

Natural Refrigerant Training Summit

Building a Sustainable Workforce

**E3 Supervisory Controls with CO2 Applications
& New CC200 Case Control**

Brent Cheshire

Copeland



NORTH AMERICAN
**Sustainable
Refrigeration
Council**

COPELAND

E3 Supervisory Controls with CO₂ Applications & New CC200 Case Control

NASRC – Natural Refrigerant Training Summit

St Louis, MO

November 14-16, 2023



NATE Certification Please Fill Out Sheet Provided



Official Recognized Provider Attendance Record

Submit to: NATE • attn: Recognized Provider Recorder
2111 Wilson Blvd. Suite 510 • Arlington, VA 22201

Recognized Provider Name Copeland Date _____

Training Location, City & State Plumbers & Pipefitters Local 562 Training Center

Course Name CO2 System Basics / Booster System Ops NATE Course # 1212-0136

NATE Approved Hours 2 Course Hours Total 2

Instructions on filling out this form:

1. If additional sheets are needed, please use copies of this sheet, not blank paper
2. Course name, number and hours must match as submitted and approved by NATE.
3. Records must be received within 60 days to receive credit. Records received after this WILL NOT GET CREDIT.
4. To receive credit, the original roll and all information must be provided. No copies or faxes will be accepted.
5. If handwriting is unclear, credit will not be given.
6. Instructors hours will only be recorded in instructors box at bottom.
7. This record must be used for single-day courses. Multi-day courses use a different form.

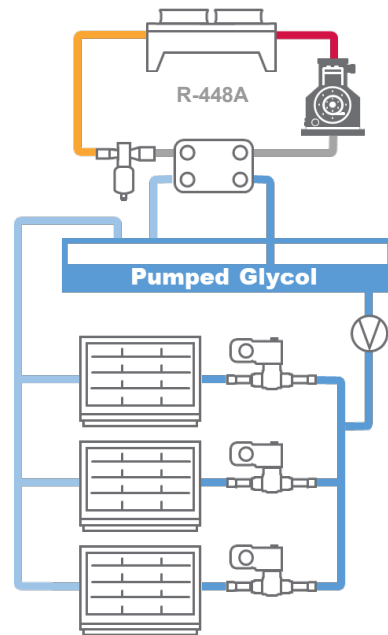
Technician Name <small>Please print as it appears on your NATE ID card</small>	NATE ID # <small>Must be included to receive credit</small>	Signature

CO₂ Refrigeration Systems

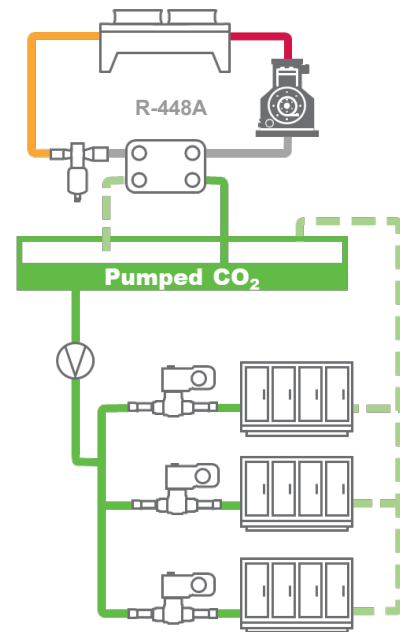
Each System Type can be Effectively Managed With Copeland E3 Platform Like DX HFC Systems

Secondary CO₂

Medium Temp
Glycol Pumped Secondary

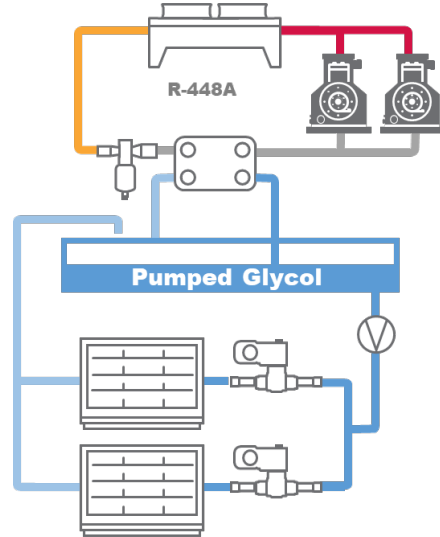


Low Temp
CO2 Pumped Secondary

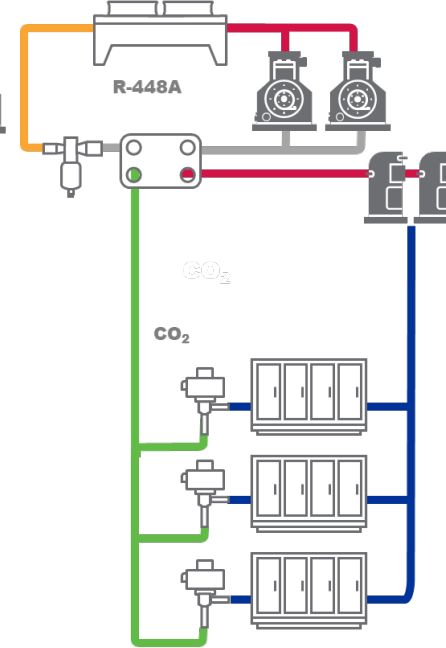


Cascade CO₂

Medium Temp
Glycol Pumped Secondary

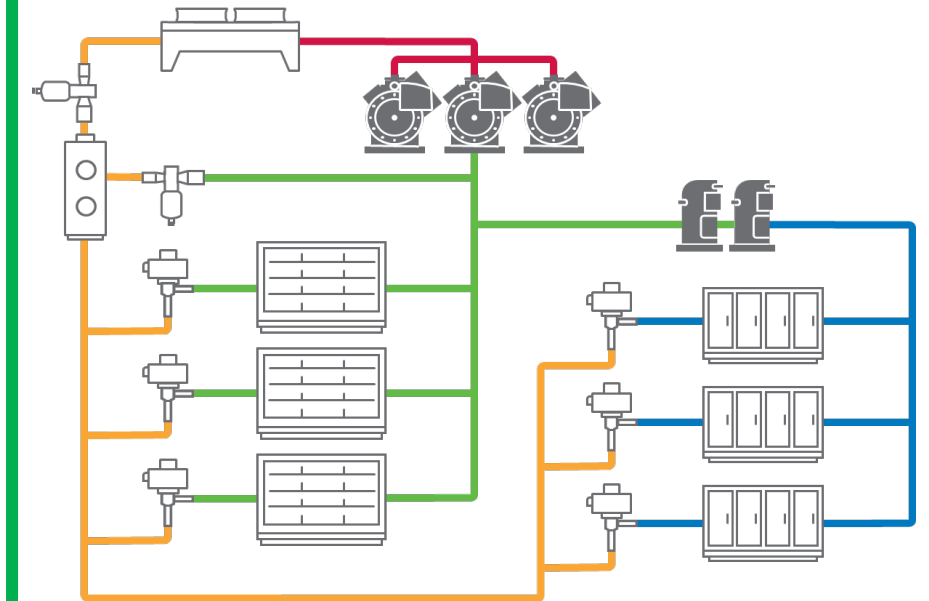


Low Temp
CO2 Cascade



Transcritical CO₂

Low & Medium Temp
Transcritical CO₂ Booster

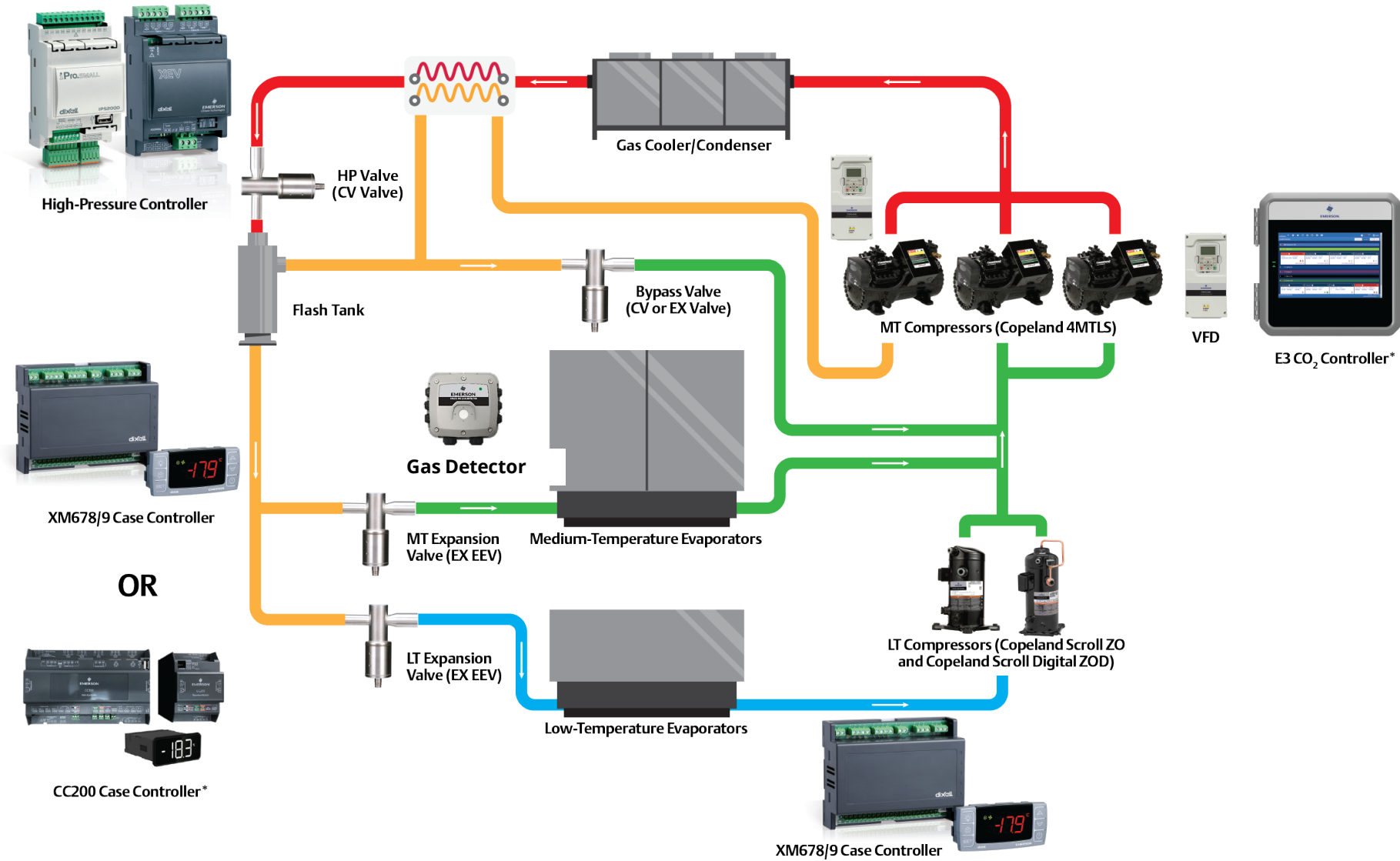


✓ **Primary Focus Today**

Unique Control Application vs. Traditional DX HFC System

- CO₂ Standstill Pressure Considerations
- **Heat Exchanger Superheat Control**
- Pump Skid Control
- **Electronic Expansion Valves/ Case Control**
- Subcritical CO₂ Compressor Envelope
- **Flash Tank & Gas Cooler Management/Optimization**

Transcritical CO₂ Booster System



- 
 OMC Oil Control
- 
 High Pressure Transducers
- 
 High Pressure Controls
- 
 Liquid / Oil Level Sensor
- 
 Ball / Check Valves
- 
 Filter Driers / Sight Glass

System Diagram

R-744 (CO₂) system that uses only CO₂ for medium-temperature and low-temperature refrigeration loads.

Integrated Solutions

Deliver seamless system integration that enables maximum system reliability, efficiency and simplicity.

Enhanced visibility of overall system through E3 CO₂ controller.

Collaborating with Strategic Channel Partners to Simplify CO2 Refrigeration with a Full Suite of Integrated Solutions



COPELAND

E3 Controller



E3 vs E2

E3 front view



E2e front view



E3 Controller is a Drop-in Replacement for the E2 Product



True E2 Drop-in Replacement

- **Identical** wiring holes, mounting points and vents
- Enclosure fits into existing panel cut-out

Updated Integrated Display

- **Larger** 10" capacitive color touch-screen
- User-friendly interface with on-screen keyboard

Equivalent COM Port Configuration and Power Connections

- **Total of four COM ports** for connected devices with two isolated COM ports
- Easily swap out an E2 with no need for rewiring

Fully Backward Compatible With MultiFlex and IONet Boards

E3 Technical Specifications

Operating Temperature	-40°F to 149°F (-40°C to 65°C)
Operating Humidity	5% - 95% RH non-condensing at 90°F
Storage Humidity	5% - 100% RH
24 VAC	24 VAC ±20%, 50/60 Hz, Class 2, 80VA
Dimensions	12" L x 12.5" W x 3.75 H"
4 RS485 ports	COMM 1 = RS485 Com 2 A and B COMM 2 = RS485 Com 6 (isolated) COMM 3 = RS485 (isolated) COMM 4 = RS485 Com 4 A and B
2 Ethernet ports	Ports 0,1
2 USB ports	J2, J3

Hardware Enhancements and Modified Applications

Hardware Enhancements

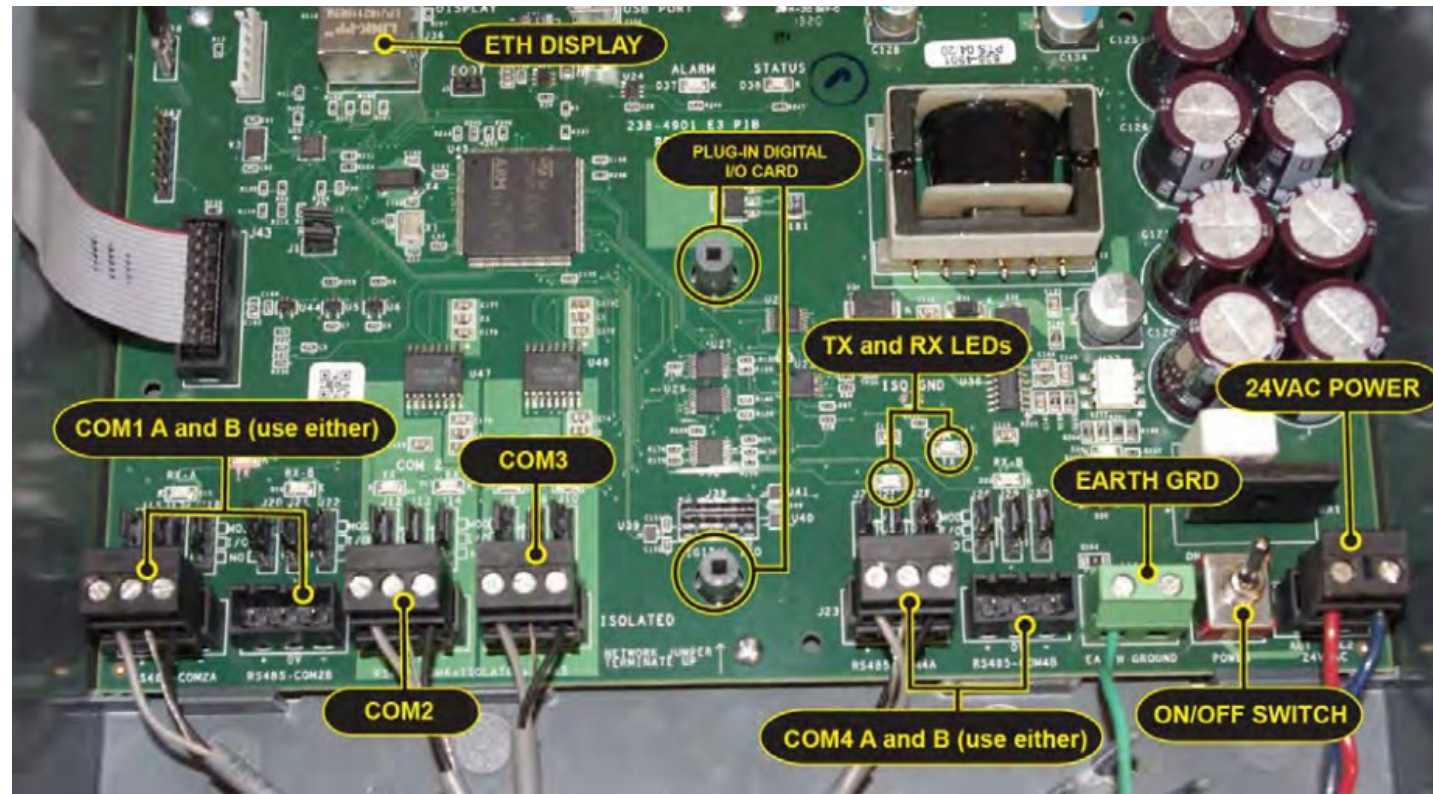
E2 Hardware	E3 Hardware
500 MHz Single Core	1.6 GHz Quad Core
128 MB RAM	2 GB RAM
1 Ethernet Port (1 MAC/PHY)	2 Ethernet Ports (2 MAC/PHY)
3 RS-485 COM Ports	4 RS-485 COM Ports (2 Isolated)
Plug for Optional I/O Daughter Card	Plug for Optional I/O Daughter Card

Modified Applications in E3

E2 Application Name	New E3 Application Name
Eng. Unit Converter	Localization
Heat/Cool Control	Thermostat or Sensor Control
Power Monitoring	Utility Monitoring
Pulse Accumulator	Utility Monitoring
Time Schedule	Scheduler

Twelve times faster processing power and 16X additional memory built in to E3 for faster response time and increased storage.

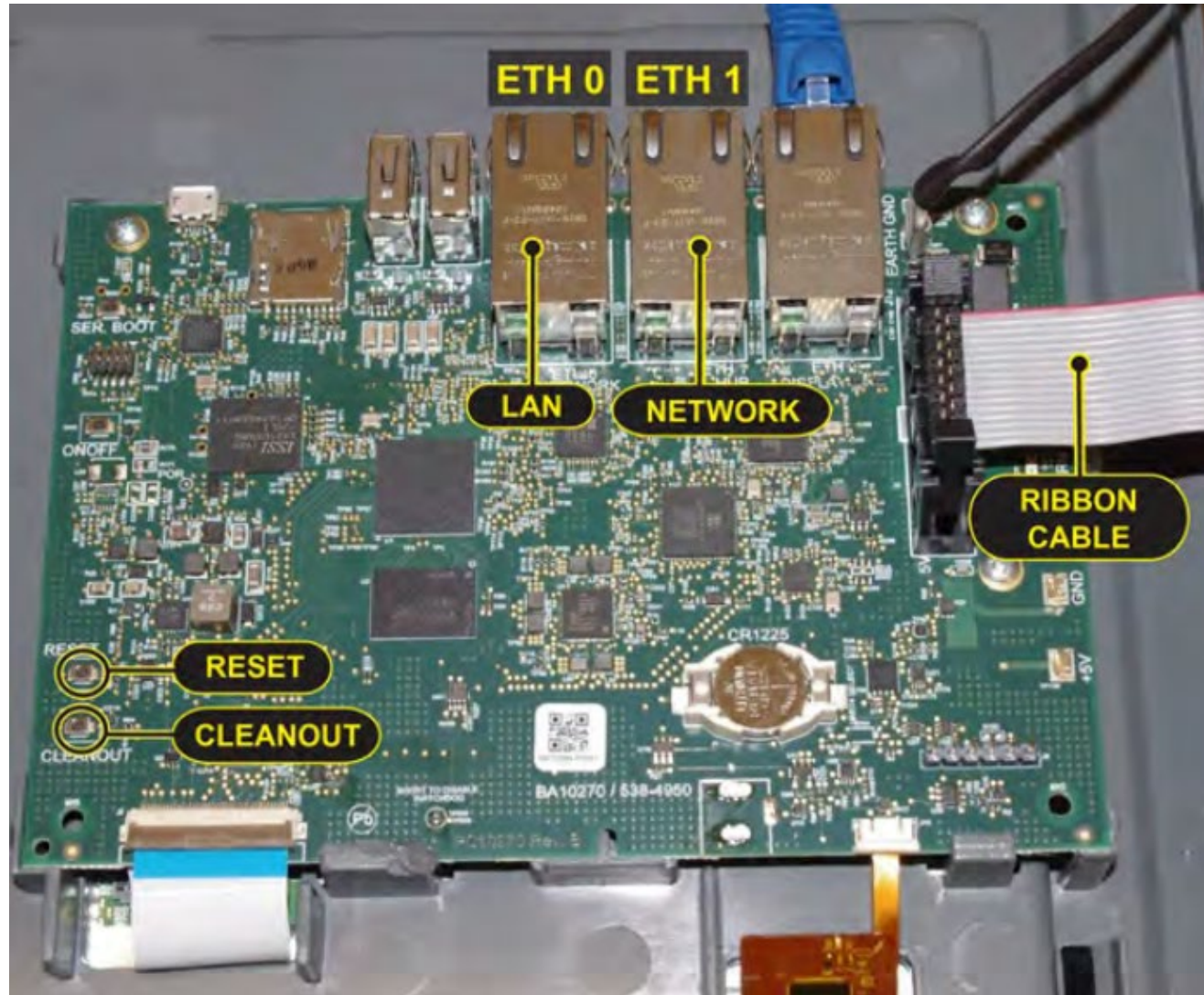
E3 Power Interface Board (PIB)



- 24VAC Transformer Class II
- (4) Universal Communication Ports
 - IO Net, ModBus, BACnet
- Optional Plug-In IO Card

Operating Temperature	-40°F to 113°F (-40°C to 45°C) <i>*Tested to UL60730-1 standard</i>
Operating Humidity Storage Humidity	5% - 95% RH non-condensing at 90°F 5% - 100% RH
24VAC	24 VAC ±20%, 50/60 Hz, Class 2
Dimensions	12" L x 12.5" W x 3.75" H
4 RS485 ports	COM 1 = RS485-COM2A and RS485-COM2B COM 2 = RS485-COM6<ISOLATED> COM 3 = <ISOLATED>RS485 COM 4 = RS485-COM4A and RS485-COM4B
2 Ethernet ports	ETH 0, ETH 1
2 USB ports	J2, J3
External Pollution Rating	All Models: Pollution Degree 3
Rated Impulse Voltage	2500/4000V
Lithium Battery Marking	Caution: The cell used in this device may present a fire or chemical burn hazard if mistreated. Do not disassemble, heat above 212°F (100°C), or incinerate.


E3 Motherboard




- Customer LAN Network (ETH0)
- Service LAN Connection (ETH1)
- Reset and Cleanout buttons

Communication

Device Type	Purpose	Communication Protocol
E3	System Manager (Compressor, Gas Cooler Fans, Circuit Management, Alarms)	Ethernet (Remote) IO Net, Modbus, BACnet (Devices)
MultiFlex Boards	Input/Outputs	IO Net
High Pressure Controller	HPV & BGV Controller	Modbus
XM678D/XM679K	Case Controller	Modbus
CC200	Case Controller	Modbus or BACnet
MRLDS-450	Leak Detection	Modbus
EVM/EVH	Variable Frequency Drive	Modbus or BACnet





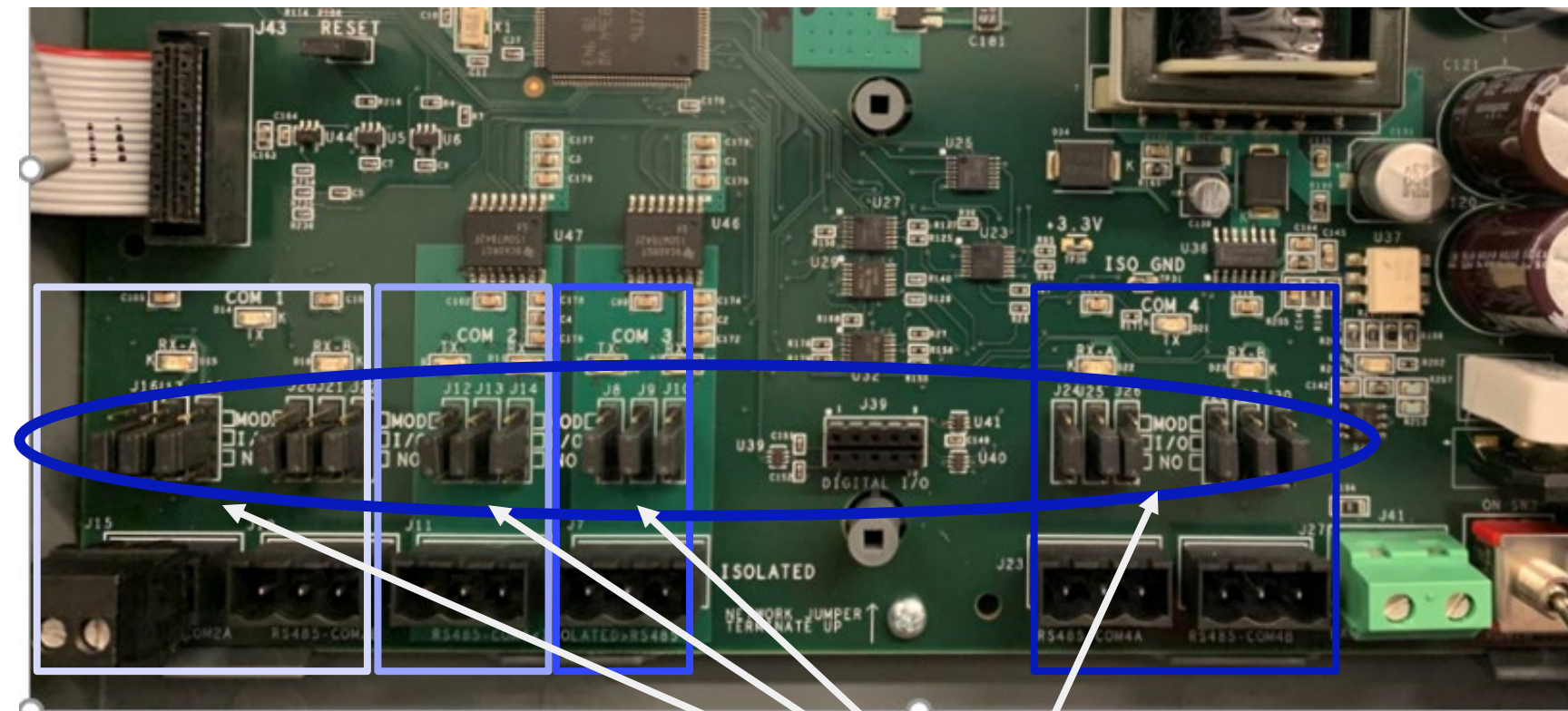
Product: [8761](#)

Electronic, 2 C #22 Str TC, PE Ins, OS, PVC Jkt, CM

Request Sample

Product Description
Electronic, 2 Conductor 22AWG (7x30) Tinned Copper, PE Insulation, Overall Beldfoil® Shield, PVC Outer Jacket, CM

E3 Comm Ports and EOL Termination Jumpers



Comm 1

Comm 2

Comm 3

Comm 4

Termination
Jumpers

- 150 ohm resistor
- Both ends of comm network loop must be terminated
- IO Net, Modbus, BACnet
- Use Termination Jumpers on E3



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Supervisory Control Software Differences

Features and Benefits



Control Software Features

Software Features

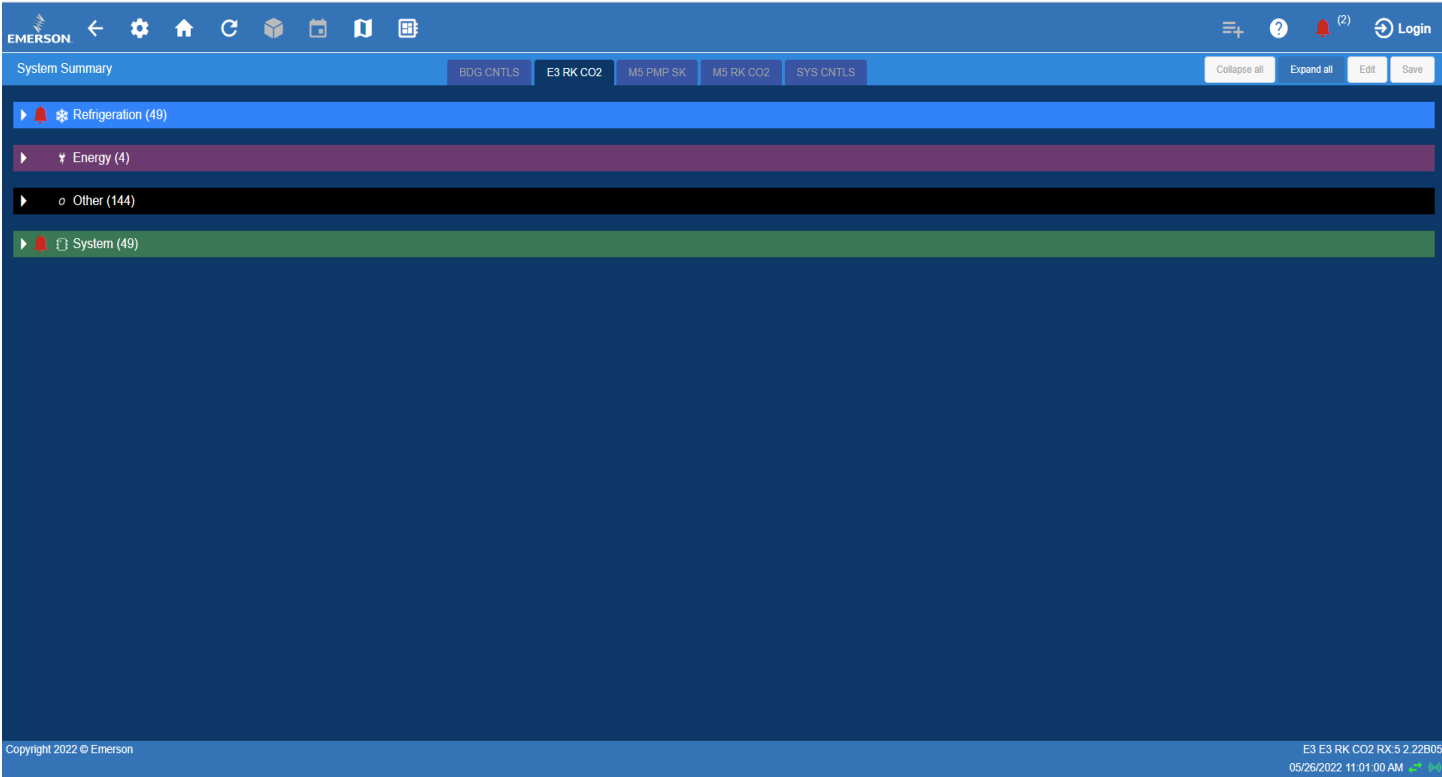
Supervisory Control Software provides the Same Control Function as E2, and includes new:

- Faster Response and Navigation
- Text and Email Alerting
- Prioritized Alarms
- Floor Plan Views
- Aggregate Devices
- Enhanced Upstream Communication Capabilities
- Intuitive Navigation with Graphical Interface
- Increased Security
- Increased Network Functionality
- No Additional Software Needed

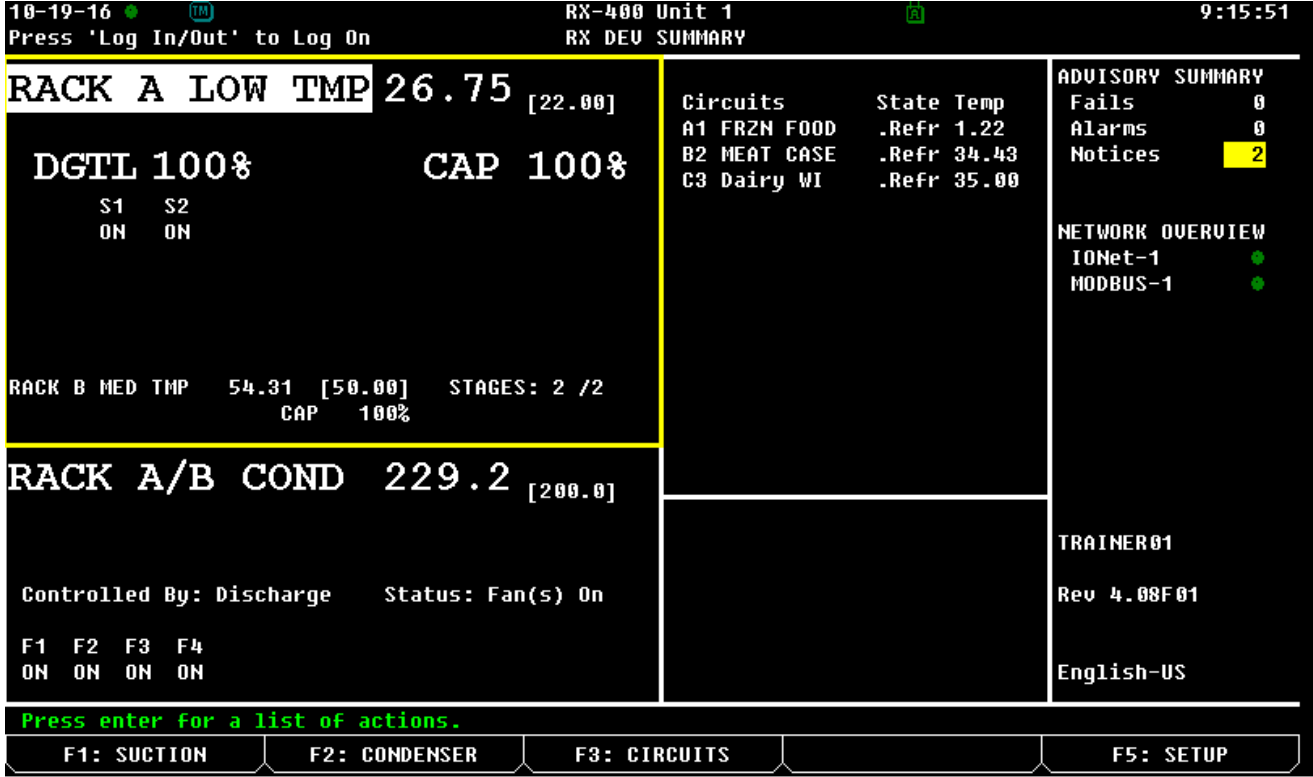


E3 vs E2

E3 software: Supervisory Control Software



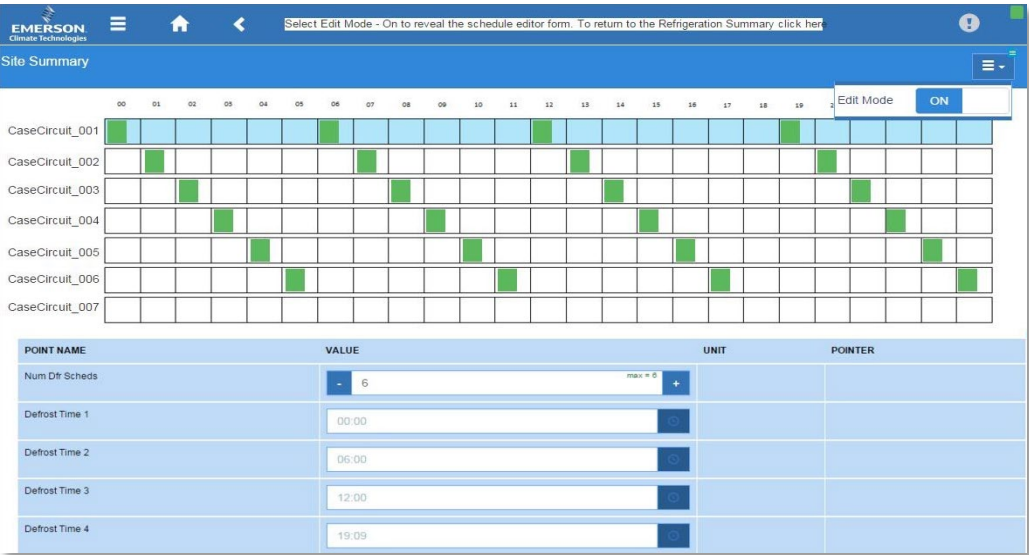
E2 Software:



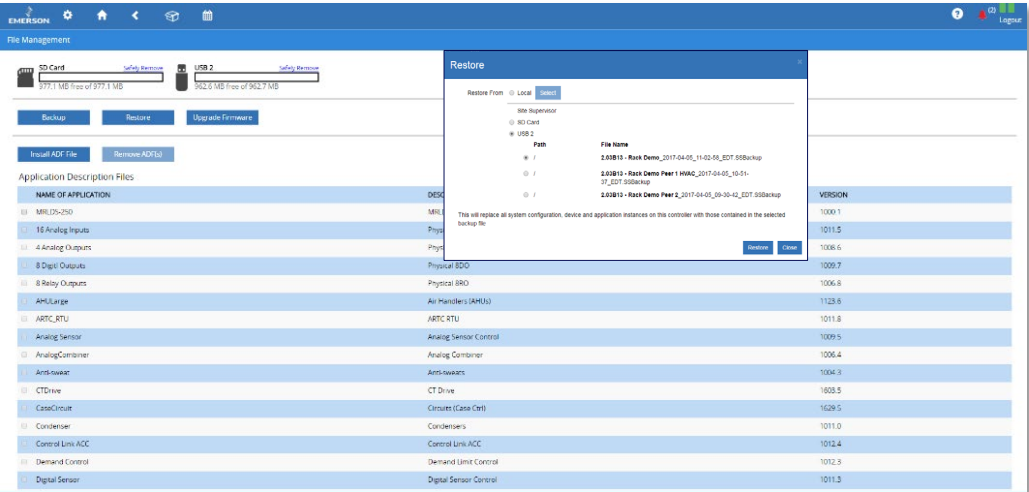
The E3 operates on a shared software platform with Site Supervisor. This new format offers intuitive navigation that technicians will find familiar and easy to use.

Supervisory Control Differentiators vs. E2

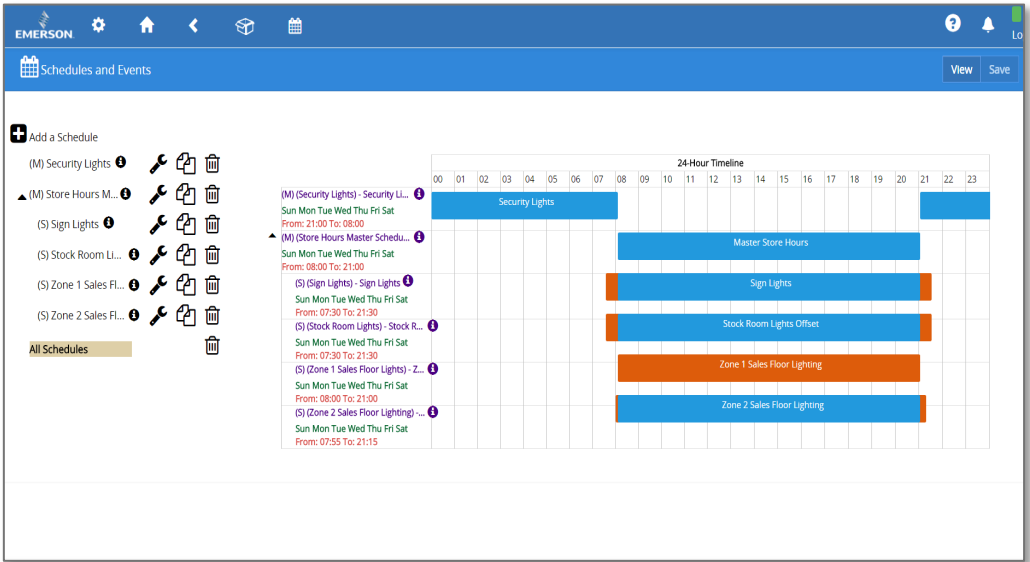
Graphical Defrost Summary



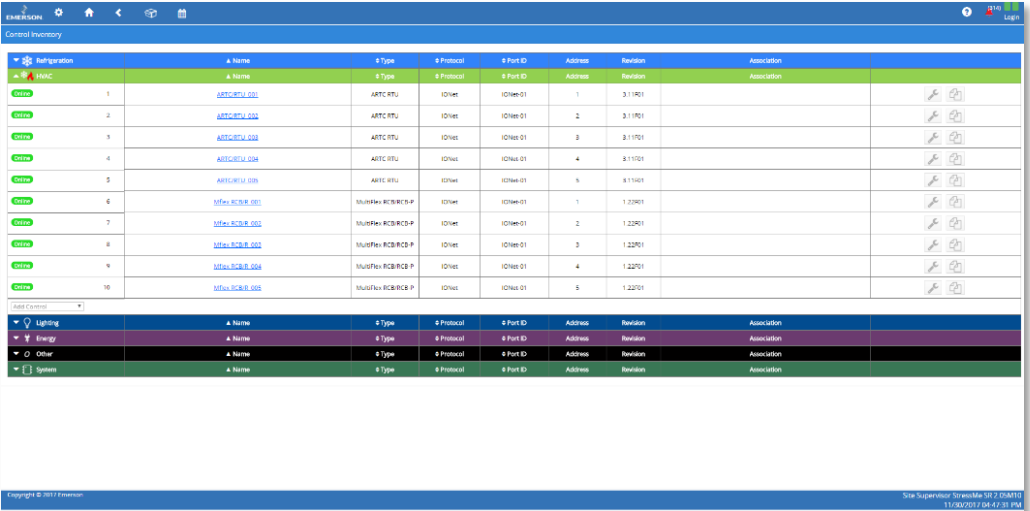
File Management



Graphical Schedule



Site Inventory



Fast Troubleshooting via Smart Alarms and Custom Graphing

Smart Alarms

- Provides high level explanation, possible causes, and suggested actions to take. Can enter custom user defined messages.

The screenshot shows the 'Active Alarms (311)' list on the left and a detailed view of a 'Non-Critical Alarm 1 of 1' on the right.

#	Description	Type	Time Occurred	Age
1	Condenser Fan Cycle	Critical	11/30/2017 03:53 PM	1d 0h 0m
2	Condenser Fan Cycle	Critical	11/30/2017 03:50:23 PM	1d 0h 45m
3	Condenser Fan Cycle	Critical	11/30/2017 03:38:28 PM	1d 0h 45m
4	Condenser Fan Cycle	Critical	11/30/2017 03:35:28 PM	1d 0h 45m
5	Condenser Fan Cycle	Critical	11/30/2017 03:30:24 PM	1d 0h 45m
6	Condenser Fan Cycle	Critical	11/30/2017 03:28:32 PM	1d 0h 45m
7	High Temp Alarm	Non-Critical	11/30/2017 04:01:29 PM	0h 2m
8	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 04:41:59 PM	0h 2m
9	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 04:41:54 PM	0h 2m
10	High Temp Alarm	Non-Critical	11/30/2017 04:40:48 PM	0h 3m
11	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 04:39:32 PM	0h 5m
12	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 04:38:38 PM	0h 5m
13	High Temp Alarm	Non-Critical	11/30/2017 04:15:01 PM	0h 23m
14	High Temp Alarm	Non-Critical	11/30/2017 03:57:54 PM	0h 48m
15	High Temp Alarm	Non-Critical	11/30/2017 03:50:24 PM	0h 53m
16	High Temp Alarm	Non-Critical	11/30/2017 03:48:08 PM	0h 55m
17	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:42:07 PM	1h 1m
18	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:42:02 PM	1h 2m
19	High Temp Alarm	Non-Critical	11/30/2017 03:33:32 PM	1h 10m
20	High Temp Alarm	Non-Critical	11/30/2017 03:29:33 PM	1h 14m
21	High Temp Alarm	Non-Critical	11/30/2017 03:25:32 PM	1h 14m
22	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:22:11 PM	1h 16m
23	Low Temp Alarm	Non-Critical	11/30/2017 03:22:11 PM	1h 16m
24	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:22:01 PM	1h 17m
25	High Temp Alarm	Non-Critical	11/30/2017 03:22:01 PM	1h 17m
26	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:22:01 PM	1h 17m
27	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:22:01 PM	1h 17m
28	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:22:01 PM	1h 17m
29	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:22:01 PM	1h 17m
30	Failed Sensor or Bad Wiring	Non-Critical	11/30/2017 03:22:01 PM	1h 17m

Non-Critical Alarm 1 of 1

Details [View Graph](#)

Explanation You are receiving this alarm because your condenser fan has cycled more than the recommended times per time period

Possible Causes

1. Failed temperature sensor.
2. Improper temperature sensor location.
3. Improper pressure transducer connection.
4. Extreme ambient conditions.
5. High pressure discharge valve malfunction.
6. PID not properly tuned.
7. Capacity cannot meet load.

Suggested Actions

1. Check temperature sensor for proper operation and placement.
2. Check pressure probe for proper operation.
3. Check valve setpoint for appropriate ambient conditions.
4. Check high pressure valve for proper operation.
5. Check PID related parameters for proper configuration.
6. Check unit sizing for proper load capacity.

User Defined Message

Type Non-Critical

Time Occurred 01/01/2021 10:12:12 PM

Age 6d 17h 44m

Unit Number 1

Unit Name Market

Device Type SS

Originator Condenser A.PRES CTRL IN
Condenser A.TEMP CTRL IN
Ex. Fan_001.Cycle number

Graphical System Status Pages

- Monitor system status and performance visually with graph-based reports that identify historical patterns, trends and issues.

The screenshot shows the graphical system status page for '+23 R507 SUC 1' (Suction Groups). The interface includes a navigation menu with options like Status, General, Setpoints, Float Setup, Inputs, Outputs, Comp Setup, Comp Outs, Alarms, Proof, Comp Oil, Advanced, Power, Hot Gas, Checkit, ISD, Associations, and Input/Output Status.

System Parameters:

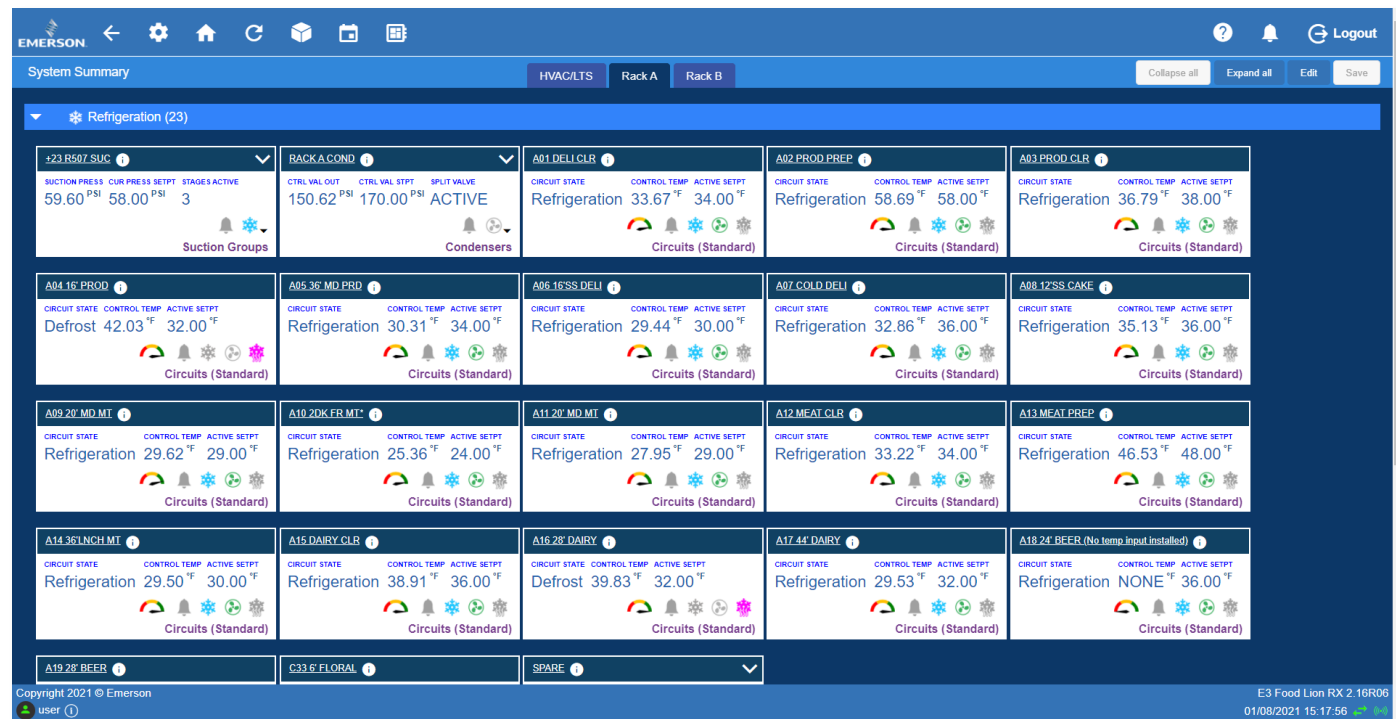
SUCTION PRESS	54.15 PSI
CUR PRESS SETPT	58.00 PSI
STAGES ACTIVE	2
TOTAL STAGES	6
PERCENT USED	37.31 %
RACK FAIL	OFF
COMP 1	OFF
COMP 2	OFF
COMP 3	ON
COMP 4	OFF
COMP 5	ON
COMP 6	OFF

Graphs:

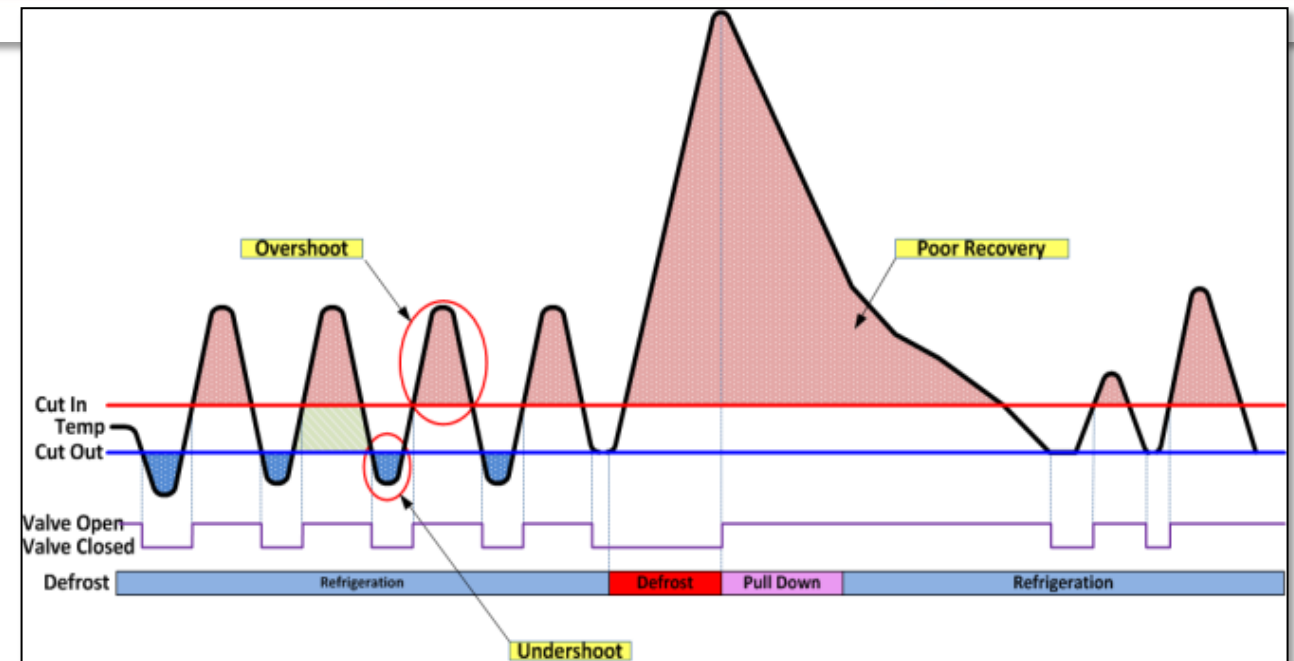
- PERCENT USED [%] (Base Log):** Shows a fluctuating line graph over time, with a current value of 44.78%.
- SUCTION PRESS [PSI] (Base Log):** Shows a fluctuating line graph over time, with a current value of 61.90 PSI.
- COMP 1 (Base Log):** Shows a binary ON/OFF status graph.
- COMP 2 (Base Log):** Shows a binary ON/OFF status graph.
- COMP 3 (Base Log):** Shows a binary ON/OFF status graph.
- COMP 4 (Base Log):** Shows a binary ON/OFF status graph.

Performance Meter, A Simple Way to Recognize Site Performance

- Case performance rolls-up into circuit performance. Graph or download performance data for detailed analysis. Up to 13 months of performance history for seasonal performance comparison is available.



POINT NAME	VALUE	POINTER
FOM	99 %	
% Time Above	3.91 %	
% Time Below	0.00 %	
% Time At Target	96.09 %	
% Time In Defrost	13.06 %	
% Time In Recovery	0.00 %	
PB Hi Offset	5.40 Δ°F	
PB Low Offset	5.40 Δ°F	
Sensitivity	1.00	



E2 VS E3

E2 Pro's

- 500+ CO2 System Installed Today with E2
- Familiar with Current Offerings
- Field Service Technicians and Contractors are more Familiar with Operation, Programming, Troubleshooting
- Already IT Approved
- Compatibility with obsolete devices that may still exist in the field like Echelon and Comtrol device
- E2's Alarm Management

E3/SS Pro's

- 12x Faster Response,
- 16x additional memory,
- Intuitive Navigation,
- Text and Email Alerting,
- Prioritized Alarms,
- Floor Plan and Graphical Interface,
- Enhanced Upstream Communication Capabilities,
- Increased Advanced Security,
- Increased Network Functionality.
- Additional Communication and Ethernet Ports.
- Installation Flexibility
- Faster System Programming and Commissioning
- **CO2 Native Applications**
- Smart Alarms
- No Possibility to be Phased Out any time soon

Dedicated CO₂ Application Reduces Programming Efforts and Complexity

CO₂ Suction Group

- Control of CO₂ Transcritical booster systems and parallel compression – centralized control provides ease of use
-

Advanced Compressor Superheat Management

- Liquid and/or hot gas injection
-

Load Management

- More precise control and recovery from out-of-range conditions
-

Enhanced CO₂ System Monitoring

- Additional advisories for out-of-range pressures/temperatures
 - Works with load management to provide better recovery
-

Oil Management

- Long compressor service life
-

Overview of Entire CO₂ System Operation in One, Customizable View

E2e Control

The E2e Control interface displays a comprehensive overview of the CO₂ system. Key sections include:

- LOW TEMP:** Shows 'NONE' status and 'CAP 100%'.
- DGTL 100%:** Displays digital status for various components.
- GAS COOLER:** Shows 'NONE' status and 'VS 950. RPM CAP 100%'.
- Circuits:** A table listing various circuits with their states and temperatures.
- MODBUS:** Shows communication status for various modules.
- RS RK CO2:** Displays system configuration and language settings.

New E3 for CO₂ Suction Group Control

The E3 interface provides a modern, customizable view of the CO₂ suction group control. Key features include:

- CO₂ Suction Groups:** A table showing filtered pressure, current pressure, setpoint, saturation suction temperature, percent used, control status, rack fail, and state for various suction groups.
- Gas Cooler:** A dedicated control panel for the gas cooler, showing temperature, discharge pressure, and fan status.
- Circuits:** A table listing various circuits with their states and control temperatures.
- High-Pressure Controller:** A control panel for the high-pressure controller, showing pressure and valve output.
- Case Controller:** A control panel for the case controller, showing case temperature and valve percentage.
- Sensors:** A table listing various sensors with their control values and command outputs.
- Graphs:** A line graph showing the control value over time.

Customize layout by user with tables, graphs and tiles!

The E2e Control interface shows a detailed control panel for a specific component, including:

- Control Val:** NONE
- Command:** OFF
- NEW OIL PULSE:** A control panel for the new oil pulse.
- ET CRT SHUTDOWN:** A control panel for the ET CRT shutdown.

The E3 interface shows a detailed control panel for a specific component, including:

- T1 TEMP:** 62.1 °F
- HPV Mode:** Subcritical
- SETPOINT:** 5.00
- CONTROL VALUE:** 6.0
- P1 PRES-OUTLET:** 625.12 PSI
- VALVE 1 OUTPUT:** 21 %
- BOV SETPOINT:** 450.00 PSI
- P2 PRES-RECEIVE:** 441.20 PSI
- T2 TEMP:** 24.1 °F
- VALVE 2 OUTPUT:** 26 %
- ENABLE:** ON



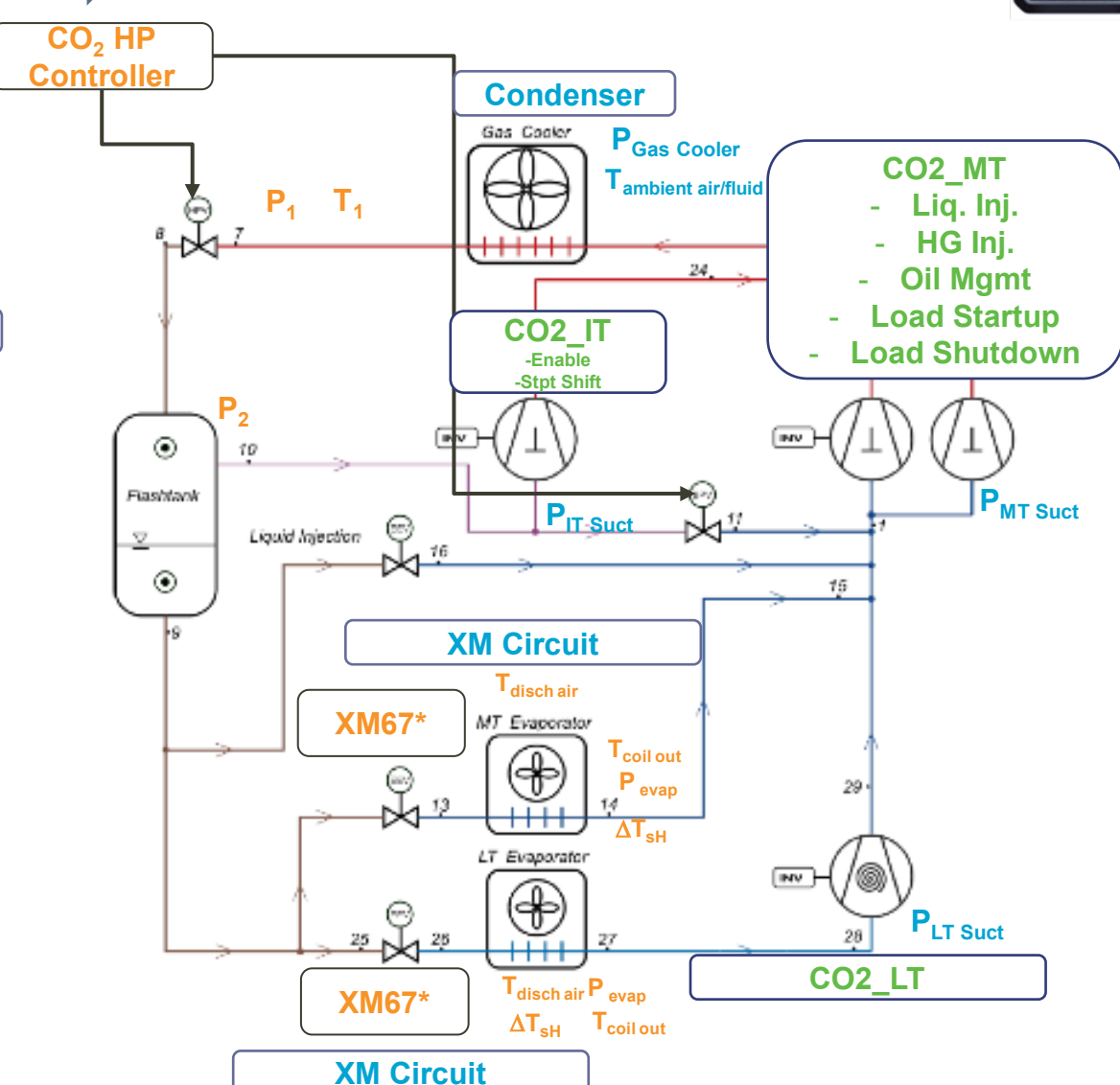
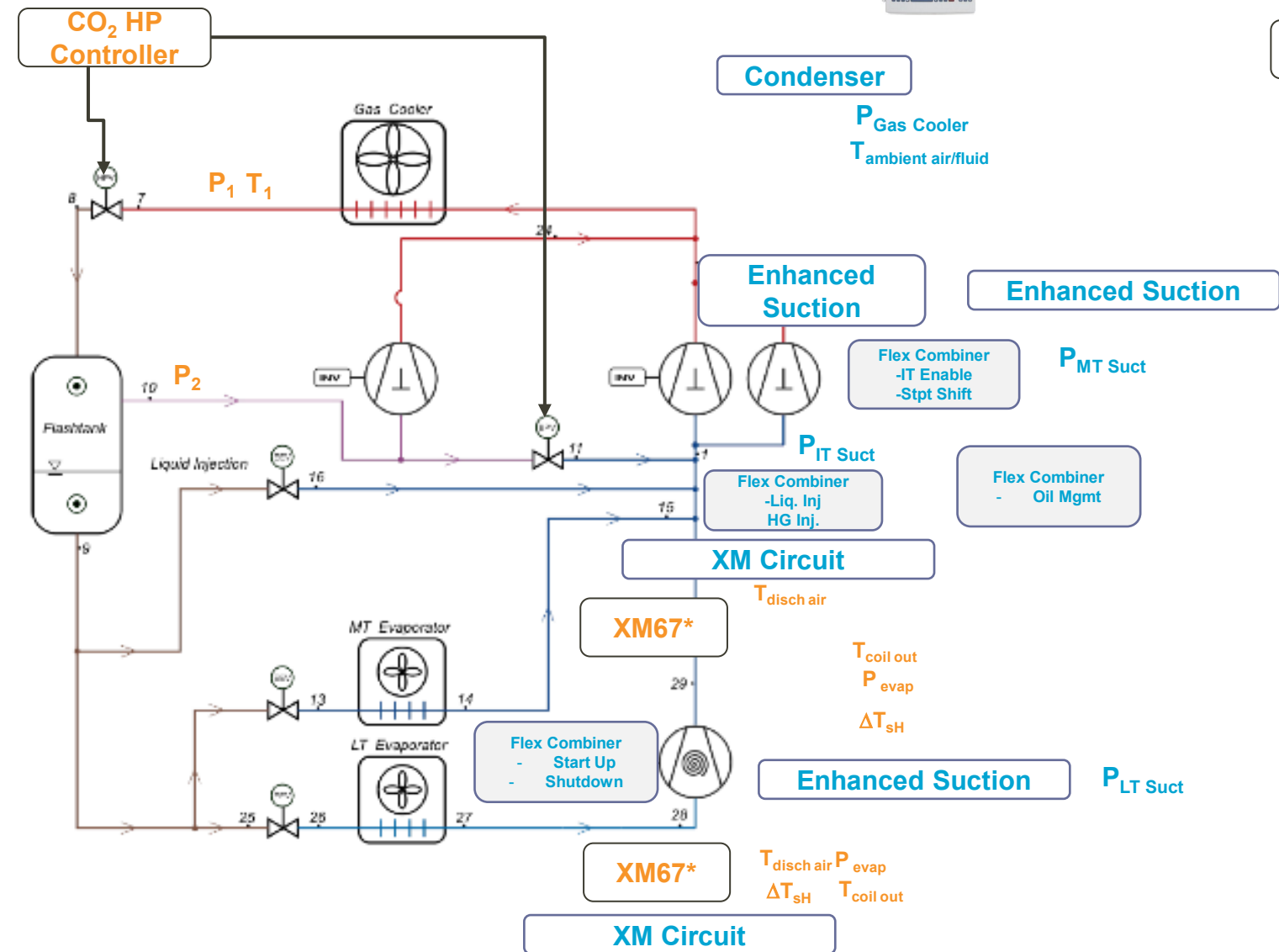
High-Pressure Controller and Valve Driver

Overview Of Software Updates Going to E3 Supervisory System

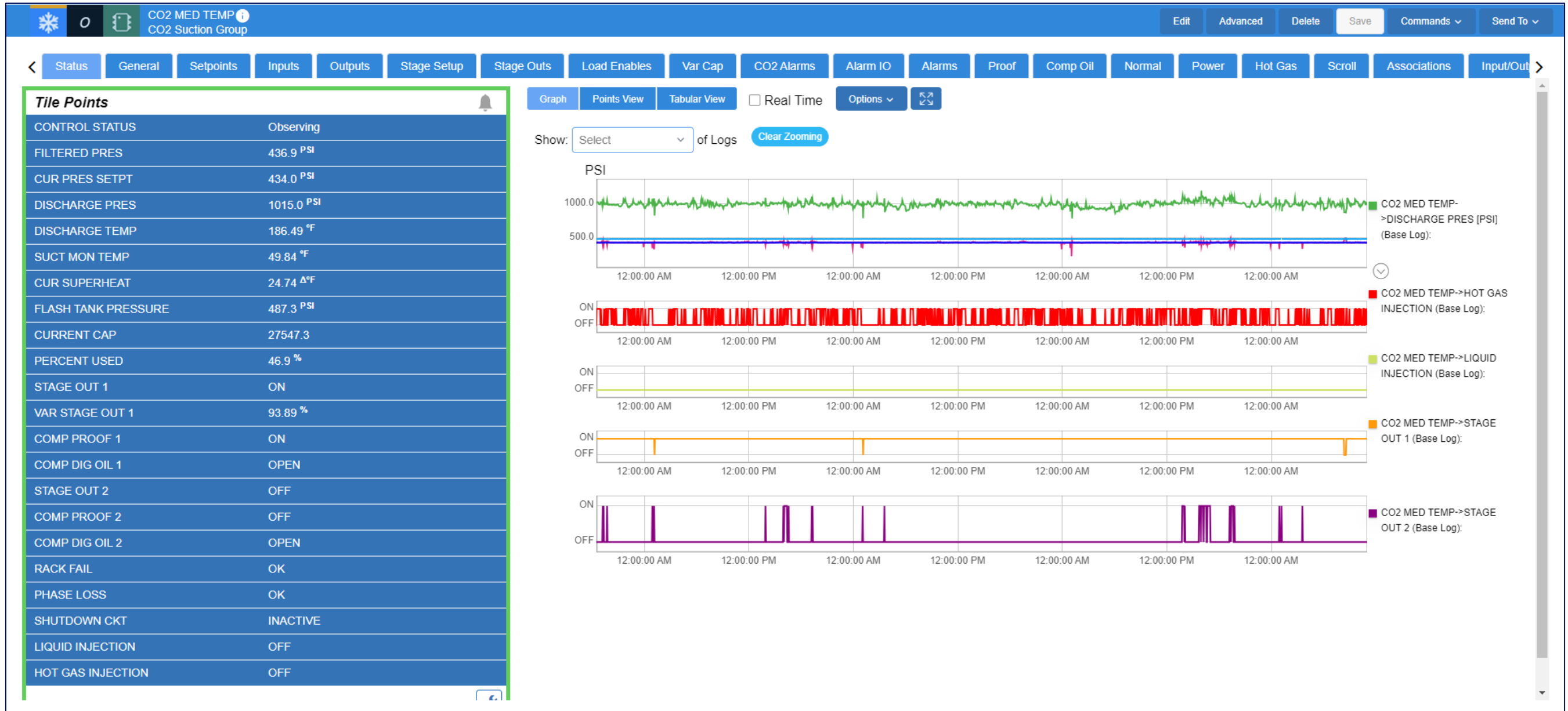
Legacy E2e Control



New E3 Native CO2 Control



E3 CO₂ Suction Group



CO2 Group & Load Management Overview

New CO2 Group Application for E3

- Enhanced Suction Compressor Control Plus Additional Functionality Necessary for Transcritical CO2 System Operation
 - Superheat Management : Liquid and/or Hot Gas Injection
 - Oil Management : Valve Control Between Oil Separator & Reservoir
 - Load Management : Enable & Disable Evaporator Loads Via Time Delays & Specific CO2 Alarms
 - Parallel Compression Control : Activate Intermediate Temperature Compressors Relative to Flash Tank Pressure and Gas Cooler Outlet Temperature



CO2 Group Cont'd

Superheat & Oil Management [Setpoints]

POINT NAME	VALUE	POINTER
SUCT PRES SETPT	414.0 PSI	
Ext Pres Shift	10.0 PSI	
Pres Deadband	14.0 PSI	
Liquid Injection Setpoint	50.00 Δ°F	
Hot Gas Injection Setpoint	20.00 Δ°F	
Enable Oil Separator Pulse	DISABLED	

Load Enable Sequence

POINT NAME	VALUE	POINTER
Load Management State	All Loads Enabled	
Num Load Enables	1	
MT Load Enable 1	ENABLED	Multiple
LT Load Enable 1	ENABLED	Multiple
Enable Discharge Sensing	DISABLED	

POINTER ✕

- A05A Fresh Case → LOAD ENABLE
- A06 Beverage Cave → LOAD ENABLE
- A07 Beverage Cave → LOAD ENABLE
- A08 Deli Cooler → LOAD ENABLE
- A13 Walk In CI → LOAD ENABLE
- A15 Walk In CI → LOAD ENABLE
- A21 Open Air Case → LOAD ENABLE
- A52A THM Front → LOAD ENABLE
- A54A THM Back → LOAD ENABLE
- A14 Walk In CI → LOAD ENABLE
- A16 Walk in CI → LOAD ENABLE
- A05B Fresh Case → LOAD ENABLE
- A52B THM Front → LOAD ENABLE
- A54B THM Back → LOAD ENABLE

OK

POINTER ✕

- A01 Deli Freezer → LOAD ENABLE
- A02 5DR Freezer → LOAD ENABLE
- A12 Novelty → LOAD ENABLE

OK

Load Management Continued...

Disable Loads Given Specific Criteria [CO2 Alarms]

MT Load Enable 1 Alarms	MT-Hi Discharge Pressure 2 Hi Flash Tank Pressure 2
LT Load Enable 1 Alarms	MT-Hi Suction Pressure 2 MT-Hi Discharge Pressure 2 Hi Flash Tank Pressure 1 LT-Hi Suction Pressure 2 LT-Low Superheat 2

CO2 Alarms

The screenshot shows the Emerson CO2 Alarms interface. The top navigation bar includes the Emerson logo, navigation icons, and a 'Login' button. The main header displays 'G2 MED TEMP +21' and 'CO2 Suction Group'. Below the header is a tabbed menu with options: Status, General, Setpoints, Inputs, Outputs, Stage Setup, Stage Outs, Load Enables, Var Cap, CO2 Alarms, Alarm IO, Alarms, and Proof. The 'CO2 Alarms' tab is active, showing a table of alarm points.

POINT NAME	VALUE	POINTER
High Superheat Alert	Non-Critical	[?]
Low Superheat Alert	Non-Critical	[?]
Low Superheat Alarm 1	Disabled	[?]
Low Superheat Alarm 2	Disabled	[?]
High Suction Pressure Alarm 1	Critical	[?]
High Suction Pressure Alarm 2	Critical	[?]
High Discharge Pressure Alarm 1	Critical	[?]
High Discharge Pressure Alarm 2	Critical	[?]
High Flash Tank Pressure 1	High Discharge Pressure Alarm 1	Critical [?]
High Flash Tank Pressure 2	Category	Refrigeration
Low Flash Tank Pressure	Display Message	
High Flash Tank Level Alert	Repeat Rate	00:00
	Monitor Alarm	OFF
	High Discharge Pressure 1	1350.0 PSI
	High Discharge Pres Delay 1	00:05:00
	High Discharge Pres Deadband 1	30.0 PSI

Custom System Graphic in E3

Added real time data on a system circuit drawing for ease of quick overview of system performance

EMERSON
← ⚙️ 🏠 ↻ 📦 📄 📅
⌵ ? 🔔 🔄 Logout

Floorplan
🟢 Install 🖨️

COPELAND

OUTSIDE TEMP: 65.14°F

Circuit Summary

XM Circuit Name	Control Temp
4A -10 Freezer Coil 1	-8.00°F
4B -10 Freezer Coil 3	-8.00°F
4C-10 Freezer Coil 5	-7.00°F
4D-10 Freezer Coil 7	-8.00°F
4E Convertible RM Coil 1	27.00°F
4F Convertible RM Coil 2	27.00°F
4G +34 Cooler Coil 1	34.00°F
4H +34 Cooler Coil 3	34.00°F
4J +34 Cooler Coil 5	33.00°F
4K +34 Cooler Coil 7	34.00°F
4L +34 Cooler Coil 9	34.00°F
4M +34 Cooler Coil 11	34.00°F

FLASH GAS	VALUE
Flash Gas Temp	44.55°F
Flash Gas Receiver Heater	568.26PSI
Flash Gas HX Out Temp	65.52°F
Flash Gas HIGH Receiver 1 Level	OFF
Flash Gas HIGH Receiver 2 Level	OFF
Flash Gas Low Receiver 1 Level	ON
Flash Gas Low Receiver 2 Level	ON

LEAVING GAS COOLER PRES: 945.36PSI
LEAVING GAS COOLER TEMP: 77.04°F

Condenser/Gas Cooler
FAN SPEED: 38.64%

Oil Reservoir
Oil Separator

Parallel Compression Line

ACTIVE VAR 0.0% STAGE 1 OFF STAGE 2 OFF

STAGE 1 ON STAGE 2 OFF STAGE 3 OFF STAGE 4 OFF

ACTIVE VAR 75.5%

Medium-Temperature Transcritical Compressors

Medium Temperature Display Cases

EEVs

Flash Tank Press 568.26PSI

Flash Gas Temp 44.55°F

Flash Gas Bypass Valve

BPV: 15%

Low-Temperature Subcritical Compressors

Low Temperature Display Cases

EEVs

Accumulator Heater ON
HPV: 27%

High Pressure Control Valve

Oil Temp	107.04°F
Oil Reservoir Level	ON
Oil Separator PSI Differential	932.50PSI
Oil Separator Solenoid PSI Setpoint	98.74PSI

GROUP 1	VALUE
G1 Suction Return Temp	-3.60°F
G1C1 Discharge Temp	129.04°F
G1C2 Discharge Temp	121.30°F
G1C3 Discharge Temp	130.23°F
G1 Comp 1	ON
G1 Comp 2	OFF
G1 Comp 3	OFF

GROUP 2	VALUE
G2 Return Suction Temp	35.20°F
G2C1 Discharge Temp	199.45°F
G2C2 Discharge Temp	148.71°F
G2C3 Discharge Temp	82.98°F
G2C4 Discharge Temp	94.89°F
G2 Comp 1	ON
G2 Comp 2	OFF
G2 Comp 3	OFF

GROUP 3	VALUE
G3C1 Discharge Temp	77.13°F
G3C2 Discharge Temp	79.29°F
G3 Comp 1	OFF
G3 Comp 2	OFF

Copyright 2022 © Emerson E3 RXe 2: RACK4 CO2 2.23F01

emerson 01/25/2023 07:12:52 PM

E3 Offline Manager

<https://offlinemanager.emerson.com/>

Offline Manager

E-mail

Password

Remember me (for 30 days)

[Log In](#)

[Forgot your password?](#)

[Create an Account](#)

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- Offline Manager is a programming tool in a cloud environment that provides a virtual E3 or Site Supervisor for you to build programs, upload existing programs and self-train

E3 Offline Manager

My Sessions (10)

[+ Create Session](#)

Session Name ↑▾ Version ↑↓ Model ↑↓ Feature Set ↑↓ Status ↑↓ Created ↑↓ Last Access Time ↑↓ Actions

Create New Session ✕

Name

Model

Version

Feature Set

Licenses & ADFs ✕

Available

- 531-0016 - Hitachi VRF
- 531-0017 - ShengNeng Water Heater
- 531-0018 - ABB ACS 510
- 531-0019 - Schneider ATV61F VFD
- 531-0020 - DAIKIN Gateway ModBus RTU DIII Interface
- 531-0021 - XCM2SD 1.3 ZXME
- 531-0022 - XCM2SD 1.3 ZXLE
- 531-0023 - XCM2SD 1.3 ZXDE
- 531-0024 - Apator FAUN Heat

Selected

Licenses & ADFs ✕

Available

- 531-0271 - ALTIVAR 212 VFD
- 531-0272 - ECB-D10_9.01 AHT Version
- 531-0273 - CoreSense
- 531-0275 - Schneider PM-5500
- 531-0276 - Simply VAV
- 531-0277 - Seasons-4 D808
- 531-0278 - BCI-R_RTU
- 531-0279 - Munters_TI
- 531-0280 - Mitsu FCU
- 531-0281 - XC450CX 34

Selected

531-0274 - iPro CO2 - HPV/BGV

- Create a virtual E3 by naming the project, selecting model, version and Feature Set

My Sessions (11)

[+ Create Session](#)

Session Name ↑▾	Version ↑↓	Model ↑↓	Feature Set ↑↓	Status ↑↓	Created ↑↓	Last Access Time ↑↓	Actions
[Redacted]	2.24F01	SS	SR	Exited	3/7/2023, 4:54:56 PM	3/15/2023, 4:50:55 PM	🔗 📄 🗑️
	2.21F01	E3	RXe	Exited	6/7/2022, 3:30:37 PM	6/7/2022, 11:18:33 PM	🔗 📄 🗑️
CBES-Summit	2.26F02	E3	RXe	Running	9/29/2023, 2:03:09 PM	Never	🔗 📄 🗑️
[Redacted]	2.26F01	E3	RXe	Exited	9/8/2023, 9:35:31 AM	9/8/2023, 9:40:16 AM	🔗 📄 🗑️
	2.23F01	E3	RXe	Exited	1/13/2023, 2:06:59 PM	1/19/2023, 2:40:10 PM	🔗 📄 🗑️
	2.25F01	E3	RXe	Exited	7/6/2023, 12:27:25 PM	7/6/2023, 10:23:01 PM	🔗 📄 🗑️
	2.21F01	E3	CXe	Exited	6/17/2022, 11:44:19 AM	6/28/2022, 5:13:13 PM	🔗 📄 🗑️
	2.25F01	SS	RXe	Exited	6/6/2023, 2:52:17 PM	7/18/2023, 5:09:05 PM	🔗 📄 🗑️
	2.23F01	E3	SR	Exited	1/17/2023, 8:30:41 PM	1/18/2023, 9:07:02 AM	🔗 📄 🗑️
	2.25F01	E3	RXe	Exited	7/1/2023, 11:29:39 AM	7/1/2023, 12:00:20 AM	🔗 📄 🗑️
	2.21F01	SS	SR	Exited	6/8/2022, 2:55:51 PM	6/8/2022, 4:05:34 PM	🔗 📄 🗑️

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CO₂ High Pressure Controller

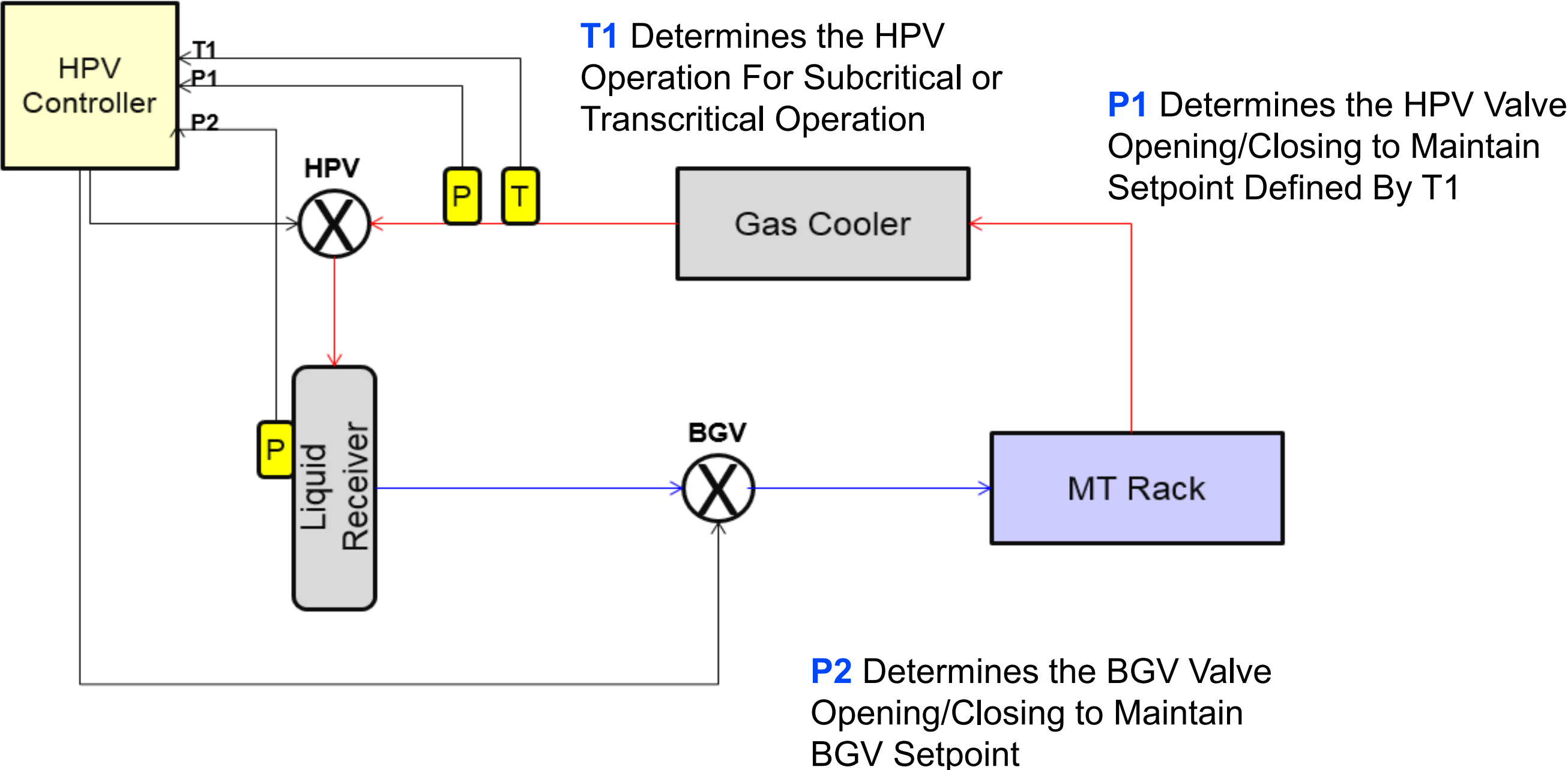


CO₂ High Pressure Controller



- Gas Cooler Pressure & Temp, Flash Tank Pressure
- High Pressure Valve & Bypass Gas Valve
- Subcritical & Transcritical Modes
- Optimizes COP In Transcritical Mode
- Heat Reclaim Mode
- Integrated to E3 for visibility and setpoint configuration

CO₂ High Pressure Controller



CO₂ High Pressure Controller

- Using the Gas Cooler Outlet Temperature (T1) and Gas Cooler Outlet Pressure (P1). The HPV control will switch control modes depending on the temperature or pressure leaving the Gas Cooler.
 - Hold Back - if the pressure is below the minimum gas cooler pressure setpoint, the HPV will abandon the Subcritical algorithm and maintain the minimum pressure setpoint.
 - Subcritical - if the pressure and temperature indicate the system is subcritical, the HPV will maintain a subcooled liquid in the Gas Cooler. The HPV will typically maintain a value of 5°F of subcooling.
 - Transcritical - If the pressure and temperature indicate the system is in Transcritical, the HPV will maintain a pressure setpoint for optimal performance.
- Flash tank pressure is monitored using the Flash Tank Pressure (P2). The Bypass Gas Valve (BGV) has a static liquid receiver pressure setpoint. The valve operates to maintain the setpoint and will open to relieve pressure from the flash tank back to medium temperature suction. It is common for BGV to be closed under low load and low ambient conditions, opening periodically to relieve any pressure once above the flash tank pressure setpoint.
 - It is recommended that the flash tank pressure maintain at least 75psi above the MT Suction Pressure to ensure pressure differential between both liquid and suction pressure and allow positive oil pressure difference.
- Features to protect the rack from a pressure relief event.
 - High flash tank pressure – if the flash tank pressure is above the high-pressure limit, the HPV will start to close to decrease the pressure in the flash tank. If the flash tank pressure is continuing to rise, the HPV may close completely to prevent a pressure relief.
 - Low flash tank pressure – if the flash tank pressure is below the low-pressure limit, the HPV will start to open to raise the flash tank pressure. If the flash tank pressure continues to fall, the HPV may open completely to try to re-pressurize the flash tank.
 - If the gas cooler outlet pressure is lost, failsafe to the remote discharge pressure sensor where installed.
 - If the gas cooler outlet temperature is lost, failsafe to remote temperature sensor where installed.
 - If both fixed sensors and remote sensors are lost, failsafe to fixed valve setting.

CO₂ High Pressure Controller

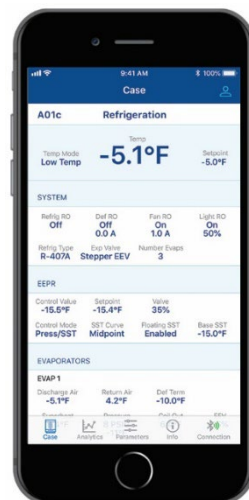


COPELAND

CC200 Case Controller



CC200 Case Controller



- Solenoid Control
- Adaptive Defrost Control
- Advanced superheat control
- Fan Control
- Light Control
- EEV Control
- Suction EEPR Control
- Multiple Evaporator Expansion
- Antisweat Control
- Remote Display
- Mobile App Capabilities
- BACnet & ModBus communication

Case Controller Series Suitable for Medium & Low Temperature Applications (Multi-Evaporator/EEV & EEPR)

CC200

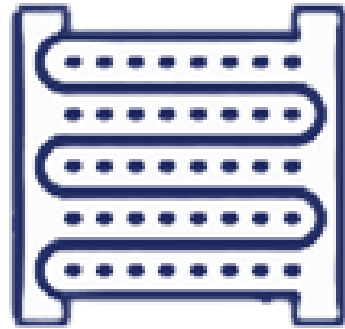
Controls bipolar or unipolar *stepper* motor with an electronic expansion valve(s) and/or *pulse* electronic expansion valve(s) to control temperature & superheat

Cold Chain Connect Mobile App

Interface with CC200 display via BLE and Mobile Phone/Tablet



Key Features Focused on Mitigating Customer Pain Points



Modular Design

Plug-in expansion modules allows for seamless installation & integration with your refrigeration setup



Bluetooth Connectivity

Allows for easy controller status check and service



Standalone Technologies

Allows for differentiation from competitors with auto tuning control, leak detection, and demand defrost



Intuitive Interface

Intuitive interface allows for customization of display and easy control setting



Communication Protocols

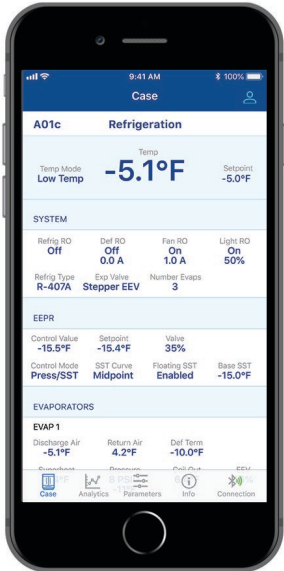
Communicates with supervisory controllers allowing for remote access, setpoint configuration, and alarming

CC200 Solution for Multiple Evaporator Control



Main Controller

Expansion Module



Cold Chain Connect App



Case Display

Overall Features

Color coded inputs and outputs and snap on **expansion modules** allowing up to 3 evaporator coils, superheat control, & an additional valve as an electronic evaporator pressure regulator (EPR)

Our new **mobile app** allows OEM team members & contractors to quickly setup and test the controller, saving time on the manufacturing line & the field

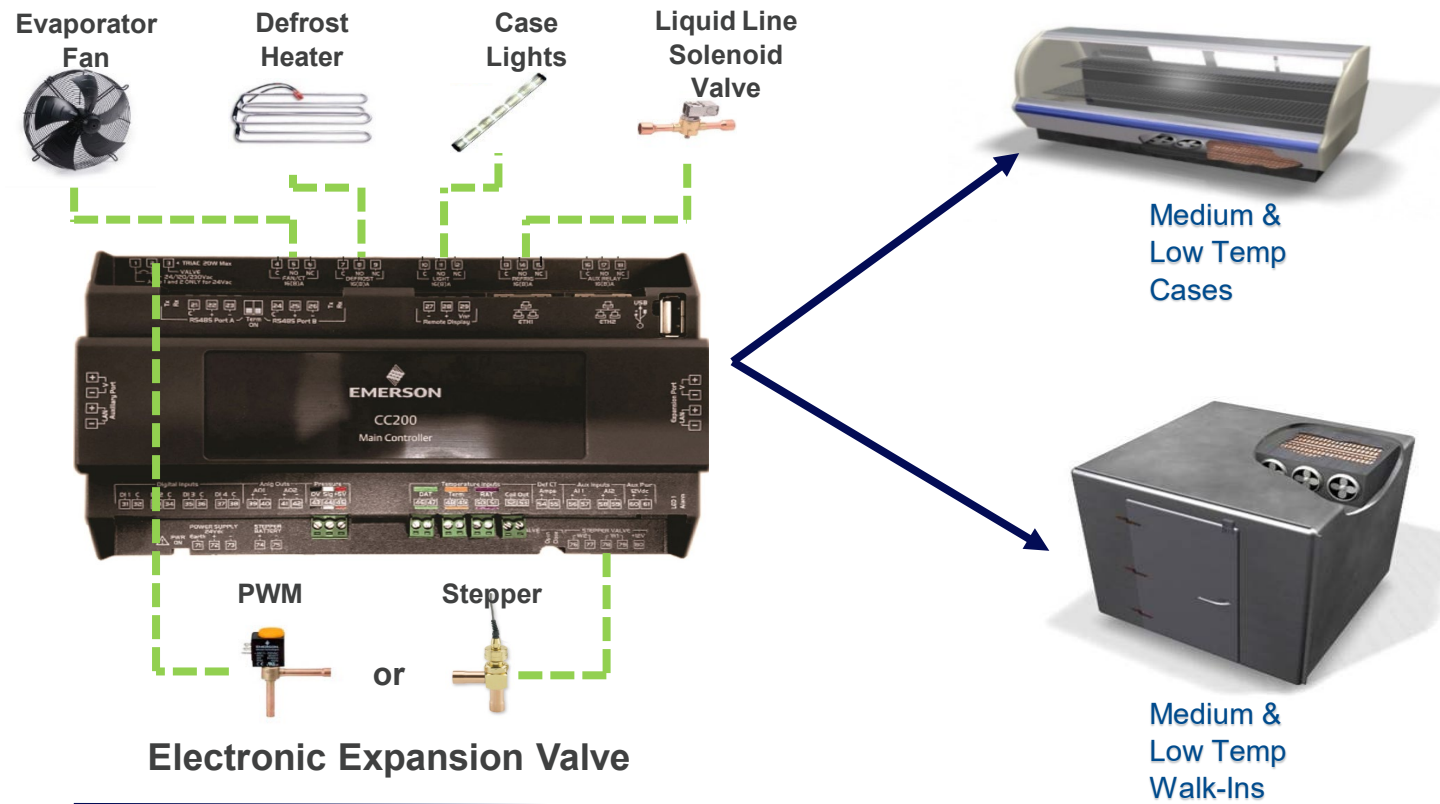
Case Display communicates operating functions with touch integration

Optimized operation with bipolar & unipolar **stepper valves or pulse valves**

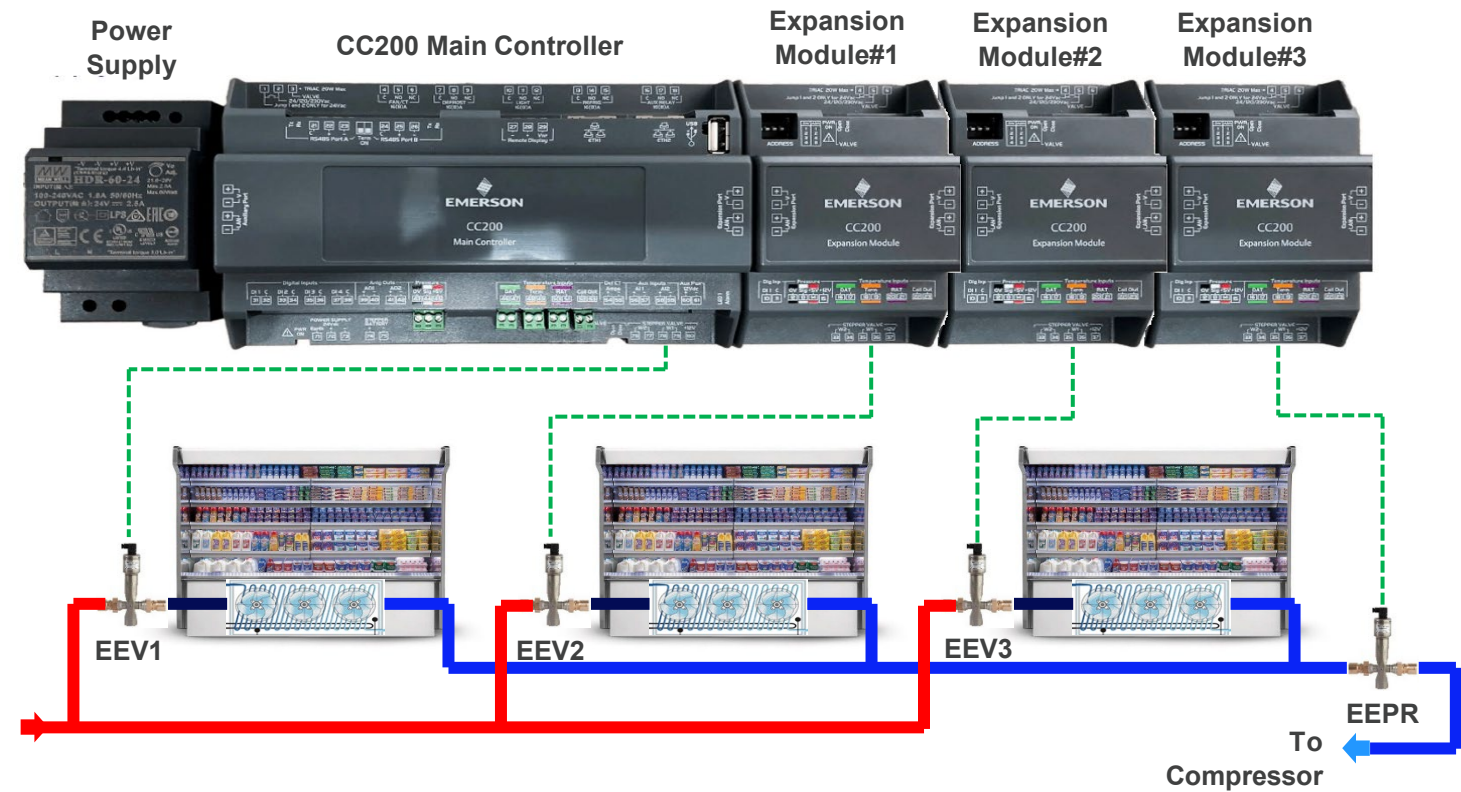
New patented control algorithms

CC200 Technical Overview

Single Evaporator



Multiple Evaporators



Relay Outputs (Main Controller)

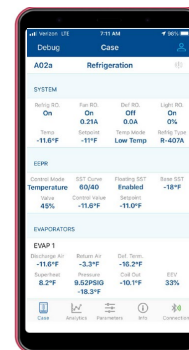
- Relay Outputs
 - Defrost
 - Refrigeration (LLSV)
 - Evaporator Fans
 - Lights
 - Auxiliary

Digital Inputs (Main Controller)

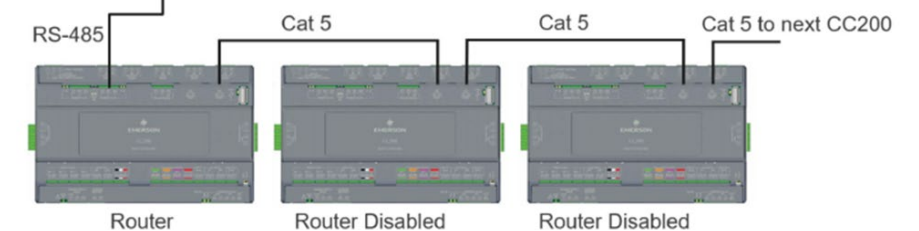
- Configurable DI1-DI4 (Free voltage)
 - Door Switch
 - Service Switch
 - Dual Temp Switch
 - Defrost Term Switch
 - Leak Shutdown
 - Satellite 1 or 2 for E2e

Analog Inputs (Main Controller & Expansion Module)

- Probe Inputs (non configurable)
 - Discharge Air Temperature (1 to 3)
 - Return Air Temperature (1 to 3)
 - Suction Pressure (1 to 3)
 - Defrost Termination (1 to 3)
 - Suction Temperature (1 to 3)
 - Fan and Defrost Amps
- Configurable Inputs (AI1 and AI2)
 - External fan CT
 - Coil Inlet Temp
 - Product Temp
 - Circuit Suction Temp



BACnet or ModBus



The Main Controller Provides Stand-Alone Control



Only Requires 1 24VDC Power Supply with Industry standard Din Rail mounting and Phoenix Connectors

- Auto-tuning superheat control
 - Decreases tune time and hone-in proper settings
 - Allows quicker commission time
- Supports low temp, medium temp and dual temp cases for flexibility in application and simplifies SKU count
- Controls multiple electronic expansion valve types including PWM or stepper valves (both unipolar and bipolar)
- Manage multi-coil case designs (up to 3 with expansion module)
- Patent pending EEPR control algorithm for automatic adjustment to the optimum setpoint for discharge
- New superheat algorithm does not use traditional PID control
- New demand defrost algorithm saves energy and quality

Expansion Module Quickly Snaps on to Main Controller for **Fast Factory Installation**



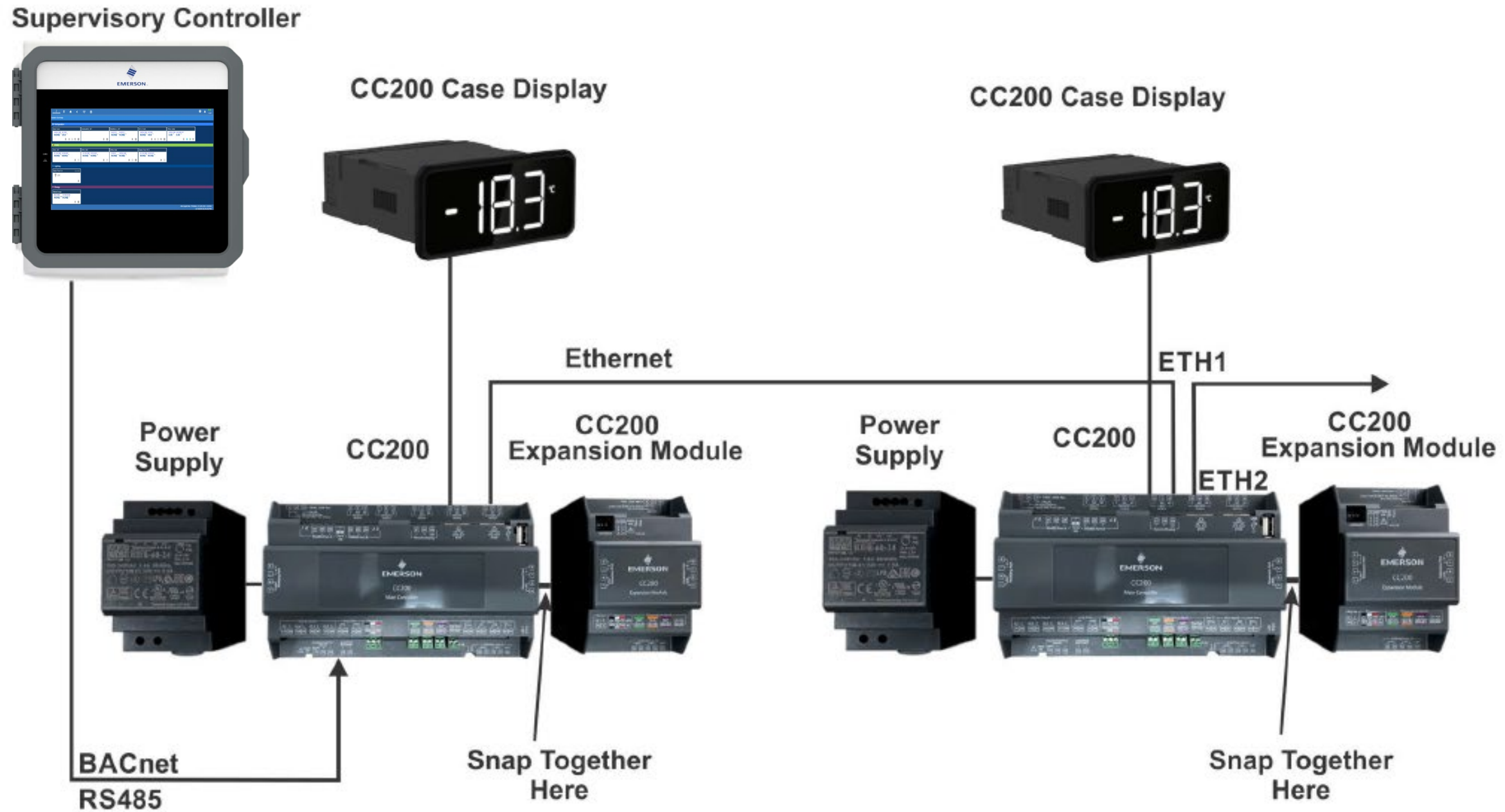
- Simplified wiring and connections reducing labor and setup time
- **Power** supply sourced from main controller side connector, eliminating the need for a dedicated power supply
- Paired / optimized operation with bipolar and unipolar stepper valves
 - Controls one PWM EEV or Stepper EEV
- Color-coded temperature inputs
 - 4 Temperature (discharge, return, defrost termination, coil out)
 - 1 Pressure
 - 1 DI (software selectable function)

Case Display Communicates Operating Functions with Touch Integration

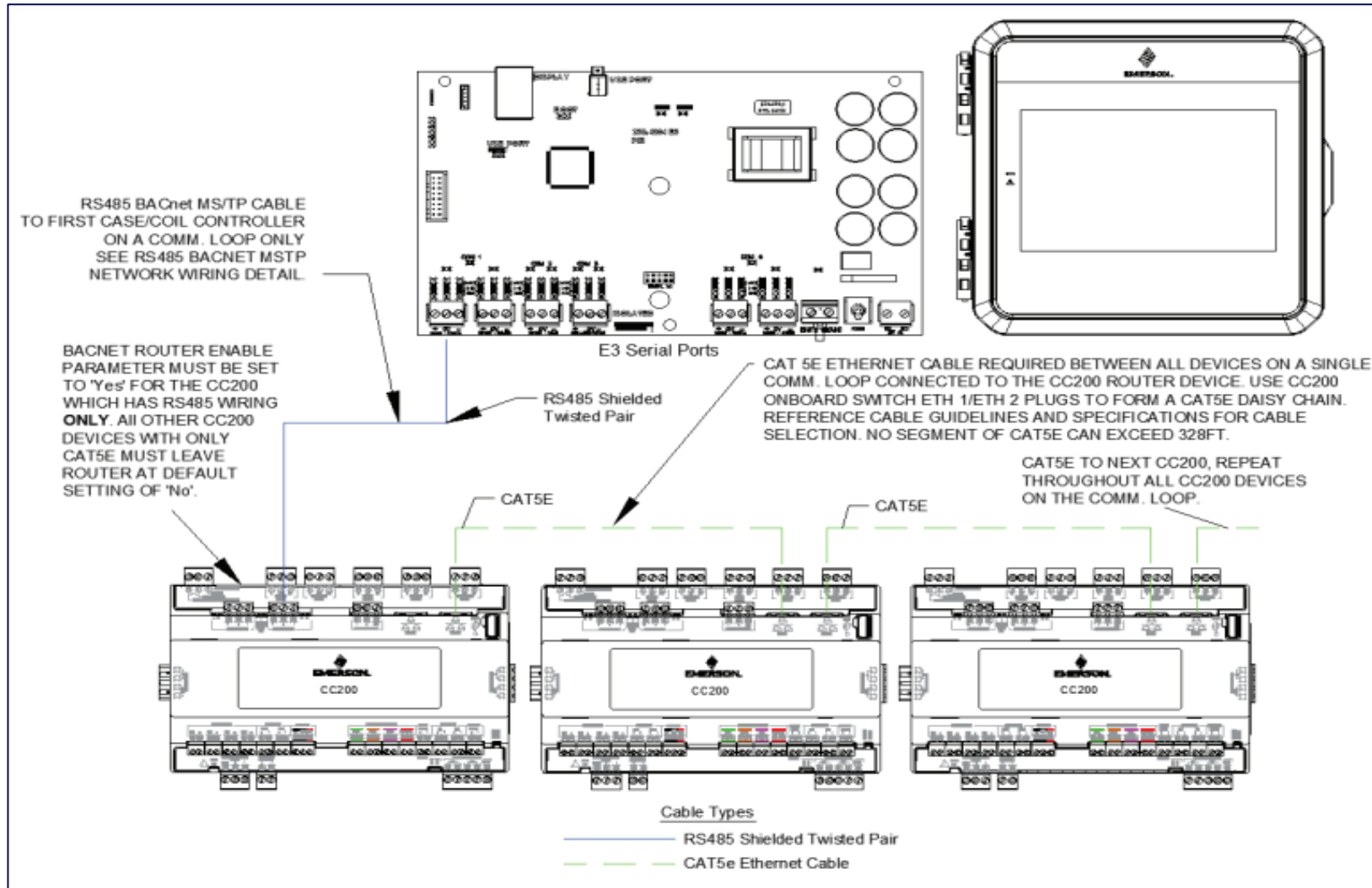


- Elegant, aesthetic design for more appealing refrigeration fixtures
- Quickly see system operation, status, and alarm information
- Displays activated functions and output with simple screen layout
- Perform quick service actions with one touch
 - Start/Stop manual defrost
 - Service shutdown
 - Reboot CC200
- Set communication parameters to bring CC200 online

CC200 Network Layout Overview

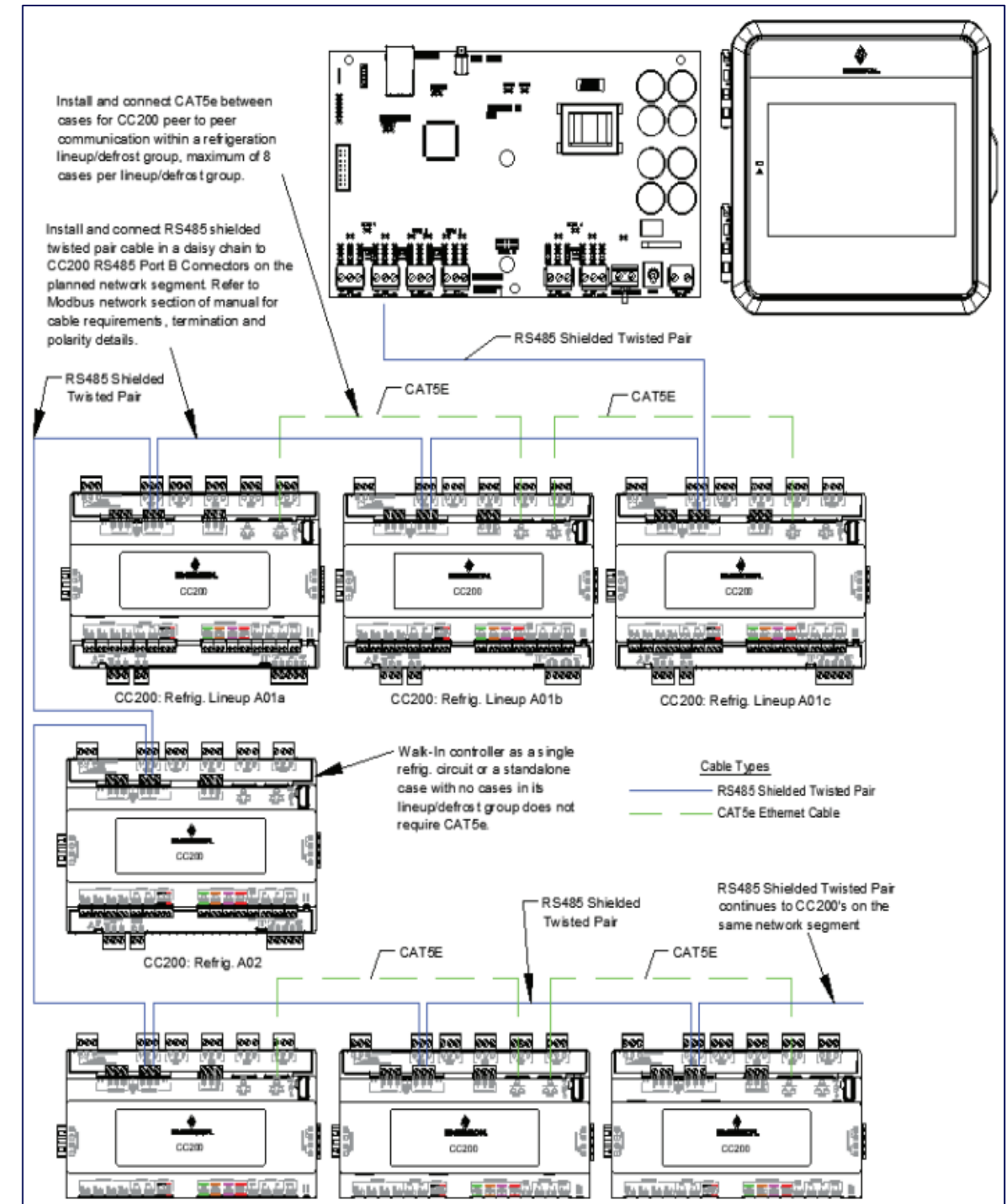


CC200 Network Layout Overview



BACNET MSTP

Up To 70 Devices Per E3; 32 Per Serial Comm Port



Modbus

[Conservative Estimate] Up To 75 Devices Per E3; 25 Per Comm Segment

Cold Chain Connect Mobile Application

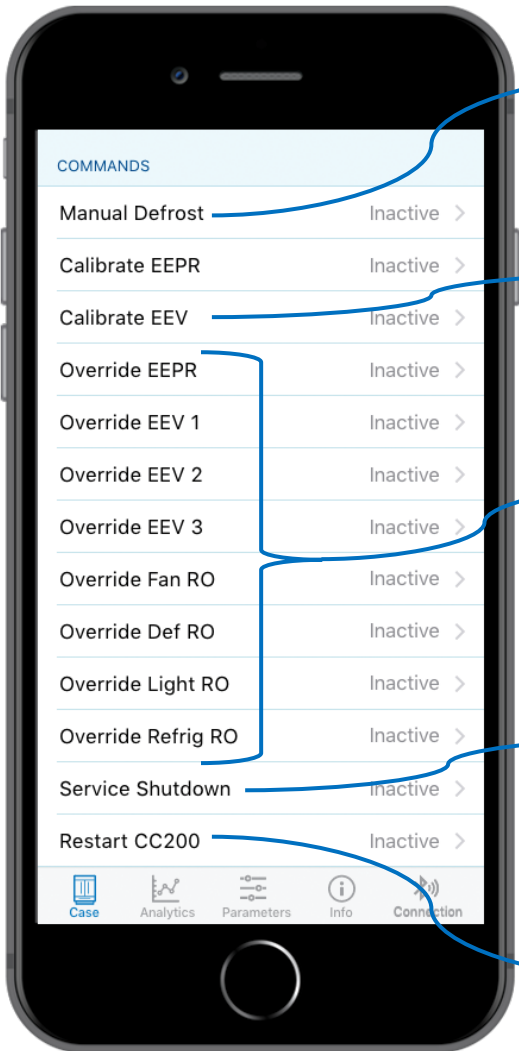
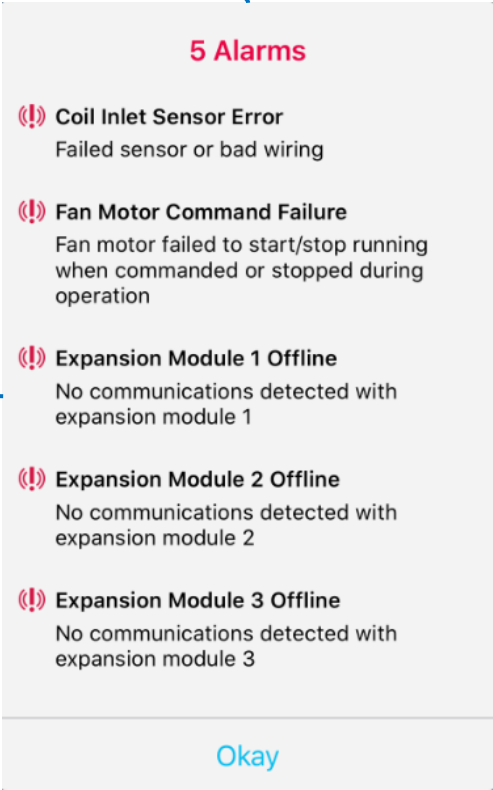
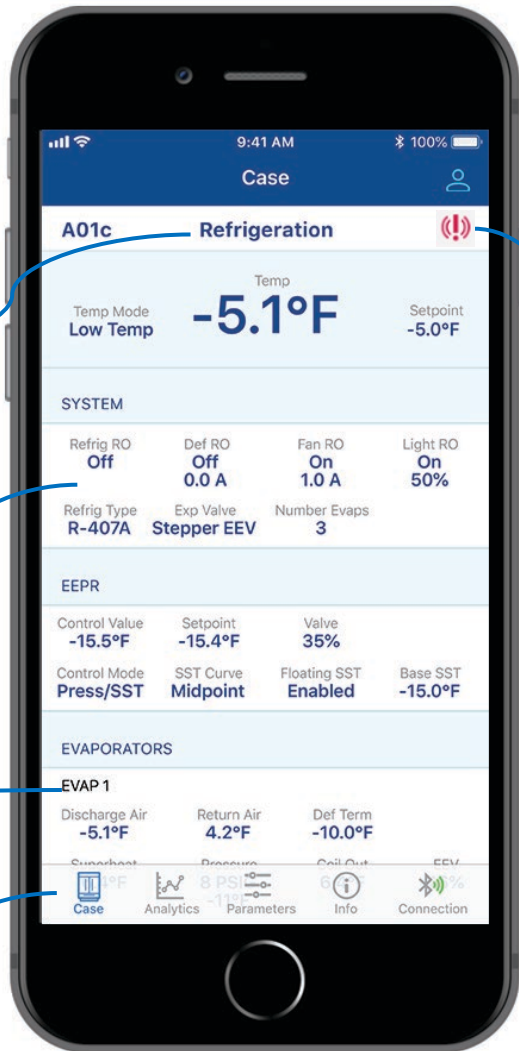
Descriptive alarm info to help troubleshoot system issues

Quickly see CC200 controller state (Refrigeration, Defrost, Pulldown Shutdown...etc.)

Useful temperature and relevant system details

Meaningful system data section for each evaporator

Intuitive navigation gets the data you need quickly



Perform manual defrost with just a tap

Single tap to calibrate stepper motor valves

Effortlessly perform component and valve checks via available overrides

Tap for service shutdown (case cleaning, inspection, service)

Easy access to Convenient reboot command

Case Control Additions Specific for CO₂ Booster Systems

- CO₂ Refrigerant Curves to Allow for Precise Superheat and Temperature Control in CO₂ Systems
- Additional Evap Pressure Transducer Selections 100, 200 , 500, 650, 1000 & 2000 PSIG
 - (e.g. 650PSI most common for CO₂ case fixtures)
- Maximum Operating Pressure Protection to Close EEV when High Pressure is Detected (HPS Shutdown)
- Input for CO₂ Load Enable to Better Facilitate Rack Coordination for System Start-up and Shutdown

POINT NAME	VALUE
REFRIGERANT	R-744
COMPRESSION TYPE	R-422A
EPR TYPE	R-427A
EXP VALVE TYPE	R-507A
LLSV PRESENT	R-438A
	R-422C
	R-448A
	R-744

PRESSURE CONFIG	1 Per Coil
PRESSURE 1 SCALE	650 PSI
PRESSURE 2 SCALE	100 PSI
PRESSURE 3 SCALE	150 PSI
DEF CT SIG TYPE	200 PSI
DEF CT ENABLE	300 PSI
	500 PSI
	650 PSI
	Custom

HPS SHUTDOWN	NONE	HPS SHUTDOWN – Input for CO2 high pressure shutdown command from a supervisor controller. A value of true/ON will put CC200 into a CO2 high pressure shutdown state and refrigeration will not run again until the true/ON value is removed.
CO2 LOAD ENABLE	ON	

COPELAND

Other System
Components



Leak Detection



- CO₂ Refrigerant Monitoring
- Visual & Audible Alerts
- Alarm Monitoring
- Walk-in Shutdown

Variable Frequency Drivers (EVM/EVH)



- Compressor Variable Frequency Control
- Gas Cooler Fans Variable Frequency Control
- Full Integrations to Copeland Supervisory Controls (E2 and E3)
- Optimized for Copeland compressor operations
- Can use for other compressors & motors

Compressor Oil Control (OMC)



- Compressor Oil Level Control
- Auto Fill oil into Compressor Sump
- Alert when low oil detected

Example Solution: E3 Controls & Services for CO₂ Rack



Compressors

Copeland Semi-Hermetic + Scroll

+

Controls

Copeland E3, OMC's, Valves, Electronics

+

Programming Support

Copeland OEM Services

+

Start-Up & Commissioning

Copeland Field Services

+

Data Services

Connect +

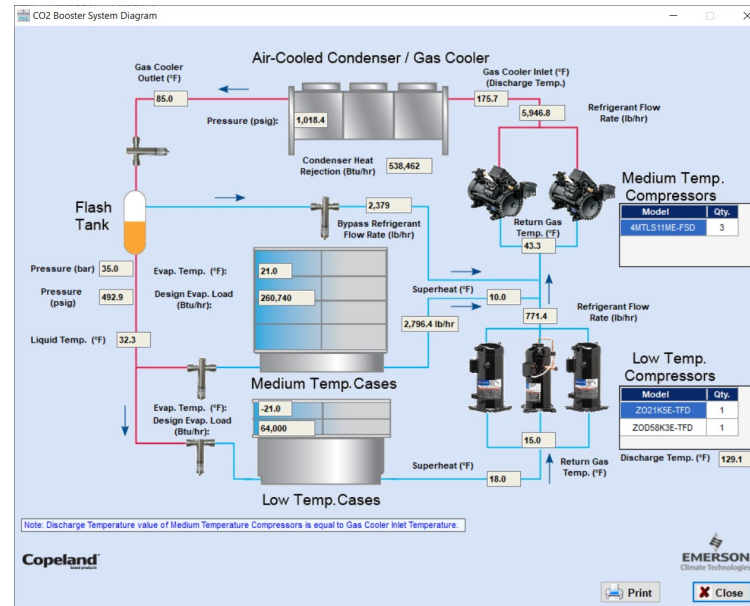
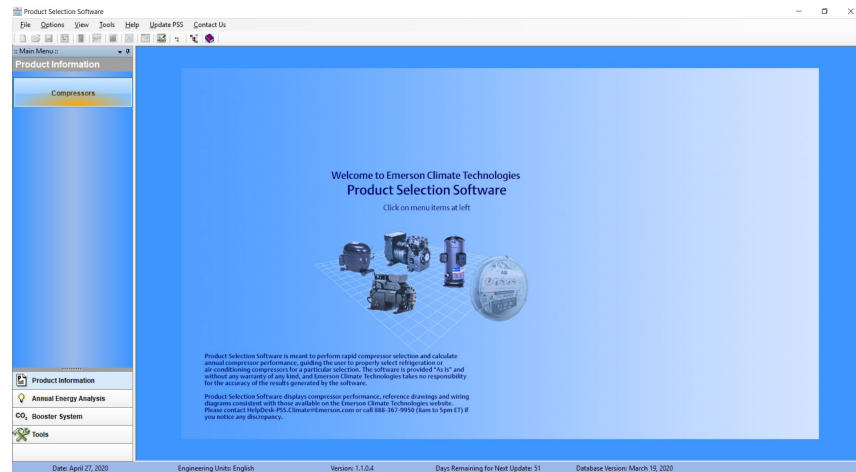
+

Aftermarket Support

Warranty, Replacement, Parts, Recoveries

CO₂ Product Information Library

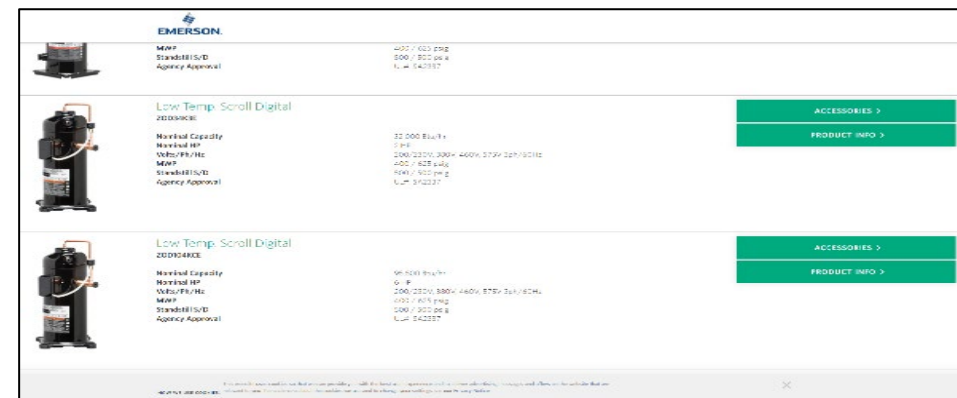
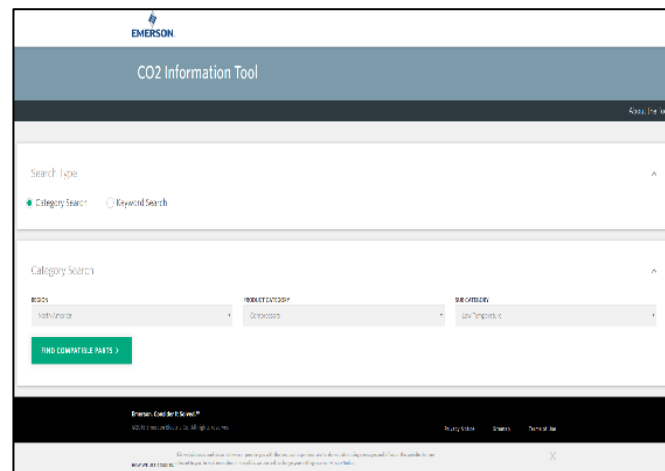
Product Selection Software with Booster Design



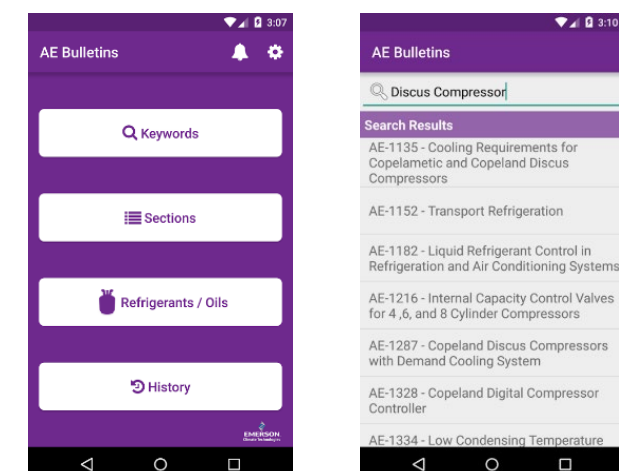
Copeland Mobile



CO₂ Information Tool



AE Bulletins



E360 Resources Hub

Providing a comprehensive view of the challenges impacting your business and how we can help.

One Stop Shop for:

- **Articles**
- **Blogs**
- **Webinars**
- **White Papers**
- **Case Studies**
- **& More**



- E360 Hub Home page: [Home \(copeland.com\)](https://www.copeland.com)
- E360 Blog: [Home - Copeland E360 Blog](#)
- CO2 Key Pages:
 - [CO₂ Refrigeration | Copeland US](#) (overview/training on CO₂)
 - [CO₂ Product Solutions | Copeland US](#) (CO₂ products page)
 - [CO₂ in Commercial Refrigeration \(copeland.com\)](#) (hub for all CO₂ content)
- E3 & E3 for CO2 Landing Page: [Supervisory Controls E3 | Copeland US](#)
- CC200 Landing Page: [CC200 | Copeland US](#)

Copeland Certificate

COPELAND

Certificate of Completion
is hereby granted to:

In recognition of completing:

E3 Supervisory Controls with CO2 Applications & CC200 Case Control

1.5 Course Hours
Granted: November 15, 2023

COPELAND

We Are Engineered for Sustainability