

EXD-HP1/2 Stand-alone Superheat/Economizer Controller

Technical Bulletin

EXD-HP1/2 are stand-alone universal superheat and or economizer controllers for heat pumps, heating units, air conditioning and precision cooling such as telecom and shelter applications.

Features EXD-HP1/2

- Self-adapting superheat/economizer control in conjunction with EMERSON stepper motor driven electronic expansion Valves EXM/EXL
- Discharge hot gas temperature control by wet refrigerant vapor/vapor injection to compressor
- EXD-HP1: Controller with one EXV output
- EXD-HP2: Controller with two independent EXV outputs
- Controllers as slave with Modbus (RTU) communication capability. All data (read/write) accessible by any third party controller having modbus communication (RTU)
- Upload/download key (accessory) for transmission of parameter settings among controllers with the same setting
- Low pressure switch and freeze protection function
- Manual positioning of valve(s)
- Limitation of evaporating pressure (MOP)
- Low/high superheat alarm
- Monitoring of sensors and sensor wiring and detection of sensor and wiring failures
- Integrated display (3-digits LEDs) and key board
- Electrical connection via plug-in type screw terminals (included with controller)
- OEM product: Box order quantities: 20 pieces (Multi-pack)



EXD-HP2

Selection table

Type	Description	Part No.	
		Multipack	Single pack
Controllers			
EXD-HP1	with 1 EXV output	807836M	807836
EXD-HP2	with 2 EXV outputs	807837M	807837
Valves / Coils			
EXM-B0A	Electronic expansion valve	800399M	-
EXM-B0B		800400M	-
EXM-B0D		800401M	-
EXM-B0E		800402M	-
EXM-125	Coil 12 VDC	800403M	-
EXL-B1F	Electronic expansion valve	800405M	-
EXL-B1G		800406M	-
EXL-125	Coil 12 VDC	800407M	-
Temperature sensor			
ECP-P30	Temperature sensor with 3 m cable	-	804495
Pressure sensors Suction pressure (Refrigerant)			
PT5-07M/PT5-07T	-0.8...7 bar (R22, R134a, R407C)	802350M / 802370M	802350 / 802370
PT5-18M/PT5-18T	0 ...18 bar (R410A, R32 /suction pressure)	802351M / 802371M	802351 / 802371
PT5-30M/PT5-30T	0 ...30 bar (R410A, R32 / Intermediate pressure)	802352M / 802382M	802352 / 802382
Plug and cable assembly for pressure sensors			
PT4-M15	1.5 m cable length	804803M	804803
PT4-M30	3.0 m cable length	804804M	804804

Note: For further details of EXM/EXL and PT5: Please see separate Technical Bulletin.

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Alarm functions - List of alarms

Condition	Delay time	Alarm relay	Valve position	Reset type	Display alarm LED
Hardware errors (sensors)	-	Triggered	Fully close	Auto	ON
Hardware errors (Stepper motor)	-	Triggered	-	Auto	ON
Low superheat	Fix: 1 min.	Triggered	Fully close	Auto/Manual	ON/Blinking
Discharge hot gas above limit	Fix: 1 min.	Triggered	Operating	Auto	ON
High superheat	Adjustable	Triggered	Operating	Auto	ON
Low pressure	Adjustable	Triggered	Operating	Auto/Manual	ON/Blinking
Freezing	Adjustable	Triggered	Fully closed	Auto/Manual	ON/Blinking

Technical Data

EXD-HP1/2

Supply voltage	24 VAC/DC \pm 10%
Power consumption	EXD-HP1: Max. 15 VA EXD-HP2: Max. 20 VA
Digital inputs	EXD-HP1: Two, each potential free EXD-HP2: Three each potential free
Relay output	SPDT contacts, AgSnO Inductive (AC15) 24 VAC : 1 A Resistive: 24 VAC/DC: 4 A
Plug-in connector size	Removable screw version wire size 0.14...1.5 mm ²
Applied directive	LVD, EMC, RoHS,
Compliance with	DIN EN60335-1 DIN EN 55014-1, DIN EN 55014-2

Protection class	IP 20
Housing	Self-extinguishing ABS
Mounting	DIN rail mounted
Temperatures storage operating	-20...+65°C -10...+60°C
Relative humidity	0...85% RH non condensing
Weight	175 g
Marking	

Input Sensors, Output Valves

Description	Specification										
Temperature input	ECP-P30 (3 meter cable length) Range: -30°C...+150°C										
Pressure sensor input	PT5 Signal: 4 ... 20 mA										
Electronic expansion valves (stepper motor) output	<p>Note: The connection of two valves are permitted as below table:</p> <table border="1"> <thead> <tr> <th>Circuit 1</th> <th>Circuit 2</th> </tr> </thead> <tbody> <tr> <td>EXM</td> <td>EXM</td> </tr> <tr> <td>EXM</td> <td>EXL</td> </tr> <tr> <td>EXL</td> <td>EXM</td> </tr> <tr> <td>EXL</td> <td>EXL</td> </tr> </tbody> </table>	Circuit 1	Circuit 2	EXM	EXM	EXM	EXL	EXL	EXM	EXL	EXL
Circuit 1	Circuit 2										
EXM	EXM										
EXM	EXL										
EXL	EXM										
EXL	EXL										

MOP table & functions

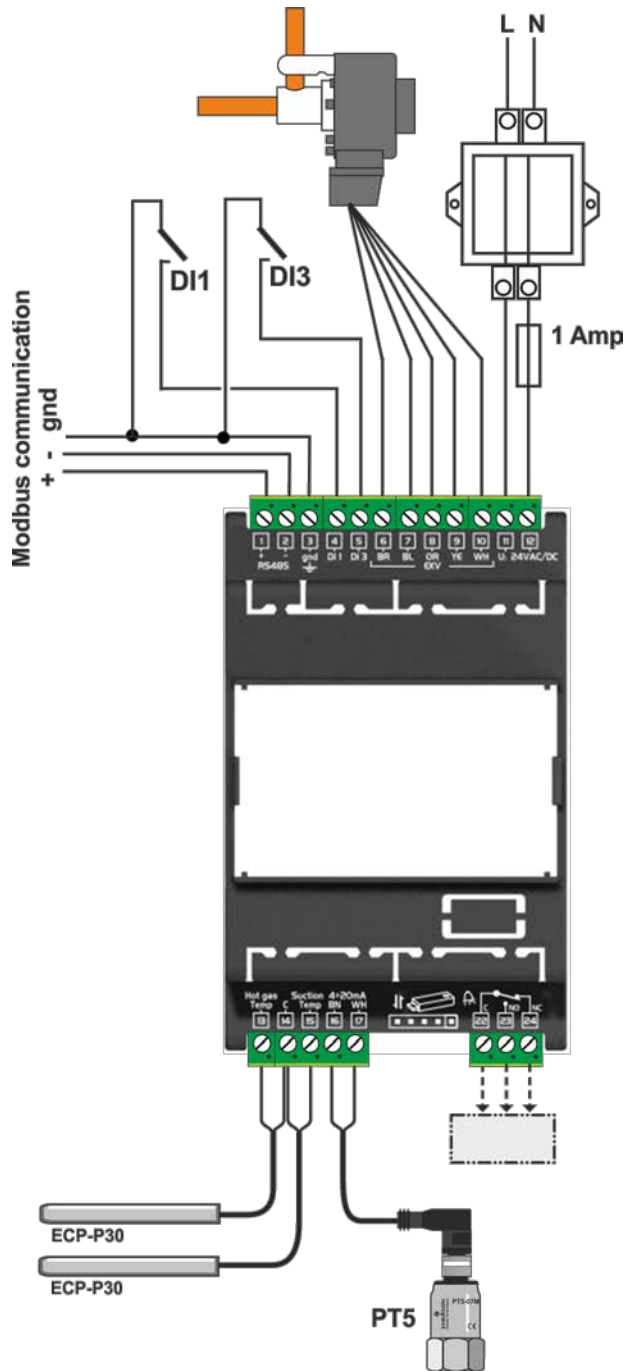
Refrigerant	Min.	Max. °C	Default	Function
R410A	-40	+45	+15	Superheat control & Economizer control
R32	-40	+30	+15	Superheat control & Economizer control
R407C	-40	+48	+15	Superheat control & Economizer control
R22	-40	+50	+13	Superheat control
R134a	-40	+66	+15	Superheat control
R290	-40	+50	+15	Superheat control

Note: R32 is mildly flammable and R290 is flammable. Installation of driver and valve in non-explosive environment.

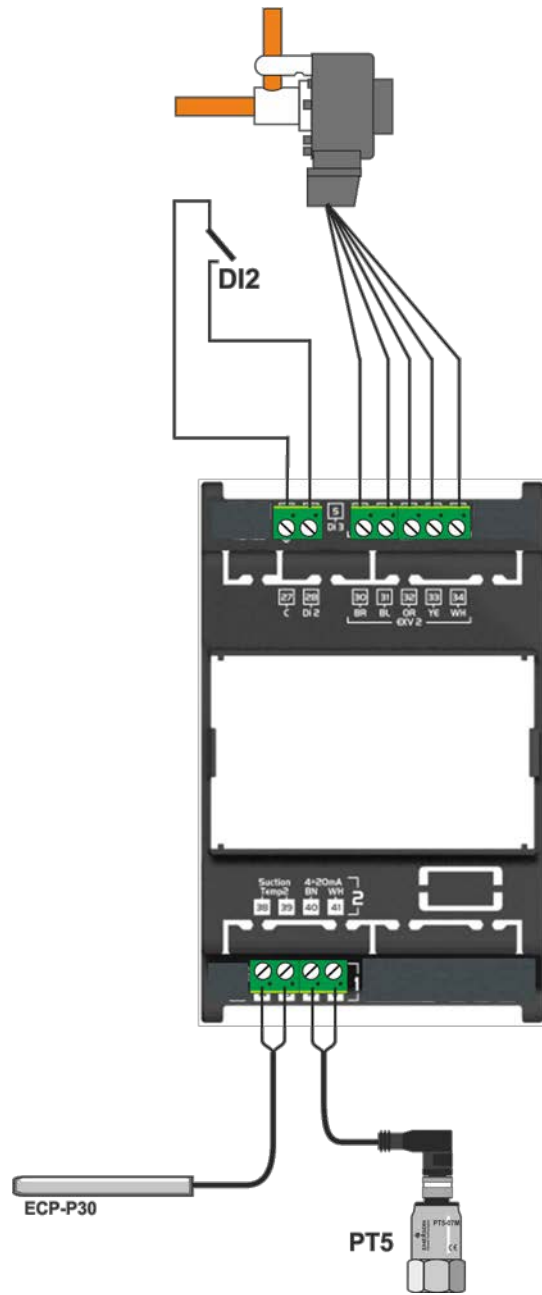
EXD-HP1/2 Stand-alone Superheat/Economizer Controller

Wiring Diagrams

EXD-HP1 and EXD-HP2 (Base board)



EXD-HP2 (Upper board)



Notes:

- Base board for superheat control or Economizer control.
- Alarm relay, dry contact. Relay coil is not energized at alarm condition or power off and energized during normal operation
- Hot gas discharge sensor input is mandatory only for economizer control function.
- Transformer shall be class 2

Notes:

- Upper board only for superheat control
- Upper board does not need to be wired if circuit 2 of EXD-HP2 is disabled

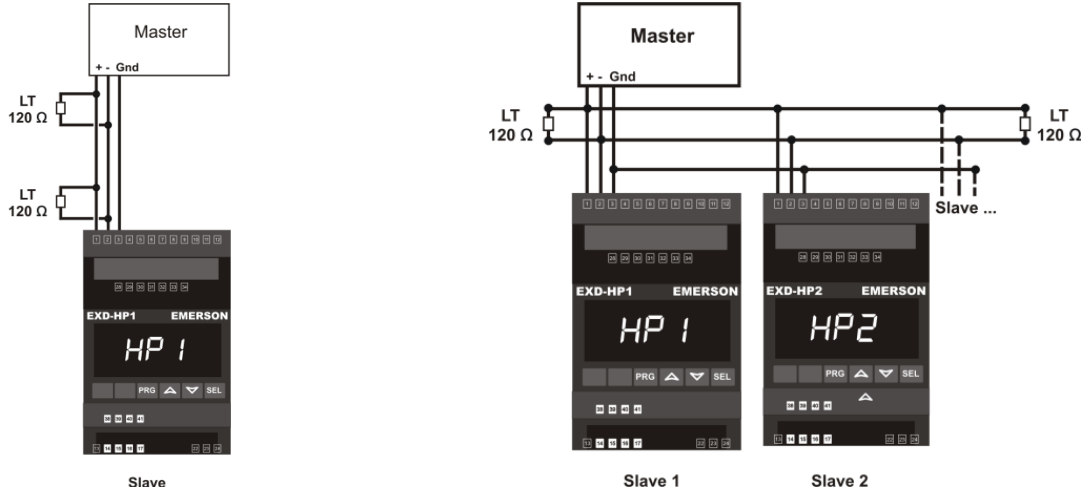
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Communication ModBus (RTU) protocol details

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-HP1/2 act as slave and third party controller is master. In case of several EXD-HP1/2 connections to master, each driver needs to be addressed for proper communication.

Bus topology



ModBus Specification

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

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)

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

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

Writable variables EXD-HP1/2

Modbus address dec.	Modbus address hex.	Display code	Description	Unit	Remarks
512	0x0200	1Ho	Manual mode Circuit 1		0 = Off, 1 = On
513	0x0201	1HP	Manual valve opening Circuit 1	%	Only active while manual mode is On
514	0x0202		Factory default (when DI1 is Off)		1 = on (Set all parameters setting to factory default setting)
515	0x0203		Digital outputs		0x0001 = Alarm relay
516	0x0204		Manual alarm reset command		1 = Clear the alarm
517	0x0205	2Ho	Manual mode Circuit 2 (only EXD-HP2)		0 = Off, 1 = On
518	0x0206	2HP	Manual valve opening Circuit 2 (only EXD-HP2)	%	Only active while manual mode is On
519	0x0207		Discharge temperature input	1/100°C	Source for discharge temperature if parameter 1EC (0x31B) = 1 Allowed temperature range 0...160°C Minimum update rate: 2 seconds
520	0x0208		Discharge temp. control		0 = Discharge Temp. Control enabled 1 = Discharge Temp. Control disabled
521	0x0209		Demand circuit 1		0 = No demand 1 = Demand
522	0x020A		Demand circuit 2		0 = No demand 1 = Demand

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Read-only variables EXD-HP1/2

Modbus address dec.	Modbus address hex.	Description	Unit	Remarks
256	0x100	Valve opening - Circuit 1	1/100 %	
257	0x101	Digital input – Circuit 1		0 = No demand 1 = Demand
258	0x102	Digital outputs		0x0001 = Alarm relay
259	0x103	Pressure sensor 1 - Circuit 1	1/100 bar	
260	0x104	Temperature sensor 1 - Circuit 1	1/100 °C	
261	0x105	Temperature sensor 3 - Circuit 1	1/100 °C	
262	0x106	Saturation temperature - Circuit 1	1/100 °C	
263	0x107	Pressure sensor 1 failure - Circuit 1		0 = No failure 1 = Failure
264	0x108	Temperature sensor 1 failure - Circuit 1		0 = No failure 1 = Failure
265	0x109	Temperature sensor 3 failure - Circuit 1		0 = No failure 1 = Failure
266	0x10A	Functional alarm set Circuit 1		0x0001 = Low pressure 0x0002 = Low superheat 0x0004 = High superheat 0x0008 = Freeze protection
267	0x10B	Hardware alarm set		0x0001 = Valve 1 alarm 0x0002 = Valve 2 alarm (only EXD-HP2) 0x0004 = Pressure sensor 1 0x0008 = Pressure sensor 2 (only EXD-HP2) 0x0010 = Temperature sensor 1 0x0020 = Temperature sensor 2 (only EXD-HP2) 0x0040 = Temperature sensor 3
268	0x10C	General application state Circuit 1		0 = No demand 1 = Demand 2 = Superheat control 3 = MOP control 4 = Alarm state 5 = Discharge temperature control 6 = Manual mode
269	0x10D	Superheat set point – Circuit 1	1/100 K	
270	0x10E	Superheat measured/calculated– Circuit 1	1/100 K	
271	0x10F	Software revision (x104)		Hexadecimal format 1 hex digit for controller type: 1= HP1, 2 = HP2 1 hex digit for major revision 2 hex digits for minor revision
272	0x110	Valve opening – Circuit 2	1/100 %	
273	0x111	Digital inputs – Circuit 2 (only EXD-HP2)		0 = No demand 1 = Demand
274	0x112	Pressure sensor 2 - Circuit 2	1/100 bar	
275	0x113	Temperature sensor 2 - Circuit 2	1/100 °C	
276	0x114	Saturation temperature 2	1/100 °C	
277	0x115	Pressure sensor 2 failure, Circuit 2 (only EXD-HP2)		0 = No failure 1 = Failure
278	0x116	Temperature sensor 2 failure, Circuit 2 (only EXD-HP2)		0 = No failure 1 = Failure
279	0x117	Superheat set point – Circuit 2	1/100 K	
280	0x118	Superheat measured/calculated– Circuit 2	1/100 K	
281	0x119	Digital input DI3		0 = no effect 1 = Only superheat control for economizer
282	0x11A	Functional alarm set Circuit 2		0x0001 = Low pressure 0x0002 = Low superheat 0x0004 = High superheat 0x0008 = Freeze protection
283	0x11B	General application state Circuit 2		0 = No demand 1 = Demand 2 = Superheat control 3 = MOP control 4 = Alarm state 5 = N/A 6 = Manual mode

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Configuration parameters EXD-HP1/2

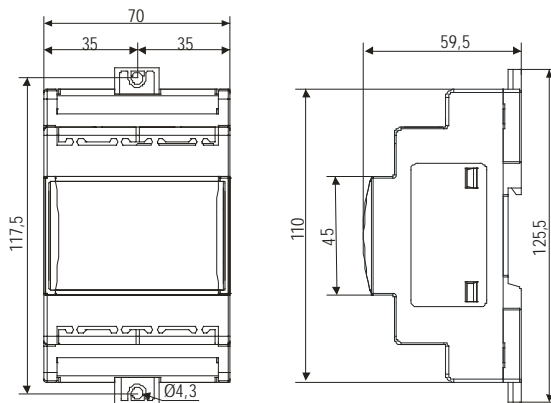
Modbus address dec.	Modbus address hex.	Display code	Description	Default value	Range	Unit	Remarks
768	0x300	H5	Password	12	1 - 1999		
769	0x301	Adr	Modbus address	1	1 - 127		
770	0x302	br	Modbus baudrate	1	0 - 1		0 = 9600 baud 1 = 19200 baud
771	0x303	PAr	Modbus parity	0	0 - 1		0 = Parity even 1 = No parity
772	0x304	-uE	Circuit 2 disabled	0	0 - 1		0 = Circuit 2 enabled 1 = Circuit 2 disabled
773	0x306	-uC	Units conversion	0	0 - 1		0 = °C, K, barg 1 = °F, psig This parameter only affects the display on device. The units are SI-based internally as well as for MODBUS communication.
774	0x305	HP-	Display mode EXD-HP1= 0 or 1 EXD-HP2= 0, 1 or 2	1	0 - 2		0 = No display 1 = Circuit 1 2 = Circuit 2
775	0x307	1uE	Function	1	0 - 1		0 = Superheat control 1 = Economizer control
776	0x308	1u4	Control mode circuit 1	0	0 - 2		0 = Standard control 1 = Slow control 2 = Fixed PID
777	0x309	1u0	Refrigerant circuit 1	2	0 - 5		0 = R22 1 = R134a 2 = R410A 3 = R32 4 = R407C 5 = R290
778	0x30A	1uP	Pressure sensor 1: type	2	0 - 3		0 = PT5-07M 1 = PT5/PT6-18M 2 = PT5-30M
779	0x30B	1uu	Start opening valve1	20	10 - 100	%	
780	0x30C	1u9	Start opening duration valve 1	5	1 - 30	Sec.	
781	0x30D	1uL	Low superheat alarm mode circuit 1	1	0 - 2		0 = Disabled 1 = Enabled auto-reset 2 = Enabled manual reset
782	0x30E	1u5	Superheat setpoint circuit 1	6		1/10 K	Range = 3-30K With 1uL = 1,2
783	0x30F	1u2	MOP mode circuit 1	1	0 - 1		0 = Disabled 1 = Enabled
784	0x310	1u3	MOP sat. temp. limit circuit1	1/10°C			See MOP table
785	0x311	1P9	Low pressure alarm mode circuit1	0	0 - 2		0 = Disabled 1 = Enabled auto-reset 2 = Enabled manual reset
786	0x312	1PA	Low pressure alarm cut-out circuit1	0	-0.8 - 17.7	1/10 bar	
787	0x313	1Pb	Low pressure alarm delay circuit1	5	5 - 199	Sec.	
788	0x314	1Pd	Low pressure alarm cut-in circuit1	0.5	0.5 - 18	1/10 bar	
789	0x315	1P4	Freeze alarm mode circuit1	0	0 - 2		0 = Disabled 1 = Enabled auto-reset 2 = Enabled manual reset
790	0x316	1P2	Freeze alarm cut-out circuit1	0	-20 - 5	1/10 °C	
791	0x317	1P5	Freeze alarm delay circuit1	30	5 - 199	Sec.	
792	0x318	1P-	Superheat control circuit1 fixed PID Kp factor	1.0	0.1 - 10	1/10	Display 1/10K
793	0x319	1i-	Superheat control circuit1 fixed PID Ti factor	100	1 - 350		
794	0x31A	1d-	Superheat control circuit1 fixed PID Td factor	3.0	0.1 - 30	1/10	Display 1/10K
795	0x31B	1EC	Discharge temp. source	0	0 - 1		0 = Hot Gas temperature input 1 = ModBus command
796	0x31C	1PE	Economizer control fixed PID Kp	2.0	0.1 - 10	1/10	Display 1/10K
797	0x31D	1iE	Economizer control fixed PID Ti	100	1 - 350		
798	0x31E	1dE	Economizer control fixed PID Td	1.0	0.1 - 30	1/10	Display 1/10K
799	0x31F	1uH	High superheat alarm mode circuit 1	0	0 - 1		0 = Disabled 1 = Enabled auto-reset
800	0x320	1uA	High superheat alarm setpoint circuit 1	30	16 - 40	1/10 K	
801	0x321	1ud	High superheat alarm delay circuit 1	3	1-15	Min.	
802	0x322	1E2	Discharge Temp. correction	0	0 - 10	1/10 K	Positive correction to the discharge temperature to take the sensor location in account.

EXD-HP1/2 Stand-alone Superheat/Economizer Controller

Configuration parameters (only for EXD-HP2)

Modbus address dec.	Modbus address hex.	Display code	Description	Default value	Range	Unit	Remarks
803	0x323	2u4	Control mode circuit 2	0	0 - 2		0 = Standard control 1 = Slow control 2 = Fixed PID
804	0x324	2u0	Refrigerant circuit 2	2	0 - 5		0 = R22 1 = R134a 2 = R410A 3 = R32 4 = R407C 5 = R290
805	0x325	2uP	Pressure sensor 2: type	1	0 - 3		0 = PT5-07M 1 = PT5/PT6-18M 2 = PT5-30M
806	0x326	2uu	Start opening valve 2	20	10 - 100	%	
807	0x327	2u9	Start opening duration valve 2	5	1 - 30	Sec.	
808	0x328	2uL	Low superheat alarm mode circuit 2	1	0 - 2		0 = Disabled 1 = Enabled auto-reset 2 = Enabled manual reset
809	0x329	2u5	Superheat setpoint circuit 2	6	0.5-30	1/10 K	Range: 3- 30K with 1uL=1 or 2
810	0x32A	2u2	MOP mode circuit 2	1	0 - 1		0 = Disabled 1 = Enabled
811	0x32B	2u3	MOP sat. temp.circuit 2			1/10 °C	See MOP table
812	0x32C	2P9	Low pressure alarm mode circuit 2	0	0 - 2		0 = Disabled 1 = Enabled auto-reset 2 = Enabled manual reset
813	0x32D	2PA	Low pressure alarm cut-out circuit 2	0	-0.8 - 17.7	1/10 bar	
814	0x32E	2Pb	Low pressure alarm delay circuit 2	5	5 - 199	Sec.	
815	0x32F	2Pd	Low pressure alarm cut-in circuit 2	0.5	0.5 - 18	1/10 bar	
816	0x330	2P4	Freeze alarm mode circuit 2	0	0 - 2		0 = Disabled 1 = Enabled auto-reset 2 = Enabled manual reset
817	0x331	2P2	Freeze alarm cut-out circuit 2	0	-20 - 5	1/10 °C	
818	0x332	2P5	Freeze alarm delay circuit 2	30	5 - 199	Sec.	
819	0x333	2P-	Superheat control circuit 2 fixed PID Kp factor	1.0	0.1 - 10	1/10	Display 1/10K
820	0x334	2i-	Superheat control circuit 2 fixed PID Ti factor	100	1 - 350		
821	0x335	2d-	Superheat control circuit 2 fixed PID Td factor	3.0	0.1 - 20	1/10	Display 1/10K
822	0x336	2uH	High superheat alarm mode circuit 2	0	0 - 1		0 = Disabled 1 = Enabled auto-reset
823	0x337	2uA	High superheat alarm setpoint circuit 2	30	16 - 40	1/10 K	
824	0x338	2ud	High superheat alarm delay circuit 2	3	1-15	Min.	

Dimensions (mm)



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