1 General information

1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual

1.2 Coated modules

Coated modules are X20 modules with a protective coating for the electronics component. This coating protects X20c modules from condensation and corrosive gases.
The modules' electronics are fully compatible with the corresponding X20 modules.

For simplification purposes, only images and module IDs of uncoated modules are used in this data sheet.

The coating has been certified according to the following standards:

- Condensation: BMW GS 95011-4, 2x 1 cycle
- Corrosive gas: EN 60068-2-60, method 4, exposure 21 days



1.3 Order data

Order number	Short description	Figure
	Analog input modules	
X20AP3111	X20 energy metering module, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 20 mA AC, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20AP3121	X20 energy metering module, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 1 A AC, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20AP3131	X20 energy metering module, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 5 A AC, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20AP3161	X20 energy metering module, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 333 mV AC, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20AP3171	X20 energy metering module, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, Rogowski adjustable (µV/A), max. 52 mV, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20AP3122	X20 energy metering module, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 1 A AC, groundable, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20AP3132	X20 energy metering module, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 5 A AC, groundable, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20cAP3121	X20 energy metering module, coated, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 1 A AC, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
X20cAP3131	X20 energy metering module, coated, 3 analog inputs, 480 VAC, 50/60 Hz, 4 analog inputs, 5 A AC, calculates effective, reactive and apparent power/energy, calculates RMS values, 240 V keyed, NetTime function	
	Required accessories	
	Bus modules	
X20BM32	X20 bus module, for double-width modules, 240 VAC keyed, internal I/O power supply connected through	
X20cBM32	X20 bus module, coated, for double-width modules, 240 VAC keyed, internal I/O power supply connected through	
	Terminal blocks	
X20TB32	X20 terminal block, 12-pin, 240 VAC keyed	

Table 1: X20AP3111, X20AP3121, X20AP3131, X20AP3161, X20AP3171, X20AP3122, X20AP3132, X20cAP3121, X20cAP3131 - Order data

1.4 Module description

The modules are used for power monitoring and energy management of a machine. Examples of application areas:

- Multiphase energy measurement for class 0.5S or class 1 for
  - 3-phase, 4-wire applications with neutral conductor (with/without grounding)
  - 3-phase, 3-wire applications (with/without grounding)
  - 2-phase networks with grounded phase B connection
- Single-phase measurement by disabling unnecessary inputs
- Network analysis according to harmonic content
- Signal trace via 8 kHz recording of the 3 voltage and 4 current channels with FIFO buffer

Functions

- Energy management
- Measurement function
- Fourier analysis
- Monitoring functions
- NetTime Technology
- Flatstream communication

Energy management

The modules' integrated functions not only map the machine's current power requirements in detail, they also serve to record the consumption of the machine or system. All relevant data is available to the user in the process image.

Measuring functions

The modules provide the following options for processing measured values:

- Temperature coefficient of the internal reference of 6 ppm/°C
- Energy registers for active, reactive and apparent energy, separate for forward and reverse, fundamental wave and harmonics
- Threshold register for status signal generation and enabling power and energy measurement
- Recording the THD harmonic component
- Discrete Fourier transform (DFT) up to the 31st harmonic component per phase for voltage and current

Monitoring functions

The module monitors numerous parameters and provides status signals for e.g. voltage dip, power failure, phase sequence, energy flow reversal and neutral conductor current monitoring.

Fourier analysis

The module calculates the harmonic component up to the 31st harmonic for voltage and current as well as the total harmonic distortion of each phase.

NetTime timestamp of the measurement

Not only is the measured value important for many applications, but also the exact time when the measurement takes place. The module is equipped with a NetTime timestamp function for this that supplies a timestamp for the recorded measurement with microsecond accuracy.

Flatstream communication

"Flatstream" was designed for X2X and POWERLINK networks and allows data transfer to be adapted to individual demands. This allows data to be transferred more efficiently than with standard cyclic polling.

2 Safety guidelines

General



Information:

If the maximum voltage value of 655 V is displayed, it is necessary to check whether the input measurement range has been exceeded.



Caution!

All current inputs must be double-insulated or reinforced-insulated.



Attention !

Toutes les entrées de courant doivent avoir une double isolation ou une isolation renforcée.

X20AP31x2

X20AP31x2 modules with current transformers that are groundable meet the requirement from the median voltage guideline that states that a current transformer connection must always be grounded in systems that exceed a certain system voltage.



Caution!

Only the connection marked "ILxb" is permitted to be grounded.



Attention !

Seule la connexion marquée « ILxb » peut être mise à la terre.



Caution!

The use of modules with current transformers that groundable is only permitted in systems with grounded median voltage. Operating these modules without connected grounding is not permitted.



Attention !

L'utilisation de modules avec des transformateurs de courant pouvant être mis à la terre n'est autorisée que dans les systèmes avec tension médiane mise à la terre. Il n'est pas autorisé de faire fonctionner ces modules sans connexion à la terre.



Information:

Because these modules do not feature a neutral conductor connection, the ground potential on the current transformer connections forms the central reference point. (See "Input circuit diagram" on page 16.)



Danger!

In consideration of a possible fault, such as insulation failure, additional insulating measures must be taken in the module beyond the basic insulation between the voltage and current inputs.
To avoid electric shock, the wiring to the module must ensure adequate insulation. The dielectric strength of the cable insulation MUST be designed for the level of the phase voltage.



Danger !

En cas de problème éventuel, tel qu'un défaut d'isolation, des mesures d'isolation supplémentaires doivent être prises dans le module en plus de l'isolation de base entre les entrées de tension et de courant.
Pour éviter les électrocutions, le câblage du module doit être suffisamment isolé. La résistance diélectrique de l'isolation du câble DOIT être conçue pour le niveau de la tension de phase.

3 Technical description

3.1 Technical data

3.1.1 X20AP3111, X20(c)AP3121 and X20(c)AP3131

Order number	X20AP3111	X20AP3121	X20cAP3121	X20AP3131	X20cAP3131
Short description					
I/O module	3-phase power and energy metering module for current transformers				
General information					
B&R ID code	0xC9DA	0xC9DB	0xE214	0xC9DC	0xEB55
Status indicators	I/O function per channel, operating state, module status				
Diagnostics					
Module run/error	Yes, using LED status indicator and software				
Inputs	Yes, using LED status indicator and software				
Power consumption					
Bus	0.85 W (Rev. <D0) 0.50 W (Rev. =D0) 0.45 W (Rev. >D0)		0.85 W (Rev. <C0) 0.50 W (Rev. =C0) 0.45 W (Rev. >C0)	0.85 W (Rev. <E0) 0.50 W (Rev. =E0) 0.45 W (Rev. >E0)	
Internal I/O	-				
Additional module power dissipation [W]	40 mW [1]	2 W [1]			
Insulation voltages					
Inputs - Bus / I/O power supply	Tested at 5500 VDC, 1 min				
Inputs - Ground	Tested at 5500 VDC, 1 min				
Bus / I/O power supply - Ground	Tested at 510 VAC, 1 min				
Certifications					
CE	Yes				
UKCA	Yes				
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta (see X20 user's manual) FTZÚ 09 ATEX 0083X				
UL	cULus E115267 Industrial control equipment				
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5		-	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5	
DNV	Temperature: **B** (0 to 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (bridge and open deck)				
LR	ENV1				
KR	Yes				
ABS	Yes				
BV	**EC33B** Temperature: 5 - 55°C Vibration: 4 g EMC: Bridge and open deck				
EAC	Yes		-	Yes	-
Voltage inputs					
Number of phases	3				
Input impedance	1.68 MΩ				
Nominal voltage U_N					
Between phases	Max. 480 VAC [2]				
Phase to N	Max. 277 VAC				
Max. display value	655 VAC				
Resolution	10 mV, with voltage connected directly				
Rated frequency	50 and 60 Hz				
Measurable frequency					
Measurement range	45 to 65 Hz				
Resolution	0.01 Hz				
Current inputs					
Quantity	4 AC inputs				
Nominal current I_N					
Secondary	20 mA	1 A		5 A	
Primary	65 A directly configurable, larger values through conversion in the application [3]				
Max. overload current	20 x I_N for 0.5 s	8 x I_N for 0.5 s			
Max. measurement current	20 mA	1 A		5 A	

Table 2: X20AP3111, X20AP3121, X20cAP3121, X20AP3131, X20cAP3131 - Technical data

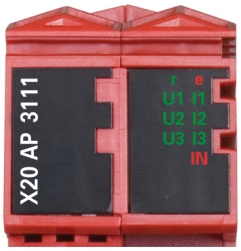
Order number	X20AP3111	X20AP3121	X20cAP3121	X20AP3131	X20cAP3131
Resolution	1 mA, based on the primary current [3]				
Load	25 Ω	500 mΩ		20 mΩ	
Measurement accuracy [4]					
U_{RMS}	±0.65% [5]				
I_{RMS}	±0.65% [6]	±0.65% [7]		±1.65% (Rev. <E0) ±0.70% (Rev. ≥E0) [8]	±0.70% [8]
Effective, reactive and apparent power	±0.80% [9]	±0.80% [10]		±1.80% (Rev. <E0) ±0.85% (Rev. ≥E0) [11]	±0.85% [11]
Frequency, power factor and phase angle	±0.50% [12]				
Active energy per phase and total [13]	±0.40% [9]	±0.40% [10]		±1.40% (Rev. <E0) ±0.45% (Rev. ≥E0) [11]	±0.45% [11]
Active energy of fundamental frequency per phase and total [13]	±0.50% [9]	±0.50% [10]		±1.50% (Rev. <E0) ±0.55% (Rev. ≥E0) [11]	±0.55% [11]
Active energy of harmonics per phase and total [13]	±0.80% [9]	±0.80% [10]		±1.80% (Rev. <E0) ±0.85% (Rev. ≥E0) [11]	±0.85% [11]
Reactive energy per phase and total [14]	±0.50% [9]	±0.50% [10]		±1.50% (Rev. <E0) ±0.55% (Rev. ≥E0) [11]	±0.55% [11]
Apparent energy					
Per phase and arithmetic total	±0.50% [9]	±0.50% [10]		±1.50% (Rev. <E0) ±0.55% (Rev. ≥E0) [11]	±0.55% [11]
Vector sum	±0.80% [9]	±0.80% [10]		±1.80% (Rev. <E0) ±0.85% (Rev. ≥E0) [11]	±0.85% [11]
Electrical properties					
Electrical isolation	Channel isolated from bus Channel not isolated from channel				
Operating conditions					
Mounting orientation					
Horizontal	Yes				
Vertical	Yes				
Installation elevation above sea level					
0 to 2000 m	No limitation				
>2000 m	Not permitted				
Degree of protection per EN 60529	IP20				
Ambient conditions					
Temperature					
Operation					
Horizontal mounting orientation	-25 to 60°C				
Vertical mounting orientation	-25 to 50°C				
Derating	-	See section "Derating".			
Storage	-40 to 85°C				
Transport	-40 to 85°C				
Relative humidity					
Operation	5 to 95%, non-condensing		Up to 100%, condensing	5 to 95%, non-condensing	Up to 100%, condensing
Storage	5 to 95%, non-condensing				
Transport	5 to 95%, non-condensing				
Mechanical properties					
Note	Order 1x terminal block X20TB32 separately. Order 1x bus module X20BM32 separately.		Order 1x terminal block X20TB32 separately. Order 1x bus module X20cBM32 separately.	Order 1x terminal block X20TB32 separately. Order 1x bus module X20BM32 separately.	Order 1x terminal block X20TB32 separately. Order 1x bus module X20cBM32 separately.
Pitch	$25^{+0.2}$ mm				

Table 2: X20AP3111, X20AP3121, X20cAP3121, X20AP3131, X20cAP3131 - Technical data

1) Power dissipation of current measurement shunts
2) The design of the module allows 480 VAC to be applied to the terminal block.
3) For measuring higher current values, see section "Current transformer - Pinout".
4) Based on the current measured value.
   The actual error value percentage may be larger due to the digital display.
5) With drift of 25 ppm/K
6) With drift of 50 ppm/K
7) With drift of 35 ppm/K
8) With drift of 225 ppm/K (Rev. < E0) or 100 ppm/K (Rev. ≥ E0)
9) With drift of 75 ppm/K
10) With drift of 60 ppm/K
11) With drift of 250 ppm/K (Rev. < E0) or 125 ppm/K (Rev. ≥ E0)
12) In power systems with approximately sinusoidal voltage starting at 10 VAC.
13) At power factor cos ϕ = 1, 0.5L and 0.8C
14) At reactive power factor sin ϕ = 1, 0.5L and 0.8C

3.2 LED status indicators

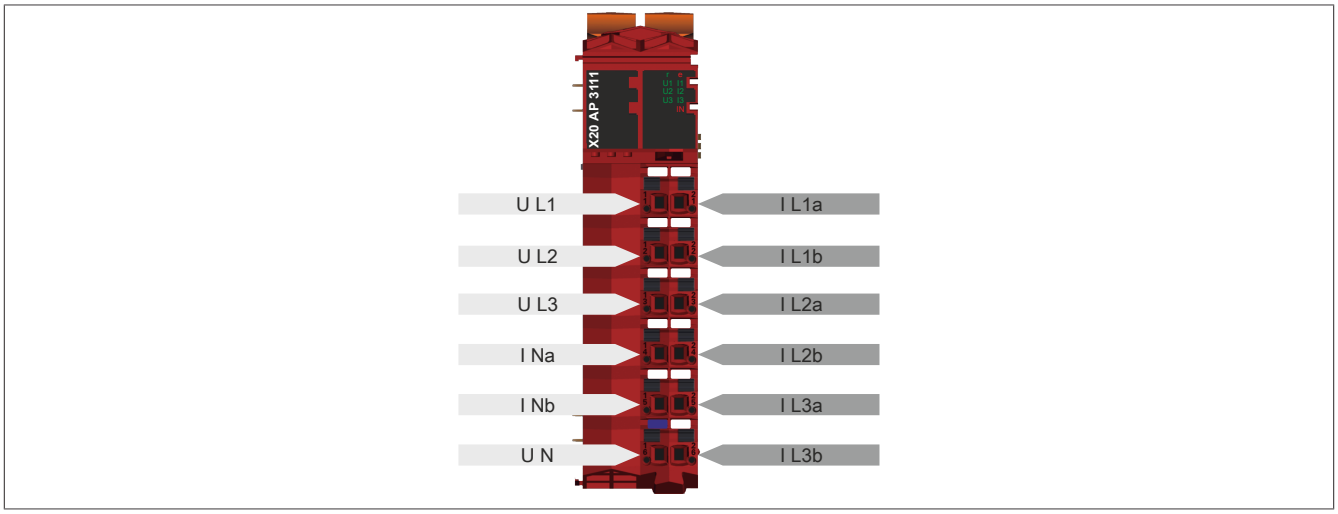
For a description of the various operating modes, see section "Additional information - Diagnostic LEDs" in the X20 system user's manual.

Figure	LED	Color	Status	Description
	**Operating state**			
	r	Green	Off	No power to module
			Single flash	UNLINK mode
			Double flash	BOOT mode (during firmware update)[1)]
			Blinking quickly	SYNC mode
			Blinking slowly	PREOPERATIONAL mode
			On	RUN mode
	Module status			
	e	Red	Off	No power to module or everything OK
			On	Error or reset status
	Analog input voltage			
	U1 - U3	Green/Yellow	Off	Display disabled or U_{Eff} < threshold value "Failure"
		Green	Blinking	Phase sequence is correct and U_{Eff} < threshold value "Warning"
			On	Phase sequence is correct and U_{Eff} > threshold value "Warning"
		Yellow	Blinking	Phase sequence is incorrect and U_{Eff} < threshold value "Warning"
			On	Phase sequence is incorrect and U_{Eff} > threshold value "Warning"
	Analog input current			
	I1 - I3	Green/Yellow	Off	Display disabled or I_{Eff} < threshold value "Display"
		Green	On	Active power positive
		Yellow	On	Active power negative
	Analog input neutral current			
	IN		Off	Neutral current < Threshold value
		Green	On	Neutral current > Threshold value "Failure", within the tolerance of the calculated total current
		Red	On	Neutral current > Threshold value "Failure", outside the tolerance of the calculated total current

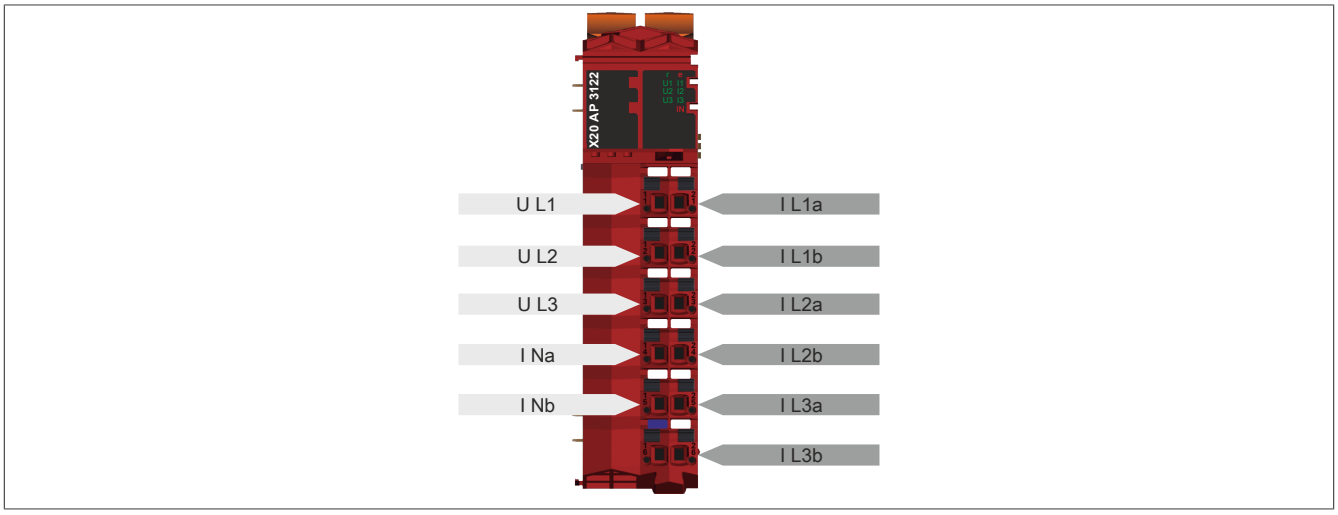
1) Depending on the configuration, a firmware update can take up to several minutes.

3.3 Pinout

X20AP31x1



X20AP31x2





Danger!

Risk of electric shock!

The terminal block is only permitted to conduct voltage when it is connected. It is not permitted to be disconnected or connected while voltage is applied or have voltage applied to it while it is removed under any circumstances!

This module is not permitted to be the last module connected on the X2X Link network. At least one subsequent X20ZF dummy module must provide protection against contact.



Danger !

Risque d'électrocution !

Le connecteur ne peut conduire la tension que lorsqu'il est connecté. Il est interdit de le déconnecter ou de le connecter lorsqu'une tension est appliquée ou lorsqu'une tension lui est appliquée lorsqu'il est retiré dans n'importe quelle circonstance !

Il est interdit que ce module soit le dernier module connecté sur le réseau X2X Link. Au moins un module factice X20ZF ultérieur doit assurer la protection contre les contacts.

3.5 Typical connection examples for different network configurations

General information

There are many different network configurations around the world. This section will present a few typical connection examples.

Notice!

Modules X20AP31x2 are not permitted to be used with network configurations B, D and F due to the lack of grounding.

Avis !

Il n'est pas autorisé d'utiliser les modules X20AP31x2 avec les configurations de réseau B, D et F en raison de l'absence de mise à la terre.

Connection example 1 - Network A

This example involves a 3-element, 3-phase, 4-line star measurement with grounded neutral conductor and optional fault current detection.

