

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Technical Bulletin

EXD-SH1/2 are stand-alone universal superheat and or temperature controllers for air conditioning units or refrigeration systems.

Features

- EXD-SH1: Control of one valve
- EXD-SH2: Control of two valves in two independent circuits
- Main function

	Circuit 1	Circuit 2
EXD-SH1	Superheat or temperature control	
EXD-SH2	Superheat or temperature control	Superheat Control
- Other functions: Limitation of evaporating pressure (MOP), Low pressure switch, freeze protection and manual positioning of valve(s)
- Self-adapting superheat control function in conjunction with EMERSON EX4-8 (EX4-7-FLR) and CV4-7 series
- For multiple refrigerants, including ultralow temperature refrigerant R23
- Modbus (RTU) communication
- Integrated keyboard with two lines display
- Monitoring of sensors and detection of sensor (ECN.../TP1.../PT5N...(FLR)) /stepper motor wiring failures
- Optional upload/download key (accessory) for transmission of parameter settings among controllers with the same setting
- Low/high superheat alarm as well as other function alarms
- Electrical connection via plug-in type screw terminals included with controller and Micro Molex EXD-M03 (must be ordered separately)
- DIN rail mounting housing



EXD-SH2



EXD-M03

Selection table

Type	Description	Part No.	
		Multipack (pcs)	Single pack
Controllers			
EXD-SH1	Controller for single refrigeration circuit	-	807855
EXD-SH2	Controller for two independent refrigeration circuits	-	807856
EXD-M03	Molex terminal with 3 m wires	-	807865
Temperature sensors			
TP1-NP3	Temperature sensor with 3 m cable	804489M (20)	804489
TP1-NP6	Temperature sensor with 6 m cable	804490M (20)	804490
ECN-Z60	Ultralow Temperature sensor with 6 m cable	-	807826
Pressure transmitters: PT5N (7/16-20UNF connection)			
PT5N-07M	Sensing pressure range -0.8...7 bar	805350M (25)	805350
PT5N-18M	Sensing pressure range 0...18 bar	805351M (25)	805351
PT5N-30M	Sensing pressure range 0...30 bar	805352M (25)	805352
PT5N-50M	Sensing pressure range 0...50 bar	805353M (25)	805353
PT5N-150D	Sensing pressure range 0...150 bar (1/4- 18 NPT)	805379M (25)	805379
Pressure transmitters: PT5N (Brazing connection)			
PT5N-07T / PT5N-07P-FLR	Sensing pressure range -0.8...7 bar	805380M / 805390M (25)	805380 / 805390
PT5N-010P-FLR	Sensing pressure range -0.8...10 bar	805391M (25)	805391
PT5N-18T	Sensing pressure range 0...18 bar	805381M (25)	805381
PT5N-30T / PT5N-30P-FLR	Sensing pressure range 0...30 bar	805382M / 805389M (25)	805382 / 805389
PT5N-50T	Sensing pressure range 0...50 bar	805383M (25)	805383

Note: Pressure range 18 bar for system with R410A, 30 bar for R410A economizer, 50/150 bar for CO₂

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Accessories

Type	Description	Part No.	
		Multipack (20 pieces)	Single pack
M12 Plug and cable for pressure transmitters PT5N(FLR)			
PT4-M15	1.5 m	804803M	804803
PT4-M30	3.0 m	804804M	804804
PT4-M60	6.0 m	804805M	804805
PT4-M60 FLR	6.0 m	-	804806
Uninterruptible Power supply			
ECP-024	Backup battery with two outputs for two controllers	-	804558
K09-P00	Electrical Terminal Kit for ECP-024	-	804560
EXD-PM	Super cap for only EXD-SH1 (two pieces of EXD-PM required for one EXD-SH2)	-	807854

Note: ⚠ Warning -Flammable refrigerants: 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!

Description of functions

Controllers are featured with a main function as superheat controller or temperature controller. The main function is selectable.

Superheat control of evaporators or economizers

This function requires the connection of temperature sensor(s) as well as pressure transmitters(s). The other functions are:

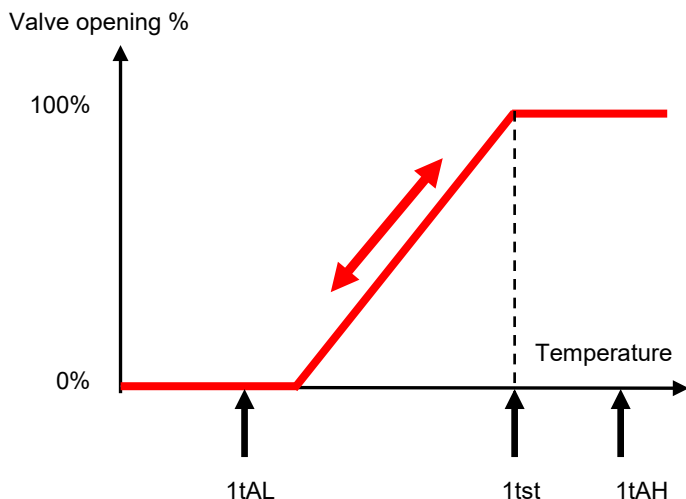
- MOP control: enables the limitation of saturated temperature of suction line (outlet of evaporator/economizer)
- Low pressure behaves similar to low pressure switch including alarm conditions
- Freeze protection is based on saturated temperature from converting measuring suction pressure. It provides alarm condition below certain adjusted temperature.

Temperature controller

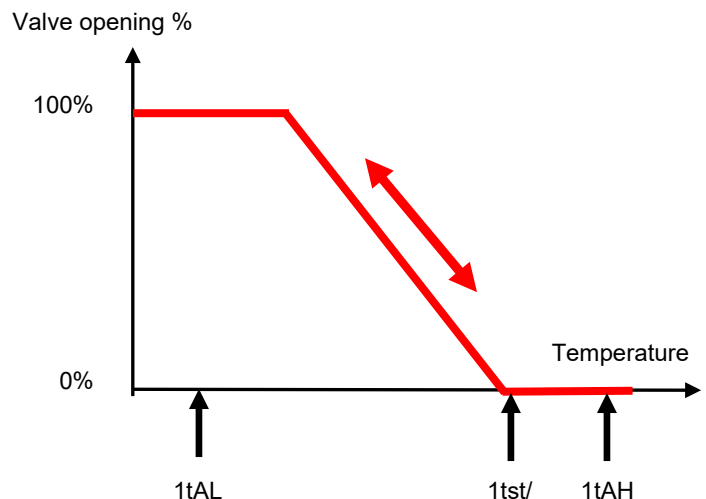
The function is to maintain desired temperature by modulating refrigerant mass flow. If controller is operated as temperature controller, the connection of pressure transmitter is not required.

In order to fulfill varieties of the applications, the refrigerant mass flow variation can be set according temperature increase or decrease.

**Temperature control in normal sense
(A: Mass flow increases if temperature rises)**



**Temperature control in reverse sense
(B: Mass flow decreases if temperature rises)**

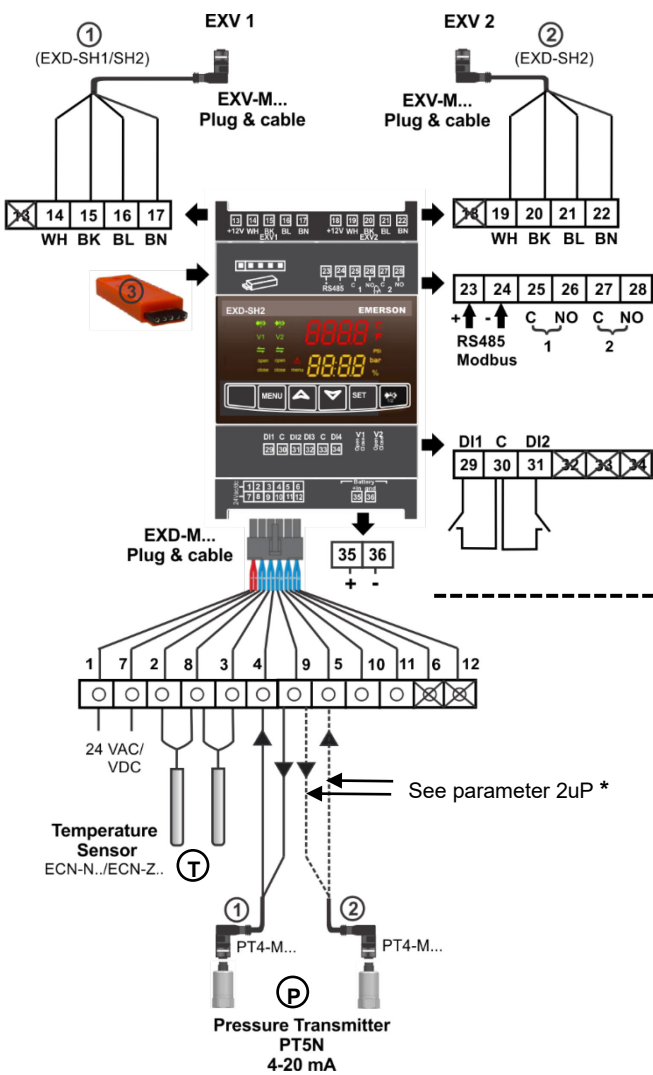


Examples of applications:

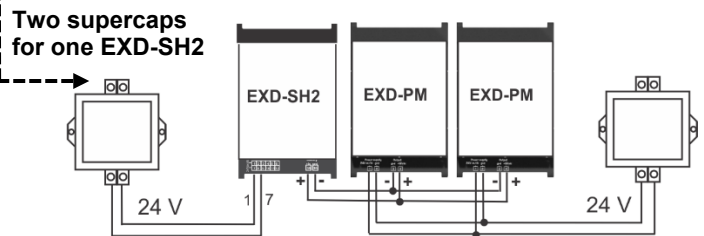
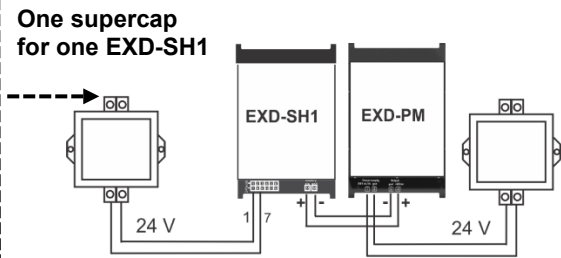
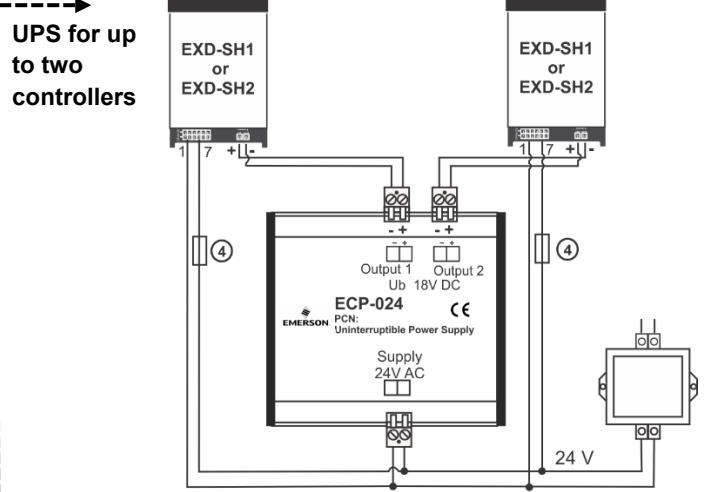
- Temperature control by throttling suction mass flow (normal sense, A)
- Temperature control by modulating hot gas into inlet or outlet of evaporators (reverse sense, B)
- Discharge temperature control by injecting liquid (normal sense, A)
- Head pressure control by means of temperature control (normal sense, A)

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Wiring



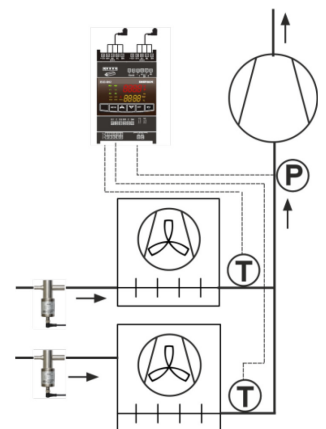
Wiring options: UPS (ECP-024) / Supercap (EXD-PM)



①	Circuit 1 (EXD-SH1/SH2)	14-17	Electronic expansion valve circuit 1 (EXV1) EXV-M... Electrical plug: wire colors WH-white BK-black BL-blue BN-brown
②	Circuit 2 (EXD-SH2)	19-22	Electronic expansion valve circuit 2 (EXV2) EXV-M... Electrical plug: wire colors WH-white BK-black BL-blue BN-brown
③	Download/upload key	23 & 24	RS485 (+/-terminal)
1 & 7	Supply voltage 24 VAC/DC	25 & 26	Alarm relay circuit 1 (C, NO) – Suitable for 24 VAC/DC
2 & 8	Temperature sensor circuit 1	27 & 28	Alarm relay circuit 2 (C, NO) – Suitable for 24 VAC/DC
3 & 8	Temperature sensor circuit 2	29 & 30	Digital input circuit1 (DI1) – Dry contact, potential free
4 & 5	PT5N... circuit 1 & circuit 2 (white wire: 4...20 mA signal)	31 & 30	Digital input circuit 2 (DI2) – Dry contact, potential free
9	+ 12 VDC Voltage input for PT5N... (brown wire)	35 & 36	Battery/Super capacitor connection terminal
Alternative ratiometric third Party Pressure Transmitter:			
4 & 5	Pressure transmitter circuit 1 & circuit 2 (0.5...4.5 V signal)	④	Fuse EXD-SH1 (1A), EXD-SH2 (2A)
11	+ 5 VDC voltage input	6,12,13,18,32-34	Not used (Terminals on EXD-SH12)
10	GND Ground		

Note: No hard failure detection if ground wire of transmitter to be interrupted.

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



EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability


Available configuration options

	Selectable Valves	
	EX	CV
Refrigerants	R22, R134a, R507, R404A, R407C, R410A, R124, R744 (subcritical), R407A, R407F, R23, R32, R1234ze, R448A, R449A, R450A, R513A, R290, R1270, R454C, R452B, R454B, R454A, R452A, R444B, R455A, R133zde, R1234yf	R744 (CO ₂)
Main function	Superheat or and temperature control	Superheat control
Pressure transmitters	PT5N... or 3 rd party ratio metric	PT5N....

Note:

EXD-SH1/2 IS NOT ATEX APPROVED!

Technical Data: EXD-SH1/2

Supply voltage	24 VAC/DC ±10%, 50/60 Hz
Power consumption	EXD-SH1: Max. 25 VA EXD-SH2: Max. 50 VA
Terminals 1 to 12	Suitable for 12 poles molex plug
Terminals 13 to 36	Suitable for removable screw version: wire size 0.14...1.5 mm ² Included in controller delivery
Protection class	IP 00
Compliance	EMC, RoHS,
Marking	

Mounting	DIN rail mounted
Temperatures	storage -25...+60°C operating/ surrounding 0...+55°C
Relative humidity	20...85% non-condensing
Accessory (12 poles molex plug with 3 m cable)	Type: EXD-M03 (to be ordered separately)
Housing	Self-extinguishing ABS
Weight	320 g

Input, Output EXD-SH1/2

Description	Specification
Analogue input(s): NTC Temperature sensor Analogue input: PT1000 Temperature sensor	TP1-N... (-45...+150°C operating range) ECN-Z60 (-80...-40°C sensing range)
Analogue input(s): 4...20 mA pressure transmitters Analogue input(s): 0.5...4.5 V pressure transmitters	PT5N... Third party ratio metric pressure transmitters (total error: ≤ 1%)
Digital input(s)	Dry contact, potential free
Digital output(s): Alarm relay(s) Contact is closed: During alarm condition Contact is open: During normal operation and supply power OFF	Resistive Load 24 VAC/DC, max. 1 A Inductive Load 24 V AC, max. 0.5 A
Communication	RS485 RTU Modbus, two wires
Stepper motor output	Valves: EX4-8 (EX4-7-FLR), CV4-7

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Optional EXD-PM Supercap

Supply voltage	24 VAC/DC $\pm 10\%$, 50/60 Hz
Output voltage	12 VDC
Max. output current	- 1.2 A - 350 mA during charging
Power consumption	12 VA
Terminals	Suitable for removable screw version: wire size 0.14...1.5 mm ²
Output: to driver/controller	Suitable for one EXD-SH1 Two EXD-PM for one EXD-SH2
Charging time	60 seconds
Max. cable length between EXD-PM and EXD-SH1/2	50 cm AWG18 wire size

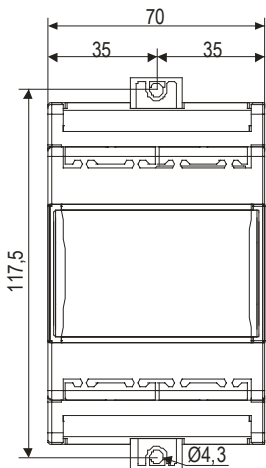
Protection class	IP 20
Mounting	DIN rail mounted
Temperatures operating/ surrounding	Storage -20...+70°C -10...+60°C
Housing	Self-extinguishing ABS
Relative humidity	20...85% non-condensing
Weight	125 g
Marking	CE, EAC

Optional Uninterruptible Power Supply ECP-024

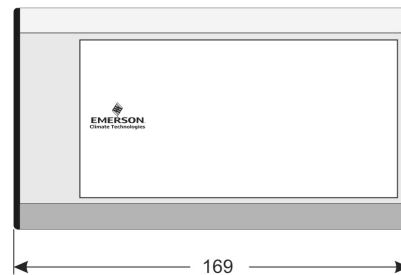
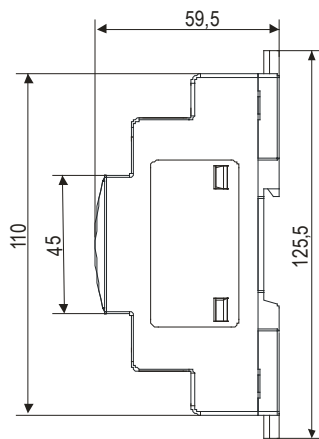
Backup battery type	Lead acid gel rechargeable battery
Number of backup batteries	2, each 12 VDC, 0.8 Ah
Supply voltage	24 VAC $\pm 10\%$, 50-60 Hz
Output voltage, UB	18 VDC
Number of outputs to drivers	2
Battery recharge time	approximately 2 hours
Temperatures operating/ surrounding	Storage -20...+65°C -10...+60°C

Protection class	IP 20
Mounting	DIN rail mounted
Housing	Aluminum
Connection	Screw terminals for wire size 0.5...2.5 mm ²
Relative humidity	< 90% non-condensing
Accessories: Terminals	K09-U00 Part No: 804559
Weight	1200 g
Marking	CE, EAC

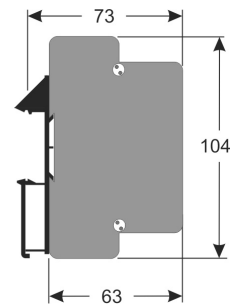
Dimensions (mm)



EXD-SH1/2 or EXD-PM



ECP-024

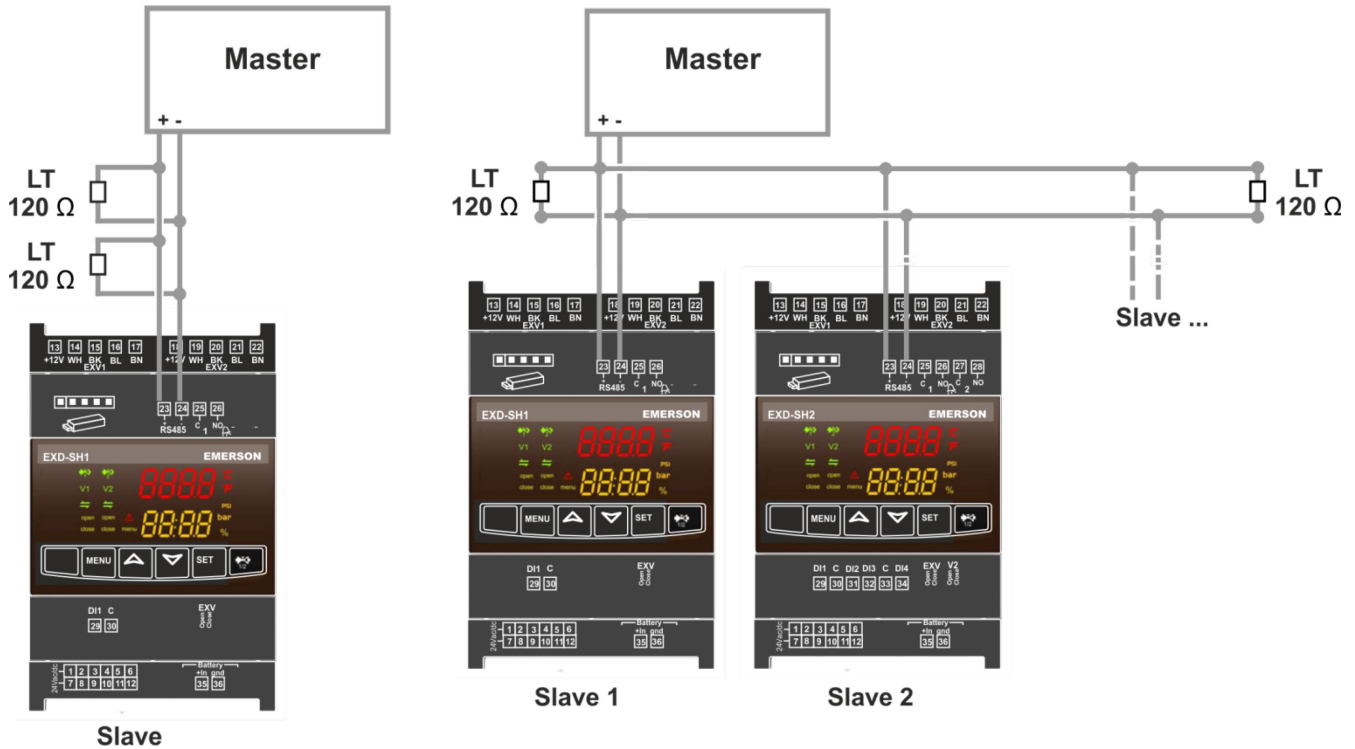


EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Communication

The use of communication is not necessary/mandatory; however, the communication is available for connection to upper level of system controller (third party controller) in order to perform data and commands transfer as well as data logging. EXD-SH1/2 act as slave and third party controller is master. In case of several EXD-SH1/2 connections to master, each driver needs to be addressed for proper communication.

Bus topology



ModBus protocol details

- Mode: RTU
- Modbus slave address range: 1 to 127 (parameter **Adr**)
- Baud rate: 9600 bps, 19200 bps (default, parameter **Br**)
- Start bit: 1
- Data bits: 8
- Parity: even (default), no parity (parameter **Par**)
- Stop bits: 1
- Master response timeout: 500ms

Transmission Details

ModBus register address ranges

- Read-only data: Starting address: 0x0100 (256)
- Writable data: Starting address: 0x0200 (512)
- Configuration data: Starting address: 0x0300 (768)

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Read Data transmission

Available through Modbus Function code 03 (0x03) Read Holding Registers

Request

Function code	1 Byte	0x03
Starting Address	2 Bytes	0x0000 to 0xFFFF
Register count	2 Bytes	1 to 125 (0x7D)

Response

Function code	1 Byte	0x03
Byte count	1 Byte	2 x N*
Holding Registers	N* x 2 Bytes	

*N = Quantity of Input Registers

Error

Error code	1 Byte	0x83
Exception code	1 Byte	01 or 02 or 03

- 01 = Function code not supported
- 02 = Starting Address or register count out of range
- 03 = Register count out of range

Write Data transmission (single register)

Available through Modbus Function code 06 (0x06) Write Holding Register

Request

Function code	1 Byte	0x06
Starting Address	2 Bytes	0x0000 to 0xFFFF
Value	2 Bytes	0x0000 to 0xFFFF

Response

Function code	1 Byte	0x06
Starting Address	2 Bytes	0x0000 to 0xFFFF
Value	2 Bytes	0x0000 to 0xFFFF

Error

Error code	1 Byte	0x86
Exception code	1 Byte	01 or 02 or 03

- 01 = Function code not supported
- 02 = Starting Address out of range

Write Data transmission (multiple registers)

Available through Modbus Function code 16 (0x10) Write Holding Registers

Request

Function code	1 Byte	0x10
Start Address	2 Bytes	0x0000 to 0xFFFF
Register count	2 Bytes	0x0001 to 0x0078
Byte count	1 Byte	2 x N
Registers values	2 x N Bytes	Value

N = register count.

Response

Function code	1 Byte	0x10
Starting Address	2 Bytes	0x0000 to 0xFFFF
Register count	2 Bytes	0x0001 to 0x0078

Error

Error code	1 Byte	0x90
Exception code	1 Byte	01 or 02 or 03

- 01 = Function code not supported
- 02 = Register Address invalid
- 03 = Register Value out of range

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Read-only variables

Modbus address dec. / hex.	Description	Unit	Remarks
256 / 0x100	Software version		
Circuit 1			
257 / 0x101	Main function, circuit 1		0 = superheat control 1 = temperature control 2 = reverse temperature control
258 / 0x102	Valve opening circuit 1	1/100%	
259 / 0x103	Digital input circuit 1		0x0000: No demand 0x0001: Demand
260 / 0x104	Digital output circuit 1		0x0001: alarm relay
261 / 0x105	P1 suction pressure circuit 1	1/100 barg	
262 / 0x106	T1 suction temperature circuit 1	1/100°C	
263 / 0x107	Sat. Temp circuit 1	1/100°C	
264 / 0x108	Pressure 1 sensor failure circuit 1		0 = No failure 1 = Failure
265 / 0x109	Temp. 1 sensor failure circuit 1		0 = No failure 1 = Failure
266 / 0x10A	Functional Alarm set circuit 1		0x0001 = N/A 0x0004 = High superheat 0x0010 = Freeze 0x0040 = Min. Temp (Temp. control) 0x0002 = Low pressure 0x0008 = Low superheat 0x0020 = Max. Temp (Temp. control)
267 / 0x10B	Hardware alarm set		0x0001 = Temp sensor 1 0x0004 = Pressure sensor 0x0010 = Stepper 1 0x0040 = Modbus timeout (3 sec.) 0x0100 = Config inconsistency 2 0x0002 = Temp sensor 2 (SH2) 0x0008 = Pressure sensor 2 (SH2) 0x0020 = Stepper 2 (SH2) 0x0080 = Config inconsistency 1 0x0200 = Power Failure
268 / 0x10C	Application state circuit 1		0 = OFF 1 = Waiting startup (valve ref pending) 2 = Startup 3 = Control 4 = Closing 5 = Alarm 6 = Manual mode 7 = Power fail 8 = MOP
269 / 0x10D	Superheat set point circuit 1	1/100 K	
270 / 0x10E	Superheat circuit 1	1/100 K	
Circuit 2			
271 / 0x10F	Valve opening circuit 2	1/100%	
272 / 0x110	Digital input circuit 2		0 = no demand 1 = demand
273 / 0x111	Digital output circuit 2		0x0001: alarm relay
274 / 0x112	P2 suction pressure circuit 2	1/100 bar	
275 / 0x113	T2 suction temperature circuit 2	1/100°C	
276 / 0x114	Sat. Temp. circuit 2	1/100°C	
277 / 0x115	Pressure 2 sensor failure circuit 2		0 = No failure 1 = Failure
278 / 0x116	Temp 2 sensor failure circuit 2		0 = No failure 1 = Failure
279 / 0x117	Functional alarm circuit 2		0x0001 = N/A 0x0004 = High superheat 0x0010 = Freeze 0x0002 = Low pressure 0x0008 = Low superheat
280 / 0x118	Application state circuit 2		0 = OFF 1 = Waiting startup (valve ref pending) 2 = Startup 3 = Control 4 = Closing 5 = Alarm 6 = Manual mode 7 = Power fail 8 = MOP
281 / 0x119	Superheat setpoint circuit 2	1/100 K	
282 / 0x11A	Superheat circuit 2	1/100 K	

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

Writable variables

Modbus address dec. / hex.	Display code	Description	Units	Remarks
512 / 0x200		Factory default		1 = do a factory default
513 / 0x201		Future use		
514 / 0x202		Alarm reset		1 = Resets alarms (only the alarms which are set as manual reset)
515 / 0x203	1Ho	Manual mode Circuit 1		0 = off 1 = on
516 / 0x204	1HP	Manual valve opening Circuit 1	%	only active while manual mode is "on"
517 / 0x205		Alternative to digital input, circuit 1 via Modbus		Demand circuit 1 0 = disabled 1 = enabled
518 / 0x206		Pressure circuit 1 via Modbus	1/100 barg	Pressure if 1uP selection is Modbus Range: -0.1 to 150 barg Minimum update rate: 1s Alarm timeout: 3 sec.
519 / 0x207		Digital output circuit 1		To set the relay 1 manually, only active when manual mode circuit1 is "on" 0 = off 1 = on
520 / 0x208	2Ho	Manual mode Circuit 2		0 = off 1 = on
521 / 0x209	2HP	Manual valve opening Circuit 2	%	only active while manual mode 2 = on
522 / 0x20A		Alternative to digital input, circuit 2 via Modbus		Demand circuit 2 0 = disabled 1 = enabled
523 / 0x20B		Pressure circuit 2 via Modbus	1/100 barg	Pressure if 2uP selection is Modbus Range: -0.1 to 150 barg Minimum update rate: 1s Alarm timeout: 3 sec.
524 / 0x20C		Digital output circuit 2		To set the relay 2 manually, only active when manual mode circuit 2 is "on" 0 = off 1 = on

Note: References to control circuit 2 of EXD-SH2 are invisible in configuration/write list if disabled.

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability



Basically 2 variants are possible to set the parameters:

1. Configuration parameters in flash memory - Max. 1000 overwrite cycle limitation!
2. Configuration parameters in RAM memory - unlimited overwrite cycles possible

Note: In case of power failure, the stored data from the RAM memory will be lost and controller switches to the configuration data. (Factory setting)

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
768 / 0x300	H5	Password		12	1 - 1999	
769 / 0x301	Adr	Modbus address		1	1 - 127	
770 / 0x302	br	Modbus baudrate		0	0 - 1	0 = 9600 baud 1 = 19200 baud
771 / 0x303	PAr	Modbus parity		0	0 - 1	0 = parity even 1 = no parity
773 / 0x305	-C2	Circuit 2 Enabled ²		1	0 - 1	0 = circuit 2 disabled 1 = circuit 2 enabled Only EXD-SH2
774 / 0x306	-uC	Units conversion		0	0 - 1	0 = °C, K, barg 1 = °F, psig This parameter only affects the display. Internally (as well as for MODBUS communication) the units are always SI-based.
775 / 0x307		Future use				
776 / 0x308		Future use				

Note: ²) References to control circuit 2 if EXD-SH2 are invisible in configuration/write list if disabled

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 1						
777 / 0x309	1Fct	Function circuit 1		0	0 - 2	Changes only allowed if circuit 1 is in "OFF" state 0 = superheat control 1 = Temperature control Normal sense 2 = Temperature control Reverse sense
778 / 0x30A	1u4	Control mode circuit 1		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
779 / 0x30B	1u0	Refrigerant circuit 1		1	0 - 27	Changes only allowed if circuit 1 is in "OFF" state 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 = R1234yff*
780 / 0x30C	1uP	Pressure sensor type 1		1	0 - 8	Changes only allowed if circuit 1 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus
781 / 0x30D	1Prr	Ratio metric range 1	1/10 bar	30	3 - 60	If ratio metric is used
782 / 0x30E	1ut	Valve type 1		0	0 - 12	Changes only allowed if circuit 1 is in "OFF" state 0 = EX4-6 1 = EX7 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

Note: *) 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!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
783 / 0x30F	1uF	Valve scaling 1	%	100	5 - 100	
784 / 0x310	1uu	Start opening valve1	%	10	0 - 100	
785 / 0x311	1u9	Start opening duration valve 1	s	5	0 - 120	
786 / 0x312	1uL	Low superheat alarm mode circuit 1		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
787 / 0x313	1u5	Superheat setpoint circuit 1	1/10 K	6	0.5 - 30	Range = 3 – 30K with 1uL = 1 or 2
788 / 0x314	1u2	MOP mode circuit 1		1	0 - 1	0 = disabled 1 = enabled
789 / 0x315	1u3	MOP sat. temp. limit circuit1	1/10°C			see MOP table (page 16)
790 / 0x316	1P9	Low pressure alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
791 / 0x317	1PA	Low pressure alarm cut-out circuit1	1/10 bar	0	-0.8 - 17.7	
792 / 0x318	1Pb	Low pressure alarm delay circuit1	s	5	5 - 199	
793 / 0x319	1Pd	Low pressure alarm cut-in circuit1	1/10 bar	0.3	-0.5 - 18	
794 / 0x31A	1P4	Freeze alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
795 / 0x31B	1P2	Freeze alarm cut-out circuit1	1/10°C	0	-5 - 5	
796 / 0x31C	1P5	Freeze alarm delay circuit1	s	30	5 - 199	
797 / 0x31D	1uH	High superheat alarm mode circuit 1		0	0 - 1	0 = disabled 1 = enabled auto-reset
798 / 0x31E	1uA	High superheat alarm setpoint circuit 1	1/10 K	30	16 - 40	
799 / 0x31F	1ud	High superheat alarm delay circuit 1	min	3	1-15	
800 / 0x320	1tSt	Temperature set point	1/10°C	4	-80 - 50	
801 / 0x321	1tbd	Temperature band	1/10 K	2	1 - 10	
802 / 0x322	1tAF	Temperature Alarm Enable		0	0 - 1	0 = disabled 1 = enabled
803 / 0x323	1tAL	Min. temperature alarm set-point	1/10°C	0	-50 - 50	
804 / 0x324	1tdL	Min. temperature alarm delay	min	3	1 - 10	
805 / 0x325	1tAH	Max. temperature alarm set-point	1/10°C	15	-50 - 50	
806 / 0x326	1tdH	Max. temperature alarm delay	min	3	1 - 10	
807 / 0x327		Future use				
808 / 0x328		Future use				
809 / 0x329	1tt-	Temperature sensor type		0	0 - 1	0 = TP1-N... 1 = ECN-Z60
852 / 0x354	1P-	Superheat control circuit1 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
853 / 0x355	1i-	Superheat control circuit1 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
854 / 0x356	1d-	Superheat control circuit1 fixed PID Td factor	1/10s	3.0	0.1 – 30	Display 1/10K, Kd = Kp*Td

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 2						
810 / 0x32A	2u4	Control mode circuit 2		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
811 / 0x32B	2u0	Refrigerant circuit 2		1	0 - 27	Changes only allowed if circuit 2 is in OFF state 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*
812 / 0x32C	2uP	Pressure sensor type circuit 2		1	0 - 9	Changes only allowed if circuit 2 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus 9 = Pressure sensor type and refrigerant settings from circuit1
813 / 0x32D	2Prr	Ratio metric range circuit 2	1/10 bar	30	3 - 60	If ratio metric is used
814 / 0x32E	2ut	Valve type circuit 2		0	0 - 12	Changes only allowed if circuit 2 is in "OFF" state 0 = EX4-6 1 = EX7 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
815 / 0x32F	2uF	Valve scaling circuit 2	%	100	5 - 100	
816 / 0x330	2uu	Start opening valve circuit 2	%	10	0 - 100	
817 / 0x331	2u9	Start opening duration valve circuit 2	s	5	0 - 120	
818 / 0x332	2uL	Low superheat alarm mode circuit 2		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
819 / 0x333	2u5	Superheat setpoint circuit 2	1/10 K	6	0.5 - 30	Range = 3 – 30K with 2uL = 1 or 2
820 / 0x334	2u2	MOP mode circuit 2		1	0 - 1	0 = disabled 1 = enabled
821 / 0x335	2u3	MOP sat. temp. limit circuit 2	1/10°C			see MOP table (page 16)
822 / 0x336	2P9	Low pressure alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
823 / 0x337	2PA	Low pressure alarm cut-out circuit 2	1/10 bar	0	-0.8 - 17.7	
824 / 0x338	2Pb	Low pressure alarm delay circuit 2	s	5	5 - 199	
825 / 0x339	2Pd	Low pressure alarm cut-in circuit 2	1/10 bar	0.3	-0.5 - 18	
826 / 0x33A	2P4	Freeze alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
827 / 0x33B	2P2	Freeze alarm cut-out circuit 2	1/10°C	0	-5 - 5	
828 / 0x33C	2P5	Freeze alarm delay circuit 2	s	30	5 - 199	
829 / 0x33D	2uH	High superheat alarm mode circuit 2		0	0 - 1	0 = disabled 1 = enabled auto-reset
830 / 0x33E	2uA	High superheat alarm setpoint circuit 2	1/10 K	30	16 - 40	

Note: *) 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!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

1. Configuration parameters In Flash memory - Max. 1000 overwrite cycle limitation (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
831 / 0x33F	2ud	High superheat alarm delay circuit 2	min	3	1-15	
832 / 0x340	2tt-	Temperature sensor type		0	0 - 1	0 = TP1-N... 1 = ECN-Z60
833 / 0x341	2P-	Superheat control circuit 2 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
834 / 0x342	2i-	Superheat control circuit 2 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
835 / 0x343	2d-	Superheat control circuit 2 fixed PID Td factor	1/10s	3.0	0.1 - 30	Display 1/10K, Kd = Kp*Td

2. Configuration parameters in RAM memory - unlimited overwrite cycles

Note: In case of power failure, the stored data from the RAM memory will be lost and switch to the configuration data. (Factory setting)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
1792 / 0x700		NA				
1793 / 0x701		NA				
1794 / 0x702		NA				
1795 / 0x703		NA				
1797 / 0x705	-C2	Circuit 2 Enabled ³		1	0 - 1	0 = circuit 2 disabled 1 = circuit 2 enabled Only EXD-SH2
1798 / 0x706	-uC	Units conversion		0	0 - 1	0 = °C, K, barg 1 = °F, psig This parameter only affects the display. Internally (as well as for MODBUS communication) the units are always SI-based.
1799 / 0x707		Future use				
1800 / 0x708		Future use				

Note: ³) References to control circuit 2 of EXD-SH2 are invisible in configuration/write list if disabled

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 1						
1801 / 0x709	1Fct	Function circuit 1		0	0 - 2	Changes only allowed if circuit 1 is in "OFF" state 0 = superheat control 1 = Temperature control Normal sense 2 = Temperature control Reverse sense
1802 / 0x70A	1u4	Control mode circuit 1		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
1803 / 0x70B	1u0	Refrigerant circuit 1		1	0 - 27	Changes only allowed if circuit 1 is in "OFF" state 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*
1804 / 0x70C	1uP	Pressure sensor type 1		1	0 - 8	Changes only allowed if circuit 1 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus

Note: *) 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!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

2. Configuration parameters in RAM memory - unlimited overwrite cycles possible (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
1805 / 0x70D	1Prr	Ratio metric range 1	1/10 bar	30	3 - 60	If ratio metric is used
1806 / 0x70E	1ut	Valve type 1		0	0 - 12	Changes only allowed if circuit 1 is in "OFF" state 0 = EX4-6 1 = EX7 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
1807 / 0x70F	1uF	Valve scaling 1	%	100	5 - 100	
1808 / 0x710	1uu	Start opening valve1	%	10	0 - 100	
1809 / 0x711	1u9	Start opening duration valve 1	s	5	0 - 120	
1810 / 0x712	1uL	Low superheat alarm mode circuit 1		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1811 / 0x713	1u5	Superheat setpoint circuit 1	1/10 K	6	0.5 - 30	Range = 3 – 30K with 1uL = 1 or 2
1812 / 0x714	1u2	MOP mode circuit 1		1	0 - 1	0 = disabled 1 = enabled
1813 / 0x715	1u3	MOP sat. temp. limit circuit1	1/10°C			see MOP table (page 16)
1814 / 0x716	1P9	Low pressure alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1815 / 0x717	1PA	Low pressure alarm cut-out circuit1	1/10 bar	0	-0.8 - 17.7	
1816 / 0x718	1Pb	Low pressure alarm delay circuit1	s	5	5 - 199	
1817 / 0x719	1Pd	Low pressure alarm cut-in circuit1	1/10 bar	0.3	-0.5 - 18	
1818 / 0x71A	1P4	Freeze alarm mode circuit1		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1819 / 0x71B	1P2	Freeze alarm cut-out circuit1	1/10°C	0	-5 - 5	
1820 / 0x71C	1P5	Freeze alarm delay circuit1	s	30	5 - 199	
1821 / 0x71D	1uH	High superheat alarm mode circuit 1		0	0 - 1	0 = disabled 1 = enabled auto-reset
1822 / 0x71E	1uA	High superheat alarm setpoint circuit 1	1/10 K	30	16 - 40	
1823 / 0x71F	1ud	High superheat alarm delay circuit 1	min	3	1-15	
1824 / 0x720	1tSt	Temperature set point	1/10°C	4	-80 - 50	
1825 / 0x721	1tbd	Temperature band	1/10 K	2	1 - 10	
1826 / 0x722	1tAF	Temperature Alarm Enable		0	0 - 1	0 = disabled 1 = enabled
1827 / 0x723	1tAL	Min. temperature alarm set-point	1/10 °C	0	-50 - 50	
1828 / 0x724	1tdL	Min. temperature alarm delay	min	3	1 - 10	
1829 / 0x725	1tAH	Max. temperature alarm set-point	1/10°C	15	-50 - 50	
1830 / 0x726	1tdH	Max. temperature alarm delay	min	3	1 - 10	
1831 / 0x727		Future use				
1832 / 0x728		Future use				
1833 / 0x729	1tt-	Temperature sensor type		0	0 - 1	0 = TP1-N... 1 = ECN-Z60
1876 / 0x754	1P-	Superheat control circuit1 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
1877 / 0x755	1i-	Superheat control circuit1 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
1878 / 0x756	1d-	Superheat control circuit1 fixed PID Td factor	1/10s	3.0	0.1 – 30	Display 1/10K, Kd = Kp*Td

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

2. Configuration parameters in RAM memory - unlimited overwrite cycles (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
Circuit 2						
1834 / 0x72A	2u4	Control mode circuit 2		0	0 - 3	0 = standard control 1 = slow control 2 = intermediate control 3 = adjustable fixed PID
1835 / 0x72B	2u0	Refrigerant circuit 2		1	0 - 27	Changes only allowed if circuit 2 is in "OFF" state 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*
1836 / 0x72C	2uP	Pressure sensor type circuit 2		1	0 - 9	Changes only allowed if circuit 2 is in "OFF" state 0 = PT5N-07x 1 = PT5N-18x 2 = PT5N-30x 3 = PT5N-50x 4 = PT5N-150 5 = PT5N-10P-FLR 6 = Ratio metric(gauge) 7 = Ratio metric(absolute) 8 = Modbus 9 = Pressure sensor type and refrigerant settings from circuit1
1837 / 0x72D	2Prr	Ratio metric range circuit 2	1/10 bar	30	3 - 60	If ratio metric is used
1838 / 0x72E	2ut	Valve type circuit 2		0	0 - 12	Changes only allowed if circuit 2 is in "OFF" state 0 = EX4-6 1 = EX7 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
1839 / 0x72F	2uF	Valve scaling circuit 2	%	100	5 - 100	
1840 / 0x730	2uu	Start opening valve circuit 2	%	10	0 - 100	
1841 / 0x731	2u9	Start opening duration valve circuit 2	s	5	0 - 120	
1842 / 0x732	2uL	Low superheat alarm mode circuit 2		1	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1843 / 0x733	2u5	Superheat setpoint circuit 2	1/10 K	6	0.5 - 30	Range = 3 – 30K with 2uL = 1 or 2
1844 / 0x734	2u2	MOP mode circuit 2		1	0 - 1	0 = disabled 1 = enabled
1845 / 0x735	2u3	MOP sat. temp. limit circuit 2	1/10°C			see MOP table (page 16)
1846 / 0x736	2P9	Low pressure alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1847 / 0x737	2PA	Low pressure alarm cut-out circuit 2	1/10 bar	0	-0.8 - 17.7	
1848 / 0x738	2Pb	Low pressure alarm delay circuit 2	s	5	5 - 199	
1849 / 0x739	2Pd	Low pressure alarm cut-in circuit 2	1/10 bar	0.3	-0.5 - 18	
1850 / 0x73A	2P4	Freeze alarm mode circuit 2		0	0 - 2	0 = disabled 1 = enabled auto-reset 2 = enabled manual reset
1851 / 0x73B	2P2	Freeze alarm cut-out circuit 2	1/10°C	0	-5 - 5	
1852 / 0x73C	2P5	Freeze alarm delay circuit 2	s	30	5 - 199	

Note: *) 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!

EXD-SH1/2 Controller for electrical control valves with ModBus Communication Capability

2. Configuration parameters in RAM memory - unlimited overwrite cycles (continued)

Modbus address dec. / hex.	Display code	Description	Unit	Default value	Range	Remarks
1853 / 0x73D	2uH	High superheat alarm mode circuit 2		0	0 - 1	0 = disabled 1 = enabled auto-reset
1854 / 0x73E	2uA	High superheat alarm setpoint circuit 2	1/10 K	30	16 - 40	
1855 / 0x73F	2ud	High superheat alarm delay circuit 2	min	3	1-15	
1856 / 0x740	2tt-	Temperature sensor type		0	- 1	0 = TP1-N... 1 = ECN-Z60
1857 / 0x741	2P-	Superheat control circuit 2 fixed PID Kp factor	1/10	1.0	0.1 - 10	Display 1/10K
1858 / 0x742	2i-	Superheat control circuit 2 fixed PID Ti factor	s	100	1 - 350	Ki = Kp/Ti
1859 / 0x743	2d-	Superheat control circuit 2 fixed PID Td factor	1/10s	3.0	0.1 – 30	Display 1/10K, Kd = Kp*Td

MOP saturation temperature limit table

Refrigerant	°C			Refrigerant	°C			Refrigerant	°C		
	Min.	Max.	Default		Min.	Max.	Default		Min.	Max.	Default
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				