USER MANUAL

XEV22D

Driver for Stepper Electronic Expansion Valves Release 1.5

COPELAND

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1 General Warning

Please read the following safety precautions and warnings before using this manual:

⚠ CAUTION

- This manual is part of the product and should be kept near the controller for easy and quick reference.
- The instrument shall not be used for purposes different from those described hereunder. It cannot be used as a safety device.
- Check the application limits before proceeding.
- Copeland reserves the right to change the composition of its products, even without notice, ensuring the same and unchanged functionality.

⚠ CAUTION

SAFETY PRECAUTIONS AND WARNINGS!

- Check that the supply voltage is correct before connecting the instrument.
- Do not expose to water or moisture: use the controller only within the operating limits and avoid sudden temperature changes with high atmospheric humidity to prevent formation of condensation.
- 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 instrument back to the distributor or to Copeland (see address) with a detailed description of the fault.
- Consider the maximum current that can be applied to each relay (see *Technical Data*).
- 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 (our mod. FT1) in parallel with inductive loads could be useful.

2 General Description

The XEV22D controller is capable of driving a wide variety of stepper electronic expansion valves. XEV22D regulates the superheat (SH) of the fluid that runs into refrigerating unit in order to obtain optimized performance and functioning of the evaporator independent by climatic or load conditions.

XEV22D modules are equipped with two (2) probe inputs, one for a 4 to 20mA or 0 to 5V pressure transducer and another one for a NTC-EU, NTC-US or Pt100 temperature probe.

The LAN connection transmits the pressure signal to other XEV modules; this allows the use of only one pressure transducer in multiplexed cabinet applications. There are also two (2) configurable digital inputs, the first one is free of voltage and the other one is at high voltage in order to simplify connections with cooling request signal.

With the integrated display, it is possible to see the superheat (SH) value, the degree of valve opening or the probe values; the local keyboard allows programming the instrument without any other devices.

An RS485 serial link connects the XEV22D to Copeland monitoring and supervising systems.

2.1 Ordering Code

Table 2-1 - Product Ordering Code

Device Name	Dixell Code	Copeland Code
XEV22D	XEV22D-1C0F0B X0JFGAESG3NA-000	318-5001

3 Probes Related to the XEV22D

3.1 Pressure Transducers

Table 3-1 - Pressure Transducer Probes

Name	Cable Length	Range	Dixell Code
PP07	2.0 meters	-0.5 to 7bar	BE009302 00
PP11	2.0 meters	-0.5 to 11bar	BE009302 07
PP30	2.0 meters	0 to 30bar	BE009302 04

3.2 Pipe Mounting Temperature Probe

The NP4-67 (NTC sensor) or PMP4-67 (PT1000 sensor) temperature probe can be used in the suction line to monitor the evaporator/heat exchanger outlet temperature. See **Figure 3-1** for Pipe Mounting Temperature Probe.

- NP4-67 - Code BN609001 52
  - 1.5 meters NTC probe
  - Measurement range: -40 to 230°F/-40 to 110°C
  - Cable 1.5 meters
- PMP4-67 - Code BZ609001 53
  - 1.5 meters Pt1000 probe
  - Measurement range: -94 to 230°F/-70 to 110°C
  - Cable 1.5 meters

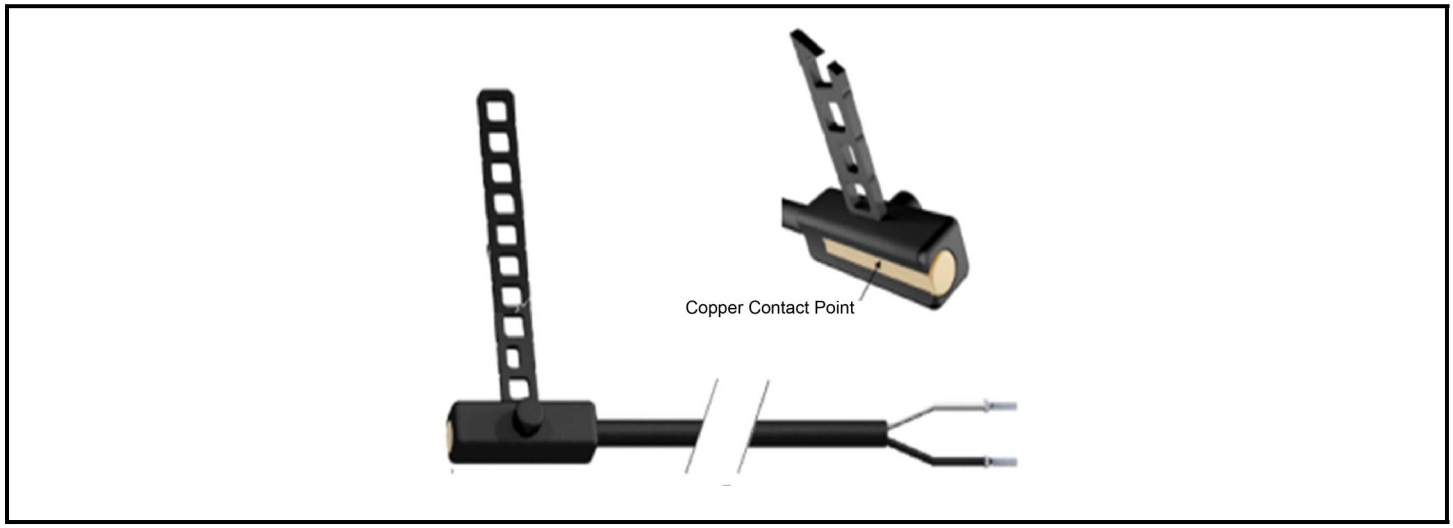


Figure 3-1 - Pipe Mounting Temperature Probe

4 Connections

The controller is provided with pluggable screw terminal block to connect cables with a cross section up to 2.5mm2. Heat-resistant cables have to be used. Before connecting cables, make sure the power supply complies with the controller's requirements. Separate the probe cables from the power supply cables, outputs, and power connection.

⚠ CAUTION

- Do not exceed the maximum allowable current on each relay.
- In case of heavier loads, use a suitable external relay.
- Before connecting the cables make sure the power supply complies with the controller's requirements.
- Separate the probe cables from the power supply cables, outputs, and power connections.

4.1 Wiring Connections

The superheat regulation is performed only when the cooling digital input is enabled. **Figure 4-1** shows how the device takes the request of cooling:

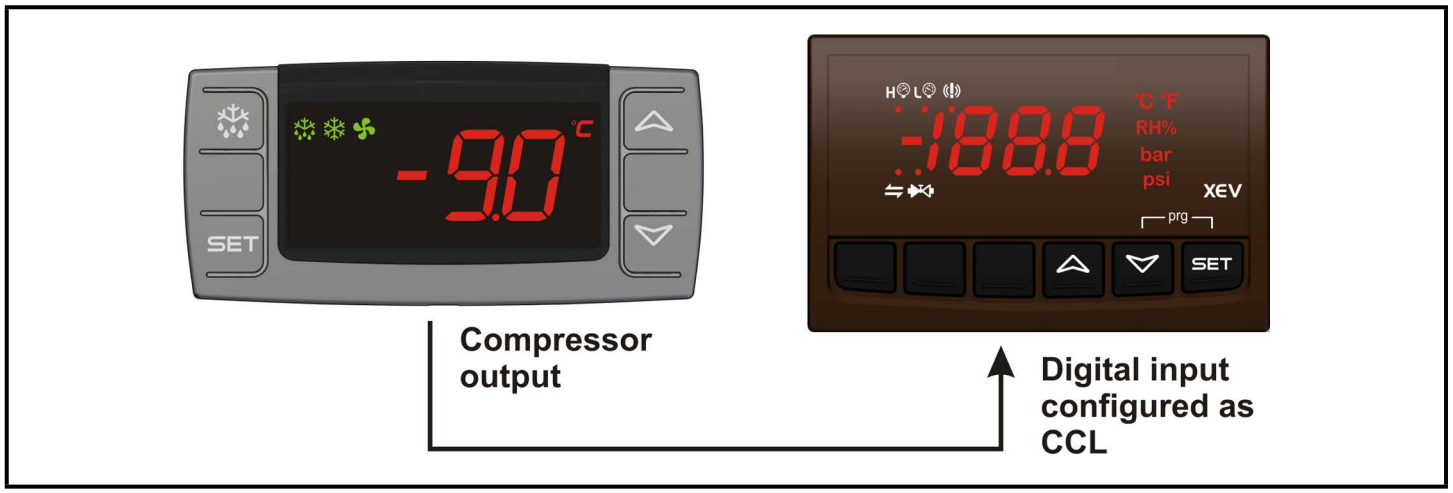


Figure 4-1 - How XEV22D Acts on Cooling Request

See **Figure 4-2** for wiring. The "**First Level**" indicates the connections on the floor of the 4-DIN module and "**Second Level**" indicates the connections on the first floor that are only for the stepper motor of the valve and for the Hot Key.

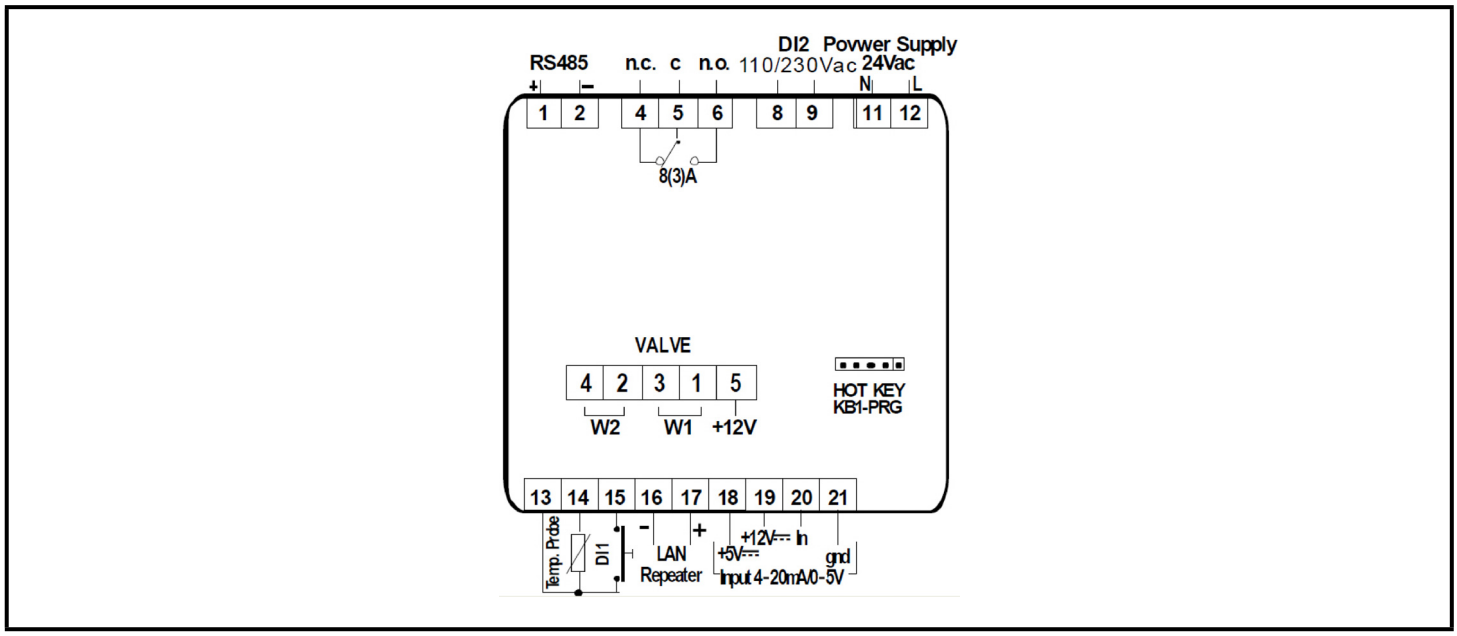


Figure 4-2 - XEV22D Wiring Connections

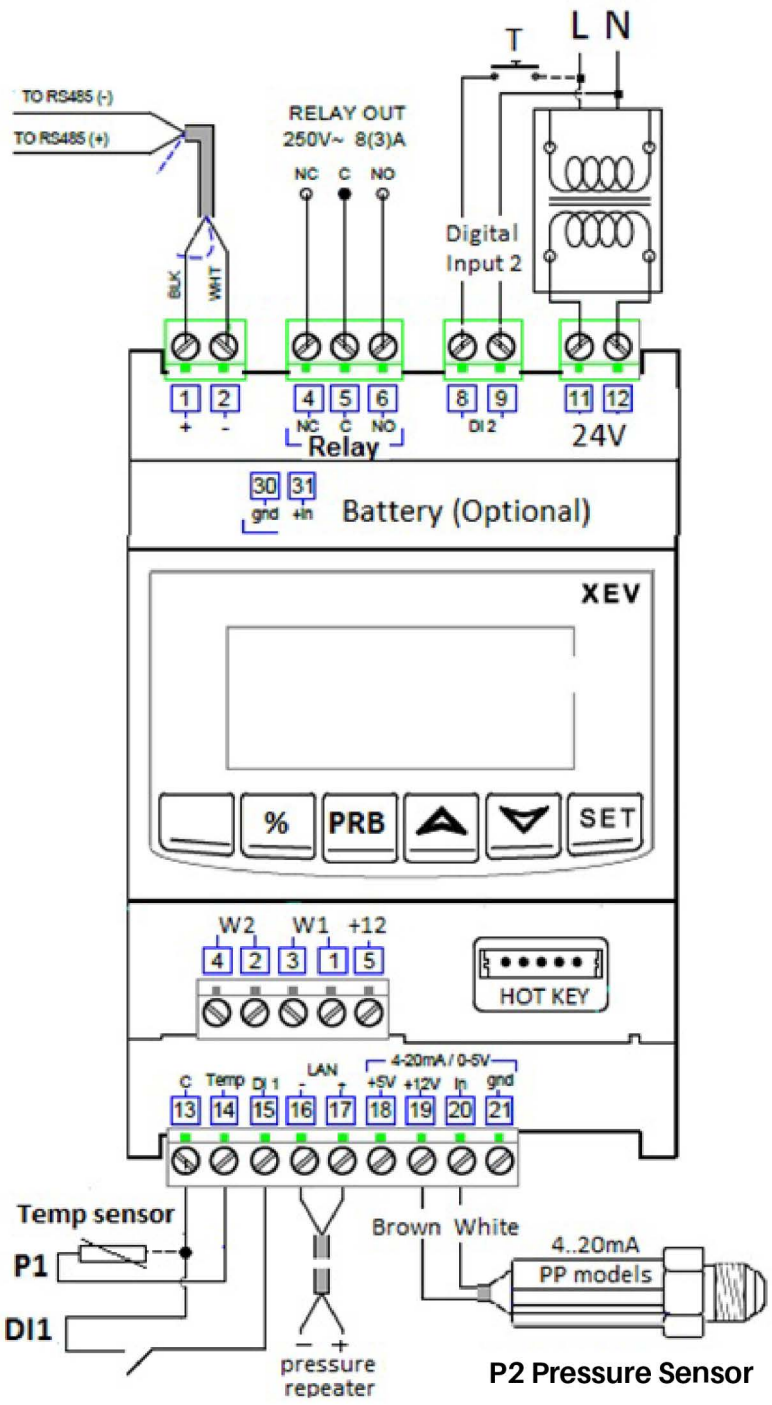


Figure 4-3 - XEV22D Release 1.5 Wiring Connections

4.2 Wiring Guidelines

Table 4-1 - Wiring Guidelines

DEVICE TYPE	COPELAND
ANALOG TEMP SENSOR DIGITAL INPUT	BELDEN #8761 #22-2 SHIELDED Copeland *P/N 035-0002*
RS485 NETWORK	BELDEN #8761 #22-2 SHIELDED Copeland *P/N 035-0002* BELDEN #8641 #24-2 SHIELDED Copeland *P/N 135-8641*
PRESSURE TRANSDUCER	**BELDEN #8771 #22-3 SHIELDED Copeland *P/N 135-8771* **#8771 for alternate 600v rated wire use BELDEN #8618 16 AWG
*STEPPER VALVE	Use valve manufacturer's harness with a maximum length not to exceed 30 feet (10 meters).
POWER LOADS AND VALVE	Allow a maximum wire size of 14 AWG (2 mm^2).

4.3 Temperature Probe Mounting

Advised temperature probe placement is illustrated in **Figure 4-4**. Between 0 and 180 inclination degrees respect to horizontal pipe section.

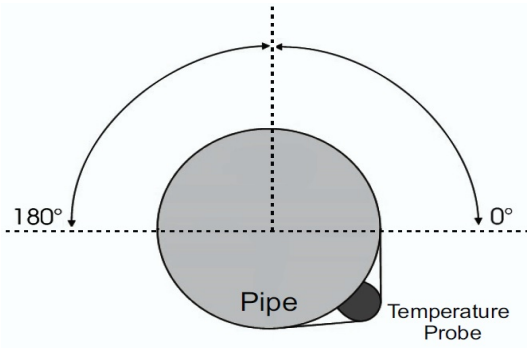


Figure 4-4 - Temperature Probe Placement

4.4 Probe Connection

4.4.1 General Warnings

- **Pressure probe (4-20mA or ratiometric)** - If using terminal ends, there should have no bare or exposed parts that could cause short circuiting or noise disturbance at high frequencies. To minimize the induced disturbances, use shielded cables with the shield connected to earth.

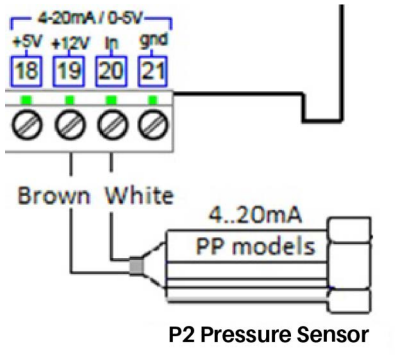
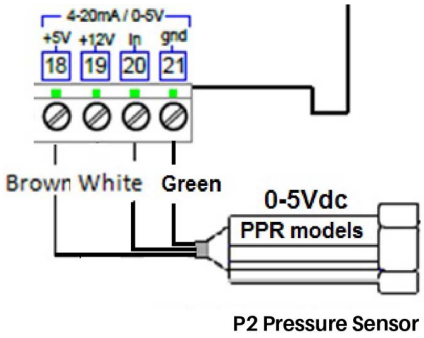
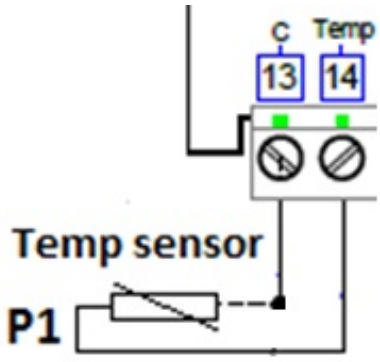
PP07 PP11, PP30, 4 to 20mA pressure transducers: **Set parameter tPP = 420.** Connect: Brown wire (+) to terminal 19; White wire (-) to terminal 20	
PPR15 PPR30 Ratiometric transducers (0.5 to 4.5Vdc) **Set parameter tPP = 5U** Connect: Brown wire (+) to terminal 18; White wire (in) to terminal 20; Green wire (gnd) to terminal 21	
Temperature probe: **Set parameter** ttE = NTC: (NTC 10K) or ttE = Pt1: (Pt1000) or ttE = nCP: (NTC-US 10K) Connect to terminals 13-14	

Table 4-2 - Probe Connection Guidelines

4.5 Configurable Digital Input Connection

The superheat regulation is performed only when the cooling digital input is enabled. It is possible to enable the SH regulation via:

- **Digital input 1, free voltage contact** - Use the terminals (14-15), set the parameter **i1F = CCL**, and polarity parameter = **i1P**.
- **Digital input 2 (8-9), main voltage contact** - Use the terminals (8-9), set the parameter, **i2F = CCL**, and polarity parameter = **i1P.**

Usually the digital input is connected to a thermostat or an activation contact.

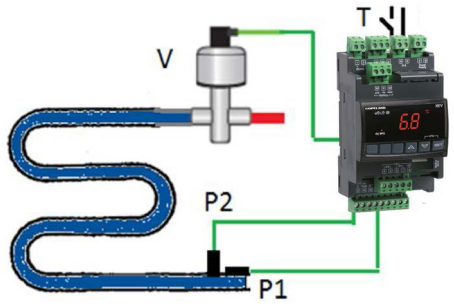
	T= Thermostat (or activation contact) V= Stepper valve (mono or bipolar) P1= Temperature sensor (PT1000 o NTC or NTC-US) P2= Pressure transducer 4.20mA or ratiometric (0-5Vdc).

Table 4-3 - Digital Input Connection

4.6 Supply Connection

4.6.1 Power supply

XEV22D is powered at 24VAC/DC. Use Class 2 transformer with at least 20VA as the TF20D. Connect transformer to terminals 11-12.

4.7 Valve Configuration

4.7.1 Before Connecting the Valve

⚠ CAUTION

- Always connect or disconnect the valve when the controller is not powered.
- Configure the valve on the XEV22D before connecting the valve.

1. To avoid any possible problems, configure the driver by making the correct changes on the parameters.
2. The max distance between an XM controller and a valve must not exceed to 10 m. To avoid possible problems, use only shielded cables with section greater than or equal to 0.325 mm^2 (AWG22).

3. Select the kind of motor (tEU parameter) and check if the valve is present in **Table 4-4** below:

Table 4-4 - tEP Parameter Table

	tEP	LSt (steps* 10)	uSt (steps* 10)	CPP (mA*10)		CHd (mA*10)		Sr (step/ s)	tEu (bip/ unip)	HSF (Half/ full)
				Version 1.1	Version 1.5	Version 1.1	Version 1.5			
1	Danfoss ETS-25/50	7	262		10		10	300	bP	FUL
2	Danfoss ETS-100	10	353		10		10	300	bP	FUL
3	Danfoss ETS-250/ 400	11	381		10		10	300	bP	FUL
4	Sporlan SEI 0.5-11	0	159	12	16	0	5	200	bP	FUL
5	Sporlan SER 1.5-20	0	159		12	0	5	200	bP	FUL
6	Sporlan SEI 30	0	319		16	0	5	200	bP	FUL
7	Sporlan SER(I) G,J,K	0	250		12	0	5	200	bP	FUL
8	Sporlan SEI 50	0	638	12	16	0	5	200	bP	FUL
9	Sporlan SEH(I) 100	0	638	12	16	0	5	200	bP	FUL
10	Sporlan SEH(I) 175	0	638	12	16	0	5	200	bP	FUL
11	Copeland EX4-EX5- EX6	5	75		50		10	500	bP	FUL
12	Copeland EX7	10	160		75		25	500	bP	FUL
13	Copeland EX8 500	10	260		80		50	500	bP	FUL
14	Copeland EX3	4	33		0		0	50	uP	HAF

If you can locate the value in the table, select the value through the tEP parameter. This way, you can be sure of the correct configuration (refer to **Table 4-4**).

Liability Limitation - All the pre-sets have been done according to the documentation available when the XEV22D has been released, see below reference:

- **Danfoss:**
  - DKRCC.PD.VD1.C6.02 / 520H8021 @ Danfoss A/ S (AC-MCI / sw), 2014-07
- **Sporlan:**
  - 92008 / Bulletin 100-20
  - RACE Catalogue 100-20-3 EDEV-2/UK - 02/2013
- **Copeland:**
  - FC-TD/ EX4-8 July 2008

In any case, for each valve the only reference is given by the manual released by the manufacturer together with the valve.

Copeland is not responsible for any changes made by the manufacturer and reported on the manufacturer manual.

4.7.2 Manual Setting of Valve

To set the valve manually, procedures are as follows:

a. Set **tEP** = **0**.
b. Then set the following parameters according to the valve manual: **LSt**, **USt**, **Sr**, **CPP**, and **CHd**.

4.8 Valve Connection

4.8.1 Terminals for Valve Connection

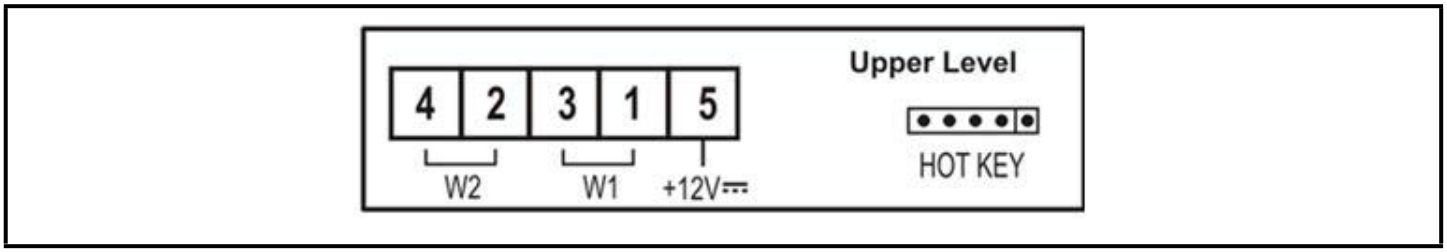


Figure 4-5 - Valve Connection Terminal

Regarding the connections, use Table 4-5 for a quick reference on the connection mode for valves of different manufacturers. In any case, the unique valid reference has to e considered the data sheet made by manufacturer of the valve.

Table 4-5 - 4-Wire Valves (Bipolar)

Connection Numbering	ALCO EX*	SPORLAN SEI-SEH	DANFOSS ETS
4	BLUE	WHITE	BLACK
2	BROWN	BLACK	WHITE
3	BLACK	RED	RED
1	WHITE	GREEN	GREEN

Table 4-6 - 5 to 6 Wire Valves (Unipolar)

Connection Numbering	COPELAND EX3	SPORLAN	SAGINOMIYA
4	WHITE	ORANGE	ORANGE
2	BROWN	RED	RED
3	BLACK	YELLOW	YELLOW
1	BLUE	BLACK	BLACK
5- Common	GRAY	GRAY	GRAY

⚠ CAUTION

- Always connect or disconnect the valve when the controller is not powered.
- Configure the valve on the XEV22D before connecting the valve.

It is highly recommended that the maximum distance of the stepper valve harness length between the valve and the XEV22D controller must not exceed 30 feet (10 meters).

If the valve harness length must be extended beyond 30 feet (10 meters), Copeland provides an Inductor Extender (*P/N 335-3500*) for use with Sporlan Valves ONLY.

The Inductor Extender (*P/N 335-3500*) is ONLY for use with Sporlan Bipolar 4-wire stepper valves with 100 ohm or 75 ohm phase resistance.

When using the Inductor Extender, the XEV22D controller "CPP" parameter setting MUST be less than 20; otherwise the Valve, Controller, and/or Inductor Extender will be damaged or have its life expectancy drastically shortened.

Refer to **Table 4-4** for the list of the XEV series controller supported Sporlan Stepper valves. The Inductor Extender can ONLY be used with Sporlan Bipolar Stepper valves that have a setting of 16 or 12 in the "CPP" column.

The recommended CPP parameter should NOT be increased to create AC voltage at the valve, if the valve harness length is over 30 feet, an Inductor Extender MUST be added into the 4-wire valve harness.

When using the Inductor Extender (*P/N 335-3500*), any stepper valve harness extensions MUST not exceed 170 feet total length.

Use 14 AWG wire for valve harness extensions in conduit. If the valve harness extension is not in conduit, use 16 AWG or 14 AWG shielded cable with the shield terminated to an earth grounded chassis. For valve harness extensions over 100 feet, 14 AWG shielded cable is recommended.

Using an AC volt meter to measure voltage at the Valve will not produce accurate results with a voltage chopper constant current stepper valve drivers as used in XEV22D controllers.

Instead, an AC current meter can be used to measure valve milliamps as a field verification method.

If the current measurement using the method described below is less than the recommended value by more than 20%, the CPP parameter may be increased by up to 2 (12 to 14 or 16 to 18). The CPP parameter MUST be less than 20 when using the Inductor Extender (*P/N 335-3500*).

For a CPP parameter of 12, the measured current should be near 120 mA AC, for a CPP setting of 16, the measured current should be near 160 mA AC.

Below is a description of using an AC current meter to test a stepper valve:

Using an AC Volt meter to measure the voltage across a stepper valve will not produce accurate results if the valve is driven by a voltage chopper constant current valve driver. XEV controllers use a voltage chopper constant current stepper valve driver.

The stepper valve voltage can be checked by using an in-line True RMS AC current meter. The AC current meter will produce a more accurate reading than AC voltage due to the valve drive switching the voltage to the valve on and off at a frequency much higher than a voltmeter can read. The voltage chopper constant current valve driver maintains a constant AC current through the valve while the valve is moving, which makes an AC mA meter ideal to test the valve. The current can be read in each of the stepper valves two windings/phases. Due to the fact that current unlike voltage is the same at any point in a wire, the current test can be performed at the XEV22D controller or at the valve, and will have the same results. It is no longer necessary to take apart the case or get on a lift to access the valve, the in-line current test can be performed at the most convenient location.

An AC clamp meter will not have enough resolution to read the stepper valve milliamps.

If the current meter used is not a True RMS meter, the readings will be approximately10% higher due to the stepper drive producing square waves and not sin waves.

1. Power down the XEV22D controller.
2. Disconnect the Sporlan valve white wire from the XEV22D controller.
3. Connect the meter red lead from the meter 10A terminal to the Sporlan valve white wire.
4. Connect the meter black lead from the meter COM terminal to the XEV22D controller where the Sporlan white wire was removed.
5. Change the meter dial selector to AC amps (~A).
6. Note the mA terminal on the meter. It should be labeled 400 mA or 300 mA.
7. Power up the XEV22D controller.
8. Cycle the valve and verify the meter AC amp reading is less than 0.3A.

⚠ CAUTION

0.3A is 300mA; if the AC amp reading in **step 8** was above your meters mA terminal label: STOP and check. DO NOT proceed or your meter will be damaged.

1. If **step 8** reading was less than 0.3A, power down the XEV22D and move the meter red lead from the meter 10A terminal to the meter 400 mA or 300mA terminal.
2. If the meter dial selector has an AC mA selection (~mA), change to the AC mA selection.
3. Power up the XEV22D controller.
4. Cycle the valve and record the maximum constant meter AC mA reading.
5. The mA reading should be within 20% of the Phase current CPP setting.
6. The valve voltage can be calculated by multiplying the mA reading by the valve coil resistance. For example: 102 mA x 100 ohm valve coil = 10.2V. 150mA x 75 ohm valve coil = 11.25V.

The 2nd valve coil current/voltage can be tested by repeating the above procedure on the Sporlan valve Green wire and XEV22D controller.

The in-line AC mA meter is also compatible with the constant voltage stepper valve drivers used in the MultiFlex ESR, CC100, and CCB.

4.9 Use of Extra Step During Closing Phase (ESt Parameter)

With **tEP** different from zero, the **ESt** parameter is forced to zero.

To set the extra steps during the closing phase, perform the following procedure:

a. Verify if the valve is present in the pre-set valve table.
b. Verify in the valve manufacturer's datasheet if the features of the valve correspond to the values reported in our table.
c. Use the **tEP** parameter to pre-set all the parameters related to the valve.
d. Set the parameter **tEP** = **0**.
e. Set the number of extra steps by the **ESt** parameter.

NOTE	The value set in the parameter ESt is multiplied by 10; thus, with ESt = 2, the driver will perform 20 extra steps.

4.10 EX3 Solenoid Valve Connection

4.10.1 Solenoid Valve Connection

The positive shut-off function eliminate the necessity of having a separate solenoid valve or any external energy storage device such as battery or super-cap boards.

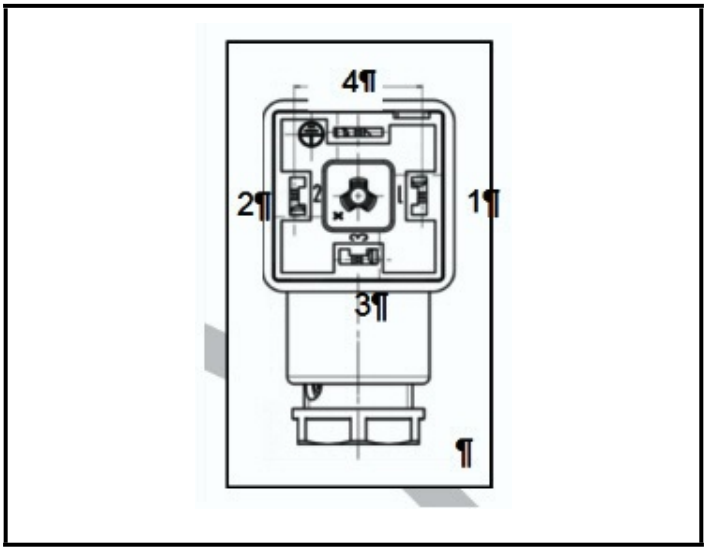


Figure 4-6 - Solenoid Valve Connection

Pin Connections:

Pin 1. Line - Power Supply

Pin 2. Neutral

Pin 3. Not Used

Pin 4. Ground

4.10.2 VAC Coil Direct Connection

Figure 4-7 shows the direct connection of the VAC coil to the main power supply.

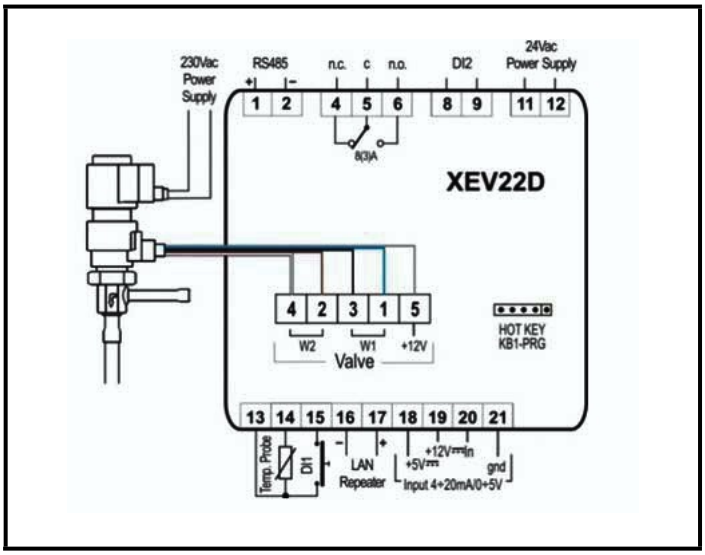


Figure 4-7 - VAC Coil (230 and 115 VAC)

NOTE EX3 Models with 115VAC coil requires 1165VAC supply.

4.10.3 Transformer Connection

With EX3 coil at 24VAC, a 40VA transformer must be used like FTF40D. Any transformer with lower capacity can damage the valve or the controller.

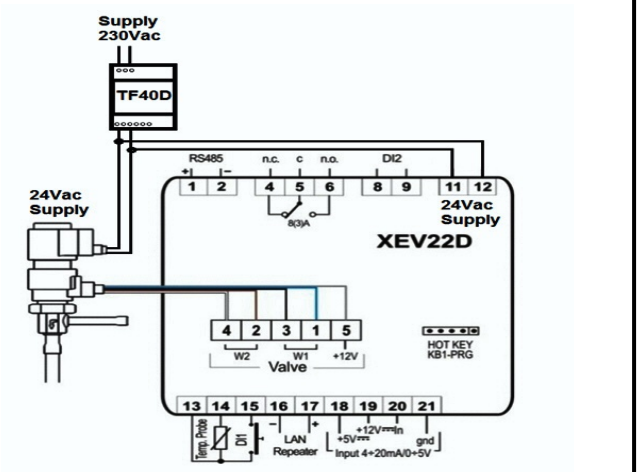


Figure 4-8 - Transformer Connection (24VAC Coil)

4.11 Absolute Maximum Power

The XEV22D controller is capable of driving a wide range of stepper valves; listed in **Table 4-7** are the maximum values of current that the actuator can supply to the stepper wiring. Use the TF20D transformer.

NOTE The electrical power absorption of the valve can be unrelated to refrigeration power that the valve has. 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 indicated below in **Table 4-7**.

4.12 RS485 Serial Line

All models can be connected to the monitoring and supervising system XWEB3000. If **Mod** = **StD**, the standard MODBUS-RTU protocol is used; if **Mod** = **AdU**, *the custom XWEB library is required*. This last configuration makes it possible to use the same serial address of the thermostat that gives the cooling request to XEV. In this way, it is possible to reduce the number of addresses used.

4.13 Connection of XEC Supercap (Back Up Battery)

XEC Supercap is designed to be used with controllers (XM678D, XEV, IEV, and others) to close the stepper valve in case of power failure.

Table 4-7 - XEC Supercap Wiring

XEV22D	XEC
Terminal 31 (+)	Terminal 4 (12 VDC)
Terminal 30 (gnd)	Terminal 3 (gnd)

NOTE **IMPORTANT:** XEC Supercap and XEV22D must be powered by two different transformers. The failure of the observance of this rule may result in damage to the XEC Supercap and/or the connected XEV22D.

5 Mounting and Powering

The XEV22D is usually mounted by the Refrigeration equipment manufacturer. Therefore, the installer need only make the necessary connections between the boards and the site controller(s).

In some instances, an installer may be required to mount the XEV22D. There are no restrictions on the location of the XEV22D; however, the controller should be mounted in a location protected from moisture. Typically, mounting inside the electrical control panel of a package unit is acceptable.

5.1 Installation

The XEV22D uses a DIN mount installation.

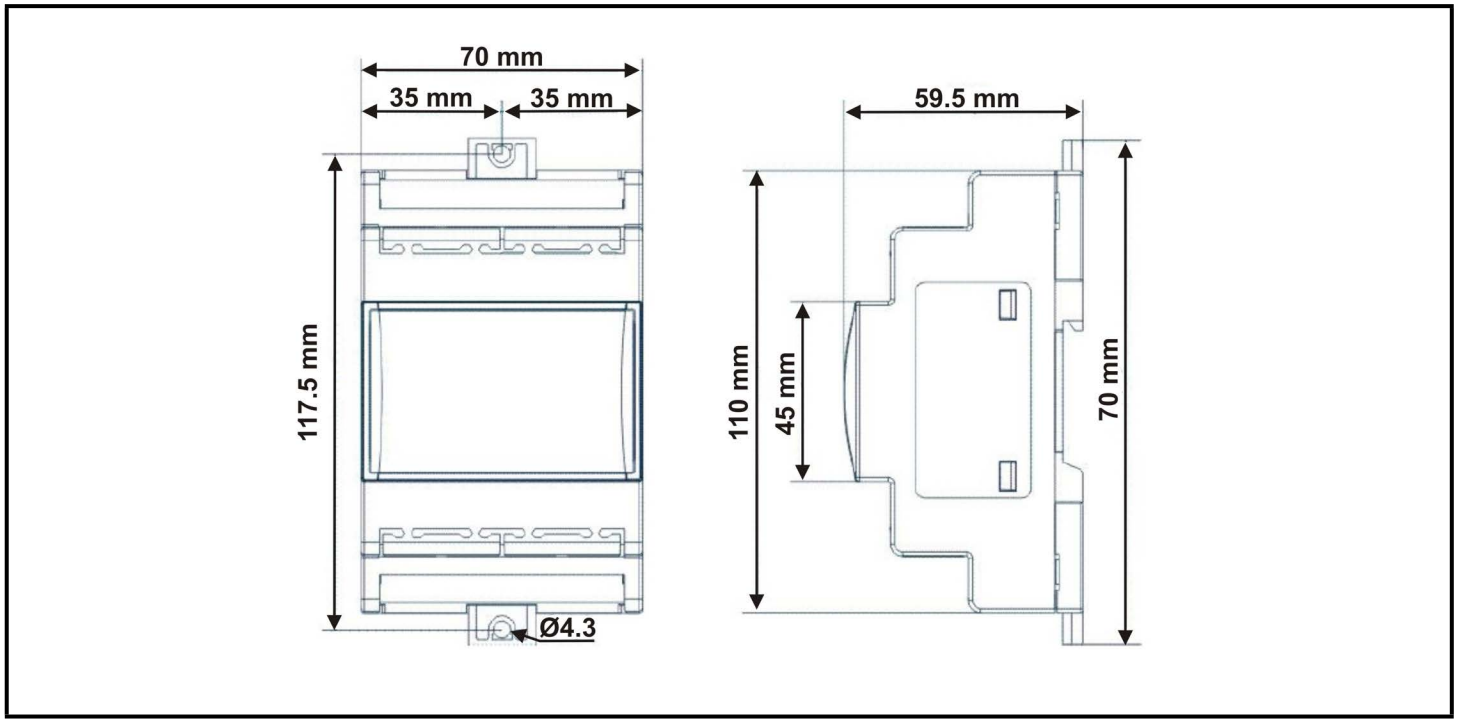


Figure 5-1 - DIN Mounting

Table 5-1- XEV22D Enclosure Specification

Mount	On a DIN rail (EN 50022, DIN 43880) Fastened with screws via the removable plastic flaps
Material	PC-ABS Thermoplastic
Self-extinguishing	VO (UL94)
Comparative Tracking Index (CTI)	300V
Color	Gray

5.2 Powering the XEV22D

Copeland supplies a wide variety of 24VAC transformers with varying sizes without center taps. **Table 5-2** shows the transformer sizes and are non center-tapped.

5.2.1 Choosing Transformer Sizes

The transformer used to power the XEV22D should have at least a 20VA rating. **The XEV22D should not share a transformer with any other devices.**

Table 5-2- Transformer Compatible with XEV22D

Transformer Part Number	VA Rating	Primary Voltage
640-0040	50VA	110/208/220 VAC
640-0041	50VA	110 VAC
640-0042	50VA	220 VAC

5.2.2 XEV22D Power Wiring

The XEV22D can be powered by one of the 50VA non-center-tapped transformers listed in **Table 5-2**.

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.

5.2.3 Wire Type and Maximum Distances

Two-conductor non-shielded cables are the recommended wire for connecting the transformer to the XEV22D, see **Table 5-3** for power wiring types. Shielded cable should not be used for power wiring. The center tap should be left disconnected, if present on the transformer.

Table 5-3- Power Wiring Types

Power Wiring Types	
14 AWG	Belden 9495
18 AWG	Belden 9495

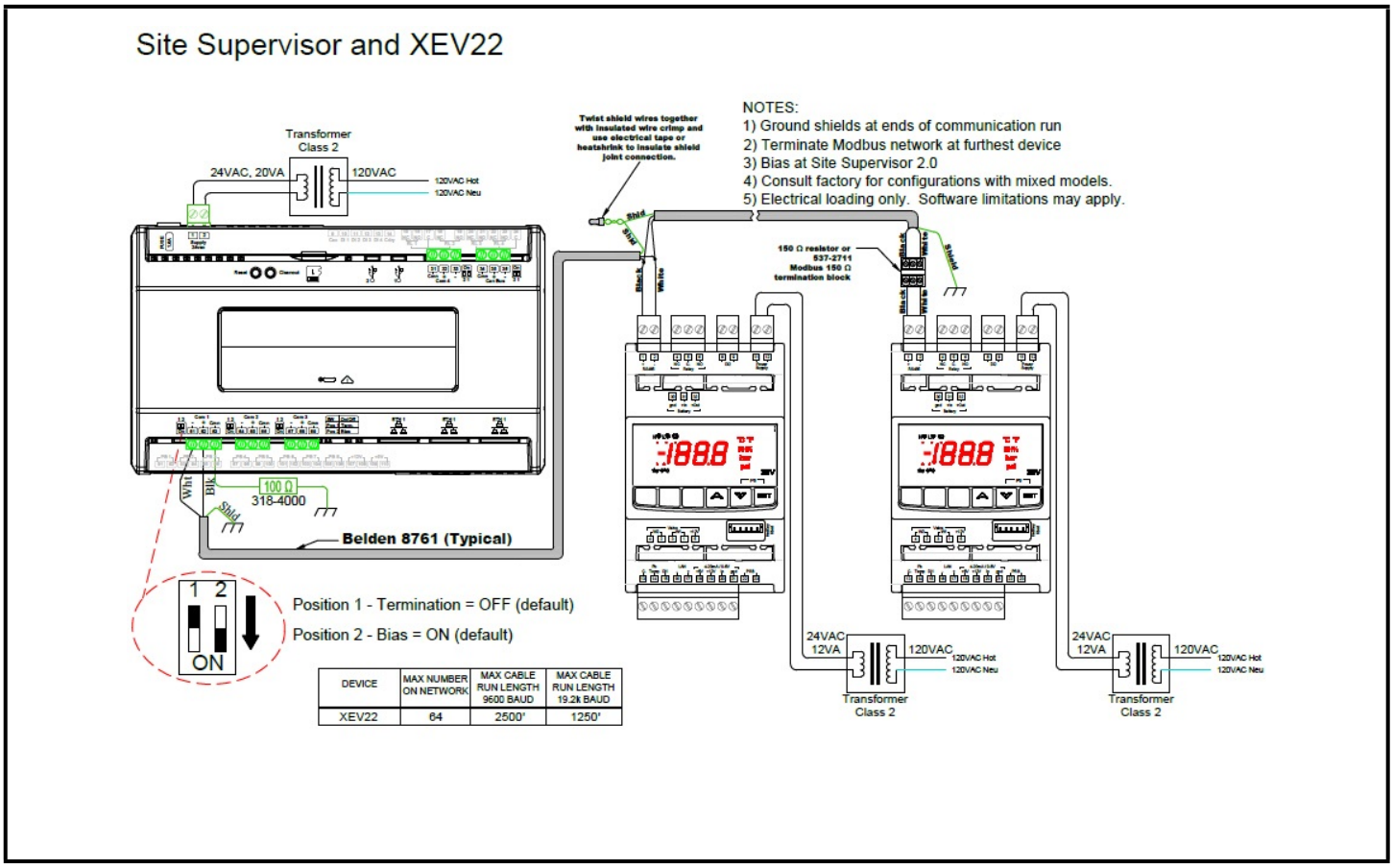
The wire length from the transformer determines the type wire gauge used. In most cases, the distance between the XEV22D and the transformer that supplies power to it is not enough to be of concern; *however, it is very important NOT to exceed this maximum wire length or the controller will not operate correctly.*

Use these formulas to determine if the wire gauge you are using fits within specification:

14AWG: Feet = 1920/VA
18AWG: Feet = 739/VA
(VA is the total VA rating of the controller)
For example, if you had an 18 VA load:
14 AWG: 24 ft.
18 AWG: 9ft. (rounded down)

Sensors requiring 24VAC should not be powered from the same transformer powering the input board. *Any devices that will be connected to the XEV22D's inputs or outputs must be powered with a separate 24VAC transformer.*

5.3 Wiring Connection to Site Supervisor



DEVICE	MAX NUMBER ON NETWORK	MAX CABLE RUN LENGTH 9600 BAUD	MAX CABLE RUN LENGTH 19.2k BAUD
XEV22	64	2500'	1250'

Figure 5-2 - Site Supervisor Wiring

6 Front Panel

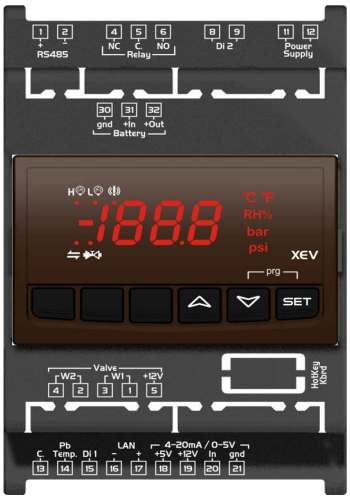


Figure 6-1 - XEV22D Front Panel

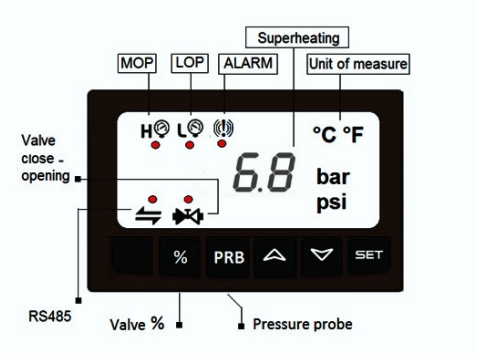


Figure 6-2 - XEV22D Release 1.5 Front Panel

6.1 Keys and Functions

Table 6-1 shows the keys found on the front panel of the XEV22D and their corresponding functions:

Key	Function
SET	To display and to modify the set point. In programming mode, it selects a parameter or confirms a value.
%	Push to display the valve opening value of 0-100% for few seconds.
∧	By pressing and releasing this key, it is possible to see the values of the probes. In programming mode, it slides the codes of the parameters or increases their values.
∨	In programming mode, it slides the codes of parameters or decreases their values.

Table 6-1- XEV22D Front Panel Keys and Functions

Key	Function
Key Combinations	
∧ + ∨	To lock and unlock the keyboard.
SET + ∨	To enter programming mode.

Table 6-1- XEV22D Front Panel Keys and Functions

6.2 XEV22D LEDS

Each LED function is described in **Table 6-2**:

LED	Mode	Function
L	ON	Low pressure alarm
H	ON	Maximum operating pressure alarm
	OFF	Valve is completely closed
	BLINKING	Valve is moving
	ON	Valve is completely opened
⇋	BLINKING	Serial communication present
⇋	OFF	Serial communication absent
	ON	Superheat alarm

Table 6-2 - XEV22D LEDs

7 User Interface

7.1 Fast Access Menu (During Regulation)

1. Press and release the **UP** arrow key.
2. The variables available in the Fast Access menu are:
   a. **CLP** - Cooling demand percentage
   b. **tP1** - Temperature from Probe 1
   c. **PPr** - Pressure value from Probe 2 transducer
   d. **tP2** - Suction temperature obtained from pressure temperature table
   e. **SH** - Superheat value
   f. **StH** - Superheat setpoint
   g. **oPP** - Valve opening percentage
   h. **d1S** - Free voltage digital input status
   i. **d2S** - Main voltage digital input status (VAC)
3. Use the **UP** or **DOWN** arrow key to browse parameters.
4. Press the **SET** key to see read-only value. To change parameters, press **SET**.
5. Press and release **SET** + **UP** arrow key or wait for the device time-out for 3 minutes to exit the fast access menu.

NOTE If the regulation is not enabled, the controller displays "PMP".

7.2 To View the Setpoint

1. Press the **SET** key until the setpoint is displayed.
2. To return and view the temperature, wait for 5 seconds or press the **SET** key again.

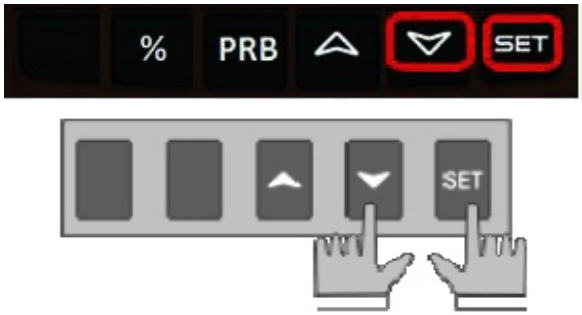
7.3 To Modify the Setpoint

To change the setpoint value, operate as follows:

1. Press the **SET** key until the set point is displayed.
2. Use the **UP** or **DOWN** arrow keys to change its value.
3. Press **SET** to save and store the new value.

7.4 To Enter Pr1 Parameters List

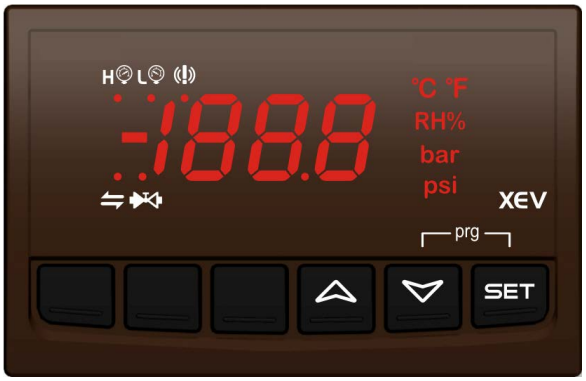
To enter in **Pr1** level menu:



1. Press the **SET** + **DOWN** arrow keys for about 3 seconds.
2. The device will display the first parameter in **Pr1** menu.

7.5 To Enter Pr2 Parameters List

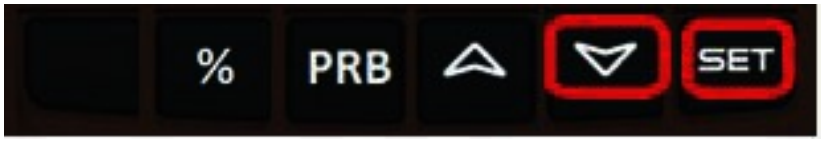
To enter to **Pr2** parameters list:



1. Enter the **Pr1** level menu.
2. Select **Pr2** parameter and press **SET**.
3. The **PAS** label will be displayed followed by a blinking **0**.
4. Insert **321** password using the **UP** or **DOWN** arrow keys.

7.6 To Modify the Parameters Value

To change the parameters valueoperates as follows:



1. Enter the programming mode by pressing the **SET** and **DOWN** arrow keys for about 3 seconds.
2. Select the required parameter.
3. Press the **SET** key to display its value.
4. Use the **UP** or **DOWN** arrow keys to change its value.
5. Press the **SET** key to store the new value and move to the next parameter.
6. To exit, press **SET** + **UP** or wait 30 seconds without pressing a key.

NOTE The set value is stored even when the time-out expires and ends the procedure**.**

7.7 How to Assign a MODBUS Address

1. To enter the programming mode, press and hold the **SET** and **DOWN** arrow keys together for about three (3) seconds or until the dots at the top of the display start flashing.
2. Arrow down to **PR2** and press **SET** to select.
3. **PAS** for password will display and flash.
4. Use the arrow keys to set the **321** password. Press **SET** to save.

NOTE If a time-out occurs while setting the password (PR2 flashes), press **SET** to resume entering the password.

5. Use the arrow keys to scroll through and locate **nod**. Press **SET**. Use the arrow keys to scroll through and locate **Std**. Press **SET**.
6. Use the arrow keys to scroll through and locate **Adr**. Press **SET**. Use the arrow keys to choose the address number of the device. Press **SET** to save.
7. To exit, press the **SET** and **UP** arrow keys together or wait 15 seconds without pressing a key.

8 Parameters

NOTE All pressure parameters are relatives or absolutes depending on the PrM parameter.

Table 8-1 - List of Parameters

Code	Description	Function
		REGULATION
Fty	Kind of gas	(R22, 134, 404, 407, 410, 507, CO2) Type of gas used by plant. *Fundamental parameter for correct functioning of all systems*.
rET	Reaction time	(1 to 100 sec; 0 = automatic time adjustment) Time delay between valve position adjustments. It is the time between the valve adjustment command and when the valve is moved. **EXAMPLE**: *With **rEt** = 1 the valve is moved continuously; **rEt** = 10 the valve is moved every 10s; **rEt** = **0** the reaction time is calculated automatically by the system, according to the SH variation. The range is between 6 to 60 sec.*
PEo	Probe error opening percentage	(0 to 100%) If a temporary probe error occurs, valve opening percentage is **PEo** until **PEd** time is elapsed. If **PEo** is different from **0**, it ensures cooling also with probe error, because even if the device cannot calculate superheat, the valve can work at **PEo** percentage.
PEd	Probe error delay before stopping regulation	(0 to 239 sec – 240 = On = unlimited) If the probe error duration is bigger than **PEd**, valve closes completely. The **Pf** message is displayed. If **PEd** = **On**, valve opening is **PEo** until probe error finishes.
tEU	Type of stepper motor	(**uP**- **bP**) Selects the kind of valve. **uP** = 5 to 6 wires unipolar valves **bP** = 4 wires bipolar valves **WARNING!** *This parameter has to be adjusted before connecting the valve.*
tEP	Predefined valve selection	(0 to 14) **Liability Limitation** - All the pre-sets listed on **Table 8-3** have been done according to the documentation available when the XEV22D has been released. See below reference: • **Danfoss** • DKRCC.PD.VD1.C6.02 / 520H8021 @ Danfoss A/S (AC-MCI / sw), 2014-07 • **Sporlan** • 92008 / Bulletin 100-20 • - RACE Catalogue 100-20-3 EDEV-2/UK - 02/2013 • **Copeland** • FC-TD/ EX4-8 July 2008 *In any case for each valve the only reference is given by the manual released by the manufacturer together with the valve. Copeland can't be considered responsible for any change made by the manufacturer and reported on the manufacturer manual.* **Manual Valve Setting** - To set the valve manually, procedures are as follows: a. Set **tEP** = **0.** b. Then set the following parameters: LSt, USt, Sr, CPP, and CHd according to the valve manual.
HFS	Kind of motor movement:	(HAF; FUL) • HAF = half step. Use this setting for the unipolar valve. • FUL = half step. Use this setting for the bipolar valve.

Table 8-1 - List of Parameters

Code	Description	Function
LSt	Minimum number of steps	(0 to **Ust**) Selects the minimum number of steps. At this number of steps, the valve should be closed. Read the manufacturer datasheet to set this parameter correctly. The number of steps should be set within the advised range of functioning. **WARNING!** *When this parameter is changed, the valve must be re-initialized. The controller performs this procedure automatically and restarts its normal functioning when the programming mode ends.*
Ust	Maximum number of steps	(**LSt** to 800*10) Selects the maximum number of steps. At this number of steps, the valve should be opened completely. Read the datasheet provided by the valve manufacturer to set this parameter correctly. The maximum number of steps should be set within the advised range of functioning. **WARNING!** *When this parameter is changed, the valve must be re-initialized. The controller performs this procedure automatically and restarts its normal functioning when the programming mode ends.*
ESt	Extra step in closing phase	(0 to 255 (*10)) Sets the number of extra steps the controller performs when the valve is closed at startup to force the closure of the valve. This value is multiplied by 10 (that is, for example, ESt = 2, controller performs 20 extra steps).
Sr	Step rate	(10 to 600 step/sec) Maximum speed to change a step without losing precision (= losing steps). Set parameter under the maximum speed.
CPP	Current per phase (Only bipolar valves)	(0 to 100 * 10mA) Maximum current per phase used to drive valve.
CHd	Holding current per phase (Only bipolar valves)	(0 to 100 * 10mA) The current per phase when the valve is stopped for more than 4 minutes.
oPE	Start opening percentage	(0 to 100%) Opening valve percentage when the start function is active and during post defrost phase. This phase duration is **SFd** time.
SFd	Start function duration	(0.0 to 42.0 min: tens of seconds) It sets start function duration and post-defrost duration. *During this phase, the alarms are neglected.*
Sti	Stop regulation interval	(0.0 to 24.0 hours: tens of minutes) After regulating continuously for **Sti** time, the valve closes for **Std** time to prevent ice from forming.
dty	Pilot duty	(2 to 10 decimal per sec) To reach the final position the valve moves for Ton sec and stops for Toff sec, where: • **Ton** = dty/10 sec • **Toff** = (1 dty/10 sec) **NOTE:** *With dty=10, the Pilot duty function is disabled. With bipolar value, during the Toff time the maintenance current is used. It can be used to drive properly some type of valves, where the manufacturer suggests to move the value with duty cycle. The duty cycle in any case slows the valve adjustment and has an effect on the regulation, making it smoother.*
MnF	Maximum opening percentage at normal functioning	(0 to 100%) During regulation, it sets the maximum valve opening percentage.

Table 8-1 - List of Parameters

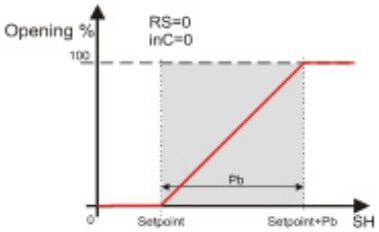
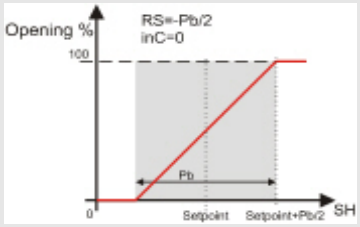
Code	Description	Function
FOP	Forced opening percentage	(0 to 100 - **not used; nU**) If **FOP** = **not used**; **nU**, valve works with regulation algorithm. If **FOP is different from not used; nU**, the valve stays at **FOP** opening percentage. This function could be useful during plant starting or during service operations.
PI PARAMETERS (For use of trained staff only)		
AMS	Self adaptive SH regulation enabling	Parameter enables the self adaptive regulation of the superheat. • **No** - Standard regulation using the PID parameters (Pb, rS, inC, dFC) • **Yes** - Self-adaptive regulation, controller regulate SH automatically, setting the PID parameter.
Atu	Minimum stable superheat search	(No; Yes) This parameter enables the search of the minimum stable superheat. The lowest admitted value is LSH+2°C.
Pb	Proportional band (0.1 to 50.0 / 1 to 90°F) **PI** proportional band. A value bigger than 5°C is advised.	
rS	Band offset (-12.0 to 12.0°C / -21to21°F) PI band offset. It moves the proportional band of the **PI**. With **rS** = **0**, the band is between Set to Set + **Pb**.	
InC	Integration time	(0 to 255 sec) **PI** integration time
dFc	Derivatisve time	(0 to 255 sec) **PID** derivative time.
tPP	Type of pressure transducer	(**420** – **5V** – **LAn**) Sets the type of pressure transducer to use: **420** = 4 to 20mA pressure transducer; **5V** = 0 to 5V ratiometric transducer; **LAn** = the pressure signal comes from another XEV module.
LPP	Enable pressure probe sending in LAN	(**n** to **Y**) If **LPP** = **Y**, the value of pressure read by device is sent in LAN. Only one device of the LAN can have **LPP** = **Y**.
PA4	Probe value At 4mA or At 0V	(-1.0 to P20 bar/ -14 to PSI) Pressure value measured by probe at 4mA or at 0V (related to **PrM** parameter).
P20	Probe value 20mA or At 5V	(PA4 to 50.0 bar/ 725 psi) Pressure value measured by probe at 20mA or at 5V (related to **PrM** parameter).
OPr	Pressure probe calibration	(-12.0 to 12.0 bar/ -174 to 174 psi)
ttE	Type of temperature probe	(**PtM** to **ntC**) Sets the kind of probe used by the controller: **PtM** = Pt1000, **ntC** = NTC probe.
otE	Temperature probe calibration	(-12.0 to 12.0°C/ -21 to 21°F)

Table 8-1 - List of Parameters

Code	Description	Function
		DIGITAL INPUTS
i1P	Digital input 1 (free of voltage) digital input polarity	(**CL**, **OP**) **CL** = activated when closed; **OP** = activated when opened
i1F	Digital input 1 (free of voltage) digital input function	(**CCL**, **rL**) **CCL** = cooling call; **rL** = digital input activates relay
d1d	Digital input 1 (free of voltage) activation delay	(0 to 255 min) This activation delay is used only if digital input is configured as **rL**.
i2P	Digital input 2 (high voltage) digital input polarity	(**CL**,**OP**) **CL** = activated when closed; **OP** = activated when opened
i2F	Digital input 2 (high voltage) digital input function	(**CCL**, **rL**) **CCL** = cooling call; **rL** = digital input activates relay
d2d	Digital input 2 (high voltage) activation delay	(0 to 255 min) This activation delay is used only if digital input is configured as **rL**.
		ALARM
dAo	Alarm delay after restarting regulation	(0.0 to 42.0 min: tens of seconds) Time between digital input activation (configured as **CCL**) and alarm signaling. The **LSH** alarm is always signaled also during this time.
tdA	Type of alarm signaled by relay	(**ALL**, **SH**, **PrE**, **di**) **ALL** = all alarm; **SH** = superheat alarm; **PrE** = pressure alarm; **di** = activation only when digital input configured as **rL** is activated.
LPL	Lower pressure limit for superheat regulation	(**PA4** to **P20** bar/ psi) When the suction pressure comes down to **LPL**, the regulation is performed with a **LPL** fixed value for pressure; when the pressure comes back to **LPL**, the normal pressure value is used. (related to **PrM** parameter).
MOP	Maximum operating pressure threshold	(**PA4** to **P20** bar/ psi) If the suction pressure exceeds the maximum operating pressure value, the controller signals a condition with a High Pressure alarm LED (related to **PrM** parameter).
LOP	Lowest operating pressure	(**PA4** to **P20** bar/ psi) If the suction pressure comes down to this value, a low pressure alarm is signaled with Low Pressure alarm LED (related to **PrM** parameter).
PHY	Pressure alarm hysteresis	(0.1 to 5.0 bar/ 1 to 72 PSI) Alarm hysteresis to disable alarm signaling.
dML	delta **MOP**-**LOP**	(0 to 100%) When a **MOP** alarm occurs, the valve will close at the **dML** percentage every one second until the **MOP** alarm is active. When **LOP** occurs, the valve will open at the **dML** percentage every one second until **LOP** alarm is active.
MSH	Maximum superheat alarm	(**LSH** to 32.0°C/ **LSH** to 176°F) When the superheat exceeds this value, a high superheat alarm is signaled after interval **SHd**.
LSH	Lowest superheat alarm	(0.0 to **MSH**°C/ 32 to **MSH**°F) When the superheat goes down to this value, a low superheat alarm is signaled after interval **SHd**.
SHy	Superheat alarm hysteresis	(0.0 to 25.5°C/ 1 to 77°F) Hysteresis for superheat alarm deactivation.

Table 8-1 - List of Parameters

Code	Description	Function
SHd	Superheat alarm activation delay	(0 to 255 sec) When a superheat alarm occurs, the time **SHd** has to pass before signaling alarm.
tdS	Pressure Filter	(0-240 sec) The pressure value used for the **SH** calculation is the average value of the pressure int he tdS time. Suggested values: **tdS:** 5-10 for heat exchanger or condensing unit **tdS:** 1-6 for supermarkets **EXAMPLE:** *With* **tdS = 5,** *the controller calculates the average pressure value in 5s and will use it to calculate the* **SH**.
tdt	Temperature filter	(0-240 sec) The value used for the **SH** calculation is the average value of the temperature in the **tdt** time. Suggested value: 1-3 **EXAMPLE:** *With* **tdt = 3**, *the controller calculates the average temperature value in 3s and will use it to calculate the* **SH**.
		DISPLAY
Lod	Local display	Display: (**SH**, **PEr**, **P1**, **P2**) **SH** = superheat; **PEr** = valve opening percentage; **P1** = value of temperature measured; **P2** = pressure measured by P2 probe;
CF	Temperature measurement units	(°C to °F) **°C** = Celsius degree; **°F** = Fahrenheit degree *CAUTION! By changing the measurement unit, the regulation parameters have to be changed correctly.*
PMU	Pressure measurement units	(**bAr**, **PSI**) **bAr** = bar; **PSI** = psi *CAUTION! By changing the measurement unit, the regulation parameters have to be changed correctly.*
rES	Resolution (only °C)	(**dE** to **in**) Whether a whole number or decimal point is used in temperature reading
PrM	Pressure visualization mode	(**rEL** to **AbS**) **rEL** = relative pressure; **AbS** = absolute pressure All pressure parameters depend on this parameter.
CLP	Cooling percentage	(Read only) Displays the percentage of time during which the cooling call was active in the time interval defined by parameter **CLt**.
tP1	Temperature probe value	(Read only) Shows the temperature probe value from **P1**.
PPr	Pressure probe value	(Read only) **S**hows the pressure probe value. The value depends on **PrM**.
tP2	Temperature from P2	Shows the temperature obtained from conversion of pressure value.
OPP	Opening percentage	Shows the actual opening percentage of the valve.
d1S	Free of voltage digital input state	(Read only) Shows the free of voltage digital input.
d2S	High voltage digital input state	(Read only) Shows the high voltage digital input state.
Adr	RS485 serial address	(1 to 247) Identifies the controller address when connected to a MODBUS compatible monitoring system.

Table 8-1 - List of Parameters

Code	Description	Function
Mod	MODBUS	(**AdU** to **StD**) **AdU** = (Only for XWEB systems) In this case, the XEV and the thermostatic controller are considered standalone controller (it requires a custom library for XWEB); **StD** = to use XEV in standalone mode, in this case normal MODBUS-RTU protocol is used.
Ptb	Parameters map	(Read only) It identifies the parameters map written by factory.
rEL	Release firmware	(Read only) It shows the firmware release.
Pr2	Second level menu	

Table 8-2 - List of Refrigerant Gases

LABEL	REFRIGERANT	OPERATING RANGE	NOTE
r22	r22	-58 to 120°F/-50 to 60°C	-
134	r134A	-94 to 120°F/-70 to 60°C	-
404	r404A	-58 to 120°F/-50 to 60°C	-
47A	r407A	-58 to 120°F/-50 to 60°C	-
410	r410	-58 to 120°F/-50 to 60°C	-
507	r507	-94 to 120°F/-70 to 60°C	-
47C	r407C	-58 to 120°F/-50 to 60°C	NEW
47F	r407F	-58 to 120°F/-50 to 60°C	NEW
290	r290 – Propane	-58 to 120°F/-50 to 60°C	NEW
CO2	r744 - Co2	-58 to 120°F/-50 to 60°C	-
450	r450A	-69 to 120°F/-45 to 60°C	NEW
513	r513	-69 to 120°F/-45 to 60°C	NEW
448	r448A	-69 to 120°F/-45 to 60°C	NEW
449	r449A	-69 to 120°F/-45 to 60°C	NEW

Table 8-3 - List of Pre-defined Valves

	tEP	LSt (steps*10)	uSt (steps*10)	CPP (mA*10)		CHd (mA*10)		Sr (step/s)	tEu (bip/ unip)	HSF (Half/ full)
				Version 1.1	Version 1.5	Version 1.1	Version 1.5			
1	Danfoss ETS-25/50	7	262		10		10	300	bP	FUL
2	Danfoss ETS-100	10	353		10		10	300	bP	FUL
3	Danfoss ETS-250/ 400	11	381		10		10	300	bP	FUL
4	Sporlan SEI 0.5-11	0	159	12	16	0	5	200	bP	FUL
5	Sporlan SER 1.5-20	0	159		12	0	5	200	bP	FUL
6	Sporlan SEI 30	0	319		16	0	5	200	bP	FUL
7	Sporlan SER(I) G,J,K	0	250		12	0	5	200	bP	FUL
8	Sporlan SEI 50	0	638	12	16	0	5	200	bP	FUL
9	Sporlan SEH(I) 100	0	638	12	16	0	5	200	bP	FUL
10	Sporlan SEH(I) 175	0	638	12	16	0	5	200	bP	FUL
11	Copeland EX4-EX5- EX6	5	75		50		10	500	bP	FUL
12	Copeland EX7	10	160		75		25	500	bP	FUL
13	Copeland EX8 500	10	260		80		50	500	bP	FUL
14	Copeland EX3	4	33		0		0	50	uP	HAF

9 Digital Inputs

The XEV22D comes with two (2) digital inputs: a voltage-free input and a high voltage input; both can be configured as cooling call. In this way the cooling signal can come from the controllers with direct load outputs or via the controllers with voltage-free outputs. One of these inputs must be configured as the cooling call.

10 Forced Opening

If necessary, change the **FOP** parameter to force the valve to open. For example, if **FOP** is set to **50** (**FOP** = **50**), the valve will be opened at half of full scale. *To disable this function, set the* **FOP** *to default value (***FOP** = **not used***)*. The valve opening is enabled only when **CCL** digital input is enabled.

11 Electrical Connections

The controller comes with a screw terminal block to connect cables with a cross section up to 2.5 mm^2. Heat-resistant cables have to be used. Before connecting the cables, verify that the power supply complies with the controller's requirements. Separate the probe cables from the power supply cables, from the outputs and the power connections. *Do not exceed the maximum current allowed on each relay, in case of heavier loads, use a suitable external relay.*

12 How to Use the Hot Key

12.1 How to Program a Hot Key From the Controller (Upload)

1. Program one controller using the front keypad.
2. When the controller is ON, insert the Hot Key and press the UP arrow key; the **uPL** message will appear followed by a flashing **End** LED.
3. Push the **SET** key and the **End** LED will stop flashing.
4. Turn OFF the controller, remove the Hot Key, then turn it ON again.
5. Use the arrow keys to set the **321** password. Press **SET** to save.

NOTE The Err message is displayed in case an error or failure in programming occurs. In this case, turn the unit OFF and then ON if you want to restart the download or remove the Hot Key to abort the operation.

12.2 How to Program the Controller Using a Hot Key (Download)

1. Turn OFF the controller.
2. Insert a programmed Hot Key into the 5-pin connector and then turn the controller ON.
3. Automatically the parameter list of the Hot Key is downloaded into the controller memory, the **doL** message will blink followed by a flashing **End** LED.
4. After 10 seconds, the controller will restart work with the new parameters.
5. Remove the Hot Key.

13 Display Messages

Table 13-1 - Alarm Signals

Message	Cause	Outputs
PMP	None of the digital inputs configured as **CCL** are activated	Valve closed
PF	The **PEd** time is elapsed and the regulation is stopped.	Valve closed after **PEd**. There is a probe error.
P1	Temperature probe fault	According to **PEo** and **PEd**
P2	Pressure transducer fault	According to **PEo** and **PEd**
HSH	High superheat alarm	By **PI**
LSH	Low superheat alarm	Valve closed
LPL	Low pressure limit	See **LPL** parameter
MoP	Maximum Operating Pressure	See **dML** parameter
LoP	Lowest Operating Pressure	See **dML** parameter
StF	Start Function enabled	See **SFd** parameter
EE	Memory anomaly	

13.1 Alarm Recovery

Probe alarms **P1** and **P2** start a few seconds after the fault in the probe; they automatically stop few seconds after the probe restarts normal operation. Check the connections before replacing the probe. Maximum and minimum alarms **HSH**, **LSH**, **MoP**, and **LoP** automatically stop as soon as the variable returns to normal values.

The controller is provided with an internal check to verify memory integrity. Alarm **EE** flashes when a failure in the internal memory is detected. In this case, call for service.

14 Technical Data

Table 14-1 - XEV22D Specifications

Housing	Self extinguishing ABS
Dimensions	**Case**: **Front**: 4 DIN modules, 70 mm x 135 mm with male and female connectors **Depth**: 60 mm **Mounting**: DIN RAIL mounted in a omega (3) din rail
Protection	IP20
Connections	Detachable screw terminal block ≤ 2.5 mm^2 wiring
Power Supply	24VAC/DC ±10%
Power Absorption (depending on the valve)	20VA max
Display	Three (3) digits with icons, red LEDs, height 14.2 mm
Inputs	1 temperature probe Pt1000 or NTC 1 pressure transducer 4 to 20mA or 0 to 5V
Digital Inputs	1 free of voltage
	1 at high voltage
Outputs for Valve	Bipolar or unipolar valves
Data Storage	On the non-volatile memory (EEPROM)
Kind of Action	1B
Pollution Grade	Normal
Software Class	A
Temperature	**Operating:** 0 to 60°C
	Storage: -25 to 60°C
Relative Humidity	20 to 85% (non-condensing)
Resolution	0.1°C or 1°F
Temperature Probe Accuracy	±0.7°C ±1 digit

15 E2 MODBUS Network Wiring

- Connect MODBUS Network to the RS485 Connector on the E2 PIB board (Belden 8641 recommended).
- Note to wire the RS485 +/- polarity at the E2 in the *reverse* of the XEV22D devices.
- Position the three termination jumpers to the UP (terminated) position to provide RS485 termination at the E2.
- Do not connect the shield of the MODBUS network to the E2 PIB center terminal. Instead, use a 100 ohm 1/2 watt resistor to connect the MODBUS cable shield to earth ground.
- At each XEV22D device, wire the MODBUS cable to the RS485 +/- terminals and connect the MODBUS shield to the pin **16** terminal.
- Terminate the end of the MODBUS network at the last XEV22D device on the daisy chain with the MODBUS termination block (*P/N 535-2711*), or by connecting a 150 ohm resistor between the MODBUS +/- terminals.

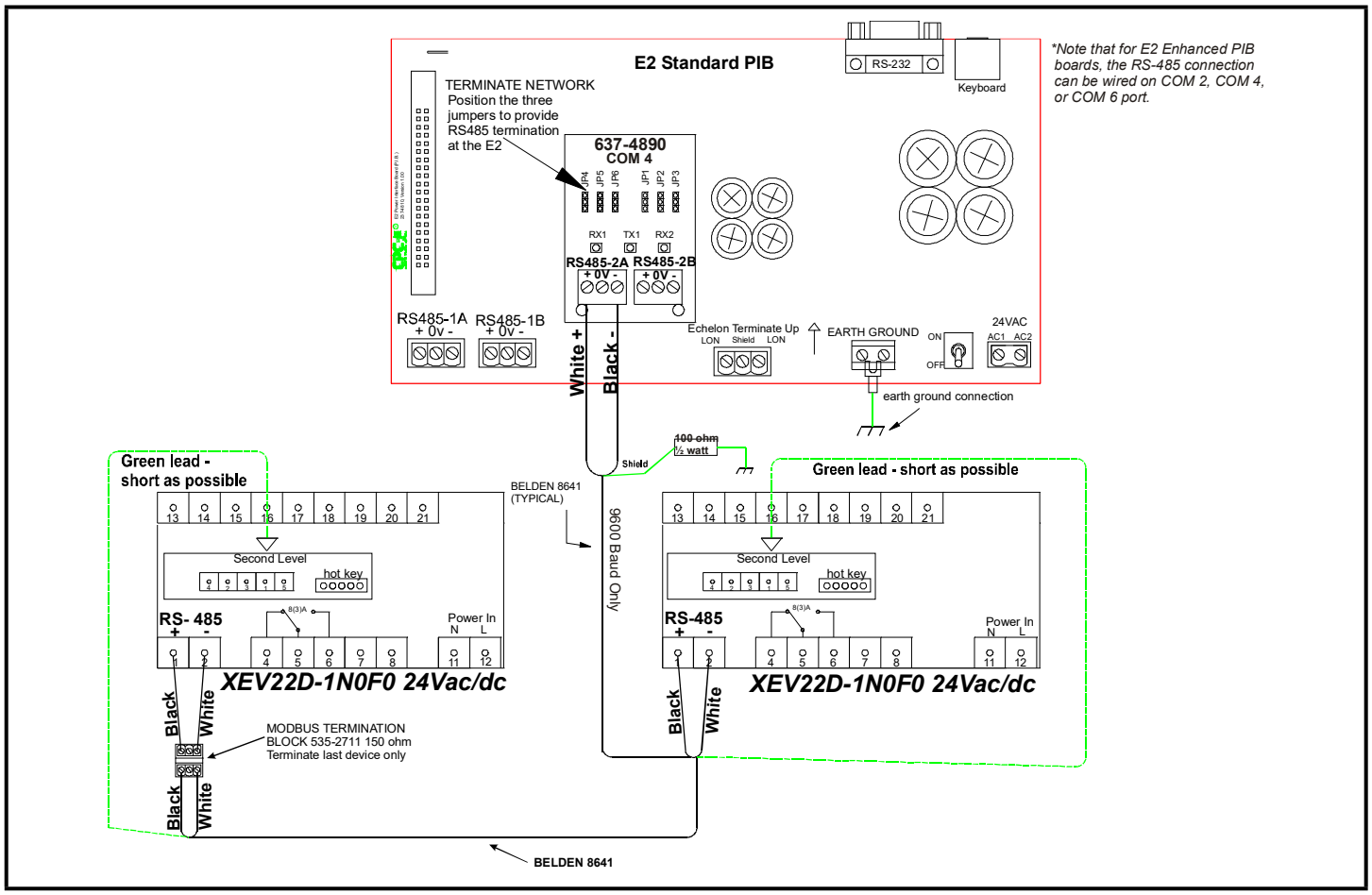


Figure 15-1 - XEV22D to E2 Wiring Diagram (E2 PIB version 3.xx and below shown in this example)

⚠ CAUTION

For the XR, XM, and XEV series of controllers, the shield wire must not come into contact with any other wire or ground source. If contact with other wires or devices does occur, the 485 MODBUS network will malfunction or connected devices will be damaged. This applies to all installations where the shield is tied to ground through a 100 ohm ½ Watt resistor.

Refer to *Appendix A - Alternate MODBUS COM Wiring Method for E2, XR, XM, and XEV Devices (Technical Bulletin P/N 026-4148).*

16 MODBUS Networking to E2s

16.1 COM Port Associations - E2 Versions 3.xx and Below

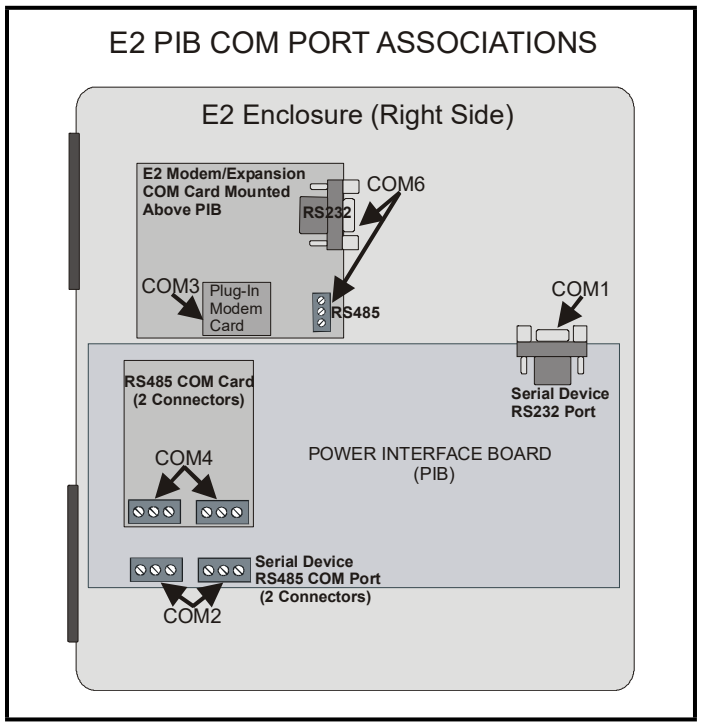


Figure 16-1 - Location of E2 COM Ports (E2 Versions 3.xx and Below)

Connecting an XEV22D controller to an E2 requires the E2 to be version 2.84 or above. Contact Copeland for upgrade information if the controller is a version before 2.84.

An E2 has up to three COM ports that can be assigned for MODBUS communication: COM2, an RS485 port on the E2 power interface board, and COM4 and COM6, which are optional ports requiring expansion cards. *COM4 is recommended for MODBUS connection of Copeland units.*

Connect the MODBUS network cable to the three-terminal connector on the COM port you wish to assign as MODBUS. Reverse polarity of +/- on RS485 cable from E2 to the device.

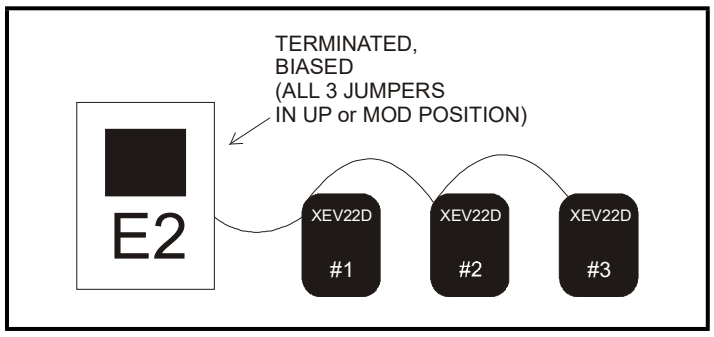


Figure 16-2 - MODBUS Networking

COM ports can only be used for one function; in other words, if COM2 is set up as the I/O network, you cannot connect MODBUS devices to COM2. Ensure your E2 is equipped with an RS485 COM Card *(P/N 637-4890)* and configured in E2 General Services (Menu 7 3 1, **Serial** tab) to enable COM4 or an E2 Expansion COM Card *(P/N 637-4871)* to enable COM6.

Connect the MODBUS network cable to the three-terminal connector on the COM port you wish to assign as MODBUS. Reverse polarity of +/- on RS485 cable from E2 to the device.

16.2 COM Port Associations - E2 Versions 4.2 and Above

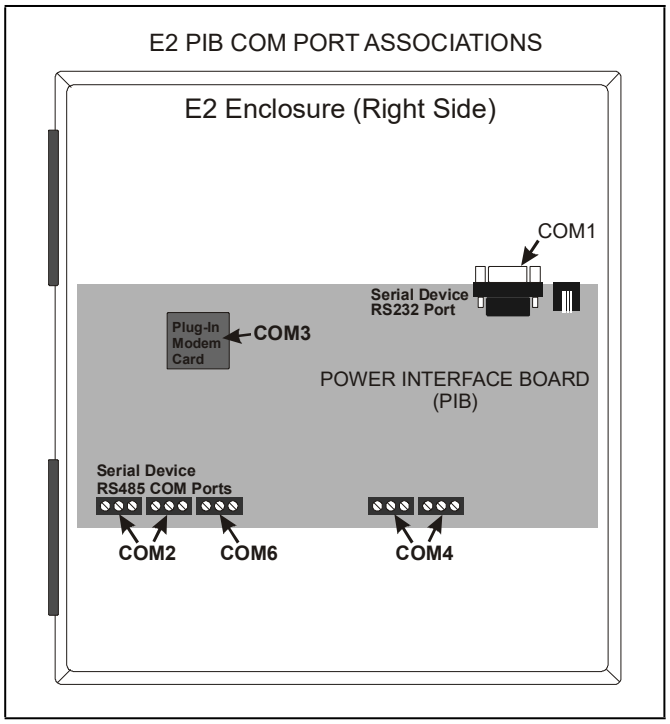


Figure 16-3 - Location of E2 COM Ports - E2 PIB Board (E2 version 4.2 and above)

An E2 has three COM ports that can be assigned for MODBUS communication (COM2). COM ports can only be used for one function; in other words, if COM2 is set up as the I/O network, you cannot connect MODBUS devices to COM2. Ensure your E2 is configured in E2 General Services (Menu 7 3 1, **Serial** tab) to enable COM4 or COM6.

16.3 E2 Setup of Devices

16.3.1 Set Up Network Ports

Before setting up device, the port on the E2 that has the MODBUS cable connected must be set up as a MODBUS port.

1. Log in to the E2 with Level 4 access.
2. Press Menu followed by & 7 # 3 ! 1 - **General Controller Info**.
3. Press Ctrl + # 3 to open the **Serial** tab of the General Controller Info setup screens:

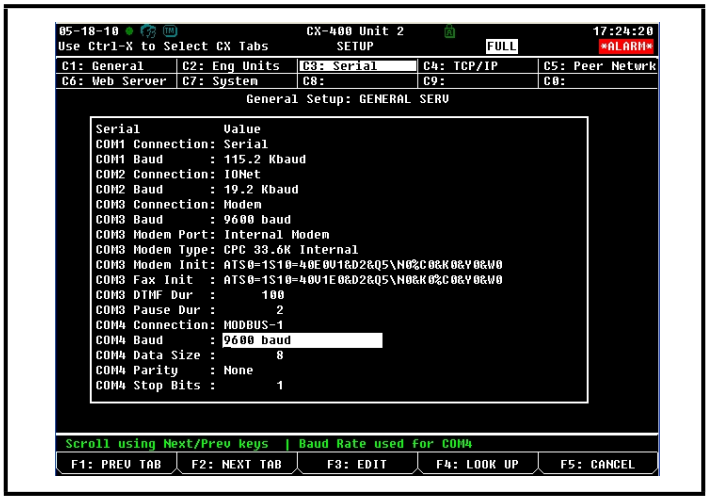


Figure 16-4 - Serial Communications Manager Screen

4. This screen will have a "Connection" field for all COM ports on the E2. Highlight the COM port connection field that will be used for the device, and press F4 - **LOOK UP**. From the list of network types, select **MODBUS**.
5. Four fields will become visible underneath the COM port connection field, which pertain to the way the device communicates:
   - **Baud -** Default setting is **19.2k**. The baud rate setting should be set to match the baud rate of the device (**9600**). (All devices connected to the same COM port should be set to the same baud rate.)
   - **Data Size -** Leave this field at the default value (**8**).
   - **Parity -** Leave this field at the default value (**None**).
   - **Stop Bits** - Leave this field at the default value (**1**).
6. Press ↵ to save changes and exit.

16.3.2 Add and Connect the Device

To enable communications between E2 and the units, the devices must be added and addressed in E2.

1. Log in to the E2 with Level 4 access.
2. Press Menu & 7 & 7 @ 2 - **Connected I/O Boards and Controllers**.

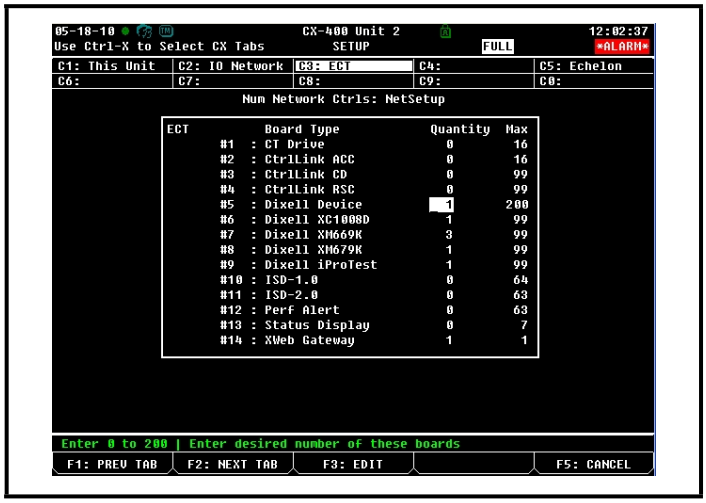


Figure 16-5 - Num Network Ctrls: NetSetup Screen

3. In the *Num Network Ctrls: NetSetup* screen, under the **ECT** tab, enter the number of devices in the **Quantity** field. (**Max** shows the maximum number of devices allowed on the network.)
4. Press ↵ to return to the *Network Setup* menu, then select ! 1 - **Network Summary**.
5. Locate the units you added to the network list (press Page Up and Page Down to scroll through the list). If desired, enter a new name for each device in the **Name** field.

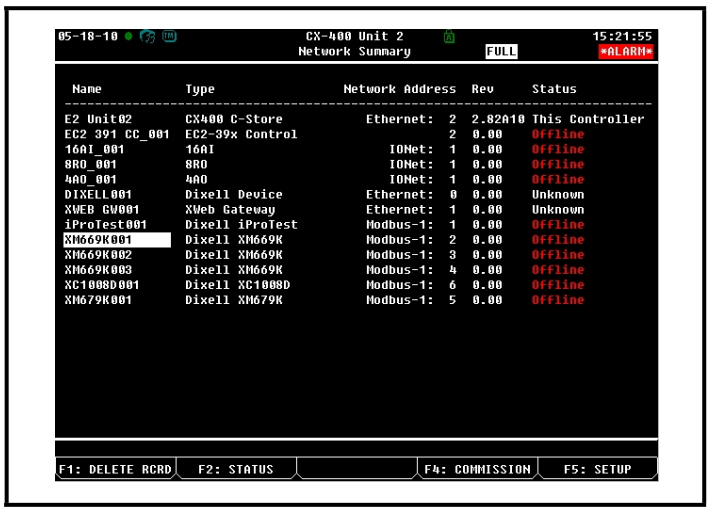


Figure 16-6 - Network Summary Screen

6. By default, each device in the network list has a board number of 0. To set the address and begin communication, choose the device and press F4. In the list of MODBUS devices, choose the address number corresponding to the address set up through the front display, and press Enter to select it. A window will open where you can specify the address of the controller. If a network ID has already been selected, its name will be shown next to the network ID in this list. If the network ID you are trying to assign has already been used, you must set the address on this device to a different number that is not being used.

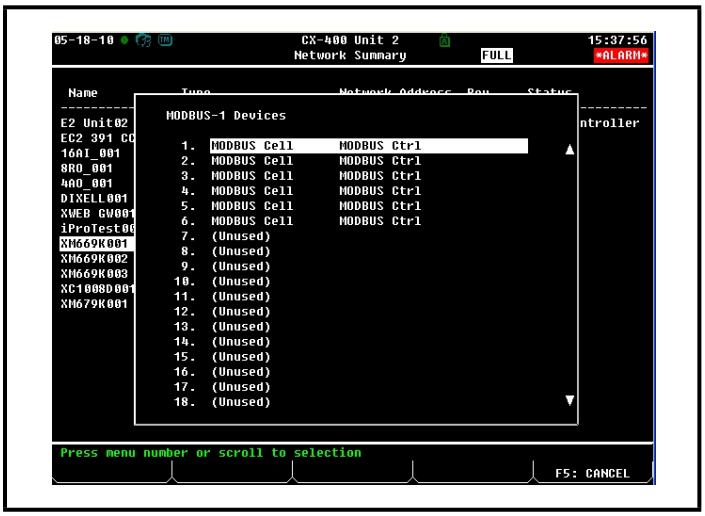


Figure 16-7 - List of MODBUS Devices

7. Repeat **Steps 5** and **6** until each device has a name and address.

8. When finished, press ESC to return to the *Network Setup* menu, then press 1 - **Network Summary** (**Figure 16-8**). Locate the devices you set up, and look at each device's status in the **Status** field. You will see one of the following messages:

   - **Online** - The device is communicating normally.
   - **Offline** - The device is not communicating, has not been commissioned, is not functional, or is not powered up. Verify the device is powered up, wired correctly, and has the proper network address, baud rate, and parity.
   - **Unknown** - The device is not communicating or has not been commissioned. Verify the device is powered up, wired correctly, and has the proper network address, baud rate, and parity.
   - **No Port** - No port is set up in the E2 Serial Configuration Manager to be a MODBUS port.
   - **Wrong FW Rev** - This message is likely caused by the device having a firmware version older than the minimum revision required by E2 for communication. Replace the device with a new one or a device that has the latest version of firmware on it.

Figure 16-8 - Network Summary Screen

16.4 Wiring Types

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

For MODBUS network wiring of XEV series of controllers to E2, Belden #8641 (*P/N 135-8641*) is the recommended wire type to use.

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

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
Maximum Length	4000 ft/18 to 22 AWG (1219.2 m) 2500 ft/24 AWG (762 m)
Nominal Impedance	120Ω±50Ω

The maximum distance between an XEV22 controller and a valve must not exceed 10 meters (32 feet). Use only shielded cables with a cross section greater than or equal to 0.325 mm^2 (AWG22).

16.5 MODBUS Termination Blocks

Because the XEV22D device has no on-board means of termination, use the MODBUS termination block (*P/N 535-2711*) for termination that can be wired to the end of the cable segment using the three-pin connector. Wire the two signal wires to the outside terminals, and connect the shield to pin **16**, keeping the exposed shield wire length as short as possible (3 inches ideal maximum length).

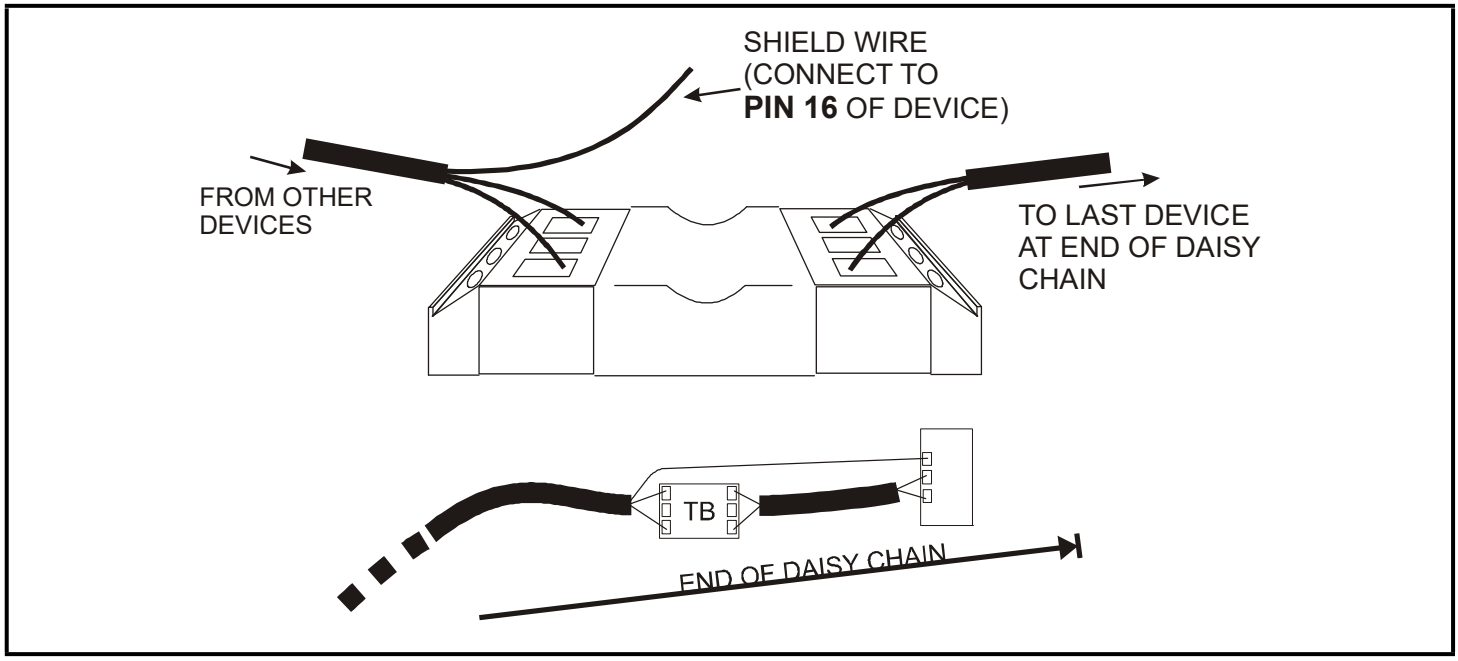


Figure 16-9 - MODBUS Termination Block (P/N 535-2711)

17 Standard Values

NOTE For viewing and adjusting setpoints, refer to: **Section 7.2, To View the Setpoint** and **Section 7.3, To Modify the Setpoint**.

Table 17-1 - XEV22D Standard Parameter Values

Label	Description	Range	Default	Level
StH	Superheat setpoint	0.0 to 24°C	3	---
Fty	Kind of gas	R22, 134, 404, 407, 410, 507, CO2	404	Pr2
rET	Reaction Time	0 to 100 sec	1	Pr2
PEo	Probe error opening percentage	0 to 100%	50	Pr2
PEd	Probe error delay before stopping regulation	0 to 239 sec - On	On	Pr2
tEU	Type of stepper motor	**uP** - **bP**	**bP**	Pr2
tEP	Automatic valve configuration	0 to 10	1	Pr2
HFS	Kind of driving	HAF; FUL	FUL	Pr2
LSt	Minimum number of steps	0 - **Ust**	See **tEP**	Pr2
Ust	Maximum number of steps	**LSt** - 800 * 10	See **tEP**	Pr2
ESt	Extra steps in closing phase	0 to 255 (*10)	0	Pr2
Sr	Step rate	10 to 600 step/s	See **tEP**	Pr2
CPP	Current per phase (only bipolar valves)	0 to 100 * 10mA	See **tEP**	Pr2
CHd	Holding current per phase (only bipolar valves)	0 to 100 * 10mA	See **tEP**	Pr2
oPE	Start opening percentage	0 to 100%	45	Pr2
SFd	Start function duration	0.0 to 42.0 min: tens of seconds	00:20	Pr2
dty	Pilot duty	2 to 10 dec/sec	10	Pr2
Std	Stop duration	0 to 60 min	0	Pr2
MnF	Maximum opening percentage	0 to 100%	100	Pr2
FOP	Forced opening time-out	0 to 100% - **not used**	**not used**	Pr2
PI PARAMETERS (For trained staff use only)				
AMS	Self Adaptive SH regulation enabling	No; Yes	No	Pr2
Atu	Minimum stable superheat search	No; Yes	No	Pr2
Pb	Proportional band	0.1 to 50.0°C/ 1 to 90°F	Δ20.0°C	Pr2
rS	Band offset	-12.0 to 12.0°C/ -21 to 21°F	Δ0.0°C Δ0.0°F	Pr2
inC	Integration time	0 to 255 sec	185	Pr2
dFC	Derivative time	0 to 255 sec	1	Pr2

Table 17-1 - XEV22D Standard Parameter Values

Label	Description	Range	Default	Level
		PROBE PARAMETERS		
tPP	Type of pressure transducer	420 - 5V- LAn	5V	Pr2
LPP	Enable pressure probe sending in LAN	**n** to **Y**	**n**	Pr2
PA4	Probe value at 4mA or at 0V (related to **PrM** parameter)	-1.0 to P20 bar/ -14 to P20 PSI	0.0	Pr2
P20	Probe value at 20mA or at 5V (related to **PrM** parameter)	**PA4** to 50.0 bar/ 725 PSI	200.0	Pr2
OPr	Pressure probe calibration	-12.0 to 12.0 bar/ -174 to 174 psi	Δ0.0°F	Pr2
ttE	Type of temperature probe	**PtM** to **ntC**	**CtC**	Pr2
otE	Temperature probe calibration	-12.0 to 12.0°C/ -21 to 21°F	Δ0.0°F	Pr2
		DIGITAL INPUTS		
i1P	Free of voltage digital input polarity	**CL** - **OP**	**CL**	Pr2
iLF	Free of voltage digital input function	**CCL** - **rL**	**CCL**	Pr2
d1d	Digital input 1 (free of voltage) activation delay	0 to 255 min	0	Pr2
i2P	Main voltage digital input polarity	**CL** - **OP**	**CL**	Pr2
i2F	Main voltage digital input function	**CCL**, **rL**	**CCL**	Pr2
d2d	Digital input 2 (Main voltage) activation delay	0 to 255 min	0	Pr2
		ALARMS		
dAo	Alarm delay after restarting regulation	0.0 to 42.0 min: tens of seconds	10.0	Pr2
tdA	Type of alarm signaled by relay	**ALL**, **SH**, **PrE**, **di**	**ALL**	Pr2
bon	Buzzer enbaling	No; Yes	No	Pr2
tbA	Alarm relay silencing	No; Yes	No	Pr2
LPL	Lower pressure limit for superheat regulation (related to **PrM** parameter)	**PA4** to **P20** bar/ PSI	0.0	Pr2
MOP	Maximum operating pressure threshold (related to **PrM** parameter)	**PA4** to **P20** bar/ PSI	11.0	Pr2
LOP	Minimum suction pressure limit (related to **PrM** parameter)	**PA4** to **MoP** bar/ PSI	0.0	Pr2
PHy	Pressure alarm hysteresis	0.1 to 5.0 bar/ 1to 72 PSI	1.0	Pr2
dML	delta **MOP**-**LOP**	0 to 100%	5	Pr2
MSH	Maximum superheat alarm	**LSH** to 32.0°C/ **LSH** to 176°F	80.0	Pr1
LSH	Lowest superheat alarm	0.0 to **MSH**°C/ 32 to **MSH**°F	4	Pr1
SHy	Superheat hysteresis	0.1 to 25.5°C/ 1 to 77°F	1	Pr2
SHd	Superheat alarm activation delay	0 to 255 sec	120	Pr1

Table 17-1 - XEV22D Standard Parameter Values

Label	Description	Range	Default	Level
DISPLAY				
tdS	Pressure filter	0 to 240 sec	5	Pr2
tdt	Temperature filter	0 to 240 sec	3	Pr2
Lod	Local display	**SH** - **PEr** – **P1** - **P2**	**SH**	Pr1
CF	Temperature measurement units	°C - °F	°F	Pr2
PMU	Pressure measurement unit	**bAr** – **PSI**	**PSI**	Pr2
rES	Resolution (only °C)	**dE** – **in**	**dE**	Pr2
PrM	Type of pressure (absolute/ relative)	**rEL** – **AbS**	**rEL**	Pr2
CLP	Cooling call percentage	Read only	---	Pr2
tP1	Temperature probe value	Read only	---	Pr1
PPr	Pressure probe value	Read only	---	Pr1
tP2	Temperature converted from pressure probe	Read only	---	Pr1
SH	Superheat value	Read only	---	Pr1
STH	Superheat setpoint value	Read only	---	Pr1
OPP	Actual opening percentage	Read only	---	Pr1
d1S	Free of voltage digital input state	Read only	---	Pr1
d2S	Main voltage digital input state	Read only	---	Pr1
Adr	Serial address	1 to 247	1	Pr2
Mod	MODBUS type	**StD** – **AdU**	**StD**	Pr2
Ptb	Parameters map	---	---	Pr2
rEL	Release software	---	---	Pr2
Pr2	Second level menu	---	---	Pr1

Appendix A - Alternate MODBUS COM Wiring Method for E2, XR, XM, and XEV Devices

Overview

To simplify MODBUS communication wiring with E2, (both Standard and Enhanced versions) XR, XM, and XEV series devices, the alternate method outlined below may be used.

Wire Type

Use Belden 8761 or equivalent cable.

Shield

DO NOT connect the shield to the device. Keep the shield continuous throughout a network segment. The shield must be twisted together and insulated with electrical tape or heatshrink at each device within a network segment. Securely connect the shield to an earth grounded chassis at each end of a network segment.

Termination

Each network segment must be biased and terminated at the E2 controller's end (all three jumpers in the MOD position for E2 Enhanced, or all three jumpers in the UP position for E2 Standard) and terminated with a 150 ohm resistor at the other end of the network segment (150 ohms between the two communication wires).

Recommended

For reliable communication on some installations, it may be necessary to connect a 100 ohm resistor between the XR, XM, or XEV device's previously identified ground terminal and earth ground.

Some E2 MODBUS COM Ports Can Support Two Network Segments

For E2 Enhanced 4.x Controller Hardware

COM2 supports two network segments: one on connector RS485-COM2A, and the second on connector RS485-COM2B.

COM4 supports two network segments: one on connector RS485-COM4A, and the second on connector RS485-COM4B.

COM6 only supports one network segment on connector RS485-COM6.

For E2 Standard 3.x Controller Hardware

COM2 supports two network segments: one on connector RS485-1A, and the second on connector RS485-1B.

For information on the maximum recommended number of XR, XM, and XEV devices for each network segment (load and bandwidth calculations), contact Copeland Technical Support at 770-425-2724.

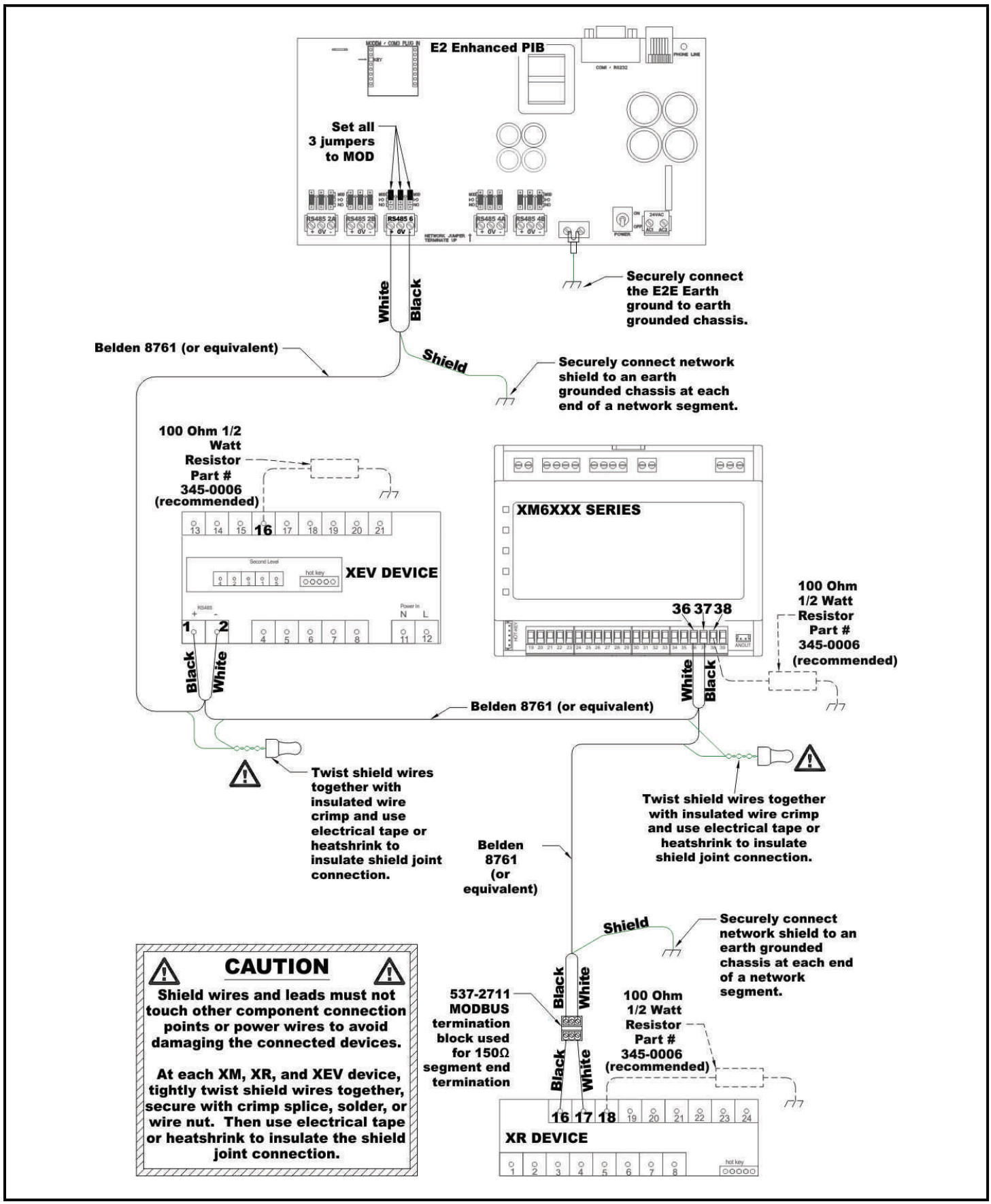


Figure A -1 - MODBUS Com Wiring Diagram

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For Technical Support call **833-409-7505** or email **ColdChain.TechnicalServices@Copeland.com**

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