Operating instructions

P/N 865917/Rev07

EXD-SH1/2 Controller with ModBus communication capability for electrical control valves

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General information:

EXD-SH1/2 are stand-alone superheat and or temperature controllers. EXD-SH1 is intended for operation of one bipolar electrical control valve whereas EXD-SH2 is designed for operation of two independent bipolar electrical control valves.
A table of the available application possibilities is listed below:

Controller	Circuit 1: Main function	Circuit 2: Main function
EXD-SH1	Superheat or temperature control	
EXD-SH2	Superheat or temperature control	Superheat Control

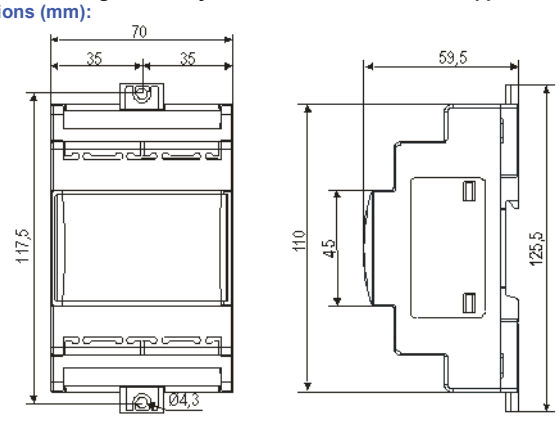
Notes:
It is possible to use only circuit 1 from EXD-SH2. In this case, the circuit 2 must be disabled (C2 parameter) and the sensors and the valve for the second circuit are not needed.
ModBus communication is described in a Technical Bulletin and it is not covered by this document.

Technical data:

Power supply	24VAC/DC +10%/-10% 50/60HZ,
Power consumption	EXD-SH1: 25VA EXD-SH2: 50VA
Plug-in connector	Removable screw terminals wire size 0.14...1.5 mm^2
Protection class	IP00
Temperature sensors	ECN-N… / TP1… (temperature range down to -45°C) ECN-Z… (temperature range down to -80°C ultra low temperature)
Allowable operating/surrounding temperature	0…+55°C
Maximum cable distance between EXD-SH and EXD-PM	50 cm AWG 18 wire size (≥ 1mm^2)
Pressure sensors	PT5N, PT5N-FLR or ratiometric probes
Output alarm relay current rating	Resistive Load 24 V AC/DC, 1 A Inductive Load 24 V AC/DC, 0.5 A
Contact is closed:	During alarm condition
Contact is open:	During normal operation and supply power OFF
Stepper motor output	Valves: EX4-8 (EX4-7-FLR) CV4-7
Mounting	For standard DIN rail
Marking	CE

Warning:
EXD-SH1/2 (EXD-PM, ECP-024) has a potential ignition source and does not comply with ATEX requirements. Installation only in non-explosive environment. For flammable refrigerants only use valves and accessories approved for it!

Dimensions (mm):

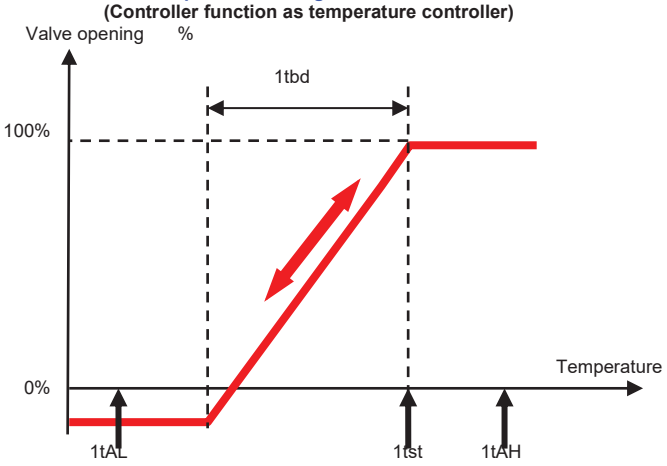


Safety instructions:

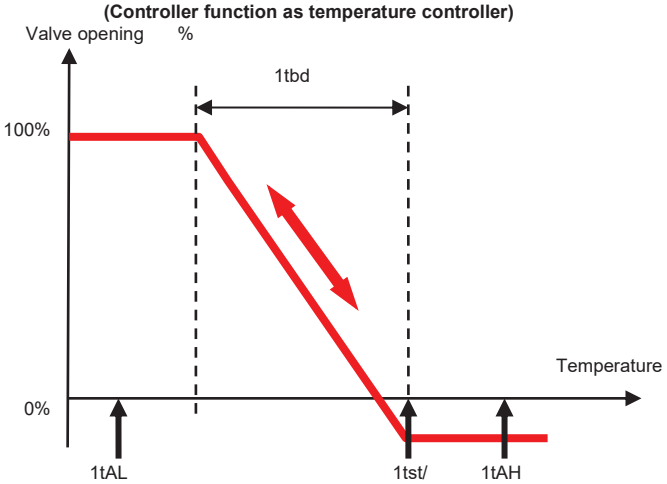
- **Read operating instructions thoroughly. Failure to comply can result in device failure, system damage or personal injury.**
- **It is intended for use by persons having the appropriate knowledge and skill.**
- **Before installation or service disconnect all voltages from system and device.**
- **Do not operate system before all cable connections are completed.**
- **Do not apply voltage to the controller before completion of wiring.**
- **Entire electrical connections have to comply with local regulations.**
- **Inputs are not isolated, potential free contacts needed to be used.**

- **Disposal: Electrical and electronic waste must NOT be disposed of with other commercial waste. Instead, it is the user responsibility to pass it to a designated collection point for the safe recycling of Waste Electrical and Electronic Equipment (WEEE directive 2012/19/EU). For further information, contact your local environmental recycling center.**

Temperature setting in normal sense
(Controller function as temperature controller)



Temperature setting in reverse sense
(Controller function as temperature controller)



Electrical connection and wiring:

- **Refer to the electrical wiring diagram for electrical connections.**
- **Note: Keep controller and sensor wiring well separated from supply power cables. Minimum recommended distance 30 mm.**
- **When connecting the wires of the EXV-M… (electrical plug of valves) consider the color coding as follows:**
  EXV-M…: WH: White; **BK**: Black; **BN**: Brown; **BL**: Blue

- The digital input DI1 (EXD-SH1/SH2) and DI2 (EXD-SH2) are the interfaces between EXD-SH1/2 and upper level system controller if the Modbus communication has not been used. The external digital inputs must be free of potential (dry contact) and shall be operated in function system's compressor/demand.

Operating condition	Digital input status
Compressor starts/run	External contact to be closed (Start)
Compressor stops	External contact to be open (Stop)

Note: Connecting any EXD-SH1/2 inputs to the supply voltage will permanently damage the EXD-SH1/2

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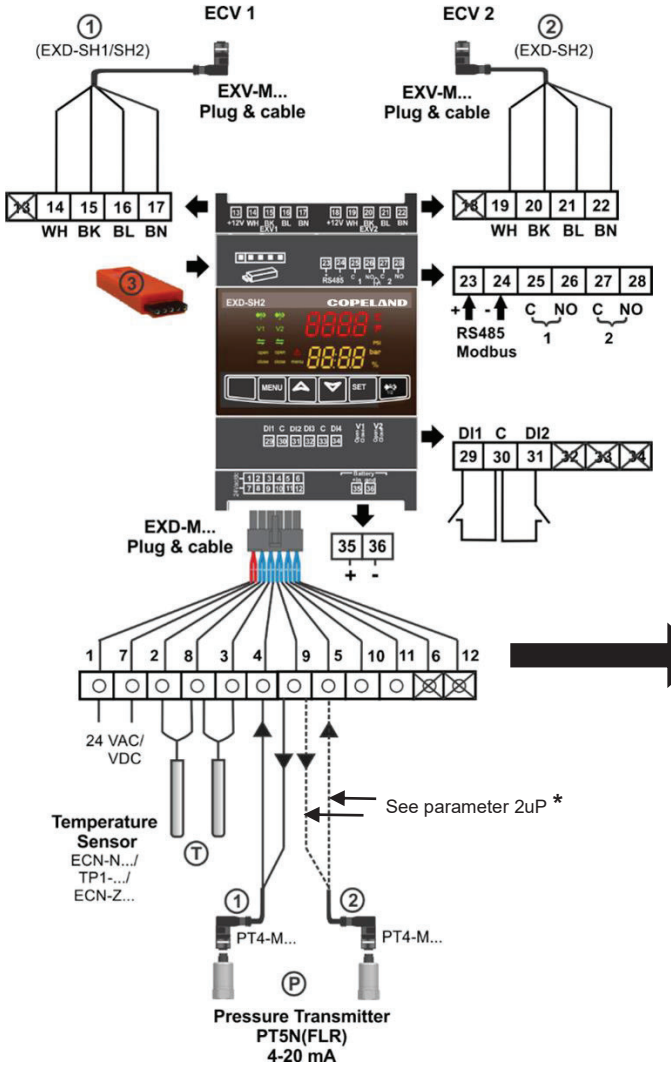
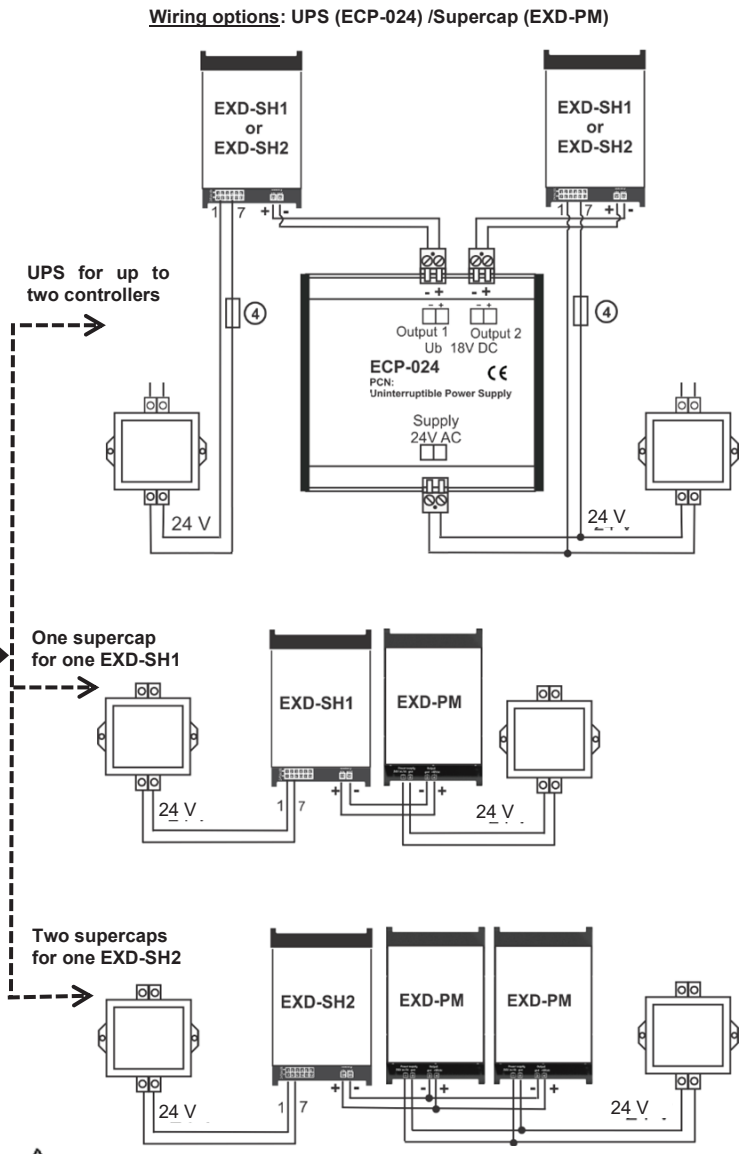




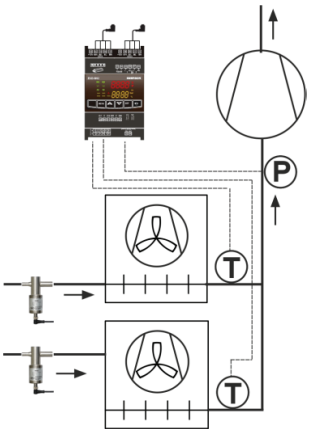
Note: When RS485 is not used, multiple EXD-SH1/2 can be powered from one transformer

Warning:

- **Use a class II category transformer for 24VAC power supply. Do not ground the 24VAC lines. We recommend using individual transformers for EXD-SH1/2 controller and for third party controllers to avoid possible interference or grounding problems in the power supply.**
- **If EXD-PM is connected, it is mandatory to have individual transformer for EXD-SH… and EXD-PM.**

①	Circuit 1 (EXD-SH1/SH2)	**14-17**	Electrical control valve circuit 1 (ECV1) EXV-M… Electrical plug: wire colors *WH-white BK-black BL-blue BN-brown*
②	Circuit 2 (EXD-SH2)		
③	Download/upload key	**19-22**	Electrical control valve circuit 2 (ECV2) EXV-M… Electrical plug: wire colors *WH-white BK-black BL-blue BN-brown*
1 and 7	Supply voltage 24 VAC/DC		
2 and 8	Temperature sensor circuit 1	**23 and 24**	RS485 (+/-terminal)
3 and 8	Temperature sensor circuit 2	**25 and 26**	Alarm relay circuit 1 (C, NO) – Suitable for 24 VAC/DC
4 and 5	PT5N… circuit 1 & circuit 2 (white wire: 4 – 20 mA signal)	**27 and 28**	Alarm relay circuit 2 (C, NO) – Suitable for 24 VAC/DC
9	+ 12VDC Voltage input for PT5N… (brown wire)	**29 and 30**	Digital input circuit1 (DI1) – Dry contact, potential free
Alternative ratiometric third Party Pressure Transmitter: *Warning: Read the note in the last page for limitation of error condition*		**31 and 30**	Digital input circuit 2 (DI2) – Dry contact, potential free
4 and 5	Pressure transmitter circuit 1 & circuit 2 (0.5 - 4.5 V signal)	**35 and36**	Battery/Super capacitor connection terminal
11	+ 5 VDC voltage input	④	Fuse: EXD-SH1 (1A), EXD-SH2 (2A)
10	GND Ground	**6,12,13, 18,32-34**	Not used (Terminals on EXD-SH12)

*) Parameter **2uP** with No. 9 = only pressure sensor circuit 1 is used



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Preparation for Start-up:

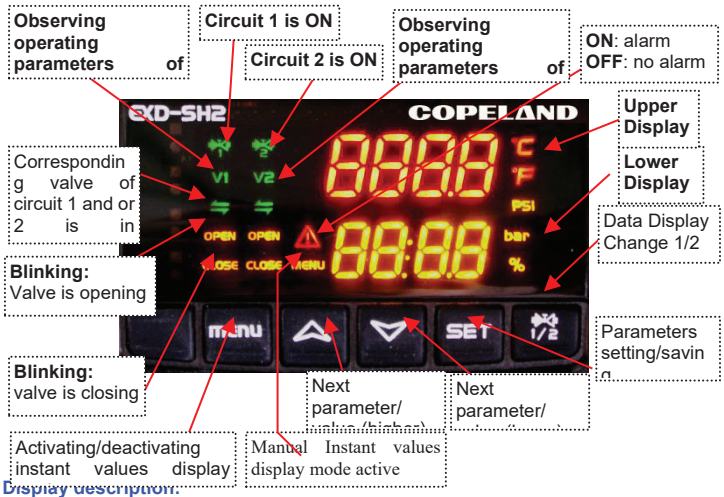
- Vacuum the entire refrigeration circuit.
- **Note: EXV/CV valves are delivered partially open position. Do not charge system with refrigerant before closure of valve.**
- Apply supply voltage 24V to EXD-SH1/2 while the digital input (DI1/DI2) is open. The valve will be driven to close position.
- After closure of valve, start to charge the system with refrigerant.

Setup of parameters:

(need to be checked/modified before system start-up)

- Make sure that digital input (DI1/DI2) is open. Turn on the 24V power supply to EXD-SH1/2.
- Parameters Password (H5), type of function (1Fct), refrigerant type (1u0/2u0), pressure sensor type (1uP/2uP) and valve scaling (1uF/2uF) need to be set according system requirement and only when digital input DI1/DI2 is open. This feature is for added safety to prevent accidental damage of compressors and other system components.
- Once the main parameters have been selected and saved, the EXD-SH1/2 is ready for startup. All other parameters can be modified at any time during operation or in system standby, if it is necessary.

Display/keypad unit: (LEDs and button functions)



Display description:

	Selected main function		
	Superheat control		Temperature control
	Compressor ON	Compressor OFF	
Upper display shows	Superheat (K/F)	Superheat (K/F)	Controlled temperature (°C/F)
Lower display shows	Valve opening (%)	Suction pressure (bar/psig)	Valve opening (%)

Note: when Superheat value is blinking, the controller is in MOP function.

Instant value display mode:

- The controller displays the values of one circuit at a time, to change from one circuit to the other, press 1/2 button (Function only for EXD-SH2).
- By pressing the MENU key, the instant value display mode can be activated/deactivated, which allows the user to check the measured/calculated values in real time in a sequence shown as below table:

Value on upper display	Code on lower display
Superheat (K/F)	SH
Valve opening (%)	OPEn
Suction temperature (°C/°F)	tASP
Suction pressure (bar/psig)	PEuA
Saturation temperature (°C/°F)	tEuA
Software version: (0A)	SH1 or SH2
Repeating display of values	

Parameter configuration mode:

The configuration of parameters is protected by a numerical password. The default password is "**12**". To enter the parameter configuration:

- Press both the ▼ and SET buttons for more than 5 seconds.
- A flashing "0" is displayed in upper and "PAS" at lower.
- Press ▲ until "12" is displayed; (password).
- Press SET to confirm password.
- Press ▲ or ▼ to show the code of the parameter (see table of parameter codes) that has to be accessed/changed.
- Press SET to choose and adjust parameter value.
- Press ▲ or ▼ to increase or decrease the value.
- Press SET to temporarily confirm the new value. The selected value blinks a few times and the display shows the next available parameter code.
- Repeat the procedure for other parameters if needed.

To exit and save the new settings:

- When all parameters where changed press MENU to save all the new values and exit the parameters modification procedure.

To exit and not save the new settings:

- Press SET and ▲ to cancel the parameter modification and delete any changes made.
- Another way to exit without saving the changes made at the parameters is to not press any button for at least 120 seconds (TIME OUT).
- **Note: While in parameter modification mode, the controller will display the parameter code on the lower display and the parameter value on the upper display.**

Special manual functions: (Rest, clear)

- Press both the ▼ and ▲ buttons for more than 5 seconds.
- A flashing "0" is displayed.
- Press ▲ until "12" is displayed; (if default password has been changed, it must select the new password)
- Press SET to confirm password
- Select the special function as explained at the parameter configuration mode

The special functions are:

Displayed Value	Code
Factory Reset	-Fdt
Clear Alarms (only manual reset)	ALrr

- The default value for each variable is 0, when it set to 1 it will trigger the corresponding function.
- The factory reset of the controller (-Fdt) is possible when digital input DI1/DI2 is open.

Manual Valve operation (service /maintenance):

- Press SET for more than 5 seconds

Select, modify and save the variables like explained at the parameter configuration mode

Code	*Parameter description and choices*	*Min*	*Max*	*Factory setting*	*Field setting*
1Ho	Manual mode operation; circuit 1 0 = disabled 1 = Enabled	0	1	0	
1HP	Valve opening (%)	0	100	0	
2Ho	Manual mode operation; circuit 2 0 = disabled 1 = Enabled	0	1	0	
2HP	Valve opening (%)	0	100	0	

Note: During manual operation, functional alarms such as low superheat are disabled. It is recommended to monitor the system operation when the controller is operated manually. Manual operation is intended for service or temporary operation of valve at a specific condition. After achieving the required operation, set the parameter 1Ho and 2Ho at 0 so the controller automatically operates the valve(s) according to its setpoint(s).

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List of parameters in scrolling sequence by pressing button:

Code	Parameter description and choices	Min	Max	Factory setting
H5	Password	1	1999	12
Adr	ModBus address	1	127	1
br	Modbus baudrate	0	1	0
PAr	Modbus parity	0	1	0
-C2	Circuit 2 of EXD-SH2 enabled 0 =Disabled 1 = Enabled	0	1	1
-uC	Units conversion 0 = °C, K, bar, 1 = °F, psig	0	1	0
Circuit 1 Parameters				
1Fct	Function 0 = Superheat control 1 = Temperature control normal sense 2 = temperature control reverse sense	0	2	0
1u4	Control Mode 0 = standard 1 = slow 2 = intermediate control 3 = adjustable fixed PID	0	3	0
1u0	Refrigerant type 0 = R22 1 = R134a 2 = R507 3 = R404A 4 = R407C 5 = R410A 6 = R124 7 = R744 8 = R407A 9 = R407F 10 = R23 11 = R32* 12 = R1234ze* 13 = R448A 14 = R449A 15 = R450A 16 = R513A 17 = R290* 18 = R1270* 19 = R454C* 20 = R452B* 21 = R454B* 22 = R454A* 23 = R452A 24= R444B* 25 = R455A* 26 = R1233zde* 27= R1234yf*	0	27	1
1uP	Pressure sensor type 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150D 5 = PT5N-10P-FLR 6 = Ratio metric (gauge) 7 = Ratio metric (absolute) 8 = Modbus	0	8	1
1Prr	Ratio metric range (bar)	3	60	30
1ut	Valve type 0 = EX4-6(FLR) 1 = EX7(FLR) 2 = EX8 3 = N/A 4 = N/A 5 = N/A 6 = N/A 7 = N/A 8 = N/A 9 = N/A 10 = CV4 11 = CV5-6 12 = CV7	0	12	0
1uF	Valve scaling (%)	5	100	100
1uu	Start opening (%)	0	100	10
1u9	Start opening duration (s)	0	120	5
1uL	Low superheat alarm 0 = disabled 1 = enabled auto reset 2 = enabled manual reset Alarm at 0.5K (if it maintains 1 min.); Alarm clear immediately at 3K	0	2	1
1u5	Superheat set point (K) Range = 3-30 K if 1uL = 1 or 2, Range = 0.5-30 K if 1uL = 0			6
1u2	MOP function 0 = disabled 1 = Enabled	0	1	1
1u3	MOP saturation temp (°C) Factory setting according to selected refrigerant (1u0). The default value can be changed	(see MOP default value table)		
1P9	Low pressure alarm mode 0 = disabled 1 = enabled auto-reset 2 = enabled manual reset	0	2	0
1PA	Low pressure alarm cut-out (bar)	-0.8	17.7	0
1Pb	Low pressure alarm delay (s)	5	199	5
1Pd	Low pressure alarm cut-in (bar)	-0.5	18	0.3
1P4	Freeze alarm delay mode 0 = disabled 1 = enabled auto-reset 2 = enabled manual reset	0	2	0
1P2	Freeze alarm cut-out (°C)	-5	5	0
1P5	Freeze alarm delay (s)	5	199	30
1P-	Superheat control circuit1 (Kp factor) Display 1/10K	0.1	10	1.0
1i-	Superheat control circuit1 (Ti factor)	1	350	100
1d-	Superheat control circuit1 (Td factor) Display 1/10K	0.1	30	3.0
1uH	High superheat alarm mode 0 = disabled 1 = enabled auto-reset;	0	1	0
1uA	High superheat alarm set point (K)	16	40	30
1ud	High superheat alarm delay (min)	1	15	3
1tSt	Temperature control set point (°C)	-80	50	4
1tbd	Temperature band (K)	1	10	2
1tAF	Temperature alarm mode 0 = disabled 1 = enabled	0	1	0
1tAL	Min. temperature alarm set point (°C)	-50	50	0
1tdL	Min. temperature alarm delay (min)	1	10	3
1tAH	Max. temperature alarm set point (°C)	-50	50	15
1tdH	Max. temperature alarm delay (min)	1	10	3
1tt	Temperature sensor type 0 = ECN-Nxx (-45…+40°C) / TP1-…(-45…+150°C) 1 = ECN-Z... (-80…-40°C) for R23	0	1	0

Code	Parameter description and choices	Min	Max	Factory setting
Circuit 2 Parameters (only EXD-SH2)				
2u4	Control Mode 0 = standard 1 = slow 2 = intermediate control 3 = adjustable fixed PID	0	3	0
2u0	Refrigerant type 0 = R22 1 = R134a 2 = R507 3 = R404A 4 = R407C 5 = R410A 6 = R124 7 = R744 8 = R407A 9 = R407F 10 = R23 11 = R32* 12 = R1234ze* 13 = R448A 14 = R449A 15 = R450A 16 = R513A 17 = R290* 18 = R1270* 19 = R454C* 20 = R452B* 21 = R454B* 21 = R454A* 22 = R452A 23= R444B* 24 = R455A* 25 = R1233zde* 26 = R1234yf*	0	27	1
2uP	Pressure sensor type 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150D 5 = PT5N-10-FLR 6 = Ratio metric (gauge) 7 = Ratio metric (absolute) 8 = Modbus 9 = Pressure sensor circuit1 is used (1uP)	0	9	1
2Prr	Ratio metric range (bar)	3	60	30
2ut	Valve type 0 = EX4-6(FLR) 1 = EX7(FLR) 2 = EX8 3 = N/A 4 = N/A 5 = N/A 6 = N/A 7 = N/A 8 = N/A 9 = N/A 10 = CV4 11 = CV5-6 12 = CV7	0	12	0
2uF	Valve scaling (%)	5	100	100
2uu	Start opening (%)	0	100	10
2u9	Start opening duration (s)	0	120	5
2uL	Low superheat alarm 0 = disabled 1 = enabled auto reset 2 = enabled manual reset Alarm at 0.5K (if it maintains 1 min.); Alarm clear immediately at 3K	0	2	1
2u5	Superheat set point (K) Range = 3-30 K if 2uL = 1 or 2, Range = 0.5-30 K if 2uL = 0	0.5	30	6
2u2	MOP function 0 = disabled 1 = Enabled	0	1	1
2u3	MOP saturation temp (°C) Factory setting according to selected refrigerant (2u0). The default value can be changed	(see MOP default value table)		
2P9	Low pressure alarm mode 0 = disabled 1 = enabled auto-reset 2 = enabled manual reset	0	2	0
2PA	Low pressure alarm cut-out (bar)	-0.8	17.7	0
2Pb	Low pressure alarm delay (s)	5	199	5
2Pd	Low pressure alarm cut-in (bar)	-0.5	18	0.3
2P4	Freeze alarm delay mode 0 = disabled 1 = enabled auto-reset 2 = enabled manual reset	0	2	0
2P2	Freeze alarm cut-out (°C)	-5	5	0
2P5	Freeze alarm delay (s)	5	199	30
2P-	Superheat control circuit2 (Kp factor), fixed PID Display 1/10K	0.1	10	1.0
2i-	Superheat control circuit2 (Ti factor), fixed PID	1	350	100
2d-	Superheat control circuit2 (Td factor), fixed PID Display 1/10K	0.1	30	3.0
2uH	High superheat alarm mode 0 = disabled 1 = enabled auto-reset;	0	1	0
2uA	High superheat alarm set point (K)	16	40	30
2ud	High superheat alarm delay (min)	1	15	3
2tt	Temperature sensor type 0 = ECN-Nxx (-45…+40°C) / TP1-…(-45…+150°C) 1 = ECN-Z60 (-80°C…-40°C) for R23	0	1	0

*) ⚠ **Warning -Flammable refrigerants:**

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MOP default value table (°C):

Refr.	Min.	Max.	(C°)	Refr.	Min.	Max.	(C°)	Refr.	Min.	Max.	(C°)
R22	-70	+50	+13	R23	-70	-18	-40	R452B	-45	+66	+25
R134a	-57	+66	+15	R32	-52	+30	+15	R454B	-40	+45	+18
R507	-75	+42	+7	R1234ze	-57	+66	+24	R454A	-57	+66	+10
R404A	-76	+42	+7	R448A	-57	+66	+12	R452A	-45	+66	+15
R407C	-66	+48	+15	R449A	-57	+66	+12	R444B	-45	+66	+15
R410A	-52	+30	+15	R450A	-57	+66	+19	R455A	-57	+66	+14
R124	-45	+91	+50	R513A	-57	+66	+13	R1233zde	-45	+90	+15
R744	-40	-4	-5	R290	-66	+48	+15	R1234yf	-52	+66	+15
R407A	-66	+48	+10	R1270	-66	+48	+15				
R407F	-66	+48	+10	R454C	-66	+48	+17				

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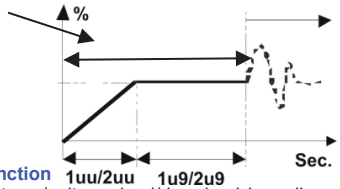
Control (valve) start-up behavior factory settings
(1uu + 1u9) / (2uu +2u9)



EX4/5/6	≤ 5.3 Seconds
EX7	≤ 5.6 Seconds
EX8	≤ 5.9 Seconds
CV4	≤ 5.3 Seconds
CV5/6	≤ 5.3 Seconds
CV7	≤ 6.6 Seconds

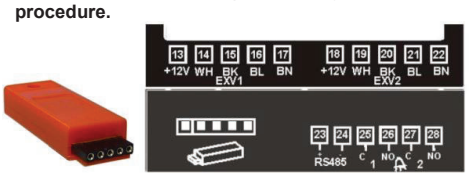
Upload/download Key: Function
For serial production of systems/units, upload/download key allows the transmission of configured parameters among range of identical systems.

Uploading procedure (storing configured parameters in key):

- Insert the key while the first (reference) controller is ON and press button; the "**uPL**" message appears followed by "**End**" message for 5 seconds.
- **Note: If the "Err" message is displayed for failed programming, repeat the above procedure.**

Downloading procedure (configured parameters from key to other controllers):

- Turn off power to new controller.
- Insert a loaded Key (with stored data from reference controller) into new controller and turn on the power supply.
- The stored parameters of the key will be downloaded automatically into the new controller memory; The "**doL**" message appears followed by a "**End**" message for 5 seconds.
- The new controller with new loaded parameters setting will start to operate after "**End**" message disappears.
- Remove the key.
- **Note: If the "Err" message is displayed for failed programming, repeat the above procedure.**



Error/Alarm handling:

Alarm code	Description	Related parameter	Alarm relay	Valve	What to do?	Requires clear alarm after resolving alarm
1E0/2E0	Pressure sensor circuit 1/2 error	-	Triggered	Fully close	Check wiring connection and measure the signal.	No
1E1/2E1	Temperature sensor circuit 1/2 error	-	Triggered	Fully close	Check wiring connection and measure the resistance of sensor.	No
1П-/2П-	Valve Circuit 1/2 electrical connection error	-	Triggered	-	Check wiring connection and measure the resistance of winding.	No
AFE 1/2	Freeze protection circuit 1/2	1P4/2P4:1	Triggered	Fully close	Check the system for cause of low pressure such as insufficient load on evaporator.	No if it is ON
AFE 1/2		1P4/2P4:2	Triggered	Fully close		Yes if it is blinking
LSH 1/2	Low superheat (<0,5K)	1uL/2uL:1	Triggered	Fully close	Check wiring connection and operation of valve.	No if it is ON
LSH 1/2		1uL/2uL:2	Triggered	Fully close		Yes if it is blinking
tAL1	Min. temperature alarm	1tAL	Triggered	Fully close	Check wiring connection, operation of valve, size of valve and load.	No
tAH1	Max. temperature alarm	1tAH	Triggered	Fully close		No
HSH 1/2	High superheat circuit 1/2	1uH/2uH:1	Triggered	Operating	Check the system.	No
LOP 1/2	Low pressure circuit 1/2	1P9/2P9 1	Triggered	Operating	Check the system for cause of low pressure such as refrigerant loss.	No if it is ON
LOP 1/2		1P9/2P9 2	Triggered	Operating		Yes if it is blinking
Err	Failed uploading/downloading	-	-	-	Repeat again the procedure for uploading/downloading.	No
ACEr	Modbus Timed Out	-	-	-	Check Modbus communication. Note: Modbus alarm (ACEr) detection is active only when the pressure sensor type is configured to be Modbus type and the corresponding circuit is on demand.	No
PFA	Power failure alarm	-	Triggered	Fully close	When the controller is connected to the battery supply and power supply interrupted, this alarm code will be displayed while the valve is closing.	No

ACF1 or ACF2: Alarm code (circuit1/2) for "not permitted configuration/ selection" Alarm will be displayed for the following cases:

- If two circuits of the EXD-SH2 are connected to two different type of pressure transducers i.e. 4-20 mA and 0-5 V. It is mandatory that two circuits always are connected to the same type of pressure transmitter technology.
- Temperature control function is possible only with EX4-8 series valves. If other valves are used, then the ACF alarm will be displayed.
- Ratiometric pressure transmitters cannot be selected in conjunction with R744.

Notes:

- **When several alarms are present, the alarms will be shown one after the other on the lower display.**
- **Pressure sensor error for third party ratiometric pressure transmitters is based on detection of interruption of two wires (5 V and signal 0.5 - 4.5 V). If only third wire (ground) is open/ interrupted, no error can be detected and controller will receive a false signal between 50% and 100% higher. This false signal leads to improper operation of EXD-SH1/2 controller and can lead to system/compressor damage. COPELAND is not responsible in such cases.**

Service / Troubleshooting:

Symptom	Cause	Action
Operating superheat is several degrees higher or lower than set-point	Incorrect signal from pressure or temperature sensors	1- Check the sensors (see list of parameters) 2- Make sure the sensor cables are not installed along with other high voltage cables
Operating superheat is too low i.e. compressor wet running	1- Incorrect wiring of ECVs 2- Defective sensors	1- Check the wiring 2- Check the sensor
Valve is not fully closed	1- The digital input is ON 2- Wrong setting of parameter ut.	1- Valve is shut off only when the digital input is turned off. 2- Check the setting of parameter ut.
Instable superheat (hunting)	Evaporator is designed to operate at higher superheat	Increase the superheat set-point.
Valve opens when EXD commands to close and vice versa	Wrong wiring between EXD-SH... and valve	Correct the wiring.
EX8 is not able to open at high differential pressure	Wrong setting of parameter ut	Check the parameter ut. (Larger valve requires higher torque and higher current)
Superheat set-point is shifting after several months of uninterrupted operation or permanent jumper of 24 V digital input	Stepper motor driven valves require synchronization	Do not jumper digital input permanently. Interrupt digital input once every week for 10 seconds if compressor never stops.