Data sheet

GEN series
GN441

Universal ISO 1 MS/s Input Card

Special features

- **IEPE support**
- **1 A current shunt**
- **Isolated balanced differential inputs**
- **± 20 mV to ± 100 V input range**
- **50 V DC Isolation**
- **Analog/digital anti-alias filters**
- **4 analog channels**
- **1 MS/s sample rate**
- **16 bit resolution**

Universal ISO 200 kS/s Input Card

The Universal ISO 200 kS/s Input Card supports true differential voltage inputs as well as a 1 A current shunt to directly measure currents. In IEPE mode the card supports all IEPE based sensors with selectable supply currents.

The card provides four channels of isolated balanced differential inputs from ± 20 mV to ± 100 V Full Scale with auto-zero capability.

Optimum anti-alias protection is achieved by the 7-pole analog anti-alias filter combined with a fixed 1 MS/s over sampling Analog-to-Digital converter. For all sample rates the digital anti-alias filter allows for a large range of high order filter characteristics with precise phase match and noise-free digital output.

Each channel 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.

Capabilities Overview

Model	GN441
Maximum sample rate per channel	1 MS/s
Memory per card	512 MB
Analog channels	4
Anti-Alias filters	Fixed bandwidth analog AA-filter combined with sample rate tracking digital AA-filter
ADC resolution	16 bit
Isolation	Channel to channel and channel to chassis
Input type	Analog, isolated balanced differential
Passive voltage/current probes	Passive, single-ended isolated voltage probes and Passive, differential matched isolated voltage probes
Sensors	IEPE and current output sensors up to 1 A
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

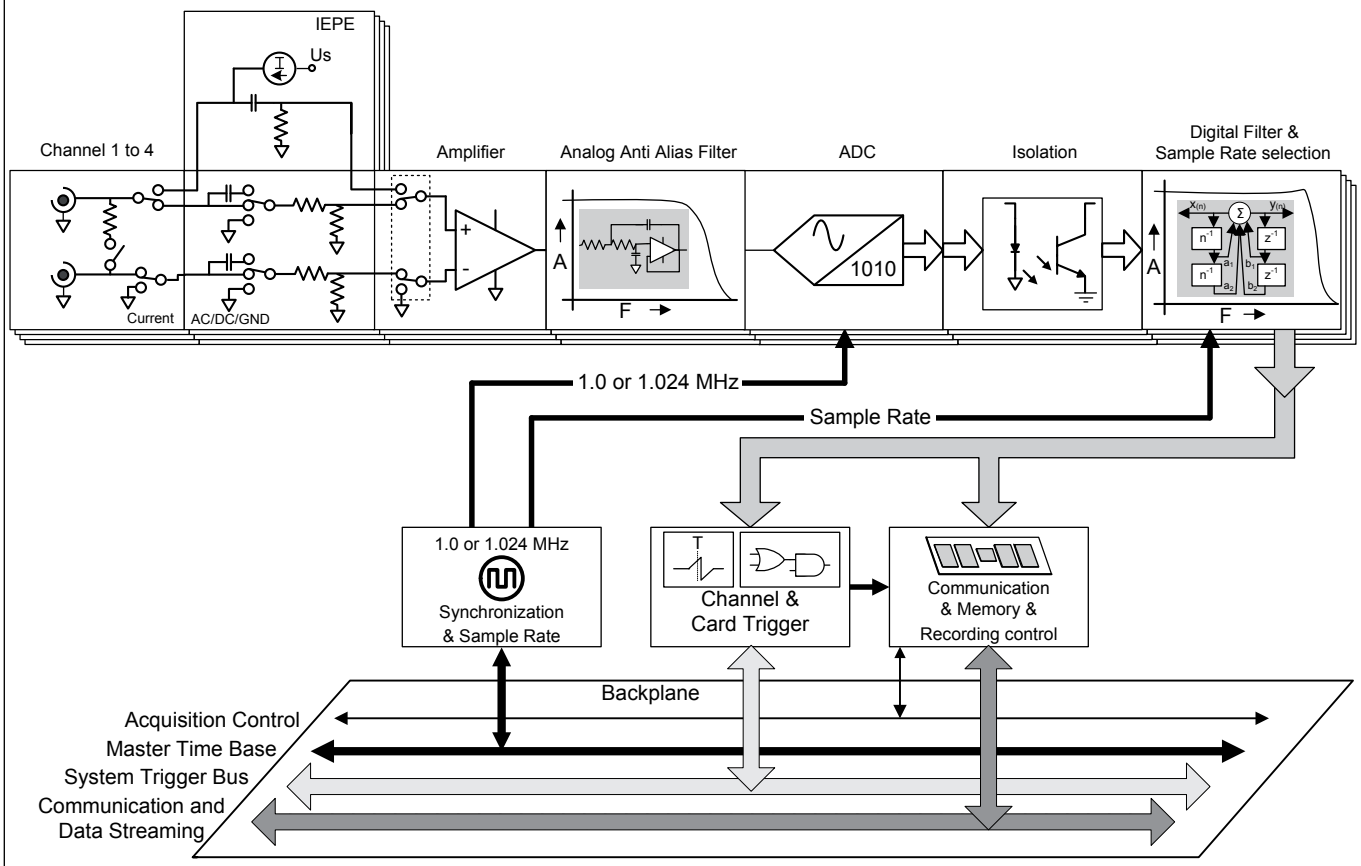


Figure 1.1: Block Diagram

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 Section		
Channels	4	
Connectors	2 isolated (plastic) BNCs per channel	
Input type	Analog, isolated balanced differential	
Input impedance	2 * 1 MΩ ± 1% // 100 pF ± 10%	
Input coupling		
Coupling modes	Current, AC, DC, GND	
AC coupling frequency	0.16 Hz, ± 10%; -3 dB	

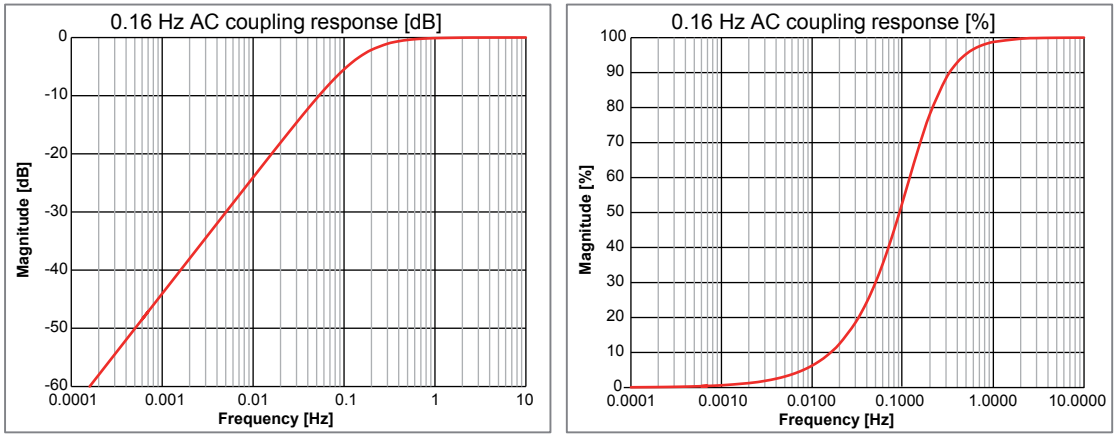


Figure 1.2: Representative AC coupling response

Ranges	± 10 mV, ± 20 mV, ± 50 mV, ± 0.1 V,± 0.2 V, ± 0.5 V, ± 1.0 V,± 2.0 V, ± 5.0 V, ± 10.0 V, ± 20.0 V, ± 50.0 V, ± 100.0 V Each range supports a variable gain in 1000 steps (0.1%). This creates 1000 extra ranges between 2 specified ranges	
Offset	± 50% in 1000 steps (0.1%) ± 100 V range has fixed 50% offset	
DC Offset error	**Voltage**	**Current**
Wideband	0.1% of Full Scale ± 600 µV	0.175% of Full Scale ± 825 µV
Bessel IIR and FIR	0.1% of Full Scale ± 100 µV	0.200% of Full Scale ± 300 µV
Offset error drift	± 120 ppm/°C (± 216 ppm/°F)	± 120 ppm/°C (± 216 ppm/°F)
DC Gain error	**Voltage**	**Current**
Wideband	0.1% of Full Scale ± 100 µV	0.2% of Full Scale ± 300 µV
Bessel IIR and FIR	0.1% of Full Scale ± 100 µV	0.2% of Full Scale ± 300 µV
Gain error drift	± 70 ppm/°C (± 126 ppm/°F)	± 70 ppm/°C (± 126 ppm/°F)
Maximum static error (MSE)	**Voltage**	**Current**
Wideband	0.1% of Full Scale ± 600 µV	0.165% of Full Scale ± 1035 µV
Bessel IIR and FIR	0.1% of Full Scale ± 100 µV	0.200% of Full Scale ± 300 µV
RMS Noise		
Wideband	0.02% of Full Scale ± 116 µV	
Bessel IIR and FIR	0.02% of Full Scale ± 116 µV	

Analog Input Section

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)	> 72 dB	> 72 dB	> 72 dB
Maximum common mode voltage	4 V DC	40 V DC	250 V DC
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	± 100 V DC; Ranges ≤ ± 1 V ± 250 V DC; Ranges > ± 1 V		

IEPE Sensor

Input ranges	± 10 mV, ± 20 mV, ± 50 mV, ± 0.1 V, ± 0.2 V, ± 0.5 V, ± 1 V, ± 2 V, ± 5 V, ± 10 V, ± 20 V
Over voltage protection	- 1 V of Full Scale
IEPE gain error	0.5% of Full Scale
IEPE gain error drift	± 25 ppm/°C (± 14 ppm/°F)
IEPE compliance voltage	≥ 23 V
Excitation current	2, 4, 6, 8 mA, software selectable
Excitation current accuracy	± 5%
Coupling time constant	1.5 s
Lower bandwidth	-3 dB @ 0.11 Hz
Maximum cable length	100 m (RG-58)

Isolation

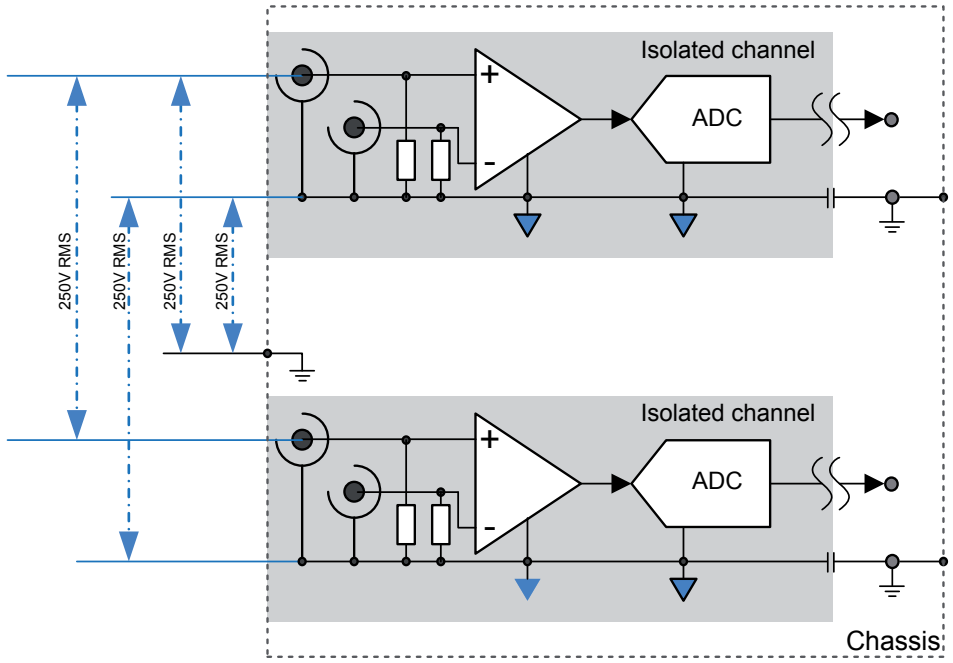


Figure 1.3: Isolation schematic

Channel to chassis (earth)	250 V RMS
Channel to channel (Isolated GND to isolated GND)	250 V RMS
Input signal to input signal	250 V RMS

Analog to Digital Conversion	
Sample rate per channel	0.1 S/s to 1 MS/s
ADC resolution; one ADC per channel	16 bit
ADC Type	Successive Approximation Register (SAR); TI ADS8401IB
Time base accuracy	Defined by mainframe: ± 3.5 ppm (1); aging after 10 years ± 10 ppm
Binary sample rate	Supported; when calculating FFTs results in rounded/integer BIN sizes
Maximum binary sample rate	1.024 MS/s
External time base sample rate	0 S/s to 500 kS/s
External time base level	TTL
External time base minimum pulse width	200 ns

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

Anti-Alias Filters

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

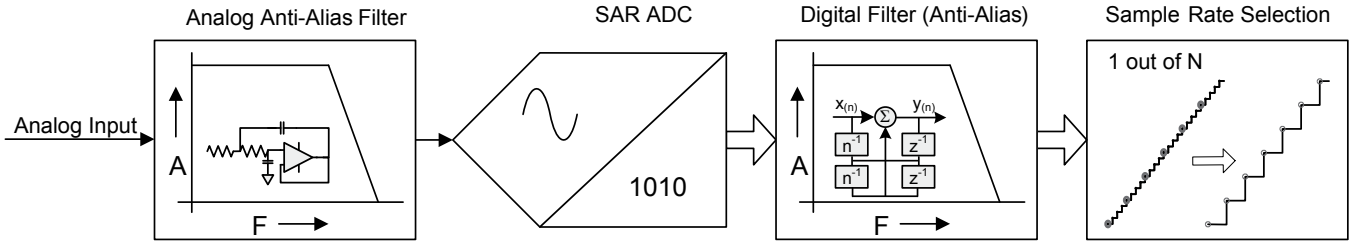


Figure 1.4: Combined analog and digital anti-alias filter block diagram

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 is programmed to a fraction of the user sample rate and automatically tracks any user sample rate selection. 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. Should not be used if working in a frequency domain with recorded data.
Digital 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. Bessel filters are typically used when looking at signals in the time domain. Best used for measuring transient signals or sharp edge signals like square waves or step responses.
Digital FIR (Fc @ -0.1 dB)	Standard FIR filter with corner frequency (Fc) defined at -0.1 dB. When FIR filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital FIR filter to prevent aliasing at lower sample rates. This filter is best used when working in the frequency domain. When working in the time domain, this filter is best used for signals that are (close to) sine waves.
Digital FIR (Fc @ -3 dB) Supported by Perception V6.40 and higher	Adapted FIR filter with corner frequency (Fc) calculated as close as possible to -3 dB. When FIR filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital FIR filter to prevent aliasing at lower sample rates. This filter is best used when working in the frequency domain. When working in the time domain, this filter is best used for signals that are (close to) sine waves.

Wideband Filter (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.

Bandwidth	Between 290 kHz and 330 kHz (-3 dB) all ranges < 200 mV Between 490 kHz and 550 kHz (-3 dB) all ranges ≥ 200 mV
0.1 dB passband flatness (1)	DC to 10 kHz all ranges < 200 mV DC to 80 kHz all ranges ≥ 200 mV

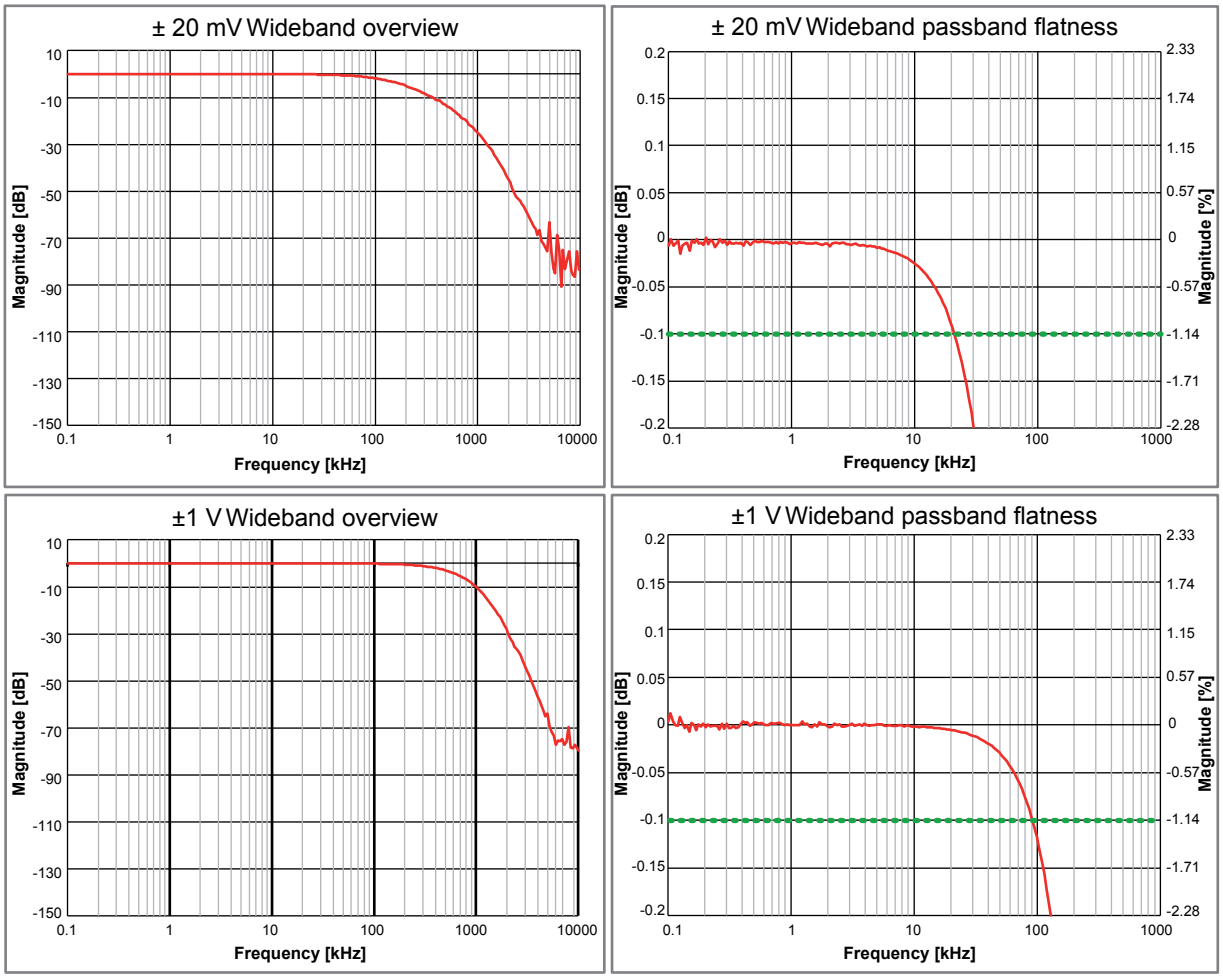
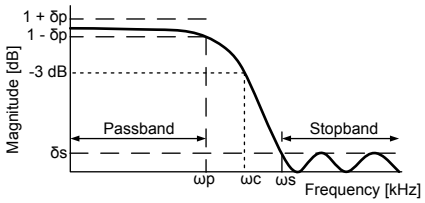


Figure 1.5: Representative Wideband examples

(1) Measured using a Fluke 5700 calibrator, DC normalized

Bessel IIR Filter (Digital Anti-Alias)



δp: Passband ripple
δs: Stopband attenuation

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

Figure 1.6: Digital Bessel IIR filter

When Bessel IIR filter is selected, this is always a combination of an analog Bessel anti-alias filter and a digital Bessel IIR filter	
Analog anti-alias filter	
Characteristic	7-pole Bessel, optimal step response
Bandwidth	185 kHz ± 20 kHz (-3dB) All Ranges < 200 mV 220 kHz ± 20 kHz (-3 dB) All Ranges ≥ 200 mV
Digital Bessel IIR filter	
Characteristic	6-pole Bessel style IIR
User selection	Auto tracking for sample rate divided by: 10, 20, 40, 100 User selects divide factor, software then adjusts filter when sample rate is changed
Bandwidth (ωc)	User selectable from 0.0125 Hz to 100 kHz
0.1 dB passband flatness (ωp)(1)	DC to 10 kHz
Stopband attenuation (δs)	60 dB
Roll-off	36 db/Octave

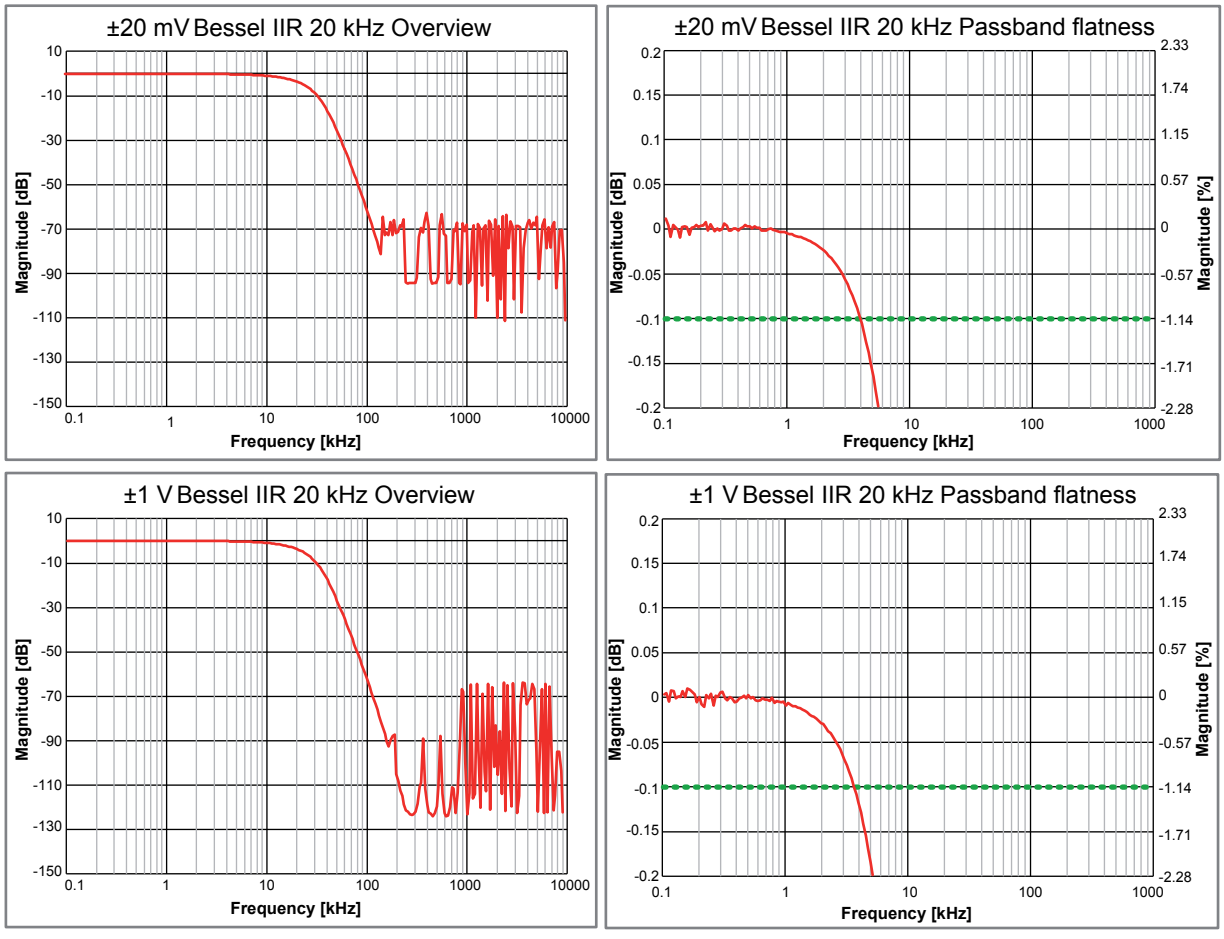
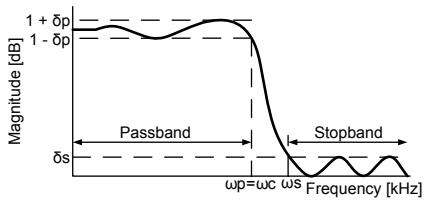


Figure 1.7: Representative Bessel IIR examples

(1) Measured using a Fluke 5700 calibrator, DC normalized

FIR (Fc @ -0.1 dB) Filter (Digital Anti-Alias)



δp: Passband ripple
δs: Stopband attenuation

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

Figure 1.8: Digital FIR (Fc @ -0.1 dB) filter

When FIR (Fc @ -0.1 dB) filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital FIR filter	
Analog anti-alias filter	
Characteristic	7-pole Butterworth, extended passband response
Bandwidth	300 kHz ± 20 kHz (-3 dB) All Ranges < 200 mV 350 kHz ± 20 kHz (-3 dB) All Ranges ≥ 200 mV
Digital FIR (Fc @ -0.1 dB) filter	
Characteristic	12-pole FIR; FIR is a purely digital characteristic. Its closest analog resemblance is to an Elliptic filter. However, FIR has both ringing on the signal before the step input is started and ringing after the step input is complete.
User selection	Auto tracking for sample rate divided by: 4, 10, 20, 40 User selects divide factor, software then adjusts filter when sample rate is changed
Bandwidth (ωc)	User selectable from 0.031 Hz to 250 kHz
0.1 dB passband flatness (ωp) (1)	DC to ≈ωc DC to 60 kHz; bandwidth selection ωc = > 50 kHz, limited by the analog anti-alias filter amplitude response. For all Ranges < 200 mV, ωp is limited to 10 kHz due to the anti-alias filter
Stopband attenuation (δs)	60 dB; with the bandwidth selection of ωc = 250 kHz, a peak of -45 dB occurs between 500 kHz and 1 MHz due to limited analog anti-alias filter amplitude reduction. At lower bandwidth selections, the digital filter reduces this peak to -60 dB.
Roll-off	72 dB/Octave

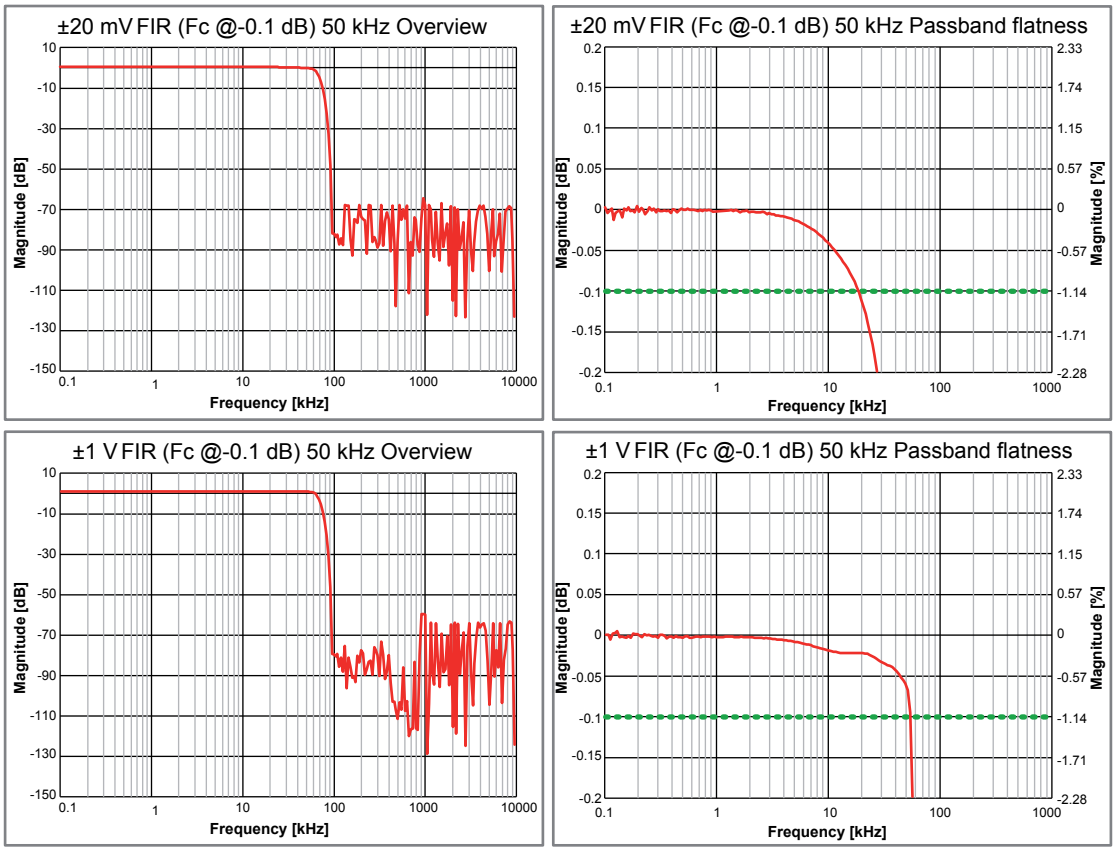
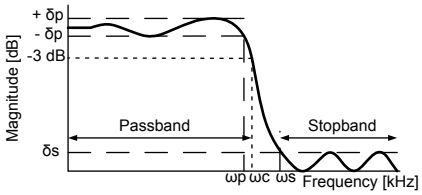


Figure 1.9: Representative FIR examples

(1) Measured using a Fluke 5700 calibrator, DC normalized

FIR (Fc @ -3 dB) Filter (Digital Anti-Alias)



δp: Passband ripple
δs: Stopband attenuation

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

Figure 1.10: Digital FIR (Fc @ -3 dB) filter

When FIR (Fc @ -3 dB) filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital FIR filter	
Analog anti-alias filter	
Characteristic	7-pole Butterworth, extended pass band response
Bandwidth	300 kHz ± 20 kHz (-3 dB) All Ranges < 200 mV 350 kHz ± 20 kHz (-3 dB) All Ranges ≥ 200 mV
Digital FIR (Fc @ -3 dB) filter	
Characteristic	12-pole FIR; FIR is a purely digital characteristic. Its closest analog resemblance is to an Elliptic filter. However, FIR has both ringing on the signal before the step input is started and ringing after the step input is complete.
User selection	Auto tracking for sample rate divided by: 4, 10, 20, 40
Bandwidth (ωc)	User selectable from 0.031 Hz to 250 kHz
0.1 dB passband flatness (ωp)(1)	DC to ≈ωc/1.4 (adapter FIR filter behavior) DC to 50 kHz; bandwidth selection ωc = > 50 kHz, limited by the analog anti-alias filter amplitude response. For all Ranges < 200 mV, ωp is limited to 10 kHz due to anti-alias filter
Stopband attenuation (δs)	60 dB; with the bandwidth selection of ωc = 250 kHz, a peak of -45 dB occurs between 500 kHz and 1 MHz due to limited analog anti-alias filter amplitude reduction. At lower bandwidth selections, the digital filter reduces this peak to -60 dB.
Roll-off	72 dB/Octave

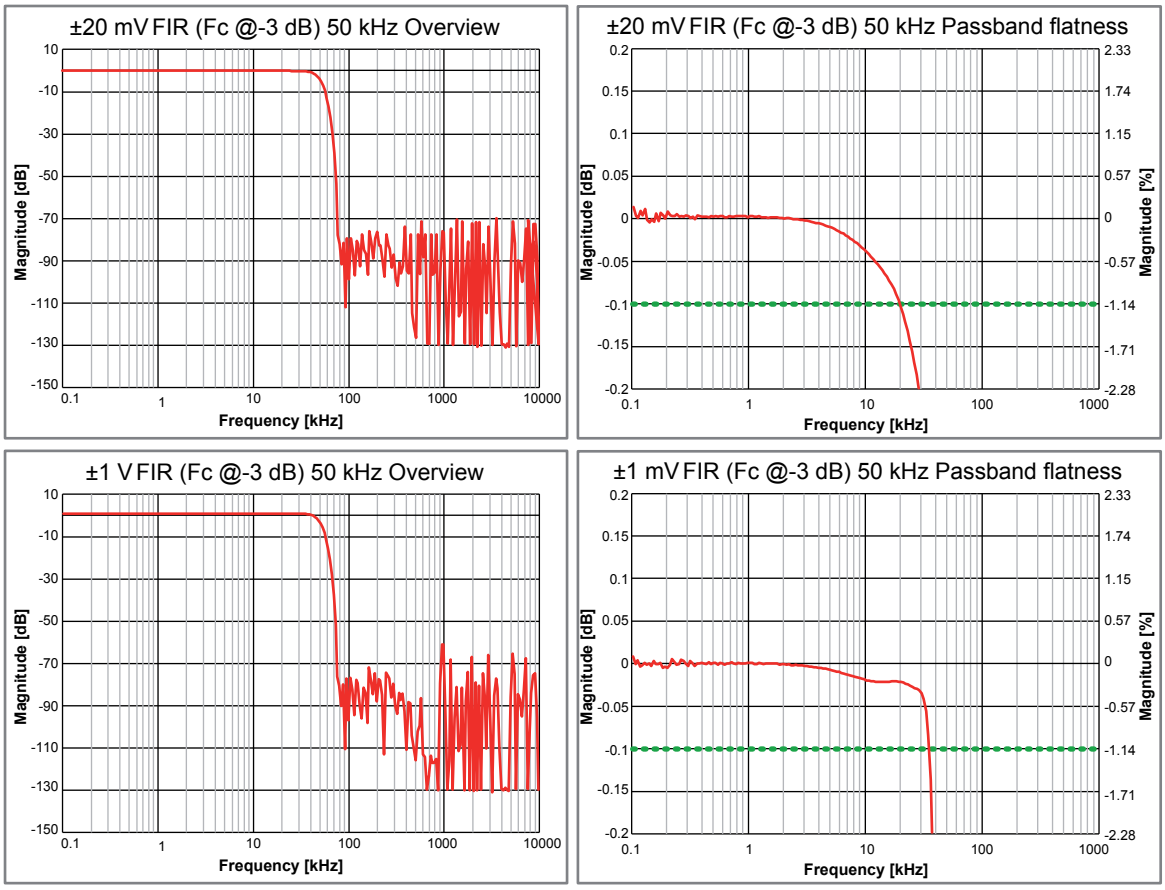


Figure 1.11: Representative FIR examples

(1) Measured using a Fluke 5700 calibrator, DC normalized

On-board Memory	
Per card	512 MB (256 MS)
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

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	± 1 µs + maximum 1 sample period (for decimal and binary time base)
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	516 µs ± 1 µs + maximum 1 sample period using decimal time base 504 µs ± 1 µs + maximum 1 sample period using binary time base
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 detect/reject	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

Triggering	
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	Counts 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	252 MS	126 MS	63 MS	not used			200 MS	100 MS	50 MS
Max. sweep sample rate	1 MS/s			not used			1 MS/s		
Max. continuous FIFO	not used			252 MS	126 MS	63 MS	50 MS	25 MS	12 MS
Max. continuous sample rate	not used			1 MS/s			Sweep sample rate / 2 Maximum 50 kS/s		
Max. aggregate continuous streaming rate	not used			1 MS/s 2 MB/s	2 MS/s 4 MB/s	4 MS/s 8 MB/s	0.05 MS/s 0.1 MB/s	0.1 MS/s 0.2 MB/s	0.4 MS/s 0.8 MB/s

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 50 kS/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.

G025: Passive, Differential Matched Isolated Voltage Probe (Option, to be ordered separately)

To be used with differential isolated or non-isolated amplifiers

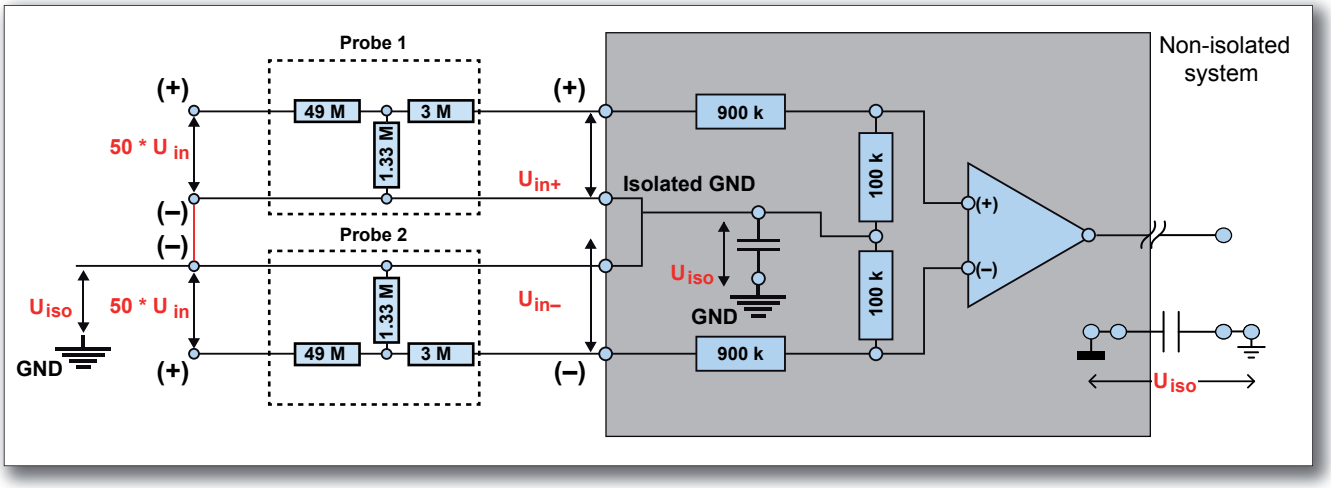


Figure 1.12: Block diagram passive, differential matched isolated voltage probe

Isolation	Supported if the acquisition card uses isolated amplifiers. Keep ground of probe below isolation level of input channel.
Capacitive compensation range	100 to 140 pF
DC In-accuracy	2%
Divide factors	200:1
Probe impedance (connected to channel)	50 MΩ for each probe
-3 dB Bandwidth	20 MHz
Maximum input voltage	2.8 kV RMS CAT II
Probe cable length	3 m (9.8 ft)
Probe weight	Typically 90 g (3.2 oz) for each probe
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Original manufacturers part number	PMK PFDF 4263-L-140 (LDS: 869-929500)

Figure 1.13: Probe and probe accessories

G026: Passive, Differential Matched Isolated Voltage Probe (Option, to be ordered separately)

To be used with differential isolated or non-isolated amplifiers

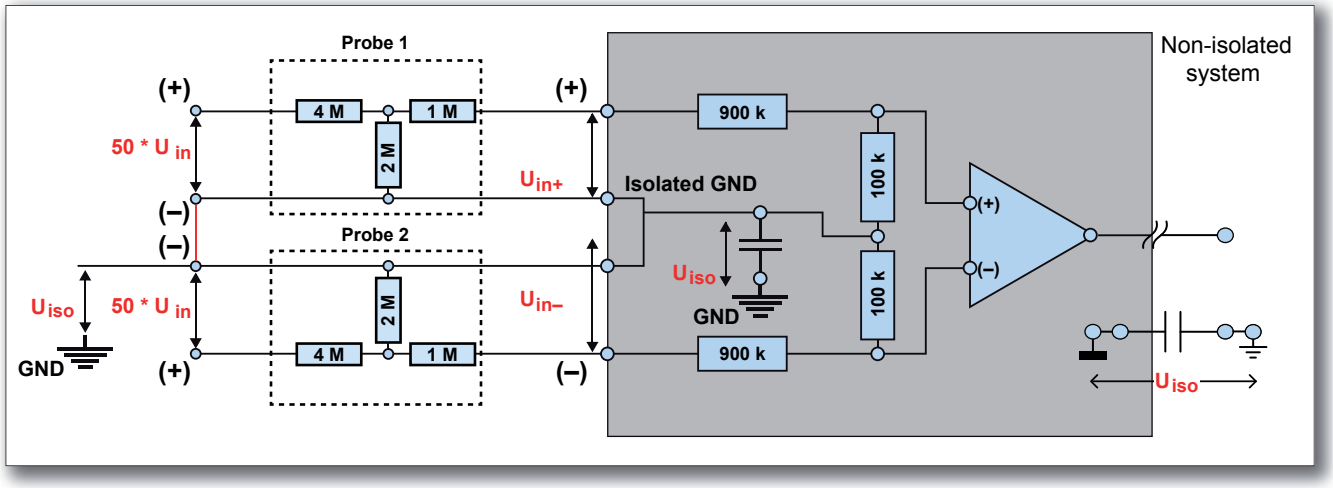


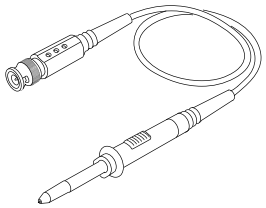
Figure 1.14: Block diagram passive, differential matched isolated voltage probe

Isolation	Supported if the acquisition card uses isolated amplifiers. Keep ground of probe below isolation level of input channel.
Capacitive compensation range	105 to 140 pF
DC In-accuracy	2%
Divide factors	10:1
Probe impedance (connected to channel)	5 MΩ for each probe
-3 dB Bandwidth	100 MHz
Maximum input voltage	300 V RMS CAT II
Probe cable length	3 m (9.8 ft)
Probe weight	Typically 90 g (3.2 oz) for each probe
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Original manufacturers part number	PMK PDD 4013A-140 (LDS: 869-929600)

Figure 1.15: Probe and probe accessories

G027: 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



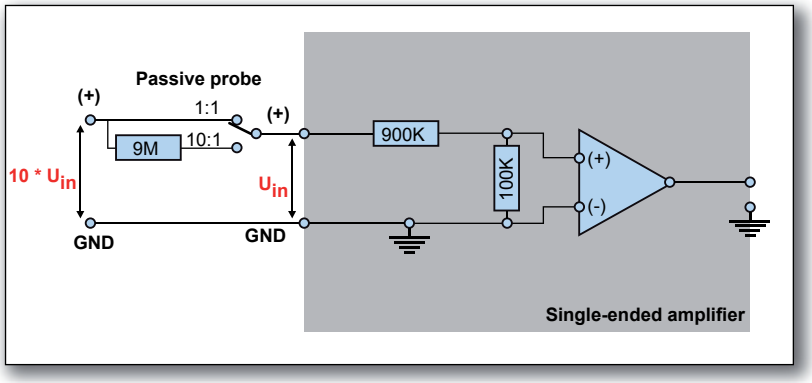


Figure 1.16: Block diagram passive, single-ended voltage probe

Isolation	Not supported, always ground the negative input of the probe.	
Capacitive compensation range	100 to 140 pF	
DC In-accuracy	2%	
Divide factors	1:1	10:1
Probe impedance (connected to channel)	1 MΩ	10 MΩ
-3 dB Bandwidth	2 MHz	50 MHz
Maximum input voltage	55 V RMS CAT II	300 V RMS CAT II
Probe cable length	3 m (9.8 ft)	
Probe weight	Typically 88 g (3.1 oz)	
Original manufacturer's part number	PMK PMTG 323A-140 (LDS: 869-929700)	
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)	

Figure 1.17: Probe and probe accessories

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

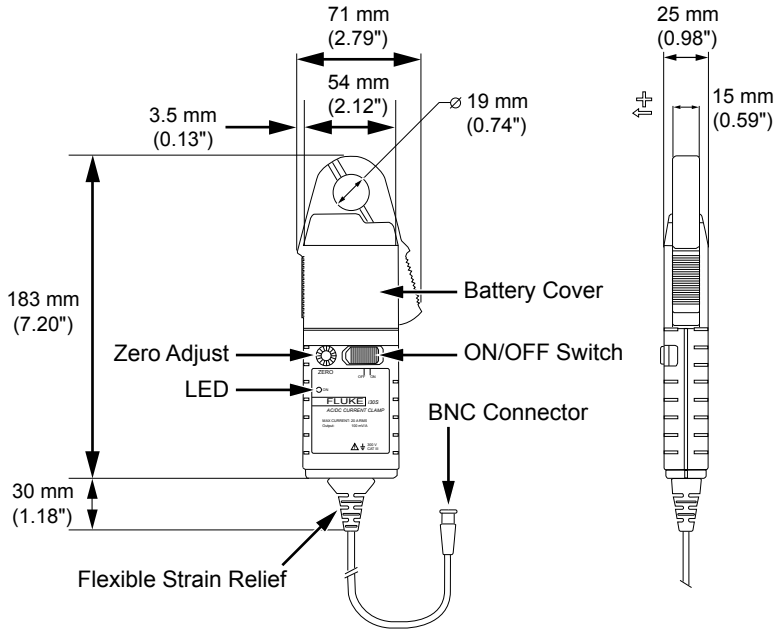


Figure 1.18: Dimensions

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 1.19: 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

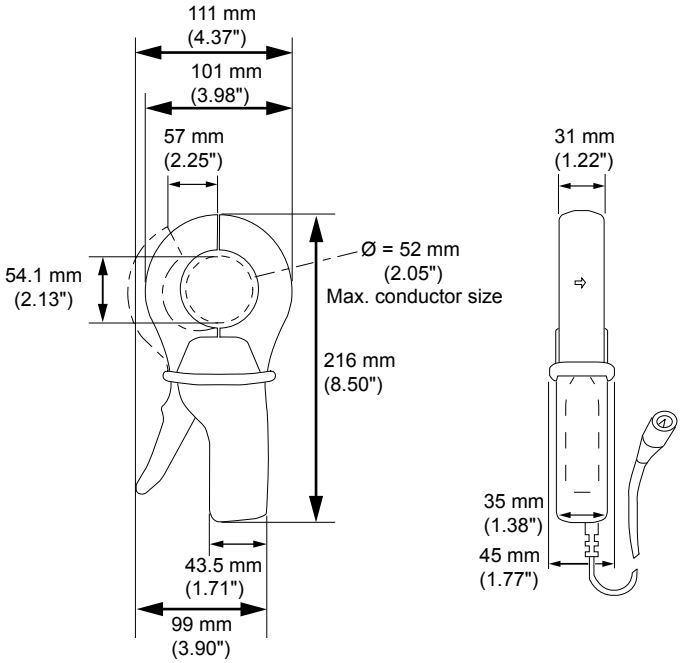


Figure 1.20: Dimensions

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 1.21: 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

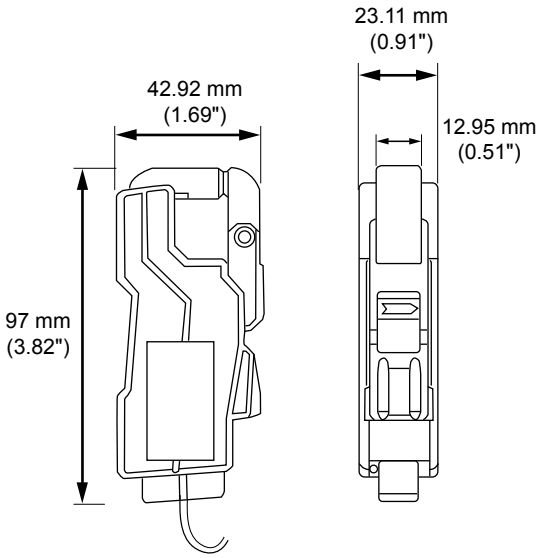


Figure 1.22: Dimensions

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 1.23: 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
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, 10 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.**
Uni1M ISO		4 channels, 16 bits, 1 MS/s, ± 10 mV to ± 100 V input range, 512 MB RAM (256 MS), isolated, balanced differential input, with 2 plastic BNCs per channel. Support IEPE sensors with programmable excitation current from 2 mA up to 8 mA. Built-in shunt resistor enables direct current measurements up to 1 A.	1-GN441-2

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

Voltage Probes (Options, to be ordered separately)			
Article		**Description**	**Order No.**
Passive, DIFF matched isolated probe, 200:1, 20 MHz, 50 MΩ		Passive, differential matched isolated voltage probe pair. Each probe has a capacitive compensation range from 100 to 140 pF. A fixed divide factor of 200:1, bandwidth is -3 dB @ 20 MHz, maximum input voltage is 2.8 kV RMS CAT II and maximum DC In-accuracy is 2%. Each probe connected to a channel has an input impedance of 50 MΩ. Probe cable length is 3 m (9.8 ft).	1-G025-2
Passive, DIFF matched isolated probe, 10:1, 100 MHz, 5 MΩ		Passive, differential matched isolated voltage probe pair. Each probe has a capacitive compensation range from 105 to 140 pF. A fixed divide factor of 10:1, bandwidth is -3 dB @ 100 MHz, maximum input voltage is 300 V RMS CAT II and maximum DC In-accuracy is 2%. Each probe connected to a channel has an input impedance of 5 MΩ. Probe cable length is 3 m (9.8 ft).	1-G026-2
Passive, SE probe 10:1, 20 MHz, 10 MΩ, 3 m		Passive, differential matched isolated voltage probe. Has a capacitive compensation range from 100 to 140 pF. Divide factors of 1:1 and 10:1 can be selected. When divide factor 10:1 is selected, the bandwidth is -3 dB @ 50 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-G027-2

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

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

measure and predict with confidence

B2636-2.0 en HBM: public