GEN series GN610

Data sheet

Isolated 1 kV 2 MS/s Input Card

Special features

- 6 analog channels
- Isolated, balanced differential inputs
- ± 20 mV to ± 1000 V input range
- 600 V RMS CAT II reinforced isolation, tested up to 6.4 kV
- Analog/digital anti-alias filters
- 2 MS/s sample rate
- 18 bit resolution
- 2 GB memory
- Two 4 mm banana plugs for each channel
- Real-time cyclic calculators
- Triggering on real-time results
- Digital Event/Timer/Counter support

Isolated 1 kV 2 MS/s Input Card

The isolated balanced differential inputs offers voltage ranges from ± 20 mV to ± 1000 V. Tested up to 6.4 kV, the reinforced isolation allows for safe measurements up to 600 V RMS CAT II (IEC61010-1:2010 safety standard).

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. At lower sample rates the digital anti alias filters allow for a large range of high order filter characteristics with precise phase match and ultra low noise output.

Besides the instantaneous values, the real-time cycle detection allows for cycle based real-time calculations like TrueRMS on all analog channels as well as torque, angle and speed on all timer counter channels simultaneously.

Every real-time calculated result 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.

The two Timer/Counters together with the GEN series mainframe Digital Event/Timer Counter connector and the G070A torque/RPM adapter allow for direct interfacing to HBM torque transducers or other torque and speed sensors.

Capabilities Overview

Model	GN610
Maximum sample rate per channel	2 MS/s
Memory per card	2 GB
Analog channels	6
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 balanced differential
Passive voltage/current probes	Special designed matching probes only (e.g. Elas HDP)
Sensors	Not supported
TEDS	Not supported
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)	Not supported
Slot width	1

Block Diagram

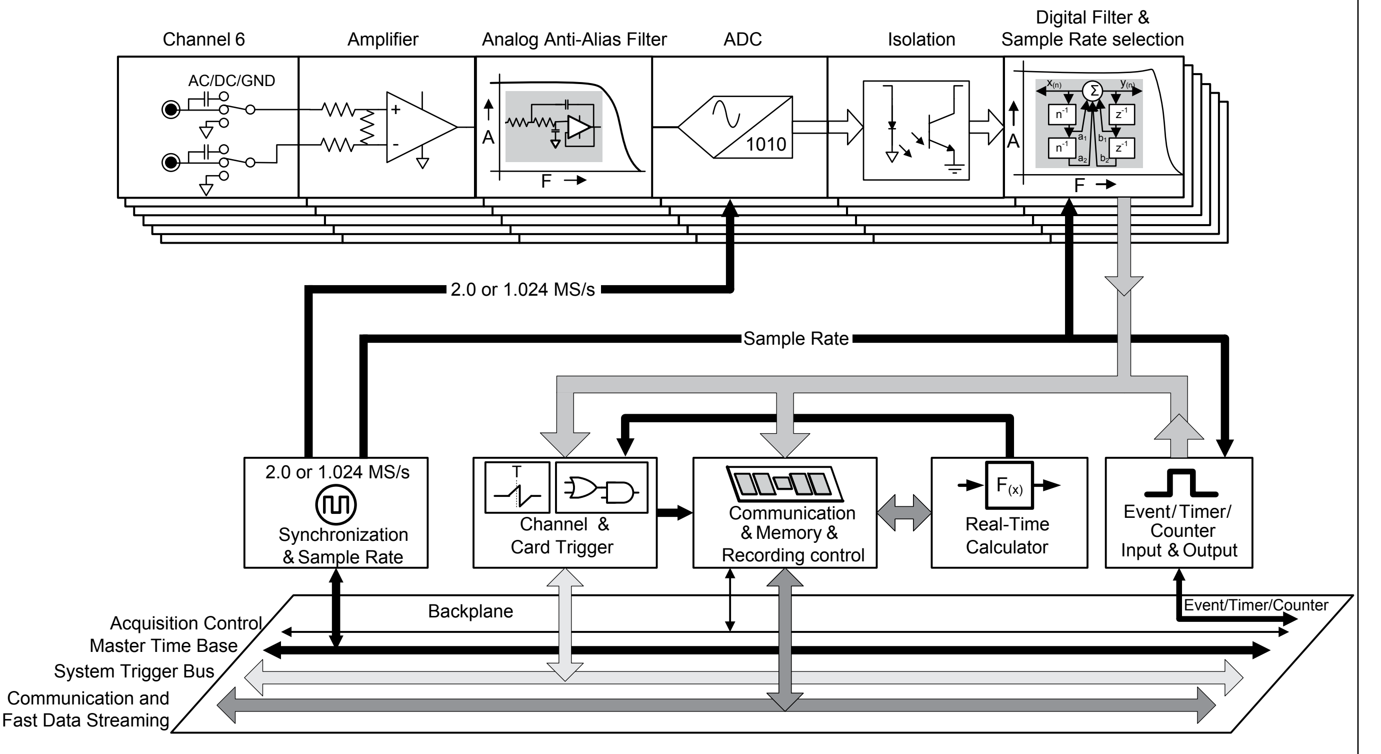


Figure 1.1: Block Diagram

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	6
Connectors	Fully isolated 4 mm banana plugs (plastic), 2 per channel (red and black)
Input type	Analog, isolated balanced differential
Input impedance	2 * 1 MΩ ± 1% // 33 pF ± 10% ranges larger than ± 5 V. All other ranges 57 pF ± 10%
Input coupling	
Coupling modes	AC, DC, GND
AC coupling frequency	48 Hz ± 5 Hz (-3 dB)

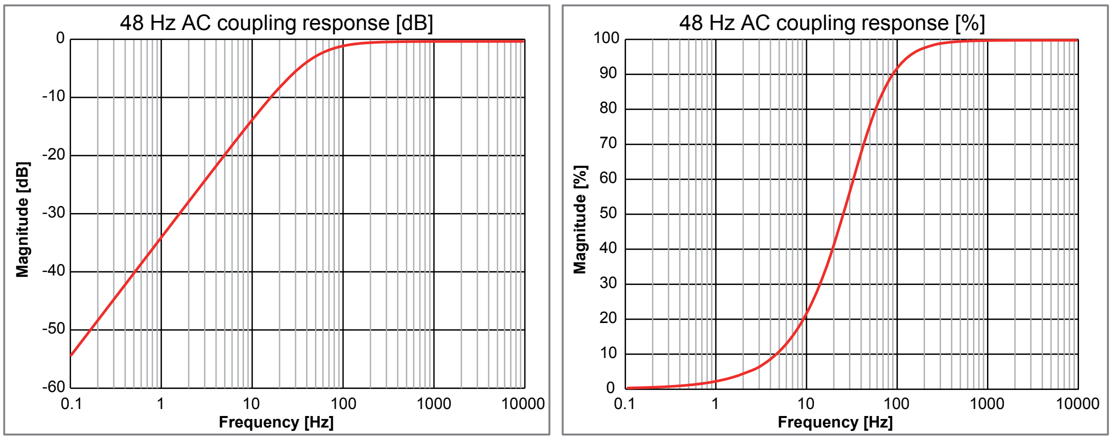


Figure 1.2: Representative AC coupling response

Ranges	± 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, ± 100 V, ± 200 V, ± 500 V, ± 1000 V
Offset	± 50% in 1000 steps (0.1%); ± 1000 V range has fixed 0% offset
DC Offset error	
Wideband	0.02% of Full Scale ± 400 µV
All IIR filters	0.02% of Full Scale ± 10 µV
Offset error drift	±(20 ppm + 10 µV)/°C (±(12 ppm + 6 µV)/°F)
DC Gain error	
Wideband	0.1% of Full Scale ± 20 µV
All IIR filters	0.1% of Full Scale ± 10 µV
Gain error drift	±30 ppm/°C (±17 ppm/°F)
Maximum static error (MSE)	
Wideband	0.075% of Full Scale ± 400 µV
All IIR filters	0.075% of Full Scale ± 10 µV
RMS Noise (50 Ω terminated)	
Wideband	0.035% of Full Scale ± 50 µV
All IIR filters	0.035% of Full Scale ± 50 µV

Analog Input Section		
Common mode (referred to system ground)		
Ranges	Less than ± 10 V	Larger than or equal to ± 10 V
Rejection (CMR)	> 80 dB @ 80 Hz (100 dB typical)	> 60 dB @ 80 Hz (80 dB typical)
Maximum common mode voltage	7 V RMS	1000 V RMS

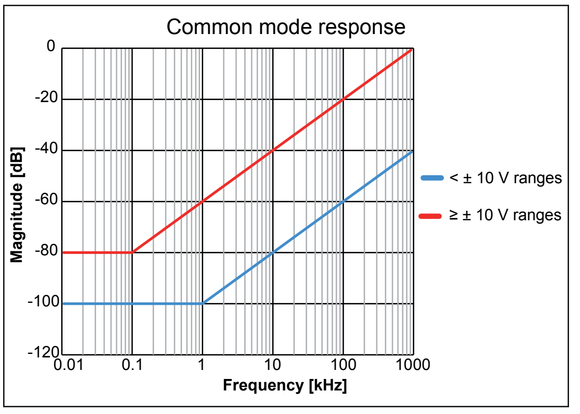


Figure 1.3: Representative common mode response

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 1250 V, whichever value is the smallest.
Maximum nondestructive voltage	± 2000 V DC
Maximum overload without auto range	200% of selected range
Automatic auto range	When overload causes the amplifier to overheat, the amplifier increases its range in steps of a factor of 10 until the overload ceases. When the overload exceeds 1000 V, the input signal is disconnected and the amplifier input is grounded. When the temperature returns to normal, the range that was originally selected is restored. The automatic auto range cannot be turned off.
Overload recovery time	Restored to 0.1% accuracy in less than 5 µs after 200% overload

Analog to Digital Conversion	
Sample rate; per channel	0.1 S/s to 2 MS/s
ADC resolution; one ADC per channel	18 bit
ADC type	Successive Approximation Register (SAR); Analog Devices AD7641BCPZ
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	1.024 MS/s
External time base frequency	0 S/s to 1 MS/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.

Isolation

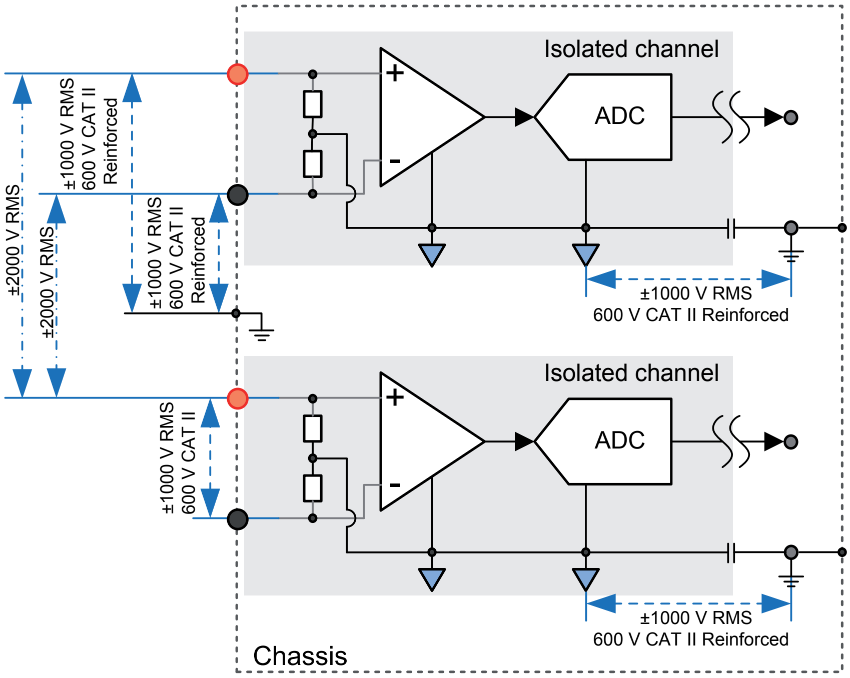


Figure 1.4: Isolation 1kV card overview

		CAT II	CAT III
Channel to chassis (earth)	1000 V RMS	600 V RMS (1)	300 V RMS(1)
Channel to channel	2000 V RMS	(2)	(2)

(1) IEC61010-1 category voltage ratings are RMS voltages.

(2) Channel to channel CAT II and CAT III ratings are not a valid method to specify.

Isolation and Input Type Testing

IEC61010-1:2010 and EC61010-2-30:2010 isolation tests	
Channel to channel	3510 V RMS and 4935 V DC for 5 s 3260 V RMS and 4596 V DC for 1 minute
Channel to chassis	3510 V RMS and 4935 V DC for 5 s 3260 V RMS and 4596 V DC for 1 minute
Channel to channel impulse	6400 V peak using a 2 Ω series resistor Rise time 1.2 µs, 50% amplitude reduction in 50 µs
Channel to chassis impulse	6400 V peak using a 2 Ω series resistor Rise time 1.2 µs, 50% amplitude reduction in 50 µs

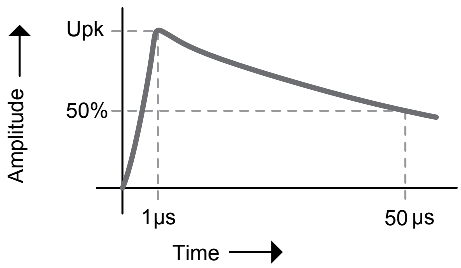


Figure 1.5: Example of 1.2/50 µs impulse

Input impulse test	
Channel positive to negative input	4000 V peak using a 12 Ω series resistor, rise time 1.2 µs, 50% amplitude reduction in 50 µs

Anti-Alias Filters

Note on phase matching channels. Every filter characteristic and/or filter bandwidth selection comes with it's own specific phase response. Using different filter selections (Wideband/Bessel IIR/Butterworth IIR/etc.) or different filter bandwidths can result in phase mismatches between channels.

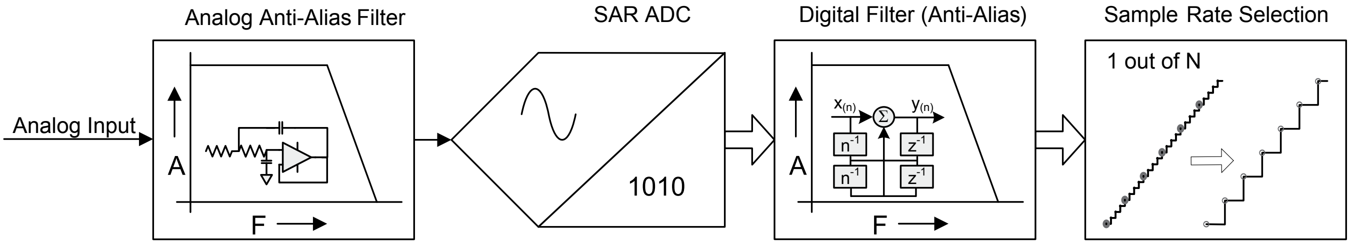


Figure 1.6: Combined analog and digital anti-alias filter block diagram

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. Wideband should not be used if working in a frequency domain with recorded data.
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.

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 900 kHz and 1500 kHz (-3 dB)
0.1 dB passband flatness(1)	DC to 160 kHz

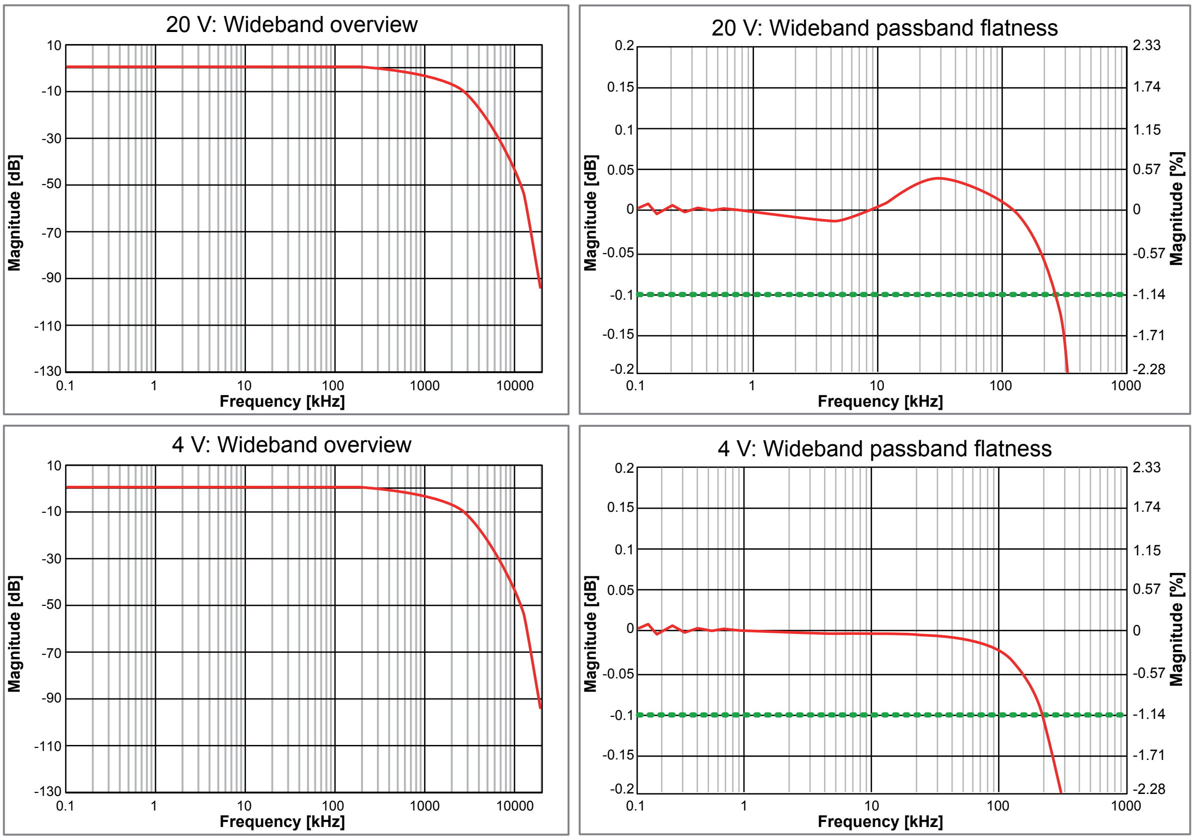


Figure 1.7: Representative Wideband examples

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

Bessel IIR Filter (Digital Anti-Alias)

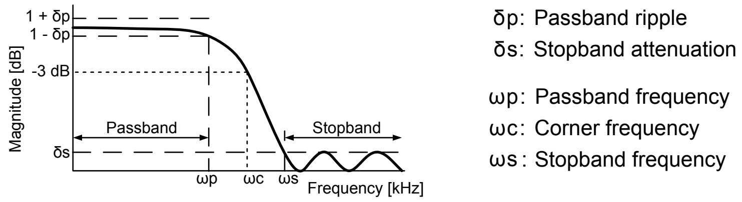


Figure 1.8: Representative Bessel IIR examples

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	400 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 200 kHz
Bessel IIR 0.1 dB passband (ωp)[1]	DC to 0.14 * ωc
Bessel IIR filter stopband attenuation (δs)	60 dB With the Bessel IIR filter bandwidth selection of ωc = 200 kHz, a peak of -55 dB occurs between 1.6 MHz and 1.8 MHz due to limited analog anti-alias filter amplitude reduction. At lower bandwidth selections, the digital filter reduces this peak to -60 dB.
Bessel IIR filter roll-off	48 dB/octave

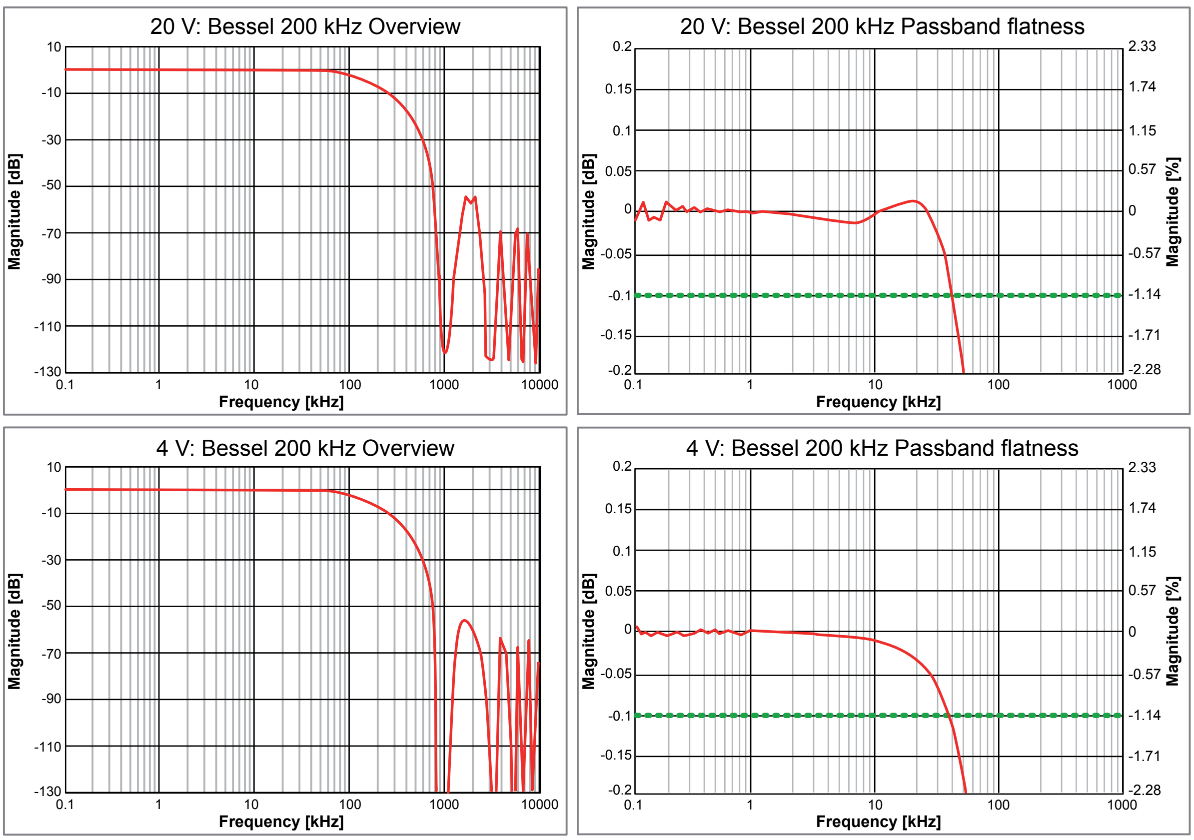
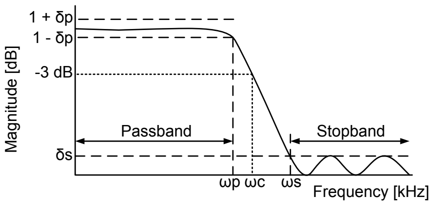


Figure 1.9: Representative Bessel IIR examples

(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 1.10: 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	465 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(1), 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 250 kHz
Butterworth IIR 0.1 dB passband (ωp)(2)	DC to 0.7 * ωc (for ωc > 100 kHz, DC to 0.6 * ωc, due to analog anti-alias filter bandwidth)
Butterworth IIR filter stopband attenuation (δs)	75 dB
Butterworth IIR filter roll-off	48 dB/octave

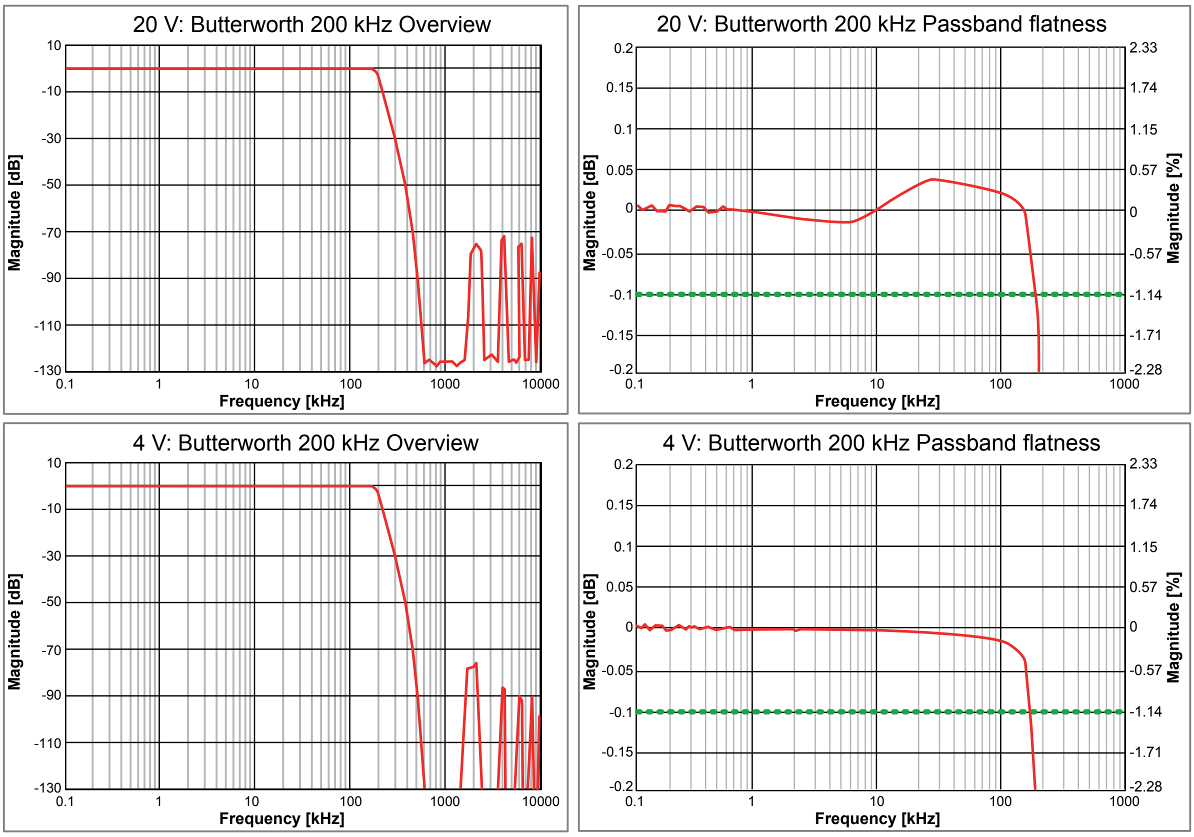
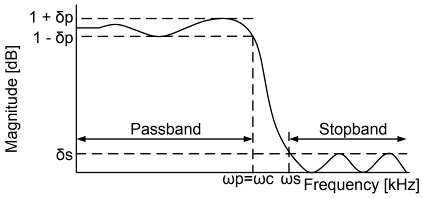


Figure 1.11: Representative Butterworth IIR examples

(1) Division by 4 not possible for the 2 MS/s sample rate

(2) 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 1.12: 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	465 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(1), 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 250 kHz
Elliptic IIR 0.1 dB passband (ωp)(2)	DC to ωc (for ωc > 100 kHz, DC to 0.7 * ωc due to analog anti-alias filter bandwidth)
Elliptic IIR filter stopband attenuation (δs)	75 dB
Elliptic IIR filter roll-off	72 dB/octave

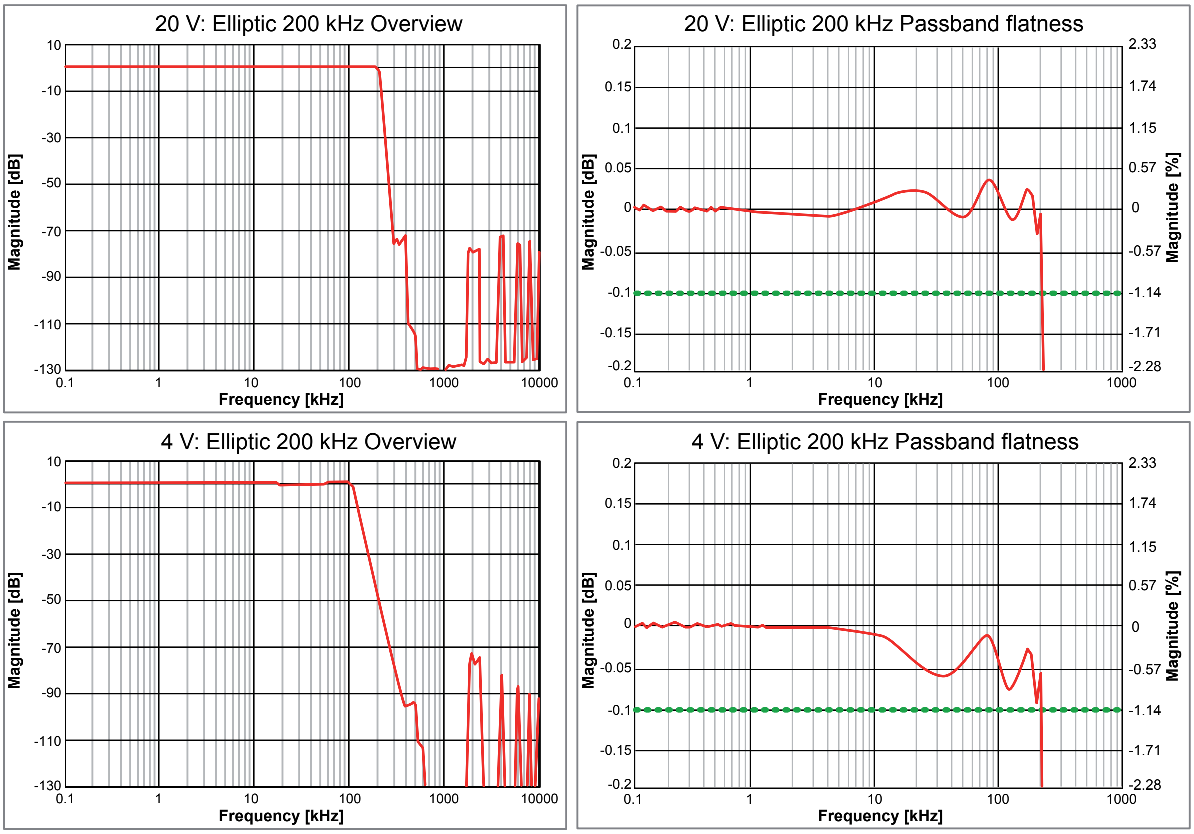


Figure 1.13: Representative Elliptic IIR examples

(1) Division by 4 not possible for the 2 MS/s sample rate

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

Channel to Channel Phase Match

Using different filter selections (Wideband/Bessel IIR/Butterworth IIR/etc.) or different filter bandwidths results in phase mismatches between channels. All specifications are typical static values and measured using a 100 kHz sine wave and 2 MS/s sample rate.

Wideband	
Channels on card	0.5 deg (14 ns)
GN610 Channels within mainframe	0.5 deg (14 ns)
Bessel IIR, Filter frequency 200 kHz	
Channels on card	0.6 deg (17 ns)
GN610 Channels within mainframe	0.6 deg (17 ns)
Butterworth IIR, Filter frequency 200 kHz	
Channels on card	0.5 deg (14 ns)
GN610 Channels within mainframe	0.5 deg (14 ns)
Elliptic IIR, Filter frequency 200 kHz	
Channels on card	0.5 deg (14 ns)
GN610 Channels within mainframe	0.5 deg (14 ns)
GN610 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 and Channels 1 and 3 are connected to the sine wave generator.

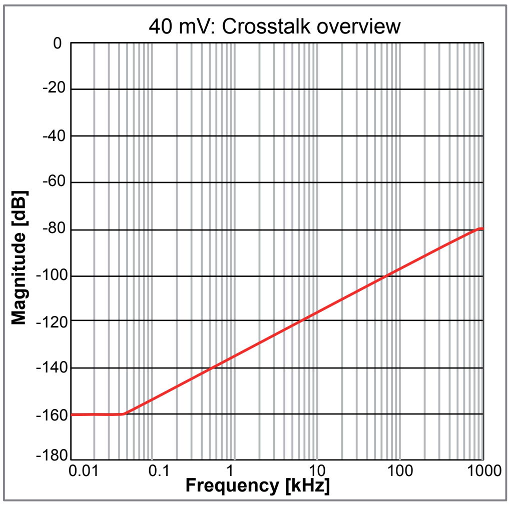


Figure 1.14: Representative Channel to Channel crosstalk

On-board Memory

Per card	2 GB (1 GS @ 16 bits, 500 MS @ 18 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	User selectable 16 or 18 bits 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

Timer/Counter Mode Uni- and Bi-directional Count

Counter mode is typically used for tracking movement of device under test. When possible use the quadrature modes as these are less sensitive to counting errors.

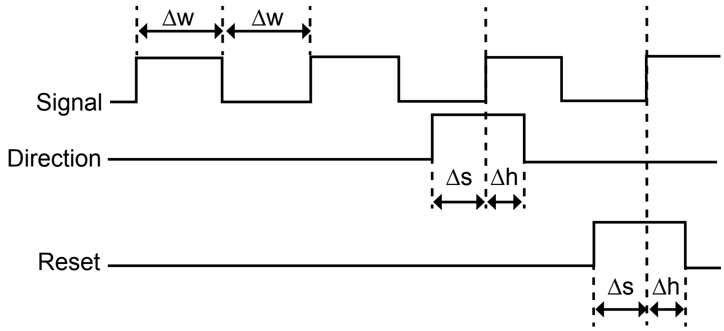


Figure 1.15: Uni- and Bi-directional count timing

Inputs	3 pins: signal, reset and direction (only used in bi-directional count)
Maximum input frequency	5 MHz
Minimum pulse width (Δw)	100 ns
Counter range	0 to 2^{31}; uni-directional count -2^{31} to $+2^{31} - 1$; bi-directional count
Gate measuring time	Sample period (1 / sample rate) to 50 s Can be selected by user to control update rate independent of sample rate
Reset input	
Level sensitivity	User selectable invert level
Minimum setup time prior to signal edge (Δs)	100 ns
Minimum hold time after signal edge (Δh)	100 ns
Reset options	
Manual	Upon user request by software command
Start recording	Count value set to 0 at Start of recording
First reset pulse	After the recording is started, the first reset pulse sets the counter value to 0. The next reset pulses are ignored.
Each reset pulse	On each external reset pulse, the counter value is reset to 0.
Direction input	
Input Level sensitivity	Only used when in bi-directional count Low: increment counter High: decrement counter
Minimum setup time prior to signal edge (Δs)	100 ns
Minimum hold time after signal edge (Δh)	100 ns

Timer/Counter Mode Bi-directional Quadrature Count

Typically used for tracking rotating/moving devices using a decoder with two signals that are always 90 degree phase shifted. E.g. allow for direct interfacing to HBM torque and speed transducers.

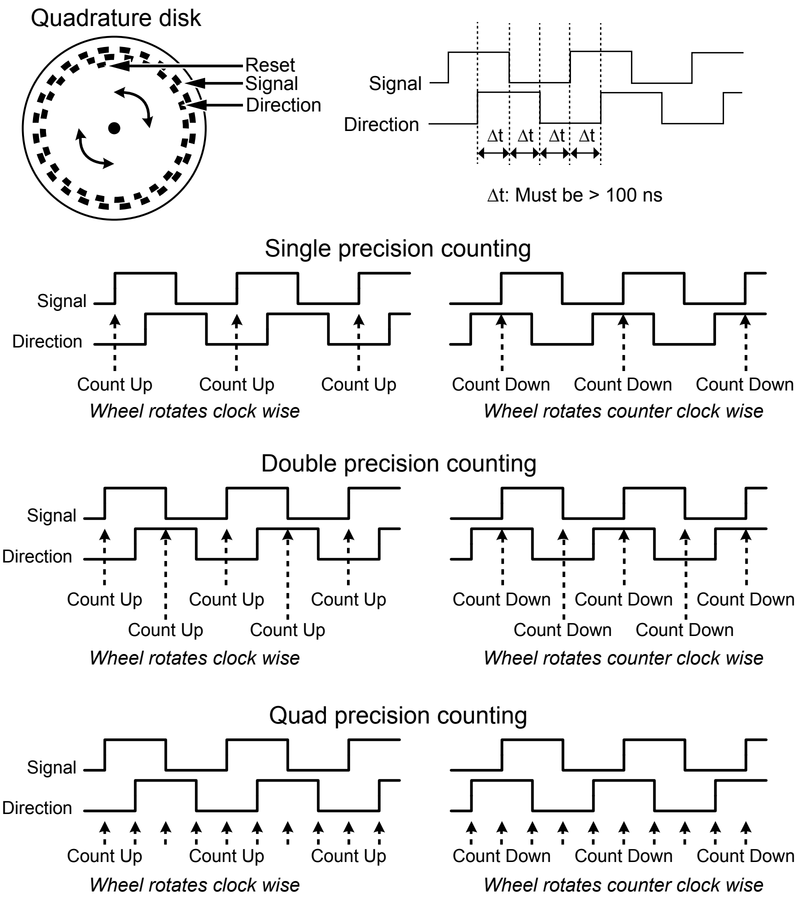


Figure 1.16: Bi-directional quadrature count modes

Inputs	3 pins: signal, direction and reset
Maximum input frequency	2 MHz
Minimum pulse width	200 ns (2 * Δt)
Minimum setup time	100 ns (Δt)
Minimum hold time	100 ns (Δt)
Accuracy	Single, dual or quad precision
Counter range	-2^{31} to $+2^{31} - 1$
Reset input	
Level sensitivity	User selectable invert level
Minimum setup time prior to signal edge (Δt)	100 ns
Minimum hold time after signal edge (Δt)	100 ns
Reset options	
Manual	Upon user request by software command
Start recording	Count value set to 0 at Start of recording
First reset pulse	After the recording is started, the first reset pulse sets the counter value to 0. The next reset pulses are ignored.
Each reset pulse	On each external reset pulse, the counter value is reset to 0.

Timer/Counter Mode Angle

In angle measurement mode the counter will use a user defined maximum angle and revert back to zero when this count value is reached. Using the reset input the measured angle can be synchronized to the mechanical angle. The real-time calculators can extract the RPM from the measured angle independent from the mechanical synchronization.

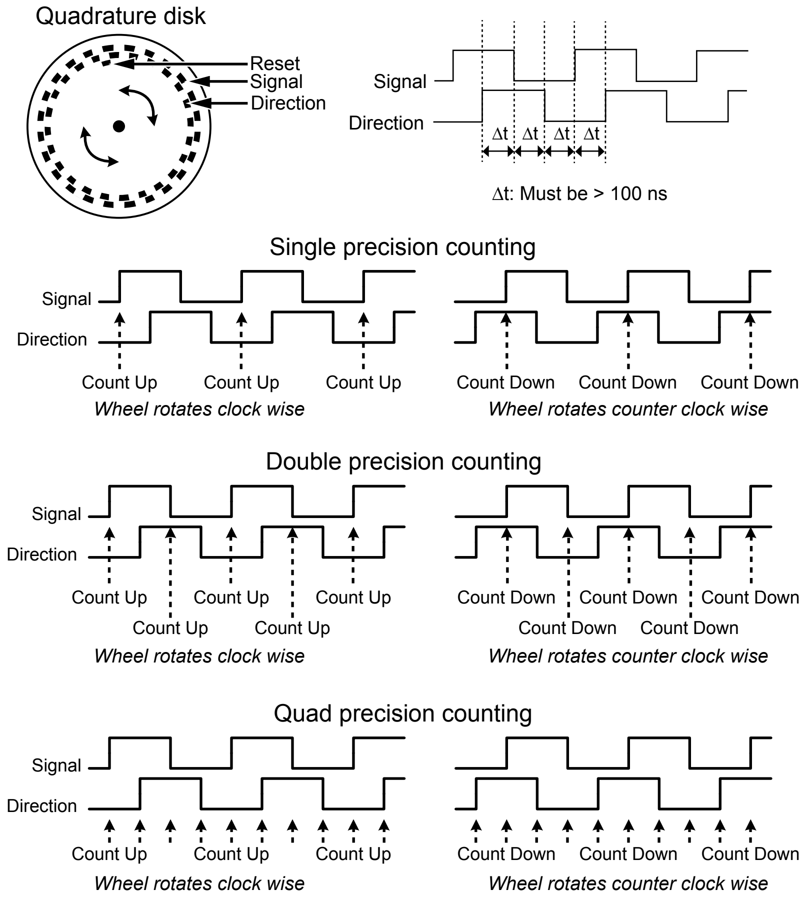


Figure 1.17: Bi-directional quadrature count modes

Inputs	3 pins: signal, direction and reset
Maximum input frequency	2 MHz
Minimum pulse width	200 ns (2 * Δt)
Minimum setup time	100 ns (Δt)
Minimum hold time	100 ns (Δt)
Accuracy	Single, dual and quad precision
Reset input	
Level sensitivity	User selectable invert level
Minimum setup time prior to signal edge (Δt)	100 ns
Minimum hold time after signal edge (Δt)	100 ns
Angle options	
Reference	User selectable. Enables the use of the reset pin to reference the mechanical angle to the measured angle
Angle at reference point	User defined to specify mechanical reference point
Reset pulse	Angle value is reset to user defined "angle at reference point" value
Pulses per rotation	User defined to specify the encoder resolution
Maximum pulses per rotation	32767
Maximum RPM	30 * sample rate (Example: Sample rate 10 kS/s means maximum 300 k RPM)

Timer/Counter Mode: Uni- and Bi-directional Frequency/RPM Measurement

Used to measure any kind of frequency like engine RPM, or active sensors with proportional frequency output signal.

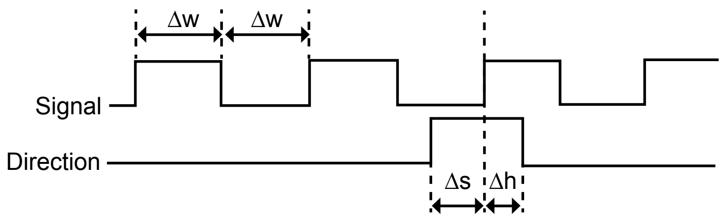


Figure 1.18: Uni- and Bi-directional count timing

Inputs	2 pins: signal, direction
Maximum input frequency	5 MHz
Minimum pulse width (Δw)	100 ns
Accuracy	0.1%, when using a gate measuring time of 40 µs or more. With lower gate measuring times, the real-time calculators or Perception formula database can be used to enlarge the measuring time and improve the accuracy more dynamically e.g. based on measured cycles.
Gate measuring time	Sample period (1 / sample rate) to 50 s Can be selected by user to control update rate independent of sample rate
Direction input	
Level sensitivity	Only used when in bi-directional frequency/RPM mode Low: Positive frequency/RPM, e.g. left rotations High: Negative frequency/RPM, e.g. right rotations
Minimum setup time prior to signal edge (Δs)	100 ns
Minimum hold time after signal edge (Δh)	100 ns

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)

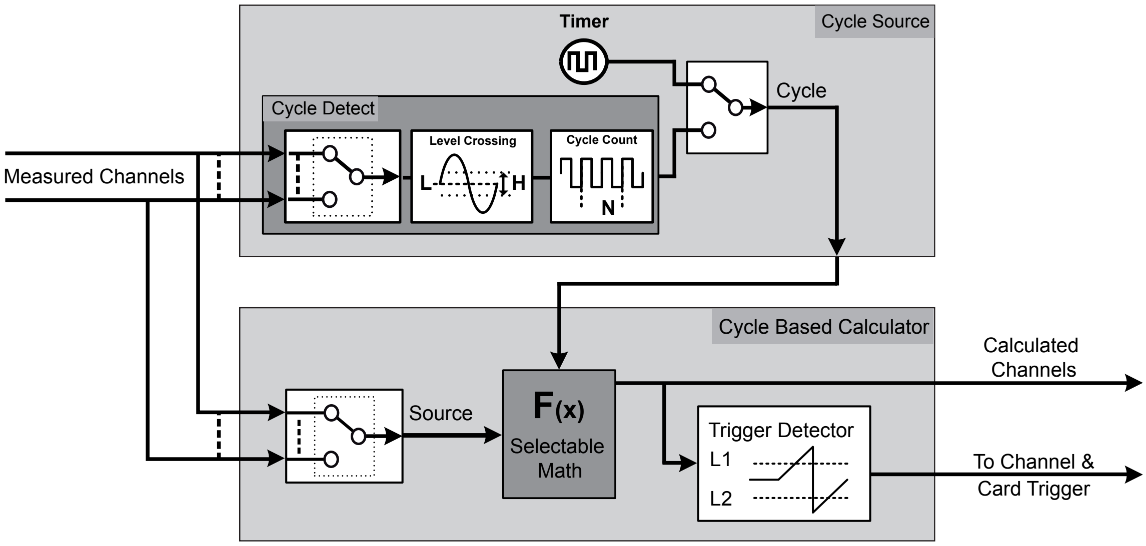


Figure 1.19: Real-time cycle based calculators

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; at sample rates 200 kS/s or lower. At higher sample rates, the number of calculators is reduced to match the available DSP power.
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	6 Ch	6 Ch & events	1 Ch	6 Ch	6 Ch & events	1 Ch	6 Ch	6 Ch & events
Max. sweep memory	1 GS	166 MS	142 MS	not used			800 MS	133 MS	113 MS
Max. sweep sample rate	2 MS/s			not used			2 MS/s		
Max. continuous FIFO	not used			1 GS	166 MS	142 MS	199 MS	33 MS	28 MS
Max. continuous sample rate	not used			2 MS/s			Sweep sample rate / 2		
Max. continuous streaming rate	not used			2 MS/s 4 MB/s	12 MS/s 24 MB/s	14 MS/s 28 MB/s	2 MS/s 4 MB/s	12 MS/s 24 MB/s	14 MS/s 28 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	6 Ch	6 Ch & events & Timer/ Counter	1 Ch	6 Ch	6 Ch & events & Timer/ Counter	1 Ch	6 Ch	6 Ch & events & Timer/ Counter
Max. sweep memory	500 MS	83 MS	55 MS	not used			400 MS	66 MS	44 MS
Max. sweep sample rate	2 MS/s			not used			2 MS/s		
Max. continuous FIFO	not used			500 MS	83 MS	55 MS	99 MS	16 MS	10 MS
Max. continuous sample rate	not used			2 MS/s			Sweep sample rate / 2		
Max. aggregate continuous streaming rate	not used			2 MS/s 8 MB/s	12 MS/s 48 MB/s	18 MS/s 72 MB/s	2 MS/s 8 MB/s	12 MS/s 48 MB/s	18 MS/s 72 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
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.

Environmental Specifications

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, 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

KAB290: Shielded 2 Wire 600 V RMS CAT II Cable (Option, to be ordered separately)

This cable is specially designed to be used with the GN610, GN611 and GN610B, GN611B cards. Significantly reduces signal disturbance pickup by using two identical signal wires with earthed shield. This cable must not be used for 3 wire measurements. The shield is not a standard signal wire.

Cable setup	2 wires with shield and isolation 3 shrouded banana plugs on each side: red, black and yellow

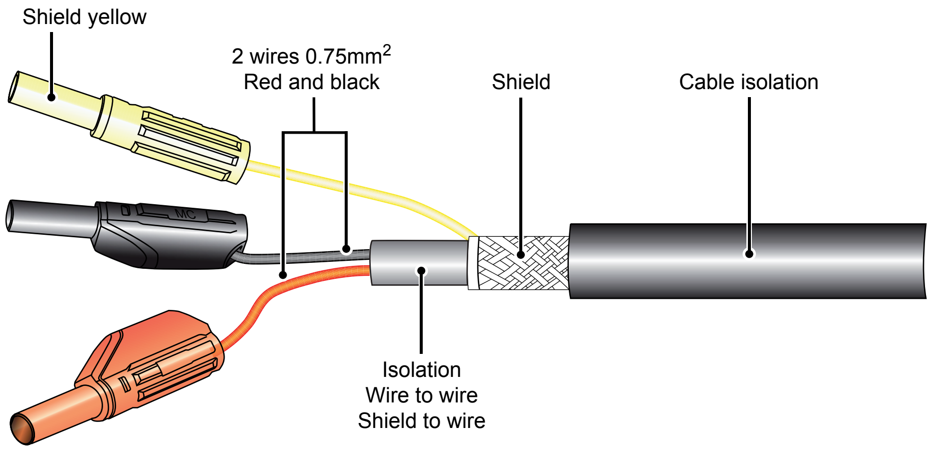


Figure 1.20: Shielded cable setup

Wire thickness	2 * 0.75 mm² (0.00116 in²)
Maximum wire resistance	0.250 Ω / m (0.0763 Ω / ft)
Weight	Approximately 143 g/m (1.54 oz/foot)
Outside cable diameter	Approximately 9 mm (0.354 inch)
Minimum bend radius	10 times that of the cable diameter
Isolation	
Resistance	20 MΩ / km (32.19 MΩ/ mile)
Voltage	600 V RMS CAT II; wire to wire; wire to shield; shield to outside
Capacitance	
Wire to wire	Approximately 110 pF/m (33.54 pF/ft)
Wire to shield	Approximately 150 pF/m (45.73 pF/ft)
Temperature range	
Operational	-15 °C (+5 °F) to +80 °C (+176 °F)
Non-operational (storage)	-40 °C (-40 °F) to +80 °C (+176 °F)
Available lengths	1.5 m (4.92 ft), 3.0 m (9.84 ft), 6.0 m (19.7 ft)

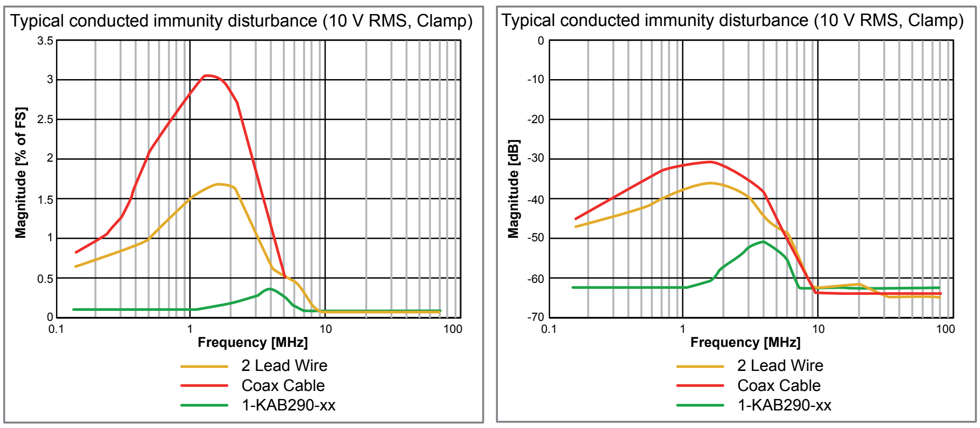


Figure 1.21: Typical conducted immunity, tested using ± 10 V range

G068: Artificial Star Adapter (Option, to be ordered separately)	
The artificial star adapter creates an artificial star point to measure 3 phase signals	
Maximum input voltage	1000 V DC (707 V RMS) between each of the phases
Inputs	3; 4 mm safety banana plugs
Outputs	6; 4 mm safety banana pins; plugs straight into GN610/GN611/GN610B/GN611B cards
Artificial star N	Reference plug only. Not to be used as input
Safety	Compliant with IEC61010-1 600 V RMS CAT II
Application use	The 3 phase signals L1, L2 and L3 can be connected with inputs L1, L2, L3 of the artificial star adapter. The connection N* is the voltage present on the artificial “star point”.

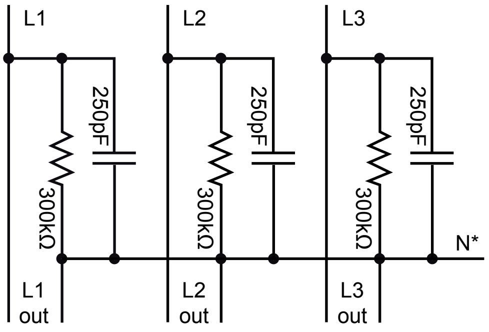


Figure 1.22: Electrical schematic

Weight	170 g (6 oz)
Material housing	Polyurethane, vacuum resin casting
Setup	Two boxes can be plugged into a single GN610/GN611/GN610B/GN611B card Two or more GN610/GN611/GN610B/GN611B cards with Artificial star adapters fit next to each other
Temperature range	
Operational temperature	0 °C to +40 °C (+32 °F to +104 °F)
Non-operational (storage)	-25 °C to +70 °C (-13 °F to +158 °F)

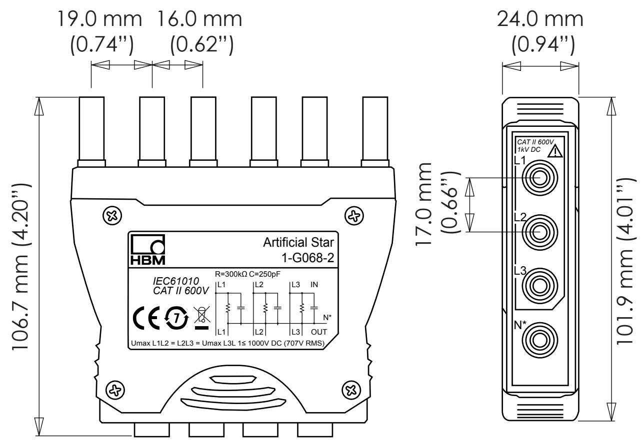


Figure 1.23: Artificial star adapter

Artifical Star Adapter Wiring Diagram

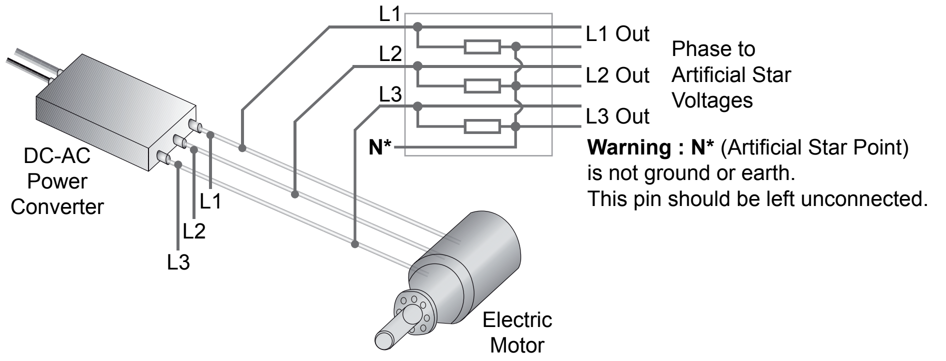


Figure 1.24: Three phase representative use of artificial star adapter

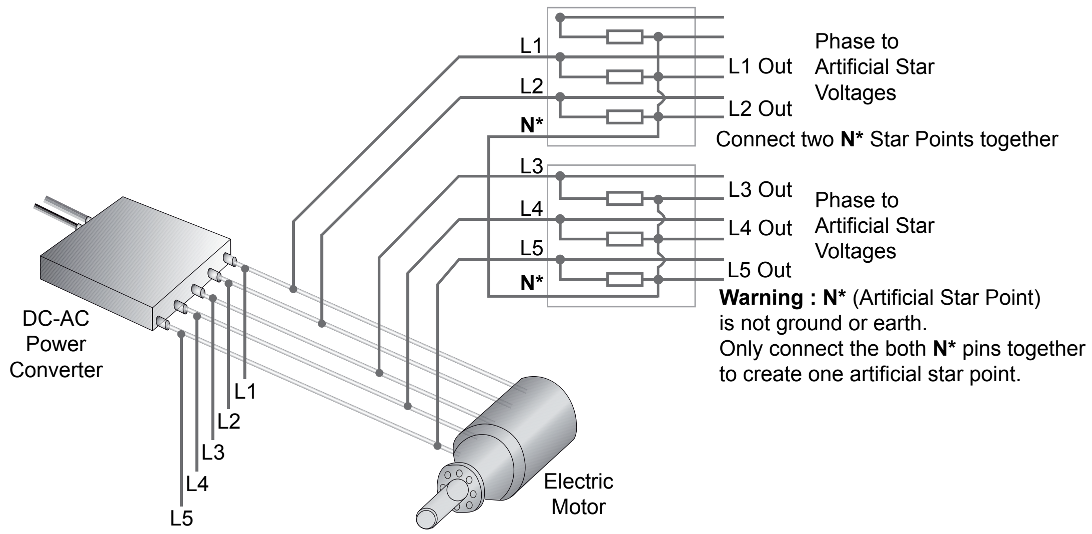


Figure 1.25: Five or more phase representative use of dual star adapter

Gxxx: 1 kV DC High Precision Differential Probe (Option, to be ordered separately)

High precision 10 MΩ differential probe (HDP) to be used in combination with GN610, GN611, GN610B and GN611B acquisition cards. Reduces the resistive/current load on the device under test by increasing the input impedance to 10 MΩ with 0.2% in-accuracy. The use of the 10:1 divider reduces the lowest user range to ± 0.1 V (± 0.2 V when using GN610/GN611). The highest input range is ± 1000 V due to the maximum voltage rating of the probe.
The HDP10H probe is optimized to match the 33 pF input capacitance when using the ranges ± 10 V up to ± 1000 V.
The HDP10L probe is optimized to match the 57 pF input capacitance when using the ranges ± 10 mV up to ± 5 V.

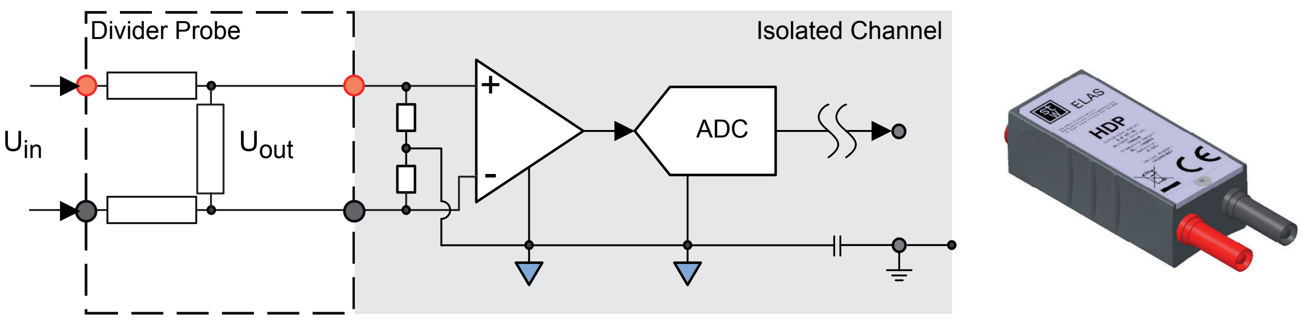


Figure 1.26: Block diagram and image

Maximum input voltage	± 1000 V DC
Divider ratio	10:1
In-accuracy	± 0.2%
Input impedance	10 MΩ ± 0.2%
Temperature coefficient	± 25 ppm / °C (± 45 ppm / °F)
-0.5 dB Bandwidth	100 kHz
Output capacitive match	HDP10H 33 pF HDP10L 57 pF
Input pins	4 mm safety banana, 13 mm (0.51") spacing
Output pins	4 mm safety banana, 19 mm (0.75") spacing
Isolation (terminals – earth)	1000 V RMS
Resistor technology	Metal foil
Original manufacturers part number	HDP
Weight	53 g (1.87 oz)
Operating temperature range	0 °C to +40 °C (32 °F to 104 °F)

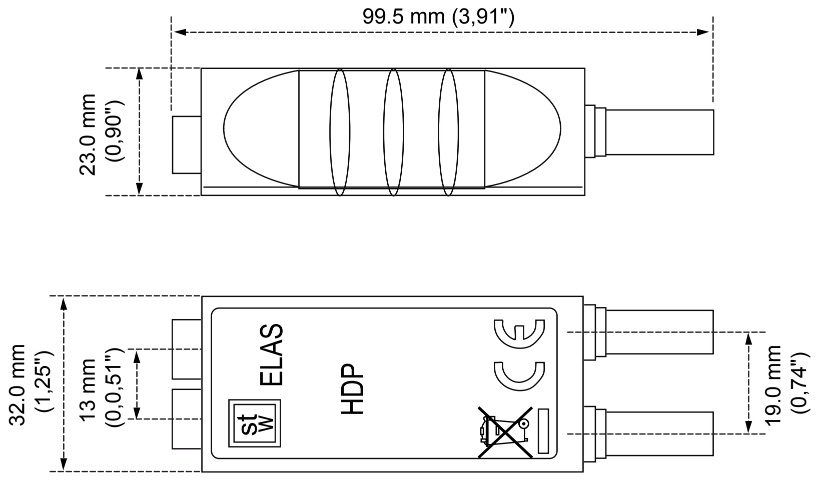


Figure 1.27: Dimensions

Gxxx: 5 kV RMS High Precision Differential Probe (Option, to be ordered separately)

5 kV RMS, 20 MΩ, 50:1, 0.2% high precision, differential probe to be used in combination with GN610, GN611, GN610B and GN611B acquisition cards. The built-in earthing monitor system increases safety of the user and protects the GEN series inputs for isolation overloads.
The probe is optimized to match the 33 pF input capacitance when using the ranges ± 10 V, ± 20 V, ± 50 V, ± 100 V, ± 200 V, ± 500 V, ± 1000 V. In the lower ranges passband attenuation exceeds the HDP specified amplitude response.

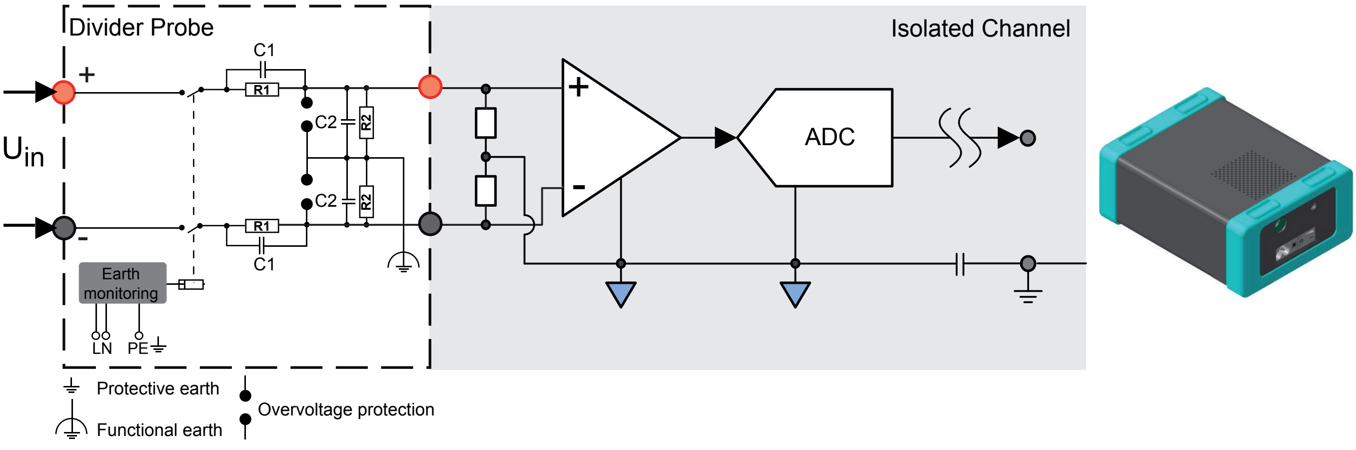


Figure 1.28: Block diagram and image

Maximum input voltage	± 5000 V RMS
Divider ratio	50:1
In-accuracy	± 0.2%
Input impedance	20 MΩ ± 0.2%
Temperature coefficient	± 25 ppm / °C (± 45 ppm / °F)
Bandwidth	-0.5 dB @ 100 kHz, phase match 0.1°
Input pins	4 mm safety banana
Output pins	Cable with 4 mm banana plugs
Isolation test voltages (terminals – earth, terminal – terminal)	12.5 kV for 5 seconds
Earth monitoring	If functional earth is not attached divider is floating and inputs are disconnected from the output
Original manufacturers part number	HVD50
Operating temperature range	5 °C to +40 °C (41 °F to 104 °F)

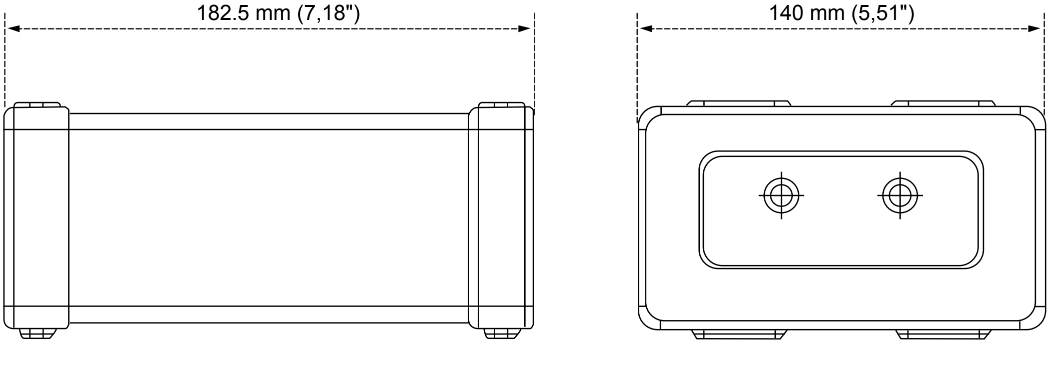


Figure 1.29: Dimensions

Gxxx: High Precision Burden Resistor (Option, to be ordered separately)

Low ohmic, 1 W, 0.02% high precision, low thermal drift burden resistor. Uses 4 wire connection to reduce inaccuracy caused by the currents running to the burden resistor. Using banana input connectors and banana output pins. Directly compatible with GN610, GN611, GN610B and GN611B acquisition cards.

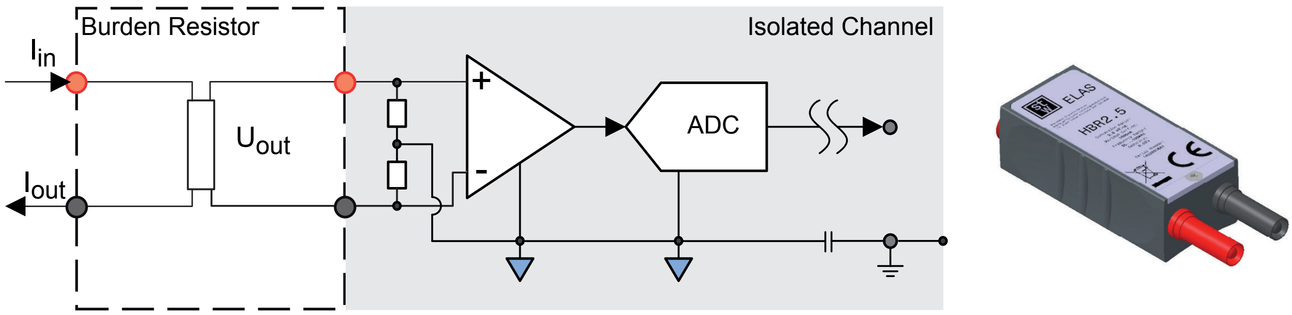


Figure 1.30: Block diagram and image

In-accuracy	± 0.02%		
Temperature coefficient	± 5 ppm / °C (± 9 ppm / °F)		
Bandwidth	-0.5 dB @ 300 kHz		
Input pins	4 mm safety banana, 13 mm (0.51") spacing		
Output pins	4 mm safety banana, 19 mm (0.75") spacing		
Isolation (terminals – earth)	50 V RMS		
Resistor technology	Metal foil		
Maximum power dissipation	1 W		
Original manufacturers part number	HBR1.0	HBR2.5	HBR10
Impedance	1 Ω	2.5 Ω	10 Ω
Maximum input current	1 A	0.63 A	0.31 A
Weight	60 g (2.12 oz)		
Operating temperature range	0 °C to +40 °C (32 °F to 104 °F)		

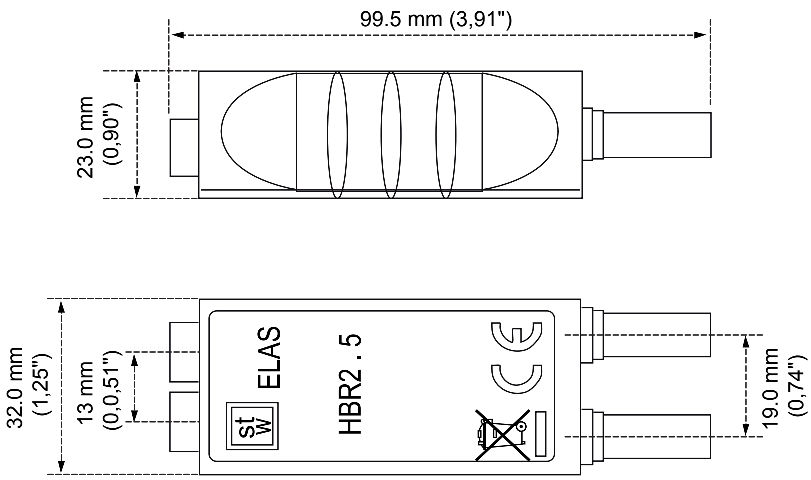


Figure 1.31: Dimensions

Gxxx: Current Transducers (Option, to be ordered separately)

Current loop (compensated) current transducers (CT) using an extremely accurate zero flux detector with excellent linearity and low temperature drift. Electrostatic shield between primary and secondary circuit, with low insertion loss and high immunity to electrostatic and magnetic fields. To be used with CT power supply and burden resistor to measure high frequency currents.

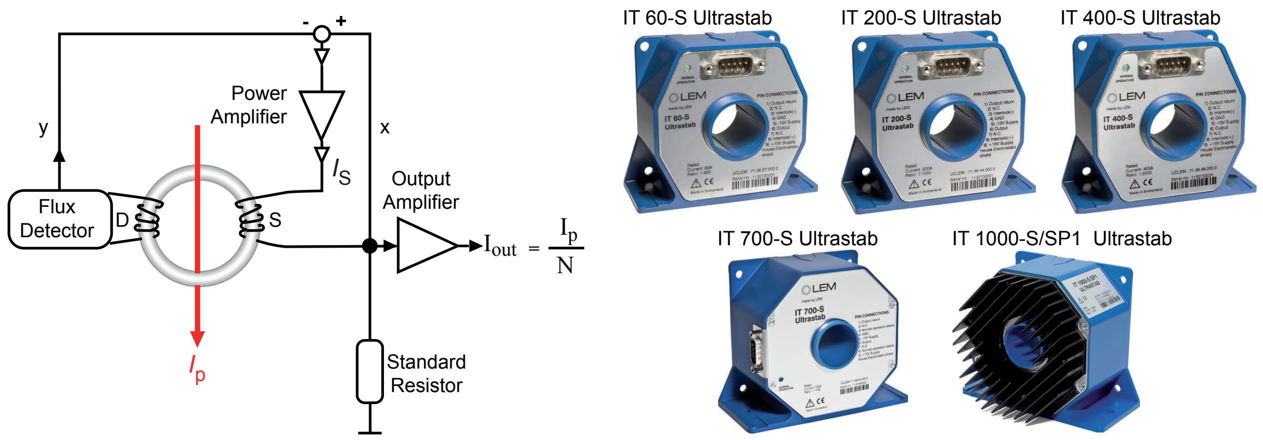


Figure 1.32: Simplified block diagram and image

Isolation	150 V RMS reinforced isolation 300 V RMS single isolation				
Linearity	≤ 3 ppm				
Temperature coefficient of I_{oe}	≤ 0.5 ppm/°C (± 0.9 ppm / °F)				
Supply voltages	+ 15 V (± 5%) and - 15 V (± 5%), ≤ 80 mA + I_s				
Original manufacturers part number	LEM ULTRASTAB series				
Operating temperature range	10 °C to +50 °C (50 °F to 122 °F)				
Device	IT 1000-S/SP1	IT 700-S	IT400-S	IT 200-S	IT 60-S
Primary nominal current DC	1000 A DC	700 A DC	400 A DC	200 A DC	60 A DC
Primary nominal current AC	707 A RMS	495 A RMS	282 A RMS	141 A RMS	42 A RMS
Secondary nominal current DC	1000 mA DC	400 mA RMS	200 mA RMS	200 mA RMS	100 mA DC
Conversion ratio (N)	1000:1	1750:1	2000:1	1000:1	600:1
Burden recommendation	HBR1.0	HBR2.5	HBR2.5	HBR2.5	HBR10.0
dI/dt risetime	≥100 A/μs	≥100 A/μs	≥100 A/μs	≥100 A/μs	≥25 A/μs
Small signal bandwidth (-3 dB)	500 kHz	500 kHz	500 kHz	500 kHz	800 kHz
Weight (typical)	1.0 kg (35.3 oz)	0.8 kg (28.2 oz)	0.3 kg (10.6 oz)	0.3 kg (10.6 oz)	0.3 kg (10.6 oz)
Dimensions					
Cable diameter	30 mm (1.18")	30 mm (1.18")	26 mm (1.02")	26 mm (1.02")	26 mm (1.02")
Width	128 mm (5,03")	128 mm (5,03")	93 mm (3,66")	93 mm (3,66")	93 mm (3,66")
Height	106 mm (4,17")	106 mm (4,17")	77.7 mm (3,05")	77.7 mm (3,05")	77.7 mm (3,05")
Depth	85 mm (3,34")	67 mm (2,63")	57 mm (2,24")	57 mm (2,24")	57 mm (2,24")

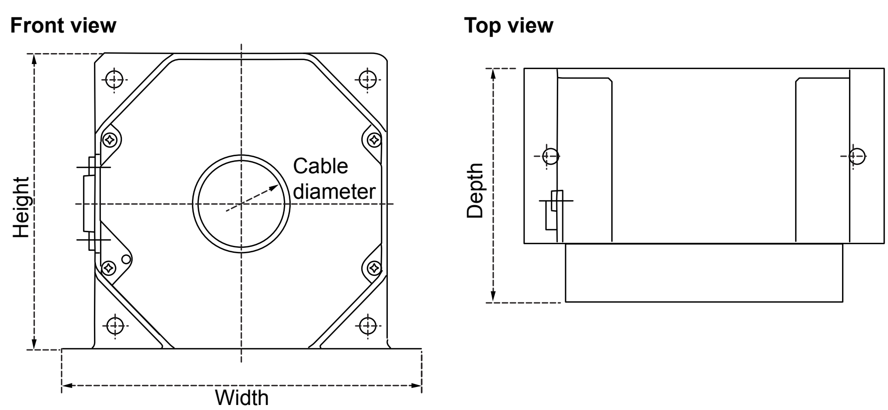


Figure 1.33: Dimensions

Gxxx: Power Supply for Current Transducer (Option, to be ordered separately)

Empty modular 19” rack with 1 to maximum 6 channel CT support. Housing for the modular power supply and control for LEM current transducers.

Figure 1.34: Front side (left) and rear side (right)

Maximum number of CTs	6
Input connectors	9 pin SUBD
Output connectors	4 mm banana plugs
Signal LEDS	CT Power, CT Status
Power supply	100 to 240 V AC, 47 to 63 Hz @ 650 mA
Weight	Typical 6.5 kg (14.33 lbs) configured with 6 channels
Original manufacturers part number	MCTS
Operating temperature range	0 °C to +50 °C (32 °F to 122 °F)
Dimensions	
Height	132 mm (5.20”)
Width / Width including mounting ears	447 mm (17.56”) / 490 mm (19.25”)
Depth / Depth including handles	256 mm (10.08”) / 276 mm (10.87”)

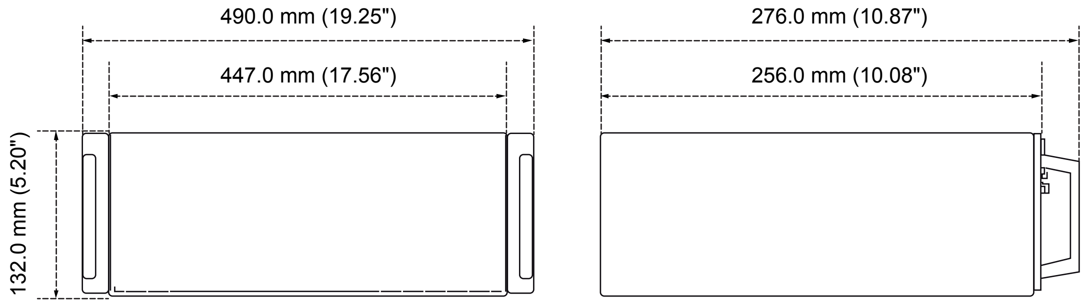


Figure 1.35: Dimensions

Current Transducer (CT) Wire Diagram

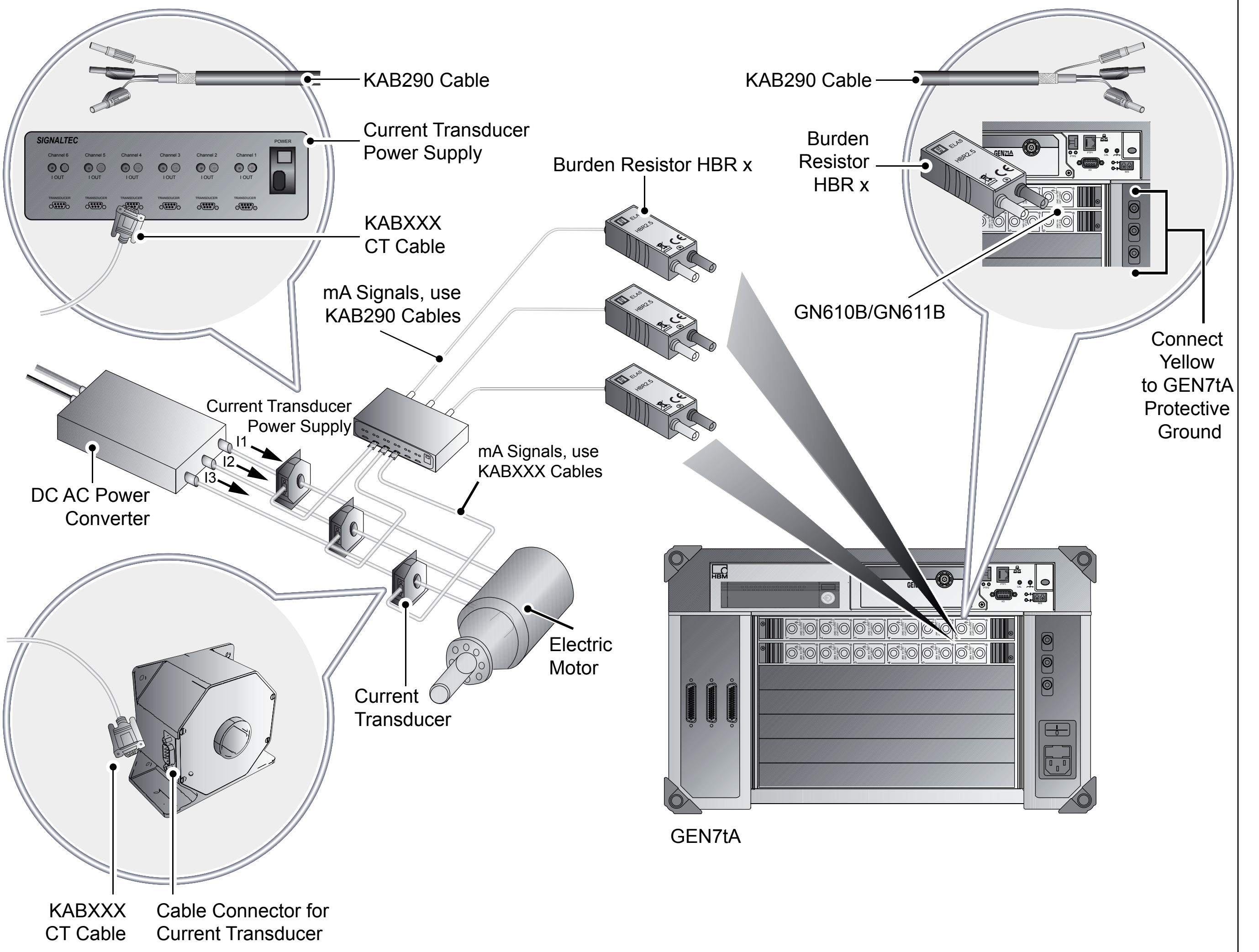
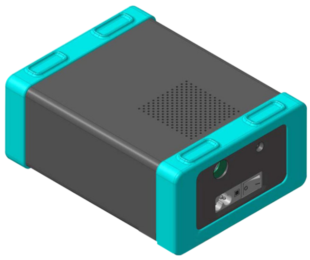


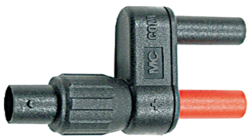
Figure 1.36: Current transducer connection diagram

Ordering Information[1]			
Article		**Description**	**Order No.**
Basic 1 kV ISO 2 MS/s		6 channels, 18 bit, 2 MS/s, ± 20 mV to ± 1000 V input range, 2 GB RAM, 1 kV isolated balanced differential input (600 V RMS CAT II isolation), 4 mm fully isolated banana plugs. Real-time cycle based calculators with triggering on calculated results Supported by Perception V6.30 and higher	1-GN610-2

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

Special Voltage Probes, to be ordered separately			
Article		**Description**	**Order No.**
1 kV DC, 10 MΩ, 10:1 differential probe		1 kV DC, 10 MΩ, 10:1, 0.2% high precision differential probe to be used in combination with GN610, GN611, GN610B and GN611B acquisition cards. Reduces the resistive/current load on the device under test by increasing the input impedance to 10 MΩ. The use of the 10:1 divider reduces the lowest range of the acquisition card to ± 0.1 V (± 0.2 V GN610/GN611). The highest input range remains at ± 1000 V due to the maximum voltage rating of the probe.	Ordered from custom systems[1]
5 kV RMS, 20 MΩ, 50:1 differential probe		5 kV RMS, 20 MΩ, 50:1, 0.2% high precision, differential probe to be used in combination with GN610, GN611, GN610B and GN611B acquisition cards. The built-in earthing monitor system increases safety of the user and protects the GEN series inputs for isolation overloads.	Ordered from custom systems[1]

(1) Contact custom systems at: customsystems@hbm.com
Request quote/information for special products for GEN series.

Accessories, to be ordered separately			
Article		**Description**	**Order No.**
Isolated shielded test leads		Black/red lead set combined within shielded housing (Yellow). 600 V RMS CAT II, safety-shrouded stackable banana plugs. Significantly reduces signal disturbance pickup on GN610/ GN611/GN610B/GN611B cards by using two identical signal wires with earthed shield. Do not use for 3 wire connections! Available lengths: 1.5 m (4.92 ft), 3.0 m (9.84 ft) and 6.0 m (19.69 ft)	1-KAB290-1.5 1-KAB290-3 1-KAB290-6
Test Leads and clips		Black/red lead set 600 V RMS CAT II, 1.5 meter (4.9 ft) with safety-shrouded banana plugs and alligator clips For better noise immunity, HBM recommends to use KAB290 in stead of this cables set.	1-KAB282-1.5
BNC to banana adapter		Set of six pieces, safety isolated female BNC to dual 4 mm protected banana adapter. 1000 V RMS CAT II, 600 V RMS CAT III and 1 A current safety ratings. Can be used with GN610/GN611/GN610B/GN611B input cards.	1-G067-2
Artificial star adapter		The artificial star adapter is a plug-on interface card to measure 3 phase signals with the GN610/GN611/GN610B/GN611B cards. This adapter is intended for measuring 3 phase signals while creating a virtual/artificial star point.	1-G068-2

Current Sensors, to be ordered separately			
Article		**Description**	**Order No.**
Ultrastab 60 A RMS current transducer		LEM IT 60-S Ultrastab. 60 A DC, 42 A RMS current transducer with 800 kHz bandwidth. Recommended burden resistor HBR10.0. Resulting ratio 60 A/V (16.6667 mV/A).	Ordered from custom systems(1)
Ultrastab 200 A RMS current transducer		LEM IT 200-S Ultrastab. 200 A DC, 141 A RMS current transducer with 500 kHz bandwidth. Recommended burden resistor HBR2.5. Resulting ratio 400 A/V (2.5 mV/A).	Ordered from custom systems(1)
Ultrastab 400 A RMS current transducer		LEM IT 400-S Ultrastab. 400 A DC, 282 A RMS current transducer with 500 kHz bandwidth. Recommended burden resistor HBR2.5. Resulting ratio 800 A/V (1.25 mV/A).	Ordered from custom systems(1)
Ultrastab 700 A RMS current transducer		LEM IT 700-S Ultrastab. 700 A DC, 495 A RMS current transducer with 500 kHz bandwidth. Recommended burden resistor HBR2.5. Resulting ratio 700 A/V (1.4286 mV/A).	Ordered from custom systems(1)
Ultrastab 1000 A RMS current transducer		LEM IT 1000-S Ultrastab. 1000 A DC, 707 A RMS current transducer with 500 kHz bandwidth. Recommended burden resistor HBR1.0. Resulting ratio 1000 A/V (1.0 mV/A).	Ordered from custom systems(1)
Connection cable LEM CT to MCTS		Connection cable between LEM current transducer and MCTS power supply. Available in lengths of 2.5 m (8.20 ft), 5 m (16.40 ft) and 10 m (32.81 ft).	Ordered from custom systems(1)
MCTS 19" rack for power supply for LEM CT		Empty mainframe for power supply and control for LEM current transducers. Modular 19” rack with 1 to maximum 6 channel CT support. 100….240 V, 47…63 Hz AC input.	Ordered from custom systems(1)
HBR 1 Ω, 1 W precision burden resistor		1 Ω, 1 W, 0.02% high precision, low thermal drift burden resistor. Internally uses 4 wire connection to reduce inaccuracy caused by the currents running to the burden resistor. Using banana input connectors and banana output pins. Directly compatible with GN610, GN611, GN610B and GN611B acquisition cards.	Ordered from custom systems(1)

Current Sensors, to be ordered separately

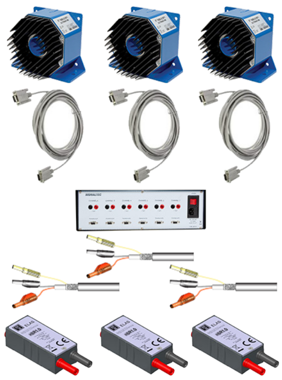
Article		Description	Order No.
HBR 2.5 Ω, 1 W precision burden resistor		2.5 Ω, 1 W, 0.02% high precision, low thermal drift burden resistor. Internally uses 4 wire connection to reduce inaccuracy caused by the currents running to the burden resistor. Using banana input connectors and banana output pins. Directly compatible with GN610, GN611, GN610B and GN611B acquisition cards.	Ordered from custom systems(1)
HBR 10 Ω, 1 W precision burden resistor		10 Ω, 1 W, 0.02% high precision, low thermal drift burden resistor. Internally uses 4 wire connection to reduce inaccuracy caused by the currents running to the burden resistor. Using banana input connectors and banana output pins. Directly compatible with GN610, GN611, GN610B and GN611B acquisition cards.	Ordered from custom systems(1)

(1) Contact custom systems at: customsystems@hbm.com
Request quote/information for special products for GEN series.

Current Measurement Solutions, to be ordered separately

3 phase 60 A RMS current solution		Package consisting of 3 * LEM IT 60-s current transducers, 1 * MCTS 19" rack with built-in 3 * power supply and CT control, 3 * MCTS to CT connection cable 10 m (32.81 ft), 3 * KAB290 3.0 m (9.84 ft) and 3 * HBR10.0 burden resistor	Ordered from custom systems(1)
1 phase 60 A RMS current extension		Package consisting of 1 * LEM IT 60-s current transducers, 1 * power supply and CT control, 1 * MCTS to CT connection cable 10 m (32.81 ft), 1 * KAB290 3.0 m (9.84 ft) and 1 * HBR 10.0 burden resistor. One extension channel for the 3 phase 60 A RMS current solution. Factory installed and must be ordered together with the 3 phase 60 A RMS current solution.	Ordered from custom systems(1)
3 phase 200 A RMS current solution		Package consisting of 3 * LEM IT 200-s current transducers, 1 * MCTS 19" rack with built-in 3 * power supply and CT control, 3 * MCTS to CT connection cable 10 m (32.81 ft), 3 * KAB290 3.0 m (9.84 ft) and 3 * HBR2.5 burden resistor	Ordered from custom systems(1)
1 phase 200 A RMS current extension		Package consisting of 1 * LEM IT 200-s current transducers, 1 * power supply and CT control, 1 * MCTS to CT connection cable 10 m (32.81 ft), 1 * KAB290 3.0 m (9.84 ft) and 1 * HBR2.5 burden resistor. One extension channel for the 3 phase 200 A RMS current solution. Factory installed and must be ordered together with the 3 phase 200 A RMS current solution.	Ordered from custom systems(1)

Current Measurement Solutions, to be ordered separately

3 phase 400 A RMS current solution		Package consisting of 3 * LEM IT 400-s current transducers, 1 * MCTS 19" rack with built-in 3 * power supply and CT control, 3 * MCTS to CT connection cable 10 m (32.81 ft), 3 * KAB290 3.0 m (9.84 ft) and 3 * HBR2.5 burden resistor	Ordered from custom systems(1)
1 phase 400 A RMS current extension		Package consisting of 1 * LEM IT 400-s current transducers, 1 * power supply and CT control, 1 * MCTS to CT connection cable 10 m (32.81 ft), 1 * KAB290 3.0 m (9.84 ft) and 1 * HBR2.5 burden resistor. One extension channel for the 3 phase 400 A RMS current solution. Factory installed and must be ordered together with the 3 phase 400 A RMS current solution.	Ordered from custom systems(1)
3 phase 700 A RMS current solution		Package consisting of 3 * LEM IT 700-s current transducers, 1 * MCTS 19" rack with built-in 3 * power supply and CT control, 3 * MCTS to CT connection cable 10 m (32.81 ft), 3 * KAB290 3.0 m 9.84 ft and 3 * HBR2.5 burden resistor	Ordered from custom systems(1)
1 phase 700 A RMS current extension		Package consisting of 1 * LEM IT 700-s current transducers, 1 * power supply and CT control, 1 * MCTS to CT connection cable 10 m (32.81 ft), 1 * KAB290 3.0 m (9.84 ft) and 1 * HBR2.5 burden resistor. One extension channel for the 3 phase 700 A RMS current solution. Factory installed and must be ordered together with the 3 phase 700 A RMS current solution.	Ordered from custom systems(1)
3 phase 1000 A RMS current solution		Package consisting of 3 * LEM IT 1000-s current transducers, 1 * MCTS 19" rack with built-in 3 * power supply and CT control, 3 * MCTS to CT connection cable 10 m (32.81 ft), 3 * KAB290 3.0 m (9.84 ft) and 3 * HBR1.0 burden resistor	Ordered from custom systems(1)
1 phase 1000 A RMS current extension		Package consisting of 1 * LEM IT 1000-s current transducers, 1 * power supply and CT control, 1 * MCTS to CT connection cable 10 m (32.81 ft), 1 * KAB290 3.0 m (9.84 ft) and 1 * HBR2.5 burden resistor. One extension channel for the 3 phase 1000 A RMS current solution. Factory installed and must be ordered together with the 3 phase 1000 A RMS current solution.	Ordered from custom systems(1)

(1) Contact custom systems at: customsystems@hbm.com
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