Data sheet

GEN series GN412

Differential 100 MS/s Input Card

Special features

- **4 analog channels**
- **Balanced differential inputs**
- **± 20 mV to ± 100 V input ranges**
- **User selectable digital Bessel IIR filters**
- **100 MS/s sample rate**
- **14/16 resolution**
- **2 GB memory**
- **Metal BNC inputs for each channel**

Differential 100 MS/s Input Card

For ultra fast signals, the 100 MS/s high speed digitizer card is equipped with four channels sampling at high speed.
The basic signal conditioner provides four channels of balanced differential voltage inputs from ± 20 mV to ± 100 V Full Scale with full offset and auto-zero capability.
With selectable 6-pole Bessel anti-aliasing filtering and 14 bit resolution, these inputs turn the GEN series into an extremely fast transient recorder. Enhanced resolution mode increases input resolution to 16 bit at speeds of 10 MS/s or lower.
The inputs feature a fully differential amplifier offering good common mode rejection and enabling off ground measurements.

The on-board transient memory size is 1 GSample (2 GB). The memory is shared among enabled channels. Each channel also features two set-points for trigger or alarm purposes. Extensive acquisition and trigger modes allow many different ways to capture valuable data even at the highest sample rates.
All channels are synchronously sampled at full speed without multiplexing and almost immeasurable crosstalk. The model uses standard metal BNC connectors, whose shells are connected to ground. The inputs are 1 MΩ impedance and are compatible with probes.
The full transient and data recorder feature set of the GN412 together with the powerful Perception software eliminate the need to use separate data acquisition hardware or software.

HBM

Capabilities Overview

Model	GN412
Maximum sample rate per channel	100 MS/s
Memory per card	2 GB (1 GS)
Analog channels	4
Anti-Alias filters	Fixed bandwidth analog AA-filter combined with a range of fixed bandwidth digital AA-filter
ADC resolution	14 bit
Isolation	Not supported
Input type	Balanced differential
Passive voltage/current probes	Passive, single-ended voltage probes Passive, differential matched isolated voltage probes
Sensors	Not supported
TEDS	Not supported
Real-time cycle based calculators	Not supported
Real-time formula database calculators (option)	Not supported
EtherCat® output	Not supported
Digital Event/Timer/Counter	Not supported
Standard data streaming (up to 200 MB/s)	Supported
Fast data streaming (up to 1 GB/s)	Not supported
Slot width	1

Block Diagram

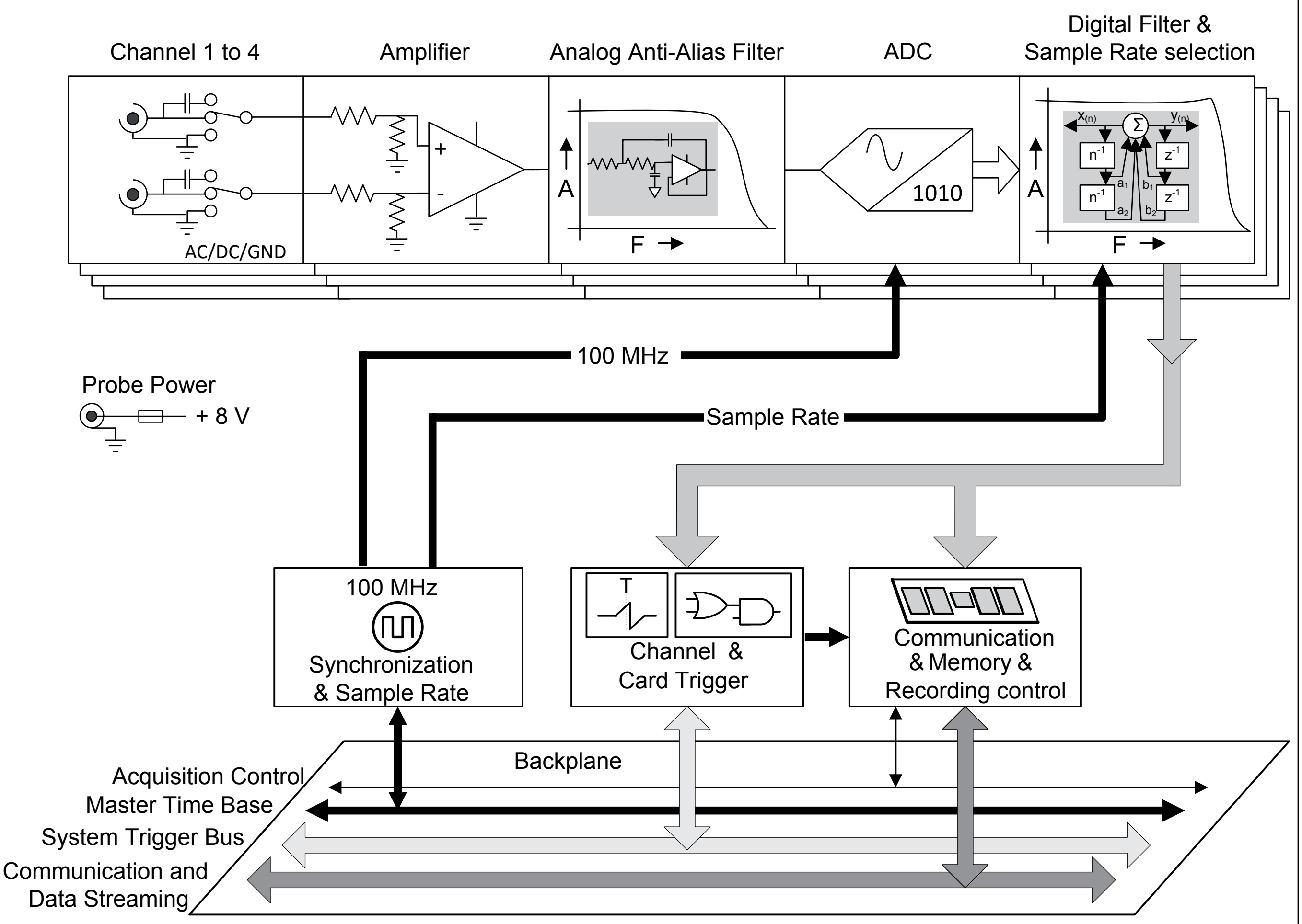


Figure 1.1: Block Diagram

Note *The specifications listed are valid for cards that have been calibrated and are used in the same mainframe and slots as they were at the time of calibration. When the card is removed from its original location and placed in another slot and/or mainframe, the Offset error, Gain error and MSE specifications are expected to increase (up to double the original specification) due to thermal differences within the configurations. All specification are defined at 23 °C ± 2 °C.*

Analog Input

Channels	4
Connector	2 per channel; Metal BNC
Input type	Balanced differential inputs
Input coupling	Single-ended positive, single-ended negative and differential
Signal input coupling	
Coupling modes	AC / DC / GND
AC coupling frequency	1.6 Hz (±10%); - 3 dB

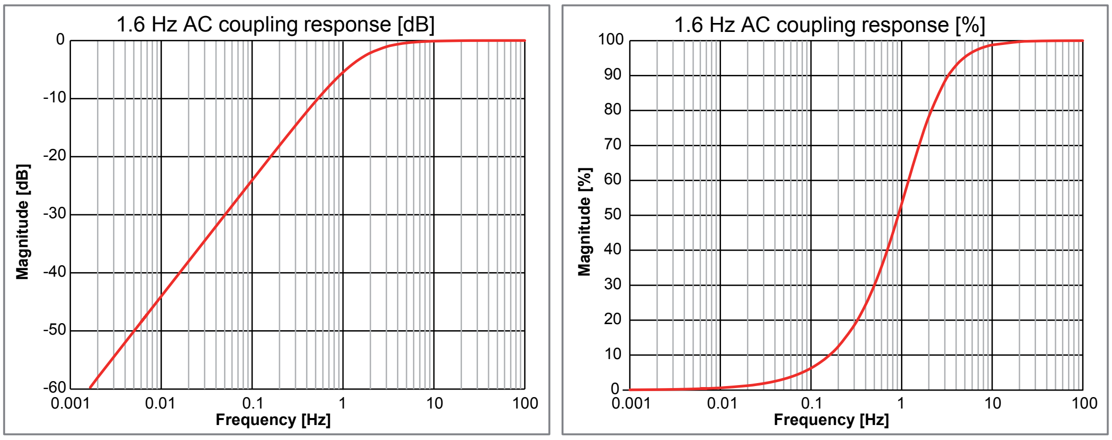


Figure 1.2: Representative AC coupling response

Impedance	2 * 1 MΩ (± 2%) // 23 pF (± 10%)
Ranges	± 20 mV, ± 50 mV, ± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2 V, ± 5 V, ± 10 V, ± 20 V, ± 50V and ± 100 V
Offset	± 50% in 1000 steps (0.1%) ± 100 V range has fixed 0% offset
DC Offset error	
Wideband	0.1% of Full Scale ± 100 µV
Bessel filter	0.1% of Full Scale ± 100 µV
Offset error drift	±(50 ppm + 20 µV)/°C (±(30 ppm + 12 µV)/°F)
DC Gain error	
Wideband	0.1% of Full Scale ± 100 µV
Bessel filter	0.1% of Full Scale ± 100 µV
Gain error drift	±100 ppm/°C (± 60ppm/°F)
Maximum static error (MSE)	
Wideband	0.1% of Full Scale ± 100 µV
Bessel filter	0.1% of Full Scale ± 100 µV
RMS Noise (50 Ω terminated)	
Wideband	0.05% of Full Scale ± 100 µV
Bessel filter	0.05% of Full Scale ± 100 µV

Common mode (referred to system ground)			
Ranges	Less than or equal to ± 1 V	± 2 V to ± 10 V	Larger than or equal to ± 20 V
Rejection (CMR)	≥ 70 dB	≥ 60 dB	≥ 60 dB
Maximum common mode voltage	4 V DC	40 V DC	250 V DC

Analog Input	
Input overload protection	
Overvoltage impedance change	The activation of the overvoltage protection system results in a reduced input impedance. The overvoltage protection is not active for as long as the input voltage remains less than 200% of the selected input range or 250 V, whichever value is the smallest.
Maximum nondestructive voltage	± 125 V DC; Ranges ≤ ± 1 V ± 250 V DC; Ranges > ± 1 V
Overload recovery time	Restored to 0.1% accuracy in less than 40 ns after 200% overload Restored to 10% accuracy in less than 20 ns after 200% overload

Analog to Digital Conversion	
Sample rate per channel	1 S/s to 100 MS/s
ADC resolution; one ADC per channel	14 bit
ADC Type	CMOS pipelined multistep converter, LTC2254
Time base accuracy	Defined by mainframe: ± 3.5 ppm (1); aging after 10 years ± 10 ppm
Binary sample rate	Not supported
Maximum binary sample rate	N/A
External time base sample rate	0 S/s to 10 MS/s
External time base level	TTL
External time base minimum pulse width	50 ns

(1) Mainframes using Interface/Controller modules shipped before 2012: ± 30 ppm

Anti-Alias Filters

Using different filter selections (Wideband/Bessel/Bessel IIR) or different filter bandwidths can result in phase mismatches between channels.

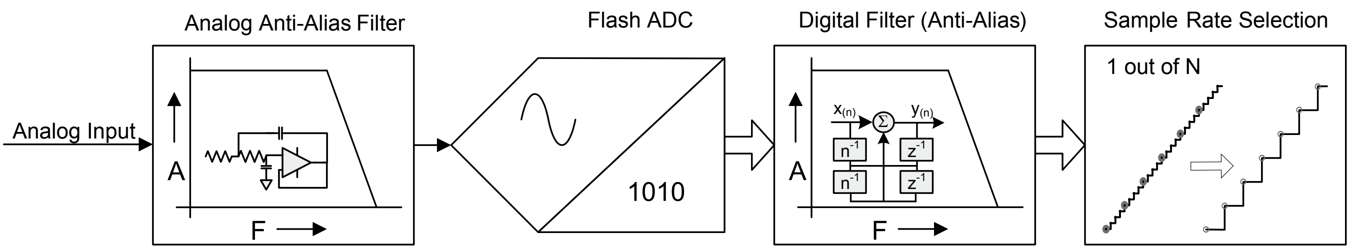


Figure 1.3: Combined analog and digital anti-alias filter block diagram

Anti-aliasing is prevented by a steep, fixed frequency analog anti-alias filter in front of the Analog to Digital Converter (ADC). The ADC always samples at a fixed sample rate. The fixed sample rate of the ADC avoids the need for different analog anti-alias filter frequencies.
Directly behind the ADC, the high precision digital filter is used as anti-alias protection before the digital downsampling to the desired user sample rate is performed. The digital filter supports a range of fixed bandwidth anti-alias filters. Compared to analog anti-alias filters, the programmable digital filter offers additional benefits like higher order filter with steep roll-off, a larger selection of filter characteristics, noise-free digital output and no additional phase shifts between channels that use the same filter settings.

Wideband	When wideband is selected, there is neither an analog anti-alias filter nor any digital filter in the signal path. Therefore, there is no anti-alias protection when wideband is selected. Wideband should not be used if working in a frequency domain with recorded data. Using wideband, enhanced resolution is not supported at lower sample rates.
Bessel (Fc @ -3 dB)	This analog Bessel filter can be used to reduce the higher bandwidth signals, but is also used to prevent aliasing at the 100 and 50 MS/s sample rates. For lower sample rates, the digital Bessel IIR filter must be used to prevent aliasing. Bessel filters are typically used when looking at signals in the time domain. They are best used for measuring transient signals or sharp edge signals like square waves or step responses. Using the Bessel filter, enhanced resolution is not supported at lower sample rates.
Bessel IIR (Fc @ -3 dB)	When Bessel IIR filter is selected, this is always a combination of an analog Bessel anti-alias filter and a digital Bessel IIR filter to prevent aliasing at lower sample rates. This can only be used for sample rates up to 50 MS/s. Bessel filters are typically used when looking at signals in the time domain. They are best used for measuring transient signals or sharp edge signals like square waves or step responses. Enhanced resolution is supported by using over sampling combined with a digital filter at the following sample rates: 15 bit resolution at 25 MS/s and lower, 16 bit resolution at 10 MS/s and lower.

Wideband (No Anti-Alias Protection)

When wideband is selected, there is neither an analog anti-alias filter nor any digital filter in the signal path. Therefore, there is no anti-alias protection when wideband is selected.

Wideband bandwidth	Between 26 MHz and 33 MHz (-3 dB)
0.1 dB passband flatness [1]	DC to 1 MHz

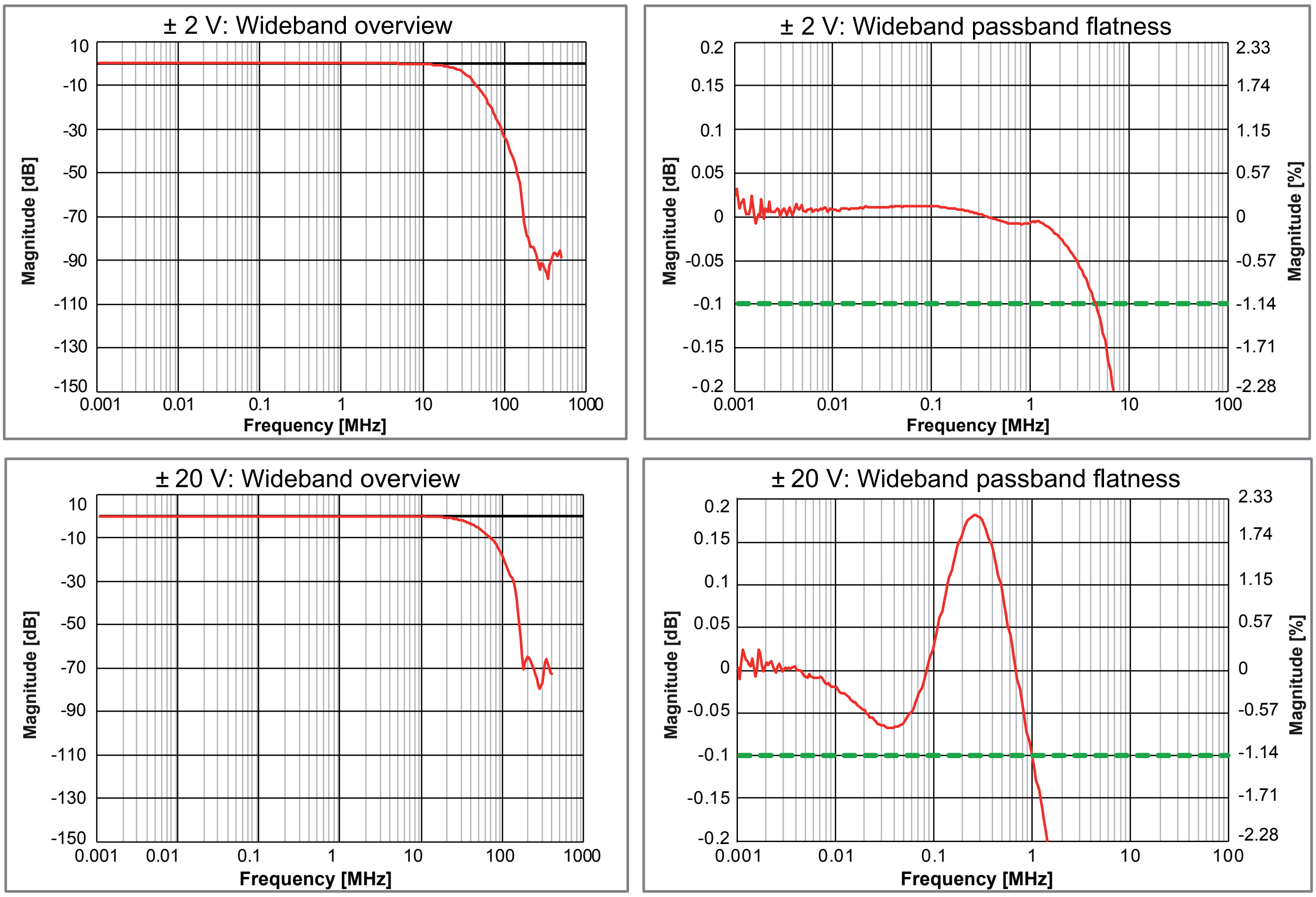
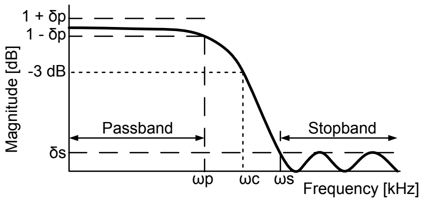


Figure 1.4: Representative Wideband examples

(1) Measured using Fluke 5700A and 5820A calibrators, DC normalized

Bessel Filter (Analog Anti-Alias)



δp: Passband ripple
δs: Stopband attenuation

ωp: Passband frequency
ωc: Corner frequency
ωs: Stopband frequency

Figure 1.5: Bessel Filter

When Bessel filter is selected, this is only the analog Bessel anti-alias filter and not a digital filter.

Bessel filter bandwidth	10 MHz ± 1 MHz (-3 dB)
Bessel filter characteristic	6-pole Bessel, optimal step response
Bessel filter 0.1 dB passband flatness(1)	DC to 500 kHz
Bessel filter stop band attenuation (δs)	60 dB
Bessel filter roll-off	36 dB/Octave

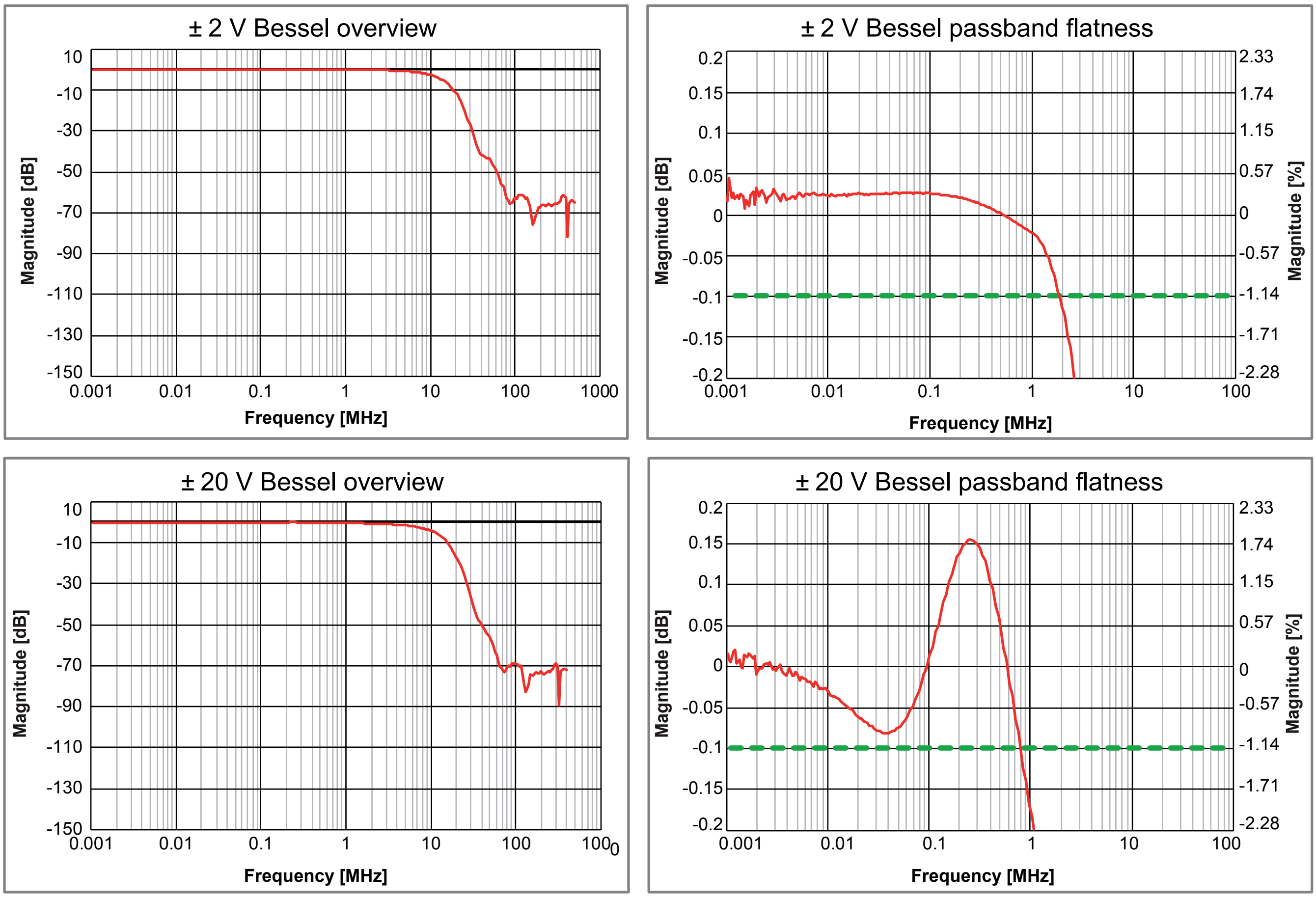
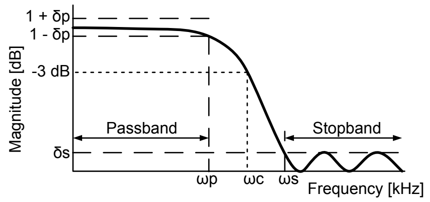


Figure 1.6: Representative Bessel examples

(1) Measured using Fluke 5700A and 5820A calibrators, DC normalized

Bessel IIR Filter (Digital Anti-Alias)



δp: Passband ripple
δs: Stopband attenuation

ωp: Passband frequency
ωc: Corner frequency
ωs : Stopband frequency

Figure 1.7: Digital Bessel IIR Filter

When Bessel IIR filter is selected, this is always a combination of the analog Bessel anti-alias filter and a digital Bessel IIR filter.

Analog anti-aliasing filter bandwidth	10 MHz ± 1 MHz (-3 dB)
Analog anti-aliasing filter characteristic	6-pole Bessel, optimal step response
Bessel IIR filter characteristic	8-pole Bessel style IIR
Bessel IIR filter user selection	User selectable fixed frequencies. If anti-aliasing must be prevented, care must be taken to adapt the selected filter frequency when the sample rate is changed.
Bessel IIR filter bandwidth (ωc)	50 kHz, 100 kHz, 125 kHz, 200 kHz, 250 kHz, 400 kHz, 500 kHz, 1 MHz, 1.25 MHz, 2 MHz, 2.5 MHz, 4 MHz, 5 MHz; fixed bandwidth selections
Bessel IIR 0.1 dB passband flatness (ωp)(1)	DC to 250 kHz @ ωc = 5 MHz
Bessel IIR filter stop band attenuation (δs)	60 dB
Bessel IIR filter roll-off	48 dB/Octave

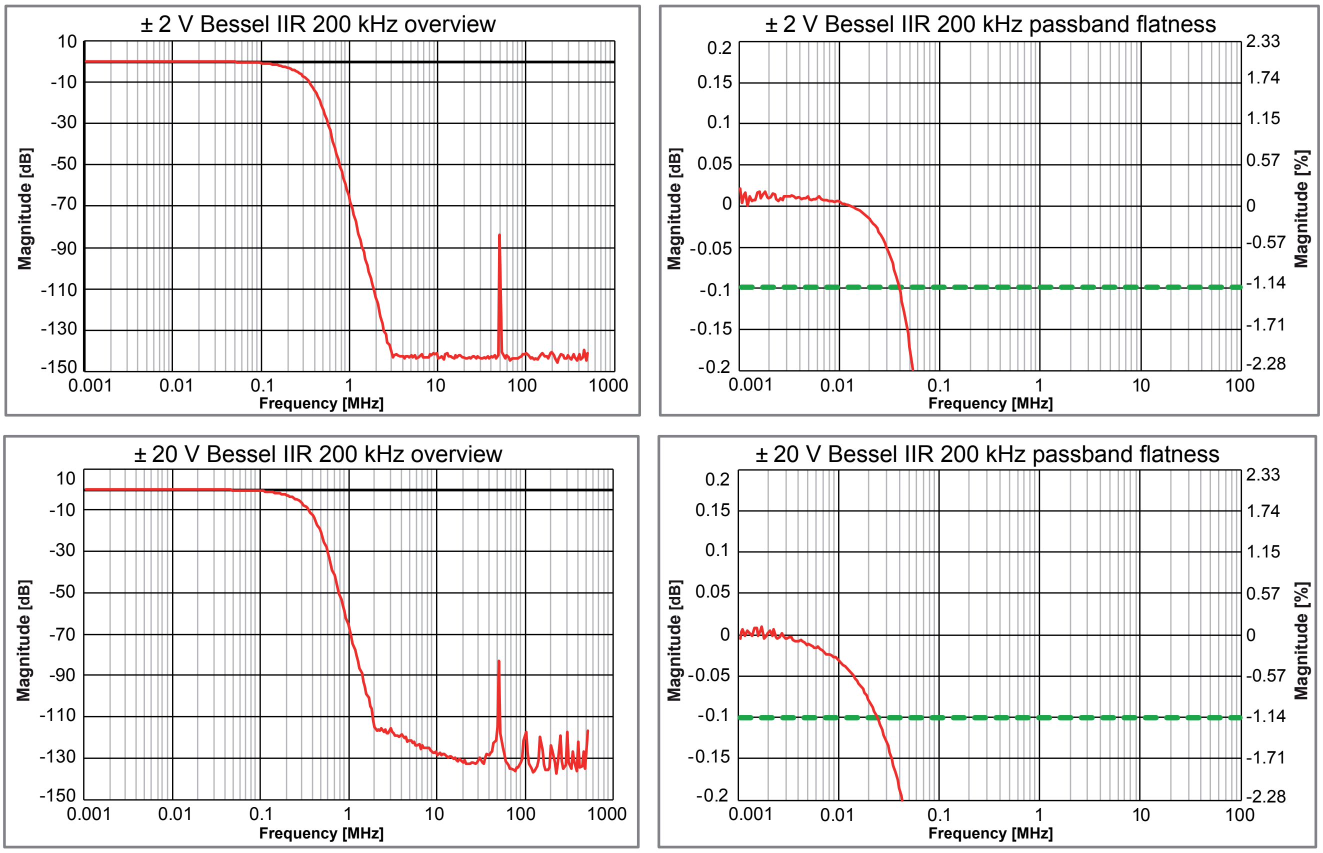


Figure 1.8: Representative Bessel IIR examples

(1) Measured using Fluke 5700A and 5820A calibrators, DC normalized

On-Board Memory	
Per card	2 GB (1 GS)
Organization	Automatic distribution amongst enabled channels
Memory diagnostics	Automatic memory test when system is powered on but not recording
Storage sample size	16 bits, 2 bytes/sample

Digital Events/Timer/Counter	
Digital event inputs	Not supported
Digital event outputs	Not supported
Timer/Counter	Not supported

Probe Power Output	
Connector type	LEMO ERD.0S.304.CLL
Mating connector type	LEMO FFA.0S.304.CLA.Cxx
Output power	3.5 Watt
Output voltage	> 8 V; Typically 8 V to 9 V
Maximum output current	0.4 A; Current limited and short circuit protected

PIN **Signal**
PIN 1 - Reserved/not connected
PIN 2 - GND
PIN 3 - Reserved/not connected
PIN 4 - +9V

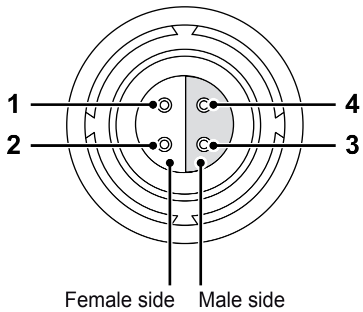


Figure 1.9: Probe power connector output

Triggering	
Channel trigger/qualifier	1 per channel; fully independent per channel, software selectable either trigger or qualifier
Pre- and post-trigger length	0 to full memory
Maximum trigger rate	400 triggers per second
Manual trigger (Software)	Supported
External Trigger In	
Selection per card	User selectable On/Off
Active edge	Rising/Falling mainframe selectable, identical for all cards
Minimum pulse width	500 ns
Delay	± 50 ns + maximum 1 sample period
Send to External Trigger Out	User can select to forward External Trigger In to the External Trigger Out BNC
External Trigger Out	
Selection per card	User selectable On/Off
Active level	High/Low/Hold High; selectable per mainframe, identical for all cards
Pulse width	High/Low: 12.8 µs Hold high: Active from first mainframe trigger to end of recording Pulse width created by mainframe
Delay	User selectable (3 µs to 516 µs) ± 1 µs + maximum 1 sample period (requires Perception V6.50 or higher). The default of 516 µs is compatible with standard behavior. Minimum selectable delay is the smallest delay available for all acquisition cards used within the mainframe
Cross channel triggering	
Measurement channels	Logical OR of triggers from all measured signals Logical AND of qualifiers from all measured signals
Calculated channels	Logical OR of triggers from all calculated signals (RTC and RT-FDB) Logical AND of qualifiers from all calculated signals (RTC and RT-FDB)
Analog channel trigger levels	
Levels	Maximum 2 level detectors
Resolution	16 bit (0.0015%); for each level
Direction	Rising/Falling; Single direction control for both levels based on selected mode
Hysteresis	0.1 to 100% of Full Scale; defines the trigger sensitivity
Pulse detection/rejection	Disable/Detect/Reject software selectable. Maximum pulse width 65 535 samples
dY/dT conversion	dY: 16 bit (0.0015%) for both levels dT: 1 to 1023 samples. dT setting shared for both levels
Analog channel trigger modes	
Basic	POS or NEG crossing; single level
Dual level	One POS and one NEG crossing; Two individual levels, OR-ed
Window	Arm/trigger and a disarm level; Trigger on peak level changes in a uni-polar signal
Dual Window	Arm/trigger/disarm per level; Trigger on peak level changes in a bi-polar signal
Sequential	One arm and one trigger level; eliminate false triggering due to noise or hysteresis
Analog channel qualifier modes	
Basic	Above or below level check. Enable/disable trigger with single level
Dual (level)	Outside or within bounds check. Enable/disable trigger with dual level
Trigger hold off	Disable channel trigger for 1 to 65 535 samples after trigger detected Maximum hold off time depends on sample rate
Interval timer	
Modes	Less than, trigger when rate is too low More than, trigger when rate is too high Between, trigger when rate between lower and upper limit Not between, trigger when rate is not between lower and upper limit
Interval timers	Start timer and width Timer
Timer value	1 to 65 535 samples
Event counter	Counted channel trigger events before card trigger is activated 1 to 256 trigger events

Alarm Output

Selection per card	User selectable On/Off
Alarm modes	Basic or Dual
Basic	Above or below level check
Dual (level)	Outside or within bounds check
Alarm levels	
Levels	Maximum 2 level detectors
Resolution	16 bit (0.0015%) for each level
Alarm output	Active during valid alarm condition, output supported through mainframe
Alarm output delay	515 µs ± 1 µs + maximum 1 sample period using decimal time base 503 µs ± 1 µs + maximum 1 sample period using binary time base

Real-Time Analysis

StatStream® Patent Number : 7,868,886	Each channel includes real-time extraction of Maximum, Minimum, Mean, Peak-to-Peak, Standard Deviation and RMS values Supports the real-time live scrolling and scoping of waveform displays and the real-time meters while recording Supports fast displaying and zooming within extremely large recordings Supports fast calculations of statistical channel information

Acquisition Modes

Single sweep	Triggered acquisition to on-board memory without sample rate limitations; for single transients or intermittent phenomena. No aggregate sample rate limitations.
Multiple sweeps	Triggered acquisition to on-board memory without sample rate limitations; for repetitive transients or intermittent phenomena. No aggregate sample rate limitations.
Slow-Fast Sweep	Identical to single sweep acquisition with additional support for fast sample rate switches during the post-trigger segment of the slow rate single sweep settings. No aggregate sample rate limitations. Slow-Fast Sweep is not supported by the RT-FDB calculators.
Continuous	Direct storage to PC or mainframe controlled hard disk without file size limitations; triggered or un-triggered; for long duration recorder type applications. Aggregate sample rate limitations depend on Ethernet speed, PC used and data storage media used.
Dual	Combination of Multiple sweeps and Continuous; recorder type streaming to hard disk with simultaneously triggered sweeps in on-board memory. Aggregate sample rate limitations depend on Ethernet speed, PC used and data storage media used. In Dual mode the RT-FDB calculators sample based results are only calculated for the sweep sections of the recorded data. Due to the asynchronous nature of cycle based results, all cycle based results are continuously stored and used in both the sweep as well as the continuous sections of the recording.

Recording Mode Details

	Single Sweep Multiple Sweeps Slow-Fast Sweep			**Continuous**			**Dual Rate**		
	Enabled channels			Enabled channels			Enabled channels		
	1 Ch	2 Ch	4 Ch	1 Ch	2 Ch	4 Ch	1 Ch	2 Ch	4 Ch
Max. sweep memory	980 MS	490 MS	235 MS	not used			800 MS	390 MS	180 MS
Max. sweep sample rate	100 MS/s			not used			100 MS/s		
Max. continuous FIFO	not used			980 MS	490 MS	235 MS	180 MS	90 MS	45 MS
Max. continuous sample rate	not used			20 MS/s			Sweep sample rate / 2 Maximum 20 MS/s		
Max. aggregate continuous streaming rate	not used			20 MS/s 40 MB/s	40 MS/s 80 MB/s	80 MS/s[1] 160 MB/s[1]	20 MS/s 40 MB/s	40 MS/s 80 MB/s	80 MS/s[1] 160 MB/s[1]

(1) Only mainframes with "fast data streaming" support can stream at this data rate continuously.

Single Sweep	
Pre-trigger segment	0% to 100% of selected sweep length If trigger occurs before the pre-trigger segment is recorded, the pre-trigger segment is truncated to recorded data only.
Delayed trigger	Maximum 1000 seconds after a trigger occurred. The sweep is recorded immediately after a delayed trigger time with 100% post-trigger after this time point.
Sweep stretch	User selectable On/Off When enabled, any new trigger event occurring in the post-trigger segment of the sweep restarts the post-trigger length. If, upon the detection of a new trigger, the extended post-trigger does not fit within the sweep memory, sweep stretch does not happen. The maximum sweep stretch rate is 1 sweep stretch per 2.5 ms.

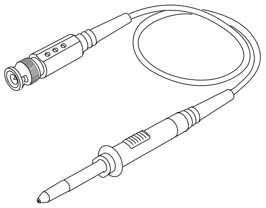
Multiple Sweeps	
Pre-trigger segment	0% to 100% of selected sweep length If trigger occurs before the pre-trigger segment is recorded, the pre-trigger segment is truncated to recorded data only.
Delayed trigger	Maximum 1000 seconds after a trigger occurred. The sweep is recorded immediately after a delayed trigger time with 100% post-trigger after this time point.
Maximum number of sweeps	200 000 per recording
Maximum sweep rate	400 sweeps per second
Sweep re-arm time	Zero re-arm time, sweep rate limited to 1 sweep per 2.5 ms
Sweep stretch	User selectable On/Off When enabled, any new trigger event occurring in the post-trigger segment of the sweep restarts the post-trigger length. If, upon the detection of a new trigger, the extended post-trigger does not fit within the sweep memory, sweep stretch does not happen. The maximum sweep stretch rate is 1 sweep stretch per 2.5 ms.
Sweep storage	Sweep storage is started immediately after the trigger for this sweep has been detected. Sweep memory becomes available for reuse as soon as storage of the entire sweep for all enabled channels of this card has been completed. Sweeps are stored one by one, starting with the first recorded sweep.
Sweep storage rate	Determined by the total number of selected channels and mainframes, mainframe type, Ethernet speed, PC storage medium and other PC parameters. For details, please refer to the mainframe datasheet.
Exceeding sweep storage rate	Trigger event markers are stored in a recording. No sweep data is stored. New sweep data is recorded as soon as enough internal memory is available to capture a full sweep when a trigger occurs.

Slow-Fast Sweep	
Maximum number of sweeps	1 per recording
Maximum slow sample rate	Fast sample rate divided by two or 20 MS/s per channel, whichever is the smallest sample rate
Maximum sample rate switches	20, sample rate switching always stops when sweep ends
Minimum time between sample rate switches	2.5 ms

Continuous	
Continuous modes supported	Standard, Circular recording, Specified time and Stop on trigger
Standard	User starts and stops recording. Recording is stopped when the storage media is full
Circular recording	User specified recording history on storage media. All recorded data is stored on the storage media as quickly as possible. As soon as the selected history time is reached, older recorded data is overwritten. Recording can be stopped by the user or any system trigger.
Specified time	Recording is stopped after the time specified or when the storage media is full
Stop on trigger	Recording is stopped after any system trigger or when the storage media is full
Continuous FIFO memory	Used by enabled channels to optimize the continuous streaming rate
Maximum recording time	Until storage media filled or user selected time or unlimited when using circular recording
Maximum aggregate streaming rate per mainframe	Determined by mainframe, Ethernet speed, PC storage medium and other PC parameters. For details, please refer to the mainframe datasheet
Exceeding aggregate streaming rate	When a streaming rate higher than the aggregate streaming rate of the system is selected, the continuous memory acts as a FIFO. As soon as this FIFO fills up, the recording is suspended (no data is recorded temporarily). During this period, the internal FIFO memory is transferred to a storage medium. When internal memory is completely empty again, the recording is automatically resumed. User notifications are added to the recording file for post recording identification of storage overrun.

Dual	
Dual Sweep Specification	
Pre-trigger segment	0% to 100% of selected sweep length If trigger occurs before the pre-trigger segment is recorded, the pre-trigger segment is truncated to recorded data only.
Delayed trigger	Maximum 1000 seconds after a trigger occurred. The sweep is recorded immediately after a delayed trigger time with 100% post-trigger after this time point.
Maximum number of sweeps	200 000 per recording
Maximum sweep rate	400 sweeps per second
Sweep re-arm time	Zero re-arm time, sweep rate limited to 1 sweep per 2.5 ms
Sweep stretch	User selectable On/Off When enabled, any new trigger event occurring in the post-trigger segment of the sweep restarts the post-trigger length. If, upon the detection of a new trigger, the extended post-trigger does not fit within the sweep memory, sweep stretch does not happen. The maximum sweepstretch rate is 1 sweep stretch per 2.5 ms.
Sweep storage	In dual mode, the storage of the continuous data is prioritized above the storage of the sweep data. If enough storage rate is available, the sweep storage is started immediately after the trigger for this sweep has been detected. Sweep memory becomes available for reuse as soon as storage of the entire sweep for all enabled channels of this card has been completed. Sweeps are stored one by one, starting with the first recorded sweep.
Sweep storage rate	Determined by the continuous sample rate, total number of channels and mainframes, mainframe type, Ethernet speed, PC storage medium and other PC parameters. For details, please refer to mainframe datasheet.
Exceeding sweep storage rate	Continuous recorded data is not stopped, trigger event markers are stored in recording and no new sweep data is stored. A new sweep is recorded as soon as enough internal memory is available to capture a full sweep when a trigger occurs.
Dual Continuous Specifications	
Continuous FIFO memory	Used by enabled channels to optimize the continuous streaming rate
Maximum recording time	Until storage media filled or user selected time
Maximum aggregate streaming rate per mainframe	Determined by mainframe, Ethernet speed, PC storage medium and other PC parameters. For details, please refer to the mainframe datasheet. When the average aggregate streaming rate is exceeded, the sweep storage speed is automatically reduced to increase the aggregate streaming rate until the sweep storage is stopped completely.
Exceeding aggregate storage rate	When a streaming rate higher than the aggregate streaming rate of the system is selected, the continuous memory acts as a FIFO. As soon as this FIFO fills up, the recording is suspended (no data is recorded temporarily). During this period, the internal FIFO memory is transferred to the storage medium. When the internal memory (Continuous and Sweep memory) is completely empty, the recording is automatically resumed. User notifications are added to the recording file for post recording identification of storage overrun.

G901, G902: Passive, Single-Ended Voltage Probe (Option, to be ordered separately)				
To be used with single-ended non-isolated amplifiers or with differential non-isolated amplifiers in single-ended mode				



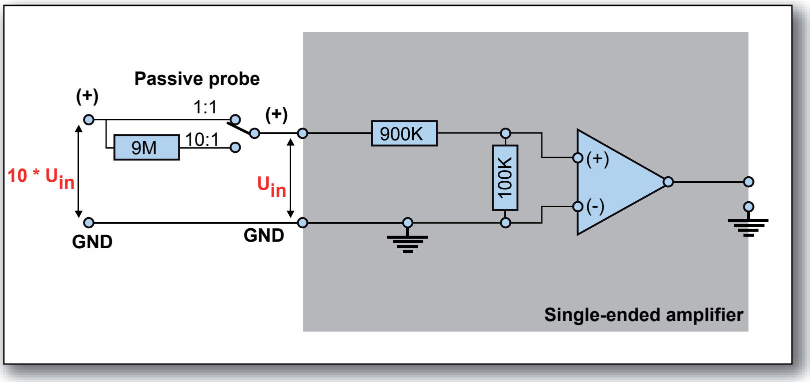


Figure 1.10: Block diagram passive, single-ended voltage probe

Isolation	Not supported			
Capacitive compensation range	7 to 75 pF			
DC In-accuracy	2%			
	G901		**G902**	
Divide factors	1:1	10:1	1:1	10:1
Probe impedance (connected to channel)	1 MΩ	10 MΩ	1 MΩ	10 MΩ
- 3 dB Bandwidth	12 MHz	200 MHz	6 MHz	100 MHz
Maximum input voltage	55 V RMS	300 V RMS CAT II	55 V RMS	300 V RMS CAT II
Probe cable length	1.2 m (3.9 ft)		3 m (9.8 ft)	
Probe weight	Typically 59 g (2.1 oz)		Typically 88 g (3.1 oz)	
Original manufacturer's part number	PMK 869-923900		PMK 869-924900	
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)			

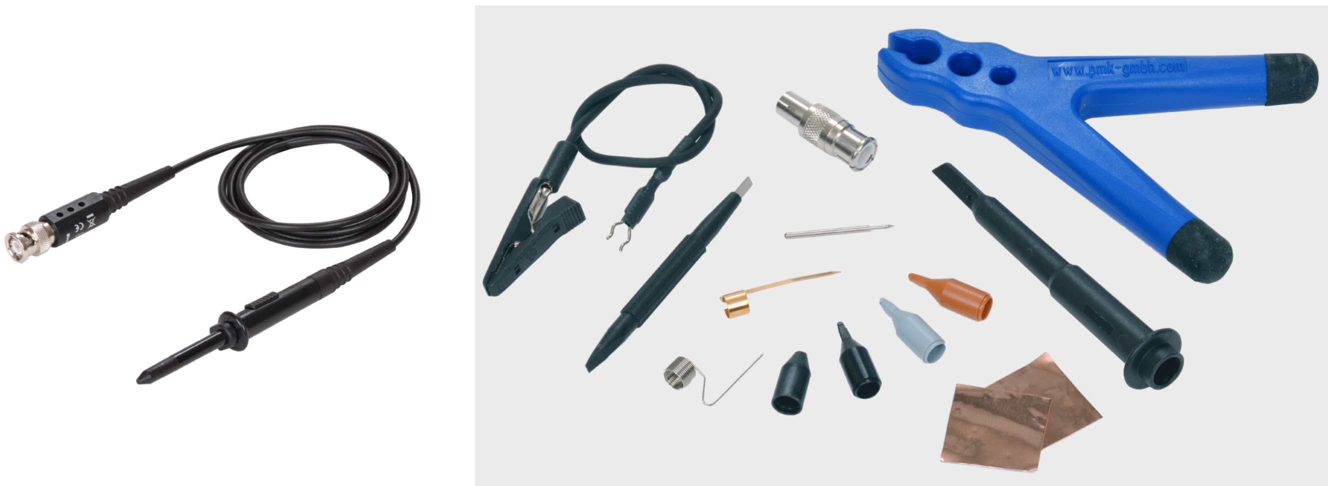
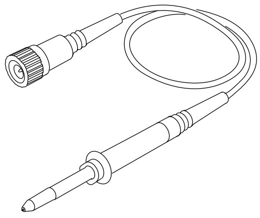


Figure 1.11: Probe and probe accessories

G903: Passive, Single-Ended Voltage Probe (Option, to be ordered separately)

To be used with single-ended amplifiers or with differential amplifiers in single-ended mode



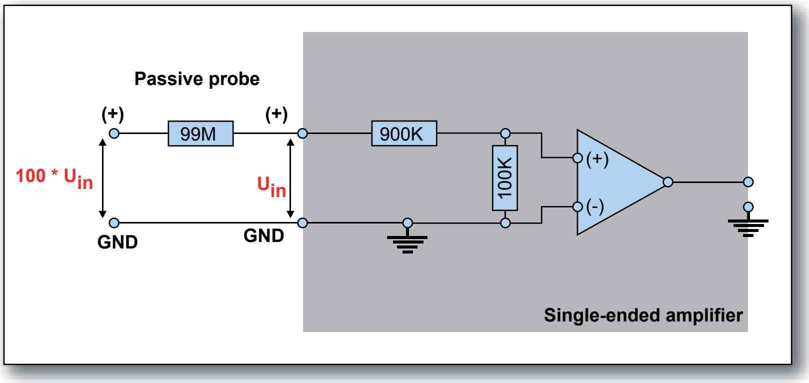


Figure 1.12: Block diagram passive, single-ended voltage probe

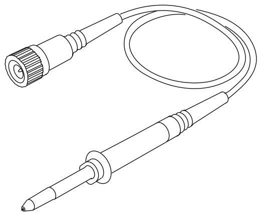
Isolation	Not supported
Capacitive compensation range	7 to 45 pF
DC In-accuracy	2%
Divide factors	100:1
Probe impedance (connected to channel)	100 MΩ
-3 dB Bandwidth	400 MHz
Maximum input voltage	1000 V RMS CAT II
Probe cable length	1.2 m (3.9 ft)
Probe weight	Typically 67 g (2.4 oz)
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Original manufacturer's part number	PMK PHV1000-1-45

Figure 1.13: Probe and probe accessories

Note *The compensation range of the G903 probe does not match that of GN1610/GN1611/GN3210/GN3211 cards. For the limited bandwidth of GN1610/GN1611/GN3210/GN3211, this has no noticeable effects. When using the G903 probe in combination with this card select the sensor "G903_NoCapacitiveCheck" from the Perception Sensor Database.*

G904: Passive, Single-Ended Voltage Probe (Option, to be ordered separately)

To be used with single-ended amplifiers or with differential amplifiers in single-ended mode



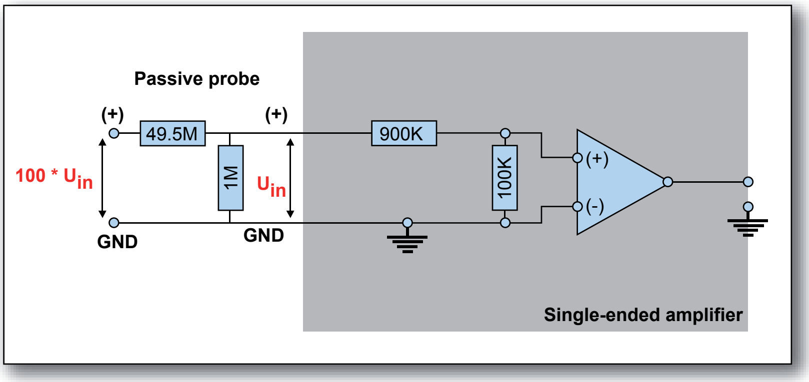


Figure 1.14: Block diagram passive, single-ended voltage probe

Isolation	Not supported
Capacitive compensation range	10 to 50 pF
DC In-accuracy	2%
Divide factors	100:1
Probe impedance (connected to channel)	50 MΩ
-3 dB Bandwidth	300 MHz
Maximum input voltage	2 kV RMS @ 50/60 Hz 3 kV DC
Probe cable length	2 m (6.7 ft)
Probe weight	Typically 68 g (2.4 oz)
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Original manufacturer's part number	PMK 117-901600

Figure 1.15: Probe and probe accessories

Note *The compensation range of the G904 probe does not match that of GN1610/GN1611/GN3210/GN3211 cards. For the limited bandwidth of GN1610/GN1611/GN3210/GN3211, this has no noticeable effects. When using the G904 probe in combination with this card select the sensor "G904_NoCapacitiveCheck" from the Perception Sensor Database.*

G906: Passive, Single-Ended Voltage Probe (Option, to be ordered separately)

To be used with single-ended amplifiers or with differential amplifiers in single-ended mode

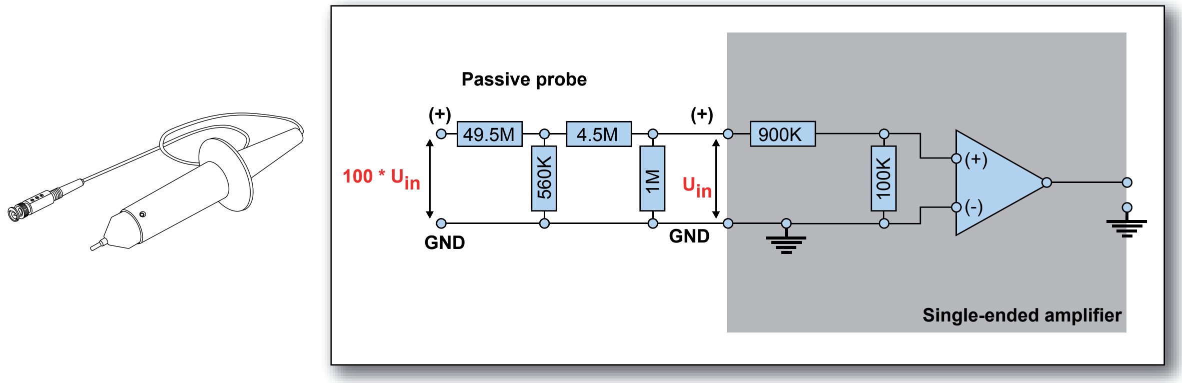


Figure 1.16: Block diagram passive, single-ended voltage probe

Isolation	Not supported
Capacitive compensation range	10 to 50 pF
DC In-accuracy	2%
Divide factors	1000:1
Probe impedance (connected to channel)	100 MΩ
-3 dB Bandwidth	100 MHz
Maximum input voltage	14 kV RMS @ 50/60 Hz, 20 kV DC
Probe cable length	Typically 3 m (9.8 ft)
Probe weight	Typically 465 g (16.4 oz)
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Original manufacturer's part number	PMK PHV 4002-3

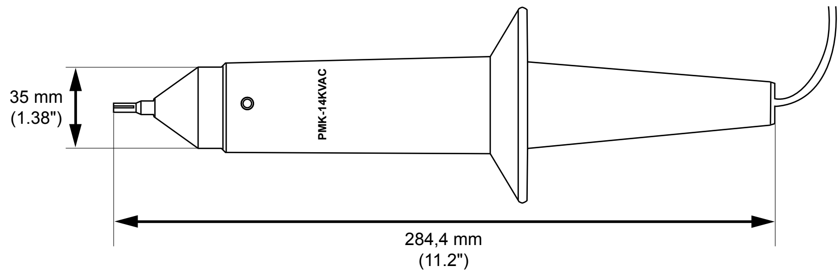


Figure 1.17: Dimensions

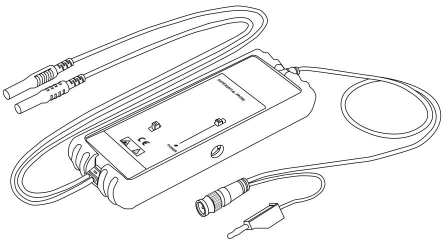
To be used with single-ended amplifiers or with differential amplifiers in single-ended mode

Figure 1.18: Probe and probe accessories

Note *The compensation range of the G906 probe does not match that of GN1610/GN1611/GN3210/GN3211 cards. For the limited bandwidth of GN1610/GN1611/GN3210/GN3211, this has no noticeable effects. When using the G906 probe in combination with this card select the sensor "G906_NoCapacitiveCheck" from the Perception Sensor Database.*

G909: Active, Differential Voltage Probe (Option, to be ordered separately)

To be used with differential isolated or non-isolated amplifiers



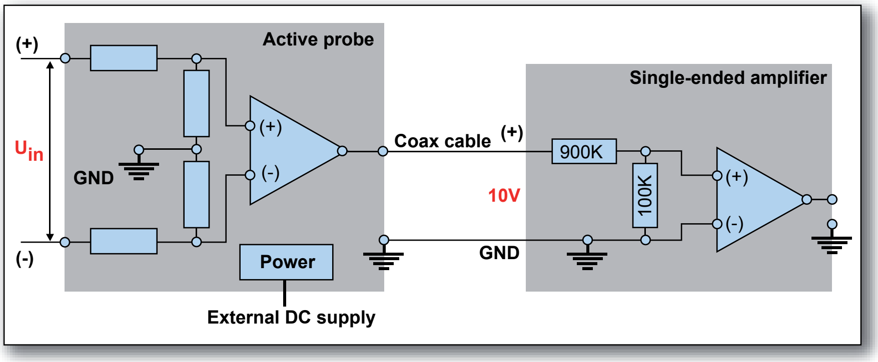


Figure 1.19: Block diagram active, differential voltage probe

Isolation	Not supported	
Capacitive compensation range	Not required as this is an active output	
DC In-accuracy	2%	
Probe impedance	4 MΩ for each input	
- 3 dB Bandwidth	25 MHz	
Rise time	14 ns	
CMRR (typical)	-80 dB @ 50 Hz, -60 dB @ 20 kHz	
Output voltage	±7 V (50 kΩ load)	
Output typical offset	< ±5 mV	
Output typical noise	0.7 mV RMS	
Output source impedance	50 Ω	
Divide factor	20:1	200:1
Maximum measuring voltage	140 V RMS CAT III	1000 V RMS CAT III
Common mode voltage	1000 V RMS	1000 V RMS
Maximum voltage on each input (Common mode + measurement voltage)	1000 V RMS	1000 V RMS
Probe power	4 * AA cell battery or external power	
External power source	Regulated voltage between 4.4 V DC and 12 V DC	
Power usage	60 mA @ 6 V DC 40 mA @ 9 V DC	
Probe cable length	Input leads 0.45 m (1.48 ft) BNC output cable 0.95 m (3.12 ft)	
Probe weight	Typically 265 g (3.6 oz)	
Probe operating temperature range	-10 °C to +40 °C (14 °F to 104 °F)	
Original manufacturers part number	Probe Master Inc™, 4231-20X/200X	

Figure 1.20: G909 Probe

G912: AC/DC Current Clamp i30s (Option, to be ordered separately)

To be used with single-ended isolated or non-isolated amplifiers or with differential isolated or non-isolated amplifiers in single-ended mode

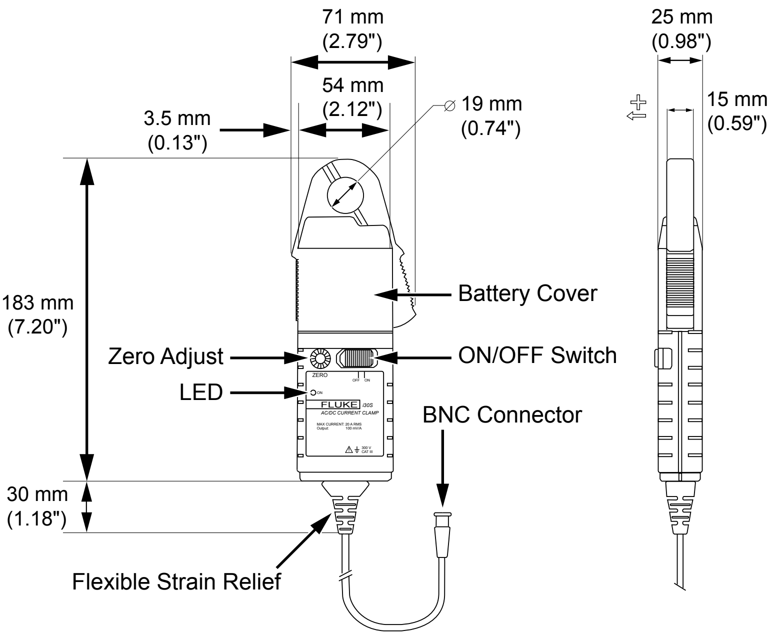


Figure 1.21: Dimensions

The i30s current clamp is based on Hall effect technology to measure both DC and AC current. The i30s current clamp may be used with recording instruments to measure the current accurately and non-intrusively.

Electrical specifications	
Current range	30 mA to 30 A DC, 30 mA to 20 A RMS
In-accuracy	± 1% of reading ± 2 mA (at +25 °C, 77 °F)
Phase shift	< 2 degrees when using frequencies below 1 kHz
Crest factor	1.4
Conductor position sensitivity	± 1% relative to center reading
Output sensitivity	100 mV/A
Bandwidth	DC to -0.5 dB @ 100 kHz
Load impedance	> 100 kΩ
Temperature drift	± 0.01% of reading/°C
Isolation/Working voltage	300 V RMS CAT III, pollution degree 2, frequencies below 1 kHz
General specifications	
Power supply	9 V Alkaline, MN1604/PP3, 30 hours, low battery indicator
Maximum conductor diameter	19 mm (0.75”)
Output connection	Safety BNC connector
Probe cable length	2 m (6.5 ft)
Probe dimensions (HxWxD)	183 x 71 x 25 mm (7.20” x 2.80” x 0.99”)
Probe weight	Typically 250 g (8.8 oz)
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Original manufacturer's part number	Fluke i30s AC/DC Current Clamp

Figure 1.22: AC/DC Current Clamp i30s

G913: AC Current Clamp SR661 (Option, to be ordered separately)

To be used with single-ended isolated or non-isolated amplifiers or with differential isolated or non-isolated amplifiers in single-ended mode

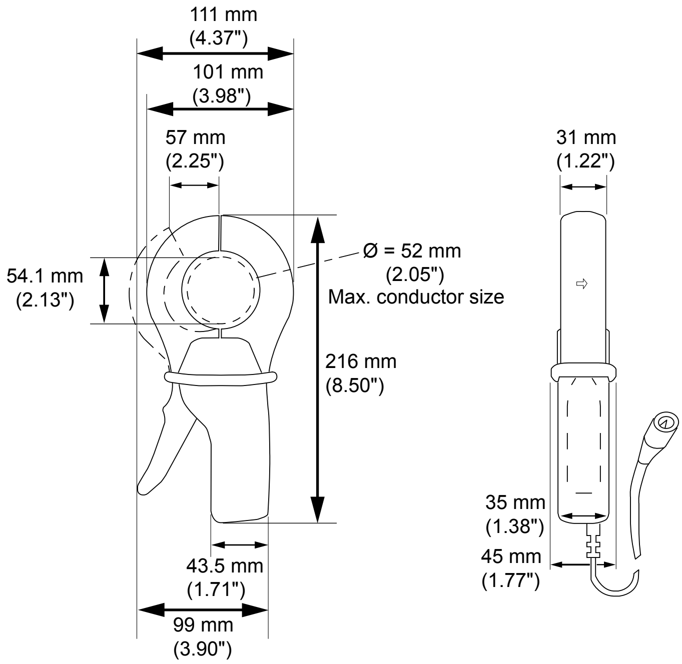


Figure 1.23: Dimensions

Built to the highest safety standards, including CE compliance and UL approval in the USA and Canada. Has excellent transformation, low phase shifts and a broad frequency response. Permits the current to be measured accurately for power and power quality applications.

Electrical specifications			
Current range	0.1 A to 1200 A RMS, can be manually selected in 3 steps: 10 A, 100 A, 1000 A		
Selected current range	**10 A**	**100 A**	**1000 A**
Measurement range	0.1 to 12 A	0.1 to 120 A	1 to 1200 A
Output sensitivity	100 mV/A	10 mV/A	1 mV/A
In-accuracy	± 3% ± 10 mV	± 2% ± 5 mV	± 1% ± 1 mV
Phase shift	≤ 15 degrees	≤ 15 degrees	≤ 3 degrees
Maximum overload	12 A, continuous	120 A, continuous	1200 A, for 20 minutes
Bandwidth	1 Hz to -3 dB @ 100 kHz		
Load impedance	1 MΩ @ 47 pF		
Isolation/Working voltage	600 V RMS CAT III, pollution degree 2		
General specifications			
Maximum conductor diameter	52 mm (2.25”)		
Output connection	Safety BNC connector		
Probe cable length	2 m (6.5 ft)		
Probe dimensions (HxWxD)	216 x 111 x 45 mm (8.50” x 4.37” x 1.77”)		
Probe weight	Typically 550 g (1.21 lbs)		
Probe operating temperature range	-10 °C to +50 °C (14 °F to 122 °F)		
Original manufacturer's part number	AEMC SR661 AC Current Clamp		

Figure 1.24: SR661 AC Current Clamp

G914: AC Current Clamp M1V-20-2 (Option, to be ordered separately)

To be used with single-ended isolated or non-isolated amplifiers or with differential isolated or non-isolated amplifiers in single-ended mode

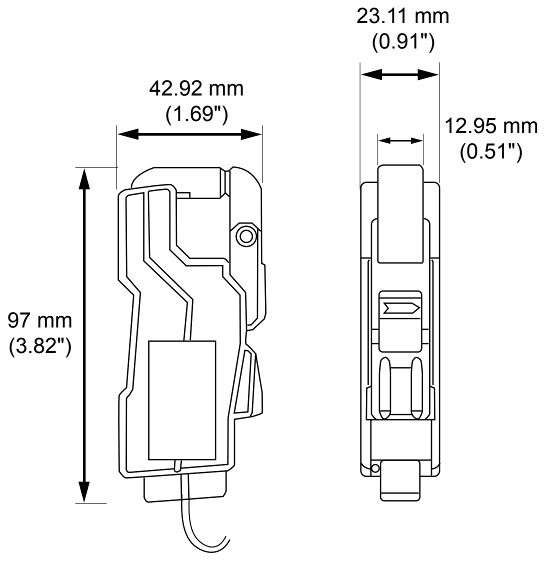


Figure 1.25: Dimensions

AC current micro clamp, compliant with IEC standard 348 CLASS II 600 V

Electrical specifications	
Current range	50 mA to 20 A RMS
In-accuracy	± 1%
Output sensitivity	100 mV/A
Bandwidth	-3 dB @ 30 Hz to 100 kHz, 3% @ 40 Hz to 2 kHz
Load impedance	> 30 kΩ
Isolation/Working voltage	640 V RMS
General specifications	
Maximum conductor diameter	15 mm (0.59”)
Output connection	Metal BNC
Probe cable length	2 m (6.5 ft)
Probe dimensions (HxWxD)	97 x 43 x 23 mm (3.82” x 1.69” x 0.91”)
Probe weight	Typically 114 g (0.25 lb)
Probe operating temperature range	-10 °C to +50 °C (14 °F to 122 °F)
Original manufacturer's part number	AYA instruments M1V-20-2

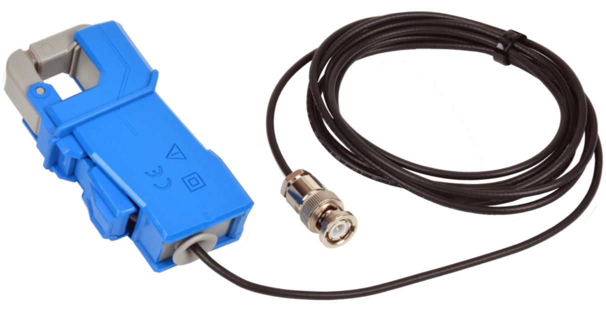


Figure 1.26: M1V-20-2

Environmental Specifications

Temperature Range	
Operational	0 °C to +40 °C (+32 °F to +104 °F)
Non-operational (Storage)	-25 °C to +70 °C (-13 °F to +158 °F)
Thermal protection	Automatic thermal shutdown at 85 °C (+185 °F) internal temperature User warning notifications at 75 °C (+167 °F) (Supported by Perception V6.30 or higher)
Relative humidity	0% to 80%; non-condensing; operational
Protection class	IP20
Altitude	Maximum 2000 m (6562 ft) above sea level; operational
Shock: IEC 60068-2-27	
Operational	Half-sine 10 g/11 ms; 3-axis, 1000 shocks in positive and negative direction
Non-operational	Half-sine 25 g/6 ms; 3-axis, 3 shocks in positive and negative direction
Vibration: IEC 60068-2-64	
Operational	1 g RMS, ½ h; 3-axis, random 5 to 500 Hz
Non-operational	2 g RMS, 1 h; 3-axis, random 5 to 500 Hz
Operational Environmental Tests	
Cold test IEC 60068-2-1 Test Ad	-5 °C (+23 °F) for 2 hours
Dry heat test IEC 60068-2-2 Test Bd	+40 °C (+104 °F) for 2 hours
Damp heat test IEC 60068-2-3 Test Ca	+40 °C (+104 °F), humidity > 93% RH for 4 days
Non-Operational (Storage) Environmental Tests	
Cold test IEC 60068-2-1 Test Ab	-25 °C (-13 °F) for 72 hours
Dry heat test IEC 60068-2-2 Test Bb	+70 °C (+158 °F) humidity < 50% RH for 96 hours
Change of temperature test IEC 60068-2-14 Test Na	-25 °C to +70 °C (-13 °F to +158 °F) 5 cycles, rate 2 to 3 minutes, dwell time 3 hours
Damp heat cyclic test IEC 60068-2-30 Test Db variant 1	+25 °C/+40 °C (+77 °F/+104 °F), humidity > 95/90% RH 6 cycles, cycle duration 24 hours

Harmonized Standards for CE Compliance, According to the Following Directives

Low Voltage Directive (LVD): 2006/95/EC
ElectroMagnetic Compatibility Directive (EMC): 2004/108/EC

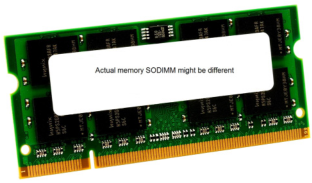
Electrical Safety	
EN 61010-1 (2010)	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
EN 61010-2-030 (2010)	Particular requirements for testing and measuring circuits
Electromagnetic Compatibility	
EN 61326-1 (2013)	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
Emission	
EN 55011	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement Conducted disturbance: class B; Radiated disturbance: class A
EN 61000-3-2	Limits for harmonic current emissions: class D
EN 61000-3-3	Limitation of voltage changes, voltage fluctuations and flicker in public low voltage supply systems
Immunity	
EN 61000-4-2	Electrostatic discharge immunity test (ESD); contact discharge ± 4 kV/air discharge ± 8 kV: performance criteria B
EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test; 80 MHz to 2.7 GHz using 10 V/m, 1000 Hz AM: performance criteria A
EN 61000-4-4	Electrical fast transient/burst immunity test Mains ± 2 kV using coupling network. Channel ± 2 kV using capacitive clamp: performance criteria B
EN 61000-4-5	Surge immunity test Mains ± 0.5 kV/± 1 kV Line-Line and ± 0.5 kV/± 1 kV/± 2 kV Line-earth Channel ± 0.5 kV/± 1 kV using coupling network: performance criteria B
EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields 150 kHz to 80 MHz, 1000 Hz AM; 10 V RMS @ mains, 3 V RMS @ channel, both using clamp: performance criteria A
EN 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests Dips: performance criteria A; Interruptions: performance criteria C

Ordering Information[1]

Article		Description	Order No.
HiSpeed 100M		4 channels, 14 bit, 100 MS/s, ± 20 mV to ± 100 V input range, 1800 MB RAM (225 MS/ channel), balanced differential input, two metal BNCs per channel	1-GN412-2

(1) All GEN series systems are intended for exclusive professional and industrial use.

Options, to be ordered separately

Article		Description	Order No.
2 Gbyte Memory Upgrade		2 Gbyte memory upgrade for 100 MS/s digitizers and fiber receiver cards with 1 Gbyte memory only (factory installed upgrade, includes re-calibration)	1-G030-2

Voltage Probes (Options, to be ordered separately)			
Article		**Description**	**Order No.**
Passive, SE probe 10:1, 200 MHz, 10 MΩ, 1.2 m		Passive, single-ended voltage probe. Has a capacitive compensation range from 7 to 75 pF. Divide factors of 1:1 and 10:1 can be selected. When divide factor 10:1 is selected, the bandwidth is -3 dB @ 200 MHz, maximum input voltage is 300 V RMS CAT II, maximum DC In-accuracy is 2%, and the probe connected to a channel has an input impedance of 10 MΩ. Probe cable length is 1.2 m (3.9 ft).	1-G901-2
Passive, SE probe 10:1, 100 MHz, 10 MΩ, 3 m		Passive, single-ended voltage probe. Has a capacitive compensation range from 7 to 75 pF. Divide factors of 1:1 and 10:1 can be selected. When divide factor 10:1 is selected, the bandwidth is -3 dB @ 100 MHz, maximum input voltage is 300 V RMS CAT II, maximum DC In-accuracy is 2%, and the probe connected to a channel has an input impedance of 10 MΩ. Probe cable length is 3 m (9.8 ft).	1-G902-2
Passive, SE isolated probe, 100:1, 400 MHz, 100 MΩ		Passive, single-ended isolated voltage probe. Has a capacitive compensation range from 7 to 45 pF. The divide factor is 100:1, bandwidth is -3 dB @ 400 MHz, maximum input voltage is 1000 V RMS CAT II, maximum DC In-accuracy is 2%, and the probe connected to a channel has an input impedance of 100 MΩ. Probe cable length is 1.2 m (3.9 ft).	1-G903-2
Passive, SE isolated probe, 100:1, 300 MHz, 50 MΩ		Passive, single-ended isolated voltage probe. Has a capacitive compensation range from 10 to 50 pF. The divide factor is 10:1, bandwidth is -3 dB @ 300 MHz, maximum input voltage is 2 kV RMS, maximum DC In-accuracy is 2%, and the probe connected to a channel has an input impedance of 50 MΩ. Probe cable length is 2 m (3.9 ft).	1-G904-2
Passive, SE isolated probe, 1000:1, 100 MHz, 100 MΩ		Passive, single-ended isolated voltage probe. Has a capacitive compensation range from 10 to 50 pF. The divide factor is 10:1, bandwidth is -3 dB @ 100 MHz, maximum input voltage is 14 kV RMS @ 50/60 Hz, maximum DC In-accuracy is 2%, and the probe connected to a channel has an input impedance of 100 MΩ. Probe cable length is 3 m (9.8 ft).	1-G906-2
Active, DIFF probe, 200:1, 25 MHz, 4 MΩ		Active, differential voltage probe. Supported by every input channel due to the active output. Divide factors of 20:1 and 200:1 can be manually selected. Supported bandwidth -3 dB @ 25 MHz. Maximum input voltage and common mode voltage both are 1000 V RMS. Maximum DC In-accuracy is 2%, and the probe has an input impedance of 4 MΩ on each input. Probe coax cable length is 0.95 m (3.12 ft).	1-G909-2

Current Probes (Options, to be ordered separately)			
Article		**Description**	**Order No.**
AC/DC current clamp i30s		AC/DC Hall effect current probe; 30 mA to 30 A DC; 30 mA to 20 A AC RMS; DC-100 kHz; BNC output cable 2 m (6.5 ft), incl. adapter for 4 mm safety banana, requires 9 V battery.	1-G912-2
AC current clamp SR661		AC current probe; 100 mA to 1200 A AC RMS; 1 Hz - 100 kHz; safety BNC output cable 2 m (6.5 ft).	1-G913-2
AC current clamp M1V20-2		Highly accurate AC current probe; 50 mA to 20 A; 30 Hz - 40 kHz; metal BNC output cable 2 m (6.5 ft).	1-G914-2

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Hottinger Baldwin Messtechnik GmbH
Im Tiefen See 45 · 64293 Darmstadt · Germany
Tel. +49 6151 803-0 · Fax: +49 6151 803-9100
E-mail: info@hbm.com · www.hbm.com

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