



## GMP232/x2 Grid Measurement and Protection Module

The GMP232/x2 enables the safe, reliable and fast measurement of all relevant values for three-phase electrical networks. It also provides a number of monitoring functions for generator and grid protection. Up to 2 circuit-breakers/trip circuits are triggered by the module directly via relay outputs. The continuous monitoring of grid harmonics up to the 50<sup>th</sup> harmonic can be used for direct reactions as well as for evaluating the power quality.

The module is provided with an integrated real-time data recorder for the high-precision recording of up to 24 measuring channels during alarm/protection events. Error events are recorded continuously and stored with a high resolution time stamp. The internal time base of the module can be synchronized to an external time source (e.g. IEEE 1588 Precision Time Protocol), which supports the analysis of the data from geographically separated measurement and protection devices.

The GMP232/x2 module is fully integrated in the Bachmann SolutionCenter. Configurations can be created simply and stored for later reuse. Both the measured channel values and also the derived values are made available directly in the user interface. Commissioning and fault analysis are simplified with tabular, vector and time sequence displays. Event logs and recorded time sequences can be exported in CSV resp. COMTRADE format. The integrated simulation function simplifies the configuration of protection and monitoring functions.

### Features

- Measurement of current, voltage, frequency, power, power factor, phase angle
- Direct connection up to 1000 V<sub>rms</sub> rated CAT III
- True RMS and fundamental RMS, symmetrical components
- High dynamic measurement / very low latency
- Measurement of grid harmonics up to the 50<sup>th</sup> (PQ)
- Configurable grid and generator protection
- Direct relay outputs for circuit-breaker/trip circuits
- Integrated real-time fault recording
- Integrated event logging
- 4Q energy meter
- Integrated mean value aggregation, grid statistics
- Measured value simulation

Part Type Designation		Part Number
120 V		
1 A	GMP232/12	00025962-20
	GMP232/12 CC	00025966-20
5 A	GMP232/32	00025964-20
	GMP232/32 CC	00025968-20
690 V		
1 A	GMP232/22	00025961-20
	GMP232/22 CC	00025965-20
5 A	GMP232/42	00025963-20
	GMP232/42 CC	00025967-20
1000 V		
1 A	GMP232/52	00033155-20
	GMP232/52 CC	00033159-20

General	
Range of application	Grid measurement, power quality monitoring, protection and fault recording in 3-phase-systems
System environment	Bachmann M1/M200 modular control system (plugable controller-integrated module)
Dimensions B × H × T <sup>3)</sup>	110 mm × 119 mm × 68.5 mm
Weight <sup>3)</sup>	495 g

<sup>3)</sup> unpacked without CPU, backplane and other peripherals

## GMP232/x2 - Grid measurement

Acquisition	
Sampling interval	Grid frequency-dependent approx. 100 µs (10 kHz)
Update intervall	RMS and power values: continuous < 1 ms   synced to cycle: 2-6 x per cycle
Sample values	Block access via application program (adjustable sampling 100 µs to 1600 µs)
Resolution	16 bit on directly measured quantities

Voltage measurement			
Voltage inputs	3 (L1, L2, L3, N)		
Model variants	/12, /32	/22, /42	/52
Rated voltage Y / Δ [V <sub>RMS</sub> ]	70 V / 120 V	400 V / 690 V	577 V / 1000 V
Acquisition range Y / Δ [V <sub>RMS</sub> ]	2 V to 196 V / 3.6 V bis 340 V	10 V to 677 V / 17.3 V bis 1173 V	13 V to 866 V / 22.5 V bis 1500 V
Continuous overload Δ [V <sub>RMS</sub> ]	1100 V	1100 V	1660 V
Short-term overload 1 s Δ [V <sub>RMS</sub> ]	2637 V	2637 V	3637 V
Overvoltage category acc. IEC 61010-1	III for ≤ 600 V <sub>RMS</sub> (L-N) IV for ≤ 300 V <sub>RMS</sub> (L-N)	III for ≤ 600 V <sub>RMS</sub> (L-N) IV for ≤ 300 V <sub>RMS</sub> (L-N)	III for ≤ 1000 V <sub>RMS</sub> IV for ≤ 600 V <sub>RMS</sub> (L-N)
Accuracy voltage <sup>1)</sup>	≤ ±0.1 % U <sub>Rated</sub>	≤ ±0.1 % U <sub>Rated</sub>	≤ ±0.1 % U <sub>Rated</sub>
Input impedance	> 3.2 MΩ	> 3.2 MΩ	> 5 MΩ
Input type	Differential (artificial Y)		

Current measurement			
Current inputs	3 (I1, I2, I3 - I <sub>N</sub> calculated)		
Model variants	/12, /22	/32, /42	/52
Rated current of transformer [A <sub>RMS</sub> ]	1 A	5 A	1 A
Response threshold [A <sub>RMS</sub> ]	2 mA	9 mA	2 mA
Acquisition range [A <sub>RMS</sub> ]	0.0025 A to 5 A	0.013 A to 25 A	0.0025 A to 5 A
Continuous overload [A <sub>RMS</sub> ]	7 A	20 A	7 A
Short-term overload 1 s [A <sub>RMS</sub> ]	100 A		
Rated peak withstand current 0.25 s [A <sub>RMS</sub> ]	250 A		
Accuracy current <sup>1)</sup>	≤ ±0.1 % I <sub>Rated</sub>	≤ ±0.1 % I <sub>Rated</sub>	≤ ±0.1 % I <sub>Rated</sub>
Burden	10 mVA	250 mVA	10 mVA
Transformer compensation	Dynamic, current-dependent correction of amplitudes and phase response		

<sup>1)</sup> Accuracy at 25 °C and under reference conditions

Frequency measurement	
Source	All 3 voltage phases, automatic reduction to any remaining phase in the valid measuring range. In the event of a 3-phase earth fault close to zero volt, the current signals are used.
Rated frequency	50 Hz / 60 Hz
Acquisition range	50 Hz: 10 Hz to 65 Hz, 60 Hz: 10 Hz to 75 Hz
Update intervall	T/12 (1.666 ms @ 50 Hz, 1.389 ms @ 60 Hz in 3 phase system)
Accuracy frequency <sup>1)</sup>	$\leq \pm 1$ mHz
Frequency resolution	0.1 mHz
Mean value calculation	f_avg: configurable arithmetic mean with sliding or sequential window
Event suppression	f2: configurable suppression of dynamic events (e.g. vector shifts)
Rate of change of frequency (df/dt)	Yes (configurable source and dynamics for ROCOF)
ROCOF range	$\pm 10$ Hz/s
Reference system	Integrated frequency-constant reference system, calculation of the angle to the measured positive, negative and zero sequence system
Vector shift detection	$\geq 4^\circ$ with accuracy $\leq \pm 0.4^\circ$

<sup>1)</sup> Accuracy at 25 °C and under reference conditions

Phase angle, sequence, asymmetry	
Angles	Phase shift angles (PHI_UxIx) Voltage system angles (PHI_UxUy) Angles of voltage phasors to frequency constant reference system
Asymmetry U, I	Yes (ratio negative sequence/positive sequence for voltage and current phasors)
Phase sequence U, I	Yes

Power measurement	
Power quantities	P, Q, S, $\lambda$ , $\cos\varphi$ (per phase and total); $\cos\varphi_{1+}$
Power resolution (secondary)	1 W, var, VA
Power calculations (simultaneously available)	DIN 40110-2 (incl. harmonics to 3 kHz) DIN 40110 (fundamental RMS values) IEC 61400-21 (fundamental symmetrical components)
Power accuracy <sup>1)</sup>	$\leq \pm 0.2$ % of $S_{Rated}$
Power factor convention	6 configurable calculation conventions
Energy meter	2 separate 4Q meters for True RMS and fundamental power (non-volatile)
Energy resolution (secondary)	1 Ws, vars

Power quality	
Harmonic analysis	Yes, amplitudes up to 50th harmonic per phase for U and I
Calculation method	IEC 61000-4-7
Update intervall	200 ms at rated frequency (10 cycles at 50 Hz, 12 cycles at 60 Hz)
Characteristic values	Total harmonic distortion (THD) and Total demand distortion (TDD) for current and voltage per phase, in relation to rated value or actual fundamental

<sup>1)</sup> Accuracy at 25 °C and under reference conditions

## GMP232/x2 – Signal output / Tripping

Relay outputs	
Quantity / contact arrangement	2x changeover / form C
Rated voltage [ $V_{RMS}$ ]	230 V AC, 48 V DC, 24 V DC (not mixed)
Rated current [ $A_{RMS}$ ]	5 A
Making capacity [ $A_{RMS}$ ]	30 A acc. EN 60255-1 and IEEE C37.90; 2000x
Switching time OOT <sup>2)</sup>	Make time: typical 8 ms Break time: typical 4 ms
Indication	2x LED (orange)

<sup>2)</sup> OOT Output Operating Time (additional delay of the switching device)

## GMP232/x2 – Protection functions

Protection functions		
Time independent over current (ANSI 50, 51)	3-level	I>, I>>, I>>>
Time independent directional over current (ANSI 67)	2-level	I <sub>dir</sub> >, I <sub>dir</sub> >>
Unbalanced load / asymmetry current (ANSI 46)	2-level	Asym_I>, Asym_I>>
Time independent over/under voltage (ANSI 27/59)	2x 4-level	U<, U<<, U<<<, U<<<<, U>, U>>, U>>>, U>>>>
Time dependent over/under voltage (VFRT)	4 limit curves / 11 points	U(t)>, U(t)<
Time independent positive seq. under voltage (27Vd)	1-level	U <sub>1+</sub> <
Time independent negative seq. over voltage (59Vi)	1-level	U <sub>1-</sub> >
Time independent zero seq. over voltage (59V0)	1-level	U <sub>10</sub> >
Asymmetry voltage (ANSI 47)	2-level	Asym_U>, Asym_U>>
Time independent over/under frequency (ANSI 81O, 81U)	2x 3-level	f<, f<<, f<<<, f>, f>>, f>>>
Time dependent over/under frequency (FFRT)	2 limit curves / 11 points	f(t)>, f(t)<
Rate of change of frequency (ANSI 81 R)	1-level	df/dt >
Vector shift (ANSI 78)	2-level	Delta_Phi_U>, Delta_Phi_U>>
Maximum power (ANSI 32)	2-level	P >,  P >>
Reverse power (ANSI 32R)	2-level	P <sub>dir</sub> >, P <sub>dir</sub> >>
Under voltage / reactive power (Q(U))	2-level	Q(U)>, Q(U)>>
Harmonics individual U (PQM)	1-level	U <sub>n</sub> > n=2..50
Harmonics individual I (PQM)	1-level	I <sub>n</sub> > n=2..50
Harmonics total distortion U (PQM)	1-level	THD_U>, THD <sub>n</sub> _U>
Harmonics total distortion I (PQM)	1-level	THD_I>, TDD_I>
Application specific tripping / manual	Programmable / yes	

Protection functions common	
Input values	Configurable (fundamental, fundamental positive sequence, True RMS, 10-min mean sliding window acc. EN 50549; all / any phase)
Tripping delay	0 ms to 600 000 ms (10 min) adjustable for time independent protection functions
Start blocking (inhibit)	From application program on M200 CPU e.g. operating condition or up-/downstream devices
Blocking	Configurable with criteria such as under/over voltage, under/over frequency, maximum negative sequence system
Tripping reactions	Trip relay 1   Trip relay 2   Trigger fault recording   programmed reaction

Protection functions common	
Relay reset	Configurable time delayed auto reset or manually via application program or user input
Autonomy	Acquisition, calculation and protective tripping run independently of the M200 CPU on module
Data preparation / storage	
Event recording	2048 protective tripping events non-volatile ring buffer, absolute counter
Real time fault recording	24 channels configurable, trigger from protective tripping or via user application, 100 $\mu$ s to 1600 $\mu$ s sampling (6 s to 96 s recording as COMTRADE file IEEE Std. C37.111), pre-trigger
Grid statistics	Maximum/minimum of several grid quantities with time stamp (non-volatile), resettable
Data aggregation	3 aggregation units available: 1+2: for 24 configurable channels, 2-staged 3: harmonics; automatic calculation of mean, minimum, maximum for configurable intervals from 0.2 s / 3 s to 15 min

## GMP232/x2 – Special functions

Communication interfaces	
Time synchronization	IEEE 1588 Precision Time Protocol, SNTP via M200 CPU (for time stamps)
Field busses	Profinet, Profibus, EtherCAT, CAN/CANopen via M200 CPU
RTU / telecontrol	IEC 61850, IEC 60870-5-4, -3, -1, DNP3, Modbus TCP/UDP/RTU/ASCII via M200 CPU
Supervisory control	OPC UA DA, AE, Methods server, OPC UA DA, Methods client, OPC COM via M200 CPU
Simulation	
Description	In the simulation mode, the module uses internally generated values instead of measured samples. All subsequent calculations and protection functions work exactly the same as in measurement mode. The setting of simulation parameters can be handled in the graphical user interface of the SolutionCenter (user) or dynamically from an application program on the M200 CPU (automated sequences). Thus, protection functions or general measurement reactions can be evaluated in many cases without using specialized grid emulation equipment.
Simulation input	3x $U_{RMS}$ [%pu], 3x $I_{RMS}$ [%pu], 3x $\phi_{U}$ [°], 3x $\phi_{I}$ [°], f

## GMP232/x2 – Module properties

Product safety	
Product standard / application standard	IEC/EN 61131-2 / EN 60255 / UL CSA EN IEC 61010-1, -2-101, -2-030
Pollution degree acc. IEC 61010-1	2
Overvoltage category acc. IEC 61010-1	IV / III
Rated impulse voltage	/12, /22, /32, /42: 6 kV /52: 8 kV
Isolation serial production test	/12, /22, /32, /42: 4700 V DC /52: 6000 V DC
Protection class acc. IEC 61010-2-201	2
Degree of protection acc. IEC 60529	IP20
Self-monitoring	Integrated self-testing and run time measurement, watchdog function
Self-monitoring reaction	Configurable according BDEW and FNN; Logging: Module/CPU
Environmental conditions	
Operating temperature	-30 °C to +60 °C (+70 °C on request)
Relative humidity, operation	Standard: 5 % to 95 % noncondensing ColdClimate: 5 % to 95 % with temporary condensation
Storage temperature	-40 °C to +85 °C
Relative humidity, storage	5 % to 95 % with temporary condensation
Installation altitude	2000 m above sea level (up to 4500 m with over-voltage and temperature derating)
Energy supply	
Backplane	+5 V   ≤ 250 mA, +15 V   ≤ 20 mA, -15 V   ≤ 17 mA
Front supply	+24 V   ≤ 60 mA
Approvals/Certificates	
General product safety	CE, UKCA, cULus, CCC
Generator grid connection	VDE-AR-N 4110:2018, VDE-AR-N 4120:2018, FGW TR3 Rev 26, FGW TR8 Rev 9 IEEE Std. C37.90:2005, IEEE Std. C37.90.1:2012, IEEE Std. C37.90.2:2004, IEEE Std. C37.90.3:2001 EN 50549-2, ENA ER G99 Amendment 9:2022
Maritim classifications	ABS, BV, DNV, LR, KR, NK, RINA
System requirements	
Automation system	Bachmann M200 system with CPU (except ME203), power supply and backplane (SK1 not required)
Required slots available	2 slots
Software	M-Base ≥ 4.66 for full feature set (including SolutionCenter ≥ 2.66)

## Order Data

Part Type Designation	Part Number	Description
GMP232/12 120V 1A	00025962-20	Grid measurement and monitoring module; 3x In 120V CAT IV, 3x In 1A; 2x Out relay 24/48V DC, 230V AC; U-, I-, P-, Q-, f-measurement; 4Q-energy metering, integrated monitoring/protection functions, harmonic analysis, integrated real-time data recorder (24 channels); data aggregation, sequence of event log with real-time stamp
GMP232/12 120V 1A CC	00025966-20	Like GMP232/12 120V 1A; ColdClimate (❄)
GMP232/22 690V 1A	00025961-20	Grid measurement and monitoring module; 3x In 690V CAT III, 3x In 1A; 2x Out relay 24/48V DC, 230V AC; U-, I-, P-, Q-, f-measurement; 4Q-energy metering, integrated monitoring/protection functions, harmonic analysis, integrated real-time data recorder (24 channels); data aggregation, sequence of event log with real-time stamp
GMP232/22 690V 1A CC	00025965-20	Like GMP232/22 690V 1A; ColdClimate (❄)
GMP232/32 120V 5A	00025964-20	Grid measurement and monitoring module; 3x In 120V CAT IV, 3x In 5A; 2x Out relay 24/48V DC, 230V AC; U-, I-, P-, Q-, f-measurement; 4Q-energy metering, integrated monitoring/protection functions, harmonic analysis, integrated real-time data recorder (24 channels); data aggregation, sequence of event log with real-time stamp
GMP232/32 120V 5A CC	00025968-20	Like GMP232/32 120V 5A; ColdClimate (❄)
GMP232/42 690V 5A	00025963-20	Grid measurement and monitoring module; 3x In 690V CAT III, 3x In 5A; 2x Out relay 24/48V DC, 230V AC; U-, I-, P-, Q-, f-measurement; 4Q-energy metering, integrated monitoring/protection functions, harmonic analysis, integrated real-time data recorder (24 channels); data aggregation, sequence of event log with real-time stamp
GMP232/42 690V 5A CC	00025967-20	Like GMP232/42 690V 5A; ColdClimate (❄)
GMP232/52 1000V 1A	00033155-20	Grid measurement and monitoring module; 3x In 1000V CAT III, 3x In 1A; 2x Out relay 24/48V DC, 230V AC; U-, I-, P-, Q-, f-measurement; 4Q-energy metering, integrated monitoring/protection functions, harmonic analysis, integrated real-time data recorder (24 channels); data aggregation, sequence of event log with real-time stamp
GMP232/52 1000V 1A CC	00033159-20	Like GMP232/52 1000V 1A; ColdClimate (❄)

## Accessories

Part Type Designation	Part Number	Description
SS-GMP232/x2	00037391-00	Terminal set screw contact (1x SS 51/03; 1x SS 51/06; 1x SS 76/06 inv.; 1x SS 76/07 reduced pins) with labeling strips
SS-GMP232/x2 KZ	00037392-00	Terminal set screw / cage (1x KZ 51/03; 1x KZ 51/06; 1x SS 76/06 inv.; 1x SS 76/07 reduced pins) with labeling strips