

Upgrade Procedures for Parallel Applications Using Digital Capacity Control for Copeland® and Intelligent Store Discus™ Refrigeration Compressors (for 4D & 6D Discus)

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This bulletin describes upgrade procedures for the Copeland Discus Digital and Intelligent Store Discus v2.1 digital compressors.

Requirements

Copeland® and Intelligent Store® brand 4D/6D Discus compressors produced with serial code 03D (April 2003) or later can be updated to digital capacity modulation. This is because the compressor valving design prior to April 2003 is different than the design currently used that is compatible with Discus digital hardware.

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. If upgrading to digital on an Intelligent Store Discus (ISD) compressor. The ISD must be hardware version 2.1 or newer to be compatible with 4D or 6D Digital. For more details on ISD v2.1, refer to **AE8-1368, Intelligent Store Discus 2.1**.

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® 4D & 6D Discus® compressors can be retrofitted for enhanced modulation performance. Once a Copeland 4D or 6D Discus compressor is upgraded to Discus digital¹, the compressor can unload up to 33 or 67% on a 6D or 50% on a 4D, allowing the system to more precisely match capacity to the desired load of the refrigeration system.

¹ 6D Digital is only available with Emerson Climate Technologies' Intelligent Store Discus v2.1 and newer.

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 4D or 6D 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
- Pipe Sealant
- Gasket Scraper
- Hammer
- Adjustable Wrench
- Pliers
- Assembly Oil

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

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 v2.1¹? 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.

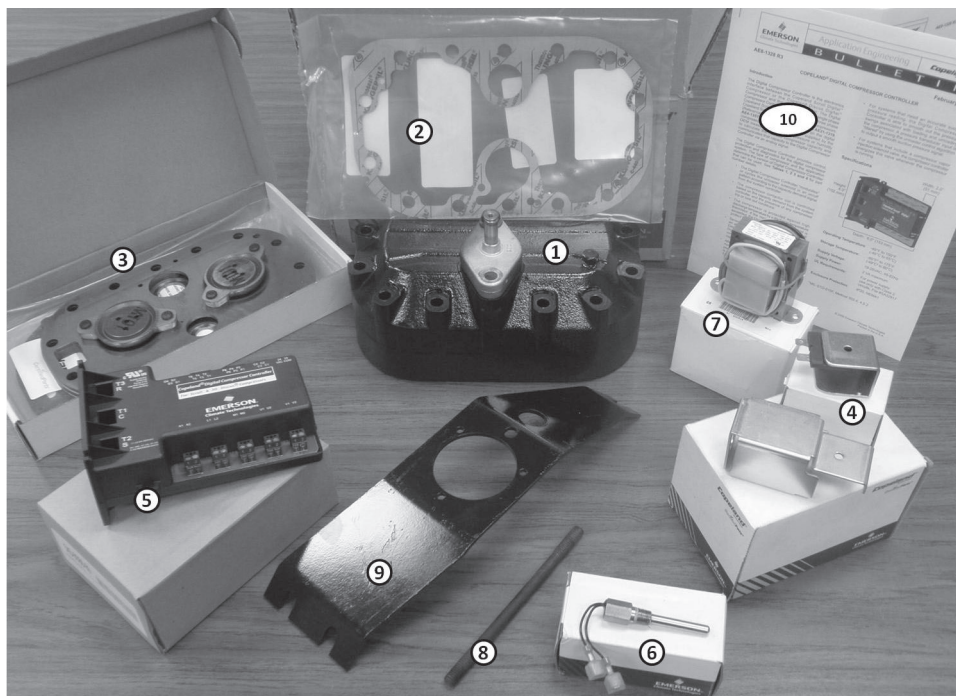


Figure 1
Items in a Typical Discus Digital Upgrade Kit (corresponding to Item No. in Tables 1 and 2)

¹ 6D Digital is only available with Emerson Climate Technologies' Intelligent Store Discus v2.1 and newer

Table 1 – 4D Discus Digital Upgrade Kits

Kit	Kit P/N	Item No.	Item Description	Item P/N
Medium Temperature 4D Discus Digital Upgrade Kit (Non-ISD)	980-6000-00	1 & 2	Head Service Kit - Digital Head Assembly - Gaskets	902-0323-00
		3	4D Discus Digital Valve Plate Kit (MT) - Digital Valve Plate - Gaskets	998-2661-66
		4	Solenoid Coil Kit x2 (120V & 220V) - Solenoid Bracket - Screw	923-0084-01, -02
		5	4D IDCM Module Kit / Copeland Digital Compressor Controller	943-0088-00
		6	Sensor Temp Probe Kit	985-0109-07
		7	24V Transformer (Class 2)	037-0023-00
		8	Head Stud	103-0087-07
		10	Instructional Sheets - AE8-1328 Copeland Digital Discus Compressor Controller - AE4-1373 Upgrade Procedures for Copeland Digital Discus	N/A
Low Temperature 4D Discus Digital Upgrade Kit (Non-ISD)	980-6000-01	1 & 2	Head Service Kit - Digital Head Assembly - Gaskets	902-0323-00
		3	4D Discus Digital Valve Plate Kit (LT) - Digital Valve Plate - Gaskets	998-2661-65
		4	Solenoid Coil Kit x2 (120V & 220V) - Solenoid Bracket - Screw	923-0084-01, -02
		5	4D IDCM Module Kit / Copeland Digital Compressor Controller	943-0088-00
		6	Sensor Temp Probe Kit	985-0109-07
		7	24V Transformer (Class 2)	037-0023-00
		8	Head Stud	103-0087-07
		9	Fan Bracket	074-1243-00
10	Instructional Sheets - AE8-1328 Copeland Digital Discus Compressor Controller - AE4-1373 Upgrade Procedures for Copeland Digital Discus	N/A		

Table 2 – 4D/6D Intelligent Store Discus v2.x Digital Upgrade Kits

Kit	Kit P/N	Item No.	Item Description	Item P/N
Medium Temperature 4D/6D Intelligent Store Discus v2.x Digital Upgrade Kit	980-6000-10	1 & 2	Head Service Kit - Digital Head Assembly - Gaskets	902-0323-00
		3	4D/6D Discus Digital Valve Plate Kit (MT) - Digital Valve Plate - Gaskets	998-2661-66
		4	Solenoid Coil (24VAC)	023-0084-00
		8	Head Stud	103-0087-07
		10	Instructional Sheets - AE4-1373 Upgrade Procedures for Copeland Digital Discus	N/A
Low Temperature 4D/6D Intelligent Store Discus v2.x Digital Upgrade Kit	980-6000-11	1 & 2	Head Service Kit - Digital Head Assembly - Gaskets	902-0323-00
		3	4D/6D Discus Digital Valve Plate Kit (LT) - Digital Valve Plate - Gaskets	998-2661-65
		4	Solenoid Coil (24VAC)	023-0084-00
		8	Head Stud	103-0087-07
		9	Fan Bracket	074-1243-00
		10	Instructional Sheets - AE4-1373 Upgrade Procedures for Copeland Digital Discus	N/A

Table 3 – Valve Plate Gasket Kit Part Numbers

First 3 Digits of Compressor Model Number	Valve Plate Gasket P/N (From Discus Digital Upgrade Kit)
4DA*, 4DE*, 4DN*	020-1378-04
4DB*, 4DC*, 4DH*, 4DK*, 4DL*, 4DP* 6DB*, 6DW*, 6DY*, 6DH*, 6DK*, 6DP*, 6DL*, 6DC*, 6DD*	020-1378-00
6DG*, 6DM*, 6DN*	020-1378-06
4DJ*, 4DR*, 4DT*, 4DS* 6DJ*, 6DR*, 6DS*, 6DT*, 6DE*, 6DF*	020-1378-02

There are four valve plate gaskets provided in both the head-service kit and the valve plate kit. The appropriate gasket should be matched to the first three digits of the compressor model number.

Copeland Discus/Intelligent Store Discus v2.1 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.

Note! The 4D/6D Digital head must be installed on the far right hand bank (when facing the oil pump end) of compressor

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. Remove any high pressure connections from the head and the head fan (if equipped).
3. Note the location of any studs on the head (high pressure control and oil pressure module may be mounted here).
4. Remove the cylinder head bolts.
5. Tap the head to break it loose from the valve plate.
6. Remove dowel pins and center bolt. Save dowel pins for digital head and valve plate installation. Center bolt will NOT be needed for digital head and valve plate installation.
7. 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.
8. Check that the pistons travel up and down freely.
9. 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.
10. 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.

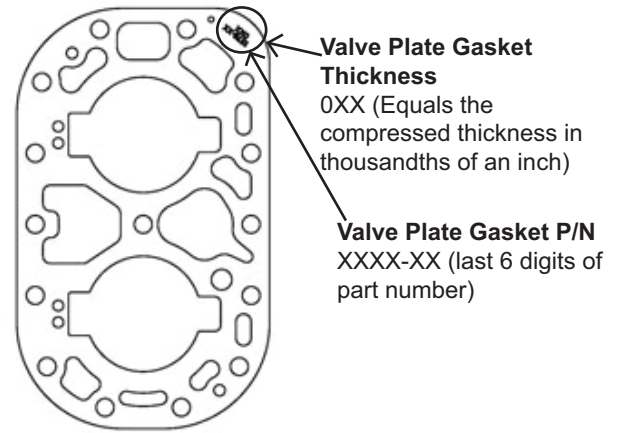


Figure 2



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

11. Select the proper valve plate gasket for the bore size of the compressor. (See **Table 3**)
12. 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.**
13. Inspect new valve plate for handling damage and install.
14. 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.**
15. Visually inspect pistons in head for loose debris. **Note!** The digital head has two internal pistons, one protrudes farther out than the other. This is intentional. See **Figure 5**.

CAUTION: DO NOT REMOVE PISTONS FROM INSIDE HEAD!

16. Install the Discus digital cylinder head. Take care to not damage the solenoid stem mounted on the compressor head. Install the longer head stud (p/n 103-0087-07) into the unloader solenoid valve flange. Ensure that the bolt is threaded completely into the compressor body.
17. Relocate existing stud bolts (if equipped) to their correct location to mount components/head fan. **NOTE!** If upgrading on a low temperature 4D Discus compressor with head fan the stud bolt locations will change. A new mounting bracket is included in the Low Temp Upgrade kits for this purpose. See **Figure 6**.

The head fan for 6D does not need to be changed. Refer to **AE4-1135, Cooling Requirements For Copelametic® And Copeland Discus® Compressors** for more details on Discus head fan requirements.

18. Finger tighten bolts and torque evenly in crossing pattern to 50 ft-lbs. (See **Torque Patterns** on following page for proper torquing procedures.)
19. Reassemble the high pressure port connections with appropriate thread sealant.
20. Discharge temperature probe should be installed on far left hand bank when facing the oil pump end of the compressor. Tighten temperature probe and discharge pressure pickup connections firmly and recheck torque on all the bolts. See **Figure 7**.

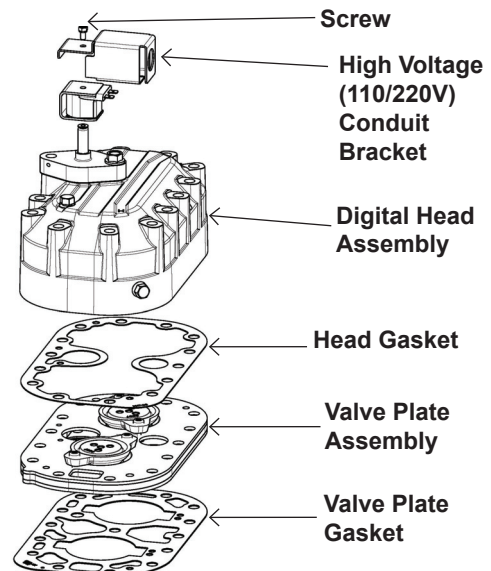


Figure 4 – Exploded View of Copeland Discus Digital head and valve plate assembly

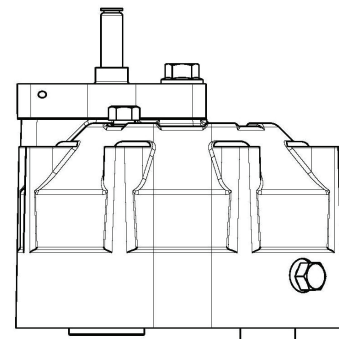


Figure 5 – Two pistons inside the digital cylinder head, one piston sticks out farther by design

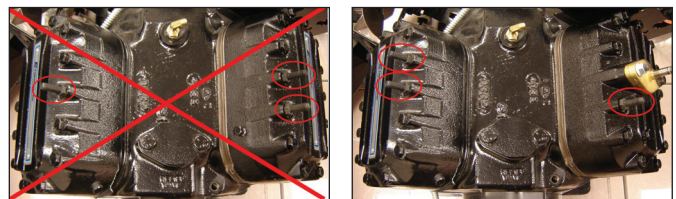


Figure 6

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.

21. Refer to **Checklist #1** in Appendix to verify all steps have been completed in the head and valve plate conversion.
22. Evacuate compressor and reopen all the necessary valves to the compressor per industry standards.
23. Leak test the compressor.
24. Install Discus Digital™ solenoid coil, solenoid bracket², and conduit² on solenoid valve stem². Make sure to choose correct voltage solenoid coil. See **Figure 8**.
25. If the compressor is equipped with a head fan, install³ fan bracket and head fan³.

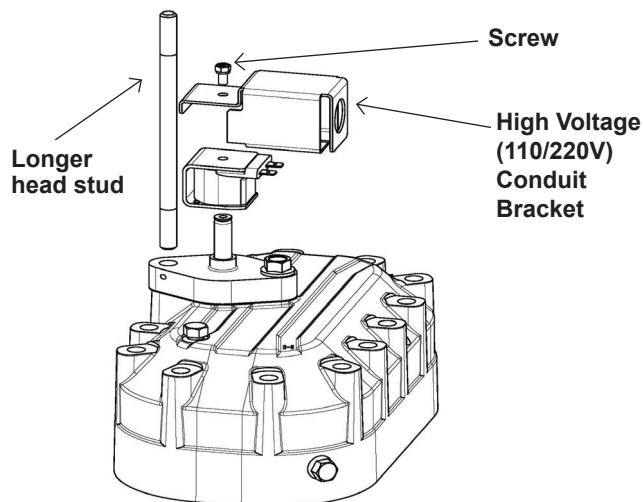


Figure 8 – Solenoid coil assembly including bracket

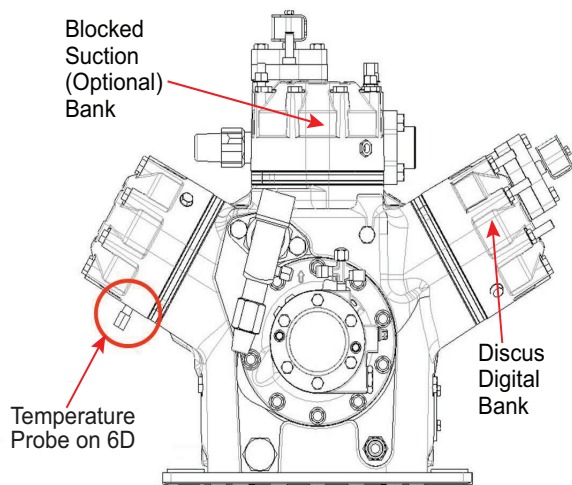
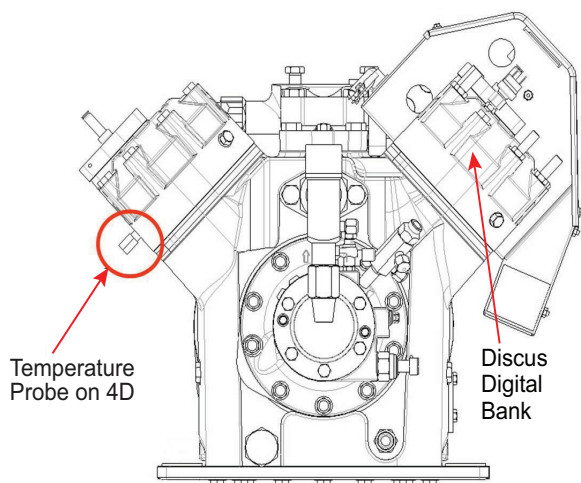


Figure 7 – The temperature probe should be installed on the far left bank of the 4D/6D.

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.

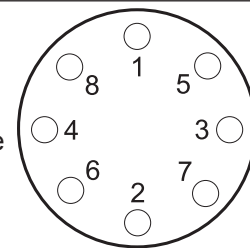


Figure 9

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 9**. 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.

¹ Intelligent Store Discus compressors with Demand Cooling are pending approval.

² Required for non-Intelligent Store Discus only.

³ Refer to installation instructions supplied with fan mounting kit.

The following pages cover wiring the solenoid and digital compressor controller as well as programming the E2 for 4D/6D Discus digital compressors. If you are upgrading an ISDv2.1 compressor to Discus digital, skip to page 15 for further instruction.

Wiring for 4D Discus Digital Compressors (Non-ISD)

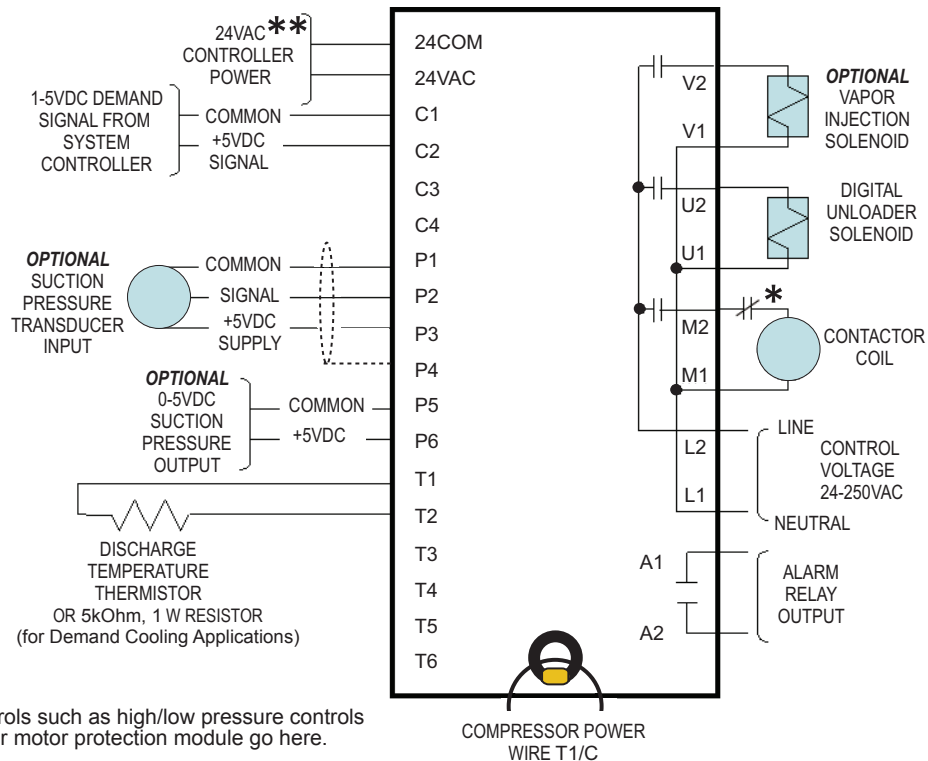
Digital Compressor Controller

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 10**.

For more information and installation instructions for the Copeland® Digital Compressor Controller refer to **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 10 – 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® blocked suction, 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

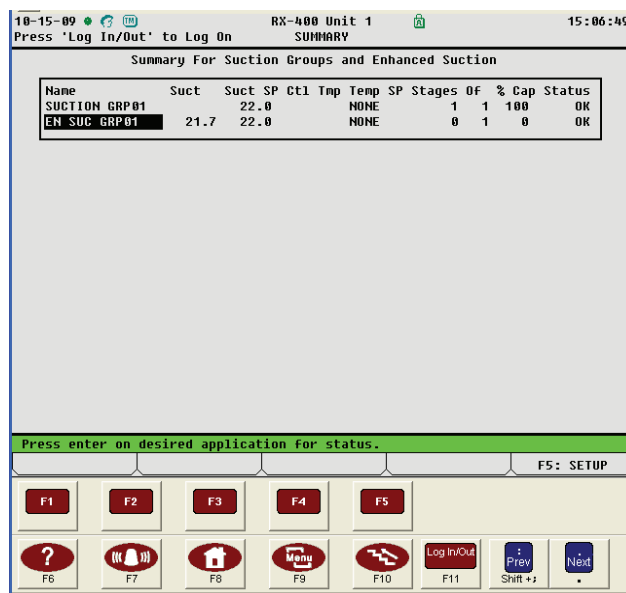
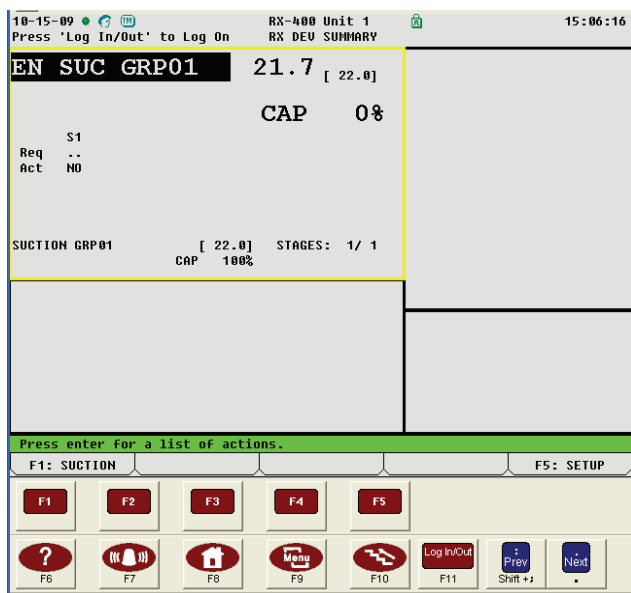
way to properly program the E2 for Discus digital. Use **Checklist #3** in the Appendix to verify the digital is being controlled properly.

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 Into¹ The E2, From The Home Screen² Press **F1: Suction** To Arrive At the '**Summary For Suction Groups and Enhanced Suction Screen**'. Select The Enhanced Suction³ Group That Has The Digital Compressor Installed.

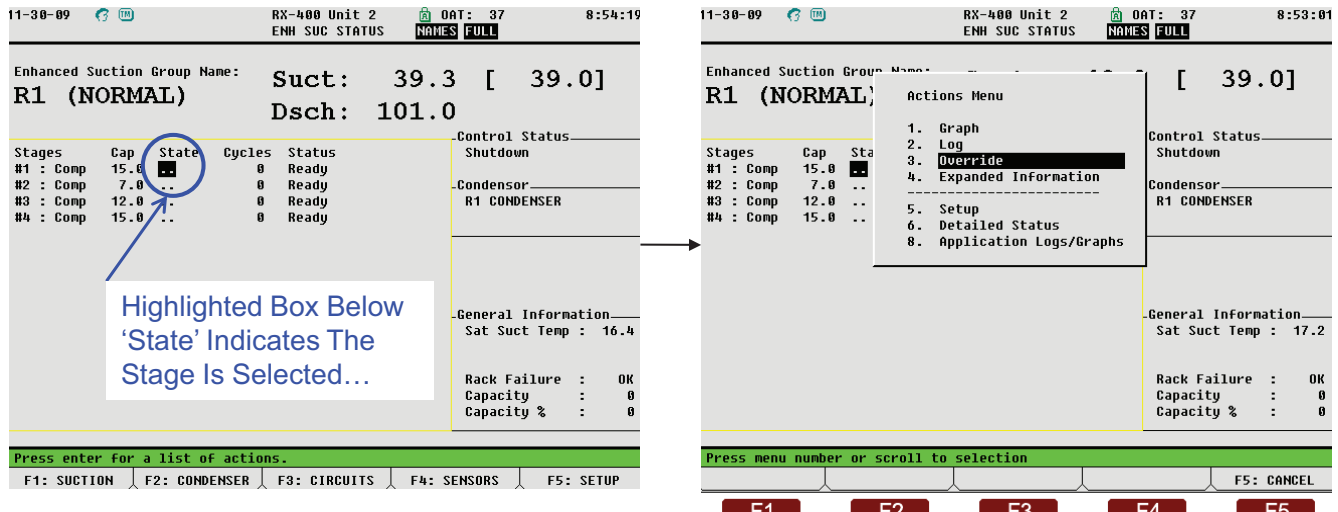


¹ Press The And Enter Your User ID and Password To Log On

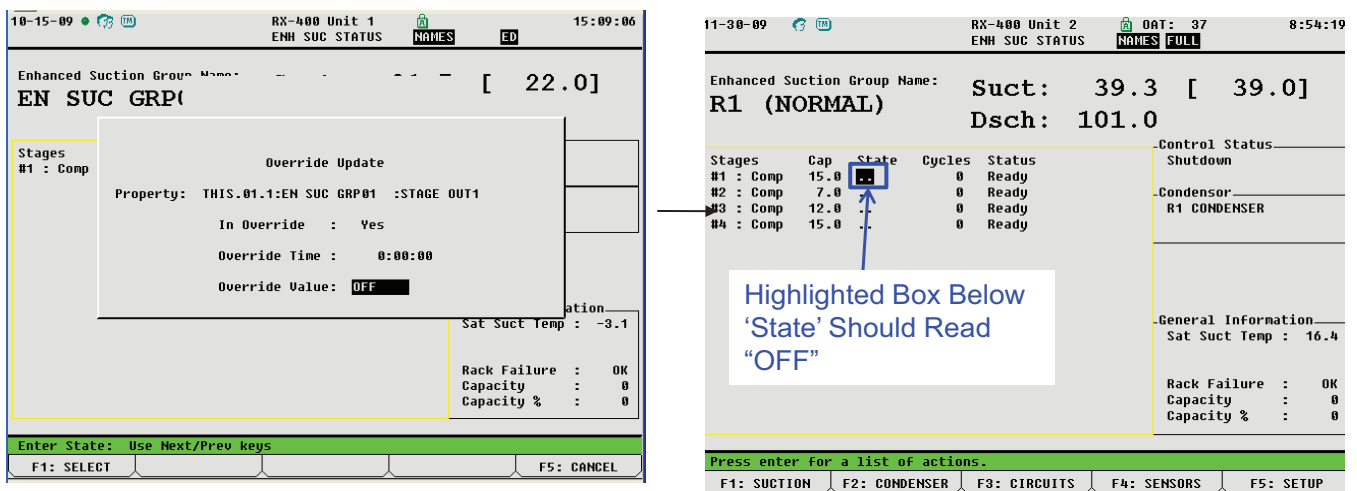
²The Button Takes You To The Home Screen

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

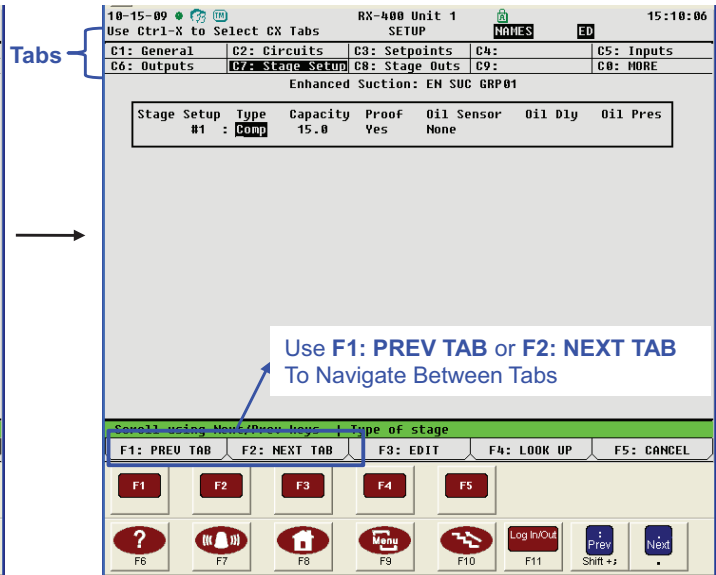
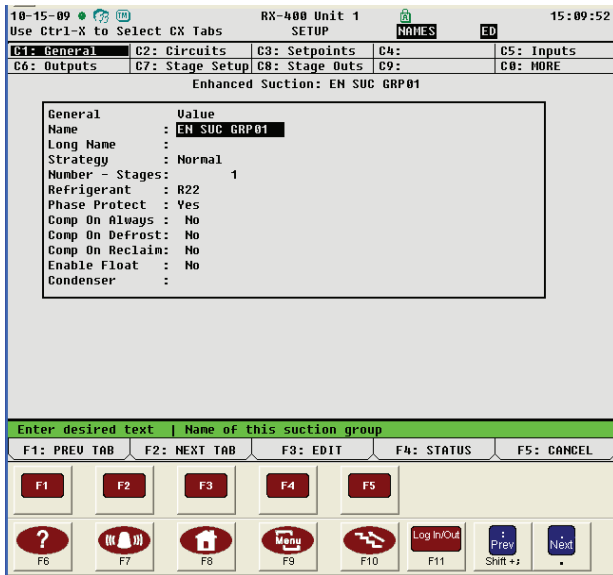
2. Scroll Down And Highlight The Compressor That Contains The Digital Unloader And Press Enter To Show The 'Actions Menu'. Select **Override** And Press Enter.




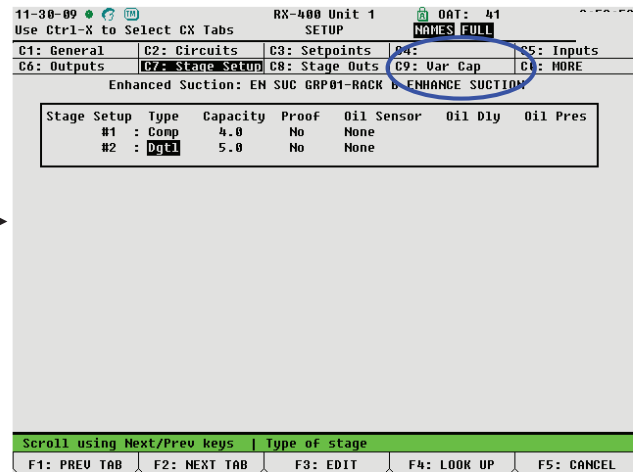
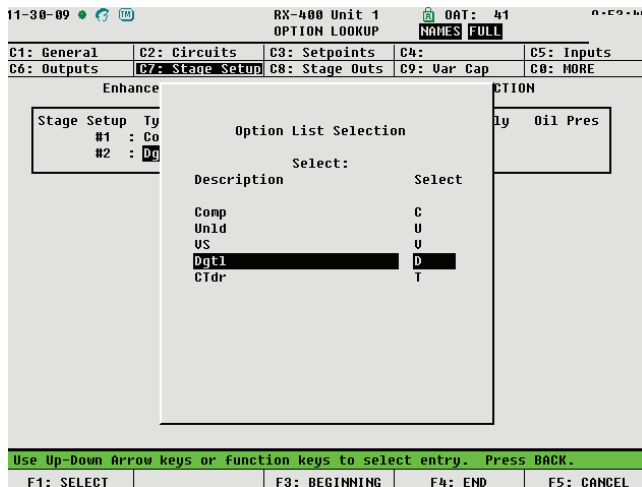
The 'Override Update' Window Will Appear. Type "YES" in The In Override Space and Type "OFF" Where It Shows Override Value. You Do Not Need To Change The Override Time. Press Enter To Return To the Suction Group Summary Screen.



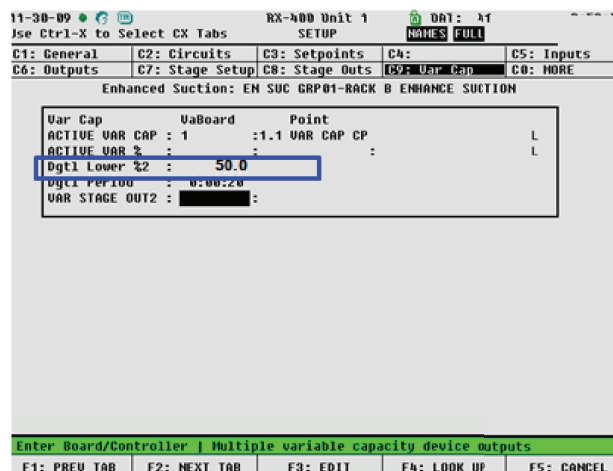
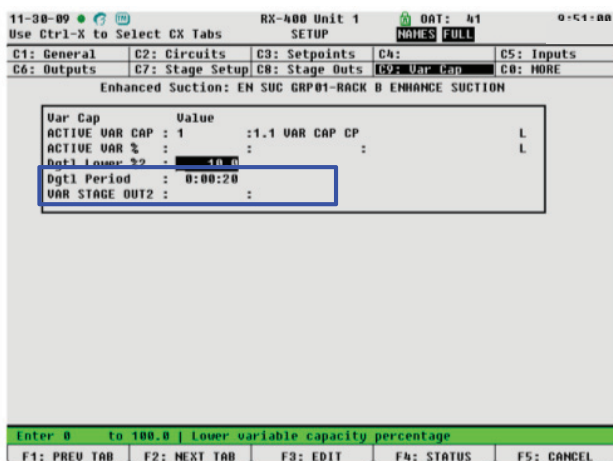
3. Press **F5: Setup** To Enter the 'Setup' Screen. Advance To **C7: Stage Setup**. Select The Compressor Stage With Digital Installed, Press **F4: Look Up** To Show The 'Options List Selection' Window.



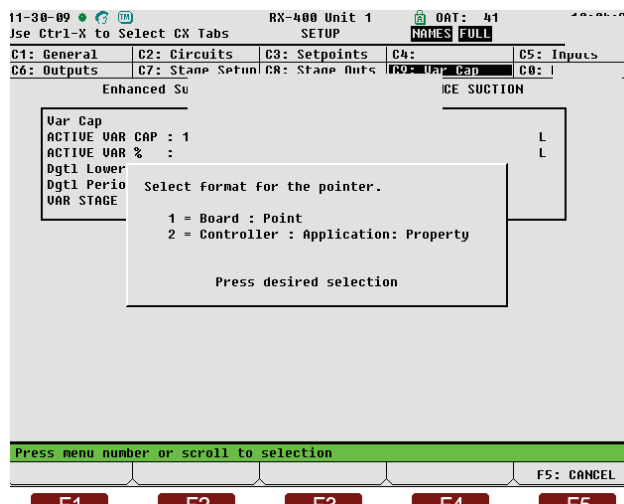
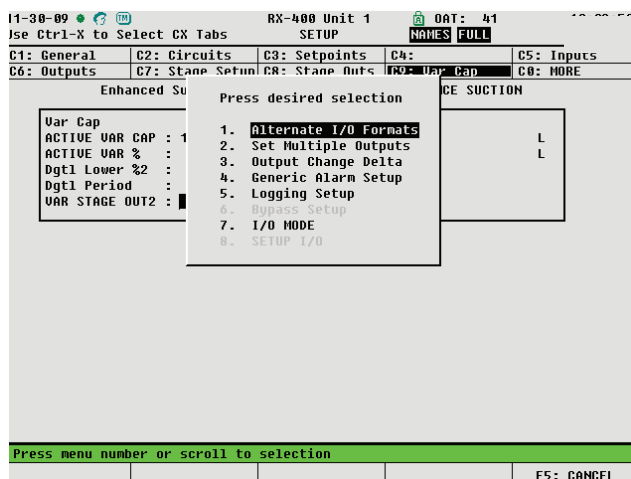
Select **Dgtl** By Typing "D." This Will Return You To The Stage Setup Screen. Press The Stairstep () Key To Return To The 'Enhanced Suction Summary' Screen And Confirm 'DGTL' Appears Under The 'Stages' Column For The Digital Compressor. When You Return To The Setup Screen The **C9:Var Cap** Tab Will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



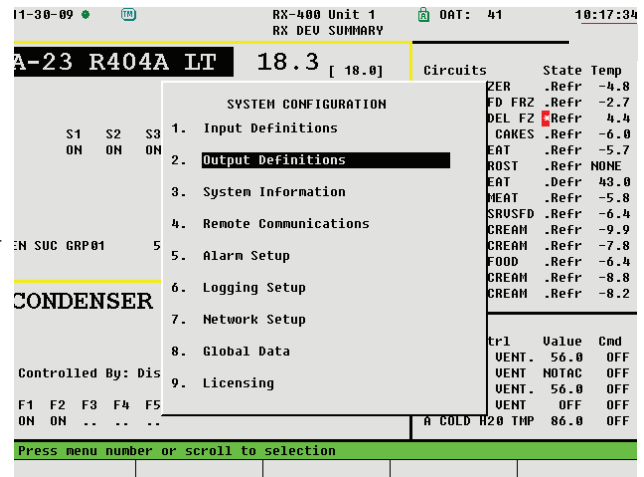
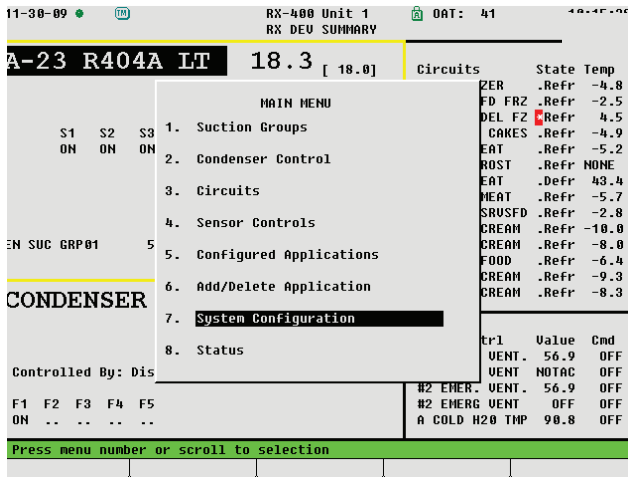
- Open The **C9: Var Cap** Tab. Select the '**Dgtl Lower %***' field and change value to 50.0 (Where * Refers To The Stage Number Assigned To The Digital Compressor On The Suction Group). Make Sure The '**Dgtl Period**' Is Set To 0:00:20.
- Scroll Down To '**VAR STAGE OUT***' Press **F3: Edit** To Pull Up The "Press Desired Selection" Menu



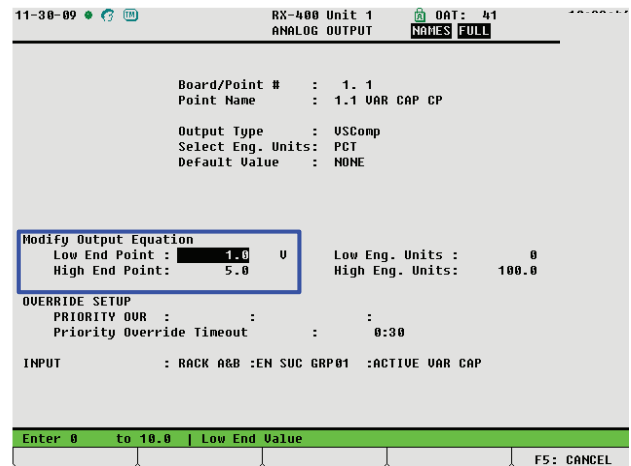
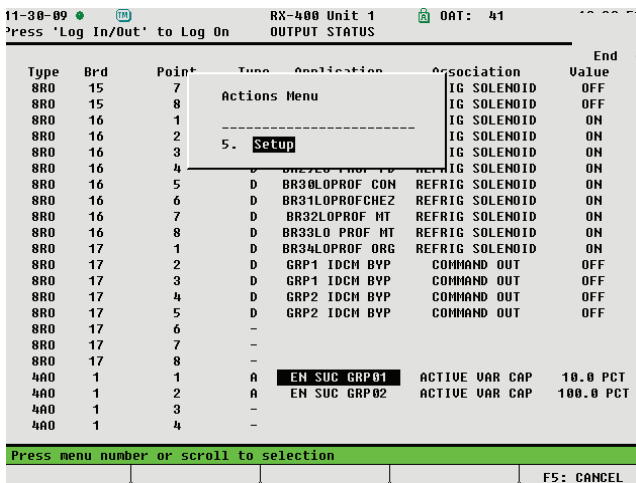
Select **1. Alternate I/O Formats**. This Brings Up The "Select Format For The Pointer", Choose **1 = Board : Point** and Enter The Analog Output Point That Controls The Digital Compressor Controller (i.e. 1:1, 1:2, 1:3, etc)



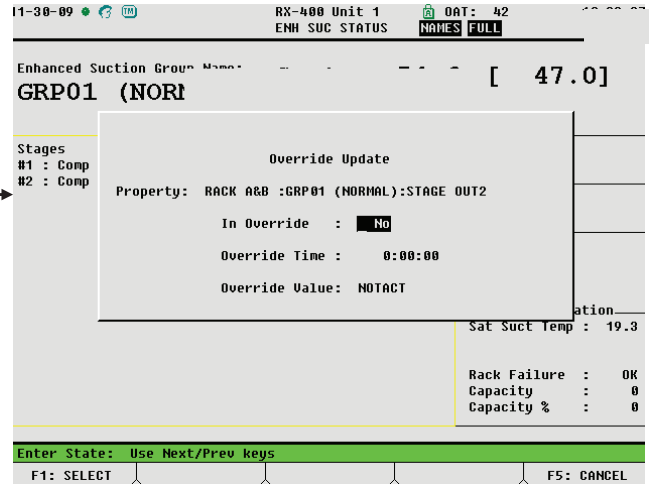
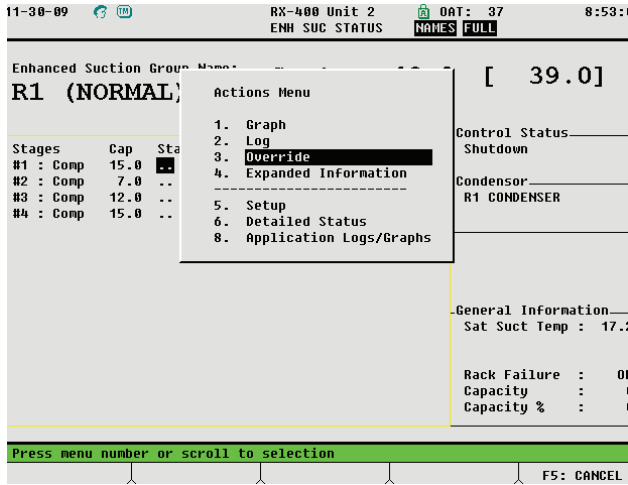
7. Return To The Home Screen (Press ). Go To The Main Menu (Press ). Select **7. System Configuration**. Select **2. Output Definitions**.



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 v2.1 or Newer

If installing Discus digital on an Intelligent Store Discus v2.1 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 ISD side cover and connect the unloader wires (yellow) found in the wiring harness to the solenoid coil.

NOTE! Always connect Unl 1 (yellow wires) to digital bank solenoid. If using on a 6D with blocked suction bank on middle bank connect Unl 2 (purple wires) to blocked suction solenoid.

Replace the ISD side cover. See **Figure 11**.

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 blocked suction, you will need to delete the extra unloader stage(s) set up accordingly in the suction group.

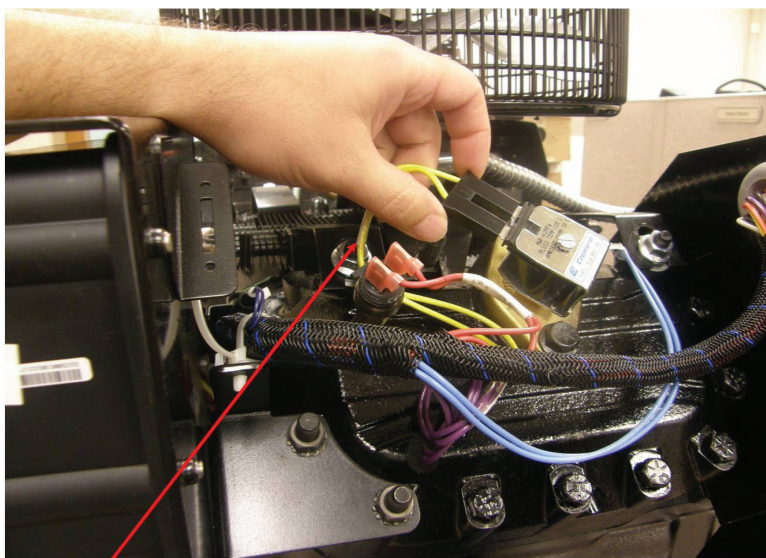
Note! These instructions are based on E2 v2.8

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

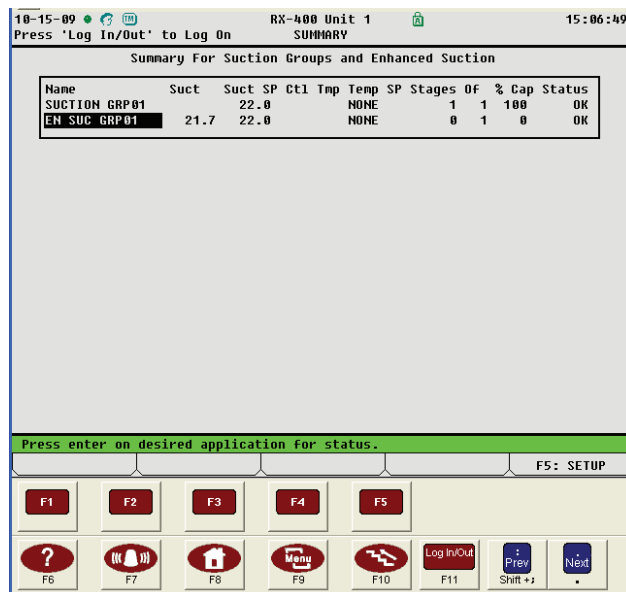
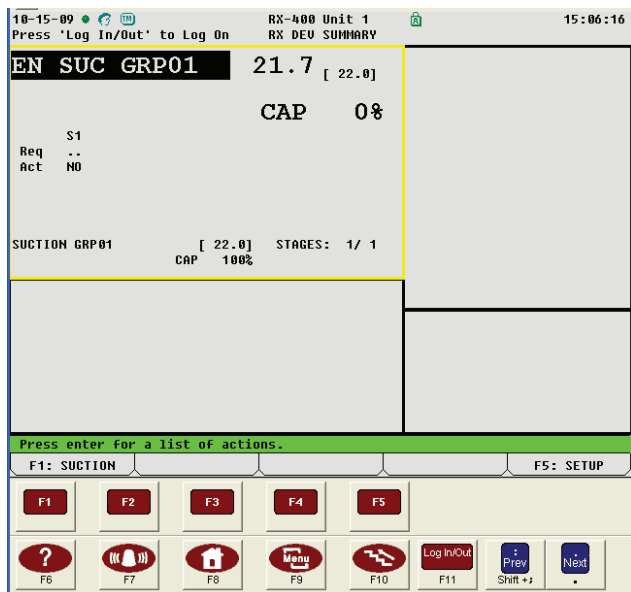
On the following pages you will see screen shots taken from the E2 to perform the above steps.





Yellow Unloader Wire

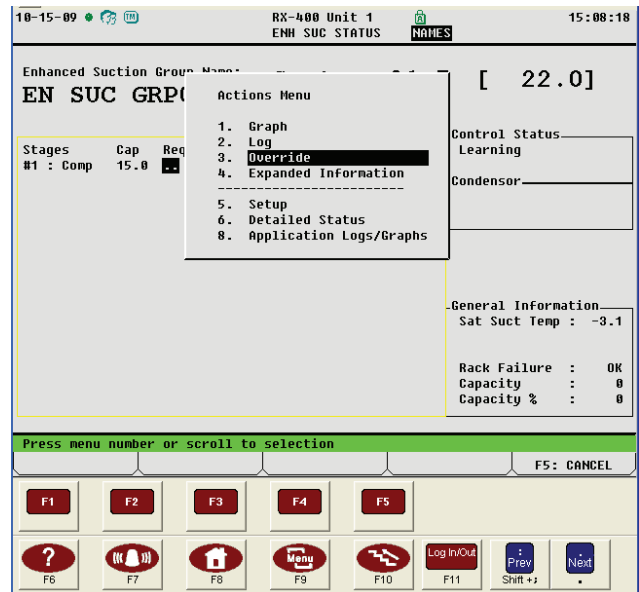
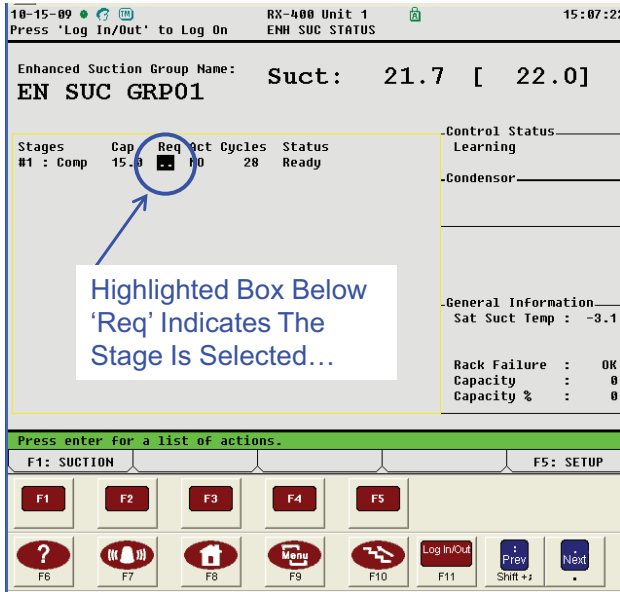
Figure 11
Intelligent Store Discus v2.1 Wiring

1. After Logging Into¹ The E2, From The Home Screen² Press **F1: Suction** To Arrive At the **'Summary For Suction Groups and Enhanced Suction' Screen**. Select The Enhanced Suction³ Group That Has The Digital Compressor Installed.

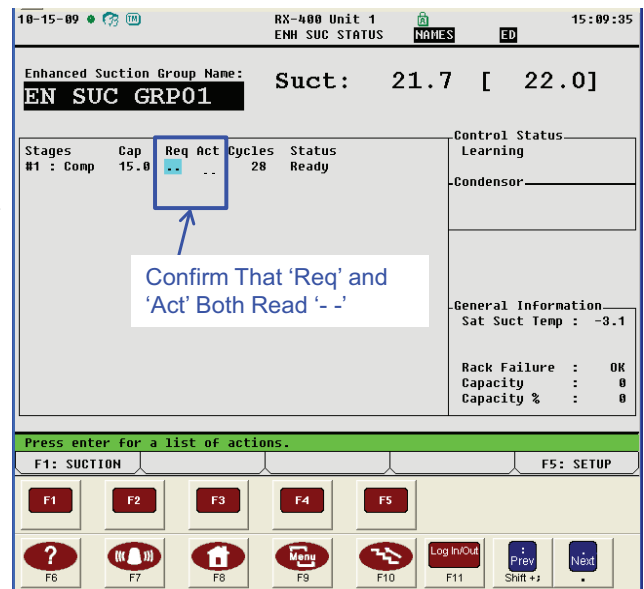
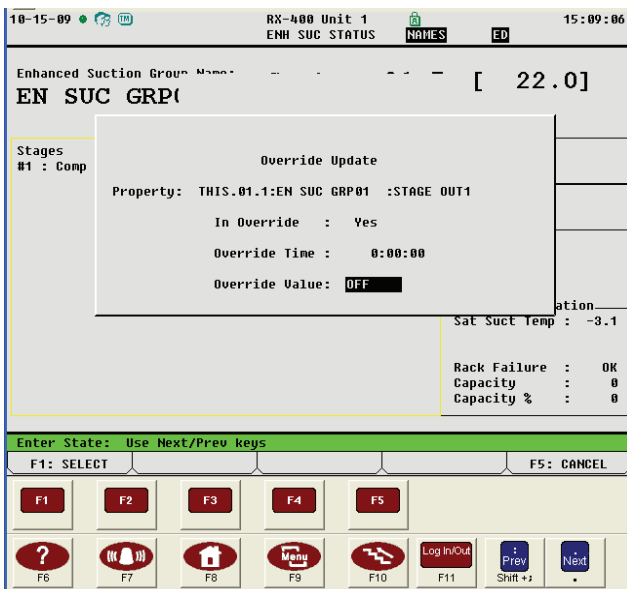


- ¹ Press The  And Enter Your User ID and Password To Log On
- ² The  Button Takes You To The Home Screen
- ³ When Using Copeland Digital™ Compressors With CPC E2 You Must Use The Enhanced Suction Feature To Properly Control The Digital Compressor

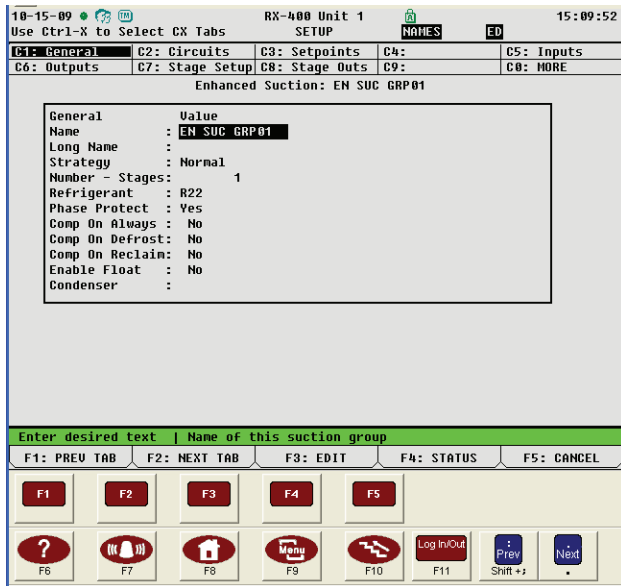
2. Scroll Down And Highlight The Compressor That Contains The Digital Unloader And Press Enter To Show The 'Actions Menu'. Select **Override** And Press Enter.



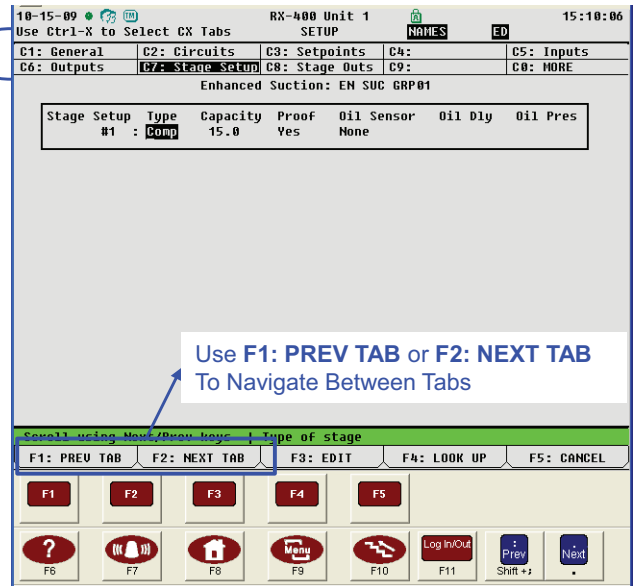
The 'Override Update' Window Will Appear. Type "YES" in The In Override Space and Type "OFF" Where It Shows Override Value. You Do Not Need To Change The Override Time. Press Enter To Return To the Suction Group Summary Screen.



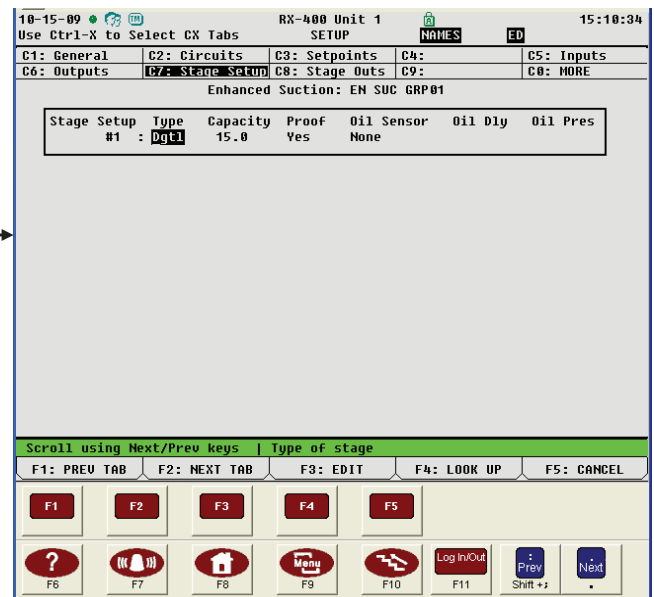
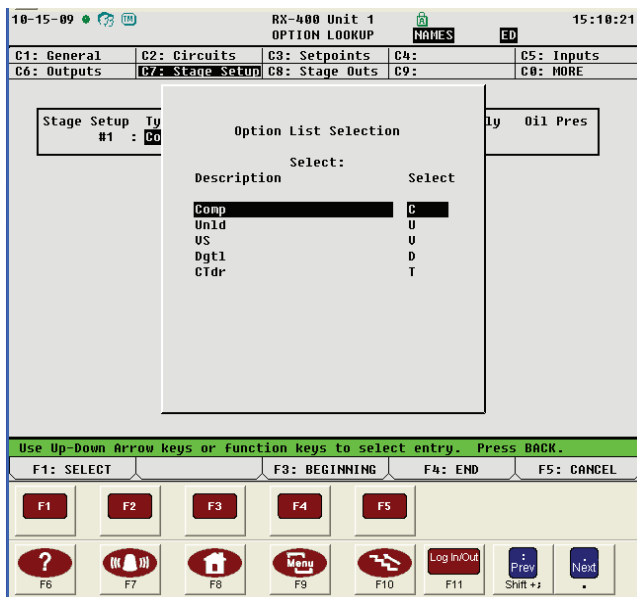
3. Press **F5: Setup** To Enter the 'Setup' Screen. Advance To **C7: Stage Setup**. Select The Compressor Stage With Digital Installed, Press **F4: Look Up** To Show The 'Options List Selection' Window.



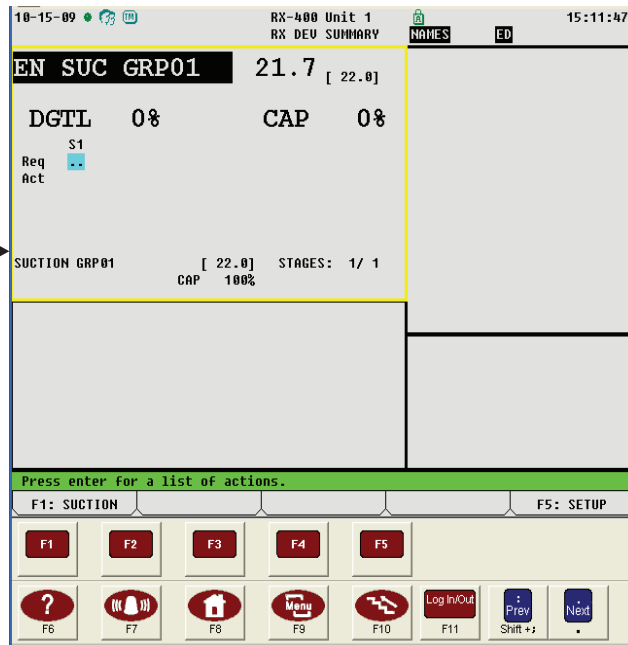
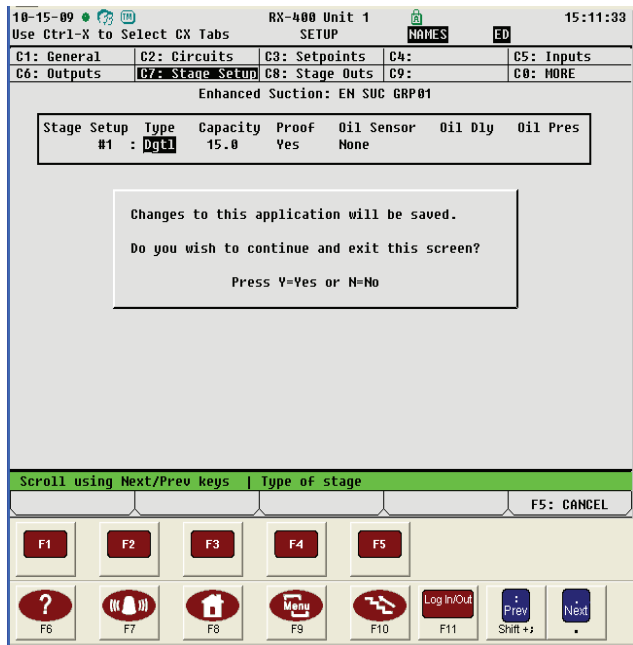
Tabs



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

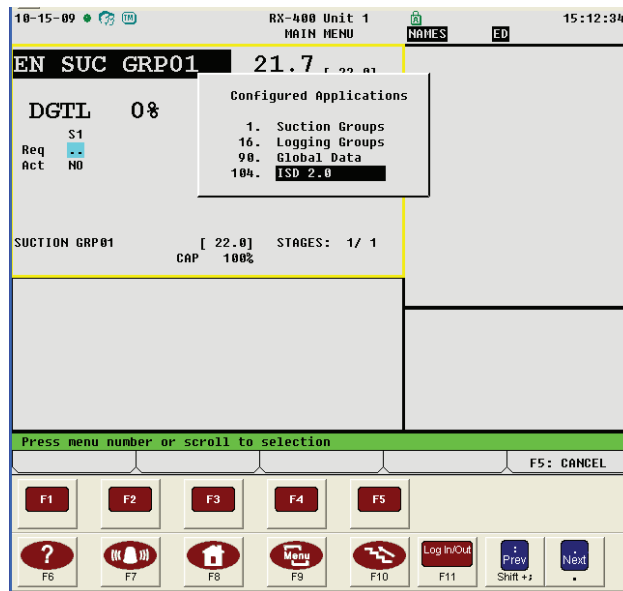
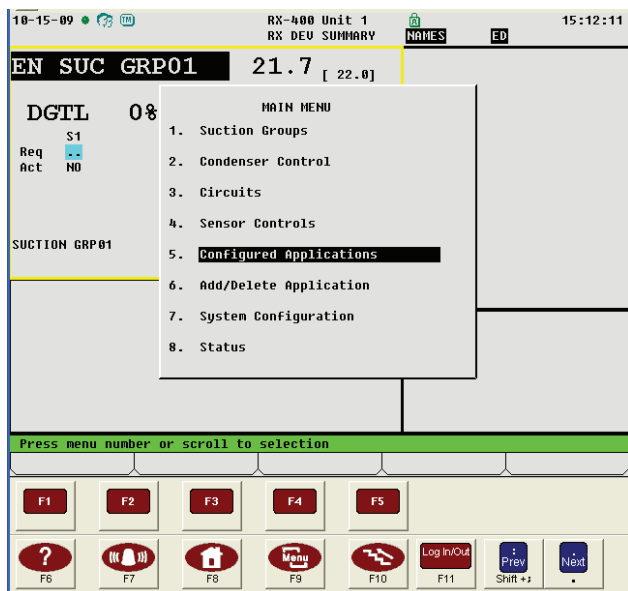


4. Press The Home Key To Return To The Home Screen. A Window Will Pop Up Notifying That Changes Were Made To The Application Type “Y” To Confirm You Would Like To Continue. The Home Screen Should Show DGTL 0%

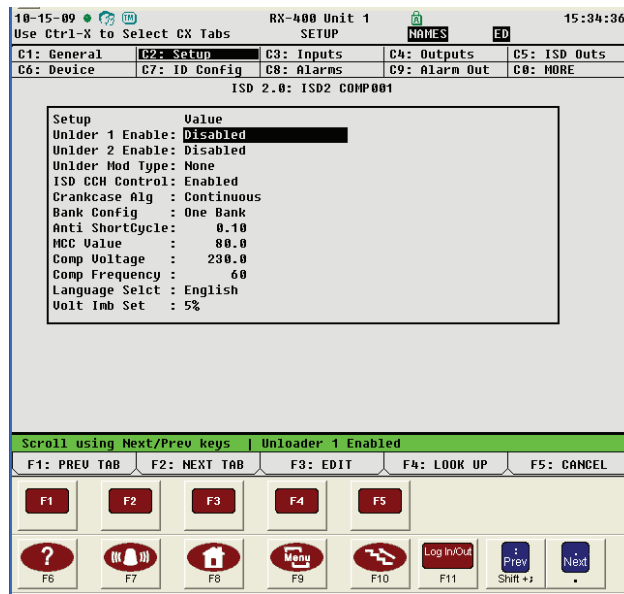
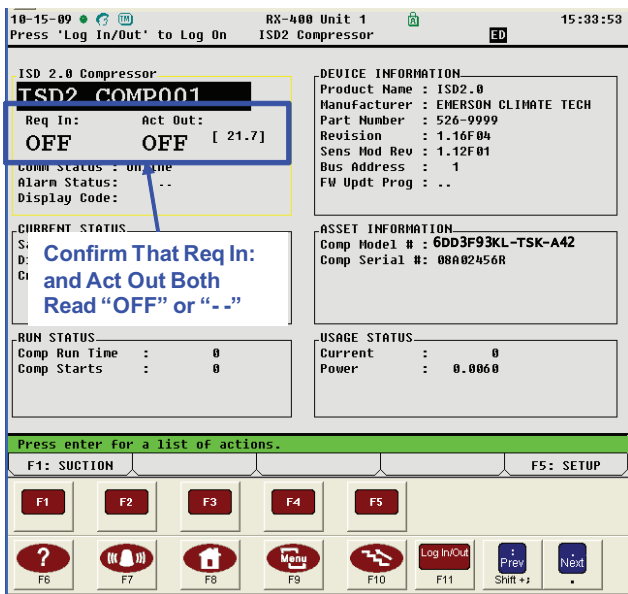


---Communication SEND Link Is Now Established---

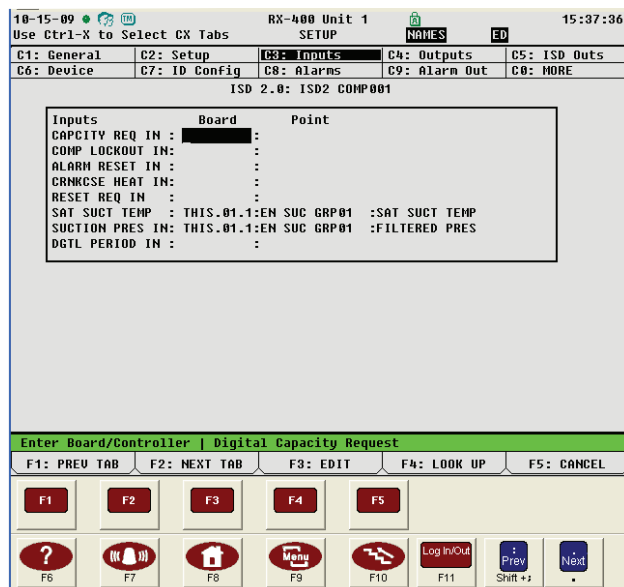
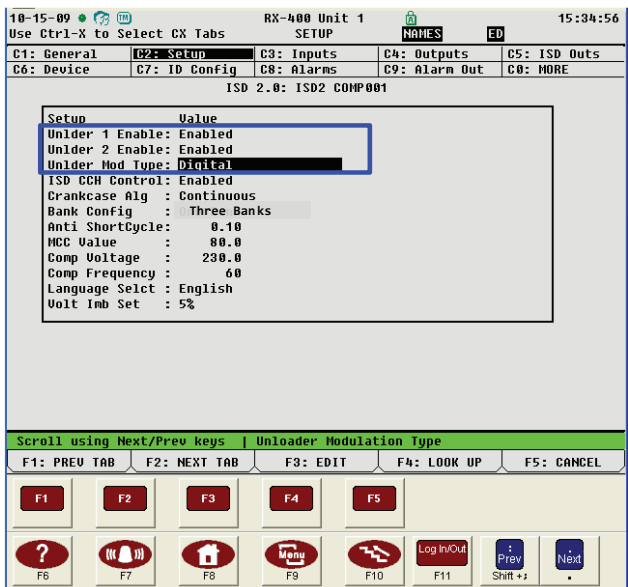
5. Press The Menu Button () To Bring Up The 'Main Menu.' Select **Configured Applications**. This Produces The 'Configured Applications' Window, Select **ISD 2.0**



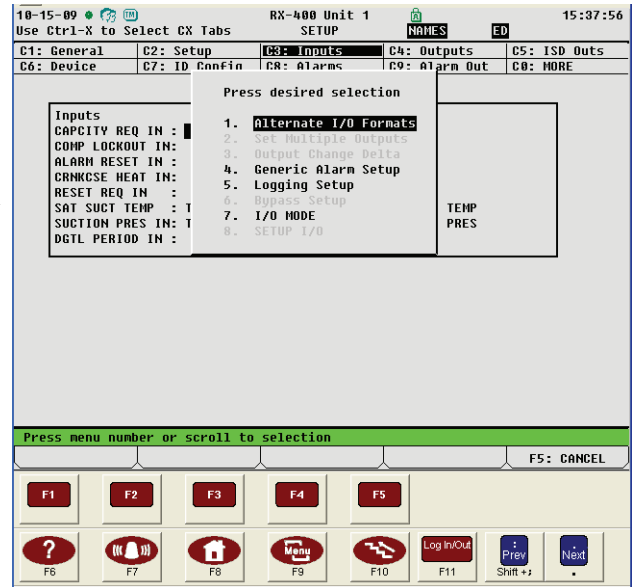
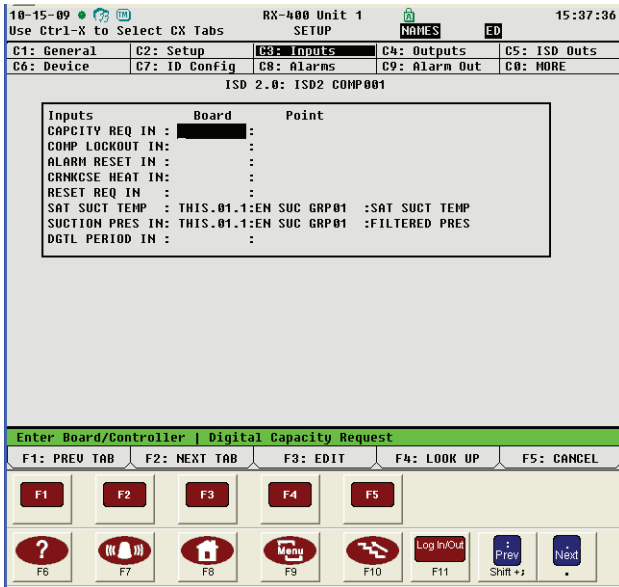
6. The 'Summary of ISD 2.0 Compressors' Screen Will Come Up. Select The ISD Compressor You Have Upgraded To Discuss Digital. Press Enter To Show The ISD Compressor Summary Screen. Press **F5: Setup** To Proceed To The Setup Screen. Go To **C2: Setup** Tab.



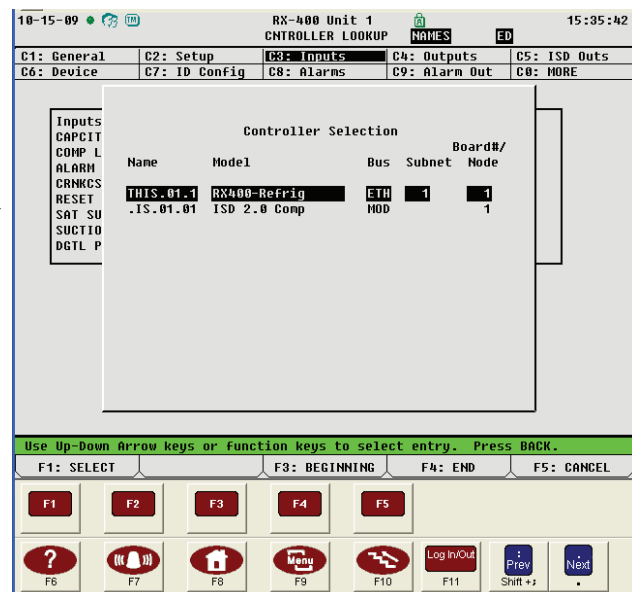
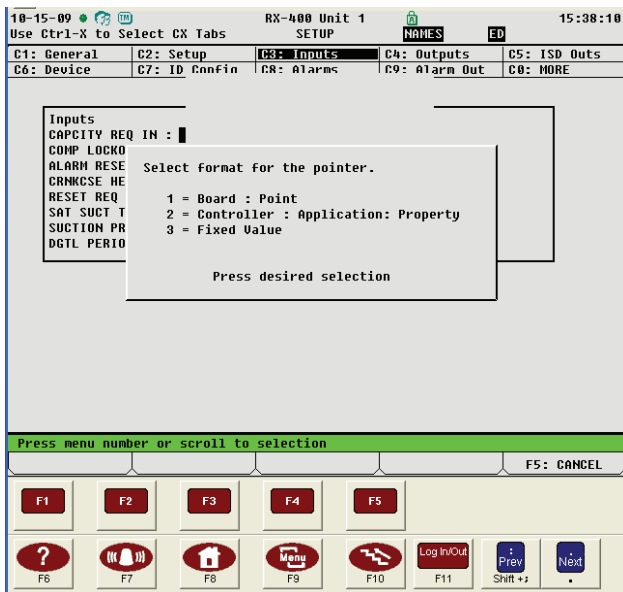
7. Move The Cursor To "Unlder 1 Enable" Press The Next Button () To Change From 'Disabled' To '**Enabled**.' Do The Same With "Unlder 2 Enable" if using blocked suction on middle of 6D or if using with Copeland Demand Cooling, otherwise leave Unlder 2 Enable set to "Disabled." Change The "Unlder Mod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



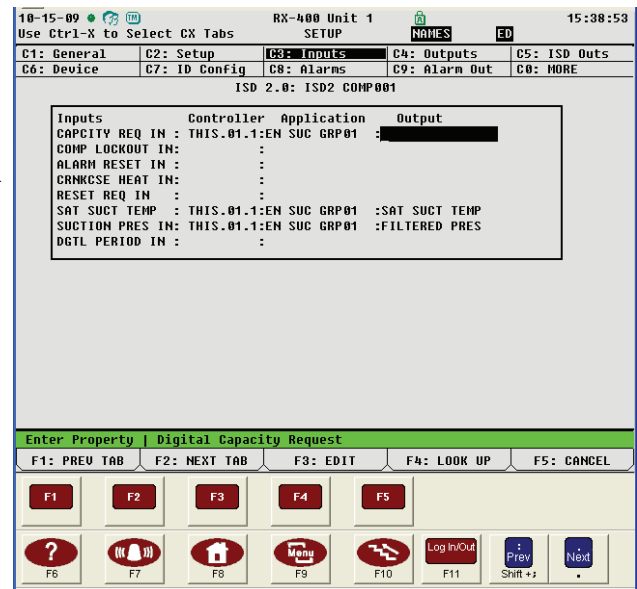
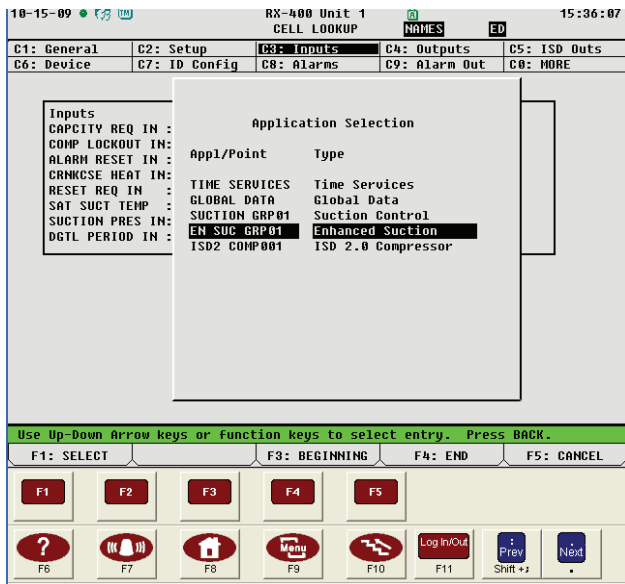
8. Move The Cursor To “Capacity Req In”. Press **F3: Edit**. In The New Window, Select **Alternate I/O Formats**



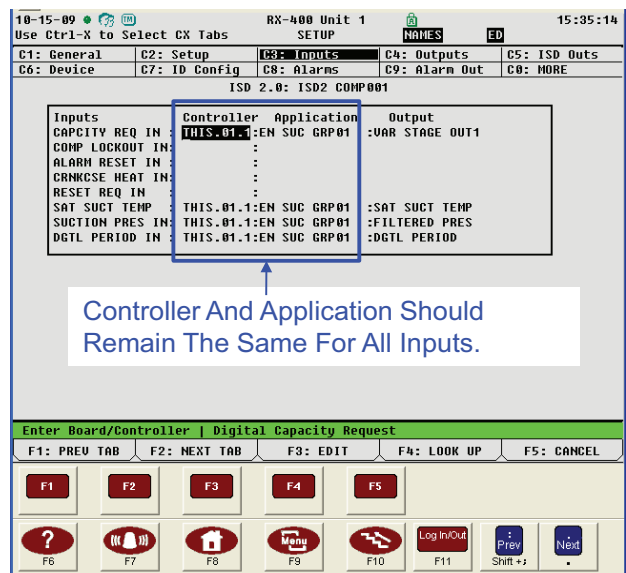
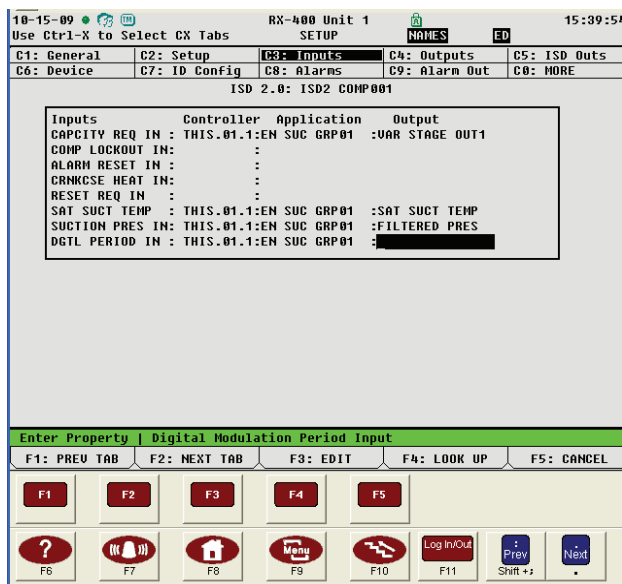
9. Type “2” To Select The **Controller : Application : Property** Format For The Pointer. With The Cursor In The Controller Field Of “Capacity Req In” Press **F4: Look Up**. Select the Controller From The ‘Controller Selection’ Window.



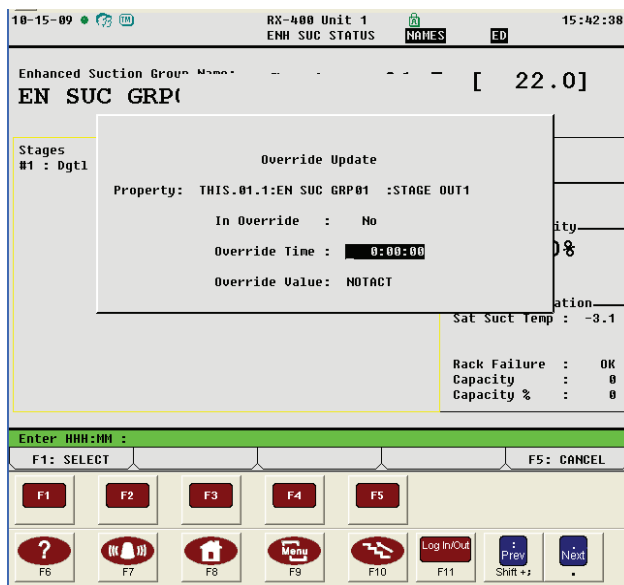
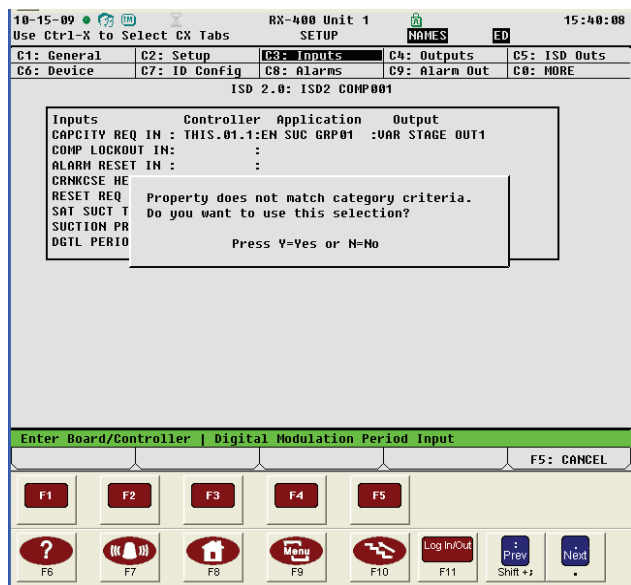
Move the Cursor To The Application Space. Press **F4: Look Up** And Select The Suction Group Application The Digital Is On. Next Move The Cursor To The Output Space And Type "VAR STAGE OUTX" Where X Represents The Stage Number Of The Digital Compressor.



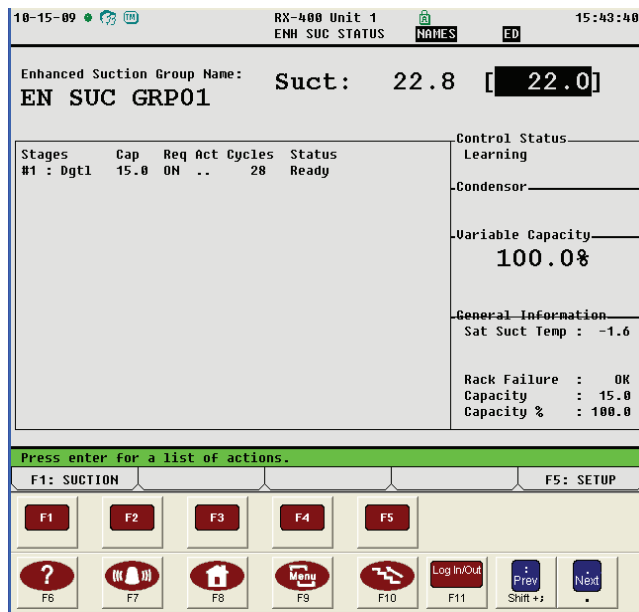
10. Move The Cursor Down To "DgTL Period In" Follow The Same Steps As Before To Edit The Format Of The Input (Use **F3: Edit** and **F4: Look Up** Features). In The Output Space Type "DGTL PERIOD".



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 or contact Emerson Climate Technologies, Inc. at 1-888-EMR-9950.

APPENDIX

Upgrade Kit Piece Description

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

Head Service Kit - Included in the head kit, the 4D/6D digital head has two individual pistons built inside the bottom of the head and a solenoid valve mounted on top of the head. One of the 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 and four valve plate gaskets (one gasket for each 4D/6D bore size).

Discus Digital Valve Plate - Like the cylinder head, the valve plate is unique to Discus digital. It has two 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 4D/6D 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 v2.1 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.**

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 ISDv2.1 compressor, your kit will only contain the 24V solenoid coils. Non-ISDv2.1 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!

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-ISDv2.1 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.

Sensor Temp Probe Kit - The non-ISD digital upgrade kits each contain a special discharge temperature probe that connects to the digital compressor controller. On 4D/6D ISDv2.1 there is a temperature probe already located in the left hand bank (when facing the oil pump end of compressor). This temperature probe should remain installed in the digital head.

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!

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

Head Stud - a longer head stud is provided in the 4D/6D digital upgrade kits to hold the solenoid valve, and valve plate aligned. Ensure that the stud is fully threaded when installing.

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 fan bracket.

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.

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
- Unl 1 (yellow wires) are connected to Digital solenoid. Purple (Unl 2) wires are connected to blocked suction or Demand Cooling solenoid or not used at all.

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 4D/6D Discus compressors (with serial number of 03D 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

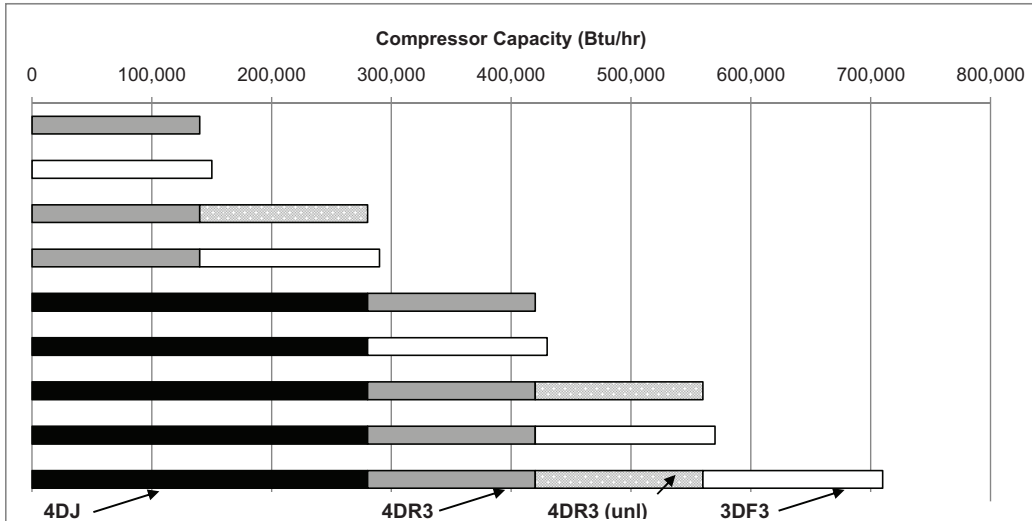
Example #2

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

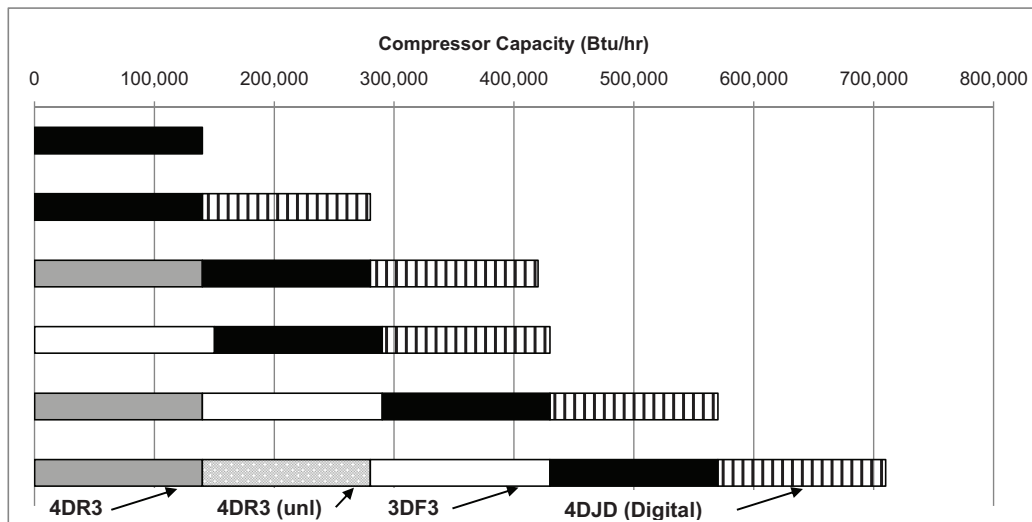
1. 4DJ3R28ML-TSK (280,000 BTUH)
2. 4DR3R28ML-TSK (280,000 BTUH) - 1 Bank Unl
3. 3DF3R15ML-TFD (150,000 BTUH)

Based on the above guideline, the first compressor should be upgraded to 4D Discus². 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 50 -100%.

² Or a 3D Discus Digital kit could be applied on compressor 3 (see AE4-1357 for more details on 3D Discus Digital). No more than one Digital compressor should be used per suction group.



Without Digital



With 4D Discus Digital

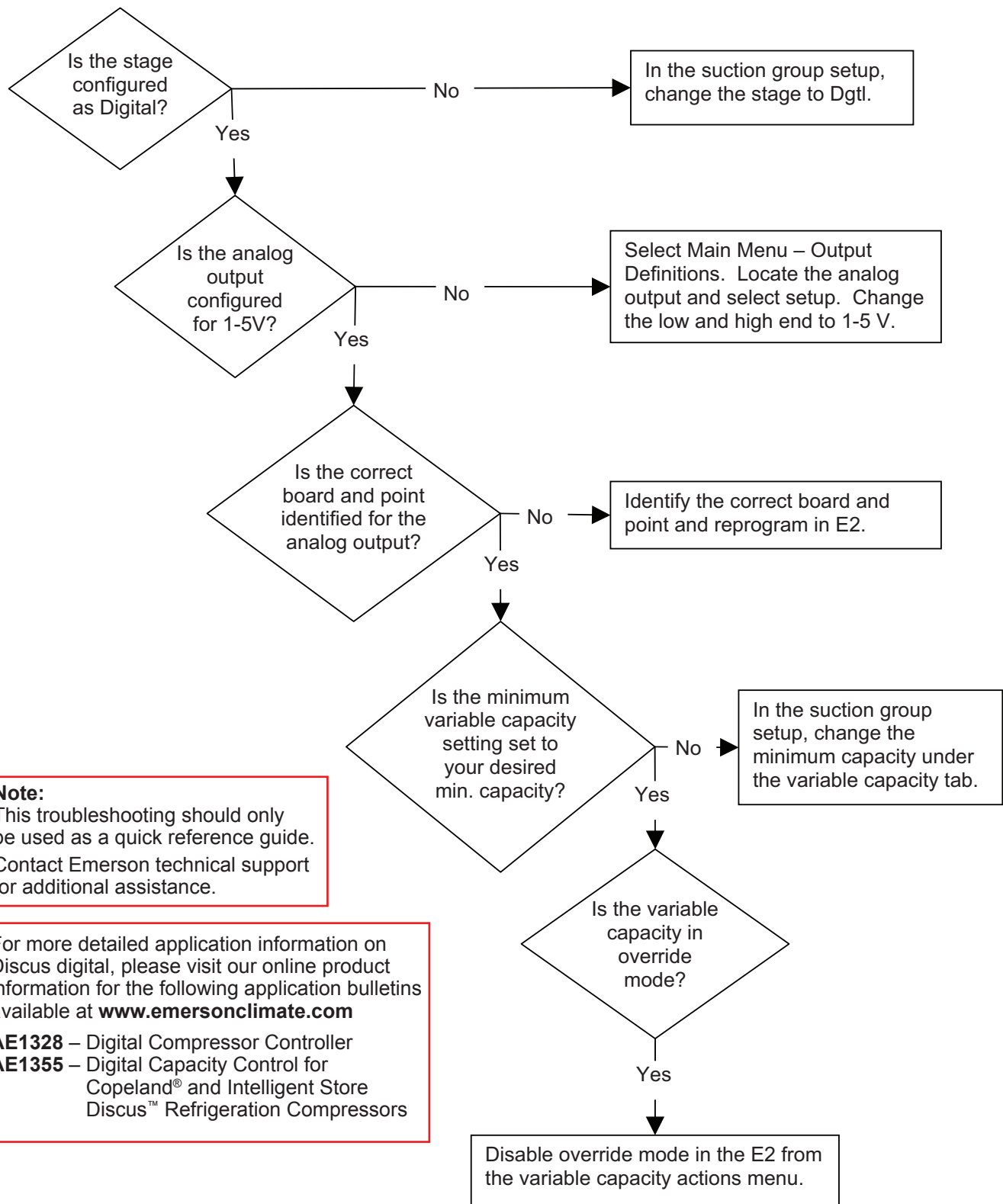
Raised Suction Pressure Setpoint

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 1-2% per pound of raised suction pressure.

Minimum Percent Digital Capacity

Copeland Discus Digital is designed to run all the way down to 50% compressor capacity on a 4D or to 33% on a 6D Digital with blocked suction on the middle bank of the compressor. 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. 67% 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 the minimum allowable percentage of full load compressor capacity.

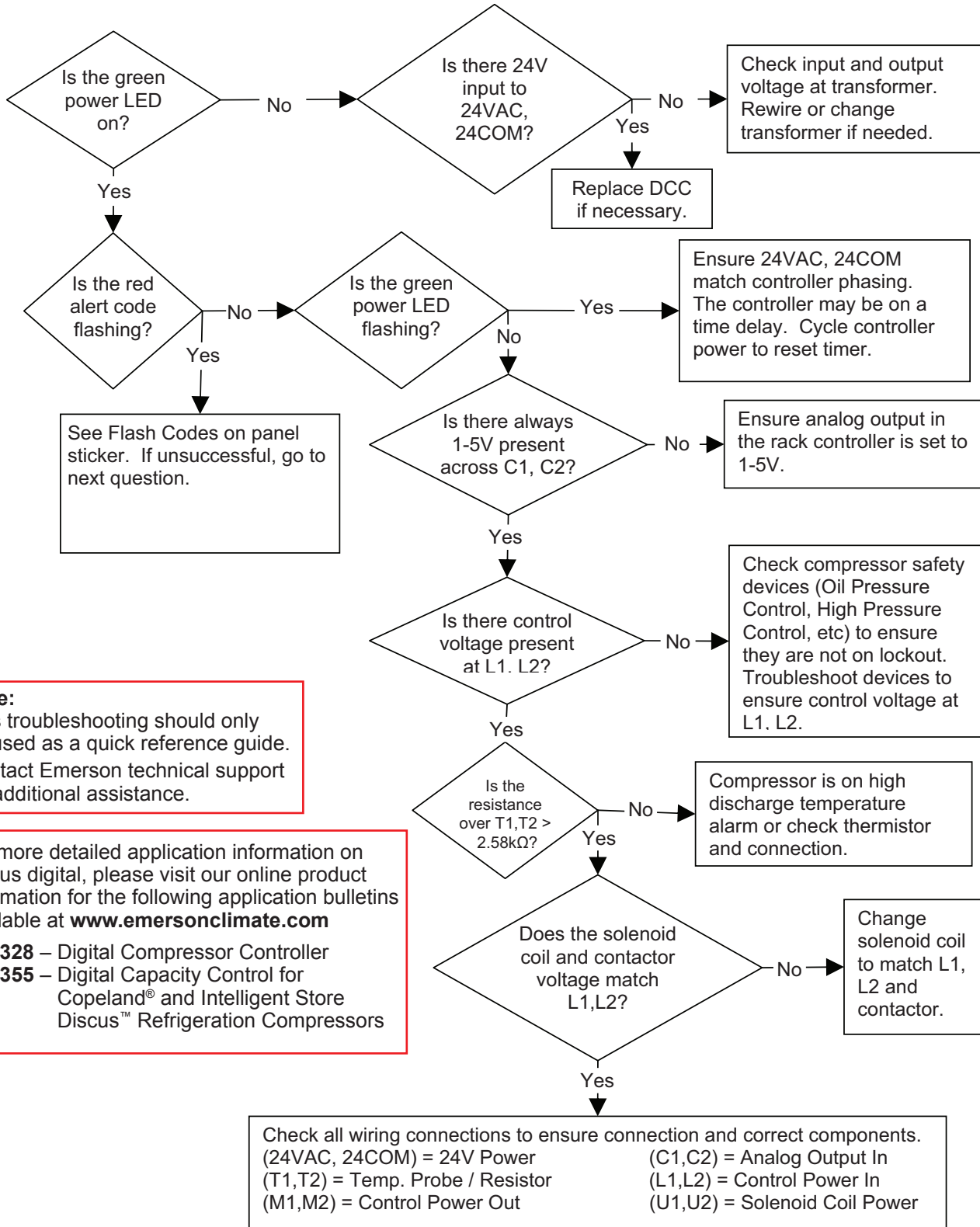
Troubleshooting Guide - Digital Compressor Setup in E2



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
AE1328 – Digital Compressor Controller
AE1355 – Digital Capacity Control for Copeland® and Intelligent Store Discus™ Refrigeration Compressors

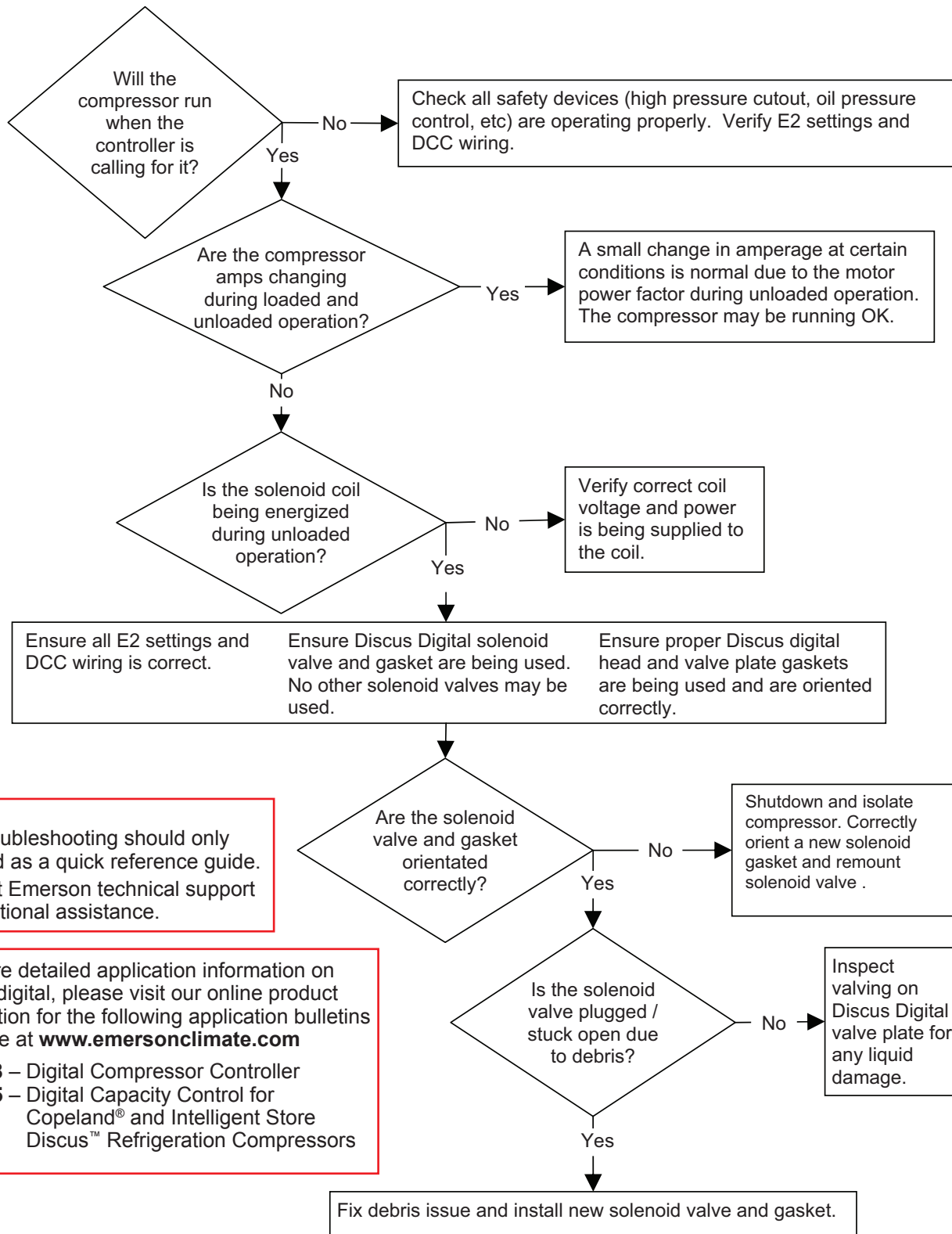
Troubleshooting Guide - Digital Compressor Controller



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Troubleshooting Guide - Digital Compressor



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