



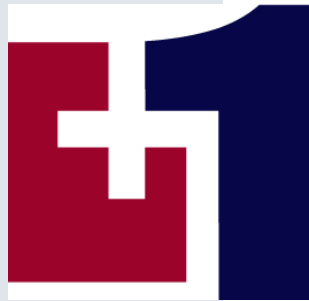
# SCHWARZMÜLLER INVERTER

MEMBER OF THE SAUER-DANFOSS GROUP

PLUS+1™ Inverters

## Data sheet

70300001 V1.4



## Data sheet for PLUS+1™ Inverters

### Versions

#### Version History

*Table of Versions*

Date	Page	Description	Version
08.09.2010	All	Complete rework of old document, new format, change over to Versions	1.0
27.01.2010	All	Mlxx-X1 added	1.1
09.02.2011	3, 5, 9	Status update availability Remark added, that "sensor supply" for Mlxx-X1 has a constant value.	1.2
22.03.2012	2	MI08 updated after development / MI14 deleted	1.3
20.06.2012	2, 4, 5	MI08 update after release, Legend update page 2/4 new pages 4/5 was former page 10	1.4
	2	New words for nominal, maximum, peak current	

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Schwarz Müller Inverter welcomes suggestions to improve our documentation. If you have suggestions for improving this document, please contact Schwarz Müller Inverter at [info@schwarzmueller-inverter.com](mailto:info@schwarzmueller-inverter.com).

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**Power data**

Type: MI-	24/240	24/300	24/400	24/550	24 V	
Size	MI03	MI04	MI06	MI08		
Nominal voltage [VDC]	24					
Voltage range [VDC]	16...36					
3 ~ Continuous current [Arms] <sup>1)</sup>	120	150	200	275		
3 ~ Nominal current [Arms] <sup>2)</sup>	240	300	400	550		
3 ~ Boost current [Arms] <sup>3)</sup>	260	330	420	600		
3 ~ Output voltage [Vrms] <sup>4)</sup>	3 x 0...16					
Dimensions [mm]	W	140	140	140		150
	H	200	200	200		225
	D <sup>5)</sup>	90/110	90/110	100/120	100 / 120	
Weight [kg]		2,8	3,0	3,5	4,1	
Power connectors		M6	M8	M10	M10	

Type: MI-	48/180	48/300	48/400	48/550	36-48 V	
Size	MI03	MI04	MI06	MI08		
Nominal voltage [VDC]	36 or 48					
Voltage range [VDC]	18 ... 62					
3 ~ Continuous current [Arms] <sup>1)</sup>	100	150	200	275		
3 ~ Nominal current [Arms] <sup>2)</sup>	180	300	400	550		
3 ~ Boost current [Arms] <sup>3)</sup>	200	330	420	600		
3 ~ Output voltage [Vrms] <sup>4)</sup>	3 x 0...24 or 3 x 0...32					
Dimensions [mm]	W	140	140	140		150
	H	200	200	200		225
	D <sup>5)</sup>	90/110	90/110	100/120	100 / 120	
Weight [kg]		2,8	3,0	3,5	4,1	
Power connectors		M6	M8	M10	M10	

Type: MI-	80/80	80/300	80/400	80/650	80V	
Size	MI03	MI08	MI08	MI-20		
Nominal voltage [VDC]	80					
Voltage range [VDC]	40...105					
3 ~ Continuous current [Arms] <sup>1)</sup>	40	150	200	325		
3 ~ Nominal current [Arms] <sup>2)</sup>	80	300	400	650		
3 ~ Boost current [Arms] <sup>3)</sup>	90	330	440	715		
3 ~ Output voltage [Vrms] <sup>4)</sup>	3 x 0...53					
Dimensions [mm]	W	140	150	150		280
	H	200	225	225		280
	D <sup>5)</sup>	90/110	100 / 120	100 / 120	141	
Weight [kg]		2,8	4,1	4,1	11,5	
Power connectors		M6	M10	M10	M10	

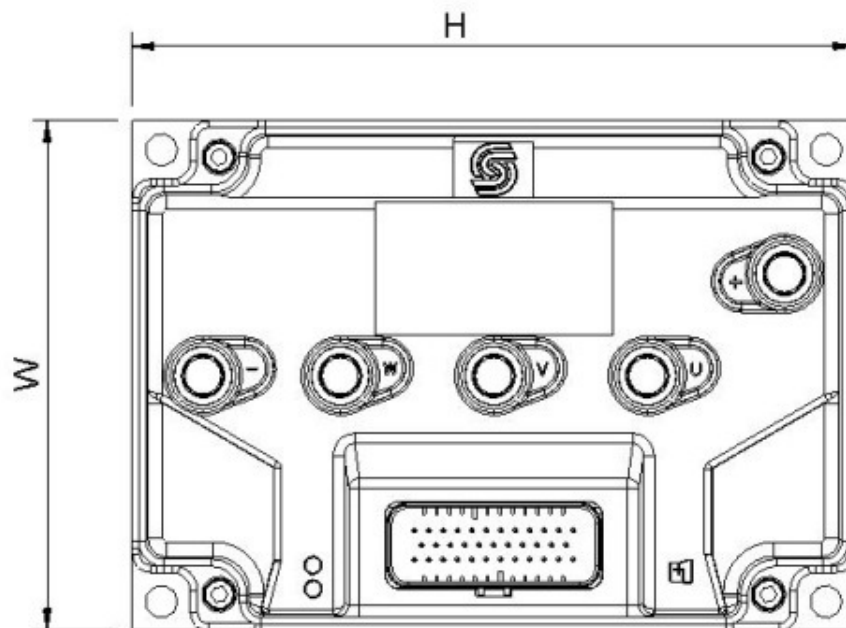
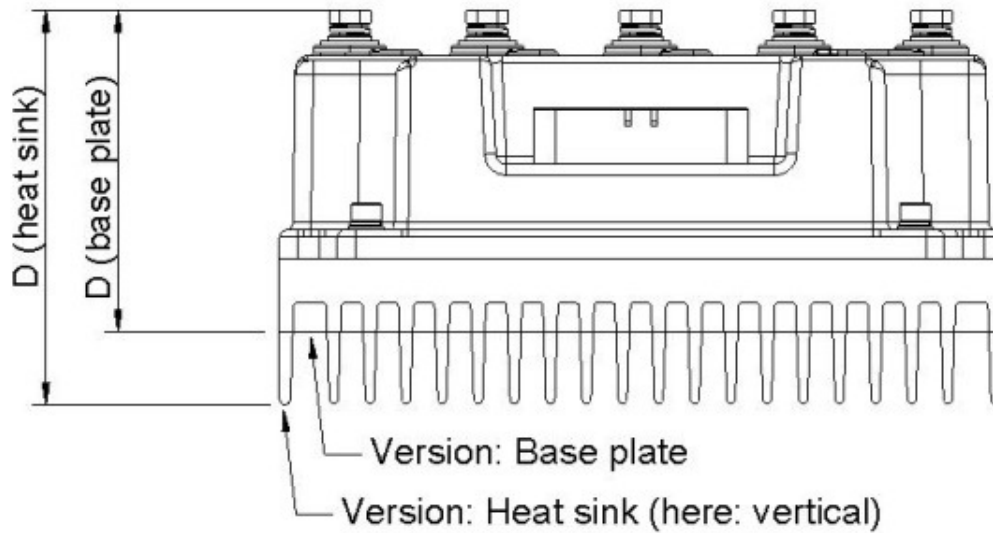
Legend:

xx/yyy	In pilot production - samples available
xx/yyy	Product under development – require for availability

- <sup>1)</sup> @ 8kHz switching frequency
- <sup>2)</sup> S2 - 2min
- <sup>3)</sup> for 10 seconds
- <sup>4)</sup> @ input voltage = nominal voltage
- <sup>5)</sup> plate / fins

**Dimensions**

Type: MI-		MI03	MI04	MI06	MI08	MI20
Dimensions [mm]	W	140	140	140	150	280
	H	200	200	200	225	280
	Base plate D	90	90	100	100	101
	Heat sink D	110	110	120	120	141



### Other characteristics

Switching frequency	8kHz standard; adjustable 4, 8, 12, 16 kHz
Efficiency	about 95% at nominal output
Output frequency	0...300 Hz
Tolerable supply voltage drop	Down to 50% of nominal voltage for max. 50ms.
Ambient temperature range	-40°C ... 50°C; -40°F ... 122°F
Maximum heat-sink temperature @ full current	85°C; 185°F
Heat-sink switch off temperature	85°C; 185°F
Relative humidity	100%, condensation is allowed
Operation signal	2 built-in LEDs (red and green)
Signal line connectors	AMP-Seal 35 pins
IP protection	IP67 with membrane
EMC / ESD	EN 12895 (EN61000-6-2 / EN61000-6-3 / EN61000-4-2 / EN61000-4-3) SAE J1113-13 CISPR 25 Class 1 ISO7637 / 1-3 (only for 24V – models) ISO 11452-2 level IV
Safety of industrial trucks – electrical requirements	EN 1175
Vibration, broad-band random, resonance	EN 60068-2-64 / EN 60068-2-28
Shock	EN 60068-2-27
Bump	EN 60068-2-29
Cold	EN 60068-2-1
Heat	EN 60068-2-2
Change of temperature	EN 60068-2-14
Damp heat, cyclic	EN 60068-2-30
UL	UL583 listed
Chemical resistance	ISO 16750-5

AMPSEAL 35 pin connector for version Mlxx-S

Power supply – (Ground)	C1-P1
Power supply +	C1-P2
CAN H	C1-P3
CAN L	C1-P4
Power supply – (Ground)	C1-P5
CAN H	C1-P6
CAN L	C1-P7
IO supply input	C1-P8
IO supply output	C1-P9
AIN unipolar	C1-P10
AIN bipolar	C1-P11
Power supply – (Ground)	C1-P12
DOUT safety /PWMOUT safety/ DIN	C1-P13
DOUT / PWMOUT / DIN	C1-P14
DOUT / PWMOUT / DIN	C1-P15
POUT / DOUT / PWMOUT / DIN	C1-P16
Encoder channel A	C1-P17
DIN / DIN PU	C1-P18
DIN	C1-P19
DIN	C1-P20
DIN	C1-P21
AIN bipolar	C1-P22
Sensor supply	C1-P23
DOUT MC / PWMOUT MC	C1-P24
DOUT / PWMOUT / DIN	C1-P25
DOUT / PWMOUT / DIN	C1-P26
POUT safety / DOUT safety / PWMOUT safety / DIN	C1-P27
Encoder supply	C1-P28
Encoder channel B	C1-P29
DIN / DIN PU	C1-P30
DIN	C1-P31
DIN	C1-P32
DIN	C1-P33
Rheo	C1-P34
Power supply – (Ground)	C1-P35

AMPSEAL 35 pin connector for version Mlxx-X1 with reduced numbers of IOs

Power supply – (Ground)	C1-P1
Power supply +	C1-P2
CAN H	C1-P3
CAN L	C1-P4
Power supply – (Ground)	C1-P5
CAN H	C1-P6
CAN L	C1-P7
IO supply input	C1-P8
IO supply output	C1-P9
AIN unipolar	C1-P10
AIN bipolar	C1-P11
Power supply – (Ground)	C1-P12
Not connected	C1-P13
Not connected	C1-P14
Not connected	C1-P15
Not connected	C1-P16
Encoder channel A	C1-P17
DIN / DIN PU	C1-P18
DIN	C1-P19
DIN	C1-P20
DIN	C1-P21
AIN bipolar	C1-P22
Sensor supply +10V (not programmable)	C1-P23
DOUT MC / PWMOUT MC	C1-P24
DOUT / PWMOUT / DIN	C1-P25
Not connected	C1-P26
POUT safety / DOUT safety / PWMOUT safety / DIN	C1-P27
Encoder supply	C1-P28
Encoder channel B	C1-P29
DIN / DIN PU	C1-P30
DIN	C1-P31
DIN	C1-P32
DIN	C1-P33
Rheo	C1-P34
Power supply – (Ground)	C1-P35

**Interface**

Type: MI	24/xxx	36 - 48/xxx	80/xxx
<b>Power supply +</b>	Power supply input for internal power supplies of control circuits		
Input voltage range [VDC]	16 .. 36	18 .. 62	40 .. 105
Supply current (typ.) @ nominal voltage [A]	0,24	0,13	0,1
Inrush current [A] (<100ms)	24	10	12
<b>Power supply – (Ground)</b>	Power supply and signal ground		
Internal structure	Connection with minus power supply		
<b>DIN</b>	Digital input with pull down		
Logic	high-active		
Input resistance [Ω]	18 k	18 k	47 k
Low-level [V] max.	3,75	3,75	3,75
High-level [V] min.	9,0	9,0	9,0
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
<b>DIN PU</b>	Digital input with pull up resistor to +15V		
Logic	low-active		
Input resistance [Ω] to +15V	1,1 k	1,1 k	1,1 k
Low-level [V] max.	3,75	3,75	3,75
High-level [V] min.	9,0	9,0	9,0
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
<b>AIN unipolar</b>	Analog input unipolar		
Resolution	12 bit		
Input resistance [Ω]	120 k		
Voltage range [V]	0 .. 10		
Recommended resistance range of external potentiometer [Ω]	1 k .. 10 k		
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
<b>AIN bipolar</b>	Analog input bipolar		
Resolution	12 bit		
Input resistance [Ω]	120 k		
Voltage range [V]	-10 .. 10		
Recommended resistance range of external potentiometer [Ω]	1k .. 10 k		
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120



**Interface**

Type: MI	24/xxx	36 - 48/xxx	80/xxx
<b>IO supply input</b>	Power supply input for IOs		
Maximum current [ADC]	8,0		
Voltage range			
Max. input voltage [V]	36	62	105
Min. input voltage [VDC]	12		
<b>IO supply output</b>	Power supply output for IOs		
Maximum current [ADC]	8,0		
Output voltage	IO supply input		
<b>DOUT</b>	Digital output		
Internal structure	low-side-switch with free wheeling diode		
Cathode of free wheeling diode connected to	IO supply output		
Signal condition	Reactions time minimum 1ms, dependent of application SW loop time.		
Nominal current [A]	2,0		
Maximum current [A] <sup>6)</sup>	3,0		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k
<b>PWMOUT</b>	Digital output		
Internal structure	low-side-switch with free wheeling diode		
Cathode of free wheeling diode connected to	IO supply output		
Signal condition	Programmable PWM signal from 0% to 100% with 10% step. PWM frequency = 100Hz.		
Nominal current [A]	2,0		
Maximum current [A] <sup>6)</sup>	3,0		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k
<b>DOUT MC</b>	Digital output for main contactor		
Internal structure	low-side-switch with free wheeling diode		
Cathode of free wheeling diode connected to	Power supply +		
Signal condition	Reactions time minimum 1ms, dependent of application SW loop time.		
Nominal current [A]	2,0		
Maximum current [A] <sup>6)</sup>	3,0		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k
<b>PWMOUT MC</b>	Digital output		
Internal structure	low-side-switch with free wheeling diode		
Cathode of free wheeling diode connected to	Power supply +		
Signal condition	Programmable PWM signal from 0% to 100% with 10% step. PWM frequency = 100Hz.		
Nominal current [A]	2,0		
Maximum current [A] <sup>6)</sup>	3,0		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k

**Interface**

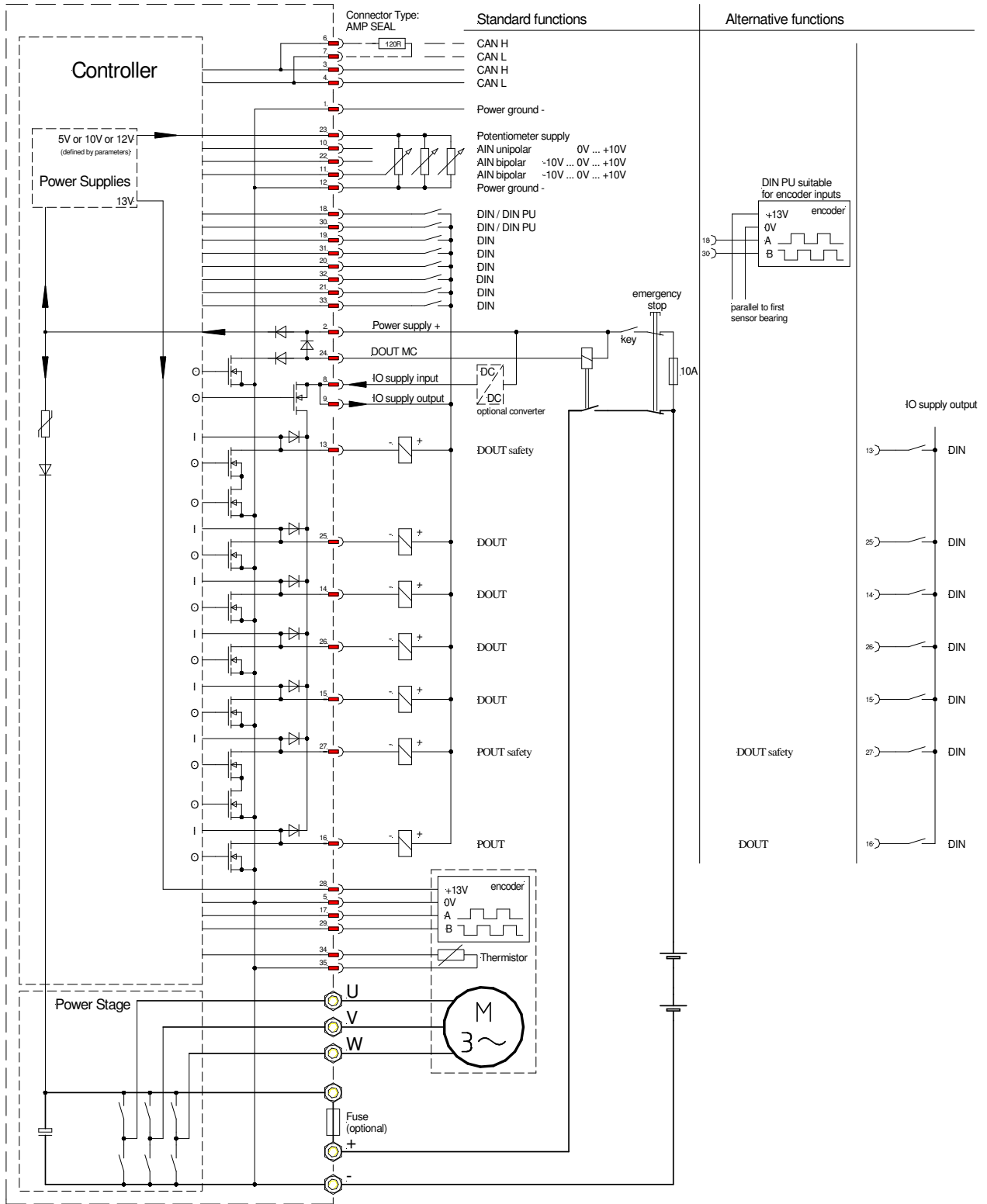
Type: MI	24/xxx	36 - 48/xxx	80/xxx
<b>POUT</b>	current controlled output - superposed with dither signal		
Internal structure	low-side-switch with free wheeling diode		
Cathode of free wheeling diode connected to	IO supply output		
Current range [A]	0,04...2,0		
Dither signal frequency / amplitude	62,5 Hz / 0...0,25 A		
Repeat accuracy from unit to unit	< ±10mA (for set values 0 to 330 mA) < ±3% (for set values 330 mA to 2A)		
Switching frequency [Hz]	500 ... 2000		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k
<b>DOUT safety</b>	Digital output for safety relevant components e.g. magnetic brake		
Internal structure	low-side-switch with additional safety switch in series and free wheeling diode		
Cathode of free wheeling diode connected to	IO supply output		
Signal condition	Reaction time minimum 1ms, dependent of application SW loop time		
Nominal current [A]	2,0		
Maximum current [A] <sup>6)</sup>	3,0		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k
<b>POUT safety</b>	current controlled output for safety relevant components e.g. lower valve - superposed with dither signal		
Internal structure	low-side-switch with additional safety switch in series and free wheeling diode		
Cathode of free wheeling diode connected to	IO supply output		
Current range [A]	0...2,0		
Dither signal frequency / amplitude	62,5 Hz / 0...0,25 A		
Repeat accuracy	< ±10mA (for set values 0 to 330 mA) < ±3% (for set values 330 mA to 2A)		
Switching frequency [Hz]	500 ... 2000		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k
<b>PWMOUT safety</b>	Digital output		
Internal structure	low-side-switch with free wheeling diode		
Cathode of free wheeling diode connected to	IO supply output		
Signal condition	Programmable PWM signal from 0% to 100% with 10% step. PWM frequency = 100Hz.		
Nominal current [A]	2,0		
Maximum current [A] <sup>6)</sup>	3,0		
Resistance to minus power supply [Ohm]	136 k		
Maximum load resistance [Ohm] (A higher resistance works, but will be detected as "Output disconnected")	45 k	266 k	468 k

## Interface

Type: MI	24/xxx	36 - 48/xxx	80/xxx
<b>Encoder supply</b>	Power supply for encoder (e.g. sensor bearing)		
Supply voltage [VDC]	13V ± 10%, Ri = 30 Ohm		
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
Over current, short circuit	Current limitation at 0,1 A		
<b>Encoder channel A / Encoder channel B</b>	Square wave signal from encoder with 90° phase shift between channel A and channel B		
Internal structure	Internal pull-up-resistors to power supply encoder		
Pull-up-resistor [Ω]	1,1 k		
Maximum frequency [kHz] (open collector)	10		
Maximum frequency [kHz] (push-pull)	50		
Low-level (maximum) [V]	1,77		
High-level (minimum) [V]	7,1		
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
<b>Rheo</b>	Measurement of an external resistance to minus power supply (e.g. motor temperature sensor)		
Range of resistance [Ω]	0 .. 12 k		
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
<b>CAN H / CAN L</b>	Serial interface V2.0B		
Baud rate	Maximum 1 Mbps		
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
<b>Sensor supply</b>	Power supply for external sensors		
Programmable output voltage [VDC]	5 / 10 / 12 (MIxx-X1-version: Constant value = 10V)		
Tolerance [%]	5		
Maximum output current [A]	0,1		
Protection			
Max. input voltage [V]	36	62	105
Max. input voltage spikes for < 100ms [V]	36	72	120
Over current, short circuit	Current limitation at 0,1 A		

<sup>6)</sup> For 1 second.

Wiring diagram for version Mlx-S



Wiring diagram for version Mlx-X1 with reduced numbers of IOs

