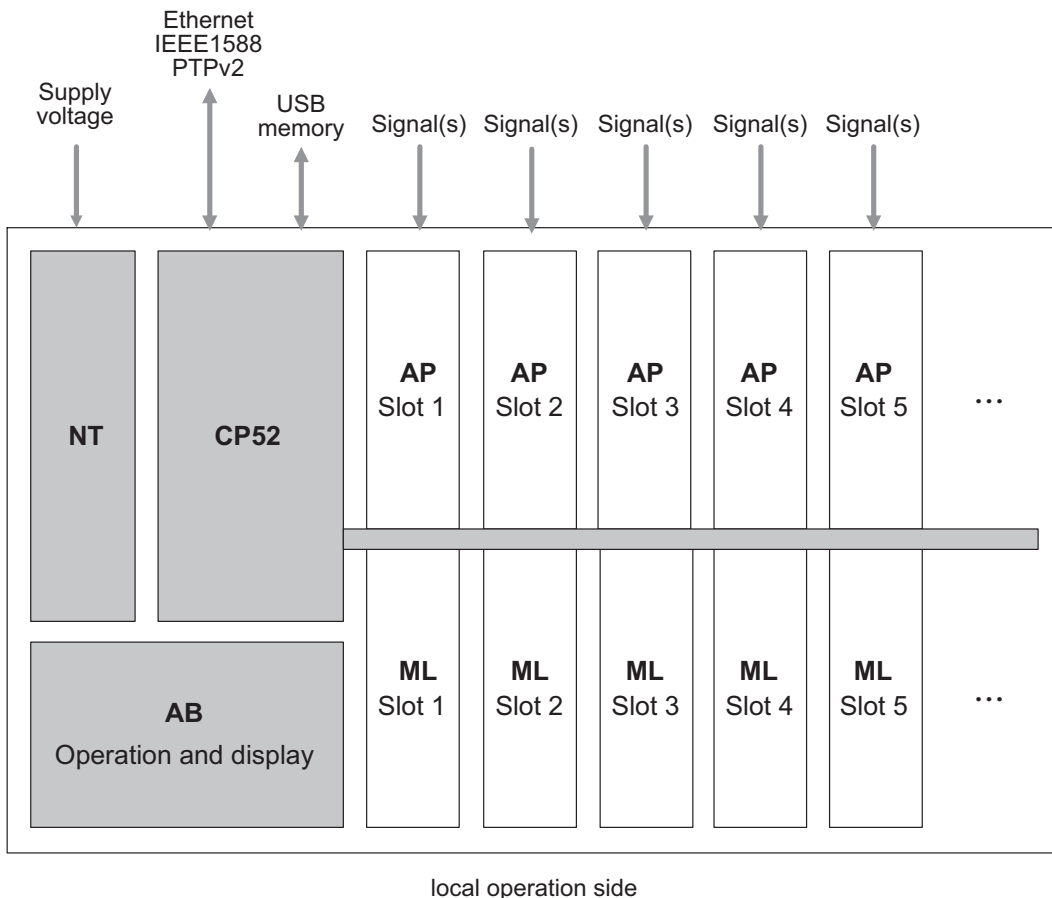


MGCplus

Measuring amplifier system

Special features

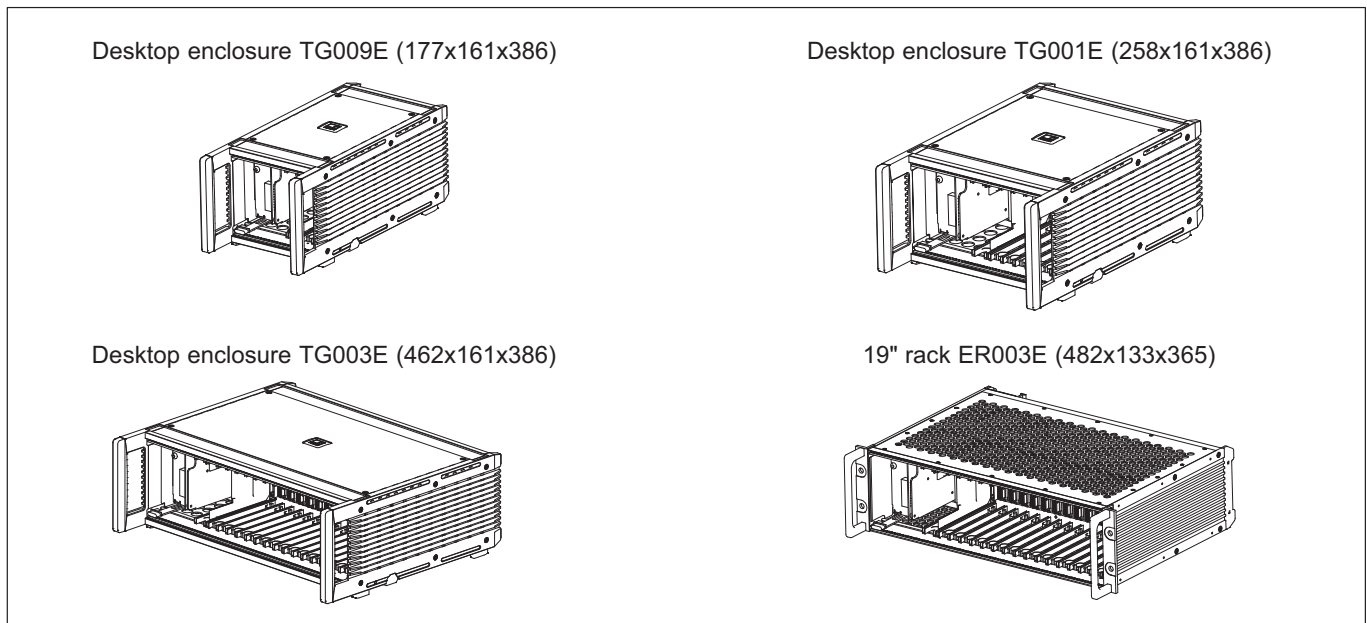
- Up to 128 channels per MGCplus enclosure (256 or 512 with CANHEAD or CAN)
- Sampling rates up to 19.2 kS/s per channel
- Simultaneous and parallel measurement with three independent sampling rates
- Stand-alone data logging with USB mass storage device
- Accuracy class to 0.0025
- Carrier frequency measuring amplifier for ambient conditions susceptible to error



MGCplus system devices

Mains power supply NT030		NT03	NT040
Rated input voltage	V AC	85-264	90-264
Max. power consumption	W	170	170
Inrush current	A	<16	<16
Input frequency	Hz	40-65	40-65
Nominal temperature range	°C	-20 ... +60	
Relative humidity	%	5 ... 85 (non-condensing)	
Degree of protection		IP20	

MGCplus enclosure dimensions (in mm)



Desktop housing	19" rack	Slots	Supply voltage (V)	Weight, approx. (kg) TG/ER
TG001E	-	6	230 (115) ~	5.9 ¹⁾
TG003E	ER003E	16	230 (115) ~	8.3 / 5.5 ¹⁾
TG009E	-	2	230 (115) ~	5.0 ¹⁾

¹⁾ With the NT030 power pack, the enclosures weigh about 150g less each

Notes

The MGCplus system is tested in accordance with the harmonized European standards EN61326-1:2013 and EN61010-1:2010. It therefore conforms to the applicable directives 89/336/EEC (Electromagnetic compatibility, EMC) and 73/23/EEC (Low-voltage electrical equipment) in relation to protection against hazards. Mechanical stress is tested in accordance with European standards EN60068-2-6 for vibration and EN60068-2-27 for shock. The devices are exposed to an acceleration of 25 m/s² within the frequency range 5 ... 65 Hz in all 3 axes. Duration of this vibration test: 30 minutes per axis. The shock test is implemented at a nominal acceleration of 200 m/s² for a duration of 11 ms, half sine and with shocks in each of the six possible directions. The maximum load per MGCplus slot is 150 mA with 16 slots. Double slot loading is possible if an adjoining slot is left vacant.

General technical specifications for single-channel measurement cards

Width	mm	20.3 (4HP) ¹⁾
Maximum sampling rate without linearization	Measured values/s	19200
Limit value switch Number Reference level Reference value (independently adjustable) Hysteresis factory setting Adjustment accuracy Response time	 % % % ms	 4 Gross, net, peak values -100 ... +100 of measuring range 1 of measuring range 0.0033 of measuring range 1.0 with Butterworth filter > 5 Hz and Bessel filter > 1.25 Hz
Peak-value memory Number Function Combination Update time Clear peak-value memory (switch to instantaneous measured value) Retaining the current measured value/peak value Time constant for envelope function	 s	 2 Maximum; Minimum Peak-to-peak; Arithmetic mean 30 with Butterworth filter > 250 Hz and Bessel filter > 100 Hz within 1ms, via control inputs within 1ms, via control inputs 0.01 ... 10000
Remote controls (HCMOS) Inputs (8 lines freely assignable) Allowed input voltage High level Low level Schmitt trigger, hysteresis Pull-up resistors (internal)	 V V V V kΩ	 -0.5 to +5.5 minimum +4.0 maximum +0.7 > 1.1 100
Outputs (limit value switches, errors) High level at maximum 1 mA Low level at maximum 0.7 mA Internal resistance	 V V kΩ	 > 4.0 <0.7 1
Nominal temperature range Storage temperature range	°C °C	-20 ... +60 -25 ... +70
Operating voltages	V	± 14.6 ... 17.0; (< 120 mA) ± 7.7 ... 8.3; (< 120 mA) ²⁾ +4.9 ... 5.1; (< 150 mA)
Card format Weight Connector plug	mm g	Europa 100 x 160 300 indirect DIN 41 612
Analog outputs Ua1 and Ua2 Rated voltage Allowed load resistance Internal resistance The two output voltages can optionally represent five signal voltages Max. deviation of analog outputs from digital value	V KΩ Ω mV	± 10 V (unbalanced) > 5 <5 Measuring amplifier output with zero balance Output offset by tare value Output of peak-value memory 1 (max. or min.) Output of peak-value memory 2 (max. or min.) Output of peak-value memory 3 (combination of 1 and 2) < 3 (for ML10B < 10)

Control output for Ua1 via BNC plug on front panel		
Rated voltage	V	± 10 (unbalanced)
Allowed load resistance	kΩ	> 1000
Internal resistance	kΩ	1
Effect of 10 K change in ambient temperature (additional effect to digital value) on outputs Ua1 and Ua2		
Sensitivity	%	< 0.08
Zero point	mV	< 3

1) With ML38B: 40.6 mm (8HP)

2) Can also be connected to ± 16 V

Single-channel measurement card ML01B

Accuracy class		0.03						
DC voltage amplifier		balanced						
Input for voltage measurement		10 V		75 mV				
Amplifier setting	V	-10.2 ... +10.2		-0.0765 ... +0.0765				
Amplifier input signal range (reversible)	V	± 0.4 ... 10.2		± 0.002 ... 0.0765				
Measuring range digitally adjustable	V	± 10		± 0.075				
Zero offset	V	± 10		± 0.075				
Measurement frequency range	Hz	0 ... 2400 -1 dB ¹⁾		0 ... 250 -1 dB				
Internal resistance of signal voltage source	kΩ	< 1.3		< 1.3				
Maximum permissible common-mode voltage	V	62		62				
Input for current measurement		unbalanced (to internal normal resistor 50 Ω)						
Input signal range	mA	-20 ... +20						
Measuring range digitally adjustable	mA	± 4 ... 20						
Max. measurement frequency range	Hz	0 ... 2400 -1 dB						
Zero drift adjustable (live zero point)	mA	0 ... 20						
Measurement frequency range		Nom. value	f_c	-1dB	-3dB	Runtime	Rise time	Overshoot
Low pass with Butterworth characteristic		(Hz)	(Hz)	(Hz)	(ms)	(ms)	(ms)	%
		2400 ²⁾	2400	3250	0.28	0.105	5.2	
		2000 ²⁾	2050	2350	0.40	0.170	12	
		1000 ³⁾	1050	1190	0.66	0.336	12	
		500	500	588	0.90	0.64	11	
		250	246	291	1.45	1.3	10	
		80	79	99	3.65	3.8	9	
		40	37.5	49.5	6.0	7.0	7	
		20	19	25.5	11	13.3	6	
		10	8.9	12.4	20	26	5	
		5	4.5	6.2	42	50	4	
Low pass with Bessel characteristic		Nom. value	f_c	-1dB	-3dB	Runtime	Rise time	Overshoot
		(Hz)	(Hz)	(Hz)	(ms)	(ms)	(ms)	%
		1100 ³⁾	1100	1780	0.45	0.23	1.3	
		400	445	805	0.7	0.45	1.3	
		200	235	410	1.1	0.86	1.3	
		100 ³⁾	117	210	1.8	1.7	1.3	
		40	38.5	68	4.3	5.1	1	
		20	22.0	37.5	7.4	9.4	1	
		10	10.5	19.0	12	19.0	0	
		5	5.1	9.6	22	35.5	0	
		2.5	2.6	4.8	50	70	0	
		1.25	1.35	2.4	100	135	0	
		0.5	0.7	1.2	200	280	0	
		0.2	0.17	0.3	650	1100	0	
		0.1	0.08	0.15	1400	2200	0	
		0.05	0.043	0.075	3000	4600	0	
High pass								
from 0.2 Hz Be; 5 Hz Bu	Hz				0.1			
from 2.5 Hz Be; 5 Hz Bu	Hz				1.0			
from 20 Hz Be; 40 Hz Bu	Hz				10			
Absolute zero error	%	0.1 ⁴⁾						
Non-linearity	%	< 0.02 f.s.						

Noise relative to input at filter setting	Hz	1.25	100
Measuring range 75 mV	μV_{SS}	3	75
Measuring range 10 V	μV_{SS}	40	120
Long-term drift over 48 hours		With autocalibration	Without autocalibration
Measuring range 75 mV	μV	5 / 10	5 / 10
Measuring range 10 V	mV	0.5 / 1	0.5 / 1
Influence of ambient temperature for change of 10 K on digital signals S1 and S2		With autocalibration	Without autocalibration
Sensitivity	%	< 0.02	< 0.2
Zero point			
Measuring range 75 mV	μV	< 5	< 50
Measuring range 10 V	mV	<0.2	<6
Measuring range 20 mA	μA	<4	<120
Analog outputs Ua1 and Ua2			
Residual carrier voltage (38.4 kHz)	mV _{SS}		< 12
Long-term drift (over 48 h)	mV		< 3

*) Factory setting

1) At $U_e > 2.5 V_{SS}$ take account of measurement frequency limitations

2) Applicable to $U_{eSS} < 2.5 V$ with range = 10 V (corresponding to 25 % range level control)

3) Applicable to $U_{eSS} < 5 V$ with range = 10 V (corresponding to 50 % range level control)

4) 0.2 % in current measurement

Single-channel measurement card ML10B

Accuracy class		0.03			
Bridge excitation voltage ($\pm 5\%$)	V	10	5 ^{*)}	2.5	1
Transducer					
SG full and half bridge, potentiometer, piezoresistive transducers	Ω	220 ... 5000	110 ... 5000	60 ... 5000	30 ... 5000
SG quarter bridge		in conjunction with connection board AP14			
Allowed cable length between transducer and amplifier	m	max. 500 ¹⁾			
DC voltage amplifier					
Measuring ranges					
SG (Low)	mV/V	$\pm 0.10 \dots 3.06$	$\pm 0.20 \dots 6.12$	$\pm 0.40 \dots 12.24$	$\pm 1.0 \dots 30.6$
Potentiometer, piezoresistive transducers (High)	mV/V	$\pm 10 \dots 306$	$\pm 20 \dots 612$	$\pm 40 \dots 1224$	$\pm 100 \dots 3060$
Bridge balance range					
SG (Low)	mV/V	± 3.06	± 6.12	± 12.24	± 30.6
Potentiometer, piezoresistive transducers (High)	mV/V	± 306	± 612	± 1224	± 3060
Measurement frequency range		Nom. value f_c	-1dB	-3dB	Runtime
Low pass with Butterworth characteristic		(Hz)	(Hz)	(Hz)	(ms)
		10000	8900	9900	0.13
		3000	2920	3480	0.16
		2000	2160	2500	0.24
		1000	1010	1165	0.66
		500	500	588	0.9
		250	246	291	1.45
		80	79	99	3.65
		40	37.5	49.9	6
		20	19	25.5	11
		10	8.9	12.4	20
		5	4.5	6.2	42
					Rise time
					(ms)
					0.05
					0.116
					0.15
					0.35
					0.64
					1.3
					3.8
					7
					13.3
					26
					5
					4
					Overshoot
					%
					19 ²⁾
					13
					12
					12
					11
					10
					9
					7
					6
					5
					4

Single-channel measurement card ML10B (continued)

Measurement frequency range		Nom. value f_c (Hz)	-1dB (Hz)	-3dB (Hz)	Runtime (ms)	Rise time (ms)	Overshoot %
Low pass with Bessel characteristic							
Only for the analog output (Digital interface 5000 Hz Butterworth)	}	100000	111000	188000	0.0027	0.0025	10.8 (High)
		100000	104000	145000	0.0027	0.0025	10.8 (Low)
		50000	49000	84000	0.0044	0.004	6.6
		1000	900	1800	0.27	0.2	0.6
		400	400	800	0.47	0.44	0.5
		200	230	405	0.82	0.96	0.4
		100 ^{*)}	117	210	1.58	1.8	0.4
		40	38.5	68	4.21	5.4	0
		20	22	37.5	7.2	9.3	0
		10	10.5	19	13.9	19	0
		5	5.1	9.6	25	37	0
		2.5	2.6	4.8	50	75	0
		1.25	1.35	2.4	100	155	0
		0.5	0.7	1.2	200	300	0
		0.2	0.17	0.3	650	1200	0
	0.1	0.08	0.15	1400	2300	0	
	0.05	0.043	0.075	3000	4600	0	
High pass							
from 0.2 Hz Be, 5 Hz Bu	Hz			0.1			
from 2.5 Hz Be, 5 Hz Bu	Hz			1.0			
from 20 Hz Be, 40 Hz Bu	Hz			10			
Max. allowed common-mode voltage	V	±6					
Common-mode rejection							
SG	dB	>120 (DC)					
Potentiometer	dB	>95 (DC)					
Non-linearity	%	< 0.03 of full scale value					
Noise relative to input		SG		Potentiometer			
with selected low-pass filter (Bessel)		(0.2 ... 6.12 mV/V)		(20 ... 612 mV/V)			
100000 Hz	$\mu V/V_{SS}$	4		300			
50000 Hz		3 ³⁾		300			
10000 Hz		3		300			
1000 Hz		1.3		100			
100 Hz		0.35		35			
Influence of ambient temperature for change of 10 K		With autocalibration		Without autocalibration			
on digital signals S1 and S2							
SG (Low):	Sensitivity	%	<0.03	<0.2			
	Zero point	$\mu V/V$	<0.6	<10			
Potentiometer (High):	Sensitivity	%	<0.03	<0.2			
	Zero point	$\mu V/V$	<30	<500			
Long-term drift over 48 hours							
SG (Low):	$\mu V/V$	<0.25		<5			
Potentiometer (High):	$\mu V/V$	<20		<400			
Analog outputs Ua1 and Ua2							
Residual carrier voltage	mV _{SS}	<5					
Long-term drift over 48 h	mV	<3					

*) Factory setting

1) 100 m maximum distance between connection board and T-ID/TEDS module

2) At max. 25 % level control ($U_{ASS \max} = 5 \text{ V}$)

3) With half bridge 20 $\mu V/V$. We recommend only measuring up to a cut-off frequency of 10 kHz.

Single-channel measurement card ML30B

Accuracy class		0.03					
Carrier frequency	Hz	600.15 ± 0.06 (synchronized)					
Bridge excitation voltage (± 5 %)	V	5 ^{*)}		2.5		1	
Transducer SG full bridge SG quarter bridge	Ω	110...5000		60...5000		30...5000	
		in conjunction with connection board AP14					
Allowed cable length between transducer and amplifier	m	500 max.					
Carrier frequency amplifier							
Measuring ranges	mV/V	± 0.1000 ... 3.0600		± 0.2000 ... 6.1200		± 0.5000 ... 15.3000	
Bridge balance range	mV/V	± 3.06		± 6.12		± 15.3	
Measurement frequency range Low pass with Butterworth characteristic		Nom. value f_c (Hz)	-1dB (Hz)	-3dB (Hz)	Runtime (ms)	Rise time (ms)	Overshoot %
		200	235	277	2.5	1.4	10
		80	88	103	4.6	3.8	9
		40	43	51	8.2	7.4	7
		20	22	26	14	14	6
		10	10.6	12.7	27	30	5
		5	5.3	6.3	52	56	4
Low pass with Bessel characteristic		Nom. value f_c (Hz)	-1dB (Hz)	-3dB (Hz)	Runtime (ms)	Rise time (ms)	Overshoot %
		100 ^{*)}	99	180	2.7	2	1
		40	40	72	5.2	4.8	1
		20	20	35.5	9.8	10	1
		10	9.8	18	18	20	0
		5	4.4	8.6	35	40	0
		2.5	2.35	4.4	65	80	0
		1.25	1.2	2.15	125	160	0
		0.5	0.6	1.15	220	300	0
		0.2	0.17	0.31	640	1100	0
		0.1	0.087	0.155	1400	2200	0
		0.05	0.042	0.08	3000	4600	0
High pass							
from 0.2 Hz Be, 5 Hz Bu	Hz				0.1		
from 2.5 Hz Be, 5 Hz Bu	Hz				1.0		
from 20 Hz Be, 40 Hz Bu	Hz				10		
Max. allowed common-mode voltage	V	±6 V					
Common-mode rejection	dB	> 50 (0 ... 600Hz)					
Maximum differential voltage DC	V	±0.1					
Residual carrier voltage (600 Hz)	μV/V _{SS}	< 0.3 ¹⁾					
Non-linearity	%	< 0.02 f.s.					
Noise relative to input with selected low-pass filter	μV/V _{SS}	(Butterworth) 200 Hz					< 0.3
		(Bessel) 1.25 Hz					< 0.03
Effect of 10 K change in ambient temperature on digital signals S1 and S2		With autocalibration		Without autocalibration			
Sensitivity	%	< 0.01		< 0.2			
Zero point	μV/V	< 0.1		< 2			
Long-term drift over 48 hours	μV/V	< 0.1		2			
Analog outputs Ua1 and Ua2							
Residual carrier voltage	mV _{SS}	< 3					
Long-term drift over 48 h	mV	< 3					

^{*)} Factory setting

¹⁾ measured at U_B = 5 V and input signal 2 mV/V

Single-channel measurement card ML38B

Accuracy class		0.0025¹⁾							
Accuracy	%	± (0.0025 of measured value; +0.0025 of full scale value)							
Carrier frequency	Hz	225.05 ± 0.02							
Bridge excitation voltage (± 5 %)	V	5 ^{*)}				2.5			
Transducer SG full bridge	Ω	30 ... 5000							
Allowed cable length between transducer and amplifier	m	max. 500							
Carrier frequency amplifier		5 V				2.5 V			
Measuring ranges	mV/V	± 0.2 ... 5.1				± 0.4 ... 10.2			
Bridge balance range	mV/V	± 5.1				± 10.2			
Measurement frequency range Low pass with Butterworth characteristic		Filter stages							
Nominal value	Hz	f1	f2	f3	f4	f5	f6	f7	f8
f (-3 dB)	Hz	1.0	1.5	2.5	3	5	6	9	10
f (loss=1000)	Hz	1.1	1.6	2.3	3.2	4.6	6.3	8.3	10
f (loss=1000000)	Hz	18.9	21.6	24.5	27.4	30.5	33.8	37.3	41
Settling time to 99 %	s	50	54	57	61	65	68	70	72
Settling time to 99.999 %	s	1	0.7	0.5	0.37	0.26	0.2	0.16	0.13
	s	2.3	1.6	1.14	0.82	0.58	0.42	0.30	0.23
Low pass with Bessel characteristic		Filter stages							
Nominal value	Hz	f1	f2	f3	f4	f5	f6	f7	
f (-3 dB)	Hz	0.03	0.05	0.1	0.2	0.5	0.9	1.5	
f (loss=1000)	Hz	0.03	0.05	0.1	0.22	0.45	0.9	1.7	
f (loss=1000000)	Hz	0.125	0.25	0.5	1	2	4	8	
Settling time to 99 %	s	0.2	0.4	0.8	1.7	3.5	7	14	
Settling time to 99.999 %	s	32	16	8	4	2	1	0.5	
	s	48	24	12	6	3	1.5	0.75	
Transducer adaptation		Linear or polynomial characteristic ²⁾							
Max. allowed common-mode rejection	V	± 2							
Common-mode rejection	dB	> 100							
Input resistance	MΩ	1000							
Effect of 10 K change in ambient temperature on digital signals S1 and S2									
Sensitivity	%	< 0.002 of measured value							
Zero point	%	< 0.001 of full scale value							
Non-linearity	%	< 0.002							
Long-term drift over 24 h	ppm	max. ± 20							
Short-term drift over 5 min, from 2 h after switch-on	ppm	max. ± 10							
Noise with selected low-pass filter									
0.9 Hz (Bessel)	μV/V _{SS}	0.02							
5 Hz (Bessel)	μV/V _{SS}	0.05							
Sampling rate	1/s	1.18 / 2.34 / 4.69 / 9.38 / 18.75 / 37.5 / 75							
Analog outputs Ua1 and Ua2									
Residual carrier voltage	mV _{SS}	< 3							
Long-term drift over 48 h	mV	< 3							

^{*)} Factory setting

¹⁾ With irradiation as per EN 61326, table 1

²⁾ Attention: When calibrating the measurement chain, the measured values must be recorded in the electrical unit (mV/V) with no display adjustment!

Single-channel measurement card ML55B

Accuracy class		0.03					
Carrier frequency	Hz	4801.2 ± 0.48 (synchronized)					
Bridge excitation voltage (± 5 %)	V	5 ^{*)}	2.5	1			
Transducer ¹⁾							
SG half and full bridge ²⁾	Ω	110 ... 5000	60 ... 5000	30 ... 5000			
Inductive half and full bridge	mH	n/a	2.5 ... 30	1 ... 30			
SG quarter bridge ²⁾		in conjunction with connection board AP14					
Allowed cable length between transducer and amplifier	m	500 ³⁾					
Carrier frequency amplifier		5 ^{*)}	2.5	1			
Measuring ranges							
SG	mV/V	± 0.1 ... 3.06	± 0.2 ... 6.12	± 0.5 ... 15.3			
Inductive		± 1.5 ... 45.9	± 3.0 ... 91.8	± 7.5 ... 229.5			
Bridge balance range							
SG	mV/V	± 3.06	± 6.12	± 15.3			
Inductive		± 45.9	± 91.8	± 229.5			
Measurement frequency range		Nom. value	f_c -1dB	-3dB	Runtime	Rise time	Overshoot
Low pass with Butterworth characteristic		(Hz)	(Hz)	(Hz)	(ms)	(ms)	%
		1500	1600	2180	0.32	0.17	7
		1000	1010	1165	0.66	0.35	12
		500	500	588	0.9	0.64	11
		250	246	291	1.45	1.3	10
		80	79	99	3.65	3.8	9
		40	37.5	49.5	6	7	7
		20	19	25.5	11	13.3	6
		10	8.9	12.4	20	26	5
		5	4.5	6.2	42	50	4
Low pass with Bessel characteristic		Nom. value	f_c -1dB	-3dB	Runtime	Rise time	Overshoot
		(Hz)	(Hz)	(Hz)	(ms)	(ms)	%
		900	900	1550	0.47	0.25	4.1
		400	445	805	0.7	0.45	1.3
		200	235	410	1.1	0.86	1.3
		100 ⁷⁾	117	210	1.8	1.7	1.3
		40	38.5	68	4.3	5.1	1
		20	22	37.5	7.4	9.4	1
		10	10.5	19	12	19	0
		5	5.1	9.6	22	35.5	0
		2.5	2.6	4.8	50	70	0
		1.25	1.35	2.4	100	135	0
		0.5	0.7	1.2	200	280	0
		0.2	0.17	0.3	650	1100	0
		0.1	0.08	0.15	1400	2200	0
		0.05	0.043	0.075	3000	4600	0
High pass							
from 0.2 Hz Be; 5 Hz Bu	Hz				0.1		
from 2.5 Hz Be; 5 Hz Bu	Hz				1.0		
from 20 Hz Be; 40 Hz Bu	Hz				10		
Max. allowed common-mode voltage	V	± 6 V					
Common-mode rejection	dB	> 50 (0 ... 4800 Hz)					
Maximum differential voltage DC	V	± 1					
Absolute zero error	%	0.1					

Non-linearity	%	< 0.02	
Noise With selected low-pass filter 1500 Hz (Butterworth) 100 Hz (Bessel) 1.25 Hz (Bessel)	$\mu\text{V}/V_{SS}$	SG < 2 < 1 < 0.2	Inductive < 100 < 50 < 5
Effect of 10 K change in ambient temperature on digital signals S1 and S2: SG: Sensitivity Zero point Inductive: Sensitivity Zero point	% $\mu\text{V}/V$	With autocalibration <0.02 0.2 <0.02 <4	Without autocalibration <0.2 4 <0.2 <60
Long-term drift over 48 hours SG Inductive	$\mu\text{V}/V$ $\mu\text{V}/V$	<0.2 <20	<4 <60
Analog outputs Ua1 and Ua2 Residual carrier voltage Long-term drift over 48 h	mV_{SS} mV	<5 <3	

*) Factory setting

1) At bridge resistances $R_B > 500 \Omega$, $R_B/2$ resistors must be inserted in the return lines.

2) When combining the ML55B with AP14, after configuring the measurement chain it is essential to perform a one-off zero balancing.

3) 100 m maximum distance between connection board and T-ID/TEDS module

Single-channel measurement card ML60B

Accuracy class	0.01	
Input signals Frequency F1 Direction of rotation signal F2 Zero index Transducer error (only with AP01i)		Input level 0.1 .. 30 V_S (with control amplifier) or CMOS level 0.1 .. 30 V_S (with control amplifier) or CMOS level CMOS level CMOS level
Transducer HBM torque transducers in conjunction with AP17 Frequency signal sources with square or sine-wave voltage, Incremental encoder	kHz	T10 series ¹⁾ , T12/T12HP, T40 series 0.0001 ... 2000
Allowed cable length between transducer and amplifier	m	70 ²⁾
Input level 5 V setting 100 mV setting (auto. gain control) Input impedance Detection of direction of rotation Measuring ranges Frequency measurement Pulse counting Maximum pulse rate with pulse counting Zero balance range Measuring ranges to 2 kHz Measuring ranges to 20 kHz Measuring ranges to 200 kHz Measuring ranges to 1 MHz	V_S V_S k Ω Hz Pulses Pulses/s Hz Hz Hz Hz	5...30 0.1...30 typ. 20 via additional 90° phase-shifted frequency signal 100 ... 2000 1 000 ... 20 000 10 000 ... 200 000 100 000 ... 2 000 000 100 ... 1 000 000 1 000 000 -2000 ... +2000 -20 000... +20 000 -200 000 ... +200 000 -2 000 000 ... + 2 000 000

Single-channel measurement card ML60B (continued)

Measurement frequency range		Nom. value (Hz)	f_c (Hz)	-1dB (Hz)	-3dB (Hz)	Runtime (ms)	Rise time (ms)	Overshoot (%)
Without filter		-	2500	3100	0.4	0.12	8	
Low pass with Butterworth characteristic		2000	2000	2400	0.5	0.18	10	
		1000	1000	1200	0.8	0.35	8	
		500	470	570	0.9	0.70	11	
		250	246	291	1.45	1.3	10	
		80	79	99	3.65	3.8	9	
		40	37.5	49.5	6	7	7	
		20	19	25.5	11	13.3	6	
		10	8.9	12.4	20	26	5	
		5	4.5	6.2	42	50	4	
Low pass with Bessel characteristic								
		900	900	1800	0.6	0.35	0	
		400	400	800	0.8	0.52	1.0	
		200	235	410	1.1	0.86	1.3	
		100 ¹⁾	117	210	1.8	1.7	1.3	
		40	38.5	68	4.3	5.1	1	
		20	22	37.5	7.4	9.4	1	
		10	10.5	19	12	19	0	
		5	5.1	9.6	22	35.5	0	
		2.5	2.6	4.8	50	70	0	
		1.25	1.35	2.4	100	135	0	
		0.5	0.7	1.2	200	280	0	
		0.2	0.17	0.3	650	1100	0	
		0.1	0.08	0.15	1400	2200	0	
		0.05	0.043	0.075	3000	4600	0	
High pass								
from 0.2 Hz Be; 5 Hz Bu	Hz				0.1			
from 2.5 Hz Be; 5 Hz Bu	Hz				1.0			
from 20 Hz Be; 40 Hz Bu	Hz				10			
Noise (10 kHz input signal) with selected low-pass filter from 1 kHz (Butterworth) 100 Hz (Bessel)	Hz						± 3	
	Hz						± 1	
	Hz						± 0.2	
Input filter							Glitch filter, selective	
Long-term drift over 90 d	%						<0.005	
Effect of 10 K change in ambient temperature on digital signals S1 and S2	%						0.005	
Analog outputs Ua1 and Ua2								
Residual carrier voltage (38.4 kHz)	MV _{SS}						< 5	
Long-term drift over 48 h	mV						<3	

*) Factory setting

1) Does not apply to version -KF1

2) Max. 20 m if internal transducer supply is used

Connection boards for single-channel amplifiers

AP01i

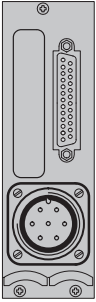


AP01i (connection board with D plug)		
Width	mm	20.3 (4HP)
Transducer connection		D-sub-HD15, 15-pin, DA-15P ¹⁾
Connection for output signal		D-sub-HD15, 25-pin, DB-25P ²⁾
Weight	kg	0.3

1) HBM ordering number 3-3312.0182

2) HBM ordering number 2-9278.0293

AP03i



AP03i (connection board with MS plug)		
Width	mm	40.6 (8HP)
Transducer connection		MS cable plug, 7-pin, MS3106A 16S-1P ¹⁾
Connection for output signal		D-sub-HD15, 25-pin, DB-25P ²⁾
Weight, approx.	kg	0.3

1) HBM ordering number 1-MS3106-PEMV

2) HBM ordering number 2-9278.0293

AP14



AP14 for single strain gage		
Width	mm	20.3 (4HP)
Accuracy class		
SG full bridge		0.1
SG half bridge		0.5
SG quarter bridge		0.5
Transducer		
SG full bridge		
SG half bridge		
SG quarter bridge (in 3- or 4-wire configuration)		
Measurement cards that can be connected		ML10B, ML30B, ML55B ¹⁾
Transducer connection		D-sub-HD15, 15-pin DA-15P ²⁾
Connection for output signal		D-sub-HD15, 25-pin DB-25P ³⁾
Internal completion resistors	Ω	120, 350, 700
Max. allowed cable length between transducer and connection board	m	500
Measurement frequency range	kHz	0...50
Non-linearity	%	0.05
Effect of 10 K change in ambient temperature		
SG full bridge	Sensitivity	%
	Zero point	%
SG half and quarter bridge	Sensitivity	%
	Zero point	%
Operating temperature range	°C	-20...+60
Weight, approx.	kg	0.3

1) When combining the ML55B with AP14, after configuring the measurement chain it is essential to perform a one-off zero balancing.

2) HBM ordering number 3-3312.0182

3) HBM ordering number 2-9278.0293

Connection boards for single-channel amplifiers

AP17



AP17 for connection of torque flanges T10 series ¹⁾ , T12/T12HP, T40 series and frequency signals to ML60B		
Width	mm	20.3 (4HP)
Transducer HBM torque transducers Frequency signal sources with square or sine-wave voltage, incremental encoder	kHz	T10 series ¹⁾ , T12/T12HP, T40 series 0.0001...1000
Transducer connection		D-sub-HD15, 15-pin, DA-15P ²⁾
Connection for output signal		D-sub-HD15, 25-pin, DB-25P ³⁾
Outputs		
Transducer supply	V (DC)	+16 (max. 500 mA) ⁴⁾
	V (DC)	-16 (max. 500 mA) ⁴⁾
	V (DC)	+5 (max. 300 mA) ⁴⁾
Calibration signal trigger	V (DC)	approx. 5 (max. 100 mA)
Inputs		
Rated input voltage		
balanced	V _{SS}	10
unbalanced	V _{SS}	5
Minimum/maximum voltage swing		
balanced	V _{SS}	0.3/14
unbalanced	V _{0S}	3/20
Common-mode range	V	-5 ... +4
Maximum input frequency	kHz	1000
Nominal temperature range	°C	-20 ... +60
Weight, approx.	kg	0.3

1) Except for the -KF1 version

2) HBM ordering number 3-3312.0182

3) HBM ordering number 2-9278.0293

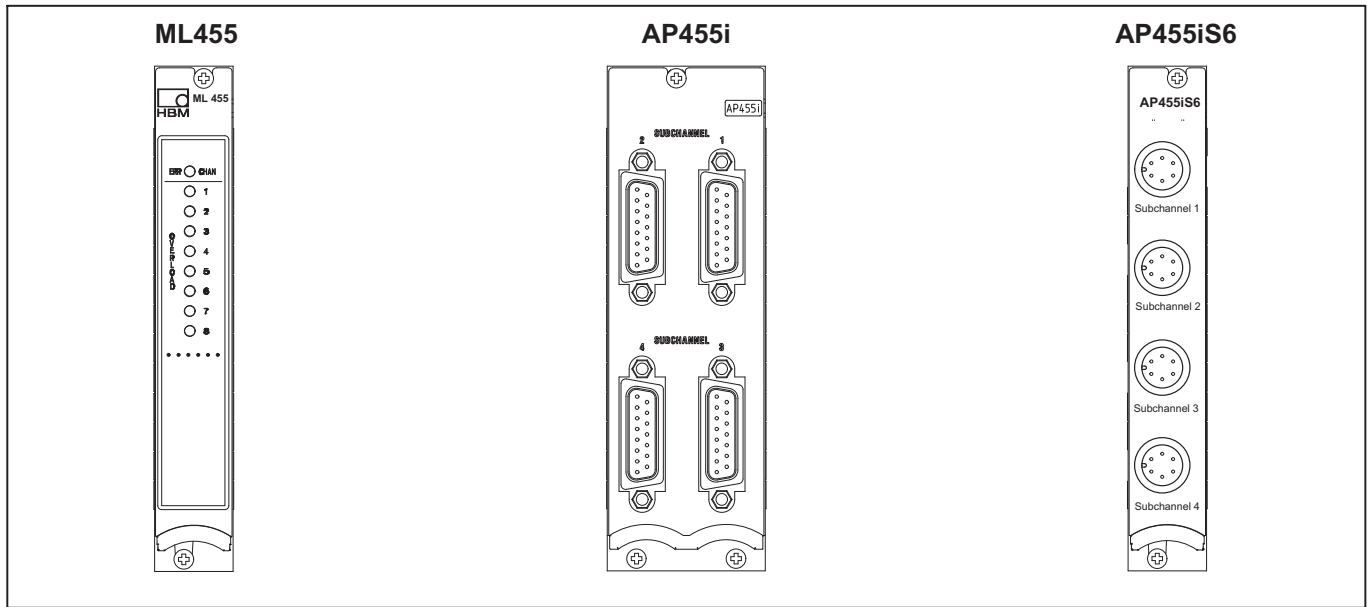
4) The currents indicated are the maximum allowed continuous currents of the AP17. The number of connection boards per enclosure is not restricted, though a maximum of three connection boards can be used to supply the transducer (16V e.g. for torque measurement flange T10 series, T12/T12HP, T40 series).

If multiple torque flanges are supplied with power, make certain they are powered up one after the other, not simultaneously.

Multi-channel measurement card ML455

ML455 + connection board		AP455i/AP455iS6		
Accuracy class		0.05		
Accuracy	%	± (0.05 of measured value + 0.05 of full scale value)		
Carrier frequency	Hz	4801.2 ± 0.48		
Bridge excitation voltage (± 5 %)	V	2.5		
Transducers that can be connected*) in 6- (5)-wire configuration		SG half or full bridge Inductive half or full bridge LVDT		
Allowed cable length between transducer and connection board ¹⁾	m	100		
Measuring ranges				
SG	mV/V	± 4		
Inductive	mV/V	± 100		
LVDT	mV/V	± 1000		
Transducer impedance				
SG half and full bridge	Ω	120 ... 1000		
Inductive half and full bridge, LVDT	mH	4 ... 330		
Noise at 25 °C		SG	Inductive	LVDT
Butterworth/Bessel				
1000 Hz/200 Hz	μV/V	< ± 3	< ± 30	< ± 140
80 Hz/40 Hz	μV/V	< ± 0.5	< ± 3	< ± 28
20 Hz/5 Hz	μV/V	< ± 0.2	< ± 1.5	< ± 14
5 Hz/1.25 Hz	μV/V	< ± 0.1	< ± 0.5	< ± 6
Non-linearity	%	< 0.02		
Effect of 10 K change in ambient temperature		With autocalibration	Without autocalibration	
on sensitivity	% of m. ²⁾	< ± 0.01	< ± 0.03	
on zero point	% of f.s. ³⁾	< ± 0.005	< ± 0.01	
Operating temperature range	°C	-20...+60		
Transducer connection		4x15-pin Sub-D Lemo® FGG.1B.306 6-pin ⁴⁾		
Width	mm	20.3 (4 HP)		

*) The transducer type can be selected separately for each of the four subchannels
 1) Use shielded cable pairs with outside shielding (e.g. HBM no. 4-3301.0071)
 2) Of measured value
 3) Of full scale value
 4) HBM ordering number 3-3312.0126



Multi-channel measurement card ML460

ML460 + connection board		AP460i
Accuracy class		0.01 ¹⁾
Transducers that can be connected		
HBM torque transducers ²⁾		T10 series, T12/T12HP, T40 series
Frequency signal sources with square or sine-wave voltage, incremental encoder	kHz	0.0001...500
Inductive rotational speed meters (T-R coils) via input filtering	kHz	0.5 ... 200
Measuring ranges		
Frequency measurement	kHz	0..2 0...20 0...200 0...500
Accuracy, referred to full scale value	%	0.01
Pulse counting	Pulses	100 ... 1 000 000
Maximum pulse rate with pulse counting	Pulses/s	500 000
Accuracy	k pulses	0.001
PWM carrier frequency	Hz	1...10 000
Accuracy	%/kHz	0.05
Pulse duration	ms	0 ... 2500
Accuracy	ms	0.001
Input frequency range	Hz	0.25 ... 10 000
Channel properties		
Number of subchannels		4
Class accuracy		0.01
Signals per subchannel F ₁ F ₂ Zero index		Frequency/pulse or PWM signal ± 90° Phase shift to F ₁ (detection of direction) To detect the zero position in pulse counting
Electrical isolation of all inputs mutually and against MGC ground	V	Typ. 500
Input frequency range	kHz	0 ... 500
Nominal temperature range	°C	-20 ... +60
Storage temperature range	°C	-25 ... +70
Input signals		
Direct inputs, differential signals		
Input voltage range	V _{SS}	0.4...30
Direct inputs, bipolar		
Input voltage range	V _{SS}	0.4...30
Direct inputs, unipolar		
Input voltage range	V	5...30
Minimum pulse width	µs	3

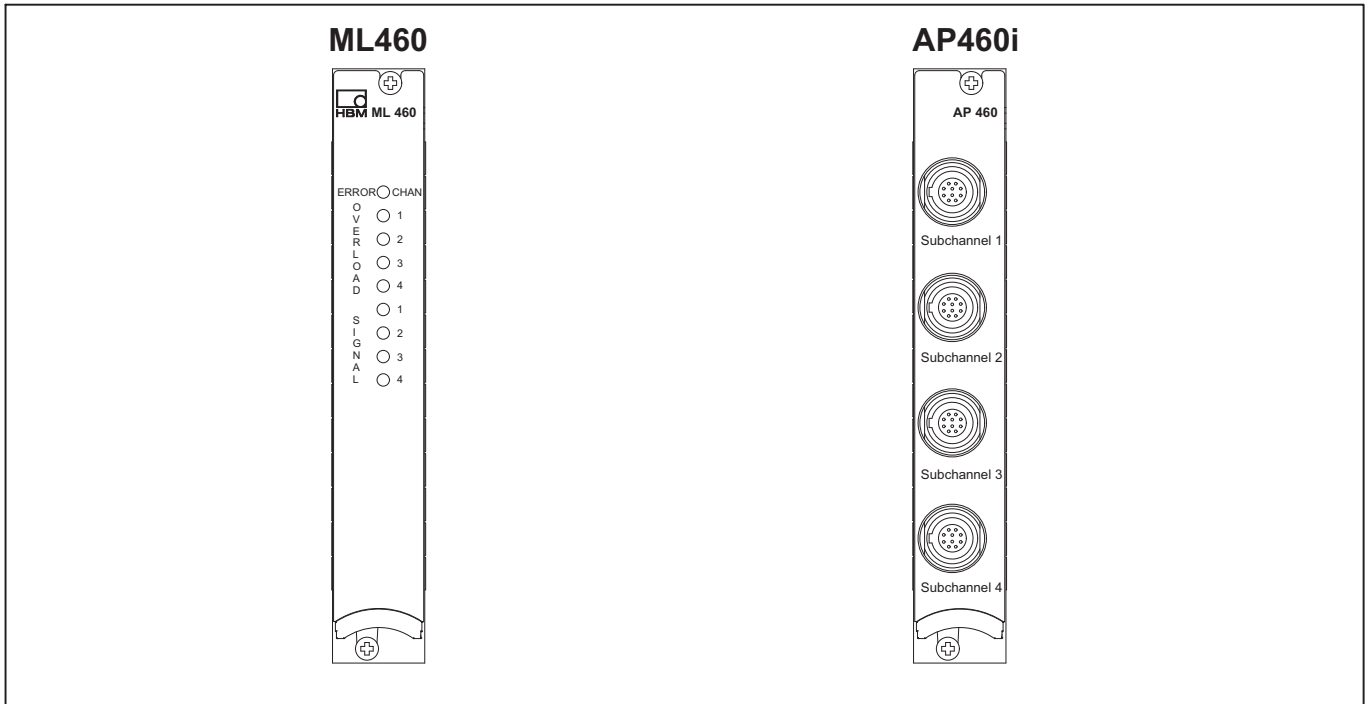
Multi-channel measurement card ML460 (continued)

Input for inductive transducers, filtered (only F1 signals)							
Required minimum input voltage (peak-to-peak)							
500 Hz					50 mV		
1 kHz					100 mV		
10 kHz					750 mV		
25 kHz					1 V		
50 kHz					1.5 V		
75 kHz					2 V		
100 kHz					2.5 V		
125 kHz					3 V		
150 kHz					4 V		
175 kHz					5 V		
200 kHz					7 V		
Maximum input voltage	V				30		
Input resistance F₁ signal	kΩ				approx. 6		
Transducer excitation							
Maximum current per module		16 modules per device	1 module per device				
5 V		10 mA	160 mA				
8 V		62.5 mA	600 mA				
16 V		62.5 mA	600 mA				
Measurement frequency range		Nom. value f_c	-1dB	-3dB	Runtime	Rise time	Overshoot
		(Hz)	(Hz)	(Hz)	(ms)	(ms)	%
Without filter		-	740	1750	1	<0.6	0
Low pass with Butterworth characteristic		500	450	550	1.5	1	9.4
		250	250	290	2.5	2.1	12
		80	83	99	5	6.2	8.5
		40	41	49.5	7.5	13	7.8
		20	20	25.5	12	24	7
		10	9	12.4	25	50	4.7
		5	5	6.5	46	100	4.7
Low pass with Bessel characteristic		Nom. value f_c	-1dB	-3dB	Runtime	Rise time	Overshoot
		(Hz)	(Hz)	(Hz)	(ms)	(ms)	%
		400	380	650	1.4	1	1
		200	235	380	1.5	1.75	1
		100 ¹⁾	125	210	2.6	3	2
		40	43	70	5.2	7.5	1
		20	24	40	7.4	15	1
		10	11	18	15.7	31	0
		5	4	10	27	55	0
		2.5	2.6	4.8	53	125	0
		1.25	1.35	2.4	104	210	0
		0.5	0.7	1.2	195	450	0
		0.2	0.17	0.3	730	2000	0
		0.1	0.08	0.15	1480	3700	0
		0.05	0.04	0.075	3000	7500	0
Mechanical							
Card format	mm	Europa 100 x 160					
Width	mm	20.3 (4 HP)					
Connections		Lemo® 1B 10-pin EXG.1B.310.HLN					
Designation of the matching plug (manufacturer Lemo®)		Fixed plug (1st letter in model name) : F Key (3rd letter in model name) : G Series: 1B Type: 310 Example: FGG.1B.310.CLAD62 (Variants in bold must be selected)					

1) 0.05 at PWM

2) These torque transducers are not excited by connection board AP460!

Front panel of multi-channel measurement card ML460 and connection board AP460i



Multi-channel measurement card ML801B

ML801B connection board		AP801/AP801S6 ¹⁾	AP809 ²⁾	AP835 ³⁾																																																																						
Accuracy class		0.05	0.05 ⁴⁾	0.05																																																																						
Number of measuring points		8																																																																								
Transducer		± 10 V balanced	Thermocouples type K, J, N, T ±75 mV	Pt100 4-wire-connection 0...500 Ω resistance																																																																						
Width	mm	20.3 (4HP)																																																																								
Maximum sampling rate per channel	Hz	2400 (8 subchannels), 4800 (4 subchannels), 9600 (2 subchannels) ⁵⁾																																																																								
Measurement frequency range	kHz	0 ... 1																																																																								
Max. allowed input voltage and common-mode voltage	V	50	10	-																																																																						
Absolute zero error	%	0.05	0.05 ⁴⁾	0.05																																																																						
Total error limit at 22 °C ambient temperature	K	-	± 1 ⁶⁾ 7) 8)	-																																																																						
Filter ⁹⁾																																																																										
Low pass Butterworth HD		<table border="1"> <thead> <tr> <th>Nominal (Hz)</th> <th>f_{g max} -1dB (Hz)</th> <th>-3dB (Hz)</th> <th>Internal Sampling rate¹⁰⁾ (Hz)</th> </tr> </thead> <tbody> <tr><td>1000</td><td>1189</td><td>1518</td><td>9600</td></tr> <tr><td>500</td><td>523</td><td>691</td><td>9600</td></tr> <tr><td>250</td><td>253</td><td>322</td><td>9600</td></tr> <tr><td>200</td><td>203</td><td>265</td><td>9600</td></tr> <tr><td>80</td><td>78</td><td>103</td><td>9600</td></tr> <tr><td>1000</td><td>1206</td><td>1516</td><td>4800</td></tr> <tr><td>500</td><td>613</td><td>816</td><td>4800</td></tr> <tr><td>250</td><td>255</td><td>327</td><td>4800</td></tr> <tr><td>200</td><td>203</td><td>264</td><td>4800</td></tr> <tr><td>80</td><td>78</td><td>102</td><td>4800</td></tr> <tr><td>250</td><td>312</td><td>413</td><td>2400</td></tr> <tr><td>200</td><td>226</td><td>300</td><td>2400</td></tr> <tr><td>80</td><td>82</td><td>109</td><td>2400</td></tr> <tr><td>40</td><td>41</td><td>54</td><td>1200</td></tr> <tr><td>20</td><td>21</td><td>27</td><td>600</td></tr> <tr><td>10</td><td>10</td><td>13</td><td>300</td></tr> <tr><td>5</td><td>5.3</td><td>7</td><td>150</td></tr> </tbody> </table>	Nominal (Hz)	f _{g max} -1dB (Hz)	-3dB (Hz)	Internal Sampling rate ¹⁰⁾ (Hz)	1000	1189	1518	9600	500	523	691	9600	250	253	322	9600	200	203	265	9600	80	78	103	9600	1000	1206	1516	4800	500	613	816	4800	250	255	327	4800	200	203	264	4800	80	78	102	4800	250	312	413	2400	200	226	300	2400	80	82	109	2400	40	41	54	1200	20	21	27	600	10	10	13	300	5	5.3	7	150
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Multi-channel measurement card ML801B (continued)

ML801B + connection board		AP801/AP801S6	AP809	AP835
Filter				
Low pass Butterworth compatible		Nominal (Hz)	f_{g max} -1dB (Hz)	Internal -3dB Sampling rate (Hz)
		1000	1076	4800
		500	596	4800
		250	279	2400
		200	214	2400
		80	78.9	2400
		40	38.7	2400
		20	19.5	2400
		10	9.36	2400
		5	4.37	1200
Low pass Bessel compatible		Nominal (Hz)	f_{g max} -1dB (Hz)	Internal -3dB Sampling rate (Hz)
		200	322	2400
		100	125	2400
		40	41	2400
		20	21	2400
		10	11	2400
		5	5.5	2400
		2.5	2.7	1200
		1	1.36	600
		0.5	0.68	300
		0.2	0.186	75
		0.1	0.093	37.5
		0.05	0.047	18.7
Input for voltage measurement				
Input range	V	-10.5...+10.5		-
	mV		-80...+80	
Zero offset	V	-10.5...+10.5		-
	mV		-80...+80	
Internal resistance of voltage source	kΩ	< 1.0		-
Input resistance balanced/unbalanced	kΩ	500/250	2000/1000	
Noise relative to input at 1.25 Hz Filter	μV _{SS}	< 50	<0.5	-
Effect of 10 K change in ambient temperature				
on the zero point (relative to the full scale value)	%	<0.05	<0.05	-
on the sensitivity (relative to the measured value)	%	<0.05	<0.05	-
Long-term drift over 48 hours with/without autocalibration	mV	0.8/1.5	0.01/0.02	-
Non-linearity	%	<0.03	<0.03	-
Transducer excitation voltage¹¹⁾ (only AP801S6)				
Supply voltage for transducer (only selectable for all channels together each time)	V	8/16	-	-
Max. output current per channel	mA	50	-	-
Max. output current per connection board	mA	150	-	-

Multi-channel measurement card ML801B (continued)

ML801B + connection board		AP801/ AP801S6	AP809	AP835
Input for thermocouples				
Linearization error	°C	-	< 0.06	-
Linearization range				
NiCr-Ni (K)	°C	-	-158...+1414	-
Fe-CuNi (J)	°C	-	-167...+1192	-
NiCrSi-NiSi (N)	°C	-	-186...+1300	-
Cu-CuNi (T)	°C	-	-210...+393	-
Temperature range of cold junction	°C	-	-20...+60	-
Influence of ambient temperature for change of 10 K (T _{ref} = 22 °C)	K	-	± 1	-
Long-term drift over 48 hours with/without autocalibration				
Type K, J, N, T	K	-	0.2/0.4	-
Noise with 1.25 Hz filter				
Type K, J, N, T	K	-	< 0.1	-
Input for Pt100				
Measuring range	Ω	-	-	500
Linearization error	°C	-	-	< 0.02
Linearization range	°C	-	-	-200 ... +848
Noise with 1.25 Hz filter	mΩ _{SS}	-	-	2
Effect of 10 K change in ambient temperature				
on the zero point (relative to the full scale value)	%	-	-	<0.05
on the sensitivity (relative to the measured value)	%	-	-	<0.05
Measuring current	mA	-	-	0.5
Allowed cable length between transducer and amplifier	m	-	-	300 ¹²⁾
Non-linearity	K	-	-	± 0.1
Long-term drift over 48 h with autocalibration	mΩ	-	-	< 30
Input for the resistance measurement				
Measuring range	Ω	-	-	500
Noise with 1.25 Hz filter	mΩ _{pp}	-	-	2
Effect of 10 K change in ambient temperature				
on the zero point (relative to the full scale value)	%	-	-	<0.05
on the sensitivity (relative to the measured value)	%	-	-	<0.05
Measuring current	mA	-	-	0.5
Permissible cable length between transducer and amplifier	m	-	-	300 ¹¹⁾
Non-linearity	%	-	-	<0,03
Long-term drift over 48 h with autocalibration	mΩ	-	-	<30

- 1) Customer-side connector plug: e.g. Phoenix Contact MC1,5/3-ST-3,5; art.no. 1840379 (connector plug for AP801S6: LemoR FGG0B.304 CLAD52)
- 2) No line break detection
- 3) Customer-side connector plug: HBM order no. 3-3312.0258
- 4) Accuracy class and absolute zero error for voltage measurement only
- 5) The number of subchannels can be changed via the MGCplus Setup Assistant or the MGCplus Firmware Loader .
- 6) From AP809 : Hardware revision 3.00
- 7) The total error limit for thermocouple type N is ±2 K
- 8) In industrial electromagnetic environments under the influence of continuous disturbance variables, the total error limit is ±1.5 K.
- 9) ML801B/AP801 resp. AP801S6: The 1000 Hz Butterworth filter is only supported as from the AP801/AP801S6 hardware version 1.20.
- 10) Internally, the signals are converted independently of the preset number of of subchannels at 38.4 kHz. The implementation of a digital filter calls for a reduction in the sampling rate (through repeated averaging and sub-sampling). This reduced sampling rate is called the "internal sampling rate".
- 11) A maximum of 1 A may be drawn from the MGCplus to supply the transducer.
- 12) 100 m max. distance between connection board and T-ID/TEDS module

Multi-channel measurement card ML801B (continued)

ML801B + connection board ¹⁾		AP402i
Accuracy class		0.1
Measuring ranges	V mA	1, 10, 60 20
Electrical isolation of measurement inputs	V DC	typ. 500
Max. common-mode input voltage (against enclosure/ground)	V	100
Max. differential input voltage	V	70
Input impedance Measuring ranges 1 V, 10 V Measuring range 60 V Measuring range 20 mA	MΩ MΩ Ω	10 0.6 45
Common-mode rejection (at 50 Hz, 20 V _{SS}) (at DC 10 V)	dB dB	typ. 75 min. 100
Measurement frequency range	Hz	1000 (-1 dB)
Non-linearity	%	0.03
Noise Filter characteristics Measuring range 1 V Measuring range 10 V Measuring range 60 V Measuring range 20 mA over 45 Ω	μV _{SS} μV _{SS} μV _{SS} μV _{SS}	5 Hz Bessel / 500 Hz Butterworth < 40 / < 300 < 400 / < 3000 < 2400 / < 18000 < 100 / < 500
Effect of 10 K change in ambient temperature on zero point (relative to full scale value) Autocal on Autocal off on sensitivity Autocal on Autocal off	% % % %	max. 0.02 max. 0.075 max. 0.05 (measuring range 10 V: max. 0.02) max. 0.1
Transducer connection		6-pin jack, compatible with Lemo® series S, size 0 Matching plugs: e.g. FGG.1B.306.CLA.441.D42 ²⁾ FGG.1B.306.CLA.441.D62
Transducer excitation voltage ³⁾ Ampacity Electrical isolation	V DC mA -	Adjustable via jumper panel: open, +5, +8 or +16 (for all subchannels) max. 100 (for all subchannels together) no
Transducer identification Max. distance of TEDS module from AP402i Electrical isolation	m	TEDS-capable (only external TEDS modules) 100 no
Nominal temperature range	°C	-20 ... +60
Operating temperature range	°C	-20 ... +60
Storage temperature range	°C	-25 ... +70
Width	mm	20.3 (4 HP)

¹⁾ With one ML801B two AP402i can be operated.

²⁾ HBM ordering number 3-3312.0126

³⁾ A maximum of 1 A may be drawn from the MGCplus to supply the transducer.

Multi-channel measurement card ML801B (continued)

ML801B + connection board		AP418i
Accuracy class		1
Transducers that can be connected ^{*)}		4 current-fed piezo transducers (e.g. Deltatron™)
Transducer identification		T-ID and TEDS capable
Transducer excitation	mA	4
Input voltage range	V	2 ... 20
Measuring ranges	V	± 0.05; ± 0.5; ± 5
Measurement frequency range	Hz	1000 (-1 dB)
Lower cut-off frequency (-3 dB)	Hz	0.72
Non-linearity	%	0.05
Noise Filter characteristics		5 Hz Bessel/500 Hz Butterworth
Measuring range ± 0.05 V	V_{SS}	< 25 μ / μ < 60 μ
Measuring range ± 0.5 V	V_{SS}	< 25 μ / μ < 0.35 m
Measuring range ± 5 V	V_{SS}	< 100 μ / μ < 3.5 m
Effect of 10 K change in ambient temperature on the zero point (relative to the full scale value)	%	Measuring range ± 0.05 V Measuring range ± 0.5 V and 5 V 0.1 0.03
Width	mm	20.3 (4 HP)
Operating temperature range	°C	-20...+60

^{*)} If the transducer cable is laid outside enclosed rooms, or with cable lengths of more than 30 meters between the connection board AP418i and transducer, the sensor cables must be executed with an additional, separately grounded, shield in order to ensure protection against overvoltage. This can be accomplished, for example, by laying the cable in a metal tube, or by using double-shielded cable, with the outside shield then having to be connected to ground and protective conductor potential close to the connection board (e.g. at the entry into the control cabinet). HBM recommends Triaxial cable for this.

Multi-channel measurement card ML801B (continued)

ML801B + connection board		AP810i			
Accuracy class		0.1			
Transducers that can be connected		8 SG half or full bridges			
Bridge excitation voltage (DC)	V	10; 5; 2.5; 0.5			
Transducer resistance at U_B		10 V	5 V	2.5 V	0.5 V
R_{\min} (full bridge)	Ω	330	160	120	120
R_{\max}	Ω	4000			
Measuring ranges	mV/V	± 4 ($U_B=10$ V) ± 8 ($U_B=5$ V) ± 16 ($U_B=2.5$ V) ± 80 ($U_B=0.5$ V)			
Control signal (shunt)	mV/V	approx. 1 (with 350 Ω SG full bridge) approx. 0.5 (with 350 Ω SG half bridge)			
Noise at 350 Ω		Bessel/Butterworth			
Filter characteristics		1.25/5 40/80 200/500			
Filter frequency	Hz				
$U_B=10$ V	$\mu\text{m/m}$	$< \pm 0.025$	$< \pm 0.15$	$< \pm 1.8$	
$U_B=5$ V	$\mu\text{m/m}$	$< \pm 0.05$	$< \pm 0.3$	$< \pm 3.5$	
$U_B=2.5$ V	$\mu\text{m/m}$	$< \pm 0.1$	$< \pm 0.6$	$< \pm 7$	
$U_B=0.5$ V	$\mu\text{m/m}$	$< \pm 0.4$	$< \pm 3$	-	
Transducer connection		D jack, 25-pin			
Allowed cable length between transducer and connection board	m	200 (100m max. distance between connection board and T-ID/TEDS module)			
Width	mm	20.3 (4 HP)			
Non-linearity	%	0.05			
Measurement frequency range	Hz	1000 (-1 dB)			
Effect of 10 K change in ambient temperature on the zero point (relative to the full scale value)	%	0.05			
on sensitivity	%	0.1			
Operating temperature range	$^{\circ}\text{C}$	-20...+60			

Multi-channel measurement card ML801B (continued)

ML801B + connection board		AP814Bi
Accuracy class		0.1 ¹⁾
Transducers that can be connected		8 SG quarter bridges in 3-wire configuration
Internal completion resistors	Ω	120, 350, 700, 1000 ²⁾
Bridge excitation voltage (DC)	V	5; 2.5; 1; 0.5
Measuring ranges	mV/V	± 8 (U _B =5 V) ± 16 (U _B =2.5 V) ± 40 (U _B =1 V) ± 80 (U _B =0.5 V)
Control signal (shunt)	mV/V	approx. 1 (at 350 Ω)
Noise at 350 Ω		
Filter characteristics		Bessel/Butterworth
Filter frequency	Hz	1.25/5 40/80 200/500
U _B =5 V	μm/m	<± 0.05 <± 0.3 <± 2.5
U _B =2.5 V	μm/m	<± 0.1 <± 0.65 <± 6.5
U _B =1 V	μm/m	<± 0.25 <± 1.5 <± 13
U _B =0.5 V	μm/m	<± 0.45 <± 3.5 -
Transducer connection		D jack, 25-pin
Allowed cable length between transducer and connection board	m	200 ³⁾⁴⁾
Width	mm	20.3 (4 HP)
Non-linearity	%	0.05
Measurement frequency range	Hz	500 (-1 dB)
Effect of 10 K change in ambient temperature		
on the zero point (relative to the full scale value)	%	0.1
on sensitivity	%	0.1
Operating temperature range	°C	-20...+60

1) The effect of faults due to unbalanced cable resistances is not included in the accuracy class.

2) Option

3) Use a connection cable with wire cross-section $\geq 0.25 \text{ mm}^2$!

4) 100m max. distance between connection board and T-ID/TEDS module

Multi-channel measurement card ML801B (continued)

ML801B + connection board		AP815i
Accuracy class		0.1 ¹⁾²⁾³⁾
Transducers that can be connected		8 SG full bridges in 6-wire configuration or 8 SG half bridges in 6-wire configuration or 8 SG half bridges in 5-wire configuration or 8 SG quarter bridges in 4-wire configuration or 2 SG rosettes
Internal completion resistors	Ω	120, 350, 700, (optionally 1000)
Total transducer resistance with half and full bridges	Ω	240 ... 4000 (2x120 ... 2000 with half bridges; 4x240 ... 4000 with full bridges)
Bridge excitation voltage (DC)	V	5; 2.5; 1; 0.5
Measuring ranges	mV/V	± 8 (U _B =5 V) ± 16 (U _B =2.5 V) ± 40 (U _B =1 V) ± 80 (U _B =0.5 V)
Control signal (shunt)	mV/V	1.0078 ± 0.1 % (at 350 Ω)
Noise at 350 Ω Filter characteristics Filter frequency U _B =5 V U _B =2.5 V U _B =1 V U _B =0.5 V	Hz μV/V _{SS} μV/V _{SS} μV/V _{SS} μV/V _{SS}	Bessel/Butterworth 1.25/5 40/80 200/500 <± 0.1 <± 0.6 <± 4 <± 0.2 <± 1.2 <± 8 <± 0.5 <± 3 <± 20 <± 1 <± 6 <± 40
Transducer connection		Two D jacks, 25-pin (4 channels each)
Allowed cable length between transducer and connection board	m	200 ⁴⁾
Width	mm	20.3 (4 HP)
Non-linearity	%	0.05
Measurement frequency range	Hz	1000 (-1 dB)
Effect of 10 K change in ambient temperature on the zero point (relative to the full scale value) on sensitivity	% %	0.1 ²⁾ 0.1
Operating temperature range	°C	-20...+60

1) 0.2 with irradiation as per EN 61000-4-3:1996 + A1:1998

2) 0.2 with 5 V bridge excitation voltage

3) If zero balancing is not possible, the following accuracy classes apply: 0.2 with R_{transducer} > 2 kΩ and 0.3 with R_{transducer} > 3 kΩ.

4) 100m max. distance between connection board and T-ID/TEDS module

Multi-channel measurement card ML801B (continued)

ML801B + connection board		AP836i
Accuracy class		0.1
Transducers that can be connected		8 x transducers in 5-wire configuration, 8 x voltage, Ungrounded active transducers with 5V/10V voltage supply and voltage output, selectable specific to channel
Bridge excitation voltage (DC)	V	5
Transducer resistance		
R _{min}	Ω	190
R _{max}	Ω	5000
Measuring ranges		
Potentiometric transducers	mV/V	± 500
Active transducers ¹⁾	V	± 10
Noise		
Filter characteristics		Bessel/Butterworth
Filter frequency	Hz	1.25/5 40/80 200/500
	mV/V	< ± 0.01 < ± 0.05 < ± 0.5
Transducer connection		D jacks, 25-pin
Allowed cable length between transducer and connection board	m	200 (100m max. distance between connection board and T-ID/TEDS module)
Width	mm	20.3 (4 HP)
Non-linearity	%	0.05
Measurement frequency range	Hz	500 (-1 dB)
Effect of 10 K change in ambient temperature		
on the zero point (relative to the full scale value)	%	0.05
on sensitivity	%	0.1
Operating temperature range	°C	-20...+60

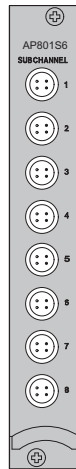
¹⁾ Bridge excitation voltage adjustable via display and control panel or software to 5V; 10V.

Connection boards for multi-channel amplifiers

AP801
for 8 DC voltage sources



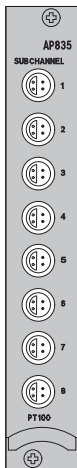
AP801S6
for 8 DC voltage sources with voltage supply 8 V/16 V



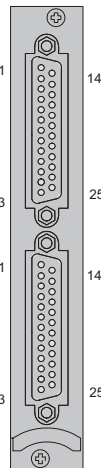
AP809
for 8 thermocouples



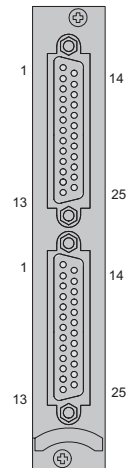
AP835
for 8 resistance thermometers Pt100



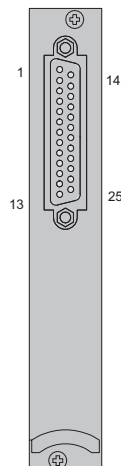
AP836i
for 8 potentiometric transducers



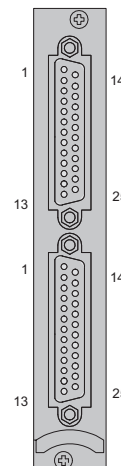
AP810i
for 8 SG half or full bridges



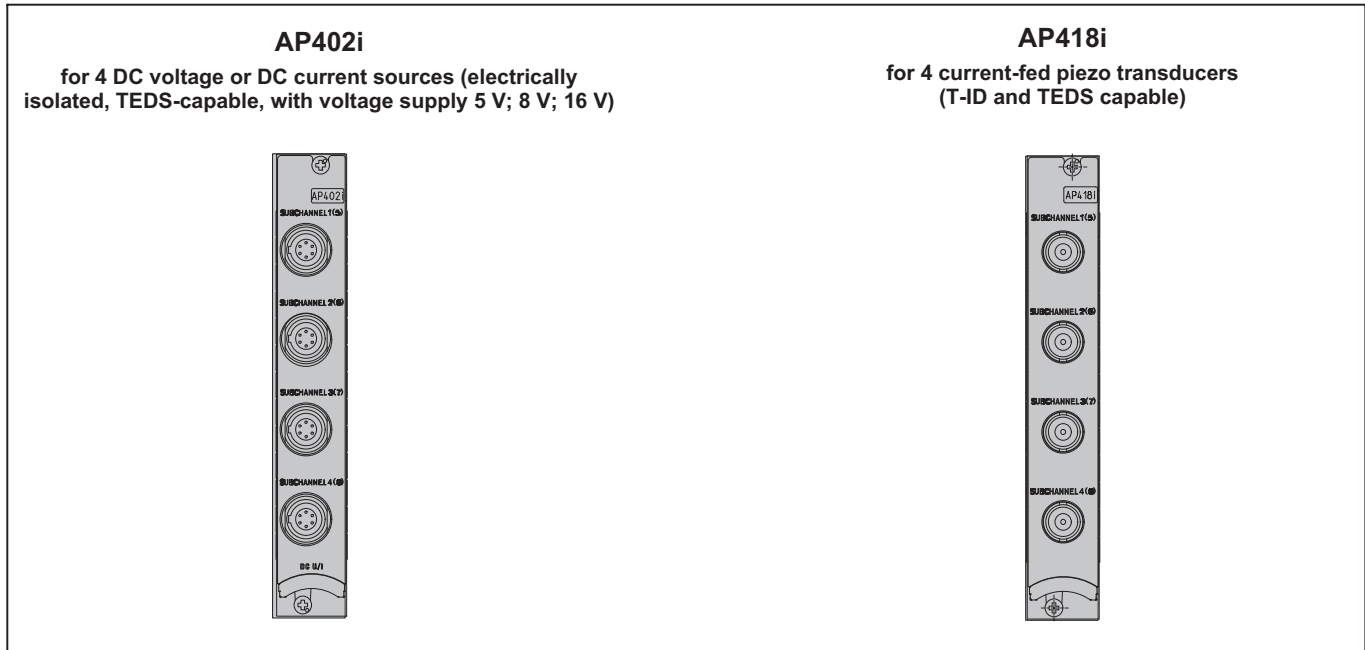
AP814Bi
for 8 SG quarter bridges in 3-wire configuration



AP815i
for 8 SG quarter, half or full bridges



Connection boards for multi-channel amplifiers



Programmable module ML70B¹⁾

Analog outputs		
Max. number of analog outputs		2 (10 with AP78)
Update rate of analog outputs	Hz	2400
Rated voltage	V	± 10 V unbalanced
Allowed load resistance	kΩ	> 5
Internal resistance	Ω	< 5
Residual carrier voltage (76.6 kHz)	mV _{ss}	< 12
Long-term drift (over 48 h)	mV	< 3
Effect of 10 °K ambient temperature:		
Sensitivity	%	< 0.08
Zero point	mV	< 3
Programming		
Programming language		IEC61131-3
Program memory for data (volatile)	kByte	224
Program memory for data (non-volatile)	kByte	16
Program memory for code (volatile) (2 provided for online change)	kByte	2 x 160
Program memory for code (non-volatile)	kByte	160
Memory for project sources (non-volatile)	kByte	192
IEC program call frequency	Hz	2400, synchronized with measurement signal conditioning of MGCplus
Number of subchannels		1...128 (programmable by user)
Usable computing power		75,000 float operations per s or 300,000 integer operations per s
Mechanical		
Nominal temperature range	°C	-20 ... +60
Storage temperature range	°C	-25 ... +70
Operating voltages	V	+14.6 ... +17.0 (< 90 mA) -14.6 ... -17.0 (< 100 mA) -7 ... -9 (<10 mA)

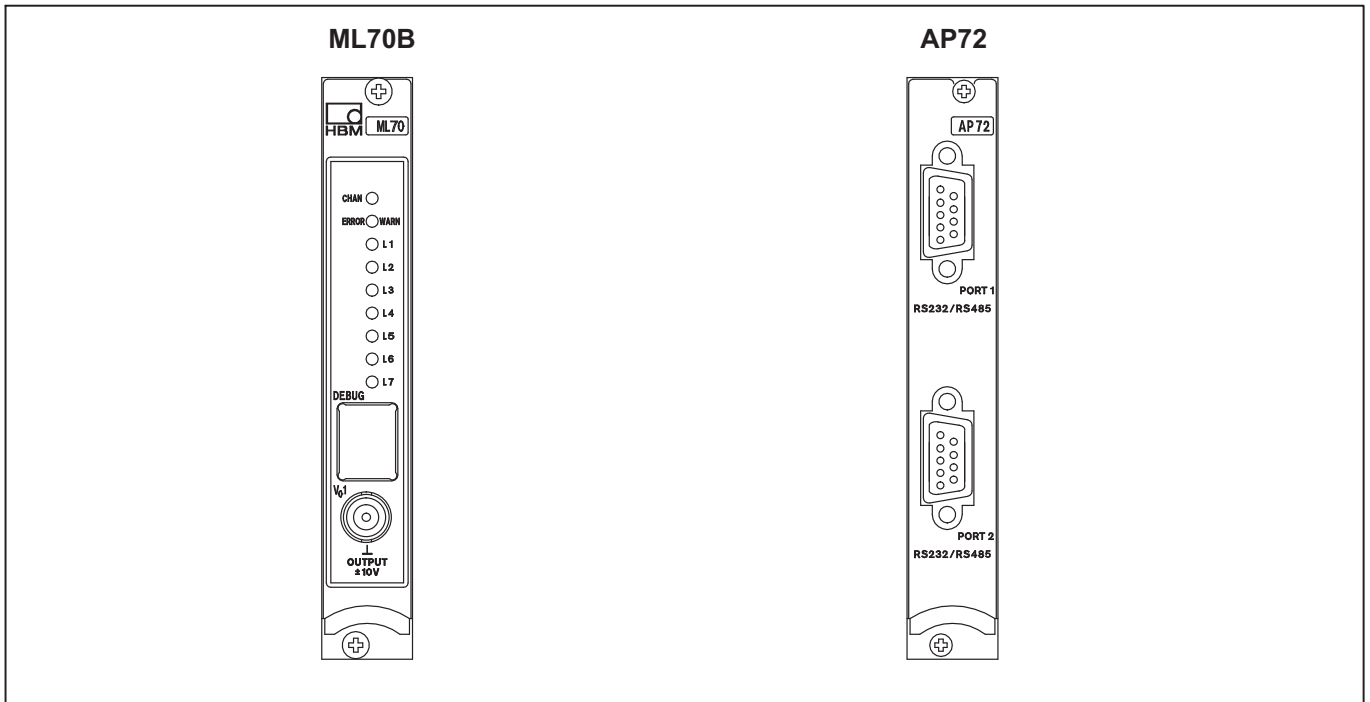
Card format	mm	Europa 100 x 160
Width	mm	20.3 (4 HP)
Connector plug		indirect DIN 41612
Supported connection boards		
Number of controllable connection boards		0.1 or 2
Supported connection board types		AP71 (2 CAN interfaces) AP72 (2 serial interfaces) AP75 (8 Digital-In, 8 Digital-Out, 24V level) AP78 (8 analog outputs)

1) Only in systems with CP22, CP42 and CP52 or in systems with no communications processor.

AP72 connection board

Interfaces		
Baud rate	kBaud	9.6; 19.2; 38.4; 57.6; 115.2
Electrical isolation	V	Typ. 500
Connection technique		9-pin Sub-D jack
Mechanical		
Nominal temperature range	°C	-20 ... +60
Storage temperature range	°C	-25 ... +70
Operating voltages	V	+5 ... (< 100 mA)
Card format	mm	102 x 112
Width	mm	20.3 (4 HP)

Programmable module ML70B and connection board AP72



Communication card ML71B with connection board AP71 (CAN bus)¹⁾

CAN interface									
Number of CAN interfaces		2							
Protocol		CAN 2.0B							
Baud rate	baud	10 k	20 k	50 k	125 k	250 k	500 k	667 k	1 M
Line length	m	1000	1000	1000	500	250	100	50	25
Hardware bus link per CAN interface individually reversible		Standard High SPEED ISO 11898-24V Fault Tolerant Low Speed							
Connection technique		2x 9-pin DSUB, individually electrically isolated from supply and measurement ground							
Measured value recording									
Number of recordable signals/signals to be transmitted		max. 128 per module ²⁾							
Maximum number of signals (16-bit signals each with 4 signals per message)		Signals per second							
		25	50	100	400	1200			
		128	72	36	8 ³⁾	1 ... 8 ⁴⁾			
Data base with parameter setting information via the CAN signals		2 (1 data base per CAN interface)							
Data base size	Byte	2 x 100k							
Data base storage		Non-volatile, in flash memory in ML71B							
Mechanical									
Nominal temperature range	°C	-20 ... +60							
Storage temperature range	°C	-25 ... +70							
Operating voltages	V	+14.6 ... +17.0 (<90 mA) -14.6 ... -17.0 (<100 mA) -7 ... -9 (<10 mA)							
Card format	mm	Europa 100 x 160							
Width	mm	20.3 (4 HP)							
Connector plug		Indirect DIN 41612							
Analog output									
The analog output can optionally represent one of the max. 128 input signals									
Rated voltage	V	± 10 V unbalanced							
Allowed load resistance	kΩ	> 5							
Non-linearity	%	<0.05							
Internal resistance	Ω	< 5							
Effect of 10 K change in ambient temperature on the zero point	mV	3							
Effect of 10 K change in ambient temperature on the sensitivity	%	< 0.08							

¹⁾ Only in systems with CP22, CP42 and CP52 or in systems with no communications processor.

²⁾ Maximum 256 channels per CP42, maximum 512 channels per CP52

³⁾ In operation with more than 8 subchannels

⁴⁾ In 8-channel operation

Communication card ML74B¹⁾

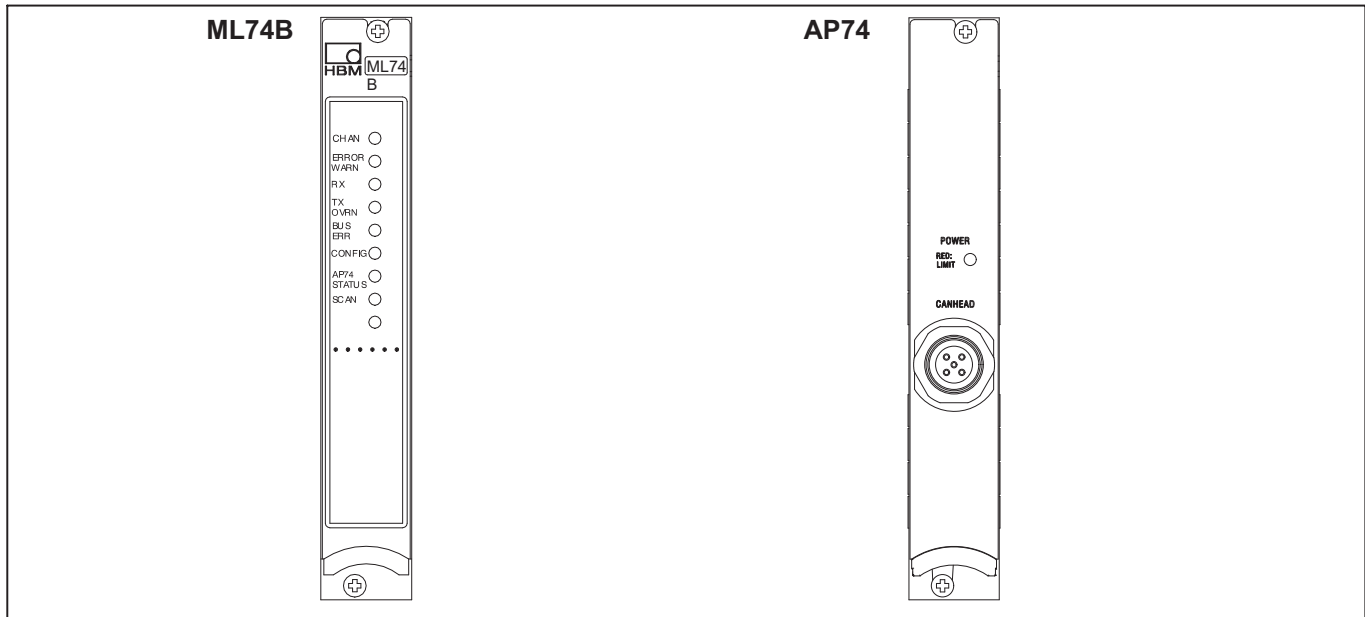
CAN interface				
Connection board		AP74		
Protocol		CAN 2.0B		
Baud rate	kBaud	250		
Line length	m	250		
Hardware bus link per CAN interface individually reversible		ISO 11898		
Maximum bus length (with no branches) ²⁾		120 Ω; 2.5 V P=1.8W/CANHEAD	350 Ω; 2.5 V P=1.15W/CANHEAD	700 Ω; 2.5 V 1000 Ω; 2.5 V P=1.0W/CANHEAD
Number of CANHEADs				
12		90	140	165
11		100	155	180
10		110	170	200
9		120	190	220
8		135	215	250
7		155	250	
6	m	180		
5		220		
4		250		
3				
2				
1				
Measured value recording				
Maximum number of CANHEAD modules		12		
Number of subchannels		10 ... 120 ³⁾		
CANHEAD supply				
Cut-off current	A	2		
Cut-off upon current to earth	A	0.1		
Mechanical				
Nominal temperature range	°C	-20 ... +60		
Storage temperature range	°C	-25 ... +70		
Card format	mm	Europa 100 x 160		
Width	mm	20.3 (4 HP)		

¹⁾ Only in systems with CP22, CP42 and CP52 or in systems with no communications processor.

²⁾ Thin Media Cable (0.38 mm²) at 45°C ambient temperature

³⁾ Maximum of 256 channels per CP42 and CP52; the combination of CP52 with the NT040 power pack enables up to 512 channels to be connected

Communication card ML74B and connection board AP74



Communication card ML77B with connection board AP77 (Profibus-DP)¹⁾

Protocol		Profibus-DP slave as per DIN 19245-3
Baud rate	baud	9.6 k ... 12 M
Profibus ident number		04A9 (hexadecimal)
Electrical isolation	V	typ. 500
Connection technique		9-pin DSUB
Transmission of measured values		
Supported formats		4 byte integer 2 byte integer 4 byte float (IEEE) 4 byte float (Siemens) 4 byte raw values 2 byte raw values
Data rate on Profibus		
Float; 24 signals	Hz	2400
Float; 48 signals	Hz	1200
Integer 32 bit; 32 signals	Hz	2400
Integer 16 bit; 48 signals	Hz	2400
Integer 16 bit; 88 signals	Hz	1200
Integer 16 bit; 120 signals	Hz	800
Measured value update rate with 15 channels and 1 signal per channel	1/s	1200
Mechanical		
Nominal temperature range	°C	-20 ... +60
Storage temperature range	°C	-25 ... +70
Operating voltages	V	+14.6 ... +17.0 (< 120 mA) -14.6 ... -17.0 (< 120 mA) -7 ... -9 (<10 mA)
Card format	mm	Europa 100 x 160
Width	mm	20.3 (4 HP)
Connector plug		indirect DIN 41612
Weight	kg	approx. 0.3

¹⁾ Only in systems with CP22, CP42 and CP52 or in systems with no communications processor.

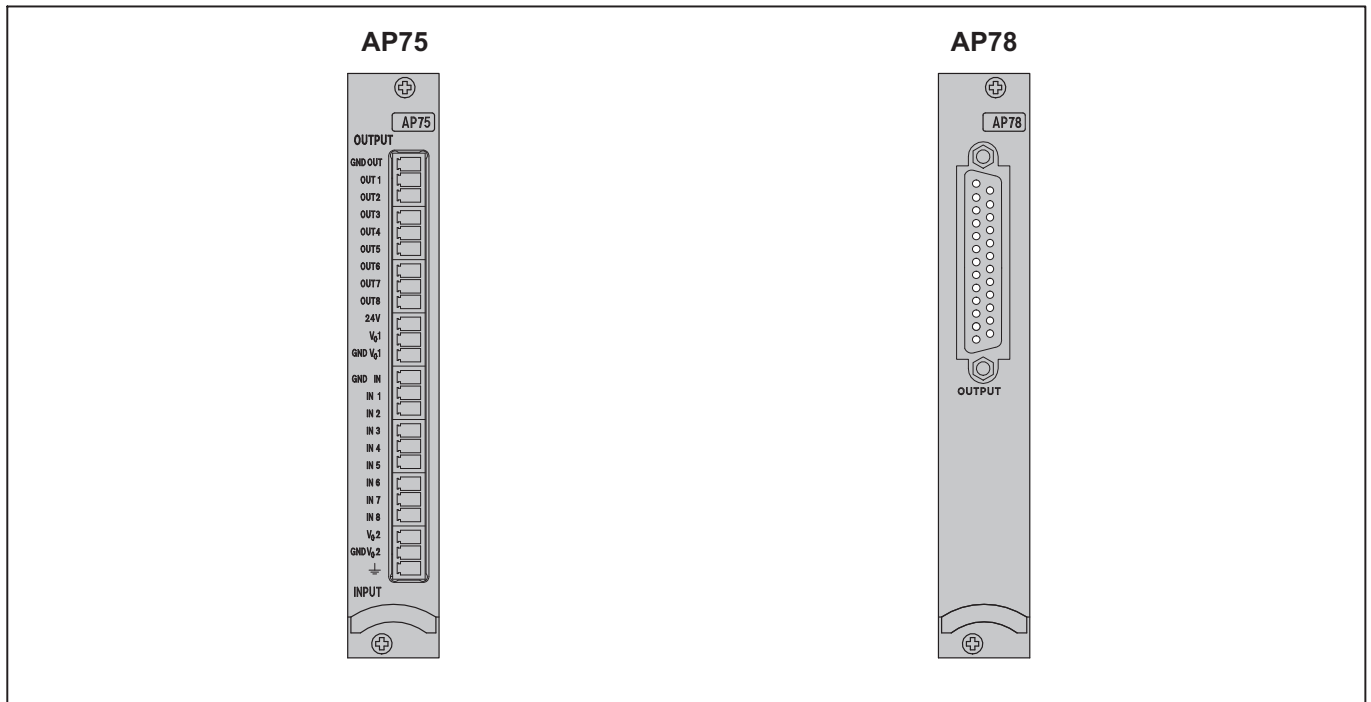
Multi-channel I/O module ML78B¹⁾

ML78B + connection board		AP78	AP75
Analog outputs			
Max. number of analog outputs		10 (2 outputs filterable, 1 of which additionally accessible on ML78B front panel)	2 (both outputs filterable, 1 of which additionally accessible on ML78B front panel)
Electrical isolation	V	Typ. 200 ²⁾	-
Update rate of analog outputs	Hz	2400	
D/A converter resolution	bit	16	
Ground systems		2 ³⁾	1, isolated from dig. ground systems
Rated voltage	V	± 10 unbalanced	
Allowed load resistance	kΩ	≥ 5	
Internal resistance	Ω	< 5	
Residual carrier voltage (76.6 kHz)	mV _{SS}	< 12	
Long-term drift (over 48 h)	mV	< 3	
Effect of 10 K change in ambient temperature	%	< 0.08	
	mV	< 3	
Digital inputs			
Max. number of digital inputs			8 (16) ⁴⁾
Input voltage range	V		0 ... 30 (nominal 0 V...24 V)
Electrical isolation	V		Typ. 500
Low potential	V		< 5
High potential	V		> 10
Ground systems			1, isolated from digital output
Control functions for groups of MGCplus channels			Turn autocalibration on/off; Zero; Tare; Clear /hold peak value; Synchronization of internal curve generator
Digital outputs			
Max. number of digital outputs			8 (16) ⁴⁾
Output voltage range	V		0 ... 30 (nominal 0 V...24 V)
Output current	A		0.5
Short-circuit current	A		1.5
Electrical isolation	V		Typ. 500
Response time (not for "external" mode)	ms		< 4
Ground systems			1, isolated from digital inputs
Bridge excitation voltage	V		18 ... 30 (nom. 24); external
Possible function assignment of the outputs			<ul style="list-style-type: none"> - Limit values of up to 120 MGCplus channels can be combined - Acknowledgement signal for input - Set by external software command - Overload signaling for groups of measurement channels
Curve generator			
Max. number of waveforms			10
Update rate (programmable per channel)	Hz	1; 2; 5; 10; 20; 50; 100; 200; 600; 1200; 2400	
Max. number of curve points		≤ 128000, can be permanently stored in Flash memory	

Mechanical			
Nominal temperature range	°C	-20 ... +60	
Storage temperature range	°C	-20 ... +60	
Operating voltages	V	+14.6 ... +17.0 (< 100 mA) / -17.0 ... -14.6 (< 90 mA) / -9.0 ... -7.0 (< 10 mA)	
Card format / width	mm	Europa 160 x 100 / 20.3 (4HP)	
Connection technique		25-pin Sub-D	Pluggable screw terminals
Allowed connection board configurations		1 x AP78 / 1 x AP75 / 1 x AP78 and 1 x AP75 / 2 x AP75 ⁵⁾	

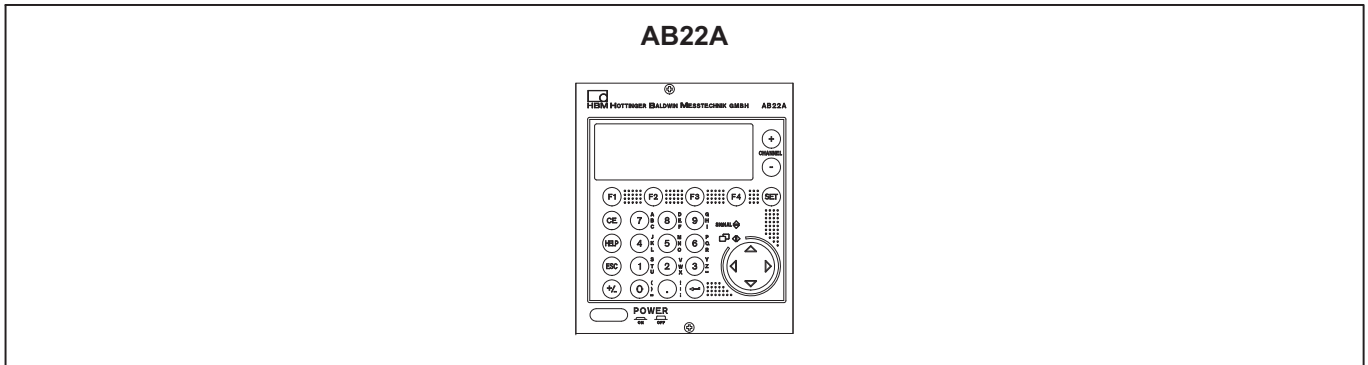
- 1) Only in systems with CP22, CP42 and CP52 or in systems with no communications processor.
- 2) The digitally filterable outputs are not electrically isolated!
- 3) 1 Ground system for 2 digitally filterable analog outputs and 1 ground system for the remaining 8 analog outputs
- 4) When using 2 AP75 connection boards: 16 digital inputs and 16 digital outputs
- 5) Both analog outputs V_{O1} and V_{O2} are available on both connection boards

Connection boards for multi-channel I/O module ML78B



Display and control panel AB22A

Width AB22A	111.8 mm (22 HP)
Display AB22A	Backlit LCD display, resolution 192x64 pixels
Keypad	Alphanumeric keypad, 4 function keys, cursor keys and 5 dialog keys. All keys are membrane keys with real keys behind them.
Password	It is possible to protect specific operator control levels by a password.
Dialog	Menu languages: German/English
Display formats	1, 3, 6 measured values; ty, xy graph; limit value status; recording status
Weight	approx. 0.5 kg



Communication processor CP52

Width	mm	60.9 (12 HP)		
Interfaces to PC Ethernet (2 x independent)		Electrical isolation 500 V	Connection technique RJ45	Bit rate 100 Mbit
Stand-alone data logging USB ¹⁾ mass storage (FAT32)		No	USB host	480 Mbit (USB 2.0)
Data rate²⁾ Ethernet	kS/s	307.2		
USB	kS/s	307.2		
Nominal temperature range	°C	-20 ... +60		
Storage temperature range	°C	-25 ... +70		
Weight	kg	approx. 0.6		
I/O contacts				
Electrical isolation	V DC	250 ³⁾		
Connection technique 2 x In, 2 x Out, 24 V, GND		Screw terminals (line length < 30 m)		
Input voltage level LOW	V	0 ... 5		
Input voltage range HIGH	V	10 ... 24		
Input current, typ., High level = 24 V	mA	12		
Input current, typ., High level = 10 V	mA	3		
Output level active High at 0 A		Level supply minus 1.5 V		
Output level active High at 0.5 A		Level supply minus 3 V		
Supply (external)	V	24 (11 V ... 30 V)		
Output current max.	A	0.5		
Short-circuit current, typ.	A	0.6		
Short-circuit period		unlimited		

1) Cable length ≤ 5 m; extension cable not allowed

2) 128 channels at 2.4 kS/s, 16 channels at 19.2 kS/s or combined

3) From hardware revision 1.01, for hardware revision 1.0: 50V

Subject to modifications.
All product descriptions are for general information only. They are not to be understood as a guarantee of quality or durability.

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