

Table of Contents

Part I CPA

I	СРА	8
1	General Information	9
	Update	
	Version	
	Requirements	
	Multivalve	11
	Offline	13
	Trouble shooting	13
2	Main Window	14
	Status Information	14
	Control Panel	15
	Chart	16
	Record	18
	Chart Content	18
	Settings	19
3	Parameters	20
	Features	22
4	Pressure	23
	Pressure Control	23
	Pressure Sensor	23
	Adaptive Learn	
	Adaptive Learn Data	
	Chart Settings	
5	Tools	29
	Chart Analyzer	29
	Overlay Function	30
	Zoom Function	30
	Chart Settings	33
	Terminal	34
	Chart Commands	
	Command structure	35
	Sequencer	36
	Commands	
	Command structure	38
	Trace Log	39
	Interface Trace	40
	Fieldbus	40
	RS232/485	41
	Load Error Data	41
	System Trace	43
	Update Tool	43
	Update Procedure	43
	Verify VAT firmw are update	45
	Trouble shooting	47
	Diagnostic File	48
	Gate Adjustment	50

2

	Contents	3
6	CPA Scaling	E 2
0	CFA Scaling	
7	About	54
Part II	Valve Firmware	56
1	System	57
	Services	57
	Control Mode	57
2	Valve	59
	Homing	59
	Position Adaption	60
	Offset	60
	Oring Pull Out Prevention	62
	Settings	62
3	Pressure Control	63
	Control Algorithm	63
	Overview	63
	Choose correct control algorithm	63
	Adaptive algorithm	64
	Control Parameter	65
	Learn	65
	Execute a learn procedure	66
	Gasflow calculation for Learn	
	Tuning	
	Gain Factor adjustment	
	Sensor Delay adjustment	
	Pressure Control Speed adjustment	70
	Pl algorithm	
	Control Parameter	71
	Tuninia	
	Pressure and gas flow for optimization	
	Optimization P-Gain	
	Optimization I-Gain	
	Softpump algorithm	74
	Control Parameter	74
	Tuning	
	Optimizing P-Gain	75
	Optimizing I-Gain	
	Pressure Ramp	
	Configuration	
		/ / جج
	Lype	/ / حح
	Applications Examples	/ / 79
	Automated Controller	
	Profile Ramp	
	Store Control Parameter Volatile	
4	Pressure Sensor	
-	Mechanical connection requirements	
	Configuration	ວວ ຊາ
	Crossover (2 sensor operation)	
	Zero Adjust	

rface	
EtherCAT	
Connection	
Installation (example)	
Netw ork and cable	
Device identification, Rotary switches	
ESI	
Connection Loss Reaction	
Communication failure	
LEDs	
Run LED (1)	
Error LED (2)	
Link/Activity LED's (5/6)	
Communication	
Interface scaling	
Cyclic Communication	
PDO Process data objects – cyclic communication	
Configurable PDO mapping	
SDO Service data objects – acyclic communication	······································
File over EtherCAT (FoE)	······ '
RS232/485	······ ·
Settings	······ ·
Operation Mode	
Command Structure	
Syntax	
Compound Commands	·····
Compatible Command Sets	·····
	······
RS485 Multiply device commands	·····
GET Command	
SEI Command	
Scaing	
Digital inputs	
Functionality	
Digital Outputs	
Falalielei	
Functionality	
Analog Outputs	
Wiring	
Villing	
R\$232	
R\$485	
PS/85 Half dupley	
Inout/Output	······
"Ipur Output	
Configuration with Voltage	
Device Net	
Micro Connector Pinout	

5

	Contents	5
Ma da	L	4
		1
NEI		1
		1
EDS		1
Initial Communication Settings		1
Connection Loss Reaction		1
Profile		1
Comparison GD and PCD profile		1
Cyclic Communication (Assenblies)		1
Acyclic Communication		1
Generic Device		<i>'</i>
Process Control Device		····· ·
Process Control Valve		
Tunnel Command		
Diaital Innuts		
Parameter		
r aranneter Functionality		
Functionality		
Digital Outputs		····· ·
Parameter		••••••
Functionality		
Analog Input		
Parameter		
Analog Output		
Parameter		
Functionality		
Connector assembling		
Wiring		····· ·
Configuration w ith sw itches		······
Configuration with Voltage		
C-Link		
LEDs		
Configuration		
Station Number		
Number of occupied stations		
Futended evelie setting		
Data Type of Dressure and Desition values		
Data Type of Pressure and Position values		
Range of Pressure and Position Values		
Connection Setup		
Handshake Procedure		
Location of the handshake bits		
Cyclic Communication - Process Data		
Output Buffer		
Input Buffer		
ofibus		
Connection		
Connector		
Cable		
Line Termination		
L FDs		
LED Communication (COM)		
LED Diagnostic (DIA)		
LED Diaynosiic (DIA)		
Communication		

	Station address	185
	Baud Rate	186
	I&M0 record	186
	Record fields description	187
	Cyclic Data Settings	188
	Connection Loss Reaction	189
	Cyclic Buffers	189
	Input Buffer	189
	General Status - Bitmap description	191
	General Warnings - Bitmap description	192
	Extended Warnings - Bitmap description	192
	Slave Status - Bitmap description	193
	Slave Warnings - Bitmap description	193
	Output Buffer	193
	General Control - Bitmap description	195
	Communication betw een Master (PLC) and Slave (VAT-Valve)	195
6	Power connector IO	197
	Digital Inputs	
	Digital Outputs	
	Connector assembling	
	Wiring	
7	Ontions	199
'		
	Power Down, Power Failure Option	
	Benaviour in case of powier failure	
	Pow er Failure Option	
	Cluster	
	Connection	
	UPA Parameters	
~	Position Urtset	
8	Sequencer	210
	Intro	210
	Main Parameter	210
	Interface EtherCAT	214
9	Display information	218
	Power up	
	Operation	
	Error	
10	Trouble shooting	
	Conorol	
	General	220
11	Appendix	
	Conversion Tables	
	Pressure	224
	Gas flow and leak rate	225
	Temperature	225
	Torque	225

6

	Contents	7
Index		0

Part I

9

1 CPA

1.1 General Information

1.1.1 Update

Link for download: Downloads

Select Software & Updates Tab and filter for CPA IC2 (USB).

		Product Documentation	CAD Files	Safety, Quality and Environmental Statements	Software & Opdates	
(CPA IC2					Q
0	CPA IC2(USB) Manual v1.0			9 MB ZIP	Download 🗸
o	CPA IC2(USB) Controller Update Instruction			254 KB PDF	Download 🗸
o	CPA IC2(USB) v4.1.0 Controller Update Versior	ו		2 MB CPA	Download 🗸
0	CPA IC2(USB) v4.1.0 Windows Executable Vers	sion		1 MB ZIP	Download 🗸

Here are two types of CPA IC2 (USB) available.

Controller Update Version

Version is to update the CPA software on the valve directly. See Update Procedure for more details. Load *.cpa version.

Windows Executable Version

Version is to use as a local version on the PC.

- Unzip the downloaded file is necessary.
- Connect the valve with your PC
- Start CPA from the unzipped folder (CPA4.exe)
- Data
 Autorun.inf
- CPA4.exe

No installation is necessary for both versions.

1.1.2 Version

In this chapter you will find the different CPA versions listed and the main changes and improvements of each version.

CPA Version 4.2.1

*Online Help (Download link: Downloads, Tab: Software&Updates) *Improve CPA IC2 (USB) Manual rider (Contents shows only main chapters, Keyword search over whole help) *About Window (Including Check for Update functionality for CPA IC2 (USB) Manual)

*Gate Adjustment Window (653, guided instruction to center the valve plate)

10 CPA IC2(USB) Manual

*Improve long term recording of Trace Log (Save Trace Log data automatically by disconnection)

*Bugfixes:

- Remote Desktop connection issue

CPA Version 4.2.0

*Multivalve (Update, Operating)

*Chart Analyzer improvements (Overlay, Records, Zoom and Cursor Function, with No Limit scan rate no successive equal values)

*Parameters Features (Highlight non-volatile parameters, Export Parameters to Excel includes also parameter description, Autosave option also for Parameters window)

*New Parameter values functions (shows single parameter description when the parameter is selected with the cursor, Copy Function of right parameter window)

*Update Tool (Support Sequencer Files)

*Simplified Adaptive Learn Window

*Improve long term recording of Chart Analyzer and Trace Log (Save Chart Analyzer data automatically by disconnection)

*Extend CPA IC2 (USB) Manual with the extended CPA functionalities as well as with a valve firmware chapter (also available in offline mode)

*Bugfixes:

-Forbid update in Remote Locked

-Now it is sufficient if a newer version than .NET Framework 3.5 is installed

CPA Version 4.1.0

*Pressure Control Window

*Pressure Sensor Window

*Adaptive Learn Window

*Chart Analyzer: separate description for plot axis

*Sequencer & Terminal: Add Commands and Value format option

*General: Permit open multiple Menus

*General: Parameter Window without Value-Refresh

*CPA 4 Manual with Help&Manual

*CPA loadable with .zip format

*Bugfixes:

-CPA crash because of out of memory error

-Chart Analyzer: Record Function activated -> Analyze shows not the whole chart

-Chart Analyzer: Deselect Auto scale Axis Settings -> Max value not correct

-Sequencer: No Limit Lines (old: 1000)

-Update Tool: Problem if attribute is read only

-Update Tool: Header needs also 1 Tab space beetween words if not an internal error occurs -General: Problem with low screen size without high resolution

CPA Version 4.0.8

*New Update Tool

*Trace Log Tool

*Interface Firmware down-loadable

*Learn data Analyzer Tool

*Many minor improvements

*Bugfix: -chart display issue

1.1.3 Requirements

- PC or Laptop with windows 7 (or higher)
- USB cable A/B male/male → *Recommandation*: max. length 5 meters

1.1.4 Multivalve

Since the CPA v4.2.0

CPA supports to connect more than one Valve to the PC. This means the user can ether open for every connected Valve a separate CPA window or open once the CPA and than, switch between the connected Valves in one CPA window to do any local operations or Updates.

Recommandations:

-maximum of Valve 4

1. Switch between the Valves in one CPA window

- as you can see in the CPA version(picture bellow), is in the Status-bar the actual Serial Number of the connected Valve displayed.
- if there is more than one Valve connected to your PC, it will be able to Select the other Valve under the Status-bar (Drop-down)
- after that the CPA window will show you all the Parameters and information of the selected Valve.

CPA IC2(USB) Manual

12

	ashrzer						X
Local Bemote	laiyzei					Version 4.2.1	
	status information		control buttons	control panel		control panel	
Parameters	Valve Series	65.3	Open	Actual Position		Actual Pressure	
Information Pressure	Access Mode	Local	Close		0		1.399885 mbar
Pressure Control	Control Mode	Position	Start Learn	Target Position	0 🔹	Target Pressure	0 🌩
Pressure Sensor	Controller Selector	Controller 1	Zero Adjust	100-	100	1,333224 -	1.333224
Adaptive Learn	Error Number	0	Restart	80 —	80	1,066579 —	1.066579
Adaptive Learn Data Tools	Error Code	0	status indication	60 —	60	0,7999342 —	0.7999343
Chart Analyzer			Open	40 —	40	0,5332895 —	0.5332895
Terminal	Valve Firmware Version	F01.0C.61.00	Closed	20 —	20	0,2666447 —	0.2666447
Sequencer Trace Log				0-	0	0-	0
Update Tool	shart			•		•	
Diagnostic File	11					r 100	
Gate Adjustment	0.9					90	
CPA Scaling	0.8					80	
About	0.7					70	
	0.6					60	plots axis 1
	S 0.5					50 5	Actual Position
	a . 0.4					40	
	0.3					30	plots axis 2
	0.2					20	Position state
	0.1					10	
	0					i_0	
	13:55:06		Time			14:00:06	
	Record	Clear St	op Analyze]			
		Device: 65365	344-JAAQ-0001 🔻 🖬 🖛	•			Scan Rate: 20ms

2. Separate CPA window for each Valve

- If there are e.g. 3 Valves connected to your PC (via USB) then open 3 times CPA, so you will see in each CPA window the Parameters and information of one of these 3 Valves. If already a CPA instance is open than is possible to start a second one by pressing the plus button.
- In this case you will not have an Drop-down-Menu in the Status-bar to switch between the Valves.
 → In the Status bar will only be the Serial number of the actual Valve displayed.

3. Updates via Multivalve

Attention: The Update with Multivalve is only supported for newer Firmware Versions (not older than 26.04.2020) and Valves with a official Serial Number!

→ See Chapter Update Procedure

1.1.5 Offline

This window can be opened by selecting Offline CPA if no USB communication is available.



Adaptive Learn Data

- Adaptive Learn Data
- Load from Valve and Save to Valve functionality are not available in Offline Mode.

Chart Analyzer

- Chart Analyzer
- Open recorded data file first.

Update Tool

- Update Procedure for general use.
- Trouble shooting for recovering an update issue.

Trace Log

- Interface Trace
- Load Error Data
- System Trace

About

- About
- Update CPA IC2(USB) Manual

1.1.6 Trouble shooting

- In case of a CPA failure following data are welcome:
- Failure description
- Print Screen of failure message
- Error text file (located under C:\Users\(Username)\AppData\Roaming\VAT\CPA; Necessary to enable hidden folder option)

Please provide this information to your local contact Contact.

Your Local Contact	Get in touch, we are happy to support yo country, if not already selected, to make	u and answer your questions and inquiries. Please select your sure we can respond to you quickly.
United States	VAT Inc. San Jose	🕲 +1 800 935 1446 >
Ukraine	655 River Oaks Parkway 95134-1907, San Jose, CA United States	O us@vatvalve.com >
United Kingdom		
United States	VAT USA	
Uruguay		
Uzbekistan	 VAT US Representatives 	~
Vanuatu 🗸		

1.2 Main Window

1.2.1 Status Information

This part of the main window shows current defined parameter values.

status information ————————————————————————————————————				
Valve Series	65.3			
Access Mode	Local			
Control Mode	Position			
Controller Selector	Controller 1			
Error Number	0			
	_			
Error Code	0			
Status Con	tent			
Valve Firmware Version	F01.0C.28.30			
Cluster Address	0			

Right Click Menu

• Define status content



- Use right arrow to include selected parameter from the left parameters tree into the selected display area.
- Use left arrow to eliminate the selected parameter from the display area.
- Status content window allowed's to modify the parameter name.

1.2.2 Control Panel

Position

• Switch Control *Mode* to *Position* and define *Target Position*.



• Right click on button value for value definition.

Pressure

- Only visible if the valve supports pressure control.
- Switch Control *Mode* to *Pressure Control* and define *Target Pressure*.
 control panel



• Right click on button value for value definition.

1.2.3 Chart

Chart allowed to record any available parameter (max 10). This can be defined under Chart Content.



Right Click Menu

- Chart Content
- Scroll: Steady advance of the data display.
- Settings

Plots Axis 1, Plots Axis 2

• Option to hide parameter signal in the chart (if disabled this parameter is still recorded)

17

Record

- Start and stop of the recording.
- For more information see Record.

Clear

- Delete the actual chart data
- An active record is not interrupted by clear chart

Stop

- Stop the actual chart data
- Stop button change the function to "Start"
- An active record is not interrupted by clear chart

Analyze

- Opens the Chart Analyzer with the current chart data for deeper analyze.
- For more information see Chart Analyzer.

Scan Rate

• right click on "Scan Rate" at the right bottom corner and select the desired scan rate.



🚾 CPA - Control Performance Ana	alyzer						- 🗆 ×
Local 🏓 Remote						Version 4.2	
navigation Parameters Information # Pressure Pressure Control	status information Valve Series Access Mode Control Mode	65.3 Local Position	Control buttons Open Close Start Learn	control panel Actual Position Target Position	0	control panel Actual Pressure Target Pressure	1.399885 mbar
Pressure sensor Adaptive Learn Adaptive Learn Data ▲ Tools Chart Analyzer Terminal Sequencer Trace Log	Controller Selector Error Number Error Code Valve Firmware Version	Controller 1 0 0 F01.0C.61.00	Status indication Open Closed	80 - 60 - 40 - 20 - 0 -	100 80 60 20 0	1,333224 1,066579 - 0,7999342 - 0,5332895 - 0,2666447 - 0 -	1.333224 1.066579 0.7999343 0.5332895 0.2666447 0
Update Tool Diagnostic File Gate Adjustment CPA Scaling About	chart 1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0.4 0.3 0.2 0.1 0.4 0.3 0.2 0.1 0.4 0.3 0.2 0.3 0.2 0.3 0.4 0.3 0.4 0.4 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	Clear Sto	Time p Analyze			100 90 80 70 50 50 87 40 20 10 0 14:06:22	plots axis 1 - Actual Position - Target Position plots axis 2 - Position State
				, 			Scan Rate: 20ms No limit 10ms 20ms 50ms 100ms

CPA IC2(USB) Manual

1.2.3.1 Record

18

Recommandations:

- For long term recordings we recommend to use CPA version from 4.2.0, cause the Data saving process is improved.

Procedure

- By pressing Record button the recording is starting and in addition the green light is visible.
- It the Record button is selected again than following options are available:

we Record



Please select an action for the the recorded data:

Save Analyze Discard

Save

- Opens the save dialog for saving the recording data in a texfile.
- This text file can be used later in Chart Analyzer for deeper analysis.
- Default text file name includes Serial Number, date, time and text "ChartData".

Analyze

- Show the recorded data in the Chart Analyzer window.
- Their is also the possibility to save the recorded data.

Discard

• The recorded data are discarded.

Note

- In case that chart record is running and a restart or power cycle of the controller happens, the user will be prompted to decide either to save the lastly recorded data or discard it.
- To change the Chart contents see Chart Content.
- Record start, stop commands are available in Sequencer (see Sequencer Commands)
- Duration of the recording can be defined under Settings.Time Range.Record.

1.2.3.2 Chart Content

Change the Parameters under Plots Axis 1, Plots Axis 2

- Right click on the Chart in the CPA window, and select the option "Chart Contents".
- A second window will pop-up and show the Parameter-Tree, here it is possible with the arrows in the middle area to add the desired Parameters to the Chart Content.

CPA - Control Performance Ar	nalyzer						- 🗆 ×	1				
Local 🄑 Remote						Version 4.	2.1 0					
navigation Parameters	status information Valve Series	65.3	Control buttons	control panel Actual Position		control panel Actual Pressure	2					
Information A Pressure	Access Mode	Local	Close	To and Buckley	0		1.399885 mbar					
Pressure Control Pressure Sensor	Controller Selector	Controller 1	Start Learn Zero Adjust	100 -	100	1,333224 -	1.333224					
Adaptive Learn Adaptive Learn Data	Error Number Error Code	0	Restart	80-	80	1,066579	1.066579					
 Tools Chart Analyzer 			Open	40-	40	0,5332895-	0.7999343					
Terminal Sequencer	Valve Firmware Version	F01.0C.61.00	Closed	20-	20	0,2666447	0.2666447		Chart Content			×
Trace Log				· •								VAT
Diagnostic File Gate Adjustment CPA Scaling About	0.9 0.8 0.7 0.6 \$\vec{x}{x}\$ 0.5		Chart Content Scroll Settings			100 90 80 70 60 50 S	plots axis 1 C — Actual Position C — Target Position	_	parameters b System b Volve Position Control P Pressure Control P Pressure Sensor b Interface EtherCAT b Power Connector	0	axis 1 Actual Position Target Position	
	 0.4 0.3 0.2 0.1 0 14:09:58 		Time			40 30 20 10 0 14:10:32	plots axis 2 - Actual Pressure - Target Pressure			0	axis 2 Actual Pressure Target Pressure 	
	Record	Clear St	op Analyze									
							Scan Rate: 20ms					

1.2.3.3 Settings

🚾 Settings		×
axis settings axis 1 Autoscale Min -1 ‡ Max 1 ‡ Log Scale	Autoscale Min 0.2666447 Max 1.399885 Log Scale	chart colors Parameter 1 Parameter 2 Parameter 3 Parameter 4 Parameter 5 Parameter 6
time range Chart (Record (30 Seconds Unlimited ▼	Parameter 7 Parameter 7 Parameter 8 Parameter 9 Parameter 10
		OK Cancel

Axis Settings

Axes range:	every axis range (Axis 1	l, Axis 2) can be defined individually
	Autoscale	\rightarrow the Chart will automatically adapt the scaling depending
on the recorded	data.	
	Manual scaling	\rightarrow the User can set min and max values for individual axis
	Log scale	ightarrow the Chart will show the axis in logarithmic format

Time Range

Chart defines the maximum duration of the showed data in the main window chart. *Record* defines the duration of the recording. 1 hours means that only the last hour of the measurement is saved.

Chart Colors

In the field chart colors, it is possible to change the chart color of individual parameters(Auto save).

1.3 Parameters

This menu shows all customer settings.

Parameters		- 🗆 X
Local 🔑 Remote		* 0 VAT
parameters Access Mode Control Mode Identification Statistics Warning/Error Services Valve Position Control Pressure Control Pressure Sensor Interface EtherCAT Power Connector	Control Mode *	Close • Save
Parameter ID: 0F020000		

* character after the parameter name means that this value has not yet been saved.

Parameter ID

The supported parameters is depending on the specific firmware version and the used hardware. This list of visible parameter can be exported by the CPA4 program directly. Please see chapter Export Parameters to Excel.

The parameter ID of a selected parameter is visible on the bottom of the parameter window. By using right-click on the parameter ID, the corresponding command (Set or Get) is copied to the clipboard. If using a set-command, the command needs to be completed by the new value.

Parameter ID: 0F1002	ID: 0F1002					
	Copy parameter ID to clipboard	- H				
	Copy set command to clipboard					
	Copy get command to clipboard					

See Services for special parameter functionality.

Copy to Clipboard with right click in values window

With this feature all parameters are copied to clipboard, which are visible on the right side under values. For example to copy the current learn data set of bank 1 in an excel.

Y Parameters		- 🗆 ×	XI Map	– 🗆 X
Local 🄑 Remote		* 0 VAT	E7	• : × ~
parameters	values			
System	Data [0]	1 🗘 📩		
▷ Valve	Data [1]	1074220255		
Position Control		1074330355 🗸	A	B ^
Pressure Control Actual Pressure	Data [2]	6 🗘 🔤	1 Data [0]	1
Target Dressure	Data [3]	4059077840	2 Data [1]	1074330355
Target Pressure Used		4000077040 🕹	3 Data [2]	6
Pressure Control Speed	Data [4]	1080460041 🗘	4 Data [3]	4059077840
Controller Selector	Convite Cliphoard	1078840758 🗘	5 Data [4]	1080460041
Controller 1	Data [C]		6 Data [5]	1078840758
Controller 2	Data [6]	1077221475 🗸	7 Data [6]	1077221475
Controller 3	Data [7]	1075602192 🗘	8 Data [7]	1075602192
Controller 4	Data [8]	1072082000	9 Data [8]	1073982909
Adaptive Learn	Data [0]	1073982909 🗸	10 Data [9]	1070985428
Start Learn	Data [9]	1070985428 🗘	11 Data [10]	1067746863
Туре	Data [10]	1067746863	12 Data [11]	1063663377
Bank Selection		1007740000 🗸	13 Data [12]	1059207921
Pressure Limit [SFS]	Data [11]	1063663377 🤤	14 Data [13]	1056913741
Pressure Limit	Data [12]	1059207921 🗘	15 Data [14]	1053268928
Status	Data [12]	1055010741	16 Data [14]	10497200720
Warning Info	Data [15]	1050913741 🗸	17 Data [15]	1043030378
▲ Learn Bank 1	Data [14]	1053268928 🗘	17 Data [10]	1045522117
Status	Data [15]	1048730978	18 Data [17]	1041500397
Data		1040/005/0	19 Data [18]	1040298535
Warning Info	Data [16]	1043922117 🤤	20 Data [19]	1036830838
Type Delete Learn Bank Dete	Data [17]	1041506397 🗘	21 Data [20]	1031820457
Elearn Bank 2	Data [18]	1010000505	22 Data [21]	1025579151
Learn Bank 3	Data [10]	1040298535 🗸	23 Data [22]	1022021982
Learn Bank 4	Data [19]	1036830838 🗘	24 Data [23]	1018801023
Delete All Learn Bank Data	Data [20]	1031820457 ^	25 Data [24]	1017011603
Pressure Sensor		1001020407	26 Data [25]	1015937951
Interface EtherCAT	Data [21]	1025579151 🗘	27 Data [26]	1015222181
Power Connector	Data [22]	1022021982 🗘	28 Data [27]	1013991264
	Data [22]		29 Data [28]	1013275494
	Data [23]	1018801023 😴	30 Data [29]	1012559724
	Data [24]	1017011603 🔶 🎽	31 Data [30]	1012187524
				×
Parameter ID: 07501102				

1.3.1 Features

22

Since the CPA v4.2.0

- Accessible over the "Gearwheel" symbol (red marked) in the picture bellow.
- Features setting are active after closing the window.

Parameters		$ \Box$ \times
Local 🄑 Remote		
 parameters System Valve Position Control Pressure Control Pressure Sensor Interface EtherCAT Power Connector Fieldbus VAT Profile Sequencer 	 Parameter Features × Parameter Features × features Highlight non-volatile parameters Autosave export Export Parameters to Excel 	

Highlight non-volatile parameters

Parameter which are saved in non-volatile memory and therefore not loose their actual value after restart or power cycle are **bold and cursive**.

Parameters				_		×	
Local 🄑 Remote			۰.	0	V		
parameters	values						
> System	Actual Pressure	[mbar]			1.399	885 (h. P
Position Control	Target Pressure	[mbar]				0	r
Pressure Control Pressure Sensor	Target Pressure Used	[mbar]				0	r.
Interface EtherCAT	Pressure Control Speed					1 ;	•
 Power Connector Safe Torque Off 	Controller Selector		Contro	ller 1			•
	Controller 1						
	Controller 2						
	Controller 3						
	Controller 4						
	General Settings						
	Adaptive Learn						

Autosave

Drop-down values are saved immediately when changed. Numerical values are saved either by

leaving the field or by pressing the Enter key or the Save button.

Without Autosave, all value changes in the Parameter window are saved with the Save button or by pressing Enter.

Note: Most CPA windows (e.g. Pressure Control or Pressure Sensor window) works in Autosave mode (no adjustable).

Export Parameters to Excel

E	xport the	full put	olic p	barar	net	er li	st	to	Excel		
6	a •s• c°·•								Public_Parameters.csv - Excel		
A3	• • ×	√ fx s	ystem.Acce	ss Mode							÷
1	Α	В	С	D	E	F	G	н	L. L.		
1	Created										
2	Full Name	Name	Id	DataType	Access	Volatile	Min	Max	EnumStrings	Description	
3	System.Access Mode	Access Mode	0F0B0000	SINT8	RW	v	0	2	0:Local,1:Remote,2:Remote Locked	Set the Access Mode to Local to operate over CPA, or to Remote to operate over the Interface.	
4	System.Control Mode	Control Mode	0F020000	SINT8	RW	V	0	14	0:Init,1:Homing,2:Position,3:Close,4:Open,5:Pressure Contro	Device state machine	

1.4 Pressure

All this windows under Pressure are only visible if the controller hardware support pressure control with an pressure sensor input or EtherCAT interface.

1.4.1 Pressure Control

This window show all pressure controller specific settings. For more information about the functionality of the single parameter see Pressure Controller.

1.4.2 Pressure Sensor

This window shows all sensor relevant parameters for an easy set up. For more information of each setting see Configuration.

CPA IC2(USB) Manual

1.4.3 Adaptive Learn

24

Learn is required for adaptive control algorithm. For further information see Learn.

In the upper half of the adaptive learn window are the possible learn settings listed.

🕶 Adaptive Learn	×
Local 🏓 Remote	
learn limits	
Pressure Limit [mbar]	1.333224 🗘
Open Speed	1 🔹
learn data destination	
Bank Selection	Bank 1 🔹
gas flow recommendation	
Calculate	
Start Learn	Not Started
Warnings:	
-	

Pressure Limit defines the maximum pressure which during the learn shall be executed. Standard value is sensor full scale. Reduce this value in case of the sensor full scale cannot or should not be reached.

Open Speed defines the speed for opening the valve during learn procedure between position 0% and 50%. Used to protect the pump from excessive gas flow. 1 means full speed.

Bank Selection defines where the learn data is saved after successfully execution. It exist four different learn bank which can be defined in each single pressure controller if the **Control Algorithm** is *adaptive*.

Gas flow recommendation

This tool helps to find a propper learn gas flow. This window can be opened with Calculate button.

CPA 25

🕶 Gas Flow Recommendatio	n				×
					VAT
valve					
Valve Series		65.5		Ŧ	
Valve Variant		Face Seal		Ŧ	
Nominal Diameter		DN250		Ŧ	
Min Conductance [l/s]				2 🗘	🔲 edit
working point table					
Gas Flow Unit		sccm		•]
Pressure [mbar]	Gas Flov	w [sccm]		Conduct	ance [l/s]
0.25	118.4			8.00	
0.5	290			9.80	
calculated gas flow					
[sccm]	568.	273 🗘	Note: / consta	Apply this ntly durin	gas flow value g learn procedure

Working point table

By filling in the work point table the learning time can be reduced, only the valve positions that are needed for these work points will be learned.

For the calculation of the recommended gas flow the resulted lowest conductance value of the working point table will be considered. All conductance values which fall below the minimum valve conductance limit are ignored for this calculation (Warning).

Is the working point table empty than recommended gas flow is calculated using the *Pressure Limit* and the *Min Conductance [I/s]* (Value is saved in firmware and can be adjusted by using edit check box).

For more information regarding learn flow calculation see Gasflow calculation for Learn. The Pressure unit of the working point table can be adjusted under Scaling.

Start Learn

Learn procedure starts by pressing Start Learn button. On the right side the progress bar shows the learn state. Is now the learn ongoing than the learn can be terminate with the Terminate Learn

button. .

Warnings

Shows the occurred warnings during the learn procedure. For possible learn warnings see Learn Warnings.

For more information about single learn steps see Execute a learn procedure.

1.4.4 Adaptive Learn Data

Adaptive Learn Data window supports different learn data functionality. It shows the saved actual pressure value on the specific learn position of each learn bank.



Per default the graph shows the current learn data information of the connected controller. Pressure unit of the y-axis can be adapted here Scaling.

Load from File

This function load the learn bank information and show it in the graph. It's possible to load the learn data directly from diagnose file as well as single learn bank information which previous saved by Save to File option.

If a file content is loaded than the Filename shows the file path.

Save to File

Learn Data information which is showed in the graph will be exported. This file can be loaded later again with the Load from File option in case of the file format is not changed.

Load from Valve

Chart data information will be updated with the connected controller learn data. This options is required if previously the Load from File option is executed and now the connected controller learn data should be displayed again.

Save to Valve

Transfer single learn bank loaded from file or from connected controller to a defined learn bank on the controller. Be aware that the original learn data bank information on the connected controller are lost afterward. In case of a recovery options is desired than execute the Save to File option before.

Save to Valve		×
Source	Destination	
File Learn Bank 1 🔻	Valve Learn Bank 1	•
File Learn Bank 1		
File Learn Bank 2		
File Learn Bank 3		
File Learn Bank 4		
Valve Learn Bank 1		
Valve Learn Bank 2		
Valve Learn Bank 3		
Valve Learn Bank 4		

Transferring Learn Data

- If no learn data information are available than either execute a learn procedure see Adaptive Learn or use Load from File option
- Execute Save to File option with the default csv file format.
- Connect different controller on which the learn data want to be transferred. Open Adaptive Learn Data window and execute Load from File option. Select the File which is created by Save to File option one step before.
- Execute Save to Valve option as last step

28 CPA IC2(USB) Manual

1.4.4.1 Chart Settings

Adaptive Learn Data graph options are selectable after right click into the graph area.



Function	Description
Zoom	Zoom in position and pressure axis
Zoom Position	Zoom in position axis
Zoom Pressure	Zoom in pressure axis
Zoom Reset	Reset the zoom in/out
Move	After zooming in desired area the move functionality is available
	Click and hold the mouse cursor to move the graph in position/pressure direction
Save to Clipboard	Allowed to copy learn position and pressure information in textfile or excel

© VAT Group AG

1.5 Tools

1.5.1 Chart Analyzer

This window can be open in the navigation as well with Analyze button in the chart.



Load

• Previous saved chart data can be loaded again for deeper analysis.

Save

- · Currently chart data is saved in a text file format.
- This file includes also the range information and the chart content.
- Note: Disabled signal are not stored in the text file.

Overlay

- Allows to compare two measurement in the same graphic.
- For further details see Overlay Function.

Right Click Menu

- Zoom
- Load from Clipboard: Update chart from clipboard.
- Save to Clipboard: Same functionality as Save button but the chart data are saved to the clipboard.

"Gearwheel"

• Chart Settings

CPA IC2(USB) Manual

1.5.1.1 Overlay Function

30

Since the CPA 4.2.0 version it is possible to Load two recordings in one Chart. So the User have the advantage to compare to graphs easier and faster with the Overlay Function.

Load a second recording

- Press the Button "Overlay" and add the desired recording File(*.txt)
- In the status bar it will show you the Filename and directory of the Data Files.
- The overlayed Parameters are marked with "(Overlay)".
- Possible to shift the overlayed graph (Time Axis) → "Time Offset". The Unit of the Time Offset is in seconds.
- With the Button "Save" It is possible to save the overlayed data and the recorded data in one File.



1.5.1.2 Zoom Function

To analyze the recorded Graphs more in detail, there is the possibility to use the Zoom functionality in Chart Analyzer.

Zoom Function

- To use the "Zoom function" move with the Cursor into the graph and right click.
- After that a second option window will show up and then select one of the Zoom options.

Function	Description
Zoom	Zoom in vertical and horizontal axis
Zoom Time	Zoom in Time axis
Zoom Axes	Zoom in Axis 1 and 2

31



• After the desired Zoom function is selected, it is able to mark the area with the cursor, where to zoom in.



1.5.1.3 Chart Settings

To adapt the recorded Graphs representation, there is the possibility to do some Settings in Chart Analyzer.



Axis settings

Axes range: every axis range (Axis 1, Axis 2, Time) can be defined individually (marked purple)
 Autoscale → the Chart will automatically adapt the scalling depending
 on the recorded data.

Manual scaling Log scale \rightarrow the User can set min and max values for individual axis

 \rightarrow the Chart will show the axis in logarithmic format

Visibility

- Cursor values: depending on the cursor position the actual axis values will be visible on the right site (marked red).
- ∆-values (Delta-Values): depending on the visible Axis Range the current axis differences will be visible on the right site (marked red).
- Data points: all real data values will marked with bullets in the chart analyzer window (marked orange)
- Comment Field: shows the commend field which allows to enter a short measurement description (marked green, will be saved in the text file)
- Grid: enable/disable the grid in the chart window
- Per default these settings (Comment field, Cursor values, Δ-values, Data points) are not selected.

Chart colors

• In the field chart colors, it is possible to change the chart color of individual parameters(Auto save).

1.5.2 Terminal

🕶 Terminal	×
Local 🔑 Remote	
value format IC2 command set	
Decimal	
command	
	Press 'ENTER' to send
response	
A:000001	
transmission history	
21:24:43.77 A: A:000001	
	Clear
	Save to Clipboard
	Save to File

Value format IC2 command set Command Set IC2

Right Click Menu

Clear: Clear terminal view. Save to Clipboard: Allowed to copy terminal data information in text file or excel. Save to File: Save terminal data in text file.

1.5.2.1 Chart Commands

Command	Description
chart clear	Deletes the current chart
chart start	Deletes the current chart and starts the plotting
chart stop	Freezing of the current chart
chart record start	Starts recording the chosen parameters (selectable via menu chart content)
chart record stop [<i>path</i>]	Stops recording and opens chart analyzer window Adding an optional filename saves

CPA

35

	Example: <i>chart record stop c:\temp\pressurelow.txt</i> Note: If spaces are requested in the name than use following notation: <i>chart record stop "c:\temp\name with spaces.txt</i>
chart record stop x.bmp chart record stop x.jpg chart record stop x.png	Stops recording and saves the chart in a file Example: <i>chart record stop x.jpg</i>
scanrate x	Setting the sampling rate in milliseconds Example: scanrate 100 : 100ms sampling interval scanrate 0 : as fast as possible (No Limit)

Note:

• Excecuting the commands clear, start or stop provides the same result as pressing the corresponding buttons below the chart

1.5.2.2 Command structure

Command structure is the same as over the RS232/485 Interface. (See in Command Set IC2)

36

CPA IC2(USB) Manual

1.5.3 Sequencer

🕶 Sequencer	×			
Local 🌽 Remote 🛛 🖿 Load 💾	Save 🕜 🔨 🕇			
value format IC2 command set				
Decimal				
sequence				
Command Duration	[s] Description			
A: 2				
Insert	low			
Delete	Row Entf			
Load fr	om Clipboard			
Save to	Clipboard			
_ run				
Start Stop Target	cycles 1 Current cycle 1			
	Duration [s]: 1			
	Bulation [5].			
transmission history				
21:27:59.64 A: A:000001				
	Clear			
	Save to Clipboard			
	Save to File			
Filename:				

Load

• Previous saved sequence can be loaded again.

Save

• Currently sequence is saved.

Value format IC2 command set
37

Command Set IC2

Right Click Menu sequence

Insert Row: New Row in sequence window for editing. Delete Row: Eliminate Row in sequence window. Load from Clipboard: Update sequence window from clipboard. Save to Clipboard: Same functionality as Save button but the sequence data are saved to the clipboard.

Start

• Start sequence functionality

Stop

• Stop sequence functionality

Target cycles

• -1 runs sequence endless.

Current cycle

• Starts with value 1.

Stop on error

- Sequence stops in case a command result in an error.
- For more information regarding error see Command Set IC1 or Command Set IC2.

Duration [s]

• Shows how long the current command is already executed.

Right Click Menu transmission history

Clear: Clear terminal view.

Save to Clipboard: Allowed to copy terminal data information in text file or excel. Save to File: Save terminal data in text file.

1.5.3.1 Commands

Command	Description
chart clear	Deletes the current chart
chart start	Deletes the current chart and starts the plotting
chart stop	Freezing of the current chart
chart record start	Starts recording the chosen parameters (selectable via menu chart content)
chart record stop	Stops recording and opens chart analyzer window
chart record stop x.bmp chart record stop x.jpg chart record stop x.png chart record stop x.txt	Stops recording and saves the data in a file (picture or data) Example: chart record stop c:\temp\x.jpg (save chart picture) chart record stop c:\temp\x.txt (save data) The resulting file will be named x_yyyymmdd_hhmmss.*

Command	Description	
	Note: If spaces are requested in the name than use following notation: <i>chart record stop "c:\temp\name with spaces.txt"</i>	
scanrate x	Setting the scan rate in the unit of milliseconds	
	Example: <i>scanrate 100</i> : 100 ms update interval <i>scanrate 0</i> : as fast as possible (no limits)	
transmission history clear	Deletes the transmission history window	
transmission history save x.txt	Save transmission history window in a text file The resulting file will be named x_yyyymmdd_hhmmss.txt	
value format hexadecimal	Set value format IC2 command set to hexadecimal	
value format decimal	Set value format IC2 command set to decimal	

Duration	Description	
[dec value]	Wait time in seconds after sending the command.	
Restart	Since the CPA v4.1.0	
	After a command which restarts the valve controller there can be use "Restart" instead of a fixed value for a delay time. With "Restart" the CPA will proceed with the sequence as soon as the controller is restarted.	
	Example: p:010F5001000001 Restart	

Note:

• Executing the commands clear, start or stop provides the same result as pressing the corresponding buttons below the chart

1.5.3.2 Command structure

Command structure is the same as over the RS232/485 Interface. (See in Command Set IC2)

38

1.5.4 Trace Log

🖙 Trace Log		_	×
🛅 Load 🛛 💾 Save		0 🔪	
trace Stop N log 2022/01/03 16:16:47.48 Rx i:01 2022/01/03 16:16:47.48 Tx i:011101000 2022/01/03 16:16:47.48 Tx i:011101000 2022/01/03 16:17:04.70 Rx A: 2022/01/03 16:17:04.70 Tx A:000999	Node 0	Interface Trace Interface Trace System Trace Load Error Data	
4		Clear Save to Clipboard Save to File	•

Load

• Previous saved trace log data can be loaded again for deeper analysis.

Save

• Currently trace log data is saved in a text file format.

Start

• Start trace log functionality

Stop

• Stop trace log functionality

Mode Interface Trace Load Error Data System Trace

Right Click Menu

Clear: Clear trace log view. Save to Clipboard: Allowed to copy trace log data information in text file or excel. Save to File: Same functionality as Save button.

1.5.4.1 Interface Trace

40

Interface Trace functionality is available for EtherCAT, DeviceNet, RS232/485, CC-Link and Profibus Interface.

It is a useful tool in case of troubleshooting, e.g. if the valve does not execute the desired host commands, it can be checked what information our controller receives via interface channel.

For more information regarding Trace log structure see: Fieldbus RS232/485

Fieldbus

Trace Log	- 0
Load 💾 Save	
Tace Mode Interface Trace 96 2021/05/11 08:07:27.81 PDO get B9686805/B9686805/379132A9/0/3/0/485/0/0/ 2021/05/11 08:07:27.84 PDO get B9686801/B9662A13/379130769/0/3/0/485/0/0/ 2021/05/11 08:07:27.84 PDO get B9662631/B9662043/379130769/0/3/0/485/0/0/ 2021/05/11 08:07:27.84 PDO get B9662059/B966208/37913249/0/3/0485/0/0/ 2021/05/11 08:07:27.84 PDO get B9662631/B966201/379182804/0/3/0485/0/0/ 2021/05/11 08:07:27.87 PDO get B9662049/B9656A49/378123805/0/3/0485/0/0/ 2021/05/11 08:07:27.87 PDO get B9662049/B9656A49/378123805/0/3/0485/0/0/ 2021/05/11 08:07:27.87 PDO get B9662A8/B9662043/378123805/0/3/0485/0/0/ 2021/05/11 08:07:27.87 PDO get B9662A8/B9662043/37832805/0/3/0485/0/0/ 2021/05/11 08:07:27.98 PDO get B9662A8/B9662043/37832805/0/3/0485/0/0/ 2021/05/11 08:07:27.98 PDO get B9662A8/B9662043/378322865/0/3/0485/0/0/ 2021/05/11 08:07:27.98 DDO get B9662A8/B9662043/37832805/0/3/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B9662A8/B9662043/37832805/0/3/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B9660370/B9660204/378288530/0/3/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B9660370/B9660204/37828830/0/3/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B9660502/B973720E40/3/30485/0/0/ 2021/05/11 08:07:27.99 DDO get B9660502/B9737020E40/3/30485/0/0/ 2021/05/11 08:07:27.99 DDO get B966026/B97608283/037307205050/0/ 2021/05/11 08:07:27.99 DDO get B9660502/B97608283/0373070485/0/0/ 2021/05/11 08:07:27.99 DDO get B9660502/B97602843/37805843/03/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B966137/B9686127/B9686250/J9782883/0/3/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B966137/B9686137/3786841/377851620/03/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B966137/B968613/37386841/377851640/3/0485/0/0/ 2021/05/11 08:07:27.99 DDO get B9661378/B968613/37868613/03/0485/0/0/	

Cyclic Structure: (Time stamp) (KODO) (CMDD) (BUFC) Acyclic Structure: (Time stamp) (KODO) (CMDD) (OBJ) (DATA)

KODO – Kind of Data Object:

PDO = Process Data Objects (cyclic communication) SDO = Service Data Objects (acyclic communication)

<u>CMDD – Command Direction:</u>

get = Received Data over Interface set = Transmitted Data over Interface

BUFC – Buffer Content:

Ethercat:	Order depends on the current PDO-Mapping
DeviceNet:	Order depends on the current used assembly
CC-Link:	Order depends on Profile 2
Pofibus:	Order depends on the current used Profile

OBJ - Object:

The Parameter object where data is received or transmitted to it

<u>DATA:</u> In case CMDD is get.

 \rightarrow All data with data type float are send in IEEE-754 Standard

 \rightarrow PDO cyclic data are traced in case of buffer content has changed.

RS232/485		
Trace Log -	- 🗆	\times
🖿 Load 💾 Save 🕜	V	
Start Stop Mode Interface Trace	Ŧ	
log 2022/01/05 14:21:12.22 Rx A: 2022/01/05 14:21:12.22 Tx A:000001 2022/01/05 14:21:52.28 Rx p:010F020000002 2022/01/05 14:21:57.61 Rx p:00010F020000004 2022/01/05 14:21:57.61 Tx p:00010F020000004		
4		•

Structure: (Time stamp) (KODO) (CMD)

KODO – Kind of Data Object:

Rx = Received Data (send from host) Tx = Transmitted Data (Answer of received command)

CMD - Command

For more information see Command Structure

1.5.4.2 Load Error Data

To read out the last 5 seconds before enter error mode.

Exceptions are:

- Firmware which are older than June 2017
- Firmware from July 2020 until November 2020 with EtherCAT interface

TraceLog — 🗆 X
🖿 Load 💾 Save 😗 🔨 🔨
trace
Start Stop Mode Load Error Data
log
Log of last 3 sectors before enter for mode: Format: ControlMode / Actual Pressure [mBar] / Actual Position 1 [01] / Actual Position 2 [01] / Stepoint / Voltage Power Supply [mV] / Voltage Motor [V] / Statusword 1 / Iq Motor 1 [mA] / Iq Motor 2 [mA]
2022/01/05 14:25:50.47 4 / 0.000047 / 1.000000 / 1.000000 / 23039 / 48.152000 / 34359 / -195 / -49
2022/01/05 14:25:50.57 4 / 0.00004 / 1.000000 / 1.000000 / 23099 / 48:25:1999 / 34:35 / -196 / -48 2022/01/05 14:25:56.07 4 / 0.00038 / 1.000000 / 1.000000 / 23099 / 48:57000 / 34:55 / -194 / -48
2022/01/05 14:25:50.77 4 / 0.000037 / 1.000000 / 1.000000 / 1.000000 / 48.152000 / 34359 / -195 / -49
2022/01/05 14:25:50.87 4 / 0.000045 / 1.000000 / 1.000000 / 23061 / 48.152000 / 43859 / 195 / -48
2022/01/05 14:25:0057 4 / 0.00004 / 1.000000 / 1.000000 / 23017 (48:152000) 73557 / 159 / 46 2022/01/05 14:25:51.07 4 / 0.00004 / 1.000000 / 1.000000 / 23017 (48:152000) 73557 / 159 / 46
2022/01/05 14:25:51.17 4 / 0.000040 / 1.0000000 / 1.000000 / 23099 / 48.152000 / 34359 / -195 / -48
2022/01/05 14:25:51.27 4/ 0.000045 / 1.000000 / 1.000000 / 23069 / 48.152000 / 34359 / 196 / 49 2022/01/05 14:25:51.37 4/ 0.000045 / 1.000000 / 1.000000 / 23069 / 48.152000 / 34359 / 196 / 49
2022/01/05 14:25:51.47 4 / 0.00004 / 1.000000 / 1.000000 / 23136 / 48.152000 / 34359 / 197 / 49
2022/01/0514:25:51574 / 0.000041 / 1.000000 / 1.000000 / 20039 / 48.152000 / 34359 / -197 / 47
2022/01/05 14:25:51:74 / 0.000043 / 1.000000 / 1.000000 / 23054 / 48:25:1999 / 4355 / -195 / -48 2022/01/05 14:25:51:74 / 0.000043 / 1.000000 / 1.000000 / 23054 / 48:25:2000 / 34559 / -195 / -48
2022/01/05 14:25:51.87 4 / 0.000041 / 1.000000 / 1.000000 / 23009 / 48.053001 / 34359 / -196 / -49
2022/01/05 14:25:51.97 4 / 0.00004 / 1.000000 / 1.000000 / 23046 / 48.152000 / 34359 / 195 / 49
2022/01/05 14:25:32.07 4 (0.00004 / 1.000000 / 1.000000 / 2014 (48.15200) 74535 / 157 46 2022/01/05 14:25:52.17 4 (0.00004 / 1.000000 / 1.00000 / 2314 (48.15200) 74359 / 158 / 49
2022/01/05 14:25:52.27 4 / 0.000041 / 1.000000 / 1.000000 / 23121 / 48.251999 / 34359 / -196 / -48
2022/01/05 14:25:52,37 4 / 0.000049 / 1.000000 / 1.000000 / 20399 / 48:152000 / 34359 / 194 / 48 2022/01/05 14:25:52 47 4 / 0.000049 / 1.000000 / 1.000000 / 20312 / 48 52000 / 34359 / 194 / 48
2022/01/05 14:25:52:57 / 0.000046 / 1.000000 / 1.000000 / 23129 / 48:152000 / 34559 / 155 / 48
2002/01/05 14:25:52.67 4 / 0.0000046 / 1.000000 / 1.000000 / 23069 / 48.152000 / 34359 / -195 / -48
2022/01/05 14/25/52 // 4 / 0.00004 / 1.000000 / 1.000000 / 230074 / 48.15/2000 / 34559 / 156 / 4/ 2022/01/05 14/25/52 87 4 / 0.00005 / 1.000000 / 1.000000 / 230074 / 48.15/2000 / 34559 / 156 / 48
2022/01/05 14:25:52.97 4 / 0.000043 / 1.000000 / 1.000000 / 23009 / 48.152000 / 34359 / -195 / -49
2022/01/05 14:25:53.07 4/ 0.000045 / 1.000000 / 1.000000 / 20022 / 48.152000 / 34355 / 196 / 48
2022/01/05 14:25:33.17 4/ 0.000187 (0.57/730 / 0.57/30 / 1.000000 / 25002 / 48:152000 / 3335 / -588 / -1.24 2022/01/05 14:25:53.27 4 / 0.000118 (0.60284 / 0.60000 / 22054 / 48:152000 / 3335 / -588 / -1.24
2022/01/05 14:25:53.37 4 / 0.000135 / 0.621743 / 0.621518 / 1.000000 / 21844 / 48.053001 / 33335 / -5921 / -5918
2022/01/05 14:25:53.47 4 / 0.000127 / 0.621743 / 0.621518 / 1.000000 / 22001 / 48.053001 / 3333 5 / 5922 / -5922 0202/01/05 14:25:53.47 4 / 0.000124 / 0.621743 / 0.621518 / 1.000000 / 21021 / 48.053001 / 3333 5 / 5922 / -5924
2022/01/05 14:25:35.7 4 / 0.000137 / 0.621743 / 0.621518 / 1.00000 / 21897 / 48.053001 / 3335 / 5522 / 5522
2022/01/05 14:25:53.77 4 / 0.000136 / 0.621743 / 0.621518 / 1.000000 / 21867 / 48.053001 / 33335 / -5920 / -5922
2022/01/05 14/25/53.87 4 / 0.000135 / 0.621/43 / 0.621518 / 1.000000 / 21964 / 48.053001 / 3333 / -5922 / -5922 2022/01/05 14/25/53 72 4 / 0.000139 / 0.621743 / 0.57184 / 0.00000 / 22001 / 48.053001 / 3333 / -5929 / 5919
022/01/05 14:25:54.07 4 / 0.000133 / 0.621743 / 0.621518 / 1.000000 / 21934 / 48.053001 / 33335 / -5921 / -5919
2022/01/05 14:25:54.17 4 / 0.000137 / 0.621743 / 0.621518 / 1.000000 / 21979 / 48.053001 / 33335 / -5921 / -5922
2022/01/05 14:25:342/ 4/ 0.000137 / 0.021/43 / 0.02138 / 1.000000 / 21912 / 48.035001 / 33335 / 5921 / 5920 / 2022/01/05 14:25:543 / 4 / 0.000137 / 0.02174 / 0.621743 / 0.621518 / 1.000000 / 21927 / 48.053001 / 3335 / 5921 / 5924
2022/01/05 14:25:54.47 4 / 0.000138 / 0.621748 / 0.621518 / 1.000000 / 21844 / 48.053001 / 33335 / -5913 / -5919
2022/01/05 14:25:54.57 4 / 0.000135 / 0.621743 / 0.621518 / 1.000000 / 21927 / 48,053001 / 3335 / -5916 / -5919 / 2022/01/05 14:25:54.67 4 / 0.000137 / 0.621518 / 1.000000 / 10155 / d7.85969 / 3335 / -596 / -5919 / 2022/01/05 / d7.8596 / 2023 / -596 / -5919 / 2022/01/05 / d7.8596 / 2023 / -596 / -5919 / 2022 / -596 / 2023 / -596 / -5919 / 2022 / -596 / 2023 / -596 / -5919 / 2022 / -596 / 2023 / -596 / -5919 / 2022 / -596 / 2023 / -596 / -5919 / 2022 / -596 / 2023 / -596 / -5919 / 2022 / -596 / 2023 / -596 / -5919 / 2022 / -596 / 2023 / -596 / -5919 / 2020 / -596 / 2023 / -596 / -5919 / 2020 / -596 / 2023 / -596 / -5919 / 2020 / -596 / 2023 / -596 / -5919 / 2020 / -596 / 2023 / -596 / -5919 / -596 / 2020 / -596 / 2023 / -596 / -
2022/01/05 14:25:54.77 / 0.000136 / 0.621743 / 0.621138 / 1.00000 / 1.1067 / 4.05239 / 3533 / 5520 / 5520
2022/01/05 14:25:54.87 4 / 0.000139 / 0.621748 / 0.621518 / 1.000000 / 21889 / 48.053001 / 33335 / -5922 / -5923
2022/01/05 14:25:56.74 / 0.000132 / 0.6211743 / 0.621518 / 1.000000 / 218/4 / 48U53001 / 3333 / -5922 / -5922 / -5922 / -292 / -292 / -2922 /
2022/01/05 14:25:55.17 4 / 0.000139 / 0.621748 / 0.621518 / 1.000000 / 21986 / 48.053001 / 33335 / -5921 / -5923
2022/01/05 14:25:55.27 4 / 0.000137 / 0.621743 / 0.621523 / 1.000000 / 21927 / 48.053001 / 3333 / 5921 / 5923 / 5921 / 5923 / 5921 / 59
2022/04/03 44:25:357 44 (0404359) (0422451 (0404000 / 2132 / 46,053001 / 42321 / -3321 / -3323 / -332 /

1.5.4.3 System Trace

The system trace records the control mode transitions.

™ Trace Log	_		×
🛅 Load 🛛 💾 Save	2	\checkmark	T
trace Start Stop Mode System Trace	2	•	
log 2021/05/10 15:21:40.74 Control Mode = 0x04 2021/05/10 15:21:41.50 Control Mode = 0x03 2021/05/10 15:21:43.51 Control Mode = 0x02 2021/05/10 15:21:44.81 Control Mode = 0x05			4

1.5.5 Update Tool

1.5.5.1 Update Procedure

Update Tool is supported since the CPA v4.0.8 Multivalve Option is supported since CPA v4.2.0 In case of lower CPA version see CPA Update.

Note: During update process the valve does not operate, communication to the host get lost. Ensure no process is in work

1. Save the valve state (optional)

Generate Diagnostic File

2. Open "Update Tool"

Activate the Local mode and open "Update Tool"

3. Load update file

Possible file type are

- *.vat (VAT Firmware)
- *.mc (Motion Controller Firmware)
- *.net (Interface Firmware)
- *.drive (Drive parameter file)
- *.config (Configuration parameter file)

- *.seq (Sequence textile, since CPA v4.2.0)
- *.zip (Collection with multiple files)
- *.cpa (CPA software)

44

- Move the update file per drag and drop into the Update Tool
- Or Press 'Load' and choose the update file.

뽀 Update Tool		×
toad	Version 1.0.4 💡	VAT
valves Valve: 65548-PHHX-CAF1/0028		
Valve firmware	O:\MT\PG5\-=FirmwareTest=-\F01.0C.56.00.vat	
start Stop		

Valve selection in case of more than one valve is connected (Multivalve option required)

4. Press "Start" to initialize the download to the valve

run	
Start	Stop

Bytes downloaded and progress of download is shown The download needs about 2 minutes

L		
start Stop	2021376 of 2818048 bytes downloaded	-

Information that update was successful

CPA 45

₩ Update Tool			X
🔀 Load		Version 1.0.3	VAT
files			
Valve firmware	653_Update_Files/F01.0C.28.05.vat		
run Stop			

VAT-version is now updated on the valve.

5. Generate Report (Optional)

Open Report (Push Show Report Button) and Save File

```
1 Created: 15.05.2019 19:11:07
3 Device Information:
4 Valve Series = 65.3
5 Valve Variant = Standard
6 Nominal Diameter = DN320
7 Serial Number = n.a.
8 Valve Firmware Version = F01.0C.28.05
9 Configuration Parameters ID = n.a.
10 Controller Type = IC2H5
11 Interface Type = EtherCAT
12 Option Type = SPS + PFO + Cluster
13 Start Up Counter = 24
14
Updating 'Valve firmware' from '653_Update_Files/F01.0C.28.05.vat'
16 Update success
17
```

Close the Update Tool

6. Save the valve state (optional) Generate Diagnostic File

1.5.5.2 Verify VAT firmware update

1. Parameters Menu

- Open "Parameters"
- Check Parameter System/Identification/Firmware/Valve Firmware Version

Y Parameters			-	×
Local 🎾 Remote		۰.	0	T
parameters A System Access Mode Control Mode Identification Serial Number Configuration Firmware Valve Firmware ID Valve Firmware Version CPA Version Interface Firmware Version Motion Controller 1 Firmware Version Notion Controller 1 Firmware Version Valve Statistics Warning/Error Services Valve Position Control Actual Position Target Position Position Control Speed Pressure Control Pressure Sensor Interface EtherCAT Power Connector	values Valve Firmware Version	F01.00	C.56.00	
Parameter ID: 0F100302				

2. Diagnostic Files

- Open Diagnostic File
 Check Parameter System.Identification.Firmware.Valve Firmware Version

6	র জন ে 😵 ন 🖻									65548-PHH	HX-CAF1_0028_2	0210510_162316	_DiagnosticFile	e - Excel
D	atei Start Einfügen	Seitenlayout	Formeln	Daten Üt	berprüfen	Ansicht ,	Add-Ins Agi	le PLM	♀ Was r	nöchten Si	ie tun?			
Einf	Ausschneiden En Kopieren ✓ Format übertragen Zwischenablage	Calibri F K U -	• 11 • A		= ≫·• = •= •=	Textuml	bruch Ien und zentrierer	Star	ndard • % 000 Zahl	▼ \$00 \$00 50	Bedingte Formatierung v	Als Tabelle formatieren *	Standard Ausgabe	C B Fori
A1	12 ▼ : × ✓ f System.Identification.Firmware.Valve Firmware Version													
		A				В			C	D	E	F	G	
1	Created						10.05.2021 16	23						
2	Name				Value									
3	System.Access Mode				Remo	Remote								
4	System.Control Mode				Positi	on								
5	System.Identification.Ser	rial Number			65548	-PHHX-CAF1/	/0028							
6	System.Identification.Con	nfiguration.Va	lve Series		Simul	ation								
7	System.Identification.Con	nfiguration.Va	lve Variant		Face S	Seal								
8	System.Identification.Con	nfiguration.No	minal Diamete	r	DN32	0								
9	System.Identification.Con	nfiguration.Dri	ive Parameters	ID	n.a.									
10 System.Identification.Configuration.Configuration Parameters ID n														
11	System.Identification.Fin	mware.Valve F	irmware ID		10745	68								
12	System.Identification.Fire	mware.Valve F	irmware Versi	on	F01.00	C.56.00								

1.5.5.3 Trouble shooting

Situation

T Update Tool	No.	Sec. or	-	larger fraction			23
🔀 Load					Version 1.0.1	V	
files							
Valve firmware		N:\-=Firmwa	areTest=-\	F01.vat			
		Summary		×			
		Failure upd	ating 'Val	ve firmware'. Close			
un Stop							

Download failure in Update Tool (since CPA v4.0.9) or Firmware Loader

Valve shows rotating 8 on display (valve is in bootloader mode) after start download a firmware over CPA.



Rotating 8 on display

Solution

- Disconnect the USB cable
- Disconnect the power cable
- Reconnect the USB cable
- Reconnect the power cable

If the CPA now reconnects

- Open Update Tool (since CPA v4.0.9) or Firmware Loader
- Start firmware download again
- Problem should now be solved and otherwise start the download again

If the CPA does not reconnect

• Start CPA local (computer) if no local version is available than see Update

Very CPA - Connect X
No valve connected. Please make sure that the USB cable is connected correctly.
Trying to connect
Offline CPA

- Open Offline CPA
- Open Update Tool (since CPA v4.0.9) or Firmware Loader
- · Select the valve firmware and start download
- If the update fails immediately could it be possible that it is a spare masterboard? In this case the update is locked and will not work.
- (Optional) Open CPA again
- (Optional) Open Update Tool
- (Optional) Select other firmware for download (example Motion Controller Firmware)
- Problem should now be solved and otherwise start the download again

1.5.6 Diagnostic File

Diagnostic File save the actual value of all parameters. This includes also additional information for troubleshooting purpose.

Following Steps are necessary to generate a diagnostic File:

- Open Diagnostic File functionality under Tools
- Define the location and press Save

© VAT Group AG

						CP	PA 49
CPA - Control Performance Ar	nalyzer						- 🗆 ×
Local 🏓 Remote						Version 4.2.0	
navigation	status information -		control buttons co	ontrol panel		control panel	
Parameters	Valve Series	Simulation	Open A	Actual Position		Actual Pressure	
Information	Access Mode	Local	Close		0	-0.0	0002180726 mbar
▲ Pressure	Control Mode	Position	Start Learn	arget Position	0 2	Target Pressure	0 🗘
Pressure Control			Start Learn			1.333224	1 222224
Adaptive Learn	Speichern unter				×	1,000221	1.555224
Adaptive Learn Data	Speichem in: De	iktop	- 🖛 📾 🕂 💷			1,000579-	1.066579
▲ Tools	* 14	Muiic Amal	Diarar PC		<u>^</u>	0,7999342 —	0.7999343
Chart Analyzer	Schnellzugriff	indjie Andr				0,5332895 —	0.5332895
Terminal		Bibliotheken	CD-Laufwerk (D:)	VAT CPA)	0,2666447 —	0.2666447
Sequencer	Desktop	•	o bytes nel von 2.0	DO IVID		0-	0
Trace Log	Bhlotheken	CD-Laufwerk (F:) VAT CPA 0 Bytes frei von 2.66 MB	Netzwerk		1	-	
Diagnostic File			~			0	
CPA Scaling	Dieser PC	CPA_Tests	Data IC2H3_Aufwä	ärtswandler	ľ	0	
	Natural .	Help&Manual_V7_METP	Live		a.	-4E-05	
	Neizweik				.	-8E-05	axis 1
	Dateinar	ne: 65548-PHHX-CAF1_00	28_20210510_163417_DiagnosticF	ile 💌	Speichern	2	Actual Position
	Dateityp	CSV files (*.csv)		•	Abbrechen	-0.00012 🙀 💌	alger Posicion
	1					plots	axis 2

Example of a Diagnostic File

	. •) - ©			980EC-24G	Q-AAZ1_0	147_20210104_10	0649_Diagnos	ticFile.csv - E	xcel		ه -	- 0	×
D	atei	Start	Einfügen	Seitenlayout	Formeln	Daten	Überprüfen	Ansicht	Add-Ins	Team	♀ Sie wüns	Stucki An.	🗛 Freigel	ben
				10										_
G	15	*	+ ×	$\checkmark f_x$										~
				А								в		
1	Creat	ted						04.01.20	021 10:07					
2	Nam	e						Value						
3	Syste	m.Acce	ss Mode					Local						
4	Syste	em.Conti	rol Mode					Error						
5	Syste	em.Ident	tification.Se	rial Number				980EC-2	4GQ-AAZ1/	/0147				
6	Syste	em.Ident	tification.Co	nfiguration.Dev	rice Series			98.0						
7	Syste	em.Ident	tification.Co	nfiguration.Dev	rice Variant			Standar	d					
8	Syste	em.Ident	tification.Co	nfiguration.Nor	ninal Diame	ter		None						
9	Syste	em.Ident	tification.Co	onfiguration.Driv	ve Paramete	rs ID		n.a.						
10	Syste	em.Ident	tification.Co	onfiguration.Con	figuration P	aramete	rs ID	n.a.						
11	Syste	em.Ident	tification.Fir	rmware.Device F	irmware ID			1059935						
12	Syste	em.Ident	tification.Fir	rmware.Device F	Firmware Ve	ersion		F04.0C.02.04						
13	Syste	em.Ident	tification.Fir	rmware.CPA Ver	sion			4.1.0						
14	Syste	em.Ident	tification.Fir	rmware.Interfac	e Firmware	Version		4.7.0.1						
15	Syste	em.Ident	tification.Fir	mware.Motion	Controller 1	Firmwar	e Version	FIR-v17	26-B521662					
16	Syste	em.Ident	tification.Fir	mware.Motion	Controller 2	Firmwar	e Version	FIR-v17	26-B521662					
17	Syste	em.Ident	tification.Fir	mware.Motion	Controller 3	Firmwar	e Version	FIR-v17	26-B521662					
18	Syste	em.Ident	tification.Fir	mware.Motion	Controller 4	Firmwar	e Version	67						
19	Syste	em.Ident	tification.Ha	rdware.Control	ler Type			IC2H4						
20	Syste	em.Ident	tification.Ha	ardware.Interfac	е Туре			EtherCA	T					
21	Syste	em.Ident	tification.Ha	rdware.Option	Туре			Not Ava	ilable					
22	Syste	em.Statis	stics.Start Up	p Counter				1610						
23	Syste	em.Statis	stics.Total Ti	ime Powered				5373056	5					
24	Syste	em.Statis	stics.Time Si	ince Power On				56						
25	Syste	em.Warn	ning/Error.W	/arning Bitmap				0						
26	Syste	em.Warn	ning/Error.Er	rror Bitmap				16384						
27	Syste	em.Warn	ning/Error.Er	rror Number				102						

1.5.7 Gate Adjustment



Desc	ription
Preconditions of Gate Adjustment:	Bonnet must be disassembled.
1. Close valve and check if pendulum plate is in center of flange. Check can be done either visual or by measurement.	When the valve is mounted to a tool, the bonnet has to be removed and the center position can be measured by a depth gauge (see 6.) If the centering (expected distance) is not correct, proceed:
2. Run CPA.	Available on CPA Version 4.2.1.
3. Set access mode to Local .	CPA - Control Performance Analyzer Local Remote navigab Paramete Information Pressure Pressure Pressure Control Control Mode Close
4. Open Gate Adjustment Valve will switch to Maintenance Speed.	Chi-Central Reformance Analyses Chi-Central Reformance Analyses Remarkers Remarker Remarkers Remarker Rema
5. Start Initialization by pressing « Start ». The valve will do a homing and close, if necessary.	Gate Adjustment X Local P Remote 2 Initialization Homing Done Valve Closed Measurement Measured distance [mm] 0.0 0

51

Desci	ription
Vale is doing a movement after pressi Human body parts must be kept out o from moving parts.	Warning X Valve is moving
6. Measure value of distance [mm]. Measured distance between bonnet flange surface and pendulum plate. Maximum of adjustable value is ±1.5 mm.	Distance
DN 63-100 160	200 250 320 350 200 2 <td< td=""></td<>
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $
 7. Type in measured distance if value ≥ ±0.5mm of expected distance. If value is in expected distance range the gate is adjusted. 	Gate Adjustment X Local P Remote Initialization Homing Done Valve Closed Measurement Ready for Measurement Measured distance [mm] * 50.1 C Adjust

Descr	iption
8. Press « Adjust », the valve will correct the center position of the gate.	Gate Adjustment × Local P Remote Initialization Homing Done Valve Closed Measurement Ready for Measurement Measured distance [mm] * 50.1 Adjust
Vale is doing a movement after pressi Human body parts must be kept out c from moving parts.	Warning X Valve is moving, center is going to be adjusted OK Abbrechen
9. Re-measure the distance. Distance should be in distance range, otherwise retry the whole procedure.	
 10. Close Gate Adjustment by closing the window. The maintenance speed will reset to normal speed. Make sure that the access mode is set to «Local», closing the Gate Adjustment tool will also ensure that the maintenance speed mode changes back to normal speed. If the access mode is set to «Remote», the valve will remain in maintenance speed mode after closing the Gate Adjustment tool. To switch to prema another walve. 	Gate Adjustment

1.6 CPA Scaling

With this window the Position and Pressure Unit can be defined for CPA. For the interface channel see the according chapter under Interface.

Very CPA Scaling			×
		0 🔪	
position	pressu	re	
Position Unit	0 - 100 • Pressu	ire Unit mbar	•
	0-1	F	Pa
	0 - 10		кРа
	0 - 90	k	bar
	0 - 100		mbar
	0 - 1000		Torr
	0 - 10000		mTorr
	0 - 100000	F	psi
	User specific		User specific



- Parameters				_	· 🗆	×
Local 🔑 Remote			۵	0	V	T
parameters > System > Valve > Position Control > Pressure Control > Pressure Sensor > Interface EtherCAT > Power Connector	values Actual Position Target Position Position Control Speed ▷ Ramp	[0 - 100] [0 - 100]				0 * 0 * 1 *
Parameter Group: 11						

Default scaling for IC1 compatible purpose is: Position Unit: 0-100000 Pressure Unit: User specific 0-1000000

1.7 About

54

Since the CPA v4.2.1

About			×
		0	VAT
software details			
CPA version	4.2.1		
CPA Manual version	Not available	Cheo	k for Update
web www.vatvalve.com			
© 2021 VAT Group AG	Switzerland.	All right	s reserved

CPA version

- Shows the current installed CPA version
- For update to latest version see Update (Controller Update Version)

CPA Manual version

- Shows the current CPA Manual version located on the PC.
- Check for Update opens the bellow window:

🖙 CPA Manual

Newer CPA IC2 (USB) Manual v1.0 available

Installed: Not available



• Online Update will load the latest CPA Manual version from VAT Homepage automatically if an active internet connection is available.

 \times

- Load from File is necessary in case of no internet connection or a specific CPA Manual version is requested.
 - CPA Manual can be downloaded from VAT Homepage see Downloads. Select Software & Updates Tab and filter for CPA IC2(USB) Manual files.

			СРА	55
Product Doct	umentation CAD Files	s Safety, Quality and Environmental Statements	Software & Updates	
CPA IC2(USB) Manual				Q
 CPA IC2(USB) Manual v1.0 			9 MB ZIP	Download 🗸

Part II

2 Valve Firmware

2.1 System

2.1.1 Services

Parameter name	Description
Restart Controller	Emulates a power cycle.
Error Recovery	Resets the <i>Error</i> state of the <i>Control Mode</i> to state <i>Init</i> . Alternative set the <i>Control Mode</i> to <i>Init</i> (Value 0) (Example EtherCAT cyclic communication) In some cases Error Recovery is not working (e.g. motor driver is in error state) and therefore a Restart Controller command is required. This function is available since mid-July 2020.
Store/Restore Settings.Restore Factory Parameters	Set Valve back to factory state.
Store/Restore Settings.Store User Parameters	Store all non volatile parameter settings in a backup memory inside the controller.
Store/Restore Settings.Restore User Parameters	Restore all non volatile parameter settings. It is important that a store user parameter function has been executed in the past.
Configuration Lock Mode	If configuration lock mode is enabled, all non volatile parameter are not settable anymore.

2.1.2 Control Mode

The **Control Mode** represents the state machine of the valve. Writing to **Control Mode** requests a change in the state while reading **Control Mode** returns the actual state of the state machine.



0	Init	State after power up.	
		Remains if Homing is not started (see <i>Homing.Start Condition</i>) or no Exception occurs	
1	Homing	The valve performs the homing procedure to initialize the position.	
		Start condition: depends on set <i>Homing.Start Condition</i>	
		Behavior at end: depends on set Homing.End Control Mode	
		Refer to chapter Homing	
2	Position	The valve moves to the desired <i>Target Position</i> .	
3	Close	The valve closes.	
4	Open	The valve opens.	
5	Pressure	The valve controls to the desired <i>Target Pressure</i> .	
	Control	Refer to chapter Pressure Control	
6	Hold	The valve remains in the actual position.	
		Usage during Pressure Control:	
		Reduce valve reaction during plasma ignition.	
		• Stopping the valve movement to evaluate the stability of the sensor, flow meter,	
		Change from Control Mode 3 Close to 6 Hold is not possible	
7	Learn	The valve performs the system learn.	
		Necessary for Adaptive Pressure Control	
		Refer to chaper Learn	
8	Interlock	The valve opens and locks due to the actuation of a digital input.	
	Open	Release behaviour: Control Mode changes to 4 Open or to 1 Init if no Homing was performed	
		yet.	
		Refer to Pow er connector IO	
9	Interlock	The valve closes and locks due to the actuation of a digital input.	
	Close	Release behaviour: Control Mode changes to 3 Close or to 1 Init if no Homing was performed	
		yet.	
		Refer to Pow er connector IO	

12	Power Failure	Power loss occurred.		
		The valve opens or closes (Only with optional Power Failure Option)		
		Closing or opening behavior depends on set Power Failure.Functionality		
		Refer to Pow er Failure Option		
13	Safety	The motor of the valve is powerless due to a digital input.		
	-	Release behavior: Control Mode changes to 1 Init		
14	Error	The valve is in an error state, no movement possible.		
		Recovery via Services.Restart Controller. Set Services.Error Recovery TRUE for recovery		
		w ithout restart (no communication lost).		
		Refer to chapter Trouble Shooting		

<u>View:</u>

СРА

status information — Access Mode	Remote
Control Mode	Position
Error Number	0
Error Code	0

First digit on display

0.0.0.0.

Init	I
Homing	Н
Close	С
Open	0
Pressure Control	Ρ
Position	Α
Interlock Open or Close	Т
Hold	Н
Learn	L
Safety Mode	S
Power Failure	F
Error	Ε

2.2 Valve

2.2.1 Homing

After a restart homing is necessary to determine the plate position

Parameter	Description			
Start	Homing start option defines when the valve performs the homing procedure.			
Condition	0 Standard	If valve is not in sealed state		
	1 Open Command	On an open command		
	2 Move Command	On any move command		
	3 At Startup	All the time		
	4 Homing Command	On homing command		
	5 Move Command Without	On any move command except close		
	Close	command if the valve is closed		
End Control	This control mode is set after	a successful homing.		

Mode	2 Position
	3 Close
	4 Open
	5 Pressure Control
End Pos	<i>ition</i> In case the <i>End Control Mode</i> is set to 2 (<i>Position</i>), this parameter defines
	which position is set after successful homing

2.2.2 Position Adaption

2.2.2.1 Offset

How to use the Position Offset at Single Valve

If the User wants to set a Position Offset, than the first step would be to "Enable" the "Position Adaption", what is possible over the CPA4 under Parameters.Valve.PositionAdaption.Enable à "TRUE" or via RS232 Command – see Chapter Set Position Offset via RS232

🚾 Parameters	– 🗆 ×
Local 🏓 Remote 🔀 Features 😯 Help	VAT
a System Access Mode Control Mode I Identification Statistics Warning/Error Services Actual Position Position State Homing Cycle Counter External Isolation Position Restriction Position Adaption Enable Speed Mode Position Control Pressure Control Pressure Sensor Interface EtherCAT Power Connector	values Enable False Image: Copy Save
Parameter Group: 1066 Valve	: 16354-PAHU-AWU1/0004

Picture : Enable - Position Adaption

The Parameter "Actual Position", what is shown in picture bellow, is a possibility for the user to show the Adapted Position or the Real Position of the Valve.

Actual Position:	Real	=	Position Setpoint + Offset
	Adapted	=	Position Setpoint

💇 Parameters			-	
Local 🏓 Remote 🔀 Features 😯 Help				
parameters	values			
▲ System	Enable		True	-
Access Mode Control Mode	Mode		Offset	
Identification	Actual Position		Real	
 Statistics Warning/Error 	Offset	[0 - 100]		5 🗘
 Services Valve 	Target Position In	[0 - 100]		0 🗘
Actual Position	Target Position Used	[0 - 100]		5 🗘
 Homing 	Actual Position Real	[0 - 100]		5 🗘
▷ Cycle Counter ▷ External Isolation	Actual Position Adapted	[0 - 100]		0 🗘
Position Adaption Enable Mode Actual Position Offset Target Position In Target Position Ised Actual Position Real Actual Position Real Actual Position Adapted Speed Mode Position Control Pressure Control Pressure Sensor Interface EtherCAT Power Connector			Сору	Save
Parameter Group: 1066 Vali	ve: 16354-PAHU-AWU1/0004			

Picture : Actual Position - Option

Now, if the Position Adaption is «Enabled» the user can set under the Parameter *Parameter.Valve.PositionAdaption.Offset* the desired Offset.

For example the User want to set an *Offset* = 5 and have selected the Option *Actual Position* = *Real* at Position Setpoint = 0.

💇 CPA - Control Performance Ana	lyzer						- 🗆 X				
Local 🤌 Remote					Ve	ersion 4.2	.0 beta 😧 Help 🛛 💦 🚺				
navigation	status information		control buttons	control panel		cont	rol panel				
Parameters	Valve Series	61.3	Open	Actual Position		Actu	al Proceuro				
Information Pressure Pressure Control Descure Control	Access Mode Control Mode	Local Position	Close Start Learn	Target Position	5	Targ	Local Parameters Local Parameters parameters Kemote	🕜 Help	values	_	
Pressure sensor	Controller Selector	Controller 1	Zero Adjust	100	100	1,00	 System Access Mode 		Enable	True	
Adaptive Learn	Error Number	0	Restart	80 —	80	1,06	Control Mode		Mode	Offset	
A Tools	Error Code	0	Pressure Sim	60	60	0.799	 Identification Statistics 		Actual Position	Real	•
Chart Analyzer		C ⁴	status indication				Worning/Error Septient		Offset	[0 - 100]	5 \$
Terminal	Valve Firmware Version	F01.0C.52.00	Open	40-	40	0,533	▲ Valve		Target Position In	[0 - 100]	0 \$
Sequencer			Closed	20-	20	0,266	Actual Position Position State		Target Position Used	[0 - 100]	5 🗘
Trace Log	Operating Time 1%-99%	0.09					Homing		Actual Position Real	[0 - 100]	5 🗘
Update Tool	Operating Time 0%-100%	0.12		0-	0		Cycle Counter External Isolation		Actual Position Adapted	[0 - 100]	0 0
Diagnostic File CPA Scaling	chart 5		ο μου ^φ ελιές αελλά Time	and the second	station of a line of a	0 -5E-05 -0.0001 -0.0002 -0.0002 -0.0003 -0.0003 :22	Pasition Refurction Pasition Refurction Pasition Refurction Pasition Refurction Mode Actual Position Target Position Ite Target Position Ite Actual Position Ite Pasition Section Interface EtherCAT Possure Section Interface EtherCAT Pressure Content Parameter Groups 1066	Valver	16354-94HU-AWU1/2004	Сору	Save
	U Necoro Clear	stop	Analyze								
		Valve: 16354-6	PAHU-AWU1/0004				Scan Rate: 20ms				

Picture : Example with Actual Position Option - Real

💇 CPA - Control Performance An	alyzer						- 🗆 🗙			
Local 🔑 Remote					v	ersion 4.2.0 beta	1 2 Help			
navigation	status information		control buttons	control panel		control par	el			
Parameters	Valve Series	61.3	Open	Actual Position		Actual Pres	sure			
Information	Access Mode	Local	Close		40		-0.0003276701 mbar			
Pressure Pressure	Control Mode	Position	Start Learn	Target Position	40 \$	Target Pres				
Pressure Sensor	Controllor Selector	Controllor 1	Zero Adiust	100-	100	1,333224 -	2 Parameters			- 0 ×
Adaptive Learn	Error Number	0	Restart				Local 🄑 Remote 🔀 Features 😧 Help			
Adaptive Learn Data	Error Code	0	Pressure Sim	80-	80	1,000579-	parameters	values	-	
▲ Tools			atatus indication	60 —	60	0,7999342 -	Access Mode	Enable	True	•
Chart Analyzer			status indication	40 -	40	0,5332895-	Control Mode Identification	Actual Position	- Onset	
Terminal	Valve Firmware Version	F01.0C.52.00	Closed	20	20	0.2666.447	Statistics Warping/Freq	Offset	[0 - 100]	5.0
Trace Log	Operating Time 1%-99%	0.09	•	20-	20	j 0,2000447 -	Services	Target Position In	[0 - 100]	40 🗘
Update Tool	Operating Time 0%-100%	0.12		•	0	0-	Actual Position	Target Position Used	[0 - 100]	45 0
Diagnostic File	chart						Position State	Actual Position Real	[0 - 100]	45 🗘
CPA Scaling	100					Lo U	Cycle Counter External Isolation	Actual Position Adapted	[0 - 100]	40 🗘
	90					-5E-05	Position Restriction			
	80						 Position Adaption Enable 			
	70					-0.0001	Mode Actual Position			
						-0.00015	Offset			
	-12 SO					-0.0002	Target Position In Target Position Used			
	20					0.00025	Actual Position Real			
	20						Speed Mode			
	10			and the state of the state of the		-0.0003	Pressure Control			
	O TRACTOR	and a state of a set	Second States of the second			-0.00035	 Pressure Sensor Interface EtherCAT 			
	8:05:32		Time		9:0	5:32	Power Connector			
	Record Clear	r Stop	Analyze						Сору	Save
		Values 16	A DALLEL MARLE MARKED				Parameter Group: 1066	Value: 16254-04411-4M/11/0004		

In this example is an **Offset** = 5 set and the **Actual Position** = **Adapted** at Position Setpoint = 40.

Picture : Example with Actual Position Option = Adapted

The Position Offset is not active, if an Open or Close command is processed or the Valve is in Control Mode: Open or Close.

2.2.3 Oring Pull Out Prevention

The stiction effect occurs when the valve has been closed for a long period of time and when the valve has cooled down after heating up in the closed position.

The surface finish and the chemical properties of the process can intensify this effect.

It is possible that the O-ring of the sealing ring is pulled out of the groove, this leads to a loss of the sealing function.

The subsequent movement of the disc damages the O-ring. Immediate service is necessary.

2.2.3.1 Settings

This function is available for valve series 620, 653, 655 and 670.

When opening, the sealing ring is lifted via compressed air. The plate remains in its position and waits for the set delay time.

This gives the O-ring time to release itself from the plate. The occurrence of the stiction effect can be reduced in this way.

Parameter	Description			
Enable	Activate the function			
Delay Homing	Delay time until start of <i>Homing</i>			
	First opening after a power down			
Delay Close	Delay time at all further openings after the <i>Homing</i>			

2.3 Pressure Control

The valve has four identical pressure controller units. Controller Selector defines which unit is used for the pressure control.

Most applications do not need more than one controller unit. But if the result of the pressure control does not meet the expectations, the different controller units can be used for optimization: With the four controller units it's possible to use an own controller unit for a specific pressure working point. This controller unit can be parametrized optimally for this specific working point.



2.3.1 Control Algorithm

2.3.1.1 Overview

Control Algorithm	Description
Adaptive	This is the most dynamic control algorithm. Before using adaptive control algorithm, a special procedure called "learn" must be executed first (see chapter Execute a learn procedure). The valve will observe the behavior of the vacuum system by moving the valve to different positions. During the learn procedure the valve performs an internal parameter estimation correspondent to the vacuum system. Note: The adaptive pressure control work at its best if the conditions (mainly gas flow) are close the conditions at the learn procedure.
PI	This is a solid algorithm for pressure control. The performance will be behind the adaptive control algorithm. But if the condition varies a lot, it's possible that the adaptive control algorithm does not work properly so the PI algorithm provides the best result.
Soft Pump	Is a modified PI control algorithm to pump down from atmospheric pressure. This control algorithm has been optimized to prevent that the pressure in the chamber is falling too fast (reduce occurrence of undershoots).

2.3.1.2 Choose correct control algorithm

System Configuration Constant gas flow available Constant gas flow
--

	Tv*<= 500 sec	Tv* > 500 sec	
Downstream Gos inlat Process chamber Control valve Pump	Adaptive	Ρ	1
Upstream Gos inlet Control valve Process chamber Pump		PI	
Soft Pump		Soft Pump	

* Use the formula below to define the applicable pressure control algorithm.

Tv -	P _{SFS} • CV	۹ _L
10-	q∟	p _{SI} Tv*

q_ gasflow for learn [mbarl/s]

SFS sensor full scale pressure [mbar]

- **v*** Vacuum time constant [sec]
- CV Chamber Volume [I]

2.3.2 Adaptive algorithm

This control algorithm may be used for downstream pressure control. Before using adaptive control algorithm, a special procedure called "learn" must be executed first (see chapter Execute a learn procedure).

2.3.2.1 Control Parameter

Parameter	Description
Gain Factor	Main parameter to adapt the performance of the pressure control algorithm. A higher gain results in a faster response, higher over- / undershoots of pressure. A lower gain results in slower response, lower over- / undershoot of pressure.
Sensor Delay	For compensation of delays during the pressure detection. Pipes and orifices for sensor attachment can cause delays in response time and could impact badly the pressure control stability. By adapting this parameter to the approximate delay time stability problems can be reduced. But control response time will be slowed down by this measure.
Learn Data Selection	There are up to 4 different learn data sets available. Select which Learn Data set the adaptive controller shall use for pressure control.

2.3.2.2 Learn

Learn adapts the PID controller of the valve to the vacuum system and its operating conditions. Learn must be executed only once during system setup. The Learn routine determines the characteristic of the vacuum system. Based on this, the PID controller is able to run fast and accurate pressure control cycles.

This characteristic depends on various parameters such as chamber volume, conductance and flow regime. Therefore it must be performed with a specific gas flow according to instruction below. The result of Learn is a pressure versus valve position data table. This table is used to adapt the PID parameters. The data table is stored in the device memory which is power fail save. The data table can be up-/downloaded via 'Control Performance Analyzer' software or remote interface. Due to encoding the data may not be interpreted directly.

By an Open, Close, Position or Pressure Control command the routine will be interrupted.

Parameter	Description
Bank Selection	Select one of four learn bank to place the result of the learn procedure. Note: Be sure pressure controller select this learn bank!
Pressure Limit [SFS]	Limit pressure to which pressure the learn shall be executed. The value is related to the sensor full scale of high sensor. 1.0 means the whole pressure range of the sensors
Open Speed	Define the speed for opening the valve during the learn procedure. May be necessary to prevent a pump from crashing. 1.0 means full speed
Status	State of the current learn 0: Not Started 1: In Progress 2: Completed Successfully 3: Aborted 4: Failed

Warning Info	Warning of current learn procedure: Bit 0: Learn is running Bit 1: Check sum error (learn data corrupt) Bit 2: Learn procedure terminated by user Bit 3: Pressure at position open > 50% of pressure limit Bit 4: Pressure at minimal conductance position < 10 % of pressure limit Bit 5: Pressure falls while move valve in direction of close Bit 6: Pressure at open position does not match pressure of previous open Bit 7: Learn procedure terminated by program Bit 8: Pressure < 0 at open position (no gas flow set?)
	Bit 8: Pressure <= 0 at open position (no gas flow set?)

Execute a learn procedure

1. Set specific gas flow according to calculation (Gasflow calculation for Learn) or select Calculate button in CPA Adaptive Learn window:

Learn does not need to be performed with the process gas. Instead N₂ or Ar may be used.

- 2. Set parameter **Bank Selection**, if only one learn is used take Bank 1. Be sure that the pressure controller also selects this learn bank!
- Reduce Open Speed if it is critical for the chamber if the pressure drops rapidly when the valve is opened.
- 4. Set a Pressure Limit [SFS] limit if sensor full scale cannot or should not be reached.
- 5. Set parameter *Control Mode* to *Learn* or press Start Learn button in CPA Adaptive Learn window.
- 6. Wait until the *Control Mode* leaves the *Learn* state which means the Learn procedure is finished or wait until progress bar is continue in CPA Adaptive Learn window.
- Check if the learn was successful by checking if *Status* shows value 2 (=Completed Successfully). In best case *Warning Info* shows no warning.
 - →Sensor signal must not shift during LEARN. Wait until sensor signal is stable before LEARN is performed. Learn may take several minutes.
 - ➔ Do not interrupt the routine as a single full run is required to ensure fast and accurate pressure control.
 - → The PID controller covers 5% to 5000% of the gas flow which was used for learn.

Gasflow calculation for Learn



Do not apply a different gasflow for learn than determined below. Otherwise pressure control performance may be insufficient. Required pressure / flow regime must be known to calculate the most suitable learn gas flow for a specific application.

1. At first it is necessary to find out about the required control range respectively its conductance values. Each working point (pressure / flow) must be calculated with one following formulas. Choose the applicable formula depending on units you are familiar with.

Π	1000 • g _{WP}	C _{WP} required conductance of working point [I/s]
	C _{WP} =	q _{WP} gasflow of working point [Pa m3/s]
	P _{WP}	p _{WP} pressure of working point [Pa]

Gwp	C _{WP} required conductance of working point [I/s]
C _{WP} =	q _{WP} gasflow of working point [mbar l/s]
Pwp	p _{WP} pressure of working point [mbar]

Gwp	C _{WP} required conductance of working point [l/s]
C _{WP} =	q _{WP} gasflow of working point [sccm]
78.7 ● p _{WP}	p _{WP} pressure of working point [Torr]

2. Out of these calculated conductance values choose the lowest.



3. Calculate gasflow for learn. Choose the applicable formula depending on units you are familiar with.

		م q_ gasflow for learn [Pa m³/s]
q∟=	P _{SFS} ● C _{min}	p _{SFS} sensor full scale pressure [Pa]
	1100	C _{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)

		q_ gasflow for learn [mbar l/s]
q∟= -	PsFs ● C _{min}	p _{SFS} sensor full scale pressure [mbar]
	1.1	C _{min} min. controllable conductance of valve [l/s], (refer to «Technical data»)
-		-

	q_ gasflow for learn [sccm]	
$q_L = 71 \bullet p_{SFS} \bullet C_{min}$	p _{SFS} sensor full scale pressure [Torr]	
	- • min ······ • • • • • • • • • • • • • • • •	

2.3.2.3 Tuning

68

Gain Factor adjustment

The Gain Factor effects: Stability, Response time

- Higher gain results in: faster response, higher over- undershoot of pressure
- Lower gain results in: slower response, lower over- undershoot of pressure

Adjustment procedure:

- 1. Start with Gain Factor 1.0
- 2. Open valve.
- 3. Control a typical pressure / flow situation.
- 4. Repeat from step 2 with lower (higher) Gain Factors until optimal pressure response is achieved and stability is ok.

Normally adjustments down to Gain Factors of 0.42 should lead to good results. Otherwise you may need to improve sensor connection. Refer to «Requirements to sensor connection».

Below graph shows response when changing pressure setpoint command:



Below graph shows response when changing gas flow:

Ē



Sensor Delay adjustment

Sensor Delay adjustment effects: Stability

Adjustment range is from 0.0 to 1.0sec

Pipes and orifices for sensor attachment delay response time and so badly impact pressure control stability.

By adapting this parameter to the approximate delay time stability problems can be reduced. But control response time will be slowed down by this measure.

Whenever possible sensors should be attached to the chamber according to «Requirements to sensor connection». This is the most effective measure against stability issues. If your gauge attachment fulfills these criteria do not use this parameter.

Adjustment procedure:

- 1. Start with Gain Factor 1.0 and sensor delay 0s.
- 2. Open valve.

- 3. Control a typical pressure / flow situation.
- 4. Repeat from step 2 with higher sensor delays until best possible stability is achieved.
- 5. Adjustment Gain Factor again. Refer to «Gain factor adjustment».

Setpoint Ramp adjustment

Setpoint Ramp effects: Undershoot of pressure, Response time

This parameter defines the time that is used to decrease / raise pressure between 2 setpoints. Especially in pressure decrease situations at low flows pressure response can be improved much by adapting setpoint ramp time.

Pressure chart



Choose the applicable formula depending on units you are familiar with.

t = Setpoint Ramp

Adjustment procedure:

- 1. Start with optimal Gain Factor and sensor delay time according to preceding tuning steps.
- 2. Control a typical pressure / flow situation.
- 3. Control a lower pressure.
- 4. Repeat from step 2 with longer setpoint ramps until best response is achieved.
- 5. Verify pressure control response for a setpoint raise situation.



In case a long ramp time is required to get optimal performance for pressure decrease situations it may be of advantage to apply different settings for decrease / raise control situations.

Pressure Control Speed adjustment

Valve speed effects: Response time

Adjustment range is from 0.001 to 1.0 Default value is 1.0

This parameter effects valve plate actuating speed. Speed adjustment is effective for PRESSURE CONTROL and POSITION CONTROL. Normally best pressure control response is achieved with maximum Pressure Control Speed. In particular applications it may be of advantage to have a slower valve response.

OPEN and CLOSE are always done with maximum speed.

Adjustment procedure:

- 1. Use optimal Gain Factor, sensor delay time and setpoint ramp according to preceding tuning steps.
- 2. Open valve.
- 3. Control a typical pressure / flow situation.
- 4. Repeat from step 2 with slower Pressure Control Speed until required response is achieved.

Required information for support:

- Go to 'Tools / Create Diagnostic File' in 'Control Performance Analyzer' and save file
- Pressure / flow / gas conditions to be controlled
- Chamber volume
- Pumping speed (I/s) and pump type (e.g. turbo pump)
- System description
- Problem description

Send diagnostic file with and all required information to tuning-support@vat.ch

2.3.3 Pl algorithm

This control algorithm may be used for downstream or upstream pressure control depending on configuration.

2.3.3.1 Control Parameter

Parameter	Description	
P-Gain	The P-Gain is the proportional factor of the fixed control algorithm. A higher P-Gain results in faster response, higher over- / undershoot of pressure.	
l-Gain	The <i>I-Gain</i> is the integral factor. The <i>I-Gain</i> helps to reach the target pressure exactly.	
Direction	The <i>Control Direction</i> defines the type of application, if the valve is mounted in downstream or upstream. Downstream means the valve is after the chamber and before the pump. Upstream, valve is mounted before chamber and pump.	

2.3.3.2 Tuninig

The PI parameters of the pressure controller require correct adjustment. These parameters must be set once during system setup and are stored in the device memory which is power fail save. Based on the PI controller configuration, the valve is able to run fast and accurate pressure control cycles. The PI parameters can be evaluated using below instruction.

- In downstream control mode valve will move towards open when current pressure is higher than set point.
 - In upstream control mode valve will move towards close when current pressure is higher than set point.

Introduction

PI controller mode is used if for any reason (e.g. too long system time constant) the adaptive control mode does not provide satisfying control performance.

In PI controller mode the parameters P-Gain and I-Gain have to be set according to the systems characteristics. The best set of parameters can be found by using the empiric method below.

Pressure and gas flow for optimization

A PI controller delivers the best results for a certain working point (pressure/gas flow). If there is only one working point, this pressure and gas flow has to be used for optimizing P and I-Gain. If there are several working points that have to be covered, the pressure for optimizing is the medium pressure between highest and lowest pressure to be controlled, the gas flow for optimizing is the highest flow out of all working points.

Two different pressure set points are necessary for optimization. Set point 1 (SP1) is the pressure for optimizing as determined above. Set point 2 (SP2) is about 10 - 20% lower than SP1.

Example: pressure range: 4 – 10 Torr Flow range: 2 – 4 slm

Pressure set points and gas flow for optimization:

SP1	=	7 Torr
SP2	=	6 Torr
Gas flow =		4 slm

Optimization P-Gain

While optimizing P-Gain, the gas flow determined above has to be constant all the time.

Start optimization with P-Gain set to 1.0 and I-Gain set to 0.0.

Set chamber pressure to SP2, wait until the pressure is stable. Set pressure to SP1. If the transition from SP2 to SP1 results in a significant pressure over shoot or even does not stabilize at all, the P-Gain is too high. If there is no over shoot and the pressure reaches SP1 asymptotically and very slow, P-Gain is too low.

The optimal P-Gain value is found if the transition from SP2 to SP1 results in a slight pressure over shoot. It does not matter if there is still a deviation between SP1 and actual pressure.

Example:


Optimization I-Gain

While optimizing I-Gain, the gas flow determined above has to be constant all the time.

Start with P-Gain set to half of the value found when optimizing P-Gain and set I-Gain to 1.0. Keep the P-Gain constant.

Set chamber pressure to SP2, wait until the pressure is stable. Set pressure to SP1. If the transition from SP2 to SP1 results in a significant pressure over shoot or if the valve position does not stabilize, I-Gain is too high. If the transition results in a slow asymptotical pressure rise and there is still a constant deviation to SP2, the I-Gain is too low.

The optimal value for I-Gain is found if the transition from SP2 to SP1 result in just a slight pressure over shoot, a stable valve position and the actual pressure matches SP2 exactly.

Example:



Check control performance over the whole control range with parameters above.

Required information for support:

- Go to 'Tools / Create Diagnostic File' in 'Control Performance Analyzer' and save file
- Pressure / flow / gas conditions to be controlled
- Chamber volume
- Pumping speed (I/s) and pump type (e.g. turbo pump)
- System description
- Problem description

Send diagnostic file with and all required information to tuning-support@vat.ch

2.3.4 Softpump algorithm

This control algorithm may be used to control pressure ramps during pump down.

2.3.4.1 Control Parameter

Parameter	Description
P-Gain	The <i>P-Gain</i> is the proportional factor of the fixed control algorithm. A higher P-Gain results in faster response, higher over- / undershoot of pressure.
I-Gain	The I-Gain is the integral factor. The I-Gain helps to reach the

	target pressure exactly.
Ramp	See chapter Pressure Ramp

2.3.4.2 Tuning

Optimizing P-Gain

Start optimization with P-Gain set to 0.1 and I-Gain set to 0.0. The pump down routine has to be controlled as follows:

- Move control valve into close position
- Start pump down by opening the pump isolation valve or starting the pump
- Send the pressure set point to the valve controller.

While pumping down chamber pressure and valve position should be data logged to compare the actual pump down curve with the ideal straight pump down line.

If the pressure follows the ideal pump down line with significant delay, the P-Gain is too low. If the pressure oscillates around the ideal pump down line or if the valve position oscillates, P-Gain is too high.

P-Gain is optimized if the pressure follows the ideal pump down line closely and the valve position is not oscillating at all.

Example:



Optimizing I-Gain

I-Gain is responsible to reach the setpoint. If reaching setpoint is not important (e.g. setpoint is 0) leave the I-Gain at 0. Otherwise start with P-Gain set to half of the value found when optimizing P-Gain and set I-Gain to 0.1. Keep the P-Gain constant. Start again the pump down. Check how the pressure reaches the setpoint:

If the setpoint is reached too slowly increase I-Gain If there is an undershoot increase I-Gain

Required information for support:

- Go to 'Tools / Create Diagnostic File' in 'Control Performance Analyzer' and save file
- Pressure / flow / gas conditions to be controlled
- Chamber volume
- Pumping speed (I/s) and pump type (e.g. turbo pump)
- System description
- Problem description

Send diagnostic file with and all required information to tuning-support@vat.ch

2.3.5 Pressure Ramp

Basically, the pressure ramp is used to limit the rate of pressure change. It can also be used to minimize over- / undershoot of pressure.



2.3.5.1 Configuration

Parameter	Description		
Enable	Activate / Deactivate pressure target ramp		
Mode	0:Use Ramp Time 1:Use Ramp Slope	See description below	
Time	Target reach time in seconds (Used if Mode	e = 0)	
Slope	Limit the rate of pressure change in pressure	e per seconds (Used if <i>Mode</i> = 1)	
Туре	0:Linear 1:Logarithmic 2:Exponential		
Start Value	0:Previous Ramp Value		

1:Actual Pressure Value

2.3.5.2 Mode

Time

100

90

80

70 60

50

40

30

20

10

0

0

1

Time is constant, slope varies Example: 2sec

2

4 5

3



Slope is constant, time varies Example: 10mTorr/second



2.3.5.3 Type



2.3.5.4 Applications Examples

Softpump

Ramp Mode: Time Ramp Time: 100 s Ramp Type: Linear Nominal pressure: 0



Without pressure ramp



With pressure ramp









2.3.6 General Settings

2.3.6.1 Automated Controller

Define different Control Settings for different pressure ranges or for up - and down control

With the 4 Controllers it is possible to define different pressure control settings. The Automated Controller Selector can select one of the 4 Controllers depending on (either or)

- Target Pressure (*Mode*: *Threshold*)
- Up- or Down Control (*Mode*: *Pressure Direction*)

Mode: Threshold Threshold Condition Equal	on : Lower or	Mode: Thresho Threshold Co	old nditi	ion: Eq	jual	Mode: Pressure D Controller Pressu Controller 1 Controller Pressu Controller 2	<i>lirection</i> ure Rising: ure Falling:
Controller Selector when the Target Pro- below a specified Th value If Target Pressure is several Thresholds lowest one is taken. If Target Pressure is the highest Thresho highest one is taken	r changes essure is hreshold s lower than values, the s higher than bld, the n.	Controller Se only when the is equal to a T	lecto Targ hres	or chan jet Pre hold w	iges <i>ssure</i> alue	Controller Select depending on whe Pressure is rising	tor changes other Target or falling
20 Chast Analyzar		2 Out Anlyzer				20 Chart Analyzar	
	100 (Pin et a) 00 (Pin et a)		dition (teu)	1000 90 90 90 90 90 90 90 90 90 90 90 90	µKts mil 1 20 − Urothof Selection 100 mil 1 20 − Farboli 1 20 − Granda 1 Threaded 21 − Granda 1 Threaded 22 − Granda 1 Threaded 23 − Granda 1 Threaded 24 − Granda 1 Threaded		Раниз] 4
Mode	Fhreshold 🔹	Mode		Threshold	•	Mode	Pressure Direction
Controller Selector Bitmap	15 🗘	Bit 0: Controller 1			15 🤤	Controller Pressure Rising	Controller 1
Image: Set 0: Controller 1 Image: Set 0: Controller 2 Image: Set 0: S	.ower or Equal	BH 1: Controller 2 BH 1: Controller 2 BH 2: Controller 3 BH 3: Controller 4 Threshold Condition Controller 1 Threshold Controller 2 Threshold Controller 3 Threshold Controller 4 Threshold	(mbar) [mbar] [mbar] [mbar]	Equal	▼ 100 ≎ 200 ≎ 400 ≎ 1000 ≎	Controller Pressure Falling	Controller 2

Valve Firmware

79

Parameter: Pressure Control.General Settings.Automated Controller Selector

Parameter	Description	
Enable	Switches on/off the function	
Mode	Threshold	
	Pressure Direction	
Controller Selector	Used if <i>Mode</i> = <i>Threshold</i>	
Bitmap	Defines which controllers are automatically selected	
Threshold Condition	Used if <i>Mode</i> = <i>Threshold</i>	
	Lower or Equal	
	Equal	
	The Thresholds are related to Target Pressure	
Controller 1 Threshold	Used if <i>Mode</i> = <i>Threshold</i>	
Controller 2 Threshold	The Thresholds are related to <i>Target Pressure</i>	
Controller 3 Threshold		
Controller 4 Threshold		
Controller Pressure	Used if <i>Mode</i> = <i>Pressure Direction</i>	
Rising	Select one Controller for up control and one for down control	

Parameter	Description
Controller Pressure	Controller 1
Falling	Controller 2
5	Controller 3
	Controller 4

2.3.6.2 Profile Ramp

Profile Ramp is a Target Pressure ramp that depends on pressure ranges (segments). It is mainly used to create soft pumping or soft venting profiles.

To design a profile, the segments (pressure ranges) must be defined A segment is defined by the pressure Threshold and the Slope. It is possible to define up to 10 segments.

Segment Nr	Threshold mBar*	Resulting Segment mBar*	Slope mBar*/sec
1	1000	500 to 1000	50
2	500	200 to 500	100
3	200	0 to 200	200

Example: Ramp Profile with 3 segments

Result is a Target Pressure Ramp with different slopes. See *Target Pressure Used*, which is the output of the ramp generator.



81

Parameters			- 0	>
ocal 🄑 Remote 🔀 Features 😯 Help				
arameters	values			
System	Enable		True	
 Valve Desition Control 	Threshold Mode		Target Pressure Used	_
Position Control Pressure Control	Dames Truca			_
Actual Pressure	катр туре		Linear	
Target Pressure	Actual Slope	[mbar]	50	0
Target Pressure Used	Controller Selector Bitmap			2
Pressure Control Speed Controller Selector	Bit 0: Controller 1			
Controller 1	Bit 1: Controller 2			
Controller 2	Bit 2: Controller 3			
Controller 3	Bit 3: Controller 4			
 Controller 4 General Settings 	Segment Selector Ritman		-	-
Store Control Parameter Volatile	Bit 0: 0: mont 1			/
Control Position Restriction	Bit 0: Segment 1			
Automated Controller Selector	Bit 1: Segment 2			
▲ Profile Ramp Enable	Bit 2: Segment 3			
Threshold Mode	Bit 3: Segment 4			
Ramp Type	Bit 4: Segment 5			
Actual Slope	Bit 5: Segment 6			
Controller Selector Bitmap	Bit 6: Segment 7			
Segment 1 Threshold	Bit 7: Segment 8			
Segment 1 Slope	Bit 8: Segment 9			
Segment 2 Threshold	Bit 9: Segment 10			
Segment 2 Slope	Segment 1 Threshold	[mbar]	1000	0
Segment 3 Slope	Segment 1 Slope	[mbar]	50	0
Adaptive Learn	Segment 2 Threshold	[mbar]	500	0
Interface EtherCAT	Segment 2 Slope	[mbar]	100	0
Power Connector	Segment 3 Threshold	[mbar]	200	0
	Segment 3 Slope	[mbar]	200	0
				_
			Save	

Parameters:

Parameter	Description	
Enable	Switches on/o	off the function
Threshold Mode	Defines which	pressure the threshold refers to
	0 Actual Pressure	Change happens if Actual Pressure reaches the Threshold
	1 Target	Change happens if <i>Target Pressure Used</i> reaches the

82

Parameter	Description	
	Pressure Used Threshold	
		600
	105	590
	100	570
	95	560
	90	540
	85 Artual Prossure	530
	80	520
	75	500
	70	490
	65 Target Pressure Used	430
		460
	50	450
		430
		420 410
	9 9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8 9.9 10 10.1 10.2 10.3 10.4 10.5 10.6 10.7 10.8 10.9 11 Time [s]	1
<i>Ramp Туре</i>	Defines the shape of the ramp in each segment	
	0 Linear	
	1 Logarithmic	
	2 Exponential	
Actual Slope	Used slope as the pressure difference per second (mBar*/sec)	
Controller Selector	Determines which Controller uses the profile ramp.	
Bitmap	When a Controller is selected, the ramp is no longer used in the o	controller
	itself. Therefore the ramp is grayed out in the CPA.	
	₩ Pressue Control	×
	Local / Kemote V Help	
	controller 1 controller 2 controller 3 controller 4	
	Selected Selected Selected Selected Selected Selected Control Algorithm PI Control Algorithm PI Control Alg	Soft Pump
	controller settings controller settings controller settings Gain Factor 1 \$ P-Gain 0.1 \$	0.1 🗘
	Sensor Delay [s] 0 0 Heain 0.1 0 Heain 0.1 0 Heain 0.1 0 Heain 0.1 0 Heain	0.1 \$
	Control Direction Downstream +	Downstream
	ramp ramp ramp ramp ramp ramp	
	Time [s] 1 \$ Time [s] 1 \$ Time [s] 1 \$	1 \$
	Slope [mbar/s] 1 Slope [mbar/s] Slope [mbar/s] Mode Use Ramp Time Mode M	1 C
	Start Value Actual Value Start	Actual Value 🔹
	Type Unear Type Unear Type Unear Type	Linear 👻
Sogmont Soloctor	Defines which cogmont is used for the Profile Romp	
Segment Selector		
Seament x Threshold	This is the upper limit of the segment	
	The lower limit is defined by the next lower Threshold or the low	er limit is 0
	if there is no lower Threshold	
	If the Target Pressure is lower than several Thresholds the lowe	st one is
	taken	
	If the Target Pressure is higher than the highest Threshold , the h	highest
	in the Target Fressure is higher than the highest Threshold , the h	lighest



* Unit adjustable

2363 Store Control Parameter Volatile

If store control parameter volatile is set, no parameter setting will save in memory. This setting is only for pressure control parameters. That means, after loosing power (also a restart command), the

2.4.2 Configuration_{active}.

רו + רז 🗧

min ýlij mm

This setting make sense if the pressure control settings is adapted continuously absolute values, so the value needs to know what sensors are connected.

Pressure Sensor

The CPA window shows a good overview of the sensor settings Mechanical connection requirements

To achieve fast and accurate pressure control a fast sensor response is required. Sensor response time: < 50ms. The sensor is normally connected to the chamber by a pipe. To maintain that the response time is not degraded by this connection it needs to meet the following requirements: • Inner diameter of connection pipe: > = 10 mm

• Length of connection pipe: < = 300 mm

These conductance guidelines must include all valves and limiting orifices that may also be present. Make also sure that there is no obstruction in front of sensor connection port inside the chamber. The sensor should also be mounted free of mechanical shock and vibration. Dynamic stray magnetic fields may introduce noise to sensor output and should be avoided or shielded.

₩ Pressure Sensor			×
Local 🔑 Remote			
sensor 1		sensor 2	
Available		Vailable	
🔽 Enable		Enable	
Input Source	Analog 🔹	Input Source	Analog 🔹
Scale	Linear 🔹	Scale	Linear 🔹
range		range	
Data Unit	Torr	Data Unit	mTorr •
Upper Limit Data Value [Torr]	1 🗘	Upper Limit Data Value [mTorr]	100 🗘
Lower Limit Data Value [Torr]	0 🗘	Lower Limit Data Value [mTorr]	0 🗘
Upper Limit Voltage Value [V]	10 🗘	Upper Limit Voltage Value [V]	10 🗘
Lower Limit Voltage Value [V]	0 🗘	Lower Limit Voltage Value [V]	0 🗘
zero adjust		⊂zero adiust	
Enable Offset Value [SFS]	0 🗘	Enable Offset Value [SFS]	0 🗘
filter		filter	
Туре	Low-pass Simple 🔹	Туре	Low-pass Simple 🔹
Time [s]	0 🗘	Time [s]	0 🔹
Value [mbar]	0.0001458005 🌲	Value [mbar]	4.108395E-05 🜲
	zero adjust		
	Sensor Selection	Sensor 1 Note Driver	: te eventing a zero adjust:
-	Target Pressure [mbar]	0 \$ - Ope	en Valve
		Execute Zero Adjust - Ens	ure no gas-flow in system
- C	crossover		
	Crossover Mode	Soft Switch 🔹	
۲	Threshold High [SFS low sensor]	1 🖕	
1	Threshold Low [SFS low sensor]	0.95 🗘	

Parameter	Description	
Available	Set to <i>True</i> if a sensor is connected	
Enable	Set to <i>True</i> if the sensor signal is used for pressure control	
Input Source	Analog Sensor has an analog voltage interface and is direct connected to the valve.	
	<i>Digital</i> Sensor and Valve have EtherCAT interface and is connected to the EtherCAT bus	
	Simulation Testing the valve and pressure control without being connected to the system	
Range.Scale	Select type of the sensor signal	
	Logarithmic	
	Most gauges are linear type gauges.	

Range.Data Unit	Set the pressure data unit of the gauge: <i>Pa, kPa, bar, mbar, Torr, mTorr, psia, psig</i>					
Range.Upper Limit Data Value Range.Lower Limit Data Value	Set the upper limit and lower limit of the gauge in the unit of <i>Range.Data Unit</i> Example for a 250mTorr linear sensor: Upper Limit = 250.0 Lower Limit = 0.0					
Range.Upper Limit Voltage Value Range.Lower Limit Voltage Value	These parameters are only used for gauges with analog voltage interface. The values corresponds to Range.Upper Limit Data Value and Range Lower Limit Data Value					
	Lixet inploteUpper Limit: 10.0Và 250mTorr Range Upper Limit DataValueà 0.0mTorr Range Lower Limit DataValueValue					
Filter.Enable	<i>True</i> enables the filter					
Filter.Type	Available since April 2021. Low-pass Simple is backwards compatible.					
Filter.Time	Set filter time in the range of 0.0 to 1.0 second. Note: Filter delays the sensor signals which is detrimental for pressure control					
Location: CPA Parameters Pressure Sensor.Sensor 1 Pressure Sensor.Sensor 2 → or use 'Pressure Sensor' win	dow					

2.4.3 **Crossover (2 sensor operation)**

When two sensors are used (enabled) for pressure control the crossover handles the two pressure signals to building one system pressure (Actual Pressure).

Parameter	Description
Crossover Mode	Crossover between 2 sensors (see below)
Threshold High [SFS low sensor] Threshold Low [SFS low sensor]	Defines the crossover area (see below) The value is related to sensor full scale of low sensor (0.1 means 10% of sensor full scale of low sensor)
Delay	Switch over delay in Crossover Mode Hard Switch
Crossover Mode Soft Switch	

Jrossover Mode Sott Switcr



Location: CPA Parameters Pressure Sensor.Crossover → or use 'Pressure Sensor' window

2.4.4 Zero Adjust

Zero Adjust allows for the compensation of the sensor offset voltage.

Note: A maximum offset voltage of +/- 1.4 V can be compensated.

Parameter Description

87

Zero Adjust Sensor	Select the sensor for the zero adjust:
Selection	$s_{1} = s_{2} s_{1} s_{2} s_$
Selection	
	Sensor 1
	Sensor 2
Zero Adjust.Target	Normally this parameter is set to 0 in case the process chamber is
Pressure	fully evacuated (pressure <=1‰ of sensor full scale).
	If not you can align the sensor value to a known pressure (displayed on
	another readout in the system). In this case set Target Pressure to
	the known pressure.
	Note: <i>Target Pressure</i> is in the unit of pressure, see relevant interface:
	Example serial interface RS232/485 Scaling
Zero Adjust.Execute	1: Start the zero adjust
	2: Clear offset value
	After executing value return to 0
Sensor 1.Enable	0: It's not possible to execute a zero adjust.
Sensor 2.Enable	A present offset value is ignored
	1: It's possible to execute a zero adjust.
	A present offset value is respected.
Sensor 1.Offset Value [SFS	Value which is deducted from the measured sensor value.
Sensor 2.Offset Value [SFS	The value is related to sensor full scale (0.1 means 10% of sensor full
	scale)

Location:

CPA Parameters Pressure Sensor.Zero Adjust Pressure Sensor.Sensor 1.Zero Adjust Pressure Sensor.Sensor 2.Zero Adjust Pressure Sensor.Sensor 1.Zero Adjust Pressure Sensor.Sensor 2.Zero Adjust → or use 'Pressure Sensor' window

Performing a zero adjust:

- 1. Turn the gas flow off
- 2. Fully open the valve
- 3. Wait until the sensor signal is not shifting anymore. Refer to manual of sensor manufacturer for warm up time.
- 4. Wait until process chamber is evacuated.
- Do not perform Zero Adjust, if the base pressure of your vacuum system is higher than 1‰ of sensor full scale. We recommend disabling Zero Adjust function or using of Zero Adjust.Target Pressure other than 0.0 in this case. Otherwise incorrect pressure reading is the result.
- 5. Perform zero with setting of Zero Adjust.Execute to 1
- 6. Check parameter Actual Pressure if the pressure is shifted as expected

2.5 Interface

In this chapter are all possible Interfaces described, which are supported by IC2 Controller.

Interface Types:

- Ethercat Interface
- DeviceNet Interface
- RS232/485 Interface

- Logic Interface
- CC-Link
- Profibus

2.5.1 EtherCAT

Neither valve display information nor *Control Mode* values or any other fieldbus cyclic/acyclic data are related to any fieldbus states/notation

2.5.1.1 Connection

The EtherCAT interface is galvanic isolated from control unit.

Installation (example)



Network and cable

- Connector type: RJ45 standard connector
- Cable: CAT5, 6 or 7 STP (shielded twisted pair), not crossover
 - Cable length between Master and Slaves max. 100 m.

For all detail information about EtherCAT refer to EtherCAT homepage: http:// www.ethercat.org

2.5.1.2 Device identification, Rotary switches

The Device Identification value (ID) is set by three hexadecimal rotary switches. That means the supported address range is 0-0xFFF in hexadecimal or 0-4095 in decimal.





Note: In IC2 both kind of addresses Requested ID and Station Alias is defined by rotary switches.

2.5.1.3 ESI

It describes EtherCAT specific as well as application specific features of the slave. For IC2 controller hardware the ESI file is depending on the installed firmware version. If the ESI file is missing please request this by your local contact Contact.

Your Local Contact	Get in touch, we are happy to support you and answer your questions and inquiries. Please select you country, if not already selected, to make sure we can respond to you quickly.						
Linited States	VAT Inc. San Jose	+1 800 935 1446 >					
Ukraine	655 River Oaks Parkway Q 95134-1907, San Jose, CA	us@vatvalve.com >					
United Arab Emirates	United States						
United Kingdom							
United States	VAT USA	~					
Uruguay							
Uzbekistan	 VAT US Representatives 	~					
Vanuatu 🗸							

2.5.1.4 **Connection Loss Reaction**

90

Connection Loss reaction defines what the valve is doing in case the EtherCAT connection get lost.

Parameter	Description
Enable	<i>True</i> enables the connection loss reaction, in case of <i>False</i> there is no
	reaction on a connection loss (compatible IC1 Setting keep Position)
State	Current connection loss state
Functionality	Defines the functionality in case of connection loss.
	This can be <i>open</i> or <i>close</i> .

Parameter location: CPA

Interface EtherCAT.Connection Loss Reaction

2.5.1.5 Communication failure

Failure detection with CPA	Action
Network failure: No EtherCAT communication is active	 Check EtherCAT cable. Check the EtherCAT connection to master. Check the process data output watchdog – SyncManager2 settings



If you need any further information, please contact one of our service centers. You will find the addresses on our website: www.vatvalve.com.

2.5.1.6 LEDs



- RUN LED^{a)}
- Error LED^{a)}
- 6 EtherCAT (port 1) IN
- 4 EtherCAT (port 2) OUT
- 0 Link/Activity (port 1) IN
- 6 Link/Activity (port 2) OUT



a) The flash sequences for these LEDs are defined in DR303-3 (CiA)

Run LED (1)

This LED reflects the status of the CoE (CANopen over EtherCAT) communication.

LED State	Indication	Description
Off	INIT	Device in 'INIT'-state (or no power)
Green	OPERATIONAL	Device in 'OPERATIONAL'-state

© VAT Group AG

Green, blinking	PRE-OPERATIONAL	Device in 'PRE-OPERATIONAL'-state			
Green, single flash	SAFE-OPERATIONAL	Device in 'SAFE-OPERATIONAL'-sta			
Red a)	EXCEPTON state (Fatal Event)	-			

^{a)} If RUN and ERR turns red, this indicates a fatal event, forcing the bus interface to a physically passive state.

Error LED (2)

This LED indicates EtherCAT communication errors etc.

LED State	Indication	Description
Off	No error	No error (or no power)
Red, blinking	Invalid configuration	State change received from master is not possible due to invalid register or object settings.
Red, single flash	Unsolicited state change	Slave device application has changed the EtherCAT state autonomously; parameter 'Change' in the AL status register is set to 01h (change/error).
Red, double flash	Application watchdog timeout	Sync manager watchdog timeout
Red ^{a)}	Application controller is not responding any more	EXCEPTION state

^{a)} If RUN and ERR turns red, this indicates a fatal event, forcing the bus interface to a physically passive state.

Link/Activity LED's (5/6)

These LED's indicate the EtherCAT link status and activity.

LED State	Indication	Description
Off	No link	Link not sensed (or no power)
Green	Link sensed, no activity	Link sensed, no traffic detected
Green flickering	Link sensed, no activity detected	Link sensed, traffic detected

2.5.1.7 Communication

92

Interface scaling

Interface Scaling - Ethercat

Interface position and pressure scaler has to be set over parameter list.

Yarameters	
Local 🄑 Remote	
pagemeters	values
System	Position
Valve	► Brassura
Position Control	v Pressure
Pressure Control	
Pressure Sensor	
Interface EtherCAT	
EtherCAT State	
Address	
▲ Scaling	
Position	
Pressure	
Connection Loss Reaction	
Device Information	
Example: Interface EtherCAT	

Digital Sensor Scaling

If Sensor Source is digital, than the input unit can be defined separately from the other pressure parameters.

		Varias	nes .												
			Name						Datatype	Master Sync Unit	Offset	▲ Siz	e Value	Forced	4
	N		Slave_1001 [VAT valve \$670].Inpu	ts Float 1.Actual Pressure					REAL	Id 0: Default 0	IN:	0.0 4.0	0.1333224		
	h		Slave_1001 [VAT valve S670].Inpu	ts Float 1.Pressure Sensor 1	nterfac	e Pressure Sca	ling	->mbar	REAL	Id 0: Default 0	IN :	4.0 4.0	0.1333224		
			Slave_1001 [VAT valve S670].Inpu	ts Float 1.Pressure Sensor 2					REAL	Id 0: Default 0	IN:	8.0 4.0	0.1333224		
			Slave_1001 [VAT valve \$670].Inpu	ts Float 1.Actual Position					REAL	Id 0: Default 0	IN:	12.0 4.0	0		
			Slave_1001 [VAT valve S670].Input	ts Float 1.Control Mode					SINT	Id 0: Default 0	IN:	16.0 1.0	3		
			Slave_1001 [VAT valve S670].Inpu	ts Float 1.Error Number					UINT	Id 0: Default 0	IN :	17.0 2.0	j o i		1
			Slave_1001 [VAT valve \$670].Inpu	ts Float 1.General Status					UINT	Id 0: Default 0	IN:	19.0 2.0) 1541		
			Slave_1001 [VAT valve \$670].Input	ts Float 1.General Warnings					UINT	Id 0: Default 0	IN :	21.0 2.0	0 (
			Slave_1001 [VAT valve S670].Inpu	ts Float 1.Extended Warnings					UINT	Id 0: Default 0	IN :	23.0 2.0) 1		
			Slave_1001 [VAT valve S670].Outp	outs Float 1. Target Pressure					REAL	Id 0: Default 0	OUT :	0.0 4.0	0 (
			Slave_1001 [VAT valve S670].Outp	outs Float 1.Target Position			TUR		REAL	Id 0: Default 0	OUT :	4.0 4.0	,		
			Slave_1001 [VAT valve S670].Out;	outs Float 1.Pressure Input Digital	Sensor 1	Interface Digi	ale	ensor 1 Input Scaling -> 1 orr	REAL	Id 0: Default 0	OUT :	8.0 4.0	0.1		
			Slave_1001 [VAT valve S670].Out;	outs Float 1.Pressure Input Digital	Sensor 2	Interface Digit	al S	ensor 2 Input Scaling -> mTorr	REAL	Id 0: Default 0	OUT :	12.0 4.0	100		
			Slave_1001 [VAT valve S670].Out;	outs Float 1.Control Mode					SINT	Id 0: Default 0	OUT :	16.0 1.0	0		1
1	Pressure Sensor	-				Σ	3	🛫 Parameters							٦
	Local 🏓 Remote	🕜 Help						Local 🏓 Remote							1
	sensor 1			sensor 2				parameters		values					
	Available			Available				System		Pressure Uni	t		m	nbar	
	Chable			Enable	G			Position Control						_	
	Input Source		Digital •	Input Source		vigital •		Pressure Control Pressure Sensor							
	scale		unear 🔹	scale	L	inear •		▲ Interface EtherCAT							
	Data Unit		Torr •	Data Unit	r	nTorr •		Address							
					6			▲ Scaling ▶ Position							
	Upper Limit Data Value [To	rr]	1 🗘	Upper Limit Data Value (m	nTorr]	100 🗘		Pressure							
	Lower Limit Data Value [To	m]	0 \$	Lower Limit Data Value [m	nTorr]	0 \$		 Digital Sensor 1 Input Digital Sensor 2 Input 							
	digital sensor input scaling			digital sensor input scalin	g			Connection Loss Reaction							
	Pressure Unit		Torr •	Pressure Unit	r	nTorr 🔹		Power Connector IO							
								Power Fail Option							

Cyclic Communication

Note: This chapter defines the standard PDO mappings which is used for the most pressure control application.

PDO Process data objects – cyclic communication

RxPDO Output mappings

The EtherCAT process data mapping is done automatically corresponding to the following list and respectively to the sync manager information.

Mapping object	Mappin	ng content	Name	Byte	Range	Description
0x1600	SINT32 SINT32 SINT32	Target Pressur Target Position Pressure Input	TARGET PRESSURE	4	Value in mBar Adjustable ¹⁾	Setpoint value for CONTROL MOD
	SINT32 SINT8 UINT16 FLOAT	Pressure Input Control Mode General Contro Pressure Ramp	TARGET POSITION	4	0100 Adjustable ¹⁾	Setpoint value for CONTROL MOD
0x1601 (default)	FLOAT FLOAT FLOAT	Target Pressur Target Position Pressure Input	PRESSURE INPUT DIGITAL SENSOR 1	4	Value in mBar Adjustable ¹⁾	Pressure from di (Sensor with Eth
	FLOAT SINT8 UINT16	Pressure Input Control Mode General Contro	PRESSURE INPUT DIGITAL SENSOR 2	4	Value in mBar Adjustable ¹⁾	Pressure from di (Sensor with Eth
0x1602	SINT32 SINT32 SINT32 SINT32 SINT32 SINT8 UINT16	Target Pressure Target Position Pressure Input Pressure Input Control Mode General Contro	CONTROL MODE	1	27	 Homing Position cont Close Open
0x1603	FLOAT FLOAT FLOAT FLOAT SINT8	Target Pressur Target Position Pressure Input Pressure Input Control Mode				5 = Pressure cor 6 = Hold 7 = Learn
	UINT16	General Contro	GENERAL CONTROL SETPOINT	2	-	See bitmap table
0x1604	SINT32 SINT8 UINT16	Target Position Control Mode General Contro	PRESSURE RAMP TIME	1	010E6	Time in ms
0x1605	FLOAT SINT8 UINT16	Target Position Control Mode General Contro	 io adjust range refer to chap 	pter: «Et	nerCA I scaling	»
UX 10FF		Configurable m				

GENERAL CONTROL SETPOINT bitmap table:

	Bit	Description					
0	ZERO ADJUST	Starts the zeroir	Starts the zeroing of the sensors				
1	NOT USED (reserved)	-					
2	PING PONG TX BIT	Handshake mechanism Valve sends the inverted value of this bit in INPUT BUFFER \rightarrow GENERAL STATUS \rightarrow PING PONG RX BIT					
3	NOT USED (reserved)	-					
4	ACCESS MODE LOCKED	Defines which ir Access Mode Local	nterface, remote (EtherC, Control Permission CPA	AT) or service (CPA), can co Comment	ntrol the valve.		

		-						
		Remote	EtherCAT Mast	er CPA can switch to Local				
		Locked	EtherCAT Mast	er CPA can't switch to Local	_			
		If bit is set to 1 th	an the Access	Mode = Locked				
		It bit changes from 1 to 0 than the Access Mode changes to Remote						
		Whether CPA has switched the Access Mode to Local can be seen in the Input Buffer: GENERAL STATUS \rightarrow ACCESS MODE EXTENDED WARNING \rightarrow REMOTE CONTROL NOT POSSIBLE						
		Overview :						
		From To ACCESS MODE LOCKED bit						
		local or remote	locked	0 → 1				
		locked	remote	1 → 0				
		local	remote	$0 \rightarrow 1 \rightarrow 0$				
E 1E	NOT LISED (reserved)							

TxPDO Input mappings

The EtherCAT process data mapping is done automatically corresponding to the following list and respectively to the sync manager information.

Mappin	Mapping		Name	Byte	Range	Description
g object 0x1A00	SINT32	Actual Pressure	ACTUAL PRESSURE	4	Value in mBar adjustable ¹⁾	
	SINT32 SINT32 SINT32	Pressure Senso Pressure Senso Actual Position	PRESSURE SENSOR 1	4	Value in mBar adjustable ¹⁾	
	SINT8 UINT16 UINT16	Control Mode Error Number General Status	PRESSURE SENSOR 2	4	Value in mBar adjustable ¹⁾	
0.44.04	UINT16 UINT32	General Warning Extended Warni	ACTUAL POSITION	4	0…100 adiustable ¹⁾	Note: 0 do not mean that the v sealing functionality is availab to the bit SEALING STATE in (
(default)	FLOAT FLOAT FLOAT SINT8 UINT16 UINT16 UINT16 UINT32	Pressure Senso Pressure Senso Actual Position Control Mode Error Number General Status General Warnin Extended Warni	CONTROL MODE	1	014	0 = init 1 = homing 2 = position 3 = close 4 = open 5 = pressure 6 = hold
0x1A02	SINT32 SINT8 UINT16 UINT16 UINT16 UINT32	Actual Position Control Mode Error Number General Status General Warnin Extended Warni				 7 = learn 8 = interlock open 9 = interlock close 12 = pow er failure 13 = safety 14 = fatal error
0x1A03		Actual Position	ERROR NUM BER	2	200888	Refer to chapter «Errors»
	UINT16	Error Number	GENERAL STATUS	2		See bitmap table below
	UINT16 UINT16	General Status General Warnin	GENERAL WARNING	2		See bitmap table below
	UINT32	Extended Warni	EXTENDED WARNING	2		See bitmap table below

94

0x1AFF Configurable me 1) To adjust range refer to chapter: «Scaling of pressure and position values»

	Bit	Description				
0	FIELDBUS DATA VALID	 Valve is not in the EtherCAT state OPERATIONAL or the process data output w atchdog. (SyncManager2) is disabled Valve is in the EtherCAT state OPERATIONAL and the process data output w atchdog (SyncManager2) is enabled 				
1	ZERO ADJUST EXECUTED	ZERO ADJUST successful executed, active for 2 seconds				
2	PING PONG RX-BIT	andshake mechanism s the inverted PING PONG TX-BIT from OUTPUTBUFFER → GENERAL CONTROL SETPOINT				
3	PRESSURE SIMULATION	1 = Internal pressure simulation active				
4	TARGET PRESSURE REACHED	1 = The actual pressure is within 2% of the pressure setpoint				
5-6	NOT USED (reserved)	-				
7-8	ACCESS MODE	bit 8bit 700=1=REMOTE10=LOCKED				
9	WARNINGS ACTIVE	1 = At least one WARNING of the warning bitmaps is active (GENERAL WARNING bitmap and EXTENDED WARNING bitmap)				
10	SEALING STATE	1 = valve is sealed, only valid if a sealing functionality is available				
11	INTERLOCK ACTIVE	1 = an interlock input is active				
12- 15	NOT USED (reserved)	-				

GENERAL STATUS bitmap table:

GENERAL WARNING bitmap table:

	Bit	Description
0	NOT USED (reserved)	-
1	LEARN DATA SET	Learn data not present. Learn required for adaptive pressure control. Just active if adaptive pressure control algorithm is choosen.
2	NOT USED (reserved)	-
3	POWER FAILURE BATTERY	Not ready, voltage too low . Just active if pow er failure is available.
4-5	NOT USED (reserved)	-
6	FAN STALL ALARM	Just available w hen fan provides a stall alarm

47-	NOT USED
15	(reserved)

EXTENDED WARNING bitmap table:

	Bit	Description
0	REMOTE CONTROL NOT POSSIBLE	Remote control not possible, access mode local is active, change to access mode remote or access mode locked
1	ACTUAL CONTROL MODE SETPOINT NOT ALLOWED	Not possible to sw itch the actual control mode to CONTROL MODE SETPOINT Control mode is interlock or fatal error CONTROL MODE SETPOINT is 5 (pressure) or 7 (learn) and no sensor is selected (sensor mode configuration)
2	ZERO DISABLED	Using zero function not possible
3	PFO DEACTIVATED	Pow er Failure Option is deactivated
4	NOT USED (reserved)	-
5	OUT OF RANGE: PRESSURE SETPOINT	Value of PRESSURE SETPOINT is out of range
6	OUT OF RANGE: POSITION SETPOINT	Value of POSITION SETPOINT is out of range
7-9	NOT USED (reserved)	-
10	OUT OF RANGE: CONTROL MODE SETPOINT	Value of CONTROL MODE SETPOINT is out of range
11	OUT OF RANGE: GENERAL CONTROL SETPOINT	Value of GENERAL CONTROL SETPOINT is out of range
12- 15	NOT USED (reserved)	-

96

Ping Pong

With the Ping pong mechanism the master can verify that the slave has read the PDO buffer content sent by the master.

Principle:

Master sets the Ping pong bit in the object "General Control Setpoint". When the slave receives the value of "General Control Setpoint", the slave will invert this Ping pong bit and put it into ping pong of "General Status"

Example:

The master wants to have a confirmation that the slave has received a new value of "Target Position":

- 1. Master sets "Target Position" to 123 and set Ping pong bit of "General Control Setpoint" to 0
- 2. Master waits till Ping pong bit of "General Status" has changed to 1 à This is the confirmation, that the PDO telegram with the new "Target Position" was received by the slave



Configurable PDO mapping

User can add additional objects to PDO Output mapping 0x16FF and the Input PDO mapping 0x1AFF.

Example 0x16FF with EC-Engineer

To add the parameters Pressure Ramp Slope and Mode in addition to the standard buffer (0x1601) in the configurable PDO buffer (0x16FF) following steps are necessary:

Mapping object	Mapping content			
0x16FF	USINT8 FLOAT	Pressure Ramp Mode Pressure Ramp Slope		

- In EC engineer the mapping the configuration is done in Configuration Mode
- Select output buffer 0x16FF "Outputs User 1" and click "Edit" button

Explorer	Device Ed	itor								
Class-A Master Slave_1001 [VAT valve S613] (10	General	PDO Mapping Varia	bles Advanced Options In	it Commands Col	E Object-Dictionar	ny Syno	c Units			FMMU/S
	Inputs					Output	s			041004
	•	Inputs Integer 1 (ex	cluded by 0x1A01)		0x1A00		Name	Index	Bit Length	
		Name	Index	Bit Length			Target Position	0x2F00:02	32	
		Actual Pressure	0x2F00:08	32	E		Control Mode Setpoint	0x2F00:05	8	
		Pressure Sensor 1	0x2F00:09	32			General Control Setpoint	0x2F00:06	16	
		Pressure Sensor 2	0x2F00:10	32			Outputs Float 3 (exclud	ed by 0x1601)		0x1605
		Actual Position	0x2F00:11	32			Name	Index	Bit Length	
		Control Mode	0x2F00:12	8			Target Position	0x2200:02	32	
		Error Number	0x2030:03	16			Control Mode Setpoint	0x2F00:05	8	
		General Status	0x2F00:13	16			General Control Setpoint	0x2F00:06	16	
		General Warnings	0x2F00:14	16		Ιг				

• Press "Add" to add a new object:

🛹 Edit PDO		
General		Optional
Name	Outputs User 1	Exclude:
Index	0x16FF	Dec Hex 1600
Flags Mandatory	Direction	1602 1603
Fixed Content	RxPdo	1604
✓ Virtual PDO		
Entries Name	Index	Bit Length Comment
	/	
Add	Delete Edit	t Up Down
	OK	Cancel

• Select object 0x2F01:01 "Pressure Ramp Slope" and press ok

🛹 Add PE	00 Entry		
General			
Name		Pressure Ramp Slope	
Comme	ent		
Swappi	ng	None	-
Settings			
Index		0x2F01 Dec Hex SubIndex 1	Dec Hex
Datatyp	be	REAL Bit Length 32	
CoE Obje	ect-Dictio	onary	
	Index	Name	Type ^
•	0x2F00	VAT Profile Objects	USINT
•	0x2F01	VAT Profile Extension Objects	USINT
	SubInde	ex Name	Туре
•		1 Pressure Ramp Slope	REAL
		2 Pressure Ramp Mode	USINT
•	0xF9F5	Output Identifier	USINT
			*
		OK Cancel	

• Press again "Add" and select 0x2F01:02 "Pressure Ramp Mode". Now the two additional objects should be added to 0x16FF:

🛹 EC-Engineer []											- 0 %
File View Network Settings Help											
🔀 Configuration Mode 🛛 🖬 Export ENI		📕 Diagnosis Mode									
Project Explorer	Device E	ditor									i de la compañía
 Class-A Master 	Genera	PDO Mapping	Variables	Advanced Options	Init Commands C	oE Object-Dictiona	ary Syr	nc Units			
Slave_1001 [VAT valve S613] (10)										PDO	FMMU/SM
	Inputs						Outpu	ıts			
		Inputs Intege	r 1 (excluded	by 0x1A01)		0x1A00		Control Mode Setpoint	0.2100.05	0	*
		Name		Index	Bit Length	_		General Control Setpoint	0x2F00:06	16	
		Actual Pressure		0x2E00:08	32			Outputs Float 3 (exclud	ed by 0x1601)		0x1605
		Procesure Sensor 1		0~2500-00	22	E		Name	Index	Bit Length	
		Pressure Sensor 1		0.0500.09	32			Target Position	0x2200:02	32	
		Pressure Sensor 2		0x2F00:10	32			Control Mode Setpoint	0x2F00:05	8	
		Actual Position		0x2F00:11	32			General Control Setpoint	0x2F00:06	16	
		Control Mode		0x2F00:12	8			Outputs User 1			0x16FF
		Error Number		0x2030:03	16			Name	Index	Bit Length	
		General Status		0x2F00:13	16			Pressure Ramp Slope	0x2E01-01	32	Ξ
		General Warnings		0x2F00:14	16			Deserve Deserve Marks	0.0501.02		
d III >						Ŧ		Pressure kamp Mode	0x2F01;02	0	Ŧ
Classic View Flat View Topology View					Add	Delete E	dit	Up Down		Load PD	O information

Change in Diagnose Mode and change state to OP $_{\odot}$ Now this parameters are visible under Variables

EC-Engineer (C:/workspace/Ecengineer/configurable_pdo_955_withkampsid	peeco	
File View Network Settings Help		
Configuration Mode 🔚 Export ENI	😰 Take Snapshot	
Project Explorer	Device Editor	
 Class-A Master <connected></connected> 	Genera Variables SC Register EEPROM Extended Diagnosis DC Diagnosis CoE Object-Dictionary FoE	
Slave_1001 [VAT valve S953] (1001)	Variables	
	Name	Datatype
	Slave_1001 [VAT valve 5953].Inputs Float 1.Actual Position	REAL
	Slave_1001 [VAT valve S953].Inputs Float 1.Control Mode	USINT
	Slave_1001 [VAT valve \$953].Inputs Float 1.Error Number	UINT
	Slave_1001 [VAT valve \$953].Inputs Float 1.General Status	UINT
	Slave_1001 [VAT valve S953].Inputs Float 1.General Warnings	UINT
	Slave_1001 [VAT valve S953].Inputs Float 1.Extended Warnings	UINT
	Slave_1001 [VAT valve \$953].Outputs Float 1.Target Pressure	REAL
	Slave_1001 [VAT valve S953].Outputs Float 1.Target Position	REAL
	Slave_1001 [VAT valve S953].Outputs Float 1.Pressure Input Digital Sensor 1	REAL
	Slave_1001 [VAT valve \$953].Outputs Float 1.Pressure Input Digital Sensor 2	REAL
	Slave_1001 [VAT valve 5953].Outputs Float 1.Control Mode Setpoint	USINT
	Slave_1001 [VAT valve S953].Outputs Float 1.General Control Setpoint	UINT
	Slave_1001 [VAT valve S953].Outputs Float 1.Pressure Ramp Time	REAL

• Save master project to load this configuration on another device.

SDO Service data objects - acyclic communication

VAT uses for acyclic parameter data handling a standard EtherCAT mailbox transfer. The mailbox protocol is CoE (CANopen over EtherCAT), compliant to DS301 (CiA Draft Standard 301 v4.02).

Note: This list of the acyclic communication is depending on the installed firmware version. Please check this information in the product specific Manual.

File over EtherCAT (FoE)

Via this profile, firmware and entire collections can be loaded via the EtherCAT interface. It is important that the name of the file must have a length of eight characters. The file ending is limited to three characters. Detailed information is given by the ETG.5003.2 profile.

Example: vat specific firmware: F01.0C.28.08.vat becomes 010C2808.vat

Example TwinCAT

Step by step instructions to load a firmware via FoE.

- Open TwinCAT Project
- Scan Device (right click on Device)



- Accept Hint Window
- Select Device (Normally the device is selected automatically)
- Scan for Boxes -> yes
- Activate Free Run -> yes
- Set Boot Mode
 - $_{\odot}$ Double-click on device
 - $_{\odot}$ Open Online Window
 - Select Bootstrap

								Valve Firmw	are	101
Image: Solution Explorer Image: Solution Explorer Image: Solution Explorer Image: Solution Explorer	AT TWINSAFE PL	C TOOLS SCOPE	WINDOW elease 🗸	HELP TwinCA	T RT (x64)	•	_م	-	₽ 🗊 🚔	© 14 D
Search Solution Explorer (Ctrl+0) Solution TwinCAT Project2's (1 project) TwinCAT Project2's (1 project) System MOTION PLC SAFETY C++ Devices Mage mage mage mage Mage Synchits Solution Synchits Solution Synchits Solution Solu	General EtherCAT II State Machine Pre-Oo Op DLL Status Port A: Cent Port B: No C Port C: No C Port C: No C Port D: No C File Access over Eth Download	Process Data Startup Col Bootstrap Safe-Op Cur Rec Clear Error r / Open anter / Oosed arter / Oosed arter / Cosed arter / Cosed arter / Cosed arter / Cosed arter / Cosed	E-Online Online	BOOT BOOT						
	Name 🔊 State 🔊 AdsAddr	Online 3 172.18.20.224.3.1:1	Type UINT AMSADDR	Size 2.0 8.0	>Addr 1548.0 1550.0	In/Out Input Input	User ID 0 0	Linked to		

- Download File (Attention File must have 8 characters)
 - Select Download
 - $\circ\,$ Change File type to All Files
 - Open requested firmware

🕅 TwinCAT Project25 - Microsoft Visual Studio 🦞 Quick Launch (Ctrl+Q)							
FILE EDIT VIEW PROJECT BUILD DEBU	G TWINCAT TWINSAFE PLC TOOLS SCOPE (WINDOW HELP					
0-0 18-1-1 🖬 🗳 🖉 A 🗗 A	🤊 - 🥂 - 🕨 Attach 🦳 Rele	ease + TwinCAT RT (x64) + 5	 同を回金(0 ₩ □			
Solution Explorer	→ # × TwinCAT Project25					-	Properties
ෙ ර ල ල ළ 🖌 🗕	General EtherCAT Process Data Startup CoE	0 📢 Offnen					8
Search Solution Explorer (Ctrl+ü)	P - State Machine	Computer PGS (\\hg.vat\VAT\MT)	(N:) -=FirmwareTest=- Anleitung			- 4+	Anleitung durchsuchen
Glution 'TwinCAT Project25' (1 project)	Int Bootstrap						
IwinCAT Project25 SySTEM	Pre-Op Safe-Op Curre	nt Organisieren 👻 Neuer Ordner					iii • 🛄 🔮
MOTION	Oo Clear Error Requ	es 🖌 🔆 Favoriten	Name	Änderungsdatum	Тур	Größe	
PLC .		Cesktop	010C2808.vat	22.09.2019 18:15	VAT-Datei	1'271 KB	
SAFETY RECENT	DLL Status	😹 Downloads	Boot Mode	03.10.2019 08:45	PNG-Bild	71 KB	
🔺 🔯 1/0	Port A: Carrier / Open	3 Zuletzt besucht	ScanDevice	03.10.2019 08:38	PNG-Bild	26 KB	
▲ ⁹ th _{th} Devices	Port B: No Carrier / Closed	a 🔽 Dik Cakhalara					
 Device 2 (EtherCAT) Image 	Port C: No Carrier / Closed	Bibliothexen					
Image-Info	Port D: No Carrier / Closed	Dokumente					
🥏 SyncUnits	- Die Access over DirecCAT	> 👌 Musik					
Inputs	Download	Subversion	1				
InfoData		Videos					
Box 1 (P02010670 R00010001)		-					
Mappings		4 (Computer					
		Coul sufwark (E) VAT CRA					
	Name Onlige	PG5 (\\hg.vat\VAT\MT) (N;)					
	😴 State 3	UI VAT (\\hq.vat) (0:)					
	P. AdsAddr 172.18.20.224.3.1:1	AN President (\\HQ.VAT\CHTransfer) (P:)					
		PROZESSE (\\hq.vat) (Q:)					
		MECPD - Mechanical Platform Development					
		METPD - Mechatronics Platform Development					
		METPD - Mechatronics Platform Engineering					
		PDPIM - Platform Development Project Manager					
	Front Litt	PG5 - Produktgruppe 5 (N)					
		PST - Processes & Standards					
	Duciation		v				
	Description A	Dateiname: 010C2808.vat				- A	Il Files (*.*)
							Öffnen 🔻 Abbrechen
							al .
Add extension	of the file						
 Start downlo 	ad process						
	au piocess						
Edit EoE Name			23				
Earch of Marrie			200				
China (01002000		014				
String: U	010C2808 Vat		UK				

Hex:	30 31 30 43 32 38 30 38 2E 76 61 74	Cancel
Length:	12	
Password (hex):	00000000	

• Wait until the green loading bar at the bottom right is finished.

- Set Init Mode
 - o valve loads firmware -> running eights on display
 - o wait until display shows general information -> firmware download process is finished
- Check Error List

O Errors A 1 Warning 0 2 Messages Clear			Search Error L	list	ρ.
Description A	File	Line	Column	Project	
03.10.2019 09:15:36 532 ms Device 2 (EtherCAT): Frame missed 10 times (frame no. 0)					
03.10.2019 09:17:13 254 ms Device 2 (EtherCAT): Frame returned -> force reinitialization!					
03.10.2019 09:17:15 768 ms 'Box 1 (P02010670 R00010001) (1001)' Communication re-established					
	Lit C 0 Errors A 1 Warning Q 2 Messages Clear Description * 03.10.2019 09:15:36 532 ms Device 2 (EtherCAT): Frame missed 10 times (frame no. 0) 03.10.2019 09:17:13 254 ms Device 2 (EtherCAT): Frame returned -> force reinitialization! 03.10.2019 09:17:15 768 ms % x 1 (P02010670 F00000000) (1001)* Communication re-established 	Litt CO 0 Errors <u>A</u> 1 Warning <u>O</u> 2 Messages Clear Description <u>A</u> 03.10.2019 09:15:36 332 ms Device 2 (EtherCAT): Frame missed 10 times (frame no. 0) 03.10.2019 09:17:13 254 ms Device 2 (EtherCAT): Frame returned -> force reinflailization! 03.10.2019 09:17:15 768 ms Text feat	Lit. C: 0 Errors: ▲ 1 Warning O 2 Messages Clear Description * O 3.10.2019 09:15:36 532 ms Device 2 (EtherCAT): Frame missed 10 times (frame no.0) O 3.10.2019 09:17:13 254 ms Device 2 (EtherCAT): Frame returned → force reinitialization! O 3.10.2019 09:17:15 768 ms Box1 (PO2010670 R00001001) (1001)' Communication re-established 	Litt C 0 Errors A 1 Warning 0 2 Messages Clear Search Error L Description A 03.10.2019 09.15:36 532 ms Device 2 (EtherCAT): Frame missed 10 times (frame no. 0) 03.10.2019 09.15:36 532 ms Device 2 (EtherCAT): Frame returned -> force reinfisilization1 03.10.2019 09.17.15 768 ms Box 1 (P02010670 F00010001) (0001) ⁺ Communication re-established	Litt Search Error List © 0 Errors ▲ 1 Warning 0 2 Messages Clear Description * File Line Column 03.10.2019 09:15:36 532 ms Device 2 (EtherCAT): Frame missed 10 times (frame no. 0) 03.10.2019 09:15:36 532 ms Device 2 (EtherCAT): Frame returned -> force reinfails/azion! 03.10.2019 09:17:15 768 ms % nu PO2010670 P00010001) (1001)* Communication re-established File

2.5.2 RS232/485

RSRS232/485 is a simple, open, serial communication protocol that is easy to implement. The Interface supports addition 2 digital inputs and 2 digital outputs with selectable functionality. Additional there are an analog output 0 to 10V for pressure and position.

IC2 command set is always available. In parallel an older command set is possible to use in parallel. If the *Command Set* does not cause a conflict, then commands from other command sets can be used even if it is not defined under *Command Set*.

General settings on the Interface can be done with the VAT Program CPA4.

2.5.2.1 Settings

The Valve COM port settings must be identical with the settings from the Host control system.

	Parameter	Description		
Baud Rate		Number of bit transfers per second Factory setting: <i>115200</i> After a Baud Rate change is a Valve reset necessary.		
Settings	Data Bit Length	Data bits in a transmission Factory setting: <i>8</i>		
	Stop Bit	End of communication for a single packet Factory setting: <i>1</i>		
	Command Set	Communication protocol Factory setting: <i>IC</i>		
Operation	Topology	Half or Full duplex topology		
Mode RS485	Network	Multiple Device or Point to Point network		
	Address	Network address at multiple device communication		

Operation Mode

Both operation modes RS232 and RS485 are with the same hardware possible.

- RS232 is a two wire point to point communication.
- RS485 is a four wire system (full duplex) or a two wire system (half duplex) and supports also multiple device communication.

|--|

Valve F	irmware	103
---------	---------	-----

	RS232	Communication over RS232 Use Pin RXD and TXD
Operation Mode	RS485	Communication over RS485 Use Pin A,B,X,Y
	Service Interface Over RS232	Communication with CPA over RS232 Use Pin RXD and TXD

2.5.2.2 Command Structure

In this chapter the command structure for the RS232/485 communication is described. Here we have to distinguish between the different Command-Sets, mainly between IC2 and IC1 Command-Sets.

Syntax

- IC2 Command Set is always available independent from the setting Command Set
- Commands and values are case sensitive.
- Acknowledgement within 10ms after reception of command (worst case).
- Wait for acknowledgement before sending a new command.
- Default command termination is CR and LF. This is adjustable. CR = Carriage Return (0D hexadecimal), LF = Linefeed (0A hexadecimal)
- Same Syntax for Commands over Terminal in the CPA as over RS232 interface.
- All characters are in ASCII code

	Command	Response
GET	p: service parameter index	p: error service parameter index value
SET	p: service parameter index value	p: error service parameter index value

service	service code in hexadecimal, 2 digits
parameter	parameter ID in hexadecimal, 8 digits
error	error code in hexadecimal, 2 digits
index	array index, if parameter is not an array use 00, 2 digits
value	set or response value, digits depends on value format

Service

code	description
01	Set a parameter to a value
0B	Get a value of a parameter

Parameter

The supported parameters is depending on the specific firmware version and the used hardware. This list of visible parameter can be exported by the CPA4 program directly. Please see chapter Export Parameters to Excel.

The parameter ID of a selected parameter is visible on the bottom of the parameter window. By using right-click on the parameter ID, the corresponding command (Set or Get) is copied to the clipboard. If using a set-command, the command needs to be completed by the new value.

Parameter ID: 0F1002

Copy parameter ID to clipboard

Copy set command to clipboard Copy get command to clipboard

Error

code	error text	description
00	no error	no error
0C	wrong command length	wrong command length
1C	value too low	value out of range: lower then min limit
1D	value too high	value out of range: higher then max limit
20	resulting zero adjust offset value out of range	resulting zero adjust offset value out of range
21	not valid because no sensor enabled	not valid because no sensor enabled
50	wrong access mode	wrong access mode
51	time out	
6D	EEProm not ready	
6E	wrong parameter ID	wrong parameter ID
6F	set to default value not possible	set to default value not allowed
70	parameter not settable	set value not allowed
71	parameter not readable	get value not allowed
72	set to initial value not possible	initial value not allowed
73	wrong parameter index	wrong parameter ID index (array)
74	initial value out of range	wrong initial value
76	wrong value	wrong value within range
77	wrong value, only reset possible	only value reset possible
78	not allowed in this state	not allowed in this state
79	Setting lock is active	configuration lock mode is active
7A	wrong service	service (action) not valid
7B	parameter not active	parameter is inactive
7C	parameter system error	parameter system error

105

code	error text	description
7D	communication error	communication error (e.g. buffer overrun)
7E	unknown service	
7F	unexpected character	
80	no access rights	wrong access mode
81	no adequately hardware	
82	wrong object state	example: wrong execution mode (DeviceNet)
84	no slave command	
85	command to unknown slave	
87	command to master only	
88	only G command allowed	
89	not supported	
8A	Not allowed: Internal sequencer is running	
8F	Not allowed: Entry already exists	
A0	function is disabled	
A1	already done	

Examples:

Open valve:			
command p:010F020000004		response p:00010F020 error	000004 00 (successfully)
service parameter Index Value	01 (set) 0F020000 00 4	service parameter index value	01 (set) 0F020000 00 4
Close valve:			
command p:010F020000 service parameter Index Value	0003 01 (set) 0F020000 00 3	response p:00010F020 error service parameter index value	0000003 00 (successfully) 01 (set) 0F020000 00 3
Position contr	ol:		
command p:010F020000002 service 01 (set)		response p:00010F020 error service	000002 00 (successfully) 01 (set)

106

parameter Index Value	0F020000 00 2	parameter index value	0F020000 00 2
Set Target Po	osition:		
command		response	
p:0111020000	00070.0	p:000111020	0000070.0
		error	00 (successfully)
service	01 (set)	service	01 (set)
parameter	11020000	parameter	11020000
Index	00	index	00
Value	70.0	value	70.0
-			
Pressure con	trol:		
command		response	
p:010F02000	0005	p:00010F02	000005
		error	00 (successfully)
service	01 (set)	service	01 (set)
parameter	0F020000	parameter	0F020000
Index	00	index	00
Value	5	value	5

Note:

• Pressure and position range depend on scaling settings. See chapter CPA Scaling for USB Communication. Otherwhise the relevant interface: Example serial interface see RS232/485 Scaling

Compound Commands

This function allows to GET and/or SET several values with one command. Note: This commands are available since firmware version July 2021.

Service	
Code	Description
29	GET the values of all parameters in the compound array
28	SET the values of all parameters in the compound array
30	SET and GET combined. All parameters until the first empty entry (ID = 0) are set. All parameters after the first empty entry (ID = 0) are get.

Group	Parameter	ID [hex]	Data Type	Acces s	NV	Description
Parameter	Compound 1	A10A0100	UINT32[20]	RW	NV	Compound of Parameter IDs
	Compound 2	A10A0200	UINT32[20]	RW	NV	
	Compound 3	A10A0300	UINT32[20]	RW	NV	

107

0	A 10A 0400			NN/	
Compouna 4	A 10A0400	011132[20]	RVV		

Example:

Build Compound 1 (A10A0100) to get the values of several parameters:

Index	Parameter	ID [hex]	Commands to set the compound members
00	Access Mode	0F0B0000	p:01A10A0100000F0B0000
01	Control Mode	0F020000	p:01A10A0100010F020000
02	Actual Position	10010000	p:01A10A01000210010000
03	Position State	00100000	p:01A10A01000310100000
04	Actual Pressure	07010000	p:01A10A01000407010000
05	Target Pressure	07020000	p:01A10A01000507020000
06	Target Pressure Used	07030000	p:01A10A01000607030000
07	Warning Bitmap	0F300100	p:01A10A0100070F300100
08	not used	0	p:01A10A0100080

Note: All not used indexes must be set to 0

Execution:

Send	Receive
------	---------

Get p:29A10A010000 p:0029A10A0100000;2;45.0;0;1.45;30.0;30.0;0

Build Compound 2 (A10A0200) to set the several parameters:

Index	Parameter	ID [hex]	Commands to set the compound members
00	Access Mode	0F0B0000	p:01A10A0200000F0B0000
01	Control Mode	0F020000	p:01A10A0200010F020000
02	Target Position	11020000	p:01A10A02000211020000
03	Target Pressure	07020000	p:01A10A02000307020000
08	not used	0	p:01A10A0200080

Note: All not used indexes must be set to 0

Execution:

	Send	Receive
Set	p:28A10A0200000;2;45;30	p:0028A10A0200000;2;45;30

Get **p:29A10A020000**

..

p:0029A10A0200000;2;45.0;30.0

Compatible Command Sets

IC1

Note:

- All position and pressure values are integer values and they are scalable.
- Default range pressure 0 ... 1000000, position 0 ... 100000

System

Set	Resp	Get	Resp	Data Set, Get Resp	Description							
c:01	c:01			aa	Access Mode: 0=Local, 1=Remote, 2=Locked							
		i:80	i :80	abcdefgh	Hardware Configuration							
					a Power Failure Option: 0=no, 1=yes							
					b Sensor Power Supply: 0=no, 1=yes							
					c Interface Type: 2=RS232, 3=RS323 with AO, 8=RS232/RS485, 9=RS232/485 with AO							
					d Sensor Inputs: 0, 1 or 2							
					e Cluster Option: 0=no, 1=yes							
					f External Isolation Valve: 0=no, 1=yes							
					g Reserved							
					h Small Size Controller: 0=no, 1=yes							
		i:82	i:82	string	Firmware							
		i:83	i:83	string	Serial Number							
		i:30	i:30	abcdeeef	Device Status							
					a Access Mode: 0=Local, 1=Remote, 2=Locked							
					b Control Mode: 0=Init,1=Homing,2=Position,3=Close,4=Open,5=Pressure Control,6=Hold,7=Learn,8=Interlock Open,9=Interlock Close,12=Power Failure,13=Safety,14=Error							
					c PFO Disabled: 0=no, 1=yes							
					d Warning Present: (in i:51 or i:52) 0=no, 1=yes							
					e Reserved							
					f Sensor Simulation Active: 0=no, 1=yes							
		i:76	i:76	aaaaaa	Compound							
				bbbbbbbbbcde	a Pressure							
					b Position							
					c Access Mode: 0=Local, 1=Remote, 2=Locked							
					d Control Mode: 0=Init,1=Homing,2=Position,3=Close,4=Open,5=Pressure Control,6=Hold,7=Learn,8=Interlock Open,9=Interlock Close,12=Power Failure,13=Safety,14=Error							
					e Warning Present: (in i:51 or i:52) 0=no, 1=yes							
s :04	s :04	i:04	i:04	abcdefgh	Valve Configuration							
					a Homing End Position: 0=Close, 1=Open							
					b Power Failure Position: 0=Close, 1=Open							
Set	Resp	Get	Resp	Data Set, Get Resp	Description							
------	------	-------	------	-----------------------	--	----------	---------	---------	---------	------	--	--------------
					c External Isolation Valve Enable: 0=no, 1=yes							
					d Control Stroke Limitation Enable: 0=no, 1=yes							
					e Network Failure Position							
					f Cluster Valve Offline							
					g Homing Start: 0=Not Isolated or Move Command, 1=c:4303 Command, 2=Open Command, 3=Move Command, 4=At Power Up							
					h Reserved							
		i:50	i:50	aaa	Fatal Error Number: 20=Limit Stop Not Detected, 21=Blocked, 22=Blocked, 40=Motor Driver							
		i:51	i:51	abcdefgh	Warnings 1							
c:53	c:53	i :53	i:53		a Service Request							
					b Learn Data Warning							
					c PFO not ready							
					d Compressed Air Failure							
					e Sensor Ratio							
					f External Isolation Valve Warning							
					g Cluster Slave Offline							
					h Network Failure							
					i :53 = nonvolatile, c :5300 = reset							
		i:52	i:52	abcdefgh	Warnings 2							
c:54	c:54	1.54	1:54	4 1:54	1.54 1.54	:54 1:54	54 1:54	JH 1.34	JH 1.34	1.34		a Rom Memory
					b Interface							
					c Sensor ADC							
					d Interface ADC							
					e Reserved							
					f Sensor value not valid							
					g Cluster Slave Offline							
					h Network Failure							
					i:54 = nonvolatile, c :5400 = reset							
c:20	c:20	i:70	i:70	aaaaaaaaa	Counter Control Cycles c:2000 = reset							
c:21	c:21	i:71	i:71	aaaaaaaaa	Counter Isolation Cycles c:2100 = reset							
c:22	c:22	i:72	i:72	aaaaaaaaaa	Counter Power Up c:2200 = reset							
c:10	c:10			aa	Power Failure Option Off: 0=Off (volatile), 1=On							
c:82	c:82		_	aa	Reset: 1=Reset							

Position Control

Set	Resp	Get	Resp	Data Set, Get Resp	Description
		A:	A:	aaaaaa	Actual Position
C:	C:				Close
0:	0:				Open
R:	R:	i:38	i:38	aaaaaaa a	Position Control, a Target Position
H:	H:				Hold
N:	N:				Position Mode (Release Hold)
V:	V:	i:68	i:68	aaaaaa	Speed: 0 - 1000

Pressur	e Con	trol				
Set		Cat		Data	Description	
Set	Resp	Get	Resp	Set, Get Resp		
<u>S:</u>	<u>S:</u>	1:38	1:38	aaaaaaaa	Pressure Control, a Target Pressure	
H:	H:				Hold	
К:	K:				Pressure Control Mode (Release Hold)	
s :02	s :02	i:02	i:02	abcdeeff	Pressure Control Setup	
s:02a		i:02a			a Controller: 0=Adaptive,1=PI Downstream,2=PI Upstream,3=Softpump	
					b Gain Factor (Adaptive, not for this valve) 0=0.1,1=0.13,2=0.18,3=0.23,4=0.32,5=0.42,6=0.56,7=0.75,8=1.0,9=1.33,A=1.78,B=2.37, C=3.16,D=4.22,E=5.62,F=7.5,G=0.0001,H=0.0003,I=0.001,J=0.003,K=0.01,L=0.02,M=0.05	
					c Sensor Delay (Adaptive, not for this valve) 0=0,1=0.02,2=0.04,3=0.06,4=0.08,5=0.1,6=0.15,7=0.2, 8=0.25,9=0.3,A=0.35,B=0.4,C=0.5,D=0.6,E=0.8,F=1.0 sec	
					d Ramp Time 0=0.0,1=0.5,2=1.0,3=1.5,4=2.0,5=2.5,6=3.0,7=3.5,8=4.0,9=4.5,A=5.0 sec	
					e P-Gain (Pl and Softpump) 0=0.001,1=0.0013,2=0.0018,3=0.0024,4=0.0032,5=0.0042,6=0.0056, 7=0.0075,8=0.01,9=0.013,10=0.018,11=0.024,12=0.032,13=0.042, 14=0.056,15=0.075,16=0.1,17=0.13,18=0.18,19=0.24,20=0.32,21=0.42, 22=0.56,23=0.75,24=1.0,25=1.3,26=1.8,27=2.4,28=3.2,29=4.2,30=5.6, 31=7.5,32=10,33=13,34=18,35=24,36=32,37=42,38=56,39=75,40=100	
					f I-Gain (PI and Softpump): Same values as P-Gain	
s:02a0 1	s :02	i:02a01	i:02	value	Ramp Time: 0.0 – 1000000.0sec, a = Controller: A,B,C,D	
s:02a0 2	s :02	i:02a02	i:02	value	Ramp Mode: 0=constant time, 1=constant slope, a = Controller: A,B,C,D	
s:02a0 3	s :02	i :02a 03	i:02	value	Control Direction: 0=downstream, 1=upstream, a = Controller: A,B,C,D	
s:02a0 4	s :02	i :02a 04	i:02	value	P-Gain: 0.001 – 100.0 (Control Algorithm = PI or Softpump) a = Controller: A,B,C,D	
s:02a0 5	s :02	i :02a 05	i:02	value	I-Gain: 0.001 – 100.0, a = Controller: A,B,C,D	
s:02a0 6	s :02	i:02a06	i:02	value	Ramp Type: 0=linear, 1=logarithmic, 2=exponential, a = Controller: A,B,C,D	
s:02a1 0	s :02	i:02a10	i:02	value	Control Algorithm: 0=Adaptive, 1=PI, 2=Softpump, a = Controller: A,B,C,D	
s:02Z00	s :02	i:02Z00	i:02	value	Control Unit Selector: 03	
s:02Z10	s:02	i:02Z10	i:02	value	Save Volatile: 0=non volatile, 1=volatile	

FIESS	lie re	aung				
				Data		
Set	Resp	Get	Resp	Set, Get Resp	Description	
		P:	P:	aaaaaaaa	Actual Pressure	
s:01	s :01	i:01	i:01	abcccccc	Setup	
					a Sensor Mode	0=No Sensor 1=Sensor1 Only 3=Sensor2 Only 2=Sensor1 High, Sensor2 Low, Crossover Soft Switch 4=Sensor2 High, Sensor1 Low, Crossover Soft Switch 5=Sensor2 High, Sensor2 Low, Crossover High Disabled 6=Sensor2 High, Sensor1 Low, Crossover High Disabled 7=Sensor1 High, Sensor2 Low, Crossover Target Pressure 8=Sensor2 High, Sensor1 Low, Crossover Target Pressure 9=Sensor1 High, Sensor1 Low, Crossover Hard Switch 10=Sensor2 High, Sensor1 Low, Crossover Hard Switch
					b Zero Adjust Enable	0=disable, 1=enable
					c Sensor Factor	Ratio between the sensors * 100 Example: Sensor 1=1Torr, Sensor 2=100mTorr \rightarrow c = 010000
Z:	Z:				Zero	
		i:60	i:60	aaaaaaaa	Offset Sensor 1	
		i:61	i:61	aaaaaaaa	Offset Sensor 2	
		i:62	i:62	aaaabbbb	Offsets: a Sensor 1,	b Sensor 2, range -140 +150 of 1000
		i:62	i:62	aaaaaaaa	Pressure Sensor 1	
		i:63	i:63	aaaaaaaa	Pressure Sensor 2	
c:6002	c:60			aaaaaaaa	Pressure Alignment,	a = Alignment pressure
c:6102	c:61			aaaaaaaa	Pressure Alignment,	a = Alignment pressure
c:90	c:90			аа	Pressure Simulation	1, 0=Off, 1=On

Pressure Reading

Interface

Set	Resp	Get	Resp	Data Set, Get Resp	Description
s:20	s:20	i:20	i:20	abcdefgh	Setup1
					a Baud Rate: 0=600,1=1200,2=2400,3=4800,4=9600,5=19200,6=38400,7=57600,8=115200,9=230400
					b Parity Bit: 0=Even, 1=Odd, 2=Mark, 3=Space
					c Data Length: 0=7bit, 1=8bit
					d Stop Bit: 0=1bit, 1=2bit
					e Command Set: 0=IC, 1=PM
					f Digital Input 1: 0=Interlock Open, 1=Interlock Open Inverted, 2=Disabled
					g Digital Input 2: 0=Interlock Close, 1=Interlock Close Inverted, 2=Disabled
					h Second Answer (PM Command Set): 0=disabled, 1=enabled
s:21	s:21	i:21	i:21	abbbbbb	Setup2
					a Position Range: 0=1000, 1=10000, 2=100000
					b Pressure Range: 1000100000
s:22	s:22	i:22	i:22	abbbcdee	Setup3
					a Operation Mode: 0=RS232, 1=RS485, 2=RS485 Peer to Peer
					b Device Address: 0 999
					c Duplex Mode: 0=Full, 1=Half
					d Termination: 0=LF (CR/LF), 1=CR
					e Reserved

Errors

Description	Error message
Protocol	
Parity error	E:000001
Input buffer overflow (to many characters)	E:000002
Framing error (data length, number of stop bits)	E:000003
Overrun (Service interface: Input buffer register overflow)	E:000004
Commands	
<cr> or <lf> missing</lf></cr>	E:000010
: missing	E:000011
Invalid number of characters (between : and)	E:000012
Invalid value	E:000023
Value out of range	E:000030
Hardware	
Pressure mode, Zero or Learn without Sensor	E:000040
Command not applicable for hardware configuration	E:000041

Setup	
ZERO disabled	E:000060
Device Status	
Command not accepted due to local operation	E:000080
Command not accepted, Service Interface locked	E:000081
Command not accepted due to synchronization, CLOSED or OPEN by digital input, safety mode or fatal error	E:000082
Not accepted calibration and test mode	E:000089

RS485 Multiply device commands

To address multiply device, put [#][xxx] bevor the standard command. Instead xxx set the device address.

GET Command

Transmitted data

[#][xxx][p:][service][parameter][index]

Received data

[#][xxx][p:][error][service][parameter][index][value]

SET Command

Transmitted data

[#][xxx][p:][service][parameter][index][value]

Received data

[#][xxx][p:][error][service][parameter][index][value]

2.5.2.3 Scaling

Use the Parameter Scaling to set the communication range for position and pressure.

Parameter location: CPA

Interface RS2332/RS485.Scaling

Parameter D	Description
-------------	-------------

Secling	Position	Set one of the available position range: 0-1 0-10 0-90 0-100 0-1000 0-10000 0-100000 User specific
Scaling	Pressure	Set one of the pressure unit: Pa kPa bar mbar Torr mTorr psi User specific

2.5.2.4 Input/Output

The RS232/485 Interface allows the user to operation with digital and analog signals. Thera are following Inputs and Outputs available.

- 2 Digital Input
- 2 Digital Output
- 2 Analog Output

Digital Inputs

There are 2 Digital Inputs available. The Digital Input functionality has the higher priority that the RS232/485 Communication

Parameter

	Parameter	Description
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported
Digital Input 12	State	<i>True</i> means it is active. <i>False</i> means it is not active.
	Functionality	Each digital input can be assigned one of the functionality descript at the <i>table Functionality</i> .
	Inverted	Inverted the functionality of the signal.

Functionality

Functionality	Description
Interlock Open	Open the Valve
Interlock Close	Close the Valve

Digital Outputs

There are 2 Digital Outputs available.

Parameter

	Parameter	Description
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported
Digital Output 12	State	True means it is active. False means it is not active.
	Functionality	Each digital input can be assigned one of the functionality descript at the <i>table Functionality</i> .
	Inverted	Inverted the functionality of the signal.

Functionality

Functionality	Description
Open	Indicate the Open status of the Valve.
Close	Indicate the Close status of the Valve.
Hold	Indicate the Hold status of the Valve.

Analog Outputs

Parameter

There are two outputs, one for **pressure** and one for **position**

	Parameter	Description	
	Value	Indicate the applied voltage	
Analog Output	User Factor	1 default value for Input voltage 0 to 10V UserFactor = (MaxVolt – MinVolt) / 10	
		Example: Input voltage 2V to 8V (8-2)/10 = 0.6 User Factor	

llean Officia	0 default value for Input voltage 0 to 10V UserOffset = MinVolt
User Offset	Example: Input voltage 2V to 8V 2.0 = User Offset

2.5.2.5 Wiring

Connector assembling

The Connector on the Controller is a D-Sup 25 Pin female.

0	(• • • • • • • • • • • • • • • • • • •	
Pin	Signal	Description
1	Chassis GND	Connected to case. Use this to connect cable shield.
2	TXD	Transmitted data to RS232
3	RXD	Received data from RS232
7	GND Digital output	GND (2) Digital output
8	Open	Digital output 1
9	Close	Digital output 2
11	Υ	RS485 T+
12	A	RS485 R+
13	В	RS485 R-
15	Close	Digital Input 2
17	Open	Digital Input 1
20	GND Analog output	GND (1) Analog output
21	Position	Analog Output 1
22	Pressure	Analog Output 1
23	GND Digital input	GND (3)
24	Z	RS485 T-
25	Common Digital input	3.3V (3)

RS232



RS485

.









Input/Output

Configuration with switches



Configuration with Voltage



2.5.3 DeviceNet

2.5.3.1 Connection

Connector type: Micro-style male (5 pin), connector is shown on panel refer to chapter «Installation into the system».

At valve controller	DeviceNet® cable		
PIN	Name	Wire color	Description
1	Drain	Bare	Shield
2	V+	Red	DeviceNet® power supply +
3	V-	Black	DeviceNet® power supply -
4	CAN_H	White	DeviceNet [®] signal
5	CAN_L	Blue	DeviceNet [®] signal



The $\mathsf{DeviceNet}^{\ensuremath{\mathbb{R}}}$ interface is galvanic isolated from control unit.

Micro Connector Pinout

Male (pins) at valve controller	Female (sockets) at DeviceNet® cable

2.5.3.2 LEDs

Mode

State of operation

LED Color	Description
GREEN	Operating in Normal Condition
FLASHING GREEN	The device needs commissioning due to configuration missing, incomplete or incorrect. The Device may be in the Standby state.
FLASHING RED	Recoverable Fault
RED	 The device has an unrecoverable fault may need replacing. Bus Off Queue overload Duplicate MAC ID
FLASHING GREEN & RED	The Device is in Self Test.

NET

State of the communication

LED Color	Description
FLASHING GREEN	Device is on-line but has no connections in the established state. The device has passed the Dup_MAC_ID test, is on-line, but has no established connections to other nodes.
FLASHING RED	One or more I/O Connections are in the Timed–Out state.

2.5.3.3 Communication

EDS

EDS file describe the communication parameters which are available from the specific device.

Choose the EDS file depending on valve series (example 613), data type (Int or Float) and profile (Process Control Device or Generic Device). If the EDS file is missing please request this by your

local contact Contact.

Your Local Contact	Get in touch, we are happy to support you and answer your questions and inquiries. Please select your country, if not already selected, to make sure we can respond to you quickly.		
United States Ukraine United Arab Emirates	VAT Inc. San Jose +1 800 935 1446 655 River Oaks Parkway 95134-1907, San Jose, CA United States 		
United Kingdom United States Uruguay	• VAT USA	~	
Uzbekistan Vanuatu	• VAT US Representatives	~	

Initial Communication Settings

To establish communication via DeviceNet, the following settings should be defined.

Parameters			– 🗆 X
Local 🄑 Remote 🔀 Features 😯 Help			VAT
parameters		values	
▲ System	*	Device Type	PCV
Access Mode Control Mode		Standard Revision	E54-0997
Identification		Manufacturer Name	VAT Vakuumventile AG
 Statistics Warning/Error 		Manufacturer's Model Number	n.a.
 Services Valve 		Software Revision Level	F01.0C.28.22
Position Control		Hardware Revision Level	IC2H3
Pressure Control Pressure Sensor	=	Manufacturer's Serial Number	4294967296
Interface DeviceNet Identity Object		Device Status	Executing -
 DeviceNet Object Connection Object Discrete Input Point Object Discrete Output Point Object Selection Object S-Device Supervisor Class Instance Device Type Standard Revision 		Exception Status Bit 2: ALARM manufacturer-specific Bit 6: WARNING manufacturer-specific Bit 7: Expanded Method Exception Detail Alarm Exception Detail Warning Alarm Enable	196 🗘 <array> <array> True</array></array>
Manufacturer Name Manufacturer's Model Number Software Revision Level Hardware Revision Level Manufacturer's Serial Number	Ŧ	Warning Enable	True Save
Parameter Group: A43001		Valve: n.a.	

1. First to verify if no cyclic communication is active

If Device Status shows Executing than execute stop service (see above)



2. Define Data Type for example under S-Single Stage Controller Object

- relements			
.ocal 🤌 Remote 🔀 Features 😧 He	lp		
parameters	values		
> System	Data Type *	REAL	
Valve Position Control	Data Units	Counts	
Pressure Control	Control Mode	Control	•
 Pressure Sensor Interface DeviceNet 	Setpoint		0 2
Identity Object DeviceMet Object	Process Variable		0 0
Connection Object	Exception Status		0 \$
Discrete Input Point Object Discrete Output Point Object	Alarm Enable	False	
Selection Object Sources Support	Warning Enable	False	•
S-Analog Sensor Object	Alarm Settling Time		0 🗘
 S-Analog Actuator Object S-Sinale Stage Controller Object 	Alarm Error Band		0 ‡
Class Instance	Warning Settling Time		0 0
 Process Variable Control Control Valve Position 	Warning Error Band		0 ‡
Services Services	Safe State	Close Valve	•
Pressure Controller Object Connection Loss Reaction Power Connector	Safe Value	Constant of the second	0 🗘
	Calibrating State	False	*
	Delay Time		0 2
		1	17.255
		Сору	Save

3. Define Profile and Assemblies



4. Define Data Units

Note: General Device Profile allowed only Counts for Pressure and Position. Default Range is 0-10'000 (Gain value 1). With the gain value this can be limited in a range of 0-1 (Gain value 0.0001) until 0-32767 (Gain value 3.2767)

Pressure (Only necessary to set if Profile is Process Control Device):

Parameters			- 🗆 X
Local 🎉 Remote 🔀 Features 🤅) Help		
parameters		values	
▲ System		Data Type	INT 🔹 📩
Access Mode Control Mode		Data Units	Counts 👻
 Identification Statistics 		Reading Valid	True
▷ Warning/Error		Value	1.438044 🤤
 Services Valve 		Exception Status	0 🗘
Position Control Prossure Control		Offset - A	0 🗘
Pressure Control Pressure Sensor		Gain	1 🗘
▲ Interface DeviceNet > Identity Object		Safe State	Zero 🔹
 DeviceNet Object 	=	Safe Value	0 \$
 Connection Object Discrete Input Point Object 		Subclass	6 🗘
Discrete Output Point Object		Sensor operation mode	S1 •
Selection object		Zero Enable	True
▲ S-Analog Sensor Object ▷ Class		Sensor Factor	1000 🗘
Pressure Sensor 1		Sensor Reading Selected	High Sensor 🔹
Control Valve Position		Sensor Crossover Mode	Soft Switch 🔹
 Services S-Analog Actuator Object 		Sensor Type	Torr 🔹
S-Single Stage Controller Object		- " -	
Pressure Controller Object	-		Save
Parameter Group: A43101		Valve: n.a.	

Set Gain value if a different range than 0-10'000 is requested (in case of Data Units is Counts).

Position (Only necessary to set if Profile is Process Control Device):

🕿 Parameters 🙀			- □ >
Local 🔑 Remote 🔀 Features 😧 I	Help		
arameters		values	
▲ System		Data Type	INT
Access Mode Control Mode		Data Units	Counts
 Identification Statistics 		Reading Valid	True
Warning/Error		Value	0
 Services Valve 		Exception Status	0
Position Control Brossura Control		Gain	1
Pressure Control Pressure Sensor		Safe State	Zero
▲ Interface DeviceNet ▷ Identity Object		Safe Value	0
DeviceNet Object Connection Object	-		
 Discrete Input Point Object 			
Discrete Output Point Object Selection Object			
Selection Object			
 S-Analog Sensor Object Class 			
 Pressure Sensor 1 			
 Pressure Sensor 2 Control Valve Position 			
Services			
S-Analog Actuator Object S-Single Stage Controller Object			
Songle Stage Controller Object Arassura Controllar Object	-		Save

Set Gain value if a different range than 0-10'000 is requested (in case of Data Units is Counts).

5. Restart valve to apply this settings

CPA - Control Performance An	alyzer						- 🗆 X
Local 🥬 Remote					Ver	sion 4.2.0 beta (Help
navigation	status information		control buttons	control panel		control panel	
Parameters	Valve Series	67.0	Open	Actual Position		Actual Pressure	
Information	Access Mode	Local	Close	-	0.2312139	-2.3	66955E-05 mbar
Pressure Control	Control Mode	Safety	Start Learn	Target Position	0 🐥	Target Pressure	0 🐥
Pressure Sensor	Controller Selector	Controller 1	Zero Adjust	100-	100	1,333224 -	1.333224
Adaptive Learn	Error Number	0	Restart	80 —	80	1,066579 —	1.066579
Adaptive Learn Data	Error Code	0	Pressure Sim	60 —	60	0.7999342	0 7999343
 Tools 						·	
Chart Analyzer			-status indication	40 —	40	0,5332895 —	0.5332895
Terminal	Valve Firmware Version	F01.0C.28.22	Open	20-	20	0,2666447	0.2666447
Sequencer			Closed				
Trace Log					U		0

The easiest way to execute a restart is by pressing restart button on the CPA 4 main window.

Connection Loss Reaction

Connection Loss reaction defines what the valve is doing in case the DeviceNet connection get lost.

Parameter	Description
Enable	<i>True</i> enables the connection loss reaction, in case of <i>False</i> there is no reaction on a connection loss (compatible IC1 Setting <i>keep Position</i>)
State	Current connection loss state

128 CPA IC2(USB) Manual

Functionality Defines the functionality in case of connection loss. This can be *open* or *close*.

2.5.3.4 Profile

In general two different profiles are supported. Generic Device (GD) is the older and more common profile which is developed by VAT. Process Control Device (PCD) is a profile which is defined by ODVA.

Comparison GD and PCD profile

Function	Generic Device	Process Control Device			
S-Analog Sensor Instances	PressurePosition	Sensor 1Sensor 2Position			
Data Units Pressure	CountsPercent	 Counts Percent Psi Torr mTorr Bar mBar Pa atm 			
Data Units Position	Counts	CountsPercentDegrees			
Set Point Type	Class 51, Instance 0, Attribute 8 Data Length 1 Byte Value: 0=pressure, 1=position	Class 46, Instance 1, Attribute 14 Data Length 2 Byte Value: 0=none,1=pressure, 2=position			
Poll Output Assembly	Class 5, Instance 2, Attribute 100	Class 5, Instance 0, Attribute 100			
Poll Input Assembly	Class 5, Instance 2, Attribute 101	Class 5, Instance 0, Attribute 101			
Bit Strobe Produce Assembly	-	Class 5, Instance 0, Attribute 102			
COS/Cyclic Produce Assembly	Class 5, Instance 4, Attribute 101	Class 5, Instance 0, Attribute 103			
Sensor Setup	Sensor Mode, Sensor Factor	Sensor Full Scale, Sensor Unit (or Sensor Mode, Sensor Factor)			
Learn	Service 100 in Class 51 Start with 0, Stop with 1	Service 99 in Class 51 Start with 1, Stop with 0			
Additional Attributes and Functions		 Alarm / Warning Bands Sensor Crossover Process Variable Source Control Direction 			

© VAT Group AG

Valve	Firmware	129

Firmware Download	No	Yes
Configuration and Read via Service Interface	No	 Sensor 1 Gain Sensor 2 Gain Position Gain Position Units Pressure Units Data Type Poll Input Poll Output Factory Reset Reset Exception Status Device Stats
Exception Detail	Device Exception Size: 5 Device Exception: Sensor Expt. Manufacturer Byte#5: FE Value	Device Exception Size: 4 Device Exception: not used Manufacturer Byte#5: FE Bits

Cyclic Communication (Assenblies)

PCD: Each Data Type has an assembly number GD: Each assembly supports both data types

			GD			PCD			
Arrangement	Туре		Integer	Integer Float		teger	Float		
		Nr	Length	Length	Nr	Length	Nr	Length	
PRESSURE	Input	-	-	-	1	2	17	4	
EXCEPTION STATUS PRESSURE	Input	-	-	-	2	3	18	5	
EXCEPTION STATUS PRESSURE POSITION	Input	3	5	9	3	5	19	9	
EXCEPTION STATUS PRESSURE SETPOINT	Input	4	5	9	4	5	20	9	
EXCEPTION STATUS PRESSURE SETPOINT POSITION	Input	5	7	13	5	7	21	13	
EXCEPTION STATUS PRESSURE SETPOINT CONTROL MODE POSITION	Input	-	-	-	6	8	22	14	
SETPOINT SETPOINT TYPE	Output	7	3	5	7	4	23	6	
CONTROL MODE SETPOINT SETPOINT TYPE	Output	8	4	6	8	5	24	7	
EXCEPTION STATUS	Input	-	-	-	10	1	-	-	
EXCEPTION STATUS PRESSURE POSITION CLOSE/OPEN CHECK	Input	-	-	-	11	6	26	10	
CONTROL MODE SETPOINT KP (Gain Faktor) KI (Sensor Delay) KD (Ramp Time or Ramp Slope)	Output	-	-	-	-	-	32	17	
EXCEPTION STATUS PRESSURE POSITION DEVICE STATUS 2 ACCESSMODE	Input	100	7	11	100	7	105	11	
EXCEPTION STATUS PRESSURE POSITION CLOSE/OPEN CHECK DEVICE STATUS 2	Input	-	-	-	101	7	-	-	
CONTROL MODE SETPOINT SETPOINT TYPE LEARN LEARN PRESSURE LIMIT ZERO	Output	102	8	12	102	9	107	13	
CONTROL MODE SETPOINT SETPOINT TYPE CLUSTER ADDRESS CLUSTER ACTION	Output	-	-	-	103	7	108	9	
EXCEPTION STATUS PRESSURE SENSOR 2 READING POSITION ACCESS MODE DEVICE STATUS 2 CLUSTER INFOMATION	Input	104	Min 9 Max 24	Min 15 Max 29	104	Min 9 Max 24	109	Min 15 Max 2	
EXCEPTION STATUS									
PRESSURE PASTION SETPOINT DEVICE STATUS 2	Input	-	-	-	106	8	-	-	

CONTROL MODE

Acyclic Communication

Generic Device

Explicit messaging control commands

Command (DeviceNet [®] term	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field				
if deviant)		Description									
	6	5	48	1	3						
	This co	mmand	l changes the	valve to execu	ting state.						
EXECUTING	Note: E as cont	Note: EXECUTING must to be selected to enable for all executing commands such as control mode, close valve and open valve.									
	Note: If	valve is	already in exe	ecuting state a	nd anew EXE	CUTING comm	nand is sent				
	Device	Net [®] wi	ll return an err	or message.							
	-	7	48	1	3						
IDLE	This co	mmand	l changes the	valve to idle st	ate.						
	ų	5	1	1	0						
RESET	This command resets the DeviceNet [®] interface.										
	Ę	5	1	1	1						
FACTORY RESET	This co Note: A	This command resets the DeviceNet [®] interface to factory default settings. Note: All previously done configurations will be overwritten.									
	Set	16	51	0	8	1	Y				
	Get	14	51	0	8	1					
	Y:	0	pressure c	ontrol							
SETPOINT TYPE		1	position co	ntrol							
	This command selects / returns current setpoint type. It toggles valve operation mode between position and pressure control.						peration				
	Note:T selecte	o perfor d.	m either posit	ion or pressur	e control also	correct MODE	mustbe				
MODE	Set	16	51	1 (pressure) 2 (position)	5	1	Y				
(control mode)	Get	14	51	1 (pressure) 2 (position)	5	1					

Y: 0	control mode (pressure resp. position control)			
1	close valve (valve will close)			
2	open valve (valve will open)			
3	hold (stops the valve at the current position)			
4	safe state			
This command preselects / returns the mode for pressure resp. position control. By neans of instance ID either pressure or position must be addressed.				
Note: To activate SETPOINT TYP	e: To activate either pressure or position control you must select correct IPOINT TYPE separately.			
This command means of instar Note: To activate SETPOINT TYP	preselects / returns the mode for pressure resp. position connee ID either pressure or position must be addressed. e either pressure or position control you must select correct E separately.			

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal
values are indicated by the letter ,h' (e.g. 31h)

Command (DeviceNet [®] term	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field		
` if deviant)		Description							
	Set	16	51	2	6	2 or 4	Y		
	Get	14	51	2	6	2 or 4			
POSITION SETPOINT Y: position setpoint according to selected DATA (open) This command transfers/reads the position setpoint to						YPE, 0 (closed) from the valve.	ל) 10'000		
	Set	16	51	1	6	2 or 4	Y		
	Get	14	51	1	6	2 or 4			
PRESSURE SETPOINT	 Y: pressure setpoint according to selected DATA TYPE, nominal pressure range is 0 10'000 (sensor full scale) but it may scaled, refer also to command GAIN for details. This command transfers/reads the pressure setpoint to/from the valve. 						t it may be e.		
	Set	16	4	7 8 102	3	x	Y		
ASSEMBLY OBJECTS	Get	14	4	3 4 5 13 14 100 101	3	х			

X, Y: depending on respective assembly object, refer to «Assembly objects» for details.
Instance ID = assembly object number.
This command writes/reads the respective assembly object.

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ,h' (e.g. 31h)

..1 Explicit messaging inquiry commands

Command (DeviceNet [®] term	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field			
if deviant)				Descr	iption					
	Get	14	8	1	3	1				
VALVE CLOSED	This command returns:									
CHECK (discrete input 1)	0 valve is not closed									
(1	valve is clo	osed						
	Get	14	8	2	3	1				
VALVE	This co	This command returns:								
OPEN CHECK (discrete input 2)		0 valve is not open								
		1 valve is open								
POSITION	Get	14	49	3	6	2 or 4				
	This command returns the current valve position according to selected DATA TYPE. Position range is 0 (closed) 10'000 (open).									
	Get	14	49	1	6	2 or 4				
PRESSURE	This command returns the actual pressure according to selected DATA TYPE. Nominal pressure range is 0 10'000 (sensor full scale) but it may be scaled. Refer also to command GAIN and picture on the following page for details.									
	Get	14	100	1	108	2 or 4				
SENSOR 1 READING	This function returns direct reading from sensor 1 according to selected DATA TYPE. Nominal range is 0 10'000 but it may be scaled. Refer also to command GAIN and picture on the following page for details.									
	Get	14	100	1	109	2 or 4				
SENSOR 2 READING	This fu TYPE. I GAIN a	Get 14 100 1 109 2 of 4 This function returns direct reading from sensor 2 according to selected DATA TYPE. Nominal range is 0 10'000 but it may be scaled. Refer also to command GAIN and picture on the following page for details.								

Valve Firmware	135
----------------	-----

	Cot 11		49	1	12	0 == 4		
SENSOR 1 OFFSET VALUE (Sensor 1 offset A)	Gel	14	100	1	110	2 OF 4		
	These accord Value r	These commands return the offset voltage (adjusted by ZERO) of the sensor 1 according to selected DATA TYPE. Both commands are identical. Value range is -1400 +1400 (-1.40V +1.40V).						
	Get	14	100	1	111	2 or 4		
SENSOR 2 OFFSET This command returns the offset voltage (adjusted by ZERO) of the sensor 2 according to selected DATA TYPE. (Sensor 2 offset A) Value range is -1400 +1400 (-1.40V +1.40V).								

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)



Example of PRESSURE and SENSOR READING allocation:

Command (DeviceNet [®] term	Service Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field
---	--------------	----------	-------------	--------------	---	-----------------------

				Descri	ption						
	Get 14 51 1 106 2										
	This co coded.	mmand	returns the s	tatus of the LE	ARN procedu	re. The status	is binary				
		Bit	Explanatio	Explanation:							
	(L	SB) 0	0 = LEARN 1 = LEARN	0 = LEARN not running 1 = LEARN running							
		1	0 = LEARN 1 = LEARN	data set pres data set not p	ent resent						
	2 0 = ok 1 = LEARN terminated by user										
	3 0 = ok 1 = pressure in position OPEN > 50% sensor full scale (of high range sensor in case of										
		system) or									
		4	0 = ok 1 = pressure in position 0								
LEARN STATUS	< 10% sensor full scale (of low range sensor in case of a 2 s										
(calibration state)	system)										
		0	1 = pressu	1 = pressure falling during LEARN							
	6 0 = ok 1 = sensor not stable during LEARN										
		7	reserved	reserved							
		8	reserved	reserved							
		9	reserved	reserved							
		10	0 = ok 1 = LEARN	0 = ok 1 = LEARN terminated by controller							
		11	0 = ok 1 = pressu	re in position (OPEN negativ						
		12	reserved								
		13	reserved								
		14	reserved								
		15	reserved								
	(M	SB) 16	reserved								

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

					Valve Firmware 13					
Command (DeviceNet® term if deviant)	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field			
				Descr	iption					
	Get	14	48	1	11	1	Y			
	Y:	1	selftest							
		2	idle							
DEVICE STATUS 1		3	selftestex	ception						
		4	executing							
		5	abort							
	This command returns the device status.									
	Get	14	100	1	103	1				
	This command returns the device status.									
DEVICE STATUS 2	CLOSE	 0 = initialization, 1 = synchronization, 2 = POSITION CONTROL, 3 = CLOSED 4 = OPEN, 5 = PRESSURE CONTROL, 6 = HOLD, 7 = LEARN 12 = power failure, 13 = safety mode 14 = fatal error (read EXCEPTION DETAIL ALARM for details) 								
	Get	14	48	1	12	1				
EXCEPTION STATUS (status)	(MSB) (MSB) The exa In orde EXCEP	Bit Bit 0 1 2 3 4 5 6) 7 ception s r to find PTION D	I returns the e Explanation 0 (reserved 0 (reserved This bit is s 0 (reserved 0 (reserved 0 (reserved 0 (reserved This bit is s 1 status byte on out which alan ETAIL ALARM	xception status n: l) set to 1 in case l) l) set to 1 in case ly indicates that m or warning resp. EXCEP	s. e of a manufac e of a manufac at alarms or w is present, yo FION DETAIL \	cturer specific a cturer specific v arnings are pre u must read WARNING.	ılarm. varning. esent.			
EXCEPTION DETAIL ALARM	Get	14	48	1	13 14	15				

138	CPA IC2(USB)	Manual

With Attribute ID = 13 EXCEPTION DETAIL ALARM bytes will be returned.
With Attribute ID = 14 EXCEPTION DETAIL WARNING bytes will be returned.
For meaning see table on next page.

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ,h' (e.g. 31h)

Command (DeviceNet [®] term	Service Coo	le Cla	ass ID	Instance	e ID Att	tribute ID	Service data length (number of bytes) Service data fie		Service data field			
if deviant)	Description											
	Table with EX 0 1	KCEPTIC OK Exc	N DETAI eption / F	L ALARM	resp. EX ror (exce	CEPTION E pt for detail	DETAIL W size byte	ARNII s)	NG bits.			
	Data Component	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0			
	PCV Common Exception Detail Size	0	0	0	0	0	0	1	0			
	PCV Common Exception Detail Byte #0	0	0	0	0	0	0	0	0			
	PCV Common Exception Detail Byte #1	0	0	0	0	0	0	0	0			
	PCV Device Exception Detail Size	0	0	0	0	0	1	0	0			
EXCEPTION DETAIL	PCV Device Exception Detail Byte #0	0	0	0	0	0	0	0	0			
	PCV Device Exception Detail Byte #1	0	0	0	0	0	0	0	0			
WARNING	PCV Device Exception Detail Byte #2	0	0	0	0	0	0	0	0			
	PCV Device Exception Detail Byte #3	0	0	0	0	0	0	0	0			
	Manufacturer Exception Detail Size	0	0	0	0	0	1	1	0			
	Manufacturer Exception Detail Byte #1	Reserved	Reserved	Isolation valve position failure	Sensor ratio exceeded	PFO not ready	Compressed air failure	Learn data set invalid	Service request			
	Manufacturer Exception Detail Byte #2	Reserved	Reserved	Reserved	Reserved	Reserved	ADC not responding	Reserve d	Reserved			
	Manufacturer Exception Detail Byte #3	Reserved	Reserved	Reserved	Wrong controller mode	Local mode	ZERO disabled	Optiona hardwar e missing	No sensor			
	Manufacturer Exception Detail Byte #4	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PFO off	Simulation active			
	Manufacturer Exception Detail Byte #5	Reserved	Reserved	Reserved	Reserved	E40 1)	E22 1)	E21 1)	E20 1)			

are 139

Ma Ext By	Manufacturer Exception Detail Byte #6	Reserved	Reserved	Reserved	Reserved	Setpoint invalid (safe state)	IO data missing (safe state)	Setpoint type invalid (safe state)	Control mode invalid (safe state)
-----------------	---	----------	----------	----------	----------	----------------------------------	------------------------------------	--	---

1) Refer to «Trouble shooting» for details on these fatal errors.

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter h' (e.g. 31h)

Command (DeviceNet® term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field		
,	Description								
	Get	14	100	1	101	4			
THROTTLE CYCLE COUNTER	This cc integer counts is achie	ommanc . A move as one eved.	l returns the n ement from m cycle. Partial r	umber of throt ax. throttle pos movements wi	tle cycles. Dat ition to open t ill be added up	a type is unsig back to max. th b until equivale	ned long rottle position nt movement		
	Get	14	100	1	106	4			
ISOLATION CYCLE COUNTER	This command returns the number of isolation cycles. Data type is unsigned long integer. Each closing of the sealing ring counts as one cycle.								

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the lette, h' (e.g. 31h)

Explicit messaging setup commands

Command (DeviceNet [®] term	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field			
if deviant)	Description									
	Set	16	49	1	3	1	Х			
	Get	14	49	1	3	1				
	X:	195	integer							
DATATIPE	202 floating point									
	This co and PC	ommanc OSITION	l defines the d	lata type for PF	RESSURE, SE	NSOR READI	NG, OFFSET			
CAIN	Set	16	49	1	14	4	Х			
GAIN	Get	14	49	1	14	4				

CPA IC2(USB) M	lanual							
	X: gain, max. value is 3.2767 , data type is floating point This command selects the gain for PRESSURE and allows for scaling. Default value is 3.2767 . e.g.: Gain = 0.1 pressure value range results in 0-1'000 Gain = 1 pressure value range results in 0-10'000 Gain = 3.2767 pressure value range results in 0-32'767							
	Set	16	5	2	100	1	Х	
	Get	14	5	2	100	1		
POLL OUTPUT	X:output assembly object number (7, 8, 102)This command configures resp. reads the output assembly for poll connection.							
	Set	16	5	2	101	1	Х	
	Get	14	5	2	101	1		
POLL INPUT	X: input assembly object number (3 , 4 , 5 , 13 , 14 , 100 , 101) This command configures resp. reads the input assembly for polling.							
BIT STROBE INPUT	Not im	olement	ed					
	Set	16	5	4	101	1	Х	
	Get	14	5	4	101	1		
CHANGE OF STATE / CYCLING INPUT	Get 14 5 4 101 1 X: input assembly object number (3, 4, 5, 13, 14, 100, 101) This command configures resp. reads the input assembly for change of state / cycling.							

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ,h' (e.g. 31h)

Command (DeviceNet [®] term if deviant)	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field	
	Set	16	100	1	107	1	Х	
	Get	14	100	1	107	1		
	X:	0	Local (operation via service port)					
ACCESS MODE		1	Remote (operation via DeviceNet [®])					
		2	Locked (in	remote mode)			
	This command controls / returns the access mode of the valve.							
POWER UP CONFIGURATION	Set	16	100	1	112	1	х	
	Get	14	100	1	112	1		

	X:	0	closed				
		1	open				
	This co	mmanc	l controls / retu	urns the valve	position after p	oower up.	
POWER FAIL CONFIGURATION	Set	16	100	1	113	1	Х
	Get	14	100	1	113	1	
	X:	0	closed				
		1	open				
	This co Onlyfor 612	mmanc versior	l controls / retuns that have Po].	urns the target ower Fail Optic	valve position on equipped [6	in case of a p 612 C	ower failure. or

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ,h' (e.g. 31h)

Command (DeviceNet [®] term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field	
	Set	16	49	1	101	1	Х	
	Get	14	49	1	101	1		
	X:	0	no sensor	-				
		1	1 sensor o	peration (sens	sor 1 input)			
		2	2 sensor operation with automatic changeover (low range = sensor 2 input, high range = sensor 1 input					
		3						
SENSOR MODE 4 2 sensor operation with automatic char (low range = sensor 1 input, high range						utomatic changeover put, high range = sensor 2 input)		
	This command controls / returns the sensor mode for pressure control.							
	Note: Sensor modes 2, 3 and 4 are possible with 2 sensor hardware [612 QQ] only.							
	Note: For applications where the high range sensor is used for for monitoring purpose only, select sensor operation modes 1 or 3 for pressure control with low range sensor and read high range sensor from SENSOR 1 READING resp. SENSOR 2 READING.							
	Set	16	49	1	103	2 or 4	Х	
	Get	14	49	1	103	2 or 4		
SENSOR RATIO	X: sensor ratio according to selected DATA TYPE, range is 100 10'000							
	This command defines the sensor ratio for 2 sensor operation. Sensor ratio = high range sensor full scale / low range sensor full scale * 100.							
ZERO CONTROL	Set	16	49	1	102	1	Х	

	Get	14	49	1	102	1				
	X:	0	Disable							
		1	Enable							
	This co ZERO o	mmanc loes no	l enables resp t work.	o. disables the	ZERO comm	and. In case it	is disabled			
	7	5	49	1						
ZERO	This command initiates ZERO. Note: Refer to «ZERO (setup step 4)» for correct zero procedure.									

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

Command (DeviceNet [®] term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field		
	Set	16	51	1	100	2 or 4	Y		
	Get	14	51	1	100				
LEARN PRESSURE LIMIT (calibration scale)	 Y: learn pressure limit according to selected DATA TYPE, nominal pressure range is 0 10'000 (sensor full scale) but it may be scaled, refer also to command GAIN for details. This command transfers/reads the pressure limit for LEARN. Note: Refer to «LEARN (setup step 5)» for correct learn pressure limit setting. 								
	100		51	1	0				
LEARN (calibration service)	This command starts LEARN. With MODE commands open valve or close valve the routine may be interrupted. Note: Without LEARN the PID controller is not able to perform pressure control. Refer to «LEARN (setup step 5)» for correct learn gas flow and procedure.								
	5	1	48	1		11	XY		
DOWNLOAD LEARN DATA	X: Y Examp This co a total r	index e.g. 00 8 data le of XY: ommand number	(000 103 , wi 00 = 30h 30h 3 h bytes ASCII c 30h 30h 30h l loads the lea of 104 data se	nereas these i 30h, 001 = 30h oded (e.g. 30h 30h 32h 33h 3 Irn data sets fr ets. Each data	ndices must t n 30h 31h, etc n 32h 33h 33h 33h 33h 30h 3 rom the host d set needs to	oe ASCII coded .) 33h 30h 33h 3h 36h (11 byt own to the valv be downloade	l, 36h) es in total) /e. There are d separately.		
UPLOAD	5	0	48	1		3	х		

X:	index (000 103 , whereas these indices must be ASCII coded, e.g. 000 = 30h 30h 30h, 001 = 30h 30h 31h, etc.)
Th tot co 8 d	his command loads the learn data sets from the valve up to the host. There are a tal number of 104 data sets which need to be uploaded separately. Each answer onsists of 11 bytes. Whereas the leading 3 bytes are the data set index followed by data bytes. Data are ASCII coded.

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

Command (DeviceNet [®] term if deviant)	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field	
	Set	16	51	1	105	1	Х	
	Get	14	51	1	105	1		
PID CONTROLLER GAIN FACTOR	ROLLER CTOR $X:$ $0 = 0.10, 1 = 0.13, 2 = 0.18, 3 = 0.23, 4 = 0.32, 5 = 0.42, 6 = 0.567 = 0.75, 8 = 1.00, 9 = 1.33, 10 = 1.78, 11 = 2.37, 12 = 3.16, 13 = 14 = 5.62, 15 = 7.50, 16 = 0.0001, 17 = 0.0003, 18 = 0.001, 19 = 20 = 0.01, 21 = 0.02, 22 = 0.05This command selects/returns the gain factor for the PID controller.Note: Refer to «Gain factor adjustment» for details.$						6 = 4.22 = 0.003,	
	Set	16	51	1	107	1	Х	
	Get	14	51	1	107	1		
PID CONTROLLER SENSOR DELAY	 X: 0 = 0, 1 = 0.02, 2 = 0.04, 3 = 0.06, 4 = 0.08, 5 = 0.10, 6 = 0.15 7 = 0.20, 8 = 0.25, 9 = 0.30, 10 = 0.35, 11 = 0.4, 12 = 0.5, 13 = 0.6 14 = 0.8, 15 = 1.0 This command selects/returns the sensor delay for the PID controller. Note: Refer to «Sensor delay adjustment» for details. 							
	Set	16	51	1	108	1	Х	
	Get	14	51	1	108	1		
PID CONTROLLER SETPOINT RAMP	X: $0 = 0, 1 = 0.5, 2 = 1.0, 3 = 1.5, 4 = 2.0, 5 = 2.5, 6 = 3.0$ 7 = 3.5, 8 = 4.0, 9 = 4.5, 10 = 5.0, 11 = 5.5, 12 = 6.0, 13 = 6.5 14 = 7.0, 15 = 7.5, 16 = 8.0, 17 = 8.5, 18 = 9.0, 19 = 9.5, 20 = 10.0 This command selects/returns the setpoint ramp for the PID controller. Note: Refer to «Setpoint ramp adjustment» for details.							
	Set	16	51	2	101	2	Х	
VALVE OFEED	Get	14	51	2	101	2		

X: valve speed, 1 1000 (1 = min. speed, 1000 = max. speed),
This command selects/returns the actuating speed for the valve plate. Data type is unsigned integer. Speed selection is effective for pressure control and position control. Open valve and close valve are always done with max. speed.
Note: Refer to «Valve speed adjustment» for details.

Note: Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter 'h' (e.g. 31h)

Process Control Device

Connection Object (Class ID 5)

Command	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field			
		Description								
	Set	16	5	0	100	1	Х			
	Get	14	5	0	100	Ι				
POLL OUTPUT	X: objects	X: output assembly object number (default 8) (refer to list of assembly objects)								
	This co assem	ommano bly for p	l sets the outp oll connectior	out assembly r n. Host to valve	esp. reads the	e currently activ	e output			
	Note: F	POLL OL	JTPUT must h	ave always th	e same DATA	TYPE as POLI	_ INPUT.			
	Set	16	5	0	101	1	Х			
	Get	14	0	, , , , , , , , , , , , , , , , , , ,						
	X: input assembly object number (default 3) (refer to list of assembly objects)									
POLL INPUT	This command sets the input assembly resp. reads the currently active input assembly for poll connection for poll connection. Valve to Host									
	Note: POLL INPUT must have always the same DATA TYPE as POLL OUTPUT.									
	Set	16	E	0	102	4	х			
	Get	14	5	0	102	Ι				
	X:	inputa	assemblyobje	ect number (re	fer to list of as	semblyobject	s)			
	This co	ommano	l configures re	esp. reads the	input assemb	oly for bit strobe	e connection.			
CHANGE OF STATE /	Set	16	E	0	102	1	Х			
CYCLING INPUT	Get	14	Э	U	103	1				
X: output assembly object number (refer to list of assembly objects)										
--										
This command configures resp. reads the output assembly for change of state / cycling.										

Discrete Input Object (Class ID 8)

Command	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field			
	Description									
VALVE CLOSED CHECK	Get	14	8	1	3	1	Х			
	This co	This command returns:								
		0	0 valve is not closed							
	1 valve is closed									
					I					
	Get	14	8	2	3	1				
	This co	mmand	l returns:							
VALVE OPEN CHECK		0	valve is not	topen						
OF LN CHECK		1	valve is open							

Selection Object (Class ID 46)

Command	Service Code		Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field		
	Description								
	Set	16	40	1	14	2	Х		
	Get	14	40						
	X:	0	none						
		1	pressure c	ontrol					
SETPOINT TYPE		2	position co	ntrol					
	This command selects / returns current setpoint type. It toggles valve operation mode between position and pressure control.								
	Note: To perform either position or pressure control also correct CONTROL MODE must be selected.								

S-Device Supervisor Object (Class ID 48)

146	CPA IC2(USB) Ma	nual	al								
	Command	Service Code		Class ID		Instance IE	D Attribut	te ID	Ser data (num by	vice length ber of tes)	Service data field
		Description									
		6			48	1	-			3	Х
	EXECUTING	This com Note: EX such as Note: If w sent Dev	Note: EXECUTING must to be selected to enable for all executing commands such as control mode, close valve and open valve. Note: If valve is already in executing state and anew EXECUTING command i sent DeviceNet® will return an error message.								
		7			48	1	1 3			-	-
	IDLE	This com	ommand changes the valve to idle state.								
		Get	14		48	1	11			1	Х
		X:	1	self	test						
			2 idle								
	DEVICE STATUS		3 self test exception								
			4	exec	uting						
			5	abor	t						
		This command returns the device status.									
		Get	14		48	1	12			1	
	EXCEPTION STATUS	The exce details s EXCEPT	ption s ee ION DE	tatus b	oyte only i	indicates that	at alarms o	r warr IL WA	nings RNIN	are pre G.	sent. For
		Bit 7	Bi	t 6	Bit 5	Bit 4	Bit 3	Bi	t 2	Bit 1	Bit 0
			Manuf spe war	acturer cific ning	reserved	reserved	reserved	Manufa specifio	acturer c alarm	reserved	reserved

Command	Servic	Service Code		ass ID	Instance	e ID At	tribute ID	Service data length (number of bytes)		Service data field	
					Desc	ription					
EXCEPTION DETAIL	Get	Get 14 Table with EX		48	1 -		3 (alarm) (warning)	15			
ALARM	Table w			able with EXCEPTION DETAIL ALARM resp. EXCEPTION DETAIL							
EXCEPTION DETAIL WARNING	0		 0 OK 1 Exception / Failure / Error (except for detail size bytes) 								
	Dat Compo	a nent	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	
	PCV Common Exception Detail Size PCV Common Exception Detail Byte #0		0	0	0	0	0	0	1	0	
			0	0	0	0	0	0	0	0	
	PCV Common Exception Detail Byte #1		0	0	0	0	0	0	0	0	
	PCV Device Exception Detail Size		0	0	0	0	0	1	0	0	
	PCV Device Exception Detail Byte #0		0	0	0	0	0	0	0	0	
	PCV Device Exception D Byte #1	etail	0	0	0	0	0	0	0	0	
	PCV Device Exception D Byte #2	etail	0	0	0	0	0	0	0	0	
	PCV Device Exception D Byte #3	etail	0	0	0	0	0	0	0	0	
	Manufacture Exception D Size	er etail	0	0	0	0	0	1	1	0	
	Manufacture Exception D Byte #1	er etail	Reserved	Reserved	Isolation valve position failure	Sensor rati exceeded	⁰ PFO not ready	Compressed air failure	Learn data set invalid	Service request	
	Manufacture Exception D Byte #2	er etail	Reserved	Reserved	Reserved	Reserved	Reserved	ADC not responding	Reserv ed	Reserved	
	Manufacturer Exception Detail Byte #3 Manufacturer Exception Detail Byte #4		Reserved	Reserved	Reserved	Wrong Controller Mode	Wrong Access Mode	ZERO disabled	Option al hardwa re missin g	No sensor	
			Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	PFO off	Simulation active	
	Manufacture Exception D Byte #5	er etail	Reserved	Reserved	Reserved	Reserved	E40	E22	E21	E20	
	Manufacture Exception D Byte #6	er etail	Reserved	Reserved	Reserved	Valve powe OFF or internal cor error	r Setpoint invalio n. (safe state)	IO data missing (safe state)	Setpoin t type invalid (safe state)	Control mode invalid (safe state)	

Command	Service Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field				
	Description									
	50	48	1	-	11	XY				
UPLOAD LEARN DATA	 X: index (000 103, whereas these indices must be ASCII coded, e.g. 000 = 30h 30h 30h, 001 = 30h 30h 31h, etc.) This command loads the learn data sets from the valve up to the host. There are total number of 104 data sets which need to be uploaded separately. Each answer consists of 11 bytes. Whereas the leading 3 bytes are the data set index followed by 8 data bytes. Data are ASCII coded. 									
	51	48	1	12	1					
DOWNLOAD LEARN DATA	X: index (e.g. 00 Y 8 data Example of XY: This command a total number of	000 103 , wh 10 = 30h 30h 3 bytes ASCII co 30h 30h 30h 3 loads the lea of 104 data se	nereas these in 30h, 001 = 30h 50ded (e.g. 30h 30h 32h 33h 3 30h 32h 33h 3 an data sets fro	ndices must b 30h 31h, etc. 32h 33h 33h 3h 33h 30h 3 om the host do set needs to b	e ASCII codec) 33h 30h 33h 3 3h 36h (11 byt own to the valv be downloaded	l, 36h) es in total) ⁄e. There are d separately.				
	52	48	1	-	6	Х				
SYNCHRONIZATION	X: C:8202 (string) synchronize valve This tunnel command starts the synchronization of the valve.									

S-Analog Sensor Object (Class ID 49)

Command	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field		
	Description								
DATA TYPE	Set	16	40	1	2	4	Х		
	Get	14	49		3				

Valve Firmware

Command	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field		
				Descri	ption				
	X:	195	signed inte	ger					
		202	floating poi	nt					
	This co POSITI VALUE Default	ommand ON, POS , SENS(cvalue is	I defines the d SITION SETPO DR 2 READINO 3 195.	lata type for PF DINT, SENSOF G, SENSOR 2	RESSURE, PR R 1 READING, OFFSET VALU	ESSURE SET SENOR 1 OF JE, SENSOR I	TPOINT, FSET LEARN LIMIT		
	Set	16	49	1	4	2	Х		
	Get	14	40	I	- T	2			
	X:	4097	counts						
PRESSURE UNITS		4103	percent						
		4864	psi						
		4865	Torr						
		4866	mTorr						
		4871	bar						
		4872	mbar						
		4873	Pascal						
	48/5 atm This command selects the unit for the pressure								
	Default value is 4097.								
	Set	16	10	0			Х		
	Get	14	49	3	4	2			
	X:	4097	counts						
POSITION UNITS		4103	percent						
		5891	degrees						
	This co Default	mmand value is	l selects the u s 4097	nit for the pos	itions.				
	Get	14	49	1 (Sensor 1) 2 (Sensor 2)	6	2 int 4 float			
SENSOR READING	This fui Nomina and pic	This function returns direct reading from sensor according to selected DATA TYPE. Nominal range is 0 10'000 but it may be scaled. Refer also to command GAIN and picture on the following page for details.							
POSITION READING	Get	14	49	3	6	2 int 4 float			

150 CPA IC2(USB) Manual

Command	Service CodeClass IDInstance IDAttribute IDService data length (number of bytes)Service data field							
	Description							
	This command Position range	l returns the c is 0 (closed)	urrent valve po 10'000 (ope	osition accordi en).	ng to selected	DATA TYPE.		

Command	Servic	Service Code		ss ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field	
	Get	14	4	19	1 (Sensor 1) 2 (Sensor 2)	1 (Sensor 1) 2 (Sensor 2) 12			
SENSOR OFFSET VALUE These commands return the offset voltage (adjusted by ZERO) of the sense according to selected DATA TYPE. Nominal range is -1400 +1400 but it may be scaled. Refer also to comm GAIN and picture on the following page for details.							sensor 1 command		
	Set	16	49		1 (Sensor 1)		2 int		
	Get	14			2 (Sensor 2) 3 (Position)	14	specified by attribute 3	Х	
SENSOR GAIN	X: This counts The gai "counts Default e.g.:	X: gain, max. value is 3.2767 , data type is floating point This command selects the gain for PRESSURE/POSITION and allows for scaling. The gain pressure can only be used if the PRESSURE/POSITION UNITS is "counts". Default value is 1 (E8 03h).							
	Gain			Pressure/Position value		X(float)		X(int)	
	0.1			1'000		3Dh CCh Co	Ch CCh	E8 03	
	1.0			10'000		3Fh 80h 00h	n 00h	10 27	
	3.2767	3.2767				40h 51h B5ł	n 73h	FF 7F	
SENSOR TYPE	Set	16	4	19	1 (Sensor 1) 2 (Sensor 2)	198	1	х	
	Get	14			2 (0611301 2)				

	X:	0	Pa					
		1	bar					
		2	mbar					
		3	ubar	ubar				
		4	Torr	Torr				
		5	mTorr					
		6	atm					
		7	psi					
		8	psf					
	This co	mmand	sets the unit o	fsensors.				
	Set	16		1 (Sensor 1)	100			
	Get	14	49	2 (Sensor 2)	199	4	Х	
SENSOR FULL SCALE	X:	0	sensor not in use					
·	This co	11000000 sensor full scale This command sets the full scale of sensors.						

Command	Service Code		ervice Code Class ID		Attribute ID	Service data length (number of bytes)	Service data field		
	Description								
	Set	16	40	4	102	1	х		
	Get	14	49	I					
ZERO CONTROL	X: 0		Disable						
		1	Enable	Enable					
	This command enables resp. disables the ZERO command. In case it is ZERO does not work.						is disabled		
	7	5	49	1	-	-	-		
ZERO	This command initiates ZERO. Note: Refer to «ZERO (setup step 4)» for correct zero procedure.								

	valve Firmware 153								
	Attribute ID	Service data length (number of bytes)	Service data field						
i	ption								

S-Singel Stage Con	troller Object	(Class ID 51)

Command	Service Code		Service Code Class ID Instance ID		Attribute ID	data length (number of bytes)	data field				
				Descri	ption						
	Set	16	54	1 (pressure)	0	2 int	Y				
	Get	14	51	2 (position)	6	4 float					
	Y: (open)	Y: position setpoint according to selected DATA TYPE, 0 (closed) 10'000 (open)									
CONTROL SETPOINT	or	or									
	Y: scaled	Y: pressure setpoint according to selected DATA TYPE, nominal pressure range is 0 10'000 (sensor full scale) but it may be scaled,									
	This command transfers/reads the position/pressure setpoint to/from the valve.										
	Set	16	51	1 (pressure)	17	1 int	Y				
	Get	14	51	2 (position)	17	1 111					
	Y:	0	close (defa	ult)							
		1 open									
SAFE STATE	2 hold value (valve changes to Control Mode HOLD)										
	3 use SAFE VALUE (valve moves to a position, refer to SAFE VALUE)										
	This command specifies the control behavior for states others than execute.										
	Set	16	51	1 (pressure)	18	2 int	Y				
	Get	14		2 (position)		4 float					
	Y:	positio	on value acco	rding to select	ed DATA TYPE	Ξ					
SAFE VALUE		(refer	to CONTROL	SET POINT fo	r data format)						
	This co Two dif	mmanc ferent p	l defines the p ositions can b	oosition where be defined.	the valve mov	es to when in	safe state.				
	Get	14	51	1	7	2 int 4 float					
PRESSURE	This co Nomina Refer a	mmanc al press Ilso to co	l returns the a ure range is (ommand GAN	ctual pressure 0 … 10'000 (se N and picture c	e according to ensor full scal on the followin	selected DAT e) but it may b g page for det	A TYPE. e scaled. ails.				

Command	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field		
				Description					
	Set	16	51	0	101	0	Х		
	Get	14	51	2	101	Z			
VALVE SPEED	X: valve speed, 1 1000 (1 = min. speed, 1000 = max. speed), This command selects/returns the actuating speed for the valve plate. Data type is unsigned integer. Speed selection is effective for pressure control and position control. Open valve and close valve are always done with max. speed. Note: Refer to «Valve speed adjustment» for details.								
	Set	16	51	1	105	1	Х		
PID CONTROLLER GAIN FACTOR	Get 14 X: $0 = 0.10, 1 = 0.13, 2 = 0.18, 3 = 0.23, 4 = 0.32, 5 = 0.42, 6 = 0$ $7 = 0.75, 8 = 1.00, 9 = 1.33, 10 = 1.78, 11 = 2.37, 12 = 3.16, 1$ $14 = 5.62, 15 = 7.50, 16 = 0.0001, 17 = 0.0003, 18 = 0.001, 1$ $20 = 0.01, 21 = 0.02, 22 = 0.05$ This command selects/returns the gain factor for the PID controller. Note: Refer to «Gain factor adjustment» for details.						i6 = 4.22) = 0.003,		
	Set	16	51	1	107	1	Х		
	Get	14							
PID CONTROLLER SENSOR DELAY	 X: 0 = 0, 1 = 0.02, 2 = 0.04, 3 = 0.06, 4 = 0.08, 5 = 0.10, 6 = 0.15 7 = 0.20, 8 = 0.25, 9 = 0.30, 10 = 0.35, 11 = 0.4, 12 = 0.5, 13 = 0.6 14 = 0.8, 15 = 1.0 This command selects/returns the sensor delay for the PID controller. 								
	Note: Refer to «Sensor delay adjustment» fo details.								
	Set	16	51	1	108	1	Х		
	Get	14	51	I	100	I			
PID CONTROLLER SETPOINT RAMP	X: $0 = 0, 1 = 0.5, 2 = 1.0, 3 = 1.5, 4 = 2.0, 5 = 2.5, 6 = 3.0$ 7 = 3.5, 8 = 4.0, 9 = 4.5, 10 = 5.0, 11 = 5.5, 12 = 6.0, 13 = 6.5 14 = 7.0, 15 = 7.5, 16 = 8.0, 17 = 8.5, 18 = 9.0, 19 = 9.5, 20 = 10.0 This command selects/returns the setpoint ramp for the PID controller. Note: Refer to «Setpoint ramp adjustment» for details.								
LEARN	9	9	51	1	0Cancel Learn 1Start Learn	-	-		

156 CPA IC2(USB) Manual

Command	Service Code Class ID Instance ID Attribute ID Service data length (number of bytes) Service data field								
	Description								
	This command With CONTROI interrupted. Note: Without L Refer to «LEAR	starts LEARN MODE comr EARN the PIE N (setup step	N. mands open va O controller is r O 5)» for correc	alve or close v not able to per ct learn gas flo	alve the routin form pressure w and procedu	e maybe è control. ure.			

Command	Servic	Service Code Class ID Instance ID Attribute ID		Attribute ID	Service data length (number of bytes)	Service data field		
				Descri	Description			
	Set	16	54	4	100	2 int	Y	
	Get	14	51	I	100	4 float		
LEARN PRESSURE LIMIT	 Y: learn pressure limit according to selected DATA TYPE, nominal pressure range is 0 10'000 (sensor full scale) but it r scaled, refer also to command GAIN for details. 							
	This command transfers/reads the pressure limit for LEARN. Note: Refer to «LEARN (setup step 5)» for correct learn pressure limit setting							
LEARN STATUS	Get	14	51	1	106	2		

This command r coded.	returns the status of the LEARN procedure. The status is binary
Bit	Explanation:
(LSB) 0	0 = LEARN not running 1 = LEARN running
1	0 = LEARN data set present 1 = LEARN data set not present
2	0 = ok 1 = LEARN terminated by user
3	 0 = ok 1 = pressure in position OPEN > 50% sensor full scale (of high range sensor in case of a 2 sensor
syste	m) or > LEARN PRESSURE LIMIT
4	0 = ok 1 = pressure in position 0 < 10% sensor full scale (of low range sensor in case of a 2 sensor
syste	m)
5	0 = ok 1 = pressure falling during LEARN
6	0 = ok 1 = sensor not stable during LEARN
7	reserved
8	reserved
9	reserved
10	0 = ok 1 = LEARN terminated by controller
11	0 = ok 1 = pressure in position OPEN negativ
12	reserved
13	reserved
14	reserved
15	reserved
(MSB) 16	reserved

Command	Servic	e Code	Class ID	Instance ID	Attribute ID	Service data length (number of bytes)	Service data field				
	Description										
	Get	14	100	1	103	1					
	This cc	This command returns the device status.									
CONTROLLER MODE		 1 = synchronization, 2 = POSITION CONTROL, 3 = CLOSED 4 = OPEN, 5 = PRESSURE CONTROL, 6 = HOLD, 7 = LEARN 12 = power failure, 13 = safety mode 14 = fatal error (read EXCEPTION DETAIL ALARM for details) 255 = Valve power OFF or internal communications error 									
	Get	14	100	1	101	4					
THROTTLE CYCLE COUNTER	This co integer positio moverr	This command returns the number of throttle cycles. Data type is unsigned long integer. A movement from max. throttle position to open back to max. throttle position counts as one cycle. Partial movements will be added up until equivalent movement is achieved.									
	Get	14	100	1	106	4					
ISOLATION CYCLE COUNTER	This command returns the number of isolation cycles. Data type is unsigned long integer. Each closing of the sealing ring counts as one cycle.										
	Set	16	100		107		Х				
	Get	14	100	1	107	I					
	X:	0	Local (ope	ration via servi	ice port)						
ACCESS MODE		1	Remote (o	peration via De	eviceNet [®])						
		2	Locked (in	remote mode)						
	This co	ommand	l controls / ret	urns the acces	s mode of the	e valve.					
	Set	16	100	1	110	1	Х				
	Get	14	100	I	112	I					
	X:	0	closed								
CONFIGURATION		1	open								
	This co	mmanc	l controls / ret	urns the valve	position after	power up.					
POWER FAIL	Set	16	100	1	110	1	Х				
CONFIGURATION	Get	14	100		113						

Pressure Controller Object (Class ID 100)

160

X:	0	closed
This cor	1 nmand c	open
Only for	versions H -	that have Power Fail Option equipped [612or or 612 - U - or 612 - W - 1
012		



Unless otherwise specified all values in the table above are in decimal notification. Hexadecimal values are indicated by the letter ,h' (e.g. 31h)

Process Control Valve

This additional acyclic objects are available for GD and PCD profile since firmware end of January 2021

131 VAT Pressure Controller

Supported Instances: 1 (1)

RW Read Write, RO Read Only, NV Non

	Volatile								
Att r	Name	Data Type	Acc	N U V	nit Mir	n Max	Def	Description	
3	Pressure Controller Selector	USINT	RW	N V* *	1	4	1	Active Controller in <i>Control Mode</i> = Pressure 1:Controller 1 2:Controller 2 3:Controller 3 4:Controller 4	
4	Pressure Control Speed	REAL	RW	N V* *	0.00 1) 1.0	1.0	Speed valid in <i>Control Mode</i> = Pressure, 1.0 equals to full speed	
5	Target Pressure Used	REAL	RO	Vmb	oar* 0.0	SFS		This value is set as pressure controller input. It differs to the <i>Target Pressure</i> if a pressure ramp is used.	
16	Store Control Parameter Volatile	BOOL	RW	N V	0	1	0	0:Store in NV Memory 1:Do Not Store in NV Memory	
17	Pressure Control Position Restriction Enable	BOOL	RW	N V	0	1	0	Limit the valve movement in Control Mode Pressure	
18	Minimum Control Position	REAL	RW	N po V	os* 0.0*	100.0*	0.0*		
19	Maximum Control Position	REAL	RW	N po V	os* 0.0*	100.0*	100.0		

132 VAT Pressure Control Units

Supported Instances: 4 (1..4)

Att r	Name	Data Type	Acc	N V	Unit	Min	Max	Def	Description
1	Control	USINT	RW	Ν		0	2	xx	0:Adaptive
	Algorithm			۷*					1:Pl
				^					2:Soft Pump
									Controller 1 = 0, Controller 2 and 3 = 2, Controller 4 $= 2$
2	Control Direction	USINT	RW	N		0	1		Used for Control Algorithm Pl and Soft Pump
				V*				хх	0:Dow nstream
				*					1:Upstream
									XX Controller 1,2 and $4 = 0$, Controller $3 = 1$
16	Learn Data	USINT	RW	Ν		0	3	0	Used for Control Algorithm Adaptive
	Selection			V*					0 :Bank 1
				*					1:Bank 2
									2:Bank 3 3:Bank 4
17	Gain Factor	RFAI	RW	N		0.00	100.0	1.0	Used for Control Algorithm Adaptive
				V*		01			
				*					
18	Sensor Delay	REAL	RW	Ν	sec	0.0	1.0	0.0	Used for Control Algorithm Adaptive
				V*					
32	P-Gain	RFAI	R\//	N		0.00	100.0	0.1	Used for Control Algorithm Pland Soft Pump
52	1-Oum		1.00	V*		1	100.0	0.1	
				*		_			
33	l-Gain	REAL	RW	Ν		0.	100.0	0.1	Used for Control Algorithm Pl and Soft Pump
				۷*					
18	Ramp Enable	BOOL	R\//				1	1	Activate/Deactivate pressure target ramp. The
40		DOOL	1.0.0	V*		0	1	1	effective target pressure can be read in Target
				*					Pressure Used
49	Ramp Time	REAL	RW	Ν	sec	0.0	100000	1.0	Target reach time
				V*			0.0		
50	Bamp Slana			×	mh a r*/	0.0	000	1 2 2 2	Limit the rate of proceurs change
50	Ramp Stope	REAL	RVV	IN I	nibar/ sec	0.0	353	224	Linit the rate of pressure change
				*	000			227	
51	Ramp Mode	USINT	RW	Ν		0	1	0	0:Use Ramp Time
				V*					1:Use Ramp Slope
				*					
52	Ramp Start Value	USINT	RW	N \/*		0	1	1	
				v *					
53	Ramp Туре	USINT	RW	N		0	2	0	0:Linear
				V*					1:Logarithmic
				*					2:Exponential

* Scaling: Class 49 S-Analog Sensor Object, Attribute 4 Data Unit, Pressure: Instance 1, Position: Instance 3

** In case of *Store Control Parameter Volatile* is 1 (true) the value will not be stored in nonvolatile memory. *** Valve series specific

Tunnel Command

This functionality is used to send an serial command over DeviceNet interface. This enables some turnaround solution if a specific acyclic object is not available over DeviceNet interface.

Service (hex):	34
Class (hex):	30
Instance:	01
Service data:	ASCII command in HEX format

Here an example how to send an IC2 command with the tunnel command:



Receive

dec:	52	48	1	112	58	48	48	48	49	49	48	54	48	48	49	48	48	48	48	48
hex:	34	30	01	70	3A	30	30	30	31	31	30	36	30	30	31	30	30	30	30	30
ascii:				р	1	0	0	0	1	1	0	6	0	0	1	0	0	0	0	0

This command disable the Follow Valve option for an external isolation valve.

Possible Failure Response:

Note: In case of failure the response is E:xxxxxx

x	Failure 11 20, 2 22, 2 30 80 81 Exap	e Numł 21 23	ber Failure	Desc ':' in Inva Unk Inva Valu Con Con	ription the c Ilid nu nown Ilid va Ile ou nman nman	comm umbe i com alue t or ra id not id not	and i rs of i mand ange acce	missi chara d epted epted	ng acters due due	to loc to Syl	al op nchro	eration nization, CLOSED or OPEN by digital input, Safety mode or Fatal error
dec:	52	48	1	69	58	52	50	48	49	48	49	
hex:	34	30	01	45	ЗA	30	30	30	30	33	30	
				Е	:	0	0	0	0	3	0	

2.5.4 Logic

The Logic Interface allows the user to operation with digital and analog signals. Thera are following Inputs and Outputs available.

- 8 Digital Input
- 4 Digital Output
- 1 Analog Input
- 2 Analog Output

2.5.4.1 Digital Inputs

There are 8 Digital Inputs with different functionality available. At Access mode Local only the Remote Locked functionality supported.

Parameter

	Parameter	Description				
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported				
Digital Input 18	State	<i>True</i> means it is active. <i>False</i> means it is not active.				
	Functionality	Each digital input can be assigned one of the functionality descript at the <i>table Functionality</i> .				
	Inverted	Inverted the functionality of the signal.				

Table Parameter Digital Input

Functionality

Functionality	Description	Priority Control Mode
Open	Open the Valve.	4
Close	Close the Valve.	2
Pressure Control	Activates the Control Mode Pressure. The non- activated Control Mode is Position.	5
Pressure Low Range	Set the low range of sensor full scale The Low Range is defined on Parameter: Settings, Pressure Range [SFS]	
Zero	Compensates the Pressure Offset Voltage. Set the Pressure Value to Zero.	
Learn	Activates the Control Mode Learn. At case the Learn procedure should not run over the complete scale. A Learn Limit can be set with Parameter: Settings, <i>Learn Limit</i> = True. Now the Learn Limit can be set over the Analog Input.	1 Negative edge interrupt the procedure 3 Positive edge start the procedure
Remote Locked	Activates the Access Mode Remote Locked. At Access Mode Remote Locked is operation via service port in Local mode not possible.	Supported at Access Mode Local
Hold	Stops the Valve at the current position, Learn procedure will be not interrupted.	5
Controller Selector	Set the Controller Selector to Controller 1 or	

Controller 2	
--------------	--

Table Functionality Digital Input

Priority:

Highest priority is 1. Functions with lower priorities will not be effective as long as higher priority functions are active.

These digital inputs have higher priority than all RS232 commands.

RS232 commands will not be accepted while digital inputs are active.

2.5.4.2 Digital Outputs

There are 4 Digital Outputs available.

Parameter

	Parameter	Description
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported
Digital Output	State	<i>True</i> means it is active. <i>False</i> means it is not active.
1	Functionality	Each digital input can be assigned one of the functionality descript at the <i>table Functionality</i> .
	Inverted	Inverted the functionality of the signal.

Table Parameter Digital Outputs

Functionality

Functionality	Description
Open	Indicate the Open status of the Valve.
Close	Indicate the Close status of the Valve.
	In case of selected(= <i>True</i>) <i>IC Compatible Mode</i> , the Busy Output functionality will have the same behavior as in the past the Alarm Output (IC1 naming). ⇒ The <i>IC Compatible Mode</i> is settable under <u>Settings</u> .
Busy	IC Compatible Mode False: Busy is when: Control Mode is: Init, Homing, Learn, Power failure or in Error. At Control Mode Pressure: Actual Pressure is +/- 2% out of range. Position: Actual Position is +/- 0.1% out of range. → same ranges for Position and Pressure, if Hold will be active

	<u>IC Compatible Mode True:</u> Busy is when:								
	Control Mode is: Homing, Learn, Power Failure or in Error.								
	At control mode:								
	Pressure:Actual Pressure is +/- 2% out of range.Position, Open & Interlock Open:Actual Position is +/- 0.1% out of range \rightarrow same ranges for Position and Pressure, if Hold will be activeInit, Close & Interlock Close:Valve is still not isolated/sealed.								
	If <i>IC Compatible Mode</i> is selected (= <i>True</i>), the Ready Output will have a slightly different functionality.								
	⇒ The IC Compatible Mode is settable under <u>Settings</u> .								
	\rightarrow Ready means. Ready for remote operation.								
	IC Compatible Mode False:								
Ready	Valve is not in Access Mode Local and <u>not</u> in one of following Control Mode : Init, Homing, Interlock Open, Interlock Close, Power failure, Safety, Error or Not define.								
	IC Compatible Mode True:								
	Valve is not in Access Mode Local and <u>not</u> in one of following Control Mode : Interlock Open, Interlock Close, Power failure, Safety, Error or Not define.								
	Init & Homing: when valve is or was not isolated/sealed								

Table Functionality Digital Outputs

-> If *IC Compatible Mode* is not visible, installed firmware does not provide this setting. Please check with VAT for firmware update.

2.5.4.3 Analog Input

There are 1 Analog Inputs from 0 to 10 V available.

Parameter

	Parameter	Description				
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported				
	Value	Indicate the applied voltage				
Analog Input	User Factor	1 default value for Input voltage 0 to 10V UserFactor = (MaxVolt – MinVolt) / 10				
		Example: Input voltage 2V to 8V (8-2)/10 = 0.6 User Factor				
	User Offset	0 default value for Input voltage 0 to 10V				

166 CPA IC2(USB) Manual

	UserOffset = MinVolt Example: Input voltage 2V to 8V 2.0 = User Offset
Functionality	The Functionality is depend on the Current Control Mode Control Mode Learn: <i>Pressure Limit</i> [SFS] Control Mode Pressure: <i>Target Pressure</i> Control Mode Position: <i>Target Position</i> For settings <i>Pressure Limit</i> [SFS] must be Settings, <i>Learn Limit</i> = <i>True</i>

Table Parameter Analog Input

2.5.4.4 Analog Output

There are 2 Analog Outputs from 0 to 10V available

Parameter

	Parameter	Description	
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported	
	Value	Indicate the applied voltage	
Analog Output	User Factor	1 default value for Input voltage 0 to 10V UserFactor = (MaxVolt – MinVolt) / 10 Example: Input voltage 2V to 8V	
		True means it is supported. False means it is not supported Indicate the applied voltage 1 default value for Input voltage 0 to 10V UserFactor = (MaxVolt – MinVolt) / 10 Example: Input voltage 2V to 8V (8-2)/10 = 0.6 User Factor. 0 default value for Input voltage 0 to 10V UserOffset = MinVolt Example: Input voltage 2V to 8V (2.0 = User Offset Each analog output can be assigned one of the functionality descript at the table Functionality.	
	User Offset	0 default value for Input voltage 0 to 10V UserOffset = MinVolt Example: Input voltage 2V to 8V	
		2.0 = User Offset	
	Functionality	Each analog output can be assigned one of the functionality descript at the <i>table Functionality</i> .	

Table Parameter Analog Output

Functionality

Functionality	Description
Position	Indicate the Valve position
Pressure	Indicate the Valve pressure

Table Functionality Analog Output

2.5.4.5 Connector assembling

The Connector on the Controller is a D-Sup 25 Pin female.

0	$\bigcirc \circ \circ$		
Pin	Function	Description	
1	Chassis GND	Connected to case. Use this to connect cable shield.	
2	Reserve 3	Digital Input 11	
3	Zero	Digital Input 3	
5	Pressure Low Range	Digital Input 2	
6	GND	Input (GND)	
7	Pressure Control	Digital Input 1	
8	Open	Digital Output 1	
9	Close	Digital Output 2	
10	Reserve 2	Digital Input 10	
11	Position	Analog Output 1	
12	Pressure	Analog Output 2	
13	GND	Analog	
14	Reserve 4	Digital Input 12	
15	Close	Digital Input 4	
16	Hold	Digital Input 8	
17	Open	Digital Input 5	
18	Remote Locked	Digital Input 7	
19	Learn	Digital Input 6	
20	Output Common	Output Common	
21	Ready	Digital Output 3	
22	Busy	Digital Output 4	
23	Reserve 1	Digital Input 9	
25	Position/Pressure	Analog Input 1	

Table Connector

2.5.4.6 Wiring

Configuration with switches



168

Configuration with Voltage



", "", "" isolated from other circuits

2.5.5 CC-Link

2.5.5.1 LEDs

CC-Link Slave LEDs

The communication status LEDs are used to represent the CC-Link Slave status. There are two LEDs: L RUN and L ERR.

LED	Color	State	Meaning
L RUN	LED green		
	Green	On	After establishing the connection with the CC-Link network, the device is receiving the cyclic data
	Off	Off	 Connection with network not yet established No carrier can be recognized Timeout occurred Hardware reset happened
L ERR	LED red		
	red	blinking	Switch position has been changed while pulling the reset (It blinks for 0.4 seconds)
	red	On	 CRC error Address parameter error (Address 0, or greater than 64 is set, including number of occupied stations) Error in settings of baud rate switches while pulling the reset (5 or greater)
	Off	Off	 Normal communication Hardware is resetting

2.5.5.2 Configuration

Station Number

The parameter "Station number" is used to distinguish between stations on the CC-Link network. Unique station numbers in consecutive order without duplication must be used, when assigning stations to the CC-Link network. The allowed range is from 1 to 64. "Station number" can be set via CPA as it is shown on the snapshot:

170

₩ Parameters		– 🗆 X
Local 🏓 Remote 💥 Features 😯 Help		
 parameters System Volve Position Control Pressure Control Pressure Sensor Interface CC-Link Station number Transmission speed Number of occupied stations Extended cyclic setting Vendor code Model type Software version Scaled Signals Power Connector 	valuesStation number	1 ¢
Parameter ID: A6110000	Valve: 653-PHHX	

Number of occupied stations

This parameters represents the number of stations (occupying one stations worth of memory area) used by a single slave station in a network. It is one of the two parameters that define operational settings. In case of VAT controllers, it is always paired with parameter "extended cyclic setting" in the following way.

Number of occupied stations: **1** & Extended cyclic setting: **Octuple** Number of occupied stations: **4** & Extended cyclic setting: **Double**

The VAT slave supports only these two combinations of the CC-Link parameter settings. It can be configured via CPA as it is shown on the snapshot:



Extended cyclic setting

This is the extended cyclic transmission. The extended cyclic points can be set as 2 times, 4 times or 8 times of the normal cyclic transmission points. In case of VAT controllers, it is always paired with "Number of occupied station" in the following way.

Number of occupied stations: **1** & Extended cyclic setting: **Octuple** Number of occupied stations: **4** & Extended cyclic setting: **Double**

The VAT slave supports only these two combinations of the CC-Link parameter settings. It can be configured via CPA as it is shown on the snapshot:

Parameters	-		×
Local 🏓 Remote 🔀 Features 😯 Help		\checkmark	
 parameters System Valve Position Control Pressure Control Pressure Sensor Interface CC-Link Station number Transmission speed Number of occupied stations Extended cyclic setting Vendor code Model type Software version Scaled Signals Power Connector 	Extended cyclic setting Octuple Double Octuple	Save	
Parameter ID: A6140000	Valve: 653-PHHX		

Data Type of Pressure and Position values

The data type of different pressure and position values can be optionally changed between 32-bit signed integer and 32-bit floating point (IEEE-754 standard).

They are all set to the floating point type by default. The data type can be set via CPA for each of the 12 parameters separately:

₩ Parameters	- 🗆 X	
Local 🏓 Remote 🔀 Features 😗 Help		
parameters > System > Valve > Position Control > Pressure Control > Pressure Control > Pressure Sensor Interface CC-Link Station number Transmission speed Number of occupied stations Extended cyclic setting Vendor code Model type Software version Scaled Signals > Pressure Sensor 1 Pressure Sensor 1 > Pressure Sensor 2 Data Type Value Max > Position Data Type Value Max > Target Position > Cluster Valve Position > Pressure Alignment Setpoint > Pressure Alignment Setpoint > External Digital Pressure Sensor 2 > Cluster Valve Freeze Position Setpoint > Pressure Alignment Setpoint > Pressure Connector 	values Data Type Floating Point Signed Integer Floating Point Save	
Parameter ID: A6400401	Valve: 653-PHHX	

Range of Pressure and Position values

The range of all listed pressure and position values can be adjusted. That means, for example, that the valve position values for "CLOSE" and "OPEN" can be set to other ones then the default values 0 and 100'000.

		Default ra	ange limits
#	Parameter name	Min	Max
Inputs			
1	Pressure	0	1'000´000
2	Pressure Sensor 1	0	1'000'000
3	Pressure Sensor 2	0	1'000'000
4	Position	0	100'000
5	Target Position	0	100'000
6	Cluster Valve Position	0	100'000
Outputs			
7	Pressure Setpoint	0	1'000'000
8	Position Setpoint	0	100'000
9	Pressure Alignment Setpoint	0	1'000'000

175

10	External Digital Pressure Sensor 1	0	1'000'000
11	External Digital Pressure Sensor 2	0	1'000'000
12	Cluster Valve Freeze Position Setpoint	0	100'000

The range of pressure and position values can be configured via CPA for each of the 12 parameters separately:

The range of pressure and position values is independent of the data type (signed integer and floating point). The internal accuracy of valve is for all positions is the precision of IEEE-754 Floating point number. If the range of pressure and position values is rising, the accuracy of pressure and position does not rise. This is only scaling that doesn't improve internal accuracy of values.



2.5.5.3 Connection Setup

Handshake Procedure

Before the communication between the CC-Link master and the CC-Link slave (IC2 controller) is possible, the handshake process needs to take place. Without it no data from the master will be transmitted to station. The procedure has 3 steps:

1. If the network parameter are correct, the slave station will set the bit "Initial data processing request flag".

2. Upon receiving thi bit, the master answers to the request with the bit "Initial data processing complete flag".

3. Finally, the station (slave) sets the bit "Remote READY". That means the slave is in the normal

operation mode.

Location of the handshake bits

Slave (Controller) à Master		
Device	Signal name	
RX(m+n)8	Initial data processing request flag	
RX(m+n)9	Initial data setting complete flag	
RX(m+n)A	Error status flag	
RX(m+n)B	Remote READY	

Master à Slave (Controller)		
Device Signal name		
RY(m+n)8	Initial data processing complete flag	
RY(m+n)9	Initial data setting request flag	
RY(m+n)A Error reset request flag		

The two tables are showing the part of the memory, mapped in bits, where the handshake flags are located.

m - Address assigned to the master module by the station number setting. This defines the memory area dedicated for this slave. It begins at address m of the master.

n - It depends on the number of occupied stations and the extended cyclic setting, as shown in the table:

	Case 1	Case 2
Number of occupied stations	1	4
Extended cyclic setting	Octuple	Double
n	0x7	0xD

2.5.5.4 Cyclic Communication - Process Data

The buffer naming (output and input) is always from the customer's point of view, which is from the master (PLC).

The data are transmitted using Intel format, where the lower byte is being sent first. Since the communication goes over words (16bit), each one byte signal is stored in a lower byte of the word, and the upper one is a padding one, not used. The lower byte is also called LSB (Least

Significant Byte)

Output Buffer

Output Buffer					
Byte	Wor d	Paramete r	Content	Byte s	Word s
0	0				
1		1	Dragouro Sotroint	4	2
2	1			4	2
3					
4	2				
5		2	Desition Saturiat	4	2
6	3	2	Position Selpoint	4	2
7					
8	4				
9		2	Proseuro Alignmont	1	2
10	5	3	Plessure Alignment	4	2
11					
12	6				
13		1	External Digital	1	2
14	7	4	Pressure Sensor 1	4	2
15					
16	8				
17		F	External Digital	4	2
18	9	5	Pressure Sensor 2	4	2
19					
20	10	6	Control Mode Setpoint	1	1
21			Padding	1	1
22	11	7	Conoral Control Sotucint	2	1
23		1			
24	12	0	DKM	2	1
25		0			
26	13	0		2	1
27		3		2	

178

28	14	10		2	1
29		10		2	1
30	15	11		C	1
31				2	1
32	16				
33		10	Cluster Freeze Desition	4	2
34	17	12	Cluster Freeze Position	4	2
35					
36	18	13	Cluster Address	1	1
37			Padding	1	
38	19	1.4	Cluster Valve Control	2	1
39		14	Setpoint	Z	
40	20	15	Cluster Monitoring Address	1	1
41			Padding	1	

Bitmap parameter definitions:

Object	Bit	Parameter
General control setpoint	0	Zero
General control setpoint	1	Not Used
General control setpoint	2	Ping Pong TX
General control setpoint	3	Not Used
General control setpoint	4	Access Mode
General control setpoint	5	Plasma Mode On
General control setpoint	6	Plasma Mode Off
General control setpoint	515	Not Used

Input Buffer

П

Input Buffer					
Byte	Word	Parame ter	Content	Bytes	Words
0					
1	0	1	Pressure	1	2
2			Flessule	4	2
3	1				
4					
5	2	2	Brossura Sansar 1	1	റ
6		2		4	2
7	3				

8						
9	4	2			0	
10		3	Pressure Sensor 2	4	2	
11	5					
12			Position			
13	6	1		4	2	
14		4				
15	7					
16				4		
17	8	5	Target Position		2	
18				т	-	
19	9					
20	10	6	Control Mode	1	1	
21	10		Padding Byte	1		
22		7	Fatal Error	2	1	
23	11 /			2	•	
24		8	PKW	2	1	
25					'	
26	10	9	PKW	2	1	
27				-	1	
28	14 10		PKW	2	1	
29						
30	15 11		PKW	2	1	
31				<u>-</u>	1	
32	10	12	General Status	2	1	
33	10			2	1	
34	47	13	General Warnings	2	1	
35	17					
36	10	14	Extended Warnings	2	1	
37	ы					
38	19	15	Cluster Monitoring Address	1	1	
39			Padding Byte	1		
40	16	16	Cluster Valve Position	4	2	
41						

42	17				
43					
44	18	17	Cluster Valve Control Mode	1	1
45			Padding Byte	1	
46	19	1/	Cluster Valve	2	1
47		14	Status	2	I
48	20	15	Cluster Valve Warnings	2	1

Bitmap parameter definitions:

General status	0	Fieldbus Data Valid
General status	1	Zero Executed
General status	2	Ping Pong RX
General status	3	Pressure Simulation
General Status	4	Pressure Setpoint Reached
General Status	5,6	Not Used
General Status	7	Access Mode
General Status	8	Access Mode
General Status	9	Warnings Active
General Status	10	Sealed
General Status	1115	Not Used
General Warnings	0	Service Request
General Warnings	1	Learn Data Set
General Warnings	2	Compressed Air Failure
General Warnings	3	Power Failure Battery
General Warnings	4	Sensor Overlapping
General Warnings	5	lso Valve Failure
General Warnings	6	Offline
General Warnings	79	Not Used
General Warnings	10	Sensor Measurement Unit Faulty, Plasma On
General Warnings	1115	5Not Used
Extended	0	Remote Control Not Possible
Warnings		
Extended	1	Actual Control Mode Setpoint Not
Warnings	-	Allowed
Extended	2	Zero Disabled
Warnings		
Extended	3	PFO Deactivated
Warnings		N 1 1 1
Extended	4	Not Used
Warnings	~	Out Of Dense Dressure Catesiat
Extended	5	Out Of Range Pressure Setpoint
vvarnings Extended	6	Out Of Panga Position Schoint
	0	Out Of Range Position Selpoint
Extended	7	Notlised
	1	NUL USEU

180
Warnings Extended	8	0	ut Of Range Sensor 1
Warnings Extended	9	0	ut Of Range Sensor 2
Warnings		0	
Extended Warnings	10	S C	etpoint
	11	0	ut Of Range Control Setpoint
Extended	12	Р	rocess Data Settings not valid
Warnings Extended Warnings	131	5 N	ot Used
Cluster Valve Con	trol	0	Freeze
Cluster Valve Con	trol	1	Freeze Mode: 0 Position, 1
Cluster Valve Con	trol	2	Data Valid
Setpoint Cluster Valve Con Setpoint	trol	3 15	Reserved
Cluster Valve	01		Access Mode
Cluster Valve	2		Freeze Mode
Cluster Valve	3		Offline Status
Status Cluster Valve	47		Reserved
Status Cluster Valve	8		Service Request
Status Cluster Valve	9		Compressed Air Failure
Status Cluster Valve	10		PFO Voltage Low
Status Cluster Valve	11		lso Valve Failure
Status	10 1	F	Decented
Status	101	5	Reserved
Cluster Valve	0	Out o	f Range Freeze Position
Warning Cluster Valve	1 (Setpo Out o	int f Range Freeze Address
Warning	2	Setpo	int M Dange Central Setucint
Warning	2	Out C	n Range Control Selpoint
Cluster Valve	3	Out o	f Range Monitoring Address
Cluster Valve	4 I	Reser	ved
Warning	15		

2.5.6 Profibus

182

General information about PROFIBUS is available on the homepage http://www.profibus.com

Naming:

The naming given in this chapter corresponds to the view from the customer (master's) side. In practice it is from a PLC perspective.

Data format:

All signals are transmitted and received in Motorola format (high byte first). Float32 signals are used according the standard data format IEEE754

2.5.6.1 Connection

Connector

The Profibus interface is DB9F (DB-9 pin female). It is galvanic isolated from the rest of the controller. The PIN allocation is given in the table.

PIN	Signal	Description	
1	-	Not Used	
2	-	Not Used	
3	B Line	Positive RxD/TxD, RS485 level	
4	RTS	Request to send	
5	GND Bus	Bus Ground (isolated)	
6	+5V Bus Output	+5V termination power (isolated)	
7	-	Not Used	
8	A Line	Negative RxD/TxD, RS485 level	
9	-	Not Used	
Housing	Cable Shield	Internally connected to the protective earth via cable shield filters according to the Profibus standard.	

Table -	- Connector	PIN	Allocation
---------	-------------	-----	------------

Caution!

Any current drawn from the pin 6 will affect the total power consumption. The Profibus connector must not be used for other application that may damage the Profibus interface.

Cable

Table shows the recommended specification for cables.

Table	- Profibus	Cable S	pecification

Measure	Range
---------	-------

Impedance	135 165 Ω
Capacitance	< 30 pF / m
Resistance	< 110 Ω / km
Wire Diameter	> 0,64 mm
Conductor cross section	> 0,34 mm²

Dependency between the maximum cable length an the baud-rate is given in the following table.

Baud rate [kbit/s]	Max. cable length [m]
9.6	1200
19.2	
31.25	
45.45	
93.75	
187.5	1000
500	400
1500	200
3000	100
6000	
12000	

Table - Baud Rate & Max Cable Length

Line Termination

At the connectors of the first and the last station, the Profibus line must be terminated by a resistor network. Sometimes this network is already integrated on the Profibus connector as an On/Off Switch. The switch position must be ON at the first and last station and OFF at "X..Station". The shield of the cable must be connected to protection earth. The following picture describes this.



Figure - Line Termination

2.5.6.2 LEDs

Geben Sie hier den Text ein.

LED Communication (COM)

LED COM description

Light Color	State	Meaning	
Green	On	Online, running, data exchange, cyclic communication	
	Blinking cyclic at 2Hz	Master in the state "Clear"	
Red	Blinking acyclic at 1Hz	Device (controller) is not configured	
	Blinking cyclic at 2Hz	Not running, no communication, connection error	
	On	Wrong Profibus DP-Configuration	
Green and Red	Off	Device if Off. No power.	

LED Diagnostic (DIA)

LED DIA is always on. No diagnosis information. This is an application-specific function.

2.5.6.3 Communication

To configure the Profibus interface or to edit pre-configured settings, the easiest way is through the CPA tool.

The following picture shows the overview of all available parameters. They are described in the sub-topics.



Parameter Group: A7

GSD

4

GSD file describe the communication parameters which are available from the specific device.

Device: -

Link for download: Downloads Select Software & Updates Tab and filter for GSD File IC2.

	Product Documentation	CAD Files	Safety, Quality and Environmental Statements	Software & Updates	
GSD File IC2					Q
 GSD File IC2 	(USB) Profibus			2 KB ZIP	Download 🗸

Station address

Profibus Station Address has range from 0 to 126 but zero is reserved for diagnosis devices.

Therefore the selected address needs to be in range 1..126.

Addresses are checked for duplicates. Master should have the lowest address 1, and slaves should follow starting with 2. This is only a recommendation: 1 is still allowed for a slave.

Baud Rate

The GSD sets the Profibus to the auto detection of the baud rate. The controller can be set to any among the offered baud rates:

Baud Rates		
9.6	kBit/s	
19.2		
31.25		
45.45		
93.75		
187.5		
500		
1.5	Mbit/s	
3		
6		
12		

I&M0 record

This is a collection of manufactured data. Its fields are listed in the table.

I&M0 is a read-only data record provided by the device manufacturer. I&M0 data is permanently stored inside the device by the device vendor, this data is related to the device application layer.

w Parameters			_	· []	×
Local 🎾 Remote		•	0	V		T
Local Remote parameters > System > Valve > Position Control > Pressure Control > Pressure Sensor > Interface Profibus Station Address Baud Rate > I&MO > Connection Loss Reaction > Cyclic Data Settings > Power Connector > Sequencer	valuesManufacturer IDOrder IDSerial NumberHardware RevisionSoftware Revision PrefixSoftware Revision 1Software Revision 2Software Revision 3Revision CounterProfile IDProfile Specific TypeVersionSupported				49	8 ÷ 1 ÷ 6 ÷ 8 ÷ 0 ÷ 1 ÷ 0 ÷ 0 ÷ 7 ÷
Parameter Group: A/04	Device: -			_		at

Record fields description

Table - Description of the I&M0 record fields

Field	Description
Manufacturer ID	Manufacturer ID of VAT Vakuumventile AG listed at www.profibus.com/IM/ Man_ID_Table.xml
Order ID	Order ID of the device. This is the Order ID, or model number or SKU number of the device. It is assigned by the vendor and should be equal to customer readable markings on the device.
Serial Number	Controller Serial Number
Hardware Revision	Hardware revision of the device
Software Revision Prefix	Same value as in GSD file Part FAB.CD.EF.GH
Software Revision 1	Part YY of the controller Firmware Version F01.XXYY.ZZ
Software Revision 2	Part ZZ of the controller Firmware Version F01.XX.YY.ZZ
Software Revision 3	Mapped part XX of the controller Firmware Version F01.XX.YY.ZZ in following way: XX == 0B à 'Software Revision 1' = 0 XX == 0C à 'Software Revision 2' = 1 XX == 0T à 'Software Revision 3' = 2

	XX == 0P à 'Software Revision 4' = 3 XX == something else à 'Software Revision 4' = 9
Revision Counter	Initial value 0. Increments on every set of I&M data.
Profile ID	For details refer to\nwww.profibus.com/IM/Profile_ID_Table.xml
Profile Specific Type	For details refer to\nwww.profibus.com/IM/ Profile_specific_type_table_6282.xml
Version	I&M version the Hilscher Stack
Supported	Bitmask that defines which I&M fields are supported by the device For details refer to Hilscher API manual PROFIBUS DP Slave Protocol API 19 EN.pdf chapter PROFIBUS_FSPMS_CMD_SET_IM0_REQ

Cyclic Data Settings

Depending on profile (standard or some other) here is possible to configure the profile relevant scalable cyclic parameters. For each of these parameters are settable the data type and its range. This makes the slave flexible to accept variety of incoming data and to apply them on its internal ranges. For example, as shown on Figure bellow, if Target Position is set to has "signed type" with range from 50 to 60, it means all incoming values over the fieldbus between 50 and 60 will be automatically scaled in order to control the local target position that internally might have range, for example, 0 to 1000.

The external value 50 corresponds to internal 0, 60 to 1000, 54 to 400 etc.

Figure: Configuration of scalable parameter

Marameters			_	×	
Local 🔑 Remote		\$	2		
parameters > System > Valve > Position Control > Pressure Control > Pressure Control > Pressure Sensor > Interface Profibus Station Address Baud Rate > I&MO > Connection Loss Reaction > ICC Data Settings > Actual Pressure > Sensor 1 Pressure > Sensor 1 Pressure > Actual Position > Actual Position > Actual Position > Actual Position > Target Pressure > Target Possition > Data Type Value Min Value Min Value Max > Zero Adjust Target Pressure > Pressure Input Digital Sensor 1 > Pressure Input Digital Sensor 2 > Power Connector > Sequencer	values Data Type Value Min Value Max	Signed I	nteger	▼ 50 \$ 60 \$	
Parameter Group: A72008	Device: -				

The ranges can encompass the negative number as well, in case of both, float and signed integer data type.

The float type is 32 bit, IEEE-754 standard. The signed integer is 32 bit long.

Scalable cyclic data parameters are in Table. These parameters are integral part of the complete cyclic data buffers described in next section "Cyclic Buffers"

#	Parameter	Input/Output	Default Value Range	
			Min	Max
1	Actual Pressure	Input	0	1'000'000
2	Sensor 1 Pressure	Input	0	1'000'000
3	Sensor 2 Pressure	Input	0	1'000'000
4	Actual Position	Input	0	100'000
5	Actual Target Position	Input	0	100'000
6	Slave Actual Position	Input	0	100'000
7	Target Pressure	Output	0	1'000'000
8	Target Position	Output	0	100'000
9	Zero Adjust Target Position	Output	0	1'000'000
10	Pressure Input Digital Sensor 1	Output	0	1'000'000
11	Pressure Input Digital Sensor 2	Output	0	1'000'000
12	Slave Freeze Target Position	Output	0	100'000

Table - Scalable Cyclic Parameters

Connection Loss Reaction

If the connection to the Profibus gets lost, the valve will go to desired state (open or close).

Enable = Activating of the featureState = True if the the connection loss has been detectedFunctionality = Position/Mode where the valve ends up upon the connection loss

Parameter location: CPA Interface Profibus.Connection Loss Reaction

2.5.6.4 Cyclic Buffers

The highlighted **slave** parameters in both buffers are used in case of cluster configuration. Otherwise they can be ignored.

Input Buffer

Table - Cyclic Data: Input buffer

Byte	SI	Name	Size	Data	Description	Default Range
S	ot		[Byt	Туре		for scalable
			es]			parameters

CPA IC2(USB) Manual

0 - 3	16	Actual Pressure	4	SINT3 2 or FLOAT		0 - 1'000'000
4 - 7	17	Pressure Sensor 1	4	SINT3 2 or FLOAT	In case of default valid range: Physical full scale value of the sensor (10 Volt) equals to 1'000'000.	0 - 1'000'000
8 - 11	18	Pressure Sensor 2	4	SINT3 2 or FLOAT	Optional signal, only in case of two sensors. In case of default valid range: Physical full scale value of the sensor (10 Volt) corresponds to 1'000'000.	0 - 1'000'000
12 - 15	19	Actual Position	4	SINT3 2 or FLOAT	Maximal value in the range = Valve is open Minimal value in the range = Valve is closed* *Valid for valves without isolation function	0 - 100'000
16 - 19	20	Actual Target Position	4	SINT3 2 or FLOAT		0 - 100'000
20	21	Control Mode	1	UINT	$\begin{array}{llllllllllllllllllllllllllllllllllll$	Not scalable
21 - 22	22	Error Number	2	UINT1 6	20 = no stop detected during homing 21 = valve blocked during homing 22 = valve blocked 40 = motor driver fault	Not scalable
23 - 24	23	PKW_PKE In	2	UINT1 6	NotUsed	Not scalable
25 - 26	24	PKW_IND In	2	UINT1 6	NotUsed	Not scalable
27 - 28	25	PKW_PWE1 In	2	UINT1 6	NotUsed	Not scalable
29 - 30	26	PKW_PWE2 In	2	UINT1 6	NotUsed	Notscalable
31 - 32	27	General Status	2	UINT1 6	Bitmap that holds device status bits. For details, see the sub-chapter General Status - Bitmap Description.	Notscalable
33 - 34	28	General Warnings	2	UINT1 6	For details, see the sub-chapter General Warnings - Bitmap Description.	Not scalable
35 - 36	29	Extended Warnings	2	UINT1 6	For details, see the sub-chapter Extended Warnings - Bitmap description	Not scalable

37	30) Slave Address	1	UINT8	Address of the slave that reports back following parameters: - Slave Actual Position - Slave Control Mode - Slave Status - Slave Warnings	Not scalable
38 - 41	31	Slave Actual Position	4	SINT3 2 or FLOAT	Actual position of the slave selected by the output buffer parameter " Slave Monitoring Address"	0 - 100'000
42	32	2 Slave Control Mode	1	UINT8	Control mode of the slave selected by the output buffer parameter " Slave Monitoring Address"	Not scalable
43 - 44	33	Slave Status	2	UINT1 6	Slave status bit-field of the slave selected by the output buffer parameter " Slave Monitoring Address". For details, see the sub-chapter Slave Status - Bitmap description	Not scalable
45 - 46	34	Slave Warnings	2	UINT1 6	Slave warnings bit-field of the slave selected by the output buffer parameter " Slave Monitoring Address" Details are given in the sub-chapter Slave Warnings - Bitmap description	Not scalable

General Status - Bitmap description

	General Status				
Bit	Name	Description			
0	Fieldbus Data Valid	Communication over the bus is running errorless			
1	Zero Executed	ZERO success	ful executed, activ	e for 2 seconds	
2	Ping Pong RX	Inverted bit "Ping Pong TX" from General Control bitmap. Details given in section Communication between Master (PLC) and Slave (VAT-Valve)			
3	Pressure Simulation	Internal pressure simulation is active. Real sensor inputs are being ignored			
4	Target Pressure Reached	Actual pressure is within 2% of the target pressure			
5	lso Valve Open	External valve isolation is in state Open			
6	Iso Valve Close	External valve isolation is in state Close			
7 – 8	Access Mode		Bit 7	Bit 8	
		Local	0	0	
		Remote	1	0	
		Locked	0	1	
9	Warnings Active	At least one bit of General Warnings or Extended Warnings is active.			
10	Plasma Mode Status	Plasma mode i	s active. Pressure	e control is slowed down	
11	Interlock Active	Interlock input i	s active		

12 - 15 Not Used

Reserved

General Warnings - Bitmap description

		General Warnings
Bit	Name	Description
0	Service Request	Service Request Active. Valve movement tight.
1	Learn Data Set	No valid learn parameter data present. Learn is required for adaptive pressure control. It can be active only when adaptive pressure control algorithm is chosen.
2	Compressed Air Pressure	Compressed air pressure has not a valid operational level
3	Power Failure Battery	Battery is not ready. Voltage is too low
4	Sensor Overlapping	Sensor deviation between sensor 1 and sensor 2 is $\geq \pm 10\%$
5	Isolation Valve Failure	Invalid state of isolation valve signals: open or close
6	Not Used	Reserved
7-9	Not Used	Reserved
10	Sensor Measurement Unit Faulty	Analog-Digital Convertor of Sensor 1 or 2 on the master board is faulty.
11 - 15	Not Used	Reserved

Extended Warnings - Bitmap description

		Extended Warnings
Bit	Name	Description
0	Remote Control Not Possible	Remote control not possible, access mode local is active, change to access mode remote or access mode locked
1	Actual Control Mode Target Not Allowed	Not possible to switch the current control mode to given "Control Mode Target" because of reasons: • Actual Control mode is interlock or fatal error • Control Mode Target is 5 (pressure), 6 (hold) or 7 (learn) and no sensor is selected (sensor mode configuration)
2	Zero Disabled	Using zero function not possible
3	PFO Deactivated	Power Failure Option is deactivated
4	Not Used	Reserved
5	Out Of Range: Target Pressure	Target Pressure value is out of its defined range
6	Out Of Range: Target Position	Target Position value is out of its defined range
7	Not Used	Reserved
8	Out Of Range Sensor 1	Pressure Sensor 1 value is out of the defined range
9	Out Of Range Sensor 2	Pressure Sensor 2 value is out of the defined range
10	Out Of Range Control Mode	Control Mode Target value is out of its defined range

© VAT Group AG

	Target	
11	Out Of Range: General Control	General Control value is out of its defined range
12	Not Used	Reserved
13 - 15	Not Used	Reserved

Slave Status - Bitmap description

		Slave Status	
Bit	Name	Description	
0 - 1	Access Mode	0 = Local 1 = Remote 2 = Remote Locked 3 = Local and Remote	
2	Freeze Mode	0 = Not Frozen, 1 = Frozen	
3	Offline Status	0 = Online, 1 = Offline	
4 - 7	Not Used	Reserved	
8	Service Request	0 = Inactive, 1 = Active	
9	Compressed Air Failure	0 = No Failure, 1 = Failure	
10	PFO Voltage Low	0 = Voltage High Enough, 1 = Voltage Low	
11	lso Valve Failure	0 = No Failure, 1 = Failure	
10 - 15	Not Used	Reserved	

Slave Warnings - Bitmap description

	Slave Warnings			
Bit	Name	Description		
0	Slave Freeze Target Position	Out of range: Slave Freeze Target Position		
1	Slave Control Address	Out of range: Slave Control Address		
2	Slave Control	Out of range: Slave Control		
3	Slave Monitoring Address	Out of range: Slave Monitoring Address		
4 - 15	Not Used	Reserved		

Output Buffer

By te s	S I o t	Name	Si ze [B yt es]	Data Type	Description	Default Range
0 - 3	1	Target Pressure	4	SINT32 or	Used as the target value In case the valve is in pressure mode (5),	0 - 1'000'

				FLOAT		000
4 - 7	2	Target Position	4	SINT32 or FLOAT	Used as the target value in case the valve is in position mode (2)	0 - 100'00 0
8 - 11	3	Zero Adjust Target Pressure	4	SINT32 or FLOAT	Typically 0, when the chamber is completely pumped down. Valid internal range is from -0.14 to 0.14	0 - 1'000' 000
12 - 15	4	Pressure Input Digital Sensor 1	4	SINT32 or FLOAT	Input from the digital sensor 1	0 - 1'000' 000
16 - 19	5	Pressure Input Digital Sensor 2	4	SINT32 or FLOAT	Input from the digital sensor 2	0 - 1'000' 000
20	6	Control Mode Target	1	UINT8	2 = Position 3 = Close: 4 = Open 5 = Pressure 6 = Hold: Valve kept in current position (Valid for Position and Pressure mode) 7 = Learn: Valve starts the internal learn procedure	Not scalabl e
21 - 22	7	General Control	2	UINT16	Bit-field of control bits. See the sub-chapter General Control - Bitmap description	Not scalabl e
23 - 24	8	PKW_PKE Out	2	UINT16	NotUsed	
25 - 26	9	PKW_IND Out	2	UINT16	NotUsed	
27 - 28	1 0	PKW_PWE1 Out	2	UINT16	NotUsed	
29 - 30	1 1	PKW_PWE2 Out	2	UINT16	NotUsed	
31 - 34	1 2	Slave Freeze Target Position	4	SINT32 or FLOAT	Used as the target position whenever " Slave Control" brings freeze mode 0 (position) to the controller. Scalable parameter.	0 - 100'00 0
33 - 34	1 3	Slave Control Address	1	UINT8	The address of controlled slave. Used for addressing for parameters " Slave Freeze Target Position" and " Slave Control"	Not scalabl e
35 - 36	1 4	Slave Control	2	UINT16	Bit 0 - Freeze: 1 = True, 0 = False Bit 1 - Freeze Mode: 0 = Position, 1 = Close Bit 2 - Data Valid: 0 = False, 1 = True	Not scalabl e

	-	1	1	1	1	r
37	1	Slave	1	UINT8	Address of the slave that should report back	Not
	5	Monitoring			following parameters within the input buffer:	scalabl
		Address			- Slave Actual Position	е
					- Slave Control Mode	
					- Slave Status	
					- Slave Warnings	

General Control - Bitmap description

	General Control					
Bit	Name	Description	Description			
0	Zero	0 = No Operation 1 = ZERO adjust, the actual pressure signal is set to internal pressure 0. The valid range for adjustment is limited to range from -1.4V to+1.4V. Otherwise the sensor must be adjusted!				
1	Notused	Reserved				
2	PING PONG TX BIT	This bit, transmitted from the master (PLC), is used to check the loop "Master - VAT station". See Section Communication between Master (PLC) and Slave (VAT-Valve)				
3	Notused	Reserved				
4	Access Mode Locked	Start Mode	Access Mode Locked	End Mode		
		local or remote	$0 \rightarrow 1$	locked		
		locked	$1 \rightarrow 0$	remote		
		Example: From local to remote: $0 \rightarrow 1, 1 \rightarrow 0$				
5	Plasma Mode On	0 = No Action 1 = Turn Plasma Mode ON if previously this bit was 0				
6	Plasma Mode Off	0 = No Action 1 = Turn Plasma Mode OFF if previously this bit was 0 Bits 5 and 6 are in collision. Therefore the bit 6 has higher priority than the bit 5.				
5 – 15	Not used	Reserved				

Communication between Master (PLC) and Slave (VAT-Valve)

Ping Pong Rx' and 'Pink Pong Tx' bits are listed in Table 8 and Table 12. The diagram below on Figure bellow shows visually the exchanging between the master (PLC) and the slave (VAT Controller)

Figure - Communication Master-Slave: Ping Pong Rx and Tx bits



2.6 Power connector IO

Do not connect other pins than indicated in the schematics! Use only screws with 4-40UNC thread for fastening the DA-15 connector!

2.6.1 Digital Inputs

_	Parameter	Description
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported
Digital Input 1.2	State	<i>True</i> means it is active. <i>False</i> means it is not active.
	Functionality	Interlock Open Open the Valve. Interlock Close Close the Valve. Hold Hold the actual position. High priority functionality
	Inverted	Inverted the functionality of the signal.

2.6.2 Digital Outputs

	Parameter	Description
	Enable	<i>True</i> means it is supported. <i>False</i> means it is not supported
Disital Output 1, 2	State	<i>True</i> means it is active. <i>False</i> means it is not active.
Digital Output 12	Functionality	<i>Open</i> Indicate the Open status of the Valve. <i>Close</i> Indicate the Close status of the Valve. <i>Hold</i> Indicate the Hold status of the Valve.
	Inverted	Inverted the functionality of the signal.

2.6.3 Connector assembling

The Connector on the Controller is a D-Sup 15 Pin male.



Pin	Signal	Description
1	+24VDC	Power supply fuse recommendation 5 AF
2	+24VDC	Power supply

З	GND	Ground
4	GND	Ground
5	Open	Digital output 1
6	Close	Digital output 2
7		Common output
9	Sensor power +15V	Input Sensor power +15V
10	Sensor power -15V	Input Sensor power -15V
11	Safety	Input Enable. Safety function. Input must be bridged to GND. Otherwise motor drive is not energized.
12	Open	Digital input 1
13	Close	Digital input 2
14		Common input

2.6.4 Wiring

Note: Only voltage control is possible for digital input. Specification: +-5..24V / 4..8mA



a) slow-blow fuse

2.7 Options

In this chapter are all possible Options for the IC2 Controller described in general.

Options:

- Cluster
- PFO (Power Failure Option)
- SPS (Sensor Power Supply)

2.7.1 **Power Down, Power Failure Option**

2.7.1.1 Behaviour in case of power failure

Valve position	Reaction of valve:		
before power failure:	Without Power Failure Option (PFO) 	With Power Failure Option (PFO) 	
Closed (isolated)	Valve remains closed.	Valve will close or open depending	
Valve open or in any intermediate position	The plate remains at the current position.	on Power Failure Option configuration. Default is close.	
		Display indicates F .	



All parameters are stored in a power fail save memory.

2.7.1.2 Power Failure Option

Power Failure option is circuit board that can store as much energy to close or open the valve in the event of a power failure.

Technical data

Charging Time	2 minutes max.
Durability	Up to 10 years @ 25°C ambient

These settings define what the valve is doing in case the power fails.

Valve must be equipped with the 'Power Failure Option' For PFO retrofit and other options refer to chapter: «Spare parts».

Parameter	Description
Enable	'True' enables the power fail reaction. 'False' there is no reaction on a power fail
State	 0 Battery is Charging 1 Ready to Use 2 Active 3 Failure
Functionality	0 Open 1 Close
Delay	In seconds After this delay the power failure reaction starts after the power failed. Helps to bridge a short power interruption.
Battery Voltage	Shows state of charge
Power Fail Cycles	Counts Power Failure

Location: CPA Parameters Power Fail Option

2.7.2 Cluster

2.7.2.1 Connection

The valve cluster uses a two wire bus for the inter communication between the Master and the Slave valves. The valves are connected in a daisy chain and the **bus must be terminated on both sides** by a 'Terminating Resistor' switch (**TR**). Refer to chapter: «Valve cluster address configuration».



valve cluster daisy chain

Link Adapter



Link cable



RJ45 pinning: active pins 4 and 5

Pin	Description						
1	not used						
2	not used						
3	not used						
4	Data						
5	Data						
6	not used						
7	notused						
8	not used						

VAT recommends a cable with the following specification:

- Standard patch cable
- Category 5 or higher
- Double ended with shielded RJ45 connector
- Straight through connection 1:1

2.7.2.2 CPA Parameters

In this Chapter the Program behavior and the most relevant Cluster functionalities and parameters of the CPA 4 will be described. The following picture shows an overview about the Cluster system Parameters.



Access Mode

In this case the parameter "Access Mode" stays for the whole Cluster system, means if one Slave is in Local-Mode it will be visible at the Parameter "Access Mode". In normal operation all cluster participants are in REMOTE mode. In this Mode the periodically and aperiodically commands (named "SDO" – are commands that can be send to an individual slave in the cluster) from the Master to the slave valves will be received and processed. If a Slave is in Local-Mode the periodically commands will be ignored, but the aperiodically commands will be processed, if the actual state of the valve controller will let them to process.

Control Mode Setpoint/ Control Mode

Within the Parameter "Control Mode Setpoint" it is possible to set different Control Modes to the whole Cluster system. There are not all Control Modes setable. The parameter "Control Mode" shows only the actual state.

Freeze Mode

With the Freeze Mode functionality it is possible to decouple an individual Slave from the cluster system. This means that the Slave, which is actual in the Freeze state, is not anymore following the cluster system and can be operate individually. From the Master it is possible to see, which slave is in Freeze Mode at the parameter "Freeze Status".

Connection Status

If a cluster participant does not respond within a defined timeout, the Offline status for this Slave will be set in the Master. This can have several reasons (e.g. Controller Power-OFF, cluster network error, other

defects). If the cluster participants are not able to communicate on the cluster network (timeout), then they will move to a defined position (connection-loss reaction) and remain there until communication is available again.

Position Offset

Through the Position Offset it is possible to adapt the Actual Position of a valve. The Position Offset can be set in a range of -/+ 30 % of the actual position scaling. It is also possible to select at the position offset whether the adapted position or the real position of the valve should be output. The Adapted Position is equal to the position setpoint and the real position is the sum of the position setpoint and the position offset. The Position Offset is available at a single valve or in the Cluster system. If the Position offset is used in a cluster system the Parameter - Actual Position "Adapted/Real" will be broadcasted from the master to each slave. Only the Position Offset is setable at each participating valve individually.

The following Schematic will show a cluster system with the same position offset, that is +20 % of the actual position scaling. Actual Position of the master valve (no position offset) is set to 10% of the actual position scaling. In this case the Real position will be shown – means at each valve where a position offset is set – the expected position should be the sum of the Actual Position and the position offset.



G-Command:

The G-commands are used to communicate with the individual cluster members individually. At the IC2 the G commands are still supported and finally transferred as aperiodical data (named "SDO") to the respective slave. The corresponding conversion takes place in the master Controller.

Display on the valve controller:

Is a Valve configured as a Slave, it will show the Slave Address (SLxx) on the display. Here is the Master represented as Slave 0 (SL 0). Leading zeros in the slave address are not displayed. The display changes periodically with the contents of the standard display (control mode + position).

If the Cluster option is active the parameter groups: Valve, Position Control, Pressure Control, Warning and Error Bitmap will be shown under the Cluster parameter group. The Functionality of these Parameters are the same, it is just that the Settings at the Master valve will be broadcasted to each salve to have the same behavior.

Settings:

Under the parameter group Settings it is possible to do general settings to configure the cluster system as it is needed. For example the **Number of Valves** that are participating in the cluster system. Slave x(x= stands for the cluster address):

The Parameter group e.g. Slave 0 represents all the settings that are processed to the Master valve. The same overview is given for every participating valve in the cluster system. That gives the possibility to steer all the settings from the master valve. The following picture should give an overview what parameters are covered by the parameter group Slave x.

₩ Parameters		– 🗆 X
Local 🌽 Remote 😯 Help		
parameters	/alues	
System	Freeze	False 🔹
 Valve Position Control 	Control Mode Setpoint	Position -
Pressure Control Pressure Sensor	Control Mode	Position •
 Interface RS232/RS485 	Access Mode	Remote 👻
 Power Connector Cluster 	Target Position [0 - 100]	80 ‡
Enable Control Mode Setpoint	Actual Position [0 - 100]	80 🌲
Control Mode	Speed Position Control	1 🖕
Access Mode	Isolated	False *
Position Control Pressure Control	Warning Bitmap	0 🐥
Isolated	Error Bitmap	0 🐥
Warning Bitmap Error Bitmap	Error Number	0 🐥
Connection Status	Connection Status	Online 🔻
SDO	Position Offset [0 - 100]	0 🗘
 Settings Slave 0 	Air Pressure [mbar]	4582.899 🌻
Slave 1	Restart Controller	False 🔹
Control Mode Setpoint Control Mode Access Mode Target Position Actual Position Speed Position Control Isolated Warning Bitmap Error Bitmap Error Number Connection Status Position Offset Air Pressure Restart Controller		Save
Parameter Group: 200F		ll.

2.7.2.3 Position Offset

Attention: Position Offset for Master Valve is no more available from Firmware Version F01.0C.28.27! (same as IC1)

If the User wants to set a **Position Offset**, than the first step would be to **Enable** the Position Adaption,

what is possible over the Master through the CPA4 under

Parameters.Cluster.Valve.PositionAdaption.Enable à TRUE

The Parameter *Actual Position*, what is shown in picture 7, is a possibility for the user to show the Adapted Position or the Real Position of the individual Slave.

Actual Position:	Real	=	Position Setpoint + Offset
	Adapted	=	Position Setpoint

This settings will be shared with all the other participants (=Slaves), that means every Slave will have Position Adaption Enable on TRUE and the same *Actual Position* setting(e.g. Adapted). (picture 7)



Picture : Position Adaption Enable - TRUE

Now the user can set an individual Position Offset to every Slave in the Cluster System over the Master Valve (Cluster Address 0). For example to set a Position Offset to Slave1 (Cluster address 1) Through the CPA4 à Parameters.Cluster.Slave1.PositionOffset (picture 8)

20 CPA - n.a.					- 0 X				2" CPA - 65346-PMGH-CDM	/0001				- 0 ×
Local 🤌 Remote				Version 4.	22" Parameters		- 0	×	Local 🤌 Remote				Version 4.1.1 (multi-val	
navigation	status information	control buttons	control panel	control p	Local 🤌 Remote 😧 Help			Т	Pacameters	status information Value Series	65.1	control buttons	control panel Actual Position	
Parameters	Valve Series 65.3	3 Open	Actual Position	Actual P	parameters	values	Palas	-	Information	Access Mode	Remote			80
hangsoon Parameters Information Pressure Pressure Pressure Strong Adaptive Learn Adaptive Learna Adaptive Lear	Value Sarias 65.1 Value Sarias 65.1 Access Mode Loco Control Mode Provi Control Mode Provi Control Mode Provi Control Residence Con Error Number 0 Error Number 0 Univer Firmsere Version F01. Cluster Address 0 Chart	a contraction and a contraction of the second secon	Land protect And Protect 100 100 100 100 100 100 100 10	Actual P Target P 1,33322 1,06657 0,799934 0,533289 0,266644	A class in the second sec	vites Press Press Control Mode Selpcen Control Mode Access Mode Access Mode Access Mode Target Position Accusal Position Select Sociated Sociated Sociate Connection Salas Econ Mande Connection Salas Econ Parater Econ	False Fundion Position Position Position Remote Position 450502 Feature 450502		Persenters Information	Valve Sanins Auces Mude Control Mude Error Number Error Cale Valve Firmware Version Cluster Adhess Mail Colleter Adhess	45.3 Renote Poston 0 P01.0C.28.11 2 Enable Mode Comet	Open Char Restart Presare Ster Statis Industry Costal Costal	Actual Position	80 80 00 00 00 00 00 00 00 00 00 00 00 0
	024 102 103 103 103 103 103 103 103 103	Time Stop Analyze	3864 3864 3864 3864 3864 3864 3864 3865 13655 3865 3865 3865 3865 3865 3865 3865	1.4 pi 1.2 2:00 pi 1.6 12 1.4 12 1.6 12 1.4 12 1.4	BRBE Free Free Free Correl Mode Exponen Correl Mode Information Acres Mode Information Acres Mode Acres Mode Acres Mode Acres Mode Acres Ac	Hessen Longsver	Jane Sart		 Faschar Rank Fasch	nton 568 Presention iz Presoure 5485 5485 Station Set Recention M Recention M Recention M Recention M Recention	target Pio Target Ann Actual Pio	iton I Iton Uad Iton Ral Iton Adapted	10 - 100 10 - 200 10 - 100 10 - 1	80 0 85 0 80 0 80 0
					Parameter Group: 200F			1	Parameter Group: 1066					

Picture : Set Position Offset over Master in CPA4

The following pictures should give an overview how it looks like if the Parameter *Actual Position* is set to Real and what impact it have to the Actual Position.



Ef CRA - n.a.					*		- 0 ×					
Local 🤌 Remote						Version 4.1	2017 Parameters				-	□ ×
navigation	status information		control buttons	control panel		control p	Local 🔎 Remote 😧 Help					
Parameters	Valve Series	65.3	Open	Actual Position		Actual Pr	parameters		values			
Information	Access Mode	Local	Close		85		+ Cluster	*	Freeze		False	•
 Pressure Pressure Control 	Control Mode	Position	Start Learn	Target Position	80 (Target Pr	Control Mode Setpoint		Control Mode Setpoint		Position	*
Pressure Sensor	Controller Selector	Controller 1	Zero Adjust	100-	100	1,333224	Control Mode Access Mode		Access Mode		Position	
Adaptive Learn	Error Number	0	Restart	80-	80	1,066579	# Valve I: Homing		Target Position	[0 - 100]	LUCA	80 0
Adaptive Learn Data	Error Code	0	Pressure Sim	60- D	60	0.7999345	Position Restriction Position Adaption		Actual Position	10 - 1001		85 0
# Tools			status indication				Enable		Speed Position Control			10
Terminal	Valve Firmware Version	F01.0C.28.11	Open	40-	40	0,533289	Oring Pull Out Prevention		isolated		False	÷
Sequencer			Closed	20-	20	0,266644	Speed Mode Position Control		Warning Bitmap			0.0
Trace Log	Cluster Address	0		0- -	0		Pressure Control Isolated		Error Bitmap			0 0
Update Tool	chart						Warning Bitmap		Error Number			0.0
Diagnostic File	85				138	647	Connection Status		Connection Status		Online	÷
CPA Scaling					-38	646.8	Freeze Status		Position Offset	[0 - 100]		5 0
	84				38	646.6	 Settings 		Air Pressure	[mbar]		5361.708 0
					-38	646.4	Freeze		Restart Controller		False	•
	83				38	646.2	Control Mode Setpoint					
	3					646 🖇 🖌	Access Mode					
	82				38	645.8 old	Target Position					
					-38	645.6	Speed Position Control					
	81				38	645.4	Isolated Warning Bitmap					
					-38	645.2	Error Bitmap					
	80				12:225	645	Connection Status					
			Time				Position Offset					
	Record Cle	ar Stop	Analyze				Restart Controller					
							# stove I Freeze					Save
							Parameter Group: 200E					

Picture : Position Offset with Actual Position - Real Setting



Picture : Position Offset with Actual Position - Real setting PositionOffset = 3 (at Slave1 means Cluster Address 1) and Position Offset = 5 (at Slave0 means Master \rightarrow Cluster Address 0)

2.8 Sequencer

2.8.1 Intro

210

Sequencer is an internal feature of the IC2 firmware that provides possibility to program and run several consecutive commands on the controller, without using any external interface and device. It supports up to 20 different commands that also could be periodic. Its main purpose is to have long time tests possible and to investigate performance and behavior of device in a timely controlled way.

Activation in the CPA

In the CPA, by default, the sequencer is hidden. It can be made visible by sending the command "p:010DF000000001" over Terminal:

Terminal		×
Local 🏓 Remote	0	VAT
value format IC2 command set]
Oecimal O Hexadecimal		
command		
	Pre	ss 'ENTER' to send
response		
p:00010DF00000001		
transmission history		
19:05:19.73 p:010DF000000001 p:00010DF000000001		

2.8.2 Main Parameter

Run - The main control that activates and deactivates the sequence running.

State – The main state (read-only) that tells in which stage is the sequence running now: IDLE, RUNNING, STOPPING, STOPPED, FINISHED, TIMEOUT or ERROR.

Starting Command – This parameter defines at which command in the sequence the execution starts at beginning.

Current command – Currently executing command or the last executed command in case a delay is going on.

Pre-Cycle Commands – String that lists all commands executed before the loop (cycle) if any. **Cycle commands** – String that lists commands executed in a loop, if any.

Target Cycles - Number of cycles that the sequence need to pass before it reaches the state FINISHED.

Target Time – Number of seconds that the sequence need to run before it goes to state FINISHED *Cycle Counter* – Number of executed cycles. Depending on "Saving Mode" parameter, it might be stored in memory.

Cycle time – Number of seconds that tells how long is current cycle running.

Running Time – Total sequence execution time. Depending on "Saving Mode" parameter, it might be stored in memory.

Controlword Bitmap – This bit-field controls more parameters at once It supports controlling the valve over EtherCAT. Bit 0 with it rising edge (from 0 to 1) makes the parameter "Run" to be TRUE.

Bit 1 makes the same parameter "Run" to be FALSE, regardless of its rising edge. In addition, it has higher priority than the bit 0, which means, as long as the bit 1 is high, the sequencer will never run. Bit 2 makes "Cycle Counter" zero whenever its transition from 0 to 1 happens (rising edge).

Section "Settings"

Run From State Stopped – This is relevant only in case the sequence is in state stopped. The parameter defines how the sequence will starts again. Possibilities are to continue with the next command or to start the whole sequence from the beginning again with or without the pre-cycle. If not, the first command will be the beginning of the loop (cycle).

Automatic Run After Restart – In case an external restart (power cycle) or an internal one (restart command) happens; here we define if we want automatically to continue the sequence run, once the controller has power supply again. Optionally, the pre-cycles can be included.

Stop At Command Error – Each command internally receives a feedback that may be an error report. If this happens, for whatever reason, here we define whether the sequencer stops (and goes to state ERROR) or not.

Command Timeout – In case that some command execution takes too long, here we define how long the sequencer will wait. Once this timeout is been reached, the sequencer will act according the following parameter "Command Timeout Action": stop or proceed to the next command.

Command Timeout Action – Here is defined what happens in case the timeout has been reached. Option "Stop" will bring the sequencer in state "Timeout". Option "Next Command" executes the next command (if any) after the timeout.

Saving Mode – In case the sequencer is running for a long time we might need to store the counter (cycles or time) in the non-volatile memory. «Saving Mode» defines whether the controller periodically stores elapsed time or number of already finished cycles in memory. In this way, the sequencer will continue counting after any kind of interruption. There are three options for saving: time, cycles, or nothing

Saving Cycle period and Saving Time Period – Depending on the previous parameter, here we define the saving period (how often the parameters will be saved). For example, if it is selected "Saving Cycle period" to be 100, and a system restart happens at the cycle number 294, the "Cycle counter" will have stored value 200, because it is the biggest number that is multiplication of 100 and less than 294. The current cycle number is sometimes additionally stored in memory after stopping and starting, regardless of the defined periods.

₩ Parameters		_		×
Local 🎾 Remote		\$ 0	\checkmark	Т
parameters > System > Valve > Position Control > Pressure Control > Pressure Sensor > Interface RS232/RS485 > Power Connector > Power Connector > Power Fail Option > Sequencer Enable Run State Starting Command Current Commands Cycle Commands Target Cycles Target Time Cycle Counter Cycle Time Running Time > Settings > Commands	values Run From State Stopped Automatic Run After Restart Stop At Command Error Command Timeout Command Timeout Action Saving Mode Saving Time Period	New Start Ind Without Pre- False Next Comma Running Tim	Cycle nd e 36	
Parameter Group: 0D41				

Section "Commands"

Function – For each command in the sequence this parameter defines the function. There are eight options: Parameter ID, Open, Close, Position, Pressure, Learn, Homing and Time Delay. Depending on selected function, the rest of parameters might be irrelevant. For example, Open and Close functions don't depend on the parameter Value.

Parameter ID and Parameter ID [hex] explicitly define which parameter is being controlled in case the function "[Parameter ID]" has been selected.

Parameters		– 🗆 X
Local 🏓 Remote		* 0 VAT
Power Connector Power Connector Power Fail Option Sequencer Enable Run State Starting Command Current Command Pre-Cycle Commands Cycle Commands Target Cycles Target Time Cycle Counter Neutron Parameter ID [hex] Value Delay / Tolerance Next Command 3 4 5	values Function Parameter ID [hex] Value Delay / Tolerance Next Command	[Parameter ID] ● 07100000 1 ↓ 2 ↓ 3 ●
Parameter Group: 0D4302	Valve: 670EC-24AG-AII1	

Valvo Firmwaro

212

Value - The value feeds different functions with position, pressure, etc.

Delay/Tolerance – This parameter has several purposes, depending on its value.

<u>If it is positive</u>, it defines a delay that the sequencer will wait until it starts execution of the next command in a sequence.

<u>If it is equal to -1</u>, it means that next command, if any, will be executed only when the current command reaches its goal: "Open" and "Position" reach the final positions, Homing is done, Target Pressure is achieved etc.

<u>If it is negative, bug greater than -1</u>, it will define the percentage tolerance of the given target Position or Pressure. For example -0.1 represents 10%, -0.25 represents 25% of the full scale etc. If a command's function is position with the target of 73 (out of 100), and the tolerance is -0.2 (20%), the goal will be achieved as soon as position reaches the range between $73 - 0.2 \times 100$ and $73 + 0.2 \times 100$, which is [53, 93]. Therefore, the next command will execute earlier comparing to the case with tolerance 0. This range has no effect on functions other than pressure and position.

Next command – It defines the following command. It can even be the same command, or some that is already been executed. Changing of these connections between commands directly updates the order of the commands execution.

Example

In the following example is described how the sequencer via CPA can be set to periodically run following 6 commands:

Command	1	2	3	4	5	6
Function	open	position	position	open	pressure	Open

Value	/	20%	70%	/	3 Torr	/
Delay	2s	0.2s	0.2s	2s	5s	2s

Commands need to be defined with all their fields, as shown in following snapshots:

Commands 1, 4 and 6:

Function	Open	•
Delay / Tolerance		2 🗘
Next Command	2	•

Command 2

214

Function		Position	•
Value	[0 - 100]		20 🗘
Delay / Tolerance			0.2 🗘
Next Command		3	•

Command 3

Function		Position •
Value	[0 - 100]	70 🗘
Delay / Tolerance		0.2 🗘
Next Command		4

Command 5

Function	F	Pressure	•
Value	[Torr]		з 🗘
Delay / Tolerance			4 🗘
Next Command	3	}	•

2.8.3 Interface EtherCAT

To use this sequencer functionality over EtherCAT a special firmware is required as well a specific ESI File to have all sequencer objects available in offline mode.

Sequencer Configurable PDO mapping

User can add additional objects to PDO Output mapping 0x16FF and the Input PDO mapping 0x1AFF.

How to create Input & Output mapping with EC-Engineer

To add the PDO parameters for the Sequencer in addition to the standard buffer (0x1601) in the configurable PDO buffer (0x16FF) following steps are necessary:

Mappin g object	Mapping co	ontent	Index	Sub- Index	Note
0x16FF	SINT UDINT REAL UINT	<i>Starting Command Target Cycles Target Time Controlword Bitmap</i>	0x2D00 0x2D00 0x2D00 0x2D00 0x2D00	3 5 6 10	See Note below* See Note below* Bit0:Run, Bit1:Stop, Bit2:Reset Cycle Counter

0x1AFF	UDINT SINT REAL	Cycle Counter Current Command Cycle Time Bunning Time	0x2D00 0x2D00 0x2D00	7 4 8	Optional
	REAL	Running Time State	0x2D00 0x2D00	9 2	Optional

*The Objects **Target Cycles** and **Target Time** are there to limit the Sequence. If both Objects are set to ZeSro this means that the Sequence will run until the user will set the Parameter/Object 'Run' to 'False'. If both Objects are set e.g. **Target Cycles**=3, **Target Time**=10 then the sequence will run until the lower limit of these two Objects are reached.

- In EC engineer the mapping the configuration is done in Configuration Mode
- Select output buffer 0x16FF "Outputs User 1" and click "Edit" button

✓ EC-Engineer [] File View Network Settings Help								- • •
Configuration Mode	🧱 Diagnosis Mode							
Project Explorer	Device Editor							
 Class-A Master Slave_1001 [VAT valve S613] (10) 	General PDO Mapping Vari	ables Advanced Option	s Init Commands Col	Object-Dictionary	Sync Units			FMMU/SM
	Inputs			0	utputs			
	▼	cluded by 0x1A01)		0x1A00	Name	Index	Bit Length	0X1004 ×
	Name	Index	Bit Length		Target Position	0x2E00:02	32	
	Actual Pressure	0x2F00:08	32	=	Control Mode Setpoint	0x2E00:05	8	
	Pressure Sensor 1	0x2F00:09	32	-	General Control Setpoint	0x2E00:05	16	
	Pressure Sensor 2	0x2F00:10	32		Output: Elast 3 (evolu	ded by 0x1601)	10	0/1605
	Actual Position	0x2F00:11	32		Outputs Hoat 5 (Exclu	Index	Pit Length	0.1003
	Control Mode	0x2F00:12	8		Transit De silier	Index	Bit bength	
	Error Number	0x2030:03	16		larget Position	0x2200:02	52	-
	General Status	0x2F00:13	16		Control Mode Setpoint	0x2F00:05	8	-
	General Warnings	0x2F00:14	16		General Control Setpoint	0x2F00:06	16	0x16FF
Classic View Flat View Topology View	L		Add	Delete Edit	Up Down		Load P	DO information

• Press "Add" to add a new object:

🛹 Edit PDO				
General				Optional
Name	Outputs Use	r 1		Exclude:
Index	0x16FF		Dec Hex	1600
Flags	Dire	ction		1602
Mandatory	0	TxPdo		1604
Fixed Content	0	RxPdo		1605
Virtual PDO				
Entries				
Name	1	ndex	Bit Lengt	th Comment
Add	Delete	Edit	Up	Down
	OK		Cancel	

• Now the User should enter the settings – e.g.: **Name:** 'Starting Command'

Index: '0x2D00'

Sub-Index: '3'

Datatype: SINT à lf a Datatype is selected, the Bit Length will be adapted automatically by the program EC-Engineer.

After all settings are Edit – the user can press OK.

产 EC-Engineer []													[- • •	
File View Network	Settings Help														
Configuration Mode	Export ENI	1	Diagnosis Mo	de											
Project Explorer		Device Edi	tor)r)	1								9
Class-A Master	/AT valve \$6131 (10)	General	PDO Mappin	Variables	Advanced O	options Init C	ommands	CoE Object-Dict	tionary	Syn	c Units			EN AL ICH	
<u> 2</u> 00002[0														FMMU/SM	
		Inputs	_						Ou Ou	utput	Culpus integer 5 (exc	uucu by 0x1001)		0.100-	
		•	Inputs Inte	ger 1 (exclude	d by 0x1A01)		Distances	0x1A00			Name	Index	Bit Length		
			Name		Index		Bit Length				Target Position	0x2F00:02	32		
			Pressure Sensor	1	0x2F00-09		32		Ξ		Control Mode Setpoint	0x2F00:05	8		
			Pressure Sensor	2	0x2E00:10		32				General Control Setpoint	0x2F00:06	16		
			Actual Position	-	0x2F00:11		32			•	Outputs Float 3 (exclud	led by 0x1601)		0x1605	
			Control Mode		0x2F00:12		8				Name	Index	Bit Length		
			Error Number		0x2030:03		16				Target Position	0x2200:02	32		
			General Status		0x2F00:13		16				Control Mode Setpoint	0x2F00:05	8	=	
			General Warnin	gs	0x2F00:14		16			Г	General Control Setpoint	0x2F00:06	16		
۲ III	•								*	-	Uputs User 1			0x16FF +	
Classic View Flat View	Topology View						Add	Delete	Edit		Up Down		Load PD	O information	
			-						_	_					-
General Name	Starting Co	ommand	ł												
Comment Swapping	None							-							
i i i i i i i i i i i i i i i i i i i	None														
Settings			_												
Index	0x2D00	Dec	Hex	ubIndex		3	Dec	Hex							
Datatype	SINT		▼ E	it Length	n	8									
CoE Object-Dictio	onary														
Index	Name						Ту	/pe 🗠							
	Control Mod	e					SI	NT							
⊕	Position Cont	trol					US	SINT							
€ ► 0x2300	Pressure Con	trol					US	SINT							
€ ► 0x2310	Pressure Con	troller S	elector				US	SINT							
⊕ ▶ 0x2311	Pressure Con	troller 1					US	SINT							
⊕ 0x2312	Pressure Con	troller 2					US	SINT							
	Pressure Con	troller 3					US								
		OK	(Cano	cel										

After pressing OK, the user should see the new Added Object. (Red Arrow)

• Press again "Add" and edit the other 3 PDO output objects (Target Cycles, Target Time, Controlword Bitmap) to the PDO output buffer 0x16FF.
217

tion Mode 🖶 Export ENI 🗮 Diagnosis Mode								
	Device Editor							
-A Master ave_1001 [VAT valve \$655] (1001)	General PDO Mapping Variables	Advanced Options Init Comm	ands CoE Object-Dictionary S	ync Units				PDO FMP
	Inputs				Outputs			
	Pressure Sensor 2	0x2402:24	32	^	Pressure Input Digital Sensor 1	0x2F00:03	32	
	Actual Position	0x2200:01	32		Pressure Input Digital Sensor 2	0x2F00:04	32	
	Control Mode	0x2002:00	8		Control Mode	0x2002:00	8	
	Error Number	0x2030/03	16		General Control Setpoint	0x2F00:06	16	
	General Status	0x2F00:13	16		 Outputs Float 2 			Ox1
	General Warnings	0x2F00:14	16		Name	Index	Bit Length	
	Extended Warnings	0x2F00:15	16		Target Pressure	0x2300:02	32	
	💌 🔲 Inputs Integer 2			0x1A02	Target Position	0x2200:02	32	
	Name	Index	Bit Length		Pressure Input Digital Sensor 1	0x2401:20	32	
	Actual Position	0x2F00:11	32		Pressure Input Digital Sensor 2	0x2402:20	32	
	Control Mode	0x2002:00	8	_	Control Mode	0x2002:00	8	
	Error Number	0x2030:03	16		General Control Setpoint	0x2F00:06	16	
	General Status	0x2F00:13	16		Outputs Integer 3			Ox
	General Warnings	0x2F00:14	16		Name	Index	Bit Length	
	Extended Warnings	0x2F00:15	16		Target Position	0x2F00:02	32	
	V Inputs Float 2			0x1A03	Control Mode	0x2002:00	8	
	Name	Index	Bit Length		General Control Setpoint	0x2F00:06	16	
	Actual Position	0x2200:01	32		Outputs Float 3			01
	Control Mode	0x2002:00	8		Name	Index	Bit Length	
	Error Number	0x2030/03	16		Target Position	0x2200.02	32	
	General Status	0x2F0013	16		Control Mode	0x2002-00	8	
	General Warnings	0/250014	16		General Control Setpoint	0x2E00:06	16	
	Extended Warnings	0/250015	16		V V Outputs liker 1			01
	Y Pl Insuits liter 1			OVIAFE	Name	Index	Bit Length	
	Name	Index	Bit Length		Starting Command	0/200003	8	
	Curle Time	0/200007	10		Tarnet Curles	0/200004	v	
	Punting Time	0/200005	12		Tarnet Time	0/200005	22	
	Automation and A							

Change in Diagnose Mode and change state to OP $_{\odot}$ Now this parameters are visible under Variables

•						
# EC-Engineer [C:\Users\muam\Documents\Testing\EC-Engineer\sequencer_configurablePDOmapping.ecc]					٥	×
File View Network Settings Help						
Configuration Mode 🚽 Export ENI 🗮 Diagnosis Mode 🕮 Take Snapshot						
Project Explorer	exice Editor					
	General Variables ESC Register EEPROM Extended Diagnosis DC Diagnosis CoE Object-Dictionary FoE					
Slave_1001 [VAT valve S655] (1001)						
	variables					
	Name Da	statype Master Sync Unit	Offset	- Size	Value Fo	rced
	Slave_1001 [VAT valve \$655].Outputs User 1.Starting Command Sil	NT Id 0: Default 0	OUT: 0	0.0 1.0	>	
	Siave_1001 [VAT valve S655] Outputs User 1.Target Cycles UD	DINT Id 0: Default 0	OUT:	1.0 4.0	5	
	Slave_1001 [VAT valve S655].Outputs User 1.Target Time R8	AL Id 0: Default 0	OUT:	5.0 4.0)	
	Siave_1001 [VAT valve 5655].Outputs User 1.Controlword Bitmap UI	NT Id 0: Default 0	OUT: 9	9.0 2.0	5	
						_

• The PDO Input buffer(0x1AFF) can be Added in the same way.

EC-Engineer [C:\Users\muam\Documents\Test	ing\EC-Engineer\sequencer_configurablePDOmapping.ecc	1							- 0 ×
File View Network Settings Help									
Configuration Mode 🖬 Export ENI	📕 Diagnosis Mode								
Project Explorer		Device Editor							
 Ulass-A Master 		General PDO Mapping Variables	Advanced Options Init Comm	ands CoE Object-Dictionary S	ync Units				
Slave_1001 [VAT valve \$655] (1001)									PDO FMMU/SM
		Inputs				Outputs			
		Actual Position	0x2200:01	32	^	Outputs integer 1			0/1600
		Control Mode	0x2002:00	8		Name	Index	Bit Length	
		Error Number	0x2030:03	16		Tarnet Pressure	0v2E00:01	v	
		General Status	0x2F00:13	16		Threat Parities	0-2500.02	22	
		General Warnings	0x2F00:14	16		Pressure Input Digital Sensor 1	0-2500.03	12	
		Extended Warnings	0x2F00:15	16		Pressure Input Digital Sensor 2	0x2500.04	32	
		▼ □ Inputs Integer 2			0x1A02	Control Mode	0x2002:00	8	
		Name	Index	Bit Length		General Control Seteniet	0-2502.05	16	
		Actual Position	0x2F00:11	32		Pressure Parent Time	0-2500-07	22	
		Control Mode	0x2002:00	8			04210007	24	0-1601
		Error Number	0x2030:03	16		Name	Index	Bit Lepath	GRIGOT
		General Status	0x2F00:13	16		Theory Bused on a	A-1200.03	the composition	
		General Warnings	0x2F00:14	16		Thread Davidian	0-2200.02	22	
		Extended Warnings	0x2F00:15	16		Press of District Press 1	0.2401.02	22	
		Inputs Float 2			0x1A03	Pressure input Digital Sensor 1	0-2401-20	24	
		Name	Index	Bit Length		Pressure input Digital Sensor 2	062402220	54	
		Actual Position	0x2200:01	32		Control Mode	0x200200	8	
		Control Mode	0x2002:00	8		General Control Setpoint	0x2F00:06	16	
		Error Number	0x2030:03	16		Pressure kamp Time	062F0007	54	
		General Status	0x2F00:13	16		Outputs integer 2		The Local Division of	0x1602
		General Warnings	0x2F00:14	16		Name	Index	bit Length	
		Extended Warnings	0x2F00:15	16		larget Pressure	0x2F00(01	32	
		▼ ✓ Inputs User 1			0x1AFF	Target Position	0x2F00:02	32	
		Name	Index	Bit Length		Pressure input Digital Sensor 1	06290003	52	
		Cycle Time	0x2D00:07	32		Pressure input Digital Sensor 2	0%2100004	st	
		Running Time	0x2D00:08	32		Control Mode	0x200200	8	
		State	0x2D00:02	8		General Control Setpoint	012100:06	16	
		Cycle Counter	0x2D00:06	32	~	Outputs Float 2			0x1603
					1	Name	Index	Bit Leooth	
Classic View Flat View Topology View				Add	Delete E				

• It is possible to select also Standard PDOmappings to 'Variables' and use them. In the picture bellow e.g. Target Position, Control Mode and General Control Setpoint.

Configuration Mode H Export ENI R Diagnosis Mode								
A fundamental and a	Durales Fallers			_				_
Class-A Master	General PDO Mapping Variables	Advanced Ontions Init Comm	ands Coli Object-Dictionany Su	ne llaite				
Slave_1001 [VAT valve \$655] (1001)	Contral		and cor object or control of s	inc only				PDO FMM
	too to			L.				
	Pressure Sensor 2	0x2402:24	12		Pressure Input Digital Sensor 1	0x2F00:03	32	
	Actual Position	0x2200:01	32		Pressure Input Digital Sensor 2	0x2F00:04	32	
	Control Mode	0x2002:00	8		Control Mode	0x2002:00	8	
	Error Number	0x2030.03	16		General Control Setpoint	0x2F00:06	16	
	General Status	0x2F00:13	16		Outputs Float 2			Ox1
	General Warnings	0x2F00:14	16		Name	Index	Bit Length	
	Extended Warnings	0x2F00:15	16		Target Pressure	0x2300:02	32	
	▼ □ Inputs Integer 2			0x1A02	Target Position	0x2200:02	32	
	Name	Index	Bit Length		Pressure Input Digital Sensor 1	0x2401:20	32	
	Actual Position	0x2F00:11	32		Pressure Input Digital Sensor 2	0x2402:20	32	
	Control Mode	0x2002:00	8		Control Mode	0x2002:00	8	
	Error Number	0x2030:03	16		General Control Setpoint	0x2F00:06	16	
	General Status	0x2F00:13	16		Outputs Integer 3			0x
	General Warnings	0x2F00:14	16		Name	Index	Bit Length	
	Extended Warnings	0x2F00:15	16	•	Target Position	0x2F00:02	32	
	V Inputs Float 2			0x1A03	Control Mode	0x2002:00	8	
	Name	Index	Bit Length		General Control Setpoint	0x2F00:06	16	
	Actual Position	0x2200:01	32		Outputs Float 3			0x
	Control Mode	0x2002:00	8		Name	Index	Bit Length	
	Error Number	0x2030/03	16		Target Position	0x2200:02	32	
	General Status	0x2F00:13	16		Control Mode	0x2002:00	8	
	General Warnings	0x2F00:14	16		General Control Setpoint	0x2F00:06	16	
	Extended Warnings	0x2F00:15	16		▼ ✓ Outputs User 1			0x
	▼ ✓ Inputs User 1			0x1AFF	Name	Index	Bit Length	
	Name	Index	Bit Length		Starting Command	0x2D00:03	8	
	Cycle Time	0x2D00:07	32		Target Cycles	0x2D00:04	32	
	Running Time	0x2D00r08	32		Target Time	0x2D00:05	32	
	State	0x2D00:02	8		Controlword Bitmap	0x2D00:09	16	

• At the End - Save master project to load this configuration on another device.

2.9 Display information

There is a 4 digit display located on the controller. It displays configuration, status and position information. For details refer to following tables.



2.9.1 Power up

Description	Digit 1	Digit 2	Digit 3	Digit 4
? 1 st Power On: All dots are illuminated	#	#	#	#
? 2 nd Valve series e.g. 67.0		6	7	0
? 3 rd Firmware: generation.type e.g. 01.0C	0	1	0	С
?4 th Firmware: version.firmware e.g. 07.00	0	7	0	0
? 5 th Controller configuration: e.g. 11.00	Controller 1=H1 2=H2 3=H3 4=H4 5=H5 6=H6 7=H7	Interface 1=RS232/RS485 2=EtherCAT 3=DeviceNet 5=Logic	Options 00=none 01=SPS 02=PFO 03=Cluster 04=SPS & PFC 05=SPS & Clus 06=PFO & Clus 07=SPS & PFC) ster ster) & Cluster
' Ho' homing is running	н	o		

2.9.2 Operation

Description / Mode	Digit 1	Digit 2	Digit 3	Digit 4		
Init (start up)	Ι	n.				
lnit (start up, leak tight)	I	n.		С		
Close	C.		-			
Open	0.		C. 0100			
Pressure control	Ρ.	valve position				
Position control	А.		C = closed	, leak tight		

CPA IC2(USB) Manual

Interlock Valve closed or open by digital input	I.
Hold (position frozen)	H.
Learn	L.
Safety Refer to «Safety mode» for details.	S.
Power failure	F.

2.9.3 Error

220

Description	Digit 1	Digit 2	Digit 3	Digit 4		
Error number (xyz)	E.	x	У	z		
alternately (if error code exist)						
Error code		u	v	w		

For Error number / code. Refer to «Trouble shooting» for details

2.10 Trouble shooting

2.10.1 General

Failure	Check	Action
Display does not light up	- 24 V pow er supply	 Connect valve to pow er supply according to 'Pow er, ground and sensor connection' and make sure that pow er supply is w orking.
Remote operation does not work	- Local operation via service port active	 Sw itch to remote or locked operation Refer to 'Remote and local operation'
	- Safety mode active Check for S on display	 Check 'Drive Pow er Enable Sw itch' Refer to 'Pow er, ground and sensor connection'
	 Interlock mode active Check for I on display 	 Check Digital Input Refer to 'Pow er connector IO' >> 'Digital Input'
POSITION CONTROL does not w ork	- Safety mode active Check for S on display	 Check 'Drive Pow er Enable Sw itch' Refer to 'Pow er, ground and sensor connection'
	 Interlock mode active Check for I on display 	 Check Digital Input Refer to 'Pow er connector IO' >> 'Digital Input'
	 POSITION CONTROL selected, check for A on display? 	- Select POSITION CONTROL mode. Refer to 'Control Mode' in 'EtherCAT' interface
Pressure reading is w rong	- Sensor connection	- Refer to 'Pow er, ground and sensor connection'

© VAT Group AG

Failure	Check	Action
	- ZERO done?	 Perform ZERO w hen base pressure is reached. Refer to 'Pressure Sensor' >> 'Zero Adjust'
	 Does sensor pow er supply provide enough pow er for sensor(s)? 	- Verify sensor supply voltage.
ZERO does not work	- ZERO disabled?	 Enable ZERO. Refer to 'Pressure Sensor' >> 'Zero Adjust'
	- Sensor voltage shifting?	- Wait until sensor does not shift any more before Performing ZERO.
Pressure is not '0' after ZERO	- System pumped to base pressure?	 OPEN VALVE and bring chamber to base pressure before performing ZERO.
	- Sensor offset voltage	- Adjust the offset direct at the sensor
	exceeds ±1.4V	- Check function of the sensor.
PRESSURE CONTROL does not w ork	 PRESSURE CONTROL selected, check for P on display? 	- Select PRESSURE CONTROL mode. Refer to 'Control Mode' in 'EtherCAT' interface
	- LEARN done?	 Perform LEARN. Refer to 'Pressure control' >> 'Adaptive algorithm' >> 'Learn'
	- Sensor signal ok?	- Refer to 'Pressure Sensor'
	- Pressure control setup done	- Refer to 'Pressure control'
PRESSURE CONTROL not optimal	- LEARN successfully done?	 Perform LEARN. Check 'Status' and 'Warning Info' in 'Pressure control' >> 'Adaptive algorithm' >> 'Learn'
	- ZERO performed before LEARN?	 Perform ZERO then repeat LEARN. Refer to 'Pressure Sensor' >> 'Zero Adjust'
	- Was gas flow stable during LEARN?	 Repeat LEARN w ith stable gas flow . Refer to 'Pressure control' >> 'Adaptive algorithm' >> 'Learn'
	- Tuning done?	- Tune valve for application. Refer to the tuning sections in 'Pressure Control'
	 Is sensor range suited for application? 	- Use a sensor with suitable range (controlled pressure should be >3% and < 98% of sensor full scale).
	- Noise on sensor signal?	- Make sure a shielded sensor cable is used.

2.10.2 Errors

2.10.2.1 Error numbers

Error numbers are three-digit decimal numbers (xyz) whereas:

x = component	y = mode	z = error type
 All Motor Units = Motor Unit 1 = Motor Unit 2 = Motor Unit 3 = Other 	 0 = Homing 2 = Operation Mode 8 = Other 	 0 = Position Error ¹) 1 = Not running: No communication with component x 2 = Error State: component x is running but in Status Error 8 = Other

1) Only in combination with component 1, 2, 3

2.10.2.2 Error code

Procedure in case of an error

- For deeper analysis of the error case are following data necessary:
 - Diagnostic file (before Restart command) -> see Diagnostic File. Load Error Data -> see Load Error Data.
- Check the corresponding error code and execute the necessary steps
- To leave the *Error* **Control Mode**, the **Error Recovery** function can be used or **Restart Controller** see Services.

Code	Description	Solution
u v w		
1	No valve connected	Connect valve controller to the valve
2	Non volatile memory failure	Replace valve controller
3	Analog digital converter of sensor input failure	Replace valve controller
4	Initialization of motion controller failed	 Wrong motion controller firmware version → Update motion controller firmware
5	Encoder index pulse not found	 Encoder failure O-Ring sticking 1)
6	Initialization of interface module failed	 Fieldbus: Valve firmware does not support interface type → Update valve firmware Wrong interface firmware version → Update interface firmware
7	Initialization of external drive eeprom failed	Check cables
1 0	Closing position can't be reached	• 1)
1 1	Homing position can't be reached	• 1)

Co	de	Description	Solution			
u v	w					
			Plate not mounted			
1	2	Motion controller: Internal voltage error	Check power supply			
1	3	Motion controller: Internal error temperature	Check for a heat accumulation			
1	4	Motion controller: Unexpected behavior	Contact vat support • Axis inverted • Encoder not connected • Break not released			
1	5	Motion controller: Target position can't be reached	1)Current settings			
1	6	Motion controller: Position minimal conductance cannot be reached	 1) Check Plate and Seal ring Check Parameter "Isolation Position Enter [r]" 			
1	7	Motion controller: Position to push back the Differential Plate cannot be reached	 1) Check Different Plate Check Parameter "Differential Plate Push Back Position [r]" 			
1	8	Motion controller: Minimal isolation position cannot be reached	 1) Check Plate and Seal ring Check Parameter "Isolation Position [r]" 			
2	0	Break slippery detected	Replace actuator			
3	0	SFV: Motion controller failure in master- slave communication	Contact vat support			
4	0	Compressed air error	Check compressed air			
4	2	Power supply, low voltage detected	Check if power supply is ok and is able to deliver needed power			
9	6	SFV: Position deviation axis1 to axis2 at homing procedure	O-Ring sticking1)			
9	7	SFV: Position deviation axis1 to axis2 at operating	1)			
9	8	Position error during closing procedure	1)			
9	9	Position error at operating	1)			
20	0	Valve configuration error, not possible to operate the valve with these configuration	Contact VAT support			
70	1	Wrong ident code axis 1	Check wiring			
70	2	Wrong ident code axis 2				
70	3	Wrong ident code axis 2 AND axis 1				
70	4	Wrong ident code axis 3				
70	5	Wrong ident code axis 3 AND axis 1				
70	6	Wrong ident code axis 3 AND axis 2				
70	7	Wrong ident code axis 3 AND axis 2 AND axis 1				
77	7	Do not operating mode active				

- Mechanical movement problem:
 Check for differential pressure
 Remove foreign object in movement area

224 CPA IC2(USB) Manual

- Eliminate tight movement
- Repair mechanical failure

If you need any further information, Please provide this information to your local contact Contact.

Your Local Contact	Get in touch, we are happy to support you and answer your questions and inquiries. Please select your country, if not already selected, to make sure we can respond to you quickly.				
United States	VAT Inc. San Jose	😢 +1 800 935 1446 >			
Ukraine	655 River Oaks Parkway 95134-1907, San Jose, CA) us@vatvalve.com >			
United Arab Emirates	United States				
United Kingdom					
United States	VAT USA	~			
Uruguay					
Uzbekistan	VAT US Representatives	~			
Vanuatu 🗸					

2.11 Appendix

2.11.1 Conversion Tables

2.11.1.1 Pressure

	Pa (N m ⋅²)	bar	mbar	µbar (dyn cm· ²)	Torr (mmHg)	micron (μ, mTorr)	atm	psi (lbf inch [.] ²)	psf (lbf ft-²)
Pa (N m⁻²)	1	1.10-₅	1·10 ⁻²	10	7.5·10 ⁻³	7.5	9.87·10 ⁻⁶	1.45.104	2.09·10 ⁻²
bar	1.10₅	1	1000	1·10 ⁶	750	7.5·10⁵	0.987	14.5	2.09·10 ³
mbar	100	1·10 ⁻³	1	1000	0.75	750	9.87·10 ^{_4}	1.45.10-2	2.09
µbar (dyn cm⁻²)	0.1	1.10-6	1·10 ⁻³	1	7.5·10-₄	0.75	9.87·10 ⁻⁷	1.45 · 10 - 5	2.09·10 ⁻³
Torr (mm Hg)	133	1.33·10 ⁻³	1.33	1330	1	1000	1.32·10 ⁻	1.93.10-2	2.78
micron (µ,mTorr)	0.133	1.33·10 ⁻⁶	1.33·10 [.] ₃	1.33	1·10 ⁻³	1	1.32.10-6	1.93 · 10 - 5	2.78·10 [.] 3
atm	1.01·10 ^₅	1.013	1013	1.01.106	760	7.6·10⁵	1	14.7	2.12·10 ³
psi (lbf inch ⁻²)	6.89·10 ³	6.89·10 ⁻²	68.9	6.89·10 ⁴	51.71	5.17·10 ⁴	6.8·10 ⁻²	1	144
psf (lbf ft-2)	47.8	4.78·10 ⁻⁴	0.478	478	0.359	359	4.72·10-4	6.94·10 ⁻³	1

2.11.1.2 Gas flow and leak rate

	Pa m₃ s	mbar Is	Torr Is	atm cm₃ s	lusec	sccm	slm	Mol s-1
Pa m³ s⁻¹	1	10	7.5	9.87	7.5·10 ³	592	0.592	4.41·10 ^{-₄}
mbar Is-1	0.1	1	0.75	0.987	750	59.2	5.92·10 ⁻²	4.41·10 ⁻⁵
Torr Is-1	0.133	1.33	1	1.32	1000	78.9	7.89·10 ⁻²	5.85·10 ^{-₅}
atm cm³ s-1	0.101	1.01	0.76	1	760	60	6·10-2	4.45 • 10 - 5
lusec	1.33 ⋅ 10-4	1.33·10 ⁻³	10 ⁻³	1.32·10 ⁻³	1	7.89·10 ⁻²	7.89·10 ^{-₅}	5.86·10 ⁻⁸
sccm	1.69.10-3	1.69·10 ⁻²	1.27·10 ⁻²	1.67·10 ⁻²	12.7	1	10 ⁻³	7.45·10 ⁻⁷
slm	1.69	16.9	12.7	16.7	1.27.104	1000	1	7.45.104
Mol s ⁻¹	2.27·10 ³	2.27·10 ⁴	1.7·10⁴	2.24.104	1.7·10 ⁷	1.34.106	1.34·10 ³	1

2.11.1.3 Temperature

	К	°C	°F
κ	1	K -273.15	9/5 x K -459.67
°C	°C +273.15	1	9/5 x °C +32
°F	5/9 x (°F +459.67)	5/9 x (°F -32)	1

2.11.1.4 Torque

	Nm	ft Ibs	kp m	kgf cm
Nm	1	0.738	0.102	10.2
ft Ibs	1.36	1	0.138	13.8
kp m	9.81	7.23	1	100
kgf cm	0.098	0.072	0.01	1