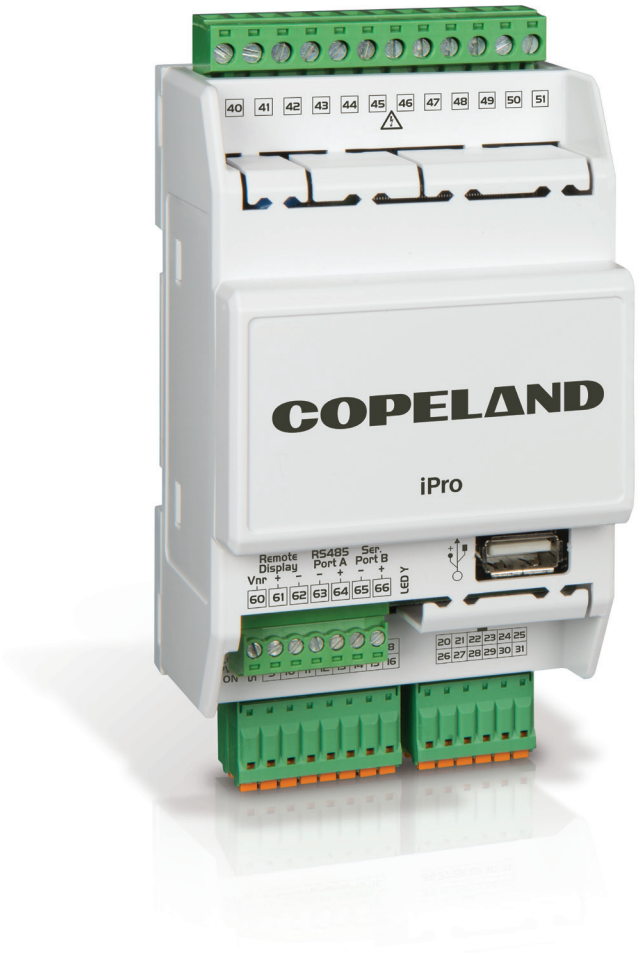
USER MANUAL

High Pressure CO_2 Controller



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1. Overview

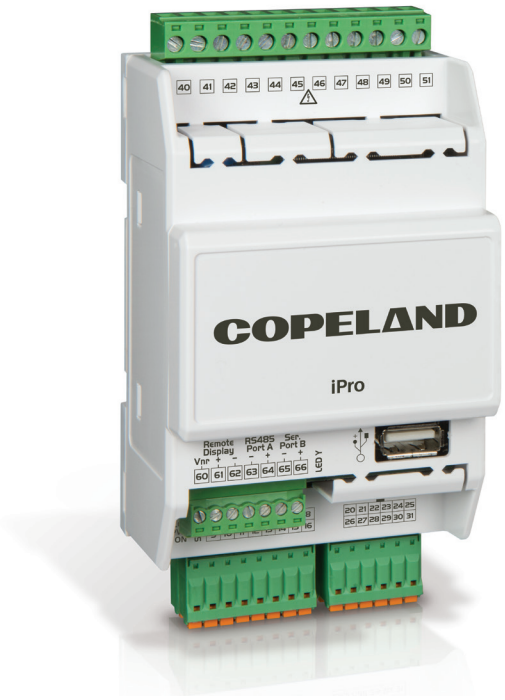
The High-Pressure CO_2 controller *(P/N 818-9010)* application is a standalone controller that operates the High Pressure Valve (HPV) and the Bypass Gas Valve (BGV) in a Transcritical CO_2 system. The controller has a heat reclaim feature, safety parameter operation for the flash gas receiver tank and calibration feature for the HPV and BGV.

⚠ CAUTION GND is Common, not earth ground. **Do not earth ground this device.**

1.1 The High-Pressure CO_2 Controller I/O Points

The controller has 6 analog inputs and 11 digital inputs that can be used for the gas cooler outlet pressure, gas cooler temperature, receiver pressure, and system enable. Its 8 relay outputs, rated 2.0 amps max, are used for activating and deactivating alarms. It is possible to use the 4 analog outputs as 0-10V signals to control the HPV and BGV with an external valve driver. The analog inputs, digital inputs, relay outputs, and analog outputs have default values for fast setup.

The High Pressure CO_2 controller supports local physical inputs and outputs and communicates with the Supervisory controller via the RS485 MODBUS network.



High Pressure CO_2 Controller

1.2 Independent System Control

The High Pressure CO_2 controller can control the HPV and BGV in a refrigeration Transcritical CO_2 System independently. However, the High Pressure CO_2 controller is designed to interface with a Supervisory Controller. Networking the High Pressure CO_2 controller to a central controller allows you to view status at the Supervisory Controller (for example, Copeland E2, E3 or Site Supervisor), report alarms, and log point values. The High Pressure CO_2 controller configuration can also be programmed through the Supervisory Controller user interface.

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2. Hardware Setup

2.1 Connections

Table 1: Connections

Connector	Description
	Connector for 24VAC/DC power supply. Analog inputs (Pb1 - Pb6, PbC). Additional power: +5VDC, +12VDC, Common (-). Analog outputs (Out1 - Out4, Common).
	24VAC/DC digital inputs: DI1 - DI11, Common (-).
	Remote Display terminals to connect a Visograph, (maximum of one Visograph per controller). RS485 connector. Serial port connector (LAN or RS485).
	USB port for uploads (BIOS, ISaGRAF® application, parameter mappings, remote display applications, network configuration, and websites) and downloads (log files). Connection with the computer via a USB-ETH converter.
	Digital relay outputs 4 NO relays, 2 Common.
	Digital relay outputs 4 NO relays, 2 Common.

High Pressure CO_2 Controller

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2.2 Inputs and Outputs

Table 2: Description of the Inputs and Outputs

Input Number	Type of Input	Description
1	Supply	Reference "- "/Common power (24VAC or 24VDC)
2	Pb1	Configurable analog input 1 (NTC, PTC, 0 - 20mA, 4 - 20mA, 0 - 10V, 0 - 1V, 0 - 5V, DI, CPC)
3	Pb2	Configurable analog input 2 (NTC, PTC, 0 - 20mA, 4 - 20mA, 0 - 10V, 0 - 1V, 0 - 5V, DI, CPC)
4	Pb3	Configurable analog input 3 (NTC, PTC, 0 - 20mA, 4 - 20mA, 0 - 10V, 0 - 1V, 0 - 5V, DI, CPC)
5	+12V	Additional power +12VDC
6	+5V	Additional power +5VDC
7	Out1	Analog output 1, 0 - 10V, 4 - 20mA, Relay
8	Out2	Analog output 2, 0 - 10V, 4 - 20mA, Relay
9	Supply	Reference "+" power supply (24VAC or 24VDC)
10	Pb4	Configurable analog input 4 (NTC, PTC, 0 - 20mA, 4 - 20mA, 0 - 10V, 0 - 1V, 0 - 5V, DI, CPC)
11	Pb5	Configurable analog input 5 (NTC, PTC, 0 - 20mA, 4 - 20mA, 0 - 10V, 0 - 1V, 0 - 5V, DI, CPC)
12	Pb6	Configurable analog input 6 (NTC, PTC, 0 - 20mA, 4 - 20mA, 0 - 10V, 0 - 1V, 0 - 5V, DI, CPC)
13	PbC	Common analog inputs (NTC, PTC, DI, CPC)
14	Voltage Common (-)	Additional power reference 5VDC and 12VDC, analog inputs (0 - 20mA, 4 - 20mA, 0 -10V, 0- 1V, 0 - 5V), analog outputs
15	Out3	Analog output 3, 0 - 10V, 4 - 20mA, Relay
16	Out4	Analog output 4, 0 - 10V, 4 - 20mA, Relay
20	DI1	Digital input 1, 24VAC/DC
21	DI2	Digital input 2, 24VAC/DC
22	DI3	Digital input 3, 24VAC/DC
23	DI4	Digital input 4, 24VAC/DC
24	DI5	Digital input 5, 24VAC/DC
25	DI6	Digital input 6, 24VAC/DC
26	DI7	Digital input 7, 24VAC/DC
27	DI8	Digital input 8, 24VAC/DC
28	DI9	Digital input 9, 24VAC/DC
29	DI10	Digital input 10, 24VAC/DC
30	DI11	Digital input 11, 24VAC/DC
31	Digital Common (-)	Reference "-" for digital inputs from1 to 11 (if version with dry contacts, this input must use only as common for the digital inputs).
40	C	Common relays 1, 2, 3 and 4
41	C	Common relays 1, 2, 3 and 4
42	RL1	Relay 1 normally open contact
43	RL2	Relay 2 normally open contact
44	RL3	Relay 3 normally open contact

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Table 2: Description of the Inputs and Outputs

Input Number	Type of Input	Description
45	RL4	Relay 4 normally open contact
46	RL5	Relay 5 normally open contact
47	C	Common relays 5, 6, 7 and 8
48	C	Common relays 5, 6, 7 and 8
49	RL6	Relay 6 normally open contact
50	RL7	Relay 7 normally open contact
51	RL8	Relay 8 normally open contact
60	Remote Display	Connection for VISOGRAPH remote terminal (Vnr)
61	Remote Display	Connection for VISOGRAPH remote terminal (+)
62	Remote Display	Connection for VISOGRAPH remote terminal (-)
63	RS485	RS485 connection (-)
64	RS485	RS485 connection (+)
65	LAN	LAN Connection (-)
66	LAN	LAN Connection (+)

2.3 Technical Specifications

2.3.1 Analog Inputs

Table 3: Analog Input

Analog Conversion Type	10-bit A/D converter
Number of Inputs	6
Type of Analog Input: (configurable via software parameter)	NTC Copeland (-50T110°C; 10KΩ±1% at 25°C) PTC Copeland (-55T115°C; 990Ω±1% at 25°C) Digital input (potential free contact) Voltage: 0 - V, 0 - 5V, 0 - 10V (input resistance 3.7KΩ) Current: 0 - 20mA, 4 - 20mA (input resistance 100Ω)
Accuracy	NTC, PTC: ±1 0-1V: ±20mV 0-5V: ±100mV 0-10V:±200mV 2-20mA, 4-20mA: ±0.30mA
Additional Power	+12V: 200mA in total (between +12V and analog outputs) +5V: 100mA

⚠ CAUTION

Any analog inputs that are powered with a voltage that differs from that supplied by the device (+12V or +5V) must be powered separately with another transformer (do not use the same secondary of the controller's power) to prevent the inputs from malfunctioning or being damaged.

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2.3.2 Digital Inputs

Table 4: Digital Inputs

Type: (configurable via software parameter)	Opto-insulated live contact (24VAC/DC) External power 24VAC/DC ±20%
Number of Inputs	11
Digital Input Status Variation Detection Time	100ms (depends on the cycle time set by the user in the given application)

⚠ CAUTION

Use another transformer (Do not use the same secondary of the controller's power) to prevent the inputs from malfunctioning or being damaged.

Use of a DC power supply is PREFERRED.

2.3.3 Analog Outputs

Table 5: Analog Outputs

Type	Non opto-insulated internal power
Number of Outputs	4
Type of Analog Output: (configurable via software parameter)	4 configurable outputs 0-10VDC 4-20mA (Out1 - Out4)
Maximum Load	40mA (Out1 - Out4) max with configured outputs 0-10VDC 400Ω max with configured outputs 4-20mA 22Ω per live analog output
Accuracy	Out1 - Out4: ±2% full scale
Resolution	8-bit

⚠ CAUTION

The electrical devices controlled by these analog outputs must be powered separately with another transformer (do not use the same secondary of the controller's power) to prevent the outputs from malfunctioning or being damaged.

2.3.4 Digital Outputs

Table 6: Digital Outputs

Type	Relays with NO contacts
Number of Outputs	8
Type of Analog Output: (configurable via software parameter)	Relays with normally open contact
Maximum Load	5A(250VAC) SPST 5(2)A

⚠ CAUTION

Verify the capacity of the output used. There is double insulation between the digital outputs and the low voltage of the rest of the circuit.

Do not use different voltages for the various groups of relays or within each group.

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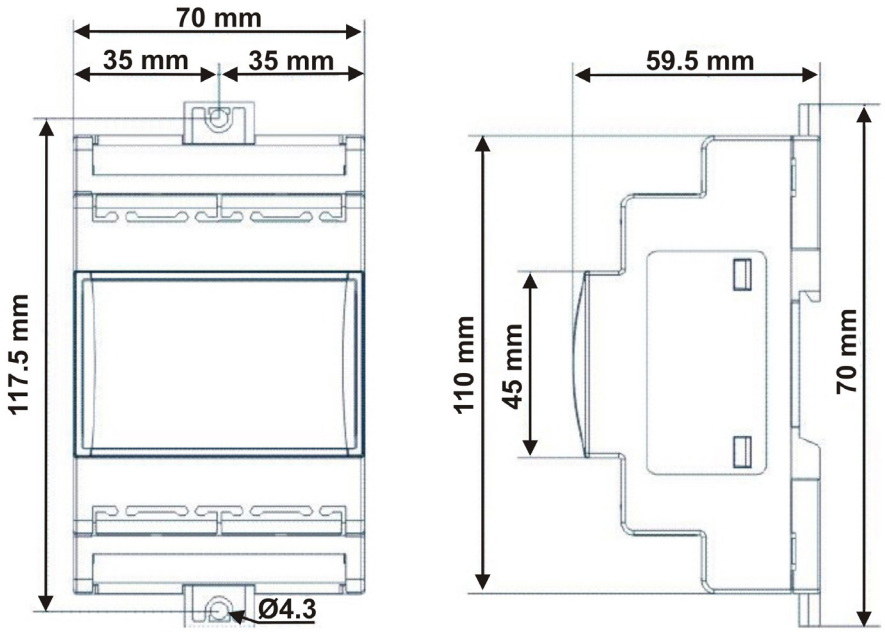
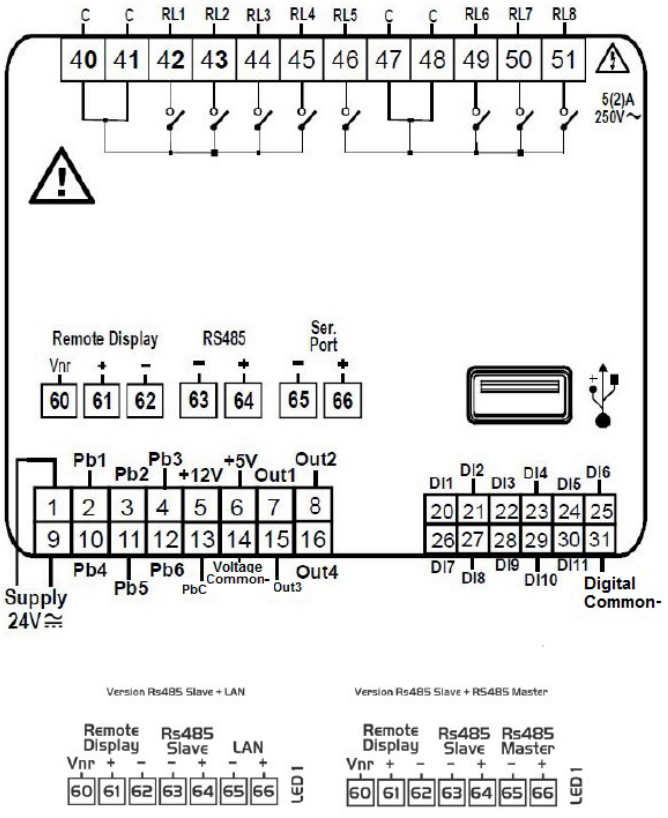
2.3.5 Dimensions



2.3.6 Wiring Diagrams



NOTICE	To ensure control in case of a power failure, it is recommended that an uninterruptible power supply (UPS) be used on the High Pressure CO_2 controller.

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2.3.7 Electrical Specifications

Table 7: Electrical Specifications

Power Supply	24VAC +10/-15%, 50/60Hz, 20 - 36VDC.
Consumption	From 30VA (VAC), From 25W (VDC)
Connectors	Phoenix quick coupling connectors for low voltage (for IPG208D). STELVIO 90° screw connectors for digital outputs (250VAC, 6A max).
Microprocessor	AT91SAM9260 32-bit 200Mhz
Permanent FLASH Memory	16Mb, in 8-bit chunks
RAM	2x128Kb, in 16-bit chunks
Internal Clock	Standard

2.3.8 Plastic Enclosure

Table 8: Enclosure Specifications

Mount	On a DIN rail (EN 50022, DIN 3880) Fastened with screws via the removable plastic flaps.
Material	PC-ABS Thermoplastic
Self-extinguishing	V0 (UL94)
Comparative Tracking Index (CTI)	300V
Color	White

2.4 Powering the High Pressure CO_2 Controller

Copeland supplies a wide variety of 24VDC power supplies and 24VAC transformers with varying sizes without center taps. The table below shows the transformer sizes and are non- center- tapped.

⚠ CAUTION	DC power supply is PREFERRED.

2.4.1 UPS Information

Use a UPS that is sufficiency large enough to supply all the loads attached to it. The UPS will supply power to the respective power supplies of both the HPV controller and the XEV20D driver. If UPS is used, the use of external battery backup or XEC devices is not required.

2.4.2 Choosing Transformer Sizes

The power supply used to power the High Pressure CO_2 controller should have a minimum rating of 30VA/30W. The High Pressure CO_2 controller should not share a power supply with any other devices.

Table 9: Compatible Transformers with CO_2 Controller

Transformer P/N	VA Rating	Primary Voltage
640-0041	50 VA	110 VAC
640-0042	50 VA	220 VAC

Table 10: 24V DC Power Supply to Power HPV Controller

24V DC Power Supply P/N	Output	Primary Voltage
318-3183	60W	100-240V

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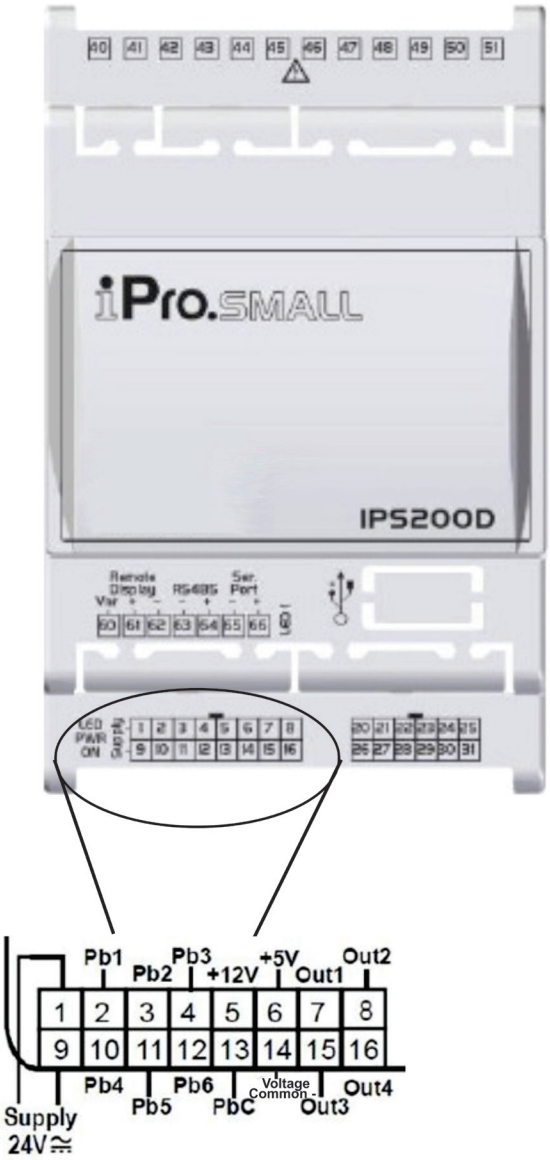
Neither side of the secondary should be connected to ground. Also, do not connect the center tap (if provided on the transformer) to ground. The entire secondary of the transformer should be isolated from any ground.



Power and Analog Inputs

2.4.3 Wire Types and Maximum Distances

For powering the controller, use only the listed wire types in the table below. Two-conductor non-shielded cables are the recommended wire for connecting the transformer to the High Pressure CO_2 controller. Shielded cable should not be used for power wiring. *The center tap should be left disconnected if present on the transformer.*

Table 11: Power Wiring Types

Power Wiring Types	
14 AWG	Belden 9495
18 AWG	Belden 9495

The wire length from the transformer determines the wire gauge used. In most cases, the distance between the High Pressure CO_2 controller and the transformer that supplies power to it is not enough to be of concern, *however, it is very important NOT to exceed this maximum wire length or the controller will not operate correctly.*

Use these formulas to determine if the wire gauge used is within specification:

14 AWG:

Feet = 1920/VA

18 AWG:

Feet = 739/VA

(VA is the total VA rating of the controller)

For example, for a load of 80VA:

14 AWG: 24 ft.

18 AWG: 9 ft. (rounded down)

Power Wire Lengths

Sensors requiring 24VAC should not be powered from the same transformer that is powering the input board. *Any devices that will be connected to the High Pressure CO_2 controller inputs or outputs must be powered with a separate 24VAC transformer.*

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3. The MODBUS Network

Although the High Pressure CO_2 controller can operate as a stand-alone controller, it relies on a Supervisory Controller unit for advanced features such as remote connection, logging, and alarm control. The High Pressure CO_2 controller uses an RS485 network connection to communicate with Supervisory Controller site.

3.1 Wiring Types

Copeland specs Belden #8761 shielded twisted pair cables for use as MODBUS wiring (or Belden #82761 and Belden #88761 for plenum installations).

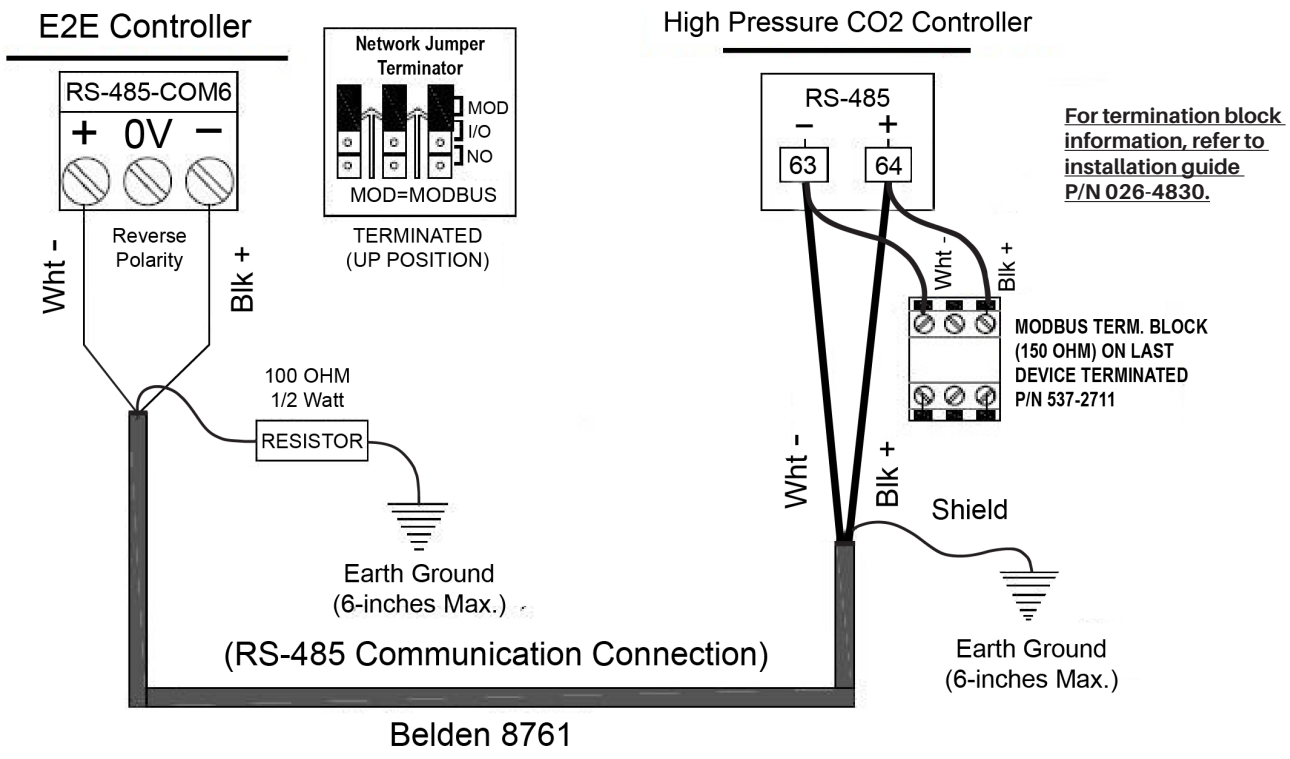
If the recommended cable is not available in your area, be sure the wiring meets or exceeds the following specs:

Table 12: Modbus Communication Cable Types

Shielded	Yes
Conductor Type	Twisted Pair
Gauge	18 - 24 AWG
Capacitance between signal wires	31 pF/ft or less (9.45 m) or less
Capacitance between signal and shield	59 pF/ft or less (17.98 m) or less
Nominal Impedance	120Ω ± 50Ω

3.1.1 Daisy Chains

Connect the MODBUS network cable to the three-terminal connector on the Supervisory Controller COM port you wish to assign as MODBUS. Reverse the polarity of +/- on the RS485 cable between the Supervisory Controller and the High Pressure CO_2 controller.



MODBUS Networking

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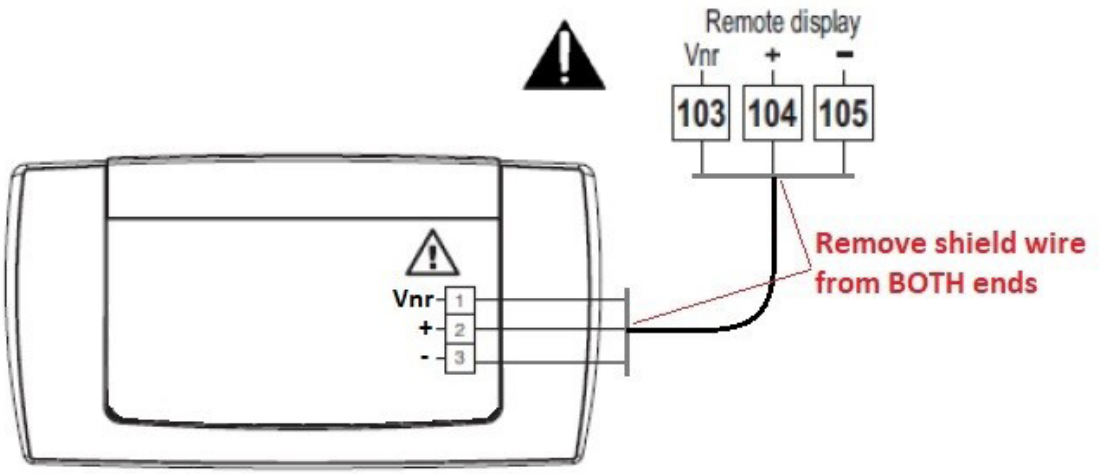
3.1.2 Network Addressing - Visograph

The network address makes a board unique from other boards on the network of the same type. This allows the site controller to find it and communicate with it easily.

The network address of the High Pressure CO_2 controller is set using a local display called Visograph (*P/N 818-9002*).

3.1.2.1 Connecting the Visograph

The Visograph is connected using a three-wire connection on pins 60, 61, and 62. Beldin 8771 recommended.



Visograph Wiring

⚠ CAUTION The High Pressure CO_2 controller may be damaged if the wires are crossed when connecting the Visograph, especially if pin 60 (Vnr) is accidentally connected to + or –.

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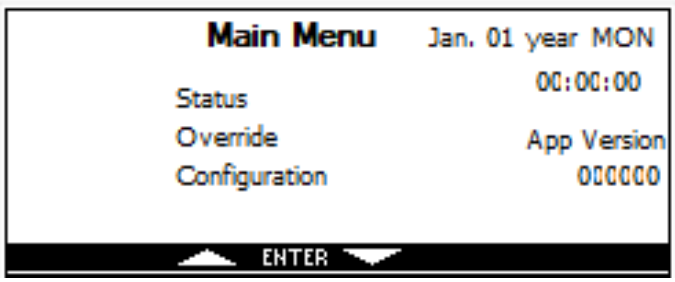
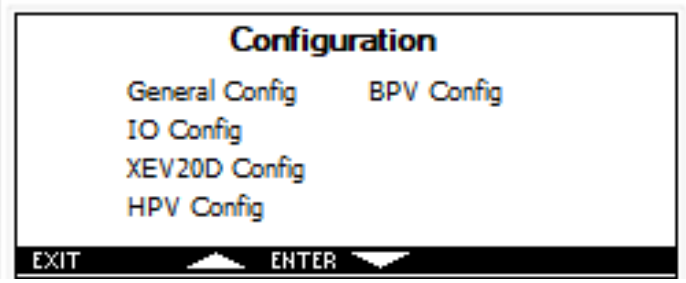
3.1.3 Setting the MODBUS Address

To configure the MODBUS settings, start by entering the **Configuration Menu** from the **Main Menu**.



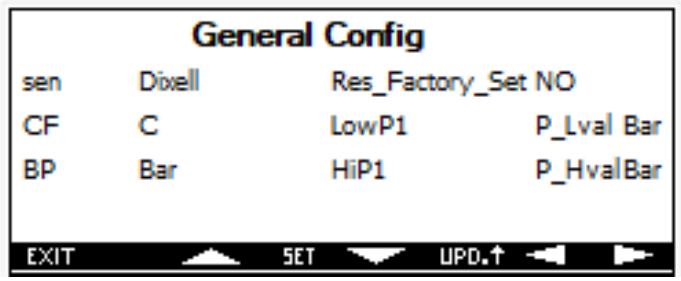
Main Menu

From the **Main Menu**, use the up and down arrows to highlight **Configuration** and select **ENTER** to access the **Configuration Menu**.



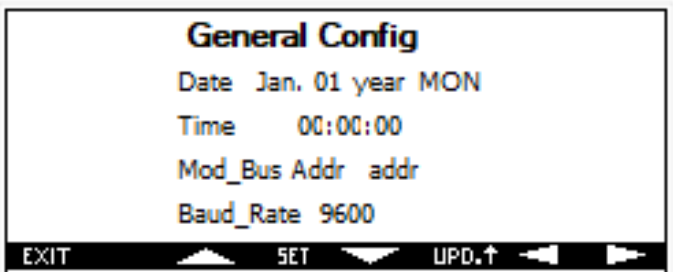
Configuration Menu

Highlight **General Configuration** and select **ENTER**.



General Configuration Screen

Press the **RIGHT** arrow to advance to the next screen.



General Configuration Screen #2

Using the up and down arrows, highlight the **MODBUS Addr** value and select **SET** to edit. Use the up and down arrows while the value is blinking to change the Modbus Address. Select **SET** to save the new address. The address value will stop blinking.

Select **EXIT** to go back through the previous menus.

⚠ CAUTION	When the MODBUS address or Baud rate is changed, the High Pressure CO_2 controller MUST be rebooted.

3.2 MODBUS Termination

If the High Pressure CO_2 controller is located at the physical end of the MODBUS network, install the MODBUS termination block (*P/N 537-2711*).

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4. Inputs and Outputs Setup

4.1 Inputs Setup

The High Pressure CO_2 application can assign all inputs to be any of the possible options for an analog input in the application. The analog inputs will have offsets available while the digital inputs will have a polarity option. All inputs will use physical local sensors and may have a network input from the Supervisory Controller as a backup if available. The default input configuration is:

Table 13: High Pressure CO_2 Controller Inputs

Inputs	Description	Local	Network	Sensor Type
Pb1	Temperature-Gas Cooler Outlet (T1)	Yes	Yes	NTC/CPC
Pb2	Pressure-Gas Cooler Outlet (P1)	Yes	Yes	0-5V/4-20mA
Pb3	Pressure-Receiver (P2)	Yes	Yes	0-5V/4-20mA
Pb4	Temperature-Bypass Gas Cooler Outlet (T2)	Yes	Yes	NTC/CPC
Pb5	H-R Signal	Yes	Yes	0-10V
DI1	Heat Reclaim (HTR)	Yes	Yes	24VAC/DC
DI2	Emergency Shutdown (Enable)	Yes	Yes	24VAC/DC
DI3	Control Temp Selector (Digital Input) (CTS)	Yes	Yes	24VAC/DC

The application can use a local or Supervisory Controller network value, if online, but the local value will have priority over the network value. However, if a sensor failure has been detected, its corresponding network value will be used. Network sensors are set via the "Inputs" tab in the Supervisory Controller application.

HPV CO2 Inputs Setup Tab in Supervisory Controller for Network Sensors

If no network value is available, refer to Section *"7.1 Sensor Failure"*.

The input assignment will be available from the Visograph local display and the Supervisory Controller.

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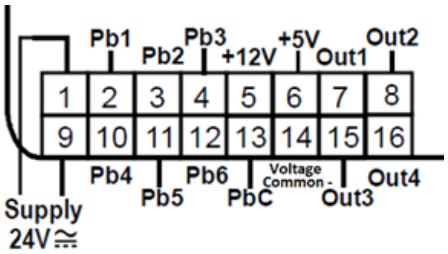
4.1.1 Wiring Analog and Digital Inputs

The analog inputs are located on the same connector terminal as the controller power supply. Pay attention to input commons as they are shared on terminal 13 (PbC) for temperature probes and terminal 14: Voltage Common (-) for pressure transducers.

⚠ CAUTION Terminal 14 is labeled Voltage Common (-) for use as common and **should NOT be earth chassis grounded.**



Analog Input Connectors

⚠ CAUTION Any inputs that are powered with a voltage that differs from that supplied by the High Pressure CO_2 controller (+12V or +5V) must be powered separately with another transformer to prevent the inputs from malfunctioning or being damaged. **Do not use the same secondary of the controller's power to power the sensors.**

Table 14: Analog Connector Terminal

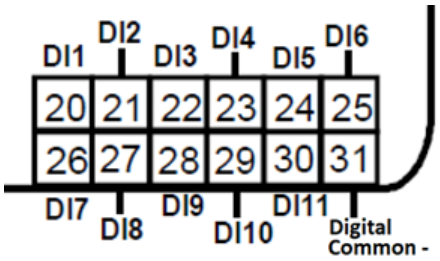
Terminal Number on Connector	Name
1	24VAC or DC Supply (-)
2	Probe Input 1: default: Temperature- Gas Cooler Outlet (T1)
3	Probe Input 2: default: Pressure-Gas Cooler Outlet (P1)
4	Probe Input 3: default: Pressure-Receiver (P2)
5	+12VDC
6	+5VDC
7	Analog Output 1 (default HPV Stepper Valve 1)
8	Analog Output 2 (default BGV Stepper Valve 2)
9	24VAC or DC Supply (+)
10	Probe Input 4
11	Probe Input 5
12	Probe Input 6

Table 14: Analog Connector Terminal

Terminal Number on Connector	Name
13	Temperature Common
14	Transducer/Analog Output Common
15	Analog Output 3
16	Analog Output 4

The digital inputs are located on the corresponding connector terminal below. *Pay attention to the input commons as they are shared on terminal 31: Digital Common (-) and the digital inputs are voltage inputs that can handle 24VAC/DC.*

⚠ CAUTION Terminal 31 is labeled Digital Common (-) for use as common and should NOT be earth chassis grounded.



Digital Input Connectors

Table 15: Digital Input Connector Terminal

Terminal Number on Connector	Name
20	Digital Input 1: Heat Reclaim (HTR)
21	Digital Input 2: Enable/Shutdown
22	Digital Input 3: CTS – Control Temp Selector
23	Digital Input 4
24	Digital Input 5
25	Digital Input 6
26	Digital Input 7
27	Digital Input 8
28	Digital Input 9
29	Digital Input 10
30	Digital Input 11
31	Digital Common

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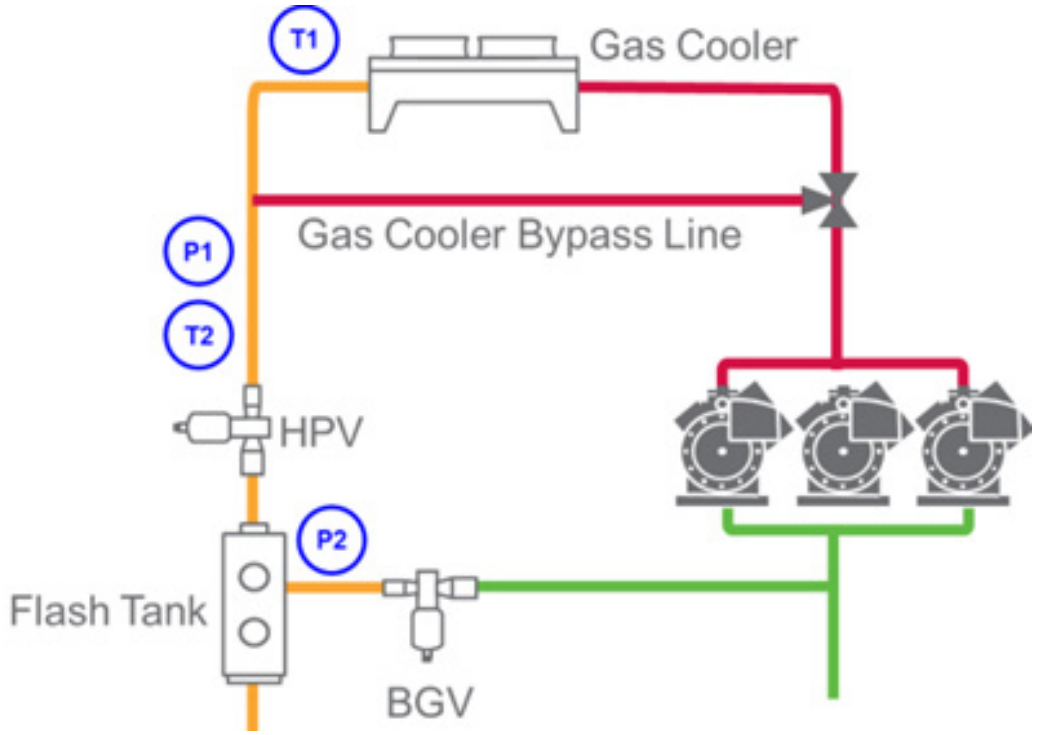
4.1.2 Probe Location

Gas Cooler Outlet Temperature Sensor (T1) – The sensor must be mounted at or as close to the Gas Cooler outlet as possible at a 4 or 8 o'clock position to ensure most accurate readings. It must be thermally insulated with insulation at least 1" thick from the outlet of the Gas Cooler and at least 12" after the sensor.

Gas Cooler Outlet Pressure Sensor (P1) – The pressure transmitter must be mounted at or as close to the Gas Cooler outlet to ensure accurate readings. It must be mounted upright to ensure oil does not collect in sensor.

Flash Tank Pressure Sensor (P2) – It must be mounted upright to ensure oil does not collect in sensor.

Gas Cooler Bypass Temperature Sensor (T2) – The sensor must be mounted between the Gas Cooler Bypass Line and the HPV valve to ensure most accurate readings. It must be thermally insulated with insulation material at least 1" thick at least 12" after the sensor.



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4.2 Outputs Setup

The High Pressure CO_2 application can assign all relay outputs to be any of the possible options for a digital output in the application. The digital outputs will have delays and polarity options available.

Table 16: Relay Outputs

Rly Out	Description	Local	Network
RL1	General Alarm	Yes	Yes
RL2	Low Pressure Alarm (Flash Tank)	Yes	Yes
RL3	High Pressure Alarm (Flash Tank)	Yes	Yes
RL4	Shutdown Alarm	Yes	Yes

The High Pressure CO_2 application can assign all analog outputs to be any of the possible options for an analog output in the application. The High Pressure Valve (Valve 1) and Bypass Gas Valve (Valve 2) are controlled by an XEV20 (Dual Valve) stepper valve driver connected through LAN by default. The valves can be controlled with 0-10V signals through the analog outputs, but this is set up as the default (see *Table 17* below):

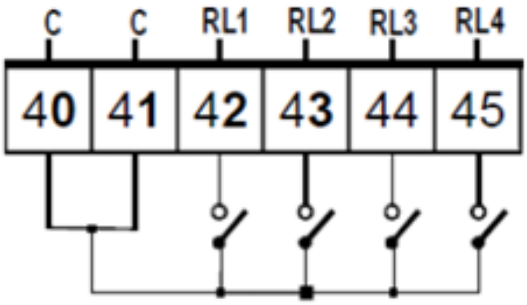
Table 17: Analog Outputs

Analog Out	Description	Local	Network	LAN
Out1	Stepper Valve 1	Yes	Yes	Yes
Out2	Stepper Valve 2	Yes	Yes	Yes

The output assignment will be available from the Visograph and the Supervisory Controller. If an XEV20 is configured, the application will provide the online status of the XEV20 on both the Visograph and Supervisory Controller.

4.2.1 Wiring Relay and Analog Outputs

The first 4 relay outputs are located on the corresponding connector terminal (see illustration below). These relays share the same common which is accessible on either terminal 40 or 41 (C).



Relay Output Connectors

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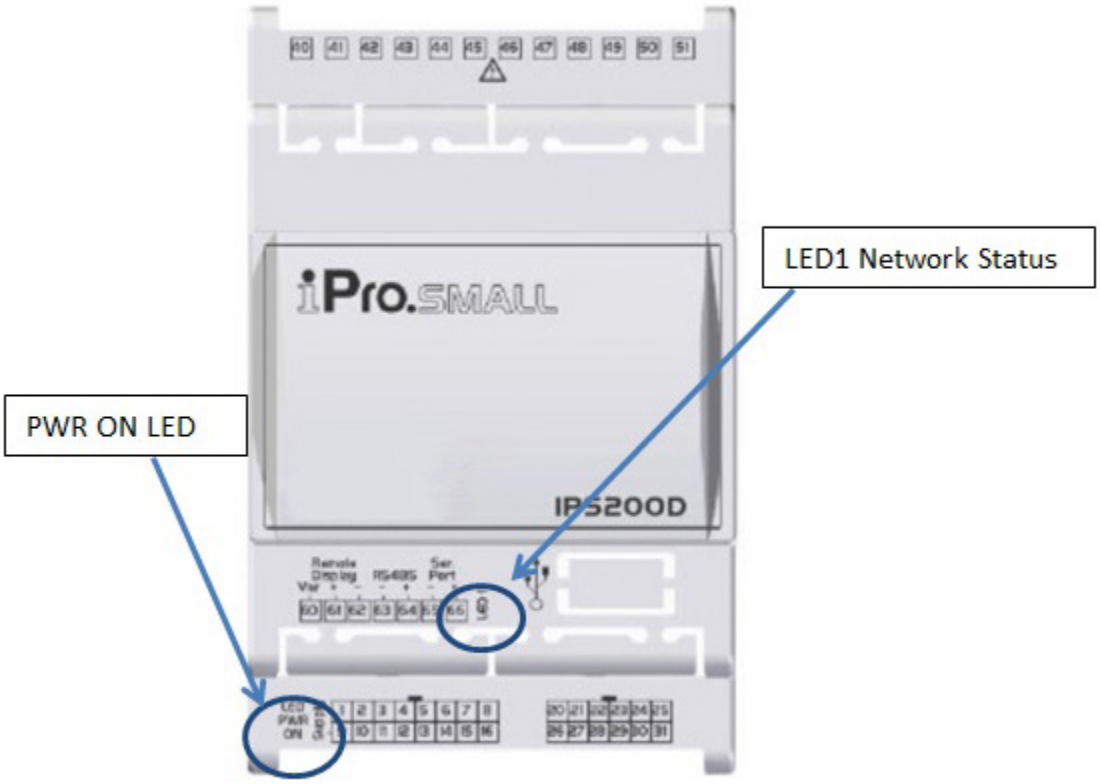
5. High Pressure CO_2 Controller Status LED

When a High Pressure CO_2 controller board is powered up, the operating status of the board can be determined by observing its status LEDs.



Visograph Wiring

5.1 Power On (PWR ON) LED

The PWR ON LED stays on continuously to show that the board is powered and operational. If this light is dark, the controller has likely lost power.

5.2 LED1 Network Status

The amber colored LED1 indicates whether the High Pressure CO_2 controller is online or offline with the Supervisory Controller. When the High Pressure CO_2 controller is online, the LED1 will turn on for one second and off for one second. However, if the High Pressure CO_2 controller is offline, the LED1 will turn on for half a second and off for half a second (blink twice as fast). **When the High Pressure CO_2 controller is offline with the Supervisory Controller, you can change setpoints from the Visograph display.**

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6. Software Overview

The High Pressure CO_2 controller application controls the operation of the High Pressure Valve and the Bypass Gas Valve in a Transcritical CO_2 system. The controller will modulate both valves to maintain a setpoint.

Both the HPV and the BGV have safety modes. The safety control point in both valves is the receiver pressure. If the receiver pressure is higher than the high pressure setpoint, the HPV closes to its minimum position and the BGV opens. If the receiver pressure is too low, the HPV minimum position will be increased and the BGV will close.

6.1 High Pressure Valve Control

The High Pressure Valve (HPV) operates in two control modes: Subcritical and Transcritical. In Subcritical Mode, the valve will modulate to maintain a subcooling setpoint using pressure (P1) and temperature (T1) control values being read from the gas cooler outlet to calculate subcooling. In Transcritical Mode, the HPV starts modulating to maintain a setpoint defined by an equation to achieve to achieve optimal gas cooler pressure to maximize evaporator capacity while minimizing compressor power.

6.1.1 HPV Subcritical Mode

During Subcritical Mode, the control temperature is either T1 or T2 depending on the digital input CTS (Control Temperature Selector). If the control temperature is below **HPV Mode Setpoint** minus **Hysteresis**, the system is in Subcritical Mode. During Subcritical Mode, if **OPNS** is greater than -1 (0-100%), the HPV will be fixed to the value of **OPNS** (**OPNS** defines the percentage of the valve position in Subcritical Mode). If **OPNS** is set to -1, the valve will be controlled by the PID; during PID control, the subcooled temperature will be calculated from the pressure and control temperature from the outlet of the gas cooler and be used as the control input. The Subcritical inputs, outputs, and PID parameters are listed below:

Table 18: Subcritical Inputs

Inputs	Description	Type
T1	Gas Cooler Outlet Temperature	Temperature
T2	Bypass Gas Cooler Temperature	Temperature
P1	Gas Cooler Outlet Pressure	0-5VDC Only
Control Temp Selector (CTS)	Choose T1 or T2 as the Control Temperature	Digital Input

Table 19: Subcritical Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HPV Mode Stpt	SptO	HPV Setpoint to switch between Subcritical and Transcritical	87°F
HPV Mode Hyst	HyO	HPV Hysteresis when switching between Subcritical and Transcritical	4°F
HPV Subcl Stpt	SptS	HPV Subcritical Setpoint	5°F
HPV RS-Temp	RSBT	HPV Subcritical PID Band Offset	0°F
HPV PB-Temp	PBBT	HPV Subcritical PID Proportional Band	40°F
HPV INC	INC	HPV Subcritical PID Integral Sampling Time	240 Sec
HPV DERT	DERT	HPV Subcritical PID Derivative Sampling Time	0 Sec
HPV DDERT	DDERT	HPV Subcritical PID Derivative Time	0 Sec

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Table 19: Subcritical Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HPV Max %	HMax	HPV Maximum Valve Percentage	100%
HPV Min %	HMin	HPV Minimum Valve Percentage	0%
OPNS	OPNS	HPV Valve Percentage during Subcritical (-1 for PID control)	-1

6.1.1.1 Gas Cooler Minimum Pressure (App ver 231001)

When the Saturated Condenser Pressure target (**T1+ Subcl Stpt**) is below the minimum Gas Cooler Pressure (**HPmin**) for a delay (**HPminT**), the **HPV** control will switch to Gas Cooler Minimum Pressure Mode. During this mode, the **HPV** will use **HPmin** value and maintain the Gas Cooler Outlet Pressure (**P1**) to **HPmin** setpoint. When the Saturated Condenser Pressure target (**T1+ Subcl Stpt**) is above **HPmin** setpoint for a delay (**HPminL**), the **HPV** control will exit Gas Cooler Minimum Pressure Mode. It is **recommended** that **HPmin** is set at a value lower than the minimum Gas Cooler Outlet Pressure value (in supervisor condenser application) to ensure smooth operation for this feature to be effective. (Fan should be **OFF** at a value higher than the set value of **HPmin**).

6.1.1.2 Gas Cooler Minimum Pressure (App ver 240731)

When Gas Cooler Outlet Pressure (**P1**) is below the minimum Gas Cooler Pressure (**HPmin**), the High Pressure Valve (**HPV**) will use **HPmin** value and maintain the **P1** to **HPmin** setpoint. When **P1** is above **HPmin** the control will resume normal TD Subcooling control uninterrupted. It is **recommended** that **HPmin** is set at a value lower than the Minimum Gas Cooler Outlet Pressure value (in supervisor condenser application) to ensure smooth operation for this feature to be effective. (Fan should be **OFF** at a value higher than the set value of HPmin).

Table 20: Gas Cooler Minimum Pressure Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HPMin	HPMin	Gas Cooler Minimum Pressure	650 PSI
HPminT	HPminT	Delay before reacting to Gas Cooler Minimum Pressure	5 Min (app v231001) 0 Min (app v240731)
HPminL	HPminL	Delay before exiting Gas Cooler Minimum Pressure	5 Min (app v240731) 1 Min (app v231001)
RSBTHPM	RSBTHPM	HPV Subcritical PID Band Offset during Gas Cooler Minimum Pressure	0 PSI
PBBTHPM	PBBTHPM	HPV Subcritical PID Proportional Band during Gas Cooler Minimum Pressure	200 PSI

Table 21: Analog Outputs

Outputs	Description	Type
Valve % Output	Valve Percentage Output	0-10VDC Only or LAN to XEV20D

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6.1.1.3 HPV Heat Reclaim

Heat Reclaim can only be active when in **Subcritical Mode**, **OPNS** is set at -1 and H-R Signal is greater than **HTRC1**. Heat Reclaim is controlled based on the Heat Reclaim Enable (**HTR**) digital input or network input and the **H-R Signal** analog input value. When **HTR** has an active input, the **H-R Signal's** value will select the level of Heat Reclaim to be used. If the H-R Signal value is below **HTRC1**, Heat Reclaim is not active. When H-R Signal is between **HTRC1** and **HTRC2**, the minimum Heat Reclaim pressure setpoint will be **HTRC3**. When H-R Signal is greater than **HTRC2**, the minimum Heat Reclaim pressure setpoint will be **HTRC4**.

Table 22: Heat Reclaim Digital Inputs

Inputs	Description	Type
Heat Reclaim (HTR)	Reclaim Setpoint Added	24VAC/DC
H-R Signal	A signal that determines the amount of heat reclaim	0 to 10V

⚠ CAUTION A separate 24V power supply must be used. Do not use the same power supply that is used to power the controller.

Table 23: Heat Reclaim Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HTRC1	HTRC1	H-R Signal Input Starting Point for Heat Reclaim	2V
HTRC2	HTRC2	H-R Signal Input Ending Point for Heat Reclaim	8V
HTRC3	HTRC3	Pressure Setpoint at Starting Point for Heat Reclaim	800 PSI
HTRC4	HTRC4	Pressure Setpoint at Ending Point for Heat Reclaim	950 PSI
HTRCT	HTRCT	Delay before entering Heat Reclaim	0 Min
HTRCL	HTRCL	Delay before exiting Heat Reclaim	5 Min
RSBPHR	RSBPHR	HPV Subcritical PID Band Offset during Heat Reclaim	0 PSI
PBBPHR	PBBPHR	HPV Subcritical PID Proportional Band during Heat Reclaim	200 PSI

6.1.2 HPV Transcritical Mode

In a Transcritical system, when the refrigerant temperature exceeds the critical point, there is no longer an accurate temperature-to-pressure relation. Because of this, the control temperature of T1 or T2 (defined by digital CTS), will be the deciding factor of when the application will switch modes from Subcritical to Transcritical. If the control temperature is above the **HPV Mode Setpoint**, the application will be in Transcritical Mode. Once the control temperature is below the **HPV Mode Setpoint** minus **HPV Mode Hysteresis**, the system returns to Subcritical Mode.

In Transcritical Mode, the application will stop maintaining a subcooled setpoint and start maintaining a setpoint value from an equation to achieve an optimal pressure using only the pressure input (**P1**) as a control point.

The control temperature (T1 or T2) will still be used as a reference to calculate the setpoint equation. Below is a table with an estimation of what the setpoint will be for the given control temperature readings.

During Transcritical Mode, if the calculated pressure setpoint is greater than the Maximum Gas Cooler Pressure (**PGmax**), **PGmax** will be used as the setpoint. If the Gas Cooler Outlet Pressure (P1) rises above PGmax, the PGmax Alarm is activated. If the **PGmax Alarm** is active and P1 drops below **PGmax** minus **PGmaxHy**, the **PGmax Alarm** returns to normal.

During Transcritical Mode, if the calculated pressure setpoint is less than the Minimum Gas Cooler Pressure (**PGMin**), **PGMin** will be used as the setpoint. The setpoint will remain at **PGMin** until such time as the calculation determine it should increase or the controller switches to Subcritical mode.

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In Transcritical mode the valve will step according to parameters **PIDSmin**, **PIDSmax**, **PIDSband** and **NRHP**. If P1 exceeds **NRHP** pressure, the valve will move at **PIDSmax %** each cycle. When P1 is below **NRHP** but above (Setpoint + **PIDSband**) pressure from the Setpoint, the valve will step at (**PIDSmax/10**) % each cycle, the same will occur when below the (Setpoint – **PIDSband**). When P1 is within **PIDSband** pressure from **Setpoint**, the % change will vary linearly between (**PIDSmin/10**) % and (**PIDSmax/10**) %, depending on the distance from the Setpoint with (**PIDSmax/10**) % being the max value the valve % will change. This will help the system recover faster from high pressure event by increasing the valve step size when **NRHP** in exceeded. To disable this function, set **PIDSmin**, **PIDSmax** and **PIDSband** to 1 and **NRHP** to 0.

Table 24: Setpoint Estimates for Temp Readings

Gas Cooler T1 or T2 Transcritical Setpoint			
C	Bar	F	PSI
21	50.48	69.8	732
22	53.09	71.6	769.79
23	55.7	73.4	807.58
24	58.3	75.2	845.37
25	60.91	77	883.16
26	63.51	78.8	920.95
27	66.12	80.6	958.74
28	68.73	82.4	996.53
29	71.33	84.2	1034.32
30	73.94	86	1072.11
31	76.54	87.8	1109.9
32	79.15	89.6	1147.69
33	81.76	91.4	1185.48
34	84.36	93.2	1223.26
35	86.97	95	1261.05
36	89.58	96.8	1298.84
37	92.18	98.6	1336.63
38	94.79	100.4	1374.42
39	97.39	102.2	1412.21
40	100	104	1450
41	102.61	105.8	1487.79
42	105.21	107.6	1525.58

The Transcritical inputs, outputs, and PID parameters are listed below:

Table 25: Transcritical Inputs

Inputs	Description	Type
Temperature - 1 (T1)	Gas Cooler Outlet Temperature	NTC/CPC Temperature
Temperature - 2 (T2)	Bypass Gas Cooler Temperature	NTC/CPC Temperature
Pressure - 1 (P1)	Gas Cooler Outlet Pressure	0-5VDC Only
Control Temp Selector (CTS)	Choose T1 or T2 as the Control Temperature	Digital Input

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Table 26: HPV Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HPV Mode Stpt	SptO	HPV Setpoint to switch between Subcritical and Transcritical	87°F
HPV Mode Hyst	HyO	HPV Hysteresis when switching between Subcritical and Transcritical	4°F
----------	----------	HPV Transcritical Setpoint	From Calculation
HPV RS-Press	RSBP	HPV Transcritical PID Band Offset	0 PSI
HPV PB-Press	PBBP	HPV Transcritical PID Proportional Band	200 PSI
HPV INC	INC	HPV Transcritical PID Integral Sampling Time	180 Sec
HPV DERP	DERP	HPV Transcritical PID Derivative Sampling Time	0 Sec
HPV Max %	HMax	HPV Maximum Valve Percent	100%
HPV Min %	HMin	HPV Minimum Valve Percent	0%
PIDSMin	PIDSmin	HPV Minimum PID Percent	1%
PIDSMax	PIDSmax	HPV Maximum PID Percent	10%
PIDSBand	PIDSband	HPV PID Step Band	30 PSI
PGMax	PGMAX	HPV Maximum Pressure in Gas Cooler	1450 PSI
PGMaxHy	PGmaxHy	HPV Hysteresis for Maximum Gas Cooler Pressure Alarm	50 PSI
SF Setpoint	SFSpt	HPV High Pressure Safety Setpoint	1500 PSI
PGMin	PGMin	Minimum Gas Cooler Setpoint	1093 PSI
SF Delay	SFDly	HPV High Pressure Safety Exit Delay	0 Sec
NRHP	NRHP	HPV Pressure Value near High Pressure Cut Out	1400 PSI

Table 27: Analog Outputs

Outputs	Description	Type
HPV Valve % Output	Valve Percentage Output	0-10VDC Only or LAN to XEV20D

Analog Outputs

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6.2 Bypass Gas Valve Control

The Bypass Gas Valve (BGV) only operates in one control mode, which is to modulate the valve accordingly to maintain a pressure setpoint. The control value is from the flash tank (P2). If the BGV enters a safety mode, the PID will reset to begin safety operation.

Table 28: BGV Input

Inputs	Description	Type
Pressure 2 - P2	Flash Gas Tank Liquid Receiver	0-5VDC only

Table 29: BGV Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
BGV Setpoint	SptF	BGV Setpoint	510 PSI
BGV PB	PBF	BGV PID Proportional Band	100 PSI
BGV RS	RSF	BGV PID Band Offset	0 PSI
BGV INC	INCF	BGV PID Integral Sampling Time	240 Sec
BGV DER	DERF	BGV PID Derivative Sampling Time	0 Sec
BGV DDER	DDERF	BGV PID Derivative Time	0 Sec
BGV Max Open	BPV Max%	BGV Maximum Valve Percent	100%
BGV Min Open	BPV Min%	BGV Minimum Valve Percent	0%

Table 30: BGV Output

Outputs	Description	Type
BGV Valve % Output	Valve Percentage Output	0-10VDC Only or LAN to XEV20D

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7. Safety Conditions and Alarms

7.1 Sensor Failure

This section covers how the system reacts to different sensor input failures.

7.1.1 Control Temperature Failure

If a failure occurs on the Gas Cooler Outlet Temperature (T1) or the Bypass Gas Cooler Outlet Temperature (T2), a network value from the Supervisory Controller will be used (Section *"4.1 Inputs Setup"*). If there is no network value available from the Supervisory Controller:

- If T1 is the control temperature (CTS is not active), Supervisory Controller Network input will be used, if no Network input or it also fails the HPV will open to a fixed value according to the parameters **HPV% OpFail-SC** (during Subcritical) or **HPV% OpFail-TC** (during Transcritical).
- If T2 is the control temperature (CTS is active), the application will use T1 as the control value. If T1 is not configured or it has also failed, the HPV will open to a fixed value according to the parameters **HPV% OpFail-SC** (during Subcritical) or **HPV% OpFail-TC** (during Transcritical).

Table 31: Sensor Input

Inputs	Description	Sensor Type
Pb1	Temperature-Gas Cooler Outlet (T1)	NTC/CPC
Pb4	Temperature-Bypass Gas Cooler Outlet (T2)	NTC/CPC
DI3	Control Temp Selector (CTS)	24VAC/DC
T1 Network	Input from Supervisory Controller	NTC/CPC
T2 Network	Input from Supervisory Controller	NTC/CPC

Table 32: Control Temperature Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HPV% OpFail-SC	SC	HPV Percent during Subcritical with T1/P1 Sensor Failure	50%
HPV% OpFail-TC	TC	HPV Percent during Transcritical with T1/P1 Sensor Failure	50%
HPV Close Rate	CR	HPV Close Rate during Safety	3 Sec

7.1.2 Gas Cooler Outlet Pressure Failure

If a failure occurs on the Gas Cooler Outlet (P1), the network pressure from the Supervisory Controller will be used (Section *"4.1 Inputs Setup"*). If there is no network value available from the Supervisory Controller, the HPV will open to a fixed value according to the parameters **HPV% OpFail-SC** (during Subcritical) or **HPV% OpFail-TC** (during Transcritical).

Table 33: Sensor Input

Inputs	Description	Sensor Type
Pb2	Pressure - Gas Cooler Outlet (P1)	0-5V

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Table 34: Control Temperature Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HPV% OpFail-SC	SC	HPV Percent during Subcritical with T1/P1 Sensor Failure	50%
HPV% OpFail-TC	TC	HPV Percent during Transcritical with T1/P1 Sensor Failure	50%
HPV Close Rate	CR	HPV Close Rate during Safety	3 Sec

7.1.3 Receiver Pressure Failure

If a failure occurs on the Receiver pressure (P2), the network pressure from the Supervisory Controller will be used (Section *"4.1 Inputs Setup"*). If there is no network value available from the Supervisory Controller, the BGV will open to a fixed value according to the parameter **BGV% P2Fail**.

Table 35: Sensor Input

Inputs	Description	Sensor Type
Pb3	Temperature-Gas Cooler Outlet (T1)	0-5V

Table 36: Receiver Pressure Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
BGV% P2Fail	P2Fail	BGV Percent with P2 Sensor Failure	0%

7.2 Low Pressure Operation

Low Pressure occurs when the Receiver Pressure (P2) drops below the Low Pressure Setpoint (**Low Press Stpt**). During the Low-Pressure conditions, the HPV will use a new minimum position (**HPV% OpFail-Lo**). To exit Low Pressure conditions, P2 must rise above the Low Pressure Setpoint (**Low Press Stpt**) + the Low-Pressure Hysteresis (**Low Press Hyst**).

Table 37: Sensor Input

Inputs	Description	Sensor Type
Pb3	Pressure-Receiver (P2)	0-5V

Table 38: Low Pressure Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
Low Press Stpt	LSpt	Low Pressure Setpoint	450 PSI
Low Press Hyst	LoHy	Low Pressure Hysteresis	50 PSI
HPV% opFail-Lo	Lo	HPV Position in Low Flash Tank Pressure Mode	30%

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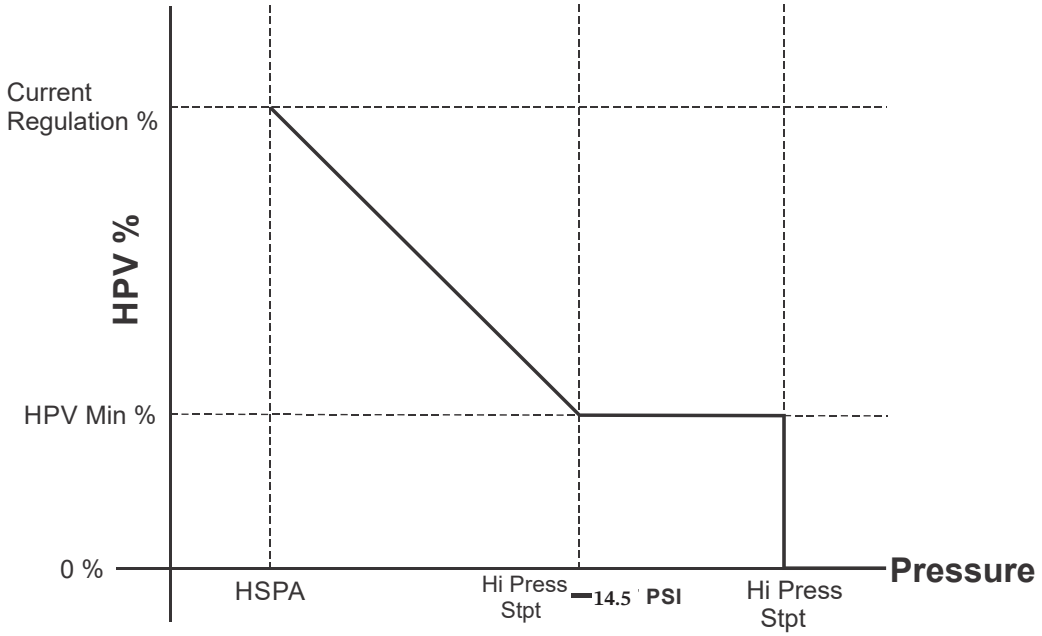
7.3 High Pressure Operation

There are both a High-Pressure Pre-Alarm and a High-Pressure Alarm that can occur based on the value of the Receiver pressure (P2).



Pressure Regulation Graph

When P2 reaches the High-Pressure Pre-Alarm Setpoint (**HSPA**), a High-Pressure Pre-Alarm will occur. During the High-Pressure Pre-Alarm, as P2 increases from **HSPA** to the High Pressure Setpoint (**Hi Press Stpt**), the HPV will move from its regulation position (at **HSPA**) to its minimum position (**HPV Min %**) when it is close to the **Hi Press Stpt**. The High-Pressure Pre-Alarm will end when P2 falls below **(HSPA-14.5PSI)**.

If P2 reaches **Hi Press Stpt**, a High-Pressure Alarm will occur. During the High-Pressure Alarm, the HPV will fully close and the BGV will open to the High-Pressure Safety Position (**BGV% Open Fail**). The High-Pressure Alarm will end when P2 falls below (**Hi Press Stpt - HiHY**). As P2 decreases from **Hi Press Stpt** to **HSPA**, the HPV will return to the High-Pressure Pre-Alarm control.

Table 39: Sensor Input

Inputs	Description	Sensor Type
Pb3	Pressure-Receiver (P2)	0-5V

Table 40: High Pressure Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HSPA	HSPA	High Pressure Pre-Alarm Setpoint	575 PSI
Hi Press Stpt	HSpt	High Pressure Setpoint	620 PSI
Hi Press Hyst	HiHy	High Pressure Hysteresis	25 PSI
HPV Min %	HMin	HPV Minimum Valve Percent	0 %
BGV% Open Fail	Opn Fail	BGV Percent during High Pressure Safety	100 %

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7.4 Emergency Shutdown Input (Enable)

This input is used for emergency safety shutdown. If the input signal is inactive, the application will close both the HPV and BGV first before disabling the application and generating an alarm. *For normal operation, this digital input must be active for the application to be enabled*.

If the High-Pressure CO_2 controller is online with Supervisory Controller, both the physical digital input and the Supervisory Controller network enable signal must be active for the application to be enabled.

7.5 Gas Cooler High Pressure Safety Operation

In the case of an active signal from the digital input HP Cut Out, the HPV control will prevent high pressure in the gas cooler. During this active signal, the Gas Cooler Outlet Pressure (P1) will be compared to the Gas Cooler High Pressure Safety Setpoint (**SF Setpoint**).

While P1 is below **SF Setpoint**, the HPV will go to its minimum position (**HPVMin%**). If P1 increases to **SF Setpoint** or higher, the HPV will fully close. When the HP Cut Out signal changes to inactive, there will be a delay (**SF Delay**) before returning to normal operation.

Table 41: Sensor Input

Inputs	Description	Sensor Type
Pb2	Pressure-Gas Cooler Outlet (P1)	0-5V
DI4	HP Cut Out	24VAC/DC

Table 42: Gas Cooler High Pressure Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
SF Setpoint	SFSpt	HPV High Pressure Safety Setpoint	1500 PSI
SF Delay	SFDly	HPV High Pressure Safety Exit Delay	0 Sec
HPV Min %	HMin	HPV Minimum Valve Percent	0 %

7.6 Alarms

The local display and the Supervisory Controller can read and display each alarm. Any sensor failure alarms will turn on the relay designated as the General Alarm. The Shutdown alarm is active if the system is not enabled (see Section *"7.4 Emergency Shutdown Input (Enable)"*)

Table 43: Alarm Designations

Alarm	Description
Low Press	Low Pressure in Receiver (P2)
High Press	High Pressure in Receiver (P2)
General	Any Sensor Failure Alarm
Sensor 1	PB1 Sensor Failure
Sensor 2	PB2 Sensor Failure
Sensor 3	PB3 Sensor Failure

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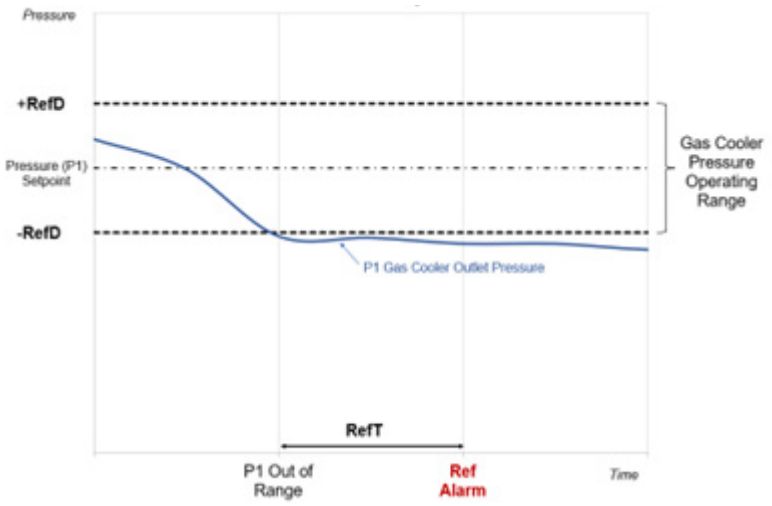
Table 43: Alarm Designations

Alarm	Description
Sensor 4	PB4 Sensor Failure
Sensor 5	PB5 Sensor Failure
Sensor 6	PB6 Sensor Failure
Pre-Alarm	Receiver Pressure (P2) Reached Pre-Alarm Limit
PGMax	Gas Cooler Pressure (P1) Limit Exceeded
Ref Alarm	Out of Gas Cooler Operating Range (more than RefD away from setpoint for RefT time)
Enable Alarm	System Is Not Enabled
HP Cut Out Alarm	High Pressure During HP Cut Out

7.6.1 Gas Cooler Operating Range Alarm (Ref Alarm)

This alarm will occur when the Gas Cooler Outlet Pressure (P1) is outside of the Gas Cooler Differential (**RefD**). When the Gas Cooler is being controlled by a subcooling temperature setpoint (Subcritical Mode), the setpoint is converted to a pressure before calculating the operating range (Subcl Stpt +T1). If P1 is outside of the operating range for a period (**RefT**), the Gas Cooler Operating Range alarm (Ref Alarm) will be active. When P1 returns to the operating range, Ref Alarm will deactivate. This alarm will not occur if the HPV is set to a fixed position or if there is currently a Gas Cooler Minimum Pressure (Section *"6.1.1.1 Gas Cooler Minimum Pressure"*) condition.

For example: If T1 is at 75F, HPV Subcl Setpt = 5F, P1 Pressure Should be 955psig (Psat of 80F), but if it is 1172psig or 738psig (±217psi) for RefT a Ref Alarm is issued.



Ref Alarm

Supervisory Controller Parameter	Visograph Parameter	Description	Default	Range	Unit
RefD	RefD	Pressure Differential for Ref Alarm	217	0 to 3000	PSI
RefT	RefT	Time Delay for Ref Alarm	5	0 to 3000	Min

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8. Valve Calibration

Valve calibration allows the user to set a time schedule to calibrate the HPV and/or BGV fully open (100%) or fully closed (0%) to keep the valve position accurate during long periods of runtime. The valve calibration can be set to occur when the system will be disrupted the least within a range of time.

Note/Caution: Verify with valve manufacturer if calibration to "fully open" is acceptable. i.e. Some manufacturers strictly caution against doing this as it may damage the valve.

Valve calibration is handled whether the valve is connected to an XEV20D or an analog output. Both Visograph and Supervisory Controller will show that the valve calibration has initiated.

Calibration is initiated by setting an interval of days (**Cal Day**) and a start time (**Cal Time**). The **Cal Time** and **Cal Day** values must be greater than 0 to enable calibration. For example, if **Cal Day** is set to 4 and **Cal Time** is set to 10, the calibration will begin at 10am every four days.

Calibration will begin when the valve percentage falls below or rises above the set **Cal Min Valve %** within the **T Frame** range. If the **T Frame** range has elapsed, the valve will immediately calibrate. The valve will calibrate to a fully closed or fully open position based on the **Direct** parameter setting.

Table 44: Valve Calibration Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default Value
HPV Cal Time	HCalT	Hour to initiate HPV Calibration (0 to disable)	0
HPV Cal Day	HCalD	Day interval for HPV Calibration (0 to disable)	0
HPV Cal T Frame	HCalFrame	Time frame before forcing HPV Calibration	0
HPV Cal Val Min	HCalValve	HPV target percent before initiating Calibration	0
HPV Cal Direct	HCalDirect	HPV Calibration Direction	0
BGV Cal Time	BCalT	Hour to initiate BGV Calibration (0 to disable)	0
BGV Cal Day	BCalD	Day interval for BGV Calibration	0
BGV Cal T Frame	BCalFrame	Time frame before forcing BGV Calibration	0
BGV Cal Val Min	BCalValve	BGV target percent before initiating Calibration	0
BGV Cal Direct	BCalDirect	BGV Calibration Direction	0

Table 45: Sensor Outputs

Outputs	Description	Sensor Type
Out1	Stepper Valve 1	0 to 10V
Out2	Stepper Valve 2	0 to 10V

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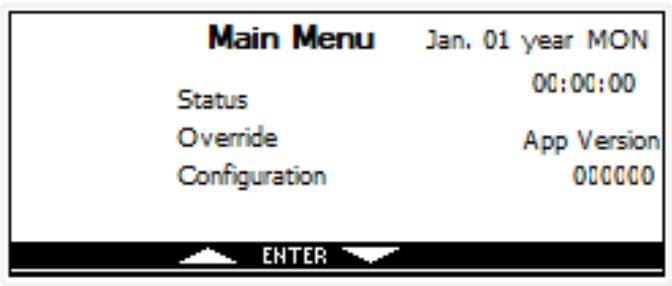
9. Visograph

The Visograph is a local display used to interface with the application. The screens provide access for setting up and assigning all inputs and outputs. In addition to the entire parameter configuration, the user can change the time and date, ModBUS address, baud rate (9600 or 19200), and update the Visograph with new screens if needed. When the Visograph boots up for the first time, you will see the splash screen:

Bootup/Splash Screen

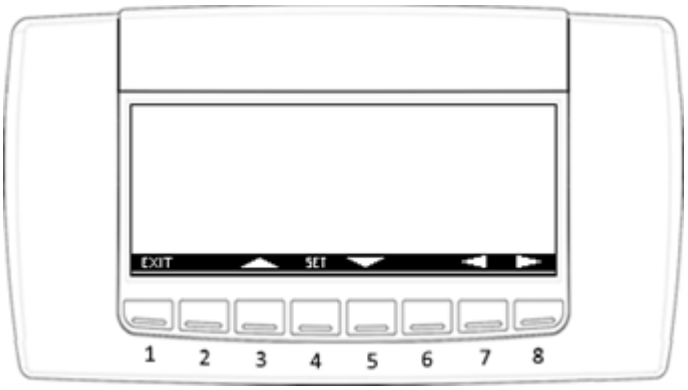
After the splash screen, the Main Menu will appear:



Main Menu Screen

***NOTE**: Once the High Pressure CO_2 controller is online with Supervisory Controller, changes can be made on the Supervisory Controller only. For some preference settings, please make changes on the Visograph before bringing the device online with Supervisory Controller.*

9.1 Navigation



Visograph Display with all buttons labeled 1-8

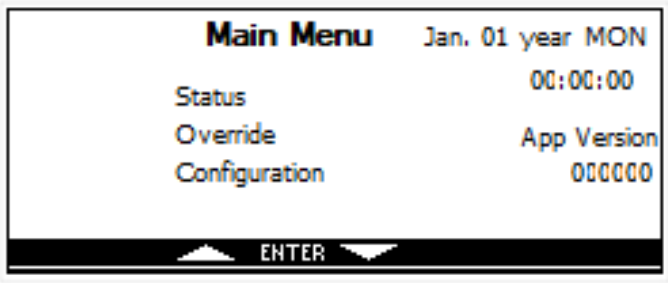
Visograph programming is done by using the eight buttons on the front of the display (labeled here as 1 through 8 for example). For the screen above (*Visograph Display with all buttons labeled 1-8*), to exit the screen, select **EXIT** by pressing the first button (**1**). To change a selection, use the up and down arrows (buttons **3** and **5**). To switch between different pages in a screen, use the left and right arrows (buttons **7** and **8**). To select or set a value, select **SET** by pressing the fourth button (**4**).

9.2 Status Screen

Status screens contain the current operating values of the system. This includes the current temperatures, pressures, valve positions, and alarms.

9.2.1 How To Access Status Screens

Access the list of available Status screens from the Main Menu:



Main Menu with Status Selected

Highlight Status using the up and down arrows and select **ENTER**.

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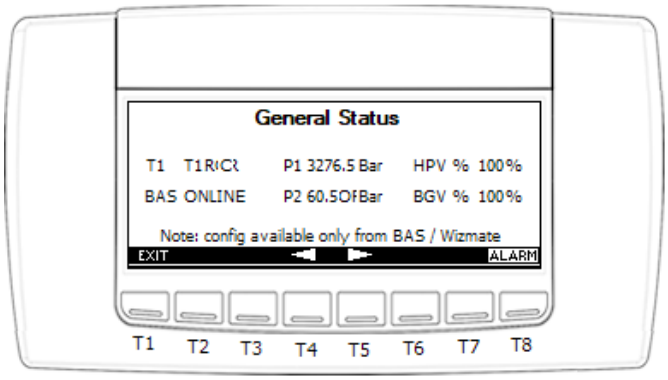
Finding The Application Version:

The App Version can be found in the top right of this **Status** menu.

The **Status** menu opens:



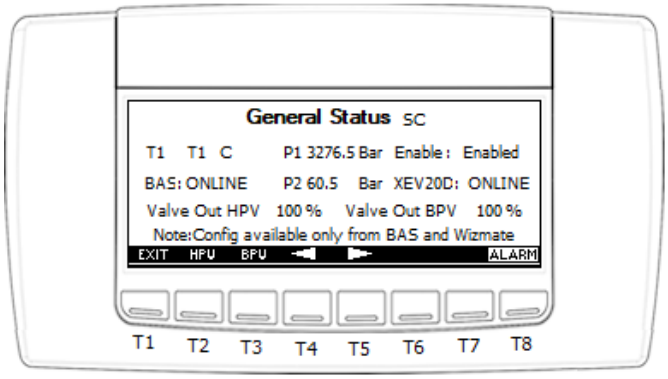
Status Menu

From this menu, any of the following screens can be accessed: **General Status, HPV Status, BGV Status, and Alarms**.

9.2.2 General Status Screens

General Status contains multiple screens that display information including temperatures, pressures, valve positions, and current operating modes.

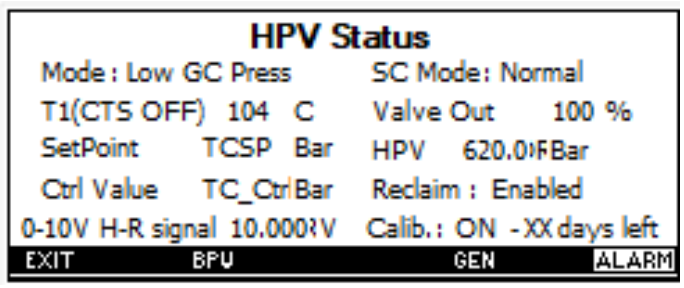
Use the left and right arrows to switch between screens. If an alarm is active, **ALARM** will flash and can be selected to enter the Alarms screen. Select **EXIT** to return to the **Status** menu (*"Status Menu"*).



General Status Menu

9.2.3 HPV Status Screens

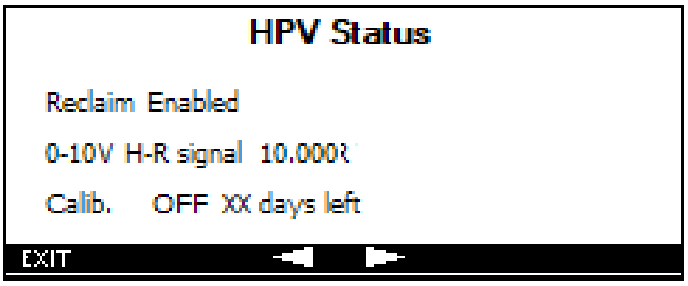
HPV Status contains multiple screens that display information including temperature, pressure, valve position, and current operating modes related to the HPV.



HPV Status Screen

Use the left and right arrows to switch between screens. If an alarm is active, **ALARM** will flash and can be selected to enter the Alarms screen. Select **EXIT** to return to the **Status** menu (*"Status Menu"*).

Additional **HPV Status** screen:



Additional HPV Status Screen

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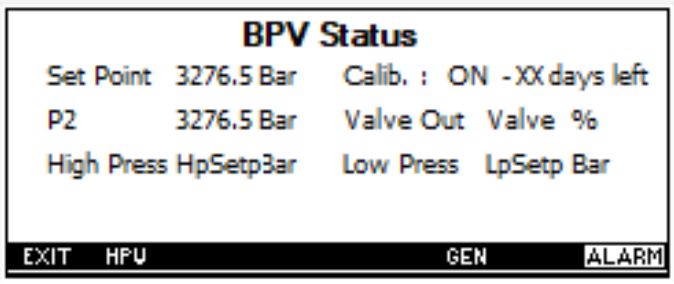
9.2.4 BGV Status Screens

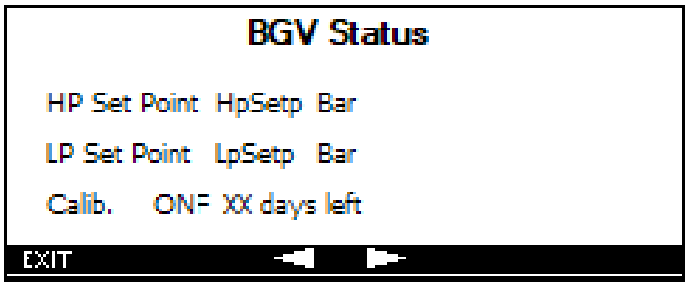
BGV Status contains multiple screens that display information including pressure, valve position, and current operating modes related to the BGV.



BGV Status Screen

Use the left and right arrows to switch between screens. If an alarm is active, **ALARM** will flash and can be selected to enter the **Alarms** screen. Select **EXIT** to return to the Status Menu (**"Status Menu"**).

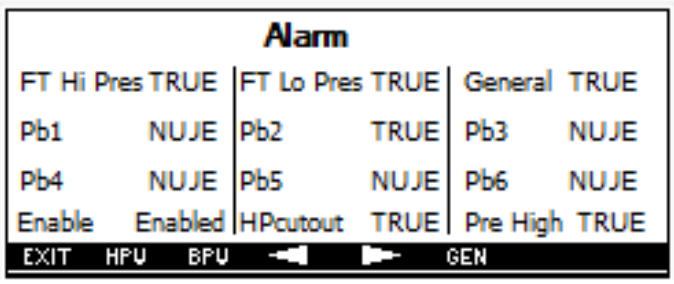
Additional **BGV Status** screen:



Additional BGV Status Screen

9.2.5 Alarms

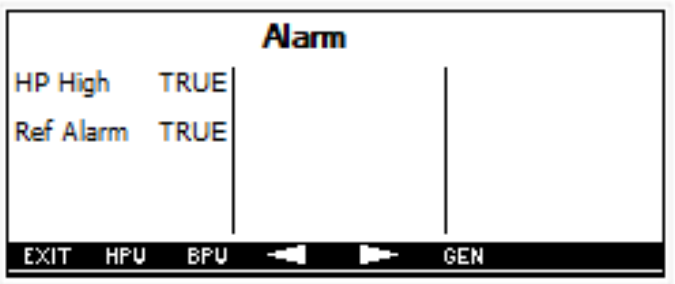
Alarms contains multiple screens that display whether each system alarm is active.



Alarms Screen

Use the left and right arrows to switch between screens. Select **EXIT** to return to the Status menu (*"Status Menu"*).

Additional **Alarms** screen:



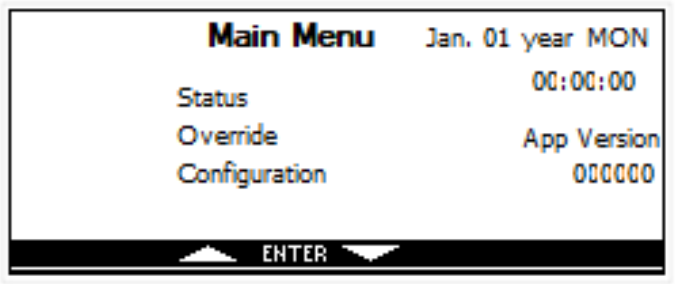
Additional Alarms Screen

9.3 Configuration Screens

System parameters are set up in the **Configuration** screens. System parameters can include setpoints, alarm limits, valve setup, and sensor configuration.

9.3.1 How To Access Configuration Screens

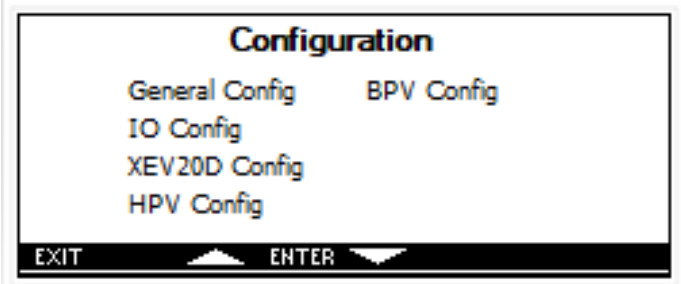
Access the list of available **Configuration** screens from the **Main Menu**:



Main Menu with Configuration Selected

Highlight ***Configuration*** using the up and down arrows and select **ENTER**.

The **Configuration Menu** opens:



Configuration Menu

From this menu, any of the following screens can be accessed: **General Configuration, IO Configuration, XEV20D Configuration, HPV Configuration, BGV Configuration**, and **Heat R Configuration**.

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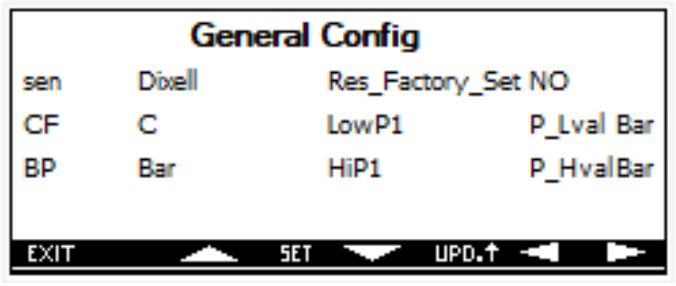
9.3.2 General Configuration Screens

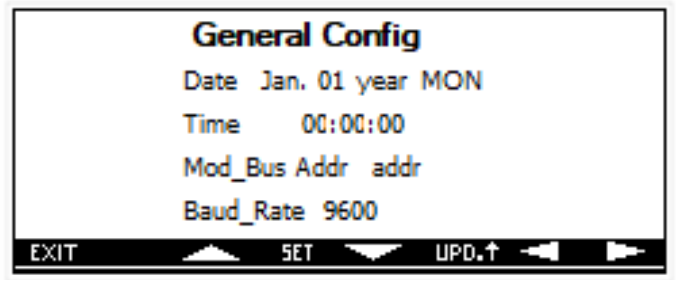
General Configuration screens contain parameters to control display units, time and date, and MODBUS settings.



General Configuration Screen

1. Use the left and right arrows to switch between screens. Use the up and down arrows to highlight the desired parameter to change.
2. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
3. Use the up and down arrows to modify the value.
4. Select **SET** again to save.
5. Select UPD (Update) to install the new screens onthe Visograph.
6. Select **EXIT** to return to the **Configuration** menu (*"Configuration Menu"*).

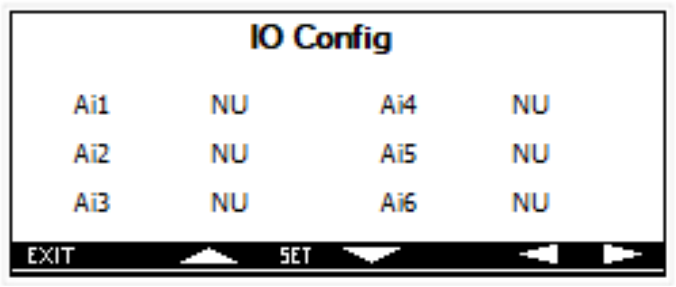
Additional **General Configuration** screens:



Additional General Configuration Screen

9.3.3 IO Configuration Screens

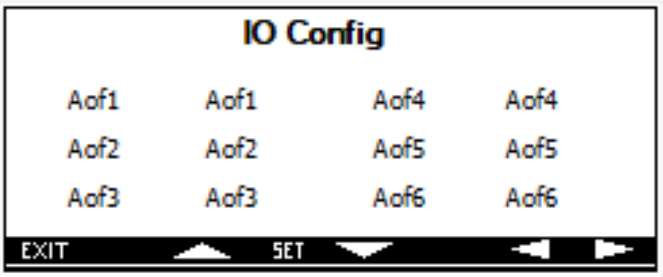
IO Configuration screens contain parameters to control physical input and output settings.



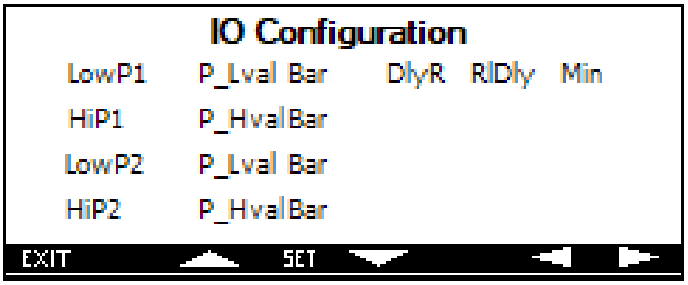
IO Configuration Screen

1. Use the left and right arrows to switch between screens. Use the up and down arrows to highlight the desired parameter to change.
2. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
3. Use the up and down arrows to modify the value.
4. Select **SET** again to save.
5. Select **EXIT** to return to the **Configuration** menu (*"Configuration Menu"*).

Additional **IO Configuration** screens:

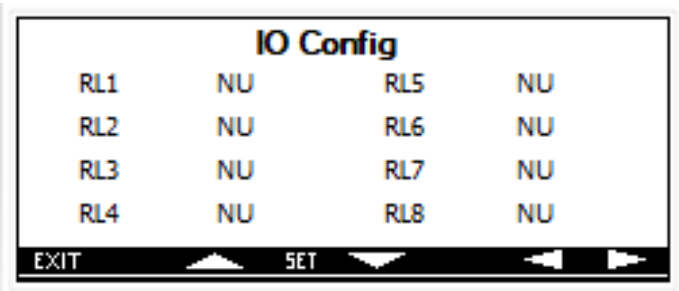


Additional IO Configuration Screen

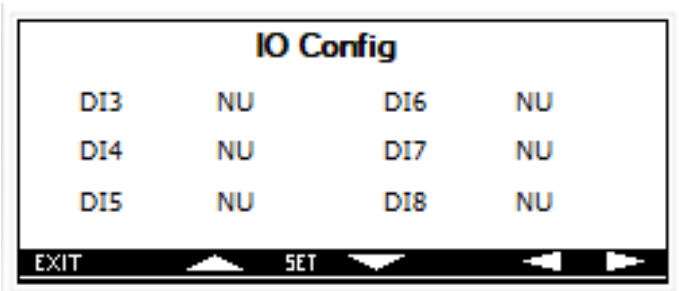


Additional IO Configuration Screen

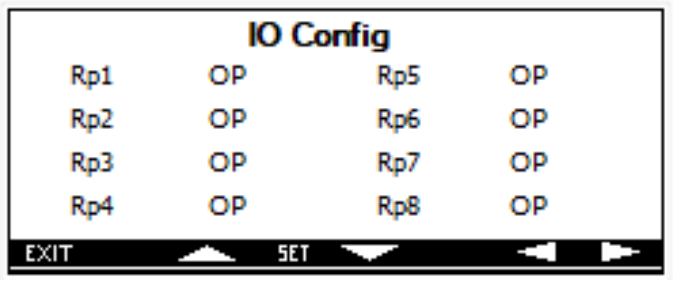
 ©2024 Copeland LP.



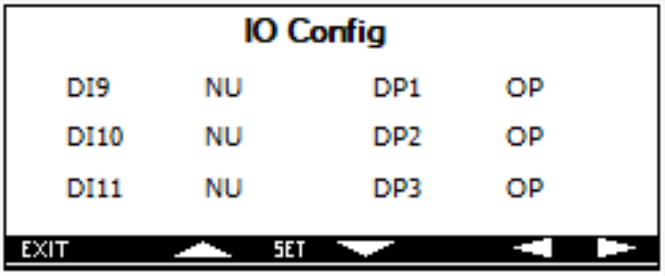
Additional IO Configuration Screen



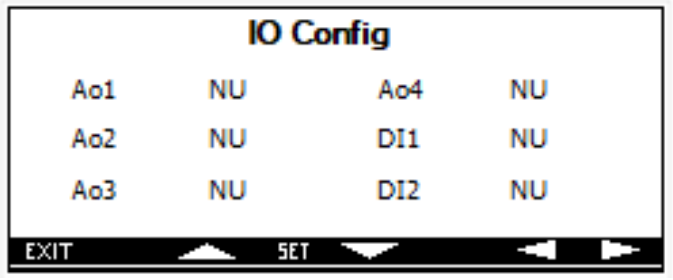
Additional IO Configuration Screen



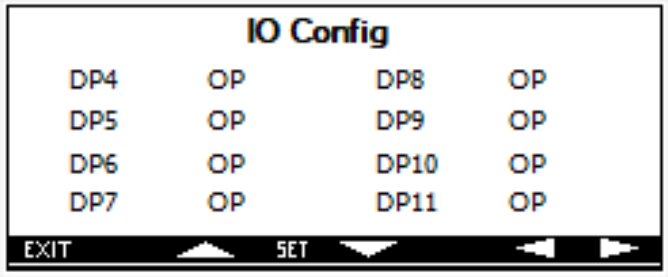
Additional IO Configuration Screen



Additional IO Configuration Screen



Additional IO Configuration Screen



Additional IO Configuration Screen

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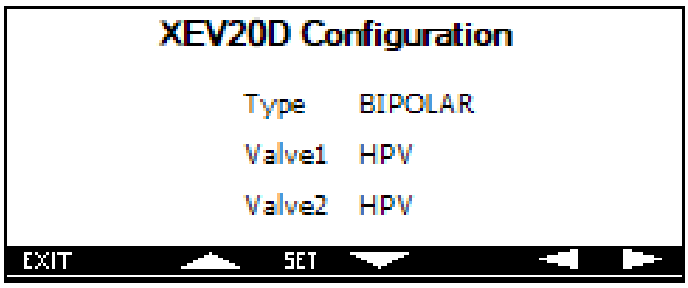
9.3.4 XEV20D Configuration Screens

NOTICE

A reboot is required when valve configuration settings are changed.

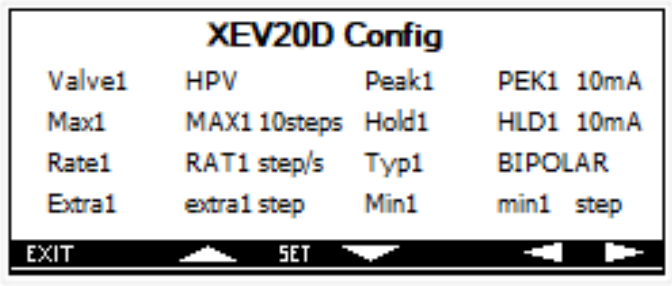
XEV20D Configuration screens contain parameters to set up the XEV20D valve driver.



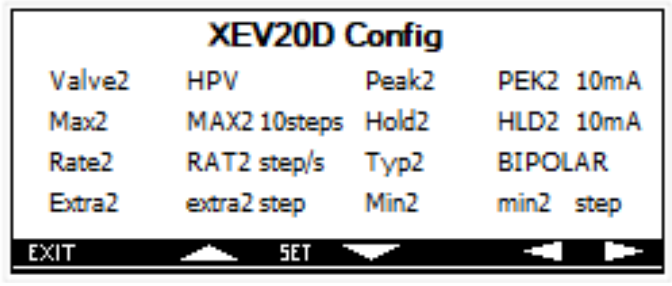
XEV20 Configuration Screen

1. Use the left and right arrows to switch between screens. Use the up and down arrows to highlight the desired parameter to change.
2. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
3. Use the up and down arrows to modify the value.
4. Select **SET** again to save.
5. Select **EXIT** to return to the **Configuration** menu (*"Configuration Menu"*).

Additional **XEV20D Configuration** screens:



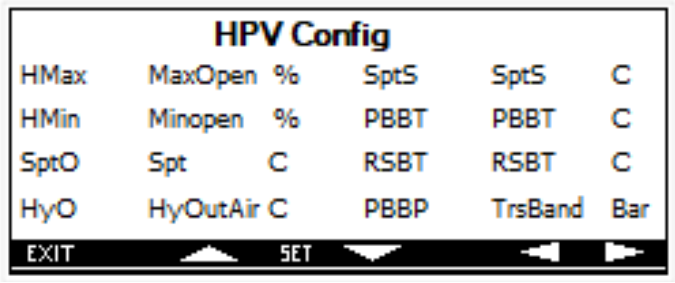
XEV20 Configuration Screen - Valve 1



XEV20 Configuration Screen - Valve 2

9.3.5 HPV Configuration Screens

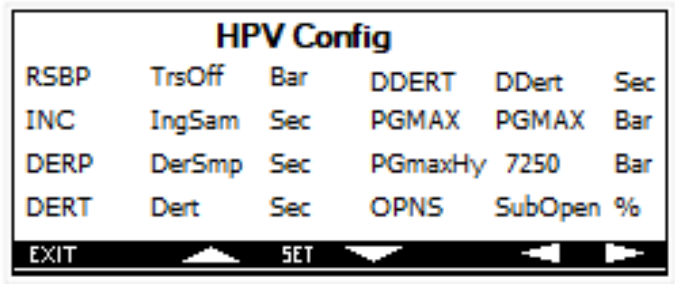
HPV Configuration screens contain parameters that control the HPV. Available parameters include setpoints, PID values, calibration settings, and safety limits.



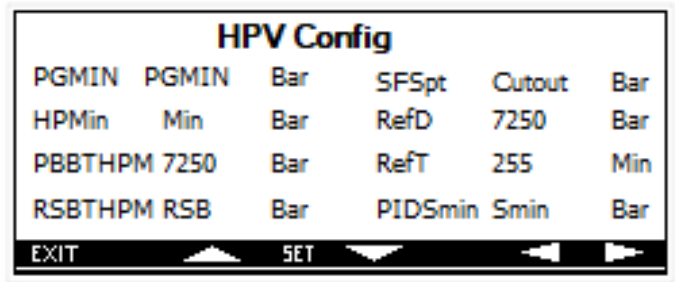
HPV Configuration Screen

1. Use the left and right arrows to switch between screens. Use the up and down arrows to highlight the desired parameter to change.
2. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
3. Use the up and down arrows to modify the value.
4. Select **SET** again to save.
5. Select **EXIT** to return to the **Configuration** menu (*"Configuration Menu"*).

Additional **HPV Configuration** screens:



Additional HPV Configuration Screen



Additional HPV Configuration Screen

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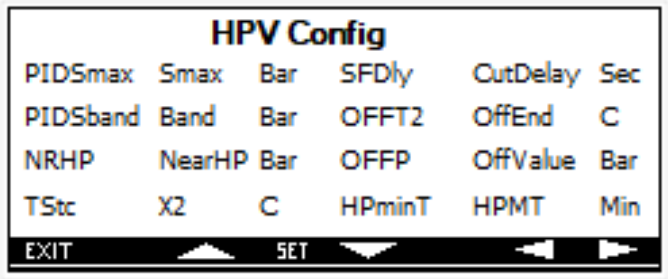
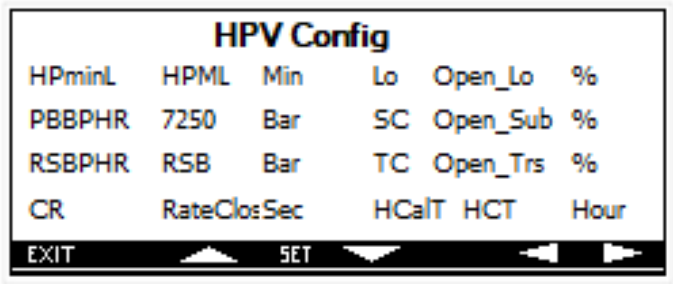
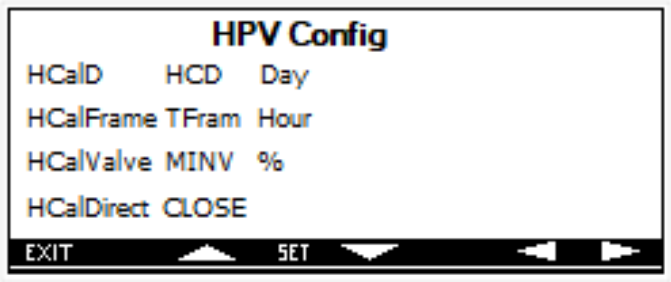


Additional HPV Configuration Screen



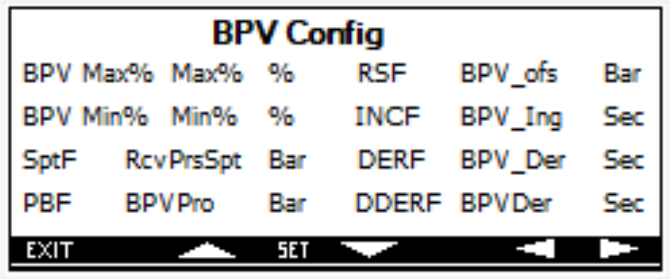
Additional HPV Configuration Screen



Additional HPV Configuration Screen

9.3.6 BGV Configuration Screens

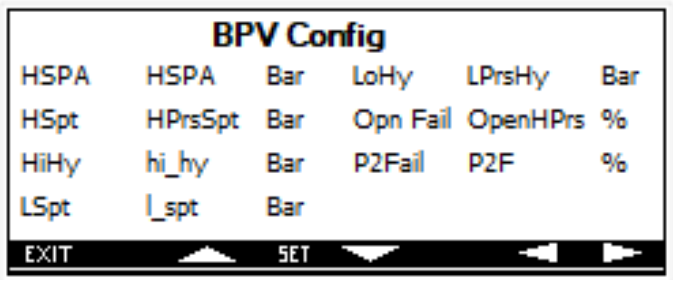
BGV Configuration screens contain parameters that control the BGV. Available parameters include setpoints, PID values, calibration settings, and safety limits.



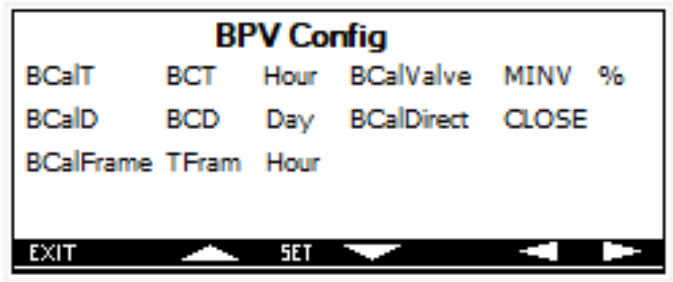
BGV Configuration Screen

1. Use the left and right arrows to switch between screens. Use the up and down arrows to highlight the desired parameter to change.
2. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
3. Use the up and down arrows to modify the value.
4. Select **SET** again to save.
5. Select **EXIT** to return to the **Configuration** menu (*"Configuration Menu"*).

Additional **BGV Configuration** screens:



Additional BGV Configuration Screen



Additional BGV Configuration Screen

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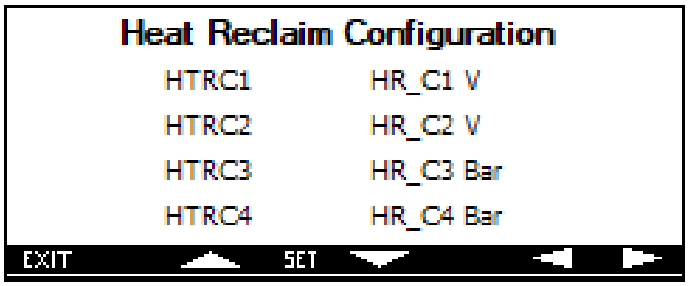
9.3.7 Heat Reclaim Configuration Screens

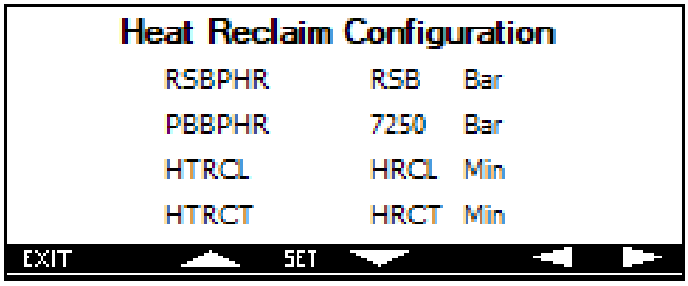
Heat Reclaim Configuration screens contain parameters that control when the system enters and exits heat reclaim.



Heat Reclaim Configuration

1. Use the left and right arrows to switch between screens. Use the up and down arrows to highlight the desired parameter to change.
2. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
3. Use the up and down arrows to modify the value.
4. Select **SET** again to save.
5. Select **EXIT** to return to the **Configuration** menu (*"Configuration Menu"*).

Additional **Heat Reclaim Configuration** screen:



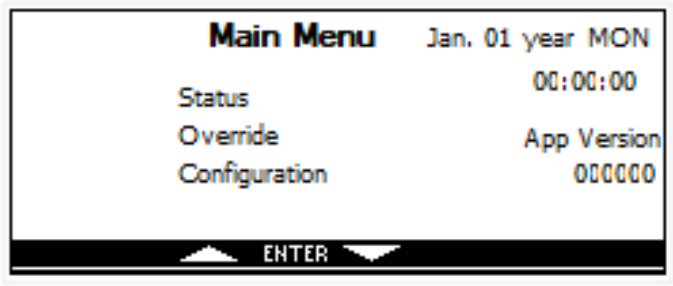
Additional Heat Reclaim Configuration

9.4 Override Screens

Override screens are used to force the valve position and bypass control logic. Each valve can be overridden individually.

9.4.1 How To Access Override Screens

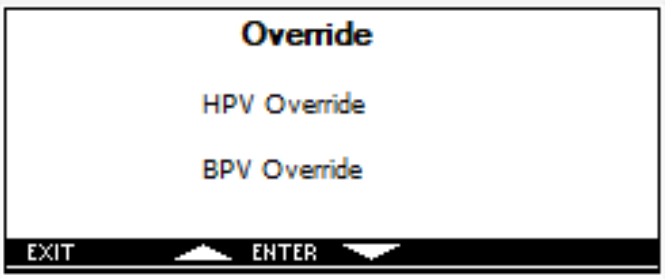
Access the list of available **Override** screens from the Main Menu:



Main Menu with Status Selected

Highlight Override using the up and down arrows and select **ENTER**.

The **Override** menu opens:



Override Menu

From this menu, any of the following screens can be accessed: **HPV Override** and **BGV Override**.

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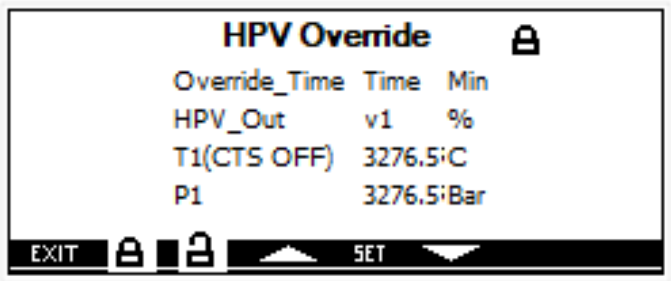
9.4.2 HPV Override Screen

The **HPV Override** screen displays information including temperature, pressure, and valve positioning.

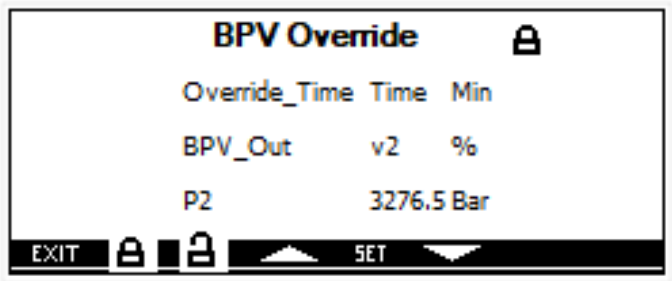


HPV Override

1. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
2. Use the up and down arrows to modify the value.
3. Select **SET** again to save.
4. Select the lock to enable the override. Select unlock to disable the override.
5. Select **EXIT** to return to the **Override** menu (*"Override Menu"*).

9.4.3 BGV Override Screen

BGV Override screen displays information including pressure and valve positioning.



BGV Override

1. Select **SET** to activate the highlighted parameter (the parameter will flash when it can be modified).
2. Use the up and down arrows to modify the value.
3. Select **SET** again to save.
4. Select the lock to enable the override. Select unlock to disable the override.
5. Select **EXIT** to return to the **Override** menu (*"Override Menu"*).

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10. High Pressure CO_2 Parameters

Table 46: High Pressure CO_2 Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default	Range	Unit
HPV Mode Stpt	SptO	HPV Setpoint to switch between Subcritical and Transcritical	87	79 to 90	F
HPV Mode Hyst	Hyo	HPV Hysteresis when switching between Subcritical and Transcritical	4	0 to 36	F
HPV Subcl Stpt	SptS	HPV Subcritical Setpoint	5	0 to 180	F
HPV RS-Temp	RSBT	HPV Subcritical PID Band Offset	0	-148 to 148	F
HPV PB-Temp	PBBT	HPV Subcritical Proportional Band	100	0 to 180	F
HPV DERT	DERT	HPV Subcritical PID Derivative Sampling Time	0	0 to 1000	Sec
HPV DDERT	DDERT	HPV Subcritical PID Derivative Time	0	0 to 1000	Sec
HPV RS-Press	RSBP	HPV Transcritical PID Band Offset	0	-200 to 200	PSI
HPV PB-Press	PBBP	HPV Transcritical PID Proportional Band	200	0 to 1000	PSI
HPV INC	INC	HPV Subcritical PID Integral Sampling Time	240	0 to 1000	Sec
HPV DERP	DERP	HPV Transcritical PID Derivative Sampling Time	0	0 to 1000	Sec
PIDSMin	PIDSmin	HPV Minimum PID Step	1	1 to 1000	%
PIDSMax	PIDSmax	HPV Maximum PID Step	10	1 to 1000	%
PIDSBand	PIDSband	HPV PID Step Band	30	0 to 500	PSI
HPV Max %	HMax	HPV Maximum Valve Percent	100	0 to 100	%
HPV Min %	HMin	HPV Minimum Valve Percent	0	0 to 500	%
PGMax	PGMAX	HPV Maximum Pressure in Gas Cooler	1450	0 to 2000	PSI
PGMaxHy	PGmaxHy	HPV Hysteresis for Maximum Gas Cooler Pressure Alarm	50	0 to 1000	PSI
SF Setpoint	SFSpt	HPV High Pressure Safety Setpoint	1500	0 to 2000	PSI
SF Delay	SFDly	HPV High Pressure Safety Exit Delay	0	0 to 255	Sec
PGMin	PGMin	Minimum Gas Cooler Setpoint	1035	1000 to 2000	PSI
OPNS	OPNS	HPV Valve Position during Subcritical (-1for PID control)	-1	-1 to 100	%
NRHP	NRHP	HPV Pressure Value near High Pressure Cut Out	1400	0 to 2000	PSI
BGV SETPOINT	SptF	BGV Setpoint	510	0 to 2000	PSI
BGV PB	PBF	BGV PID Proportional Band	100	0 to 1000	PSI
BGV RS	RSF	BGV PID Band Offset	0	-200 to 200	PSI
BGV INC	INCF	BGV PID Integral Sampling Time	180	0 to 1000	Sec
BGV DER	DERF	BGV PID Derivative Sampling Time	0	0 to 1000	Sec

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Table 46: High Pressure CO_2 Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default	Range	Unit
BGV DDER	DDERF	BGV PID Derivative Time	0	0 to 1000	Sec
BGV Max Open	BPV Max%	BGV Maximum Valve Percent	100	0 to 100	%
BGV Min Open	BPV Min%	BGV Minimum Valve Percent	0	0 to 100	%
Hi Press Stpt	HSpt	High Pressure Setpoint	620	0 to 2000	PSI
HSPA	HSPA	High Pressure Pre-Alarm Setpoint	575	0 to 2000	PSI
Hi Press Hyst	HiHy	High Pressure Hysteresis	25	0 to 500	PSI
Low Press Stpt	LSpt	Low Pressure Setpoint	450	0 to 2000	PSI
Low Press Hyst	LoHy	Low Pressure Hysteresis	25	0 to 200	PSI
HPV Close Rate	CR	HPV Close Rate during Safety	30	0 to 600	Sec
HPV% OpFail- SC	SC	HPV Percent during Subcritical with T1/P1Sensor Failure	25	0 to 100	%
HPV% OpFail- TC	TC	HPV Percent during Transcritical with T1/P1Sensor Failure	25	0 to 100	%
HPV% OpFail- Lo	Lo	HPV Percent during Low Pressure Safety	25	0 to 100	%
BGV% Open Fail	Opn Fail	BGV Percent during High Pressure Safety	80	0 to 100	%
BGV% P2Fail	P2Fail	BGV Percent with P2 Sensor Failure	35	0 to 100	%
RefD	RefD	Pressure Differential for Ref Alarm	217	0 to 500	PSI
RefT	RefT	Time Delay for Ref Alarm	2 (P15V)	0 to 255	Min
AI 1Config	AI1	Analog Input 1Configuration	1 (T1)	--------	--------
AI 2 Config	AI2	Analog Input 2 Configuration	2 (P15V)	--------	--------
AI 3 Config	AI3	Analog Input 3 Configuration	4 (P25V)	--------	--------
AI 4 Config	AI4	Analog Input 4 Configuration	0	--------	--------
AI 5 Config	AI5	Analog Input 5 Configuration	0	--------	--------
AI 6 Config	AI6	Analog Input 6 Configuration	0	--------	--------
AI 1Offset	Aof1	Analog Input 1 Offset	0	-100 to 100	--------
AI 2 Offset	Aof2	Analog Input 2 Offset	0	-100 to 100	--------
AI 3 Offset	Aof3	Analog Input 3 Offset	0	-100 to 100	--------
AI 4 Offset	Aof4	Analog Input 4 Offset	0	-100 to 100	--------
AI 5 Offset	Aof5	Analog Input 5 Offset	0	-100 to 100	--------
AI 6 Offset	Aof6	Analog Input 6 Offset	0	-100 to 100	--------
P1Xducer Low	LowP1	P1Low Value	0	-15 to 2000	PSI
P1Xducer High	HiP1	P1High Value	2000	0 to 2000	PSI
P2 Xducer Low	LowP2	P2 Low Value	0	-15 to 2000	PSI
P2 Xducer High	HiP2	P2 High Value	2000	0 to 2000	PSI
RL 1Config	RL1	Relay 1 Configuration	1 (Gen alarm)	--------	--------

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Table 46: High Pressure CO_2 Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default	Range	Unit
RL 2 Config	RL2	Relay 2 Configuration	2 (LP)	--------	--------
RL 3 Config	RL3	Relay 3 Configuration	3 (HP)	--------	--------
RL 4 Config	RL4	Relay 4 Configuration	4 (Enable)	--------	--------
RL 5 Config	RL5	Relay 5 Configuration	0	--------	--------
RL 6 Config	RL6	Relay 6 Configuration	0	--------	--------
RL 7 Config	RL7	Relay 7 Configuration	0	--------	--------
RL 8 Config	RL8	Relay 8 Configuration	0	--------	--------
RL 1Polarity	Rp1	Relay 1Polarity	0	--------	--------
RL 2 Polarity	Rp2	Relay 2 Polarity	0	--------	--------
RL 3 Polarity	Rp3	Relay 3 Polarity	0	--------	--------
RL 4 Polarity	Rp4	Relay 4 Polarity	0	--------	--------
RL 5 Polarity	Rp5	Relay 5 Polarity	0	--------	--------
RL 6 Polarity	Rp6	Relay 6 Polarity	0	--------	--------
RL 7 Polarity	Rp7	Relay 7 Polarity	0	--------	--------
RL 8 Polarity	Rp8	Relay 8 Polarity	0	--------	--------
Delay of Relay	DlyR	Relay Delay	0	0 to 30	Min
AO 1 Config	Ao1	Analog Output 1 Configuration	1 (HPV)	--------	--------
AO 2 Config	Ao2	Analog Output 2 Configuration	2 (BPV)	--------	--------
AO 3 Config	Ao3	Analog Output 3 Configuration	0	--------	--------
AO 4 Config	Ao4	Analog Output 4 Configuration	0	--------	--------
Sensor Type	Sen	Sensors Type	1 (CPC)	--------	--------
--------	CF	Visograph Display Unit of Measure for Temperature	--------	--------	--------
--------	BP	Visograph Display Unit of Measure for Pressure	--------	--------	--------
--------	Baud_Rate	Modbus Baud Rate	--------	--------	--------
--------	Mod_Bus_Addr	Modbus Address	--------	--------	--------
HPV Override	Button 2/Button 3	HPV Override Enable	0	--------	--------
HPV OvrdTime	Override_Time	HPV Override Duration	1	0 to 30	Min
BGV Override	Button 2/Button 3	BGV Override Enable	0	--------	--------
BGV OvrdTime	Override_Time	BGV Override Duration	1	0 to 30	Min
Valves Type	Type1	Valve Type	2	--------	--------
Val 1 Max Steps	Max1	Valve 1 Maximum Steps (x10)	0	0 to 800	10Steps
Val 1 Step Rate	Rate1	Valve 1 Steps per Second	10	10 to 600	Steps/ Sec
Val 1 Peak Cur	Peak1	Valve 1 Peak Current (x10)	0	0 to 100	mA

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Table 46: High Pressure CO_2 Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default	Range	Unit
Val 1 Hold Cur	Hold1	Valve 1 Holding Current (x10)	0	0 to 100	mA
Valve 2 XEV20D	Valve1	Valve 1 Selection - V1 (HPV) or V2 (BGV)	0	--------	--------
Val 1 Overclose	Extra1	Valve 1 Extra Steps	1	1 to 500	Steps
Val 1 Min Steps	Min1	Valve 1 Minimum Step	0	0 to 500	Steps
Val 2 Max Steps	Max2	Valve 2 Maximum Steps (x10)	0	0 to 800	10Steps
Val 2 Step Rate	Rate2	Valve 2 Steps per Second	10	10 to 600	Steps/ Sec
Val 2 Peak Cur	Peak2	Valve 2 Peak Current (x10)	0	0 to 100	10A
Val 2 Hold Cur	Hold2	Valve 2 Holding Current (x10)	0	0 to 100	10A
Valve 2 XEV20D	Valve2	Valve 2 Selection - V1 (HPV) or V2 (BGV)	V2	--------	--------
Val 2 Overclose	Extra2	Valve 2 Extra Steps	0	0 to 500	Steps
Val 2 Min Steps	Min2	Valve 2 Minimum Step	10	0 to 500	--------
DI 1 Config	DI1	Digital Input 1 Configuration	0	--------	--------
DI 2 Config	DI2	Digital Input 2 Configuration	2 (Enable)	--------	--------
DI 3 Config	DI3	Digital Input 3 Configuration	0	--------	--------
DI 4 Config	DI4	Digital Input 4 Configuration	0	--------	--------
DI 5 Config	DI5	Digital Input 5 Configuration	0	--------	--------
DI 6 Config	DI6	Digital Input 6 Configuration	0	--------	--------
DI 7 Config	DI7	Digital Input 7 Configuration	0	--------	--------
DI 8 Config	DI8	Digital Input 8 Configuration	0	--------	--------
DI 9 Config	DI9	Digital Input 9 Configuration	0	--------	--------
DI 10 Config	DI10	Digital Input 10 Configuration	0	--------	--------
DI 11 Config	DI11	Digital Input 11 Configuration	0	--------	--------
DI 1 Polarity	DP1	Digital Input 1 Polarity	0	--------	--------
DI 2 Polarity	DP2	Digital Input 2 Polarity	1 (CL)	--------	--------
DI 3 Polarity	DP3	Digital Input 3 Polarity	0	--------	--------
DI 4 Polarity	DP4	Digital Input 4 Polarity	0	--------	--------
DI 5 Polarity	DP5	Digital Input 5 Polarity	0	--------	--------
DI 6 Polarity	DP6	Digital Input 6 Polarity	0	--------	--------
DI 7 Polarity	DP7	Digital Input 7 Polarity	0	--------	--------
DI 8 Polarity	DP8	Digital Input 8 Polarity	0	--------	--------
DI 9 Polarity	DP9	Digital Input 9 Polarity	0	--------	--------
DI 10 Polarity	DP10	Digital Input 10 Polarity	0	--------	--------
DI 11 Polarity	DP11	Digital Input 11 Polarity	0	--------	--------
HPV Cal Time	HCalT	Hour to initiate HPV Calibration (0 to disable)	0	0 to 23	--------

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Table 46: High Pressure CO_2 Parameters

Supervisory Controller Parameter	Visograph Parameter	Description	Default	Range	Unit
HPV Cal Day	HCalD	Day interval for HPV Calibration (0 to disable)	0	0 to 7	--------
BGV Cal Time	BCalT	Hour to initiate BGV Calibration (0 to disable)	0	0 to 23	--------
BGV Cal Day	BCalD	Day interval for BGV Calibration (0 to disable)	0	0 to 7	--------
HPV Cal T Frame	HCalFrame	Time Frame before forcing HPV Calibration	0	0 to 12	--------
HPV Cal Val Min	HCalValve	HPV Target Percent before initiating Calibration	0	0 to 100	--------
HPV Cal Direct	HCalDirect	HPV Calibration Direction	0	--------	--------
BGV Cal T Frame	BCalFrame	Time Frame before forcing BGV Calibration	0	0 to 12	--------
BGV Cal Val Min	BCalValve	BGV Target Percent before initiating Calibration	0	0 to 100	--------
BGV Cal Direct	BCalDirect	BGV Calibration Direction	0	--------	PSI
HPMin	HPMin	Gas Cooler Minimum Pressure	638	0 to 1000	PSI
HPMinT	HPMinT	Delay before reacting to Gas Cooler Minimum Pressure	5	0 to 30	V
HPMinL	HPMinL	Delay before exiting Gas Cooler Minimum Pressure	5	0 to 30	V
RSBTHPM	RSBTHPM	HPV Subcritical PID Band Offset during Gas Cooler Minimum Pressure	0	-1000 to 1000	PSI
PBBTHPM	PBBTHPM	HPV Subcritical PID Proportional Band during Gas Cooler Minimum Pressure	200	0 to 655	PSI
HTRC1	HTRC1	H-R Signal Input Starting point for Heat Reclaim	2	0 to 10	V
HTRC2	HTRC2	H-R Signal Input Ending point for Heat Reclaim	8	0 to 10	V
HTRC3	HTRC3	Pressure Setpoint at Starting point for Heat Reclaim	800	725 to 950	PSI
HTRC4	HTRC4	Pressure Setpoint at Ending Point for Heat Reclaim	950	725 to 950	PSI
HTRCT	HTRCT	Delay before entering Heat Reclaim	0	0 to 30	Min
HTRCL	HTRCL	Delay before exiting Heat Reclaim	5	0 to 30	Min
RSBPHR	RSBPHR	HPV Subcritical PID Band Offset during Heat Reclaim	0	-1000 to 1000	PSI
PBBPHR	PBBPHR	HPV Subcritical PID Proportional Band during Heat Reclaim	200	0 to 2000	PSI

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10.1 Dynamic Parameter Limits

Some parameters have a dynamic range (the min or max can change depending on the value of another parameter). If the **Minimum/Maximum Dynamic Limit** contains a name, the range can be limited by the specified parameter's value. Using **PIDSMin** as an example, because **PIDSMax** is the **Maximum Dynamic Limit**, the value of **PIDSMin** cannot be set above the value of **PIDSMax**.

Table 47: Dynamic Parameter Ranges

Supervisory Controller Parameter	Visograph Parameter	Range	Minimum Dynamic Limit	Maximum Dynamic Limit
PIDSMin	PIDSmin	1 to 100	----------	PIDSMax
PIDSMax	PIDSmax	1 to 100	PIDSMin	----------
HPV Max %	HMax	0 to 100	HPV Min %	----------
HPV Min %	HMin	0 to 100	----------	HPV Max %
Hi Press Stpt	HSpt	0 to 2000	HSPA+1	----------
HSPA	HSPA	0 to 2000	Low Press Stpt	Hi Press Stpt-1
Low Press Stpt	LSpt	0 to 2000	----------	HSPA
P1 Xducer Low	LowP1	-15 to 2000	----------	P1 Xducer High
P1 Xducer High	HiP1	0 to 2000	P1 Xducer Low	----------
P2 Xducer Low	LowP2	-15 to 2000	----------	P2 Xducer High
P2 Xducer High	HiP2	0 to 2000	P2 Xducer Low	----------
HTRC1	HTRC1	0 to 10	----------	HTRC2
HTRC2	HTRC2	0 to 10	HTRC1	----------
HTRC3	HTRC3	725 to 950	HPMin	----------
HTRC4	HTRC4	725 to 950	HTRC3	----------

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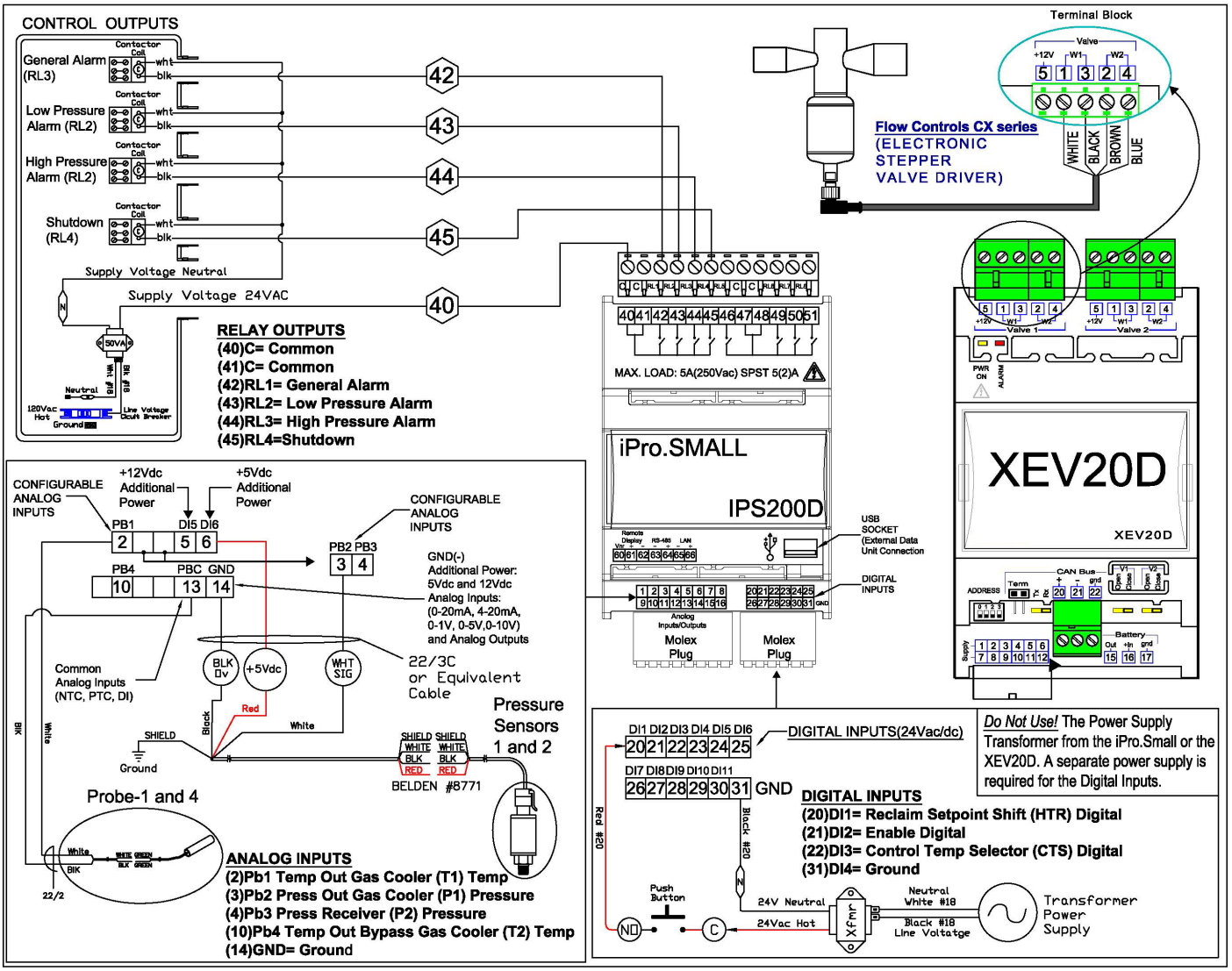
11. XEV20D Setup and Network Connection

The XEV20D is a stepper valve driver that can drive a bipolar stepper valve or unipolar stepper valve. It is a dummy voltage chopper constant current driver that will be controlled by the High Pressure CO_2 controller through a LAN communication network. It can control the High Pressure Valve function and/or the Bypass Gas Valve function. For controlling the valve, the user has the option to use this driver or use the 0-10 voltage output from the High Pressure CO_2 controller to another driver. If XEV20D driver is preferred, **please check the valve manufacturer's technical specifications** for the current ratings and verify if the XEV20D can drive the valve. **The XEV20D address MUST be set to 1 to communicate with the High Pressure CO_2 controller.**

⚠ CAUTION GND is Common (-), not earth ground. **Do not earth ground this device**.



High Pressure CO_2 Device Wiring and Network Connection

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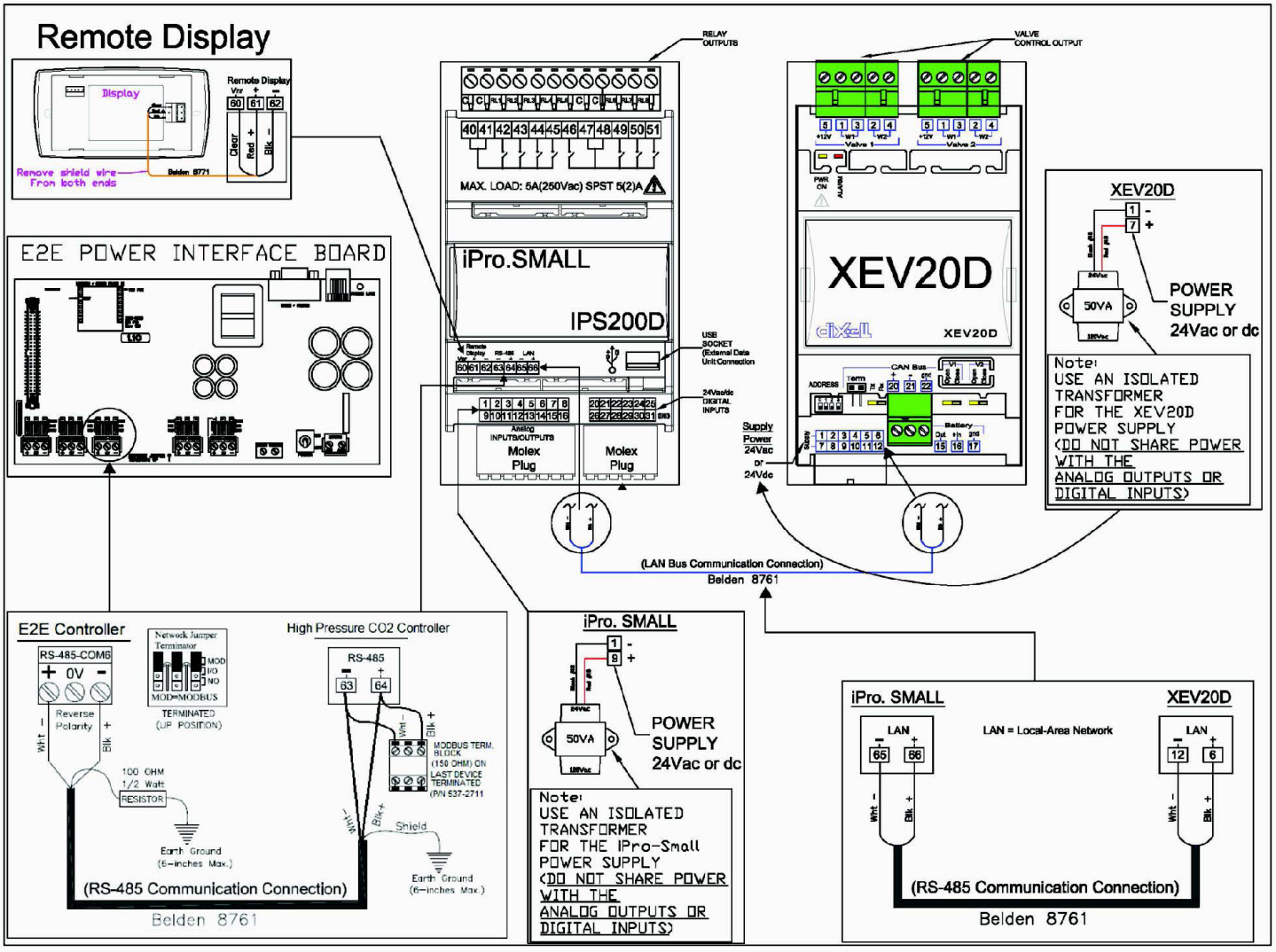

High Pressure CO_2 Device Wiring and Network Connection

Below are some settings for most used valves, please ensure you compare these with the latest available documentation from the valve manufacturer to ensure no changes were made to specifications.

Table 48: Valve Parameter Settings

Parameter	Parameter Description	Danfoss CCMT2-4	Danfoss CCMT8	Danfoss CCMT16
Valve x Type	Valve Types	BIPOLAR	BIPOLAR	BIPOLAR
Val x Max Steps	Max Steps	110	110	80
Val x Min Steps	Min Steps	0	0	0
Val x Overclose	Overclose/Extra Steps	50	110	80
Val x Step Rate	Step Rate	200-300	200-300	200-300
Val x Peak Cur	Peak/Phase Current	10	10	30
Val x Hold Cur	Holding Current	10	8	0

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Parameter	Parameter Description	Danfoss CCMT24	Danfoss CCMT30	Danfoss CCMT42
Valve x Type	Valve Types	BIPOLAR	BIPOLAR	BIPOLAR
Val x Max Steps	Max Steps	140	230	220
Val x Min Steps	Min Steps	0	0	0
Val x Overclose	Overclose/Extra Steps	80	100	100
Val x Step Rate	Step Rate	200-300	200	200
Val x Peak Cur	Peak/Phase Current	30	30	30
Val x Hold Cur	Holding Current	0	0	0

Parameter	Parameter Description	Danfoss CCM10	Danfoss CCM20-30	Danfoss CCM40
Valve x Type	Valve Types	BIPOLAR	BIPOLAR	BIPOLAR
Val x Max Steps	Max Steps	262	262	353
Val x Min Steps	Min Steps	0	0	0
Val x Overclose	Overclose/Extra Steps	100	100	100
Val x Step Rate	Step Rate	200	300	200
Val x Peak Cur	Peak/Phase Current	10	10	10
Val x Hold Cur	Holding Current	8	8	8

Parameter	Parameter Description	Sporlan GC and FGB	Copeland CV4	Copeland CV5
Valve x Type	Valve Types	BIPOLAR	BIPOLAR	BIPOLAR
Val x Max Steps	Max Steps	250	75	75
Val x Min Steps	Min Steps	0	0	0
Val x Overclose	Overclose/Extra Steps	250	15	15
Val x Step Rate	Step Rate	400	500	500
Val x Peak Cur	Peak/Phase Current	27	63	80
Val x Hold Cur	Holding Current	0	10	30

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12. Stepper Valve Actuator Quick Reference Guide XEV20D

12.1 General Warnings

Please read the following safety precautions and warnings before using the instructions in this section:

⚠CAUTION

- This section should be kept near the controller for easy and quick reference.
- The controller should not be used for purposes different from those described in this manual. It cannot be used as a safety device.
- Check the application limits before proceeding.

⚠WARNING

SAFETY PRECAUTIONS AND WARNINGS!

- Check that the supply voltage is correct before connecting the controller.
- Do not expose to water or moisture: use the con- troller only within the operating limits and avoid sud- den temperature changes with high atmospheric humidity to prevent condensation from forming.
- Disconnect all electrical connections before performing any kind of maintenance.
- Fit the probe where it is not accessible by the end user. The controller must not be opened.
- In case of failure or faulty operation, send the controller back to the distributor with a detailed description of the fault.
- Verify the maximum current that can be applied to each relay (see Section *"12.8 XEV20D Technical Specifications"*).
- Ensure that the wires for probes, loads, and the power supply are separated and far enough from each other, without crossing or intertwining.
- In case of applications in industrial environments, the use of main filters (mod. FT1) in parallel with inductive loads could be useful.

12.2 General Description

XEV20D is a stepper valve actuator intended for bipolar stepper valves or unipolar stepper valves. The XEV20D is equipped with:

- Two configurable valve outputs to drive bipolar or unipolar valves.
- Pb1/Pb2 configurable analog inputs: NTC/PTC/Pt1000/CPC
- Pb3/Pb4 configurable analog inputs: 4 to 20mA/0 to 5V/Pt1000
- CAN Bus serial line
- LAN to communicate with instrument of the same series.

12.3 Absolute Maximum Power

XEV20D can drive a wide range of stepper valves. Indicated in the following table are the maximum values of current that the actuator can supply to the stepper wiring. Select the correct transformer depending on the application seeing the following table, for each kind of driving and functioning is reported to the transformer to use.

***NOTE**: The electrical power absorption of the valve can be unrelated to refrigeration power of the valve. Before using the actuator, read the technical manual of the valve supplied by the manufacturer and check the maximum current used to drive the valve to verify that they are lower than those indicated below.*

		CONFIGURATION	
		ONE VALVE	TWO VALVES
	DRIVING MODE	Full step	Full step
VALVE TYPE	BIPOLAR VALVES (4 wires)	Current 0.9A max Æ TF20D	Current 0.9A max for each valve Æ TF40D
	UNIPOLAR VALVES (5-6 wires)	Current 0.33A max Æ TF20D	Current 0.33A max for each valve Æ TF20D

Valve Max Power

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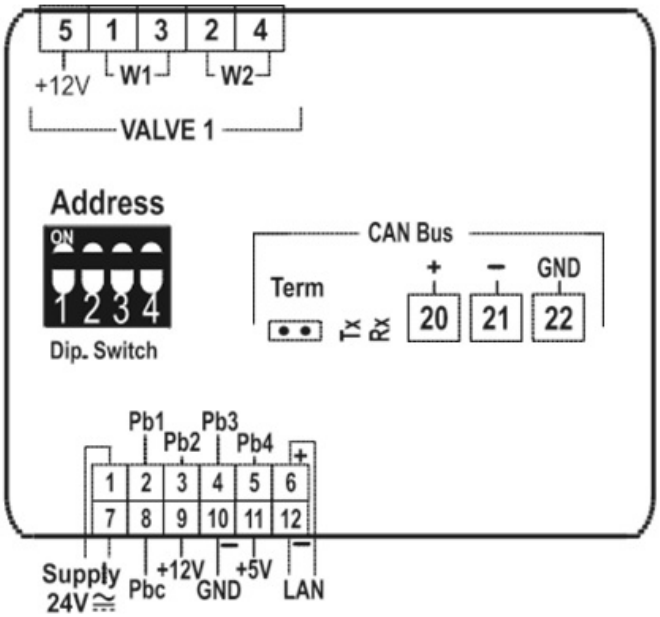
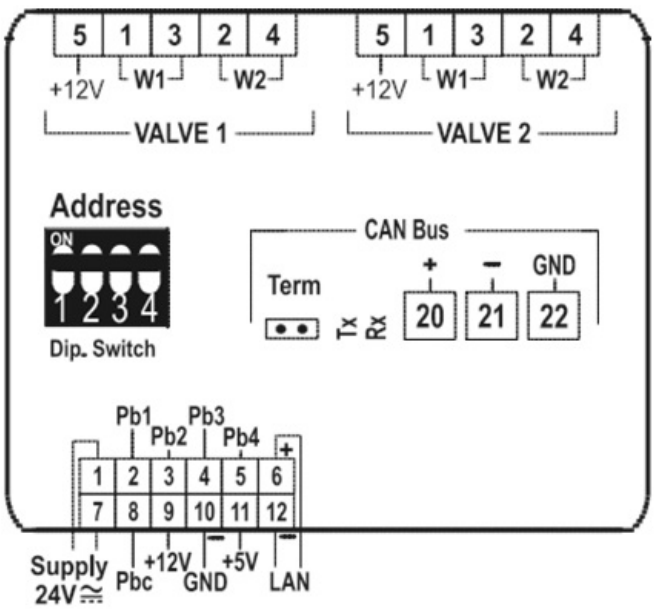
12.4 Wiring Diagrams

12.4.1 One Valve Configuration



One Valve Configuration

12.4.2 Two Valve Configuration



Two Valve Configuration

12.5 Valve Connections

The following table is a quick reference on the connection mode for valves of different manufacturers:

Pay attention to the terminal numbers associated with each wire, if connected incorrectly the valve may turn in reverse/not turn at all, or it could damage the valve and/or valve driver.

Danfoss CCMT & CCM	Carel E2V for CO_2	Copeland CV4-7	Sporlan GC and FGB
W1, pin1 = White	W1, pin1 = Green	W1, pin1 = White	W1, pin1 = White
W1, pin3 = Black	W1, pin3 = Brown	W1, pin3 = Black	W1, pin3 = Black
W2, pin2 = Red	W2, pin2 = Yellow	W2, pin2 = Brown	W2, pin2 = Red
W2, pin4 = Green	W2, pin4 = White	W2, pin4 = Blue	W2, pin4 = Green

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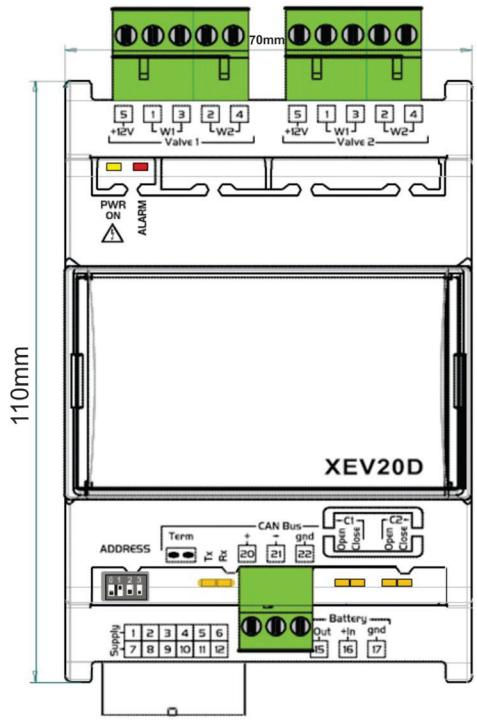
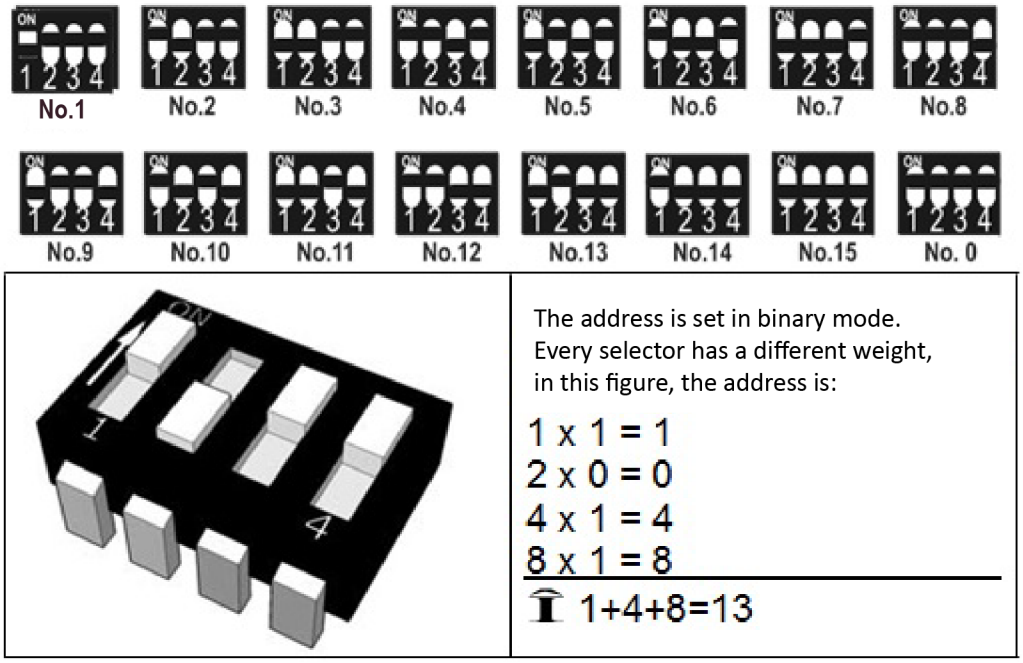


XEV20D

12.6 Serial Line - LAN Bus

The device can communicate through LAN Bus serial line only when the address is set correctly. The addressing is made through the dipswitch called Address as shown below. The XEV20D address will have to be set to 1 to communicate with the High Pressure CO_2 controller.



XEV20D

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12.7 LED Descriptions

The following table contains LED functions:

LED	MODE	MEANING
PWR ON	On	Tells that the model is powered correctly
ALARM	On	Tells that an alarm is present
TX/RX	Blinking	CAN Bus or LAN activity, communication actived
TX/RX	On	No link
OPEN V1	Blinking	Valve 1 is opening
OPEN V1	On	Valve 1 completely opened
CLOSE V1	Blinking	Valve 1 is closing
CLOSE V1	On	Valve 1 completely closed
OPEN V2	Blinking	Valve 2 is opening
OPEN V2	On	Valve 2 completely opened
CLOSE V2	Blinking	Valve 2 is closing
CLOSE V2	On	Valve 2 completely closed

LED Functions

12.8 XEV20D Technical Specifications

Table 49: XEV20D Technical Specifications

Case	4 DIN
Connectors	Disconnectable Terminal Block: 2.5 mm2 for valve outputs and minifit connector for low voltage section
Power Supply	24VAC/DC Absorption: 40VA max (**AC Transformer preferred**)
Probe Inputs	2 configurable as NTC/PTC/Pt1000 2 configurable as NTC/PTC/Pt1000/4 to 20mA/to 5V
Valve Outputs	Refer to the "*Valve Max Power*" table illustration
Serial Connection	CAN Bus and LAN for iCHILL200CX
Data Storing	On non-volatile flash memory (EEPROM)
Kind of Action	1B; Pollution Grade: 2 Software Class: A
Rated Impulse Voltage	2500V; Overvoltage Category: II
Operating Temperature	-10°C to 60°C (14°F to 140°F) Storage Temperature: -30°C to 85°C (-22°F to 185°F)
Relative Humidity	20% to 85% (non-condensing)
Measuring and Regulation Range	PTC probe: -50°C to150°C (-58°F to 302°F) NTC probe: -40°C to110°C (-40°F to 230°F) Pt1000 probe: -50°C to100°C (-58°F to 212°F) Pressure transducer: -1.0 Bar to 50.0 Bar (-14.5 PSI to 725 PSI)
Resolution	0.1°C or 1°F; Accuracy@ 25°C: ±0.1°C ±1 digit

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