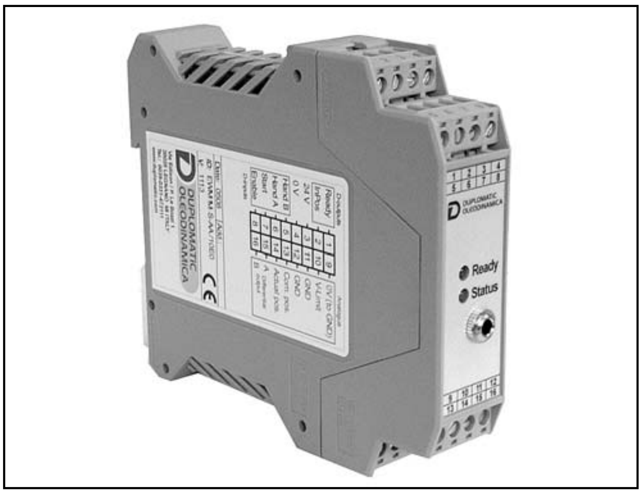


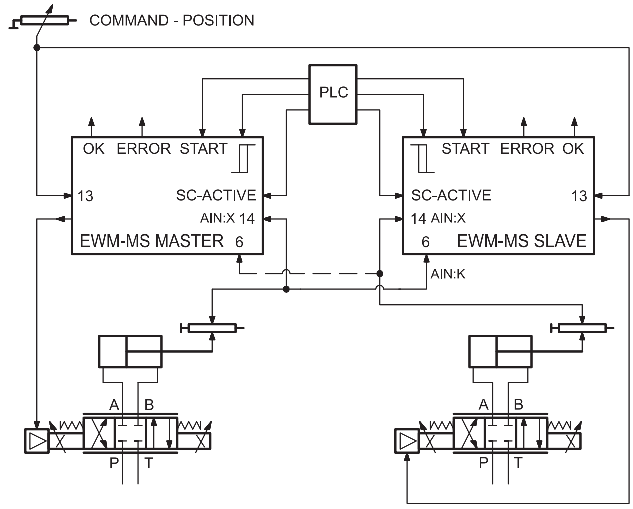
EWM-MS-AA

CARD FOR SYNCHRONIZATION CONTROL WITH ANALOGUE SIGNALS

SERIES 10

RAIL MOUNTING TYPE: DIN EN 50022

OPERATING PRINCIPLE



— This card has been developed for an easy synchronization of two actuators with an overriding synchronization controller.

— The card can drive only an axis; to get the complete master and slave synchronization two cards are necessary.

— Proportional valves with integrated electronics can be driven by the differential output. As option, an integrated amplifier is available.

— The synchronization controller correct the speed of the axis (slave axis). Positioning failures during the movement will increase or reduce the slave axis velocity, so the synchronization failure will be compensated.

— The axes speed can be limited by an external analogue speed input.

— The card use the RS232C interface, and is settable via notebook, using the software kit (EWMPC).

TECHNICAL CHARACTERISTICS

Power supply	V DC	12 ÷ 30 ripple included external fuse 1,0 A (5 A for M2 version)
Current consumption: - E0 and E1 version - M2 version	mA A	100 + sensor power consumption depending from solenoid current
Command value	V mA	0 ÷ 10 (R_I = 33 kΩ) 4 ÷ 20 (R_I = 250 Ω)
Command value resolution	%	0,01 (internally 0,0031)
Speed input value	V	0 ÷ 10 (R = 90 kΩ)
Speed input value resolution	%	0,024
Feedback value	V mA	0 ÷ 10 (R_I = 33 kΩ) 4 ÷ 20 (R_I = 250 Ω)
Output value: - E0 version - E1 version - M2 version	V mA A	±10 (max load 5 mA) 4 ÷ 20 (max load 390 Ω) 1,0 - 1,6 - 2,6
Interface		RS 232 C
Electromagnetic compatibility (EMC): 2004/108/CE std		Emissions EN 61000-6-3 Immunity EN 61000-6-2
Housing material		thermoplastic polyammide PA6.6 - combustibility class V0 (UL94)
Housing dimensions	mm	120(d) x 99(h) x 23(w) (M2 version: w = 46)
Connector		4x4 poles screw terminals - PE direct via DIN rail
Operating temperature range	°C	-20 / +60
Protection degree		IP 20

1 - IDENTIFICATION CODE

E	W	M	-	MS	-	A	A	/	10	

Digital card for closed loop systems
DIN EN 50022 rail mounting (E W M)

Master and slave control (MS)

Analog command value (A)

Analog feedback value (A)

Series No. (from 10 to 19 sizes and mounting dimensions remain unchanged) (10)

Output value:
E0 = voltage 0 ÷ ±10V (**standard**)
E1 = current 4 ÷ 20 mA
M2 = embedded power amplifier

NOTE: one card per axis is needed. To synchronize 2 axes, 2 cards are needed.

The structure of the synchronisation controller was deduced from our positioning modules. The positioning function is controlled by target position of the axis (input PIN 13) and by the actual position of the axis (PIN 14). With input PIN 6 (normally the sensor of the master axis) the actual position of the other axes is given to the module. In case of two axes, the position information can be linked crosswise from PIN 14 to PIN 6.

If the synchronisation controller is active, it overrides the position control process. When the actual position of the master axis is given to the slave axis (SC = active), all slave axes will follow the master axis.

The ways are: master/master (both SC inputs are active), master/slave with selectable master function by deactivating of the SC input or independent positioning by deactivation of both SC inputs and separate command positions at PIN 13. The function of the STATUS output is - depending on SC input - in position signal (failure between PIN 13 and 14) or synchronisation error signal (failure between PIN 6 and PIN 14).

For a reliable function of the synchronisation control the speed should be limited to app. 70/80% of maximum speed. The slave axis must be able to increase the speed against the master axis to compensate position failures.

The card sample time is 1 ms.

NOTE: By using positioning sensors with current input (4…20 mA) PIN 6 of the slave and with PIN 14 of the master are connected parallel. DIL switches are removed; the right current input is set automatically.

2 - FUNCTIONAL SPECIFICATIONS

2.1 - Power supply

This card is designed for 12 to 30 VDC (typical 24 V) of a power supply. This power supply must correspond to the actual EMC standards.

All inductivities at the same power supply (relays, valves) must be provided with an over voltage protection (varistors, free-wheel diodes).

It is recommended to use a regulated power supply (linear or switching mode) for the card supply and the sensors.

NOTE: in the type M2 the value of the power supply voltage on the card must not be lower than the rated working voltage of the solenoid to be controlled.

2.2 - Electrical protections

All inputs and outputs are protected with suppressor diodes and RC-filters against transient overshoots.

2.3 - Digital Input

The card accepts digital input. The digital input must have a voltage from 12 to 24 V; Low level: <4V, high level >12V with current <0,1A. See the block diagram at paragraph 7 for the electric connections.

2.4 - Command value

The card accepts analogue input signals. The command value can be 0 ÷ 10 V (RI = 25kΩ) or 4 ÷ 20 mA (RI = 250Ω).

2.5 - Feedback input values

The card accepts analogue feedback input. The feedback value can be 0 ÷ 10 V (RI = 33 kΩ) or 4 ÷ 20 mA (RI = 250Ω). The sensors parameters are settable via software (see parameters table).

2.6 - Command speed input

The card accepts the command speed input with value 0 ÷ 10 V (R = 90 kΩ)

2.7 - Analog output values

E0 version: output voltage 0 ±10 V.
E1 version: output current 4 ÷ 20 mA.
M2 version: embedded power stage configurable via software with a value of 1, 1.6 or 2.6 A.

All analogue output have to be wired with screened cables.

2.8 - Digital Output

Two digital output are available, INPOS and READY, that are displayed via LEDs on the front panel As common potential 0V used (PIN 4). Low level <4V High Level > 10 V Max 50 mA with load 200Ω

3 - LED FUNCTIONS

There are two LED on the card: GREEN and YELLOW.

GREEN: Shows if the card is ready.

- ON - System in process
- OFF - No power supply or the ENABLE parameter is inactive
- FLASHING - Failure detected (internal or 4 ÷ 20 mA). Only if the parameter SENS is ON

YELLOW: Is the signal of the control error monitoring.

- ON - No control error
- OFF - Error detected, depending of a parameter error.

4 - ADJUSTMENTS

On the EWM cards, the adjustment setting is possible only via software. Connecting the card to the PC, the software automatically recognises the card model and shows a table with all the available commands, with their parameters, the default setting, the measuring unit and an explanation of the commands and its uses. The parameters change depending on the card model.

EXAMPLE OF PARAMETERS TABLE

Commands	Parameter	Defaults	Units	Description
ain:i a b c x	i= W|X|K a= 0… 10000 b= 0… 10000 c= 0… 10000 x= V|C	 : 1000 : 1000 : 0 : V	 - - 0,01% -	Analogue output selection. **(NOTE)** **W, X** and **K** for the input and **V** = voltage, **C** = current. With the parameters **a**, **b** and **c** the inputs can be scaled. Because of the programming of the **x**-value (**x** = **C**) the corresponding input will be switched over to current automatically.
a:i x	i= A|B x= 1… 2500	:A 100 :B 100	ms ms	Acceleration time depending on direction. **A** indicates analogue output 15 and **B** indicates analogue output 16. Normally **A** = flow P-A, B-T and **B** = flow P-B, A-T.
d:i x	i= A|B x= 50… 10000	:A 2500 :B 2500	0,01% 0,01%	Deceleration stroke depending on direction. The loop gain is calculated by the deceleration stroke. The shorter the higher. In case of instabilities longer deceleration stroke will be sufficient.
ctrl x	x= lin|sqrt1|sqrt2	sqrt1	-	Selection of the control function: (**NOTE**) **lin** = standard linear P-control, **sqrt1** = progressive time optimized deceleration curve, **sqrt2** = sqrt1 with a higher gain in position
glp x **t1 x**	X= -10000… +10000 X= 0… 100	500 10	0,01 ms	Synchronisation control gain and damping of the synchronisation control function. Used to optimize the synchronization controller. The SYNC-controller works as a compensator for optimized controlling of hydraulic drives. Both controller (sync and positioning) are working parallel. The higher the sync-gain the lower must be the gain of the positioning controller. A time constant value (T1) can be used to damp the sync-controller for better stability.
velo x	x= 1000… 10000	10000	0,01%	Internal limitation of maximum velocity. The limitation function corresponds to the external velocity preset if VS was parameterized with EXT.
vs x	x= ext|int	int	-	Switch over between internal and external velocity preset
vramp x	x= 1… 2000	50	ms	Ramp time for velocity input.
vmode x	x= on|off	off	-	Activation of the NC-generator. The command position is generated by a velocity profile (internal or external preset of v). The axis drives more or less speed controlled.
th x	x= 100… 60000	5000	ms	Stroke time for 100% velocity and 100% nominal sensor stroke.
min:i x	i= A|B x= 0… 5000	:A 0 :B 0	0,01% 0,01%	Deadband compensation of positive overlapped proportional valves. Good adjustment will increase positioning accuracy.
max:i x	i= A|B x= 5000… 10000	:A 10000 :B 10000	0,01% 0,01%	Maximum output range for adapting control range to maximum flow range.
trigger x	x= 0… 2000	200	0,01%	Point to activate the deadband compensation (**min**). Also useful for reduced sensitivity in position with control valves.
inpos x	x= 0… 2000	200	0,01%	Range for the InPos signal (status output). The INPOS command defines the window where the INPOS message is indicated. The positioning process is not influenced by this message. The controller remains active. In NC-mode this message has to be interpreted alternatively as following error. SC-activ = OFF INPOS output SC-activ = ON synchronisation error
offset x	x= -2000… 2000	0	0,01%	The corresponding OFFSET will be added to the control error (demand value - actual value + offset). With this parameter the zero point failure can be compensated
pol x	x= +|-	+	-	For changing the output polarity. All **A** and **B** adjustments depend on the output polarity. The right polarity should be defined first.
sens x	x= on|off	on	-	The sensor monitoring can be activated (with 4… 20 mA sensors).
save	-	-	-	Storing the programmed parameter in E²PROM.
loadback	-	-	-	Reloading the parameter from E²PROM in working RAM
din	-	-	-	Status of the digital inputs.
w **x** **k** **xw** **xk** **u** **v**	Demand value Actual value Master synch value Control deviation Synchronization error Velocity Actuator signal	-	0,01%	
default	-	-	-	Preset values will be set.

ADDITIONAL PARAMETERS ON VERSION *M2

Command	Parameter	Defaults	Unit	Description
current x	x=0… 2	0	-	Selection of the output current range: **0** = 1,0 A **1** = 1,6 A **2** = 2,6 A
dfreq x	x= 60… 400	120	Hz	Dither frequency
dampl x	x= 0… 3000	500	0,01%	Dither amplitude. Typical values between 500 and 1200 (good experience were made with 700).
pwm x	x= 100… 7700	2600	Hz	PWM Frequency. PWM Frequencies of ≥2000 Hz improve the current loop dynamics. PWM Frequencies in the range of 100… 500 Hz will be used for low dynamic valves with high hysteresis. In this case, DAMPL must be zero.
ppwm x **ipwm x**	x= 0… 30 x= 1… 500	3 40	- -	PI-compensator for the current controller. Changes should be only done with good experience in optimizing of current loops. In some cases a PWM Frequency of >2500 Hz; PPWM can be increased to 7… 15. ATTENTION: The dither amplitude must be optimized after that.

NOTE about the AIN command: With this command each input can be scaled individually. For the scaling function the following linear equation is taken: output signal = a / b * (input signal - c).

At first the offset (c) will be subtracted (in 0,01% units) from the input signal, then the signal will be multiplied with factor **a** / **b**. **a** and **b** should always be positive. With these both factors every floating-point value can be simulated (for example: 1.345 = 1345 / 1000).

With the x parameter value the internal measuring resistance for the current measuring (4… 20 mA) will be activated (V for voltages input and C for current input). ATTENTION: This resistor is never activated at the k input.

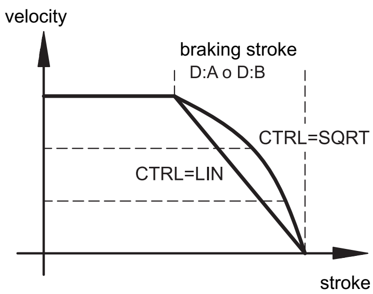
	AIN:X	a	b	c	x
i with voltage:	AIN:i	1000	1000	0	V
i with current:	AIN:i	1250	1000	2000	C

NOTE about the CTRL command:: This command controls the braking characteristic of the hydraulic axis. With positive overlapped proportional valves one of both SQRT braking characteristics should be used because of the linearization of the non-linear flow curve typical of these valves If zero overlapped proportional valves (control valves) are used, you can choose between LIN and SQRT1 according to the application. The progressive gain characteristic of SQRT1 has the better positioning accuracy.

According to the application there is maybe a longer braking distance, so that the total stroke time will be longer.

LIN: Linear braking characteristics (control gain corresponds to: 10000 / d:i).

SQRT*: Root function for the calculation for the braking curve.
  SQRT1: with small control error. control gain corresponds to 30000 / d:i ;
  SQRT2: control gain corresponds to 50000 / d:i



5 - INSTALLATION

The card is designed for rail mounting type DIN EN 50022. It is recommended to use cable sections of 0.75 mm^2, up to 20 m length and of 1.00 mm^2 up to 40m length, for power supply and solenoid connections on version M2. For other connections it is recommended to use cables with a screened sheath connected to earth only on the card side.

NOTE 1

To observe EMC requirements it is important that the control unit electrical connection is in strict compliance with the wiring diagram.

As a general rule, the valve and the electronic unit connection wires must be kept as far as possible from interference sources (e.g. power wires, electric motors, inverters and electrical switches).

In environments that are critical from the electromagnetic interference point of view, a complete protection of the connection wires can be requested.

5.1 Start-up

- Control of correct wiring with the circuit diagrams.
- Switch-on the power supply and measure the supply current. If the supply current is higher than the nominal current, this indicates an electrical failure.
- Measure the analogue command and actual signals whether they are in the specified area.
- Measure the feedback values and then adjust the analogue input values for scaling with AIN:X and AIN:K
- If use the synchronization control set the AIN values as AIN:K = AIN:X
- Activate ENABLE input, the drive is in closed loop position control mode (command position = actual position). If the system drives immediately after enabling to one of the mechanical end stops, probably the polarity of the loop must be inverse (command POL for the output polarity or change both terminal pins 15 and 16).
- Activate START (RUN), the external Command position (0.. 10 V or 4.. 20 mA at Pin 13) is used. The system is driving to the new target position. With the actual pre-adjustment (uncritical control gain and no deadband compensation) higher position errors are possible.
- Optimising of the controller by setting the parameters. A:A, A:B, D:A and D:B for acceleration and deceleration. Deceleration parameters (D:A and D:B) are used for the calculation of the control gain. Be careful with short deceleration strokes. In case of positive overlapped proportional valves the MIN:A and MIN:B parameters should be used to compensate the deadband.

  For applications with zero overlapped valves a TRIGGER value of five can improve positioning.
- When the setup has finished, the command SAVE will store all parameters in the E²PROM. If there are, made some other adjustments, the latest saved parameter set can be called back using the LOADBACK command.
- PARA shows the complete parameter setup.

5.2 Synchronisation control:

The speed of the master axis should be limited at app. 70 % of maximum speed (command velo or external analogue input).

- Command VS ON will activate the external analogue speed input (0… 10 V).
- The synchronisation control is activated with the digital input SC-active and the gain of the synch. control can be optimized with the command GLP.
- The maximum error bandwidth can be defined with the INPOS command.

6 - SOFTWARE KIT EWMPC/10 (code 3898401001)

The software kit comprising a USB cable (2.70 mt length) to connect the card to a PC or notebook and the software.

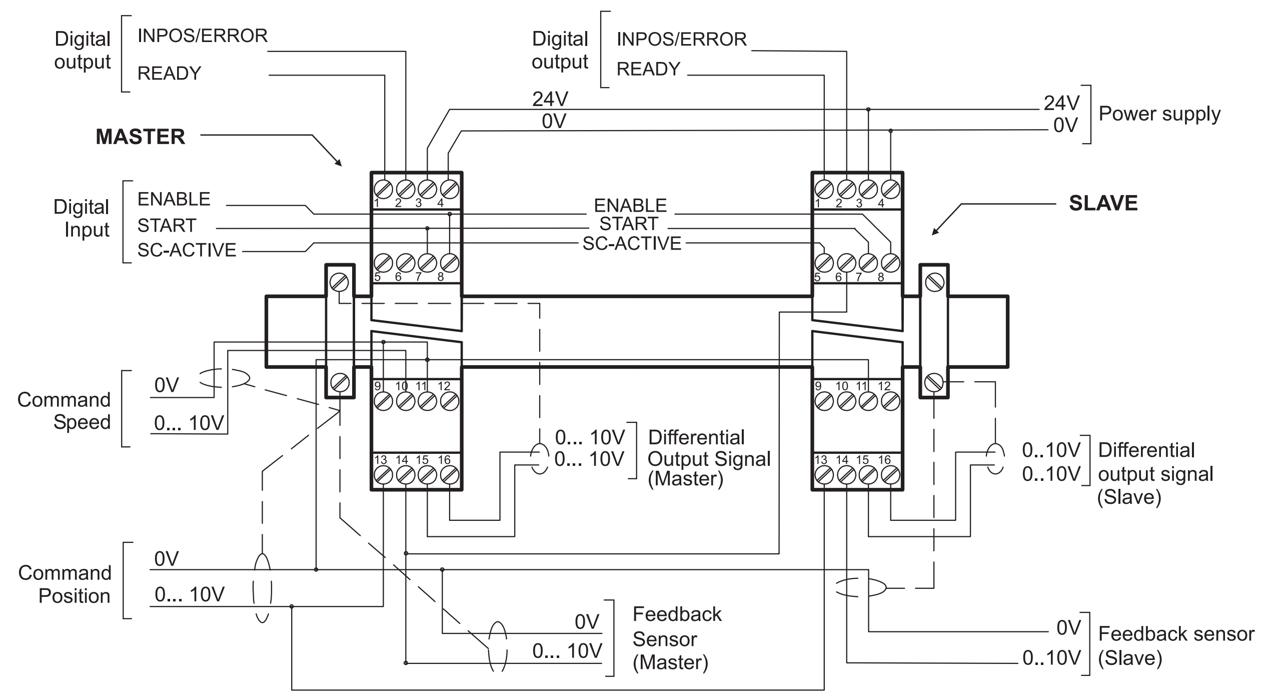
During the identification all information are read out of the module and the table input will be automatically generated.

Some functions like baud rate setting, remote control mode, saving of process data for later evaluation are used to speed up the installation procedure.

The software is compliant with Microsoft XP® operating systems.

7 - WIRING DIAGRAM

MASTER-SLAVE WIRING WITH VOLTAGE (0..10V) SENSORS OUTPUT SIGNAL



DIGITAL INPUT AND OUTPUT

PIN 1 — READY output.
General operationality, ENABLE is active and there is no sensor error (by use of 4÷20 mA sensors). This output corresponds with the green LED.

PIN 2 — STATUS output.
Monitoring of the control error (INPOS). Depending on the INPOS command, the status output will be deactivated, if the position difference is greater then the adjusted window. If SC-ACTIVE (pin 5) is on, this output is used to monitor the synchronization error.
The output is only active if START = ON.

PIN 5 — SC-ACTIVE:
The synchronisation controller is activated. If this input is not activated, the system works as a normal positioning controller.

PIN 7 — START input:
The positioning controller is active; the external analogue command position is taken over as command value.
If the input is switched off during movement, the command position is set to the actual position plus a defined emergency deceleration stroke

PIN 8 — ENABLE input:
This digital input signal initializes the application. The analogue output is active and the READY signal indicates that all components are working correctly. Target position is set to actual position and the drive is closed loop controlled.

ANALOGUE INPUT

PIN 6 — Actual (feedback) value (K) of the master axis
range 0÷100% corresponds to 0 ÷ 10V or 4 ÷20 mA

PIN 9/10 — External command speed (V),
range 0 ÷ 100 % corresponds to 0 ÷ 10 V

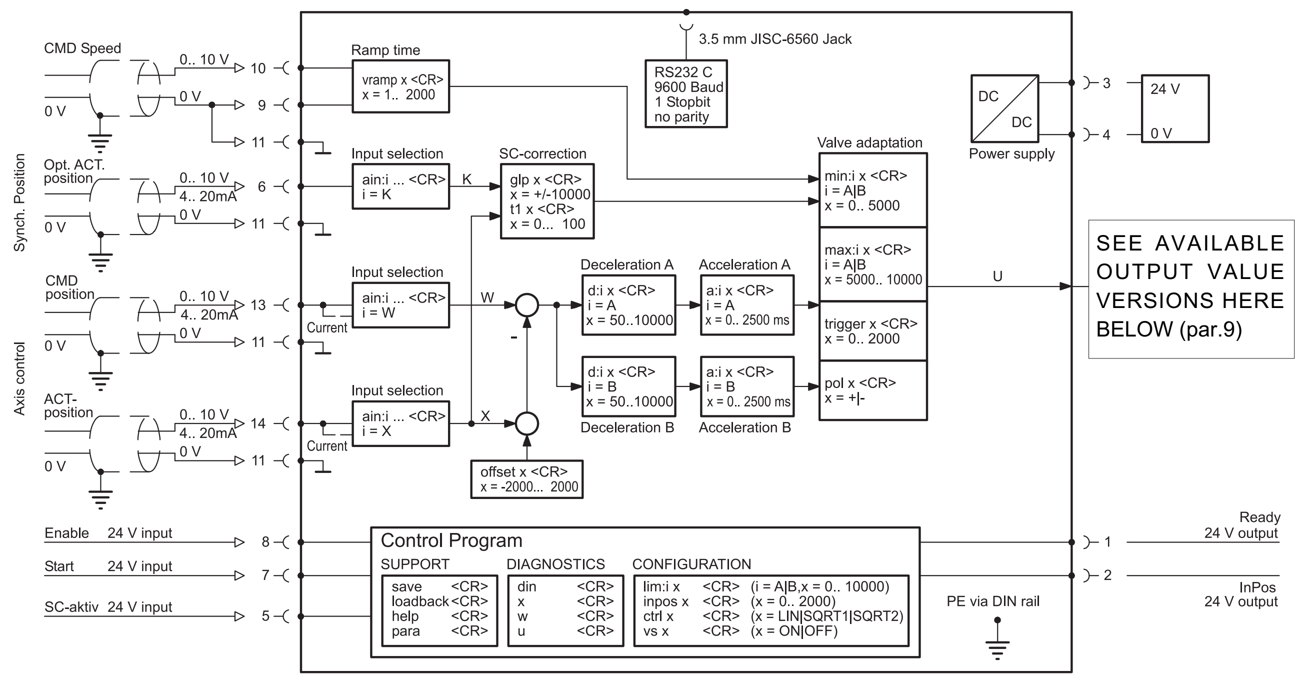
PIN 13 — Command position (W),
range 0 ÷ 100% corresponds to 0 ÷ 10V or 4 ÷ 20 mA

PIN 14 — Actual (feedback) value (X),
range 0 ÷ 100% corresponds to 0 ÷ 10V or 4 ÷ 20 mA

ANALOGUE OUTPUT

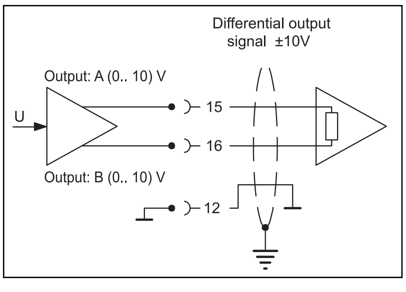
PIN 15/16 — Differential output (U)
± 100% corresponds to ± 10V differential voltage, optionally (E1 version) current output ±100% corresponds to 4 ÷ 20 mA (PIN 15 to PIN 12)

8 - CARD BLOCK DIAGRAM

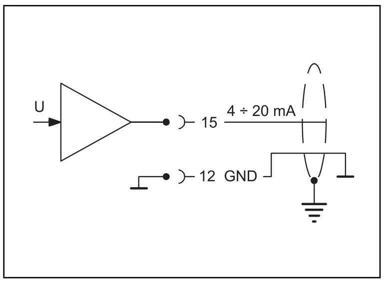


9 - AVAILABLE OUTPUT VALUE VERSIONS

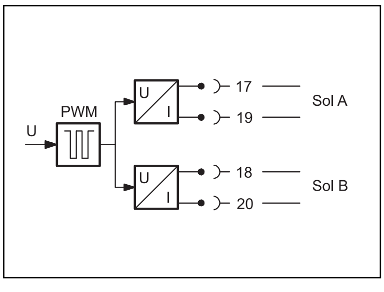
E0 VERSION



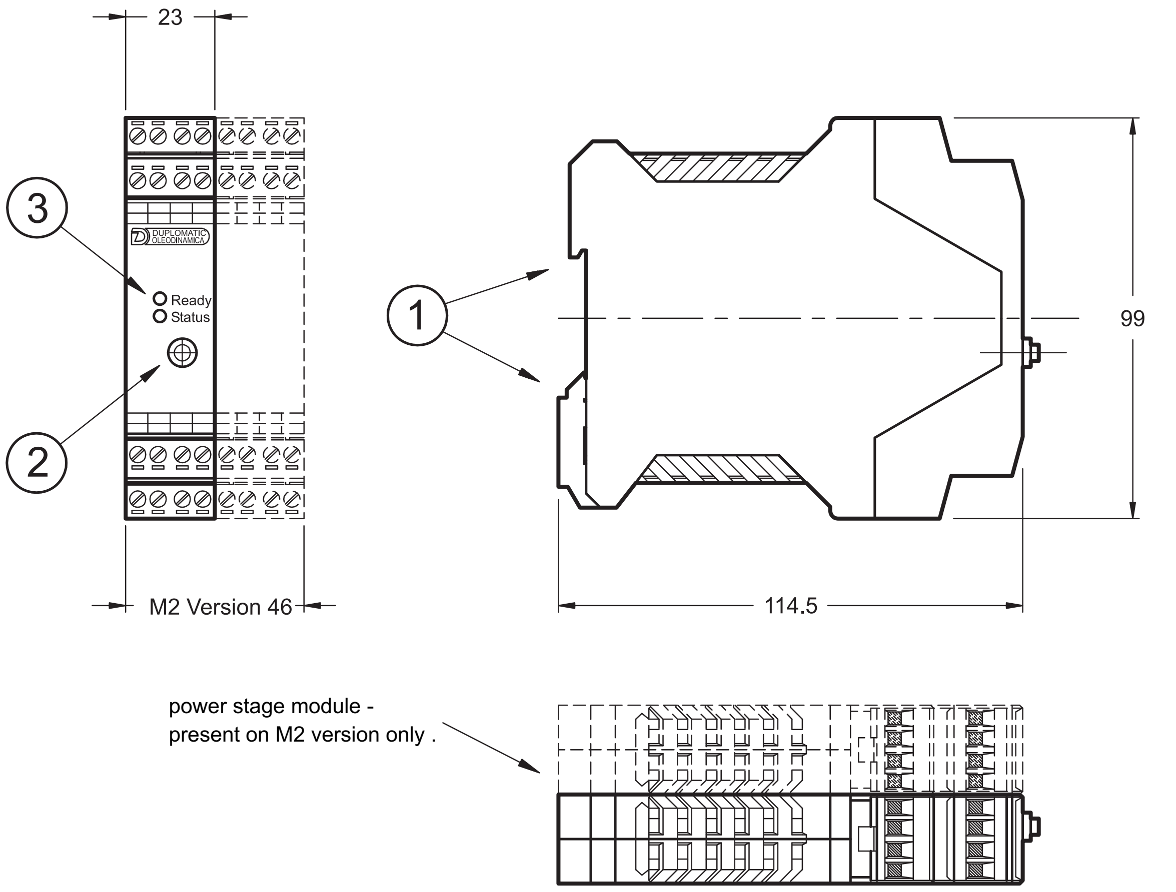
E1 VERSION



M2 VERSION



10 - OVERALL AND MOUNTING DIMENSIONS



1	DIN EN 50022 rail type fastening
2	Plug for PC cable connection
3	LED for Output signals

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