

## Upgrade Procedures for Parallel Applications Using Digital Capacity Control for Copeland™ and Intelligent Store Discus™ Refrigeration Compressors (for 3D Discus)

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### Introduction

There are three main steps in the Copeland Discus Digital™ upgrade procedure: (1) head and valve plate conversion, (2) wiring the digital solenoid and/or the digital compressor controller, and (3) programming the master controller (in this document CPC's E2 Rack Controller).

On refrigeration applications where the load may vary over a wide range, some means of capacity control is often desirable for optimum system performance and control. In addition, compressor capacity modulation can reduce power and energy consumption, provide better load matching, reduce compressor cycling, and decrease the starting electrical load.

Copeland™ 3D Discus™ compressors can be retrofitted for enhanced modulation performance. Once a Copeland 3D Discus compressor is upgraded to Discus digital, the compressor can modulate from 10-100 percent of its capacity range, allowing the system to more precisely match capacity to the desired load of the refrigeration system.

This bulletin describes upgrade procedures for the Copeland Discus Digital and Intelligent Store Discus v2.x digital compressors.

### Requirements

As Copeland™ and Intelligent Store™ brand Discus Digital compressors become more readily adopted and used in the marketplace, revised recommendations are being outlined for the use of Discus Digital compressors in existing systems.

It is always the best choice to install a new Discus Digital compressor when the benefits of modulation are desired in an existing refrigeration system. However, if the compressor is less than 4 years old, then the Discus™ compressor can be upgraded to a digital with the recommended retrofit kit.

These revised guidelines will ensure that all digital upgrades of existing compressors in the field will function reliably under all circumstances of operation. If you have any questions or need additional information, please contact your Application Engineer or Service Engineering.

If using E2, E2 controller version 2.3 or later is required, or any rack control capable of providing a 1-5 variable voltage signal. Update firmware if necessary. An analog output point is needed on the controller. See section on analog output (AO) board for E2.

### On-Site Parts

As you work through the procedures below, make sure that you keep any parts removed from the compressor or mounted to the compressor, including bolts and studs. Some of the parts will be reused for the upgrade. The existing compressor head, valve plate and corresponding gaskets will not be reused.

### Tools/Supplies Needed

In order to upgrade a 3D Discus compressor there are some extra tools or supplies you may need. The following is a suggested list:

#### Mechanical Installation

- Ratchet
- Torque Wrench Capable of 60 ft-lbs
  - 9/16" Deep Well Socket
  - 3/4" Crow's Foot Attachment
- Hex Jaws Pipe Wrench for Rotalock Fitting
- Pipe Sealant
- Gasket Scraper

- Hammer
- Adjustable Wrench  
– 3/4" Wrench
- Pliers
- Assembly Oil

**NOTE!** Emerson strongly recommends using a torque wrench to ensure all bolt torque specifications are met.

**Note!** If using a torque wrench for tightening bolts, you will need a 3/4" crow's foot to properly attach the discharge flange connection to the cylinder head.

**Electrical Installation**

- Drill & Self Tapping Screws for Mounting Components in Electrical Panel
- Screwdriver  
– Large and Small
- Wire Stripper
- Wire Connector Ends (1/4" Spade)
- Conduit Connections
- Wire Ties
- Electrical Tape
- Power wires (to connect Digital Compressor Controller to solenoid coil, transformer, and AO Board)
- Shielded cable (for connection to the E2)
- Flexible 3/8" Metal Conduit For High Voltage Coil Applications
- Flexible 3/8" Plastic Conduit (Optional)

**Note!** Consult your rack controller manufacturer for the appropriate wire and power cables.

**Choosing the Correct Upgrade Kit**

When deciding which upgrade kit to choose, you need to know two things: (1) is the compressor equipped with Intelligent Store Discus v2.x? and (2) what is the application? (e.g. low, or medium/ high temperature) Based on this information, you have four different upgrade kits to choose from in **Tables 1 and 2** on the following pages. Each upgrade kit includes a digital head, valve plate, gaskets, sensors, and high cycle solenoid coils. Each part is numbered and depicted in **Figure 1**. For further explanation of the kit pieces, refer to the Appendix of this bulletin.

Emerson also recommends using a select fit valve plate gasket for each Discus Digital upgrade to ensure optimal compressor performance. The Select Fit Valve Plate Gasket Kits are shown in **Table 3**. There are kits available for both OEM compressors and remanufactured service compressors. If the compressor you are upgrading is the original compressor for the site, then it is most likely an OEM compressor. However, if the compressor has been replaced by a compressor from a wholesaler, then there is a good chance this is a remanufactured service compressor. You can verify by checking the compressors serial number listed on the nameplate. Remanufactured service compressors are indicated by a "6", "7", or "8" in the 4th character of the serial number. Any other character in this location will designate an OEM compressor. More information on selecting the appropriate valve plate gasket is covered on Page 8.



**Figure 1 – Items in a Typical Discus Digital Upgrade Kit (corresponding to Item No. in Tables 1 and 2)**

**Table 1 - Non-ISD Discus Digital Upgrade Kits**

<b>Kit</b>	<b>Kit P/N</b>	<b>Item No.</b>	<b>Item Description</b>	<b>Item P/N</b>
Medium Temperature Non-ISD Upgrade Kit	980-3000-00	<b>1 &amp; 2</b>	Head-Service Kit - Gaskets	902-0317-00
		<b>3</b>	3D Discus Digital Valve Plate Kit - Gaskets	998-6661-30
		<b>4</b>	IDCM Module Kit /Copeland Digital Compressor Controller - 5kOhm, 1W Resistor**	943-0086-00
		<b>6</b>	Sensor Temp Probe Kit	985-0109-07
		<b>7</b>	Solenoid Coil x2 (120V & 220V) - Solenoid Bracket - Screw	923-0084-01, -02
		<b>8</b>	24V Transformer	037-0023-00
		<b>9</b>	Instructional Sheets - AE8-1328 Copeland Digital Compressor Controller - AE4-1357 Upgrade Procedures ... - 2009ECT-48 Discus Digital Upgrade Kit Instructions	N/A
Low Temperature Non-ISD Upgrade Kit	980-3000-01	<b>1 &amp; 2</b>	Head-Service Kit - Gaskets	902-0317-00
		<b>3</b>	3D Discus Digital Valve Plate Kit - Gaskets	998-6661-31
		<b>4</b>	IDCM Module Kit /Copeland Digital Compressor Controller - 5kOhm, 1W Resistor**	943-0086-00
		<b>5</b>	Tall Fan Bracket	074-0805-00
		<b>6</b>	Sensor Temp Probe Kit	985-0109-07
		<b>7</b>	Solenoid Coil x2 (120V & 220V) - Solenoid Bracket - Screw	923-0084-01, -02
		<b>8</b>	24V Transformer	037-0023-00
		<b>9</b>	Instructional Sheets - AE8-1328 Copeland Digital Compressor Controller - AE4-1357 Upgrade Procedures ... - 2009ECT-48 Discus Digital Upgrade Kit Instructions	N/A

**Table 2 - Intelligent Store Discus v2.x Digital Upgrade Kits**

<u>Kit</u>	<u>Kit P/N</u>	<u>Item No.</u>	<u>Item Description</u>	<u>Item P/N</u>
Medium Temperature Intelligent Store v2.x Upgrade Kit	980-3000-10	<b>1 &amp; 2</b>	Head-Service Kit - Gaskets	902-0317-00
		<b>3</b>	3D Discus Digital Valve Plate Kit - Gaskets	998-6661-30
		<b>7</b>	Solenoid Coil (24V)	923-0084-00
		<b>9</b>	Instructional Sheets - AE4-1357 Upgrade Procedures ... - 2009ECT-48 Discus Digital Upgrade Kit Instructions	N/A
Low Temperature Intelligent Store v2.x Upgrade Kit	980-3000-11	<b>1 &amp; 2</b>	Head-Service Kit - Gaskets	902-0317-00
		<b>3</b>	3D Discus Digital Valve Plate Kit - Gaskets	998-6661-31
		<b>5</b>	Tall Fan Bracket	074-0805-00
		<b>7</b>	Solenoid Coil (24V)	923-0084-00
		<b>9</b>	Instructional Sheets - AE4-1357 Upgrade Procedures... - 2009ECT-48 Discus Digital Upgrade Kit Instructions	N/A

**Table 3 - Select Fit Valve Plate Gasket Kit Part Numbers**

Kit Description	Kit Part #	
	OEM Compressor	Remanufactured/ Service Compressor
3DB*,3DP*, 3DJ* Select Fit Valve Plate Gasket Kit	920-1367-00	920-1233-01
3DF*,3DK*, 3DG* Select Fit Valve Plate Gasket Kit	920-1367-01	920-1233-03
3DA*,3DE*, 3DH* Select Fit Valve Plate Gasket Kit	920-1367-02	920-1233-05
3DS*,3DT*, 3DR* Select Fit Valve Plate Gasket Kit	920-1367-03	920-1233-07

Note: More information on Choosing the Correct 3D Valve Plate Gasket available on Page 8.

Remanufactured compressors are designated by a “6”, “7”, or “8” in the 4th character in the serial number (e.g. 06B6xxxxx). Any other character in this location will designate an OEM compressor. (e.g. 03C0xxxxx)

### Copeland Discus/Intelligent Store Discus v2.x to Copeland Discus Digital Head and Valve Plate Conversion

**Note!** Please review this section even if you are familiar with a standard Discus head and valve plate conversion. Refer to **Checklist #1** for the compressor head and valve plate change, which can be found in the Appendix at the end of this document.

1. Prepare compressor for a head change, per industry standards:
  - Front seat suction service valve
  - Pumpdown compressor
  - Disconnect power to compressor
  - Front seat discharge service valve and oil supply valve (If applicable)
  - Depressurize compressor
2. Loosen the discharge service valve away from the compressor.
3. Remove the discharge valve adaptor (it will be used on the new head); keep it in a safe place.
4. Scrape off all gaskets from the discharge flange and adaptor.
5. Remove any high pressure connections from the head and the head fan (if equipped).
6. Note the location of any studs on the head (high pressure control and oil pressure module may be mounted here).
7. Remove the cylinder head bolts.
8. Tap the head to break it loose from the valve plate.
9. Remove dowel pins and save for digital head and valve plate installation.
  - Record valve plate gasket thickness and part number for reference when selecting appropriate new valve plate gasket. (See **Figure 2**.)
10. Lightly tap up on the tab or on the side of the valve plate to loosen and then remove valve plate. Use caution to not damage the compressor deck surface.
11. Check that the pistons travel up and down freely.

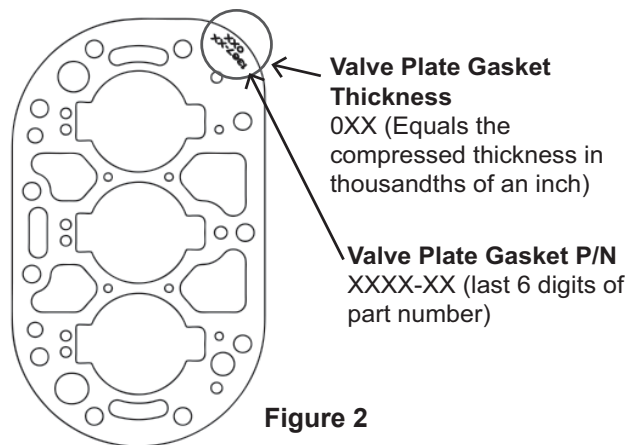


Figure 2



Figure 3 - Check that the pistons travel up and down freely by pressing down on each of the cylinders.

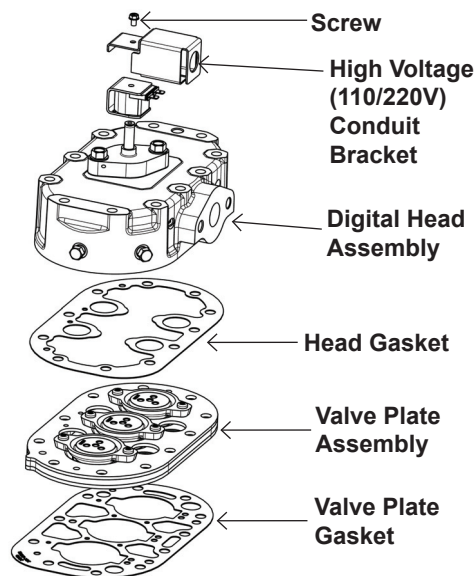


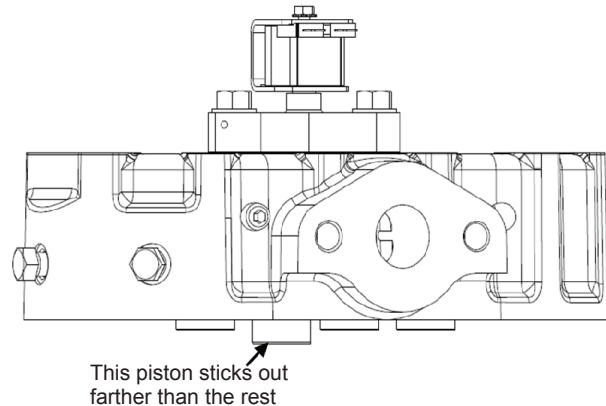
Figure 4 - Exploded View of Copeland Discus Digital head and valve plate assembly

12. Inspect the valves and valve plate for any damage (i.e. broken reeds) and that there are not any existing system issues that should be addressed.
13. Scrape any gasket material from the compressor deck; take care to keep any debris from entering suction passages of the body or cylinder bores and make sure not to damage the compressor deck.
14. Select the proper valve plate gasket for the bore size of the compressor. (See **Choosing the Correct 3D Valve Plate Gasket Selection** on Page 7.)
15. Lightly coat both sides of the new valve plate gasket with assembly oil. Orient the valve plate gasket with dowel pins and ports. Install valve plate gasket. TAB SHOULD BE ORIENTED ON THE OIL PUMP END WITH PART NUMBER ON TOP.
16. Inspect new valve plate for handling damage and install.
17. Lightly oil both sides of the Discus digital head gasket and install. TAB SHOULD BE ORIENTED ON THE OIL PUMP END WITH PART NUMBER ON TOP.
18. Visually inspect pistons in head for loose debris. **Note!** The digital head has four internal pistons, one protrudes farther out than the other three. This is intentional. See **Figure 5**.

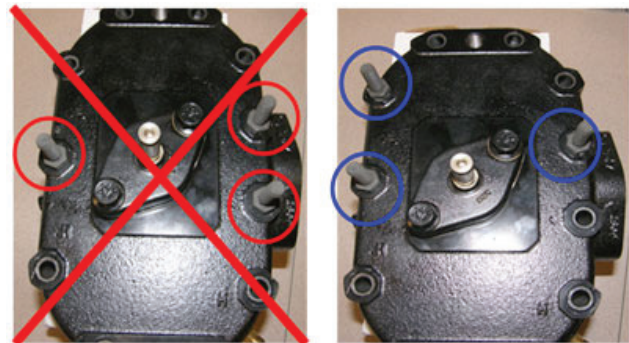
**CAUTION: DO NOT REMOVE PISTONS FROM INSIDE HEAD!**

19. Install the Discus digital cylinder head. Take care to not damage the solenoid stem mounted on the compressor head.
20. Replace stud bolts (if equipped) in their correct location to mount components/head fan.
 

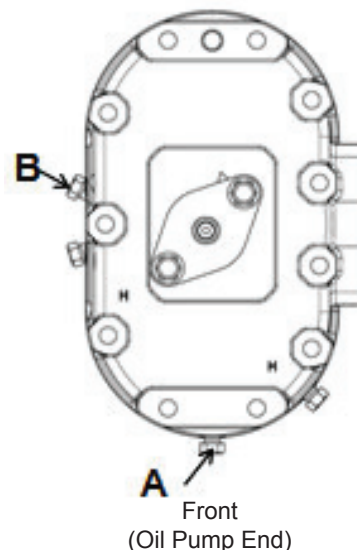
NOTE! If upgrading on a low temperature Discus compressor with head fan, you will need to replace the fan bracket with taller fan bracket supplied in the upgrade kit. **Figure 6** shows the new stud bolt locations.
21. Finger tighten bolts and torque evenly in crossing pattern to 50 ft-lbs. (See **Torque Patterns** on following page for proper torquing procedures.)
22. Reassemble the high pressure port connections with appropriate thread sealant.



**Figure 5** - Four pistons inside the digital cylinder head, one piston sticks out farther by design



**Figure 6** - (left) Standard discus head fan mounting stud bolt locations; (right) Discus Digital head fan mounting stud bolt locations with taller bracket. The taller fan bracket (also used with Moduload) requires different stud bolt locations than the standard 3D Discus.



**Figure 7** - Top view of 3D Discus cylinder head with possible temperature probe locations.

23. Install discharge temperature probe (see **Figure 7**)

- Copeland Discus use port (A) or port (B)
- If equipped with Demand Cooling<sup>1</sup> use the existing discharge temperature probe from the removed head assembly. Only install the demand cooling temperature probe in port (A)
- ISD v2.x use port (B) only

24. Tighten temperature probe and discharge pressure pickup connections firmly and recheck torque on all the bolts.

25. Install new teflon seal provided in gasket kit in the discharge/flange adaptor. (See **Figure 8**.)

26. Place metal gasket (Orient raised ribbed side towards compressor body) on the discharge adaptor and connect adaptor to head.

**Note! If there is a muffler plate install gaskets on both sides of muffler plate.**

27. Incrementally torque flange bolts to 60 ft-lbs. in an alternating pattern. (See **Torque Patterns** below for proper torquing procedures.)

28. Reconnect the discharge service valve.

29. Refer to **Checklist #1** in Appendix to verify all steps have been completed in the head and valve plate conversion.

30. Evacuate compressor and reopen all the necessary valves to the compressor per industry standards.

31. Leak test the compressor.

32. Install Discus Digital™ solenoid coil, solenoid bracket<sup>2</sup>, and conduit<sup>2</sup> on solenoid valve stem<sup>2</sup>. Make sure to choose correct voltage solenoid coil. See **Figure 9**.

33. If the compressor is equipped with a head fan, install<sup>3</sup> taller fan bracket (Used on Copeland 3D Moduload™ models) and head fan<sup>3</sup>.

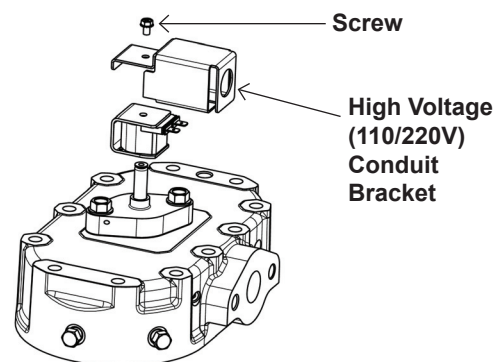
<sup>1</sup> Intelligent Store Discus compressors with Demand Cooling are pending approval.

<sup>2</sup> Required for non-Intelligent Store Discus only.

<sup>3</sup> Refer to installation instructions supplied with fan mounting kit.



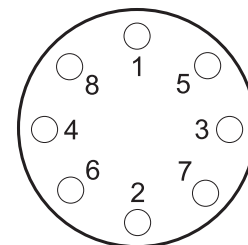
**Figure 8** - Install a new Teflon seal into the discharge/flange adaptor.



**Figure 9** - Solenoid coil assembly including bracket

**Torque Patterns**

For all cover plates (heads, bottom plates, shipping pads, valves, etc.) to achieve a proper seal, it is important when applying torque to use a criss-cross pattern. Follow the steps below.



**Figure 10**

Do not apply torque in a circular pattern. For the initial torque, apply no more than 70% of the final torque using a diagonal criss-cross pattern, similar to the example in **Figure 10**. Once the initial torque has been applied, apply the proper full torque value, again using a criss-cross pattern. Once the final torque has been applied, start at any bolt, and circle the entire part in sequence. This will verify that a bolt has not been missed and that final torque has been applied.

**Choosing the Correct 3D Valve Plate Gasket**

**For use with 3D Delta Reed compressors only.**

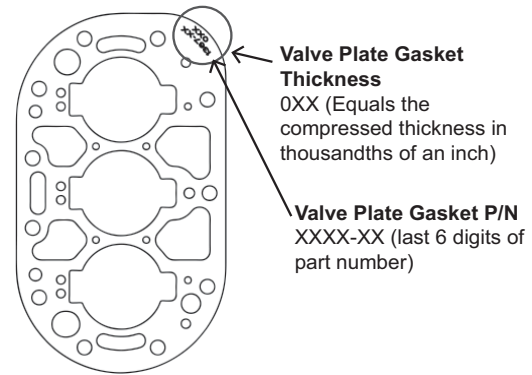
**Note!** Emerson offers an optional select-fit valve plate gasket kit (sold separately) to optimize your compressor's performance. If you choose not to use select fit gaskets the thickest gasket for each compressor bore size is already provided to you in your upgrade kit.

Valve plate gasket kits with thicknesses in 0.002" increments are offered to minimize compressor performance loss due to increased re-expansion volume. Kits are available for each bore size (both OEM and remanufactured\* models). OEM kits range from 031(0.031") to 039 (0.039"). Remanufactured kits range from 031 to 041. The thickest remanufactured gasket (045) will be provided with the head and valve plate kits.

1. Record the existing valve plate gasket part number and thickness found on the tab of the valve plate gasket before removing existing valve plate and head.

2. Choose the correct gasket part number (per the table below) and match the thickness shown on the tab of the existing gasket.

- If the exact thickness is not available, select the next thickest gasket. For example, existing gasket reads 032, select 033 gasket or thicker.
- If you can not read the gasket thickness on existing valve plate gasket, use the thickest replacement gasket (see table below).



3D Model	OEM Compressor Valve Plate Gasket Selection				Remanufactured Compressor Valve Plate Gasket Selection*			
	OEM compressor gaskets are NOT included in Upgrade Kit, only the Select Fit Valve Plate Gasket kits (sold separately).				The maximum thickness remanufactured compressor gaskets for each 3D bore size are included in Upgrade Kits. Other thickness gaskets are available in a Select Fit Valve Plate Gasket Kit (sold separately).			
	Existing Part #	Gasket Kit #	Number of Gaskets & Thickness	Maximum Thickness	Existing Part #	Gasket Kit #	Number of Gaskets & Thickness	Maximum Thickness
3DB* 3DP* 3DJ*	020-1367-00 020-1232-00	<b>920-1367-00</b>	(1) 0.031 (4) 0.033 (4) 0.035 (2) 0.037 (2) 0.039	039	020-1233-01	<b>920-1233-01</b>	(1) 0.031 (1) 0.033 (2) 0.035 (2) 0.037 (2) 0.039 (1) 0.041	045
3DF* 3DK* 3DG*	020-1367-02 020-1232-02	<b>920-1367-01</b>	(1) 0.031 (4) 0.033 (4) 0.035 (2) 0.037 (2) 0.039	039	020-1233-03	<b>920-1233-03</b>	(1) 0.031 (1) 0.033 (2) 0.035 (2) 0.037 (2) 0.039 (1) 0.041	045
3DA* 3DE* 3DH*	020-1367-04 020-1232-04	<b>920-1367-02</b>	(1) 0.031 (4) 0.033 (4) 0.035 (2) 0.037 (2) 0.039	039	020-1233-05	<b>920-1233-05</b>	(1) 0.031 (1) 0.033 (2) 0.035 (2) 0.037 (2) 0.039 (1) 0.041	045
3DS* 3DT* 3DR*	020-1367-06 020-1232-06	<b>920-1367-03</b>	(1) 0.031 (4) 0.033 (4) 0.035 (2) 0.037 (2) 0.039	039	020-1233-07	<b>920-1233-07</b>	(1) 0.031 (1) 0.033 (2) 0.035 (2) 0.037 (2) 0.039 (1) 0.041	045

\*Remanufactured compressors are designated by a "6", "7", or "8" in the 4th character in the serial number (e.g. 06B6xxxxx). Any other character in this location will designate an OEM compressor. (e.g. 03C0xxxxx)



**Warning: Using a gasket that is too thin may result in reduced compressor life due to piston or valve plate damage.**

If you can not read the part number on the existing valve plate gasket, select replacement gasket by matching existing valve plate gasket or by matching the compressor cylinder bores. You can verify correct selection by using the model number, serial number and table below.

**Warning: The proper valve plate gasket will match the cylinder bore or be slightly larger. Gasket material should never overlap into the cylinder bore.**

The following pages cover wiring the solenoid and digital compressor controller as well as programming the E2 for Non- Intelligent Store Discus (ISD) compressors. If you are upgrading an ISDv2.x compressor to Discus digital, skip to page 14 for further instruction.

**Wiring for Non-Intelligent Store Discus Compressors**

**Digital Compressor Controller**

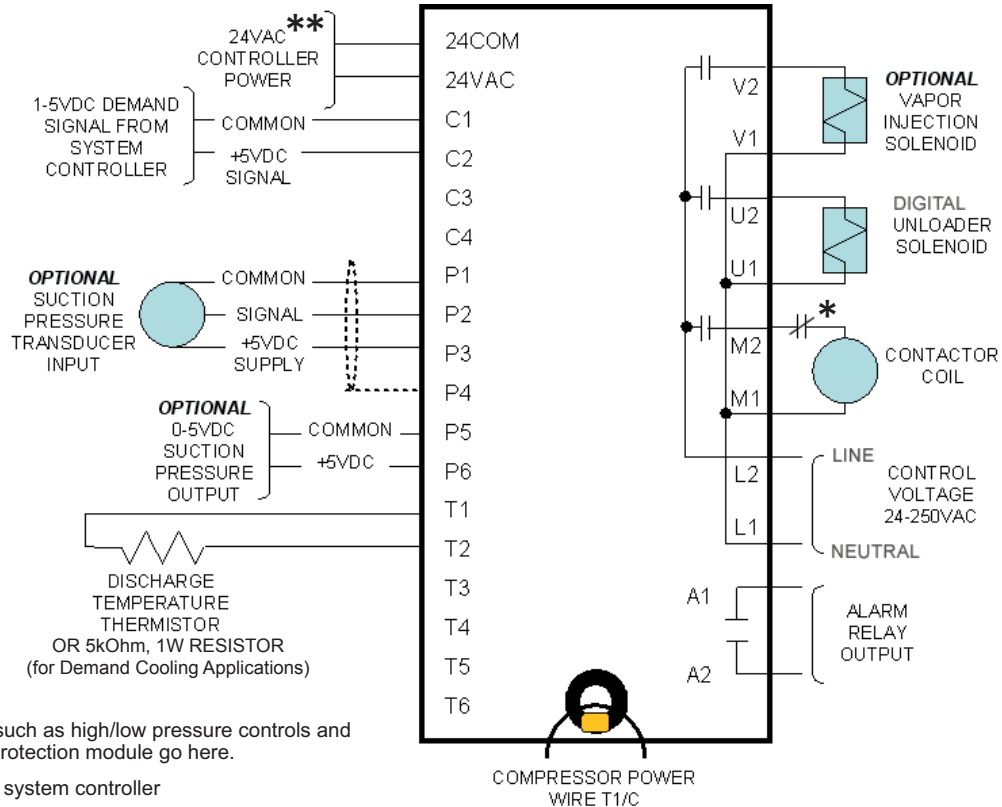
The Digital Compressor Controller is the electronics interface between the Discus digital compressor and the system controller. The rack controller measures

temperature or pressure to calculate the needed compressor capacity and communicates that capacity to the Digital Compressor Controller via a 1-5VDC analog signal. The wiring diagram for the digital compressor controller is shown below in **Figure 11**.

For more information and installation instructions for the Copeland Digital Compressor Controller refer to Application Engineering Bulletin **AE4-1328**, Copeland Digital Compressor Controller.

**Analog Output (AO) Board (If spare analog output is not available)**

Find room in the electrical panel to install the AO board. The AO board takes the variable voltage signal from the E2 controller and delivers it to the Digital Compressor Controller and other components. The AO board has a plastic mounting plate which is mounted in the electrical control panel; the board is snapped into place. Slide the AO board into the bracket. Wire power supply to the AO board. Connect the 485 network to the AO board; the AO will communicate with the E2 controller. Emerson Climate Technologies has used CPC's 4AO board (CPC part number 810-3030) for most of their own testing with Discus digital. However, any analog output can be applied for use with the Discus digital compressor.



\* Protection controls such as high/low pressure controls and compressor motor protection module go here.

\*\* Polarity must match system controller

Note: The Neutral to L1, M1, U1, V1 is connected together.

**Figure 11 – Digital Compressor Controller Wiring Diagram**

### Programming The E2 For Non-ISD Copeland Discus Digital

When using the digital compressor controller you need an E2 v2.3 or newer. An analog output point is needed on the controller. You may need to install an AO board if there is not an available point in the E2.

**Note!** The digital compressor should be set as one stage in the E2. If upgrading from Copeland Modu-load™, you will need to delete the extra unloader stage set up accordingly in the suction group.

**Note!** These instructions are based on E2 v2.6

These are suggested E2 instructions based on Emerson's experience. There may be more than one

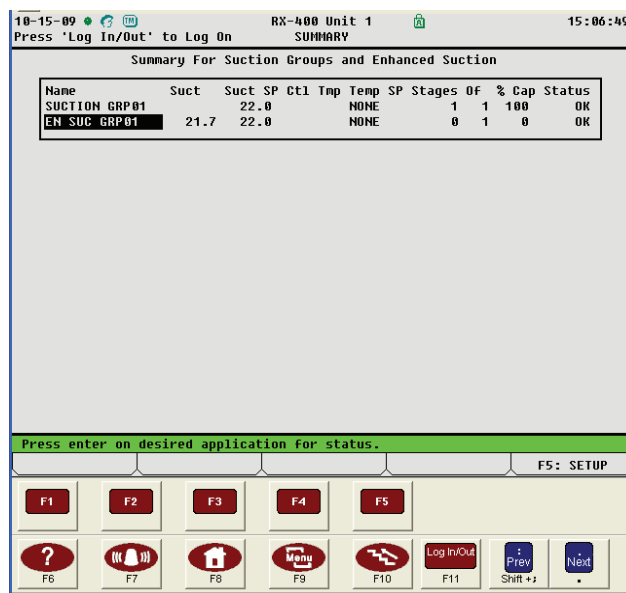
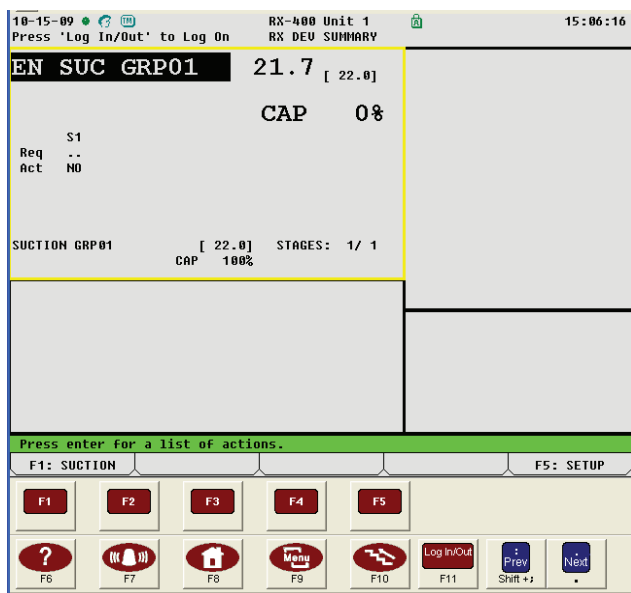
way to properly program the E2 for Discus digital. Use **Checklist #3** in the Appendix to verify the digital is being controlled properly.


In order to program the E2 for Copeland Discus Digital using the digital compressor controller you will perform the following steps:


1. Override compressor OFF
2. Setup suction group and assign an output to the Digital Compressor Controller
3. Setup analog output
4. Disable compressor override

Below you will see screen shots taken from the E2 to perform the above steps.

1. After Logging Into<sup>1</sup> The E2, From The Home Screen<sup>2</sup> Press **F1: Suction** To Arrive At the **'Summary For Suction Groups and Enhanced Suction' Screen**. Select The Enhanced Suction<sup>3</sup> Group That Has The Digital Compressor Installed.

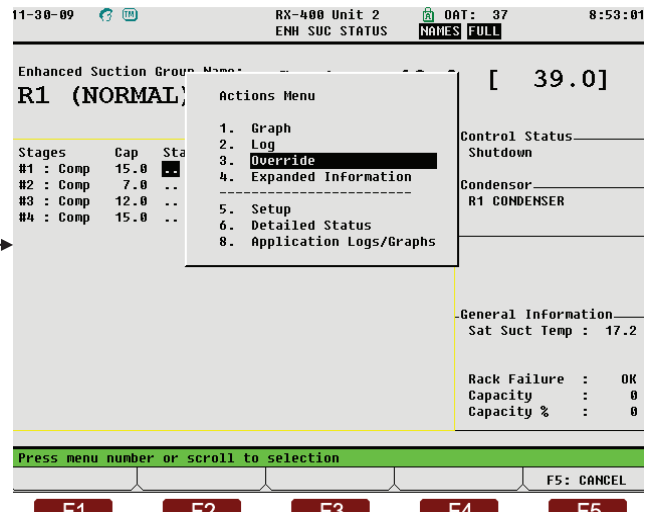
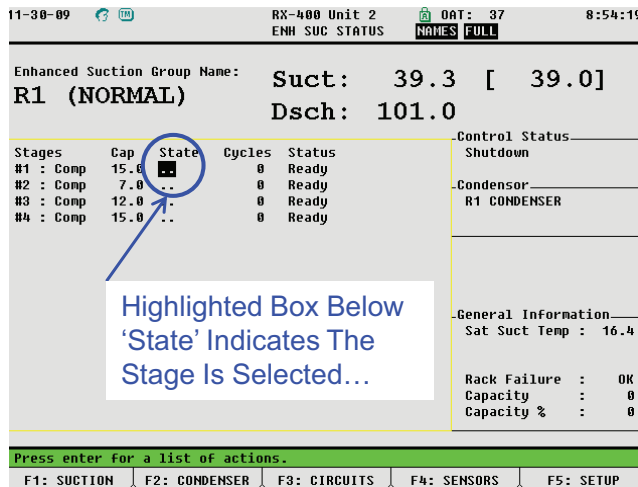


<sup>1</sup> Press The  And Enter Your User ID and Password To Log On

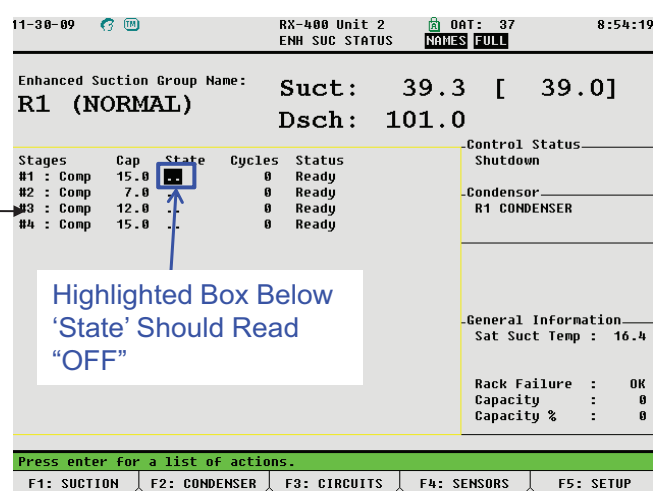
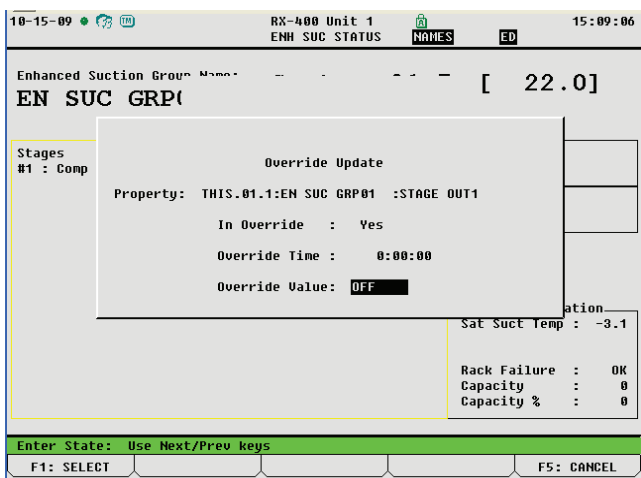
<sup>2</sup>The  Button Takes You To The Home Screen

<sup>3</sup> When Using Copeland Digital™ Compressors With CPC E2 You Must Use The Enhanced Suction Feature To Properly Control The Digital Compressor

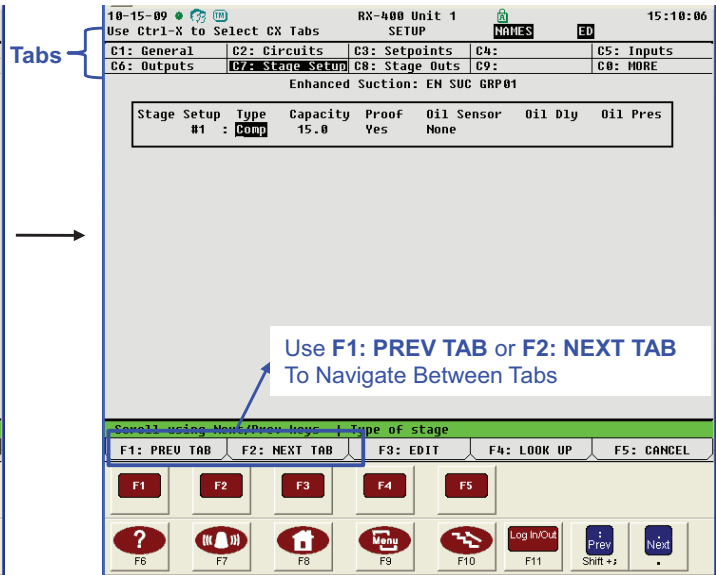
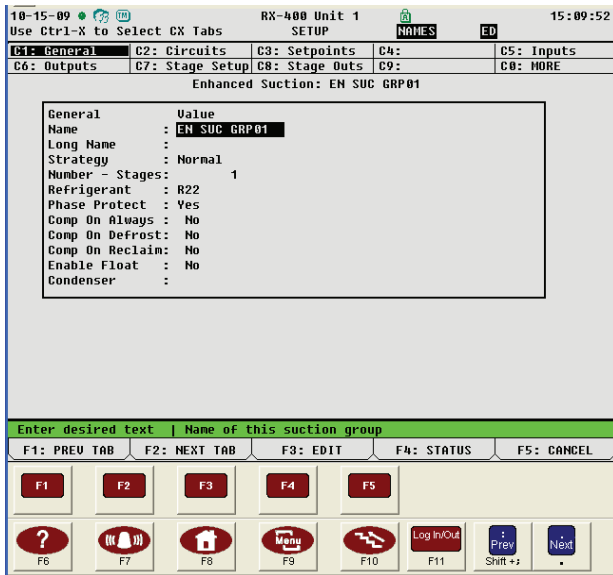
2. Scroll Down And Highlight The Compressor That Contains The Digital Unloader And Press Enter To Show The 'Actions Menu'. Select **Override** And Press Enter.



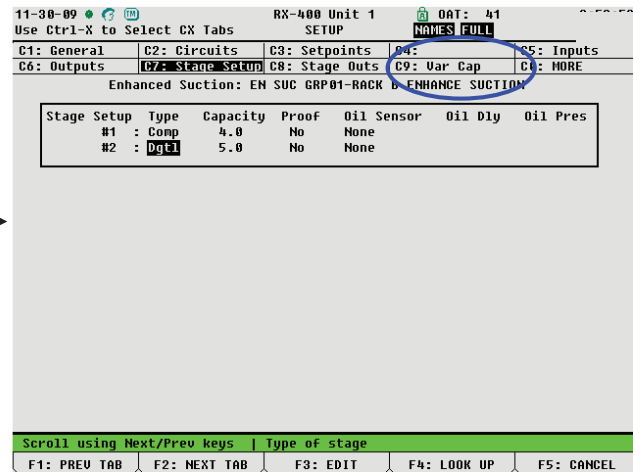
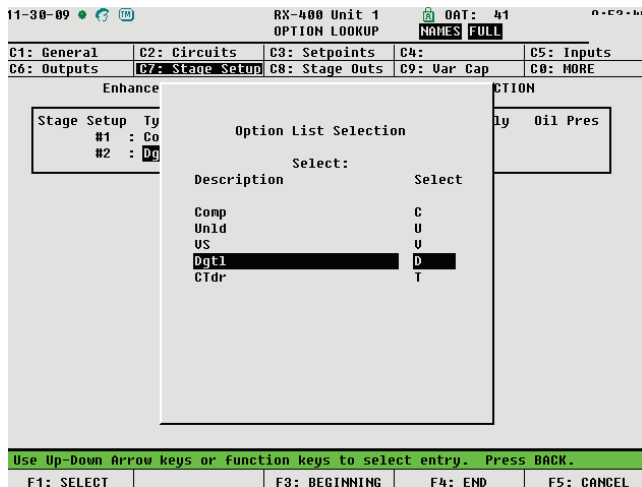
The 'Override Update' Window Will Appear. Type "YES" in The In Override Space and Type "OFF" Where It Shows Override Value. You Do Not Need To Change The Override Time. Press Enter To Return To the Suction Group Summary Screen.



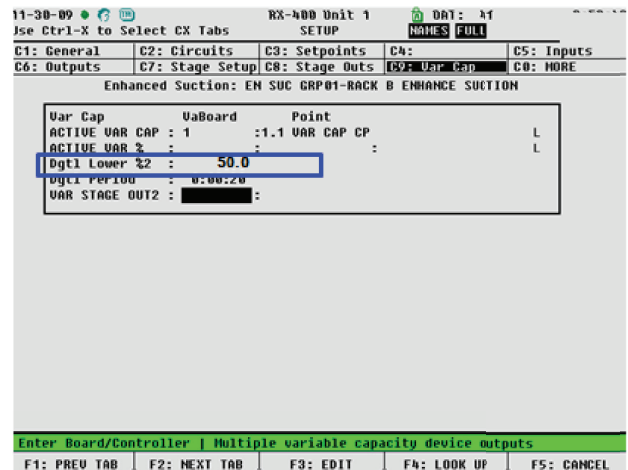
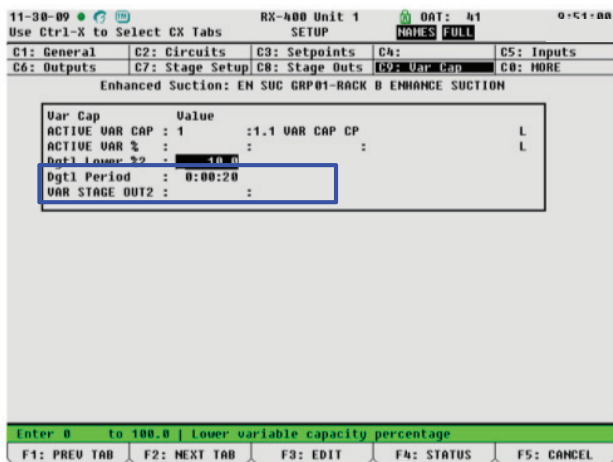
3. Press **F5: Setup** To Enter the 'Setup' Screen. Advance To **C7: Stage Setup**. Select The Compressor Stage With Digital Installed, Press **F4: Look Up** To Show The 'Options List Selection' Window.



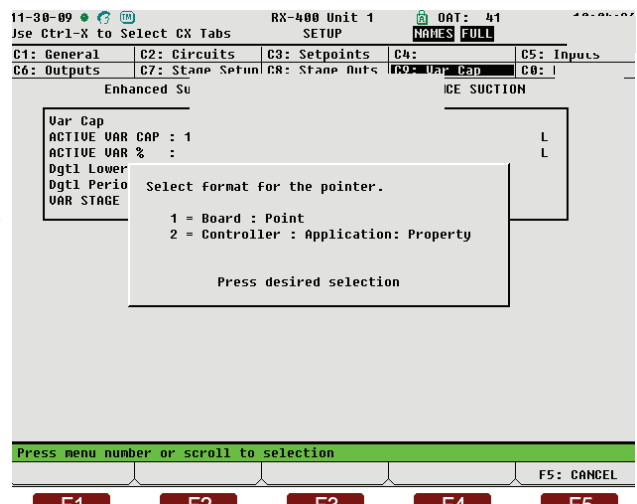
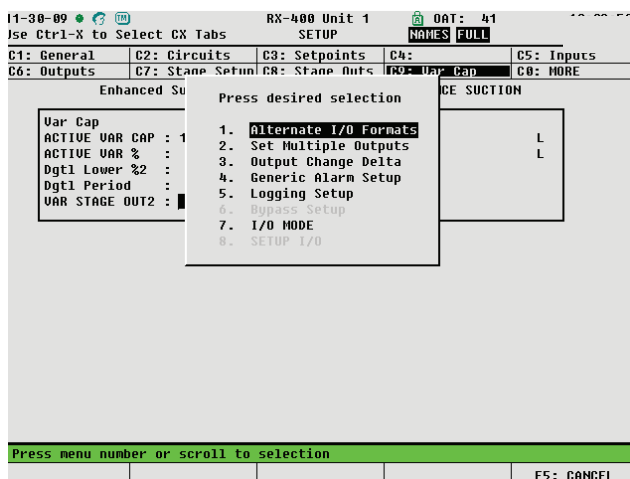
Select **Dgtl** By Typing "D." This Will Return You To The Stage Setup Screen. Press The Stairstep ( ) Key To Return To The 'Enhanced Suction Summary' Screen And Confirm 'DGTL' Appears Under The 'Stages' Column For The Digital Compressor. When You Return To The Setup Screen The **C9:Var Cap** Tab Will Appear



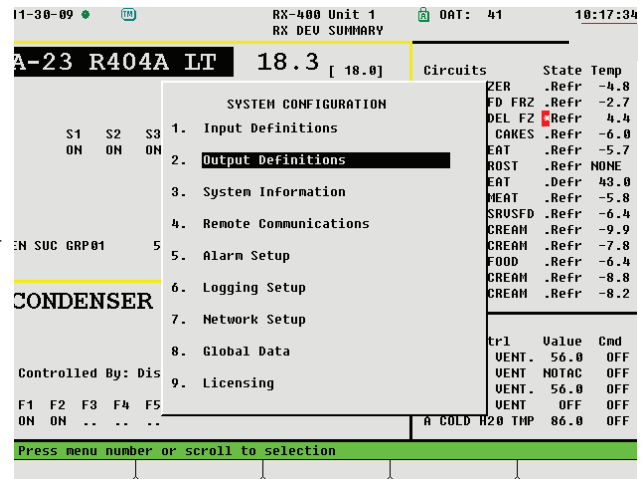
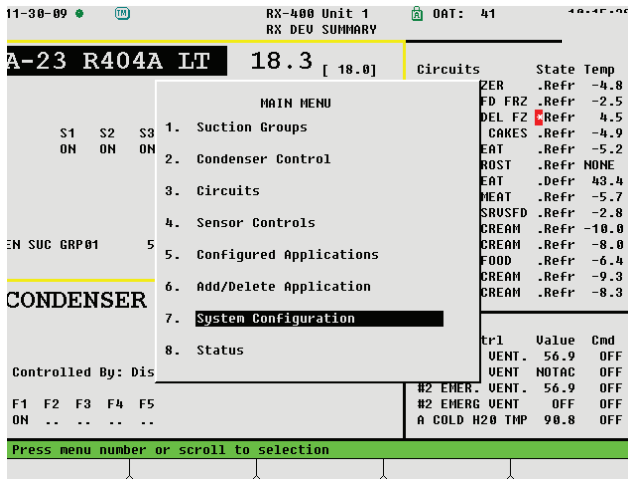
- Open The **C9: Var Cap** Tab. Select the '**Dgtl Lower %\***' field and change value to 10.0 (Where \* Refers To The Stage Number Assigned To The Digital Compressor On The Suction Group). Make Sure The '**Dgtl Period**' Is Set To 0:00:20.
- Scroll Down To '**VAR STAGE OUT\***' Press **F3: Edit** To Pull Up The "Press Desired Selection" Menu



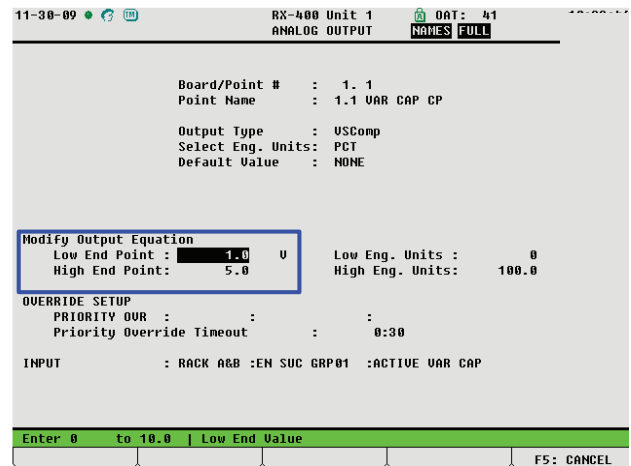
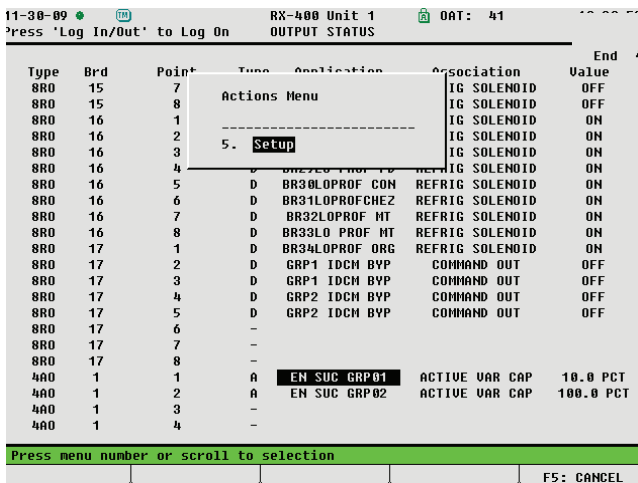
Select **1. Alternate I/O Formats**. This Brings Up The "Select Format For The Pointer", Choose **1 = Board : Point** and Enter The Analog Output Point That Controls The Digital Compressor Controller (i.e. 1:1, 1:2, 1:3, etc)



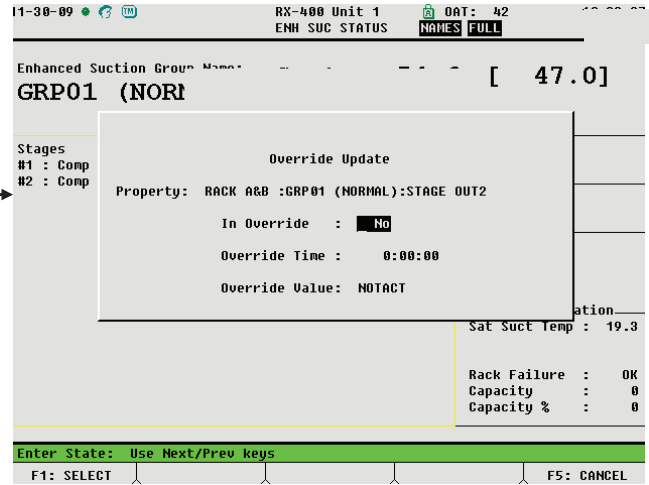
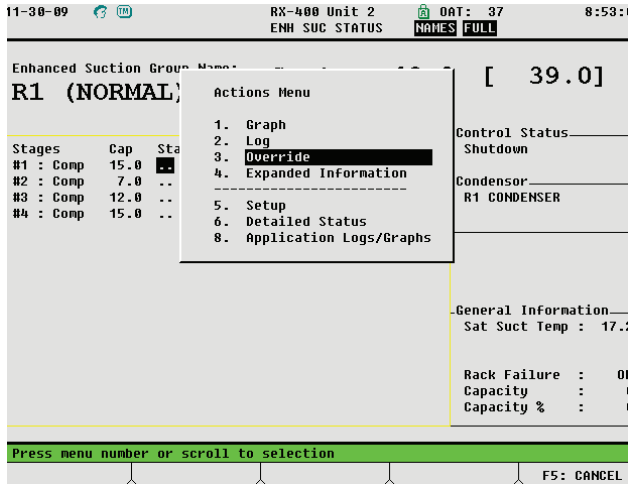
7. Return To The Home Screen (Press ). Go To The Main Menu (Press ). Select **7. System Configuration**. Select **2. Output Definitions**.



8. Scroll Down To Select The Analog Output Point Connected To The Digital Compressor Controller. Press Enter and Select **5. Setup** From The Actions Menu. Modify The **'Low End Point'** and **'High End Point'** To 1.0 And 5.0 Respectively.



9. Return To The Suction Group Page And Remove The Compressor Override (Type “No” After ‘In Override’)



**Wiring for Intelligent Store Discus v2.x**

If installing Discus digital on an Intelligent Store Discus v2.x compressor the only wiring needed after head and valve plate change is connecting the unloader wire connections found in the Intelligent Store Discus wiring harness. To connect, remove the pressure switch cover and connect the unloader wires (yellow) found in the wiring harness to the solenoid coil. Replace the pressure switch cover. See **Figure 12**.

**Programming The E2 for Intelligent Store Discus Digital**

When using with ISD v2.x, E2 v2.6 or newer must be used. Update E2 firmware if necessary. An analog output point is not needed on the controller. Communication is done through the RS485 communication cable.

Note! The digital compressor should be set as one stage in the E2. If upgrading from Copeland Moduload, you will need to delete the extra unloader stage set up accordingly in the suction group.

**Note!** These instructions are based on E2 v2.6

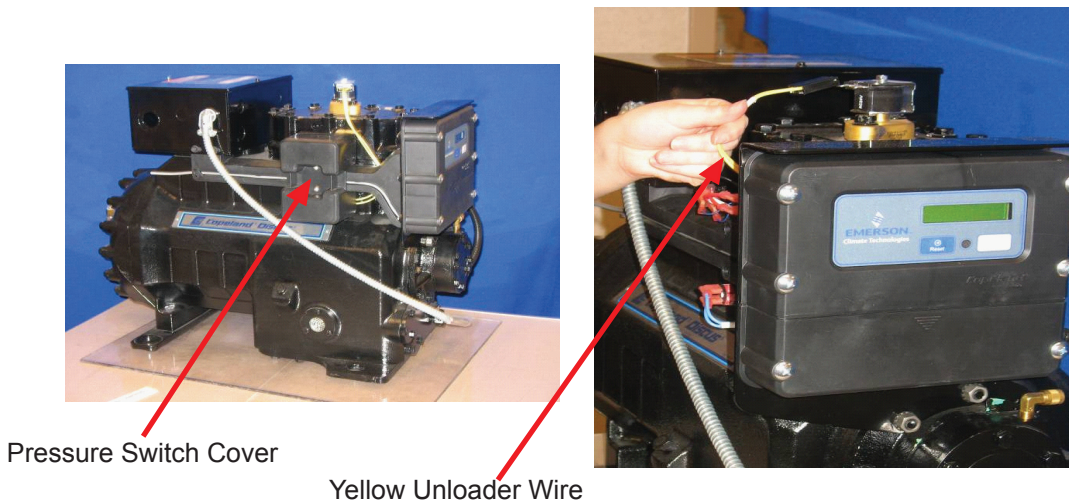
These are suggested E2 instructions based on Emerson’s experience. There may be more than one

way to properly program the E2 for Intelligent Store Discus Digital. Use Checklist #3 to verify the digital is being controlled properly.

In order to program the E2 for Copeland Discus Digital using the digital compressor controller you will perform the following steps:

1. Establish the E2 control and communication SEND link
  - a. Override compressor OFF
  - b. Identify the compressor stage as a digital compressor
3. Establish the ISDv2.x communication RECEIVE link
  - a. Setup unloader control in ISDv2.x and define unloader control type as digital
  - b. Define digital controller, application and property inputs
  - c. Disable compressor override

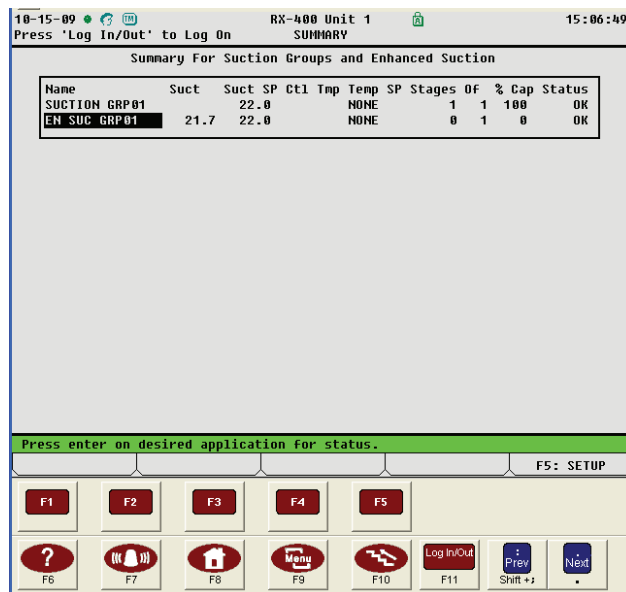
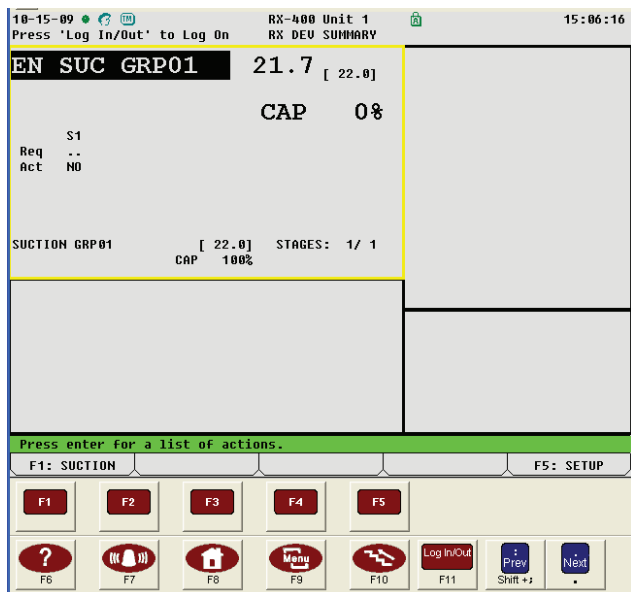
On the following pages you will see screen shots taken from the E2 to perform the above steps.





**Figure 12  
Intelligent Store Discus v2.x Wiring**

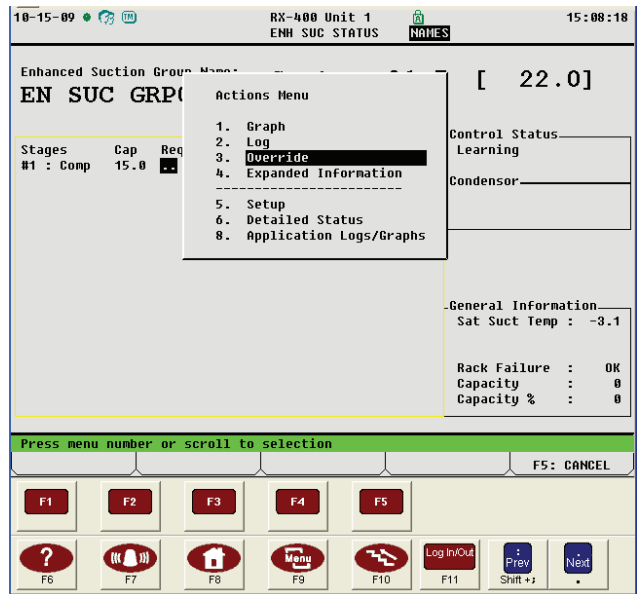
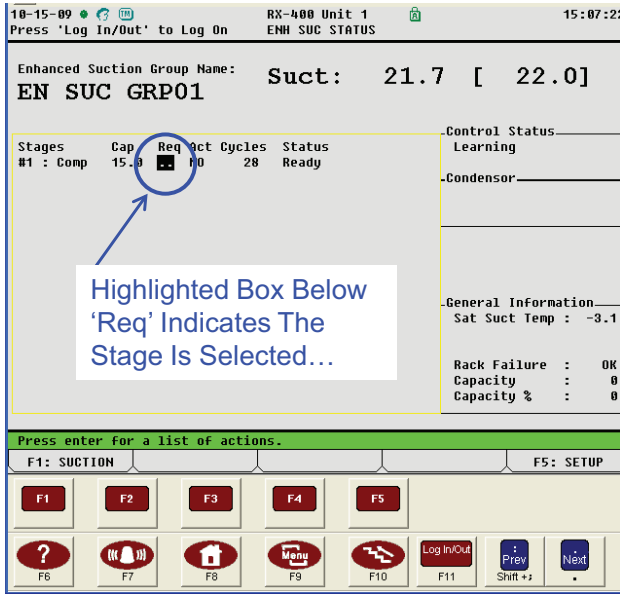


1. After Logging Into<sup>1</sup> The E2, From The Home Screen<sup>2</sup> Press **F1: Suction** To Arrive At the **'Summary For Suction Groups and Enhanced Suction' Screen**. Select The Enhanced Suction<sup>3</sup> Group That Has The Digital Compressor Installed.

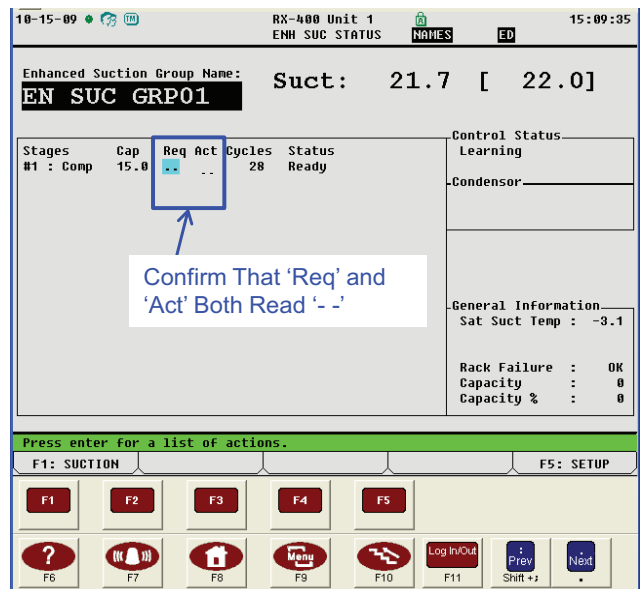
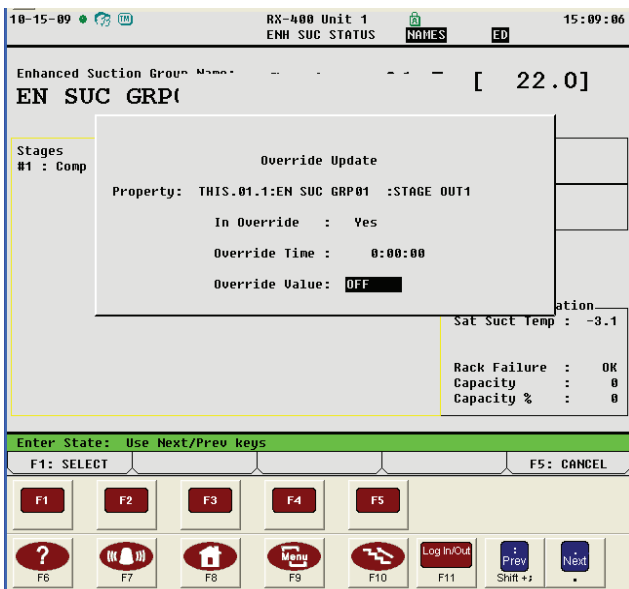


- <sup>1</sup> Press The  And Enter Your User ID and Password To Log On
- <sup>2</sup> The  Button Takes You To The Home Screen
- <sup>3</sup> When Using Copeland Digital™ Compressors With CPC E2 You Must Use The Enhanced Suction Feature To Properly Control The Digital Compressor

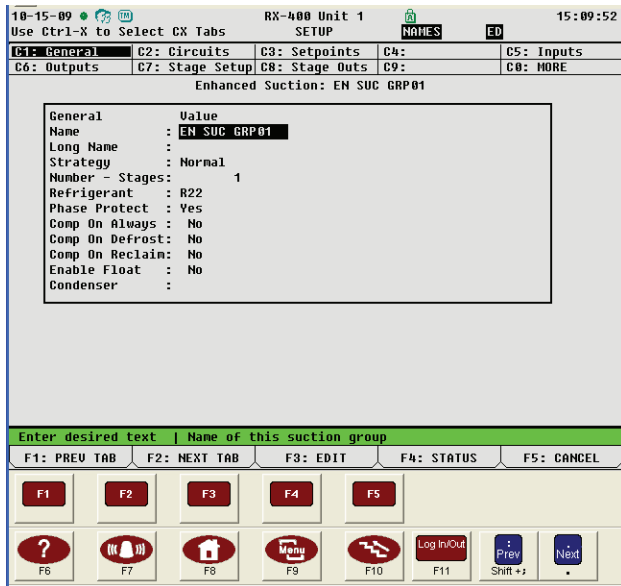
2. Scroll Down And Highlight The Compressor That Contains The Digital Unloader And Press Enter To Show The 'Actions Menu'. Select **Override** And Press Enter.



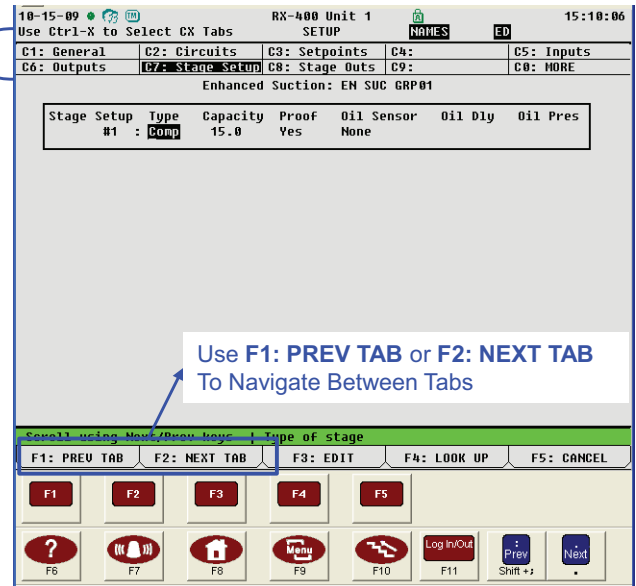
The 'Override Update' Window Will Appear. Type "YES" in The In Override Space and Type "OFF" Where It Shows Override Value. You Do Not Need To Change The Override Time. Press Enter To Return To the Suction Group Summary Screen.



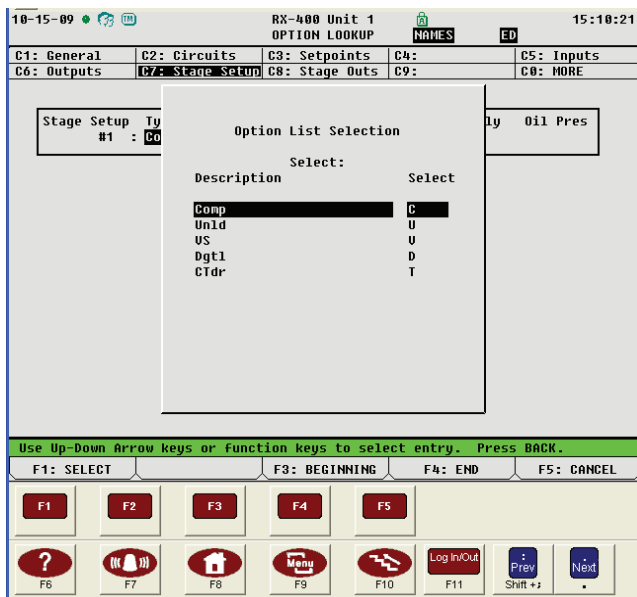
3. Press **F5: Setup** To Enter the 'Setup' Screen. Advance To **C7: Stage Setup**. Select The Compressor Stage With Digital Installed, Press **F4: Look Up** To Show The 'Options List Selection' Window.



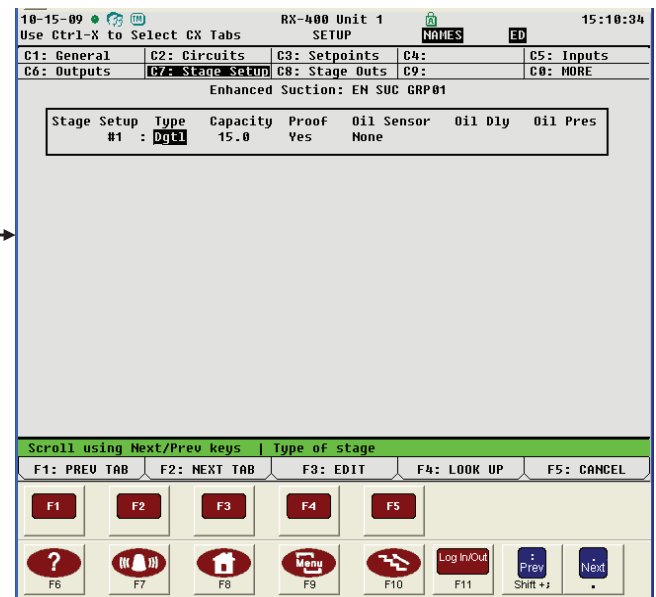
Tabs →



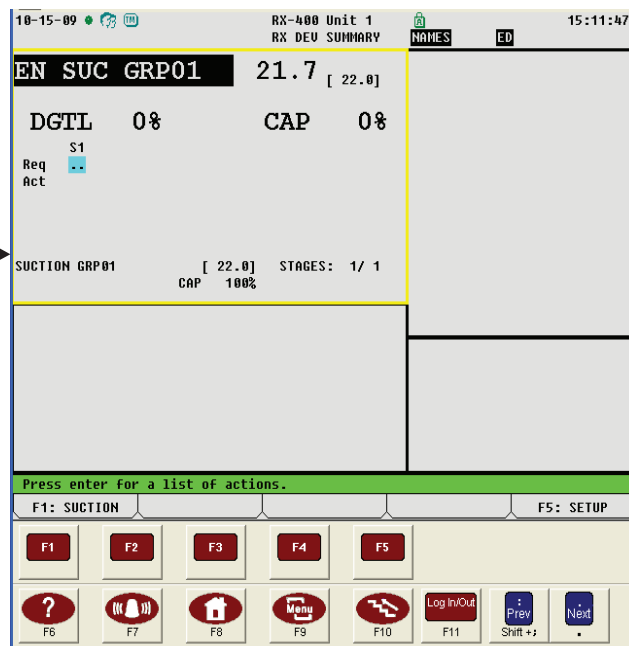
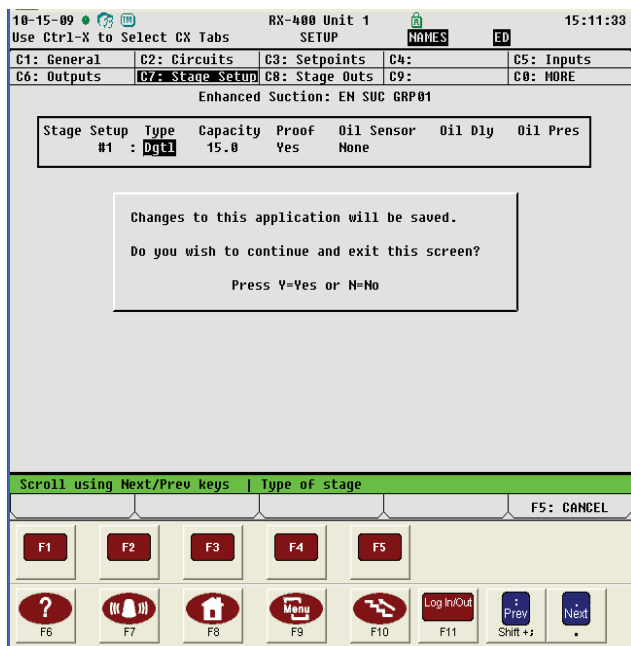
Select **Dgtl** By Typing "D." This Will Return You To the Stage Setup Screen.




→

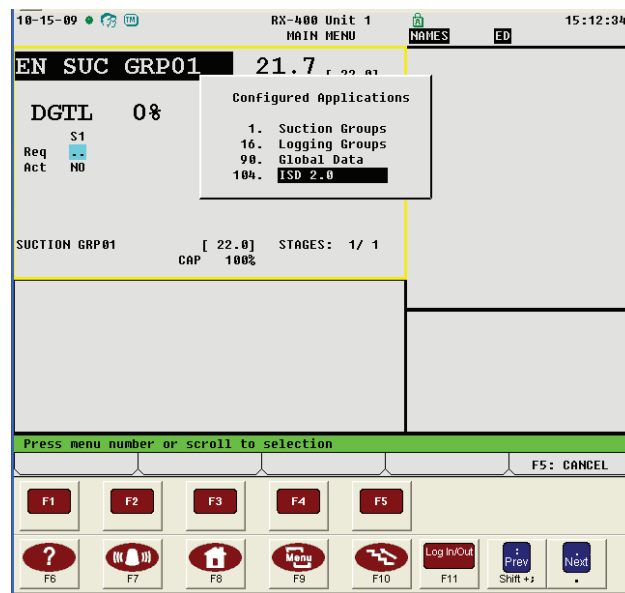
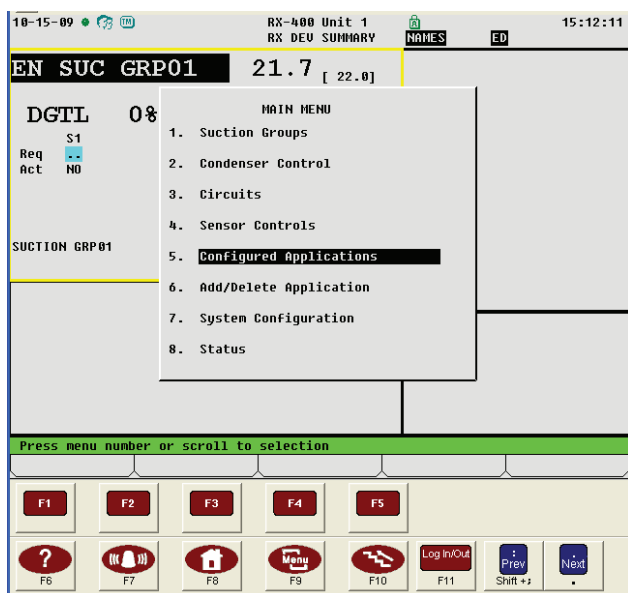


4. Press The Home Key To Return To The Home Screen. A Window Will Pop Up Notifying That Changes Were Made To The Application Type “Y” To Confirm You Would Like To Continue. The Home Screen Should Show DGTL 0%

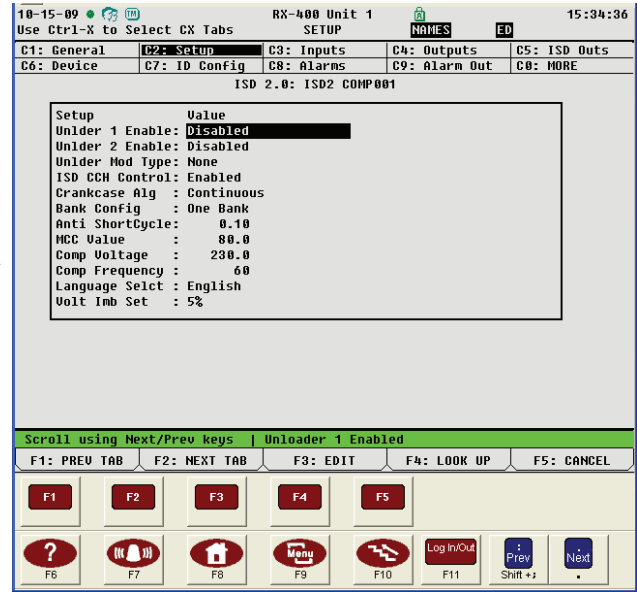
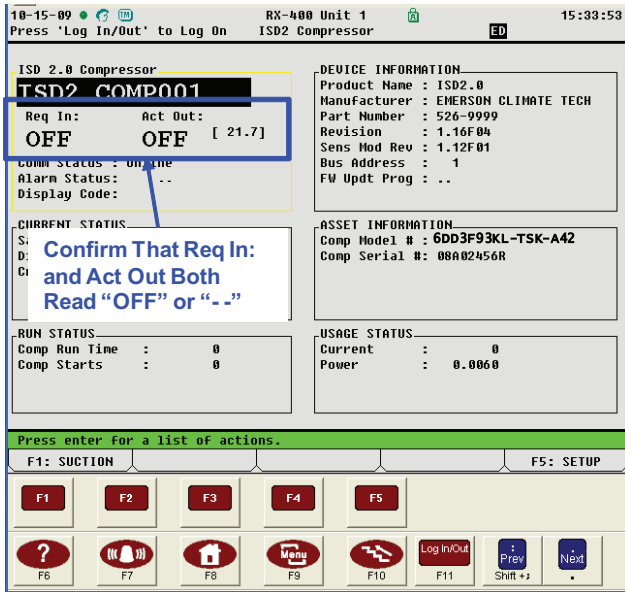


---Communication SEND Link Is Now Established---

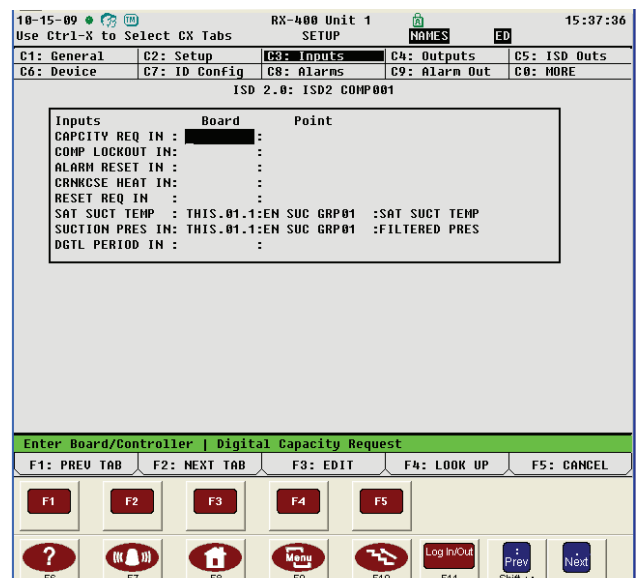
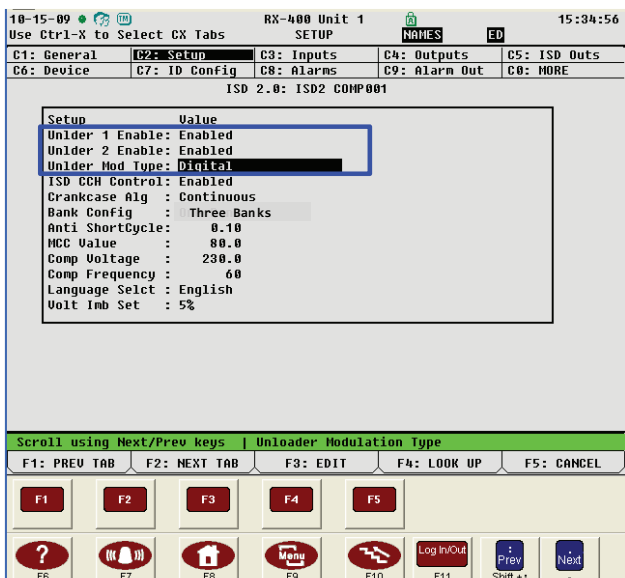
5. Press The Menu Button (  ) To Bring Up The 'Main Menu.' Select **Configured Applications**. This Produces The 'Configured Applications' Window, Select **ISD 2.0**



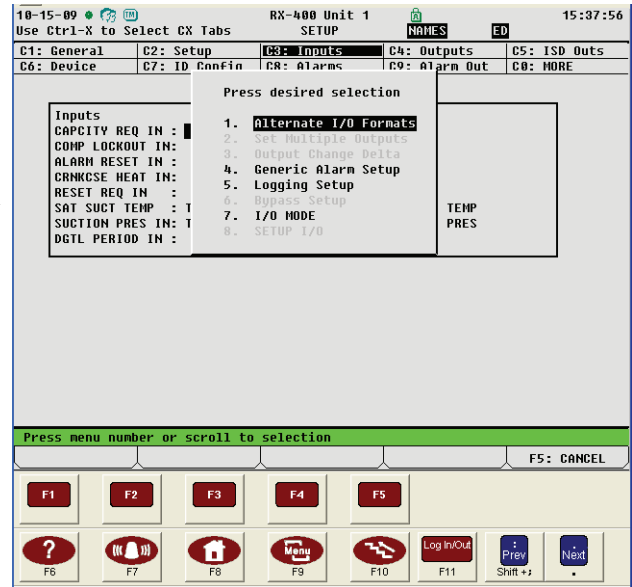
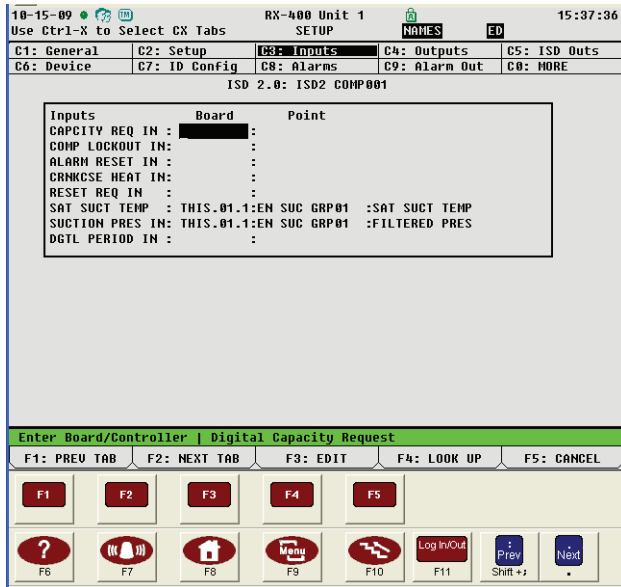
6. The 'Summary of ISD 2.0 Compressors' Screen Will Come Up. Select The ISD Compressor You Have Upgraded To Discuss Digital. Press Enter To Show The ISD Compressor Summary Screen. Press **F5: Setup** To Proceed To The Setup Screen. Go To **C2: Setup** Tab.



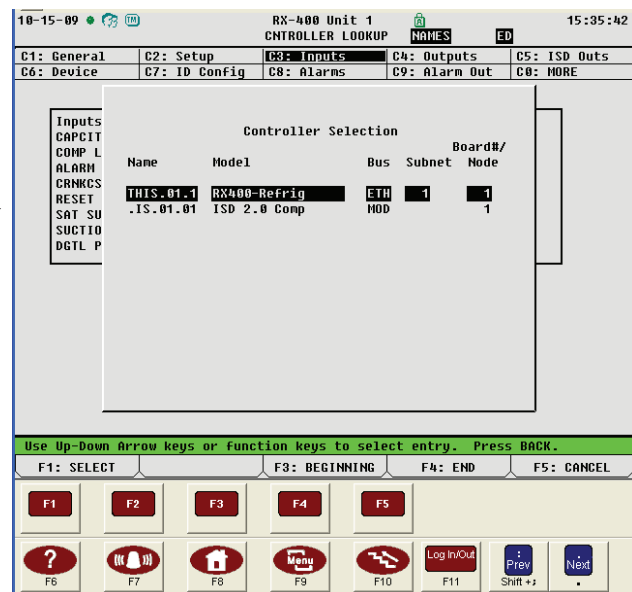
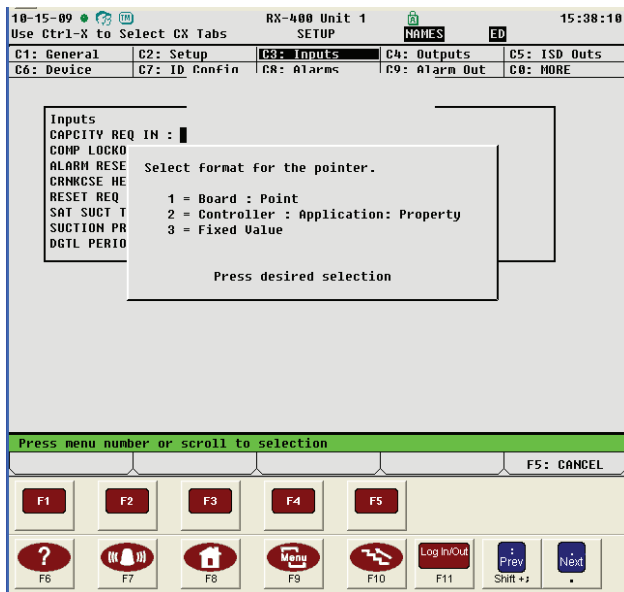
7. Move The Cursor To "Unldr 1 Enable" Press The Next Button ( ) To Change From 'Disabled' To **Enabled.** Do The Same With "Unldr 2 Enable" if using blocked suction on middle of 6D or if using with Copeland Demand Cooling, otherwise leave Unldr 2 Enable set to "Disabled." Change The "Unldr Mod Type" To **Digital** Again By Pressing The Next Button. When Finished Go To The **C3: Inputs** Tab



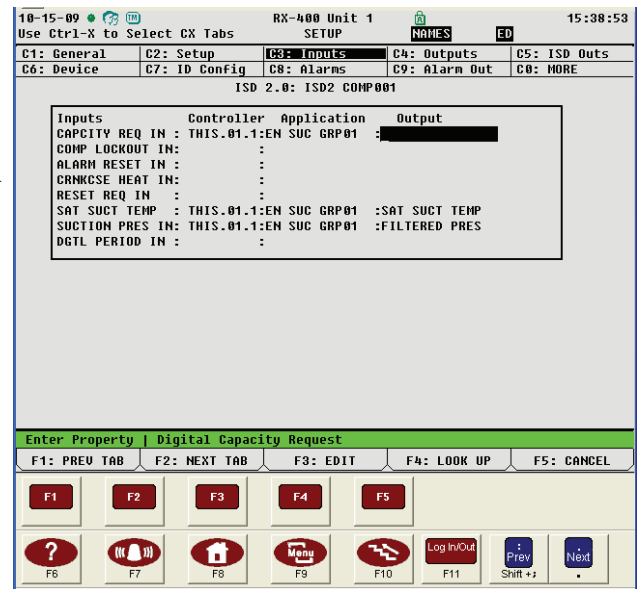
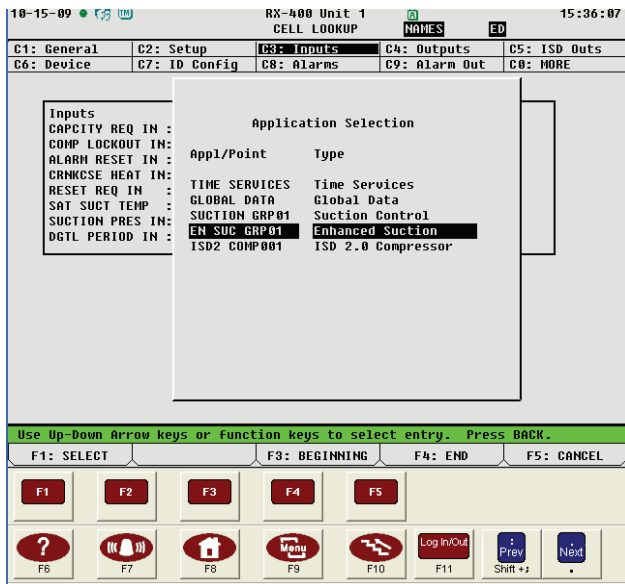
8. Move The Cursor To “Capacity Req In”. Press **F3: Edit**. In The New Window, Select **Alternate I/O Formats**



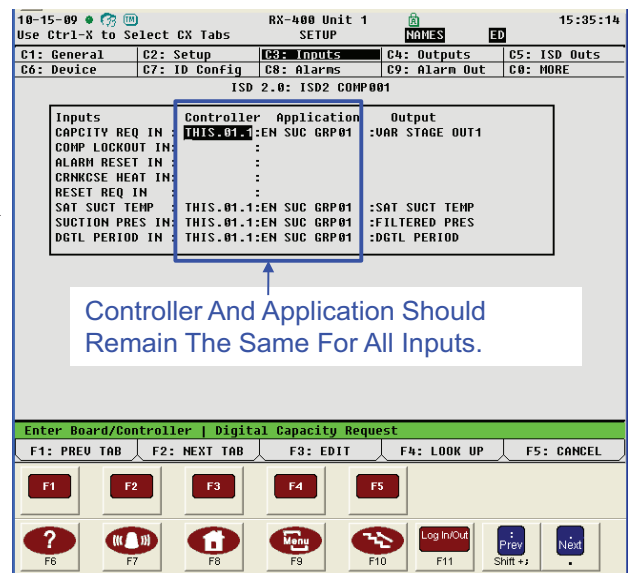
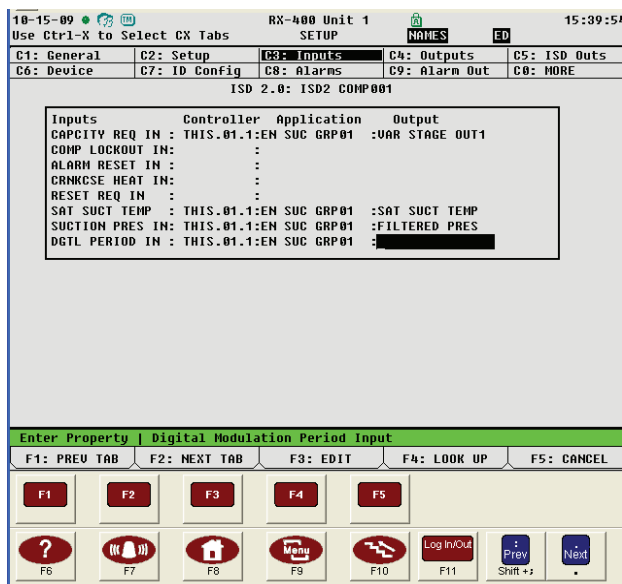
9. Type “2” To Select The **Controller : Application : Property** Format For The Pointer. With The Cursor In The Controller Field Of “Capacity Req In” Press **F4: Look Up**. Select the Controller From The ‘Controller Selection’ Window.



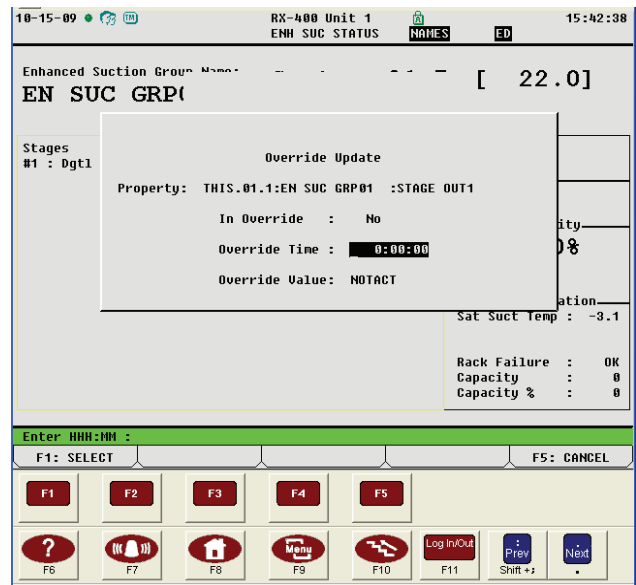
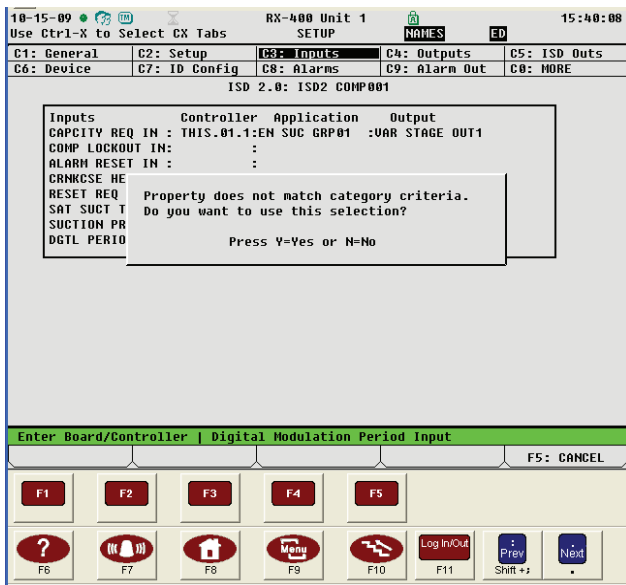
Move the Cursor To The Application Space. Press **F4: Look Up** And Select The Suction Group Application The Digital Is On. Next Move The Cursor To The Output Space And Type “VAR STAGE OUTX” Where X Represents The Stage Number Of The Digital Compressor.



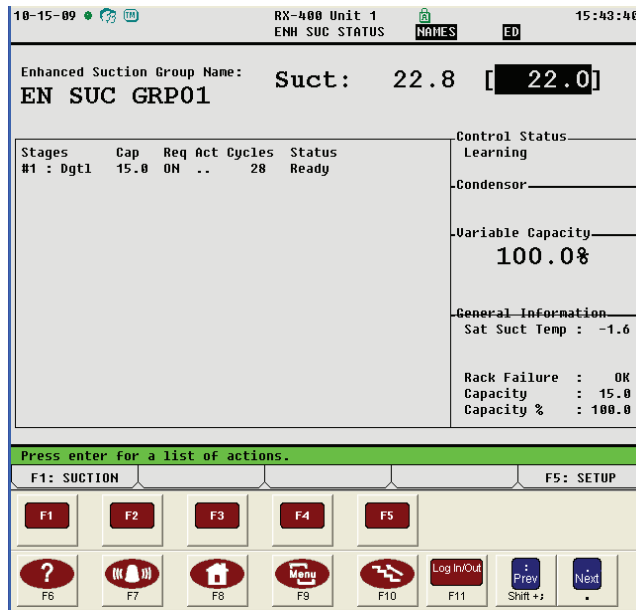
10. Move The Cursor Down To “DgTL Period In” Follow The Same Steps As Before To Edit The Format Of The Input (Use **F3: Edit** and **F4: Look Up** Features). In The Output Space Type “DGTL PERIOD”.



After Establishing The Digital Inputs, Press The Home Key To Return To The Home Screen. A Warning Will Pop Up Saying The Property Does Not Match The Category Criteria. Type “Y” For Yes To Use This Selection. Finally Disable The Override (Refer Back To Step 1) Change The “In Override” Field To ‘No’ And Use The Stair Step Key To Back Out



**--The ISDv2.x Communication RECEIVE Link Is Now Established--**



For more detailed information on programming the E2, refer to the E2 User manual found at <http://www.emersonclimate.com/Documents/026-1610.pdf>



### Warranty Information

Emerson Climate Technologies, Inc. warrants its Digital Compressor Controller to be free from defects in materials and workmanship under normal use for a period of one year from the date of purchase or twenty months from manufacture whichever comes first. During this period, Emerson Climate Technologies, Inc. will replace any defective module without charge.

This warranty is valid for the original purchaser from the date of initial purchase and is not transferable. Keep the original sales receipt. Proof of purchase is required to obtain warranty replacement. Dealers or service centers selling this product do not have the right to alter, modify or in any way change the terms and conditions of this warranty.

This warranty does not cover normal wear of parts or damage resulting from any of the following: negligent use or misuse of the product, use on improper voltage or current, use contrary to the operating instructions, disassembly, repair or alteration by anyone other than Emerson Climate Technologies, Inc.. Further, the warranty does not cover acts of God, such as fire, flood, hurricanes and tornadoes.

**EMERSON CLIMATE TECHNOLOGIES, INC. MAKES NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE WITH RESPECT TO THE Copeland Digital Compressor Controller.**

Emerson Climate Technologies, Inc. shall not be liable for any incidental or consequential damages caused by the breach of any express or implied warranty. Some states, provinces, or jurisdictions do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state, or province to province.

Units under warranty and in need of repair should be returned to an authorized wholesaler or original equipment manufacturer.

### Support

For more information visit [www.EmersonClimate.com](http://www.EmersonClimate.com) or contact Emerson Climate Technologies, Inc. at 1-888-EMR-9950.

APPENDIX

Upgrade Kit Piece Description

1 & 2	Head Service Kit
3	3D Discus Digital Valve Plate Kit
4	IDCM Module Kit/ Copeland Digital Compressor Controller
5	Tall Fan Bracket
6	Sensor Temp Probe Kit
7	Solenoid Coil Kits
8	24V Transformer
9	Instructional Sheets

**Head Service Kit** - Included in the head kit, the 3D digital head has four individual pistons built inside the bottom of the head and a solenoid valve mounted on top of the head. One of the four pistons will stick out farther than the other three. This is intentional. **DO NOT REMOVE PISTONS FROM INSIDE HEAD!** Handle the cylinder head carefully, so as not to damage either the solenoid valve stem or the individual unloader pistons.

The head kit contains the Discus Digital cylinder head, the digital head gasket, four valve plate gaskets (one gasket for each 3D bore size) and the gaskets and seals for the discharge/flange adapter.

**Discus Digital Valve Plate** - Like the cylinder head, the valve plate is unique to Discus digital. It has four ports that are blocked and unblocked by the unloader pistons in the head when modulating takes place.

The valve plate kit contains the Discus digital valve plate (either for low temperature (LT) or medium temperature (MT) based on the kit selected), a head gasket, and four valve plate gaskets (one gasket for each 3D bore size).

**Note!** In the upgrade kits you will notice you have multiple gaskets. You will only need one valve plate gasket and one head gasket per compressor upgrade. This will be described in more detail in **Copeland Discus/Intelligent Store Discus v2.x to Copeland Digital Head and Valve Plate Conversion** found on Page 3 of this bulletin.

**Note!** To ensure your digital compressor operates correctly, the valve plate gasket and head gaskets are designed specifically for Copeland Discus Digital. **Make sure you install only the provided head and valve plate gaskets (in upgrade kit and/or select fit valve plate gasket kit) when upgrading your compressor to Discus digital.**

**Tall Fan Bracket -**

Because the solenoid valve stem makes the compressor assembly slightly taller, you may need to replace the existing head fan bracket to accommodate the height change. Therefore, in each of the low temperature upgrade

kit you will find the taller fan bracket that has traditionally been used with Copeland Moduload compressors.

**IDCM Module Kit/ Copeland Digital Compressor Controller** - The Copeland Digital Compressor Controller (formerly IDCM) is used to convert a demand signal from the master controller to a 1-5V signal to properly energize and de-energize the solenoid coil on a non-ISDv2.x compressor. Included with digital compressor controller is a 5 kOhm, 1 Watt resistor. This resistor is for use in low temperature applications requiring Demand Cooling only and is used to bypass the discharge temperature protection feature in the digital compressor controller to allow the Demand Cooling module to properly protect against high discharge temperature. The Application Engineering Bulletin (AE8-1328) for the digital compressor controller is included in your upgrade kit, but is also available online at [www.emersonclimate.com](http://www.emersonclimate.com).

**Sensor Temp Probe Kit** - The non-ISD digital upgrade kits each contain a special discharge temperature probe that connects to the digital compressor controller. If upgrading on ISDv2.x you will need to remove the existing probe from the current compressor head and install into the new digital cylinder head. This is covered in more detail on Page 5.

**Note!** If installing Discus Digital on a compressor using Copeland Demand Cooling use the discharge temperature probe from the current compressor head, not the probe included in your upgrade kit!

**Solenoid Coils** (available for 24V, 120V, 220V) - Included in each of the upgrade kits you will find one or two solenoid coils. If upgrading on an ISDv2.x compressor, your kit will only contain the 24V solenoid coils. Non-ISDv2.x kits will contain 120V and 220V coils. In addition to the 120V and 220V solenoid coils, a special bracket and screw are included to attach the conduit to the coil. You will also need to insert the coil wires through protective conduit per UL high voltage requirements. There is a conduit connector also included to connect the bracket to the conduit. Because wiring lengths will vary, conduit was not included in the Discus digital upgrade kits.

**Note!** These coils were specifically designed for high-cycle life. Any other coil is not approved for use with Discus digital!

**24V Transformer** - A 24V transformer is included in each of the Non-ISDv2.x kits to power the digital compressor controller.

**Instructional Sheets** - The digital upgrade kits include this bulletin along with additional instructional documentation for the Copeland Digital Compressor Controller where applicable. This information and more product information on Emerson Climate Technologies products can be found on the Online Product Information website at [www.emersonclimate.com](http://www.emersonclimate.com).

## Functionality Checklists

### Checklist #1 (After Head and Valve Plate Conversion)

- Valve Plate And Head Gasket Tabs Are Oriented At The Oil Pump End With Part Numbers On Top
- Bolts (Including Solenoid Valve Bolts), Temperature Probe And Pressure Connections Are All Properly Torqued
- All Valves To The Compressor Are Open
- Head Fan (If Installed) Is Properly Wired In The Terminal Box
- Leak Check Performed

### Checklist #2 (After Wiring The Solenoid Coil and Digital Compressor Controller (if equipped) Into The Control Circuit)

- Verify Solenoid Coil Voltage Is The Same As Contactor Coil Voltage When Using The Digital Compressor Controller
- If Using ISD v2.x, The Solenoid Coil Is 24V.
- Verify That All Wire Connections Are Correct And Secure

### Checklist #3 (After Programming The E2 and Starting The Compressor)

#### Non-ISD/With Digital Compressor Controller

- Verify That There Is 24V At The Digital Compressor Controller (24VAC, 24COM) Connection
- Verify That Sentronic™ Oil Protection Is Operational  
Green Light Should Be On When Compressor Is Running  
Unplug The Oil Pressure Transducer. The Compressor Should Shut Off In Approximately Two Minutes And Light On Sentronic Will Turn Red
- Verify That Control Circuit Panel Switch Will Shut Off 24V Transformer For The Digital Compressor Controller
- Check To See If Unloader Solenoid Coil Is Energized When Yellow Unloader Light On Digital Compressor Controller Is On
- Compressor Amp Reading Changes When The Compressor Unloads
- Voltage Across Terminals C1 And C2 On Digital Compressor Controller Should Be Between 1 And 5 VDC

#### ISDv2.x

- Amp Reading On Control Module LCD Changes When The Compressor Unloads

**Note!** At Lower % Load Conditions, The Compressor May Unload And Load Quicker Than The LCD Screen Updates. May Need To Use Ammeter To Read Compressor Amperage

## Optimizing your System with Discus Digital

When applying digital in a multiple compressor application, please consider the following to optimize system performance: (1) compressor staging with respect to Discus Digital, (2) raising your suction pressure setpoint and (3) minimum digital capacity.

### Compressor Staging

In an upgrade situation, enhanced performance will result from installing Discus Digital. However; if you have multiple 3D Discus compressors (with serial number of 99C or newer) to choose from, performance can be optimized by applying the following guideline:

### Compressor Selection Guideline (from Pages 5 and 6 of AE-1355)

To ensure smooth and continuous modulation, selection of the digital and non-digital compressor capacities can be made according to the following rule.

**Rule:** For optimum suction pressure control, the following guideline is recommended in the selection of Discus digital and fixed compressors, per suction header:

- $D > F1$
- $F2 < D+F1$
- $F3 < D+F1+F2$
- ....
- $FN < D+F1+2+....FN-1$

In the above equations, D is digital Discus capacity or horse power, F1,...FN are the standard Discus compressor capacity or horse power. The compressor selected should be the smallest compressor capacity that still covers all the gaps between steps to ensure the most efficient system control.

**Note!** For best results, the digital compressor needs to be the lead compressor. It must be the first compressor on and last compressor off in multiple compressor applications.

### Example #1

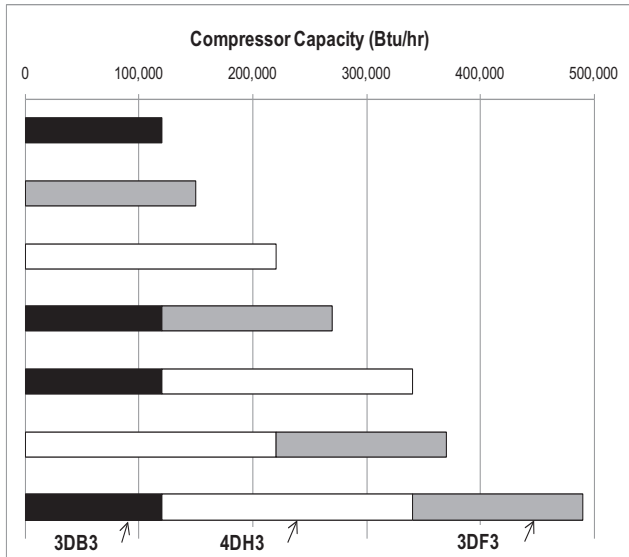
Cooling Demand (HP)	Digital (HP)	Fixed (HP)	Fixed (HP)	Fixed (HP)	System Output (HP)
Load = 0	OFF	OFF	OFF	OFF	0
10.10 < Load < 17.50	0.10 - 10	7.5	OFF	OFF	10.10 -- 17.50
17.10 < Load < 25	0.10 - 10	7.5	7.5	OFF	17.10 -- 25
23.10 < Load < 31.50	0.10 - 10	7.5	7.5	7.5	23.10 -- 31.50

### Example #2

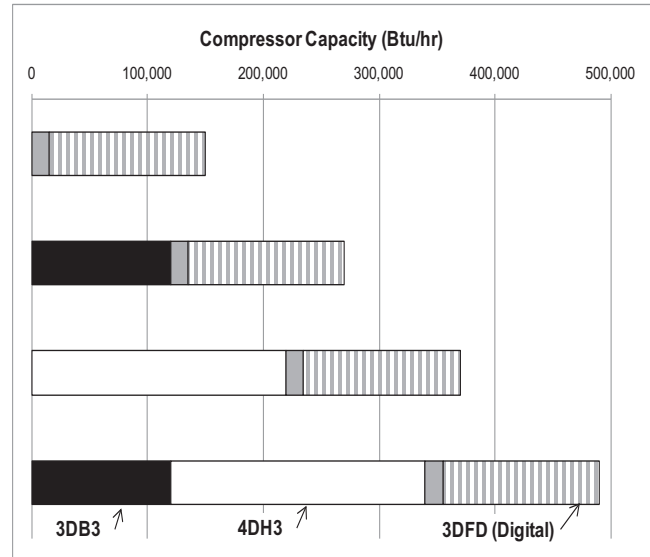
Consider the following suction group (the approximate compressor capacity at the ARI rating point is listed next to the compressor model number):

1. 3DB3R12ML-TFD (120,000 BTUH)
2. 3DF3R15ML-TFD (150,000 BTUH)
3. 4DH3R22ML-TFD (220,000 BTUH)

Based on the above guideline, the second compressor should be upgraded to Discus digital. The figures on the following page show both the staging with and without digital; each box represents a compressor stage. The digital compressor is indicated by the box with vertical cross-hatching for the variable capacity control from 10-100%.



Without Digital



With Digital

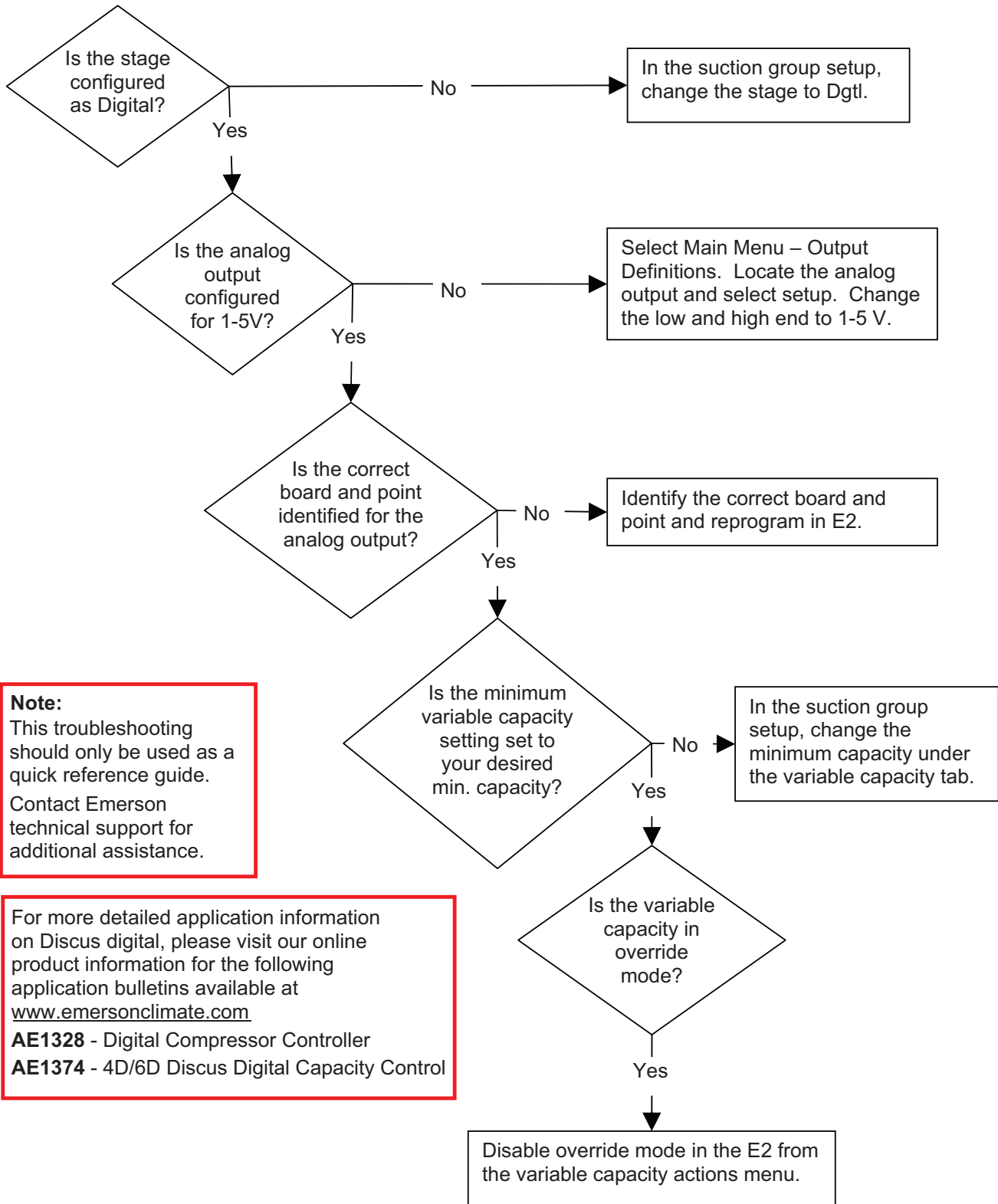
**Raised Suction Pressure Setpoint**

With Copeland Discus Digital, suction pressure can be controlled much tighter. By eliminating large pressure swings and improving case temperature control, there is often the opportunity to raise suction pressure set points. Compressors running at higher suction pressures run more efficiently and theoretically should increase system efficiency approximately 2% per pound of raised suction pressure.

**Minimum Percent Digital Capacity**

Copeland Discus Digital is designed to run all the way down to 10% compressor capacity. An unloaded compressor has a lower overall efficiency compared to a fully loaded compressor because the compressor motor is still running but not pumping. To improve your system's efficiency the minimum percent digital capacity can be adjusted in your rack controller to a higher percent digital capacity (e.g. 50% minimum capacity). However, a higher minimum capacity will negatively affect suction pressure control and increase overall compressor cycling versus allowing the digital compressor to modulate down to 10% full load compressor capacity.

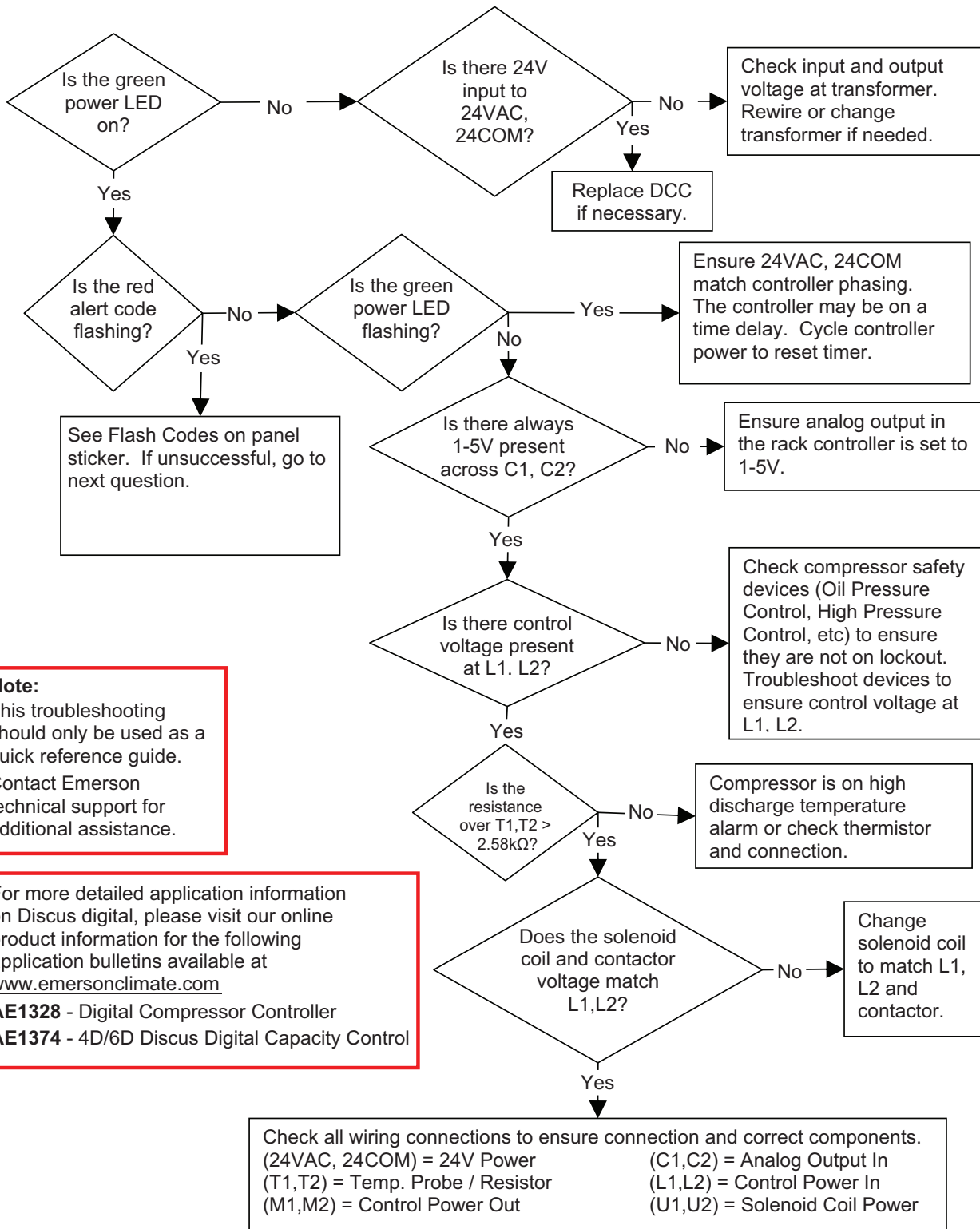
**Troubleshooting Guide - Digital Compressor Setup in E2**



**Note:**  
This troubleshooting should only be used as a quick reference guide. Contact Emerson technical support for additional assistance.

For more detailed application information on Discus digital, please visit our online product information for the following application bulletins available at [www.emersonclimate.com](http://www.emersonclimate.com)  
**AE1328** - Digital Compressor Controller  
**AE1374** - 4D/6D Discus Digital Capacity Control

**Troubleshooting Guide - Digital Compressor Controller**

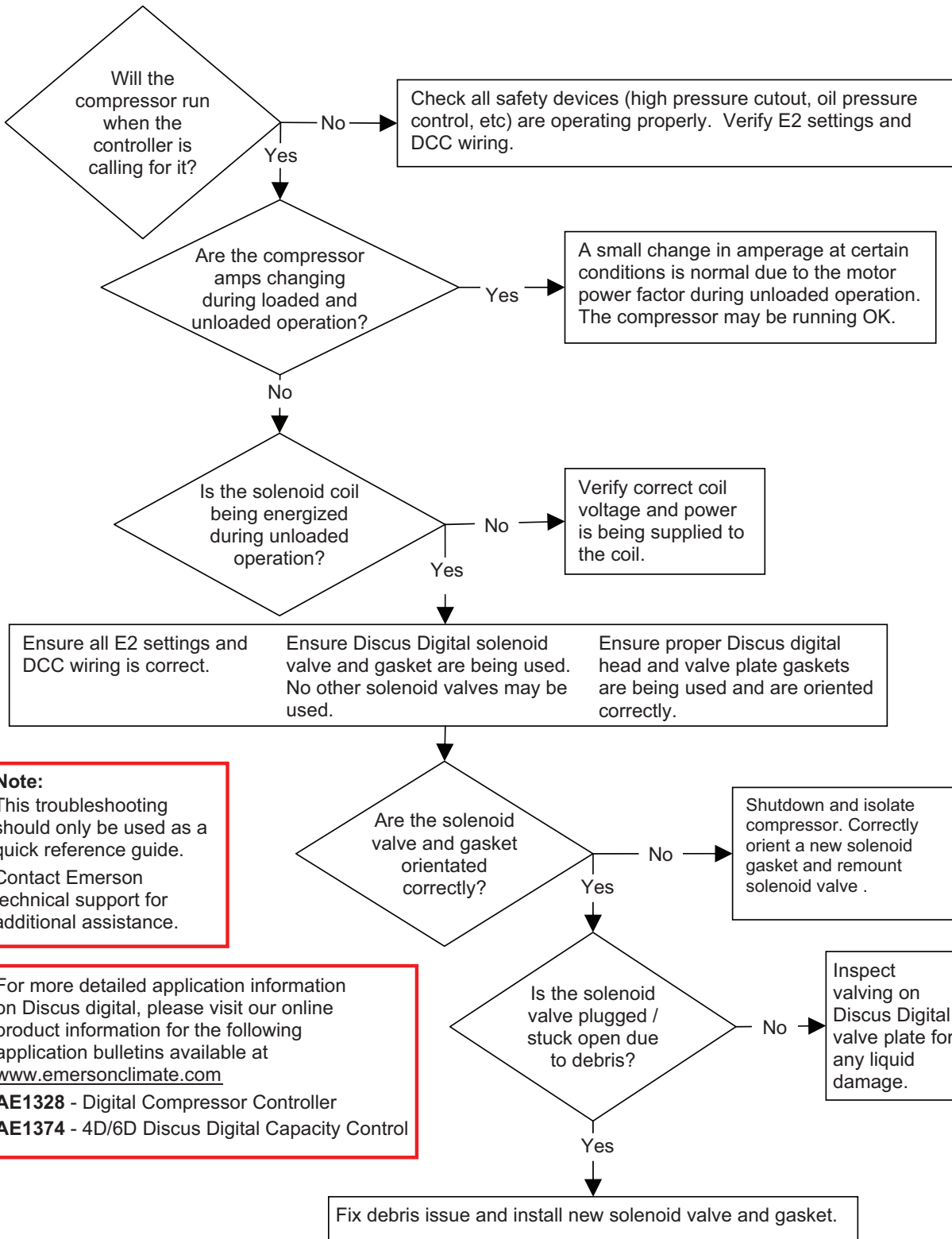


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Check all wiring connections to ensure connection and correct components.  
 (24VAC, 24COM) = 24V Power (C1,C2) = Analog Output In  
 (T1,T2) = Temp. Probe / Resistor (L1,L2) = Control Power In  
 (M1,M2) = Control Power Out (U1,U2) = Solenoid Coil Power

**Troubleshooting Guide - Digital Compressor**



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