

Frese OPTIMA Compact Modbus actuators DN10-DN50

Application

The Frese Modbus Actuator is designed to be used with the Frese OPTIMA Compact valves in heating, ventilating and air conditioning systems.

The actuator can be mounted on the valve by hand and without the need of a specific tool.

Due to the compact design of the actuator, it is particularly suitable for installations where space is limited.



Features motoric actuators

- Nominal stroke up to 15 mm.
- Auto calibration to all valve strokes
- Direct assembly with union nut to the neck of the valve. No tools required
- Position indicator for stem travel
- The actuator is short-circuit-proof and protected against polarity reversal
- Plug-in cable for supply voltage and control signal
- Small outer dimensions
- Removable cable (Protection class only apply with standard cable mounted)
- Auto zero detection

Approval

- Conforms to: EMC directive 2014/30/EU
- Low voltage directive 2014/35/EU
- Protection class IP54 (EN60529)
- Protection class III (EN 60730)
- Over voltage category III
- Level of contamination: 2
- RoHS 2011/65/EU



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Technical data motoric actuators

Supply voltage:	See "Types and Operation Data"
Protection class:	IP 54
Frequency:	50/60 Hz
Force:	150N (DN10-DN32) 500N (DN40-DN50)
Stroke:	Max. 9 mm (DN10-DN32) Max 15 mm (DN40-DN50)
Noise level:	Below 31 dBA
Ambient conditions:	Temperature 0°C-50°C Humidity 10-85% r.F.
Cable length:	1.5 m
Weight:	338 g (53-1975/ 396 g (53-1977)

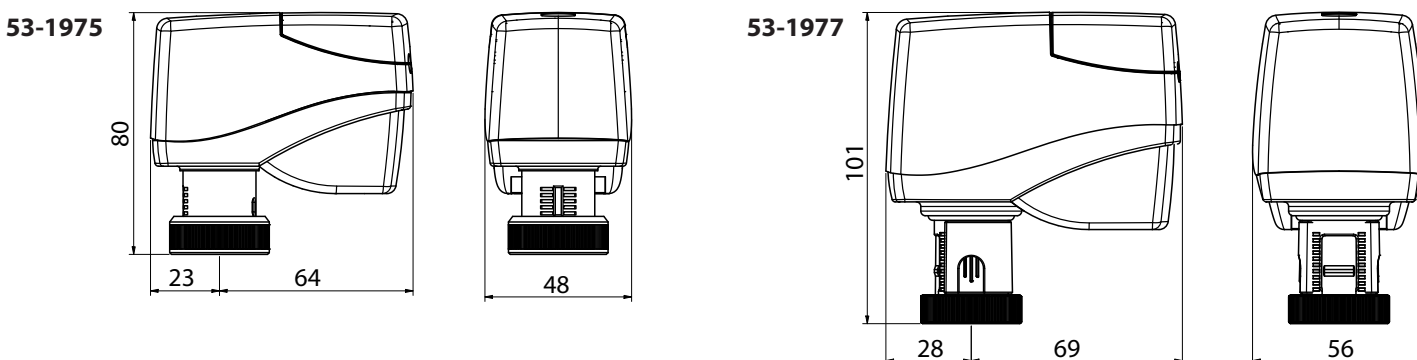


Types and Operation Data

Types	Valve Dim.	Control signal	Feedback signal	Running time (50 Hz)	Supply voltage	Power Consumption	Swith on current
53-1975	DN10-DN32	Modbus	0-10V DC	22 s/mm	AC/DC 24 V +/- 10%	2.2 W (*4.2VA)	DC - 24 V; 5.0 A AC - 24 V; 7.2 A
53-1977	DN40-DN50	Modbus	0-10V DC	22 s/mm	AC/DC 24 V +/- 15%	2.5 W (*4.8VA)	DC 24 V; 5.0 A AC 24 V; 7.2 A

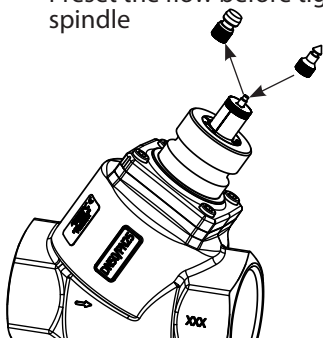
*) Max consumption - for transformer sizing

Dimensions [mm]

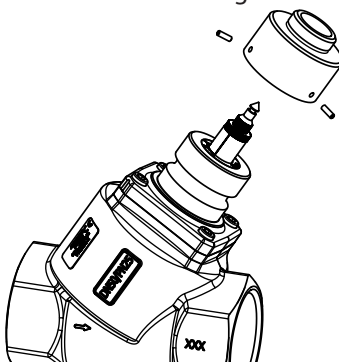


Mounting actuators on OPTIMA Compact DN40-50

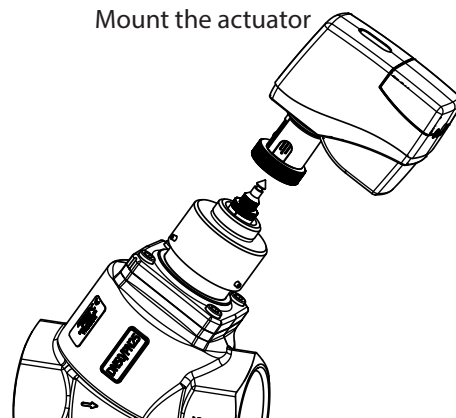
Replace the spindle on the valve with the spindle supplied with the actuator
Preset the flow before tightening the spindle



Mount the adapter on the valve neck and tighten the 3 screws

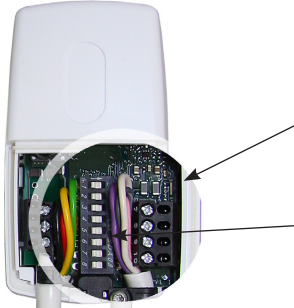


Mount the actuator



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LED status indicators



The status LED is located below the inspection cover under the terminal and indicates the operating state of the actuator.
The status LED is still visible when the inspection cover is closed.

DIP switches

PLEASE NOTE: Delivery state:

The actuators are delivered from the factory in the assembly position (spindle fully retracted, valve open) and switches 1 to 8 in switch position OFF.

Status LED	Description
Steady green	Normal operation
Flashing green quickly	Mounting position switch position 0 (All switches 1 to 6 are set to OFF)
Flashing green	Initialization run
Flickering green (When data is sent)	Modbus communication
Flashing yellow	Manual adjustment, valve closed
Flashing red	Valve adaptation error
Off	Operating voltage interrupted

DIP switch settings



DIP switch number	Function Off position	Function On position
1	BIT 0 = 0	BIT 0 = 1
2	BIT 1 = 0	BIT 1 = 1
3	BIT 2 = 0	BIT 2 = 1
4	BIT 3 = 0	BIT 3 = 1
5	BIT 4 = 0	BIT 4 = 1
6	BIT 5 = 0	BIT 5 = 1
7 *	Baud rate default value	Baud rate default value
8	Terminating resistor inactive	Terminating resistor active

*) Moving switch 7 back and forward for 1second resets the baud rate to 38400 8-N-2

Switches 1 to 6:

Modbus address setting

The six switches are used to set the address in binary form.

The valid address range is 1 to 63.

BIT 5 [32]	BIT 4 [16]	BIT 3 [8]	BIT 2 [4]	BIT 1 [2]	BIT 0 [1]	Adress
0	0	0	0	0	1	1
0	0	0	0	1	0	2
0	0	0	0	1	1	3
0	0	0	1	0	0	4
0	0	0	1	0	1	5
0	0	0	1	1	0	6
0	0	0	1	1	1	7
0	0	1	0	0	0	8
0	0	1	0	0	1	9
0	0	1	0	1	0	10
0	0	1	0	1	1	11
0	0	1	1	0	0	12
:	:	:	:	:	:	:
1	1	1	1	1	1	63

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BUS communication

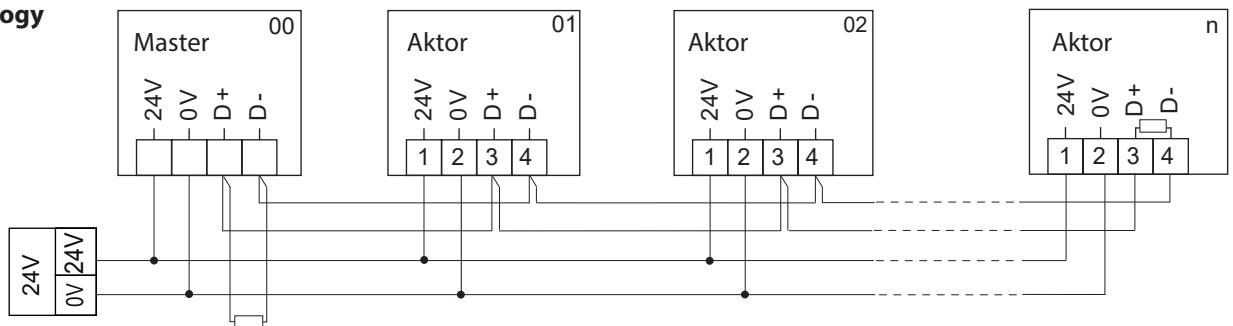
Interface	EIA-485 / RS-485
Transmission type	Modbus RTU slave
Supported baud rates	9,600, 19,200, 38,400*, 57,600, 115,200 bps
Start/stop bits	8N1, 8N2*, 8E1, 8E2, 8O1, 8O2
Number of bus participants	Up to 32 recommended, max. 64
Bus load	1/8 unit load
Termination	Switchable in the device, 120 Ohm
Bias network	To be set in the master
Recommended cable	Twisted-pair cable with shielding (characteristic impedance approx. 120 ohm)
For bus topology with 115,200 baud	Recommended maximum cable length 500 m
For bus topology with 38,400/57,600 baud	Recommended maximum cable length 750 m
For bus topology with 9,600/19,200 baud	Recommended maximum cable length 1000 m
Stub lines	Max. line length 2 m

Supported modbus function codes

Code	Function
0x03	Read Holding Register
0x06	Write Holding Register
0x03	Read Holding Multiple
0x10	Write Holding Multiple

*) As-delivered condition

Modbus topology



Baud rate changing

To change the baudrate, which defaults to 38400-8-N-2, registers 105, 106 and 107 can be written.

After changing the settings, the actuator must either be powercycled (Turned off, then on), or register 138 be written with "5", to enable the new settings to become active.

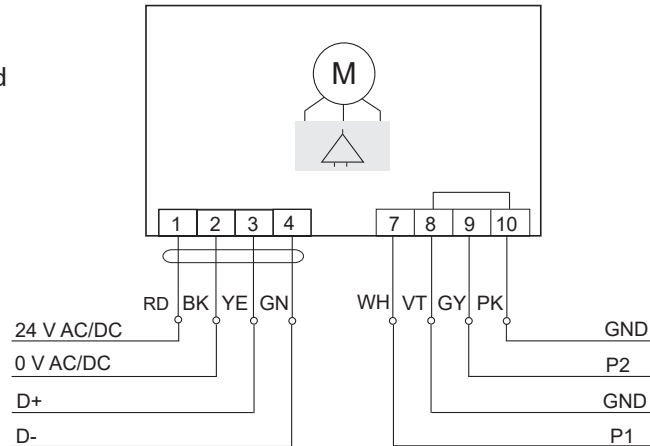
Register address	Data type	Name	R/W	Values
105	Uint16	RS485 baud rate	R/W	0: default (38400,8,N,2)
				1: 9600
				2: 19200
				3: 38400
				4: 57600
106	Uint16	RS485 stop bits	R/W	5: 115200
				1, 2
107	Uint16	RS485 parity	R/W	0: none
				1: equal
				2: unequal

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Connection diagram

Cable:

Two built-in cables:
1.5 m; 2 x 2 x 0,5 mm², insulated
and 1.5 m; 4 x 0,5 mm²



Commissioning actuator

Given that the Modbus-address has already been setup using the DIP-switches shown at page 3, these registers are needed to setup the Modbus communication.

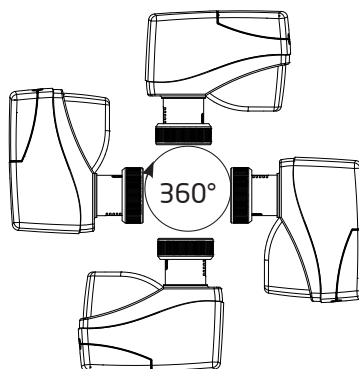
As a default, the Modbus communication is 38400 baud, 8 databits, No parity, and 2 stopbits.

To select the needed communication, these registers must be setup (using 38400,8,N,2):

Register address	Data type	Name	R/W	Values
105	Uint16	RS485 baud rate	R/W	0: default (38400,8,N,2)
				1: 9600
				2: 19200
				3: 38400
				4: 57600
				5: 115200
106	Uint16	RS485 stop bits	R/W	1, 2
107	Uint16	RS485 parity	R/W	0: none
				1: equal
				2: odd
138	Uint16	Command	W	5 (Baud rate change *)

*) Writing **5** in register 138 can be replaced by power cycling the actuator.

Mounting positions



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Applications example #1 - Valve selection

Example:

Select the valve for the flow range 100-575 l/h and control the flow from 0-100%

Register 110: Select valve with the flow range 100-575 l/h - 2.5mm High from the tables on page 8.

Register 400: Input signal can vary from 0-100% by the input signal from the BMS controller.

Register address	Data type	Name	R/W	Values
110	Int16	Valve selection	W	3 (OPTIMA Compact DN15-20 100-575 l/h)
400	Uint16	Volume flow setpoint (actuating signal)	W	0-10000 (0-100% input signal from BMS controller)

Applications example #2 - Remote flow limitation

Example:

Select the valve for the flow range 100-575 l/h and limit the flow remotely to 345 l/h

Register 110: Select valve with the flow range 100-575 l/h - 2.5mm High from the tables on page 5.

Register 313: Reduce the stroke to $345/575 = 60\%$

Register 400: Input signal can vary from 0-60% by the input signal from the BMS controller.

Register address	Data type	Name	R/W	Values
110	Int16	Valve selection	W	3 (OPTIMA Compact DN15-20 100-575 l/h)
313	Uint16	Nominal stroke limit in % max.	W	6000 (60%)
400	Uint16	Volume flow setpoint (actuating signal)	R/W	0-6000 (0-60% input signal from BMS controller)

Applications example #3 - Valve manual preset and remote flow limitation

Example:

Select the valve for the flow range 100-575 l/h, manual presetting 3 (435 l/h) and limit the flow remotely to 348 l/h

Register 110: Select valve with the flow range 100-575 l/h - 2.5mm High from the tables on page 5.

Register 313: Reduce the stroke to $348/435 = 80\%$

Register 400: Input signal can vary from 0-80% by the input signal from the BMS controller.

Register address	Data type	Name	R/W	Values
110	Int16	Valve selection	W	3 (OPTIMA Compact DN15-20 100-575 l/h)
313	Uint16	Nominal stroke limit in % max.	W	8000 (80%)
400	Uint16	Volume flow setpoint (actuating signal)	W	0-8000 (0-80% input signal from BMS controller)

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Applications example #4 - Installation of temperature sensors for DT measurement

Example: Select PT1000 sensors for measurement of supply and return temperatures

Register 123: Select PT1000 sensor as sensor type P1.
 Register 126: Select PT1000 sensor as sensor type P2.
 Register 130: Select P1 for the supply temperature and P2 for the return temperature
 Register 406: Read the values for the differential temperature.

Register address	Data type	Name	R/W	Values
123	Uint16	Sensor type P1	W	6 (PT 1000 sensor)
126	Uint16	I/O type P2	W	6 (PT 1000 sensor)
130	Uint16	Configuration of sources for differential temperature calculation	W	1 (Supply: P1 Return: P2)
406	Uint16	Differential temperature	R	(Example measured 15 K) Value = 15*10 = 150

Applications example #5 - Estimate actual flow

**Example: Estimate the actual flow on the selected valve with flow range 100-575 l/h and control the flow from 0-100%
 Valve is preset to 4, maximum flow of 575 l/h**

Register 400: Input signal is 75% from the BMS controller.
 Register 401: Read the values for the actual opening position: $0,75 * 575 \text{ l/h} = 431 \text{ l/h}$ (Value 4310)
 Flow calculation in BMS controller: $575 \text{ l/h} * 0,75 = 431 \text{ l/h}$

Register address	Data type	Name	R/W	Values
400	Uint16	Volume flow setpoint (actuating signal)	W	0-7500 (0-75% input signal)
401	Uint16	Actual value for opening position	R	7500 (75% l/h)

Applications example #6 - Estimate energy delivered at terminal unit

**Example based on example #4 & #5:
 Calculate the actual delivered energy based on estimated flow and measured differential temperature
 Valve is preset to 4, maximum flow of 575 l/h**

Register 110 & 401: BMS reading registers and calculating actual flow = $575 \text{ l/h} * 0,75 = 431 \text{ l/h}$ (0.119 l/s)
 Register 406: Read the values for the differential temperature. 15 K
 Energy calculation in BMS controller: $15\text{K} * 0.119 \text{ l/s} * 4.186 \text{ KJ/kg} * ^\circ\text{K} = 7.4 \text{ kW}$

Register address	Data type	Name	R/W	Values
110	Int16	Valve selection	W	3 (OPTIMA Compact DN15-20 100-575 l/h)
401	Uint16	Actual value for opening position	R	4310 (431 l/h)
406	Uint16	Differential temperature	R	(Example measured 15 K) Value = 15*10 = 150

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Modbus RTU functionality

The actuator is using RS485 to communicate using Modbus RTU protocol.

Data point (register) list for 53-1975 & 53-1977

Register address	Data type	Name	R/W	Values
1	Uint16	FW version	R	For example, 123 = version 1.23
2	Uint16	HW ID	R	e.g. 0x00F1
3	Uint16	SerNum1	R	0-65535
4	Uint16	SerNum2	R	0-65535
5	Uint16	SerNum3	R	0-65535
105	Uint16	RS485 baud rate	R/W	0: default (38400,8,N,2)
				1: 9600
				2: 19200
				3: 38400
				4: 57600
				5: 115200
106	Uint16	RS485 stop bits	R/W	1, 2
107	Uint16	RS485 parity	R/W	0: none
				1: equal
				2: odd

Valve selection via Register 110

53-1975

Number	Flow l/h Minimum	Flow l/h Maximum	Dimension	Stroke/Type	Valve & Actuator Characteristic
0	50 (Dummy value)	500 (Dummy value)	N/A	2.8 mm (Dummy value)	LIN (Dummy value)
1	30	200	DN10-DN15	2.5 mm/Low	LIN
2	65	370	DN10-DN15	5.0 mm/Low	LIN
3	100	575	DN15-DN20	2.5 mm/High	LIN
4	220	1330	DN15-DN20	5.0 mm/High	LIN
5	300	1800	DN20	5.5 mm/High	LIN
6	280	1800	DN25	5.5 mm/Low	LIN
7	600	3609	DN25L	5.5 mm/High	LIN
8	550	4001	DN32	5.5 mm	LIN

53-1977

Number	Flow l/h Minimum	Flow l/h Maximum	Dimension	Stroke/Type	Valve & Actuator Characteristic
0	50 (Dummy value)	10000 (Dummy value)	N/A	N/A	LIN (Dummy value)
1	1370	9500	DN40	15 mm	LIN
2	1400	11500	DN50	15 mm	LIN

The actuator will recognize a longer stroke, than is available for control of the valve. After register 110 setup, the valve will move to the selected stroke, for 100% opening.

Register 113 shows the maximum flow for the set valve in register 110.

Register 114 is used to limit the max flow, via stroke-limitation.

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Modbus RTU functionality

Register address	Data type	Name	R/W	Values
123	Uint16	Sensor type P1	R/W	0: off
				1: Binary input
				2: 0..10 V input
				3: KP10
				4: NI1000_DIN
				5: NI1000_LG
				6: PT1000
124	Uint16	Inversion P1	R/W	0: = normal, 1: = inverse
125	Int16	Correction value/offset P1	R/W	V*100,K*10
126	Uint16	I/O type P2	R/W	0: off
				1: Binary input
				2: 0..10 V input
				3: KP10
				4: NI1000_DIN
				5: NI1000_LG
				6: PT1000
				8: Y output 0..10V
10: Changeover output (0 V = cooling, 5 V = shut-off, 10 V = heating)				
127	Uint16	Inversion P2 (input)	R/W	0: = normal, 1: = inverse
128	Int16	Correction value/offset P2	R/W	V*100,K*10
129	Uint16	Inversion P2 (output)	R/W	0: = normal, 1: = inverse
130	Uint16	Configuration of sources for differential temperature calculation	R/W	0: Supply and return temperature: Bus register value
				1: Supply: P1 Return: P2
				2: Supply: P2, Return: P1
				3: Supply: P1, Return: Bus
				4: Supply: P2, Return: Bus
				5: Supply: Bus, Return: P1
6: Supply: Bus, Return: P2				
133	Uint16	Bus failure function	R/W	0: no monitoring
				1: CLOSED when time is exceeded (120 s)
				2: OPEN when time is exceeded (120 s)
				3: Setting in "Emergency position" register when time is exceeded (120 s)
134	Uint 16	Emergency position	R/W	0..10000 = 0..100.0%
135	Int 16	Flush timer	R/W	Value in minutes, 0: = inactive

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Modbus RTU functionality

Register address	Data type	Name	R/W	Values
136	Int16	Valve exercise timer	R/W	Value in hours, 0: = inactive
138	Uint16	Command	R/W	0: Normal operation
				1: Valve adaptation/initialization run
				2: Test run
				3: Sync
				4: ErrorReset
200	Uint16	Operating mode	R/W	5: baud rate change:
				0: Controlled using setpoint
				1: Open
				2: Closed
201	Uint16	Changeover mode	R/W	3: MinPos
				5: MaxPos
				0: Shut-off
312	Uint16	Nominal stroke limit in % min.	R/W	1: Heating
				2: Cooling
313	Uint16	Nominal stroke limit in % max.	R/W	0..10000 = 0..100.0%
318	Uint16	Operating status/error	R	0x0000: Normal operation, no message
				0x0001: Internal memory fault
				0x0002: Internal AD conversion fault
				0x0004: Valve adaptation fault
				0x0008: Internal motor function fault
				0x0010: P1 out of range
				0x0020: P2 out of range
0x0100: Command execution test run/adaptation active				
319	Uint16	Flush timer currently	R	Remaining minutes until flushing
320	Uint16	Valve exercise timer currently	R	Remaining hours up to valve exercise
321	Uint32	Operating time	R	Seconds
323	Uint32	Distance counter	R	mm
400	Uint16	Volume flow setpoint (actuating signal)	R/W	0..10000 = 0..100%
401	Uint16	Actual value for opening position	R	0..10000 = 0..100%
404	Int16	Supply temperature	R/(W)	Current supply temperature in °C*10 (write-protected when source P1 or P2 is assigned)
				If the range is exceeded, the value is set to 151 °C If the value is below the range, the value is set to -51 °C

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Modbus RTU functionality

Register address	Data type	Name	R/W	Values
405	Int16	Return temperature	R/(W)	Current return temperature in °C*10 (write-protected when source P1 or P2 is assigned)
				If the range is exceeded, the value is set to 151 °C If the value is below the range, the value is set to -51 °C
406	Int16	Differential temperature	R	Calculated difference from the supply/return temperature register in K*10
407	Uint16	Leak warning	R	0: no warning
				1: leak detected (when valve is closed for 6 hours, differential temperature greater than 8K)
408	Uint16	Digital contact 1	R	0/1
409	Uint16	Digital contact 2	R	0/1
418	Uint16	Setpoint position	R	mm*10
419	Uint16	Actual position	R	mm*10
420	Uint16	Learned positioning distance	R	mm*10
424	Int16	Sensor input P1	R	V*100,°C*10; 0/1
425	Int16	Sensor input P2	R	V*100,°C*10; 0/1
426	Uint16	Y output P2	R/W	Voltage level 0..1000 for 0..10 V output signal (with I/O type configuration P2: 8: Y output 0..10V)

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