Data sheet

GEN series
GN816

Basic/IEPE ISO 200 kS/s Input Card

Special features

- **IEPE transducer support**
- **TEDS Class 1 support for IEPE**
- **8 analog channels**
- **Isolated, unbalanced differential inputs**
- **± 10 mV to ± 50 V input range**
- **Analog/digital anti-alias filters**
- **200 kS/s sample rate**
- **18 bit resolution**
- **200 MB memory**
- **Isolated metal BNC per channel**
- **Real-time cyclic calculators**
- **Triggering on real-time results**
- **Digital Event/Timer/Counter support**

Basic/IEPE ISO 200 kS/s Input Card

The GEN DAQ Basic/IEPE ISO 200 kS/s Input Card is a general purpose signal conditioner for use with voltage inputs, externally conditioned signals or probes and current clamps. This card also supports IEPE transducers and TEDS Class 1 for easy setup of the acquisition channels.

The amplifier provides voltage inputs from ± 10 mV to ± 50 V. The model uses an isolated metal BNC for each channel.

Optimum anti-alias protection is achieved by the 7-pole analog anti-alias filter combined with a fixed 2 MS/s 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.

For true real-time analysis, the card offers real-time cycle or timer based calculations. Automatic zero crossing detection allows for asynchronous true RMS, mean and other calculations that can be used to trigger the recording.

If supported by the selected mainframe, the GEN DAQ series input card offers 16 digital input events, two digital output events and two Timer/Counter channels.

Using voltage probes a single-ended 600 V RMS CAT III / 1000 V CAT II or a differential 1000 V RMS CAT III (1000 V RMS common mode) measurement range is created. The use of current clamps allow for direct current measurements.

Capabilities Overview

Model	GN816
Maximum sample rate per channel	200 kS/s
Memory per card	200 MB
Analog channels	8
Anti-Alias filters	Fixed bandwidth analog AA-filter combined with sample rate tracking digital AA-filter
ADC resolution	18 bit
Isolation	Channel to channel and channel to chassis
Input type	Analog, isolated, unbalanced differential
Passive voltage/current probes	Passive, singled-ended voltage probes
Sensors	IEPE
TEDS	Class 1, IEPE sensors
Real-time cycle based calculators	32; Cycle and Timer based calculations with triggering on calculated results
Real-time formula database calculators (option)	Not supported
EtherCat® output	Not supported
Digital Event/Timer/Counter	16 digital events and 2 Timer/Counter channels
Standard data streaming (up to 200 MB/s)	Supported
Fast data streaming (up to 1 GB/s)	Supported
Slot width	1

Block Diagram

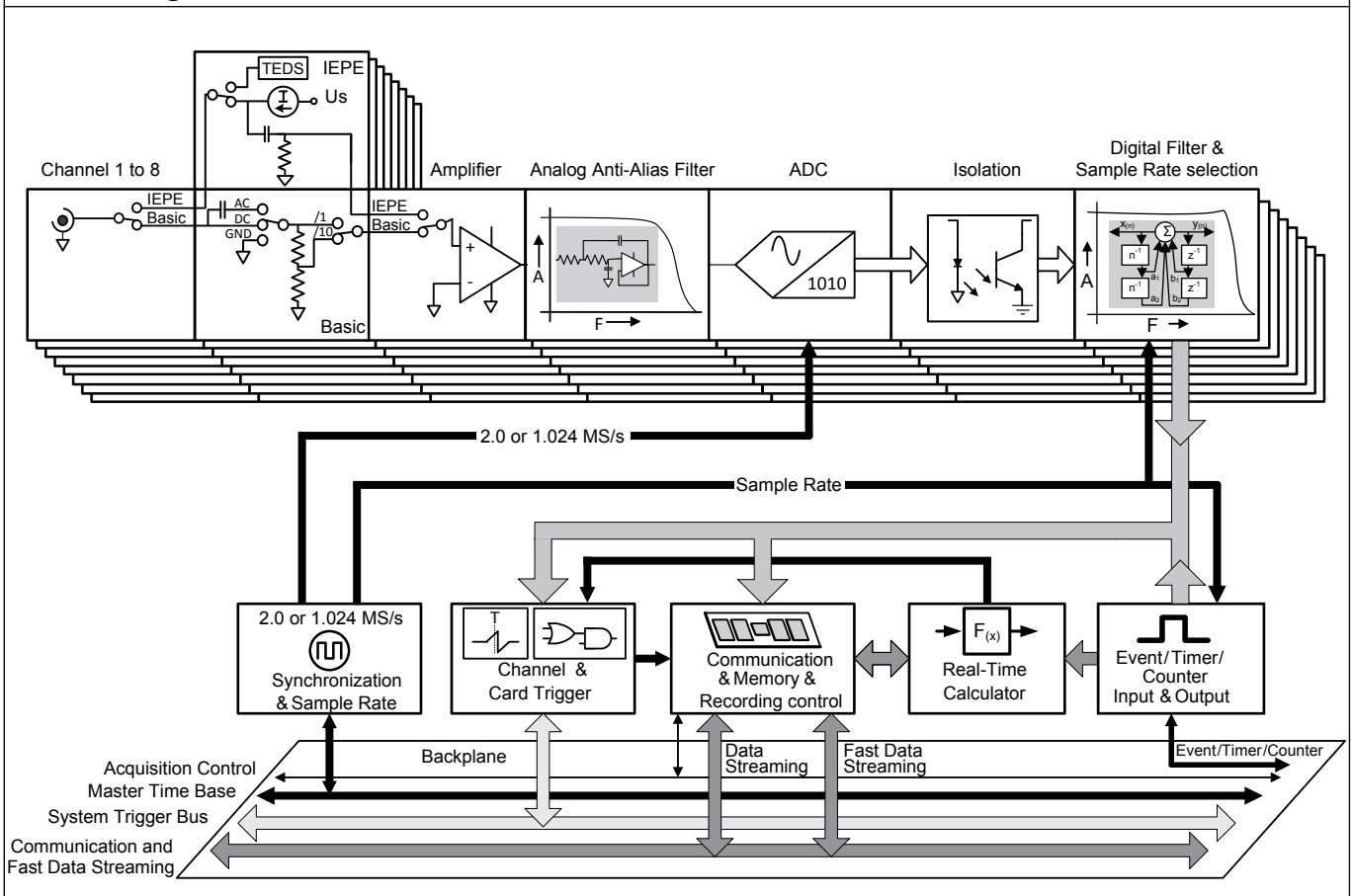


Figure 1.1: Block Diagram

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	8
Connectors	Isolated metal BNC
Input type	Analog, isolated, unbalanced differential
Impedance	1 MΩ ± 1% // 58 pF ± 10% ranges larger than ± 1 V. All other ranges 66 pF ± 10%
Input coupling	
Coupling modes	AC, DC, GND
AC coupling frequency	1.6 Hz ± 10%; - 3 dB

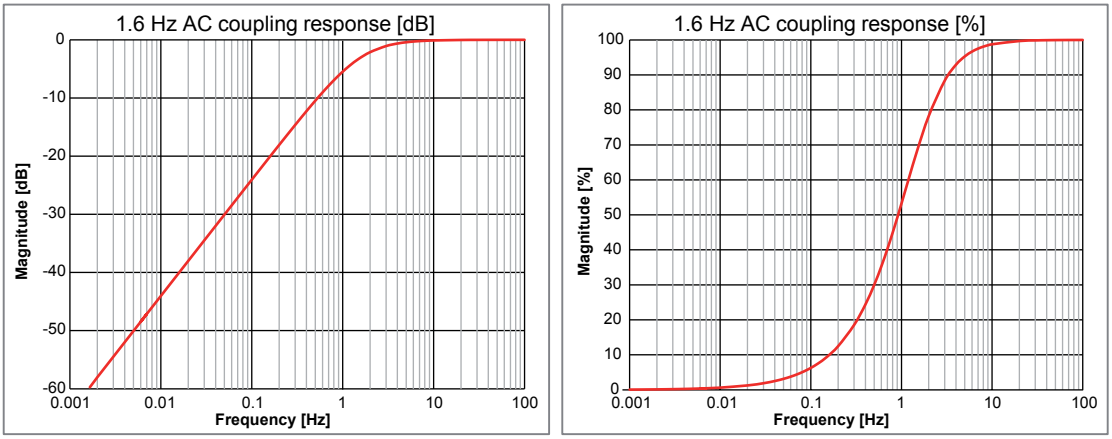


Figure 1.2: Representative AC coupling response

Ranges	± 10 mV, ± 20 mV, ± 50 mV, ± 0.1 V, ± 0.2 V, ± 0.5 V, ± 1 V, ± 2 V, ± 5 V, ± 10 V, ± 20 V, ± 50 V
Offset	± 50% in 1000 steps (0.1%); ± 50 V range has fixed 0% offset
DC Offset error	
All IIR filters	0.01% of Full Scale ± 35 µV
Offset error drift	±(45 ppm + 5 µV)/°C (±(25 ppm + 3 µV)/°F)
DC Gain error	
All IIR filters	0.035% of Full Scale ± 35 µV
Gain error drift	±25 ppm/°C (±14 ppm/°F)
Maximum static error (MSE)	
All IIR filters	0.035% of Full Scale ± 35 µV
RMS Noise (50 Ω terminated)	
All IIR filters	0.015% of Full Scale ± 20 µV

Analog Input Section

Common mode (referred to system ground)		
Ranges	Less than ± 2 V	Larger than or equal to ± 2 V
Rejection (CMR)	> 80 dB @ 80 Hz (100 dB typical)	> 60 dB @ 80 Hz (80 dB typical)
Maximum common mode voltage	33 V RMS	33 V RMS

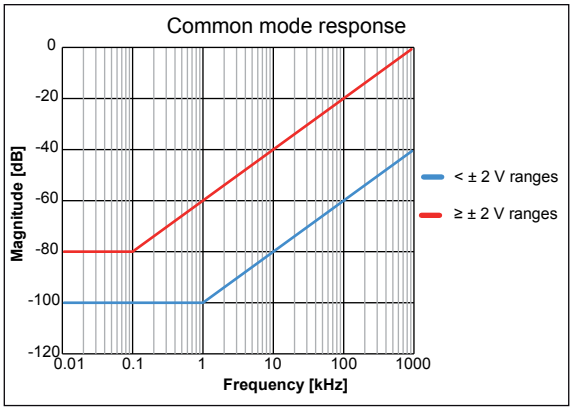


Figure 1.3: Representative common mode response

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 70 V, whichever value is the smallest.
Maximum nondestructive voltage	± 70 V DC
Overload recovery time	Restored to 0.1% accuracy in less than 5 µs after 200% overload

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
Overvoltage protection	- 1 V to 22 V
IEPE gain error	0.1% ± 250 µV
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)
TEDS support	Yes; class 1

Isolation

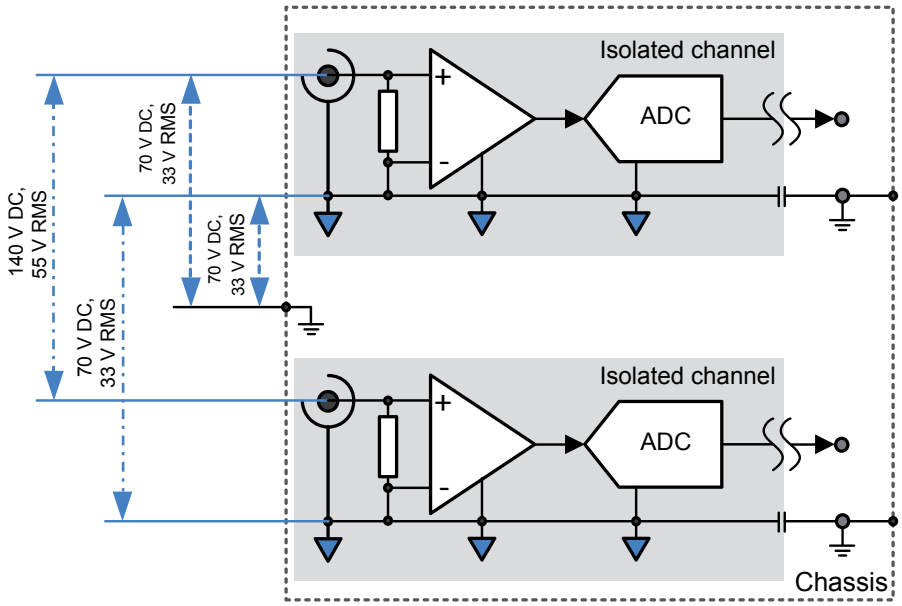


Figure 1.4: Isolation schematic

Channel to chassis (earth)	33 V RMS, ± 70 V DC
Channel to channel (Isolated GND to isolated GND)	33 V RMS, ± 70 V DC
Input signal-to-input signal	55 V RMS, ± 140 V DC

Analog to Digital Conversion

Sample rate; per channel	0.1 S/s to 200 kS/s
ADC resolution; one ADC per channel	18 bit
ADC type	Successive Approximation Register (SAR); Analog Devices AD7986BCPZ
Time base accuracy	Defined by mainframe: ± 3.5 ppm (1); aging after 10 years ± 10 ppm
Binary sample rate	Supported; calculating FFTs results in rounded BIN values
Maximum binary sample rate	204.8 kS/s
External time base frequency	0 S/s to 200 kS/s
External time base frequency divider	Divide external clock by 1 to 2^{20}
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 (Bessel IIR/Butterworth IIR/etc.) or different filter bandwidths can result in phase mismatches between channels.

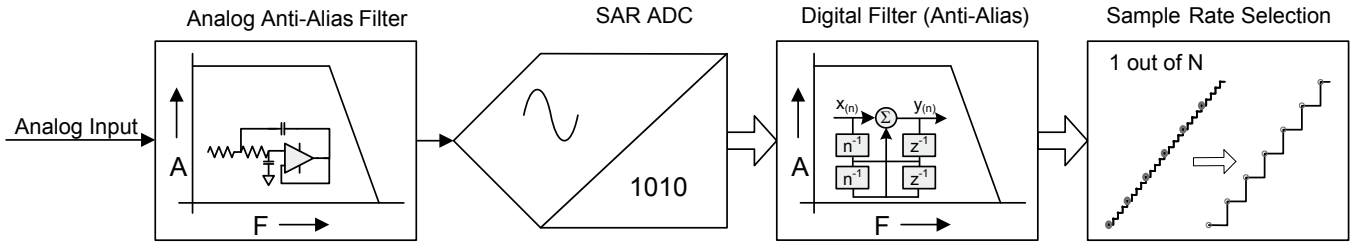
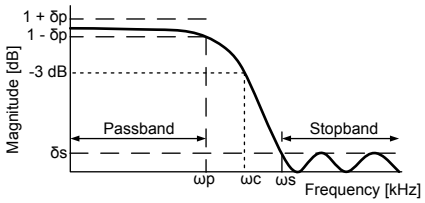


Figure 1.5: Combined analog and digital anti-alias filter block diagram

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.

Bessel IIR	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. They are best used for measuring transient signals or sharp edge signals like square waves or step responses.
Butterworth IIR	When Butterworth IIR filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital Butterworth IIR 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.
Elliptic IIR	When Elliptic IIR filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital Elliptic IIR 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.

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 bandwidth	390 kHz ± 25 kHz (-3 dB)
Analog anti-alias filter characteristic	7-pole Bessel, optimal step response
Bessel IIR filter characteristic	8-pole Bessel style IIR
Bessel IIR filter user selection	Auto tracking for sample rate divided by: 10, 20, 40, 100 The user selects a division factor from the current sample rate; software then adjusts the filter when the sample rate is changed.
Bessel IIR filter bandwidth (ωc)	User selectable from 0.4 Hz to 20 kHz
Bessel IIR 0.1 dB passband (ωp)(1)	DC to 3.5 kHz @ ωc = 20 kHz
Bessel IIR filter stopband attenuation (δs)	75 dB
Bessel IIR filter roll-off	48 dB/octave

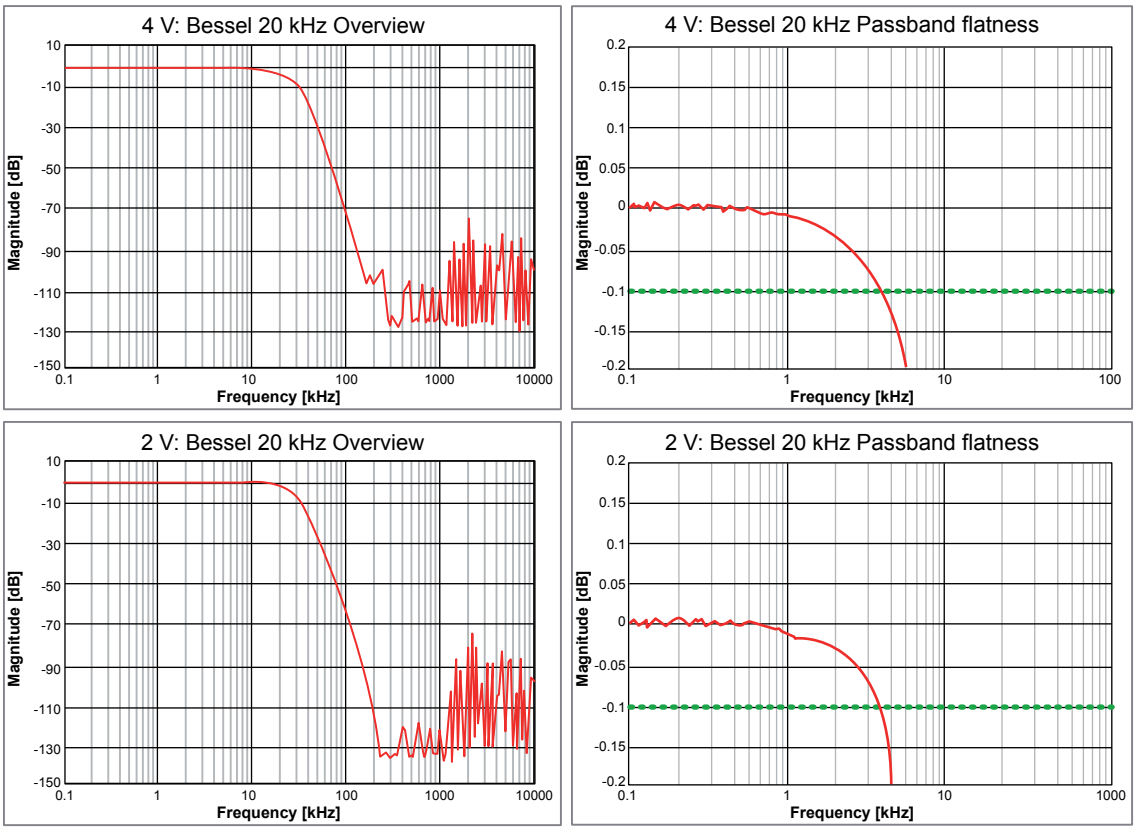
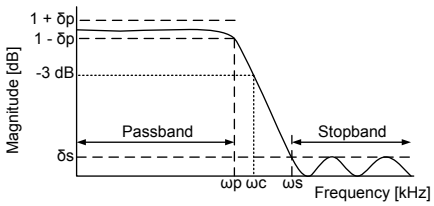


Figure 1.7: Representative Bessel IIR examples

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

Butterworth IIR Filter (Digital Anti-Alias)



δp: Passband ripple
δs: Stopband attenuation

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

Figure 1.8: Digital Butterworth IIR Filter

When Butterworth IIR filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital Butterworth IIR filter.	
Analog anti-alias filter bandwidth	460 kHz ± 25 kHz (-3 dB)
Analog anti-alias filter characteristic	7-pole Butterworth, extended passband response
Butterworth IIR filter characteristic	8-pole Butterworth style IIR
Butterworth IIR filter user selection	Auto tracking for sample rate divided by: 4, 10, 20, 40 The user selects a division factor from the current sample rate; software then adjusts the filter when the sample rate is changed.
Butterworth IIR filter bandwidth (ωc)	User selectable from 1 Hz to 50 kHz
Butterworth IIR 0.1 dB passband (ωp)(1)	DC to 35 kHz @ ωc = 50 kHz(1)
Butterworth IIR filter stopband attenuation (δs)	75 dB
Butterworth IIR filter roll-off	48 dB/octave

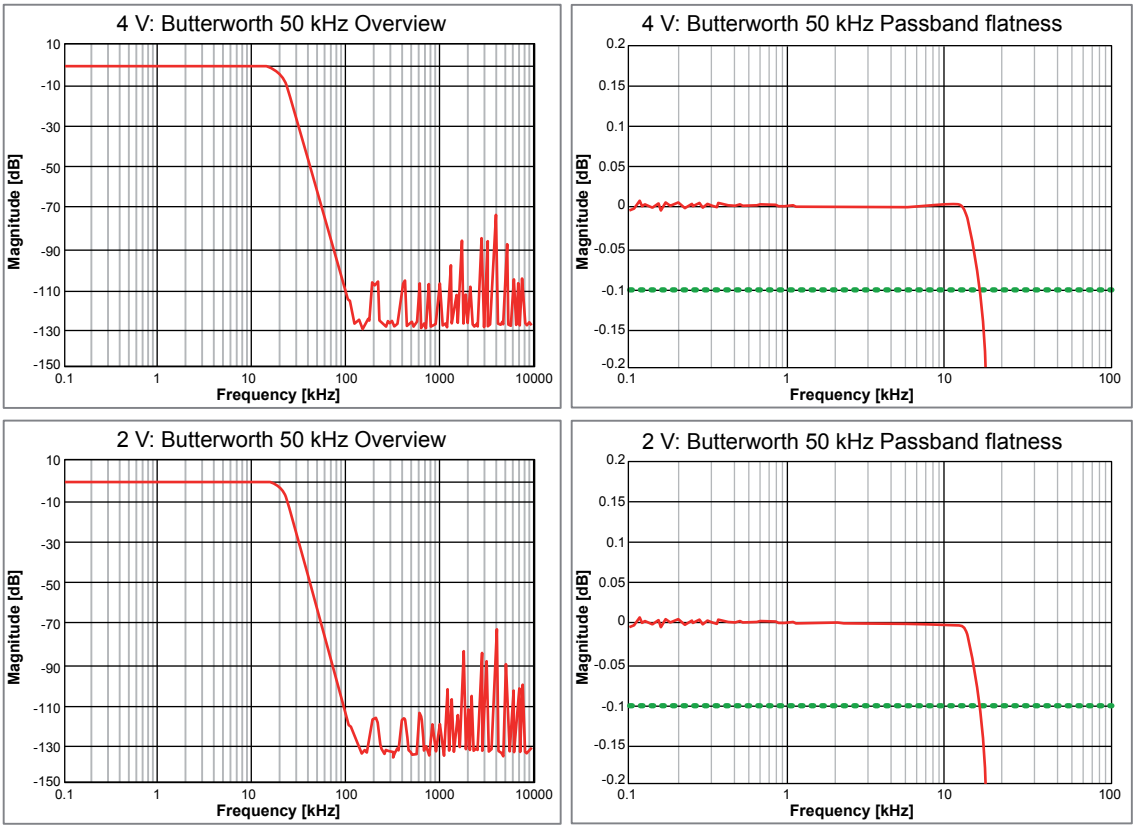
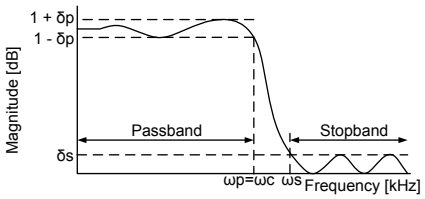


Figure 1.9: Representative Butterworth IIR examples

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

Elliptic IIR Filter (Digital Anti-Alias)



δp: Passband ripple
δs: Stopband attenuation

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

Figure 1.10: Digital Elliptic IIR Filter

When Elliptic IIR filter is selected, this is always a combination of an analog Butterworth anti-alias filter and a digital Elliptic IIR filter.	
Analog anti-alias filter bandwidth	460 kHz ± 25 kHz (-3 dB)
Analog anti-alias filter characteristic	7-pole Butterworth, extended passband response
Elliptic IIR filter characteristic	7-pole Elliptic style IIR
Elliptic IIR filter user selection	Auto tracking for sample rate divided by: 4, 10, 20, 40 The user selects a division factor from the current sample rate; software then adjusts the filter when the sample rate is changed.
Elliptic IIR filter bandwidth (ωc)	User selectable from 1 Hz to 50 kHz
Elliptic IIR 0.1 dB passband (ωp)(1)	DC to ωc
Elliptic IIR filter stopband attenuation (δs)	75 dB
Elliptic IIR filter roll-off	72 dB/octave

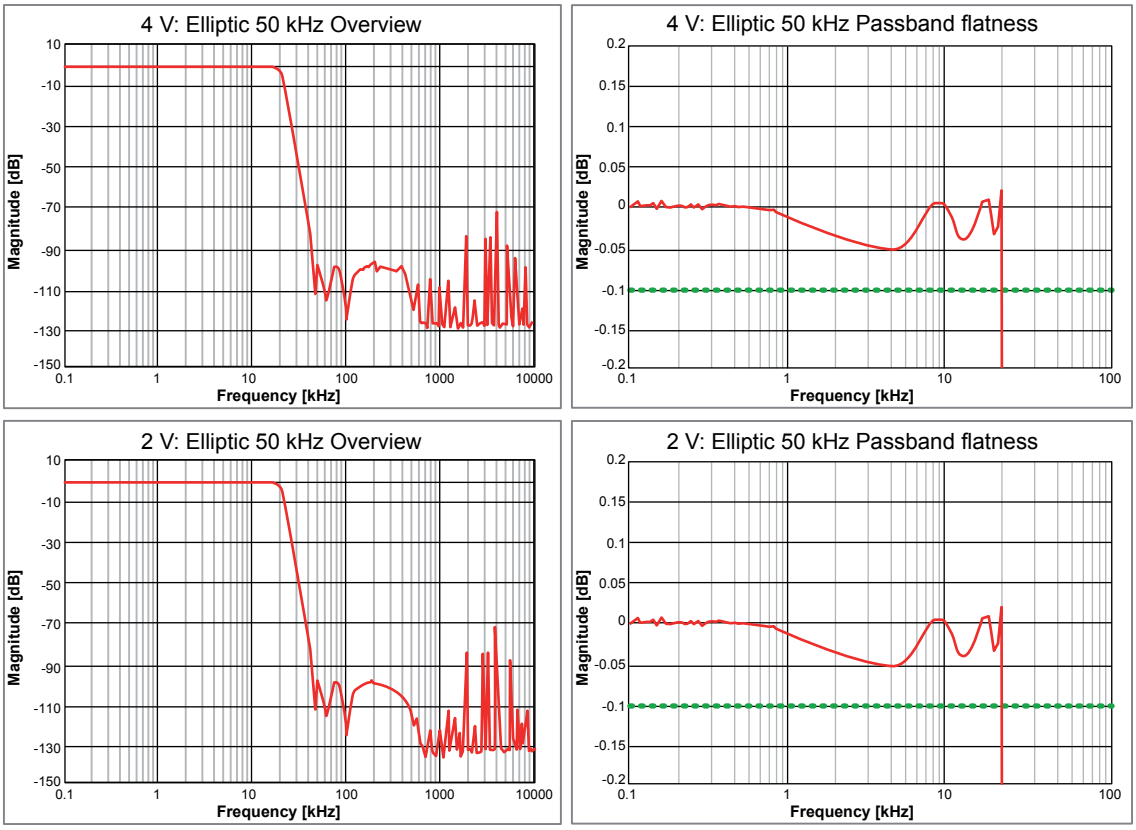


Figure 1.11: Representative Elliptic IIR examples

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

Channel to Channel Phase Match

Using different filter selections (Bessel IIR/Butterworth IIR/etc.) or different filter bandwidths results in phase mismatches between channels.	
Bessel IIR, Filter frequency 20 kHz @ 200 kS/s; 10 kHz Sine wave	
Channels on card	0.5 deg (0.14 µs)
GN816 Channels within mainframe	0.5 deg (0.14 µs)
Butterworth IIR, Filter frequency 20 kHz @ 200 kS/s; 10 kHz Sine wave	
Channels on card	0.5 deg (0.14 µs)
GN816 Channels within mainframe	0.5 deg (0.14 µs)
Elliptic IIR, Filter frequency 20 kHz @ 200 kS/s; 10 kHz Sine wave	
Channels on card	0.5 deg (0.14 µs)
GN816 Channels within mainframe	0.5 deg (0.14 µs)
GN816 channels across mainframes	Defined by synchronization method used (None, IRIG, GPS, Master/Slave, PTP)

Channel to Channel Crosstalk

Channel to channel crosstalk is measured with a 50 Ω termination resistor on the input and uses sine wave signals on the channel above and below the channel being tested. To test Channel 2, Channel 2 is terminated with 50 Ω, while Channels 1 and 3 are connected to the sine wave generator.

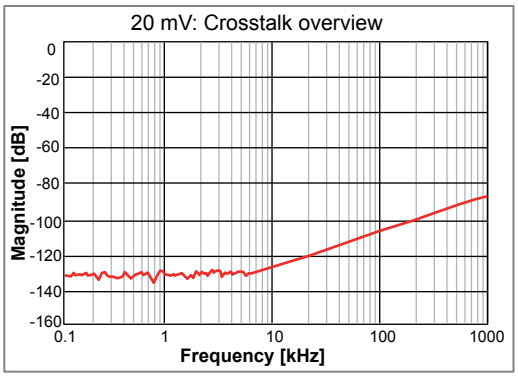


Figure 1.12: Representative crosstalk overview

On-board Memory

Per card	200 MB (100 MS @ 16 bits storage)
Organization	Automatically distributed amongst channels enabled for storage or real-time calculations
Memory diagnostics	Automatic memory test when system is powered on but not recording
Storage sample size	16 bits, 2 bytes/sample 18 bits, 4 bytes/sample (required for Timer/Counter usage)

Digital Event/Timer/Counter[1]	
The Digital Event/Timer/Counter input connector is located on the mainframe. For exact layout and pinning see mainframe data sheet.	
Digital input events	16 per card
Levels	TTL input level, user programmable invert level
Inputs	1 pin per input, some pins are shared with Timer/Counter inputs
Overvoltage protection	± 30 V DC continuously
Minimum pulse width	100 ns
Maximum frequency	5 MHz
Digital output events	2 per card
Levels	TTL output levels, short circuit protected
Output event 1	User selectable: Trigger, Alarm, set High or Low
Output event 2	User selectable: Recording active, set High or Low
Digital output event user selections	
Trigger	1 high pulse per trigger (on every channel trigger of this card only) 12.8 µs minimum pulse width 200 µs ± 1 µs ± 1 sample period pulse delay
Alarm	High when alarm condition is activated, low when not activated (alarm conditions of this card only) 200 µs ± 1 µs ± 1 sample period alarm event delay
Recording active	High when recording, low when in idle or pause mode Recording active output delay of 450 ns
Set High or Low	Output set High or Low; can be controlled by Custom Software Interface (CSI) extensions; delay depends on specific software implementation
Timer/Counter	2 per card; only available in 32 bit storage mode
Levels	TTL input levels
Inputs	All pins are shared with digital event inputs
Timer-Counter modes	Uni- and bi-directional count Bi-directional quadrature count Angle Uni- and bi-directional frequency/RPM measurement
External start	Rising/Falling edge selected by user starts a new recording
External stop	Rising/Falling edge selected by the user stops the recording

(1) Only if supported by mainframe

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
Maximum delayed trigger	1000 seconds after a trigger occurred
Manual trigger (Software)	Supported
External Trigger In	
Selection per card	User selectable On/Off
Trigger In edge	Rising/Falling mainframe selectable, identical for all cards
Minimum pulse width	500 ns
Trigger In delay	± 1 µs + maximum 1 sample period (identical 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
Trigger Out level	High/Low/Hold High; mainframe selectable, identical for all cards
Trigger Out pulse width	High/Low: 12.8 µs Hold High: Active from first mainframe trigger to end of recording Pulse width created by mainframe; For details, please refer to the mainframe datasheet
Trigger Out delay	Selectable (10 µs to 516 µs) ± 1 µs + maximum 1 sample period using decimal time base Selectable (9.76 µs to 504 µs) ± 1 µs + maximum 1 sample period using binary time base Default 516 (504) µs for decimal (binary) time base, 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
Analog channel trigger modes	
Basic	POS or NEG crossing; single level
Dual level	One POS and one NEG crossing; two individual levels, logical OR
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
Event channel trigger	
Event channels	Individual event trigger per event channel
Levels	Trigger on rising edge or trigger on falling edge
Qualifiers	Active High or Active Low for every event channel

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 Statstream®

Patent Number : 7,868,886
Real-time extraction of basic signal parameters.
Supports real-time live scrolling and scoping waveform displays as well as real-time meters while recording.
During recording reviews, it enhances speed for displaying and zooming extremely large recordings and it reduces the calculation time for statistical values on large data sets.

Analog channels	Real-time extraction of Maximum, Minimum, Mean, Peak to Peak, Standard Deviation and RMS values
Event/Timer/Counter channels	Real-time extraction of Maximum, Minimum and Peak to Peak values

Real-Time Cycle Based Calculators (Perception V6.72 and higher)

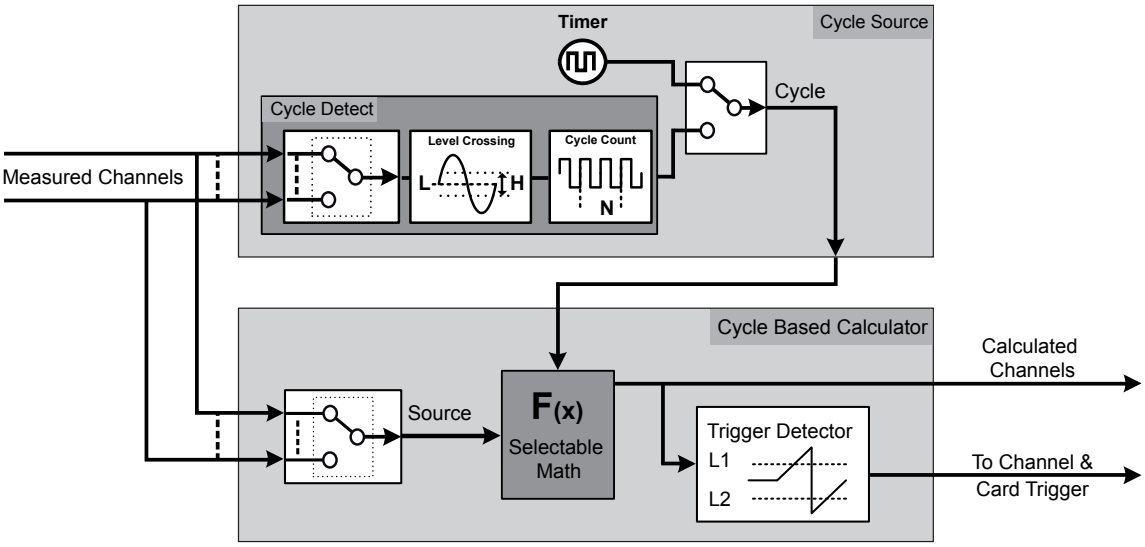


Figure 1.13: Real-time cycle based calculators

Cycle Source	Determines the periodic real-time calculation speed by either setting a timer or using a real-time cycle detect
Cycle Source: Timer	
Timer duration	1.0 ms (1 kHz) to 60 s (0.0167 Hz)
Cycle Source: Cycle detect	
Level crossing	Real-time monitors one input channel using a signal level, hysteresis and direction to determine the cyclic nature of the signal
Cycle count	Sets the counted number of cycles used for periodic calculation output
Cycle period(1)	Maximum Cycle period that can be detected: 0.25 s (4 Hz) Minimum Cycle period that can be detected: 0.91 ms (1.1 kHz) Calculations are stopped when the Cycle period exceeds its maximum Cycle period (0.25 s). Cycle count is temporarily increased when Cycle period becomes shorter than minimum Cycle period (0.91 ms). Time event notifications in the channel data indicate when the Cycle period has been exceeded or when the automatic Cycle count is increased.
Cycle based calculator	
Number of calculators	32
DSP load	Each calculator can perform 1 calculation. Not every calculation uses the same DSP power. Selecting a calculation with the highest computation power could result in a reduction in the total number of calculators. Different combinations require different computation power. The effects of selected combinations is reflected in Perception software.
Cycle Source calculations	Cycle and Frequency
Analog channel calculations	RMS, Minimum, Maximum, Mean, Peak-to-Peak, Area, Energy and MeanOfMultiplication
Timer/Counter channel calculations	Frequency (to enable triggering). RPM of Angle.
Cycle	Square wave signal, 50% duty cycle. Represent Cycle Source; rising edge indicates start of new calculation period.
Frequency	Detected cycle interval is converted to a frequency (1/cycle time of input signal)

Real-Time Cycle Based Calculators (Perception V6.72 and higher)	
Trigger detector	
Number of detectors	32; One per real-time calculator
Trigger level	Defined by the user for each detector. Generates trigger when the calculated signal crosses the level.
Trigger output delay	Triggers are delayed by 100 ms on calculated signals. The trigger time is corrected internally so that the sweep triggering is correct. An additional pre-trigger length of 100 ms is added to enable the trigger time correction. This reduces the maximum sweep length by 100 ms.

(1) Cycle period range depends on signal wave shape and hysteresis setting. Specified for Sine wave with 25% Full Scale hysteresis.

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.

Acquisition Mode Details

16 Bit Resolution

Recording Mode	Single Sweep Multiple Sweeps Slow-Fast Sweep			Continuous			Dual Rate		
	Enabled channels			Enabled channels			Enabled channels		
	1 Ch	8 Ch	8 Ch & events	1 Ch	8 Ch	8 Ch & events	1 Ch	8 Ch	8 Ch & events
Max. sweep memory	100 MS	12 MS	10.5 MS	not used			80 MS	9.5 MS	8 MS
Max. sweep sample rate	200 kS/s			not used			200 kS/s		
Max. continuous FIFO	not used			100 MS	12 MS	10.5 MS	20 MS	2 MS	2 MS
Max. continuous sample rate	not used			200 kS/s			Sweep sample rate / 2		
Max. aggregate continuous streaming rate	not used			0.2 MS/s 0.4 MB/s	1.6 MS/s 3.2 MB/s	1.8 MS/s 3.6 MB/s	0.1 MS/s 0.2 MB/s	0.8 MS/s 1.6 MB/s	0.9 MS/s 1.8 MB/s

18 Bit Resolution

Recording Mode	Single Sweep Multiple Sweeps Slow-Fast Sweep			Continuous			Dual Rate		
	Enabled channels			Enabled channels			Enabled channels		
	1 Ch	8 Ch	8 Ch & events & Timer/ Counter	1 Ch	8 Ch	8 Ch & events & Timer/ Counter	1 Ch	8 Ch	8 Ch & events & Timer/ Counter
Max. sweep memory	50 MS	6 MS	4 MS	not used			40 MS	4.5 MS	3 MS
Max. sweep sample rate	200 kS/s			not used			200 kS/s		
Max. continuous FIFO	not used			50 MS	6 MS	4 MS	10 MS	1 MS	0.7 MS
Max. continuous sample rate	not used			200 kS/s			Sweep sample rate / 2		
Max. aggregate continuous streaming rate	not used			0.2 MS/s 0.8 MB/s	1.6 MS/s 6.4 MB/s	2.2 MS/s 8.8 MB/s	0.1 MS/s 0.4 MB/s	0.8 MS/s 3.2 MB/s	1.1 MS/s 4.4 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.

Multiple Sweeps	
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
Maximum fast 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.

G057: Passive, Single-Ended Isolated Voltage Probe (Option, to be ordered separately)

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

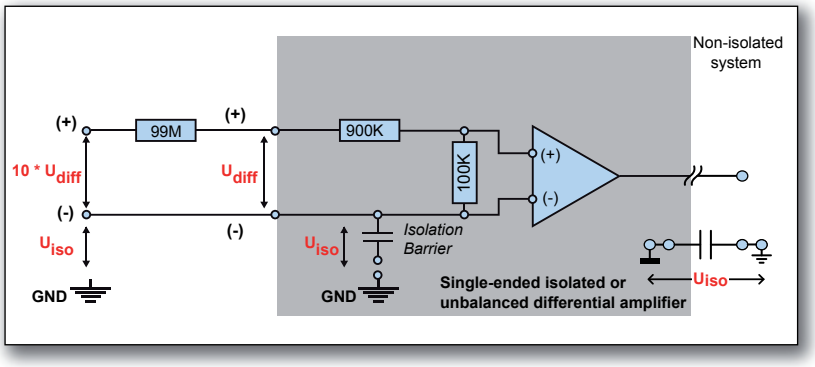


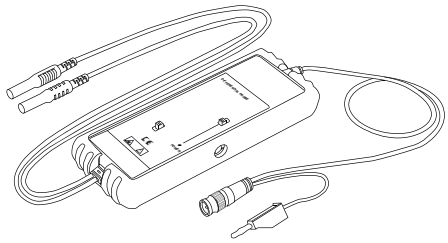
Figure 1.14: Block diagram passive, single-ended isolated voltage probe

Isolation	Supported if the acquisition card uses isolated amplifiers
Capacitive compensation range	30 to 70 pF
DC In-accuracy	2%
Divide factors	100:1
Probe impedance (connected to channel)	100 MΩ
-3 dB Bandwidth	50 MHz
Maximum input voltage	600 V RMS CAT III, 1000 V RMS CAT II, 3540 V RMS CAT I
Probe cable length	1.2 m (3.9 ft)
Probe operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Original manufacturer's part number	Multi-Contact Isoprobe II - 100:1 55pF

Figure 1.15: Probe and probe accessories

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

To be used with differential isolated or non-isolated amplifiers



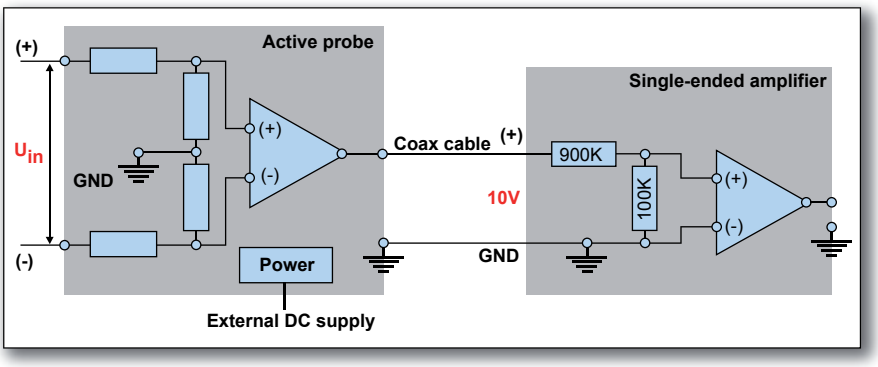


Figure 1.16: Block diagram active, differential voltage probe

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 1.17: 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

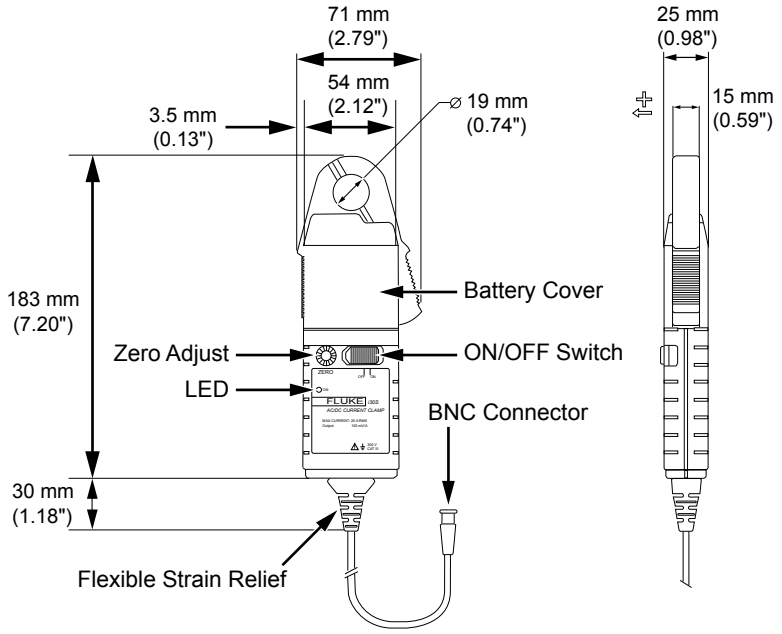


Figure 1.18: Dimensions

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

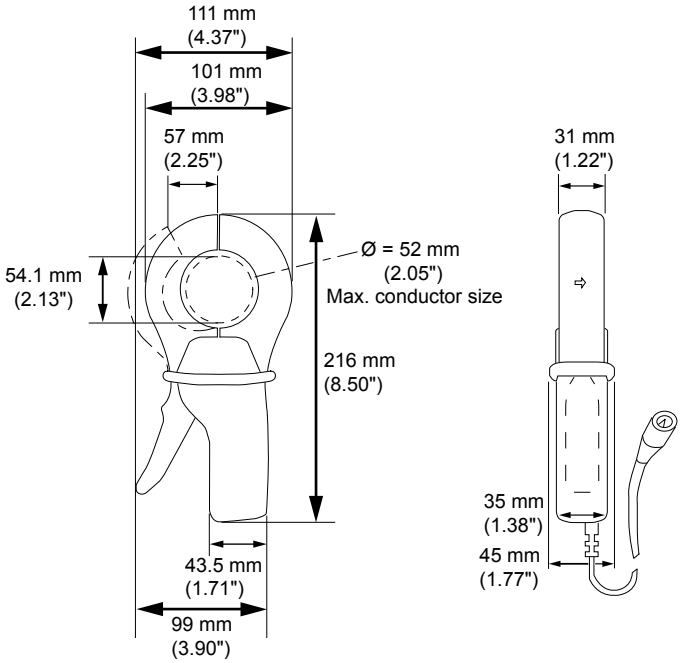


Figure 1.20: Dimensions

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

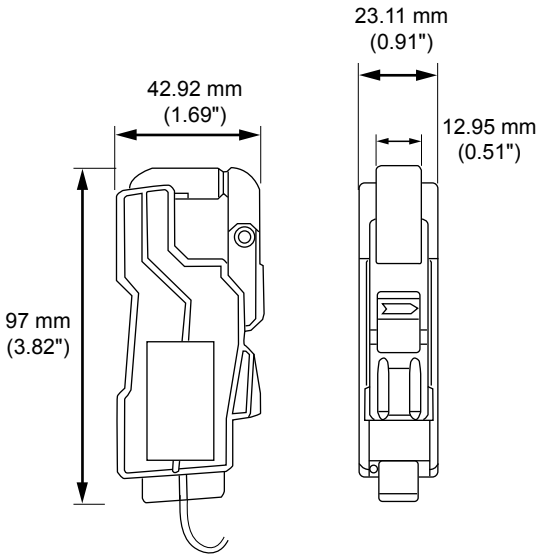


Figure 1.22: Dimensions

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)
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, 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.
Basic/ IEPE 200k ISC		8 channels, 18 bit, 200 kS/s, ± 10 mV to ± 50 V input range, 200 MB RAM, 33 V RMS isolated unbalanced differential input, single metal isolated BNC per channel. Basic voltage and IEPE sensor with TEDS class 1 support. Real-time cycle and timer based calculations with triggering on calculated results Supported by Perception V6.50 and higher	1-GN816-2

(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, SE isolated probe, 100:1, 50 MHz, 100 MΩ		Passive, single-ended isolated voltage probe. Has a capacitive compensation range from 30 to 70 pF. The divide factor is 100:1, bandwidth is -3 dB @ 50 MHz, maximum input voltage is 600 V RMS CAT III, 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-G057-2
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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