GEN series GEN17tA

Transient Recorder and Data Acquisition System

Special features

- **19" rack mount system**
- **Up to 544 analog, 96 digital and 12 Timer/ Counter channels**
- **100 MB/s to 175 MB/s of continuous streaming to a PC**
- **PTP time synchronization**
- **CAN/CAN FD output (option)**
- **EtherCAT® output (option)**
- **IRIG/GPS time synchronization (option)**
- **1 Gbit optical Ethernet (option)**
- **10 Gbit optical or electrical Ethernet with 400 MB/s continuous streaming (option)**
- **Removable SSD with 350 MB/s continuous streaming (option)**
- **Master/Sync connection (option)**

The GEN17tA is a rack mountable transient recorder and data acquisition system for high-channel-count applications. If GEN7tA mainframes cannot handle the required channel count, the GEN17tA doubles the channel count reducing the overall installation costs.

The 1 Gbit Ethernet interface can stream recorded data directly to the PC at a rate of 100 MB with compression up to 175 MB/s. The optional 1 Gbit Optical Ethernet allows for isolated control of the mainframe and for cable lengths up to 10 km (6.2 mi) while maintaining full streaming performance. For higher streaming rates of 400 MB/s, a 10 Gbit electrical or optical Ethernet option is available. Maximum reliable data storage is achieved using (optional) built-in solid state drive at 350 MB/s.

Full transparent time and trigger synchronization on multiple GEN DAQ systems can be achieved by using the standard optical Master/Sync connector. To synchronize the absolute time to non GEN DAQ systems, GEN17tA supports the PTP protocol on both the standard and optional optical 1 Gbit Ethernet interfaces. The optional EtherCAT® or CAN/CAN FD output enables low latency real-time standalone data exchange. GEN17tA is configured and controlled using Perception software that runs on a PC provided by the user. This combination results in a sophisticated instrument for ultra-fast recording, analysis and reporting.

Supported Operation Mode

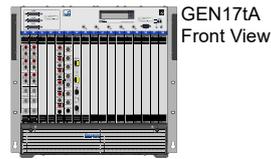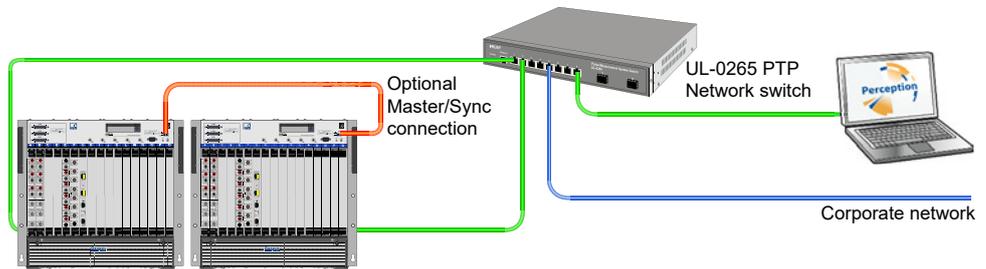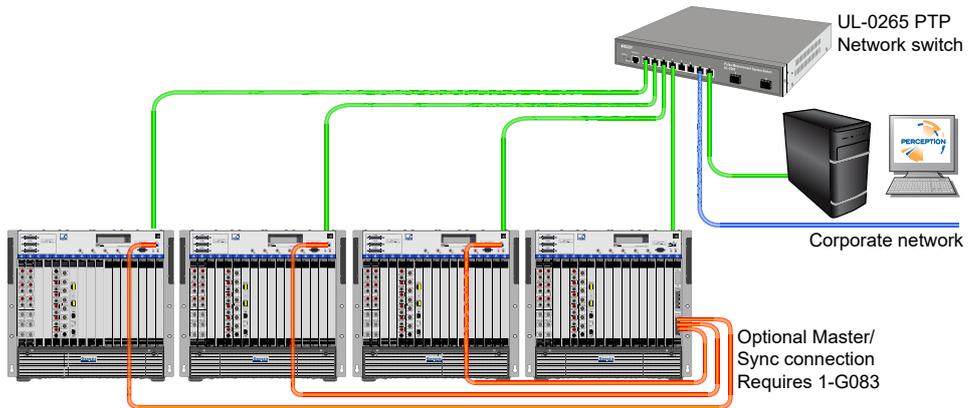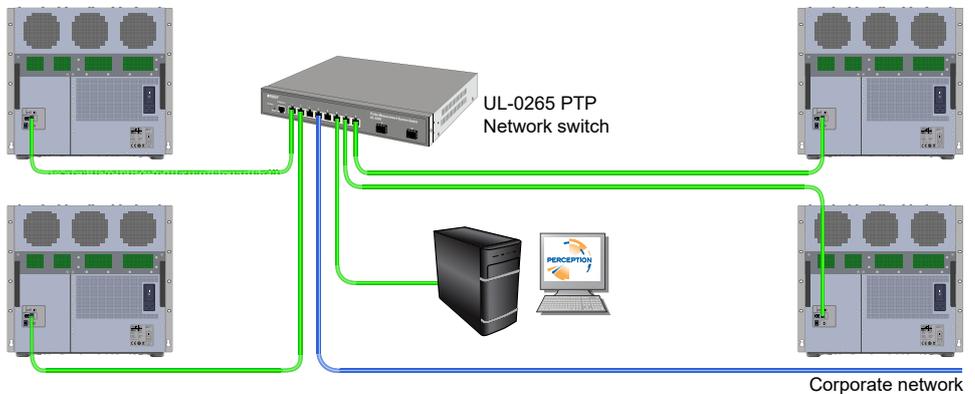| Recommended features	
Stand-alone ● Pre-configured boot settings ● 350 MB/s storage to SSD ● Start/Stop/Trigger TTL inputs ● CAN FD acquisition control ● GEN DAQ API ● Real-time formula database ● CAN-FD/EtherCAT® output ● Wi-Fi access	GEN17tA Front View **Figure 1.1:** Stand-alone
Single mainframe ● Start/Stop/Trigger TTL inputs ● CAN FD acquisition control ● 350 MB/s storage to SSD ● Real-time formula database ● CAN-FD/EtherCAT® output ● PTP (GPS/IRIG) time sync ● Wi-Fi access	GEN17tA Rear View **Figure 1.2:** Single mainframe
Dual mainframe ● Single wire Master/Sync control ● 700 MB/s storage to SSD ● Real-time formula database ● CAN-FD/EtherCAT® output ● PTP (GPS/IRIG) time sync	Optional Master/Sync connection — UL-0265 PTP Network switch — Corporate network **Figure 1.3:** Dual mainframe
Four mainframes (>2) ● Master/Sync control & trigger ● 1400 MB/s storage to SSD ● Real-time formula database ● CAN-FD/EtherCAT® output ● PTP (GPS/IRIG) time sync	UL-0265 PTP Network switch — Corporate network — Optional Master/Sync connection Requires 1-G083 **Figure 1.4:** 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	UL-0265 PTP Network switch — Corporate network **Figure 1.5:** 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 mainframes	Use Master/Sync setup 1-G083 in master mainframe 1-G091 in other mainframes
PTP Network switch (e.g. HBK UL-0265)	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 preffered 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

Block Diagram
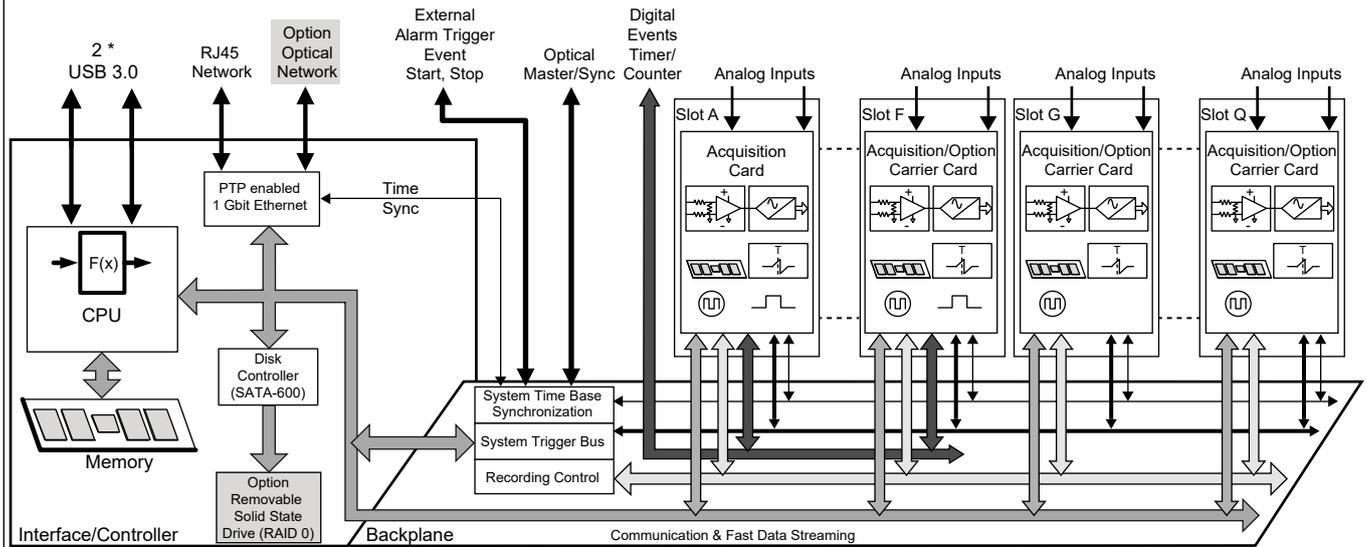
Figure 1.6: Block diagram

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	Binary, Decimal or External
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 128 Sync mainframes
PTP synchronization accuracy	± 150 ns; with one PTP compatible 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	17
Acquisition cards	Any combination of GEN DAQ acquisition cards which support fast data streaming
Digital Event/Timer/Counter connector	3; Connected to slots A and B, C and D, E and F
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

Digital Event/Timer/Counter · Chassis Ground · Removable Drive Bay · Master/Sync · ON/OFF Switch

I/O Connector · Probe Calibration Pins

USB Ports · PTP Enabled Network Optical · PTP Enabled Network RJ45 · Mains Power Supply
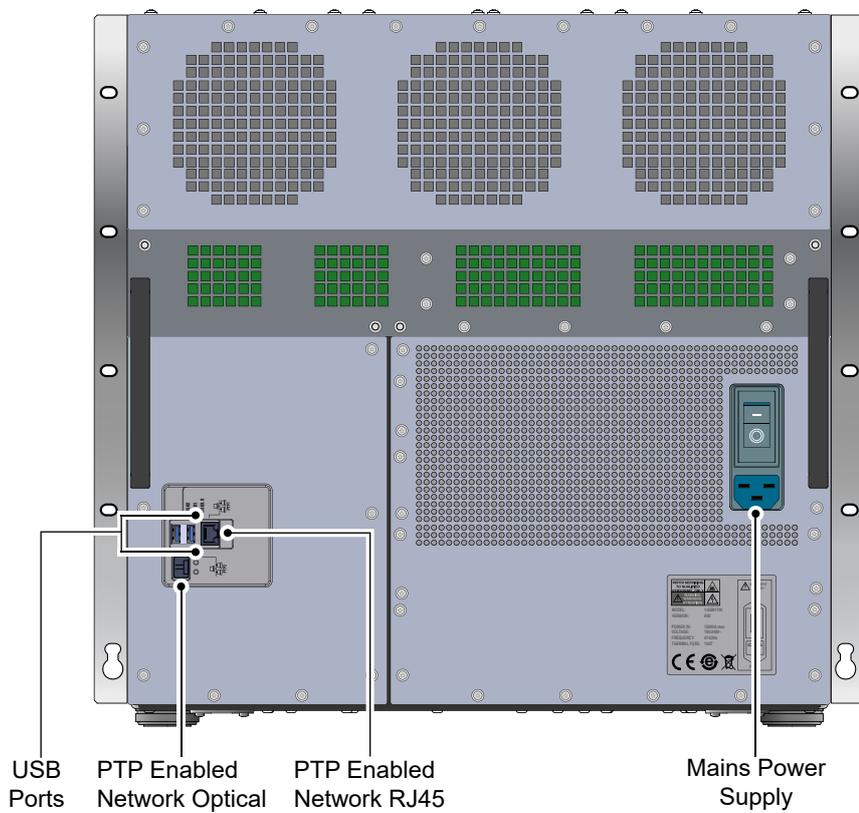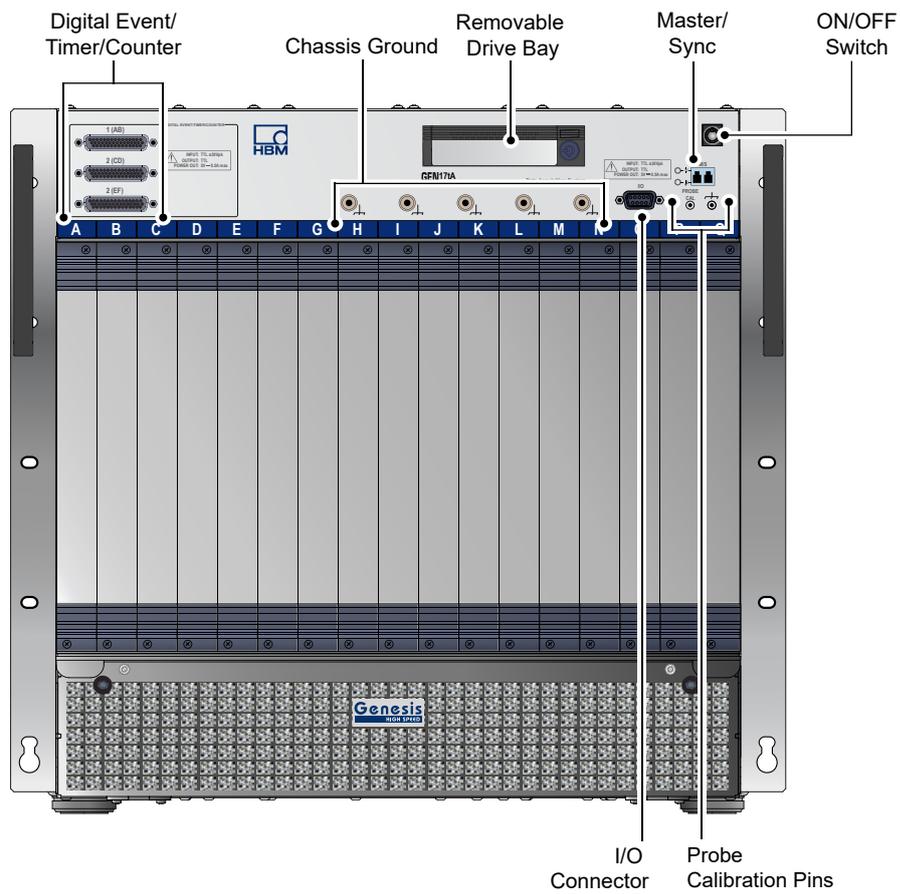
Figure 1.7: Connection overview (GEN17tA front and rear view)

1 Gbit Network Interface

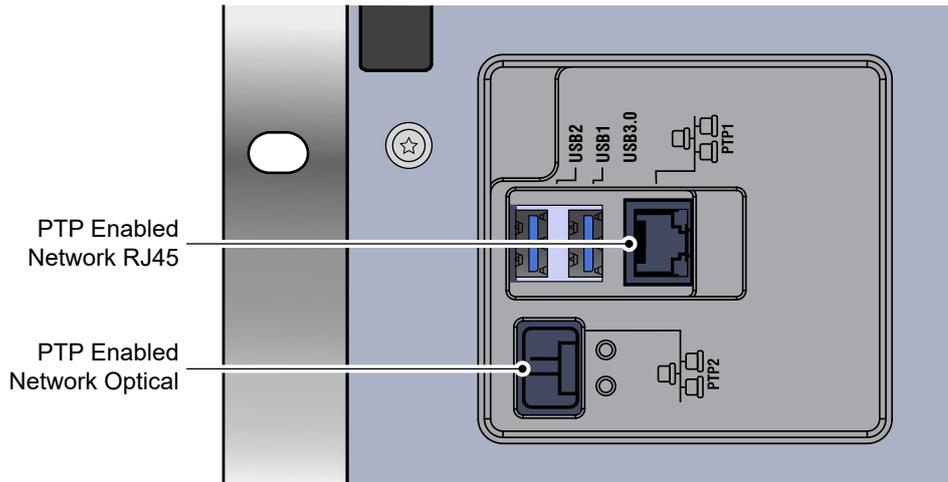GEN17tA supports an electrical and optional optical 1 Gbit Ethernet connector

Figure 1.8: Electrical and optical 1 Gbit network interface

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	
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
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	PTPv2 (IEEE1588:2008) can be used on separate (dedicated) Ethernet interface
Maximum Transfer Speed	
Continuous recording to a remote PC	100 MB/s[1] uncompressed, up to 175 MB/s with compression
CPU and Software	
CPU	Intel 6102E, Core™ i3 6th generation; 2 Core, 4 threads; 1.9 GHz
Operating System	Linux[2]
Linux boot drive	Non-removable built-in SSD; SSD 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.

GEN17tA 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.
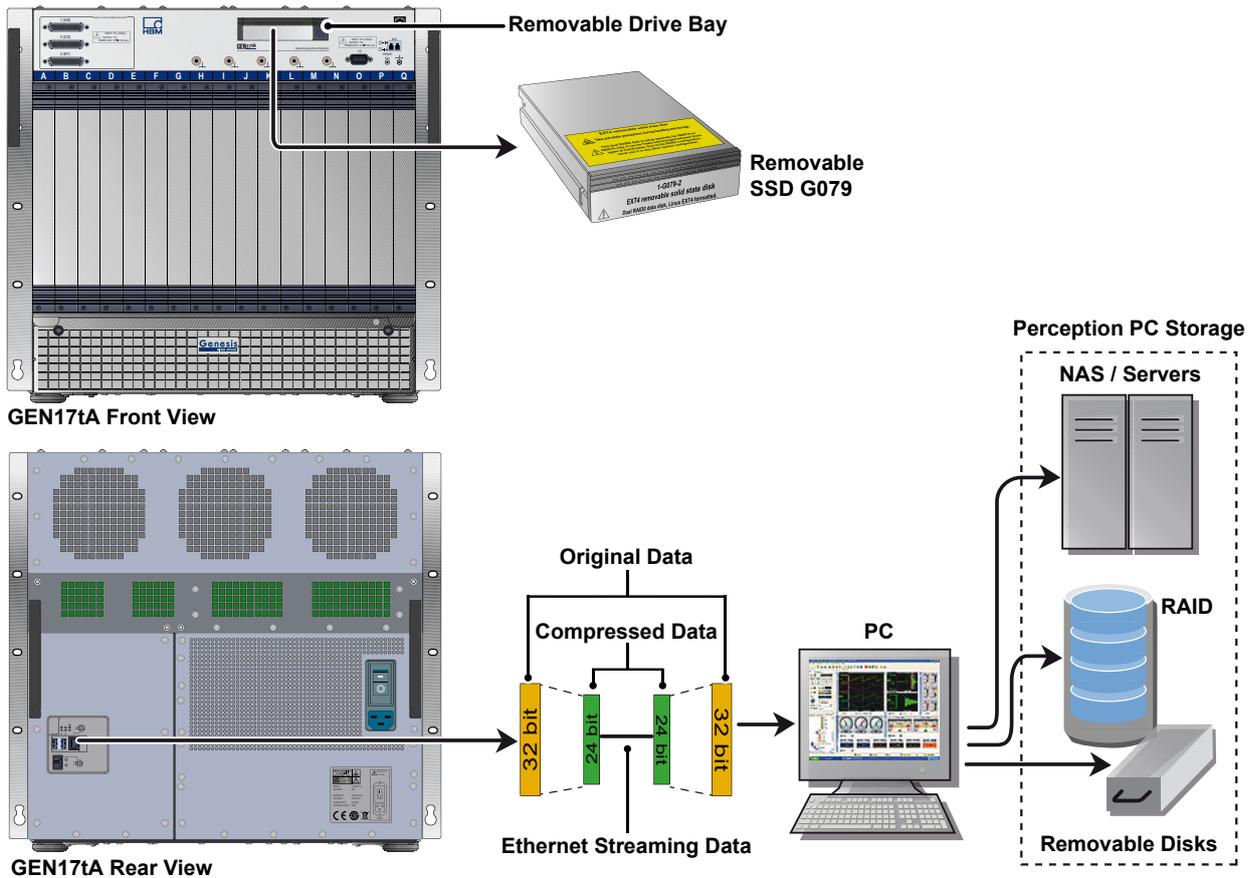

GEN17tA Front View

GEN17tA Rear View

Figure 1.9: Continuous streaming overview

Maximum continuous data storage rates (tested using full disk circular recording for 48 hours)	Removable SSD G079	Perception PC storage	
	Uncompressed	Uncompressed	Compressed
1 Gbit Ethernet (optical or electrical)	n/a	100 MB/s[1]	Up to 175 MB/s[1][2]
10 Gbit Ethernet (optical or electrical)	n/a	400 MB/s[3]	n/a
Removable drive bay	350 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.

(3)   Test setup uses a Windows® PC with Intel i7 CPU and SSD with sustained write speeds exceeding 700 MB/s and a 10 Gbit Ethernet link.

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
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
GN3210, GN3211	24 bits	1 : 1	1.33 : 1
GN8101B, GN8102B, GN8103B	14 bits	1 : 1	N/A

Master/Sync Connection

GEN series mainframes support a Master/Sync connector. The 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).
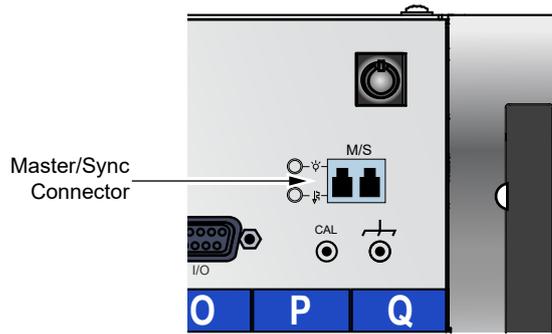

Figure 1.10: Master/Sync connector

Mainframe to mainframe phase shift	± 150 ns RMS
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	
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
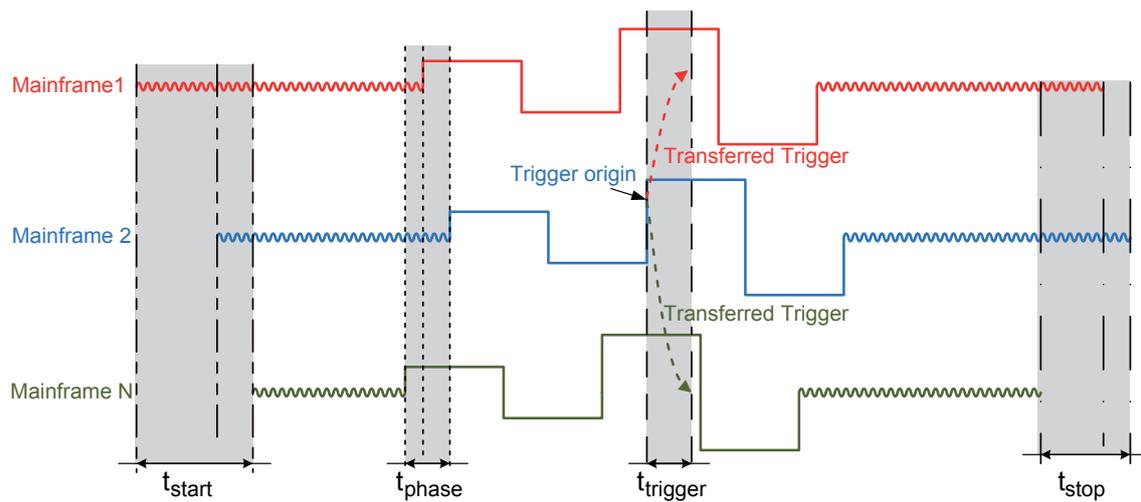
Figure 1.11: Synchronization specification overview

	t_{phase}[1]	t_{start}[2]	t_{stop}[3]	$t_{trigger}$[4][5]
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
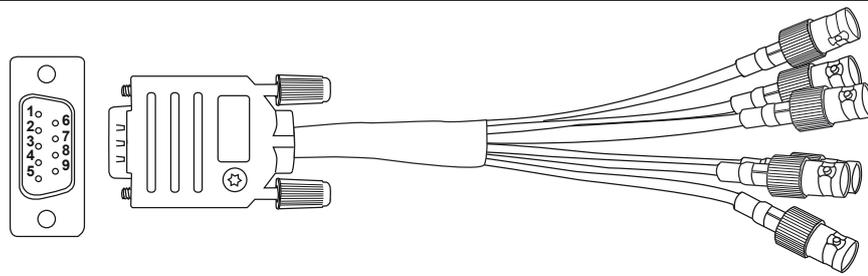PIN 7 - External Trigger Out
PIN 8 - External Stop In
PIN 9 - +5V

Figure 1.12: 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.
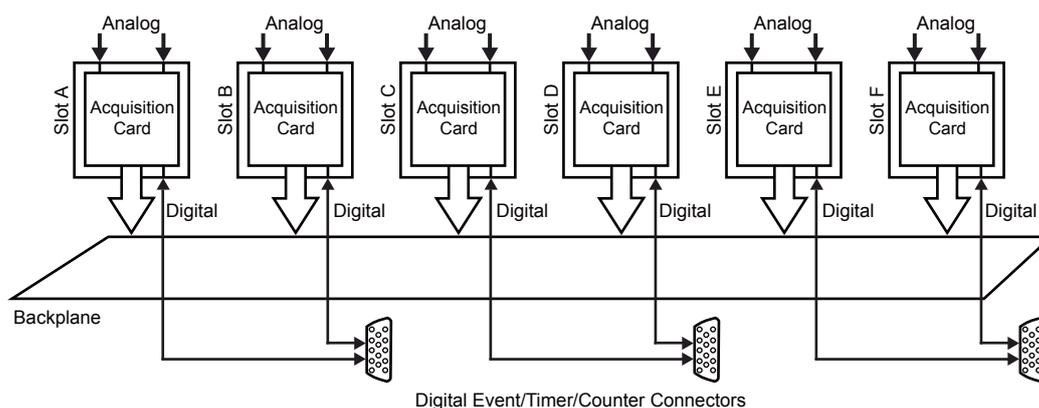
Digital Event/Timer/Counter

Figure 1.13: Digital Event/Timer/Counter block diagram

Number of connectors	3
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	1 A to be shared by the three connectors: the sum of the currents on the connectors should not exceed 1 A
Event Inputs	
Number of event inputs	16 per card, 2 cards per connector (a total of 96 events per mainframe) For special projects additional events can be added, contact HBM special projects team for more details.
Levels	TTL Compatible, Low -30 V to 0.7 V, High 2 V to 30 V Each event input has an internal pull-up of 20 kΩ ± 1% to 5 V
	  Figure 1.14: Logic threshold voltage levels
Overvoltage protection	± 30 V DC
Timer/Counter	
Number of channels	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

Digital Event/Timer/Counter Connector Pin Assignment
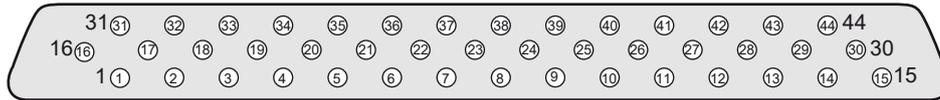
PIN 1 - Event Input A1/C1/E1 & Reset Timer/Counter A2/C2/E2

PIN 2 - Event Input A2/C2/E2 & Direction Timer/Counter A2/C2/E2

PIN 3 - Event Input A3/C3/E3 & Clock Timer/Counter A2/C2/E2

PIN 4 - Event Input A4/C4/E4

PIN 5 - Event Input A5/C5/E5

PIN 6 - Event Input A6/C6/E6

PIN 7 - Event Input A7/C7/E7

PIN 8 - Event Input A8/C8/E8

PIN 9 - Event Input A9/C9/E9

PIN 10 - Event Input A10/C10/E10 & Reset Timer/Counter A1/C1/E1

PIN 11 - Event Input A11/C11/E11 & Direction Timer/Counter A1/C1/E1

PIN 12 - Event Input A12/C12/E12 & Clock Timer/Counter A1/C1/E1

PIN 13 - Event Input B1/D1/F1 & Reset Timer/Counter B2/D2/F2

PIN 14 - Event Input B2/D2/F2 & Direction Timer/Counter B2/D2/F2

PIN 15 - Event Input B3/D3/F3 & Clock Timer/Counter B2/D2/F2

PIN 16 - Event Input B4/D4/F4

PIN 17 - Event Input B5/D5/F5

PIN 18 - Event Input B6/D6/F6

PIN 19 - Event Input B7/D7/F7

PIN 20 - Event Input B8/D8/F8

PIN 21 - Event Input B9/D9/F9

PIN 22 - Event Input B10/D10/F10 & Reset Timer/Counter B1/D1/F1

PIN 23 - Event Input B11/D11/F11 & Direction Timer/Counter B1/D1/F1

PIN 24 - Event Input B12/D12/F12 & Clock Timer/Counter B1/D1/F1

PIN 25 - Event Input B13/D13/F13

PIN 26 - Event Input B14/D14/F14

PIN 27 - Ground

PIN 28 - Ground

PIN 29 - Ground

PIN 30 - Ground

PIN 31 - Event Input B15/D15/F15

PIN 32 - Event Input B16/D16/F16

PIN 33 - Event Input A13/C13/E13

PIN 34 - Event Input A14/C14/E14

PIN 35 - Event Input A15/C15/E15

PIN 36 - Event Input A16/C16/E16

PIN 37 - Event Output B2/D2/F2

PIN 38 - Event Output B1/D1/F1

PIN 39 - Event Output A2/C2/E2

PIN 40 - Event Output A1/C1/E1

PIN 41 - Ground

PIN 42 - Ground

PIN 43 - +5 V Power

PIN 44 - +5 V Power

Figure 1.15: Pin diagram for Digital Event/Timer/Counter connectors

Probe Calibration

Pins	2; Signal and ground
Signal	~1 kHz square wave
Signal amplitude	0 V to 2 V using 1 MΩ load 0 V to 1 V using 50 Ω load

G085: GEN17tA Air Filter

Filter type	UAF Qaudrafoam 0.25 inch/25PPI
Synthetic Dust Weight Arrestance	Average 66% Tests performed in accordance with ASHRAE Standard 52.1 -1992 at 300 ft per minute (1.53 m/s) face velocity
Air inlet	Air filter installed to filter inlet air
Access	Easy access for cleaning and replacing air filter

Figure 1.16: Easy access for cleaning/replacing air filter

Power

Power Inlet	47-63 Hz, 100-240 V AC
Total Power of unit (maximum)	1200 VA

Physical, Weight and Dimensions

|	
Weight	
Mainframe	18.9 kg (41.67 lb), add ≈ 1 kg (2.2 lb) per acquisition card installed
Dimensions	
Height / Height with feet	444 mm (17.5") / 450 mm (17.7"), 10 height units of 19" rack
Width / Width including mounting ears	446 mm (17.5") / 489 mm (19.2")
Depth / Depth including handles	517 mm (20.4") / 557 mm (21.9")
Acoustic Noise	The total A-weighted SPL 61.5 dBA @ 0.6 m maximum
Temperature Sensors	Temperature monitoring and air flow control
Cooling Fans	10 (4 @ inlet, 3 @ outlet, 1 @ Linux PC, 2 @ Power supplies) all temperature regulated
Chassis ground	5 Banana plugs (4 mm)
Casing	Aluminum
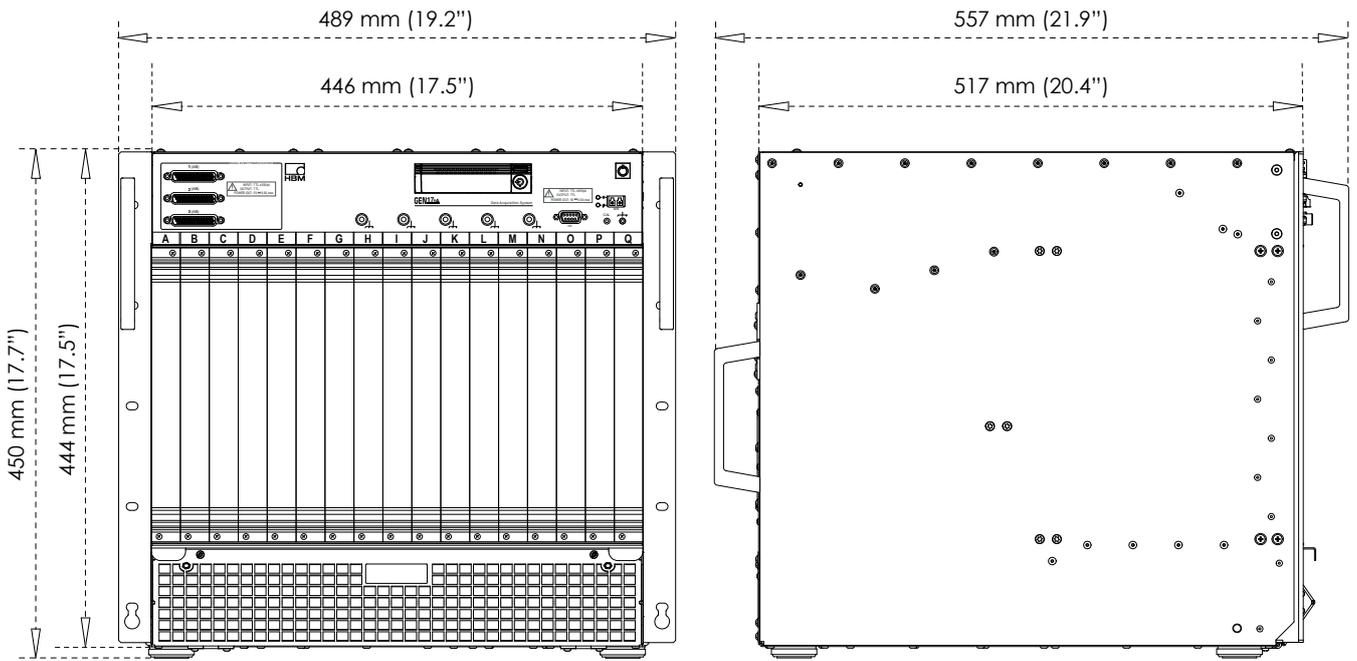
Figure 1.17: GEN17tA dimensions

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 +40 °C (+104 °F) with notifications starting at +35 °C (+95 °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 5 g/11 ms; 3-axis, 1000 shocks in positive and negative direction
Non-operational	Half-sine 25 g/6 ms; 3-axis, 3 shocks in positive and negative direction
Vibration: IEC 60068-2-64	
Operational	1 g RMS, ½ h; 3-axis, random 5 to 500 Hz
Non-operational	2 g RMS, 1 h; 3-axis, random 5 to 500 Hz
Operational Environmental Tests	
Cold test IEC60068-2-1 Test Ad	-5 °C (+23 °F) for 2 hours
Dry heat test IEC-60068-2-2 Test Bd	+40 °C (+104 °F) for 2 hours
Damp heat test IEC60068-2-3 Test Ca	+40 °C (+104 °F), humidity > 93% RH for 4 days
Non-Operational (Storage) Environmental Tests	
Cold test IEC-60068-2-1 Test Ab	-25 °C (-13 °F) for 72 hours
Dry heat test IEC-60068-2-2 Test Bb	+70 °C (+158 °F) humidity < 50% RH for 96 hours
Change of temperature test 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

Harmonized Standards for CE Compliance, According to the Following Directives

Low Voltage Directive (LVD): 2014/35/EU
Electromagnetic Compatibility Directive (EMC): 2014/30/EU

Electrical Safety	
EN 61010-1 (2010)	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
EN 61010-2-030 (2010)	Particular requirements for testing and measuring circuits
Electromagnetic Compatibility	
EN 61326-1 (2013)	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
Emission	
EN 55011	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics 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 @ mains (coupling network), 10 V RMS @ channel (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

G063: 1 Gbit Optical SFP Module Single Mode 1310 nm (Option, to be ordered separately)

Small Form-factor Pluggable (SFP)
Optical transceiver used for:
– Multi Mode 1310 nm 1 Gbit optical network support

⚠️ **WARNING**
Use HBM approved transceivers only.

Data rate	1.0 Gbps
Wavelength	1310 nm
Input connector	LC
Form factor	SFP
Laser class	1
Original manufacturer's part number	Foxconn AFCT-5710PZ
Temperature Range	
Operational	-10 °C to +60 °C (-14 °F to +140 °F)
Non-operational (Storage)	-40 °C to +85 °C (-40 °F to +158 °F)

G091: 2 Gbit Optical SFP Module Multi Mode 850 nm (Option, to be ordered separately)

Small Form-factor Pluggable (SFP)
Optical transceiver used for:
– Multi Mode 850 nm 1 Gbit optical network support
– GN1202B optical front end connection
– GEN DAQ optical Master/Sync connections

⚠️ **WARNING**
Use HBM approved transceivers only.

Data rate	2.125 Gbps
Wavelength	850 nm
Input connector	LC
Form factor	SFP
Laser class	1
Original manufacturer's part number	Finisar FTLF8519P3BNL
Temperature Range	
Operational	-20 °C to +60 °C (-4 °F to +140 °F)
Non-operational (Storage)	-40 °C to +85 °C (-40 °F to +158 °F)

G079: Removable Solid State Drive (Option, to be ordered separately)

SSD built inside protective drive carrier and configured in a RAID 0 setup. Drive carrier with SSD to be installed inside GEN7tA/GEN17tA drive bay. Used inside in the mainframe to secure data storage in the best way possible. Recorded data can be copied to a permanent archive using Perception software.

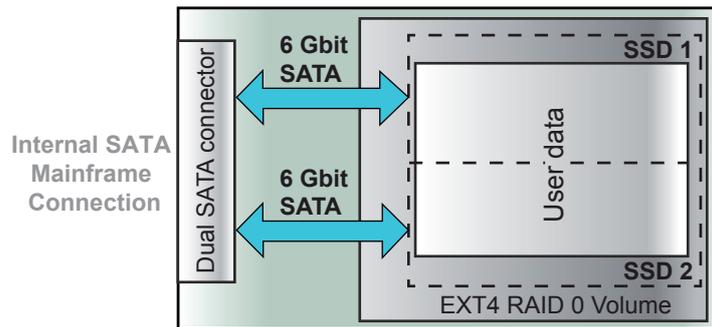**Figure 1.18:** Example of SSD in drive carrier partially slid into GEN7tA (left) and SSD built inside drive carrier (right)

Figure 1.19: Block diagram drive

Storage configuration	
Storage technology	Solid State Drive (SSD)
Number of SSDs	2
SSD operation	RAID 0
EXT4 RAID 0 Volume unformatted size	960 GB
Maximum continuous storage speed	350 MB/s[1] when using SSDs that have been authorized for use by HBM
Maximum sweep storage speed	Depends on sweep length and number of channels used
File system format	Linux EXT4 Recorded data can be read, copied and deleted by Perception software that is connected to this GEN DAQ mainframe
Drive carrier configuration	
Hot Swap	Not supported, power off the GEN7tA/GEN17tA before adding/removing drive options
Minimum SATA speed	6 Gbit/s
SATA connectors	2; configured in RAID 0 setup
External USB-based carrier	Not supported due to the RAID 0 setup of the internal disks
Special configurations	
Using multiple G079 options	Multiple G079 SSD options can be ordered, only one G079 can be used at a time
RAID 1 configuration	Contact the local HBM support team to inquire about availability and to request a special project quote
Larger data drive	The size of SSDs increases almost every year. Contact the local HBM support team to inquire about availability and to request a project quote.

(1)   Tested using circular recording with several combinations of acquisition cards for 48 hours.

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)
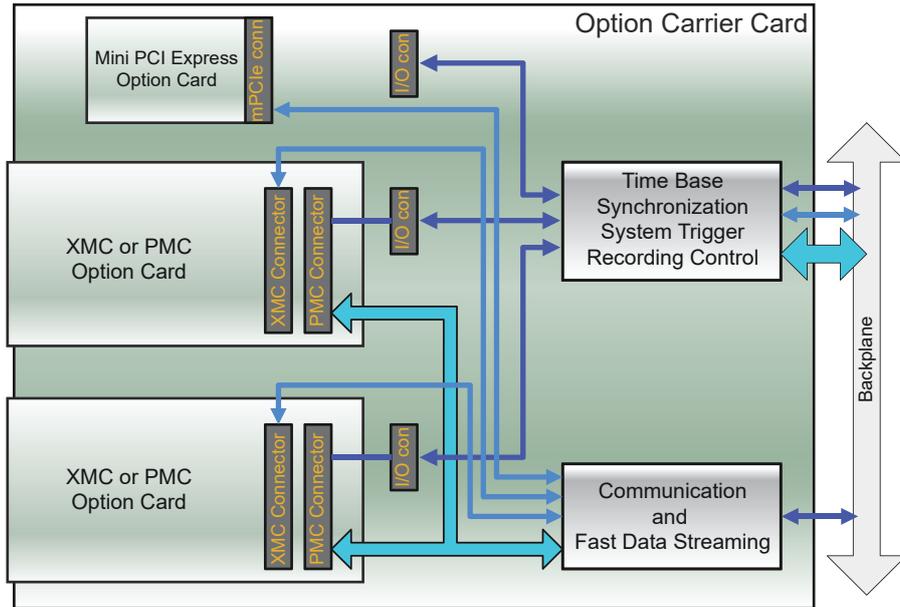
Figure 1.20: Block diagram option carrier card

Maximum option carrier cards	Mainframe number of slots - 1 Every mainframe needs at least one acquisition card.
Supported mainframes	GEN2tB, GEN3iA, GEN4tB, GEN7iA, GEN7tA and GEN17tA
Option card types	
PMC/XMC cards	Two per option carrier card
Mini PCI express cards	One per option carrier card
Supported PMC/XMC option cards	
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
10 Gbit Ethernet card, optical	1-G064 10 Gbit Ethernet card with SFP+ modules to support 850 nm and 1330 nm optical as well as RJ45 copper cable networks One Ethernet option card per mainframe, cannot be combined with 1-G084
EtherCAT® card	1-G082 EtherCAT® card with configurable SDO and PDO data output (no setup) One EtherCAT® option card per mainframe EtherCAT® card not supported in GEN3iA and GEN7iA
Supported mPCIe option cards	
2 Channel CAN/CAN FD card (No part number)	Custom special 2 channel CAN FD card, not supported in GEN3iA and GEN7iA Can only be ordered through custom systems at: customsystems@hbm.com
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)

G082: EtherCAT® Real-Time Output Card (Option, to be ordered separately)[1]

Supports one EtherCAT® connection using RJ45 connectors (option carrier card required).
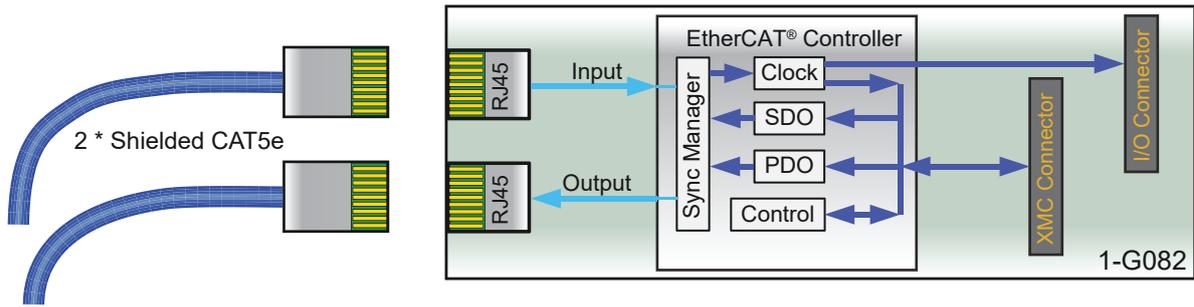Factory installed option.

Figure 1.21: Block diagram EtherCAT® card

Required cables	Shielded CAT5e or similar[2]

EtherCAT® Slave controller

Type	Beckhoff IP core
Tested	Using Beckhoff master TwinCAT 3.1
Fieldbus Memory Management Unit (FMMU)	4
Sync managers	4
ECS interface	2 x RJ45, 100BASE-TX, 100 MBit/s in accordance with IEEE-802.3, electrically isolated
LEDs	Error, Run Link/Activity for each channel

Device profiles

CANopen	Device profile supported

Process Data Objects (PDO)

DPRAM	60 kB
Maximum update rate	1000 updates per second, typical latency 1 ms
Dynamic mode	Variable ESI file dynamically configured with all published channels using the user defined channel names Dynamic channel count up to 240 channels
Static mode	Predefined ESI file, static configuration with a fixed channel count, and GEN DAQ predefined channel names Fixed channel count options: 50, 100 or 200 channels
ESI file	Perception can generate the ESI file for the selected configuration

Tested master configurations	**Vendor**	**Master/application**
	AVL	Puma
	Beckhoff	Twincat
	Intest	Inova
	Kratzer	PATools
	Kristl & Seibt	Tornado
	König PA	EtherCAT® Studio
	MAHA	MAHA RT
	National Instruments	Veristand
	D2T	Morpheé

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)   EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

(2)   For more details about the cables, please refer to the "EtherCAT_DesignGuide_en.pdf" from Beckhoff (www.beckhoff.com).

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).
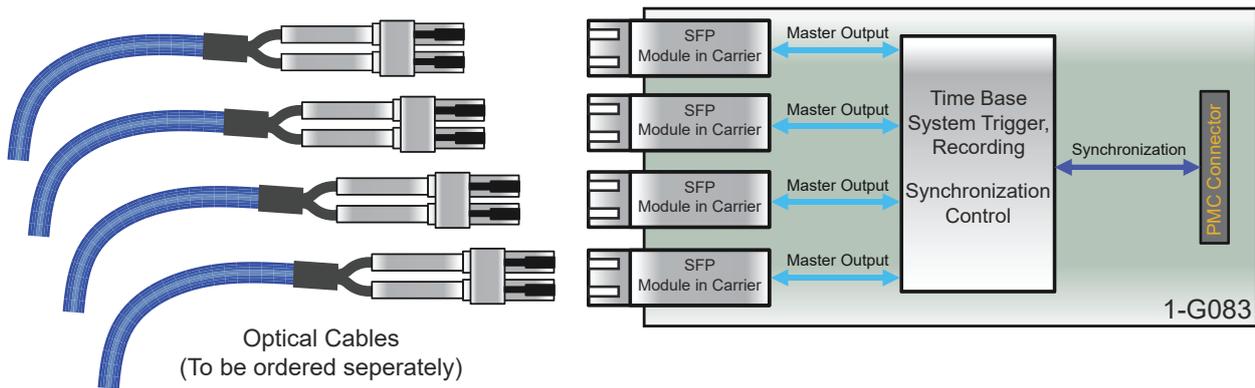Factory installed option.

Figure 1.22: 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, GEN7iA and GEN7tA: 49 Sync mainframes, 50 including Master mainframe GEN17tA: 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 GEN7iA/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)

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

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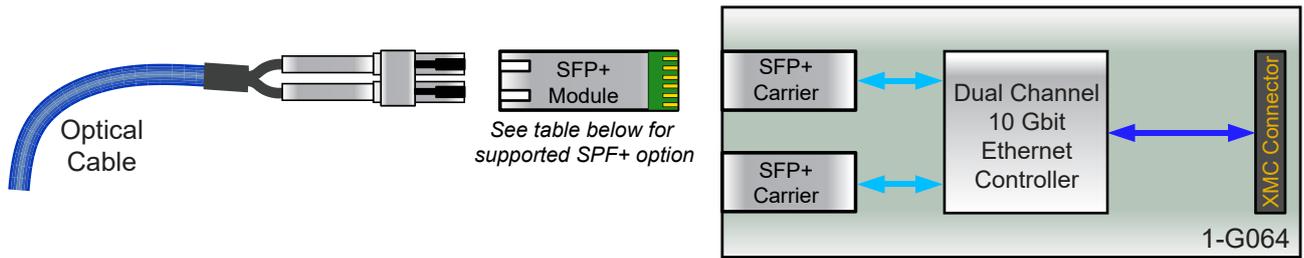Factory installed option, cannot be combined with 1-G084.

Figure 1.23: 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)		
SFP+ Module selection	1-G065	1-G066	1-SFP-10GBIT-RJ45
10GBASE-SR (Optical)	Yes	No	No
10GBASE-SR (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			
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		
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		
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.

1-G065: 10 Gbit Optical Network SFP+ module 850 nm (Option, to be ordered separately)

GEN DAQ 10 Gbit Ethernet SFP+, 850 nm Multi Mode, up to 82 m optical cable length supported, LC connector support.
10 Gbit SFP+ modules are not compatible with the 1 Gbit SFP modules.

Figure 1.24: 10 Gbit Optical Network SFP+ module 850 nm

Multi Mode SFP+ module (10GBASE-SR)	
Ordering part number	1-G065
Ethernet Speed	1 or 10 Gbit (auto detection)
Optical wave length	850 nm
Maximum cable length	82 m (269 ft) using OM3 specified optical cable (KAB280)
Connector type	LC
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-G066: 10 Gbit Optical Network SFP+ module 1310 nm (Option, to be ordered separately)

GEN DAQ 10 Gbit Ethernet SFP+, 1310 nm Single Mode, up to 10 km optical cable length supported, LC connector support.
10 Gbit SFP+ modules are not compatible with the 1 Gbit SFP modules.

Figure 1.25: 10 Gbit Optical Network SFP+ module 1310 nm

Single Mode SFP+ module (10GBASE-LR)	
Ordering part number	1-G066
Ethernet Speed	1 or 10 Gbit (auto detection)
Optical wave length	1310 nm
Maximum cable length	10 km (6.2 mi) using OS2 specified optical cable (KAB288)
Connector type	LC
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-SFP-10GBIT-RJ45: 10Gbit Electric Network SFP+ module (Option, to be ordered separately)

GEN DAQ 10 Gbit electric Ethernet SFP+, module with RJ45 connector. Enables the mixed use of optical and electric 10Gbit Ethernet using the 1-G064 SFP+ based Ethernet card.

Note: 10 Gbit SFP+ modules are not compatible with the 1 Gbit SFP modules.

Figure 1.26: 10 Gbit Copper Network SFP module

RJ45 Electrical SFP+ module (10GBASE-T)	
Ordering part number	1-SFP-10GBIT-RJ45
Ethernet Speed	1 or 10 Gbit (auto detection)
Connector type	RJ45
Maximum cable length (10GBASE-T)	
CAT6A or higher	100 m (330 ft) at 1 and 10 Gbit/s
CAT6	55 m (180 ft) at 10 Gbit/s 100 m (330 ft) at 1 Gbit/s
CAT5e	100 m (330 ft) at 1 Gbit/s (not supported at 10 Gbit/s)
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.

Tight buffered fiber
Aramid yarn
Outer jacket

Figure 1.27: 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@hbm.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.

Tight buffered fiber
Aramid yarn
Outer jacket

Figure 1.28: 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@hbm.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.
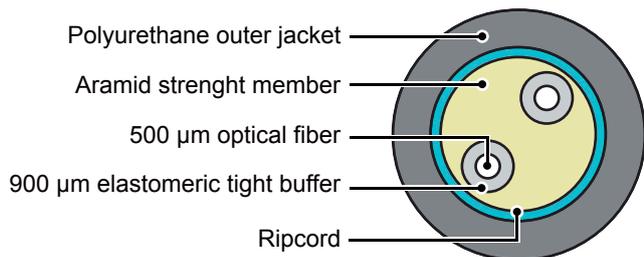
Polyurethane outer jacket
Aramid strenght member
500 µm optical fiber
900 µm elastomeric tight buffer
Ripcord

Figure 1.29: 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	Typcially 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@hbm.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.
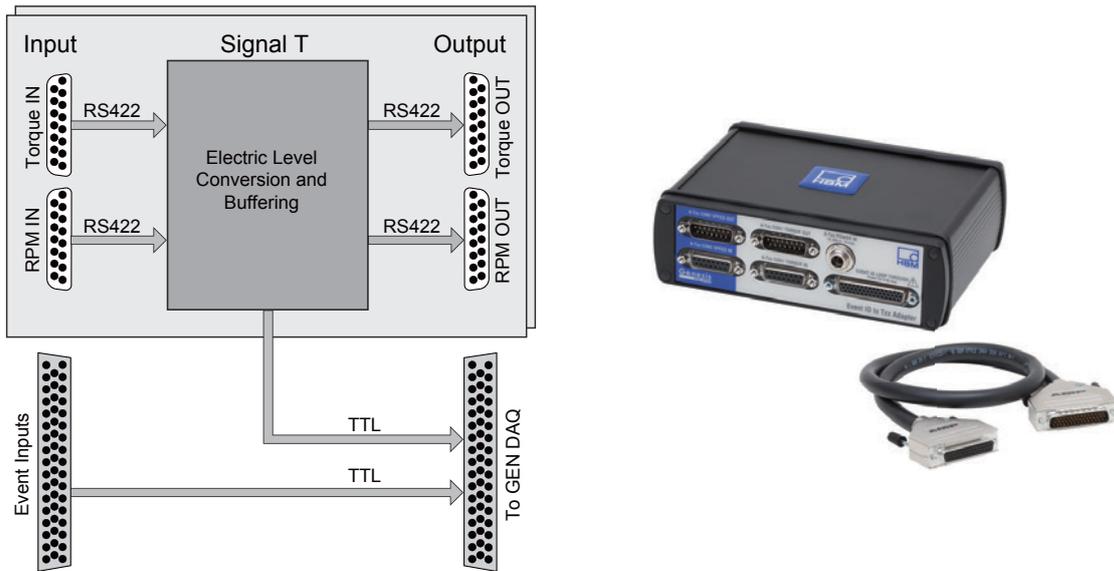

Figure 1.30: Block diagram and image

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.
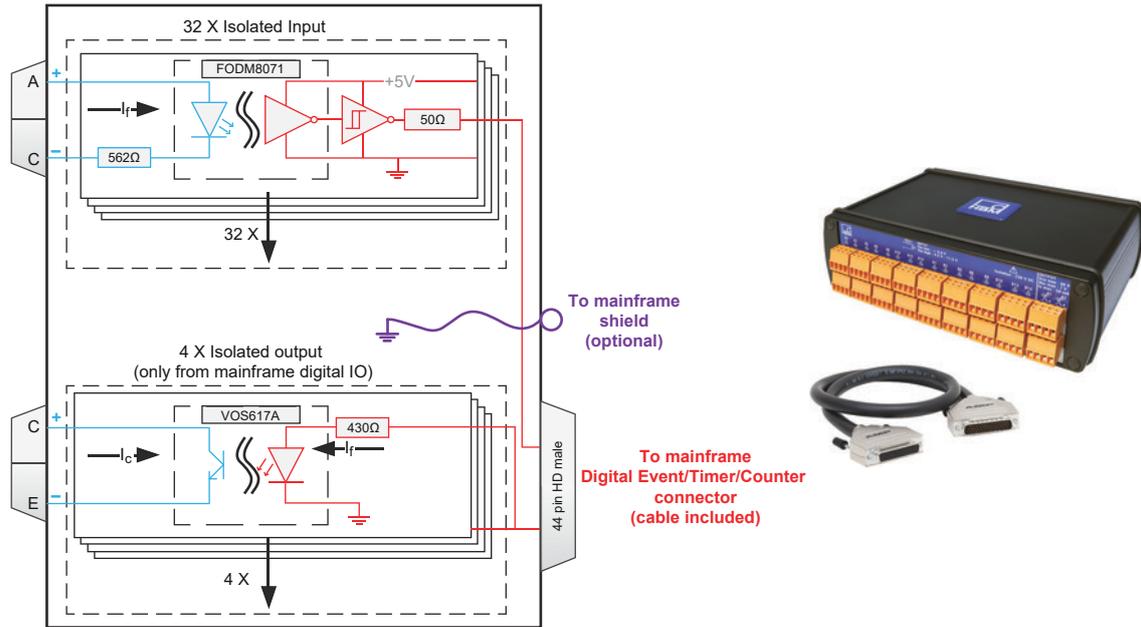

Figure 1.31: Block diagram and image

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.
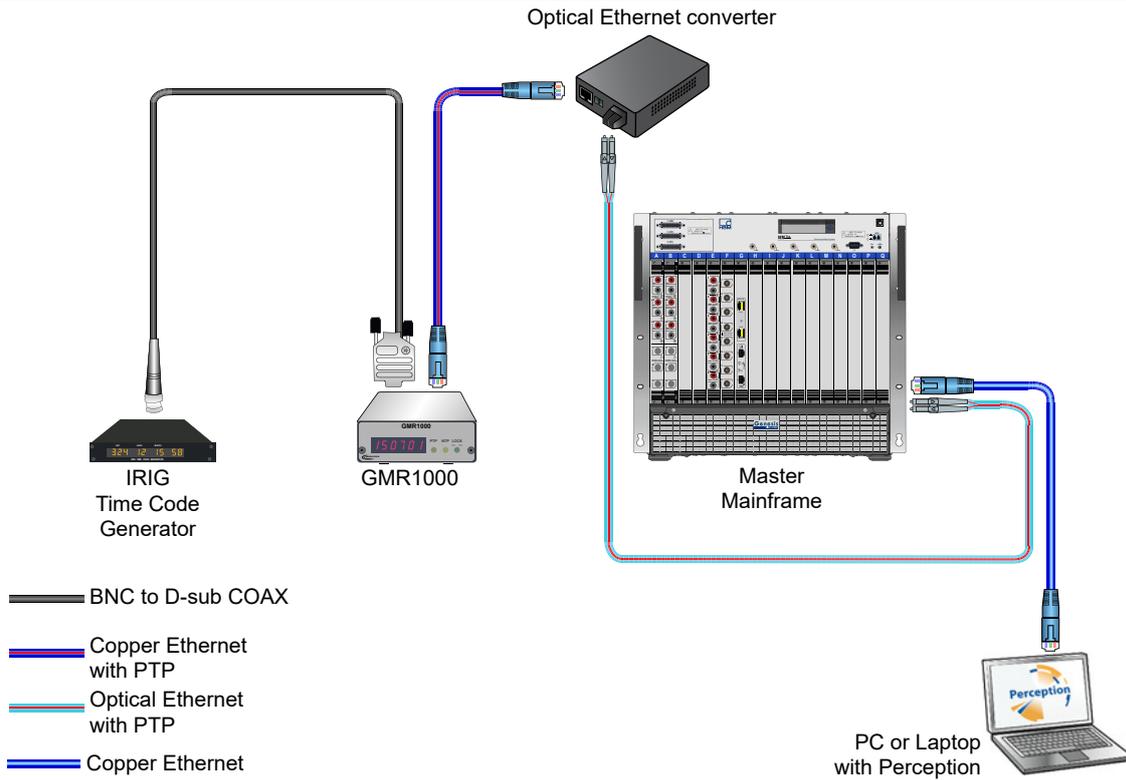

Figure 1.32: Example setup IRIG time synchronization

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	164 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 supported	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.
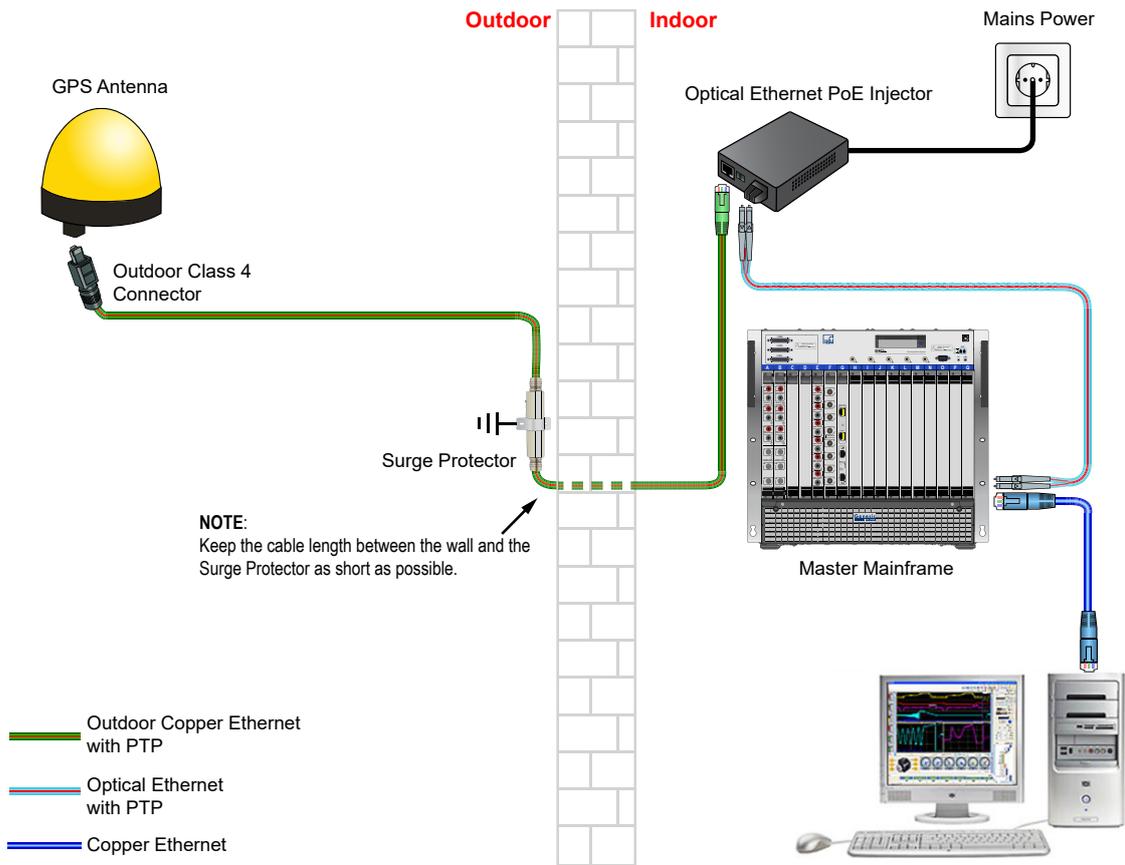

Figure 1.33: Example setup GPS time synchronization

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 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	
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)

Example Setup: GPS Receiver with Master/Sync Connected Systems

Outdoor | **Indoor**

Mains Power

GPS Antenna

Optical Ethernet PoE Injector

Outdoor Class 4 Connector

Surge Protector

NOTE:
Keep the cable length between the wall and the Surge Protector as short as possible.

Master Mainframe

Sync Mainframe

Sync Mainframe

Outdoor Copper Ethernet with PTP

Optical Master/Sync

Optical Ethernet with PTP

Copper Ethernet

Company Ethernet

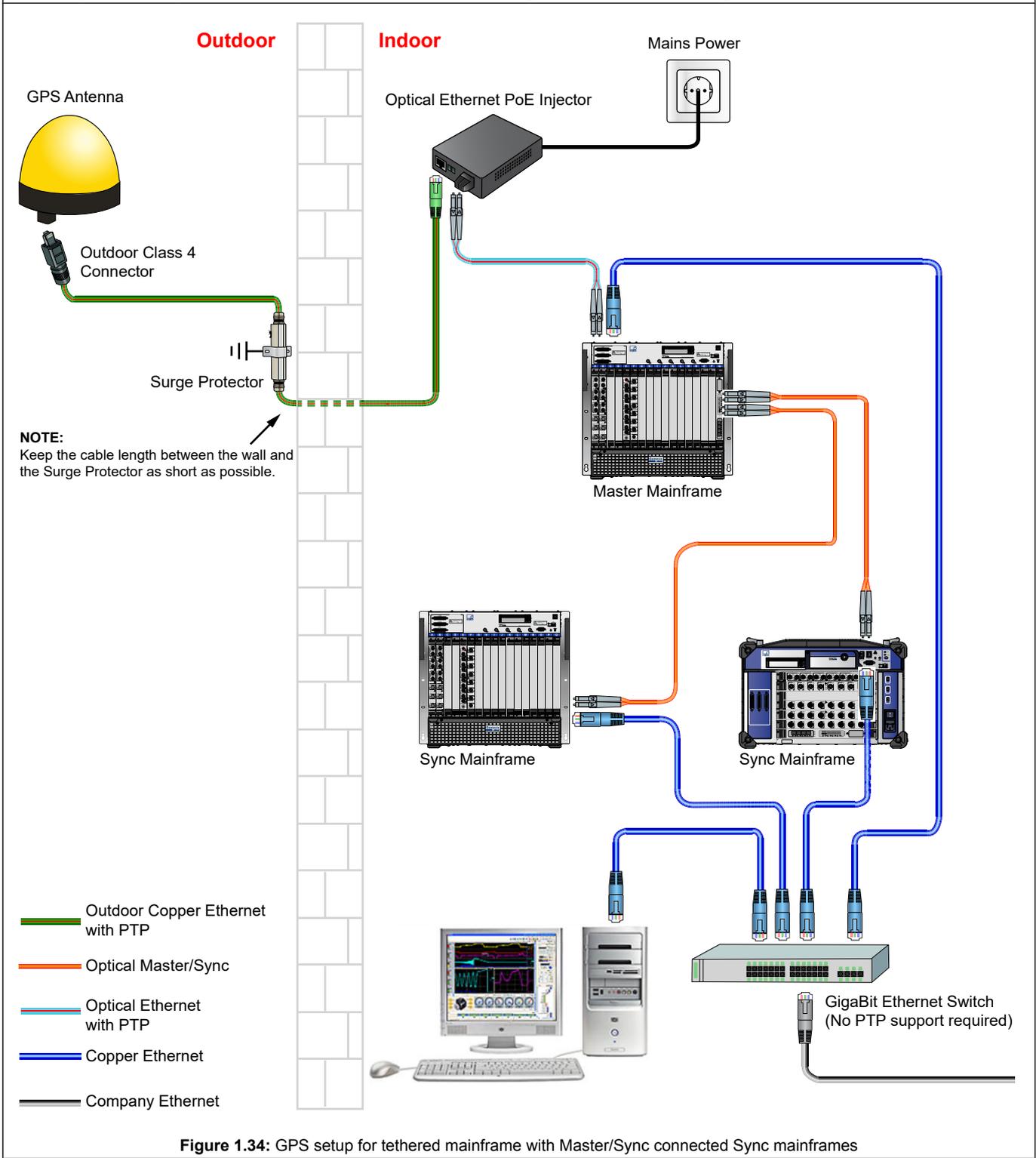GigaBit Ethernet Switch (No PTP support required)

Figure 1.34: GPS setup for tethered mainframe with Master/Sync connected Sync mainframes

Example Setup: GPS Receiver with Tethered Mainframes and QuantumX

Outdoor **Indoor**

Mains Power

GPS Antenna

Optical Ethernet PoE Injector

Outdoor Class 4
Connector

Surge Protector

NOTE:
Keep the cable length between the wall and
the Surge Protector as short as possible.

Gigabit PTP switch
HBK: UL-0265

MX1609KB

GEN series Mainframes

MX471B

Optical Ethernet
with PTP

Outdoor Copper Ethernet
with PTP

Copper Ethernet
with PTP

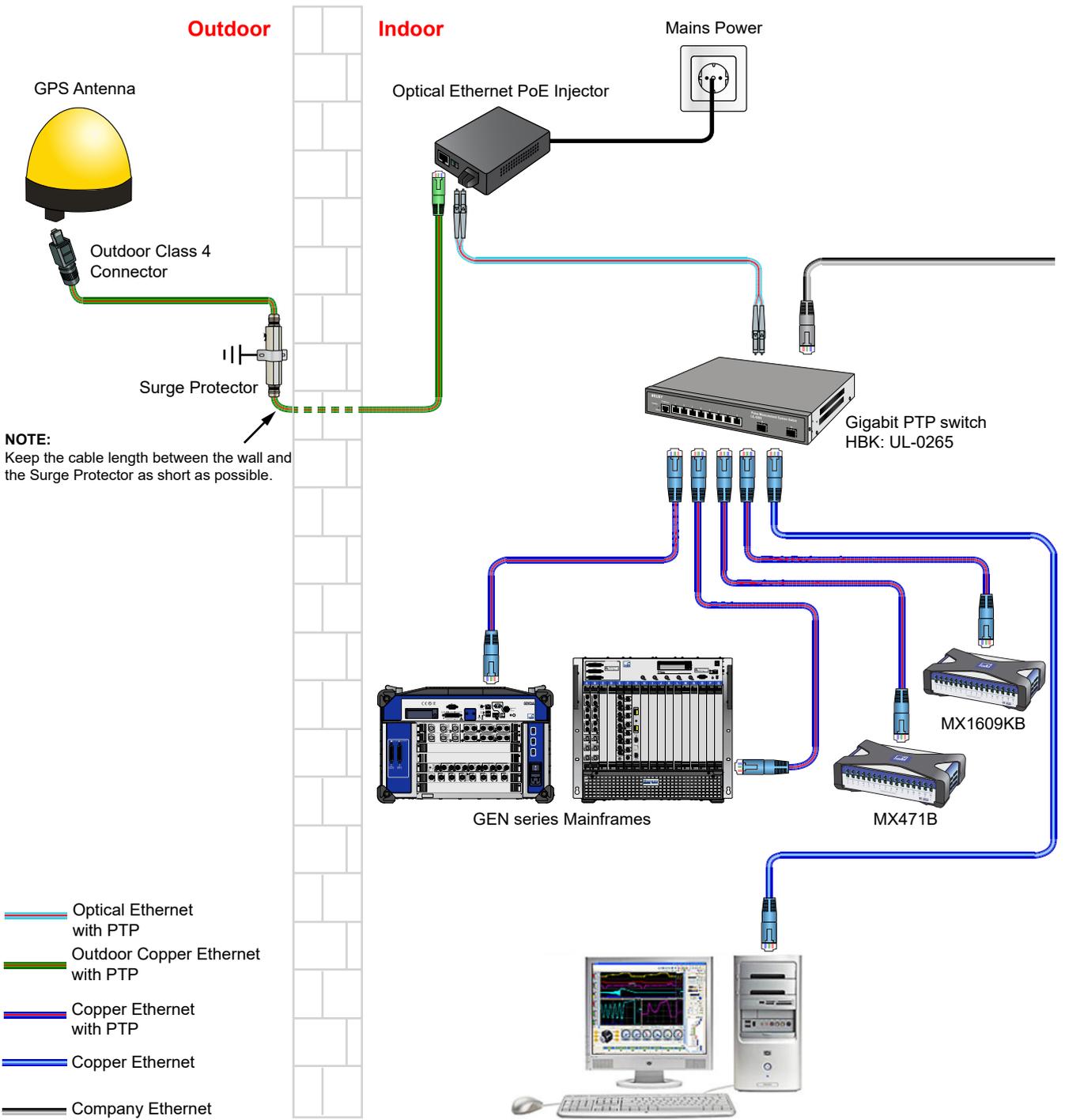Copper Ethernet

Company Ethernet

Figure 1.35: GPS setup for tethered mainframes and QuantumX

1-USB-CAN-FD-1CHN: CAN FD Semi Real-Time Data Output (Option, to be ordered separately)

The 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.

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).
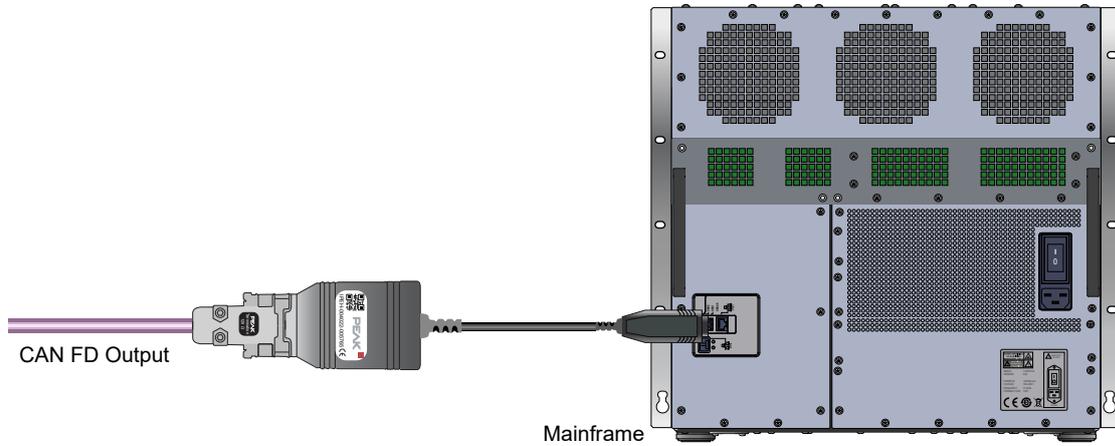

CAN FD Output

Mainframe

Figure 1.36: GEN17tA 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
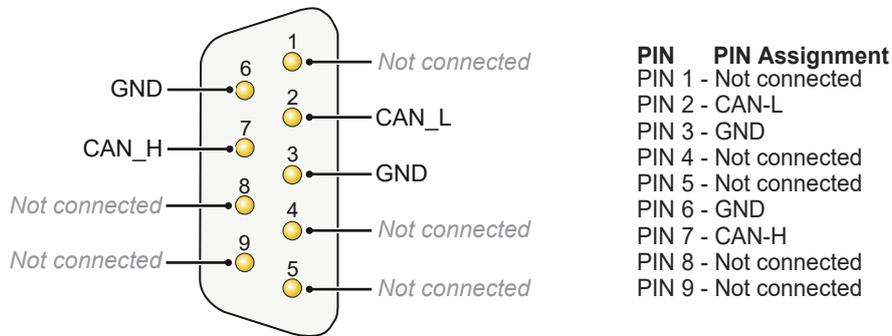
Figure 1.37: Pin assignment D-Sub

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)

CAN FD Data Output Details

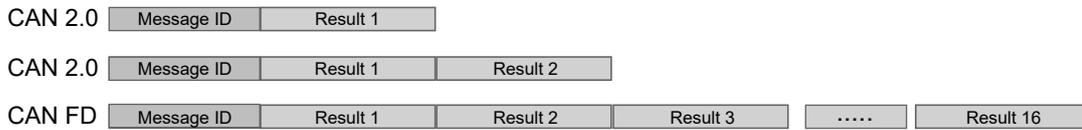|	
Plug-and-play	Not supported, insert CAN option before turning the mainframe on
Data format	Floating point values (4 bytes)
Data endianness	User selectable
CAN 2.0 message format	1 or 2 results per message
CAN FD message format	1 to 16 results per message

CAN 2.0   [Message ID][Result 1]

CAN 2.0   [Message ID][Result 1][Result 2]

CAN FD   [Message ID][Result 1][Result 2][Result 3] ..... [Result 16]

Figure 1.38: CAN message setup

Data package setup	1-GEN-OP-RT-FDB option required for real-time calculation of period results. User selectable data output package including RT-FDB periodic results as well as acquisition state, time and RT-FDB calculation latency.
Maximum data package size	240 calculated results
Data packet transfer rate	1, 2, 5, 10, 50, 100, 500 or 1000 packet updates/s
Data packet latency	If CAN bus bandwidth allows new packet transfers start as fast as 1 ms after signals have been recorded. Total transfer time depends on actual CAN bus usage.

[Message 1][Message 2][Message 3][Message 4] ..... [Message n]

Figure 1.39: GEN DAQ data packet

CAN FD Packet Transfer Rate and Overload Handling

Maximum packet transfer rate depends on CAN bit rate and number of results to be transferred. Adding third party CAN nodes transferring data at higher priority can negatively impact the overall transfer rate.
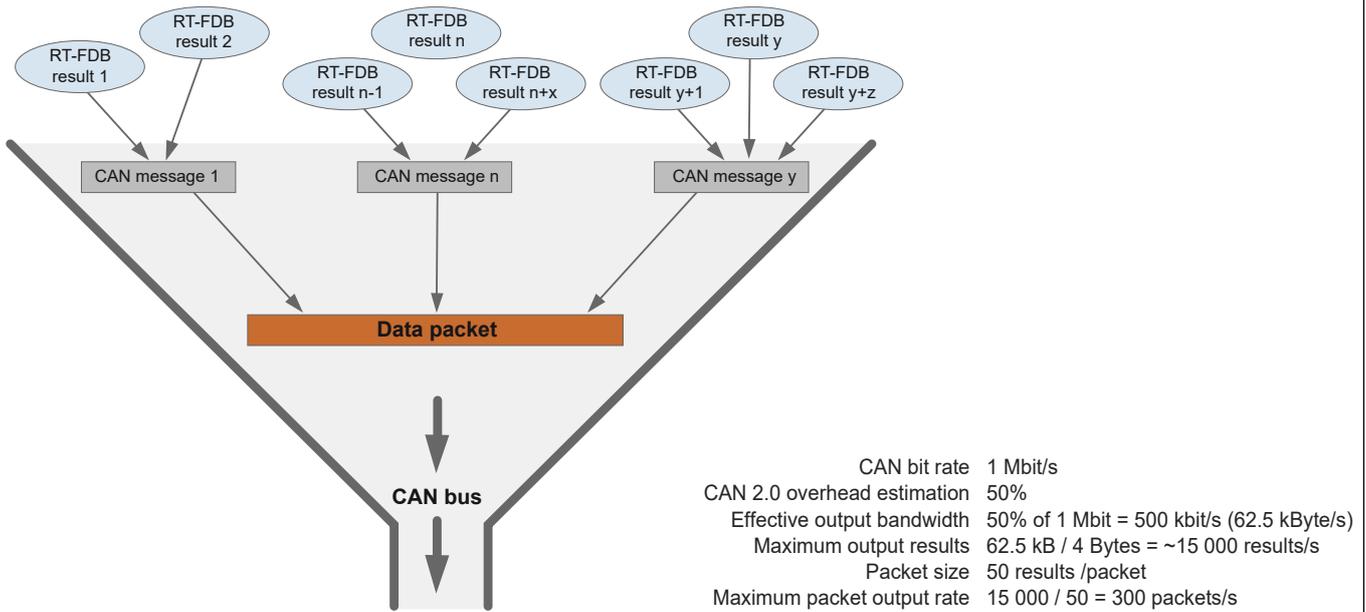

CAN bit rate	1 Mbit/s
CAN 2.0 overhead estimation	50%
Effective output bandwidth	50% of 1 Mbit = 500 kbit/s (62.5 kByte/s)
Maximum output results	62.5 kB / 4 Bytes = ~15 000 results/s
Packet size	50 results /packet
Maximum packet output rate	15 000 / 50 = 300 packets/s

Figure 1.40: Rule of thumb CAN packet transfer rate calculation

| Data packet latency	Automatic adapted to CAN bus bandwidth
CAN bus overload handling	
Temporarily overloaded	Packet data is transmitted as soon as bus is available. Single packets might be skipped if the bus overload condition was too long.
Continuous overloaded	Automatic packet transfer rate reduction to maximum achievable
Extreme overloaded	This condition will only occur when multiple devices with CAN output are used with message priorities higher than the GEN DAQ messages. Initially the overload protocol is used, if extreme overloads keeps occurring, individual message of data packets might be dropped to avoid extreme aging of data values still to be transmitted. Individual message transfers will be attempted for about 100 ms per message before dropping the message
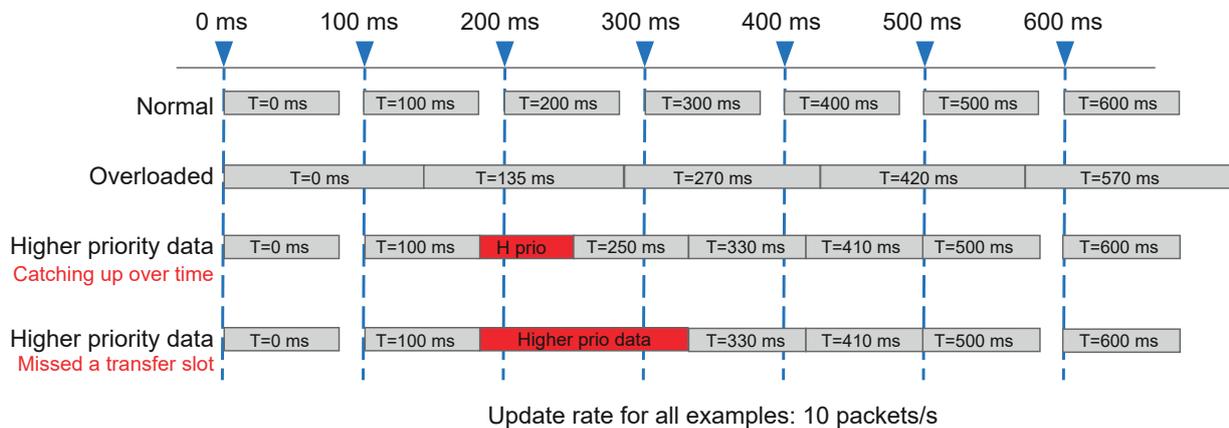
Figure 1.41: CAN output transfer rate and latency handling

Supported Acquisition Cards

Model	Type	Isolation	Maximum sample rate/ (not multiplexed)	Resolution	Memory/card	Analog Channels	Digital events	Timer/Counter channels	Streaming support	Slot width
GN310B	Balanced Differential/ Current	yes	2 M	18 bit	2 GB	6	16	2	fast	1
GN311B	Balanced Differential/ Current	yes	200 k	18 bit	200 MB	6	16	2	fast	1
GN610B	Balanced Differential	yes	2 MS/s	18 bit	2 GB	6	16	2	fast	1
GN611B	Balanced Differential	yes	200 kS/s	18 bit	200 MB	6	16	2	fast	1
GN815	Unbalanced Differential/ IEPE	yes	2 MS/s	18 bit	2 GB	8	16	2	standard & fast	1
GN816	Unbalanced Differential/ IEPE	yes	200 kS/s	18 bit	200 MB	8	16	2	standard & fast	1
GN840B	Bridge/IEPE/Charge/ 4-20 mA/PT100/PT1000/ Thermocouples	yes	500 kS/s	24 bit	2 GB	8	16	2	fast	1
GN1202B	Multi Mode Optical Fiber	yes	100 MS/s	_(1)	8 GB	12	16	2	fast	1
GN1640B	Bridge/IEPE/Charge/ 4-20 mA/PT100/PT1000/ Thermocouples	yes	500 kS/s	24 bit	2 GB	16	16	2	fast	2
GN3210	Differential/IEPE/Charge	no	250 kS/s	24 bit	2 GB	32	16	2	standard	1
GN3211	Differential	no	20 kS/s	16 bit	200 MB	32	16	2	standard	1
GN8101B	Single-ended	no	250 MS/s	14 bit	8 GB	8	16	2	fast	1
GN8102B	Single-ended	no	100 MS/s	14 bit	8 GB	8	16	2	fast	1
GN8103B	Single-ended	no	25 MS/s	14 bit	8 GB	8	16	2	fast	1

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

Optical Fiber Transmitter Channels

Transmitter
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.

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

Mainframe Feature Overview

	Tethered models				Integrated models	
	GEN2tB	**GEN4tB**	**GEN7tA**	**GEN17tA**	**GEN3iA**	**GEN7iA**
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
Portable	ultra portable	portable	transporta-ble	Not Supported	portable	transporta-ble
Rack mount support (Option)	yes					
Built-in storage drive	option 500 GB	option 500 GB or 960 GB	Not Supported		480 GB	960 GB
Removable built-in storage drive	Not Supported		option 960 GB EXT4		Not Supported	option 960 GB 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	0		8	
1 GB Ethernet (RJ45)	1				4	
Master/Sync connector	SFP option		included			
DC power output (QuantumX compliant)	NS[1]	NS[1]	30 W	NS[1]	15 W	30 W
Mechanical	**GEN2tB**	**GEN4tB**	**GEN7tA**	**GEN17tA**	**GEN3iA**	**GEN7iA**
Air filter	yes				no	yes
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			
Shipping case	option			NS[1]	option	
Option overview	**GEN2tB**	**GEN4tB**	**GEN7tA**	**GEN17tA**	**GEN3iA**	**GEN7iA**
IRIG time synchronization (G001B)	option					
GPS time synchronization (G002B)	option					
Option carrier card support (G081)	option					
Master output card (G083)	option					
10 GB Ethernet (G064)	NS[1]	option				
EtherCAT® real-time output	NS[1]	option			Not Supported	
CAN FD semi real-time output	option				Not supported	
Software	**GEN2tB**	**GEN4tB**	**GEN7tA**	**GEN17tA**	**GEN3iA**	**GEN7iA**
Included Perception package	Standard				Advanced	Enterprise
GEN DAQ API remote control	Standard supported				NS[1]	NS[1]
Perception API remote control	Standard supported					
Perception CSI (custom special software)	option					

(1)   NS: Not supported

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

Perception Versions

Features	Viewer (no copy protection)	Viewer Enterprise	Standard (no copy protection)	Advanced	Enterprise
True 64 bit support	✓	✓	✓	✓	✓
Basic review, y/t and x/y displays	✓	✓	✓	✓	✓
Horizontal, vertical and slope cursors	✓	✓	✓	✓	✓
Trace and display markers	✓	✓	✓	✓	✓
Interactive waveform calculator	✓	✓	✓	✓	✓
Interactive user keys	✓	✓	✓	✓	✓
Quick report to Microsoft® Word and Excel	✓	✓	✓	✓	✓
Automation and log-file	✓	✓	✓	✓	✓
Export to ASCII, Excel, imPression, RTPro, TEAM data	✓	✓	✓	✓	✓
Analysis functions/Formula Database	✗	✓	✗	✓	✓
Advanced Report	✗	✓	✗	✓	✓
Advanced Export adds 15 additional formats MATLAB, DIAdem, Flexpro, Famos, UFF58 etc.	✗	✓	✗	✓	✓
Synchronized Video Playback	✗	✓	✗	✓	✓
Multiple Workbooks (Monitors)	✗	✓	✗	✓	✓
Information sheet to add recording meta data	✗	✓	✗	✓	✓
Single mainframe control	✗	✗	✓	✓	✓
Multiple mainframe control[1]	✗	✗	✗	✗	✓
Macro editor for user keys and automation	✗	✓	✗	✗	✓
Basic FFT	✗	✓	✗	✗	✓
Sensor Database	✗	✓	✗	✗	✓
User/Definer Mode	✗	✓	✗	✗	✓
Application packages					
Custom Software Interface	✗	Cost option	✗	Cost option	Cost option
STL Analysis (Short-Circuit Testing Liaison methods)	✗	Cost option	✗	Cost option	Cost option
HV-IA Lightning, Switching and Current impulse analysis (IEC60060-1 and IEC61083-2)	✗	Cost option	✗	Cost option	Cost option
eDrive electrical motor/inverter/generator and drive analysis	✗	Cost option	✗	✗	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.

Perception Remote Control (Free of Charge)

Perception remote control is based on DCE/RPC network communication standards (Distributed Computing Environment/Remote Procedure Calls, free of charge). The source code supplied by HBM can be compiled on many different operating systems. For ease of use in the Microsoft®.NET environment a COM interface is created on top of the basic DCE/RPC interface. An extensive help file is available to explain interface calls offered in this API.

Figure 1.42: Functional diagram DCE/RPC

Functions	Control Perception software from an external computer/application on Windows®, Linux, Unix or Mac OS X
COM interface	All RPC commands have a COM wrapper for easier Windows® software integration
Available basic commands	Load and save Perception setup files, Setup Recording, set and review Hardware Settings, Start/Stop/Pause/Trigger, monitor Live data
Examples (free of charge)	C++ and C# getting started example programs supplied for Windows®, source code included. Unsupported Linux getting started example by request only.
LabVIEW™ integration (free of charge)	LabVIEW™ RPC/COM getting started examples available on www.hbm.com
DIAdem™ integration (free of charge)	DIAdem™ RPC/COM getting started examples available on www.hbm.com

GEN DAQ API (Free of Charge)

GEN DAQ API is based on JSON-RPC 2.0 network communication standards. The source code supplied by HBM can be compile on many different operating systems. For ease of use in the Microsoft®.NET environment source code for a COM interface is supplied as well. An extensive help file is available to explain interface calls offered in this API.
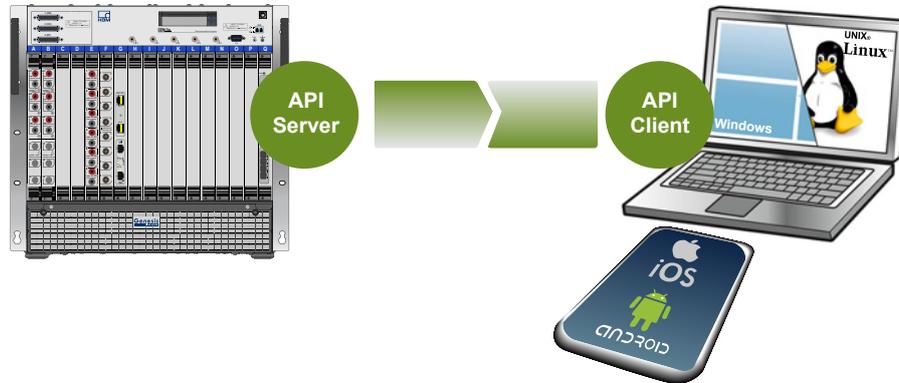

Figure 1.43: Functional diagram GEN DAQ API

Functions	Basic stand-alone control of GEN DAQ systems. Live data retrievable using EtherCAT® output. Setup and control using Perception Standard (Free of Charge)
Available basic commands	Start, Stop, Pause and Preview recording Trigger sweep based recording Load and Save system power on settings Delete recordings Change sample rate
API client Source code (free of charge)	C source code (Useable with any ANSI C compiler) Microsoft®.NET source code (Usable with any .NET compiler)
Communication technology used	Basic socket communication on TCP/IP level. JSON-RPC 2.0 calls are build and created in our source code driver. No additional OS or pre-installed JSON-RPC 2.0 dependences.

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.
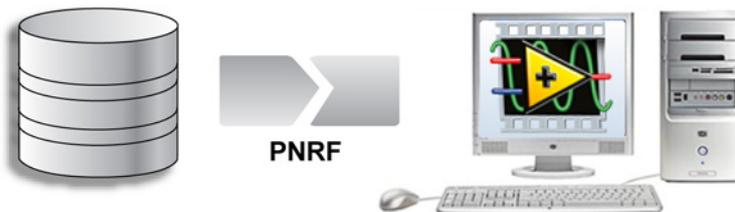

Figure 1.44: Functional diagram PNRF Reader

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 examples
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

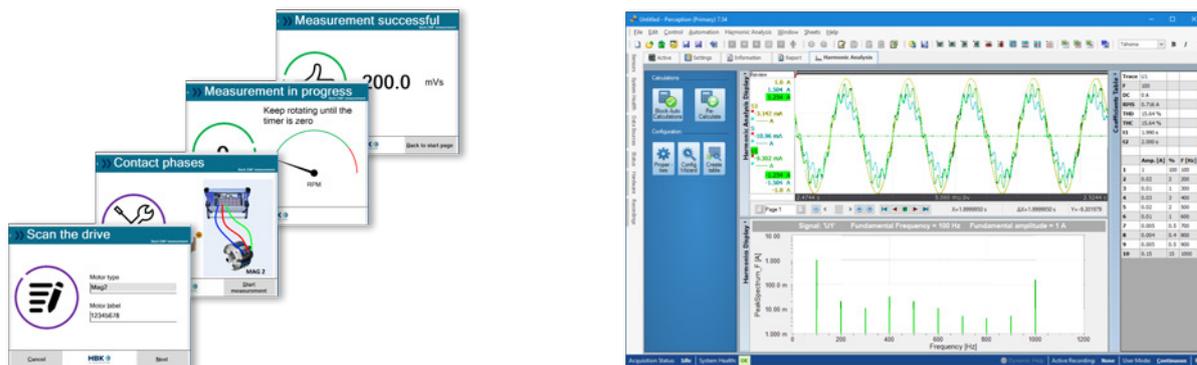# Perception CSI (Customer Software Interface)

Figure 1.45: 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 1.46: 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 analysing any kind of (performance) issue to generating basic getting started example code fragments.

Ordering Information

Article		Description	Order No.
GEN17tA		GEN17tA robust, desktop/rack mountable transient recorder and data acquisition system. Includes 17 slots for acquisition and option carrier cards, a 1 Gbit copper Ethernet interface, a master time base and a single Master/Sync connector. Has a standard continuous streaming rate (to a suitable PC) of 100 MB/s and supports fast data streaming.	1-GEN17tA

Solid State Drive (Option, to be ordered separately)

Article		Description	Order No.
Removable solid state drive		GEN7tA/GEN17tA specific Linux EXT4 pre-formatted RAID 0 Solid State Drive array mounted in removable drive carrier. Unformatted capacity 960 GB, 350 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.	1-G079

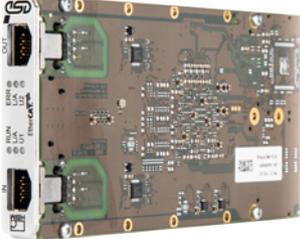## GEN17tA Accessories (Options, to be ordered separately)

Article		Description	Order No.
GEN17tA air filter		GEN17tA air filter. Regular replacement recommended.	1-G085

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
10 Gbit Optical Network SFP+ module 850 nm		GEN DAQ 10 Gbit Ethernet SFP+, 850 nm Multi Mode, up to 82 m optical cable length supported, LC connector support. 10 Gbit SFP+ modules are not compatible with the 1 Gbit SFP modules. Operating temperature: 0 °C to +40 °C	1-G065
10 Gbit Optical Network SFP+ module 1310 nm		GEN DAQ 10 Gbit Ethernet SFP+, 1310 nm Single Mode, up to 10 km optical cable length supported, LC connector support. 10 Gbit SFP+ modules are not compatible with the 1 Gbit SFP modules. Operating temperature: 0 °C to +40 °C	1-G066
10 Gbit Copper Network SFP+ module		GEN DAQ 10 Gbit Ethernet SFP+, Copper, up to 30 m cable length supported, RJ45 connector support. **Note**: 10 Gbit SFP+ modules are not compatible with the 1 Gbit SFP modules. Operating temperature: 0 °C to +40 °C	1-SFP-10GBIT-RJ45

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 Single Mode 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@hbm.com

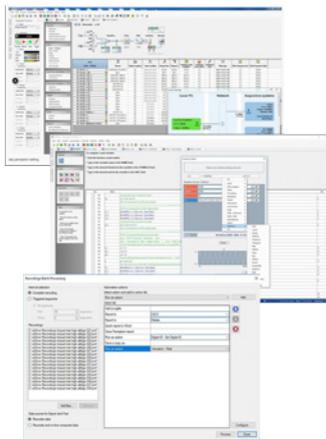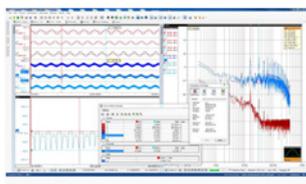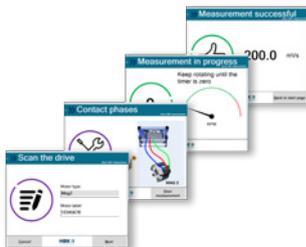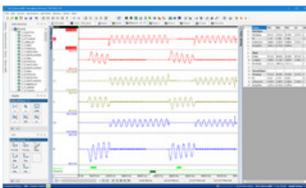## Option Carrier Card and Add-ons (Options, to be ordered separately)
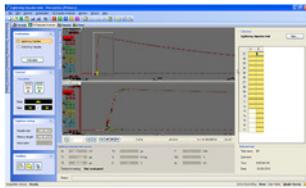
Article		Description	Order No.
Option carrier card		The option carrier card enables the use of two option cards within the GEN2tB, GEN3iA, GEN4tB, GEN7iA, GEN7tA and GEN17tA mainframes. Multiple option carrier cards are supported. Option cards enable the use of synchronization, field busses and 10 Gbit Ethernet. Operating temperature: 0 °C to +40 °C	1-G081
EtherCAT® card		Factory installed, option carrier card (G081) required. Real-time data transfer using industrial digital communication standard EtherCAT®. The card supports a single EtherCAT® slave node using two RJ45 connectors. Fixed ESI configuration with SDO and PDO data output that can be configured by the user. PDO data rates up to 1 kS/s. GEN series mainframe setup and control using EtherCAT® communication not supported. Maximum of one EtherCAT® card per mainframe. Operating temperature: 0 °C to +40 °C	1-G082
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, optical		Factory installed, option carrier card (G081) required. The optical 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 optical 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

CAN/CAN FD (Options, to be ordered separately)

Article		Description	Order No.
USB to CAN FD converter		The 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. The CAN FD option connects to the GEN DAQ mainframe's USB port and must be inserted before powering on the mainframe (No plug-and-play support). 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-USB-CANFD-1CHN

General Accessories (Options, to be ordered separately)

Article		Description	Order No.
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
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
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

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		UL-0265 is a 10/100/1000 Mbps network switch with IEEE1588:2008 PTPv2 time synchronization and PoE (Power over Ethernet) support. The switch is pre-configured for plug and play use on both IPv4 PTP used by GEN DAQ systems as well as PoE output for 8 devices. For systems using IPv6 PTP, the switch can be reprogrammed. UL-0265 has a built-in 100 to 240 V AC, 50 to 60 Hz mains power supply.	UL-0265

Software (Options, to be ordered separately[1])

Article		Description	Order No.
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
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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