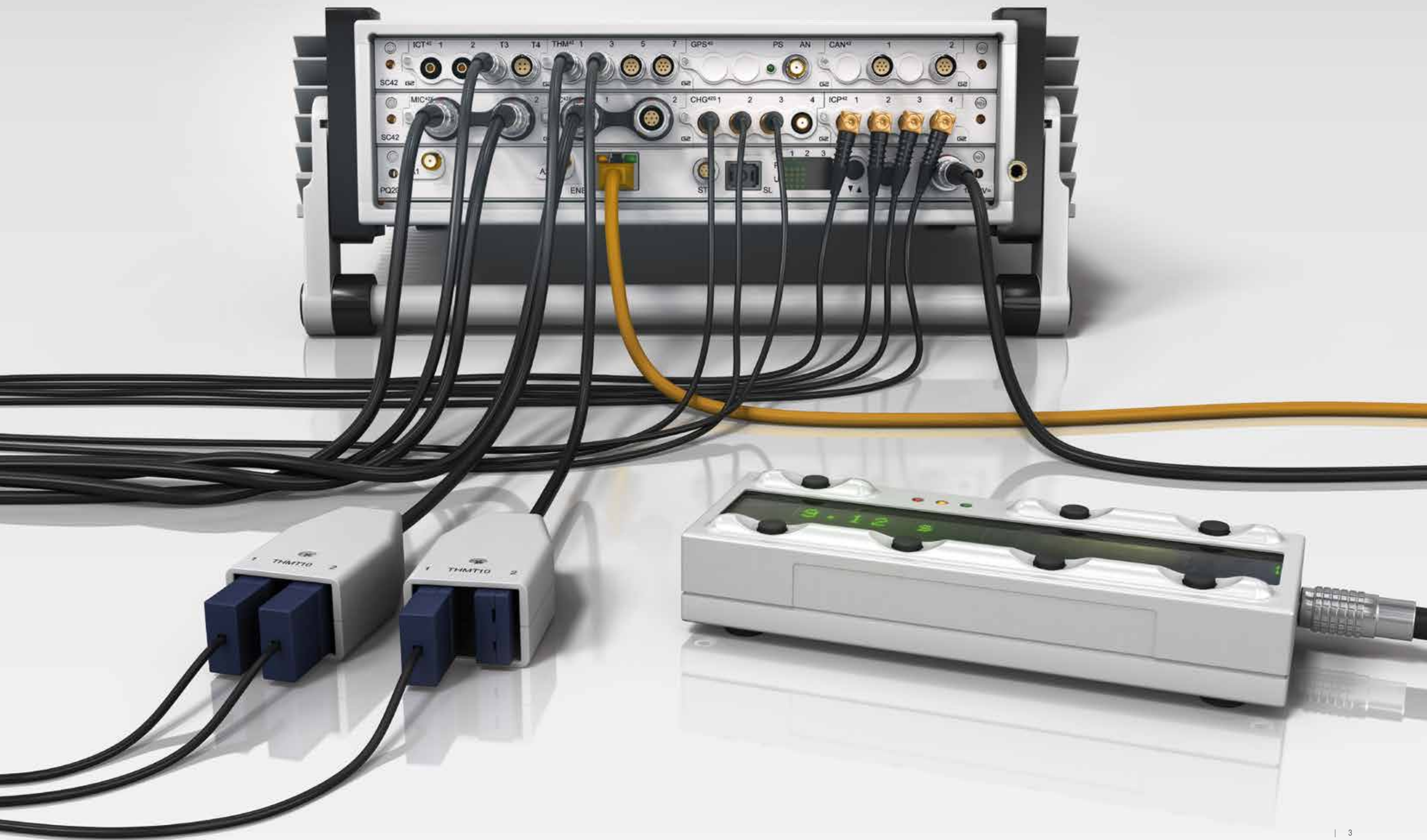




PAK **MKII**

investigate dynamic signals

The PAK MKII is a compact, highly integrated system for the measurement and output of precise, high-speed analog and digital signals. Both standard and complex multi-channel tasks are addressed by the same modular platform which can be freely configured as small troubleshooting solutions or large, distributed systems.



to be charged to innovate[®]

is to pioneer ideas and to be committed to the freedom that innovation brings

automotive
aerospace
construction machinery
consumer goods
defense
maritime
mining
precise production equipment
rail
turbine engineering
wind energy
and more

Below please find an excerpt of our customers:

AUDI | BMW | CLAAS | DAF Trucks | Daimler | Fiat | General Motors |
Honda | Hyundai | Isuzu Motors | IVECO Magirus | Kia | KTM
Sportmotorcycle | MAN Truck & Bus | Mercedes | Nissan | PIAGGIO |
PSA Peugeot Citroën | Jaguar | SAME DEUTZ-FAHR | Shanghai
Volkswagen Automotive | Shenzhen BYD Auto | Suzuki | Tata Daewoo |
Toyota | Volkswagen | Volvo | Airbus | Astrium | Boeing |
DLR | EADS | ESTEC | IABG | I.T.P. | MTU Aero Engines |
NASA Johnson Space Center | Northrop Grumman | Onera |
Rolls-Royce Deutschland | Thales ALENIA SPACE | Aisin Seiki | AVL
List | BASF | BorgWarner | Bridgestone | Continental | Dana Sealing
Products | Denso | Eaton Fluid | Eberspächer | Faurecia | FEV | Getrag |
Johnson Controls | Magna Powertrain | MAGNA STEYR | MAHLE |
MANN+HUMMEL | Michelin | Myunghwa Industries | Ningbo Tuopu |
Robert Bosch | Röchling Automotive | Schaeffler Group | SGL Brakes |
Tenneco | SOGEFI | TRW | Valeo Group | Wuhu Japhl | ZF Group |
ABB | AB Electrolux | AB Volvo Penta | ALSTOM Hydro Power |
Andreas Stihl | ASML | Bose | BSH Bosch und Siemens Hausgeräte |
Canon | Cheil Industries | CNR Tangshan Railway | HAWE Hydraulik |
IPETRONIK | Kaeser | Kohler | Komatsu | Krauss-Maffei Wegmann |
Kukje Heavy Industry | LG Electronics | Liebherr Machines | Linde
Material Handling | MAN Turbo | Meyer Burger | Philips Electronics |
REpower Systems | Samsung | Siemens | Sony | Sumitomo Construction |
Zanussi Elettromeccanica | CSI | Deutsche Bahn | EDF DER |
Mahindra & Mahindra | MBtech | SNCF | Numerous Research and
Academic Bodies





SINGLE STRUCTURED
SOLUTION

PAK **MKII**

data recording, troubleshooting, mobile applications, distributed systems, high channel density applications, testbench applications

SYSTEM

TIGHTLY INTEGRATED

ACQUIRE

- Systems start at 2 channels
- Measures analog parameters such as:
 - Voltage
 - Acceleration
 - Vibration
 - Pulse-period
 - Sound
 - Strain
 - Force
 - Pressure
 - Displacement
 - Temperature
- Outputs analog voltage
- Interfaces with
 - GPS
 - IRIG
 - CAN
 - FlexRay™
 - EtherCAT®
- Accommodates all of the above in any combination, in any Mainframe
- 204.8 kSa/s with 24-bit resolution
- High dynamic range with optimized low noise performance and distortion
- Rugged, conduction cooled and compact with an extremely high channel density
- Local storage on an internal Solid-State Disk (SSD)
- Gigabit Ethernet on all Controllers
- Optional integrated WLAN (IEEE 802.11n) for faster data transfer and robust connection
- Synchronizes multiple distributed Mainframes via SyncLink, GPS or IRIG
- Able to operate standalone
- Readily expandable

RECORD

The **PAK recorder** captures and stores dynamic data using **PAK live** software embedded on the **PAK MKII**. This intelligent operation allows the **PAK MKII** to run standalone as well as communicate with smart devices. Users are able to control and interact with the measurement running on the **PAK MKII** using a smart device. In this way, users are able to check the test status of signal overloads and sensor connections.

The data recorded is extremely secure and of the highest quality. Data can either be stored on an integrated SSD or streamed live over Ethernet to a storage solution. The data is stored in the open ASAM ODS NVH ATF/XML format.

ANALYZE

PAK MKII hardware is tightly integrated with **PAK** software and forms a formidable hardware/software partnership. The resulting system environment combines highly modular, multi-channel data acquisition hardware with high performance analysis and graphical processing for various applications. Integrated data management is also available.

PAK software supports:

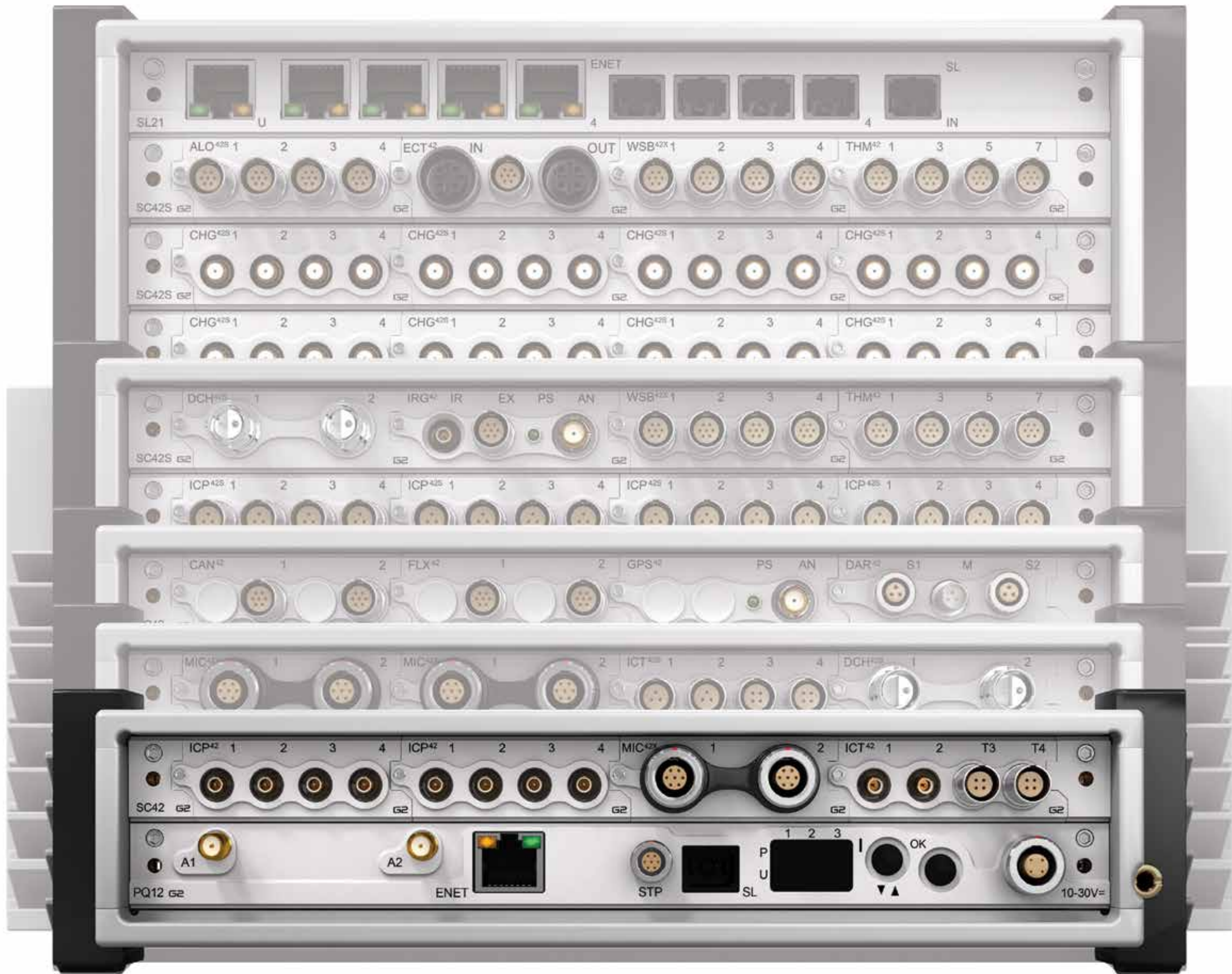
- High-performance real-time analysis with different data types and multiple sampling groups in parallel
- A wide range of applications addressing standard measurements, signatures and highly specialized applications
- **PAK Easy Measurement** interface provides an easy workflow from setup to measurement
- Storage of raw time domain data as well as analyzed data
- Close monitoring of test candidate behavior while post-processing results quickly
- Native support of ASAM ODS NVH ATF/XML as well as standard data formats for importing and exporting measurement data e.g. Universal, SDF
- To be used in both mobile and laboratory environments



MANAGE

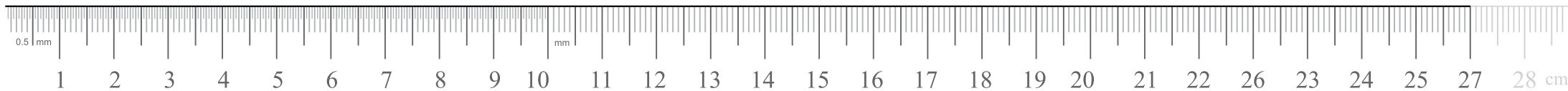
A reliable and accessible data portal is available for storing, browsing, filtering and viewing ASAM ODS compatible data. As time domain data is stored, it is possible to access the acquired data for online analysis or for post processing.

ALL PAK MKII MAINFRAMES
ARE RUGGED, LIGHTWEIGHT
AND PORTABLE. THROUGH
ITS COMPACT FORM FACTOR,
CHANNEL FOOTPRINT AND
DENSITY IS OPTIMIZED.



REAL SIZE

This image shows a 2, 3, 4, 6 and
10-slot Mainframe placed behind
one another in real size. Scale 1:1
10 |



Modules to accommodate every signal type

By having access to all required parameters in one system, a high level of phase accuracy is achieved as analog and digital signals are sampled at exactly the same time. A wide range of Signal Conditioning Modules exist to:

- Measure parameters such as voltage, vibration, acceleration, pulse-period, sound, strain, force, pressure, displacement and temperature
- Output analog voltages
- Interface with GPS, IRIG, CAN, FlexRay™ and EtherCAT®

Signal integrity built upon strong infrastructure

Highly accurate signal conditioning combined with high speed data handling is paramount to any front end. The PAK MKII accomplishes this through advanced signal conditioning supported by powerful digital circuitry and data handling capabilities. This enables the PAK MKII to achieve high-speed data acquisition with the highest analog and digital signal quality, translating into a high dynamic range with low noise performance and distortion.

Apart from regularly scheduled calibration, all input Modules are automatically calibrated upon start-up or upon request.



TAILOR YOUR SYSTEM ACCORDING TO YOUR SPECIFIC REQUIREMENTS

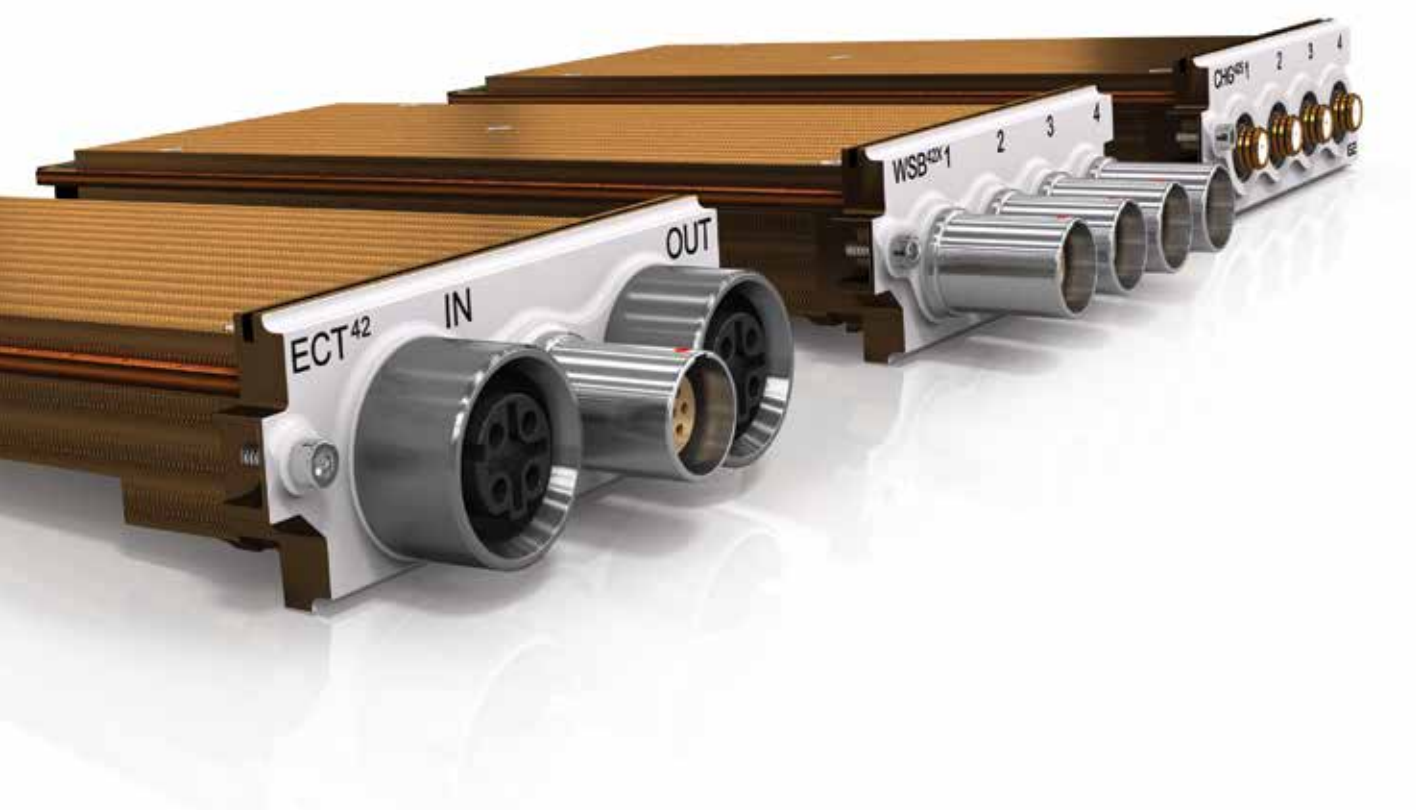
MATCH YOUR

SENSOR

to our range of signal conditioning amplifiers

CHOOSE FROM OUR BROAD RANGE
OF 17 MODULES

Each Module is optimized for a specific task whilst some combine different functions in one Module. New Modules are continuously under development to accommodate new requirements and the latest technologies.



PARAMETER	NO. OF CHANNELS	MAXIMUM DATA RATE	RESOLUTION	MODULE
ICP® based microphones, accelerometers, load cells and pressure sensors	2	102.4 kSa/s	24-bit	ICT42² G2
	4	102.4 kSa/s	24-bit	ICP42 G2
	2	204.8 kSa/s	24-bit	ICT42S² G2, MIC42X G2
	4	204.8 kSa/s	24-bit	ICP42S G2, WSB42X G2
	16	204.8 kSa/s	24-bit	ICM42S⁴
±10 V voltage input	8	3.2 kSa/s	24-bit	THM42 G2
	2	102.4 kSa/s	24-bit	ICT42² G2
	4	102.4 kSa/s	24-bit	ICP42 G2; WSB42 G2
	2	204.8 kSa/s	24-bit	ICT42S² G2; MIC42X G2
	4	204.8 kSa/s	24-bit	ICP42S G2, WSB42X G2
	16	204.8 kSa/s	24-bit	ICM42S⁴
±60 V voltage input	2	204.8 kSa/s	24-bit	ICT42S² G2
	4	204.8 kSa/s	24-bit	ICP42S G2
Tacho pulse input with 204.8 kSa/s Scope Mode	2	up to 700 kPulse/s³	20 ns	ICT42¹ G2
Tacho pulse input with 4.9 MSa/s Scope Mode	2	up to 1 MPulse/s³	14 ns	ICT42S¹ G2
200 V or non-polarized microphones	2	204.8 kSa/s	24-bit	MIC42X G2
Piezoelectric based accelerometers, load cells, etc. (Single-Ended)	4	204.8 kSa/s	24-bit	CHG42S G2
Piezoelectric based accelerometers, load cells, etc. (Differential)	2	204.8 kSa/s	24-bit	DCH42S G2
Strain gauges, load cells, pressure sensors, strain based accelerometers, inductive displacement (LVDT) and rope displacement sensors	4	102.4 kSa/s	24-bit	WSB42 G2
	4	204.8 kSa/s	24-bit	WSB42X G2
Current-excited strain gauges including dynamic strain	4	204.8 kSa/s	24-bit	WSB42X G2
E, J, K, T and U thermocouples as well as Pt100 sensors	8	3.2 kSa/s	24-bit	THM42 G2
±10 V voltage output with status handshake	4	204.8 kSa/s	24-bit	ALO42S G2
Monitoring Output capability	16	Analog	NA	ICM42S⁴
Internal GPS	1	4 Hz	NA	GPS42 G2; IRG42 G2
IRIG-A / IRIG-B	1	Standard specific	NA	IRG42 G2
CAN	2 networks	1 Mbit/s	NA	CAN42 G2
FlexRay™	1 pair	10 Mbit/s	NA	FLX42 G2
EtherCAT®	NA	Application specific	NA	ECT42 G2
Digital audio receiver	2 stereo	96 kFrames/s	24-bit	DAR42 G2

Note 1: Also has two ICP®/Analog input channels

Note 2: Also has 2 tacho pulse input channels

Note 3: Pulse rate for sum of both channels

Note 4: Compound-Module

NA: Not Applicable

THE PAK MKII'S STABILITY
AND INHERENT LONGEVITY
ENCOURAGES USERS TO
GROW THEIR SYSTEMS
ACCORDING TO THEIR
REQUIREMENTS IN
MEASUREMENT DEMANDS
AND TECHNOLOGY.



DESIGN

Proven to withstand fluctuations in technology

With a heritage dating back to 1989, the **PAK MKII** has maintained the same solid foundation since its inception. Today our single structured platform remains unchanged with only continuous improvements and expansions made to incorporate on-going pathbreaking technologies. Standards incorporated into the **PAK MKII** like VMEbus, WLAN and Ethernet, are not only powerful and versatile but most importantly stable and sustainable. This is mainly due to these standards' common use in aerospace, defense as well as professional instrumentation and control systems.

The **PAK MKII** makes use of a professional real time operating system, namely Windriver's VxWorks® on all its System Controllers. This ensures fast, logical and safe decisions when operating standalone.

Robust mechanics

Machined from aluminum, the **PAK MKII** is designed to withstand shock and vibration whilst operating in environmental temperatures from -20 °C up to +55 °C depending on system configuration. All Mainframes are internally conduction cooled ensuring that no dusty air circulates within the Mainframe. Some Mainframes never require fan cooling whilst others contain fans which only operate under high temperatures. In all cases fans can be switched off during sensitive acoustic measurements. The period for which the fans can remain switched off depends on the system configuration and environmental conditions. The fan of a MF06 Mainframe (if fully populated with 80 ICP® channels), can remain off for up to 2 hours when operating at 22 °C.

All signal conditioning Modules are encased in aluminum providing good thermal management and protection. All sensor, power and communication cables are plugged into the front panel of the Mainframe for ease of use. An optional battery is housed in the rear of the Mainframe.

Modular configuration

All Modules have been designed to be readily interchangeable. This allows each measurement test to be perfectly configured. Many users own more Modules than can fit into their Mainframes so that the perfect combination for every test is always achieved. To reduce power consumption, Modules which are not required for a particular test can be switched off.

Expandable in part

To provide more channels in a particular system or to support a new sensor, additional Modules can be easily added. In this way, users benefit from consistent improvements like finer performance balances, higher dynamic ranges, higher sampling rates, improved analog quality as well as lower noise and distortion. Some users start with a larger Mainframe than what is initially required and close off the empty Module slots with blank front panels. These blank front panels are then easily replaced with new Modules as the need arises. Partial upgrades are usually possible. This allows users to upgrade existing configurations. As our standards based concept is extremely sustainable, components of different generations can often coexist in the same Mainframe. Users are able to take advantage of this concept by refreshing their system on a regular basis for different or more advanced measurement tasks.



EMPOWER

NEW TECHNOLOGY. MORE CHANNELS

Multifaceted mobility

Due to the **PAK MKII**'s compact form factor and extremely high channel density, even larger Mainframes are often used for mobile applications. In other applications some users may prefer a smaller Mainframe or a number of smaller synchronized Mainframes for the same task.

Meet the demands of multi-channel high-speed measurements

For higher channel counts or distributed measurement positions, an unlimited number of synchronized Mainframes can operate together as a single Mainframe. Mainframes can be positioned up to 1000 m from the central Synchronization Engine if synchronizing via SyncLink or further apart if synchronizing over GPS. Users consequently benefit from shorter signal cables, reduced cable noise and reduced cabling faults as each Mainframe can be positioned exactly where it needs to be, close to the measurement position or test candidate.

Able to operate as a standalone unit

Standalone mode is an optional feature that allows the **PAK MKII** to operate independently. When acquiring data as a standalone system, an Android™ or iOS™ mobile device can be used to setup, control and monitor measurements on the **PAK MKII** through **PAK capture suite** over WLAN. The interfacing device can connect or disconnect without affecting the measurement.

Write data to local storage for enhanced security

Local Storage allows the **PAK MKII** user to store the measurement data on an internal Solid-State Disk. Data can be retrieved and analyzed independently at a later stage. Local storage has two distinctive purposes - one is to operate standalone and the second to provide a local copy of critical data should problems occur with the external Ethernet link.

STANDALONE WITH SMART DEVICES

This is an example of an entry level configuration using only 1 Mainframe, shown here as a 2-slot. The same could apply to any Mainframe. The **PAK MKII** connects to the smart device over WLAN.



STANDARD ETHERNET CONNECTION

Here the connection to the notebook is through Gigabit Ethernet.

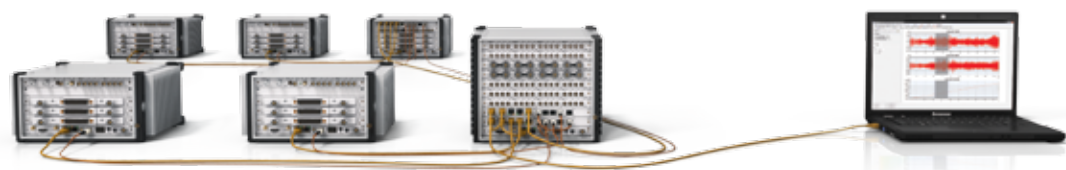


SYNCLINK SYNCHRONIZATION

If more channels are required (than what can be accommodated in a single Mainframe) or if it is better to place a Mainframe closer to where the measurement takes place, two or more Mainframes can be synchronized. The Synchronization Engine is housed in one of the two Mainframes. SyncLink and communication cables between Mainframes follow the same path in order to keep cabling simple.



More than 4 Mainframes can also be synchronized. This requires additional Synchronization Engines which can also be housed in one of the Mainframes. Limitless Mainframes can be synchronized for an unlimited channel count, greater geographical reach and an efficient use of available hardware.



GPS SYNCHRONIZATION

By adding a GPS42 G2 or IRG42 G2 Module to each Mainframe, timing and position data is provided. In this way any number of Mainframes can conveniently form a larger system through GPS or IRIG synchronization. Users may choose to connect their Mainframes over WLAN or Ethernet to a workstation.

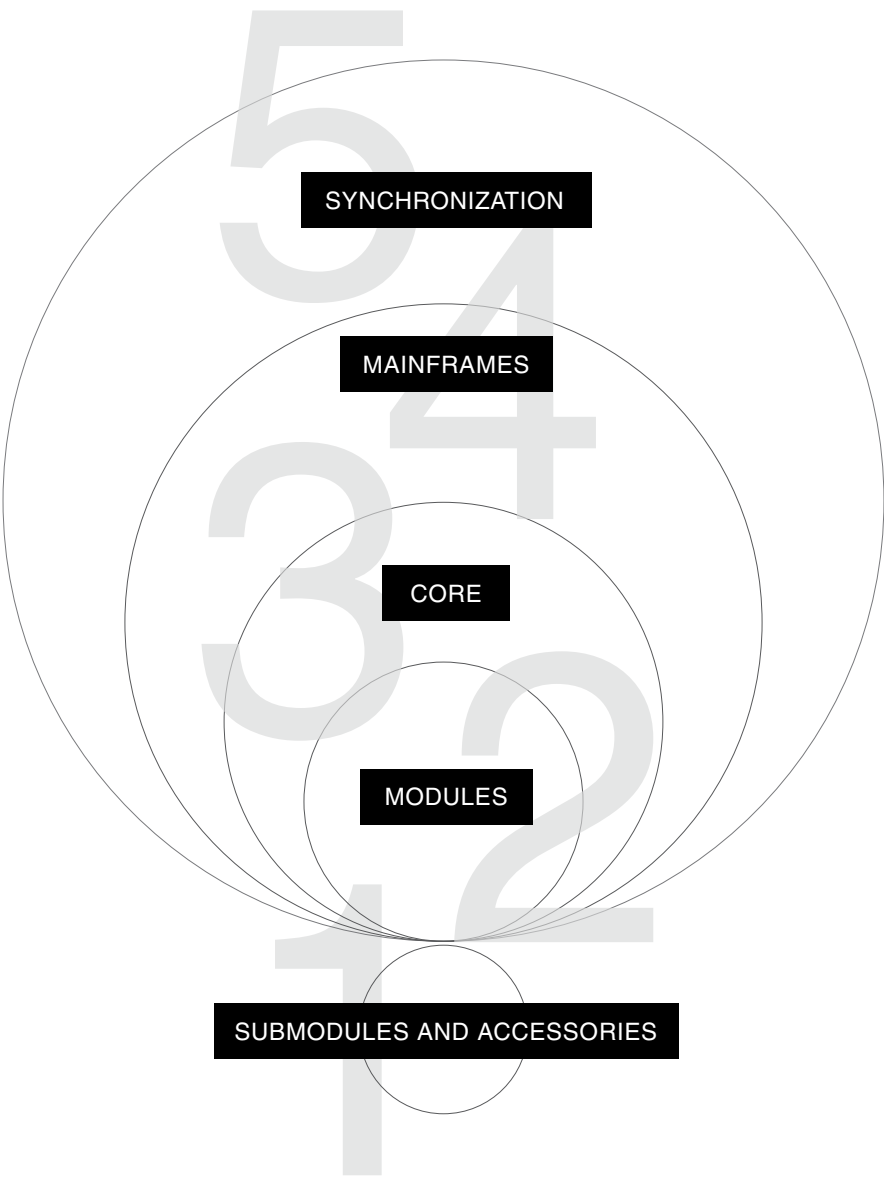


5tModularity®

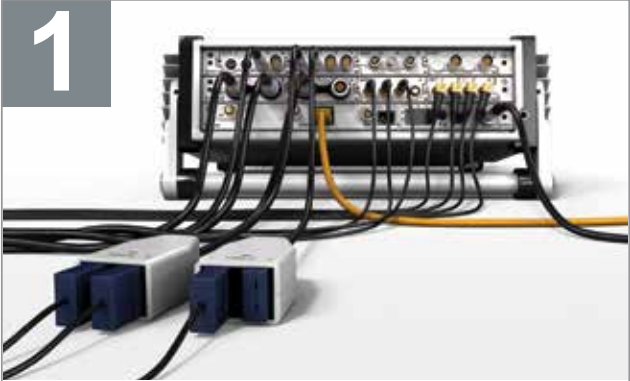
The PAK MKII system takes the concept of modularity to an uncommonly deep level with it being repeated in 5 sub-system levels or tiers. These 5 tiers of PAK MKII modularity are collectively known as 5tModularity®.

The central Core or backbone of this stable approach is tier 3. The stability of the Core allows complex boards to be developed on an ongoing basis, without compromising their sophistication and performance. This is done through the disciplined compliance to international standards.

Sensor signals enter the system through SubModules in tier 1 (only if required) or more often, through Modules in tier 2. Other Accessories such as SeatFrames and RackMounts are also found in Tier 1. Tier 4 provides Mainframes which accommodate tier 3's Core boards. Tier 5 defines systems containing synchronized Mainframes for an unlimited channel count and greater geographical reach.



1



SUBMODULES AND ACCESSORIES

SubModules and other Accessories are used to personalize a system and may be required to provide a special interface to an individual sensor. An example of this is when both a Pt100 temperature sensor and K-type thermocouple are plugged into the same Module. Here a SubModule is used to satisfy each specific signal and connector needs. **Find out more about Tier 1 on page 46.**

2



MODULES

To address nearly all sensor types and dynamic parameters, a more compact tier of modularity is required for signal conditioning amplifiers than a large VMEbus board. A Sub-VMEbus concept was therefore devised where 4 Modules fit onto a single Signal Conditioning VMEbus board which provides the mechanical and electronic infrastructure for these Modules. There are currently 17 Modules to choose from in order to match a user's sensors. **Find out more about Tier 2 on page 34.**

3



CORE

The VMEbus was chosen to be the core of the PAK MKII concept as any modular concept should be powerful and versatile but most importantly stable and sustainable. There are currently 4 types of VMEbus boards: Combined System Controller and Power Supply boards, Signal Conditioning boards (to accommodate Modules), Synchronization Engines (for the distribution of Mainframes) and blank VMEbus boards for planned later expansion. **Find out more about Tier 3 on page 26.**

4



MAINFRAMES

Currently 5 Mainframes are available to accommodate the number of VMEbus boards required to configure a suitable system. Any number of slots can be left open for planned later expansion. An optional battery is housed at the rear. **Find out more about Tier 4 on page 22.**

5



SYNCHRONIZATION

The PAK MKII Cluster concept allows any number of distributed Mainframes to be synchronized together via SyncLink, GPS or IRIG in order to operate as one virtual Mainframe. These Clusters reduce sensor cable lengths, increase the data rate coming from a test, allow for greater geographical reach and accommodate a limitless channel count. **Find out more about Tier 5 on page 50.**

TIER 4 MAINFRAMES



HOUSING SIGNALS

5 Mainframes all for both mobile and laboratory use

The PAK MKII Mainframe series consists of a 2, 3, 4, 6 and 10-slot VMEbus based Mainframe. Their mechanical design has been optimized for thermal performance together with resistance to shock and vibration whilst retaining its compact form factor. A convenient carrying handle is provided on all Mainframes (except the 10-slot) for enhanced portability which can be removed if required.

The external surfaces of the smaller 2 and 3-slot Mainframes are cooled through natural convection alone. The 4 and 6-slot Mainframes are cooled through a combination of natural and forced convection while the 10-slot Mainframe's external surfaces are cooled by forced convection only. The fan speed is controlled by software to maintain a suitable running temperature. For noise sensitive measurements the fan can be switched off. During this time the Mainframe acts as a large thermal mass.

All Mainframes have been designed for both mobile and laboratory applications. Battery backup is provided using a battery housed in the rear of the Mainframe which allows operation without an external power supply.

MAINFRAME DETAILS

The tables below show a few important parameters when selecting your mainframe.

MF02



Number of VMEbus slots:	2	Power Supply and System Controller:	Any
Maximum number of channels (if 4 ch/module):	16	Number of slots for SC42 boards:	1
Fan:	None	Cooling of external surfaces:	Natural Convection
Dimensions (W H D):	291 x 68 x 267 mm	Cooling of internal surfaces:	Conduction
Mass, fully populated with battery:	5.1 kg	Mass, fully populated without battery:	4.8 kg
Volume:	5.3 L	Battery capacity:	16 Wh

MF03



Number of VMEbus slots:	3	Power Supply and System Controller:	Any
Maximum number of channels (if 4 ch/module):	32	Number of slots for SC42 boards:	2
Fan:	None	Cooling of external surfaces:	Natural Convection
Dimensions (W H D):	307 x 88 x 267 mm	Cooling of internal surfaces:	Conduction
Mass, fully populated with battery:	7.1 kg	Mass, fully populated without battery:	6.3 kg
Volume:	7.2 L	Battery capacity:	33 Wh

MF02: 2-slot Mainframe

MF03: 3-slot Mainframe

MF04: 4-slot Mainframe

Number of VMEbus slots:	4	Power Supply and System Controller:	PQ12 G2 PQ20 G2 PQ30 G2
Maximum number of channels (if 4 ch/module):	48	Number of slots for SC42 boards:	3
Fan:	Yes	Cooling of external surfaces:	Natural/Forced Convection
Dimensions (W H D):	307 x 109 x 287 mm	Cooling of internal surfaces:	Conduction
Mass, fully populated with battery:	9.9 kg	Mass, fully populated without battery:	9.1 kg
Volume:	9.6 L	Battery capacity:	33 Wh

MF06: 6-slot Mainframe

Number of VMEbus slots:	6	Power Supply and System Controller:	PQ12 G2 PQ20 G2 PQ30 G2
Maximum number of channels (if 4 ch/module):	80	Number of slots for SC42 boards:	5
Fan:	Yes	Cooling of external surfaces:	Natural/Forced Convection
Dimensions (W H D):	307 x 151 x 287 mm	Cooling of internal surfaces:	Conduction
Mass, fully populated with battery:	15.2 kg	Mass, fully populated without battery:	12.6 kg
Volume:	13.3 L	Battery capacity:	72 Wh

MF10: 10-slot Mainframe

Number of VMEbus slots:	10	Power Supply and System Controller:	PQ20 G2 PQ30 G2
Maximum number of channels (if 4 ch/module):	128*	Number of slots for SC42 boards:	8*
Fan:	Yes	Cooling of external surfaces:	Forced Convection
Dimensions (W H D):	291 x 231 x 333 mm	Cooling of internal surfaces:	Conduction
Mass, fully populated with battery:	22.7 kg	Mass, fully populated without battery:	20.2 kg
Volume:	22.3 L	Battery capacity:	72 Wh

*Could be higher depending on Module configuration, voltage of supplied power and environmental temperature

MF04



MF06

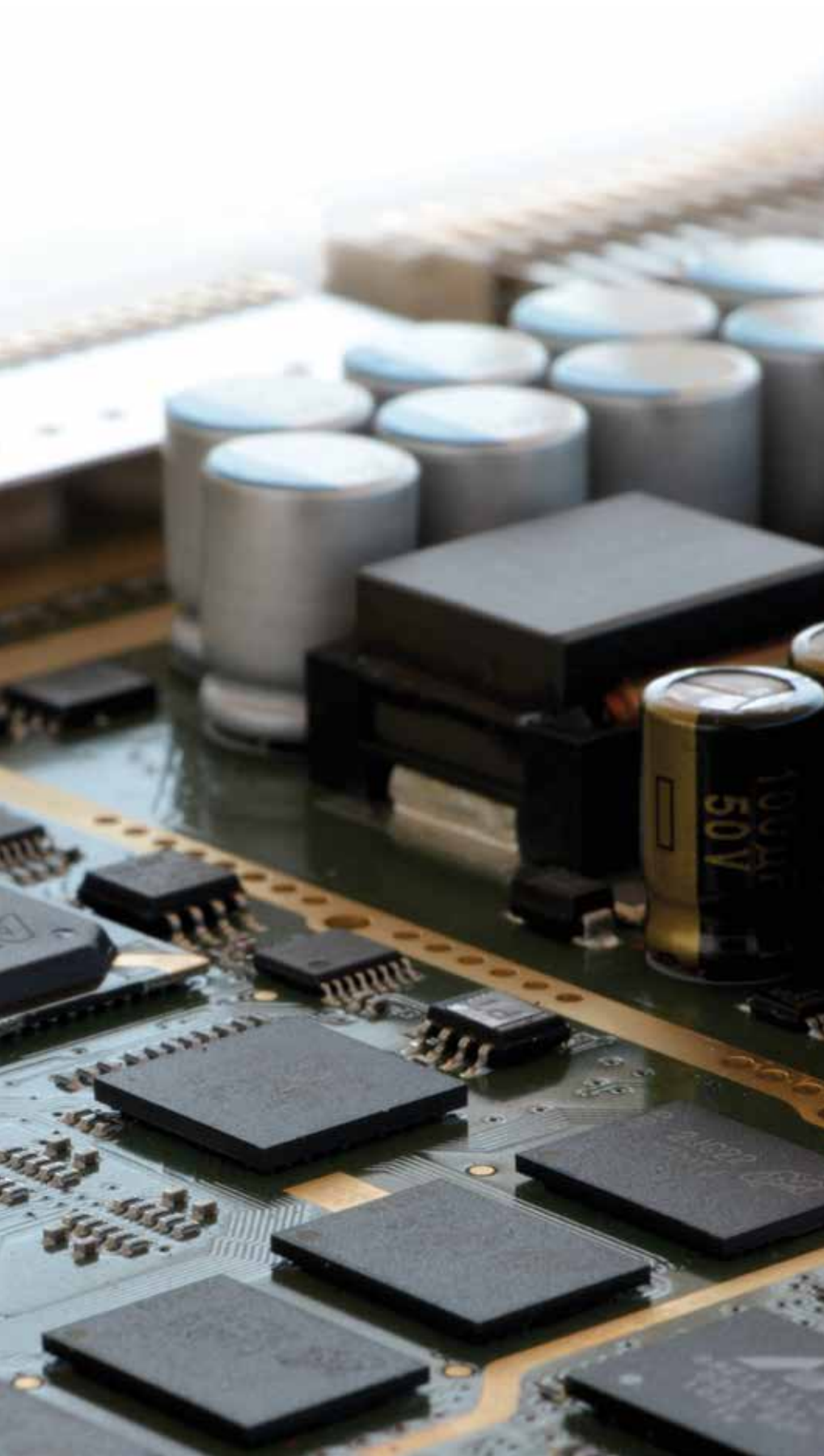


MF10



All Mainframe masses have been calculated fully populated with ICP42 G2 Modules as well as WLAN and SSD.

TIER 3 CORE



PROCESSING SIGNALS

Stable Core

All VMEbus boards are inserted into a Mainframe which provides a stable infrastructure to house 4 types of VMEbus boards:

Combined System Controller and Power Supply

This board is a dual function board which combines a VMEbus System Controller with a Power Supply for all other boards in its Mainframe. The choice of combined Power Supply and VMEbus System Controller depends only on its data processing ability and the size of its power supply. Combining the Power Supply and Controller on a single VMEbus board enhances the modularity of the whole system as the power supply can be readily maintained and upgraded.

Signal Conditioning Engine and Infrastructure

This board provides isolated power, digital signal processing using 5 powerful DSPs, automatic internal calibration and the mechanical infrastructure for 4 Modules.

Synchronization Engine

This board enables the synchronization of multiple Mainframes. It contains a VMEbus 5 port Gigabit Ethernet switch and a 5 port SyncLink hub. One board is required per cluster of 4 Mainframes.

Blank VMEbus board

This board is used to close off an empty slot when configuring systems with future expansion in mind. The blank VMEbus board is then either replaced by a Signal Conditioning Engine and Infrastructure board or a Synchronization Engine.

PQ11

PQ11: VMEbus System Controller and Power Supply



The PQ11 G2 is a dual function board combining a VMEbus System Controller, Master, Arbiter and Interrupt Handler with VMEbus Power Supply. It can be used in an MF02 and MF03 Mainframe. It is an entry level board particularly suited to smaller Mainframes.

PQ11 G2 features:

- Combined VMEbus System Controller Master, Arbiter and Interrupt Handler
- Supports 2eVME standard
- Gigabit Ethernet
- SyncLink input for synchronization in a Cluster or SuperCluster
- Multipurpose Serial-Timing-Power (STP) port for a MiniTerminal, synchronization to timing sources as well as providing 5 and 12 V to external devices
- VMEbus Power Supply
- 10-30 VDC input from external power source
- Uninterrupted Power Supply (UPS) between external power and internal battery
- Input power protection circuitry with over-voltage and under-voltage lockout
- Fast battery charger for internal battery
- Comprehensive monitoring of internal power supply circuits
- Power on/off function via front panel or MiniTerminal
- Automatic power up capability
- Web server providing information and control functions



Where used:

- In slot 1 of MF02 or MF03
- Can be used with up to 2 Signal Conditioning boards
- Supports a maximum channel count of 32

Performance:

- Maximum throughput of 8 MB/s over Gigabit Ethernet when streaming data over LAN
- 600 MHz PowerPC processor with 512 Mbyte DDR2 memory

PQ12

PQ12: VMEbus System Controller and Power Supply



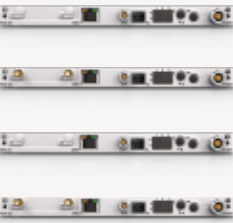
The PQ12 G2 is a dual function board combining a VMEbus System Controller, Master, Arbiter and Interrupt Handler with VMEbus Power Supply. It can be used in an MF02, MF03, MF04 and MF06 Mainframe. It is particularly suited to smaller Mainframes. Options include WLAN IEEE 802.11n for communication to external devices (including smart devices) as well as an internal Solid-State Disk (SSD) for local storage.

PQ12 G2 features:

- Combined VMEbus System Controller Master, Arbiter and Interrupt Handler
- Supports 2eVME standard
- Gigabit Ethernet
- SyncLink input for synchronization in a Cluster or SuperCluster
- Multipurpose Serial-Timing-Power (STP) port for a MiniTerminal, synchronization to timing sources as well as providing 5 and 12 V to external devices
- VMEbus Power Supply
- 10-30 VDC input from external power source
- Uninterrupted Power Supply (UPS) between external power and internal battery
- Input power protection circuitry with over-voltage and under-voltage lockout
- Fast battery charger for internal battery
- Comprehensive monitoring of internal power supply circuits
- Power on/off function via front panel or MiniTerminal
- Automatic power up capability
- Web server providing information and control functions

PQ12 G2 options:

- Optional WLAN IEEE 802.11b, g and n
- Optional internal 128 GB Solid State Disk (SSD) for local data storage



- PQ12 G2
- PQ12 G2 + WLAN
- PQ12 G2 + 128 GB
- PQ12 G2 + WLAN + 128 GB



Where used:

- In slot 1 of MF02, MF03, MF04 or MF06
- Can be used with up to 5 Signal Conditioning boards
- Supports a maximum channel count of 80

Performance:

- Maximum throughput of 10 MB/s over Gigabit Ethernet when streaming data over LAN
- 800 MHz PowerPC processor with 512 Mbyte DDR2 memory



Where used:

- In slot 1 of all Mainframes
- Can be used with up to 8 Signal Conditioning boards
- Supports a maximum channel count of 128

Performance:

- Maximum throughput of 20 MB/s when streaming data over LAN
- 1.0 GHz PowerPC processor with 512 Mbyte DDR2 memory

PQ20

PQ20 G2: VMEbus System Controller and Power Supply



The PQ20 G2 is a dual function board combining a VMEbus System Controller, Master, Arbiter and Interrupt Handler with VMEbus Power Supply for use in all Mainframes. It is particularly suited to small and medium sized Mainframes when higher data rates or larger, additional processor capability is required. Options include WLAN IEEE 802.11n for communication to external devices (including smart devices) as well as an internal Solid-State Disk (SSD) for local storage.

PQ20 G2 features:

- Combined VMEbus System Controller Master, Arbiter and Interrupt Handler
- Supports 2eVME standard
- Gigabit Ethernet
- SyncLink input for synchronization in a Cluster or SuperCluster
- Multipurpose Serial-Timing-Power (STP) port for a MiniTerminal, synchronization to external devices as well as providing 5 and 12 V to external devices
- VMEbus Power Supply
- 10-30 VDC input from external power source
- Uninterrupted Power Supply (UPS) between external power and internal battery
- Input power protection circuitry with over-voltage and under-voltage lockout
- Fast battery charger for internal battery
- Comprehensive monitoring of internal power supply circuits
- Power on/off function via front panel or MiniTerminal
- Automatic power up capability
- Web server providing information and control functions

PQ20 G2 options:

- Optional WLAN IEEE 802.11b, g and n
- Optional internal 128 GB Solid State Disk (SSD) for local data storage



PQ20 G2



PQ20 G2 + WLAN



PQ20 G2 + 128 GB



PQ20 G2 + WLAN + 128 GB

PQ30

PQ30 G2: VMEbus System Controller and Power Supply



The PQ30 G2 is the top of the line Combined System Controller and Power Supply board, clearly benchmarking high end controller performance. As a powerful dual function board combining a VMEbus System Controller, Master, Arbiter and Interrupt Handler with VMEbus Power Supply, the PQ30 G2 can be used in all Mainframes. It is particularly suited to Mainframes when higher data rates or larger additional processor capability is required. Options include WLAN IEEE 802.11n for communication to external devices (including smart devices) as well as an internal Solid-State Disk (SSD) for local storage.

PQ30 G2 features:

- Combined VMEbus System Controller Master, Arbiter and Interrupt Handler
- Supports 2eVME standard
- Gigabit Ethernet
- Advanced computational ability
- SyncLink input for synchronization in a Cluster or SuperCluster
- Multipurpose Serial-Timing-Power (STP) port for a MiniTerminal, synchronization to external devices as well as providing 5 and 12 V to external devices
- VMEbus Power Supply
- 10-30 VDC input from external power source
- Uninterrupted Power Supply (UPS) between external power and internal battery
- Input power protection circuitry with over-voltage and under-voltage lockout
- Fast battery charger for internal battery
- Comprehensive monitoring of internal power supply circuits
- Power on/off function via front panel or MiniTerminal
- Automatic power up capability
- Web server providing information and control functions

PQ30 G2 options:

- Optional WLAN IEEE 802.11b, g and n
- Optional internal 128 or 256 GB Solid State Disk (SSD) for local data storage and external eSATA port (with power) for use with an external SATA hard drive



PQ30 G2



PQ30 G2 + WLAN



PQ30 G2 + 128 GB or 256 GB



PQ30 G2 + WLAN + 128 or 256 GB



Where used:

- In slot 1 of all Mainframes
- Can be used with up to 9* Signal Conditioning boards
- Supports a maximum channel count of 144*

Performance:

- Maximum throughput of 45 MB/s when streaming data over LAN
- 1.3 GHz PowerPC processor with 1 Gbyte DDR2 memory
- Second 1000 BASE-T for peripherals or independent second network

* depending on Module configuration, voltage of supplied power and environmental temperature

SC42

SC42 G2: VMEbus Signal Conditioning Engine and Infrastructure

G2



The SC42 G2 board provides the isolated power, signal processing and mechanical infrastructure for up to 4 signal conditioning Modules. It is a highly advanced board using 5 powerful 24-bit DSPs to process large volumes of data transferred between each Module and the VMEbus. It also provides isolated power for each Module, sample timing infrastructure as well as internal communication interfaces used to set parameters for each channel. The flexibility of easy interchangeability of Modules within the same Mainframe or between Mainframes is provided by the SC42 G2 board. This allows users to include additional Modules to satisfy their measurement and control requirements. Modules are plugged in through the front panel of the SC42 G2 and can be inserted and removed without removing the SC42 G2 board itself.

SC42 G2 features:

- VMEbus Slave and Interrupter
- Supports the latest 2eVME specifications
- Mechanics to accommodate 4 Modules
- Provides accurate timing infrastructure for 4 Modules
- 5 separate 24-bit DSPs, one per Module and one on the board
- 4 isolated power supplies, one per Module
- Houses the Module's self-calibration engine
- Thermally optimized and encased in aluminium

SC42S

SC42S G2: Advanced VMEbus Signal Conditioning Engine and Infrastructure

G2



The SC42S G2 board builds on the SC42 G2 board and is suitable for all PAK MKII Mainframes and G2 series Modules but especially for the S line Modules with faster data rates. It is specially designed for high-speed multi-channel measurements.

SL21

SL21: Synchronization engine for creating SyncLink Clusters



The SyncLink concept has been specially developed to follow the same star network topology as Ethernet. This allows SyncLink and Ethernet cables to follow the same path. The SL21 is a dual function VMEbus board comprising a Gigabit Ethernet switch and a SyncLink synchronization clock distribution hub.

For more on synchronized systems please refer to page 50 - 51.

SL21 features:

- Combined Gigabit Ethernet switch and SyncLink hub
- 5 port Gigabit Ethernet switch for data communication
- 5 port SyncLink hub for synchronization clock distribution

THE SL21 VMEBUS BOARD
CAN BE INSERTED INTO ALL
MAINFRAMES AS AN INTEGRATED
SYNCHRONIZATION ENGINE
FOR BUILDING DISTRIBUTED
ACQUISITION SYSTEMS IN ANY
COMBINATION



Where used:

- In any slot of all Mainframes except slot 1 which is reserved for the VMEbus System Controller and Power Supply
- With G2 series Modules

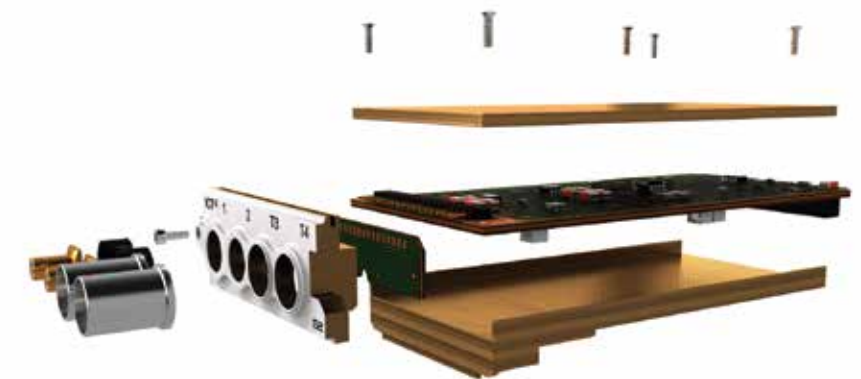
Where used:

- Provides a multi-phase synchronized clock to multiple PAK MKIIs
- Provides Gigabit Ethernet to multiple PAK MKIIs
- In any slot of all Mainframes except slot 1 which is reserved for the VMEbus System Controller and Power Supply

TIER 2 MODULES



SCALE 1:1



ACQUIRING SIGNALS

Modules for every signal type

Whereas the VMEbus Signal Conditioning Engine provides the common infrastructure for 4 Module slots, the individual Modules, provide the unique signal conditioning detail. This concept provides an effective, upgradeable solution especially for those users who configure and reconfigure their measurement systems differently for specific tests. Modules are packaged in a robust aluminum casing so as to optimize size, thermal performance as well as provide electronic protection. All Modules include the following features:

- 50 V galvanic isolation from one Module to another
- Automatic internal calibration capability
- All settings are software configurable
- Very high channel density
- Very good signal to noise performance
- Excellent spurious free-dynamic range, total harmonic distortion and crosstalk
- Finely tuned for the best performance at the lowest possible power
- Protection to accommodate both transient and continuous over-voltages
- Strong Electromagnetic Interference (EMI) screening for lower noise floor
- Firmware protection from excessive external EMI events

RPM sensor | rotational speed and rotation angle | fast tachometer | angle transducer | incremental encoder | RPM from CAN | airborne sound | ICP® microphone | 200 Volt polarized microphone | head phone | analog artificial head | digital artificial head | conducted sound | piezoelectric accelerometer | ICP® accelerometer | strain gauge | laser vibrometer | high speed voltage input | electrical energy management | digital inputs: digital audio | CAN | GPS for time and position | IRIG for time | FlexRay™ | EtherCAT® | control outputs, e.g. function generator: white noise, ramp, fade, chirp, sine, square, triangular | playback from file | temperatures: E, J, K, T, U thermocouple | Pt100 sensor | displacement | rope transducer | inductive transducer (LVDT) | stress and fatigue | force transducer | load cell pressure transducer | differential accelerometer

ICP42

ICP42 G2: 4 Channel ICP® and Voltage Input Amplifier



The ICP42 G2 Module can be used with ICP® based accelerometers, force and pressure sensors as well as to measure analog voltages. All 4 channels operate independently of each other, each with their own setting of mode, gain and coupling.

Where used:

- With any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure
- With any voltage source up to ± 10 V in voltage input mode

ICP42 G2 features:

- 4 channels
- 2 input modes of operation:
 - ICP® mode with 4 mA constant current at ± 12 V or 24 V excitation
 - Voltage input mode with AC or DC coupling
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 1)
- 24-bit resolution, 102.4 kSa/s sampling rate per channel, 45 kHz bandwidth
- $<0.2^\circ$ @ 10 kHz phase accuracy between channels of the same or any other Module
- $\pm(10$ V, 1 V and 100 mV) input ranges
- There are 3 distinctive input mode options for both ICP® and voltage input modes:
 - Differential or Balanced Float (ICP® mode provides ± 12 V excitation)
 - Single-Ended or Unbalanced Float (ICP® mode provides 24 V excitation)
 - Single-Ended or Unbalanced Ground (ICP® mode provides 24 V excitation)
- Short and open circuit cable monitoring
- Signal integrity circuit continuously monitors the input and disconnects sensitive circuits during overload conditions
- Pre and post filter overflow monitoring
- Selectable low and high pass digital filters
- 2 M Ω differential and 1 M Ω single-ended input impedance
- Low power consumption
- SMB connectors

ICP42S

ICP42S G2: Advanced 4 Channel ICP® and Voltage Input Amplifier



The ICP42S G2 Module can be used with ICP® based accelerometers, force and pressure sensors as well as to measure analog voltages. All 4 channels operate independently of each other, each with their own setting of mode, gain and coupling. The ICP42S G2 furthers the ICP42 G2 by sharing many of the same features and advancing others.

Where used:

- With any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure
- With any voltage source up to ± 60 V in voltage input mode

ICP42S G2 features:

- 4 channels
- 2 input modes of operation:
 - ICP® mode with 4 mA, 8 mA or 12 mA constant current at ± 12 V or 24 V excitation
 - Voltage input mode with AC or DC coupling
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 1)
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- $<0.2^\circ$ @ 10 kHz phase accuracy between channels of the same or any other Module
- $\pm(60$ V, 10 V, 1 V and 100 mV) input ranges
- There are 3 distinctive input mode options for both ICP® and voltage input modes:
 - Differential or Balanced Float (ICP® mode provides ± 12 V excitation)
 - Single-Ended or Unbalanced Float (ICP® mode provides 24 V excitation)
 - Single-Ended or Unbalanced Ground (ICP® mode provides 24 V excitation)
- Short and open circuit cable monitoring
- Signal integrity circuit continuously monitors the input and disconnects sensitive circuits during overload conditions
- Pre and post filter overflow monitoring
- Selectable low and high pass digital filters
- 2 M Ω differential and 1 M Ω single-ended input impedance
- Low power consumption
- Lemo 3-way EHG.0B connectors

ICM42S

ICM42S: Advanced 16 Channel ICP® and Voltage Input Amplifier with 16 Monitoring Output channels



Four high speed ICP® based Modules are integrated with an SC42S Signal Conditioning board to provide a single Compound-Module, the ICM42S. This provides 16 ICP® or voltage input mode channels as well as 16 monitoring output channels.

Where used:

- With any ICP® based sensor commonly used to measure acceleration, force or pressure
- With any voltage source up to ± 10 V in voltage input mode
- When the conditioned input signal needs to be provided to external equipment

ICM42S features:

- 16 channels
- 2 input modes of operation:
 - ICP® mode with 4 mA constant current at ± 12 V excitation
 - Voltage input mode with AC or DC coupling
- 16 monitoring output channels of conditioned signal inputs
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 1)
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- $<0.2^\circ$ @ 10 kHz phase accuracy between channels of the same or any other Module
- $\pm(10$ V, 1 V and 100 mV) input ranges
- There are 3 distinctive input mode options:
 - Differential or Balanced Float (ICP® mode provides ± 12 V excitation) for both ICP® and voltage input modes
 - Single-Ended or Unbalanced Float for voltage input mode
 - Single-Ended or Unbalanced Ground for voltage input mode
- Short and open circuit cable monitoring
- Signal integrity circuit continuously monitors the input and disconnects sensitive circuits during overload conditions
- Pre and post filter overflow monitoring
- Selectable low and high pass digital filters
- 2 M Ω differential and 1 M Ω single-ended input impedance
- Input channels use a DB50 for 16 input channels
- Monitoring channels use 4 Lemo 7 way EHG.0B connectors
- An option is available providing 8 mA constant current and 2 Lemo 16-way EGG.1B way connectors for monitoring channels

Additional compound Module features:

- Includes SC42S Signal Conditioning Board (see SC42S G2 for more details)

Related SubModules



BBOX10

The BBOX10 is a 48 channel Buffer Box, accepting an input signal from three ICM42S boards and providing five independent outputs of the input signal. One output is routed to the front patch panel for easy access and monitoring while the other four outputs are routed to 37-way D-sub connectors at the back of the BBOX10. The BBOX10 includes a self-test feature that tests and verifies if all input and output channels are functional. When used in non ICM42S applications, inputs can be differential or single ended signals.



ICPM10

The ICPM10 provides a DB50 connector for each set of ICP42 G2 or 4 ICP42S G2 Modules. As a compound SubModule, it takes the form of a breakout box which can be secured on the top of any Mainframe. Both a 16 or 32 channel option are available.

ICT42 G2: 2 Channel ICP® and Voltage Input Amplifier with 2 Channel Tacho Input Amplifier



G2

The ICT42 G2 Module is a hybrid Module which combines 2 channels from the ICP42 G2 Module with 2 tacho input channels. The tacho channels provide tacho period measurements with a 20 ns resolution, sampled where the signal intersects its trigger level settings. Triggering of tacho signals can be set for rising or falling edges with adjustable hysteresis whilst additionally providing AC coupling for sensors with varying DC voltage offsets. A 204.8 kSa/s scope mode is provided to view the tacho signals in order to assist with the definition of trigger levels.

Where used:

- When measuring the pulse rate and time between pulses such as rpm and crank angle
- With any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure
- With any voltage source up to ±10 V in voltage input mode

ICT42 G2 features: ICP® channels

- See ICP42 G2 for more details of the 2 ICP® or voltage input mode channels

ICT42 G2 features: Tacho channels

- 2 tacho channels
- Tacho input can be DC/AC coupled
- 20 ns tacho resolution
- 700 kPulse/s rate for the sum of the 2 tacho channels
- 16-bit tacho trigger level adjustment
- ±(60 V, 30 V, 12 V and 2 V) input ranges
- 2 MHz analog bandwidth for all input ranges
- Adjustable trigger level hysteresis (Schmitt trigger implementation)
- Triggering on the n'th edge
- Tacho trigger level self-calibration
- Scope mode for each tacho channel, sampled at 204.8 kSa/s
- ±12 V or 12 V voltage excitation output to tacho sensor
- Low power consumption
- Lemo 4-way EHG.0B connectors

ICT42S G2: Advanced 2 Channel ICP® and Voltage Input Amplifier with 2 Channel Tacho Input Amplifier



G2

The ICT42S G2 Module is a hybrid Module which combines 2 channels from the advanced ICP42S G2 Module with 2 advanced tacho input channels. The tacho channels provide tacho period measurements with a 14 ns resolution, sampled where the signal intersects its trigger level settings. Triggering of tacho signals can be set for rising or falling edges with adjustable hysteresis whilst additionally providing AC coupling for sensors with varying DC voltage offsets. A high speed 4.9 MSa/s scope mode is provided to view the tacho signals in order to assist with the definition of trigger levels.

Where used:

- When measuring the pulse rate and time between pulses such as rpm and crank angle
- With any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure
- With any voltage source up to ±60 V in voltage input mode

ICT42S G2 features: ICP® channels

- See ICP42S G2 for more details of the 2 ICP® or voltage input mode channels

ICT42S G2 features: Tacho channels

- 2 tacho channels
- Tacho input can be DC/AC coupled
- 14 ns tacho resolution
- 1 MPulse/s rate for the sum of the 2 tacho channels when used with the SC42S G2
- 16-bit tacho trigger level adjustment
- ±(60 V, 30 V, 12 V and 2 V) input ranges
- 2 MHz analog bandwidth for all input ranges
- Adjustable trigger level hysteresis (Schmitt trigger implementation)
- Triggering on the n'th edge
- Tacho trigger level self-calibration
- Scope mode for each tacho channel, sampled at 4.9 MSa/s
- ±12 V or 12 V voltage excitation output to tacho sensor
- Low power consumption
- Lemo 4-way EHG.0B connectors

CHG42S G2: 4 Channel Charge Input Amplifier



G2

The CHG42S G2 Module has 4 independent, single-ended input channels for piezoelectric sensors (without internal electronics). These sensors are typically used when improved signal performance such as low noise and low distortion is required or where high temperature or nuclear radiation prevents the use of ICP® based sensors.

Where used:

- With piezoelectric sensors commonly used to measure vibration, acceleration, force, torque and pressure

CHG42S G2 features:

- 4 channels
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- <0.5° @ 10 kHz phase accuracy between channels of the same or other Module
- 3 Sensitivity settings of 0.1 mV/pC, 1 mV/pC and 10 mV/pC
- 3 voltage gain ranges
- Maximum charge input ranges from ±10 pC to ±100 nC
- Low discharge time constant provides a 16 mHz high pass frequency (-3 dB) for 0.1 mV/pC and 1 mV/pC sensitivities
- Drift is lower than 4 mV/h at any sensitivity and gain
- There are 2 distinctive input mode options:
 - Single-Ended or Unbalanced Float
 - Single-Ended or Unbalanced Ground
- Selectable low and high pass digital filters
- Overvoltage detection on frontend input signals
- Low power consumption
- 10-32 Microdot connectors

DCH42S G2: 2 Channel Differential Charge Input Amplifier



G2

The DCH42S G2 Module has 2 independent differential input channels for piezoelectric sensors (without internal electronics). These sensors are typically used when improved signal performance such as low noise and low distortion is required or where high temperature and nuclear radiation prevents the use of ICP® based sensors. Additionally a differential charge measurement offers further noise immunity and higher bandwidth and is particularly suited to applications using long cables.

Where used:

- With piezoelectric sensors commonly used to measure vibration, acceleration, force, torque and pressure
- Where long cables are required necessitating the use of balanced twisted pair cables

DCH42S G2 features:

- 2 channels
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- <0.5° @ 10 kHz phase accuracy between channels of the same or other Module
- 2 Sensitivity settings of 0.1 mV/pC and 1 mV/pC when in single ended mode
- 2 Sensitivity settings of 0.2 mV/pC and 2 mV/pC when in differential mode
- 3 voltage gain ranges
- Maximum charge input ranges from ±100 pC to ±100 nC in single ended mode and from ±50 pC to ±50 nC in differential mode
- Low discharge time constant provides a 16 mHz high pass frequency (-3 dB)
- There are 2 distinctive input mode options:
 - Single-Ended or Unbalanced Float
 - Single-Ended or Unbalanced Ground
- Selectable low and high pass digital filters
- Overvoltage detection on frontend input signals
- Twin BNC connectors

THM42

THM42 G2: 8 Channel E, J, K, T and U Thermocouple and Pt100 Input Amplifier



The THM42 G2 Module contains 8 channels for use with any thermocouple type as well as Pt100 sensors. Remote cold junction compensation is provided through a SubModule (which is thermocouple type specific) whilst linearization is provided in the SC42 G2. The Module also includes a calibrated 0.2 mA current source for Pt100 sensor excitation. SubModules are available which contain a pair of commonly used miniature E, J, K, T and U thermocouple connectors (other types available upon request) with cold junction circuitry for thermocouple applications. Another SubModule contains a pair of Lemo connectors for Pt100 applications. Any combination of applicable SubModules can be connected to the THM42 G2 Module.

The THM42 G2 Module now also includes 8 channels for measuring voltage inputs up to ± 10 V.

Where used:

- When measuring E, J, K, T and U thermocouples (other types available upon request)
- When measuring Pt100 sensors in constant current mode
- With any voltage source up to ± 10 V in voltage input mode

THM42 G2 features:

- 8 channels
- 3 input modes of operation:
 - Thermocouples
 - Pt100 based temperature measurement
 - Voltage input mode
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 2)
- 24-bit resolution, 3.2 kSa/s sampling rate per channel, 1.25 kHz bandwidth
- $\pm(10$ V and 100 mV) input ranges
- 0.2 mA Pt100 excitation current
- Open circuit cable monitoring
- Signal integrity circuit continuously monitors the input and disconnects sensitive circuits during overload conditions
- Selectable low and high pass digital filters
- 2 M Ω differential input impedance
- Lemo 7-way EHG.0B connectors with 2 channels sharing one connector

Related SubModules	
A wide range of SubModules are available providing the appropriate alloy connectors and a cold junction. SubModules are identified through a TEDS interface and connected to the Module through a 300 mm fly lead.	
THMx10	
7 thermocouple based SubModules provide dedicated thermocouple connectors of the appropriate alloy and color, according to either IEC or ANSI standards. Cold-junction-compensation is facilitated through a 0.5 °C accurate temperature sensor.	
THMP10	
	Provides 2 sets of 4-way Lemo EGG.0B connectors for use with 2 Pt100 sensors. These connectors provide current to a Pt100 sensor and sense the voltage across it.
THMS10	
	Provides 2 sets of 4-way general purpose screw terminals to connect to a pair of E, J, K, T and U thermocouples or a pair of Pt100 sensors. Cold-junction-compensation is facilitated through the use of a 0.5 °C accurate temperature sensor. Constant current is provided for Pt100 use.

WSB42

WSB42 G2: 4 Channel Bridge and Voltage Input Amplifier



The WSB42 G2 Module is used with AC and DC bridge measurements including strain gauges configured as full, half or quarter bridges and inductive displacement transducers (LVDT). The Module offers numerous software selectable features such as excitation (AC/DC), bridge sensing, enabling of internal bridge completion resistors as well as calibration through an internal shunt resistor. The bridge can be balanced automatically or a previous balance value can be recalled.

Where used:

- With any strain gauge in quarter, half and full bridge, load cell and pressure transducer
- Inductive displacement transducer (LVDT)
- With any voltage source up to ± 10 V in voltage input mode

WSB42 G2 features:

- 4 channels
- 3 input modes of operation:
 - Analog input mode
 - Wheatstone bridge voltage-excitation mode with 0-5 V (AC or DC) and limited to >90 Ω bridges
 - LVDT inductive displacement transducer mode
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 2)
- 24-bit resolution, 102.4 kSa/s sampling rate per channel, 45 kHz bandwidth
- $<0.2^\circ$ @ 10 kHz phase accuracy between channels of the same or any other Module
- $\pm(200$ mV, 20 mV, 2 mV) input ranges for bridge mode
- ± 10 V input range for voltage input mode
- 0 to 10 kHz AC excitation
- Balanced differential signal input, differential voltage-excitation output and balanced sense input
- Full, half and quarter bridge configurations
- Internal half and quarter bridge completion resistors for 120 Ω and 350 Ω bridge elements
- Local and remote sense options
- 100 k Ω internal shunt calibration resistor
- Pre and post filter overflow monitoring
- Selectable low and high pass digital filters
- Lemo 7-way EHG.0B connectors

WSB42X

WSB42X G2: Advanced 4 Channel Bridge, ICP® and Voltage Input Amplifier



The WSB42X Module provides all the functionality of the WSB42. Additional features have been added including Wheatstone bridge current-excitation, dynamic strain mode, ICP® sensor support and a higher sampling rate.

Where used:

- All WSB42 G2 use cases
- Current-excited bridge modes
- Measurement of dynamic strains with 2 wires
- ICP® sensors

WSB42X G2 features:

- 4 channels
- 7 modes of operation:
 - Analog input mode
 - ICP® mode with 4, 8 or 12 mA constant current at ± 12 V excitation
 - Bridge voltage-excitation mode:
 - 0-6 V (AC or DC) for >120 Ω bridges
 - 0-4 V for 120 Ω full bridges
 - Bridge voltage-excitation mode: 8-10 V (DC) for 1 k Ω bridges
 - Bridge current-excitation mode: 4, 8 or 12 mA (DC)
 - 2 wire current-excitation dynamic strain mode: 4, 8 or 12 mA (DC)
 - LVDT inductive displacement transducer mode (AC)
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 1 and 2)
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- $<0.2^\circ$ @ 10 kHz phase accuracy between channels of the same or any other Module
- $\pm(10$ V, 1 V, 100 mV, 10 mV) input ranges for all modes
- 0 to 10 kHz AC excitation
- Balanced differential signal input, differential voltage-excitation output and balanced sense input
- Full, half and quarter bridge configurations
- Internal half and quarter bridge completion resistors for 120 Ω and 350 Ω bridge elements
- Local and remote sense options
- 100 k Ω internal shunt calibration resistor
- Pre and post filter overflow monitoring
- Selectable low and high pass digital filters
- Lemo 7-way EHG.0B connectors

MIC42X

MIC42X G2: Advanced 2 Channel Microphone, ICP® and Voltage Input Amplifier



In addition to providing excellent performance for microphone measurements, the MIC42X G2 Module also offers ICP® and voltage input modes.

Where used:

- With any 200 V or self-polarized microphones with preamplifier
- With any ICP® based sensor commonly used to measure vibration, acceleration, force and pressure
- With any voltage source up to ±12 V in voltage input mode

MIC42X G2 features:

- 2 channels
- 3 input modes of operation
 - Microphone mode with 200 V or self-polarized microphone capsules with preamplifier
 - ICP® mode with 4 mA, 8 mA or 12 mA constant current at ±12 V or 24 V excitation
 - Voltage input mode with AC or DC coupling
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 1 and 2)
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- <0.2° @ 10 kHz phase accuracy between channels of the same or any other Module
- ± (12V, ±1.2V, 120 mV) input ranges
- ±14.5V at 40 mA microphone pre-amplifier excitation voltage
- 0 or 200 V polarization output
- Microphone calibration output to inject test signals into microphone preamplifiers
- Exceptionally low distortion and noise design
- There are 3 distinctive input mode options for both ICP® and voltage input modes:
 - Differential or Balanced Float (±12 V excitation)
 - Single-Ended or Unbalanced Float (24 V excitation)
 - Single-Ended or Unbalanced Ground (24 V excitation)
- Software selectable connection of cable shield to Ground
- Short and open circuit cable monitoring
- Signal integrity circuit continuously monitors the input and disconnects sensitive circuits during overload conditions
- Pre and post filter overflow monitoring
- Low power consumption
- Lemo 7-way EGG.1B connectors

ALO42S

ALO42S G2: 4 Channel Voltage Output Source



The ALO42S G2 Module provides 4 output channels for generating analog signals. By providing its own Module status to the Device Under Control (DUC), the status of the ALO42S G2 Module can be detected and fault conditions handled safely. The ALO42S G2 Module can also monitor the DUC by monitoring the test chamber control signals or relays. Should the DUC enter a fault condition, the PAK MKII has various options to safely handle the fault condition.

Where used:

- When driving analog signals into electro-dynamic, hydraulic shaker and other controllers
- When driving analog signals into other circuits requiring ±10 V static or dynamic signals

ALO42S G2 features:

- 4 channels
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 20 kHz bandwidth
- Excellent low noise and distortion performance
- Excellent DC gain and offset stability
- ±10 V @ 30 mA output
- Provides Module Status output
- Monitors Device Under Control input
- Automatic safe shutdown upon fault condition
- Lemo 7-way EHG.0B connectors

Related SubModules

QBNC20

The Quad BNC (QBNC) SubModule is used to split signals from a 7-way Lemo connector to 4 BNC connectors.



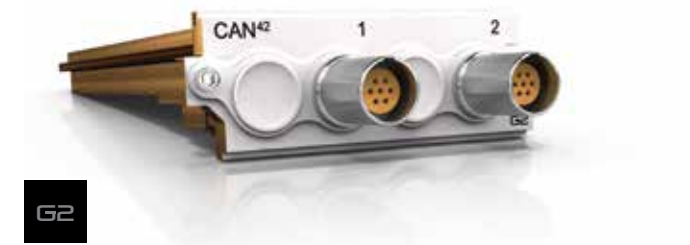
ALOP10

The ALOP10 is a rack mountable SubModule for routing the analog output signals from up to eight ALO42S G2 Modules to individual male SMB connectors.



CAN42

CAN42 G2: Interface to 2 Controller Area Networks (CAN)



The CAN42 G2 Module provides interfaces to 2 independent Controller Area Networks or CAN. Messages received from CAN are time-stamped to synchronize their reception with analog and digital measurements from other Modules in the system. Fully implemented features include Listen-Only mode, Self-Reception of CAN messages and transmission of Remote Frames. The CAN42 G2 Module provides independent channel filtering.

Where used:

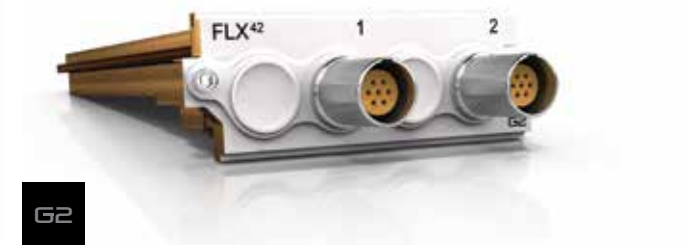
- When monitoring CAN based messages
- When controlling CAN based devices

CAN42 G2 features:

- 2 independent CAN channels each at 10 kbit/s to 1 Mbit/s data rate
- Compatible with ISO 11898-2 (High Speed) physical layer standard and with CAN 2.0B protocol (supports both 11-bit and 29-bit identifiers)
- 3 modes of operation:
 - Operational – transmit and receive CAN messages (active)
 - Listen only mode – only receive CAN messages (passive)
 - CAN bus simulator mode – simulates receiving CAN messages from CAN (no physical connection needed)
- CAN messages are time stamped with a resolution of 62.5 ns
- Individually configurable identifier list per channel provides acceptance filtering
- Data and remote frames are supported
- Software selectable 120 Ω termination per channel
- Lemo 7-way EHG.0B connectors
- 9-way D-sub connectors are provided with FLXB20 SubModules

FLX42

FLX42 G2: Interface to FlexRay™ network



The FLX42 G2 Module provides an interface to connect to a FlexRay™ network for the monitoring of FlexRay™ based messages and interfacing with FlexRay™ based sensors. The FLX42 G2 Module contains two dependent FlexRay™ channel interfaces to support either single channel or dual channel topologies. For the transmission and reception of FlexRay™ messages, selectable bit rates of 2.5, 5, 8 or 10 Mbit/s are available. The FLX42 G2 Module provides independent channel filtering and provides status and error information to the user.


Where used:

- When monitoring FlexRay™ based messages
- When interfacing with FlexRay™ based sensors

FLX42 G2 features:

- 2 dependent channels configured as:
 - Dual Channel Device or
 - Single Channel Device (connector 2 disabled)
- Compatible with FlexRay™ Protocol Specification V2.1A and FlexRay™ Electrical Physical Layer Specification V2.1A
- 3 modes of operation:
 - Operational mode – active network interaction (cold start, transmission and reception of messages enabled)
 - Listen only mode – passive network interaction (no transmission or cold start, only reception of messages)
 - Simulation or self-test mode – used for Module debugging
- FlexRay™ Bit Rate Range of 2.5, 5, 8 or 10 Mbit/s
- FlexRay™ messages are time-stamped with a resolution of 62.5 ns
- Configurable cold start
- Software selectable 110 Ω termination per channel
- Extensive firmware protection from EMI
- Lemo 7-way EHG.0B connectors
- 9-way D-sub connectors are provided with FLXB20 SubModules

Related SubModule



FLXB20

The FLXB20 provides an interface to a 9-pin D-sub connection for both CAN42 G2 and FLX42 G2. There are two cable length options of 300 mm and 3000 mm.

GPS42

GPS42 G2: Internal GPS Interface



The GPS42 G2 provides accurate GPS time and position data to the **PAK MKII**. Accurate timing information is in the form of a pulse per second (pps) logical signal.

The GPS42 G2 can also be used for synchronization purposes. Here the GPS42 G2 Module provides the G2 System Controller with the pps signal to align its internal clock. Mainframes with this capability are able to synchronize with one another without limitations as to their position or the total number of Mainframes.

Where used:

- Synchronization of numerous channels over multiple Mainframes
- When requiring accurate time and position information

- GPS42 G2 features:**
- Internal GPS channel
 - All settings made by software
 - NMEA Protocol
 - 1 Hz and 4 Hz position updates
 - Time-stamping of received GPS time and position data to 5 µs resolution
 - 3.3 V or 5 V antenna voltage
 - GPS internal receiver accuracy of <3 m
 - GPS Synchronization of Mainframes in the same **PAK MKII** System is provided as an alternative to the fibre-optic based SyncLink cables between Mainframes. A GPS42 G2 Module is required inside each Mainframe that forms part of a synchronized system
 - SMA connector for antenna

IRG42

IRG42 G2: Interface to IRIG, External GPS and Internal GPS



In addition to the same internal GPS functionality as described in the GPS42 G2, the IRG42 G2 Module provides an additional functional unit of being able to interface to IRIG. Here IRIG-A and IRIG-B data (both analog and digital formats) are digitized by a high speed ADC and decoded. The external IRIG data is time-stamped to synchronize its data with other Modules in the same system.

The IRG42 G2 can also be used for synchronization purposes. Here the IRG42 G2 Module provides the G2 System Controller with a signal to align its internal clock. Mainframes with this capability are able to synchronize with one another (limited only by the customer's installed IRIG facility).

Where used:

- Synchronization of numerous channels over multiple Mainframes
- When requiring time and other IRIG based information to synchronize other measurements

- IRG42 G2 features: GPS**
- See GPS42 G2 for more details
- IRG42 G2 features: IRIG**
- Operation modes include:
 - Internal IRIG receiver mode
 - Serial data and timing interface for possible future application
 - IRIG Formats supported:
 - A003
 - A133
 - B003
 - B123
 - Time-stamping of IRIG messages to 5 µs resolution
 - IRIG synchronization of Mainframes in the same **PAK MKII** System is provided as an alternative to the fibre-optic based SyncLink cables between Mainframes. An IRG42 G2 Module is required inside each Mainframe that forms part of a synchronized system
 - SMB connector for IRIG

ECT42

ECT42 G2: Interface to EtherCAT® network



Data which is acquired in the **PAK MKII** system can be shared synchronously with other EtherCAT® devices via the high speed Ethernet backbone using the EtherCAT® protocol and EtherCAT® system time. This data is presented along with miscellaneous parameters including units and scaling factors.

Where used:

- Provides the ability to interface to other networked EtherCAT® slave devices within a factory, laboratory or test chamber environment
- When acquiring data via other networked EtherCAT® slave devices

- ECT42 G2 features:**
- Supports slave-to-slave communication in passive mode
 - Conforms to EtherCAT® standards IEC 61158, ISO 15745-4 and SEMI E54.20
 - Supports CANopen over EtherCAT® (CoE) and Service Delivery Object (SDO) access
 - Full duplex 100-BASE-TX in upstream and downstream directions, with galvanic isolation on each interface
 - Time stamping of data in 64-bit EtherCAT® system time
 - Distributed clocks synchronized to an absolute maximum error of 100 ns
 - Supports hot-connect and slave alias addressing for high availability
 - Cycle times across the entire EtherCAT® network less than 100 µs
 - Slave Information Interface (SII) implemented for device description
 - ERNI M12 connectors

DAR42

DAR42 G2: Digital Audio Receiver



The DAR42 G2 Module provides interfaces to receive two stereo AES3 digital audio streams. For synchronization between the DAR42 G2 and external digital audio transmission equipment, the DAR42 transmits a synchronization signal which can be selected to be either an AES3 output signal (data at digital zero) or word clock signal.

Where used:

- With measuring devices which provide an AES3 based digital audio signal, such as a digital artificial head

- DAR42 G2 features:**
- Two stereo input channels
 - Frame rates of 44.1, 48.0, 88.2 and 96.0 kHz
 - Single AES3 or master word clock output
 - Lemo 3-way EGG.0B connectors for AES3 input and Lemo 3-way FAG.0B connector for synchronization output

TIER 1 SUBMODULES AND ACCESSORIES

PERSONALIZING SYSTEMS

SubModules

A SubModule is sometimes required to provide a special interface to an individual sensor. SubModules are thus used to personalize a Module as the final interface to a sensor or provide features like cold junction temperature sensing.

MiniTerminal

The MT12 MiniTerminal provides a large, bright LED display as a practical solution to show test information as well as to receive commands from a user such as start or stop. It connects to any one of the System Controller and Power Supply boards found in any Mainframe.



Rack Mounted System Accessories

The RM04, RM06 and RM10 RackMounts are compact, machined aluminum Rack Mounting Kits which house 4, 6 and 10-slot PAK MKII Mainframes in 19 inch racks. The Mainframe has specifically been recessed in each Mounting Kit to ensure that all cables are contained behind the rack's front face. These cables can then be routed to the left and right sides of the Mainframe. At the rear, a horizontal brace provides a mounting point for cable connector flanges should this be required.

Mobile System Accessories

The SF10 SeatFrame optimally secures a 2, 3, 4 or 6-slot Mainframe and notebook onto a car seat for mobile measurements. It consists of machined aluminum members which can be adjusted to optimally fit the seat, Mainframe and notebook. To prevent sideways movement, the side and rear sleds can be adjusted to best hug the seat. The rear SeatFrame handle can also be adjusted to push against the seat's backrest to prevent it flipping over. It is strapped to the seat using the safety belt. A notebook is placed on an adjustable base mounted above the PAK MKII which can fit most notebook sizes.

Accessories Brochure



Please refer to the Accessories Brochure for more information on these and other SubModules and Accessories.

TIER 5 SYNCHRONIZATION



SYNCHRONIZE SYSTEMS

Bring your Mainframes together to accommodate distributed acquisition positions or for multi-channel testing. Synchronization takes the concept of modularity one step further by grouping Mainframes together to form Clusters and larger SuperClusters. There is no limit to adding more Mainframes as long as the appropriate Synchronization engines are added. PAK MKII systems may be synchronized via SyncLink, GPS or IRIG.

WHY SYNCHRONIZE?

INCREASE CHANNEL COUNT

Limitless number of synchronized Mainframes provide an unlimited channel count.

SHORTER SIGNAL CABLES

By placing Mainframes alongside the test candidate, the acquisition system can be positioned as close as possible to the sensor. This reduces cable lengths between sensor and input module.

OPTIMIZED MEASUREMENT INFRASTRUCTURE

Multiple systems can be used separately in smaller applications but can also work together for larger tests.

AVOID DATA BOTTLENECKS

Deploy multiple measurement PCs on the same network for more processing performance.

REACH REMOTELY PLACED SENSORS

Measurements within one SyncLink Cluster can be spread over a large area with a 1000 m radius. GPS synchronized clusters are not limited by distance.

GPS | IRIG

SYNCHRONIZATION

Synchronization Engine:



GPS42 G2



IRG42 G2

GPS AND IRIG CLUSTERS

Any number of Mainframes can form part of the same system through GPS synchronization. Here, each Mainframe must contain a GPS42 G2 or IRG42 G2 Module and be connected to the same network by WLAN. This allows for accurate timing across Mainframes without the need for synchronization cables. This approach is particularly useful when two test objects are moving in respect of one another or when cabling is difficult due to large distances or under unfavorable environmental conditions. There is no limit to the number of synchronized Mainframes a GPS and IRIG Cluster can contain.



INDEPENDENT MAINFRAMES SYNCHRONIZED OVER GPS

SYNCLINK

SYNCHRONIZATION

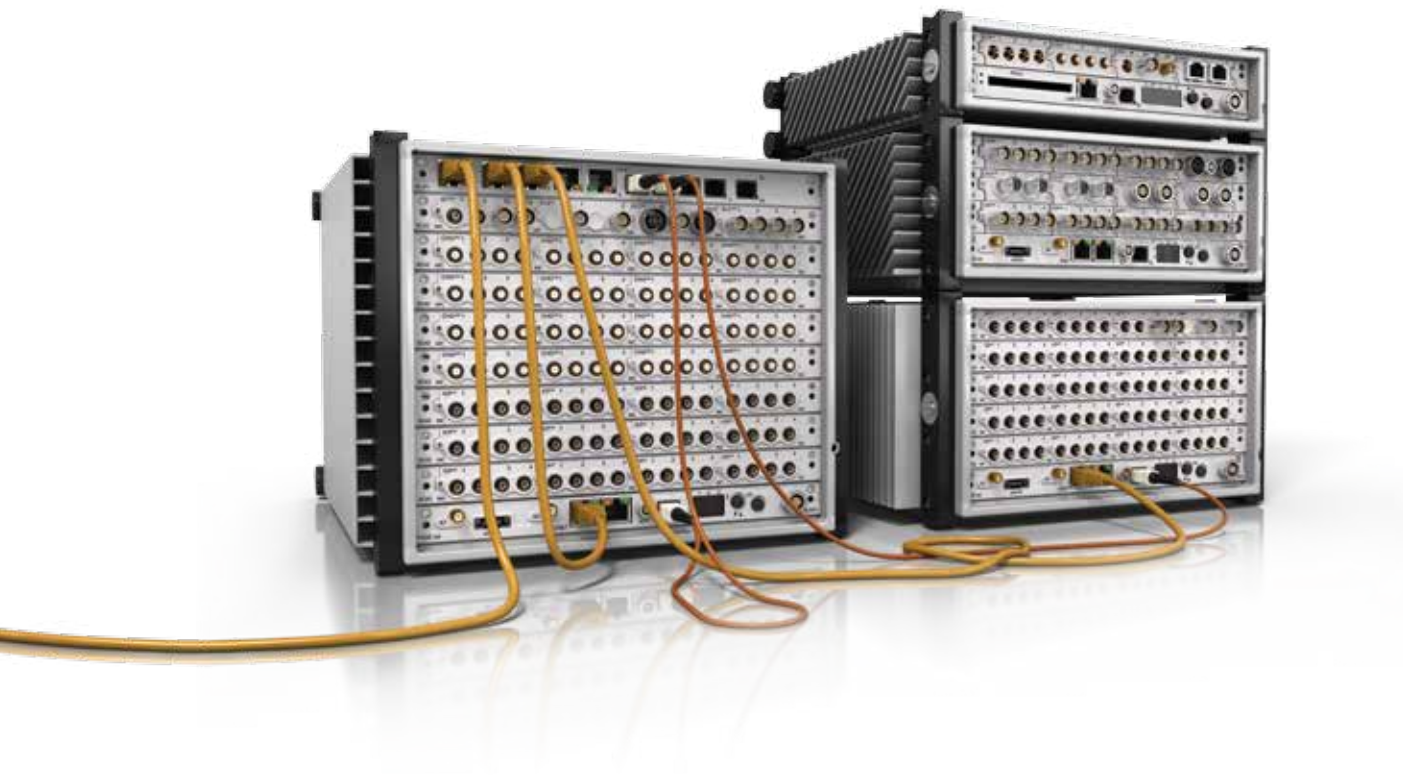
SyncLink Clusters

SyncLink synchronizes up to 4 PAK MKII systems together to form a Cluster and up to 4 Clusters to form a SuperCluster and so on. There is no limit to synchronizing more Mainframes as long as the appropriate SL21 Synchronization engines are added. This solution is especially suited to rack mounted systems.

Synchronization Engine:



SL21 VMEbus board



Supremely accurate

SyncLink Clusters are perfectly synchronized using a common multi-phase clock transmitted over a single fiber-optic cable from a SL21 Synchronization engine VMEbus board to each System Controller and Power Supply board. A fibre-optic cable is used to ensure sub-10 ns timing resolution and immunity to external electromagnetic noise.

Simplified cabling

Synchronization cables (Fiber-optic, Ethernet and power) run along the same path and can be easily placed in a single cable sheath for even simpler cable management.

CLUSTER

HUNDREDS OF CHANNELS

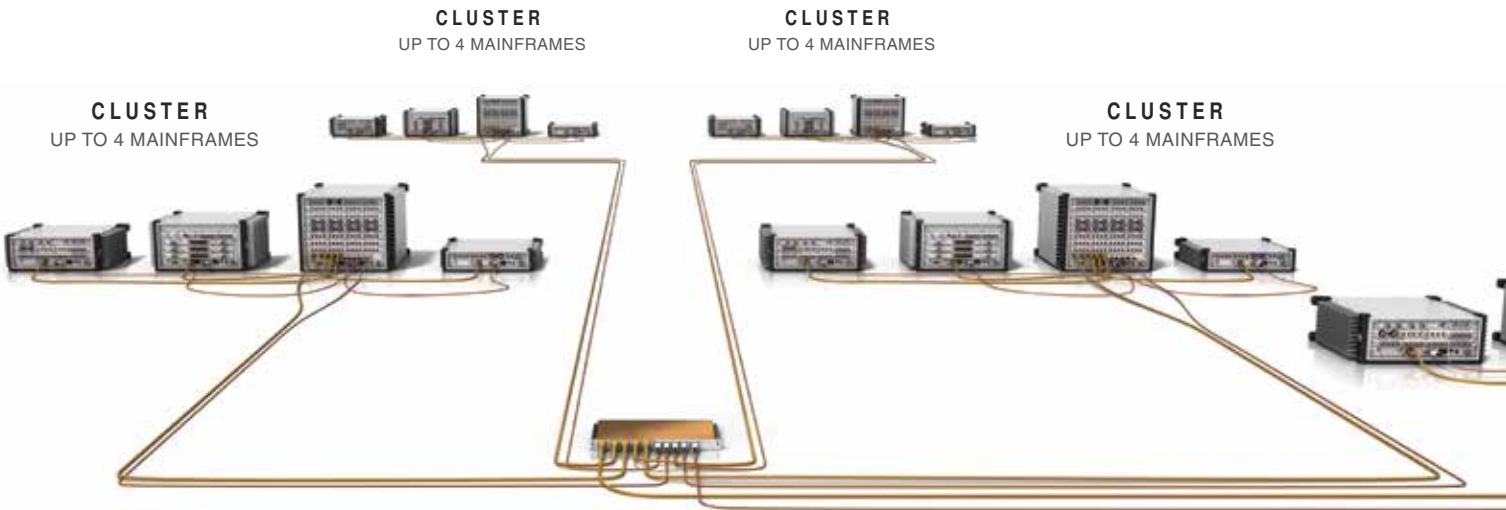


CLUSTER

UP TO 4 MAINFRAMES

SUPER CLUSTER

THOUSANDS OF CHANNELS



SUPER CLUSTER

LIMITLESS MAINFRAMES

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