CEM-AA-B

Description:

This adaptable power amplifier is configurable to drive either single or dual solenoid, or two independent proportional valve coils up to 2.6A. A wide range of analog or digital signals are accepted dependent on the configuration. User may select either voltage, current or digital input mode. These inputs are easily scaled to match system requirements.

The CEM-AA-B module has three selectable function modes:

- **Function mode AA** for operating one single or dual solenoid Proportional Control Valve
- **Function mode A-B** for operating independently two single solenoid Proportional Control Valves
- **Function mode RA**, This mode accepts 3 independent switch inputs, each which has independently adjustable speed and ramp controls. Inputs are additive, for up to 8 unique preset speed and ramp profiles.

Independent Ramp of acceleration and deceleration, IMIN and IMAX, PWM, DITHER settings are programmable. In addition the valve characteristics can also be linearized via 10 X-Y points per solenoid output.

The module is disabled if the coil outputs are shorted or open. If command current signal is outside of the proper range, the module is disabled.

This module is easily adapted to a variety of system requirements. All variables are user adjusted with easy to use CHI-PC software on your Microsoft Windows laptop. Control variables are stored in non-volatile memory internal to the module. All variables can be read by the laptop, and reproduced exactly on other modules.

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Technical Data - All Function Modes:

Power supply	**[VDC]**	12… 30 (incl. ripple)
Power consumption max.	**[W]**	60 (depending on type of solenoid, two solenoids are active)
External fuse	**[A]**	3 medium time lag
Reference voltage	**[V]**	8 (maximum 25 mA)
Digital inputs	**[V]**	logic 0: < 2
	[V]	logic 1: > 10
Input resistance	**[kΩ]**	25
Digital outputs	**[V]**	logic 0: < 2
	[V]	logic 1: > 12 (50 mA)
Analogue inputs	**[V]**	±10 / 0… 10; 90 kΩ
	[mA]	4...20; 390 Ω
Resolution	**[%]**	< 0.01
Nominal PWM output current	**[mA]**	500… 2600; broken wire monitored and short circuit proof.
PWM frequency	**[Hz]**	61...2604; adjustable in steps
Sample time (process control)	**[ms]**	1
Sample time (solenoid current control)	**[ms]**	0.125
Interface		USB type B Virtual COM port driver (CHI-PC): 9600… 57600 Baud (Default = 57600), 1 Stop bit, No parity, No handshake
Housing		Snap On Module EN 50022 Polyamide PA 6.6 Combustibility class V0 (UL94)
Weight	**[kg]**	0.190
Protection class		IP20
Temperature range	**[°C]**	-20… 60
Storage temperature	**[°C]**	-20 …70
Humidity	**[%]**	<95 (not condensing)
Vibration	**-**	IEC 60068-2-6 (category C)
Connections		USB type B 4 x 4 pol. screw terminals PE: direct via DIN rail
EMC		EN 61000-6-2: 8/2005 EN 61000-6-4: 6/2007 ; A1:2011

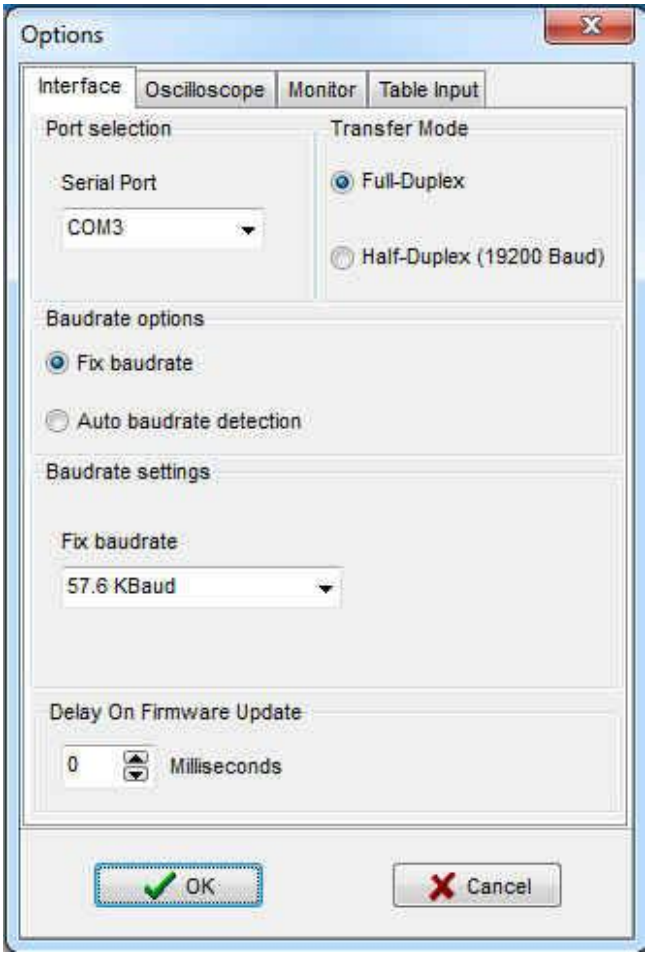
LED Indications - All Function Modes:

LED's	Description of the LED function
GREEN + YELLOW	**1. Chasing light (over all LEDs):** The bootloader is active. No normal functions are possible. **2. All LEDs flash shortly every 6 s:** An internal data error was detected and corrected automatically! The module still works regularly. To acknowledge the error the module has to have power cycled.
Yellow + Yellow	**Both yellow LEDs flash oppositely every 1 s:** The nonvolatile stored parameters are inconsistent! To acknowledge the error the data has to be saved with the SAVE command or the corresponding Function button in the CHI-PC program. If one of the FUNCTION parameter is changed to an incorrect value, that parameter value is deleted purposely, and set to default values. In this case the LEDs indicate no error.
GREEN	Identical to the READY output. **OFF:** No power supply or ENABLE is not activated **ON:** System is ready for operation **Flashing:** Error detected (e. g. valve solenoid or 4… 20 mA). Not active when SENS = OFF.
YELLOW	**LED in the middle position** = Current, Channel A; the intensity is proportional to the output current **LED in the right position** = Current, Channel B; the intensity is proportional to the output current

Steps to install and configure a new application:

All parameters are adjusted using VEA-BUSB programming cable and CHI-PC Microsoft Windows application.

1. Mount the module in a suitable location
2. Connect the power supply and valve solenoids
3. Down load and open the GUI program (www.continentalhydraulics.com/wp-content/uploads/2015/01/setup-CEWMPC-10-v3.5.0.zip)
4. Connect to Laptop via USB to USB Type B communication cable.
5. Open the Options Tab and in setting, verify that the correct com port, full-Duplex and 57.6K Baud rates are selected.



6. Select Desired Function (AA / A-B / RA) for your application as desired, Click the ID button to update the Parameter list.
7. Adjust current range to match valve
8. Adjust PWM / Dither to optimize performance of the valve
9. Adjust analog input to voltage or current, and scale input if required.
10. Adjust ramping (if desired)
11. Adjust internal monitor functions (if desired)
12. Adjust current output to the valve for the flow / pressure required (if desired)

Module Mounting Location:

This module is to be mounted in a cabinet for protection from the local environment.
Ensure there is adequate free space around the module to allow for cooling air flow.
This module is designed to snap onto an industry standard 35mm DIN rail.
Do not mount near other modules that emit high power electrical interference, such as motor controllers and high power contactors.

Power Supply:

This module is designed to operate on DC power from a regulated power supply ranging from 12 to 30 volts. Match valve solenoid voltage rating to power supply, typically 12 or 24 volts.

A 3 amp medium action fuse is recommended in the "+" power supply line.

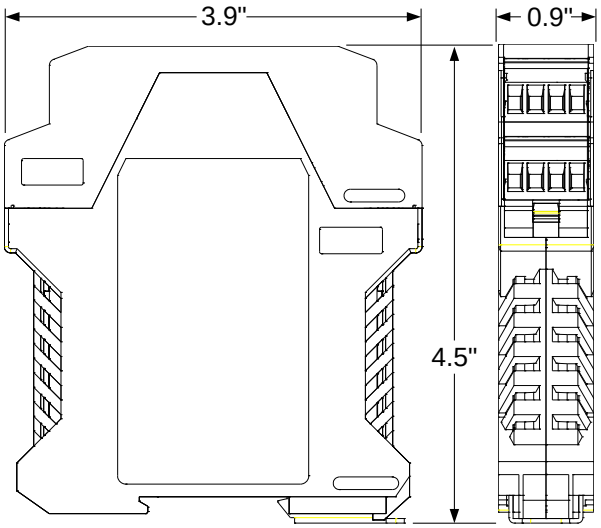
Wiring to Valve:

Two conductors are required for each solenoid. There is no need for shielding on these power conductors.

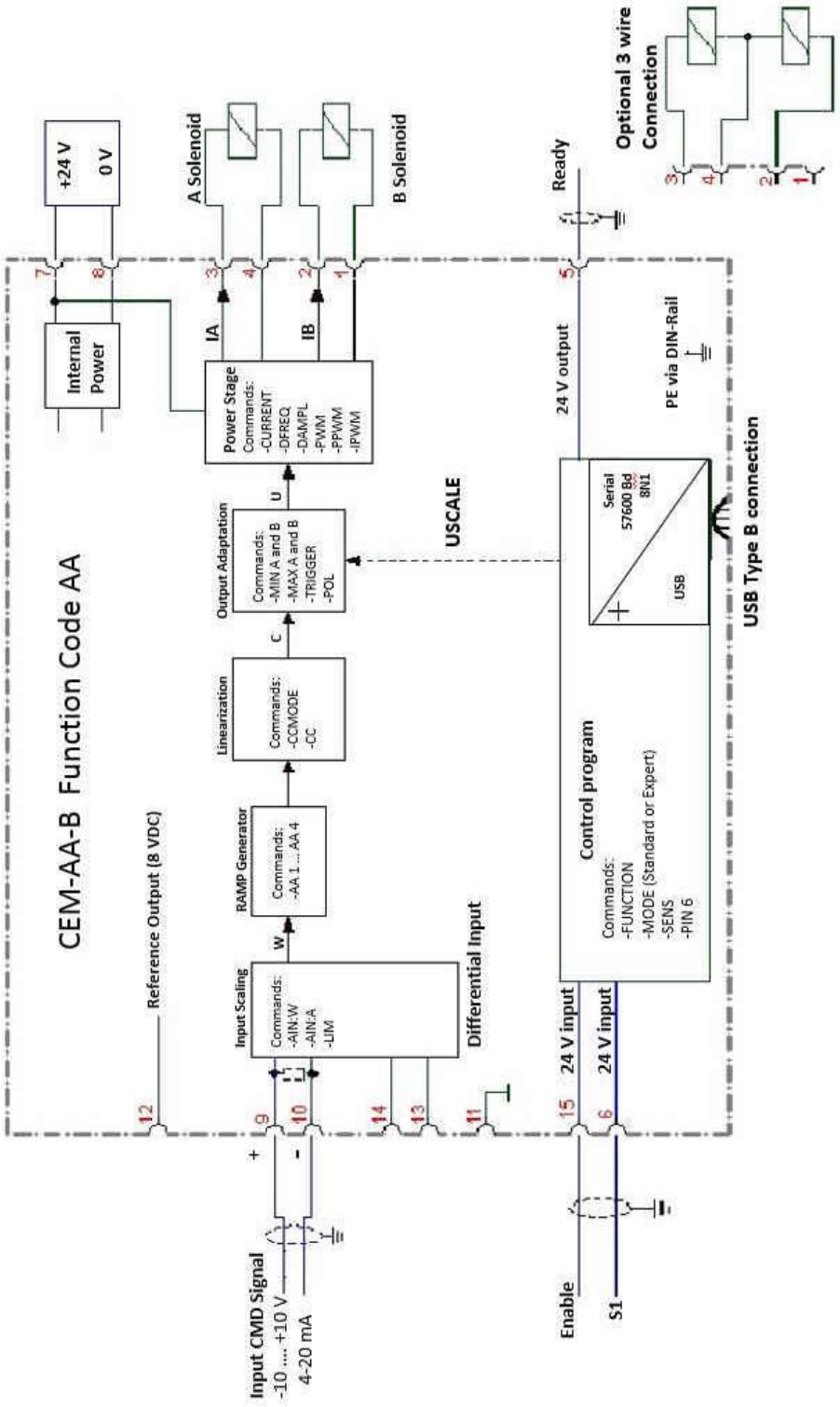
Wire size is chosen to provide an acceptable voltage drop between the module and the valve solenoid. The following chart is based on 5% drop for 12v and 24v applications. The listed cable length is distance from module to valve, and includes the voltage drop of the return conductor.

Wire size	2.6A 12v	1.6A 24v	0.86A 24v
12 gauge	66 ft max	215 ft max	400 ft max
14 gauge	49 ft max	159 ft max	295 ft max
16 gauge	31 ft max	100 ft max	186 ft max
18 gauge	19 ft max	63 ft max	117 ft max
20 gauge	13 ft max	39 ft max	73 ft max
22 gauge	8 ft max	25 ft max	46 ft max

Dimensions:



Circuit Diagram Function AA



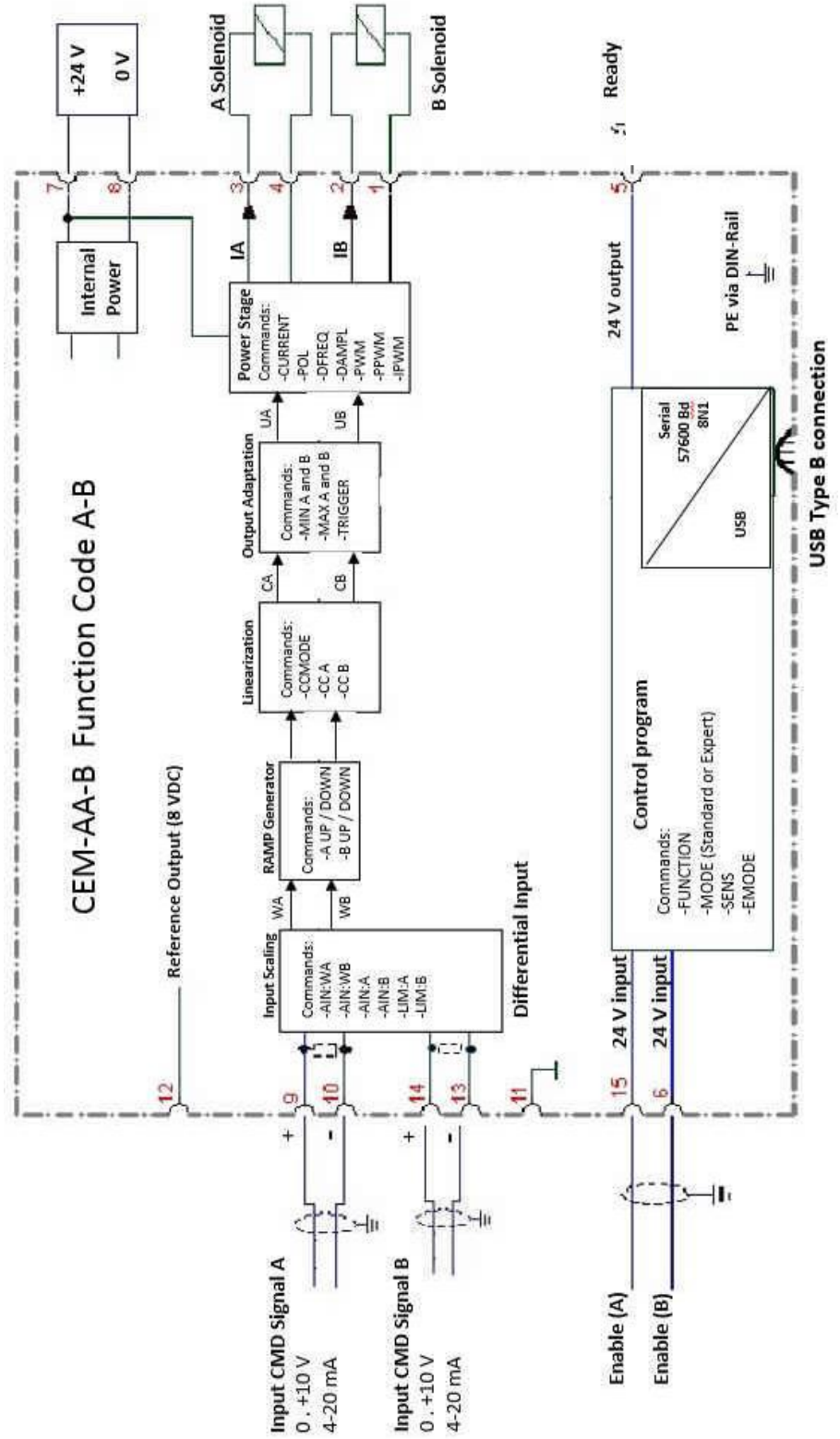
CEM-AA-B Function AA Input and Output Terminals

Connection	Supply
PIN 7	Power supply (see technical data)
PIN 8	0 V (GND) Power supply (ground). **Attention**, PIN 8 and PIN 11 are connected internally. PIN 11 is used as the GND potential for the command and feedback signals..
Connection	**Reference voltages output**
PIN 12	Reference output voltage (8 V).
Connection	**PWM output**
PIN 3 / 4	Current controlled PWM outputs for solenoid A.
PIN 1 / 2	Current controlled PWM outputs for solenoid B.
Connection	**Analogue input signals**
PIN 9 / 10	Command (input) signal (W), range -100…100 % corresponds with -10…10 V or 4…20 mA
PIN 11	0 V reference for the signal inputs. **Attention**, PIN 8 and PIN 11 are connected internally
Connection	**Digital inputs and outputs**
PIN 15	**Enable Input**: This digital input signal initializes the application. The output and the READY signal will be activated. By deactivating, error signals are reset.
PIN 6	**S1 input:** Function depends on parameter **PIN:6** (USCALE/RAMP). **OFF:** Output current depends on parameter USCALE; ramp function is deactivated. **ON:** Output current is not scaled by USCALE, ramp function is activated.
PIN 5	**READY output**: **ON:** Module is ready, no errors are detected **OFF:** ENABLE (PIN 15) is deactivated or an error is detected.

Parameter List Function AA

Ref Page	Command	Parameter	Help / Description	MODE STD	MODE EXP
16	**FUNCTION**	AA	Function mode (AA / A-B / RA) Press ID button after selection	X	X
16	**LG**	EN	EN English	X	X
16	**MODE**	EXP	Standard / Expert mode	X	X
17	**SENS**	AUTO	Malfunction monitoring [ON / OFF /AUTO]	X	X
17	**CCMODE**	OFF	Characteristics linearization [ON / OFF]		X
18	**PIN:6**	USCALE	Function of PIN 6 [USCALE / RAMP]		X
18	**USCALE**	10000	Output current scale in 0.01%		X
19	**LIM**	0	Range control input signal in 0.01%		X
20	**POL**	+	Output polarity (+/-)	X	X
20	**AINA**	V	Input switching, voltage or current [V/C] (Voltage default)	X	
20	**AIN:A**	1000 1000 0 V	Input scaling via linear equation		X
22	**AA:1**	100	Ramptime acceleration A in ms	X	X
22	**AA:2**	100	Ramptime deceleration A in ms	X	X
22	**AA:3**	100	Ramptime acceleration B in ms	X	X
22	**AA:4**	100	Ramptime deceleration B in ms	X	X
26	**CC**	characteristic curve	Free definable characteristic linearization		
27	**MIN:A**	0	Compensation of the Deadband in 0.01%	X	X
27	**MIN:B**	0	Compensation of the Deadband in 0.01%	X	X
27	**MAX:A**	10000	Output Scaling in 0.01%	X	X
27	**MAX:B**	10000	Output Scaling in 0.01%	X	X
27	**TRIGGER**	200	Trigger point of the MIN function in 0.01%	X	X
29	**CURRENT**	1000	Rated solenoid current 500…. 2600 mA	X	X
29	**DAMPL**	500	Dither amplitude in 0.01% of rated current	X	X
29	**DFREQ**	121	Dither frequency in Hz	X	X
30	**PWM**	2604	PWM frequency in Hz		X
30	**ACC**	ON	Auto Adjustment of the current loop [OFF / ON]		X
31	**PPWM**	7	P-Gain of the current loop		X
31	**IPWM**	40	I-Gain of the current loop		X

Circuit Diagram Function A-B



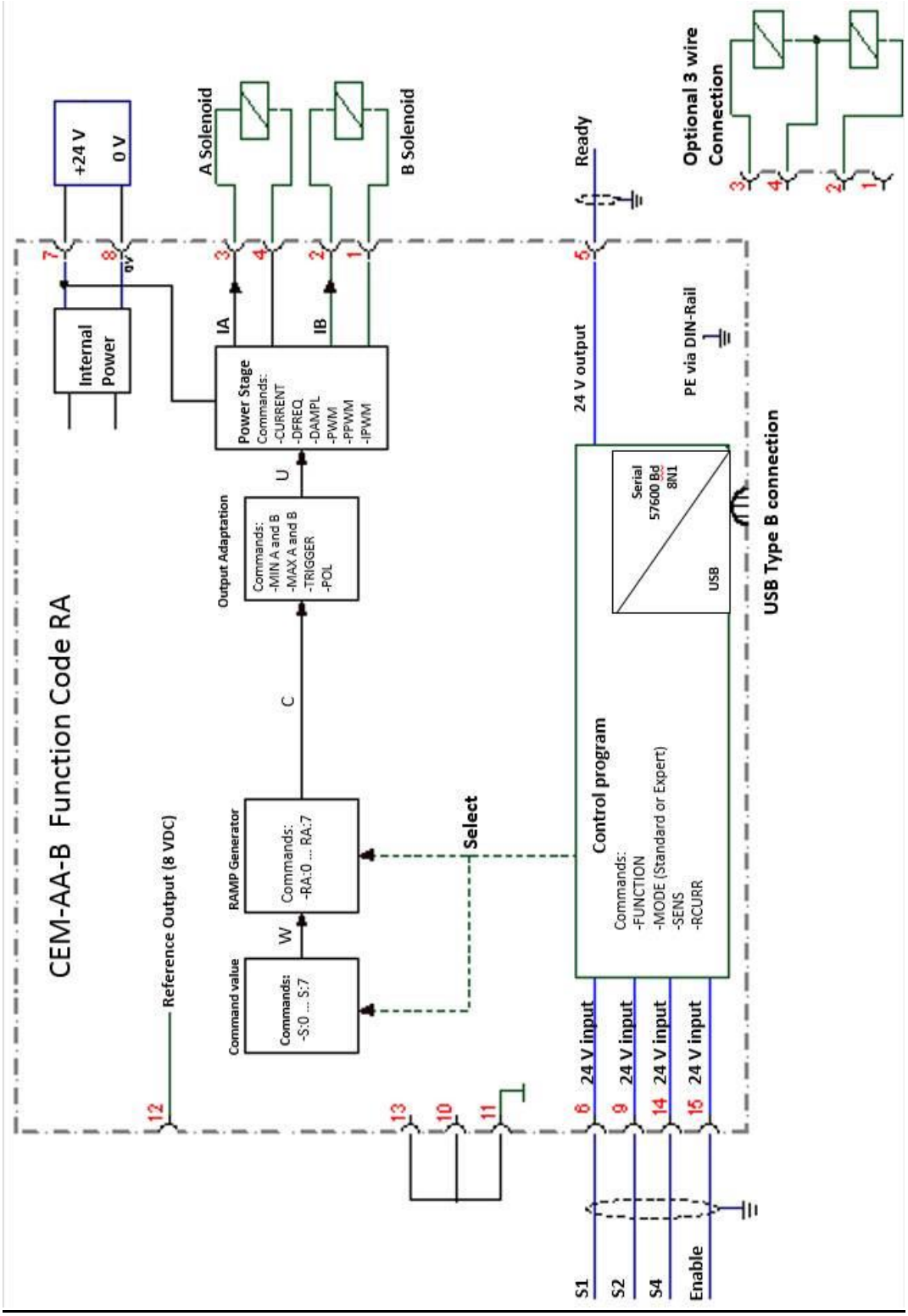
CEM-AA-B Function A-B Input and Output Terminals

Connection	Supply
PIN 7	Power supply (see technical data)
PIN 8	0 V (GND) Power supply (ground). **Attention**, PIN 8 and PIN 11 are connected internally. PIN 11 is used as the GND potential for the command and feedback signals.
Connection	**Reference voltages output**
PIN 12	Reference output voltage (8 V)
Connection	**PWM output**
PIN 3 / 4	Current controlled PWM outputs for solenoid A
PIN 1 / 2	Current controlled PWM outputs for solenoid B
Connection	**Analogue input signals**
PIN 9 / 10	Command (input) signal A, range 0…100 % corresponds with 0…10 V or 4…20 mA
PIN 13 / 14	Command (input) signal B, range 0…100 % corresponds with 0…10 V or 4…20 mA
PIN 11	0 V reference for the signal inputs. **Attention**, PIN 8 and PIN 11 are connected internally
Connection	**Digital inputs and outputs**
PIN 15	**Enable Input Channel A/B or Channel A (dependent on ENABLE_B)**: This digital input signal initializes the application. The output and the READY signal will be activated. By deactivating error signals are reset.
PIN 6	**Enable Input Channel B (dependent on ENABLE_B)**: This digital input signal initializes the application. The output and the READY signal will be activated. By deactivating error signals are reset.
PIN 5	**READY output**: **ON:** No internal or external errors are detected. **OFF:** Both power stages are deactivated or an error is detected.

Parameter List Function A-B

Ref Page	Command	Parameter	Help / Description	MODE STD	MODE EXP
16	**FUNCTION**	A-B	Function mode (AA / A-B / RA) Press ID button after selection	X	X
16	**LG**	EN	EN English	X	X
16	**MODE**	EXP	Standard / Expert mode	X	X
17	**SENS**	AUTO	Malfunction monitoring [ON / OFF /AUTO]	X	X
17	**CCMODE**	OFF	Characteristics linearization [ON / OFF]		X
18	**ENABLE-B**	OFF	Separate enable signals [OFF / ON]		x
19	**LIM:A**	0	Range control input signal in 0.01%		X
19	**LIM:B**	0	Range control input signal in 0.01%		X
20	**POL:A**	0	Output polarity (+/-)	X	X
20	**POL:B**	+	Output polarity (+/-)	X	X
20	**AINA**	V	Input switching, voltage or current [V/C] (Voltage default)	X	
22	**AINB**	V	Input switching, voltage or current [V/C] (Voltage default)	X	
21	**AIN:A**	1000 1000 0 V	Input scaling via linear equation		X
21	**AIN:B**	1000 1000 0 V	Input scaling via linear equation		X
22	**AA:UP**	100	Ramptime acceleration A in ms	X	X
22	**AA:DOWN**	100	Ramptime deceleration A in ms	X	X
22	**AB:UP**	100	Ramptime acceleration B in ms	X	X
22	**AB:DOWN**	100	Ramptime deceleration B in ms	X	X
25	**CCA**	characteristic curve	Free definable characteristic linearization		X
25	**CCB**	characteristic curve	Free definable characteristic linearization		X
27	**MIN:A**	0	Compensation of the Deadband in 0.01%	X	X
27	**MIN:B**	0	Compensation of the Deadband in 0.01%	X	X
27	**MAX:A**	10000	Output Scaling in 0.01%	X	X
27	**MAX:B**	10000	Output Scaling in 0.01%	X	X
27	**TRIGGER**	200	Trigger point of the MIN function in 0.01%	X	X
29	**CURRENT:A**	1000	Rated solenoid current 500…. 2600 mA	X	X
29	**CURRENT:B**	1000	Rated solenoid current 500…. 2600 mA	X	X
29	**DAMPL:A**	500	Dither amplitude in 0.01% of rated current	X	X
29	**DAMPL:B**	500	Dither amplitude in 0.01% of rated current	X	X
29	**DFREQ:A**	121	Dither frequency in Hz	X	X
29	**DFREQ:B**	121	Dither frequency in Hz	X	X
30	**PWM:A**	2604	PWM frequency in Hz		X
30	**PWM:B**	2604	PWM frequency in Hz		X
30	**ACC**	ON	Auto Adjustment of the current loop [OFF / ON]		X
31	**PPWM:A**	7	P-Gain of the current loop		X
31	**PPWM:B**	7	P-Gain of the current loop		X
31	**IPWM:A**	40	I-Gain of the current loop		X
31	**IPWM:B**	40	I-Gain of the current loop		X

Circuit Diagram Function RA



CEM-AA-B Function RA Input and Output Terminals

Connection	Supply
PIN 7	Power supply (see technical data)
PIN 8	0 V (GND) Power supply (ground). **Attention**, PIN 8 and PIN 11 are connected internally. PIN 11 is used as the GND potential for the command and feedback signals.
Connection	**Reference voltages output**
PIN 12	Reference output voltage (8 V).
Connection	**PWM output**
PIN 3 / 4	Current controlled PWM outputs for solenoid A
PIN 1 / 2	Current controlled PWM outputs for solenoid B.
Connection	**Analogue input signals**
PIN 6 / 9 / 14	**Digital gate inputs for selecting the command value:** PIN 6: S1 PIN 9: S2 PIN 14: S4 The whole range of set points can be chosen by binary coding of these inputs.
PIN 11	0 V reference for the signal inputs. **Attention**, PIN 8 and PIN 11 are connected internally.
Connection	**Digital inputs and outputs**
PIN 15	**Enable Input**: This digital input signal initializes the application. The output and the READY signal will be activated. By deactivating error signals are reset.
PIN 5	**READY output**: **ON:** No internal or external errors are detected **OFF:** ENABLE (PIN 15) is deactivated or an error is detected

Parameter List Function RA

Ref Page				MODE		
	Command	Parameter	Help / Description	STD	EXP-SD	EXP-4Q
16	**FUNCTION**	RA	Function mode (AA / A-B / RA) Press ID button after selection	X	X	X
16	**LG**	EN	EN English	X	X	X
16	**MODE**	EXP	Standard / Expert mode	X	X	X
17	**SENS**	AUTO	Malfunction monitoring [ON / OFF /AUTO]	X	X	X
17	**SOLENOIDS**	2	Number of Solenoids	X	X	X
23	**RMODE**	SD	Rampmode SD or 4Q	X	X	X
23	**S:0**	0	Demand value related to the digital inputs in 0.01%	X	X	X
23	**S:1**	0	Demand value related to the digital inputs in 0.01%	X	X	X
23	**S:2**	0	Demand value related to the digital inputs in 0.01%	X	X	X
23	**S:3**	0	Demand value related to the digital inputs in 0.01%	X	X	X
23	**S:4**	0	Demand value related to the digital inputs in 0.01%	X	X	X
23	**S:5**	0	Demand value related to the digital inputs in 0.01%	X	X	X
23	**S:6**	0	Demand value related to the digital inputs in 0.01%	X	X	X
23	**S:7**	0	Demand value related to the digital inputs in 0.01%	X	X	X
24	**RA:0**	100	Ramptime related to the digital inputs in ms	X	X	
24	**RA:1**	100	Ramptime related to the digital inputs in ms	X	X	
24	**RA:2**	100	Ramptime related to the digital inputs in ms	X	X	
24	**RA:3**	100	Ramptime related to the digital inputs in ms	X	X	
24	**RA:4**	100	Ramptime related to the digital inputs in ms	X	X	
24	**RA:5**	100	Ramptime related to the digital inputs in ms	X	X	
24	**RA:6**	100	Ramptime related to the digital inputs in ms	X	X	
24	**RA:7**	100	Ramptime related to the digital inputs in ms	X	X	
22	**AA:1**	100	Ramptime acceleration A in ms			X
22	**AA:2**	100	Ramptime deceleration A in ms			X
22	**AA:3**	100	Ramptime acceleration B in ms			X
22	**AA:4**	100	Ramptime deceleration B in ms			X
26	**CC**	characteristic curve	Free definable characteristic linearization		X	X
27	**MIN:A**	0	Compensation of the Deadband in 0.01%	X	X	X
27	**MIN:B**	0	Compensation of the Deadband in 0.01%	X	X	X
27	**MAX:A**	10000	Output Scaling in 0.01%	X	X	X
27	**MAX:B**	10000	Output Scaling in 0.01%	X	X	X
27	**TRIGGER**	200	Trigger point of the MIN function in 0.01%	X	X	X
29	**CURRENT**	1000	Rated solenoid current 500.... 2600 mA	X	X	X
29	**DAMPL**	500	Dither amplitude in 0.01% of rated current	X	X	X
29	**DFREQ**	121	Dither frequency in Hz	X	X	X
30	**PWM**	2604	PWM frequency in Hz		X	X
30	**ACC**	ON	Auto Adjustment of the current loop [OFF / ON]		X	X
31	**PPWM**	7	P-Gain of the current loop		X	X
31	**IPWM**	40	I-Gain of the current loop		X	X

Parameter Descriptions

FUNCTION (Function mode)

Command	Parameters	Unit	Group
FUNCTION X	x= AA|A-B|RA	-	STD

The general Operating function of the module will be defined by this command.

AA: Functionality for directional valves with two solenoids and analogue input signals

A-B: Functionality for two pressure/throttle valves with analogue input signals

RA: Functionality for directional, pressure and throttle valves with pre-programmed values, selectable by digital inputs.

After changing this parameter the **ID-button has to be pressed** in order to rebuild the parameter table and a **SAVE button** has to be conducted.

LG (Changing the language for the help texts)

Command	Parameters	Unit	Group
LG X	x= EN English DE German	-	STD

Either English or German can be selected for the help texts in the CHI-PC Microsoft Windows application.

After making a change to the language settings, the parameter list has to be updated by pressing the **“ID” button.**

MODE (Switching between parameter groups)

Command	Parameters	Unit	Group
MODE X	x= STD|EXP	-	STD

This command changes the parameter mode. Various commands (defined via STD/EXP) are blanked out in standard mode. The several commands in expert mode have more significant influence on the system performance. Therefore they should be changed with care.

SENS (Failure monitoring)

Command	Parameters	Unit	Group
SENS X	x= ON|OFF|AUTO	-	STD

This command is used to activate/deactivate the monitoring functions (4… 20 mA sensors, output current, signal range and internal failures) of the module.

ON: All monitoring functions are active. Detected failures can be reset by deactivating the ENABLE input. This mode should be used in case of active enabling and monitoring by a PLC (READY signal).

OFF: No monitoring function is active.

AUTO: **(Default Setting)** Auto reset mode. All monitoring functions are active. If the failure does not exist anymore, the module automatically resumes to work.

Normally the monitoring functions are always active because otherwise no errors are detectable via the READY output. Deactivating is possible especially for troubleshooting.

AUTO MODE: The module checks each second the actual failure status, which will (in case of a persistent error) trigger the LED and the READY output for a short time.

CCMODE (Activation of the characteristic linearization)

Command	Parameters	Unit	Group	FUNCTION
CCMODE X	x= ON|OFF	-	EXP	AA A-B

This command will be used for activation or deactivation of the characteristics linearization (CC, CCA and CCB). Through activating this parameter a simple and quick estimation of the linearization is possible. (**See pages 22 – 23 for more details**)

SOLENOIDS (One or two solenoids)

Command	Parameters	Unit	Group	FUNCTION
SOLENOIDS X	x= 1|2	-	STD	RA

This parameter allows you to adapt the amplifier to valves with one solenoid (e.g. pressure valves) or with two solenoids (directional valves).

PIN:6 (Choice of the additional function of S1/PIN 6)

Command	Parameters	Unit	Group	FUNCTION
PIN:6 x	x= USCALE | RAMP	-	EXP	AA

This parameter defines the functionality of digital input PIN:6

USCALE: PIN 6 = active, USCALE will not scale the output.
PIN 6 = inactive, the output may be scaled by the USCALE parameter.

Ramps are active.

RAMP: PIN 6 = active, the internal ramp generator is activated.
PIN 6 = inactive, the internal ramp generator is deactivated.

USCALE is inactive.

USCALE (Output current scaling depending on PIN:6)

Command	Parameters	Unit	Group	FUNCTION
USCALE x	x= -10000… 10000	0.01 %	EXP	AA

If the parameter PIN:6 is set to USCALE and the digital input S1 (PIN 6) is off, this parameter scales the output current. The default setting is 10000 (100 %) which does not change the output.

If USCALE is set to -10000 the polarity of the output will be flipped by switching the digital input S1, which allows for controlling the module with a unipolar analogue signal.

If USCALE is set to 5000 the output of the Minimum and Maximum value will be reduced by 50% with the same input command values.

ENABLE_B (Switching of the ENABLE Function)

Command	Parameters	Unit	Group	FUNCTION
ENABLE_B x	x= ON|OFF	-	EXP	A-B

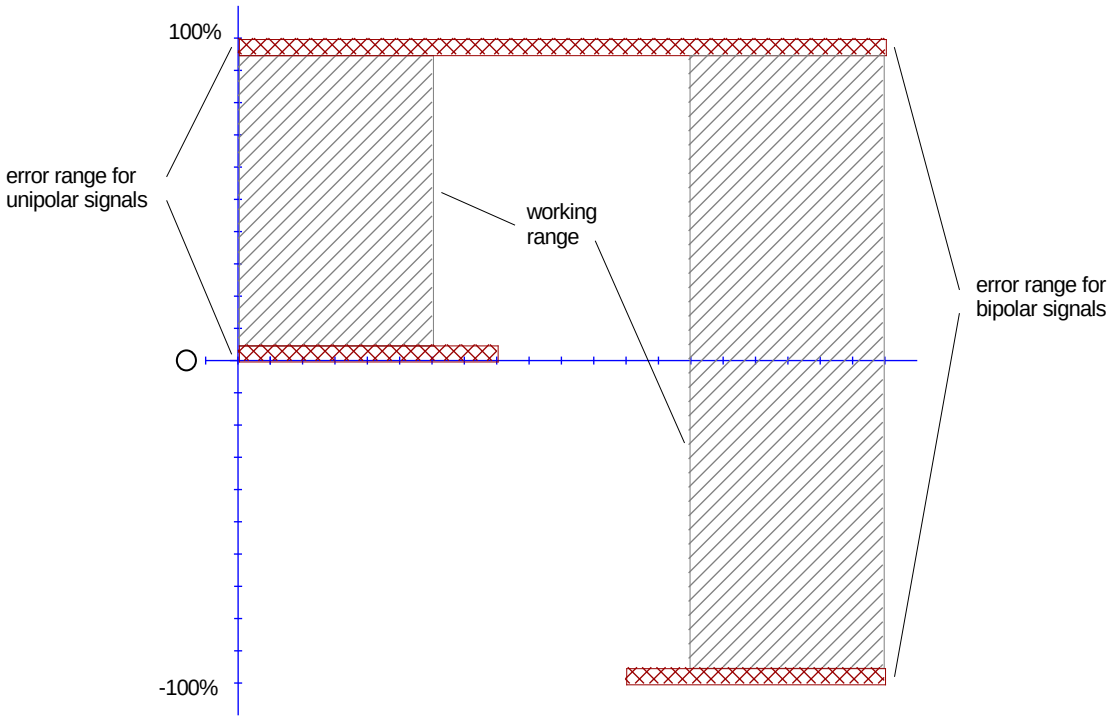
The setting of this parameter activates independent enable signals for channel A and B. If set to OFF, digital input PIN 15 enables both output channels. If set to ON, digital input PIN 15 enables only channel A and digital input PIN 6 enables channel B. If only one solenoid is to be controlled, ENABLE_B has to be set to ON and only the corresponding digital input has to be switched on.

LIM (Signal monitoring)

Command	Parameters	Unit	Group	FUNCTION
`LIM:I X`	`i= A|B` `x= 0… 2000`	`0.01%`	**EXP**	**A-B**
`LIM X`	`x= 0… 2000`	`0.01%`	**EXP**	**AA**

The signal monitoring deactivates the output current and the READY output if the input signal leaves the permitted range after scaling. This function makes it possible to detect a short circuit or cable break of a joystick or potentiometer.

Example: LIM 500 (5% lower/upper limitation) If the input signal gets higher than 95 % or lower than 5%, it leaves the permitted range and the outputs will switch off.



POL (Output polarity)

Command	Parameters	Unit	Group	FUNCTION
POL:I X	i= A|B x= +|-	-	STD	A-B
POL X	x= +|-	-	STD	AA

Valves with one solenoid:

This command allows a switch over of the output signal direction (after the MIN-MAX function).

Example: POL:A + Input signal 0… 100 %, nominal output current 0… 100 %.

POL:A - Input signal 0… 100 % nominal output current 100… 0 %.

Directional valves:

This command allows a switch over of the output polarity.

AINA (Current- / Voltage input)

AINB (Current- / Voltage input)

Command	Parameters	Unit	Group	FUNCTION
AINA X AINB X	x=V|C	-	STD	AA A-B

By the use of this command, the type of input signal may be chosen between voltage (0...10 V or +/- 10 V) or current (4…20mA). If current is chosen, the shunt will be activated automatically.

AIN (Analogue input scaling)

Command	Parameters	Unit	Group	FUNCTION
AIN:I a b c x	i = A|B	-	EXP	AA
	a= -10000… 10000	-		A-B
	b= -10000… 10000	-		
	c= -10000… 10000	0.01%		
	x= V|C	-		

AIN (Analogue input scaling Continued)

This command offers an individual scalable input. The following linear equation is used for the scaling.

$$Output = A/B \cdot (Input - C)$$

The ***"C" value*** is the offset (e.g. to compensate the 4 mA in case of a 4… 20 mA input signal). The variables ***A*** and ***B*** are defining the gain factor with which the signal range is scaled up to 100 % (e.g. 1.25 if using 4… 20mA input signal, defined in default current settings by A = 1250 and B = 1000). The internal shunt for the current input signal is activated when parameters AIN:A and AIN:B are set to Current (X=C).

The gain factor is calculated by dividing total input signal range (**A**) by the actual input range (***B***). In the case of a 4-20mA with a single solenoid valve, the total range is 0-20mA, which means **A=20**. The actual range is 4-20 mA, therefore, **B= (20-4) =16**. An offset, **C**, must be added to compensate for the 0-4mA not being used of the full range. The offset is 4mA/20mA=0.2 or 20%. Therefore **C=2000** since the unit value for **C** is 0.01%.

Shown in the below table are the most common input command signal and the corresponding settings to be used.

Typical settings (examples):

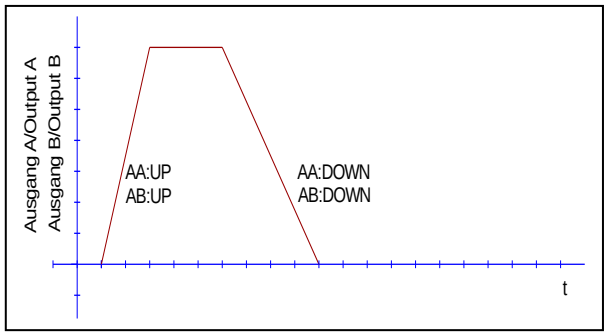
FUNCTION = AA	A	B	C		Input signal	Description
AIN:I	20	20	0 V	OR	-10… 10 V	Voltages input: Usable -10… 10V (20V) for a working range of -100… 100% (**two solenoids**).
AIN:I	1000	1000	0 V			
AIN:I	20	10	0 V	OR	-5… 5 V	Voltages input: Usable -10… 10V (20V) for a working range of -100… 100% (**two solenoids**). Really used are -5… 5V (10V).
AIN:I	2000	1000	0 V			
AIN:I	20	10	5000 V	OR	0… 10 V	Voltages input: Usable -10… 10V (20V) for a working range of -100… 100% (**two solenoids**). Really used are *only* 0… 10V for **both solenoids** with **5V zero point** setting (e.g. for joystick use).
AIN:I	2000	1000	5000 V			
AIN:I	40	16	6000 C	OR	4… 20 mA	Current input: *theoretically* usable range -20… 20mA (40mA) for a working range of -100… 100% (**two solenoids**). Really usable are *only* 4… 20mA (16mA) for both solenoids with 12mA zero point setting.
AIN:I	2500	1000	6000 C			
FUNCTION = A-B	**A**	**B**	**C**		**Input signal**	**Description**
AIN:I	10	5	0 V	OR	0… 5 V	Voltages input: Usable 0… 10V for a working range of 0… 100% (**one solenoid**). Really used are 0… 5V for 0… 100%.
AIN:I	2000	1000	0 V			
AIN:I	10	8	1000 V	OR	1… 9 V	Voltages input: Usable 0… 10V for a working range of 0… 100% (**one solenoid**). Really used are 1… 9V (8V) for 100% with 10% offset.
AIN:I	1250	1000	1000 V			
AIN:I	20	16	2000 C	OR	4… 20 mA	Current input: *theoretically* usable range 0… 20mA for a working range of 0… 100% (**one solenoids**). Really usable are 4… 20mA (16mA).
AIN:I	1250	1000	2000 C			

AA and AB (Ramp function/Acceleration time)

Commando	Parameters	Unit	Group	FUNCTION
	i= UP|DOWN		STD	A-B
AA:I X	x= 1… 120000	ms		
AB:I X	x= 1… 120000	ms		

Two quadrant ramp function.

The first quadrant means the ramp up and the second quadrant means the ramp down time. The ramp time is related to 100 % signal step.

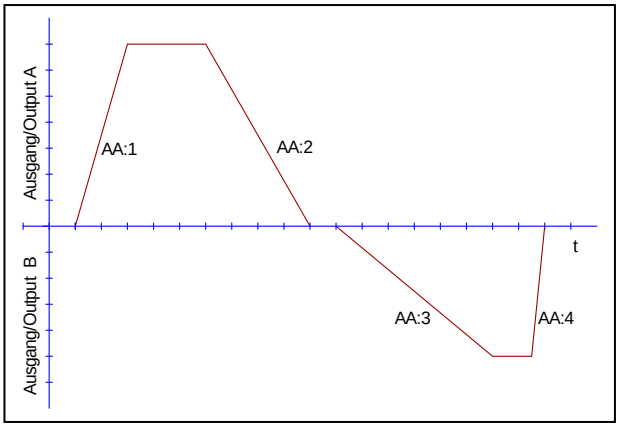


AA (Ramp function)

Command	Parameters	Unit	Group	FUNCTION
AA:I X	i= 1… 4	-	STD	AA
	x= 1… 120000	ms		RA – 4Q Mode

Four quadrants ramp function.

The first quadrant means the acceleration ramp for solenoid A and the second one stands for the deceleration ramp of solenoid A. According to this the third quadrant represents the acceleration ramp for solenoid B so that the fourth quadrant remains for the deceleration ramp for solenoid B.



RMODE (Choosing ramp function)

Command	Parameters	Unit	Group	FUNCTION
RMODE X	x= SD|4Q	-	STD	RA

Choosing the ramp function.

This command allows the switching between a set point related ramp function (SD), which makes it possible to assign an individual ramp time for each command value, and a four quadrant ramp function (4Q) with set point independent ramp times for acceleration and deceleration in both directions.

S:0 …. S:7 (Presetting command values)

Command	Parameters	Unit	Group	FUNCTION
S:I X	i= 0… 7 x= -10000… 10000	0.01%	STD/EXP	RA: SD and 4Q Mode

With this parameter eight possible command values can be set. The binary value of the three digital inputs S1, S2 and S4 determines the set point.

Setpoint >	S:0	S:1	S:2	S:3	S:4	S:5	S:6	S:7
Input S1	0	1	0	1	0	1	0	1
Input S2	0	0	1	1	0	0	1	1
Input S4	0	0	0	0	1	1	1	1

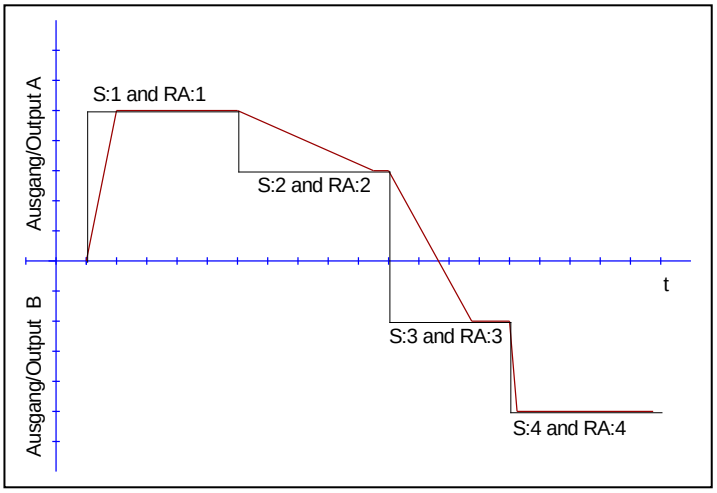
RA:0 … RA:7 (Ramp function / Acceleration time)

Command	Parameters	Unit	Group	FUNCTION
`RA:I X`	`i= 0… 7` `x= 1… 120000`	`-` `ms`	**STD**	**RA – SD Mode**

Presetting of the ramp times. Functionality depends on command RMODE.

RMODE = SD: In this mode every command value has its own ramp time.
For example: if you choose set point S:1 also ramp time RA:1 is chosen.

RMODE = 4Q Four quadrants ramp function. See command AA (page 19)



CCA (Characteristics linearization channel A)

CCB (Characteristics linearization channel B)

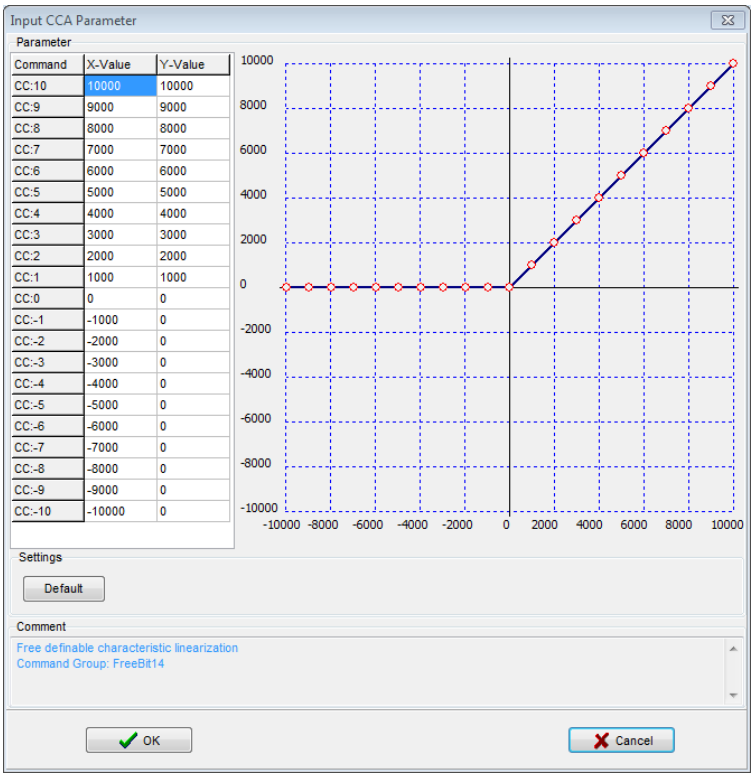
Command	Parameters	Unit	Group	FUNCTION
CCA:I X Y	i= 0… 10	-	CCMODE=ON	A-B
CCB:I X Y	x= -10000… 10000	0.01 %		
	y= -10000… 10000	0.01 %		

A user defined signal characteristic can be set by this function. For activating the parameter CCMODE has to be switched to ON.

In case of using single solenoid valves, only the first quadrant is active. The curve is calculated according to the equation of the linear interpolation **y=(x-x1)*(y1-y0)/(x1-x0)+y1**.

The influence of the linearization can be estimated via the process data on the monitor or on the oscilloscope.

For the input of the characteristics linearization, the CHI-PC program provides a table and a graphic data input. The input signal is mapped on to the X-axis and the output signal is mapped on to the Y-axis.



CC (Characteristics linearization)

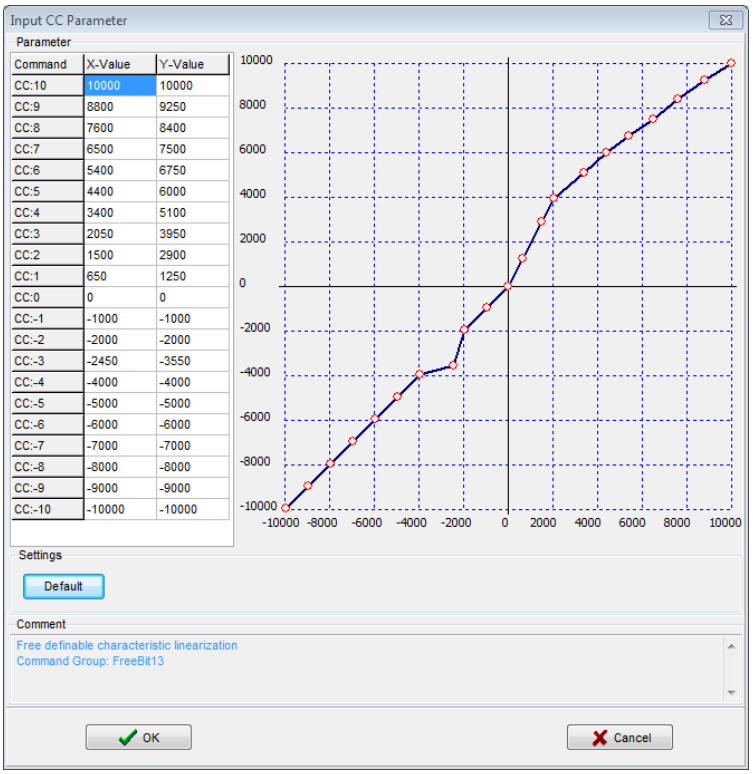
Command	Parameters	Unit	Group	FUNCTION
CC:I X Y	i= -10… 10 x= -10000… 10000 y= -10000… 10000	- 0.01% 0.01%	CCMODE=ON	AA A-B

A user defined signal characteristic can be set by this function. For activating the parameter CCMODE has to be switched to ON.

The positive indexes stand for the solenoid A, the negative ones represent the solenoid B. The curve is calculated according to the equation of the linear interpolation: **y=(x-x1)*(y1-y0)/(x1-x0)+y1**.

The influence of the linearization can be estimated via the process data on the monitor or on the oscilloscope.

For the input of the characteristics linearization, the CHI-PC program provides a table and a graphic data input. The input signal is mapped on to the X-axis and the output signal is mapped on to the Y-axis.



MIN (Overlap compensation)

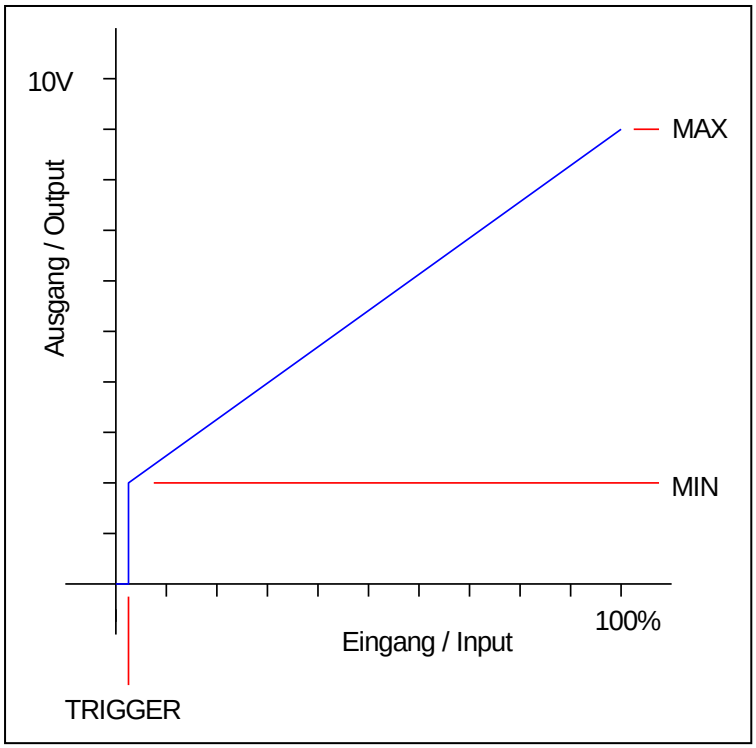
MAX (output scaling)

TRIGGER (threshold value of MIN function)

Command	Parameters	Unit	Group	FUNCTION
	i= A|B	-	STD	A-B
MIN:I X	x= 0… 6000	0.01 %		
MAX:I X	x= 5000… 10000	0.01 %		
TRIGGER X	x= 0… 3000	0.01 %		

The output signal is adapted to the valve by these commands. With the MAX value the output signal (the maximum valve current) will be defined. With the MIN value the overlap (dead band of the valve) will be compensated. Via the TRIGGER command the activation point of the MIN function is set and so a non-sensitive range around the zero-point[1] can be specified.

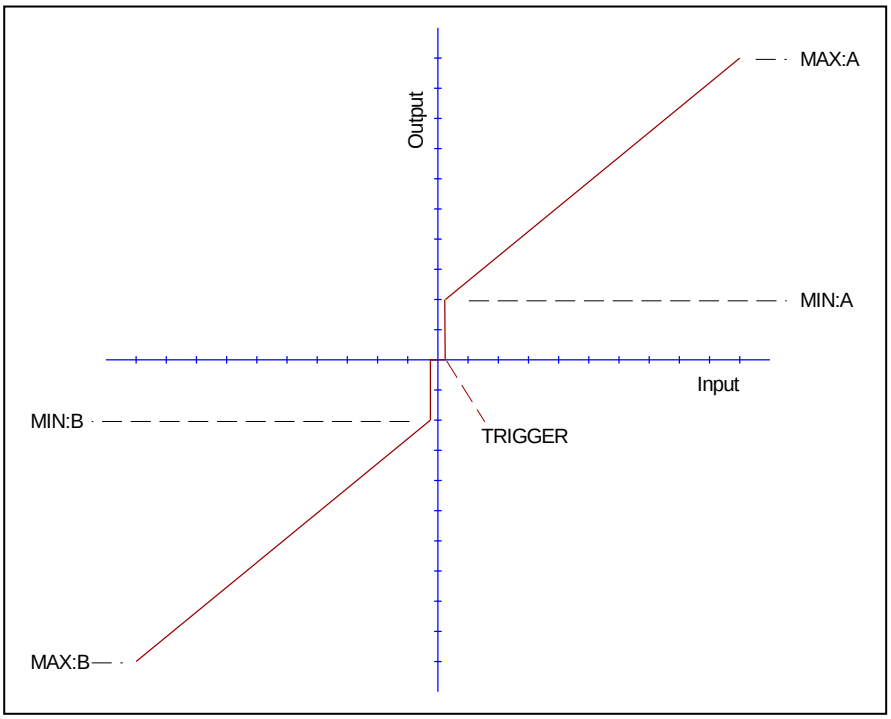
CAUTION: If the MIN value is set too high, it influences the minimal velocity, which cannot be adjusted any longer.



[1] This dead band is necessary, in order to avoid unrequested activations caused by small variations of the input signal.

Command	Parameters	Unit	Group	FUNCTION
	i= A|B	-	STD	AA
MIN:I X	x= 0… 6000	0.01%		RA
MAX:I X	x= 5000… 10000	0.01%		
TRIGGER X	x= 0… 3000	0.01%		

The output signal is adapted to the valve by these commands. The output signal (the maximum valve current) is defined by the **MAX:I** value. The overlap (dead band of the valve) is compensated by the **MIN:I** value. The activation of the MIN function is set with the **TRIGGER**. No output can occur when the command is below the TRIGGER point. The TRIGGER is used to avoid unrequested activation caused by small variations of the input signal. When using this module as part of a closed position loop the trigger value should be reduced.



CURRENT (Nominal output current)

Command	Parameters	Unit	Group	FUNCTION
CURRENT:I X	i= A|B x= 500… 2600	mA	STD	A-B
CURRENT X	x= 500… 2600	mA	STD	AA RA

The nominal solenoid current is set with this parameter. The DITHER and also the MIN/MAX parameter always refer to the selected current range.

DFREQ (Dither frequency)

DAMPL (Dither amplitude)

Command	Parameters	Unit	Group	FUNCTION
DAMPL:I X DFREQ:I X	i= A|B x= 0… 3000 x= 60… 400	0.01 % Hz	STD	A-B
DAMPL X DFREQ X	x= 0… 3000 x= 60… 400	0.01 % Hz	STD	AA RA

The dither[2] can be defined freely with this command. Different amplitudes or frequencies may be required depending on the respective valve. The dither amplitude is defined in % of the nominal current (see: CURRENT command).

CAUTION: The PPWM and IPWM parameters influence the effect of the dither setting. These parameters should not be changed again after the dither has been optimized.

CAUTION: If the PWM frequency is less than 500 Hz, the dither amplitude should be set to zero.

[2] The DITHER is a superimposed signal to reduce the hysteresis. This function is defined by the amplitude and frequency. The DITHER frequency should not be confused with the PWM frequency. In some proportional valve documentations a mistake is done by the definition of the DITHER / PWM frequency. It is recognizable by missing information about the DITHER amplitude.

PWM (PWM frequency)

Command	Parameters	Unit	Group	FUNCTION
PWM:I X	i= A|B x= 61… 2604	 Hz	EXP	A-B
PWM X	x= 61… 2604	Hz	EXP	AA RA

The frequency can be changed in the defined steps (61 Hz, 72 Hz, 85 Hz, 100 Hz, 120 Hz, 150 Hz, 200 Hz, 269 Hz, 372 Hz, 488 Hz, 624 Hz, 781 Hz, 976 Hz, 1201 Hz, 1420 Hz, 1562 Hz, 1736 Hz, 1953 Hz, 2232 Hz and 2604 Hz). The optimum frequency depends on the valve.

Attention: The PPWM and IPWM parameters should be adapted when using low PWM frequencies because of the longer dead times which forces a reduced stability of the closed loop control.

ACC (Auto adaptation of the closed loop current controller)

Command	Parameters	Unit	Group	FUNCTION
ACC x	x= ON|OFF	-	STD	AA A-B RA

Operation mode of the closed loop current control.

ON: In automatic mode PPWM and IPWM are calculated depending on the preset PWM-frequency.

OFF: Manual adjustment.

PPWM (Solenoid current controller P gain)

IPWM (Solenoid current controller I gain)

Command	Parameters	Unit	Group	FUNCTION
	i= A|B	-	EXP	A-B
PPWM:I X	x= 0… 30	-		
IPWM:I X	x= 1… 100	-		
PPWM X	x= 0… 30	-	EXP	AA
IPWM X	x= 1… 100	-		RA

The PI current controller for the solenoids is parameterized with these commands.

CAUTION: These parameters should not be changed without adequate measurement facilities and experiences.

Attention, if the parameter ACC is set to ON, these adjustments are done automatically.

If the PWM frequency is < 250 Hz, the dynamic of the current controller has to be decreased.

Typical values are: PPWM = 1… 3 and IPWM = 40… 80.

If the PWM frequency is > 1000 Hz, the default values of PPWM = 7 and IPWM = 40 should be chosen.

PROCESS DATA (Monitoring)

Command	Description	Unit	FUNCTION
W	Command value after input scaling	%	**AA**
C	Command value after linearization	%	
U	Command value to current controller	%	
IA	Output current of solenoid A	mA	
IB	Output current of solenoid B	mA	
Command	**Description**	**Unit**	**FUNCTION**
WA	Command value after input scaling channel A	%	**A-B**
CA	Command value after linearization channel A	%	
UA	Command value to current controller channel A	%	
WB	Command value after input scaling channel B	%	
CB	Command value after linearization channel B	%	
UB	Command value to current controller channel B	%	
IA	Output current of solenoid A	mA	
IB	Output current of solenoid B	mA	
Command	**Description**	**Unit**	**FUNCTION**
W	Chosen command value	%	**RA**
C	Command value after ramp function	%	
U	Command value to current controller	%	
IA	Output current of solenoid A	mA	
IB	Output current of solenoid B	mA	

The process data are the variable values which can be continuously observed on the monitor or on the oscilloscope.

Failure monitoring

Following possible error sources are monitored continuously when SENS = ON / AUTO:

Source	Fault	Characteristics
Command signal PIN 9 / 10 or Command signal PIN 14 / 13, 4...20mA	Out of range	The power stage is deactivated.
Command signal PIN 9 / 10 or Command signal PIN 14 / 13, LIM function	Out of range	The power stage is deactivated.
Solenoid A PIN 3 / 4 Solenoid B PIN 1 / 2	Broken wire	The power stage is deactivated.
EEPROM (monitored during power on procedure)	Data error	The power stage is deactivated. The module can be activated by saving new parameters (pressing of the SAVE Button).

Troubleshooting

Initial situation is an operable status of the device and existing communication between the module and the CHI-PC program. Furthermore, the parameterization of the valve control has to be done with the assistance of the valve data sheets.

The RC mode in monitor can be used to analyze faults.

FAULT	CAUSE / SOLUTION
ENABLE is active, the module does not respond, and the READY LED is off.	Probably the power supply is disconnected or the ENABLE signal is not present. If there is no power supply there is also no communication via our operating program. If the connection to the CHI-PC exists, the power supply is also available. In this case the availability of the ENABLE signal can be checked via the monitor.
ENABLE is active, the READY LED is flashing.	The flashing READY LED indicates that a fault is detected by the module. The fault could be: • Failure detection in case of current input. Input signal below 3 mA. • Failure detection in case of active LIM function (for example joystick monitoring) Input signals are out of range. • A broken cable or incorrect wiring to the solenoids. • Internal data error: execute the command / press the button SAVE to delete the data error. The system reloads the DEFAULT data. With the CHI-PC program the failure can be localized directly via the monitor.