer back to the function screen allowing the programmer to continue to the next function or return to the main screen.

12.0 Memory Chip
The ESC 201 is equipped with a non-volatile memory chip. This memory chip is an electrical erasable programmable memory (EEPROM). This chip is located under the display module labeled as U5. The EEPROM will hold the programmable configuration setting for the compressor. The EEPROM can be removed from one control and placed in another control to provide the user with the ability to transfer the compressor setting without reprogramming the ESC 201. Earlier versions of the control were equipped with an iButton located on the lower left-hand corner of the ESC 201. The iButton looks like a small battery mounted in a well and held in place with a heavy spring clip. The iButton is a programmable chip used to store
information similar to the function of the EEPROM. Due to various constrains of the iButton, it did not work as an acceptable method to store the programmable memory. If the iButton can not be visibly located on the lower left corner of the board directly above the rest button, the control has been configured with an EEPROM.

**Exchanging the EEPROM**

To exchange the EEPROM from one control to another, remove all power from the board by unplugging both connectors labeled “C” and the 24 volt power plug labeled “AC, +1, +2”. Remove the metal cover by removing the 3-5/16 nuts. The next step is to remove the four screws holding the display module. Hold the display from the top and bottom on the left side of display and gently pull on the display with an up and down motion to remove the display from the socket. The EEPROM is located under the display in the upper right corner marked on the board as U5. Place a small screwdriver between the EEPROM and the socket and gently pry up on the EEPROM. When replacing the EEPROM make sure the pins are aligned properly before pushing the EEPROM into the socket. Proper alignment of the display is crucial to the operation of the display, make sure the display pins are correctly aligned when plugging in the display to avoid any problems the display operation. Replace all screws, nuts and covers before plugging in the power connectors.

### 13.0 Alarm Boards

The N2 network is also used to communicate to the ESC 201 alarm boards. The ESC 201 is equipped with one alarm output for a general alarm. If a customer requires specific alarms, logging can be accomplished with an alarm board to either the rack controller or an alarm system. The alarm board is configured with an N2 connector for networking to the ESC 201 boards. The alarm signal is sent out across this N2 network to activate the alarm module. When the alarm module receives the signal for an individual alarm, the board closes the related contacts to generate the alarm. The N2 connector labeled (Comm. 2) is located on the lower left portion of the board to the right of the 4-position dipswitch. Located to the right of the Comm. 2 port is the terminating jumper. If it is the last board in the communication chain, then the jumper must be placed over the two pins (J2).

A non-center tapped 24VAC transformer powers the alarm board. The power requirement for each board is 15VA. The 24VAC-power supply is connected to the 2-pin connector on the lower left corner of the board labeled 24Vac. Two (2) contacts are provided for each alarm point. One is a dry set of contacts on terminal block 2 (TB2) providing a closure to signal another device as an alarm, and a voltage output set on terminal block 1 (TB1), normally used for panel lights. The voltage contacts can be utilized

<table>
<thead>
<tr>
<th>Alarm Designation</th>
<th>Dry Contact</th>
<th>Power Terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dirty Filter</td>
<td>D1</td>
<td>H1</td>
</tr>
<tr>
<td>Motor Winding Overload</td>
<td>D2</td>
<td>H2</td>
</tr>
<tr>
<td>Oil Flow</td>
<td>D3</td>
<td>H3</td>
</tr>
<tr>
<td>Oil Level</td>
<td>D4</td>
<td>H4</td>
</tr>
<tr>
<td>Discharge Gas</td>
<td>D5</td>
<td>H5</td>
</tr>
<tr>
<td>Phase</td>
<td>D6</td>
<td>H6</td>
</tr>
<tr>
<td>Rotation-Wrong Sequence</td>
<td>D7</td>
<td>H7</td>
</tr>
<tr>
<td>Run Proof / Bypass</td>
<td>D8</td>
<td>H8</td>
</tr>
<tr>
<td>Over Discharge Limit</td>
<td>D9</td>
<td>H9</td>
</tr>
<tr>
<td>Low Discharge Temp</td>
<td>D10</td>
<td>H10</td>
</tr>
<tr>
<td>Digital Alarm Common</td>
<td>D11</td>
<td>-</td>
</tr>
<tr>
<td>Alarm Output Supply Voltage</td>
<td>-</td>
<td>H11</td>
</tr>
</tbody>
</table>
with some controllers that accept a voltage input for alarms rather than a dry contact closure. The table to the right shows a schedule of alarm and terminal designations for both the dry and power terminals.

Alarm Board I.D.
The table shown in this section illustrates the switch positions to address the alarm boards. The “OFF” position for the switch is “UP”. To place the switch “ON” the switch must be in the “DOWN” position. The designation of the alarm board I.D. must correspond to the ESC 201 transmitting the alarm message. Example: if the ESC 201 has an I.D. of “1” the alarm board receiving the information must also have an I.D. of “1”. Duplicate I.D. numbers are possible on large systems where more than one Master ESC 201 is required. When this type of address scheme is used, the Master, slave and alarm boards must remain in a wiring group. The green LED light located in the middle right side of the board is the power light, indicating the unit has power when lit. The green lights next to the Comm. 2 port are communication lights, which will flash when communicating with the ESC 201.

Alarm Board Wiring
Shielded cable must be used to connect the N2 network and the 24 VAC power connections. One end of the shield must be attached to ground. Wiring the dry outputs to another input device should also be wired using shielded cable, unless the manufacture of the input device instructs differently. High voltage output from TB1 can be wired according to standard wiring practices. **Shielded cable, with one end of the shield grounded, will reduce the possibility of noise transmission to the alarm and ESC 201 boards.**

When more than one master ESC201 is used in a system with a single rack controller, the alarm boards should only be wired to that group of master and slave boards. Each time a new master is used, the address numbering scheme for ESC 201 and alarm boards will start back at “1”.

<table>
<thead>
<tr>
<th>Associated ESC ID</th>
<th>SW5-1</th>
<th>SW5-2</th>
<th>SW5-3</th>
<th>SW5-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>1</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>2</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>3</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>4</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>5</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>6</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>7</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>8</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>9</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>10</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>11</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>12</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>13</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>14</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>

14.0 Remote Reset
Remote reset can be accomplished by wiring the equipment controller output relay between terminals (A6) and (A7). When the equipment controller is equipped with a phone modem, the operator accesses the output switch wired to (A6 & A7). Closing and opening the switch will reset the ESC 201. Note: the output switch must be opened, since the activation of the remote rest is predicated on the opening not the closing of the switch.
15.0 Manual Reset
The manual reset button is located on the lower portion of the ESC 201 to the left of the green LED power light. This button will allow the operator to clear all alarms and restart the compressor.

16.0 Logging
The ESC 201 has a permanent memory that will log the following functions. This logged data can be accessed by the use of a Prolink module and the required software. This memory can be accessed but not erased.

Logged Functions:
1. Oil Failure
2. Motor Overload
3. Discharge Temperature
4. Rotation
5. Compressor Starts

The Prolink and software are optional accessories and can purchased via normal distribution.

17.0 ESC 200 upgrade to ESC 201
The ESC 200 screw controller can be replaced and upgraded to the ESC 201 with a few modifications. To change out an ESC 200 and replace the control with an ESC 201, follow these steps.

17.10 Removing the ESC 200
1. Unplug all the terminal plugs on the Esc 200.
2. Mark the three phase wires to be placed in the same position on the ESC 201.
3. Disconnect the three phase wires.
4. Remove the ESC 200 from the snap track.

17.20 Installing the ESC 201
1. Place the ESC 201 in the snap track, positing the control close to the old terminal plugs.
2. Connect the phase wires in the same position as the ESC 200.
3. Remove the control wires from the ESC 200 terminal plugs and wire them on the new terminal plugs of the ESC 201 per the wiring schematic in Appendix G.
4. Important: The Esc 201 requires a 24VAC transformer without a center tap ground connection. The power requirement will be different depending the controls operation with or without Jet Kool.

Transformer without Jet Kool & Echelon - 24VAC, 16VA
Transformer with Jet Kool & Echelon - 24VAC, 22VA

If ESC 200 and ESC 201 controls are both used on the same equipment they will require different power supplies. Suggestion, a transformer that can handle multiple ESC 201 controls maybe the best alternative for expansion or future replacement purposes.
17.30 ESC 200 Alarm Function to ESC 201 Alarm Boards

1. The ESC 201 has a provision for one high voltage alarm output to illuminate a panel light. If the alarm outputs from the ESC 200 are required by the customer, an ESC 201 alarm board can be purchased to display all the existing alarms lights.

2. If the system requires the use of only one alarm panel light, the present alarm lights can be eliminated by using the alarm output on terminal C10 of the ESC 201, calling it a “General Alarm”, illuminating one of the existing lights to indicate an alarm has occurred. The alarm can then be read on the ESC 201 display.

3. Installation of the ESC 201 alarm board will require additional panel space of approximately 6" X 8". Each alarm board requires 15VA power at 24VAC, as well as, shield cable connections between the comm. 2 networks of the alarm board and the ESC 201. The board provides for 10 high voltage and 10 digital outputs to operate panel lights and low voltage signals to the rack controller for remote alarms.

4. Listed below are the terminal relationships from the high voltage terminals on the ESC 200 to the high voltage terminals on the ESC 201 alarm board.

<table>
<thead>
<tr>
<th>Description</th>
<th>ESC 200 Outputs</th>
<th>ESC 201 Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dirty Oil Filter Alarm</td>
<td>D1</td>
<td>H1</td>
</tr>
<tr>
<td>2. Motor Winding Overload Alarm</td>
<td>D2</td>
<td>H2</td>
</tr>
<tr>
<td>3. Oil Flow Alarm</td>
<td>D3</td>
<td>H3</td>
</tr>
<tr>
<td>4. Oil Level Alarm</td>
<td>D4</td>
<td>H4</td>
</tr>
<tr>
<td>5. High Discharge Gas Alarm</td>
<td>D5</td>
<td>H5</td>
</tr>
<tr>
<td>6. Phase Loss Alarm</td>
<td>D6</td>
<td>H6</td>
</tr>
<tr>
<td>7. Rotation / Wrong Sequence</td>
<td>D7</td>
<td>H7</td>
</tr>
<tr>
<td>8. Run Proof / By-Pass Alarm</td>
<td>D8</td>
<td>H8</td>
</tr>
<tr>
<td>9. Over Discharge Limit</td>
<td>D9</td>
<td>H9</td>
</tr>
<tr>
<td>10. Low Discharge Temperature</td>
<td>D10</td>
<td>H10</td>
</tr>
</tbody>
</table>

5. When wiring alarm board please refer to section 13.0 “Alarm Board I.D. and wiring”. Appendix F, “ESC 201 alarm board wiring” can also be used as a guide.
Appendix A

Compressor Motor – Phase - Run Proof Configurations

Direct On Line

Part Winding Start

Inverter
Appendix B

Compressor Configurations

Figure #1
SHM2 to SHL2
SDM1-0084 to SDL1-0118
Front View

Figure #2
SHM2-SHL2
SDM1-0084 to SDL1-0118
Side View

Figure #3
SHM1-5000 to SHL1-5000
Front View

Figure #4
SHM1-7000 to SHL1-7500
SDM1-0165 to SDL1-0250
Front View

The Rotation Switch must be installed in the vertical position.

1/8" N.P.T.
Brass Street El

3/4" N.P.T. Plug
Remove and discard

1/4" N.P.T. Port
For high pressure control connection

CR1
CR2

Economizer Port

Rotation Switch

3/8" N.P.T. Vibration Dampener

1/8" N.P.T.
Brass Street El

3/8" N.P.T. Plug
Remove and discard

3/8" F.P.T. x 3/4" M.P.T.
Hex Bushing

3/8" N.P.T.
Vibration Dampener

Rotation Switch

The Rotation Switch must be installed in the vertical position.

1/8" N.P.T.
Brass Street El

3/8" N.P.T. Plug
Remove and discard

(Cx) ESC terminal number
Preliminary Data Subject to change
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ESC201 C-4-23-02
4/22/02
Appendix C

Electrical Wiring and Power Specifications

1. High Voltage

**Power Voltage**
208 – 480 VAC 3 φ
Terminal Block – 3 positions
Voltage Rating 600 VAC
Current Draw, 0.5 mA Ac

  Voltagess are referenced phase to phase

**Control Voltage**
C1- Compressor Control (on/off)
C2- Capacity Regulator #1 (on/off)
C3- Capacity Regulator (on/off)
Voltage 120/208/240 VAC
Terminal Block Rated 240VAC
Current Draw 0.5 mA Ac

**Power Input and Serial Communication**
TB1-1. RS-485 Comm2(-)
TB1-2. RS-485 Comm2(+)
TB1-3. RS-485 Comm1(-)
TB1-4. RS-485 Comm1(+)
TB1-5. AC 24 VAC
TB1-6. AC 24VAC
  Fuse 3A
  Operating Current 760 mA AC
  Maximum Current 900 mA AC
  Maximum Power requirement
With Jet Kool & Echelon- 22VA
Without Jet Kool & Echelon- 16VA
  Terminal Block, 6-position, 240 VAC

**Alarm and Control Outputs**
C4- Direct on Line Run Proof - Input, 120 VAC
C5- Compressor Output
C6- Part Winding Start Output
C7- Capacity Regulator #1 Output
C8- Capacity Regulator #2 Output
C9- Oil Solenoid Output
C10- Alarm Output
C11- Economizer Output
C12- Control Output and Alarm Relay Common – 5A fused
  Terminal Block, 8-position, 240VAC
Appendix C (cont)

Electrical Wiring and Power Specifications

2. Low Voltage

Input Signals (Digital)
A1- Dirty Oil Filter
A2- Oil Level
A3- Rotation
A4- Inverter Run Proof
A5- Oil Flow
A6- Remote Alarm Reset
Max Voltage Output 5V DC
A7- Input Ground
Max. Input Voltage Input 5V DC- from A1-A6
A8- +15VDC Sensor Supply
Regulated +5%, not to exceed 50mA DC total

Input Signals (Analog)
B1- Motor Overload
   PTC thermistor cut-out - 4.5kΩ and cut-in - 2.75KΩ
B2- Discharge Gas Temperature
   PTC 100 cut-out = 1385Ω and cut-in = 1309Ω
   PT1000
B3- Jet Kool Temperature
B4- Discharge Pressure
B5- Suction Pressure
B6- Oil Flow - Analog
B7- Input Ground - Analog
B8- +5VDC Sensor Power +5%, not to exceed 150 mA total
   Terminal Block- 8 position, 240VAC
Appendix F

ESC 201 Alarm Board

DIGITAL ALARM OUTPUTS

DIRTY OIL FILTER ALARM
MOTOR OVERLOAD ALARM
OIL FLOW ALARM
OIL LEVEL ALARM
DISCHARGE GAS ALARM
PHASE ALARM
ROTATION / WRONG SEQUENCE ALARM
RUN PROOF / BYPASS ALARM
OVER DISCHARGE LIMIT ALARM
LOW DISCHARGE TEMPERATURE ALARM

DIGITAL INPUTS TO CONTROLLER INPUT BOARD

DIRTY OIL FILTER ALARM
MOTOR OVERLOAD ALARM
OIL FLOW ALARM
OIL LEVEL ALARM
DISCHARGE GAS ALARM
PHASE ALARM
ROTATION / WRONG SEQUENCE ALARM
RUN PROOF / BYPASS ALARM
OVER DISCHARGE LIMIT ALARM
LOW DISCHARGE TEMPERATURE ALARM

NETWORK COMMUNICATION
"DAISY CHAINED" TO ALL ESC 201'S & ALARM BOARDS

120 OR 208-230/60/1Ø
CONTROL POWER

COMM2 - 24 VAC
24 VAC
TRANSFORMER 24 VAC
15 VA MAX

ALL WIRING MUST BE DONE IN ACCORDANCE TO NATIONAL ELECTRIC CODE.

FIELD WIRING
TIGHTEN ALL ELECTRICAL CONNECTIONS BEFORE POWER IS APPLIED.
USE COPPER CONDUCTORS ONLY
USE #14 THHN MINIMUM FOR FIELD CONNECTIONS UNLESS OTHERWISE NOTED.
USE CLASS 1 WIRING METHODS FOR ALL CONTROL FIELD CONNECTIONS.
Appendix G

ESC 200 Conversion to ESC 201

Legend
- Symbol designated ESC 200 terminal connection point
- Notes

1. Digital input grounds are connected to ESC 201 terminal A7
2. Analog input grounds are connected to ESC 201 terminal B7
3. Oil output (C9) and Economizer output (C11) functions on the ESC 200 are separate terminal points. Since the functions are combined on the same terminal point (C7) on the ESC 200, make sure the proper wire for each function on the ESC 200 are connected to the correct positions on the ESC 201.

Notes:
- It is very important for the correct operation of the ESC 201 that this ground connection is properly wired.
Appendix H

ESC 201 Low Voltage Transformer Wiring Diagram

NOTE:
DO NOT CONNECT ANY WIRES TO THE GROUND TERMINAL ON THE TRANSFORMER.
THE ESC 201 DOES NOT OPERATE ON A CENTER TAP TRANSFORMER.
Appendix I

ESC 201 Trouble Shooting Guide

Note: After each change has been made in the configuration mode that change must be saved in that section for the change to be initiated.

ESC input voltage will read 5VDC from the function terminals (A1-A6) to ground (A7) and from Terminals (B1-B6) to Ground (B7).

ESC output terminals (C5 – C11) are supplied voltage from Terminal C12. This voltage can be read from terminals (C5 – C11) to L2 when the output function is closed.

Terminal (C1- C4) are high voltage input terminals normally using control voltage as a source.

<table>
<thead>
<tr>
<th>Problems</th>
<th>Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESC will not power up.</td>
<td>Check for 24 VAC control power to terminals marked A/C.</td>
</tr>
<tr>
<td></td>
<td>Check for proper electrical connections to transformer or faulty transformer.</td>
</tr>
<tr>
<td></td>
<td>Check F2 fuse on the ESC board upper left corner.</td>
</tr>
<tr>
<td></td>
<td>Check to insure total number of ESC 201 controllers have not exceeded the transformer power limitations.</td>
</tr>
<tr>
<td>(C1) input is not present</td>
<td>Check for voltage and electrical connections between the compressor control switch, pressure controls, overload contacts and other control devices to input point C1.</td>
</tr>
<tr>
<td>No output power at (C4 – C11)</td>
<td>Check for proper input voltage at terminals (C1 &amp; C11).</td>
</tr>
<tr>
<td></td>
<td>Check F1 fuse at lower right corner of board.</td>
</tr>
<tr>
<td>ESC operates intermittently</td>
<td>Make sure ground has a good non-painted connection.</td>
</tr>
<tr>
<td></td>
<td>Make sure all fuses are tight in the fuse holder.</td>
</tr>
<tr>
<td>F1 fuse blows when the ESC is energized</td>
<td>Turn off Compressor Breaker.</td>
</tr>
<tr>
<td></td>
<td>Check the input &amp; output points for short circuits in the wiring.</td>
</tr>
<tr>
<td></td>
<td><strong>Step #1</strong> Disconnect (C1) control input and (C5 &amp; C6) control output from the ESC and connect the wires together, isolating the ESC control. Activate the compressor control circuit. If the compressor contactor closes, proceed to step #2.</td>
</tr>
<tr>
<td>Problems</td>
<td>Possible Solutions</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Step #2</strong> De-activate the compressor control circuit and reconnect (C1, C5 &amp; C6) points on the ESC. Disconnect output points (C7 to C11). Activate the compressor control circuit. If the compressor contactor closes, connect point (C7) and test this point. Test Points (C8 – C11) with the same procedure. If any of these tests produce a blown fuse, then check the corresponding circuit for the short.</td>
<td></td>
</tr>
<tr>
<td>Phase loss alarm turns on after a motor breaker closure, while the compressor control circuit is inactive:</td>
<td>The phase voltage leads from the ESC 201 are connected to the line side of the compressor contactor. Connect leads A,B,C to the load side of the compressor contactor. (The preferred locations are the compressor terminals T1,T2,T3)</td>
</tr>
<tr>
<td>ESC fails after an inverter fault:</td>
<td>Compressor input signal (C1) remains active during inverter reset attempts. Check to insure inverter relay is not defective. Check control circuit wiring diagram to insure the inverter isolation scheme has been included. Refer to the inverter fault scheme diagram in section 1.6 (Contact factory for help with this scheme if required)</td>
</tr>
<tr>
<td>Phase rotation failure:</td>
<td>Correct the compressor rotation.</td>
</tr>
<tr>
<td>Rotation failure, but compressor operates in the correct direction:</td>
<td>Phase sequence of A,B,C on the ESC 201 must be changed to match the proper electrical rotation sequence. Once the proper sequence has been determined and set, change any two leads of the phase leads on the ESC 201 control to align the system electrically.</td>
</tr>
<tr>
<td>Open type compressors indicate Motor overload failure:</td>
<td>Configure Esc 201 in the setup program for the motor overload as “Disabled”</td>
</tr>
<tr>
<td>All compressors in the same suction group start at the same Time:</td>
<td>Check the compressor start time delays to insure they have been configured properly.</td>
</tr>
<tr>
<td>Compressor fails on phase:</td>
<td>Check voltage at all three phases to determine if Voltage exists.</td>
</tr>
<tr>
<td>Discharge temperature failure:</td>
<td>Check discharge temperature for out of range condition. High compressor super heat or insufficient oil cooling will cause this problem.</td>
</tr>
<tr>
<td>ESC 201 alarms in critical discharge temperature and shuts down the Compressor:</td>
<td>Discharge temperature has been above 200°F for more than 20 minutes. Check oil cooling and other cooling criteria.</td>
</tr>
<tr>
<td>Problems</td>
<td>Possible Solutions</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **Motor overload failure:**      | Check motor temperature to determine if it is out of range.  
Read DC voltage between terminals (B1 & B7). The voltage should be stable between 0.3 & 0.6 VDC. The thermistor trip point is 2.3 VDC.  
Make sure all Thermistor connections at the compressor are tight on the spade connectors. Check the ESC setup program for proper configurations. |
| **Dirty oil filter failure:**    | If dirty filter alarms on initial start, depress reset button to initialize the switch. This procedure is required one time after an oil change or possible initial start. Switch opens with oil pressure differential across the filter of 25 PSI. Check wiring of switch for N/C operation when clean. |
| **Oil Flow Failure:**            | Check for low oil conditions: such as dirty oil filter, liquid refrigerant present in the oil system, blocked oil system. Check to make sure oil line blank off plate has been removed from compressor oil fitting.  
Check to make sure the oil flow switch has been wired properly to the Esc 201.  
Check to make sure the proper differential pressure exists between discharge and suction to flow the proper amount of oil to the compressor. |
| **Oil level failure:**           | Check oil level in separator for proper level. Check to see if the optical sensor is receiving a 5VDC signal. Check for loose wires from sensor to the ESC. |
| **Compressor fails on run proof:** | Check to insure run proofs are connected to the proper auxiliary contacts.  
Check F1 fuse for continuity.  
Make sure run proofs signal on direct on line is connected to C4 with 115 – 120 VAC.  
Make sure the direct-on-line and the inverter run proof are being energized together. |
| **Economizer Solenoid won’t energize:** | Economizer superheat below minimum set point. ESC 201 has shut down the ECO solenoid to protect the compressor against potential bearing damage.  
"LOW ECO TEMP." is displayed by ESC 201.  
ESC alarm |
<p>| <strong>“Low Discharge Temperature”</strong>  | Suction superheat extremely low causing a low discharge temperature condition. Adjust evaporator expansion valves. |</p>
<table>
<thead>
<tr>
<th>Problems</th>
<th>Possible Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiring Fault Alarm</td>
<td>Check to make sure the three-phase wires are connected from the load side of the contactor to the ESC 201 three-phase connections. This fault will occur if these wires are connected to the line side of the contactor.</td>
</tr>
</tbody>
</table>
18.0 Jet Kool System

18.1 Description

Jet Kool is the latest development of a safe and efficient means to perform oil cooling on Copeland screw compressors utilizing system refrigerant. Liquid refrigerant is supplied by the condenser liquid return line through a primary receiver to the inlet side of a plate heat exchanger, designed for oil cooler duty. The return line from the plate heat exchanger is connected to the jet pipe nozzle connection, located in the discharge line of the refrigeration system. The purpose of the jet pipe is to create a lower pressure in the Jet Pipe than in the discharge line entering the Jet Pipe, providing a positive flow of refrigerant vapor back to the condenser. The jet pipe provides an adequate pressure differential to operate the oil system and overcome the normal refrigerant pressure drops found in the discharge line, refrigerant condenser and liquid return line. Jet Kool does not affect compressor performance or capacity, since the refrigerant used for oil cooling purposes does not influence the suction side of the system or the mass flow pumped by the compressor.

Refrigerant oil from the oil separator passes through the plate heat exchanger to the compressor oil circuit. Oil heat is transferred in the plate heat exchanger to the system refrigerant and sent to the condenser. The oil, refrigerant and compressor loads make up the total heat of rejection in the screw compressor.

Compressor discharge temperatures are monitored by the ESC 201 at each compressor discharge or on the common header for some parallel systems. Based on system demand the ESC 201 provides a 0–24 V DC signal to a refrigerant control device, located in the liquid refrigerant line, feeding the plate heat exchanger. This refrigerant control device provides the proper amount of liquid refrigerant to the plate heat exchanger inlet, maintaining the precise oil temperature to furnish a safe compressor discharge temperature.

The proper control of compressor discharge temperature is essential to a safe operation of the compressor. Discharge temperature must be maintained at 50°F above condensing temperature to prevent liquid form condensing in the discharge line or oil separator. If gas is condensed into a liquid prematurely in the discharge system, liquid will be returned in the compressor oil system, causing compressor-bearing damage. The Jet Kool oil cooling system should be set to control the discharge temperature at 180°F.
19.0 Jet Kool Components

19.1 Listed below are the Jet Kool kit components provided with Jet Kool.

A. Jet Pipe
B. Plate Heat Exchanger
C. Liquid Flow Control Valve
D. 1 ¾"-12 x 1 3/8" O.D.S. Fitting (4)
E. 1 3/8" Rotalock Valve
F. Primary Receiver and Bracket
G. Liquid Check Valve

19.2 Listed below are additional components required, not supplied with Jet Kool.

I. Liquid Sight Glass (Additional sight glass optional in pipe P4)
J. Isolation Ball Valves (3 required)
K. Access Fittings (5)
L. Discharge Ball Valves

20.0 Jet Kool Piping Specifications

20.1 Minimum Condenser Height

The below listed pipe specifications are in accordance with Jet Kool Flow Diagram (section 21.0) of this manual. The vertical height distance from the bottom of the condenser liquid outlet to the plate heat exchanger refrigerant inlet must be a minimum of 6 FT.

20.2 Primary Jet Cool Condenser Line (P1)
All pipes, valves and fittings exiting the jet pipe must remain the same size as the jet pipe outlet diameter or a combination of multiple pipes, valves, and fittings totaling the equivalent cross sectional area of the jet pipe outlet.

20.3 Split Condenser Line (P2)
If split condenser is required, the split valve outlet cross sectional areas must total the cross sectional area of the jet pipe outlet. The full condenser side discharge pipe exiting the split valve must not be smaller than the total cross sectional area of the jet pipe outlet.

Example: If the Jet Pipe outlet is 2 1/8" in diameter, both discharge lines after the split valve must be a minimum of 2 1/8" in diameter.
20.4 Oil Cooler Liquid Line (P3)
Liquid line from the primary receiver feeding the plate heat exchanger refrigerant inlet must have a shut-off valve (Rotalock or Ball), sight glass, low-pressure drop liquid check valve (supplied), access fitting and refrigerant flow control in this sequence. These components must be sized in accordance with table 1.1.

Table 1.1

<table>
<thead>
<tr>
<th>Maximum Oil Cooling Capacity (KBTU'S)</th>
<th>Minimum Line/Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-22</td>
<td>R404A/507</td>
</tr>
<tr>
<td>0-250</td>
<td>1 1/8&quot; OD</td>
</tr>
<tr>
<td>0-160</td>
<td>1 1/8&quot; OD</td>
</tr>
<tr>
<td>250-400</td>
<td>1 3/8&quot; OD</td>
</tr>
<tr>
<td>160-250</td>
<td>1 3/8&quot; OD</td>
</tr>
</tbody>
</table>

20.5 Oil Cooler Vapor Return Line (P4)
The refrigerant outlet from the plate heat exchanger to the jet pipe nozzle inlet must be as short as possible with the least amount of elbows keeping this pressure drop to a minimum. This line must have an isolation ball valve, (optional sight glass), and access fitting in this sequence with a 1 3/8" line size, corresponding to the Jet Pipe Nozzle Rotalock size of 1 3/8 OD.

20.6 Hot Oil Feed Line (P5)
The oil inlet to the plate heat exchanger must be sized according to table 1.2 listed below with an access fitting.

Table 1.2

<table>
<thead>
<tr>
<th>Number of compressors</th>
<th>Oil line size OD.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>1 1/8&quot;</td>
</tr>
<tr>
<td>3-4</td>
<td>1 3/8&quot;</td>
</tr>
<tr>
<td>5-6</td>
<td>1 5/8&quot;</td>
</tr>
</tbody>
</table>

20.7 Cool Oil compressor Feed Line (P6)
The oil outlet from the plate heat exchanger must also be sized in accordance to table 1.2 with an access fitting and isolation ball valve in this sequence.
21.0 Jet Kool Component Specifications

21.1 Jet Pipe Description

Jet pipes are available in one series, “HR 66”. If the capacity range of the system exceeds the maximum pipe capacity, then more than one pipe may be required. The pipe is constructed of aluminum with flanged braze connectors. The series “HR 66” has a 2 1/8” inlet & outlet and a 1 ¾ -12 (1 3/8”) rotaLock connector at the nozzle. Access fittings are provided at the outlet of the jet pipe for reading this pressure. Access fittings are also required at the pipe inlet & nozzle inlet during installation for the same purpose. Diameter of the inlet and outlet discharge line at the Jet pipe must remain the same size as the Jet pipe inlet and outlet size.

Reference (Jet Kool Flow Diagram, section 23.0)

The jet pipe is placed in the discharge line in position P1. The Jet pipe must be installed after the last heat reclaim valve or pressure differential valve and before the split condenser valve. When piping the jet pipe into the system, a few considerations should be adhered to for positive operation of the Jet Kool System.

1. Do not reduce the pipe size from the outlet of the jet pipe to the inlet of the condenser, including the split condenser valve sizing.

2. If a ball valve is required between the jet pipe and the condenser, insure that this valve is full ported. Any reduction in line or port sizes from the outlet of the jet pipe to the inlet of the condenser will affect the performance of Jet Kool.

3. Access fittings must be installed on the Jet Pipe refrigerant inlet and the nozzle inlet. These fittings are required to check the performance of the Jet Pipe.

4. Placement of the Jet Pipe can be either in the horizontal or vertical positions. The pipe nozzle should be pointing toward the oil cooler refrigerant outlet to eliminate additional elbows.

21.2 Oil Cooler Plate Heat Exchanger Description

The plate heat exchanger is a brazed plate device with alternating refrigerant and oil passages separated by heat exchanger plates. As the refrigerant and oil past each other, the heat from the oil is transferred to the refrigerant. Both two pass and single pass counter flow type plate heat exchangers are utilized, depending upon the required load size.

Four mounting studs are provided for mounting the heat exchanger on the rack. Fluid connections for the refrigerant and oil are 1 ¾"-12 male RotaLock connectors. The two pass oil coolers have the refrigerant connections vertically opposed while the oil connections are on opposite sides. The refrigerant inlet is on the lower left connector, with the refrigerant outlet on the upper left connector.
The oil inlet & outlet connections are interchangeable. Single pass oil cooler connection fittings are located on the same side of the heat exchanger. These must be piped in a counter flow configuration with the refrigerant inlet on the lower left and the oil outlet on the lower right (Figure not shown). Reference (Jet Kool Flow Diagram, section 23.0)

The plate heat exchanger is piped between refrigerant side positions P3 and P4 and the oil side positions P5 & P6. The plate is to be mounted on lowest possible position of the rack frame in an area directly below the jet pipe (if this is not possible please consult the factory). This position will allow for a short refrigerant return line from the plate outlet to the jet pipe nozzle inlet (P4 piping configuration).

21.3 Liquid Flow Control Operation

Description

A flow control valve (JKV-100) is used to control the amount of refrigerant flow to the plate heat exchanger. The discharge temperature requirement determines the volume of refrigerant required to performing oil cooling. A 0-22 VDC signal is sent to the flow control valve from the ESC 201. The ESC 201 also monitors the discharge temperature by using either the PT 1000 sensor mounted in the compressor discharge or the rack sensor mounted on the discharge header.

ESC 201 Configuration

Proper configuration of the ESC 201 is essential to the correct Jet Kool operation. When the discharge temperature is sensed at each compressor discharge port, the “Temperature Probe” function in the ESC 201 must be configured as “PT1000” and the “Jet Kool Temperature” function must be assigned as “Compressors”. When the “Temperature Probe” function is configured as “PTC”, a single high temperature probe must be installed on the discharge header and the “Jet Kool Temperature” function must be assigned as “Rack Sensor”. The valve position and refrigerant flow are contingent upon this voltage signal. The constant control of oil temperature maintains the necessary discharge temperature setting.

Reference (Jet Kool Flow Diagram, section 23.0)

The flow control must be placed as close as possible to the plate heat exchanger refrigerant inlet and after check valve (H) in pipe P3. The valve should be properly supported and mounted in a location where physical contact and condensation will not affect the life or performance of the valve. The flow valve should be positioned in the same plane as, or above the heat exchanger refrigerant inlet to prevent a negative effect on any liquid head advantage.

21.4 JKV 100 Ana-loid Valve

The JKV 100 Ana-loid valve manufactured by Parker is used to meter refrigerant to the Jet Kool plate heat exchanger. This valve is operated from the ESC 201 control which receives a 0 – 22 VDC signal. The valve modulates from full open to 90% closed controlling the amount of refrigerant flow to the heat exchanger. JKV 100 has a ductile iron valve body with 1 3/8” copper braze fittings.
21.5 JKV 100 Ana-loid Coil
Positioning of the Ana-loid 24V coil on the valve stem is extremely important. The coil must be placed on the stem with the coil base flat against the valve housing. A screw is provided to secure the coil to the valve. This screw must be in place or the valve will not properly operate. If the screw is not in place the coil will travel up on the plunger, preventing the valve from opening and closing.

21.6 Setting Manual Oil Cooling
In the event of electronic component failure of either the JKV 100 coil or the ESC 201, the JKV 100 can be manually operated by the manual opener located on the downstream side of the valve in the adapter assembly. Remove the seal cap covering the manual opener screw on the adapter assembly.

The Ana-loid valve can be adjusted with the manual opener screw from closed to fully open with one full turn counter-clockwise. Adjustments between open and closed can control the flow through the valve to achieve the proper discharge temperature when operating in the manual mode. A discharge temperature of 150°F – 155°F is desired while operating in the manual mode.

To set this temperature, turn the manual opener 1/3 of a turn counter-clockwise and allow the temperature to stabilize. If the temperature has not been achieved a second and third adjustment may be required.

Specifications:

Ana-loid Coil Voltage: 24VDC
Design Pressure: 450 PSIG
Maximum Power: 7 Watts

21.7 Oil Cooler Fittings
Description
Four 1 ¾" – 12 X 1 3/8" ODS rotalock adapter fittings are supplied to connect refrigerant and oil lines to the plate oil cooler. An additional fitting may be supplied to connect the primary liquid refrigerant outlet to pipe P3, if the customer prefers a ball valve in place of a rotalock valve.

21.8 Primary Receiver Shut off Valve
Description (Jet Kool Flow Diagram, section 22.0)
A steel 1 3/8" rotalock valve is supplied for mounting on the bottom of the primary receiver. This valve is used to shut off refrigerant and isolate the liquid flow control valve located in pipe P3. A ball valve can also be utilized for this application as a customer preference.

21.9 Primary Receiver
Description (Jet Kool Flow Diagram, section 23.0)
A steel receiver is provided as a refrigerant reservoir to be installed in the system condensate drain line. This receiver provides a solid column of liquid to the plate oil cooler to insure positive heat transfer. Receiver is a flow through vessel holding approximately 3 gallons of liquid. A ½” NPT port is provided in the top dome for installation of a pressure relief valve. Valve type and relief setting is dependent on system refrigerant. Relief valve is not supplied in the jet Kool Kit.

21.10 Liquid Check Valve

**Description** (Jet Kool Flow Diagram, section 23.0)

Check valve is a Muller model # B34237 with less than ½ lb. pressure drop. This valve insures the refrigerant flow direction cannot reverse during pressure changes or surges. The valve is a full-ported 1 3/8” with 1 3/8” ODS. inlet and outlet connections. DO NOT SUBSTITUTE COPPER SPUN BALL CHECK VALVES. These valves normally have pressure drops that exceed the system specifications.

21.11 Liquid Sight Glass

**Description** (Jet Kool Flow Diagram, section 23.0)

A 1 3/8” ODS liquid sight glass is required in line P3 to make sure a solid column of liquid is present at all times. An optional sight glass of the same line size as P4 may be placed in this line.

21.12 Isolation Ball Valves

**Description** (Jet Kool Flow Diagram, section 23.0)

Ball valves are required in lines P3, P4 and P6 to isolate the plate oil cooler, if replacement is required. These ball valves will also permit servicing of the Ana-loid valve. It is strongly recommended that ball valves be placed in line P1 before and after the Jet Pipe. Along with the ball valve in line P4, the valves in line P1 will accommodate the removal of the Jet Pipe for changing the nozzle.

21.13 Access Fittings

**Description** (Jet Kool Flow Diagram, section 23.0)

Five ¼” access fittings with cores are required in lines P3 (2), P4, P5, and P6 to qualify and troubleshoot the system.
## 22.0 Troubleshooting the Jet Kool system

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. System will not operate during hot gas defrost:</td>
<td>1. If hot gas or cool gas defrost system has a master liquid line valve (pressure differential valve) it is highly possible the condenser hot gas is being circumvented and not supplying receiver.</td>
</tr>
<tr>
<td>2. System will not control the discharge system temperature:</td>
<td>2. Refrigerant charge is low and not feeding liquid to the primary receiver, and not supplying a solid column of liquid to the oil cooler. <strong>The liquid system cannot have any gas bubbles.</strong> Check the JKV 100 liquid valve to insure it is opening properly. Suggest opening the valve manually if there is any doubt about the valve operation. Check to make sure the liquid line from the condenser feeding the primary receiver falls from the condenser to the receiver. The liquid return line must fall without any risers to the receiver or to the oil cooler from the outlet of the primary receiver.</td>
</tr>
<tr>
<td>3. The System has operated for a long period of time, then suddenly stopped working:</td>
<td>3. Check for low refrigerant charge. There must be a solid column of liquid between the primary receiver &amp; the Analoid valve. Check system set points to make sure they have not been lowered. Jet Kool system has been calculated on a specific set of system setpoints. If the mass flow has been lowered this will adversely affect the oil cooling required and the Jet Pipe performance. If the solid column is intermittent, check for changes in hot-gas defrost schedules in the rack controller. (if applicable). Consult factory for possible solutions if the setpoints have been altered.</td>
</tr>
</tbody>
</table>
## Troubleshooting the Jet Kool system (continued)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. JKV 100 valve is not receiving an electrical signal:</td>
<td>4. Check master ESC 201 to insure a signal is being sent from the Jet Kool terminals.</td>
</tr>
<tr>
<td></td>
<td>Make sure the ESC 201 master has been configured for &quot;Jet Kool&quot; in the setup program.</td>
</tr>
<tr>
<td></td>
<td>Check the ESC 201 for the proper discharge temperature probe setup. If the temp sensors from each compressor are used to calculate the discharge temperature, then the &quot;Jet Kool Temperature Source&quot; should be &quot;Compressors&quot;.</td>
</tr>
<tr>
<td></td>
<td>If a single sensor is used from the rack discharge header, then the &quot;Jet Kool Temperature Source&quot; should be &quot;Rack&quot;.</td>
</tr>
<tr>
<td></td>
<td>Also check the &quot;Jet Kool Target Temperature&quot; for the proper setting.</td>
</tr>
<tr>
<td>5. Jet Kool will not work in split condenser mode:</td>
<td>5. Check to see if discharge lines are the same size out of the split valve as they are out of the Jet Pipe.</td>
</tr>
<tr>
<td></td>
<td>These lines must not be reduced out of the split valve. (The Jet Pipe must have a minimum of 2-1/8&quot; O.D. from the Jet Pipe outlet to the condenser inlet). Both discharge lines exiting the split valve must be a minimum of 2 1/8&quot; O.D. to the condenser inlets.</td>
</tr>
<tr>
<td></td>
<td>Check pressure drop across the condenser while in and out of split. Extremely high pressure drops when in split will adversely affect the Jet Kool performance.</td>
</tr>
<tr>
<td></td>
<td>Check the condenser split setup to make sure it is not switching into split above the manufacturer's recommended setting.</td>
</tr>
<tr>
<td></td>
<td>Make sure the condenser fans are shutting down on the proper side when in split.</td>
</tr>
</tbody>
</table>