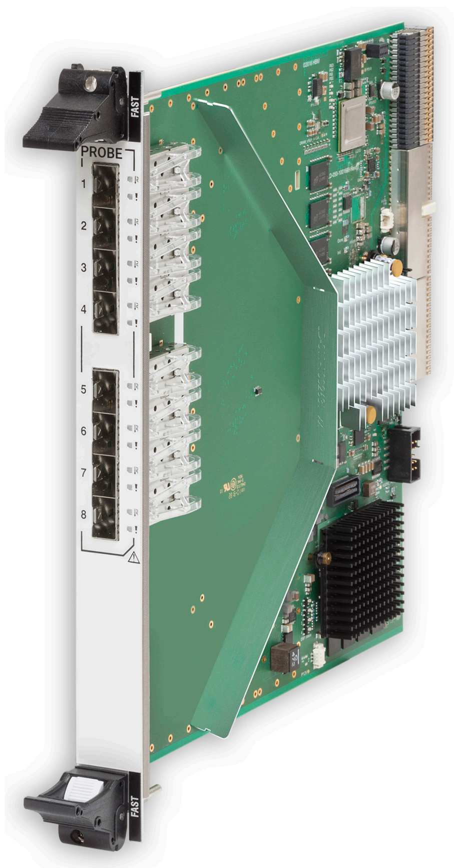
HOTTINGER BRÜEL & KJÆR

DATA SHEET

GEN series GN800B power analyzer card
Voltage, current & power measurements with Remote Probes

SPECIAL FEATURES

- Power analyzer card for Remote Probes
- Supports up to two Remote Probes at sampling rates up to 20 MS/s, or alternatively up to four Remote Probes at up to 4 MS/s.
  - Flexible channel configuration: Supports every mix of Voltage and Current Remote Probes
- Digital fiber optic connection
  - Highest possible user and instrument safety
  - No EMC issues, no noise, no drift
  - Up to 100m fiber optical cable length with automatic optical fiber cable length phase compensation
- Four Timer/Counter inputs for two torque /speed transducers
- Versatile and powerful data recording modes
  - Continuous recording to mainframe or PC hard drive
  - Triggered on-board storage to 8 GB RAM
  - Multi-sweep acquisition for Motor-Mapping
  - Mixed mode acquisition with sample rate switch
- Real-time capabilities with sample rates up to 4 MS/s (1)
  - All standard power calculations like: RMS, P, S, Q, λ, η, cosφ, THD, and much more
  - Mechanical power, “dual torque” and torque ripple calculation
  - User defined formulas
  - Result transfer to automation systems or HiL controllers with typically < 1 ms latency
  - Trigger on calculated results



GN800B FUNCTIONS AND BENEFITS

The GN800B power analyzer card can connect to up to four Remote Probes via optical fiber cables. The digital transmission does not add any drift or error to the measured signal while an automatic cable length compensation ensures phase-matched signals between Remote Probes.
Combining a Voltage and a Current Remote Probe create power channels. Due to the fiber optic connection, high voltage tests are always safe for the user and the main instrument while EMC issues are minimized.

The real-time formula database of the power analyzer card comes with all standard formulas for real-time power calculations up to 4 MS/s(1), while user-defined formulas are also possible.
Digital cycle detection enables dynamic power calculations with up to 2000 results/s, with a typical latency < 1 ms and real-time bus transfer.
All raw data including real-time results can be stored continuously or in a triggered mode for applications like real-time machine mapping.

(1) Sample rate above 2 MS/s only in combination with Remote Probes P201I-4, P211I-4 and P212I-4.

System Setup for Power Analysis using Remote Probes

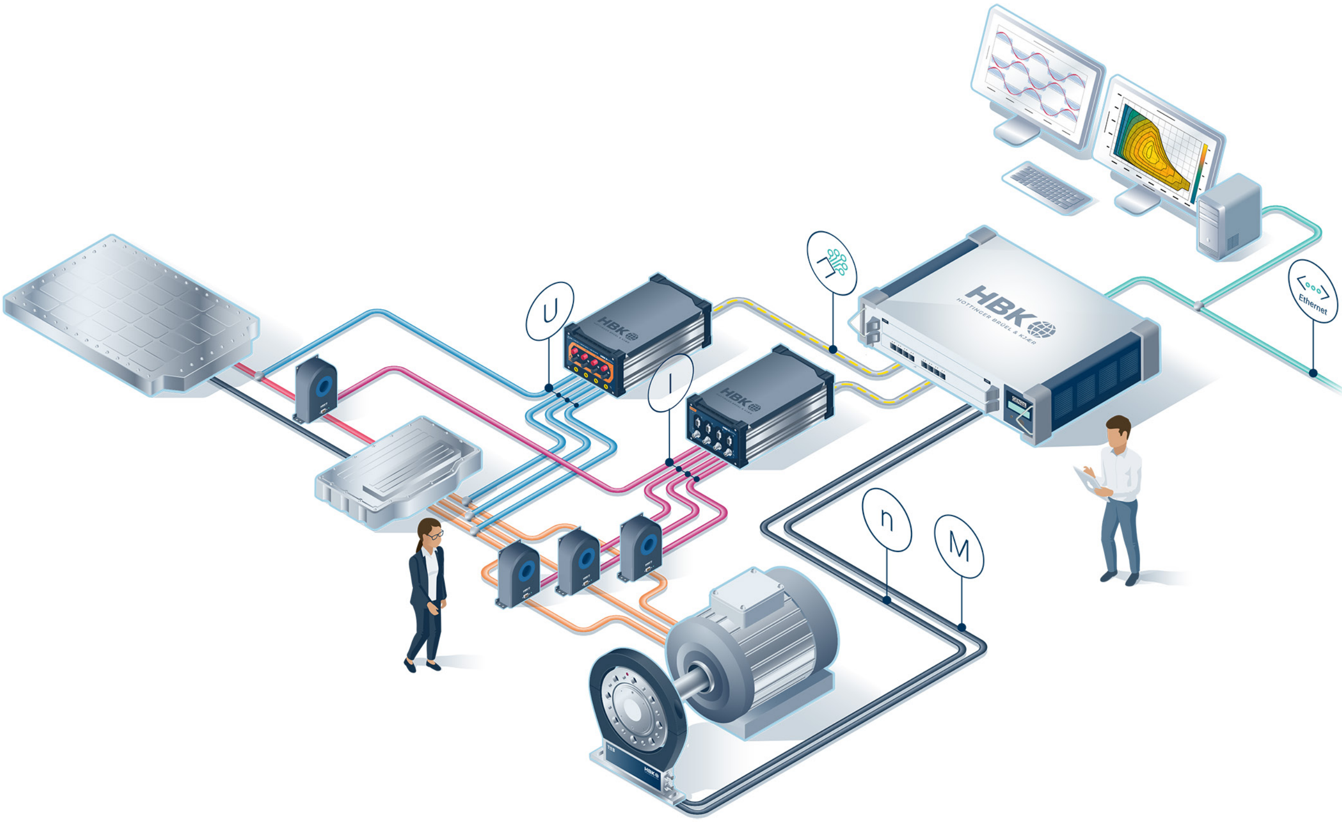


Figure 1: Power analysis using Remote Probes diagram

Capabilities Overview		
Model	**GN800B**	
Remote Probe models	20 MS/s: P201I-4, P211I-4 and P212I-4 2 MS/s: P101I-4, P111I-4 and P112I-4	
Number of Remote Probes	Max. 2 Remote Probes, all configurations possible Max. 4 Remote Probes at maximum sample rate of 4 MS/s (Perception v8.82 or higher required)	
Maximum sample rate per channel	20 MS/s, determined by the connected Remote Probe with the lowest sample rate	
	Configuration examples:	
	2 x Fast Remote Probes: 20 MS/s	4 x Fast Remote Probes: 4 MS/s
Digital Events/Timer/Counter		
Timer/Counter inputs	4, TTL single-ended; Typically used for torque and speed, but also for other frequency-based sensors. A total of two torque/speed transducers can be connected. An optional level converter/ splitter box is available for direct connection to torque and speed sensors with RS422 output (like T12 or T40B)	
Digital event input	16, TTL single-ended	
Real-time formula database		
Functionality	Extensive set of user programmable math routines, executed in real-time; results can be stored, triggered on and transferred via real-time bus	
Maximum sample rate	Two different use cases:	
	≤ 2 Remote Probes: 4 MS/s	> 2 Remote Probes: 2 MS/s (starting with Perception 8.90 - previously 1 MS/s)
Typical calculations	RMS, fundamental RMS P, S, Q, λ, η, cosφ, THD, Harmonics, Phasors, Space vectors, dq0 transformation, Torque, instantaneous torque and torque ripple Mechanical angle, electrical angle, speed, mechanical power, etc.	
Raw data storage		
Storage to on-board RAM	Full sample rate all channels to 8 GB (4 MS) on-board RAM; Storage time limited by memory size; Sweep memory divides by number of used channels; Example: with 8 channels, sweep memory is 450 MS per channel	
Streaming to PC or mainframe SSD	Full sample rate all channels to mainframe SSD or PC hard disk; potentially limited by mainframe, see mainframe data sheet	
Result storage and transfer		
Result storage	In PNRF recording file and (via Perception) in separate CSV or XML file on PC	
Result transfer – EtherCAT® option	1000 result blocks/s in real time with typically < 1 ms latency	
Result transfer – CAN FD option	1000 result blocks/s	
Result transfer – API	2000 result blocks/s	
Result transfer – XCP on Ethernet	2000 result blocks/s	

Mainframe Support

<table>
<tr><th></th><th>GEN2tB</th><th>GEN4tB</th><th>GEN7tA / GEN7tB</th><th>GEN17tA / GEN17tB</th><th>GEN3iA</th><th>GEN7iA</th></tr>
<tr><td>GN800B</td><td colspan="6">Yes</td></tr>
<tr><td>GEN DAQ API</td><td colspan="4">Yes</td><td colspan="2">Yes (1)</td></tr>
<tr><td>EtherCAT®</td><td>No</td><td colspan="3">Yes</td><td colspan="2">No</td></tr>
<tr><td>CAN/CAN FD</td><td colspan="4">Yes</td><td colspan="2">No</td></tr>
<tr><td>XCP</td><td colspan="4">Yes</td><td colspan="2">No</td></tr>
<tr><td>Real-time calculation sample rate > 2 MS/s</td><td>No</td><td>Yes (2)</td><td>Yes (2)</td><td>Yes (2)</td><td>No</td><td>Yes (2)</td></tr>
</table>

(1) Close Perception to enable GEN DAQ API access.

(2) Only supported for mainframes with local storage

Supported Digital Sensors (TTL Level Input)

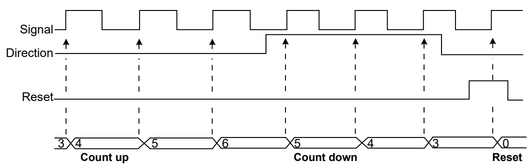
<table>
<tr><th>Timer counter Input type</th><th>Supported digital sensors</th><th>Features</th></tr>
<tr><td>

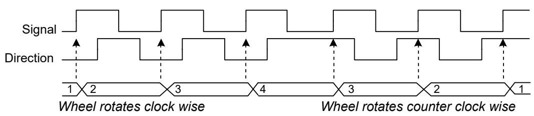
Figure 2: Uni and Bi-directional clock</td><td>• HBK Torque sensors
• Torque sensors
• Speed sensors
• Position sensors</td><td>• Angle measurement
• Frequency / RPM measurement
• Count/position measurement
• Count frequency up to 5 MHz
• Digital filter on input signals
• Several reset options
• RT-FDB can add a calculated Frequency/ RPM channel based on the angle measurement</td></tr>
<tr><td>

Figure 3: ABZ Incremental Encoder (Quadrature)</td><td>• HBK Torque sensors
• Torque sensors
• Speed sensors
• Position sensors</td><td>• Angle measure
• Frequency / RPM measurement
• Count/position measurement
• Count frequency up to 2 MHz
• Digital filter on input signals
• Single, dual and quad precision count
• Transition tracking to avoid count drift
• Several reset options
• RT-FDB can add a calculated Frequency/ RPM channel based on the angle measurement</td></tr>
</table>

Block Diagram

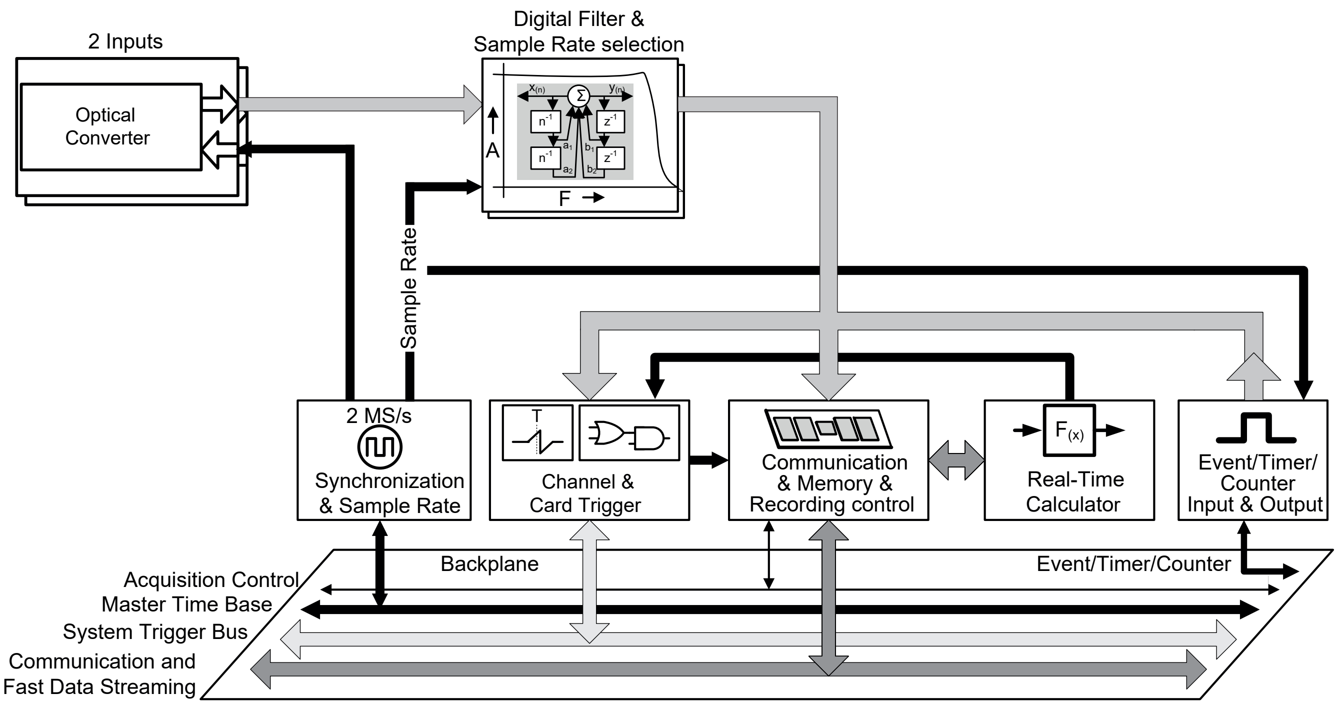


Figure 4: Block diagram

Digital Event/Timer/Counter

The Digital Event/Timer/Counter input connector is located on the mainframe. For exact layout and pinning see mainframe data sheet.

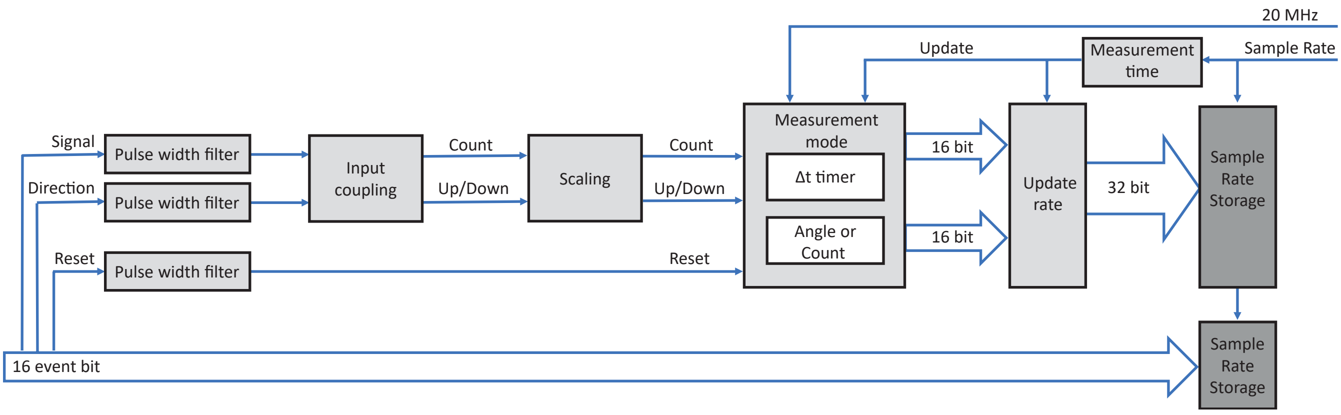


Figure 5: Timer/Counter block diagram

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 of card is activated, low when not activated 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	4 per card
Levels	TTL input levels
Inputs	3 pins: signal, reset and direction All pins are shared with digital event inputs
Input coupling	Uni-directional, Bi-directional and ABZ incremental encoder (Quadrature)
Measurement modes	Count (C) Angle (0 to 360 degrees) Frequency (Δcount / Δt) RPM (Δcount / Δt / 60 s)
Timer accuracy	± 25 ns (20 MHz)
Measurement time	1 to n samples (User selectable maximum Δt)
Measurement time and reading update rate	Measurement time sets the maximum update rate of the Measurement values
Measurement time and minimum frequency	Minimum measured frequency or RPM = 1 / Measurement time

Input Coupling Uni- and Bi-directional Signal	
Uni- and bi-directional input coupling is used when the direction signal is a stable signal.	

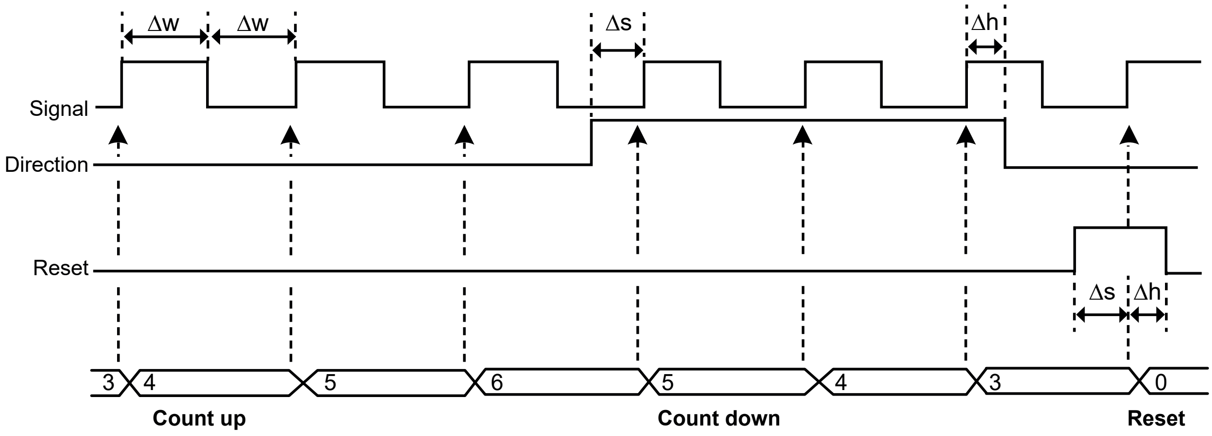


Figure 6: Uni- and Bi-directional timing

Inputs	3 pins: signal, reset and direction (only used in bi-directional count)
Minimum pulse width filter	100 ns, 200 ns, 500 ns, 1 µs, 2 µs, 5 µs
Maximum input signal frequency	4 MHz
Minimum pulse width (Δw)	100 ns
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 mode Low: increment counter/positive frequency High: decrement counter/negative frequency
Minimum setup time prior to signal edge (Δs)	100 ns
Minimum hold time after signal edge (Δh)	100 ns

Input Coupling ABZ Incremental Encoder (Quadrature)

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 HBK torque and speed transducers.

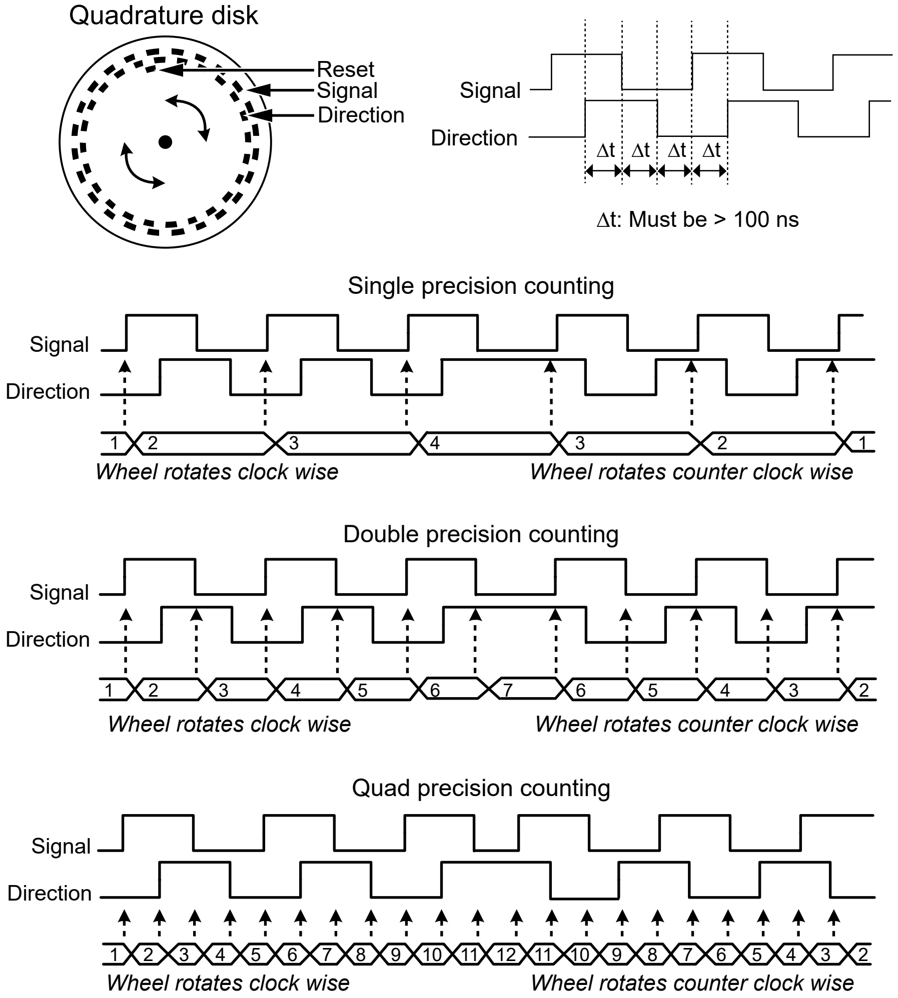


Figure 7: Bi-directional quadrature count modes

Inputs	3 pins: signal, direction and reset
Minimum pulse width filter	100 ns, 200 ns, 500 ns, 1 µs, 2 µs, 5 µs
Maximum input signal frequency	2 MHz
Minimum pulse width	200 ns (2 * Δt)
Minimum setup time	100 ns (Δt)
Minimum hold time	100 ns (Δt)
Accuracy	Single (X1), dual (X2) or quad (X4) precision
Input coupling	ABZ incremental encoder (Quadrature)
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.

Measurement 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.

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/count resolution
Maximum pulses per rotation	32767
Maximum RPM	30 * sample rate (Example: Sample rate 10 kS/s means maximum 300 k RPM)

Measurement Mode Frequency/RPM

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

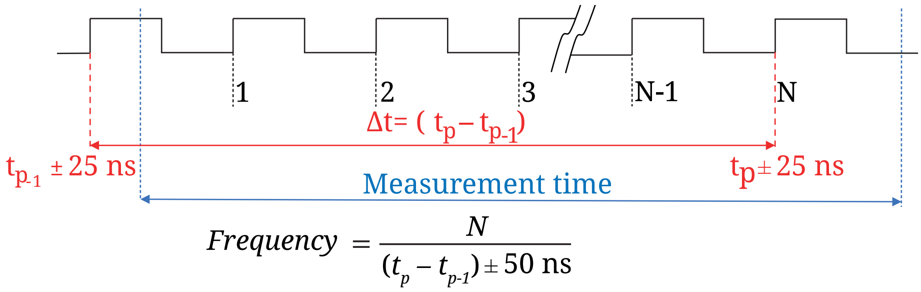


Figure 8: Frequency measurement

Accuracy	0.1%, when using a measurement time of 40 µs or more. With lower measurement times, the real-time calculators or Perception formula database can be used to enlarge the measurement time and improve the accuracy more dynamically e.g. based on measured cycles.
Measurement time	Sample period (1 / sample rate) to 50 s. Minimum measurement time is 50 ns. Can be selected by user to control update rate independent of sample rate

Measurement Mode Count/Position

Count/position mode is typically used for tracking movement of device under test.
To reduce the sensitivity for count/position errors due to clock glitches use the minimum pulse width filter or enable the ABZ in stead of uni-/bipolar input coupling.

Counter range	0 to 2^{31}; uni-directional count -2^{31} to $+2^{31}$ - 1; bi-directional count

Frequency Measurement Inaccuracy

Frequency measurement accuracy is a tradeoff between update rate and minimum required accuracy. This table shows the relationships between measured signal frequency, selected measurement time (update rate) and frequency accuracy. The inaccuracy distribution is to be considered rectangular.

Calculate the inaccuracy by using:(1)

$$Inaccuracy = \pm \frac{Signal\ frequency * \left(CEILING\left(\frac{Measuring\ time}{30000 * 50\ ns}\right)\right) * 50\ ns}{Frequency\ prescaler * FLOOR\left(\frac{Signal\ frequency * Measuring\ time}{Frequency\ prescaler}\right)} * 100\%$$

Measurement time	Higher signal frequencies: Signal frequency 2 MHz down to 10 kHz										
	Worst case (in %)	2 MHz	1 MHz	500 kHz	400 kHz	200 kHz	100 kHz	50 kHz	40 kHz	20 kHz	10 kHz
1 µs	±10.000 @ ~2 MHz(2)	±5.000%									
2 µs	±5.000 @ ~1 MHz(2)	±2.500%									
5 µs	±2.000 @ ~400 kHz(2)	±1.000%		±1.250%	±1.000%						
10 µs	±1.000 @ ~200 kHz(2)	±0.500%									
20 µs	±0.500 @ ~100 kHz(2)	±0.250%									
50 µs	±0.200 @ ~40 kHz(2)	±0.100%						±0.125%	±0.100%		
100 us	±0.100 @ ~20 kHz(2)	±0.050%									
200 us	±0.050 @ ~10 kHz(2)	±0.0250%									
500 us	±0.020 @ ~4 kHz(2)	±0.0100%									
1 ms	±0.0100 @ ~2 kHz(2)	±0.0050%									
2 ms	±0.0100 @ ~1 kHz(2)	±0.0050%									
5 ms	±0.0080 @ ~400 Hz(2)	±0.0040%									
10 ms	±0.0070 @ ~200 Hz(2)	±0.0035%									
20 ms	±0.0070 @ ~100 Hz(2)	±0.0035%									
50 ms	±0.0068 @ ~40 Hz(2)	±0.0034%									
100 ms	±0.0067 @ ~20 Hz(2)	±0.00335%									
Measurement time	**Lower signal frequencies: Signal frequency 5 kHz down to 40 Hz**										
	Worst case (in %)	**5 kHz**	**4 kHz**	**2 kHz**	**1 kHz**	**500 Hz**	**400 Hz**	**200 Hz**	**100 Hz**	**50 Hz**	**40 Hz**
500 us	±0.0200 @ ~4 kHz(2)	±0.0125%	±0.0100%								
1 ms	±0.0100 @ ~2 kHz(2)	±0.0050%									
2 ms	±0.0100 @ ~1 kHz(2)	±0.0050%									
5 ms	±0.0080 @ ~400 Hz(2)	±0.0040%				±0.00500%	±0.0040%				
10 ms	±0.0070 @ ~200 Hz(2)	±0.0035%									
20 ms	±0.0070 @ ~100 Hz(2)	±0.0035%									
50 ms	±0.0068 @ ~40 Hz(2)	±0.0034%								±0.0043%	±0.0034%
100 ms	±0.0067 @ ~20 Hz(2)	±0.00335%									

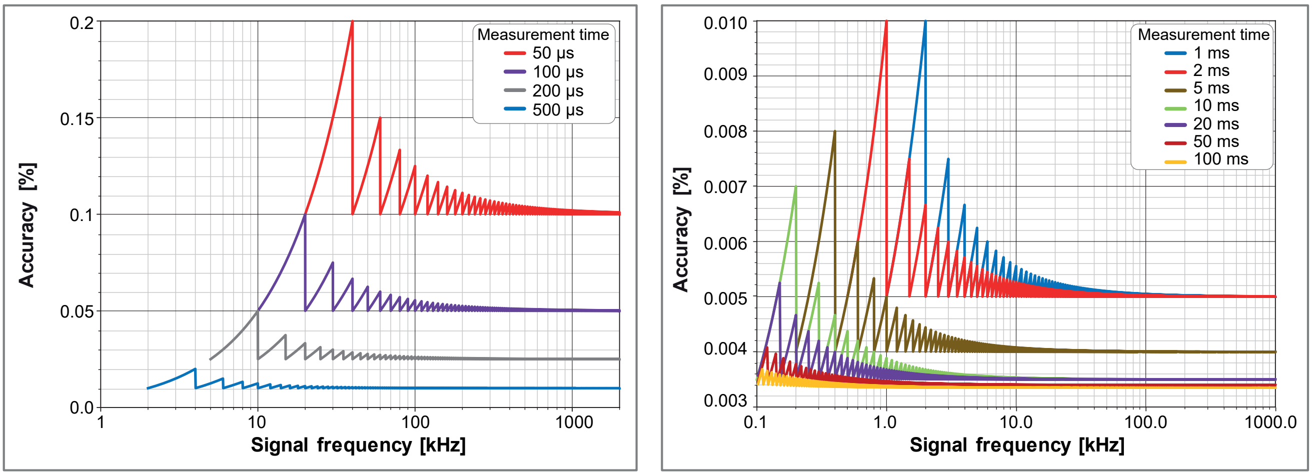


Figure 9: Maximum frequency inaccuracy

(1) Note: Keep the Frequency PreScaler as small as possible for the selected frequency range to get the best accuracy.

(2) The worst case scenario signal frequency is slightly below the displayed value, consistent with the sawtooth pattern observed in Figure 9.

Torque Measurement Uncertainty using Frequency Measurements

When using the Timer/Counter channels to measure torque, the measurement uncertainty introduced by the timer inaccuracies can be calculated using the following examples based on HBK T40 torque transducers.
The T40 torque transducer comes with 3 variants for frequency output: 10 kHz, 60 kHz or 240 kHz center frequency.
From the datasheets you can extract the minimum and maximum frequency output like table below.

T40 Variant	-Full Scale frequency output	+Full Scale frequency output
T40 - 10 kHz	5 kHz	15 kHz
T40 - 60 kHz	30 kHz	90 kHz
T40 - 240 kHz	120 kHz	360 kHz

Overlay these operating ranges on top of the timer inaccuracy plots of Figure 9 will result in Figure 10 (see below).

- Remains the step to balance the update rate (torque bandwidth) versus the torque accuracy required.
- Calculate the inaccuracy using the Full Scale frequency output and desired measurement time.

Selected measurement time	Maximum inaccuracy: T40 - 240 kHZ	Maximum inaccuracy: T40 - 60 kHZ	Maximum inaccuracy: T40 - 10 kHZ
50 µs	0.1167%	0.2000%	Not possible
100 µs	0.0542%	0.0667%	Not possible
500 µs	0.0102%	0.0107%	0.0150%
1 ms	0.0050%	0.0052%	0.0060%
2 ms	0.0050%	0.0051%	0.0055%
5 ms	0.0040%	0.0040%	0.0042%

```
For K=1 (70% probability) use the specified rectangular distribution and the maximum inaccuracy numbers and calculate:
Measurement uncertainty = Maximum inaccuracy * 0.58 (Conversion for rectangular distribution)
```

Measurement uncertainty K=1 (About 70% probability)	Maximum inaccuracy: T40 - 240 kHZ	Maximum inaccuracy: T40 - 60 kHZ	Maximum inaccuracy: T40 - 10 kHZ
50 µs	0.0677%	0.1160%	Not possible
100 µs	0.0314%	0.0387%	Not possible
500 µs	0.0059%	0.0062%	0.0087%
1 ms	0.0029%	0.0030%	0.0035%
2 ms	0.0029%	0.0029%	0.0032%
5 ms	0.0023%	0.0023%	0.0024%

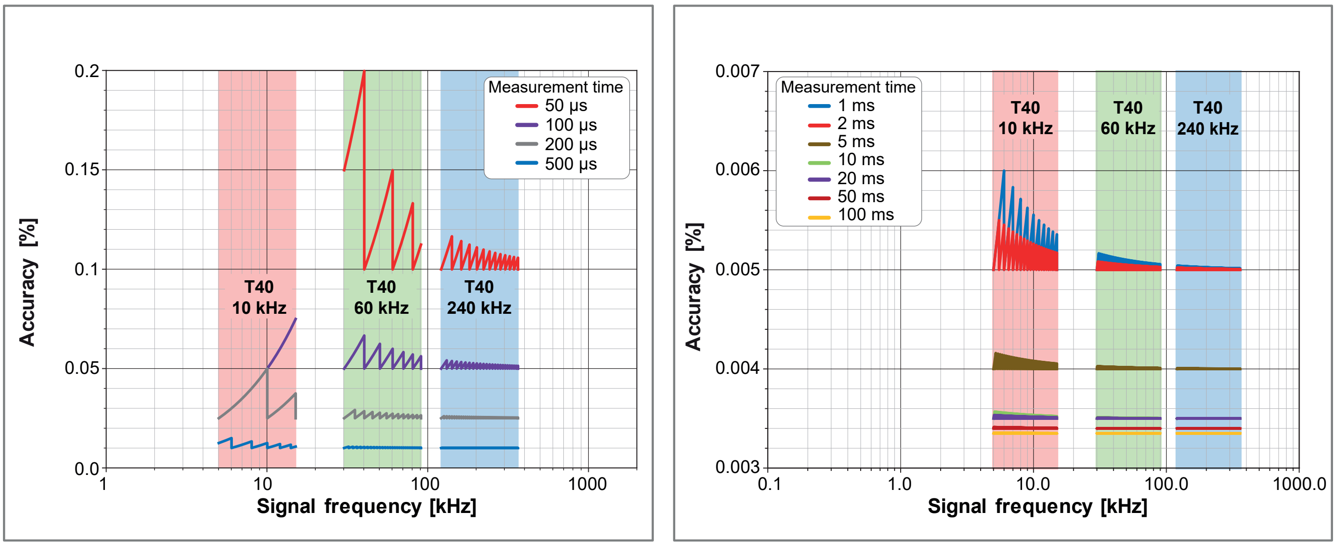


Figure 10: Torque operating range versus inaccuracy and measurement time

Speed (RPM) Measurement Uncertainty using Frequency Measurements

When using the Timer/Counter channels to measure speed (RPM), the measurement uncertainty introduced by the timer inaccuracies can be calculated using the following example.
In the datasheet of the speed sensor locate the specified number of pulse per rotation to calculate the frequency range of the sensor output:

```
Minimum frequency = minimum RPM used during testing * number of pulse per rotation / 60 sec
Maximum frequency = maximum RPM used during testing * number of pulse per rotation / 60 sec
```

Speed Sensor pulse per rotation	Frequency at 60 RPM	Frequency at 10000 RPM	Frequency at 30000 RPM
180	180 Hz	30 kHz	90 kHz
360	360 Hz	60 kHz	180 kHz
1024	1024 Hz	170.7 kHz	512 kHz

Overlay these operating ranges on top of the timer inaccuracy plots of Figure 9 will result in Figure 11 (see below).

- Remains the step to balance the update rate (RPM change updates per second) versus the RPM accuracy required.
- Using the graphs find the crossings of the overlayed operating frequencies with the measurement time curves.
- As examples the following crossings can be found in the graphs (at 60 RPM).

Selected measurement time	180 pulse sensor	360 pulse sensor	1024 pulse sensor
2 ms	Can't record at 60 RPM	Can't record at 60 RPM	0.0051%
5 ms	Can't record at 60 RPM	0.0072%	0.0041%
10 ms	0.0063%	0.0042%	0.0036%

For K=1 (70% probability) use the specified rectangular distribution and the maximum inaccuracy numbers and calculate:

```
Measurement uncertainty = Maximum inaccuracy * 0.58 (Conversion for rectangular distribution)
```

Measurement uncertainty K=1 (About 70% probability)	180 pulse sensor	360 pulse sensor	1024 pulse sensor
2 ms	Can't record at 60 RPM	Can't record at 60 RPM	0.0030%
5 ms	Can't record at 60 RPM	0.0042%	0.0024%
10 ms	0.0037%	0.0024%	0.0021%

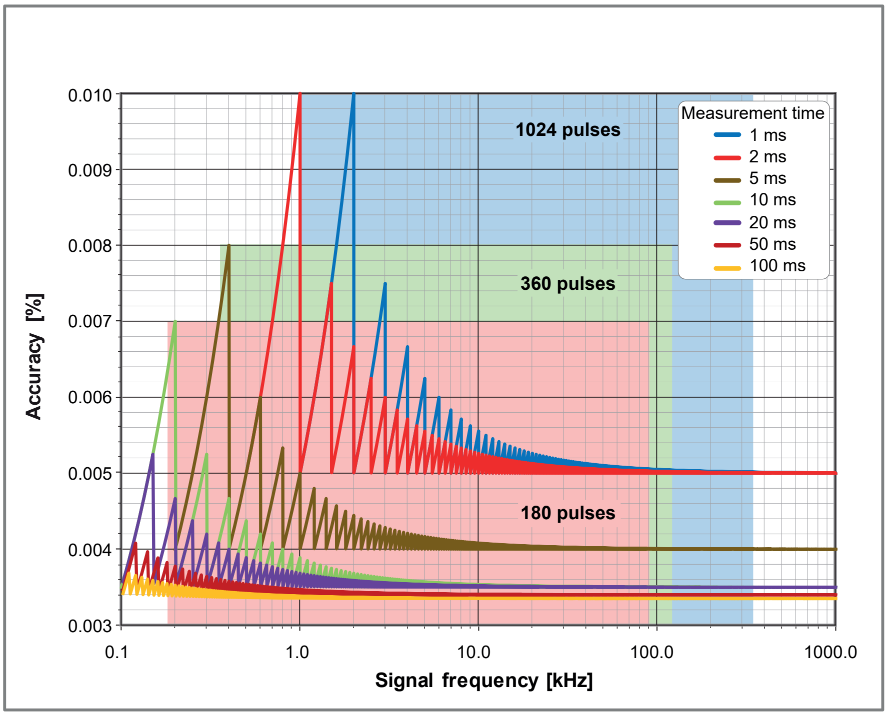


Figure 11: RPM sensor operating range versus inaccuracy and measurement time

Simultaneous Dynamic Torque Ripple and Accurate Torque Efficiency Measurement

If a high update rate is required to measure e.g. dynamic torque ripple yet for efficiency a high accuracy is required use both a measurement time of 50 µs as well as a RT-FDB function to calculate the mean value for each electric cycle.
The measured torque signal coming from the timer counter will be 0.15 to 0.17% accurate, while the torque calculate for the electric cycle (typically being 1 ms or less) results in 0.0075% accuracy.
As both signals are simultaneously available, the dynamic signal allows you to analyse the torque ripple behaviour, the electric cycle signal will be extremely accurate for efficiency calculations.

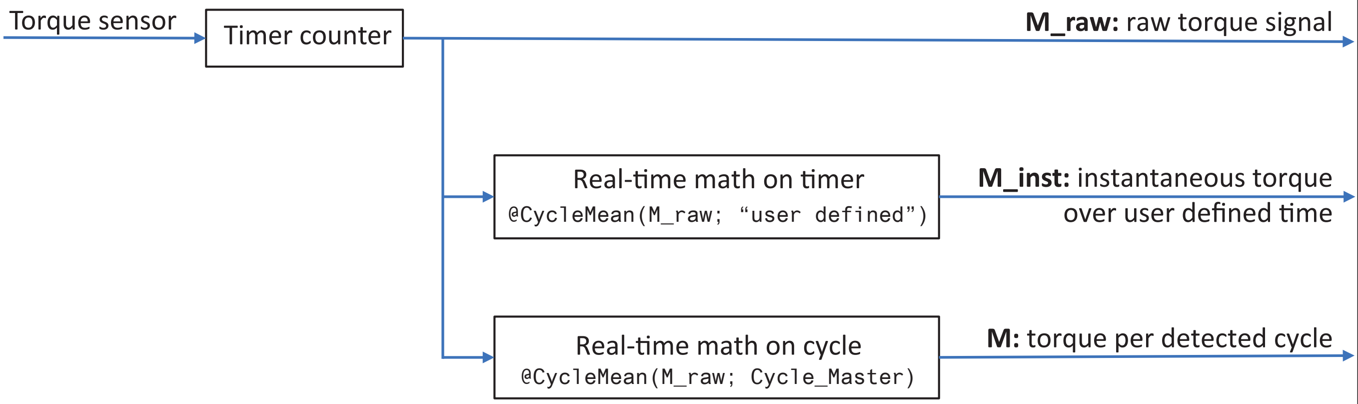


Figure 12: Simultaneous dynamic and accurate torque calculations

ePower signals	Application use	Dynamic response	Accuracy
M_raw	Torque ripple	Highest	Lowest
M_inst	Torque mean	Average	Average
M	Efficiency calculation	Lowest	Highest

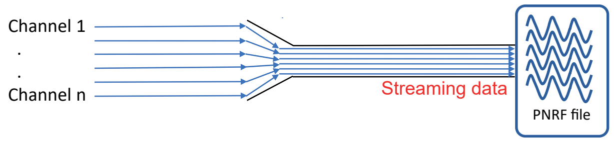
Alarm Output

Event channel alarm modes	High or low level check
Cross channel alarms	Logical OR of alarms from all measured channels
Alarm output	Active during valid alarm condition, output supported through mainframe
Alarm output level	High or low user selectable
Alarm output delay	515 µs ± 1 µs + maximum 1 sample period. Default 516 µs, compatible with standard behavior. Minimum selectable delay is the smallest delay available for all acquisition cards used within the mainframe. Delay equal to Trigger Out delay.
Selection per card	User selectable On/Off
Analog channel alarm modes	
Basic	Above or below level check
Dual	Outside or within bounds check
Analog channel alarm levels	
Levels	Maximum 2 level detectors
Resolution	16 bit (0.0015%) for each level

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
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 data sheet
Trigger Out delay	Selectable (10 µs to 516 µs) ± 1 µs + maximum 1 sample period Default 516 µs, 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 (RT-FDB) Logical AND of qualifiers from all calculated signals (RT-FDB)
Analog channel trigger levels	
Levels	Maximum 2 level detectors
Resolution	16 bit (0.0015%) for each level
Direction	Rising/Falling; single direction control for both levels based on selected mode
Hysteresis	0.1 to 100% of Full Scale; defines the trigger sensitivity
Pulse detect/reject	Disable/Detect/Reject selectable. Maximum pulse width 65 535 samples
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	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, falling edge or both edges
Qualifiers	Active High or Active Low for every event channel

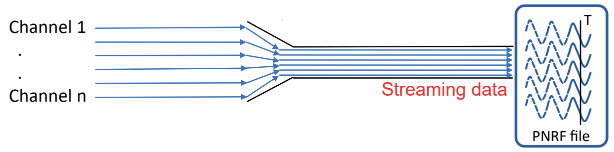
Data Recording Modes

On start of acquisition



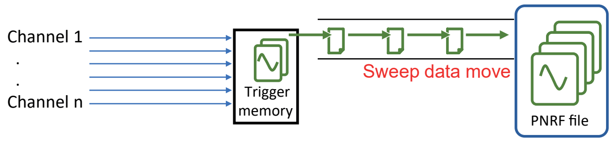
Recorded data is continuously streamed into the recording file on a mainframe or PC drive
Data recording to a drive is limited by an **aggregate sample rate**, the recording time is limited by the **size of drive**.
Note: As the aggregate sample rate limit depends on Ethernet speed and storage drive used, as well as the PC and drive not being used for other purposes as data recording, it is strongly recommended for higher aggregate sample rates to test the chosen setup prior to performing your test.

On trigger



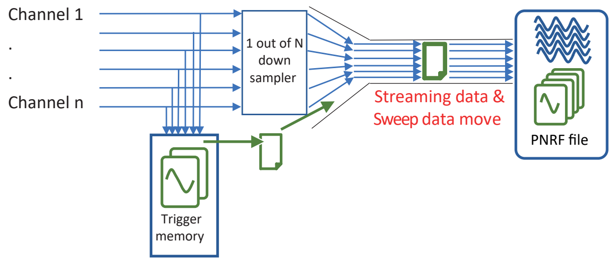
Recorded data is continuously streamed into the recording file on a mainframe or PC drive, but only the data before and after a single trigger event, the so-called 'pre-trigger' and 'post-trigger' data, is retained in the recording file.
Trigger data recording to a drive is limited by an **aggregate sample rate**, the recording time is limited by the size of drive.
Note: As the aggregate sample rate limit depends on Ethernet speed and storage drive used, as well as the PC and drive not being used for other purposes as data recording, it is strongly recommended for higher aggregate sample rates to test the chosen setup prior to performing your test.
Not recommended for transient/one time only/destructive tests.

On trigger - buffered with Low rate Storage disabled



Triggered data recording to trigger memory on the acquisition card.
Triggered data recording to trigger memory has **no sample rate limits**, the recording time is limited by the **size of trigger memory**. Triggered data recorded in trigger memory is moved to a drive as quickly as possible.
Note: This data recording mode guarantees the data will always be recorded according to the user defined settings.
Recommended for transient/one time only/destructive tests.

On trigger - buffered with Low rate Storage enabled

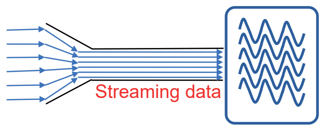


Data recording to PC or mainframe drive and simultaneous triggered data recording to trigger memory on the acquisition card.
The **Low** rate data recording to a drive is limited by an **aggregate sample rate** and the recording time is limited by the **size of drive**. The triggered data recording to trigger memory has **no sample rate limits,** the triggered data recording time is limited by the **size of trigger memory.**
The triggered data recorded in trigger memory is moved to a drive as quickly as possible. As this data move happens simultaneously with the **Low** rate data recording, it uses bandwidth of the aggregate sample rate.
Note: As the aggregate sample rate limit depends on Ethernet speed and storage drive used, as well as the PC and drive not being used for other purposes as data recording, it is strongly recommended for higher aggregate sample rates as well as higher number of triggers per second to test the chosen setup prior to performing your test.

Data Recording Compared

	Aggregate sample rate limit	Maximum recorded data	Direct recording to drive	Trigger memory first	Trigger required to start recording
On start of acquisition	Yes	Free drive space	Yes	No	No
On trigger	Yes	Free drive space	Yes	No	Yes
On trigger - buffered with Low rate Storage disabled	No	Trigger memory	No	Yes	Yes
On trigger - buffered with Low rate Storage enabled	Low rate: Yes	Free drive space	Yes	No	No
	High rate: No	Trigger memory	No	Yes	Yes

Aggregate sample rate limits when using streaming data



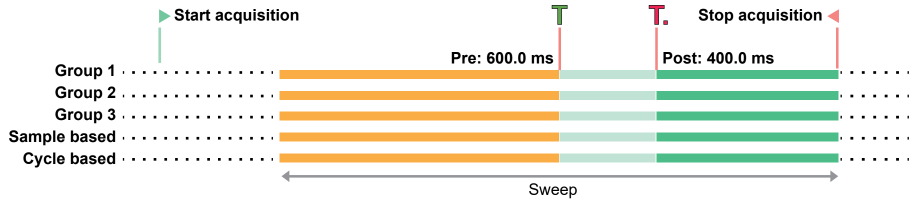
The maximum aggregate streaming rate per mainframe is defined by mainframe type and solid state drive, Ethernet speed, PC drive and other PC parameters.
When an aggregate sample rate is higher than the aggregate streaming rate of the system is selected, the memory on each acquisition card acts as a FIFO. As soon as this FIFO fills up, the recording is suspended (no data is recorded temporarily). During this period, the FIFO memory is transferred to a drive. When all FIFO's are empty, the recording is automatically resumed.
User notifications are added to the recording file for post recording identification of suspended recording.

Triggered Recording Definitions

The details in this table apply to the next recording modes:

- On trigger
- On trigger - buffered with Low rate Storage disabled
- On trigger - buffered with Low rate Storage enabled

Sweep



Defined by a trigger signal, pre- and post-trigger data and optionally between-trigger data and/or stop-trigger signal.

Triggered data segments

Pre-trigger data	Data recorded prior to a trigger signal. **Note:** If a trigger signal is received before the full length of pre-trigger data is recorded, the trigger is accepted and the pre-trigger data recorded is automatically reduced to the available pre-trigger data at the time of the trigger.
Post-trigger data	Data recorded after a trigger or stop-trigger signal. **Note:** The recording of the post-trigger data can be re-started or delayed depending on the "*post-trigger begins on*" selection.
Between-trigger data	Data recorded due to re-trigger(s) or while waiting for the Stop-trigger. The length of between-trigger data is not specified and added based on the timing of the trigger or stop-trigger signals.

Trigger signals

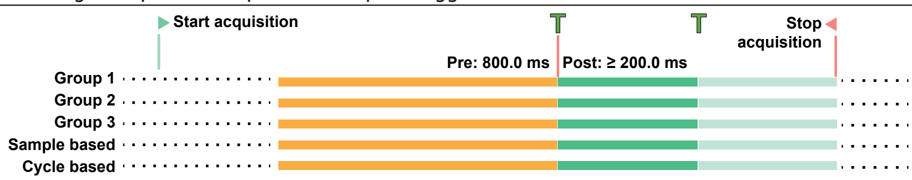
Trigger signal	This signal ends the pre-trigger and starts the post-trigger data recording. See table section "Post-trigger begins on" for more details. A trigger signal can be set up on external input trigger, analog and digital channels as well as using simple to complex RT-FDB formulas.
Stop-trigger signal	This signal starts the post-trigger data recording when in "post-trigger begins on stop-trigger" mode. See table section "Post-trigger begins on" for more details. A stop-trigger signals can be set up on external input trigger and simple to complex RT-FDB formulas.

Post-trigger begins on

First trigger

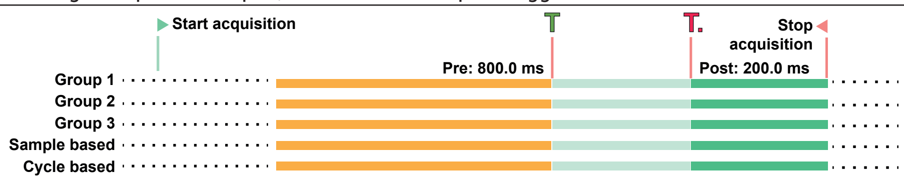
The first trigger signal ends the pre-trigger data recording and starts the recording of the post-trigger data.
Any **trigger** received during the post-trigger data recording is ignored.
Between-trigger data does not exist in this mode.
The resulting sweep contains pre- and the post-trigger data.

Every trigger



The first trigger ends the pre-trigger data recording and starts the recording of the post-trigger data.
Any **trigger** received during the post-trigger data recording restarts the recording of post-trigger data.
All recorded post-trigger data recorded at the time of the trigger is added to the between-trigger data.
The resulting sweep contains pre-, between- and the post-trigger data.

Stop-trigger



The trigger signal ends the pre-trigger data recording and starts the between-trigger data recording. The stop-trigger then ends the between-trigger data recording and starts the post-trigger data recording.
Any **trigger** received during the between-trigger and post-trigger data recording is ignored.
Any **stop-trigger** received during the pre-trigger and post-trigger data recording is ignored.
The resulting sweep contains pre-, between- and the post-trigger data.

Trigger Memory Filled While Recording

The trigger memory is limited in size and can easily get filled when using High rate samples combined with high trigger rates. This section explains how triggers are handled when the trigger memory is completely filled.

Post-trigger begins on	Sweep recording selection
First trigger	A new sweep is only recorded if both pre- and post-trigger data fits in the free trigger memory at the time a trigger signal is received. When not enough free trigger memory is available, only the trigger time and trigger source get recorded (No pre- or post data is recorded).
Every trigger	A new sweep is started using the same rules as for the first trigger mode. If during the post-trigger recording a new trigger is received, the sweep is only extended with new post-trigger data if the additional post-trigger data fits the available free trigger memory. When not enough trigger memory is available, the already recorded pre-, between and post-trigger data for the previously received trigger(s) will be recorded.
Stop-trigger	A new sweep is only recorded if both pre-, 2.5 ms between and post-trigger data fits in the free trigger memory at the time a trigger signal is received. If no stop-trigger signal is received before the trigger memory fills up, the sweep recording is automatically stopped at the time the trigger memory is completely filled.

Triggered Recording Limits

The details in this table apply to the next recording modes:

- On trigger
- On trigger - buffered with Low rate Storage disabled
- On trigger - buffered with Low rate Storage enabled

	On trigger - buffered, independent of Low rate Storage		**On trigger**	
Triggered data recording	Limited recording time		Use available size of drive	
Sample rate	Unlimited sample rates		Low to medium sample rates (Depending on system used)	
Channel count	Unlimited channel count		Low to medium channel counts (Depending on system used)	
Maximum number of sweeps				
In trigger memory	2000		Not applicable	
In PNRF recording file	200 000		1	
Sweep parameters	Minimum	Maximum	Minimum	Maximum
Pre-trigger length	0	Trigger memory of acquisition card	0	Available free drive space
Post-trigger length	0	Trigger memory of acquisition card	0	0
Sweep length	10 samples	Trigger memory of acquisition card	1 second	Available free drive space
Maximum sweeps rate	400/s		Not applicable	
Minimum time between-triggers	2.5 ms		Not applicable	
Dead time between sweeps	0 ms		Not applicable	

Data Recording Details - 16 Bit Resolution [1]

On start of acquisition & On trigger

Enabled channels	1 channel	2 channels	3 channels	4 channels	5 channels	6 channels	7 channels	8 channels	8 channels 1 Timer/Counter	8 channels 2 Timer/Counters	8 Channels 3 Timer/Counters	8 Channels 4 Timer/Counters	8 channels 4 Timer/Counters Digital events
Max. FIFO	3800 MS	1800 MS	1200 MS	900 MS	720 MS	600 MS	510 MS	450 MS	360 MS	280 MS	230 MS	210 MS	190 MS
Max. Sample rate [2]	20 MS/s (P201I-4 / P211I-4 / P212I-4) 2 MS/s (P101I-4 / P111I-4 / P112I-4)												
Max. aggregate streaming rate	20 MS/s	40 MS/s	60 MS/s	80 MS/s	100 MS/s	120 MS/s	140 MS/s	160 MS/s	200 MS/s	240 MS/s	280 MS/s	320 MS/s	340 MS/s

On trigger - buffered with Low rate Storage disabled

Enabled channels	1 channel	2 channels	3 channels	4 channels	5 channels	6 channels	7 channels	8 channels	8 channels 1 Timer/Counter	8 channels 2 Timer/Counters	8 Channels 3 Timer/Counters	8 Channels 4 Timer/Counters	8 channels 4 Timer/Counters Digital events
Max. trigger memory	1000 MS	1000 MS	1000 MS	760 MS	595 MS	490 MS	410 MS	355 MS	275 MS	220 MS	185 MS	160 MS	148 MS
Max. High rate sample rate [2]	20 MS/s (P201I-4 / P211I-4 / P212I-4) 2 MS/s (P101I-4 / P111I-4 / P112I-4)												

On trigger - buffered with Low rate Storage enabled

Enabled channels	1 channel	2 channels	3 channels	4 channels	5 channels	6 channels	7 channels	8 channels	8 channels 1 Timer/Counter	8 channels 2 Timer/Counters	8 Channels 3 Timer/Counters	8 Channels 4 Timer/Counters	8 channels 4 Timer/Counters Digital events
Max. trigger memory	1000 MS	1000 MS	1000 MS	760 MS	595 MS	490 MS	410 MS	355 MS	275 MS	220 MS	185 MS	160 MS	148 MS
Max. High rate sample rate [2]	20 MS/s (P201I-4 / P211I-4 / P212I-4) 2 MS/s (P101I-4 / P111I-4 / P112I-4)												
Max. Low rate FIFO	800 MS	400 MS	260 MS	180 MS	144 MS	120 MS	103 MS	89 MS	68 MS	55 MS	46 MS	40 MS	37 MS
Max. Low rate sample rate	High rate ≤ 2 MS/s: High rate, High rate > 2 MS/s: High rate / 2												
Max. aggregate streaming rate	20 MS/s	40 MS/s	60 MS/s	80 MS/s	100 MS/s	120 MS/s	140 MS/s	160 MS/s	200 MS/s	240 MS/s	280 MS/s	320 MS/s	340 MS/s

(1) Terminology used in alignment with Perception software.

(2) Maximum sample rate is determined by the connected and enabled Remote Probe with the lowest sample rate.

Note: Values are given in samples, while Perception settings are in time. The user needs to convert time to samples.

Real-time Formula Database Calculators

The real-time formula database (RT-FDB) offers an extensive set of math routines to enable almost any real-time mathematical challenge. The database structure enables the user to define a list of mathematical equations similar to the Perception review formula database.
The maximum supported sample rate is 4 MS/s (1).
Different versions of Perception can enable more or less features as described in this table.

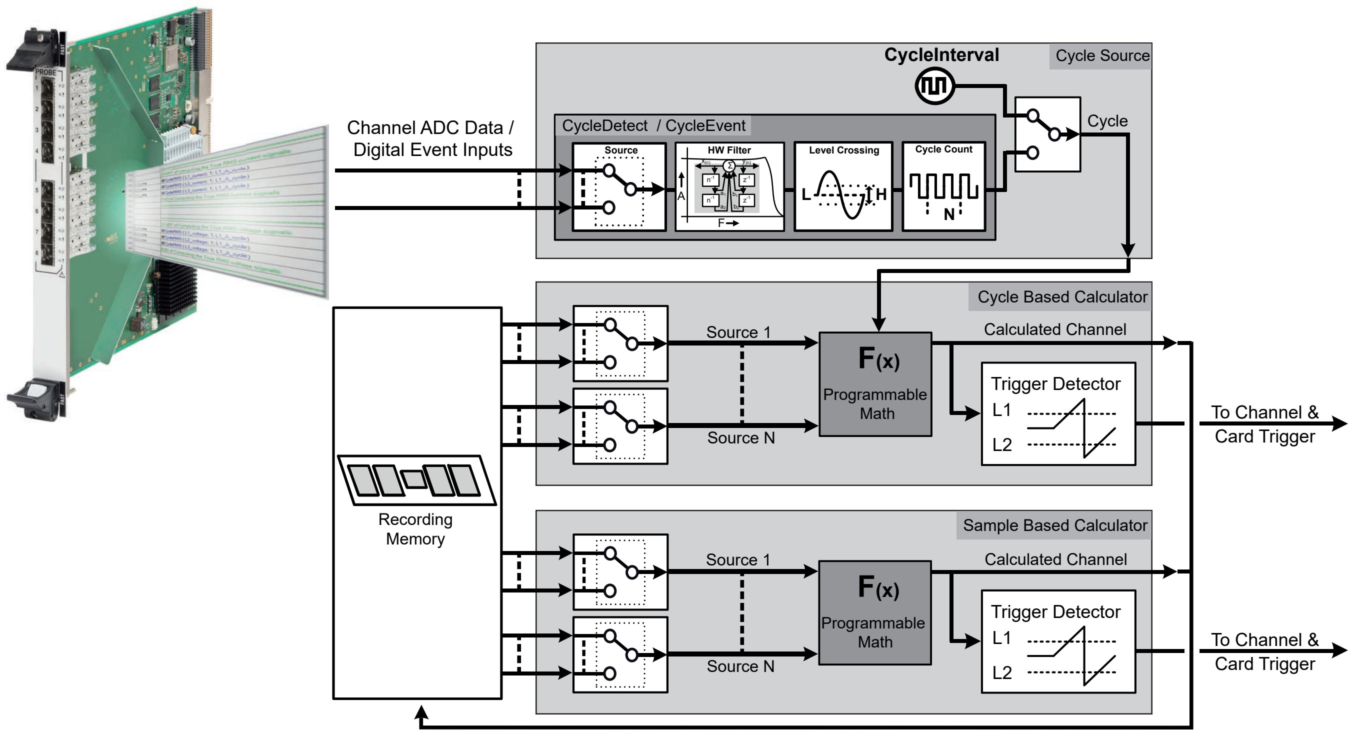


Figure 13: Real-time formula database (RT-FDB) calculators

The real-time formula database supports the following list of calculations (Details of each calculation are described in the Perception manual).	
Cycle Source	Determines the periodic real-time calculation speed by either setting a timer or using a real-time cycle detect
Number of cycle sources	4; this is the maximum number of cycle sources that can be used per card in RT-FDB context.
Cycle Source: Timer	
Timer duration	0.5 ms (2 kHz) to 1 s (1 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	Maximum Cycle period that can be detected: 1 s (1 Hz) Minimum Cycle period that can be detected: 0.5 ms (2 kHz) Calculations are stopped when the Cycle period gets outside its maximum- and minimum Cycle period (<0.5 ms or > 1 s).
Cycle Source: Cycle Event	Real-time monitors up to 2 Digital Input Events using the rising or falling edge to determine the cyclic nature of the event
Cycle Source: External Cycle Event	Real-time monitors External Event Input using the rising or falling edge to determine the cyclic nature of the event
Trigger detector	
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. This reduces the maximum sweep length by 100 ms.

(1) Note: Sample rates > 2 MS/s only supported in combination with local storage, not supported in combination with GEN2tB and GEN3iA mainframes and up to 8 Remote Probe channels in total. More channel support up to 2 MS/s (Perception 8.90 or later).

Real-time Formula Database Calculators			
Group	**Available RT-FDB functions**		
Basic			
	+ (add) - (subtract)	* (multiply) / (divide)	
Boolean			
	AlarmOnLevel And Equal GreaterEqualThan GreaterThan InsideBand	Not NotEqual OneShotTimer Or OutsideBand SetAlarm StartStopTriggerOnBooleanChange StopTriggerOnBooleanChange	ToAsyncBoolean TriggerArmOnBooleanChange TriggerOnBooleanChange TriggerOnLevel Xor
Cycle			
	CycleArea CycleBusDelay CycleCount CycleCrestFactor CycleDetect CycleEnergy CycleEvent CycleFrequency	CycleFundamentalPhase CycleFundamentalRMS CycleHarmonicPhase CycleHarmonicRMS CycleInterval CycleMax CycleMean CycleMin	CycleNOP CyclePeak2Peak CyclePhase CycleRMS CycleRPM CycleSampleCount CycleStdDev CycleTHD ExternalCycleEvent
eDrive			
	AronConversion DQ0Transformation EfficiencyMode	EfficiencyValue HarmonicsIEC61000 PowerLoss	SpaceVector SpaceVectorInv
Enhanced			
	Abs Atan Atan2 Cos DegreesToRadians Integrate IntegrateGated	LessEqualThan LessThan Max Min Minus Modulo PureDFT	RadiansToDegrees SampleCount Sin Sqrt Tan
Fieldbus			
	SetScalarFromFieldbus		
Filter			
	FilterBesselBP FilterBesselHP FilterBesselLP HWFilter	FilterButterworthBP FilterButterworthHP FilterButterworthLP	FilterChebyshevBP FilterChebyshevHP FilterChebyshevLP
Math			
	NumSamplesMean NumSamplesStdDev	TimedMean TimedStdDev	
Signal generation			
	Ramp Sinewave		

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	Maximum, Minimum, Mean, Peak to Peak, Standard Deviation and RMS values
Event/Timer/Counter channels	Maximum, Minimum and Peak to Peak values

Fiber Optic Link	
Light source	Class 1 laser product
Transfer rate	3.2 Gbit/s
Wavelength	850 nm
Connector	LC duplex on GN800B LC duplex P201I-4, P101I-4, P211I-4, P111I-4, P212I-4 and P112I-4
Cable	
Isolation	10^{15} Ω/m
Type	Duplex Multi Mode, 50/125 µm, ISO/IEC 11801 type OM3 or OM4
Coupler	LC duplex
Maximum length	100 m (328 ft) with 1 additional cable coupler used

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 shutdown above +85 °C (185 °F) with notifications starting 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 15 g/11 ms; 3-axis, 1000 shocks in positive and negative direction
Non-operational	Half-sine 35 g/6 ms; 3-axis, 3 shocks in positive and negative direction
Vibration: IEC 60068-2-64	
Operational	2 g RMS, ½ h; 3-axis, random 5 to 500 Hz
Non-operational	3 g RMS, 1 h; 3-axis, random 5 to 500 Hz
Operational Environmental Tests	
Cold test IEC60068-2-1 Test Ad	-20 °C (-4 °F) for 2 hours
Damp heat test IEC 60068-2-3 Test Ca	+55 °C (+131 °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 IEC60068-2-14 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 IEC60068-2-30 Test Db variant 1	+25 °C/+55 °C (+77 °F/+131 °F), humidity > 95/90% RH 6 cycles, cycle duration 24 hours

Harmonized Standards for CE and UKCA Compliance, According to the Following Directives[(1)]	
Low Voltage Directive (LVD): 2014/35/EU **Electromagnetic Compatibility Directive (EMC): 2014/30/EU**	
Electrical Safety	
EN 61010-1	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
EN 61010-2-030	Particular requirements for testing and measuring circuits
Electromagnetic Compatibility	
EN 61326-1	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 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

(1) UKCA The manufacturer declares on its sole responsibility that the product is in conformity with the essential requirements of the applicable UK legislation and that the relevant conformity assessment procedures have been fulfilled.

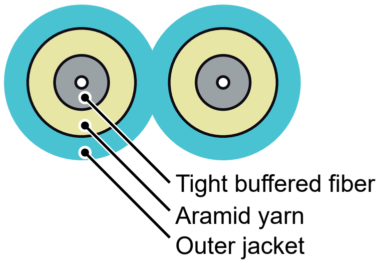
Manufacturer:

Hottinger Brüel & Kjaer GmbH
Im Tiefen See 45
64293 Darmstadt
Germany

Importer:

Hottinger Bruel & Kjaer UK Ltd.
Technology Centre Advanced Manufacturing Park
Brunel Way Catcliffe
Rotherham
South Yorkshire
S60 5WG
United Kingdom

KAB280: Fiber Optic Cable MM 50/125 µm LC-LC (Option, to be ordered separately)	
Standard zipcord fiber optic duplex Multi Mode patch cable. Used with 850 nm optical 1 Gbit or 10 Gbit Ethernet (1-G091 and 1-G065), Master/Sync, GN1202B and GN800B cards. Typically used for fixed cable routing or LAB environments.	



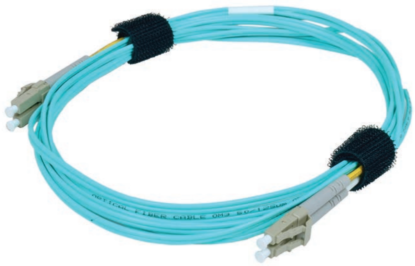


Figure 14: Block diagram and image

Connector type	LC - LC
Cable rating	OM3; Multi Mode, 850 nm
Core/Cladding diameter	50/125 µm
Jacket size/diameter	Typically 2 mm (0.08”) single core
Jacket rating	Low-smoke zero-halogen
Attenuation	≤ 2.7 dB/km @ 850 nm
Available lengths	3, 10, 20 and 50 m (10, 33, 66 and 164 ft). For other lengths contact custom systems(1).
Bend radius	30 mm (1.2”)
Weight	Typically 14 kg/km (9 lb/1000 ft)
Operating temperature	-40 °C to +80 °C (-40 °F to 176 °F)

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

Calibration Service
HBK offers a wide range of calibration services. Check your local sales contact for more information. HBK recommends yearly recalibration of all systems and transducers.

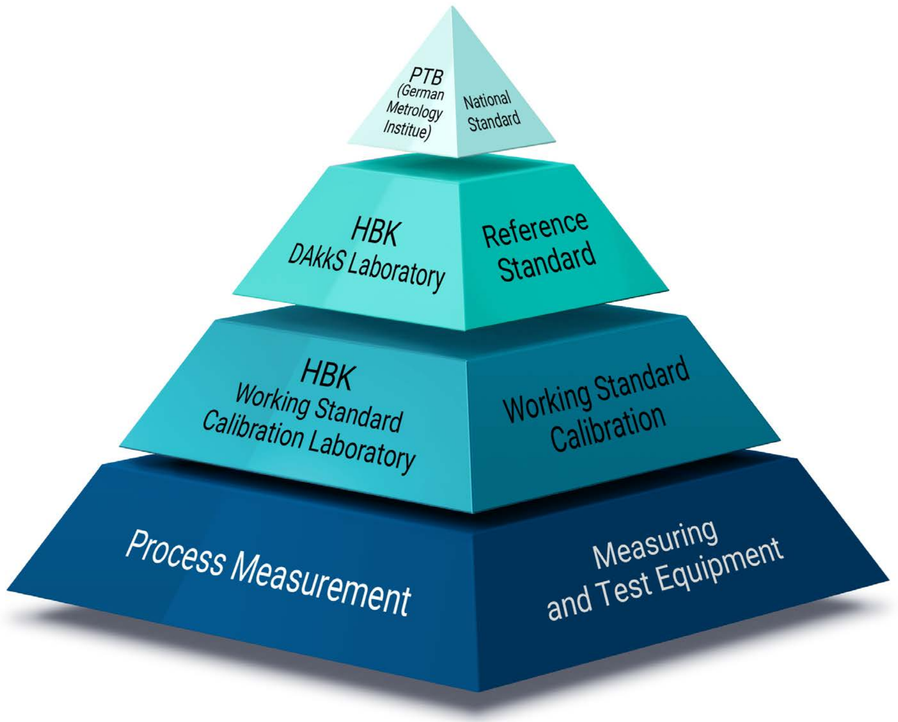


Figure 15: HBK calibration process

Ordering Information			
Article		**Description**	**Order No.**

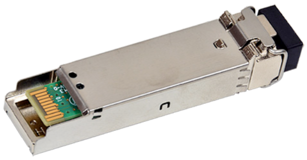
GN800B power analyzer card		Power analyzer card for two Remote Probes
		
		Features:
		• Supports up to two Remote Probes
		• 8 GB RAM
		• Optical fiber isolated Remote Probes
		• 16 digital event inputs, 4 counter/timer inputs
		• Fundamental power calculations
		  • Real-time math up to 4 MS/s
		  • Up to full sample rate in post process
		
		Requirements:
		• Tethered mainframes: GEN2tB, GEN3t, GEN4tB, GEN7tA/B, GEN17tA/B
		• Mainframes with integrated PC: GEN3i, GEN3iA, GEN7iA
			1-GN800B

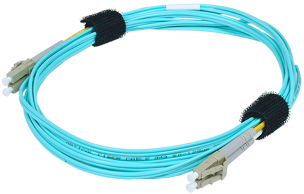
Remote Probes, to be ordered separately

Article		Description	Order No.

4 channel Voltage Remote Probe		4 channel Voltage Remote Probe isolated via fiber optical link. Comes with two SFP+ modules. One installed into the Remote Probe, one to be installed into the GN800B power analyzer card.
		
		Features:
		• Four analog voltage input channels
		• Isolated, balanced differential inputs
		• 5 MΩ input impedance (differential Plus to Minus)
		• Voltage:
		  • Input ranges (5): ± 200 V to ± 2000 V
		  • 1500 V DC CAT IV, 1000 V CAT IV
		  • Inputs: 4 mm fully isolated banana plugs
		• Voltage accuracy (wideband, worst case) 0.025 % of reading, 0.01% of range
		• Power accuracy, when matched with Current Remote Probe 0.015% of reading, 0.02% of range
		
		Requirements:
		• GN800B power analyzer card
		• FO connection cable back to GN800B power analyzer card
			1-P201I-4 (20 MS/s)
			1-P101I-4 (2 MS/s)

4 channel Current Remote Probe		4 channel Current Remote Probe isolated via fiber optical link. Comes with two SFP+ modules. One installed into the Remote Probe, one to be installed into the GN800B power analyzer card. Features: • Four analog current input channels • Isolated, unbalanced differential inputs with two precision burden resistors 0.33 Ω / 0.1 Ω • Standard 9 pin D-sub connector for current transducers • Six current input ranges up to ±2 A • Additional voltage input ±50 mV to ± 20 V for current clamps with separate BNC connector • 60 V isolation to prevent ground loops • Current accuracy (wideband, worst case) 0.025% of reading, 0.010% of range • Power accuracy, when matched with Voltage Remote Probe 0.015% of reading, 0.02% of range Requirements: • GN800B power analyzer card • FO connection cable back to GN800B power analyzer card	1-P211I-4 (20 MS/s) 1-P111I-4 (2 MS/s)
4 channel Current Remote Probe with CT-PSU		4 channel Current Remote Probe with CT-PSU isolated via fiber optical link. Comes with two SFP+ modules. One installed into the Remote Probe, one to be installed into the GN800B power analyzer card. Features: • Four analog current input channels • Isolated, unbalanced differential inputs with two precision burden resistors 0.33 Ω / 0.1 Ω • Standard 9 pin D-sub connector for current transducers • Six current input ranges up to ± 2 A • Additional voltage input ± 50 mV to ± 20 V for current clamps with separate BNC connector • 60 V isolation to prevent ground loops • Current accuracy (wideband, worst case) 0.025% of reading, 0.010% of range • Power accuracy, when matched with Voltage Remote Probe 0.015% of reading, 0.02% of range • Built-in power supply for up to 4 current transducers, ±15V @ 1000 mA per channel with common ground for all four CTs Requirements: • GN800B power analyzer card • FO connection cable back to GN800B power analyzer card	1-P212I-4 (20 MS/s) 1-P112I-4 (2 MS/s)

SFP+ Module (Option, to be ordered separately)			
Article		**Description**	**Order No.**
6.1 Gbit Optical SFP+ module MM 850 nm		6.1 Gbit SFP+, 850 nm Multi Mode, up to 300 m optical cable length supported, LC connector support. Not compatible with the 1 or 10 Gbit SFP+ modules. Operating temperature: -20 °C to +60 °C **Note:** *The delivery of the Remote Probe(s) include 2 SFP+ modules. The 6.1 GBit Optical SFP+ module can be ordered if required.*	1-G099

Fiber Optic Cables (Options, to be ordered separately)			
Article		**Description**	**Order No.**
Fiber cable MM LC-LC		GEN DAQ standard zipcord fiber optic duplex Multi Mode 50/125 µm cable, 3.0 dB/km loss, LC-LC connectors, aqua, ISO/IEC 11801 type OM3. Typically used for fixed cable routing or LAB environments. Lengths: 3, 10, 20 and 50 meters (10, 33, 66 and 164 ft) Used with 850 nm optical 1 Gbit Ethernet (1-G091), 10 Gbit Ethernet (1-G065), Master/Sync, GN1202B- and GN800B cards.	1-KAB280-3 1-KAB280-10 1-KAB280-20 1-KAB280-50

Note *Other fiber cable lengths can be ordered from custom systems at:* customsystems@hbkworld.com

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