DATA SHEET

GEN series GEN2tB
Transient Recorder and Data Acquisition System

SPECIAL FEATURES

- Cost effective solution
- Robust and portable
- Up to 16 analog, 32 digital and four Timer/ Counter channels
- 100 MB/s continuous streaming
- PTP time synchronization
- Status display
- Master/Sync connection (option)
- 1 Gbit optical Ethernet (option)
- SSD 125 MB/s (option)
- IRIG/GPS time sync (option)
- CAN FD input, output and remote control (option)

GEN2tB Functions and Benefits

GEN2tB is a portable, rack mountable transient recorder and data acquisition system, including Perception acquisition software. By selecting up to two input cards with sample rates from 200 kS/s to 250 MS/s GEN2tB turns into an entry level DAQ, a high end transient recorder or even a mix.

- Using the unique real-time math enabled 1.5 kV power cards turns GEN2tB into a cost effective, powerful 6 channel power analyzer with real-time power computation and harmonic analysis.
- Using the Basic cards the GEN2tB can be used to record voltages, or vibrations using IEPE transducers, with up to 16 channels simultaneously at up to 2 MS/s.
- With the Universal card GEN2tB can be used in material testing with physical sensors like strain gauges, IEPE sensors or thermocouples using up to 500 kS/s sample rate.
- The 250 MS/s cards can be used for ultra-fast measurements.

Data is stored on the inputs cards built-in memory and/or streamed with 100 MB/s aggregate to a remote PC running Perception software. For maximum reliable data storage GEN2tB supports an (optional) built-in solid state drive at 125 MB/s.
The system can easily be integrated by various options: GEN DAQ API, CAN/CAN FD as well as Python and LabVIEW drivers.
These interfaces enable low latency, stand-alone data exchange, also simultaneously.
Copper or optional optical Ethernet allow fast and secure connection to the PC, while the optional Master/Sync port allows using two mainframes in parallel without any further hardware needed.
Multiple mainframes can be used simultaneously using the Master/Sync option connector, while PTPv2 and IRIG/GPS timing allow synchronization between mainframes and external devices.

Mainframe Feature Overview						
	Tethered models				Integrated models	
	GEN2tB	GEN4tB	GEN7tA/B	GEN17tA/B	GEN3iA	GEN7iA/B
Number of acquisition cards	2	4	7	17	3	7
Built-in TFT screen (resolution)	Not Supported				17“ (1280x1024)	17“ (1280x1024)
Built-in Windows® PC	Not Supported				Intel© i3, 8 GB RAM	Intel© i5, 16 GB RAM
Rack mount support (Option)	yes					
Built-in storage drive	option 500 GB	option 500 GB or 1 TB	Not Supported		480 GB	960 GB
Removable built-in storage drive	Not Supported		option 2 TB EXT4		Not Supported	option 2 TB NTFS
Built-in drive continuous streaming rate	200 MB/s	350 MB/s(2)			200 MB/s	350 MB/s
1 GB Ethernet Continuous streaming rate	100 MB/s					
10 GB Ethernet Continuous streaming rate	NS(1)	400 MB/s				
IEEE1588:2008 PTPv2 support	yes					
Digital events	up to 32	up to 64	up to 96	up to 96	up to 32	up to 96
USB ports	1	2	2		4	
1 GB Ethernet (copper)	1				1	
1 GB Ethernet (optical)	0				1	
10GB Ethernet (optical or electrical)	NS(1)	option				
Master/Sync connector	SFP option		available			
DC power output (QuantumX compliant)	NS(1)	NS(1)	30 W	NS(1)	15 W	30 W
Mechanical	**GEN2tB**	**GEN4tB**	**GEN7tA/B**	**GEN17tA/B**	**GEN3iA**	**GEN7iA/B**
Weight without acquisition cards (kg)	4.0	8.0	10.9	18.9	9	15.7
Dimensions (height / width / depth [mm])	96/375/320	133/441/345	293/448/343	450/446/517	342/436/186	350/446/386
19” Rack mount	option	included	option	supported as standard	option	option
Mainframe system integration	**GEN2tB**	**GEN4tB**	**GEN7tA/B**	**GEN17tA/B**	**GEN3iA**	**GEN7iA/B**
EtherCAT®	NS(1)	option: remote control, data			Not Supported	
Hardware TTL	supported as standard: remote control				Not Supported	
GEN DAQ API	supported as standard: remote control, data				Not Supported	
CAN / CAN FD	option: remote control; data				Not Supported	
XCP over Ethernet	option: remote control; data				Not Supported	
Perception API	supported as standard					
LabVIEW	option: remote control, data				Not Supported	
Python	option: remote control				Not Supported	
Calculation capabilities	**GEN2tB**	**GEN4tB**	**GEN7tA/B**	**GEN17tA/B**	**GEN3iA**	**GEN7iA/B**
Number of cycle-based math operations	125	500	1000	1000	300	1000
Maximum mainframe results storage	256	500	1000	1000	300	1000

(1) NS: Not supported

(2) Note: *Please check specific storage option for maximum continuous streaming rate.*

Power	
Power Inlet	11.4 to 12.6 V DC (not designed for battery power supply)
Total power of unit (maximum)	125 W

G094: GEN2tB External AC-DC Power Supply	
⚠ **Use HBM approved external AC-DC power supplies only.** **G094 standard included with every GEN2tB system ordered.**	
Approved power supplies	Mean Well GSM220A12-KH XP Power AHM180PS12
Output	
Voltage	12 V DC ± 5%
Power	165 W @ 40 °C, 99 W @ 60 °C
Mains Input	
Voltage	100 V AC - 240 V AC @ 47 Hz - 63 Hz
Mains power cord	
Connector	IEC 60320 C13
Cable conductors	3 * 1.0 mm^2 minimum
Cable rating	250 V @ 10 A minimum
Flammability rating	UL 94 class V-0
Isolation material	PVC
Minimum temperature rating	70 °C
Weight	1.1 kg (2.5 lb)

Physical, Weight and Dimensions	
Acoustic Noise	Typical total A-weighted SPL 34 dBA @ 0.6 m (Environmental temperatures 25 °C or lower) Maximum total A-weighted SPL 51 dBA @ 0.6 m (Environmental temperatures 40 °C or higher)
Temperature Sensors	Temperature monitoring and air flow control
Cooling Fans	2
Grounding	2 * 4 mm Banana plug
Casing	Aluminum/Steel cover
Air filter	Replaceable air filter (1-G095)
Weight	
Mainframe	4 kg (8.8 lb) add ≈ 1 kg (2.2 lb) per acquisition card installed
Dimensions	
Height/Height with handle	96 mm (3.8”)
Width	375 mm (14.8”)
Depth	320 mm (12.6”)

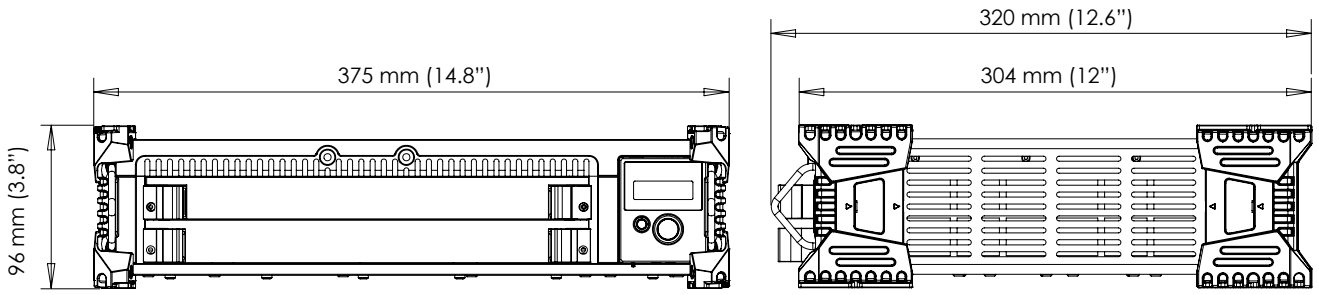
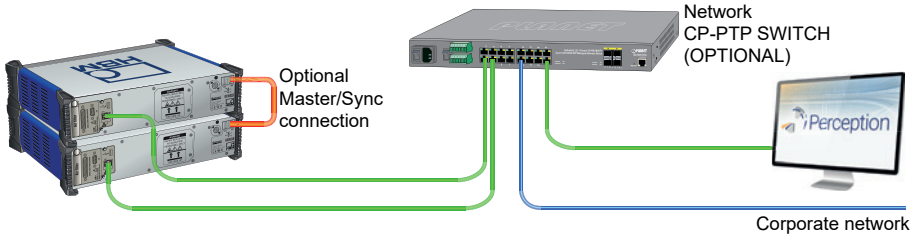
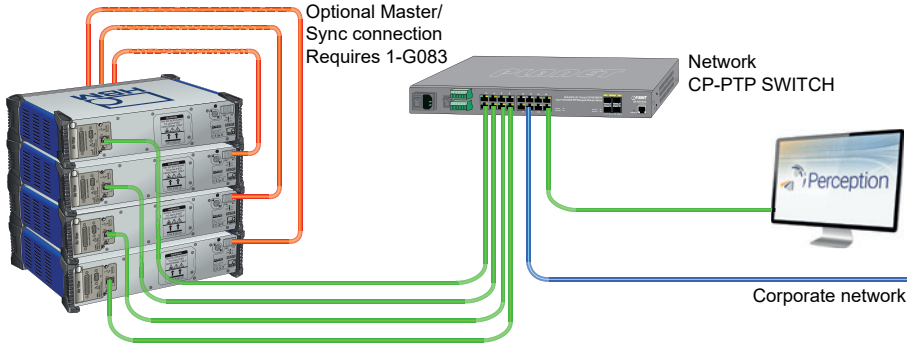
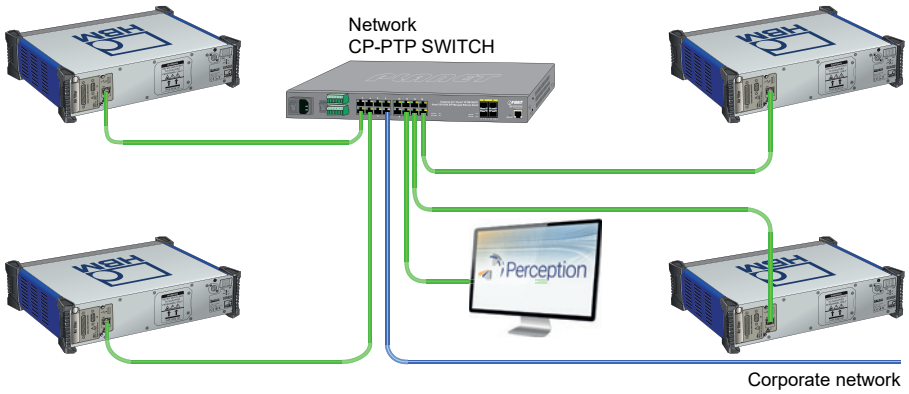


Figure 1: GEN2tB dimensions

GEN2tB Environmental Specifications	
Temperature Range	
Operational[1]	0 °C to +55 °C (+32 °F to +131 °F)
Non-operational (Storage)	-25 °C to +70 °C (-13 °F to +158 °F)
Thermal protection	Automatic thermal shutdown User warning notifications when temperature is within 5 °C of maximum.
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	2 g RMS, 1 h500 Hz
Operational Environmental Tests	
Cold test IEC60068-2-1 Test Ad	-5 °C (+23 °F) for 2 hours
Damp heat test IEC60068-2-3 Test Ca	+55 °C (+131 °F), humidity > 80% 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/+40 °C (+77 °F/+104 °F), humidity > 95/90% RH 6 cycles, cycle duration 24 hours

(1) Note *Installed options can reduce the operational temperature range.*

Supported Operation Mode	
Recommended features	
Stand-alone • Pre-configured boot settings • 350 MB/s storage to SSD • Start/Stop/Trigger TTL inputs • CAN FD acquisition control • GEN DAQ API • Real-time formula database • CAN FD semi real-time output, input and remote control	 **Figure 2:** Stand-alone
Single mainframe • Start/Stop/Trigger TTL inputs • CAN FD acquisition control • 350 MB/s storage to SSD • Real-time formula database • CAN FD semi real-time output, input and remote control • PTP (GPS/IRIG) time sync	 **Figure 3:** Single mainframe
Dual mainframe • Single wire Master/Sync control • 700 MB/s storage to SSD • Real-time formula database • CAN FD semi real-time output, input and remote control • PTP (GPS/IRIG) time sync **NOTE:** *A dual mainframe setup does not require PTP time synchronization if Master/Sync is available.*	 **Figure 4:** Dual mainframe
Four mainframes (>2) • Master/Sync control & trigger • 1400 MB/s storage to SSD • Real-time formula database • CAN FD semi real-time output, input and remote control • PTP (GPS/IRIG) time sync	 **Figure 5:** Multi mainframe
Distributed mainframes (>2) • Optical network • Distributed data storage • 1400 MB/s storage to SSD • Real-time formula database • PTP (GPS/IRIG) time sync	 **Figure 6:** Multi mainframe (distributed)

Mainframe to Mainframe Synchronization Options			
Network setup	**Number of (mixed) GEN DAQ mainframes used**		
	1	**2**	**> 2**
Direct network to PC/Notebook	Not required	Use Master/Sync setup 1-G091 in both mainframes	Use Master/Sync setup 1-G083 in master mainframe 1-G091 in other mainframes
Standard switch (No PTP support)	Not required	Use Master/Sync setup 1-G091 in both mainframe	Use Master/Sync setup 1-G083 in master mainframe 1-G091 in other mainframes
PTP Network switch (e.g. CP-PTP SWITCH-19INCH)	Not required	Works for continuous recording No synchronized triggers for dual and sweep recording OR Use Master/Sync setup 1-G091 in both mainframe	Works for continuous recording No synchronized triggers for dual and sweep recording OR Use Master/Sync setup: 1-G083 in master mainframe 1-G091 in other mainframes

Maximizing Continuous Data Recording Speed				
When using continuous data recording two elements in the setup typically impact the maximum speed: network and drive. Both bottlenecks can be addressed by selecting the right setup. Either divide (multiple network cables or drives) the data load or increase the speed (10 Gbit ethernet and/or Solid State drives / RAID drives)				
Network and/or drive setup	**Number of (mixed) GEN DAQ mainframes used**			
	1	**2**	**>2**	**Notes**
Direct 1 Gbit network to PC (no switch used) 100 MB/s per 1 Gbit network cable	100 MB/s	200 MB/s	3 MF: 300 MB/s 4 MF: 400 MB/s ... 10 MF: No support	• The PC drive might limit the speed • 4 network ports / PC will work • Notebooks usually have 1 network port
1 Gbit network switch with 1 Gbit to PC 100 MB/s per 1 Gbit network cable	100 MB/s	100 MB/s	3 MF: 100 MB/s 4 MF: 100 MB/s ... 10 MF: 100 MB/s	• A single 1 Gbit cable to PC limits the speed • Not preferred for continuous recording
1 Gbit network switch with 10 Gbit to PC 100 MB/s per 1 Gbit network cable ~700 MB/s per 10 Gbit network cable	100 MB/s	200 MB/s	3 MF: 300 MB/s 4 MF: 400 MB/s ... 10 MF: 700 MB/s	• The PC drive might limit the speed • 10 Gbit on PC's is not yet standard • Notebooks usually do not support 10 Gbit • A single 10 Gbit port reduces costs
10 Gbit network switch with 10 Gbit to PC ~700 MB/s per 10 Gbit network cable	400 MB/s	700 MB/s	3 MF: 700 MB/s 4 MF: 700 MB/s .... 10 MF: 700 MB/s	• The PC drive might limit the speed • 10 Gbit on PC's is not yet standard • Notebooks usually do not support 10 Gbit • Cost effective 10 Gbit switches exist
Mainframe local disk storage 350 MB/s per Mainframe drive 1 Gbit network switch with 1 Gbit to PC	350 MB/s	700 MB/s	3 MF: 1050 MB/s 4 MF: 1400 MB/s ... 10 MF: 3500 MB/s	• Worry free extreme reliable setup • Scales with every added mainframe • Low cost 1 Gbit switches can be used

Real-time Calculated Results Output			
	Ethernet GEN DAQ API	**EtherCAT®**	**CAN/CAN FD**
Maximum results per block	240	240	240
Maximum result blocks per second	2000	1000	1000
Latency	Ethernet dependent	1 ms	CAN bus speed

Enhanced Temperature Overview			
The GEN2tB supports an enhanced operating temperature range. This mainframe is part of a family of configurable products with not all parts rated for this enhanced operating temperature. Check the table below for details.			
Function	**Part number**	**Standard +0 °C to +40 °C**	**GEN2tB -10 °C to +55 °C**
850 nm Optical 1 Gbit network	1-G091	Yes	Yes
1310nm Optical 1 Gbit network	1-G063	Yes	Yes
Solid state drive	1-M2SSD-1T0-EXTEMP	Yes	Yes
USB to CAN FD	1-USBCANFD-1CHN	Yes	Yes
Integrated CAN FD	1-4C-PCIECANFD-4T	Yes	Yes
Power card	GN310B & 1-GN311B	Yes	Yes

Block Diagram

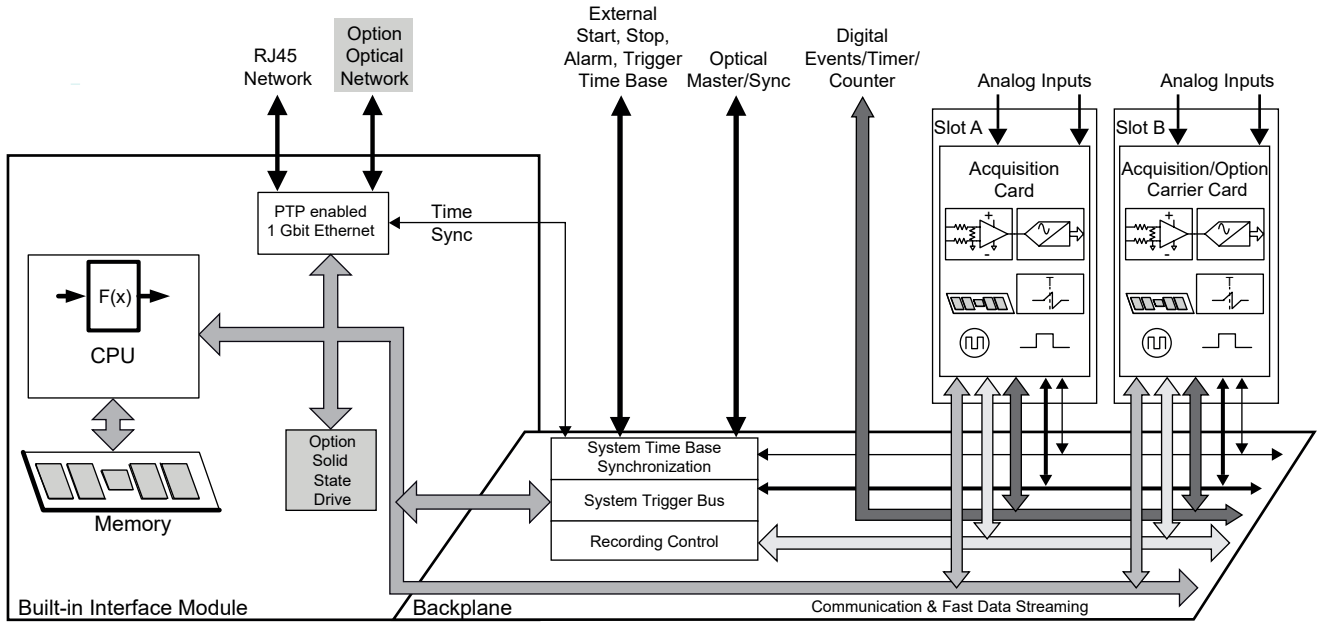


Figure 7: Block diagram

Acquisition System

System Time Base and Synchronization Central time base for all acquisition cards	
Accuracy	± 3.5 ppm; aging after 10 years ± 10 ppm
Base	Decimal
Synchronization sources	IEEE1588:2008 PTPv2 (Precision Time Protocol) using an End-to-End protocol Master/Sync; Sync or Master mode on built-in connector Master output card (G083): Option to synchronize up to 16 Sync mainframes
PTP synchronization accuracy	± 150 ns; no Ethernet switch used When network switches are required, use only PTP IPv4 aware switches that support End-to-End set-ups. Overall accuracy depends on PTP switch used. **Note:** PTP aware switches require PTP setup, refer to the operating manual of the switch for more details.
Acquisition Slots Unused slots must be covered using the GEN DAQ blind panel. This closes the mainframe front panels for EMC/EMI and safety compliance and also regulates the internal airflow to cool the acquisition system correctly.	
Number of slots	2
Acquisition cards	Any combination of GEN DAQ acquisition cards which support fast data streaming
Digital Event/Timer/Counter connector	1; Connected to slots A and B
Thermal control	Every acquisition card and the acquisition system monitors its own temperature and status. This is used to regulate fan speeds and reduce noise while optimizing airflow and power consumption.
Calibration	Any changes to the acquisition system configuration may change its internal thermal gradients. As accurate calibration relies on a steady and repeatable thermal environment, calibration is void if changes are made in the configuration. For information on calibration impact, please refer to the individual card specifications.

Connection Overview

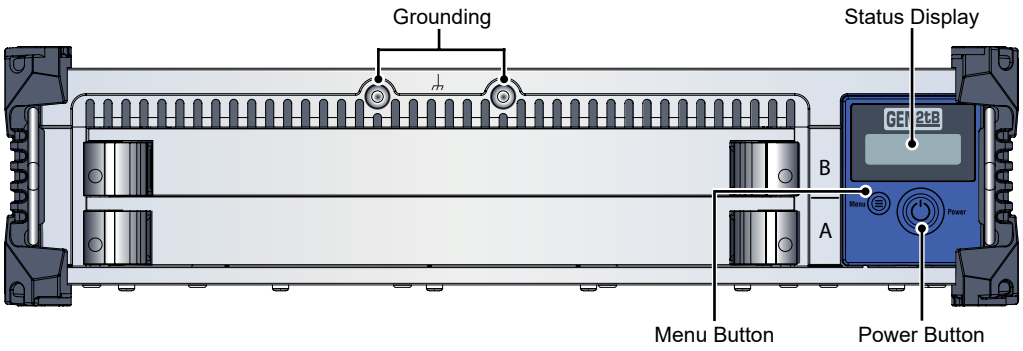


Figure 8: Electrical and optical 1 Gbit network interface

Power button	Power on the mainframe or place mainframe in stand-by mode
Mainframe status display	Mainframe name Mainframe IP address Recording progress Error messaging
Menu button	Toggle through status information (short press) Confirm selections (long press)

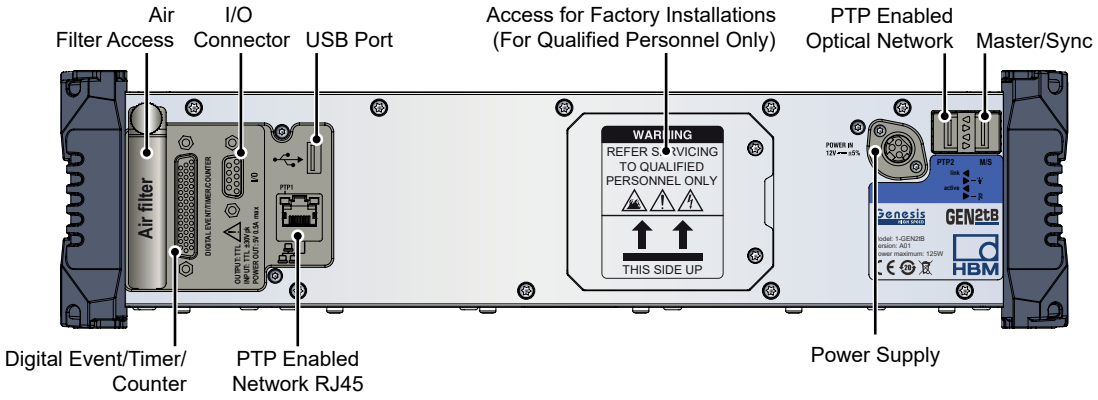


Figure 9: Rear view connection overview

1 Gbit Network Interface

GEN2tB supports an electrical and optional optical 1 Gbit Ethernet connector

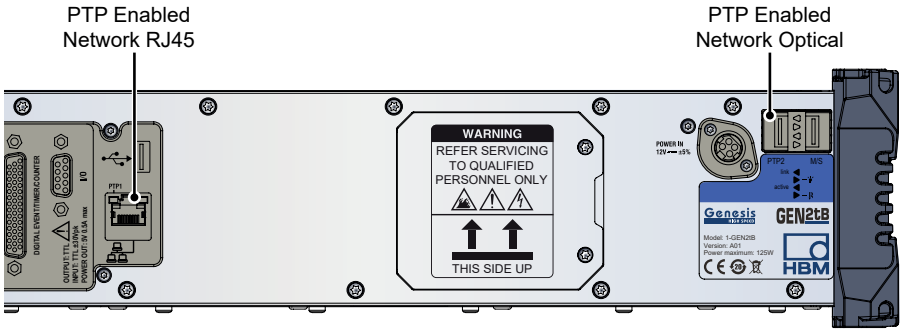


Figure 10: Electrical and optical 1 Gbit network interface

PTPv2 (IEEE1588:2008) synchronization	Supported on standard and optical 1 Gbit Ethernet interface (See table “Supported Acquisition Cards” for details)
Wake-on-LAN	Supported on standard and optical 1 Gbit Ethernet interface
Multiple Ethernet use cases	iSCSI data storage can be used on separate (dedicated) Ethernet interface PTPv2 (IEEE1588:2008) can be used on separate (dedicated) Ethernet interface
Ethernet Connectors	
Standard Ethernet	1000BASE-T; 1 Gbit, CAT5e UTP or STP (RJ-45 connector)
Optical Ethernet	1000BASE-SX or 1000BASE-LX; 1 Gbit, Ethernet using optional SFP module
1000BASE-SX SFP (option G091)	850 nm, maximum 500 m Multi Mode 50/125 µm optical cable length, LC connector
1000BASE-LX SFP (option G063)	1310 nm, maximum 10 km Single Mode 9/125 µm optical cable length, LC connector
TCP/IP IPv4/v6	
Address setup	DHCP/Auto IP or fixed IP
DHCP setup	When DHCP fails, APIPA (Automatic Private IP Addressing) is used similar to Windows® PCs
Gateway setup	Gateway setup supported for control using VPN and/or Internet
TCP/IP IPv6	Not supported
Maximum Transfer Speed	
Continuous recording to a remote PC	100 MB/s(1) uncompressed, up to 170 MB/s with compression
CPU and Software	
CPU	E3827 Intel Atom processor
Operating System	Linux(2)
Linux boot drive	Non-removable built-in Flash; Flash cannot be used to store recorded data

(1) Tested using circular recording for 48 hours. Test setup uses a Windows® PC with Intel i7 CPU and SSD with sustained write speeds exceeding 250 MB/s.

(2) Linux GPL open source code can be downloaded from the HBM website.

GEN2tB Recorded Data Storage Overview

GEN series mainframes support different ways of storing data. Continuous streaming throughput is tested by using 48 hours of circular recordings at specified data rates.

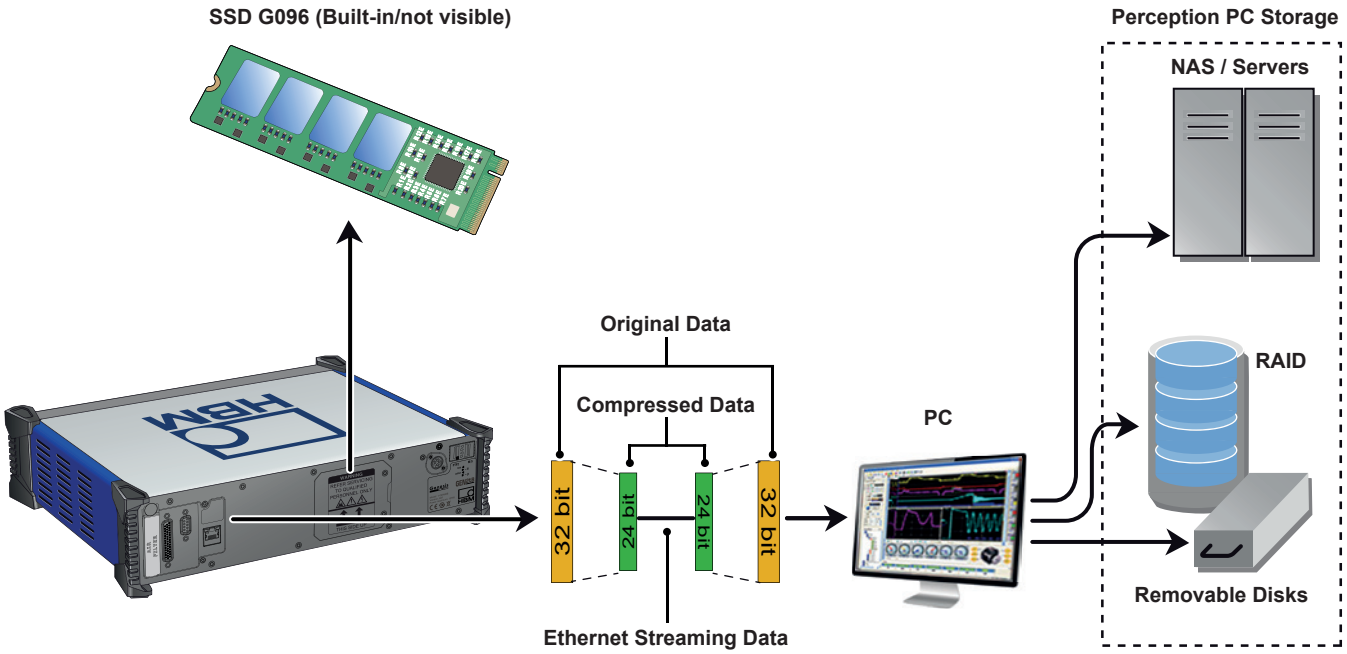


Figure 11: Continuous streaming overview

Maximum continuous data storage rates (tested using full disk circular recording for 48 hours)	**SSD G096 (Option)**	**Perception PC storage**	
	Uncompressed	Uncompressed	Compressed
1 Gbit Ethernet (optical or electrical)	n/a	100 MB/s(1)	Up to 170 MB/s(1)(2)
Local storage SSD G096	125 MB/s	Not usable	Not usable

(1) Test setup uses a Windows® PC with Intel i7 CPU and SSD with sustained write speeds exceeding 250 MB/s.

(2) Compression ratio is defined by the ADC channel width. For details, please refer to the “Streaming Compression Ratio” table (below). Rate is valid before decompressing storage data to maintain backward PNRF compatibility.

Analog Channel Streaming Compression Ratio

Acquisition cards	**Sample width**	**Compression ratio**	
		16 bit storage	**32 bit storage**
GN310B, GN311B	18 bits	1 : 1	1.75 : 1
GN610B, GN611B	18 bits	1 : 1	1.75 : 1
GN800B	16 bits	1 : 1	N/A
GN815, GN816	18 bits	1 : 1	1.75 : 1
GN840B, GN1640B	24 bits	1 : 1	1.33 : 1
GN1202B	14 bits	1 : 1	N/A
GN8101B, GN8102B, GN8103B	14 bits	1 : 1	N/A

Master/Sync Connection

GEN series mainframes support a Master/Sync synchronization connector. After installing option G091 SFP, this connector can be used as a single Master output or as a Sync input. The Master output function can be extended using the Master output card (G083).

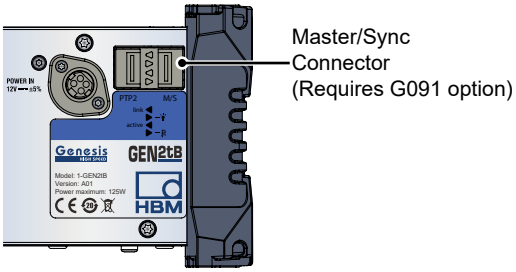


Figure 12: Master/Sync connector

Mainframe to mainframe phase shift	± 150 ns RMS; measured on analog signals using identical acquisition cards, identical sample rates and filter settings in each mainframe
LED signaling	Optical link synchronized, not connected, function disabled
Master mode	Basic and extended synchronization supported; Supports one Sync mainframe. Multiple Sync mainframes support by using one or more optional Master output cards (G083)
Sync mode	Basic and extended synchronization supported
Maximum number of mainframes	2; more mainframes supported when using one or more optional Master output cards (G083)
Time required to full synchronization after Master/Sync signal detected	
No recording active	Typically 1 minute
Recording or pause active	1 minute and an additional 25 s per ms recording time deviation from Master time
User notifications while recording	Time marks on Master/Sync signal lost/restored and Master/Sync time synchronized
Basic synchronization	
Cable length propagation delay	Automatic cable length detection and propagation delay compensation
First sample	Synchronizes the first sample in a continuous recording for each mainframe. Cable length propagation delay not compensated at start of recording. First samples not recorded in the Sync mainframes, as defined by the propagation delays. Signal phase shifts are not introduced by this propagation delay.
Synchronized time base	Prevents frequency drift of the sample rates within each mainframe
Measured channel trigger exchange	Synchronously exchanges measured channel triggers connected to the Master/Sync trigger bus to/from each connected mainframe. Typically used for the sweep recording modes.
Compatibility	Basic synchronization features are backward compatible with GEN series Master/Sync card option for both Master and Sync modes
Extended synchronization	
Calculated channel trigger exchange	Additional trigger bus to synchronously exchange trigger conditions detected on real-time calculated (RTC) channels between mainframes. RTC channel triggers have a longer delay caused by the required calculation time prior to establishing a trigger.
Synchronous manual trigger	User action within Perception to trigger all mainframes synchronously
Synchronous recording actions	Start/Stop and Pause a recording across multiple mainframes, each of which is controlled by a separate instance of Perception. Stop recording is a non-synchronous action. Synchronously records distributed data with a mix of two GEN DAQ mainframes in Master/Sync setup while running Perception on each of the mainframes. A more typical Master/Sync setup would be to stop Perception on one system and use one instance of Perception application to control both systems.
Compatibility	Extended synchronization features are not supported by the legacy Master/Sync card option. A mixed system setup automatically works with basic synchronization.
Connection	
HBM approved SFP	1-G091
Optical wavelength	850 nm
Optical cable type	Multi Mode 50/125 µm
Optical data rate	2 Gbit/s
Maximum cable length	500 m
Connector type	Duplex LC

Synchronization Specification Overview

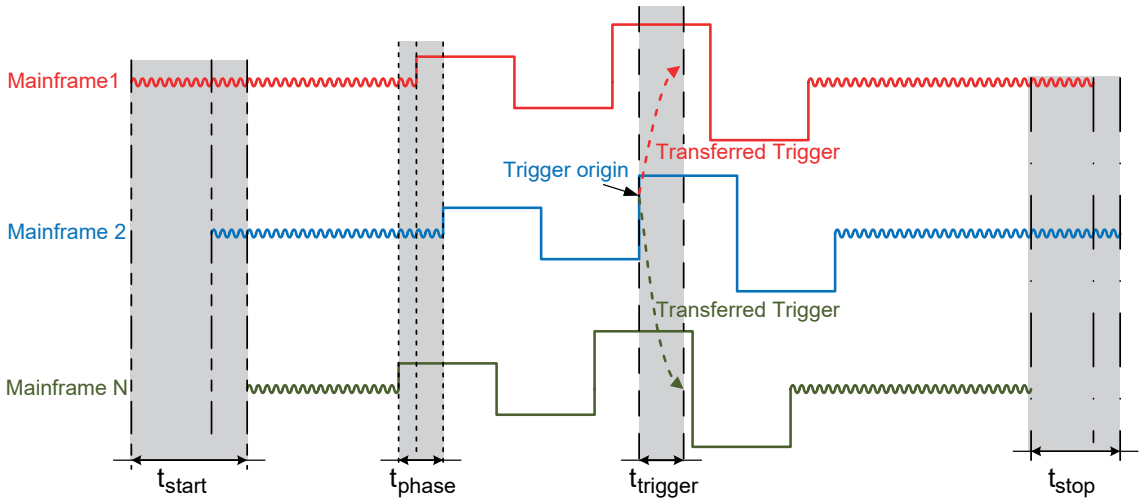


Figure 13: Synchronization specification overview

	t_{phase} (1)	t_{start} (2)	t_{stop} (3)	$t_{trigger}$ (4)
Synchronization source				
Master/Sync	≤ 150 ns	≤ cable delay	≤ 1 s	≤ 150 ns
PTP	≤ 150 ns	≤ 1 s	≤ 1 s	≤ (516 µs + cable delays)
No synchronization source				
Mainframes connected by Perception simultaneously	≤ 1 s	≤ 1 s	≤ 1 s	≤ 1 s
Additional error after connection	≤ 0.5 s/hour	≤ 0.5 s/hour	≤ 0.5 s/hour	≤ 0.5 s/hour

(1) t_{phase} Maximum phase difference between signals. *(This specification is not affected by any of the other specifications).*

(2) t_{start} Maximum delay between the start of recording for each mainframe.

(3) t_{stop} Maximum delay between the stop of recording for each mainframe.

(4) $t_{trigger}$ Maximum delay to transfer a trigger from one mainframe to all other mainframes.

(5) **Note** on trigger exchange
Trigger exchange is included in the Master/Sync cable. All other synchronization modes require that the mainframes are connected from each External Trigger Out to each External Trigger In on all the mainframes in order to exchange triggers.

I/O Connector

PIN **Signal**
PIN 1 - External Event In
PIN 2 - External Event Out
PIN 3 - External Trigger In
PIN 4 - Ground
PIN 5 - Ground
PIN 6 - External Start In
PIN 7 - External Trigger Out
PIN 8 - External Stop In
PIN 9 - +5V

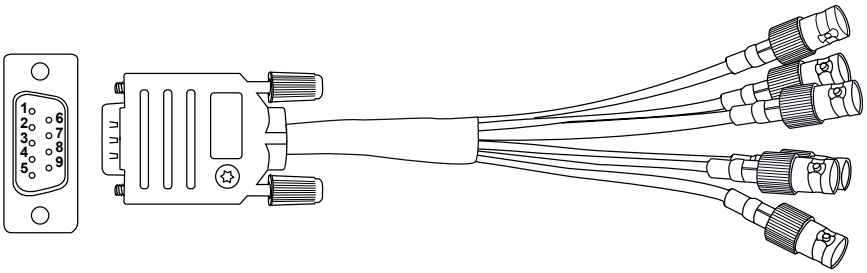


Figure 14: Pin assignment breakout cable

Connector type	TE (Tyco Electronics) connectivity: 2-5747706-0 (D-sub, 9-pin female)
Mating connector type	TE (Tyco Electronics) connectivity: 5-747904-5
1-KAB2132-0_5: Breakout cable (Option, to be ordered separately)	
Cable type	Coax
Connector type	6; BNC female
Length	0.5 m (1.6 ft)
External input details (Trigger In / Event In / Start In / Stop In)	
Levels	TTL compatible, Low -30 V to 0.7 V, High 2 V to 30 V Input has an internal pull-up of 20 kΩ ± 1% to 5 V
Input overvoltage protection	± 25 V DC, ± 30 V peak <1 minute
Resolution	50 ns
Minimum pulse width filter	500 ns, 1 µs, 2 µs, 5 µs, 10 µs
Active edge	Rising or falling; software selectable
Delay	± 1 µs + up to one sample period
Start response time	Typically 1 s when system is completely idle
Stop response time	Typically 1 s when system is recording without automation
External output details (Trigger out / Event out)	
Levels	TTL compatible; 0 V < Low < 0.6 V; 2 V < High < 5 V
Active level	High/Low/Hold High; software selectable
Pulse width	High or Low selected: 12.5 to 12.8 µs Hold High selected: Active from first trigger to end of recording
Maximum output current	50 mA, short circuit protected
Output impedance	49.9 Ω ± 1%
Short circuit protected	Continuous
External Trigger Out delay	User selectable; minimum value may vary for each acquisition card. Default 516 ± 1 µs + up to one sample period; Filter set to wideband (1)
External Event Out delay	User selected external trigger output delay - 1 µs

(1) If an analog and/or digital filter is used, extra delay will be added, depending on the type of filter and signal frequency.

Digital Event/Timer/Counter

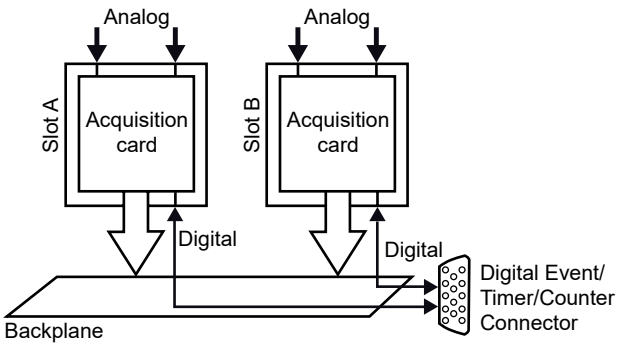


Figure 15: Digital Event/Timer/Counter block diagram

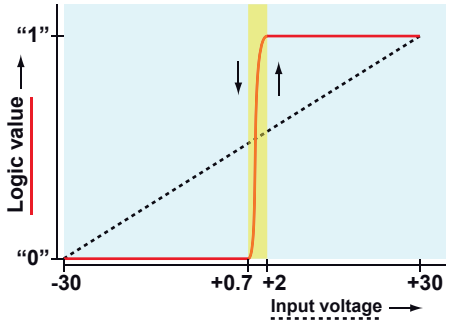
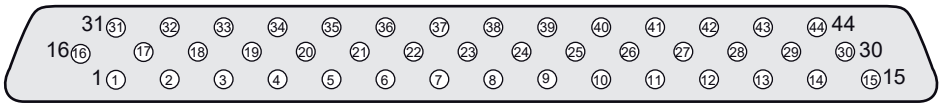
Number of connectors	1	
Connector type	44 pin, female D-type connector, AMP HD-22 series (Tyco/TE connectivity: 5748482-5)	
Mating cable connector type	44 pin, male D-type connector, HDP-22 series (Tyco/TE connectivity: 1658680-1)	
Output power		
Voltage	5 ± 0.5 V DC	
Maximum current	0.5 A	
Event Inputs		
Number of event inputs	16 per card, 2 cards per connector	
Levels	TTL Compatible, Low -30 V to 0.7 V, High 2 V to 30 V	
		

Figure 16: Logic threshold voltage levels

Overvoltage protection	± 25 V DC, ± 30 V DC peak <1 minute	
Timer/Counter		
Number of channels	GN310B/GN311B and GN610B/GN611B input cards(1)	Other input cards
	Four per card Two cards per connector	Two per card Two cards per connector
Functions	See specifications of acquisition cards that support these inputs	
Outputs		
Number of outputs	Two per card, two cards per connector	
Functions	See specifications of acquisition cards that support these outputs	
Output levels	TTL compatible; 0 V < Low < 0.6V; 2 V < High < 5 V	
Output resistance	49.9 Ω ± 1%	
Maximum output current	50 mA, short circuit protected	

(1) Perception 8.22 or later required.

Digital Event/Timer/Counter Connector 1(AB) and 2(CD) Pin Assignment



PIN 1 - Event Input A1/C1 & Reset Timer/Counter A2/C2
PIN 2 - Event Input A2/C2 & Direction Timer/Counter A2/C2
PIN 3 - Event Input A3/C3 & Clock Timer/Counter A2/C2
PIN 4 - Event Input A4/C4 & Reset Timer/Counter A4/C4 (1)
PIN 5 - Event Input A5/C5 & Direction Timer/Counter A4/C4 (1)
PIN 6 - Event Input A6/C6 & Clock Timer/Counter A4/C4 (1)
PIN 7 - Event Input A7/C7 & Reset Timer/Counter A3/C3 (1)
PIN 8 - Event Input A8/C8 & Direction Timer/Counter A3/C3 (1)
PIN 9 - Event Input A9/C9 & Clock Timer/Counter A3/C3 (1)
PIN 10 - Event Input A10/C10 & Reset Timer/Counter A1/C1
PIN 11 - Event Input A11/C11 & Direction Timer/Counter A1/C1
PIN 12 - Event Input A12/C12 & Clock Timer/Counter A1/C1
PIN 13 - Event Input B1/D1 & Reset Timer/Counter B2/D2
PIN 14 - Event Input B2/D2 & Direction Timer/Counter B2/D2
PIN 15 - Event Input B3/D3 & Clock Timer/Counter B2/D2
PIN 16 - Event Input B4/D4 & Reset Timer/Counter B4/D4 (1)
PIN 17 - Event Input B5/D5 & Direction Timer/Counter B4/D4 (1)
PIN 18 - Event Input B6/D6 & Clock Timer/Counter B4/D4 (1)
PIN 19 - Event Input B7/D7 & Reset Timer/Counter B3/D3 (1)
PIN 20 - Event Input B8/D8 & Direction Timer/Counter B3/D3 (1)
PIN 21 - Event Input B9/D9 & Clock Timer/Counter B3/D3 (1)
PIN 22 - Event Input B10/D10 & Reset Timer/Counter B1/D1
PIN 23 - Event Input B11/D11 & Direction Timer/Counter B1/D1
PIN 24 - Event Input B12/D12 & Clock Timer/Counter B1/D1
PIN 25 - Event Input B13/D13
PIN 26 - Event Input B14/D14
PIN 27 - Ground
PIN 28 - Ground
PIN 29 - Ground
PIN 30 - Ground
PIN 31 - Event Input B15/D15
PIN 32 - Event Input B16/D16
PIN 33 - Event Input A13/C13
PIN 34 - Event Input A14/C14
PIN 35 - Event Input A15/C15
PIN 36 - Event Input A16/C16
PIN 37 - Event Output B2/D2
PIN 38 - Event Output B1/D1
PIN 39 - Event Output A2/C2
PIN 40 - Event Output A1/C1
PIN 41 - Ground
PIN 42 - Ground
PIN 43 - +5 V Power
PIN 44 - +5 V Power

Figure 17: Pin diagram for Digital Event/Timer/Counter connector 1(AB) and 2(CD)

(1) Additional Timer/Counter channels are only available if a GN310B/GN311B or GN610B/GN611B card is installed.

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 (2017)	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
EN 61010-2-030 (2017)	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 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

G096: GEN2tB/GEN4tB M2 SSD, Local Storage (Option, to be ordered separately)	
Built inside the GEN DAQ series mainframes to secure data storage in the best way possible. Recorded data can be copied to a permanent archive using Perception software or by using the user account to enable network based direct drive access.	

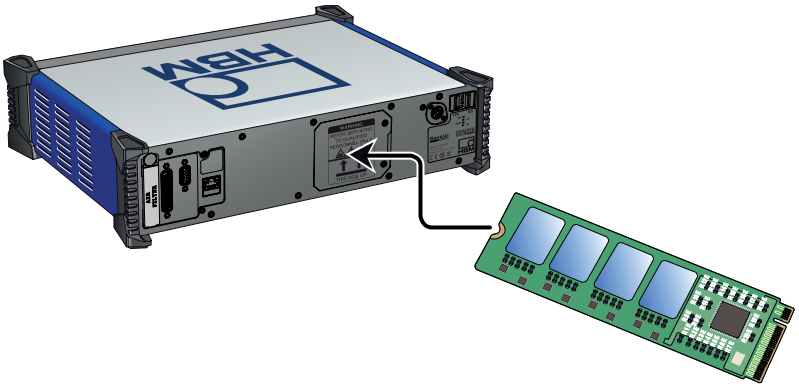


Figure 18: Block diagram Solid State Drive

Recording data access	
Perception access	Recorded data can be read, copied and deleted by Perception when connected to a GEN DAQ mainframe
Network direct access	User account based access rights. When enabled direct read, copy and delete recordings can be performed as normal drive sharing actions.
Storage configuration	
Storage technology	Solid State Drive (M.2 SSD)
Number of SSDs	1
SSD operation	Single drive
EXT4 volume unformatted size	500 GB
File system format	Linux EXT4
Data encryption	Not supported
Maximum continuous storage speed	125 MB/s Tested using full disk circular recording for 48 hours
Maximum sweep storage speed	Depends on sweep length and number of channels used
Location	Built-in, not removable
Special configurations	
Larger system disks	The storage capacity of SSDs increases almost every year. Contact the local HBK support team to inquire about availability and to request a special project quote.
Temperature range	0 °C to +70 °C

G081: Option Carrier Card (Option, to be ordered separately)	
Used to enable optional synchronization and other interface cards. (See option card specifications for more details)	

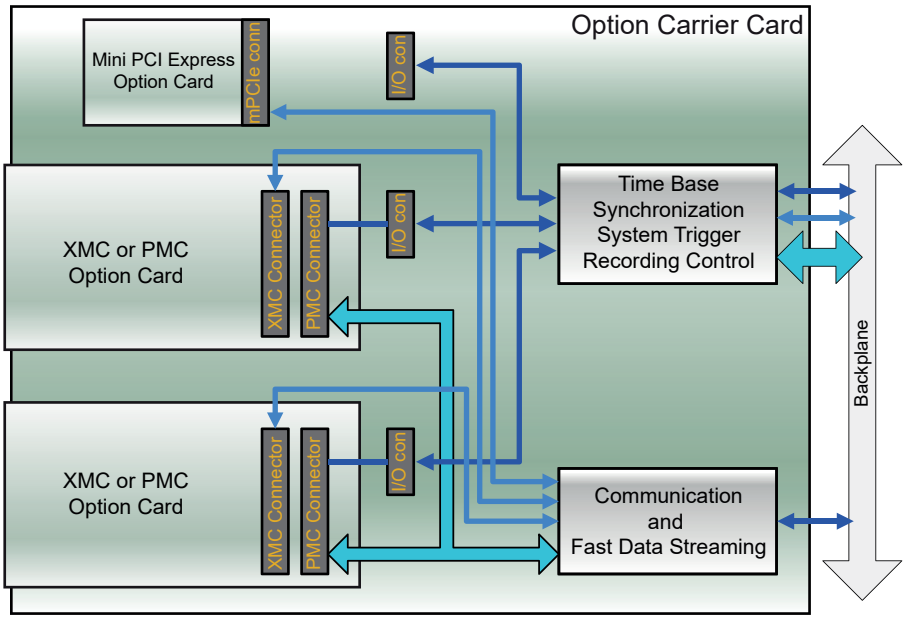


Figure 19: Block diagram option carrier card

Maximum option carrier cards	Limited by size of mainframe (number of slots -1) All mainframe slots can be used with an option carrier card. Each mainframe needs at least one acquisition card.
Supported mainframes	GEN2tB, GEN3iA, GEN4tB, GEN7iB, GEN7tB and GEN17tB Requires a fast data streaming bus
Option card types	
PMC/XMC cards	Two per option carrier card
Mini PCI express cards	One per option carrier card
Supported option cards (max. two options can be configured)	
Master output card	1-G083 Master output card to support four Sync mainframes per Master output card Two Master output cards per option carrier card, multiple option carrier cards per mainframe
At the time of this specification's release, no Mini PCI express option cards are supported	

G064: 10Gbit Ethernet Card (Option, to be ordered separately)

Supports up to two 10Gbit Ethernet connections using SFP+ modules (G081 option carrier card required).
Factory installed option, cannot be combined with 1-G084.

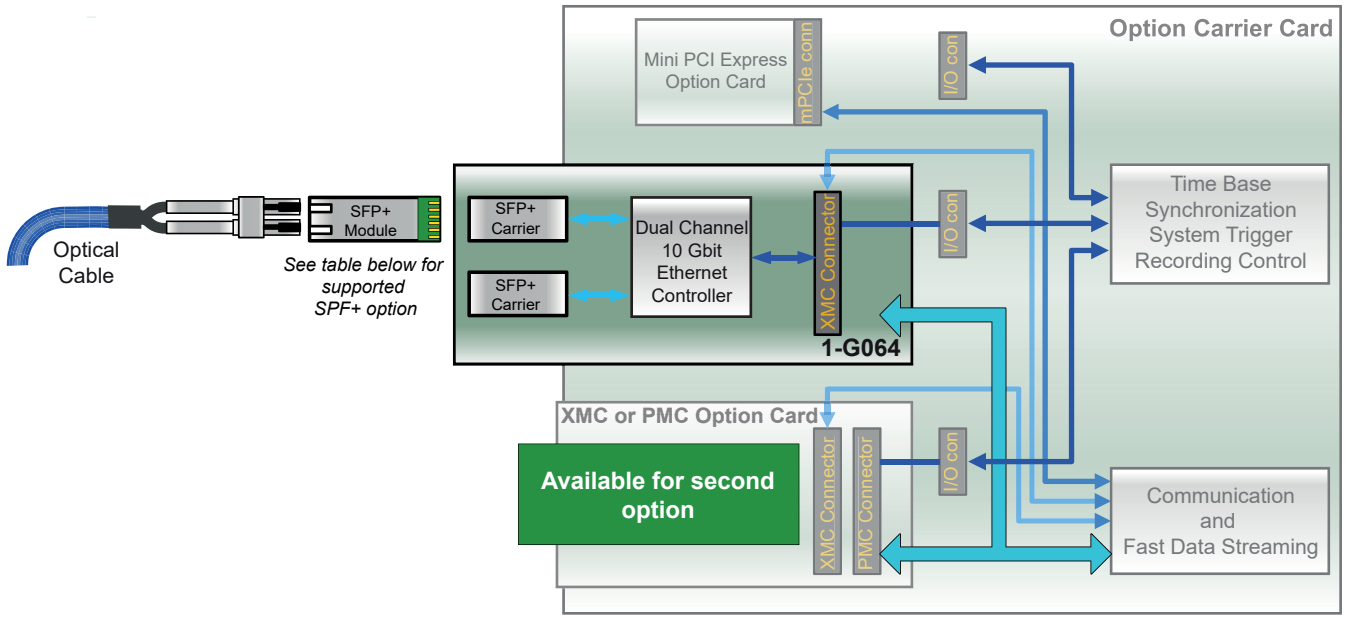


Figure 20: Block diagram 10Gbit Ethernet card, optical (G081 required)

Maximum number of Ethernet option cards	One Ethernet option card per mainframe, cannot be combined with 1-G084		
Network interface	Up to two interfaces each 10 Gbit/s optical using SFP+ modules with LC connectors		
Ethernet Speed	1 or 10 Gbit (auto detection)		
PTPv2 (IEEE1588:2008) synchronization	Not supported on Ethernet option cards		
Wake-on-LAN	Not supported on Ethernet option cards		
Multiple Ethernet use cases	PTPv2 (IEEE1588:2008) can be used on a separate 1 Gbit Ethernet interface A combination of 10 Gbit and 1 Gbit Ethernet interfaces is supported		
SFP+ Module selection	**1-G065**	**1-G066**	**1-SFP-10GBIT-RJ45**
10GBASE-SR (Optical)	Yes	No	No
10GBASE-LR (Optical)	No	Yes	No
10GBASE-T (Electrical)	No	No	Yes
Optical Wavelength	850 nm	1310 nm	-
Connector type	LC	LC	RJ45
Required cables			
Multi Mode OM3 cable	KAB280	-	-
Single Mode OS2 cable	-	KAB288 or KAB290	-
Electrical cable	-	-	CAT6A or higher
Maximum cable length	82 m (269 ft)	10 km (6.2 mi)	100 m (330 ft)
TCP/IP IPv4 / v6			
Address setup	DHCP/Auto IP or fixed IP		
DHCP setup	When DHCP fails, the APIPA (Automatic Private IP Addressing) setup is used similarly to Windows® PCs		
Gateway setup	Gateway setup supported for control through VPN and/or Internet		
TCP/IP IPv6	Not supported		
Maximum transfer speed			
Continuous recording to remote PC	400 MB/s(1)		
Temperature Range			
Operational	0 °C to 40 °C (32 °F to 104 °F)		
Non-operational (Storage)	-55 °C to +85 °C (-67 °F to +185 °F)		

(1) Tested using circular recording for 48 hours. Test setup uses a Windows® 7 PC with Intel i7 CPU and SSD with sustained write speeds exceeding 700 MB/s and a 10 Gbit Ethernet link.

G083: Master Output Card (Option, to be ordered separately)

Supports up to four Sync mainframes, multiple Master output cards supported (G081 option carrier card required).
Factory installed option.

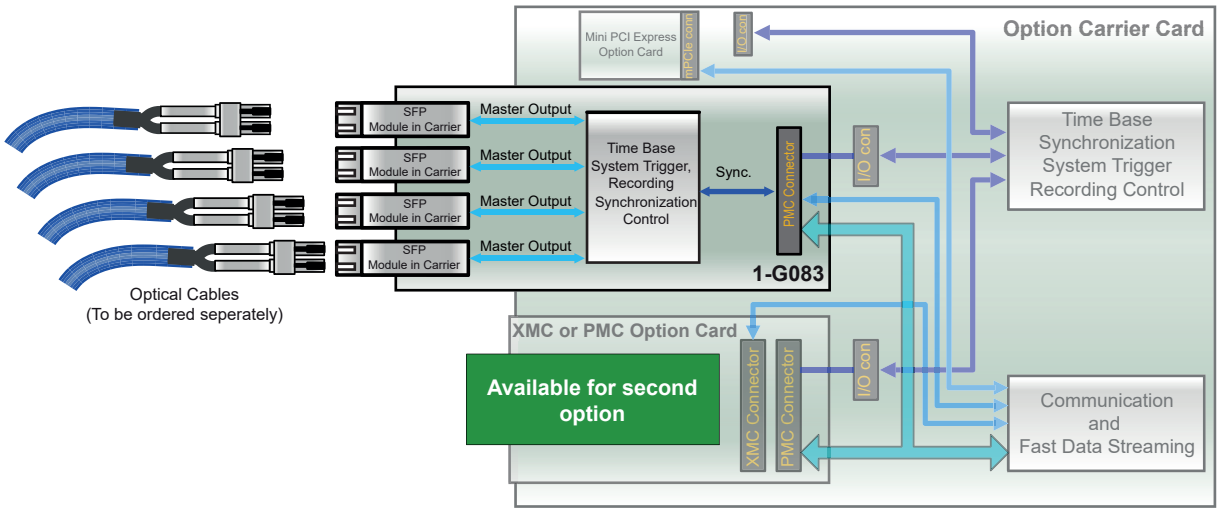


Figure 21: Block diagram Master output card (G081 required)

Master outputs	Four per Master output card. Up to two Master output cards per option carrier card. All but the first mainframe slots can be filled with option carrier cards.
Mainframe to mainframe phase shift	± 150 ns RMS; measured on analog signals using identical acquisition modules, identical sample rates and filter settings in each mainframe
LED signaling	Optical link synchronized, not connected, function disabled
Master mode	Basic and extended synchronization supported; four Sync mainframes per Master output card Two Master output cards per option carrier card, multiple option carrier cards per mainframe
Sync mode	Not supported. Use Master/Sync synchronization connector of mainframe for Sync mode
Maximum mainframes	GEN2tB: 9 Sync mainframes, 10 including Master mainframe GEN4tB: 25 Sync mainframes, 26 including Master mainframe GEN3i, GEN3iA and GEN3t: 17 Sync mainframes, 18 including Master mainframe GEN7i, GEN7iB and GEN7tB: 49 Sync mainframes, 50 including Master mainframe GEN17tB: 129 Sync mainframes, 130 including Master mainframe
Time required to full synchronization after Master/Sync signal detected	
No recording active	1 minute typical
Recording or pause active	1 minute plus 25 s per ms recording time deviation from Master time
User notifications while recording	Time marks on Master/Sync signal lost/restored and Master/Sync time synchronized
Basic synchronization (backward compatible with the legacy GEN series Master/Sync card option)	
Cable length propagation delay	±5 ns/m; Automatic cable length detection and propagation delay compensation
First sample	Synchronizes the first sample in a continuous recording for each mainframe. First samples are not recorded in the Sync mainframes defined by the cable length propagation delays. Signal phase shifts are not introduced by this propagation delay.
Synchronized time base	Prevents frequency drift of the sample rates within each mainframe
Measured channel trigger exchange	Synchronously exchanges measured channel triggers connected to the Master/Sync trigger bus between mainframes. Typically used for the sweep recording modes.
Extended synchronization (Not supported by the legacy GEN series Master/Sync card option)	
Calculated channel trigger exchange	Synchronously exchanges real-time calculated (RTC) channel triggers between mainframes. Separate exchange required due to the longer internal delays of RTC channel triggers that were caused by the mathematics prior to establishing a trigger.
Synchronous manual trigger	User action within Perception to trigger all mainframes synchronously
Synchronous recording actions	Start/Stop and Pause a recording across multiple mainframes, each controlled by a separate instance of Perception. Stop recording is a non-synchronous action. Synchronously records distributed data with a mix of GEN7iB/GEN3iA mainframes in Master/Sync setup while running Perception on each of the mainframes. A more typical Master/Sync setup would be to control both systems from one Perception application.
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)

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 and GN1202B cards. Typically used for fixed cable routing or LAB environments.

Figure 22: 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

KAB288: Fiber Optic Cable SM 9/125 µm LC-LC (Option, to be ordered separately)

Standard zipcord fiber optic duplex Single Mode patch cable
Used with 1310 nm optical 1 Gbit or 10 Gbit Ethernet (1-G063 and 1-G066). Typically used for fixed cable routing or LAB environments.

Figure 23: Block diagram and image

Connector type	LC - LC
Cable rating	OS2; Single Mode, 1310 nm
Core/Cladding diameter	9/125 µm
Jacket size/diameter	Typically 2 mm (0.08") single core
Jacket rating	Low-smoke zero-halogen
Attenuation	≤ 0.5 dB/km @ 1310 nm
Available lengths	2, 10, 20, 50 and 100 m (6.6, 33, 66, 164 and 330 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 +70 °C (-40 °F to 158 °F)

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

KAB289: Robust Fiber Optic Cable SM 9/125 µm LC-LC (Option, to be ordered separately)
Heavy duty fiber optic duplex Single Mode cable Used with 1310 nm optical 1 Gbit or 10 Gbit Ethernet (1-G063 and 1-G066). Typically used for test cell environments.

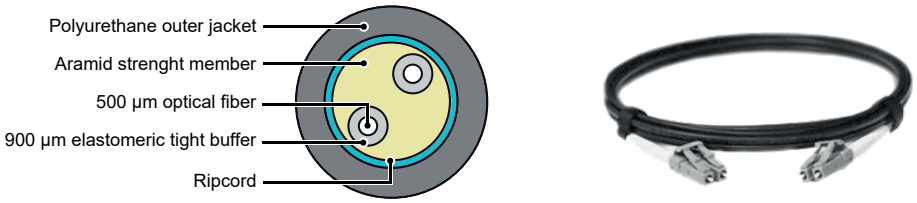


Figure 24: Block diagram and image

Connector type	LC - LC
Cable rating	OS2; Single Mode, 1310 nm
Core/Cladding diameter	9/125 µm
Jacket size/diameter	5.8 mm (0.23")
Jacket rating	Polyurethane, halogen free
Attenuation	≤ 0.5 dB/km @ 1310 nm
Available lengths	10, 20, 50, 100, 150 and 300 m (33, 66, 164, 328, 492 and 984 ft). For other lengths contact custom systems(1).
Bend radius	58 mm (2.3")
Crush resistance	2000 N/cm
Weight	Typically 32 kg/km (21.5 lb/1000 ft)
Operating temperature	-40 °C to +85 °C (-40 °F to 185 °F)

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

G070A: Torque/RPM Adapter (Option, to be ordered separately)

An external connection box to connect HBM's T12, T40B or any other RS422-based torque/RPM transducer directly to the GEN series mainframe Digital Event/Timer/Counter connector. Mainframe connection cable included.

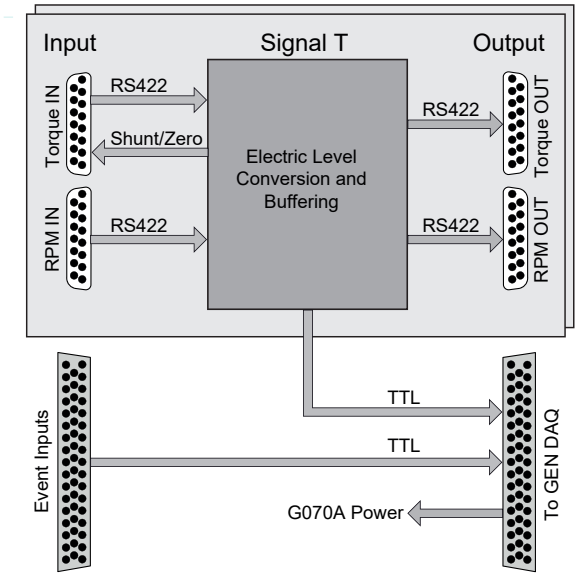


Figure 25: Block diagram and image

Torque sensor connection	
Number of torque sensors	2
Torque interface support	Torque and shunt (A-Txx CON1 Torque IN & B-Txx CON1 Torque IN)
Speed interface support	RPM, direction and reference (A-Txx CON2 Speed IN & B-Txx CON2 Speed IN)
Signal levels	Differential RS422
Signal termination	100 Ω
Torque sensor loop through	
Number of torque sensors	2
Torque interface output	Torque (A-Txx CON1 torque OUT & B-Txx CON1 torque OUT)
Speed interface output	RPM, direction and reference (A-Txx CON2 Speed OUT & B-Txx CON2 Speed OUT)
Output levels	Differential RS422, electronically retransmitted from input signals
Connectors	
Digital Event/Timer/Counter	HD22 sub-D 44 pin male (connection cable included)
Event I/O loop through connector	44 pin, female D-type connector, AMP HD-22 series (Tyco/TE Connectivity: 5748482-5)
Event I/O loop through cable connector	44 pin, male D-type connector, HDP-22 series (Tyco/TE Connectivity: 1658680-1), to be ordered separately
Torque, Speed/RPM interface IN	15 pin, female sub-D type connector (matches 1-KAB149-6 and 1-KAB163-6)
Torque, Speed/RPM interface OUT	15 pin, male sub-D type connector
Torque power input	Switchcraft L712A Matching cable connector Switchcraft 761KS17 (LD-024-1000911). Two cable connectors included
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)

Note *For more details, please refer to data sheet "B4229 en GEN series G070A Torque/RPM adapter".*

G072: Isolated Digital Event Adapter (Option, to be ordered separately)

An external connection box to isolate all input and output signals used on the GEN series mainframe Digital Event/Timer/Counter connector.
Adapter input connector pin compatible with mainframe input connector. Mainframe connection cable included.

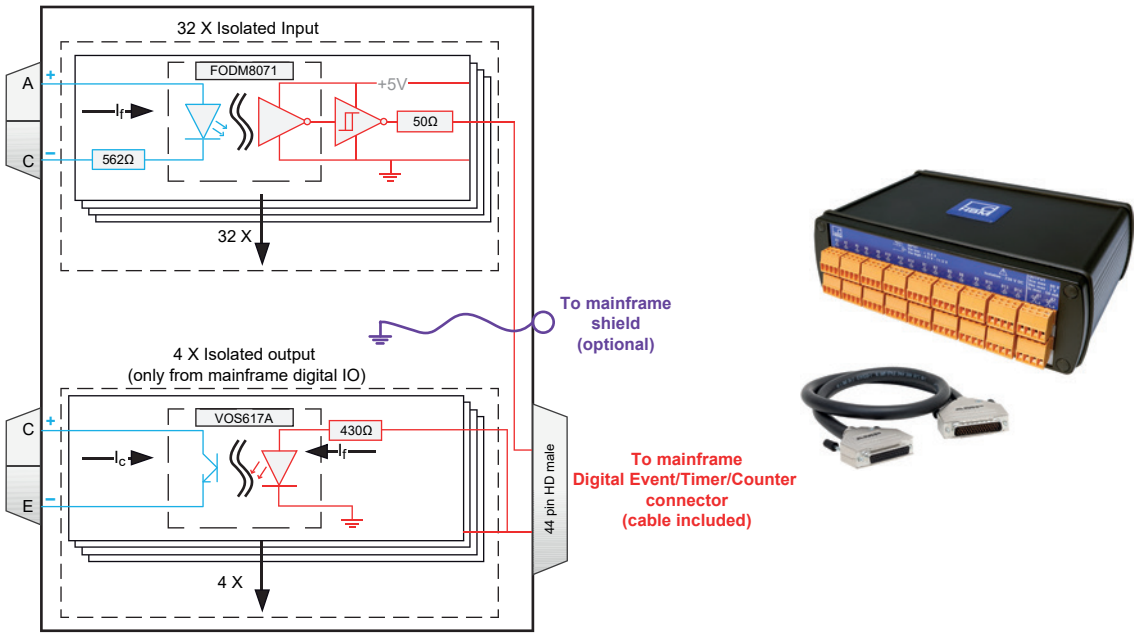


Figure 26: Block diagram and image

Event inputs	
Inputs	32 event channels (Anode, Cathode optocoupler with a 562 Ω series resistor)
Isolation voltage	230 V AC RMS or DC (channel to channel and channel to chassis/earth)
Isolation device	Fairchild FOD8071 optocoupler (or comparable)
Switching frequency	10 MHz input block signal tested. The highest frequency supported for the system is limited by the isolator box or acquisition system, whichever is the lowest.
Maximum propagation delay	55 ns
Common mode transient voltage	Typically 20 kV/µs
Input switching voltages	
Logic 0	< 1.0 V + 0.0015 A (562 Ω + R_{ext})
Logic 1	> 1.3 V + 0.0050 A (562 Ω + R_{ext}) (+100 V when R_{ext} = 20 kΩ)
Maximum nondestructive voltage	1.8 V + 0.0150 A (562 Ω + R_{ext}) (+300 V when R_{ext} = 20 kΩ)
Minimum nondestructive reverse voltage	-5.0 V
Event outputs	
Output channels	4 digital isolated output channels (open Collector, Emitter) Only supported by Digital Event/Timer/Counter connector
Isolation device	Vishay VOS617A optocoupler (or comparable)
Output frequency	170 kHz output signal tested. Maximum useable frequency for the system is limited by the Isolated Digital Event Adapter or acquisition system, whichever is the slowest.
Nondestructive control voltages	
Maximum voltage	0.007 * R_{ext} and < 80 V
Minimum voltage	-7.0 V
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)

Note *For more details, please refer to data sheet "B4232 en GEN series G072 230 Volt RMS Isolated Digital Event adapter".*

G001B: IRIG Receiver with PTP Output (Option, to be ordered separately)

External IRIG to PTPv2 convertor in a compact housing. Using the PTPv2 time source output GEN DAQ then synchronizes to IRIG time source. The solution comes as a complete package including cables, 19" rack mount kit and CD with user manual and installation instructions.

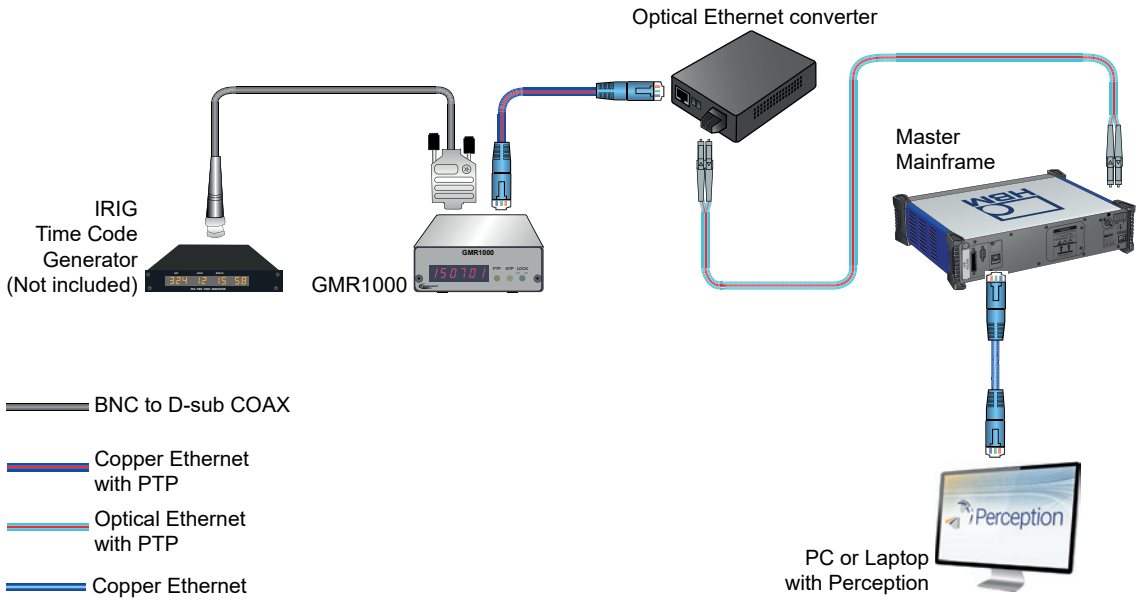


Figure 27: Example setup IRIG time synchronization

Included in G001B option	
IRIG receiver	GMR1000
IRIG input	2.5 m (8.2 ft) BNC to D-sub COAX
Ethernet cables	4.5 m (14.8 ft) CAT6 Ethernet cable to PoE adapter 20 m (65 ft) Fiber cable standard MM LC-LC 1-KAB280-20
Optical Ethernet converter	Converts the electrical Ethernet signal to an optical SFP Ethernet output signal
Optical SFP	2 * G091 for optical Ethernet converter and GEN DAQ mainframe optical ethernet option
IRIG receiver GMR1000	
DC input	9-28 V DC
AC input	External wall mount power supply
Dimensions	1164 mm (width) x 103 mm (height) x 36 mm (depth) (6.45" x 4.05" x 1.41")
Weight	0.45 kg (16 oz)
Rack mount	19", 1U height included
IRIG protocols support	IRIG-B0 (DCLS), IRIG-B1 (AM), IRIG-A0 (DCLS), IRIG-A1 (AM), IRIG-E0 (DCLS), IRIG-E1 (AM)
Time synchronization accuracy	< 50 µs to IRIG time (Measured on GEN DAQ mainframe)
GEN DAQ series functions	Capture start of recording time Synchronize master time base oscillator frequency
Time required to full synchronization	
No recording active	< 1 min
Recording or pause active	< 1 min plus 25 s per ms recording time deviation from IRIG time source
Supported PTPv2 timing protocol	PTP according to IEEE1588-2008 (1 step, End-to-End, UDP, IPv4)
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)

G002B: GPS Receiver with PTP Output (Option, to be ordered separately)

External GPS time synchronization using PTPv2 network communication.
The solution comes as a complete package, including a power over Ethernet (PoE) powered GPS antenna, all required RJ45 network cable, an outdoor RJ45 network surge protector, a PoE injector, two G091 SFPs and CD with user manual and installation instructions.

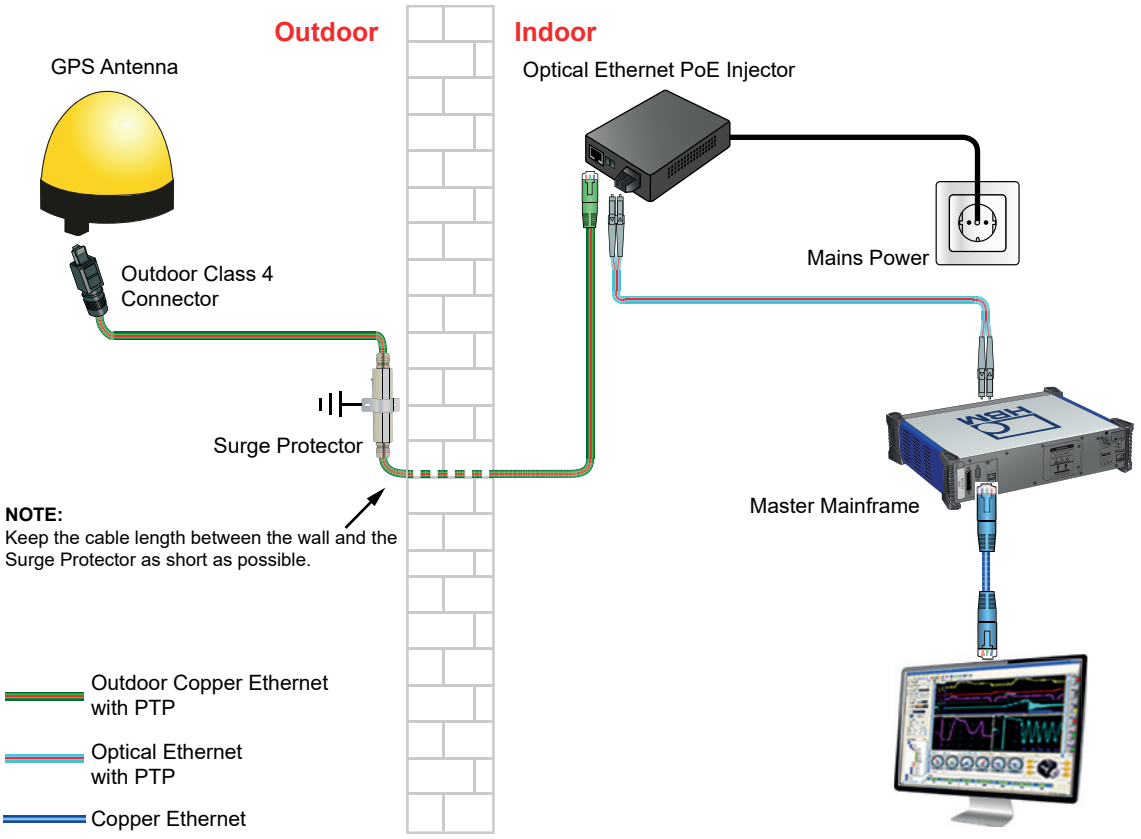


Figure 28: Example setup GPS time synchronization

Included in G002B option	
GPS antenna	OTMC 100
GPS antenna cables	50 m (164 ft) Outdoor CAT6 Ethernet cable to Surge Protector 20 m (65 ft) Outdoor CAT6 Ethernet cable to PoE adapter 20 m (65 ft) Fiber cable standard MM LC-LC 1-KAB280-20
Surge Protector	UL497B standard
Optical Ethernet PoE Injector	Power over Ethernet (PoE) injector. Supplies power to GPS antenna and converts the electrical Ethernet signal to an optical MM 50/125 um Ethernet output signal.
Optical SFP	2 * G091 for PoE injector and GEN DAQ mainframe optical ethernet option
GPS antenna specifications	
GPS antenna safety	IEC60950-1:2005 2 Ed. +A1:2009 IEC60950-22:2005
GPS antenna connector	RJ45 waterproof connector according to IEC61076-3-106 (Variant 4)
Time synchronization accuracy	<150 ns to reference time (UTC) (Measured on GEN DAQ mainframe)
GEN DAQ series functions	Capture start of recording time Synchronize master time base oscillator frequency
GPS localization time	4 to 10 minutes after power on of antenna
Time required to full synchronization after GPS localization completed / User notifications / PTPv2	
No recording active	<1 min
Recording or pause active	<1 min plus 25 s per ms recording time deviation from UTC time
User notifications while recording	Time marks on PTP time synchronization lost/restored, Mac Address of Master
Antenna Supported Timing Protocols PTPv2	PTP according to IEEE1588–2008 (1 step, End-to-End, UDP, IPv4)
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)

1-4C-PCIE-CANFD-2T: 4 Channel CAN FD (Option, to be ordered separately)

4 channel CAN FD or CAN 2.0 option for G081.CAN port 1: CAN data recording; CAN data output; Acquisition control. CAN port 2, 3, 4: CAN data recording only. After configuration the mainframe can send results to CAN bus stand-alone without the use of Perception.
Note: At least one acquisition card inside the mainframe needs to have a 1-GEN-OP-RT-FDB option installed.
1-4C-PCIE-CANFD-2T is a factory installed option (assembled inside the mainframe)

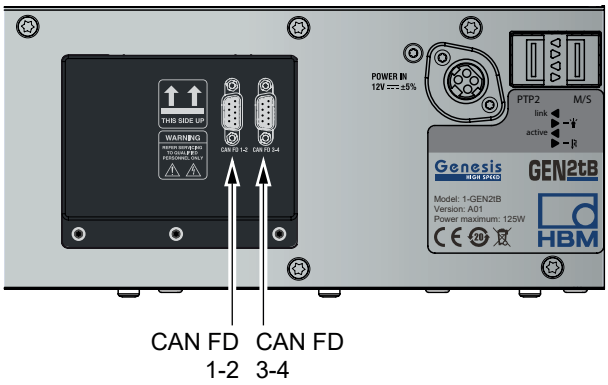
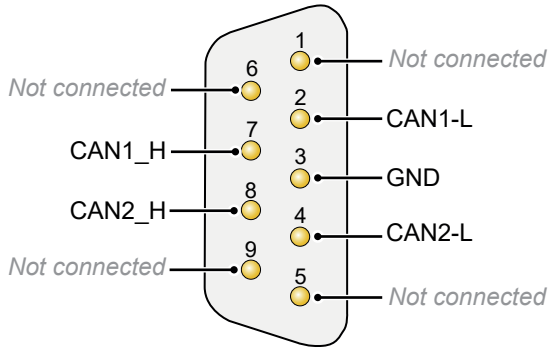


Figure 29: GEN2tB with installed CAN FD top part (Detail)

CAN FD specification	
CAN support	Complies with CAN specifications 2.0 A/B and FD
CAN bit rates	From 25 kbit/s up to 1 Mbit/s
CAN FD bit rates	From 25 kbit/s up to 12 Mbit/s
Galvanic isolation	Up to 300 V
CAN bus connector	2x D-Sub, 9-pin, 2 CAN channels per connector



Note: For pin assignment for CAN FD 3-4 replace **CAN1** with **CAN3** and **CAN2** with **CAN4**

PIN PIN Assignment CAN FD 1-2
PIN 1 - Not connected
PIN 2 - CAN1-L
PIN 3 - GND
PIN 4 - CAN2-L
PIN 5 - Not connected
PIN 6 - Not connected
PIN 7 - CAN1-H
PIN 8 - CAN2-H
PIN 9 - Not connected

Figure 30: Pin assignment CAN FD Option

Temperature Range	
Operational	-20 °C to +60 °C (-4 °F to +140 °F)
Non-operational (Storage)	-25 °C to +70 °C (-13 °F to +158 °F)

1-USB-CAN-FD-1CHN: External 1-Channel CAN FD Interface (Option, to be ordered separately)

One channel CAN FD or CAN 2.0 option.
CAN port 1: CAN data recording; CAN data output; Acquisition control. After configuration, the mainframe can send results to CAN bus stand-alone without the use of Perception.
Note: At least one acquisition card inside the mainframe needs to have a 1-GEN-OP-RT-FDB option installed. The CAN FD option connects to the mainframe's USB port and must be inserted before powering on the mainframe (No plug-and-play support).

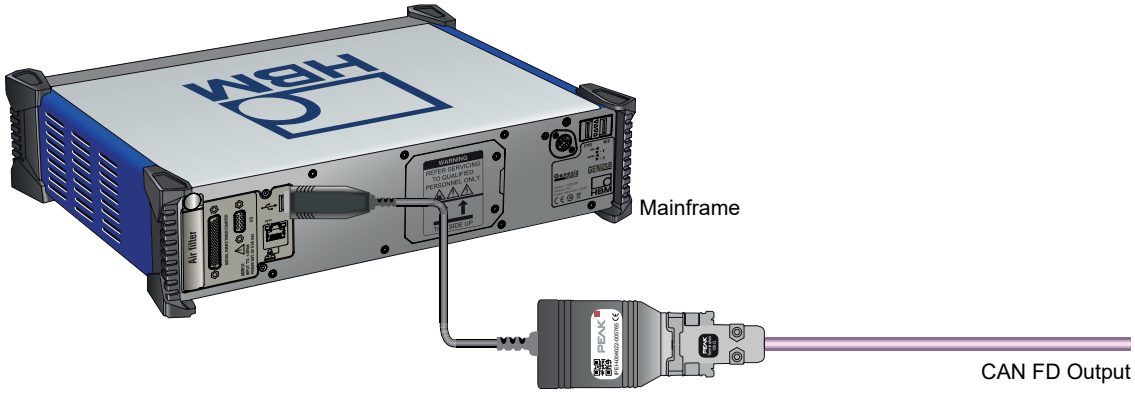
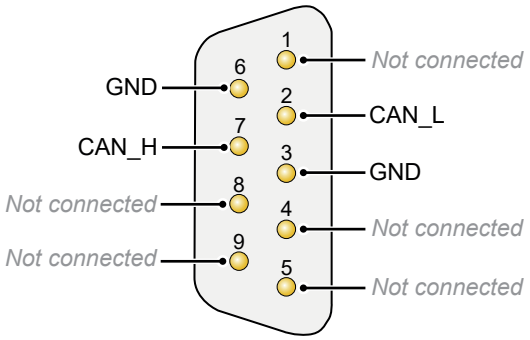


Figure 31: GEN2tB stand-alone CAN FD output

Included in CAN FD option	
USB to CAN FD convertor	Peak Systems: PCAN-USB FD

CAN FD specification	
CAN support	Complies with CAN specifications 2.0 A/B and FD
CAN bit rates	From 25 kbit/s up to 1 Mbit/s
CAN FD bit rates	From 25 kbit/s up to 12 Mbit/s
Galvanic isolation	Up to 500 V
CAN bus connector	D-Sub, 9-pin (in accordance with CiA® 303-1)



PIN PIN Assignment
PIN 1 - Not connected
PIN 2 - CAN-L
PIN 3 - GND
PIN 4 - Not connected
PIN 5 - Not connected
PIN 6 - GND
PIN 7 - CAN-H
PIN 8 - Not connected
PIN 9 - Not connected

Figure 32: Pin assignment D-Sub

Temperature Range	
Operational	-20 °C to +60 °C (-4 °F to +140 °F)
Non-operational (Storage)	-25 °C to +70 °C (-13 °F to +158 °F)

G093: Rack Mount Kit (Option, to be ordered separately)

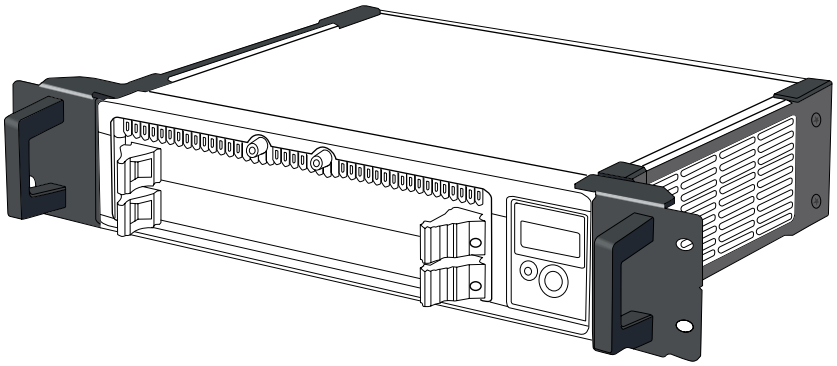


Figure 33: GEN2tB Rack Mount Kit

Rack Mount Kit	Mounting GEN2tB mainframe in a standard 19" rack. Requires no additional mounting materials. User installed option. 2 units, 89 mm (3.50") height

1-G098: GEN2tB Shipping Case (Option, to be ordered separately)

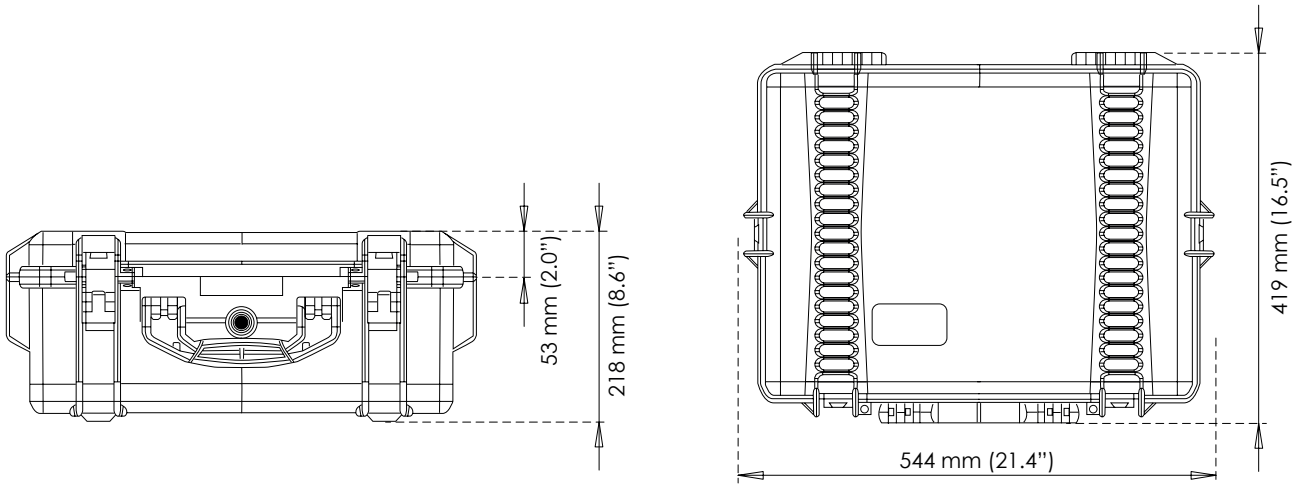


Figure 34: Reusable hardcover shipping case

Outside Dimensions	(W x H x D) 544 x 419 x 218 mm (21.4 x 16.5 x 8.6")
Weight Empty Case	4.3 kg (9.4 lb)
System Storage Area	GEN2tB slides in from the top for easy storage and easy removal. Includes area to store the GEN2tB power supply and power cable. Protects the system from impact during drops, shocks and vibrations.
Case Extras	Two lift handles and locks on side of the case for easy transport
Case Approvals	IP67, ATA300, DS 81-41 and STANAG 4280

Supported Acquisition Cards

Model	Type	Isolation	Maximum sample rate/ (not multiplexed)	Resolution	Memory/card	Analog Channels	Digital events	Timer/Counter channels	Slot width
GN310B	Balanced Differential/ Current	yes	2 MS/s	18 bit	2 GB	6	16	4	1
GN311B	Balanced Differential/ Current	yes	200 kS/s	18 bit	200 MB	6	16	4	1
GN610B	Balanced Differential	yes	2 MS/s	18 bit	2 GB	6	16	4	1
GN611B	Balanced Differential	yes	200 kS/s	18 bit	200 MB	6	16	4	1
GN800B	Remote Probe Receiver	yes	2 MS/S	16 bit	8 GB	--(2)	16	4	1
GN815	Unbalanced Differential/ IEPE	yes	2 MS/s	18 bit	2 GB	8	16	2	1
GN816	Unbalanced Differential/ IEPE	yes	200 kS/s	18 bit	200 MB	8	16	2	1
GN840B	Bridge/IEPE/Charge/ 4-20 mA/PT100/PT1000/ Thermocouples	yes	500 kS/s	24 bit	2 GB	8	16	2	1
GN1202B	Multi Mode Optical Fiber	yes	100 MS/s	--(1)	8 GB	12	16	2	1
GN1640B	Bridge/IEPE/Charge/ 4-20 mA/PT100/PT1000/ Thermocouples	yes	500 kS/s	24 bit	2 GB	16	16	2	2
GN8101B	Single-ended	no	250 MS/s	14 bit	8 GB	8	16	2	1
GN8102B	Single-ended	no	100 MS/s	14 bit	8 GB	8	16	2	1
GN8103B	Single-ended	no	25 MS/s	14 bit	8 GB	8	16	2	1

(1) This card supports up to 12 optical fiber transmitter channels.

(2) Depending on remote probes connected.

Optical Fiber Transmitter Channels

Every transmitter is a single channel unit. Every unit has an unbalanced differential input, amplifier, analog anti-alias filter and ADC with an optical data and control link to the receiver card. The receiver card has the recording logic, sample rate selection and memory. For more details, see GN1202B data sheet.

Model	Receiver card	Power	Sample rate	Resolution	Isolation
GN110	GN1202B	Battery	100 MS/s	14 bit	User application defined
GN111	GN1202B	Battery	25 MS/s	15 bit	User application defined
GN112	GN1202B	120/240 V AC	100 MS/s	14 bit	1800 V RMS
GN113	GN1202B	120/240 V AC	25 MS/s	15 bit	1800 V RMS

Remote Probes

Remote Probes to be connected via fiber optic cable with the GN800B receiver board. Two remote probes supported per receiver board. For more details, see GN800B data sheet.

Model	Input	Power	Sample rate	Resolution
P101I-4	4 channel Voltage Probe	120/240 V AC	2 MS/s with RT-FDB; 20 MS/s raw data	16 bit
P111I-4	4 channel Current Probe	120/240 V AC	2 MS/s with RT-FDB; 20 MS/s raw data	16 bit
P112I-4	4 channel Current Probe, integrated power supply for current transducers	120/240 V AC	2 MS/s with RT-FDB; 20 MS/s raw data	16 bit

Perception Versions					
Features	**Free Viewer**	**Viewer Enterprise**	**Free Standard**	**Advanced**	**Enterprise**
True 64 bit support	✓	✓	✓	✓	✓
Basic Review, Cursor, Report, Export	✓	✓	✓	✓	✓
Single mainframe control	✗	✗	✓	✓	✓
Multiple mainframe control	✗	✗	✗	✗	✓
Measurement Uncertainty	✗	✗	✗	✗	✓
Analysis	✗	✓	✗	✓	✓
Advanced Report	✗	✓	✗	✓	✓
Advanced Export	✗	✓	✗	✓	✓
Video Playback	✗	✓	✗	✓	✓
Multi-Monitor/Workbooks	✗	✓	✗	✓	✓
Information sheet	✗	✓	✗	✓	✓
Basic FFT	✗	✓	✗	✗	✓
Sensor Database	✗	✓	✓	✓	✓
User/Definer Mode	✗	✓	✗	✗	✓
Macros	✗	✓	✗	✗	✓
Application extensions					
CSI (custom software interface)	✗	Cost option	✗	Cost option	Cost option
STL & HP-HV automated analysis	✗	Cost option	✗	Cost option	Cost option
HV-IA Impulse Analysis	✗	Cost option	✗	Cost option	Cost option
ePower Testing	✗	✗	✗	✗	Cost option

(1) The maximum number of mainframes Perception can control is calculated by using 25% of PC memory divided by 50 MB FIFO required per mainframe. Minimum suggested configuration is a PC with 64 bit Windows® and 8 GB of memory.

System Integration

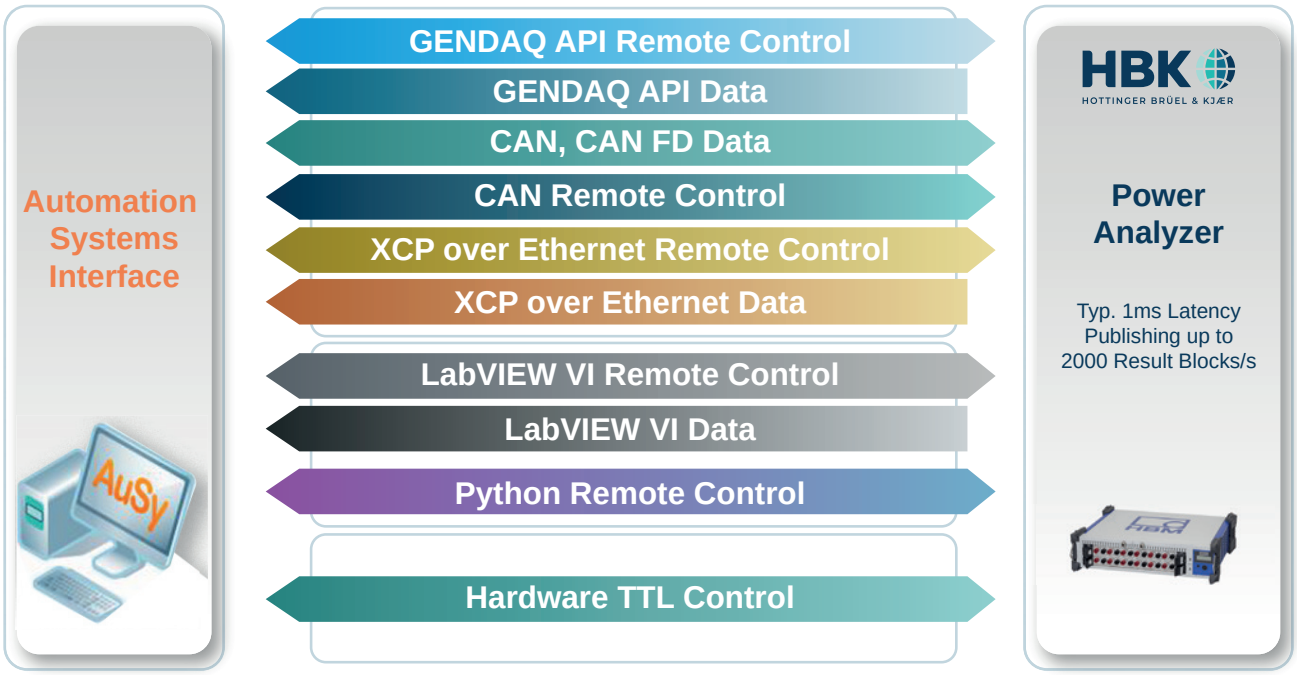


Figure 36: Available interfaces between Automation Systems and Genesis HighSpeed mainframes.

PNRF Recording File Reader (Free of Charge)

HBM maintained file reader to read the proprietary PNRF format. (Perception Native Recording File) Integrated by several industry standard analysis package suppliers. Available for all 3rd party software developers.

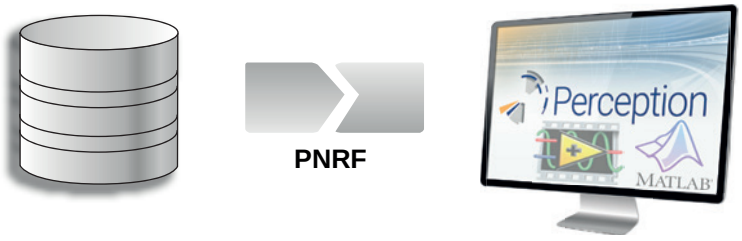


Figure 35: Functional diagram PNRF Reader

Functions	Read PNRF, NRF and LRF recording files directly in your own application
COM interface	The PNRF reader comes as a COM interface and can be used from any application or programming language which supports COM automation
PNRF Software Development Kit (SDK)	Installs PNRF dll's and supplies Visual Basic, C# and C++ getting started examples
GlyphWorks® integration	PNRF SDK integrated and available directly from HBM nCode
MATLAB® integration	PNRF SDK installs both MATLAB® PNRF reader and getting started examp
LabVIEW™ integration	PNRF SDK integrated and available directly from National Instruments
DIAdem™ integration	PNRF SDK integrated and available directly from National Instruments
FlexPRO integration	PNRF SDK integrated and available directly from Weisang GmbH
jBEAM™ integration	PNRF SDK integrated and available directly from AMS
DynaWorks® integration	PNRF SDK integrated and available directly from Intespace

Perception CSI (Customer Software Interface)

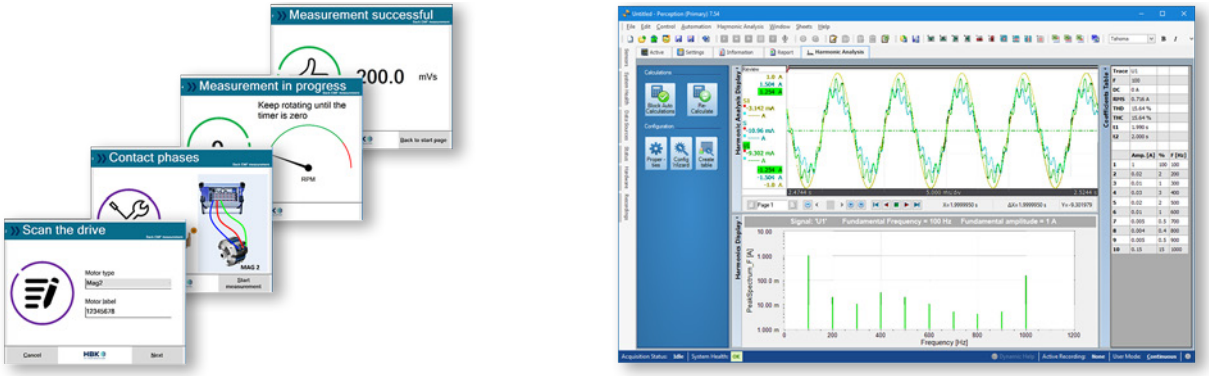


Figure 37: Perception CSI examples BackEMF (left) Harmonic analysis (right)

Functions	Create software extensions inside the Perception software by adding CSI user sheets, custom automation and extended analysis functions. Basic Windows C# sheet template included. Available for all languages that support Microsoft®.NET 4.
Available basic controls & commands	Access to every Perception part: Start/Stop/Pause and Trigger, Start Manager, Acquisition System, Hardware Settings, Displays, Meters, User Tables, Formulas, Calculations, Data Manager, Data Sources, User variables, Notifications, Logging, Conversion Functions, Automation Actions, Sheet Manager and more, to create a dedicated application GUI that hides the entire Perception standard GUI.
Examples (free of charge)	C# getting started example programs supplied, source code included

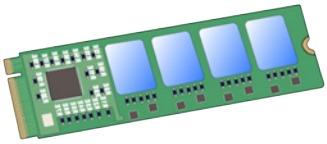
Perception and eDrive Training Program

Figure 38: Perception on-site training

HBM offers paid professional training and support programs on all API interfaces (PNRF reader, RPC and CSI). Training programs are based on C#, are on-site or are at a central HBM location. On-site training can be specific for each customer. Support can be the development of a fully customized software application or answering questions from software engineers.

S-TRAIN1-GEN_PERC	First day on-site basic training on GEN DAQ/PERCEPTION. Example content: Basic usage, hardware setup, acquisition. Training can be customized for specific training needs.
S-TRAIN2-GEN_PERC	Second day on-site enhanced training on GEN DAQ/PERCEPTION. Training can be customized for specific training needs.
S-TRAIN1-eDRIVE	First day on-site basic training on eDrive application specifics. Example content: Basic usage, hardware setup, acquisition. Training can be customized for specific training needs.
S-TRAIN2-eDRIVE	Second day on-site enhanced training on eDrive application specifics. Training can be customized for specific training needs.
1-PERC-CSI-TRAIN	Two day on-site Perception CSI training for software programmers During the training software programmers learn how to get started using the CSI template, make changes to the Perception user interface, to add new mathematical routines to the Formula Database or to add User Keys etc. The exact training details can be fully customized to the programmers needs including reviews and examples how to create the exact CSI changes of choice. Basic Microsoft® Visual Studio software C# programming skills are required before joining this training. More dedicated detailed training is available on request.
1-PERC-CSI-PROJ	One day eMail/Phone support for Perception CSI or RPC programmers. Get support from a HBM senior software engineer. Support can range anywhere from answering “how-to” question, assisting in analyzing any kind of (performance) issue to generating basic getting started example code fragments.

Ordering Information			
Article		**Description**	**Order No.**
GEN2tB		GEN2tB rugged, portable transient recorder and data acquisition system. Perception Standard and external AC-DC power adapter included..	1-GEN2tB

Solid State Drive (Option, to be ordered separately)			
Article		**Description**	**Order No.**
Solid state drive		GEN2tB range Solid State Drive option. Internal M2 SSD in GEN2tB mainframe, 500 GB capacity, 125 MB/s continuous streaming rate. Sweep storage rate depends on sweep length and number of channels. Short sweeps are stored more slowly due to administration overhead. Factory installed option. 0 °C to +55 °C.	1-G096

GEN2B Accessories (Options, to be ordered separately)			
Article		**Description**	**Order No.**
GEN2tB 19 inch rack mount kit		GEN2tB rack mount kit. Mounts the GEN2tB in a 19" rack. 2 units, 89 mm (3.50") height. Includes mounting bracket with required materials as well as mounting instructions. User installed option.	1-G093
GEN2tB air filter		GEN2tB replacement air filter. Regular replacement recommended. User changeable.	1-G095
GEN2tB shipping case		GEN2tB shipping/transport case with handle and latch. Exterior Dimensions (W x H x D) 544 x 419 x 218 mm (21.4 x 16.5 x 8.6"). Weight 4.3 kg (9.4 lb)	1-G098

Network SFP/SFP+ (Options, to be ordered separately)			
Article		**Description**	**Order No.**
2 Gbit Optical SFP module MM 850 nm		GEN DAQ 2 Gbit Ethernet SFP, 850 nm Multi Mode, up to 600 m optical cable length supported, LC connector support. Not compatible with the 10 Gbit SFP+ modules. Operating temperature: -20 °C to +60 °C	1-G091
1 Gbit Optical Network SFP module 1310 nm		GEN DAQ 1 Gbit Ethernet SFP, 1310 nm Single Mode, up to 10 km optical cable length supported, LC connector support. Not compatible with the 10 Gbit SFP+ modules. Operating temperature: -10 °C to +60 °C	1-G063

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 or 10 Gbit Ethernet (1-G091 and 1-G065), Master/Sync and GN1202B cards.	1-KAB280-3 1-KAB280-10 1-KAB280-20 1-KAB280-50
Fiber cable SM LC-LC		GEN DAQ standard zipcord fiber optic duplex Single Mode 9/125 µm cable, 0.5 dB/km loss, LC-LC connectors, yellow, ISO/IEC 11801 type OS2. Typically used for fixed cable routing or LAB environments. Lengths: 2, 10, 20, 50 and 100 meters (6.5, 33,66, 164 and 328 ft) Used with 1310 nm optical 1 Gbit or 10 Gbit Ethernet (1-G063 and 1-G066).	1-KAB288-2 1-KAB288-10 1-KAB288-20 1-KAB288-50 1-KAB288-100
Robust fiber cable SM LC-LC		GEN DAQ heavy duty fiber optic duplex SingleMode 9/125 µm cable, 0.5 dB/km loss, LC-LC connectors, black, ISO/IEC 11801 type OS2. Typically used for test cell environments. Lengths: 10, 20, 50, 100, 150 and 300 meters (33, 66, 164, 328, 492 and 984 ft) Used with 1310 nm optical 1 Gbit or 10 Gbit Ethernet (1-G063 and 1-G066).	1-KAB289-10 1-KAB289-20 1-KAB289-50 1-KAB289-100 1-KAB289-150 1-KAB289-300

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

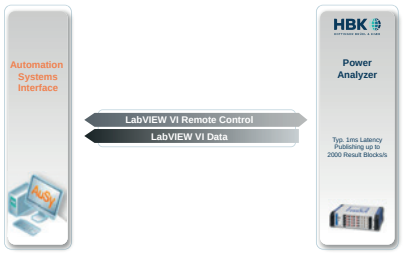
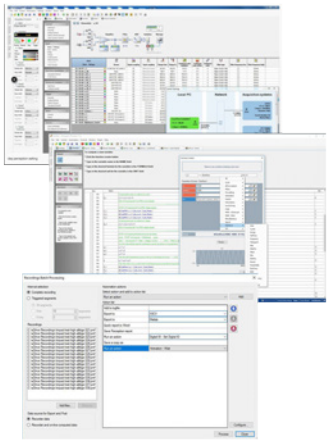
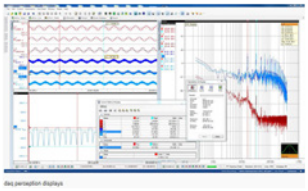
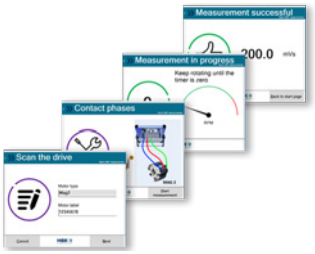
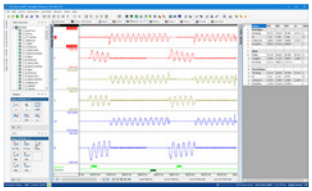
Option Carrier Card and Add-ons (Options, to be ordered separately)			
Article		**Description**	**Order No.**
Option carrier card		The option carrier card enables the use of two option cards within the GEN2tB, GEN3iA, GEN4tB, GEN7iB, GEN7tB and GEN17tB mainframes. Multiple option carrier cards are supported. Option cards enable the use of synchronization, fieldbuses and 10 Gbit Ethernet. Operating temperature: 0 °C to +40 °C	1-G081
Master output card		Factory installed, option carrier card (G081) required. The Master output card supports the use of four Sync mainframes. Up to two Master output cards are supported per option carrier card. Multiple option carrier cards supported per mainframe. Compatible with Master/Sync card (1-G040) and mainframe Master/Sync. Operating temperature: 0 °C to +40 °C	1-G083
10 Gbit Ethernet card		Factory installed, option carrier card (G081) required. The 10 Gbit Ethernet card adds up to two extra 10 Gbit Ethernet network interfaces to a GEN DAQ series mainframe. Supports up to 400 MB/s continuous data transfer from the GEN DAQ mainframe to a suitable PC. Requires a 10 Gbit network SFP+ module. Requires one or two 10 Gbit network SFP+ module. Can not be used together with 1-G084. Operating temperature: 0 °C to +40 °C	1-G064
Integrated CAN FD		The integrated CAN FD semi real-time data output option enables the mainframe to output periodically calculated RT-FDB results to CAN FD or CAN 2.0 bus. User selectable update rates as well as selectable calculation results to be transferred enable application specific setups. After configuration the mainframe can send results to CAN bus stand-alone without the use of Perception. **Note:** *At least one acquisition card inside the mainframe needs to have a 1-GEN-OP-RT-FDB option installed to enable the use of the CAN FD output.* Operating temperature: -20 °C to +60 °C	1-4C-PCIE-CANFD-2T

CAN/CAN FD (External Option, to be ordered separately)			
Article		**Description**	**Order No.**
USB to CAN FD converter		1 port CAN FD / CAN 2.0 USB Interface. CAN data recording and -output; acquisition control. • 250 channels max • D-sub-9 connectors (male) with 1 CAN port • Option will be installed at the mainframe's USB port, no plug and play CAN port result publishing: 1000 result blocks/s maximum, each block with 240 results maximum.	1-USB-CANFD-1CHN

General Accessories (Options, to be ordered separately)			
Article		**Description**	**Order No.**
Isolated digital event adapter		230 V RMS Isolated Digital Event adapter. Supports 32 channel to channel isolated digital event inputs. The inputs can either be used to connect to the GEN series mainframes that support the Digital Event/Timer/Counter connector. Input connectors and cable to connect to the GEN series mainframe are included.	1-G072
Torque/RPM adapter		Converts the differential signaling used by HBM torque transducers to TTL signal levels used by the Timer/Counter A and B available on the Digital Event/Timer/Counter connector of GEN DAQ mainframes. Both Torque and Speed are interfaced separately for 2 torque sensors. Event output connected to Shunt control. All remaining event TTL signals available on output connector. Comes with 0.7 m (2.3 ft) cable to connect adapter to the mainframe. Torque transducer cables not included.	1-G070A
eAxle Connection cable G070 to GN31xB/GN61xB		Y-type connection cable between one or two G070A Torque/RPM adapter and a GEN series HighSpeed mainframe. Use cases: • Four torque transducers; Two G070A Torque/RPM adapters; Two B-type(1) input cards: standard use case of Y-type cable. • Two torque transducers; One G070A Torque/RPM adapter; One B-type(1) input card: One end of the Y-type cable will remain unused. • One torque transducer; One G070A Torque/RPM adapter; One B-type(1) input card: One end of the Y-type cable will remain unused. Cable replaces standard connection cable delivered with the G070A Torque/RPM adapter. **Note:** For two torque / speed transducers, two G070A Torque/RPM adapter (splitter boxes) are needed.	1-KAB2148-1.5
I/O BNC Breakout cable		BNC breakout cable for direct BNC cable connection to the 9-pin D-sub I/O connector	1-KAB2132-0.5

(1) GN310B/GN311B or GN610B/GN611B card.

Time Synchronization (Options, to be ordered separately)			
Article		**Description**	**Order No.**
IRIG to PTPv2 convertor		External IRIG to PTPv2 convertor in a compact housing. Using the PTPv2 time source output GEN DAQ then synchronizes to IRIG time source. The solution comes as a complete package including cables, 19" rack mount kit and CD with user manual and installation instructions.	1-G001B
GPS to PTPv2 receiver		External GPS time synchronization using PTPv2 network communication. The solution comes as a complete package, including a power over Ethernet (PoE) powered GPS antenna (OTMC 100i), a 50 m (164 ft) IP67 CAT6 outdoor RJ45 network cable, an outdoor RJ45 network surge protector (PD-OUT/SP11), a 20 m (65 ft) CAT6 RJ45 network cable, a RJ45 to Optical SFP convertor with PoE injection on the RJ45 network, two G091 SFPs (For GEN DAQ SFP network and the SFP convertor), a KAB280-10 optical cable and CD with user manual and installation instructions.	1-G002B
Gbit PTP ethernet switch		CP-PTPSWITCH-19INCH • IGS-5225-16T4S Industrial Rackmount L2+ managed ethernet switch • 16x 1000Base Tx • 4x 1000X SFP ports • 2x DI/DO, Modbus TCP • 100-240VAC/36-60VDC redundant	CP-PTPSWITCH-19INCH

Software (Options, to be ordered separately)[1]			
Article		**Description**	**Order No.**
LabVIEW Driver		LabVIEW driver for Genesis HighSpeed data acquisition systems Requirements: • OS-System: Windows 10 • LabVIEW-Version: LabVIEW 2021 SP1 or later	1-LABVIEW-DRV-GHS
Perception Advanced		For setup and control of a single GEN series mainframe. Includes real-time live and recorded data review using y/t and x/y displays. Y/t displays support vertical, horizontal and slope cursors, trace and display markers as well as an interactive waveform calculator. On top Perception allows synchronized video playback. For data analysis Perception supports interactive user keys, Formula Database with waveform and math calculators. To create a report of the recorded and analysis data Perception supports adding additional meta data describing your test details, quick report to Microsoft Word® and Excel®, an advanced built-in report engine. If analysis in third party software is preferred 20 export format (Including MATLAB, DIAdem, MDF4/ASAM, UFF58 and more) are supported.For automated analysis, reporting or data exports Perception supports extensive automation and result logging features. Perception supports 64 bit versions of Windows® 10.	1-PERC-AD-01
Perception Enterprise		Perception Advanced with additionally: Macro editor, Basic FFT, Sensor Database, User Definer Mode and Multi Mainframe Control.	1-PERC-E64-01
Perception Viewer Enterprise		Same as Perception Enterprise without mainframe setup and control.	1-PERC-VA-01
CSI Interface		License extension to develop and use customer specific created user interface and/or mathematical / evaluation software extensions. HBM offers the service of custom made Perception extensions. An experienced software engineer will contact the end user and create a requirements document. A project quote will be made based on the agreed requirements.	1-PERC-OP-CSI-01
STL Analysis		Special analysis routines in accordance with the STL standard used in LV, MV and HV labs. Includes import of TDG data (Test Data Generator) for verification. Includes HighPower/HighVoltage automated analysis. Evaluates data from NoLoad, ShortCircuit, Capacitive and Synthetic tests of HV/MV switchgear devices.	1-PERC-OP-STL-01

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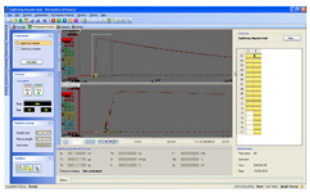
HV-IA		High Voltage Impulse Analysis option; evaluates Lightning, Switching and Current impulses; designed in accordance with IEC60060-1 and IEC61083-2 requirements. Allows for evaluation with new k-factor method.	1-PERC-OP-HIA-01
eDrive		Allows for easy and application oriented setup and efficiency calculations of electrical inverter/ drive tests with minimum interaction. Requires Perception Enterprise.	1-PERC-OP-EDR-01

(1) Software options are also sold in a package with multiple single seat licenses and multiple seat network license.

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