DECA

USER **GUIDE**

Thank you for choosing the DECA**Q**, a product in the **QuantusSeries** range.

This document will familiarise you with the DECA**Q**'s functionality. It is a comprehensive guide on how to use the device, from switching on and setting up the system, to measuring parameters with modular signal conditioning channels.

Please read this carefully before using your DECA**Q** for the first time.

Table of Contents

A. General Notes and Regulations

Intended Use

This equipment measures high speed analog and digital signals in laboratory or mobile environments. It may also be used in other areas, for example when troubleshooting or performing filed tests. The use of the DECA**Q** measurement system requires an understanding of the measurement chain and signal analysis.

Handling Precautions

Even though the DECA**Q** has been designed to withstand rough handling, it is a sensitive and complex electronic instrument and must be handled with care.

Changing Hardware

The DECA**Q** must be powered down for 30 seconds before any Module or Board can be inserted or removed. The DECA**Q** hardware is not hot swappable.

Electrostatic Discharge (ESD) Precautions

Care has been taken to provide reasonable ESD protection. However, all DECA**Q** components are sensitive to ESD and may be damaged by an ESD discharge.

To avoid damaging the DECA**Q**, antistatic precautions must be followed. This is especially important when swapping Modules. However, care must also be taken when swapping combined System Controller and Power Supply boards, Signal Conditioning boards or Synchronization Engines. Antistatic precautions are advisable when connecting cables or sensors to Modules.

Precautions include:

- Earthing the Chassis by using the Chassis Ground Socket
- Discharge any excess static your body may contain by touching the earth connection
- Power down the DECA**Q**
- When swapping boards or Modules, work on an earthed antistatic mat while wearing an earthed antistatic wrist strap
- Handle boards and Modules by their front panels or aluminium covers

- Place boards and Modules in antistatic bags immediately after removal from the DECA**Q** and close the antistatic bags securely
- Store and transport boards and Modules in padded antistatic packaging
- Never stack boards or Modules on top of each other
- Do not mark the front panels using any pen or writing tool which cannot easily be removed as additional charges will be incurred should the board or Module be returned for repair
- When connecting signal cables to Modules, keep in mind that electrostatic charge may have built up on the cables or sensors

Laser Precautions

The DECA**Q** contains IEC 825-1 AEL Class 1 LED devices. Never look directly into the SyncLink port or cables as eye damage may occur. Unused SyncLink ports should remain covered at all times with the protective rubber plugs supplied.

Cable and Power Supply Precautions

Do not use a damaged power supply, cable or any other DECA**Q** component.

Extreme Environments

The DECA**Q** may not be operated or stored in flammable environments (fumes, gasses, liquids, etc.), excessively harsh environments (corrosive, ambient temperature above 50 °C, radioactive, hydraulic fluid, etc.), nor excessively damp environments.

Exposure to Radio Frequency Radiation

The radiated output power of the DECA**Q** is within acceptable radio frequency exposure limits and is intended to be used 300 mm away from a human operator.

Weight

Depending on the configuration, the DECA**Q** may become heavy and could pose a danger if not stored or transported in a responsible manner. Please use the handle provided.

Recycling and disposal

The DECA**Q** contains NiCd or NiMH batteries. Please return the batteries to Müller-BBM VibroAkustik Systeme for safe disposal.

EU Radio Equipment Directive (RED)

The products in this manual complies with Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment, specifically:

- Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limit

- Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility

EU ElectroMagnetic Compatibility (EMC)

The following harmonized standards and technical specifications have been applied:

- ETSI EN 301 489-1 ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU and the essential requirements of article 6 of Directive 2014/30/EU

- ETSI EN 301 489-17 ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard covering the essential requirements of article 3.1(b) of Directive 2014/53/EU

EU Safety Requirements

The products in this manual complies with the safety requirements set out in:

- IEC 61010-1 2010-06 Edition 3.0: Safety requirements for electrical equipment for measurement, control, and laboratory use

- IEC 61010-2-030:2010 Edition 1: Particular requirements for testing and measuring circuits

EU Waste Electrical and Electronic Equipment (WEEE)

As required by Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) the products in this manual will be accepted back by the distributors free of charge when the products need to be disposed of.

EU Restriction of Hazardous Substances (RoHS 3)

Except for the Cadmium (CAS No. 12054-48-7) found in the MF06 and MF10 NiCad batteries in this manual do not exceed the chemical concentration limits imposed by the following EE directives:

- Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment
- Commission Delegated Directive (EU) 2015/863 of 31 March 2015 amending Annex II to Directive 2011/65/EU of the European Parliament and of the Council as regards the list of restricted substances

EU Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

Except for the Cadmium (CAS No. 12054-48-7) found in the MF06 and MF10 NiCad batteries, the products in this manual do not contain any substance of very high concern (SVHC) above a concentration of 0.1% weight by weight of product as per Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Minamata Convention on Mercury

The products in this manual do not contain any mercury or mercury compounds.

Japan Chemical Substances Control Law (CSCL)

The products in this manual do not contain any substances listed as Class I or Class II specified chemical substances under the Japan Chemical Substances Control Law (CSCL).

Conflict Minerals Sourcing Policy

MeCalc believes in ethical and responsible practices and is committed to promoting economic, environmental and social justice at all levels of our supply and manufacturing processes.

As part of this commitment, we:

- Support the "OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas"
- Have conducted a Conflict Mineral report using the Responsible Minerals Initiative's Conflict Minerals Reporting Template (CMRT)

- Require all our suppliers to source minerals exclusively from smelters or refiners that comply with principles highlighted in the "OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas"

US Federal Communications Commission (FCC)

The PAK Measurement Frontend was tested and found to be compliant to the requirements of Title 74 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B when containing a SparkLAN WPEA Wi-Fi Module.

Note: This equipment has been and conforms to the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment in operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

IC (Canada)

The PAK Measurement Frontend was tested and conforms to the requirements of ICES-003 for Class A Digital Devices, Issue 5 August 2015, when containing a SparkLAN WPEA Wi-Fi Module.

TELEC (Japan)

TRaC Global Limited, operating as a Conformity Assessment Body (CAB ID 205) with respect to the Japan/EU MRA, declared that the PAK Measurement Frontend conforms to the Certification by Type of the Ordinance Concerning Technical Regulations Conformity Certification, etc. of Specified Radio Equipment (MPT Ordinance No. 37 of 1981). The DECA**Q** was certified for categories of the Specified Radio Equipment: Article 2, Paragraph 1, Item (19) and Item (19)-3 for the GXW emission class.

Wi-Fi channels certified for use in Japan:

- 2.4 GHz channels 1-13 (2412 MHz – 2472 MHz)
- 5 GHz channels 36 (5180 MHz), 40 (5200 MHz) and 44 (5220 MHz)

Transient and surges in vehicular environment

The DECA**Q** measurement frontend conforms to ISO 7637-2 which specifies test methods and procedures to ensure the compatibility to conducted electrical transients of equipment installed on passenger cars and commercial vehicles fitted with 12 V or 24 V electrical systems.

Determining EMC compliance of a DECA**Q measurement frontend**

The EMC compliance of the DECA**Q** measurement frontend is determined by the combined System Controller and Power Supply boards (PQ) generation and type of Wi-Fi module that is installed.

Wi-Fi Module[1]	**CE**	**FCC/IC**	**TELEC**
None	Yes	Yes	Yes
Broadcom	Yes	Yes [2]	No
SparkLAN	Yes	Yes	Yes

[1] Only PQ12, PQ20 and PQ30 can be used with Wi-Fi Modules

[2] The DECA**Q** measurement frontend is classified as "a digital device used exclusively as industrial, commercial, or medical test equipment". Therefore, according to CFR47 section 15.103 the DECA**Q** measurement frontend is exempt from the specific technical standards in CFR47 part 15. Even though the starred combinations have not been explicitly certified for FCC/IC compliance, MeCalc did endeavor to have the device meet the specific technical standards. All DECA**Q** measurement frontends may therefore be used in the USA or Canada provided that according to CFR47 section 15.103 "the operator of the exempted device shall be required to stop operating the device upon a finding by the Commission or its representative that the device is causing harmful interference".

B. The DECAQ

1. Product Overview

DECA**Q** systems are compact data acquisition systems which measure high-speed analog and digital signals. Designed for portable measurement, troubleshooting, field testing and complex laboratory applications, DECA**Q** systems are capable of housing up to 192 channels in a single chassis. Each DECA**Q** system is able to securely connect, communicate and be controlled using either the User Interface, a laptop or smart device, as well as to store data for later playback.

A typical user will have an understanding of measurement chain and signal analysis.

2. Features

All DECA**Q** chassis are equipped with the following features:

- Simplified cabling for Power, Ethernet and synchronization.
- Ethernet 1000BASE-T, with data transfer at 45 MB/s.
- PTP IEEE (1588-2008) Synchronization capability.
- Modular signal conditioning with individual and separate signal conditioning **Q**Modules, Processing Units and Chassis which can be upgraded without replacing the whole system.
- Multiple signal conditioning engines to facilitate modular signal conditioning, with isolated power, digital signal processing using powerful DSPs, and automatic internal calibration.
- The ability to measure parameters with interchangeable **Q**Modules, including:

  ICP® / IEPE Voltage
  Piezoelectric Charge

Tacho
Temperature
Strain
High-speed Bridge and Voltage
High-speed Voltage Input
Pt100 Input
Microphone ICP® / IEPE Voltage
Voltage Output
Time and Precision
Synchronization
Digital Bus Interface
Digital Audio

- A data throughput of up to 45 MB/s, depending on **Q**Module (signal conditioning) configuration, voltage of supplied power, **Q**Module sampling rate and ambient temperature.

- A built-in 128 GB SSD storage to securely store measurement data, to retrieve and analyse later.

- Built-in Wi-Fi to securely control your system using Wi-Fi and a smart device, or to use Wi-Fi to connect to your workstation.

- UPS between external power and internal battery with 20 minutes to 2 hours' battery life (depending on system configuration).

- A choice of different chassis sizes:

  DECA**Q** 2-slot for 12-24 channels
  DECA**Q** 3-slot for 16-48 channels
  DECA**Q** 4-slot for 24-72 channels
  DECA**Q** 6-slot for 48-120 channels
  DECA**Q** 10-slot for 72-192 channels

- Accessible and open data formats, with intuitive interaction for set-up and control on smart devices.

- Connection to a Web Server which provides information and control functions.

- Cloud capability.

- Portable or Rack Mountable handling.

- Conduction and dynamic fan cooling.

3. Available Modular Signal Conditioning Channels

The DECA**Q** contains multiple slots which accommodate optional interchangeable signal conditioning channels (**Q**Modules).

Current available **Q**Modules include:

- **ICS42**
  6 Channel ICP® (or IEPE) and Voltage Input Amplifier

- **CHS42X***
  6 Channel Charge, ICP® (or IEPE) and Voltage Input Amplifier

  **Not yet supported in PAK live.*

- **CHG42S**
  4 Channel Charge Input Amplifier

- **DCH42S**
  2 Channel Differential Charge Input Amplifier

- **THM42**
  8 Channel E, J, K, T and U* Thermocouple and Pt100 Input Amplifier

  ** U Thermocouple not supported yet in PAK live.*

- **ICT42**
  2 Channel ICP® (or IEPE) and Voltage Input Amplifier with 2 Channel Tacho Input Amplifier

- **ICT42S**
  Advanced 2 Channel ICP® (or IEPE) and Voltage Input Amplifier with 2 Channel Tacho Input Amplifier

- **ICP42**
  4 Channel ICP® (or IEPE) and Voltage Input Amplifier

- **ICP42S**
  Advanced 4 Channel ICP® (or IEPE) and Voltage Input Amplifier

- **WSB42**
  4 Channel Bridge and Voltage Input Amplifier

- **WSB42X**
  Advanced 4 Channel Bridge, ICP® (or IEPE) and Voltage Input Amplifier

- **ALI42**
  2 Channel High Speed Bridge and Voltage Input Amplifier

- **ALI42B**
  2 Channel High Speed Voltage Input Amplifier

- **MIC42X**
  Advanced 2 Channel Microphone, ICP® (or IEPE) and Voltage Input Amplifier

- **ALO42S**
  4 Channel Voltage Output Source

- **CAN42**
  Interface to 2 Controller Area Networks (CAN)

- **FLX42**
  Interface to FlexRay™ Network

- **GPS42**
  Internal GPS Interface

- **IRG42**
  Interface to IRIG, External GPS and Internal GPS

- **ECT42**
  Interface to EtherCAT® Network

- **DAR42**
  Digital Audio Receiver

See Measurement: Signal Conditioning for more information.

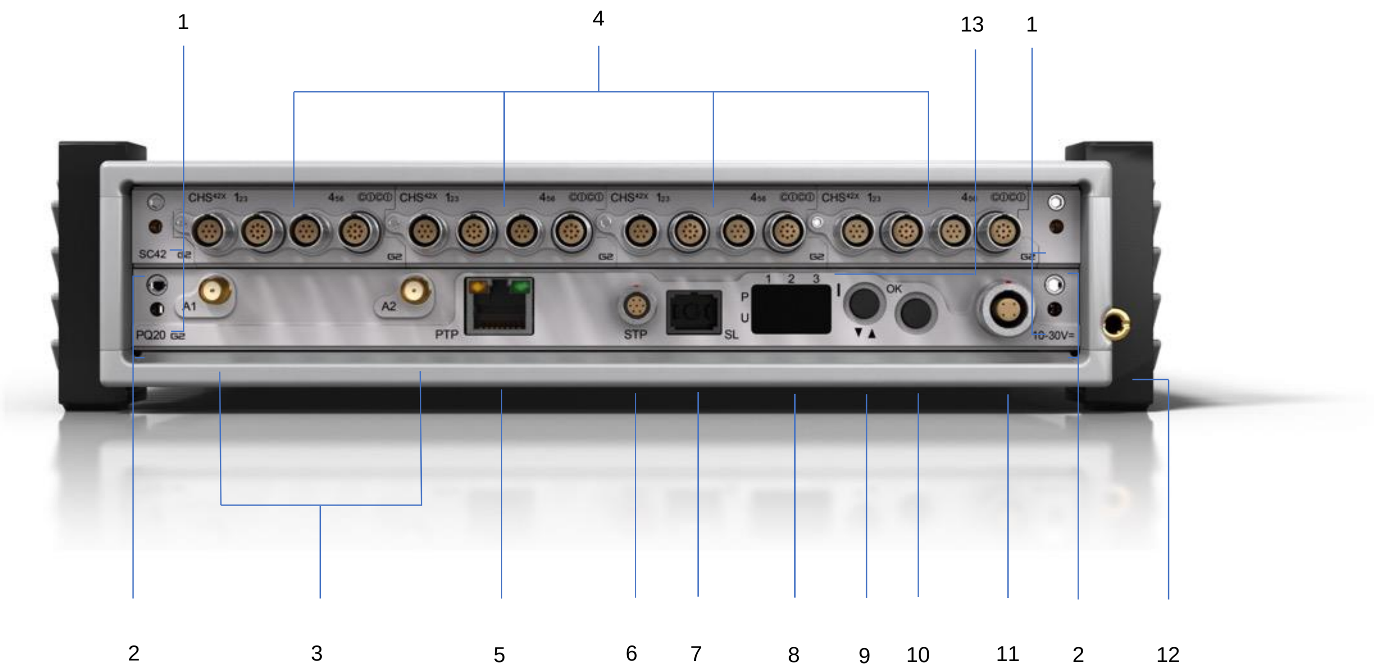
4. Views

The DECA**Q** comes in 5 chassis sizes, namely the DECA**Q** 2-slot, 3-slot, 4-slot, 6-slot and 10-slot chassis. This section shows views for each chassis size.

4.1. DECA**Q 2-slot**

12 – 24 Channels

4.1.1. Front View



1. **Extraction Jacking Screw**

   Unscrew the extraction jacking screw to extract the board from the chassis.

2. **Portal for Thermal Expanders**

   Ensure the thermal expanders have been properly fastened before conducting measurements. *See Handling Guidelines for Effective Cooling for more information.*

3. **Built-in Wi-Fi Antennas**
   IEEE 802.11 b/g/n

4. **Q**Module **slots**

   Featured Q Module**: Slot 2**
   CHS42X:6 Channel Charge or ICP®/IEPE and Voltage Input Amplifier
   See Measure: Signal Conditioning for more information.

5. **Ethernet (Ethernet / PTP)**

   Ethernet
   1000BASE-T
   PTP (Precision Time Protocol)
   IEEE 1588-2008 PTP synchronization over Ethernet.
   See Synchronization for more information.

6. **S-Port**

   Connect to the MiniTerminal and ATTO**Q**s via the S-Port.

7. **SyncLink**

   Synchronize DECA**Q** systems with SyncLink.
   See Synchronization for more information.

8. **User Interface Display**

   Receive system information and execute commands via the User Interface. *See Navigating the DECA**Q**'s User Interface Display for more information.*

9. **User Interface I Button**

   Use the **I** Button to scroll through User Interface menu options. *See Navigating the DECA**Q**'s User Interface Display for more information.*

10. **User Interface OK Button**

    Confirm User Interface menu option selections using the **OK** Button. *See Navigating the DECA**Q**'s User Interface Display for more information.*

11. **Power LEMO®**

    Power the DECA**Q** with an external power source via the Power LEMO®. *See Power for more information.*

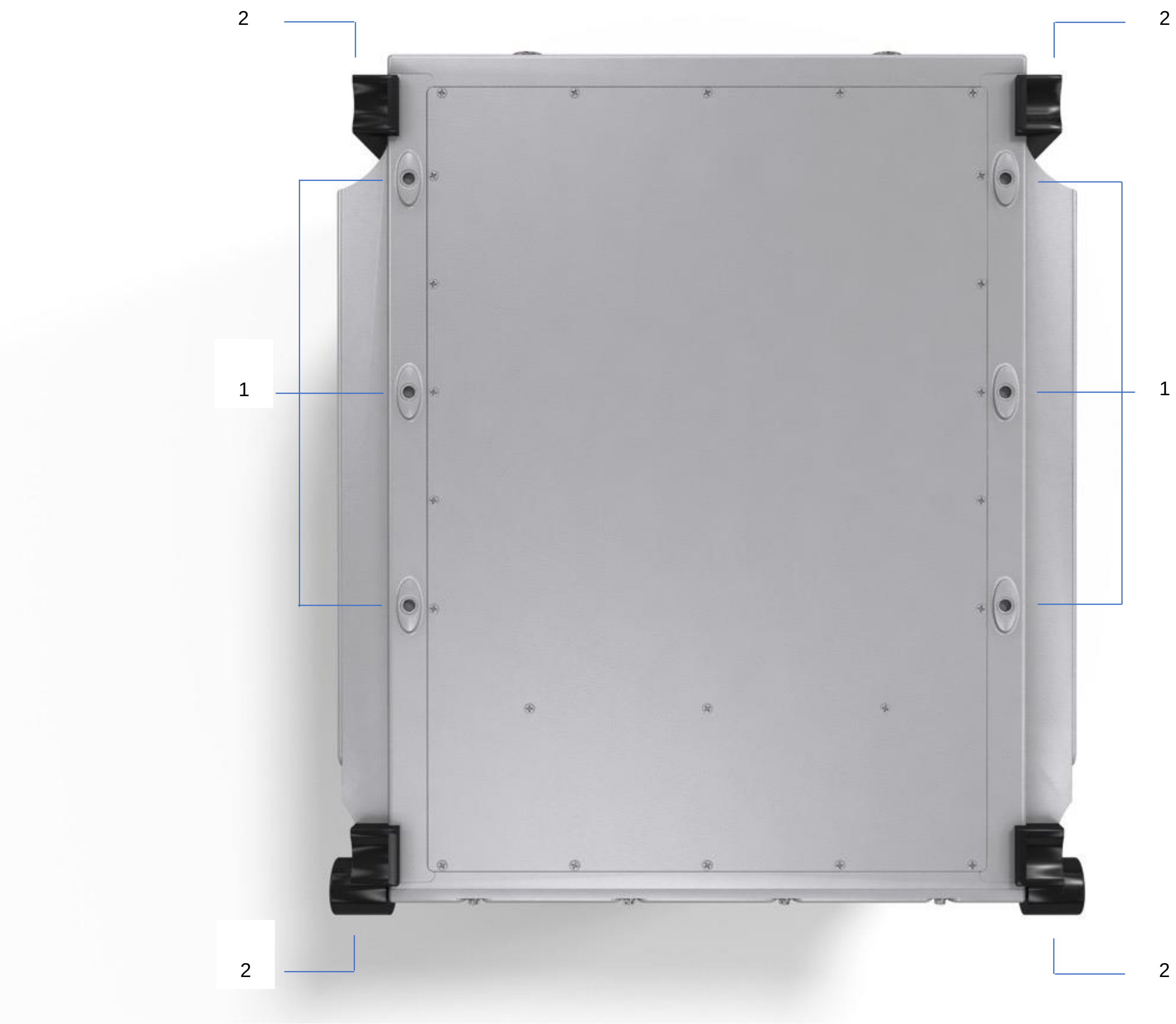
12. Earth Terminal

Connect the Earth Terminal to the building safety earth if there is any risk of electrical shock in the testing environment. It can be used to provide a ground reference for analog signal measurements, if appropriate settings are applied to the relevant **Q**Module channels. It can also be used in some cases to decrease noise on analog signals.

13. **Q**Module **Jacking Screw**

Insert and remove **Q**Modules using a Jacking Screw. *See Inserting and Removing **Q**Modules for more information.*

4.1.2. Top View



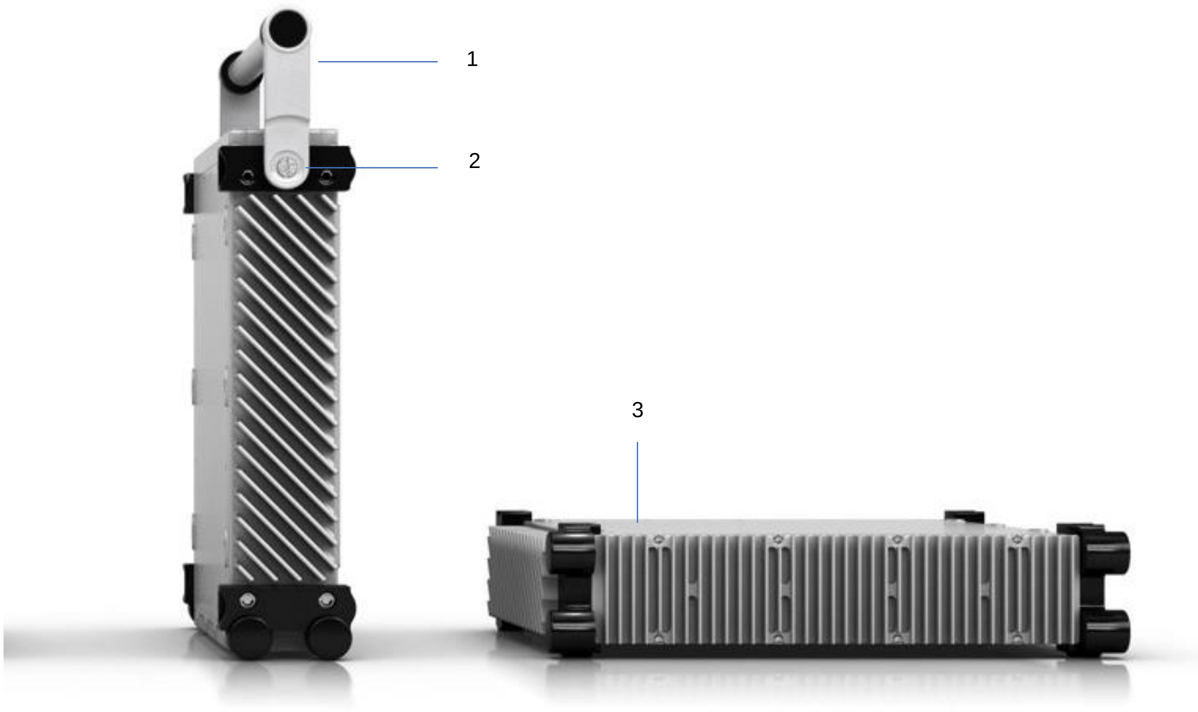
1. **Fastening Inserts**

   Fasten your chassis onto a surface using the fastening inserts.

2. **Interlocking Feet (Stackable)**

   Increase your channel count for large scale laboratory measurements by stacking your chassis on top of one another. The chassis will lock into one another to securely create one large synchronized system.

4.1.3. Side Views



1. **Handle**

   For simplified handling, use the handle when carrying the chassis.

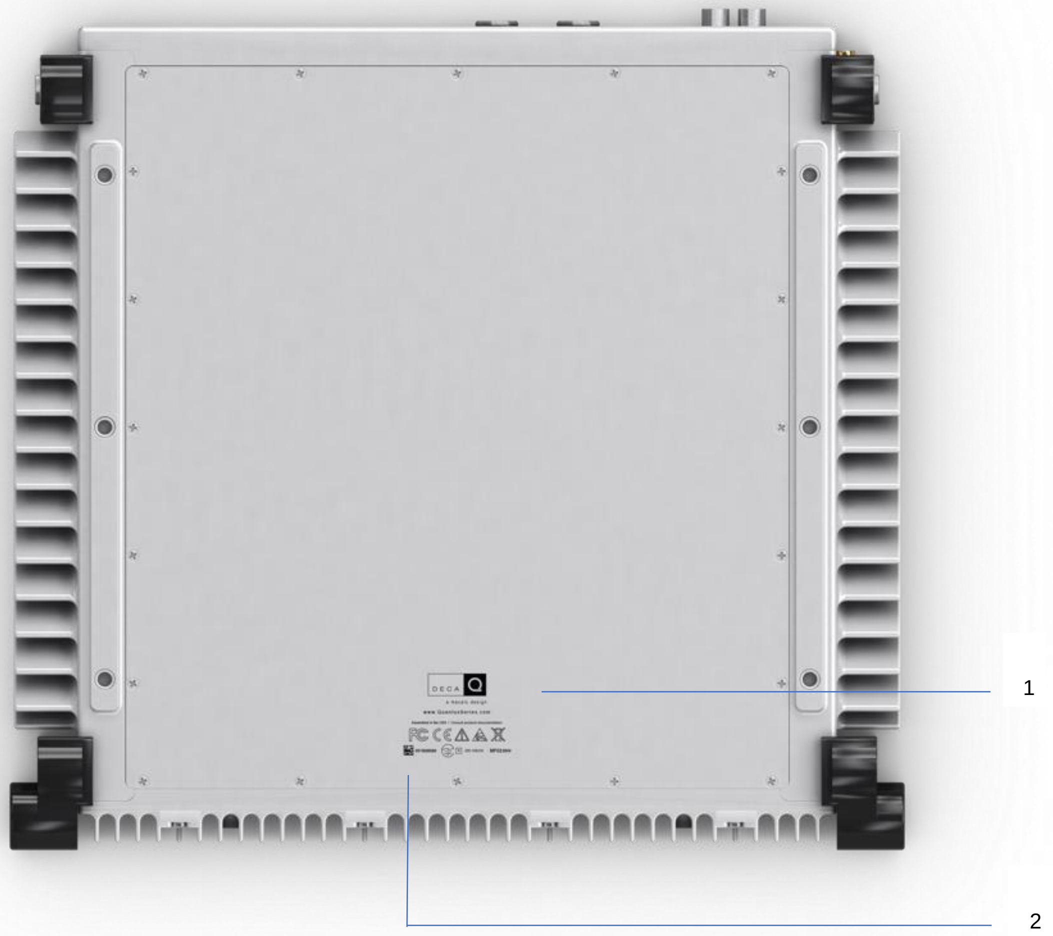
2. **Handle Adjustment Button**

   To adjust your handle, press down on the Handle Adjustment Button. Move the handle from 0° to 45°, 90°, 135° and finally 180°. Once the handle reaches any one of the four settings, it will lock into that position until the button is pressed in to adjust the handle again.

3. **Fins**

   Fins provide conduction cooling for the system chassis. Keep the chassis fins unobstructed while conducting a measurement. *See Handling Guidelines for Effective Cooling for more information.*

4.1.4. Bottom View



1. Product Label

The Product Label includes certifications and warnings related to the use of the DECA**Q**.

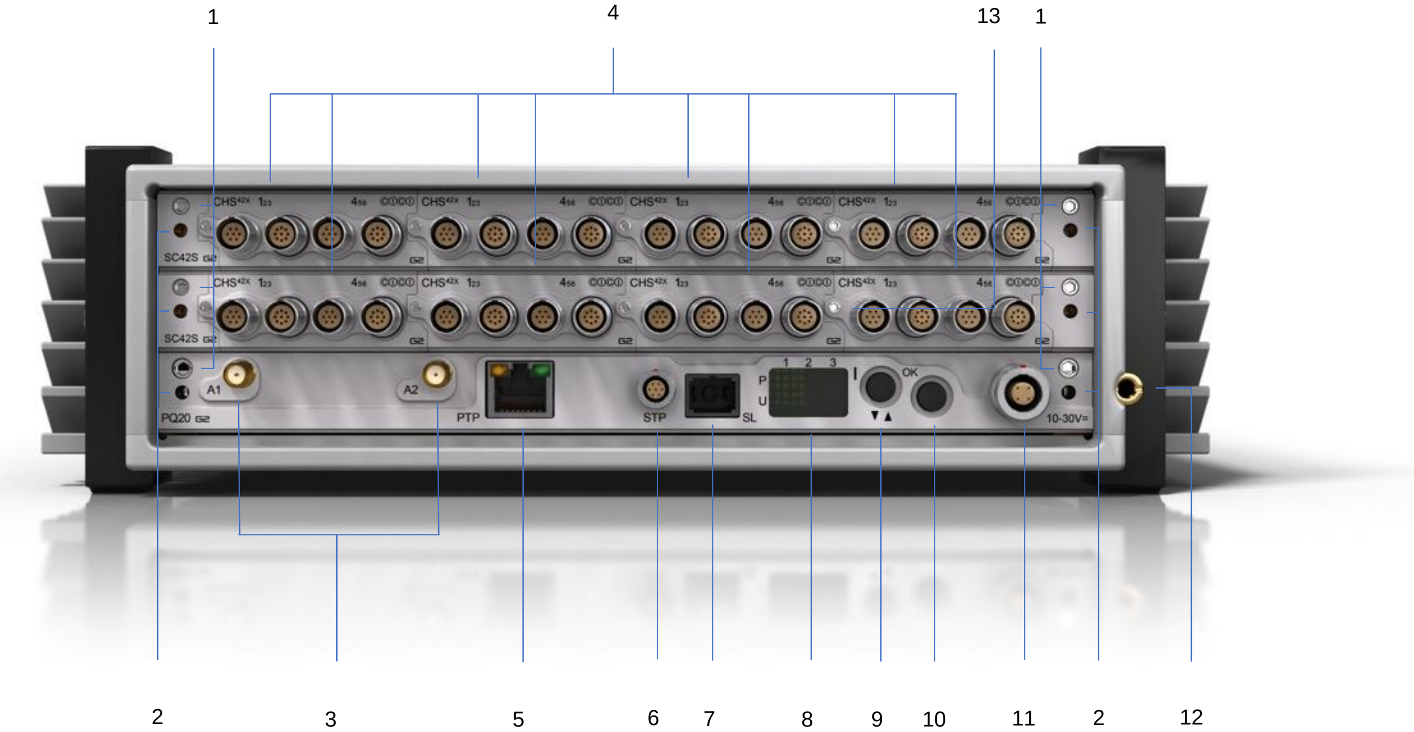
2. Serial Number

The Serial Number / Barcode of each DECA**Q** is found on its base. This identifier allows our Product Experts to access information specific to your device in order to provide valuable support services.

4.2. DECAQ 3-slot

16 – 48 Channels

4.2.1. Front View



1. Extraction Jacking Screw

Unscrew the extraction jacking screw to extract the board from the chassis.

2. Portal for Thermal Expanders

Ensure the thermal expanders have been properly fastened before conducting measurements. *See Handling Guidelines for Effective Cooling for more information.*

3. Built-in Wi-Fi Antennas

IEEE 802.11 b/g/n

4. Q Module **slots**

Featured Q Module**: Slot 2 and 3**
CHS42X:6 Channel Charge or ICP®/IEPE and Voltage Input Amplifier
See Measure: Signal Conditioning for more information.

5. Ethernet (Ethernet / PTP)

Ethernet
1000BASE-T

PTP (Precision Time Protocol)
IEEE 1588-2008 PTP synchronization over Ethernet.
See Synchronization for more information.

6. S-Port

Connect to the MiniTerminal and ATTO**Q**s via the S-Port.

7. SyncLink

Synchronize DECA**Q** systems with SyncLink.
See Synchronization for more information.

8. User Interface Display

Receive system information and execute commands via the User Interface. *See Navigating the DECA**Q**'s User Interface Display for more information.*

9. User Interface I Button

Use the **I** Button to scroll through User Interface menu options. *See Navigating the DECA**Q**'s User Interface Display for more information.*

10. User Interface OK Button

Confirm User Interface menu option selections using the **OK** Button. *See Navigating the DECA**Q**'s User Interface Display for more information.*

11. Power LEMO®

Power the DECA**Q** with an external power source via the Power LEMO®.
See Power for more information.

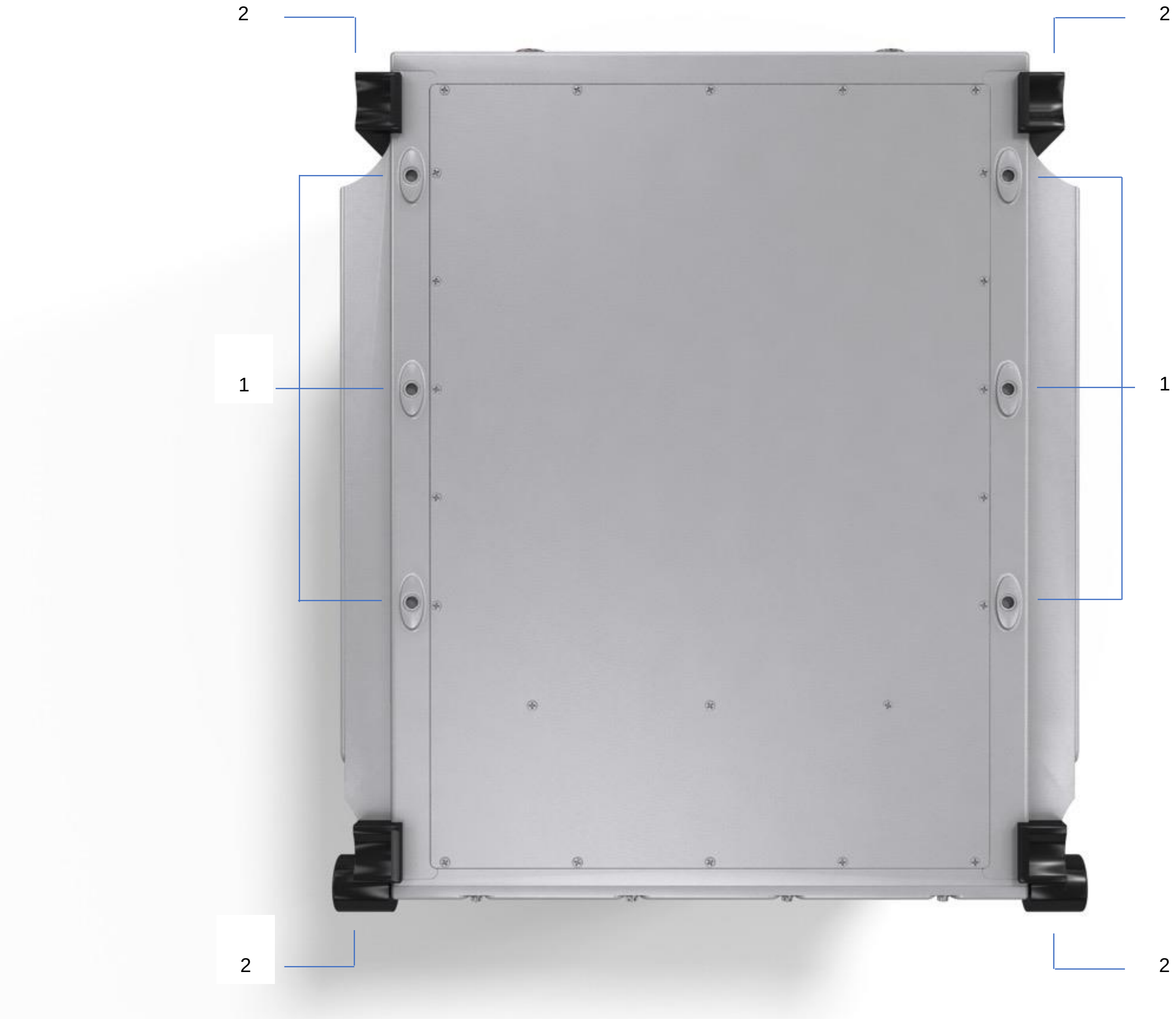
12. Earth Terminal

Connect the Earth Terminal to the building safety earth if there is any risk of electrical shock in the testing environment. It can be used to provide a ground reference for analog signal measurements, if appropriate settings are applied to the relevant **Q**Module channels. It can also be used in some cases to decrease noise on analog signals.

13. Q Module **Jacking Screw**

Insert and remove **Q**Modules using a Jacking Screw. *See Inserting and Removing **Q**Modules for more information.*

4.2.2. Top View



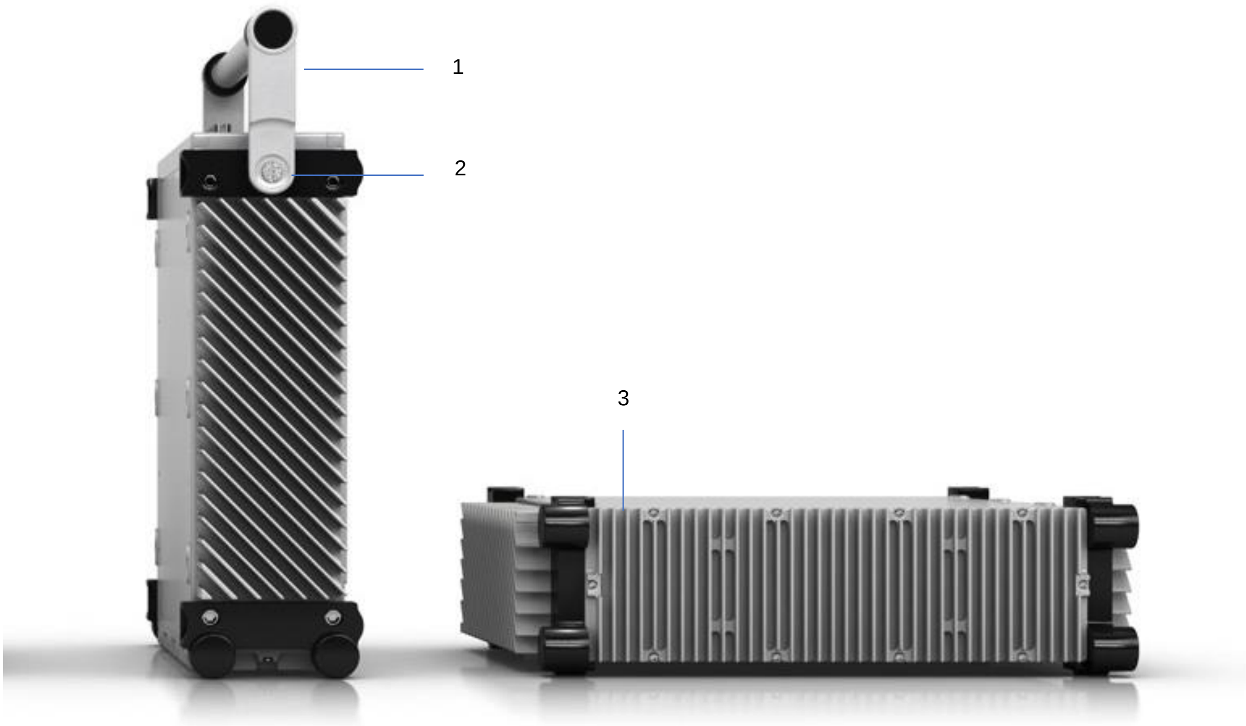
1. **Fastening Inserts**

   Fasten your chassis onto a surface using the fastening inserts.

2. **Interlocking Feet (Stackable)**

   Increase your channel count for large scale laboratory measurements by stacking your chassis on top of one another. The chassis will lock into one another to securely create one large synchronized system.

4.2.3. Side View



1. **Handle**

   For simplified handling, use the handle when carrying the chassis.

2. **Handle Adjustment Button**

   To adjust your handle, press down on the Handle Adjustment Button. Move the handle from 0° to 45°, 90°, 135° and finally 180°. Once the handle reaches any one of the four settings, it will lock into that position until the button is pressed in to adjust the handle again.

3. **Fins**

   Fins provide conduction cooling for the system chassis. Keep the chassis fins unobstructed while conducting a measurement. *See Handling Guidelines for Effective Cooling for more information.*

4.2.4. Bottom View

1. Product Label

The Product Label includes certifications and warnings related to the use of the DECA**Q**.

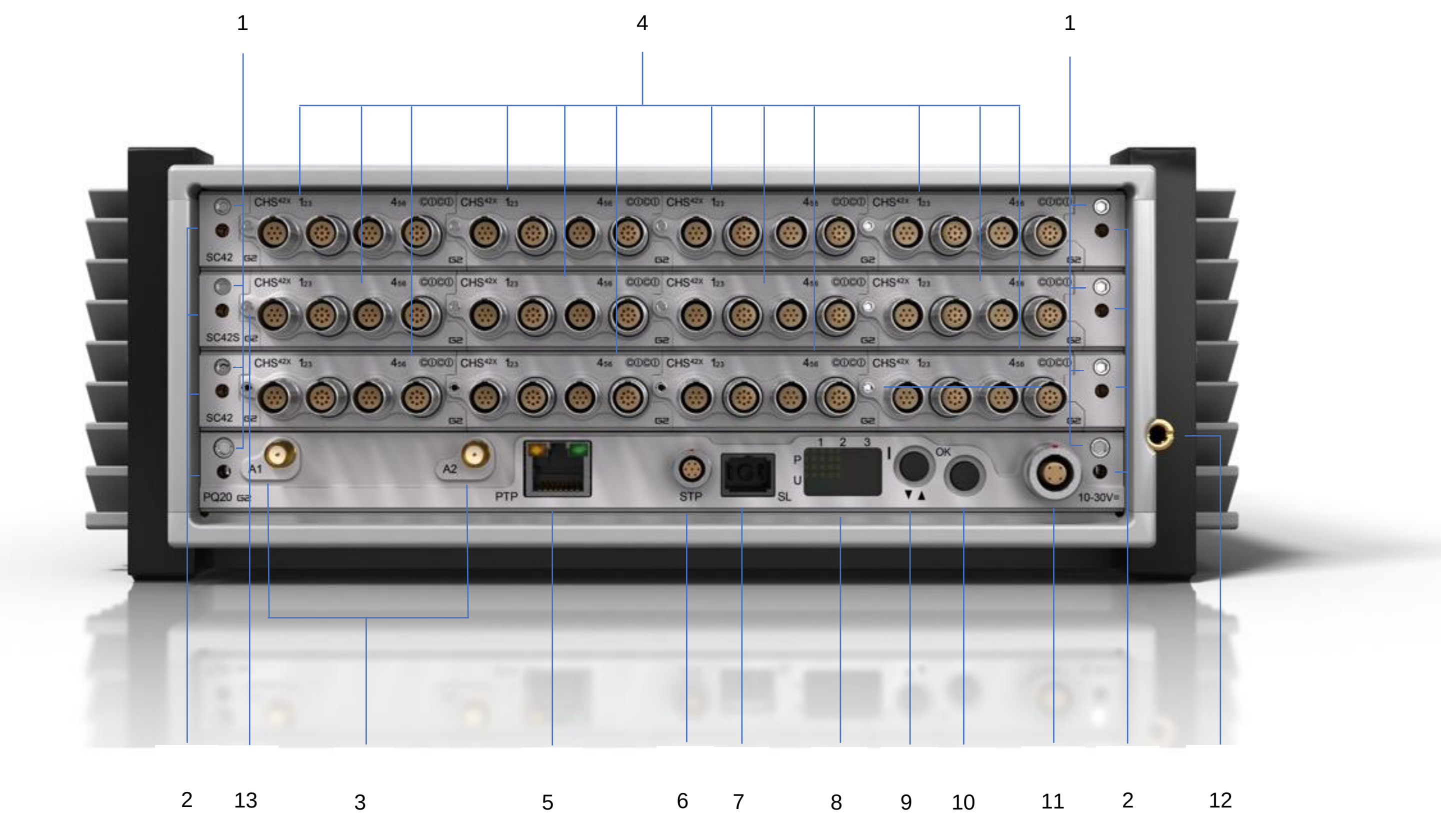
2. Serial Number

The Serial Number / Barcode of each DECA**Q** is found on its base. This identifier allows our Product Experts to access information specific to your device in order to provide valuable support services.

4.3. DECAQ 4-slot

24 – 72 Channels

4.3.1. Front View



1. **Extraction Jacking Screw**

   Unscrew the extraction jacking screw to extract the board from the chassis.

2. **Portal for Thermal Expanders**

   Ensure the thermal expanders have been properly fastened before conducting measurements. *See Handling Guidelines for Effective Cooling for more information.*

3. **Built-in Wi-Fi Antennas**
   IEEE 802.11 b/g/n

4. **Q**Module **slots**

Featured Q Module**: Slot 2, 3, 4**

CHS42X:6 Channel Charge or ICP®/IEPE and Voltage Input Amplifier

See Measure: Signal Conditioning for more information.

5. **Ethernet (Ethernet / PTP)**

Ethernet

1000BASE-T

PTP (Precision Time Protocol)

IEEE 1588-2008 PTP synchronization over Ethernet.

See Synchronization for more information.

6. **S-Port**

Connect to the MiniTerminal and ATTO**Q**s via the S-Port.

7. **SyncLink**

Synchronize DECA**Q** systems with SyncLink.

See Synchronization for more information.

8. **User Interface Display**

Receive system information and execute commands via the User Interface. *See Navigating the DECA**Q**'s User Interface Display for more information.*

9. **User Interface I Button**

Use the **I** Button to scroll through User Interface menu options. *See Navigating the DECA**Q**'s User Interface Display for more information.*

10. **User Interface OK Button**

Confirm User Interface menu option selections using the **OK** Button. *See Navigating the DECA**Q**'s User Interface Display for more information.*

11. **Power LEMO®**

Power the DECA**Q** with an external power source via the Power LEMO®.

See Power for more information.

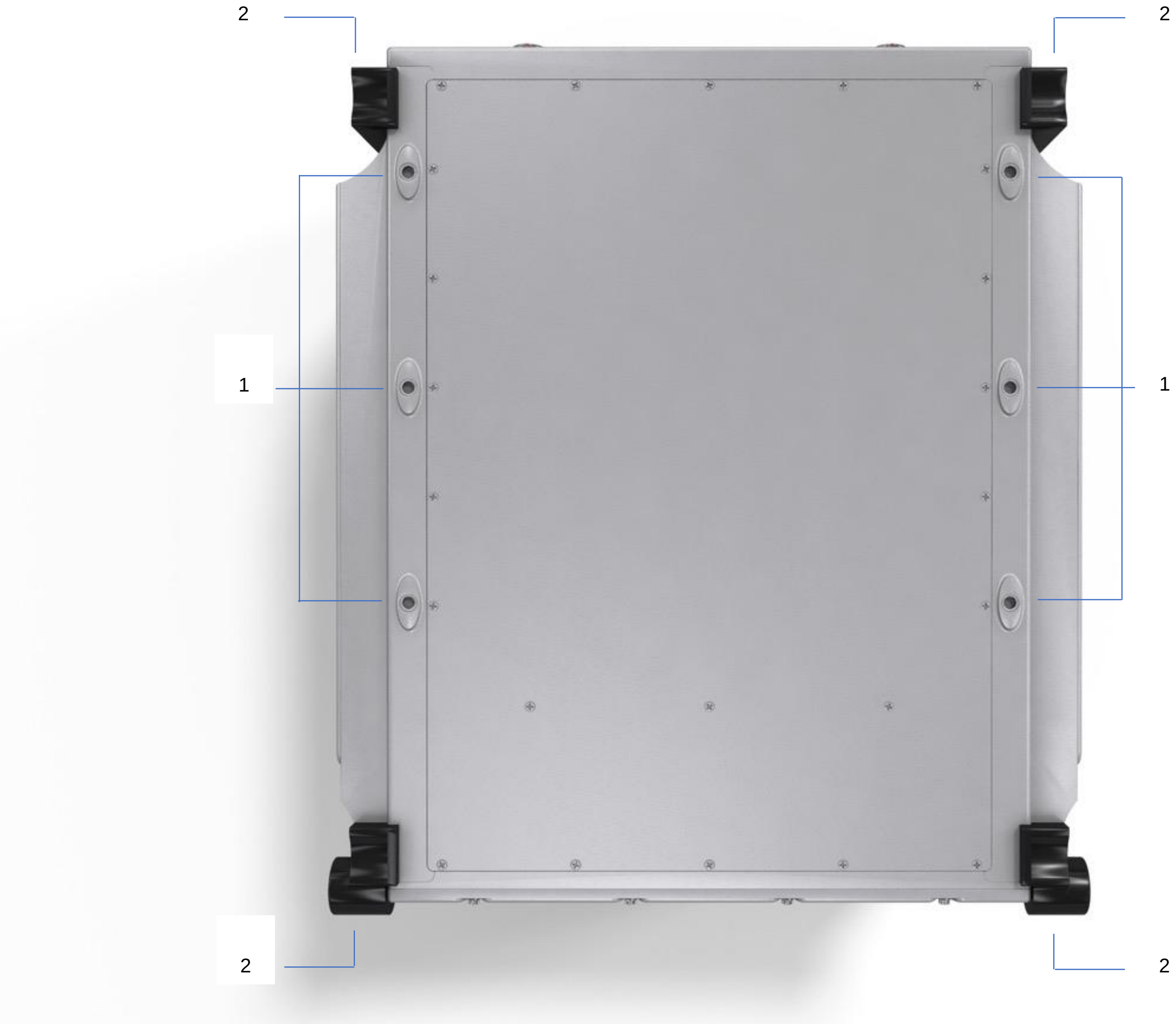
12. Earth Terminal

Connect the Earth Terminal to the building safety earth if there is any risk of electrical shock in the testing environment. It can be used to provide a ground reference for analog signal measurements, if appropriate settings are applied to the relevant **Q**Module channels. It can also be used in some cases to decrease noise on analog signals.

13. Q Module **Jacking Screw**

Insert and remove **Q**Modules using a Jacking Screw. *See Inserting and Removing **Q**Modules for more information.*

4.3.2. Top View



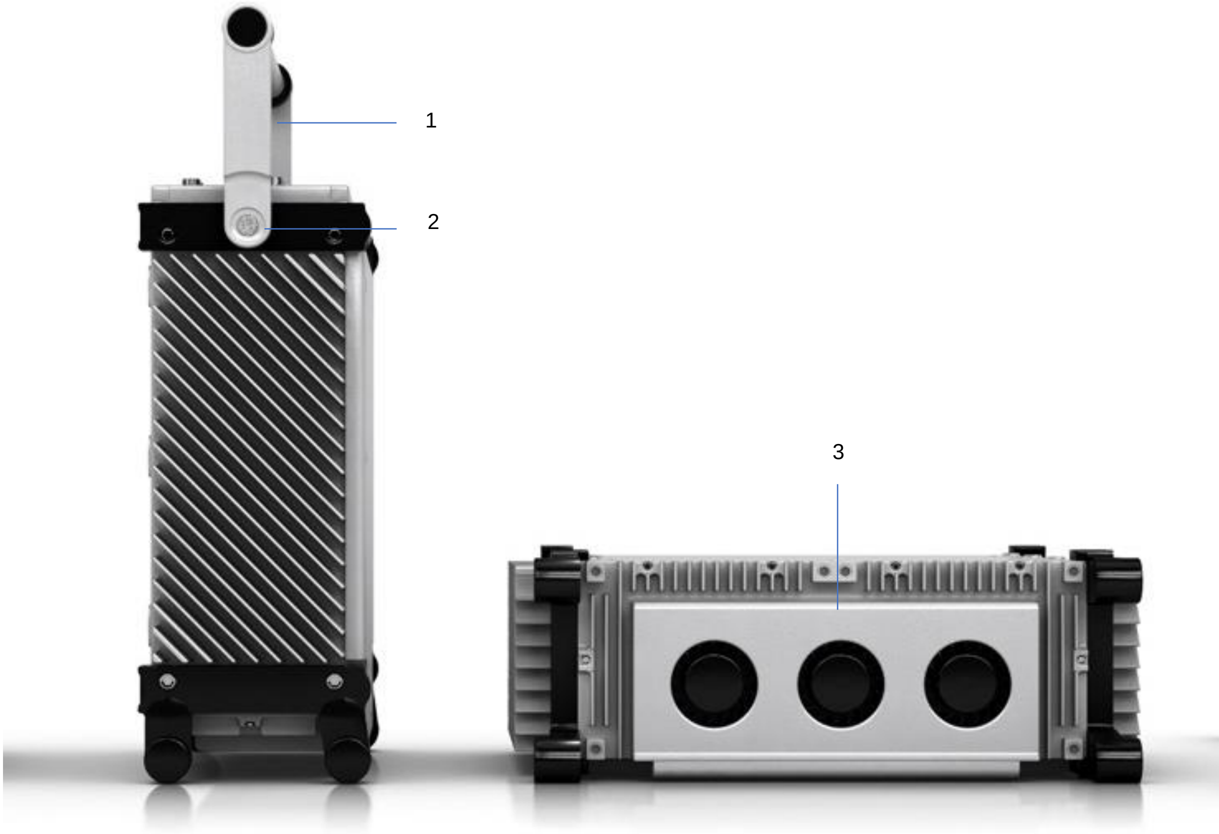
1. Fastening Inserts

Fasten your chassis onto a surface using the fastening inserts.

2. Interlocking Feet (Stackable)

Increase your channel count for large scale laboratory measurements by stacking your chassis on top of one another. The chassis will lock into one another to securely create one large synchronized system.

4.3.3. Side View



1. Handle

For simplified handling, use the handle when carrying the chassis.

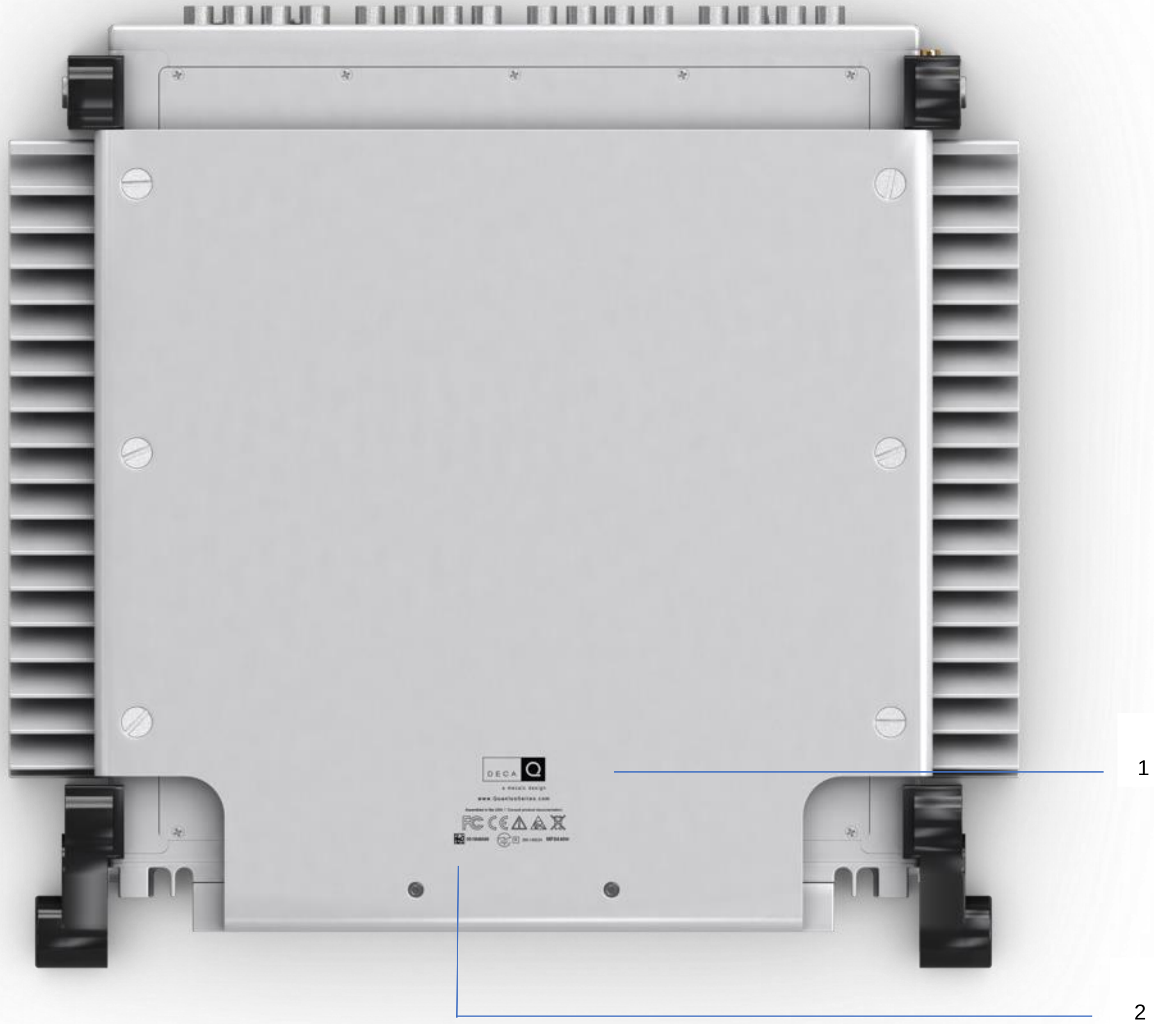
2. Handle Adjustment Button

To adjust your handle, press down on the Handle Adjustment Button. Move the handle from 0° to 45°, 90°, 135° and finally 180°. Once the handle reaches any one of the four settings, it will lock into that position until the button is pressed in to adjust the handle again.

3. Fan Intake

Fans provide cooling for the system's chassis. Keep the fan intake unobstructed while conducting a measurement. *See Handling Guidelines for Effective Cooling for more information.*

4.3.4. Bottom View



1. **Product Label**

   The Product Label includes certifications and warnings related to the use of the DECA**Q**.

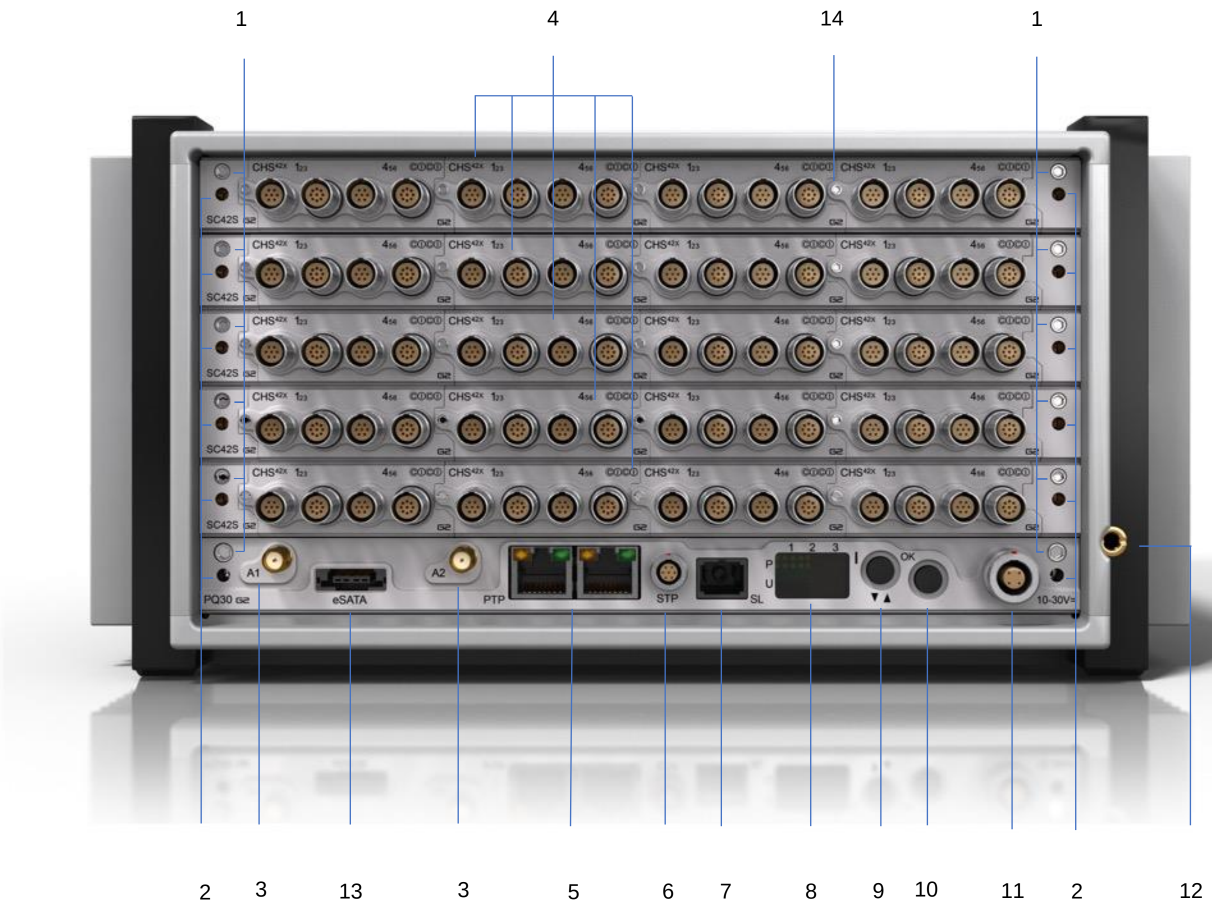
2. **Serial Number**

   The Serial Number / Barcode of each DECA**Q** is found on its base. This identifier allows our Product Experts to access information specific to your device in order to provide valuable support services.

4.4. DECAQ 6-slot

48 – 120 Channels

4.4.1. Front View



1. Extraction Jacking Screw

Unscrew the extraction jacking screw to extract the board from the chassis.

2. Portal for Thermal Expanders

Ensure the thermal expanders have been properly fastened before conducting measurements. *See Handling Guidelines for Effective Cooling for more information.*

3. Built-in Wi-Fi Antennas

IEEE 802.11 b/g/n

4. **Q**Module **slots**

Featured Q Module**: Slot 2 - 6**
CHS42X:6 Channel Charge or ICP®/IEPE and Voltage Input Amplifier
See Measure: Signal Conditioning for more information.

5. **Ethernet (Ethernet / PTP)**

Ethernet
1000BASE-T

PTP (Precision Time Protocol)
IEEE 1588-2008 PTP synchronization over Ethernet.
See Synchronization for more information.

6. **S-Port**

Connect to the MiniTerminal and ATTO**Q**s via the S-Port.

7. **SyncLink**

Synchronize DECA**Q** systems with SyncLink.
See Synchronization for more information.

8. **User Interface Display**

Receive system information and execute commands via the User Interface. *See Navigating the DECA**Q**'s User Interface Display for more information.*

9. **User Interface I Button**

Use the **I** Button to scroll through User Interface menu options. *See Navigating the DECA**Q**'s User Interface Display for more information.*

10. **User Interface OK Button**

Confirm User Interface menu option selections using the **OK** Button. *See Navigating the DECA**Q**'s User Interface Display for more information.*

11. **Power LEMO®**

Power the DECA**Q** with an external power source via the Power LEMO®.
See Power for more information.

12. Earth Terminal

Connect the Earth Terminal to the building safety earth if there is any risk of electrical shock in the testing environment. It can be used to provide a ground reference for analog signal measurements, if appropriate settings are applied to the relevant **Q**Module channels. It can also be used in some cases to decrease noise on analog signals.

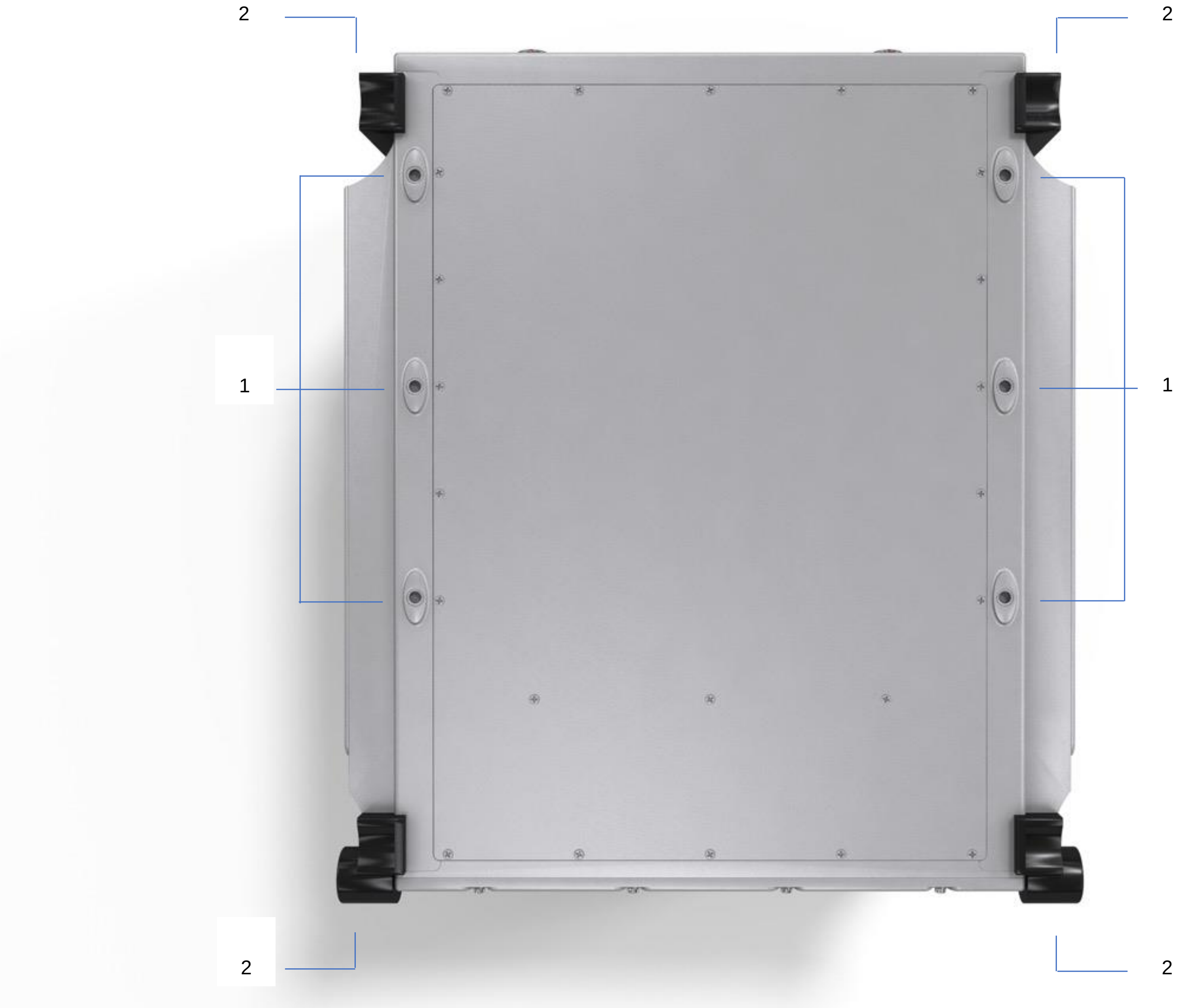
13. aSATA connector

Connector for an external hard drive.

14. Q Module **Jacking Screw**

Insert and remove **Q**Modules using a Jacking Screw. *See Inserting and Removing **Q**Modules for more information.*

4.4.2. Top View



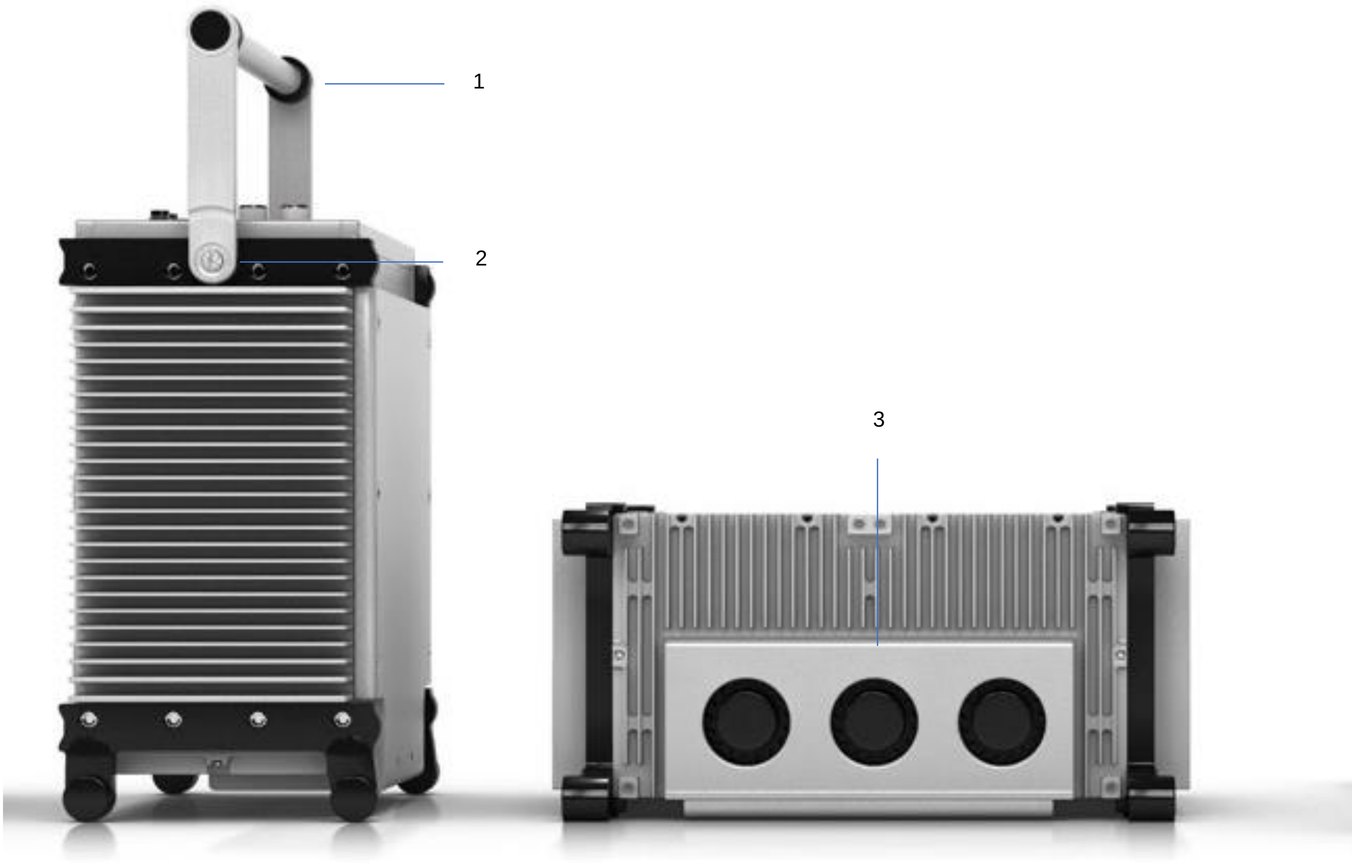
1. Fastening Inserts

Fasten your chassis onto a surface using the fastening inserts.

2. Interlocking Feet (Stackable)

Increase your channel count for large scale laboratory measurements by stacking your chassis on top of one another. The chassis will lock into one another to securely create one large synchronized system.

4.4.3. Side View



1. Handle

For simplified handling, use the handle when carrying the chassis.

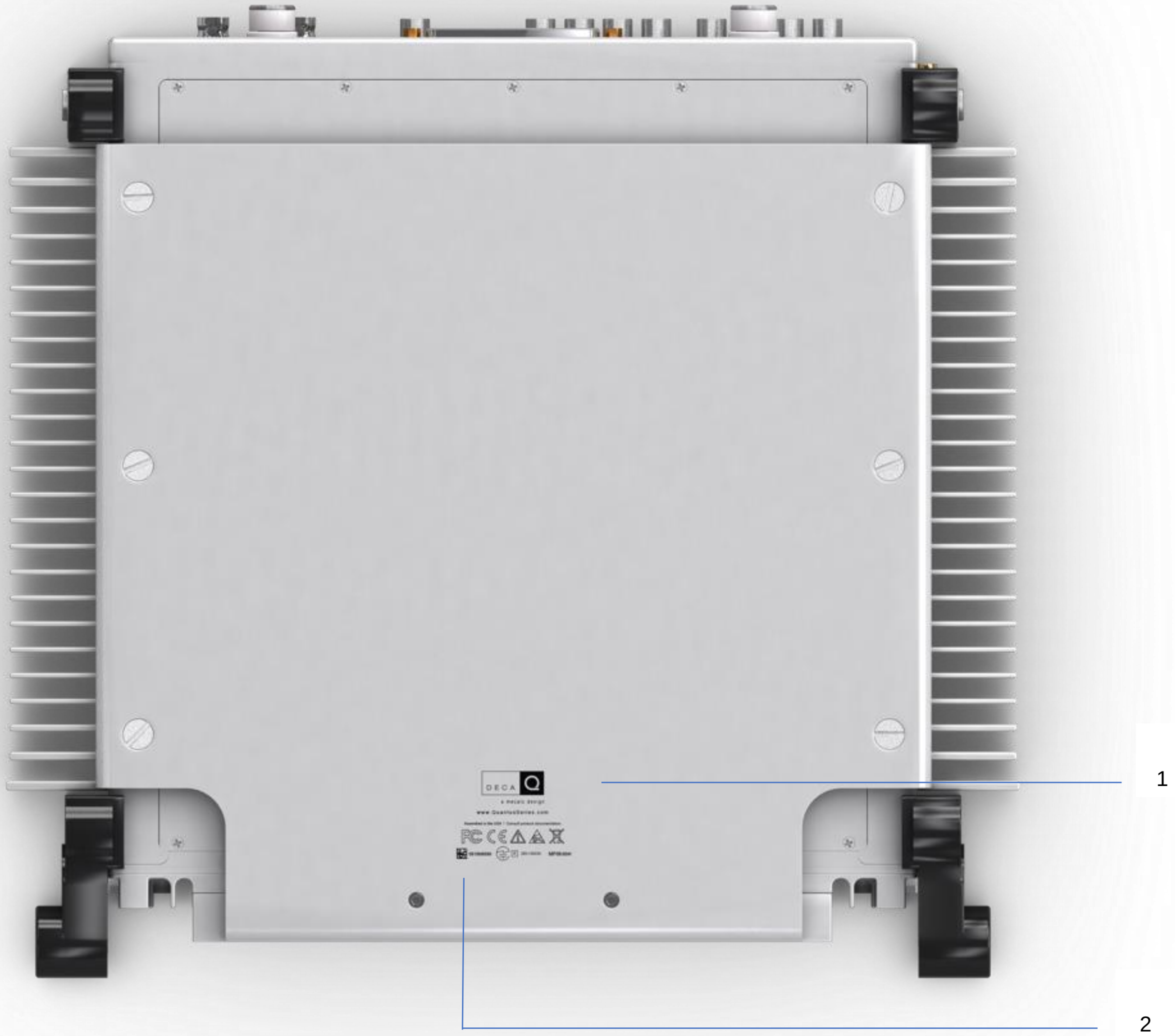
2. Handle Adjustment Button

To adjust your handle, press down on the Handle Adjustment Button. Move the handle from 0° to 45°, 90°, 135° and finally 180°. Once the handle reaches any one of the four settings, it will lock into that position until the button is pressed in to adjust the handle again.

3. Fan Intake

Fans provide cooling for the system's chassis. Keep the fan intake unobstructed while conducting a measurement. *See Handling Guidelines for Effective Cooling for more information.*

4.4.4. Bottom View



1. Product Label

The Product Label includes certifications and warnings related to the use of the DECA**Q**.

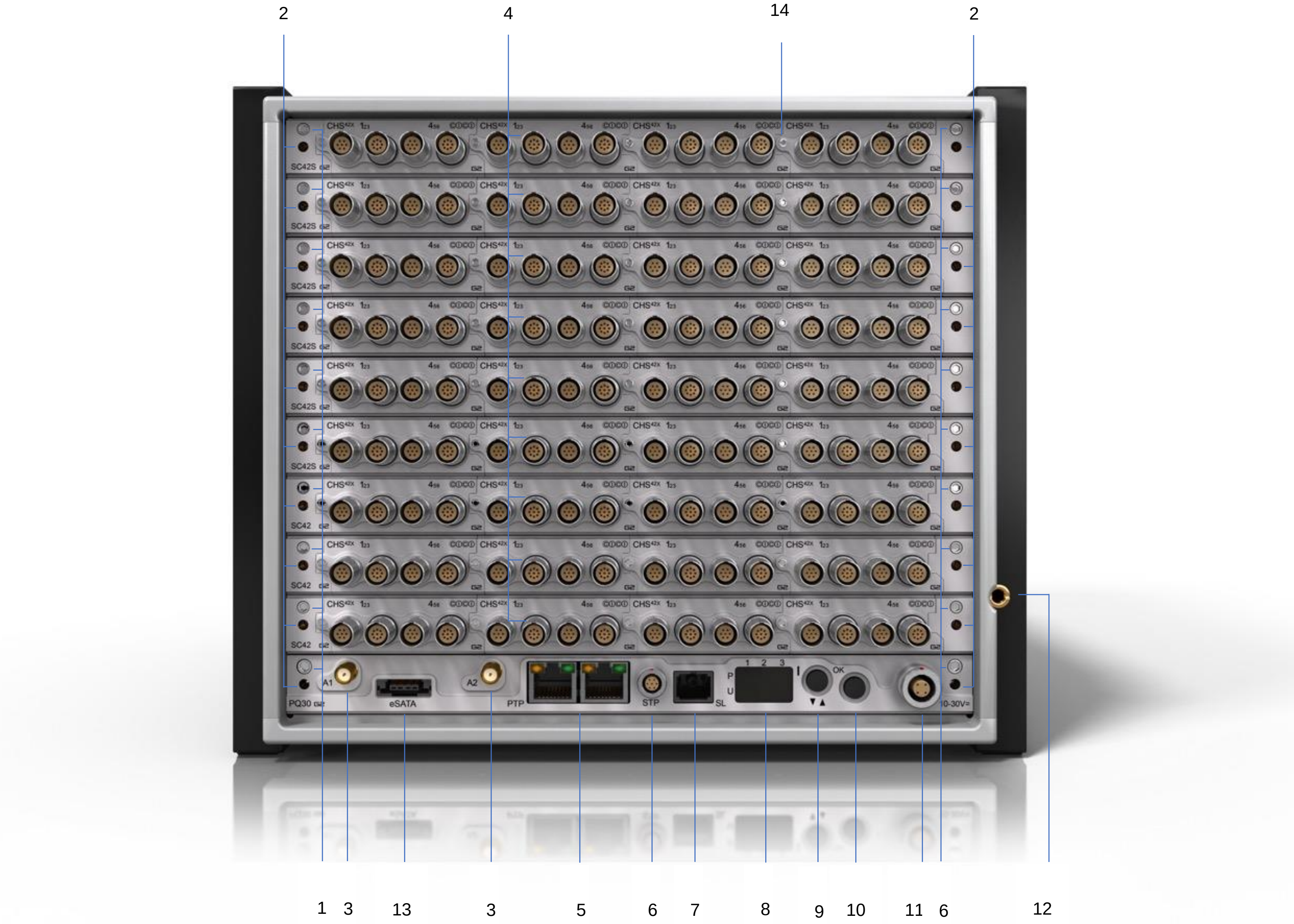
2. Serial Number

The Serial Number / Barcode of each DECA**Q** is found on its base. This identifier allows our Product Experts to access information specific to your device in order to provide valuable support services.

4.5. DECAQ 10-slot

72 – 192 Channels

4.5.1. Front View



1. **Extraction Jacking Screw**

   Unscrew the extraction jacking screw to extract the board from the chassis.

2. **Portal for Thermal Expanders**

   Ensure the thermal expanders have been properly fastened before conducting measurements. *See Handling*

Guidelines for Effective Cooling for more information.

3. **Built-in Wi-Fi Antennas**

   IEEE 802.11 b/g/n

4. **Q**Module **slots**

   Featured Q Module**: Slot 2 - 10**

   CHS42X:6 Channel Charge or ICP®/IEPE and Voltage Input Amplifier

   See Measure: Signal Conditioning for more information.

5. **Ethernet (Ethernet / PTP)**

   Ethernet

   1000BASE-T

   PTP (Precision Time Protocol)

   IEEE 1588-2008 PTP synchronization over Ethernet.

   See Synchronization for more information.

6. **S-Port**

   Connect to the MiniTerminal and ATTO**Q**s via the S-Port.

7. **SyncLink**

   Synchronize DECA**Q** systems with SyncLink.

   See Synchronization for more information.

8. **User Interface Display**

   Receive system information and execute commands via the User Interface. *See Navigating the DECA**Q’s** User Interface Display for more information.*

9. **User Interface I Button**

   Use the **I** Button to scroll through User Interface menu options. *See Navigating the DECA**Q’s** User Interface Display for more information.*

10. **User Interface OK Button**

    Confirm User Interface menu option selections using the **OK** Button. *See Navigating the DECA**Q’s** User Interface Display for more information.*

11. Power LEMO®

Power the DECA**Q** with an external power source via the Power LEMO®.
See Power for more information.

12. Earth Terminal

Connect the Earth Terminal to the building safety earth if there is any risk of electrical shock in the testing environment. It can be used to provide a ground reference for analog signal measurements, if appropriate settings are applied to the relevant **Q**Module channels. It can also be used in some cases to decrease noise on analog signals.

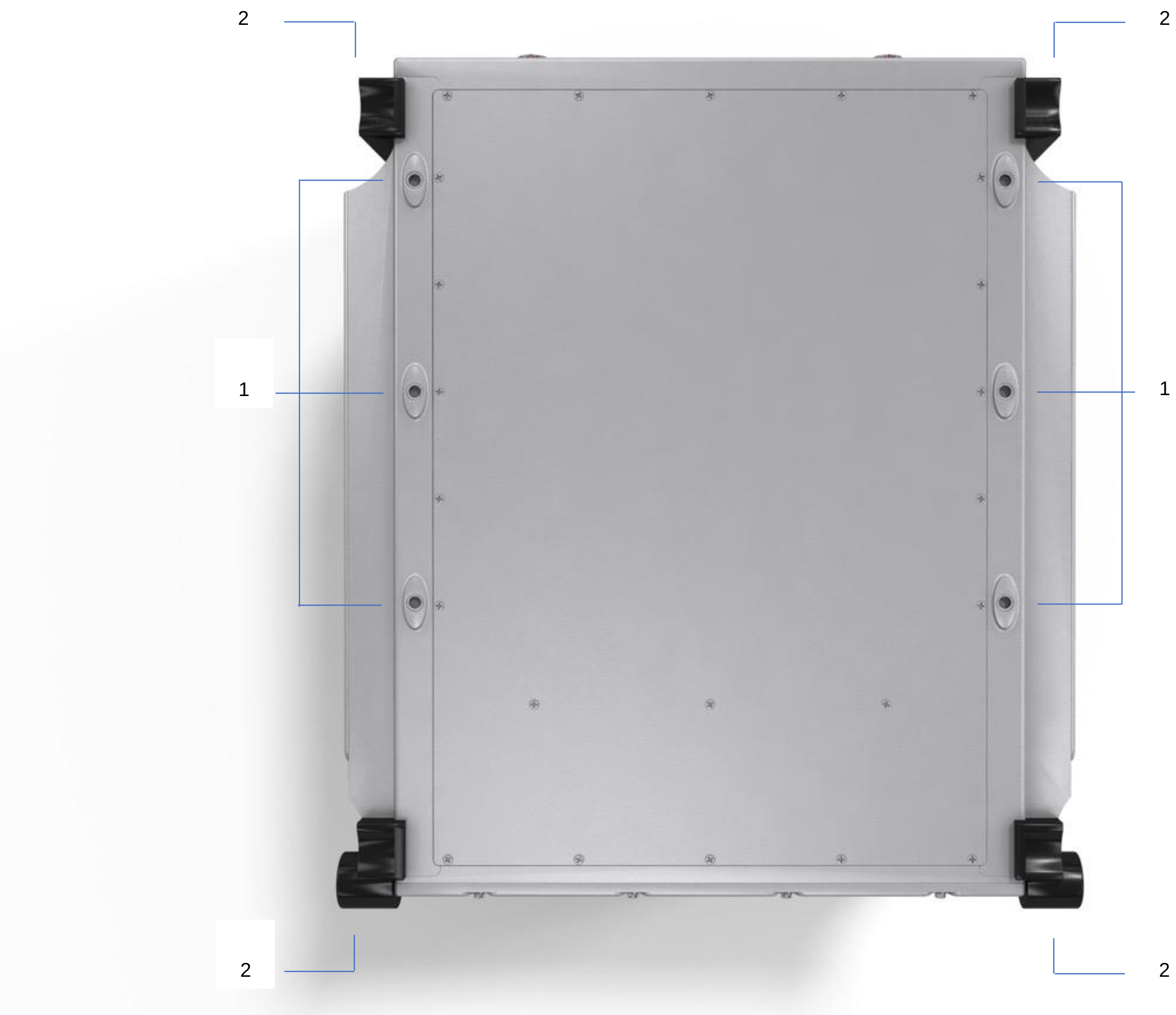
13. aSATA connector

Connector for an external hard drive.

14. Q Module **Jacking Screw**

Insert and remove **Q**Modules using a Jacking Screw. *See Inserting and Removing **Q**Modules for more information.*

4.5.2. Top View



1. Fastening Inserts

Fasten your chassis onto a surface using the fastening inserts.

2. Interlocking Feet (Stackable)

Increase your channel count for large scale laboratory measurements by stacking your chassis on top of one another. The chassis will lock into one another to securely create one large synchronized system.

4.5.3. Side Views

2 1

2

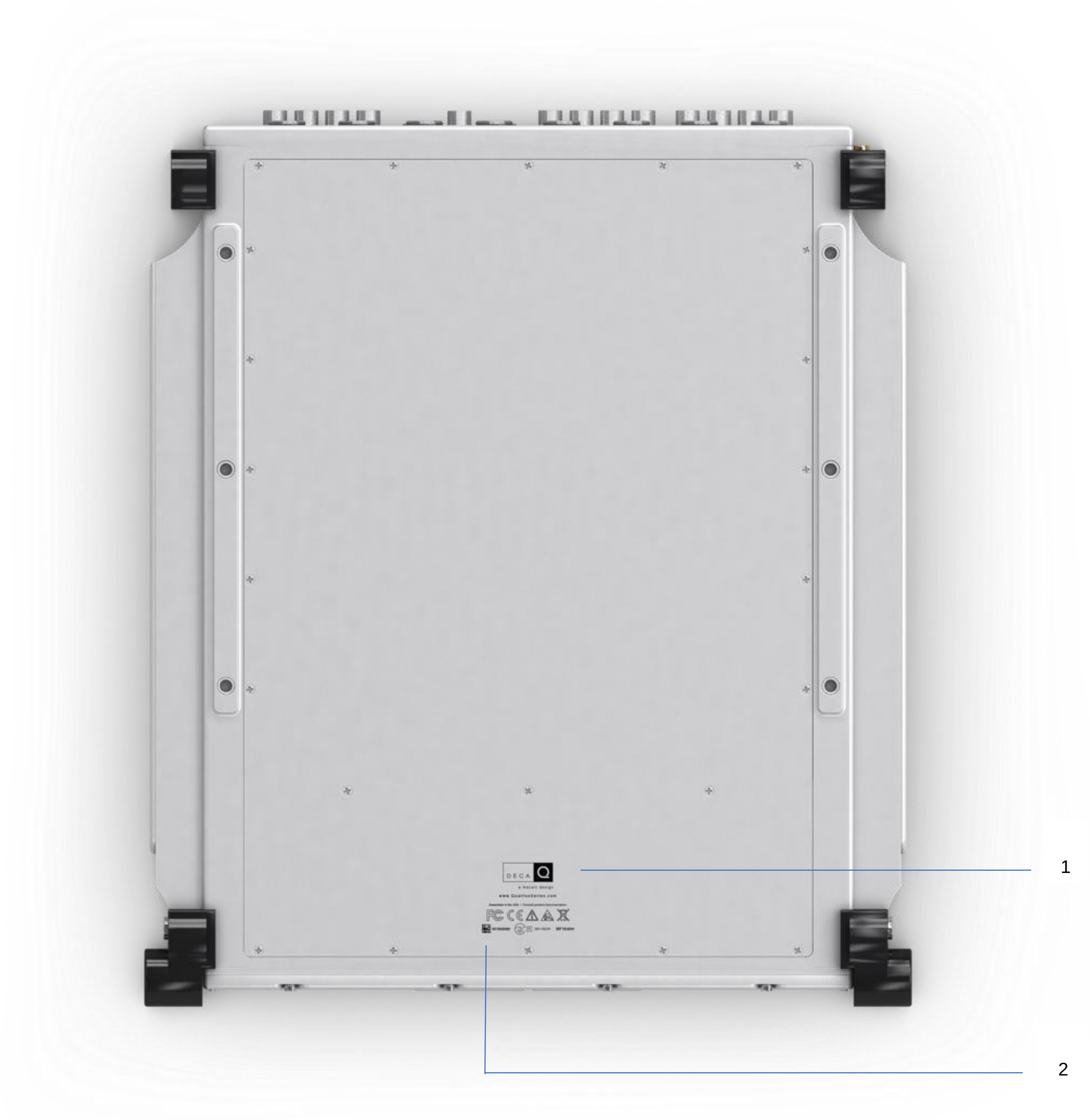
1. **Fan Cover**

   Fans provide cooling for the system’s chassis. To ensure the system maintains its optimal operation temperature, keep the fan intake unobstructed while conducting a measurement. *See Handling Guidelines for Effective Cooling for more information.*

2. **Intake Cover**

   The Intake Cover aids in distributing the air from the fan to the rest of the chassis. Make sure not to cover any space between the chassis and the Intake Cover.

4.5.4. Bottom View



1. Product Label

The Product Label includes certifications and warnings related to the use of the DECA**Q**.

2. Serial Number

The Serial Number / Barcode of each DECA**Q** is found on its base. This identifier allows our Product Experts to access information specific to your device in order to provide valuable support services.

5. Grounding and Electromagnetic Immunity

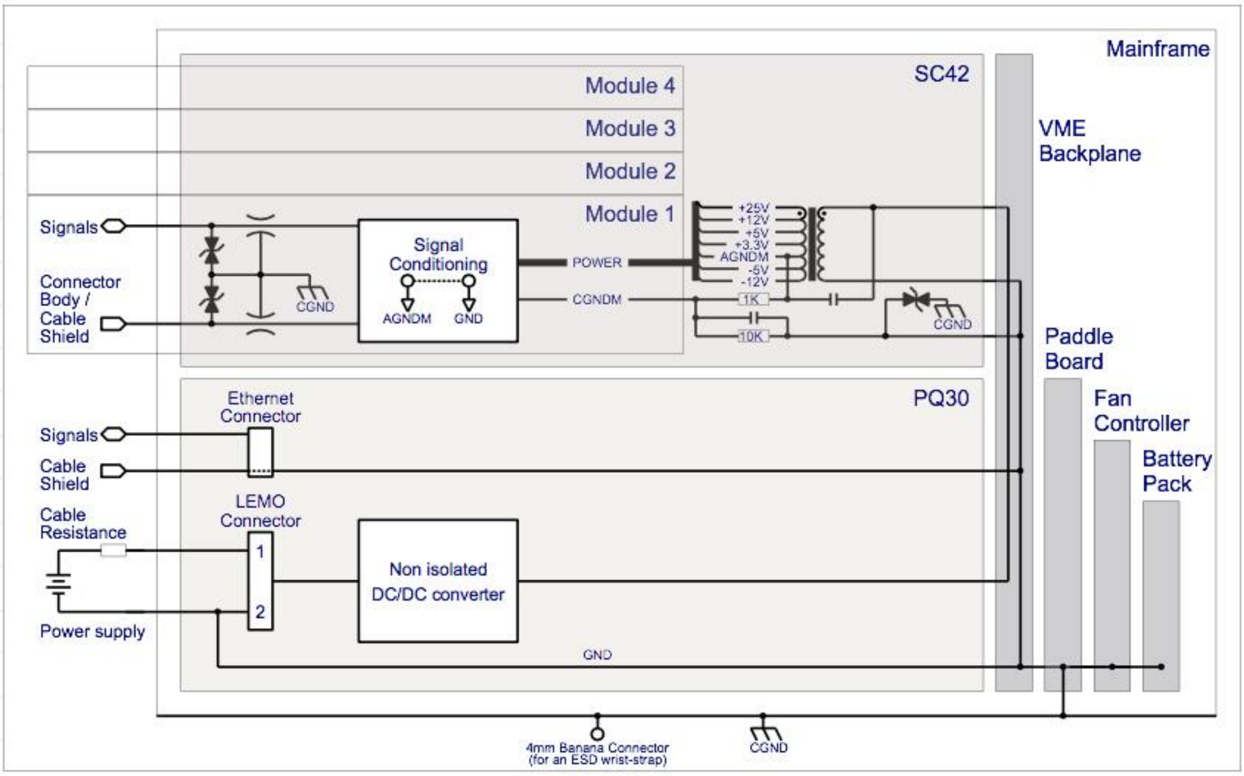
5.1. Grounding

Power and analog grounds for each **Q**Module are isolated from the rest of the DECA**Q** chassis. A resistor allows each **Q**Module's analog ground to float away from the chassis ground. Selected **Q**Modules are fitted with a software-controlled chassis ground switch/relay, which allows both the analog and chassis grounds of the selected **Q**Module to be connected to one another.

The chassis ground is directly connected to the negative terminal of the power supply and Ethernet cable shield. The power supply may or may not need to be earthed, depending on which power supply is being used.

Grounding set-ups must be evaluated on a case-by-case basis. It is often best to experiment with different grounding set-ups to determine the best combination for the measurement's specific environmental determinants and constraints.

The Ethernet connector body is connected to the DECA**Q**'s chassis ground. It is therefore recommended that a UTP network cable be used to avoid ground loops. Do not use the Ethernet connector as the primary earth connection on any DECA**Q** chassis.



5.2. Electromagnetic Immunity

The DECA**Q** complies with EMC directives.

When connecting cables, sensors or third-party devices to the DECA**Q**, electromagnetic noise could be introduced into the measurement.

Recommendations for good measurement practice include:

- Remove or isolate electromagnetic noise sources.
- Use shielded cables, with the shield and signal voltage difference minimized.
- Use twisted pair cables with differential measurements.
- Avoid ground loops by isolating sensors and/or cable shields.
- Use low impedance signal sources where possible.
- Correctly ground the DECA**Q**.
- Use shorter cables.

6. Power

6.1. Power Cables and Power Supply

The DECA**Q** systems use customized power cables to ensure they operate at their optimum level. Using a third-party cable is highly discouraged, as this may damage your system. Contact your supplier for more information about which cable is best suited for your measurement configuration.

DECA**Q** systems operate within a range of 10 - 30 VDC voltage. When running the DECA**Q** from lower voltages, the resulting increased current could cause power cables and connectors to heat up. A lowered supply voltage increases the current flowing through the resistance of the cable and connector, resulting in a quadratic rise in temperature.

When powering larger DECA**Q** systems, it is therefore recommended to:

- Use short cables.
- Use higher voltages (for example, 24 V instead of 12 V).
- Avoid the addition of any intermediate connectors or joints in the power cable.

When switching off your system, make sure it is being powered down using either the Web Server or the User Interface Buttons on the chassis front panel. Switching off the system by merely disconnecting the power supply could result in permanent hardware damage.

Additionally, avoid disconnecting the power supply if a battery is not present. The system's battery power will ensure the protection of your hardware and/or recorded data if the power supply gets disconnected. If you need to switch off the system while it is running on battery power only, please do so using the Web Server or User Interface Buttons (see above).

Warning
Do not switch off or reset your DECA**Q** system while it is booting or while a firmware upgrade is in progress. This could permanently damage the system. Wait for the display to show '**Idle**', '**live**', '**REC**', or '**FAIL**' before continuing to operate on the system.

6.1.1. Available Power Cables

The following table provides information which serves as a guideline when choosing the appropriate power cable for your external power connection:

Termination	Max Current	Length	Name
Mean Well AC-DC Adapters	15.0 A	1.0 m	230K
		Variable	231K
Banana Plugs		2.0 m	213K
Cigarette Plugs		2.0 m	214K
Banana Plugs	20.0 A	2.0 m	216K
		Variable	221K

Suggested power cables for different system configurations

Signal Conditioning and Channel Count	**Power Source**					
	Bench / Battery	**Bench / Battery**	**Cigarette Lighter Socket 214K**	**Mean Well (15 V, 144 V)** Part Number: GST160A15-R7B	**Mean Well (15 V, 201 V)** Part Number: GST220A15-R7B	TDK Lambda (26 V, 260 V) Part Number: ZUP36-12
Up to 5[3] signal conditioning boards / up to 120 channels	213K	216K, 221K	214K	230K, 231K	230K, 231K	213K, 216K, 221K
Up to 8[4] signal conditioning boards / up to 192 channels	213K	216K, 221K	214K	230K, 231K	230K, 231K	213K, 216K, 221K
Up to 9[5] signal conditioning boards / up to 192 channels	213K	216K, 221K	214K	230K, 231K	230K, 231K	216K, 221K

[3] Depending on Module configuration and sampling rate
[4] Depending on Module configuration and sampling rate
[5] Depending on Module configuration and sampling rate

6.1.2. Power Supply

The recommended power supply wattage depends on the size of your DECA**Q** chassis. The following table summarizes the recommended power supply for each DECA**Q** chassis size:

Chassis Size	Recommended Power Supply
2-slot	85 W
3-slot	125 W
4-slot	155 W
6-slot	245 W
10-slot	305 W

When operating either high channel counts (typical of 6-slot and 10-slot DECA**Q** chassis configurations) or while using the Dynamic Charge feature *(see information about DECA**Q** Battery maintenance below)*, the following recommended input voltages should be applied:

	DC Input Voltage	Input Current	Fuse
Min	10 V	-	25 A
Max	30 V	21 A	-
Recommended	> 15 V	< 16 A	-

6.1.3. Uninterruptible Power Supply (UPS) and DECA**Q** Batteries

All DECA**Q** systems contain an internal battery pack. When the power input voltage to the DECA**Q** drops below the threshold voltage (which is typically between 8.5 and 9.6 V, depending on the power technology being used), the DECA**Q**'s UPS will power the system using the battery pack.

If the DECA**Q** runs for more than 4 seconds from its battery pack, the User Interface display will show '**BACKUP**' or '**BKP**'. Once the system's power input voltage rises above the threshold, the UPS will automatically switch back to the DECA**Q**'s power input as its primary power supply.

The DECA**Q** can run from the battery pack for a specified battery pack temperature of between -20 °C and 65 °C, although battery capacity will decrease at low temperatures. No protection is provided should the DECA**Q** attempt to source its power from the battery pack at temperatures below -20 °C.

6.1.4. Battery Maintenance

Charging the battery

There are three ways to charge the DECA**Q** battery:

- **FCH – Fast Charge**

  Fast charge can only be performed if the DECA**Q** is switched off. Charging times vary according to the chassis size – a 2-slot DECA**Q** takes 2 hours to charge (the fastest charging time), whereas the 10-slot DECA**Q** takes 3 hours to charge (the slowest charging time).

- **SCH – Slow Charge**

  A slow charge is able to charge the battery when both the DECA**Q** is switched on or off. Slow charge takes about 16 hours to charge a fully depleted 10-slot DECA**Q** Battery.

- **DCH – Dynamic Charge**

  This setting charges the battery as fast as possible while the DECA**Q** is switched on. With Dynamic Charge, all available power not being used by the system is diverted to the battery.

Only one of these three charge algorithms can be active at any given time.

The battery has to be charged for the DECA**Q**'s uninterruptible power supply (UPS) to supply the system with backup power. You can use any of the three settings to recharge a discharged battery. These options can be selected on the User Interface. *(See Navigating the DECA**Q**'s User Interface Display for more information)*

The most efficient way of maintaining the battery is to use the new 'Dynamic Charge' setting. Dynamic Charge will ensure the system automatically keeps the battery in a fully charged state.

Alternatively, 'Slow Charge' and 'Fast Charge' can also be used to fully recharge a battery that has been depleted. It is recommended to fully deplete and then recharge the DECA**Q** Battery at least once every 6 months (using either Slow Charge or Fast Charge).

Please note
• If the external power source is removed while charging is in progress, the DECA**Q** will switch to backup mode and run from the battery. • Due to the properties of NiCd/NiMH rechargeable batteries, recharging can only be performed when the battery is between 10 °C and 45 °C. Once the temperature exceeds 45 °C, the User Interface will display **BHOT** and charging will stop.

BHOT

BHOT is displayed on the User Interface display when the battery pack is hot (≥65°C) or has gone above 45 °C while being charged. In both cases, the system will cease to charge the battery:

- 45 °C
  While the battery pack is being charged, the temperature at which the battery pack is considered 'hot' is 45 °C. This is for safety reasons as it is better for the battery pack to be charged at lower levels.
- 65 °C
  While the battery pack is not being charged, the temperature at which the battery pack is considered 'hot' is 65 °C.

*Please see Navigating the DECA**Q**'s User Interface Display for more information to find out how to select the relevant battery charging option.*

7. Switching On / Off the DECA**Q**

Before switching on the DECA**Q**, make sure it is being powered with an external power source or contains a charged battery.

7.1. Switch On

Switch on the DECA**Q** via the User Interface by applying the following steps:

- Press and hold in the **I** Button. The LEDs will flash to indicate initialization.
- When you see **ON?** appear on the User Interface display, press the **OK** Button (select **ON**).
- The User Interface display will then show **SURE**. Press the **OK** Button to select **SURE**.
- The User Interface display will show **DECAQ** – this indicates the system has started to boot.
- If the system is running off battery power the User Interface display will show **BKup**.
- The User Interface display will then show **Wait** – this indicates the DECA**Q** has started to initialize its signal conditioning boards and **Q**Modules. '**Wait**' will then be replaced with a boot and upgrade percentage [**xx%**].
- Wait for the User Interface display to indicate **Idle** – this indicates the DECA**Q** has powered up and booted successfully.

*See Navigating the DECA**Q**'s User Interface Display for more information about the User Interface display.*

7.2. Switch Off

Switch off the DECA**Q** via the User Interface by applying the following steps:

- Scroll using the **I** Button until the display shows **OFF?**
- Select **OFF?** by pressing the **OK** Button. The display will then show **SURE**.
- Select **SURE** using the **OK** Button. The display will then show **OK** – select **OK**.

Please note
Take care not to switch off your DECA**Q** while it is running a test. The procedure above will shut down the system irrespective of whether a test is being run or not. Please ensure the test sequence has concluded before switching off the system, since valuable data may be lost if the test is still running.

8. Setting Up Your DECA**Q**

The DECA**Q** can be connected to a Notebook / PC / network / smart device through Ethernet and/or Wi-Fi.

8.1. Connecting to the DECA**Q with Wi-Fi**

A built-in 2 MIMO streams IEEE 802.11b/g/n Wi-Fi network interface is available on the DECA**Q**. The Wi-Fi network interface can be used where truly mobile operation of the DECA**Q** is required.

The default configuration for the DECA**Q** Wi-Fi interface is:

- Access Point Mode
- Wi-Fi SSID: “DecaQ_[Serial Number printed on the bottom]” e.g. “DecaQ_1234S5678”
- Channel number: 6
- Encryption: Disabled
- Country: Germany
- IP address: 192.168.2.204
- Subnet mask: 255.255.255.0
- mDNS enabled with default name: “DecaQ_[Serial Number printed on the bottom]” e.g. “DecaQ_1234S5678”
- DHCP Server enabled

Connect to the DECA**Q** with your compatible Wi-Fi device using the SSID mentioned above. To test connectivity, use the default IP address as the URL in a web browser, for example: http://192.168.2.204.
The default mDNS name may also be used in compatible web browsers, for example: http://DecaQ_1234S5678.local.

The browser should then display the DECA**Q**’s “System Overview” page. The DECA**Q**’s start-up Wi-Fi interface configuration parameters can be edited in the Web Server’s network setting configuration pages.

Effective Wi-Fi data streaming rates of up to 2.7 MB/s can be achieved with your DECA**Q**. Please note that your DECA**Q** Wi-Fi connection performance is highly dependent on its connection settings, as well as environmental factors including (but not limited to) distance, interference and shared bandwidth.

Please note
When configuring the Wi-Fi interface, the settings for “Country”, “IP address” and “Subnet mask” might be different depending on the country in which you are setting up the device.

8.2. Connecting to the DECAQ with Ethernet

A Gigabit Ethernet connection (1000 BASE-T) is available on the DECA**Q**’s front panel that can accept compatible Ethernet cables. When using Ethernet on the DECA**Q** use only a CAT5E UTP cable. This will ensure the correct screening of signals throughout the length of the cable.

The default configuration for the DECA**Q** Ethernet interface is:

- IEEE 802.3 compliant Auto-Negotiation to determine link speed and duplex
- IEEE 802.3 compliant Auto-Negotiation to determine link speed and duplex
- mDNS enabled with default name: “DecaQ_[Serial Number printed on the bottom]”
  e.g. “DecaQ_1234S5678”
- DHCP Client mode enabled (will default to an Automatic Private IP address such as 169.254.119.144 if no DHCP Server discovered)

To test connectivity to the DECA**Q**, use a web browser that supports mDNS and enter the URL “http://MKII_1234S5678.local” (replace “1234S5678” with the Serial Number of the DECA**Q**).

The browser should then display the DECA**Q** “System Overview” page. The DECA**Q**’s start-up Ethernet interface configuration parameters can be edited in the Web Server’s network setting configuration pages.

To use the Ethernet interface, simply plug in an Ethernet cable. The DECA**Q** will automatically detect the Ethernet cable and initialize it as the primary network interface. Two RJ45 connectors are available – use the one closest to the label “ENET” or “PTP” to connect the DECA**Q**. *The connector furthest from the labels “ENET” or “PTP” is reserved for future applications.*

Once booted, the interface will show the system’s IP address. The Web Server can then be used (with the IP address as the hyperlink) to make modifications to the network set-up.

Ethernet Connection Range and Cables

Gigabit Ethernet over copper (1000BASE-T) connections allow for cable lengths of up to 100 m. If a longer connection distance is required, active repeaters need to be used at each 100 m interval. Note that longer Ethernet connection cables will increase cable resistance, resulting in power transfer inefficiencies and increased cable temperature. It is therefore recommended that CAT6A Ethernet cables be used due to their reduced cable resistance, especially when long Ethernet connection cables are required for a measurement.

8.3. Connecting to PAK capture (A product of Müller-BBM VibroAkustik Systeme GmbH)

Download the PAK capture App and pair your DECA**Q to your smart device:**

PAK capture can be used on iOS® devices. Download the latest version of the App free of charge from the Apple App Store. Once you have downloaded and opened the App, tap on "Help". This will show you how to pair your DECA**Q** to your smart device.

Read the FAQ or "Help" section found in PAK capture to find out more.

IN PARTNERSHIP WITH

MÜLLER-BBM
VibroAkustik Systeme

9. Connecting to the Web Server

DECA**Q** system information is available on the Web Server. This includes all boards that make up the specific system, their serial numbers and firmware. The following DECA**Q** parameters are shown and can be configured via the Web Server:

- Global power settings or when running on battery

  - Setting input current limit
  - Length of time to power down
  - Length of time to standby
  - Automatic on when power detected

- Battery charging method (slow, dynamic or trickle charge)

- Fan behavior and speed settings (constant or dynamic)

- S-Port settings (for example to enable the use of the MiniTerminal)

- LAN settings

  - IP address
  - Subnet mask
  - DHCP

- Wi-Fi settings

  - Network mode (Access Point or Infrastructure Mode)
  - IP address
  - Subnet mask
  - Country code
  - SSID name
  - Enable or disable Broadcast SSID
  - Channel bandwidth
  - Channel number
  - Encryption type
  - DHCP

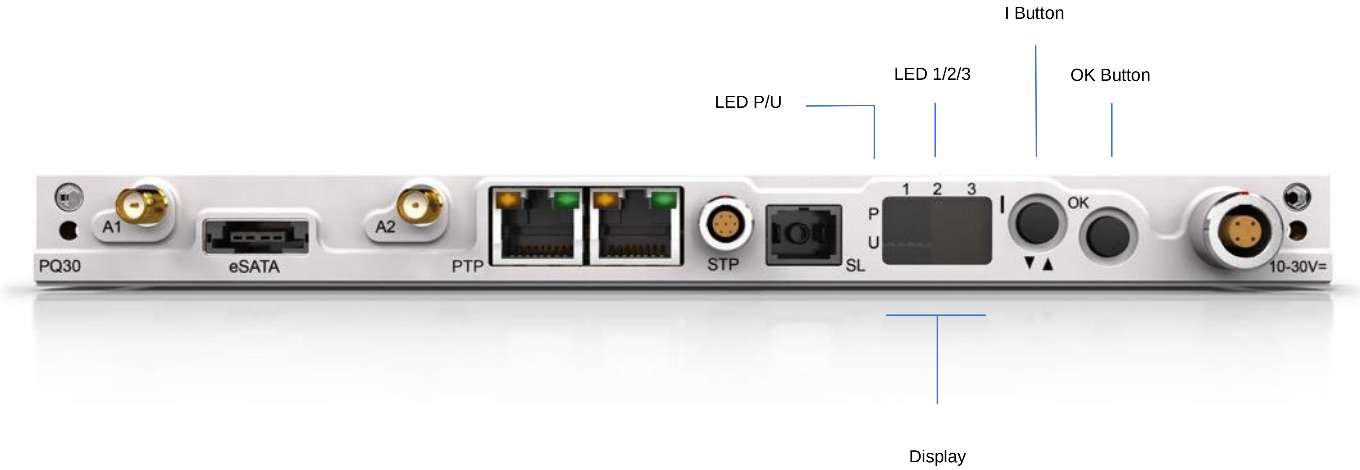
- Bridged mode settings (to allow the LAN and WLAN to share the same IP address, this enables the network traffic to be streamed from Wi-Fi to LAN and vice versa)

- Local storage device settings (change preferred device, format and perform a S.M.A.R.T assessment of the SSD)

- Advanced DECA**Q** settings

    - Change system password
    - Change system name
    - PTP Synchronization settings

10. Navigating the DECAQ's User Interface Display



The DECA**Q** User Interface provides specific system information and allows the user to perform certain vital commands. It is found on the System board of the chassis and consists of a four-character display, five LEDs (LEDs 1,2,3 and LEDs P and U) and two buttons (the **I** Button and the **OK** Button).

To control the User Interface, press the **I** Button to scroll down menu options shown on the display. Use the **OK** Button to select an item from the menu to execute its related command. As a safety feature the display might show '**SURE**', asking the user to confirm the command before the system will execute it.

To increase the brightness of the display, hold down the **OK** Button and wait for it to cycle through different brightness levels. Once the display has reached the preferred brightness level, release the **OK** Button.

Please note
Do not switch off or reset the DECA**Q** while it is busy booting or while a firmware upgrade is taking place, as this could permanently damage the system. Wait for the User Interface to display '**Idle**', '**live**', '**Rec**' or '**FAIL**' before executing additional commands.

10.1. User Interface Menu Options: DECAQ Switched Off

The following table represents the available menu options while the DECA**Q** is switched off:

	**ON?** Switch on the DECA**Q**
	**OFF?** Leave the DECA**Q** off
	**FCH?** Fast Charge the battery
	**SCH?** Slow Charge the battery
	**SVB?** Service the battery

These options will continue to loop if the user continues to press the **I** Button (i.e. **SVB?** will be followed by **ON?**).

*See Switching On / Off the DECA**Q** for more information about how to Switch on and Switch off the DECA**Q**.*

10.1.1. Fast Charge (FCH?)

Fast Charge (**FCH?**) uses approximately 60 W of additional electrical input power. If the input power supply is not capable of providing the additional power, the system might reset. Fast Charge can only be performed before the system boots. This method also introduces additional heat into the system. It is therefore highly recommended that it be performed in an area with a free flow of cool air.

To protect the system from overheating, the DECA**Q** needs to remain switched off while the Fast Charge method is being used to charge the battery.

To Fast Charge the battery (DECA**Q** switched off):

- Ensure the DECA**Q** system is switched off.
- Press the **I** Button to power-up.
- When **ON?** appears on the display, repeatedly press the **I** Button to scroll through the menu until the display shows **FCH?** or **SCH?**
- Press the **OK** Button to select **FCH?**. The display will show **SURE** (for confirmation) – press the **OK** Button again to confirm the command.
- It may take up to 5 minutes before the charging starts. Once the charging has started, the LEDs 3,2,1 will light up in sequence (the sequence is slower for Slow Charge).

See Battery Maintenance for more information about different charging modes.

10.1.2. Slow Charge: DECAQ Switched Off

Slow Charge (**SCH?**) uses approximately 10 W of electrical input power. With Slow Charge, the user can keep the system on and charge the batteries without overheating the DECA**Q**, as Slow Charge only places a small additional load on the power supply unit. It will, however, take up to 16 hours to fully recharge the battery with this setting.

In this section, the following steps show how to charge the DECA**Q** using Slow Charge while the system is **not operational**:

- Ensure the DECA**Q** system is switched off.
- Press the **I** Button to power-up.
- When **ON?** appears on the display, repeatedly press the **I** Button to scroll through the menu until the display shows **FCH?** or **SCH?**
- Press the **OK** Button to select **SCH?**. The display will show **SURE** (for confirmation) – press the **OK** Button again to confirm the command.
- It may take up to 5 minutes before the charging starts. Once the charging has started, the LEDs 3,2,1 will light up in sequence (the sequence is faster for Fast Charge).

*See Battery Maintenance for more information about different charging modes, and Slow Charge (SCH): DECA**Q** Switched On for more information about how to charge with Slow Charge while the system is still operational.*

10.1.3. Service Battery (SVB)

Selecting **SVB?** (Service Battery) fully depletes the battery and then automatically begins a Slow Charge cycle. This process can be ended at any point of the **SVB?** cycle by selecting **ESB?** (End Servicing the Battery).

For optimum battery care, deplete and fully recharge DECA**Q** Batteries at least once every six months. This ensures batteries maintain their maximum energy capacity.

10.2. User Interface Menu Options: DECA**Q** Switched On

The following menu options will be available on the User Interface display once the DECA**Q** has been switched on (to scroll through these options, press the **I** Button until the option appears on the display):

	**Idle** Default text displayed on the DECA**Q** User Interface
	**live** PAK live is running on the DECA**Q** system
	**Rec** PAK live running and recording onto the local disk
	**Trig** PAK live is running and a trigger is armed
	**IP?** Displays the IP address of LAN and Wi-Fi, as well as firmware revisions
	**RST?** Reset the DECA**Q**
	**OFF?** Power down the DECA**Q**
	**BAT?** Battery information
	**PSU?** Power Supply Unit information

	**TMP?** Temperature
	**AOn?** Automatically turn on the DECA**Q** when power is supplied to the power LEMO®
	**INF?** Information and firmware revisions of the DECA**Q**
	**BTMx** The amount of time a test can run on battery backup before shutting down
	**SCH?** Slow Charge the battery
	**DCH?** Dynamic Charge the battery
	**DFLT** Changes boot parameters of the DECA**Q** back to the system's default settings

The menu options on the User Interface cycle in a repetitive loop – press the **I** Button to scroll from **DFLT** to **IP?** and so on.

10.2.1. IP Address (IP?)

To display the IP address on the User Interface display:

- Scroll the menu by pressing the **I** Button until the display shows **IP?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK** and then 4 x 1 IP address groups, for example **192., 168., 1.,** and **231.**, to give the complete IP address **192.168.1.231.**
- If a WLAN board is fitted it will also display its IP address before displaying the firmware versions.
- After displaying the IP address, the DECA**Q**, User Interface will display other information on the Controller and Signal Conditioning firmware versions which are currently being used with the DECA**Q**:
    - The Controller firmware release number is displayed (e.g. **1 - 4 - a**)
    - The Controller firmware release information is displayed (e.g. **13582605**)
    - The Signal Conditioning firmware release number is displayed (e.g. **1 - 4 - a**)
    - The Signal Conditioning firmware release information is displayed (e.g. **16230809**)

10.2.2. Resetting the System (RST?)

To reset the DECA**Q**:

- Scroll the menu by pressing the **I** Button until the display shows **RST?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK** and then **Boot**.

Please note
Resetting the system using this procedure overrides any operation currently being performed. The DECA**Q** will therefore be reset irrespective of whether a test is running or not, increasing the risk that valuable data may be lost.

10.2.3. Switching Off the DECAQ (OFF?)

*See Switch Off the DECA**Q** for more information.*

10.2.4. Battery Information (BAT?)

This menu option will show information regarding the status of the DECA**Q** Battery:

- Scroll the menu by pressing the **I** Button until the display shows **BAT?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK**, followed by **Wait** and **BON**[6]. During this stage, the system will draw its power from the battery while measuring the battery's voltage.
- The display will show the current battery voltage, for example **15.1**.
- The display will show a comment on the battery's status (based on the battery voltage), for example **BOk+** (see below).
- The display will then show the battery temperature in degrees Celsius, for example **+26C**.

For a DECA**Q** 2-slot system (with an 8-cell battery), the voltage levels are as follows:

- **BFUL** (> 10 V)
- **BOk+** (9.4 V to 10 V)
- **BOk-** (8.6 V to 9.4 V)

[6] If no valid battery has been fitted, the display will show **NO B**

- **BLOW** (<8.6 V)

For DECA**Q** 3- , 4- , 6- and 10-slots (each with 12-cell batteries), the voltage levels are as follows:

- **BFUL** (> 15.6 V)
- **BOk+** (13.2 V to 15.6 V)
- **BOk-** (12.7 V to 13.2 V)
- **BLOW** (< 12.7 V)

10.2.5. Power Supply Status (PSU?)

This menu option on the User Interface display shows the measured electrical voltage and/or current levels of the current DECA**Q** power input in use. It also shows information regarding the internal power supplies.

In order to see this information:

- Scroll the menu by pressing the **I** Button until the display shows **PSU?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK** and will thereafter the power supply status.

The following information is displayed:

	**PVxx** The PSU firmware version currently executing on the system
	**VP: xx.x** Primary input voltage (measured at the DECA**Q** power input)
	**VS: x.xx** Secondary input voltage (battery)
	**VF: x.xx** Final input voltage used by UPS to supply the DECA**Q**
	**V3: x.xx** Voltage of 3.3 V supply (3.2 V to 3.45 V)
	**V5: x.xx** Voltage of 5 V supply (4.85 V to 5.25 V)
	**V12: x.xx** Voltage of 12 V supply (11.7 V to 12.6 V)
	**V24: x.xx** Voltage of 20 V intermediate supply (20 V to 32 V)
	**IP: xx.x** Primary input current (measured at the DECA**Q** power input)
	**IB: xx.x** Battery current

	**I5: xx.x** Current of 5 V supply
	**12: xx.x** Current of 12 V supply

Please note
If the battery is nearly or completely discharged, the system might reset.

10.2.6. Temperature (TMP?)

To let the display show the status of the chassis temperature:

- Scroll the menu by pressing the **I** Button until the display shows **TMP?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK** and thereafter the temperature of the chassis, for example **+40C**.

10.2.7. Auto or Manual ON (AOn? / MOn?)

The DECA**Q** allows the user to choose between switching on the system using the User Interface or letting the system switch on automatically when its power connector detects a voltage.

AOn? (Automatic On)

The user can choose to either switch on the DECA**Q** via the User Interface or to allow the DECA**Q** to switch on automatically when its power connector detects a voltage. Automatic On is intended for use when the location of the DECA**Q** makes it difficult for the user to reach the User Interface when conducting a measurement. For convenience, the DECA**Q** will then power up when the system's external power source is switched on[7].

[7] For Automatic On to work, the DECA**Q** must be able to detect a change in voltage at its power connector, typically between 0 V and 12-30 V.

To set to **AOn** (Automatic On):

- Scroll the menu by pressing the **I** Button until the display shows **AOn?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK**.

On this setting, the system will turn on automatically when power is applied – the display will show **ON?** and count down to 0s before completely starting the system. During the countdown, the user can stop the process by pressing any User Interface Button. Functions available before the system's start-up (with the DECA**Q** switched off) can then be selected in the usual manner. If the user does not press any User Interface Buttons during this stage, the system will power up and start.

MOn? (Manual On)

Switch on the DECA**Q** via the User Interface.

To set to **MOn** (Manual On):

- Scroll the menu by pressing the **I** Button until the display shows **MOn?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK**.

Manual On is the DECA**Q**'s default switching on mode. The instructions above will help the user restore the system power up setting back to Manual On if the setting had previously been set to Automatic On.

10.2.8. General System Information (INF?)

This menu option shows information and firmware versions related to the DECA**Q**.

To view the information:

- Scroll the menu by pressing the **I** Button until the display shows **INF?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK** and thereafter show the information.

Examples of the information displayed include:

- The current PSU firmware version currently executing on the System board:

  PSU Firmware: **PV17**

- Hardware version information about the System board that includes the name, revision and build number for the printed-circuit board (PCB):

  PCB Name: **PCB PQ30**
  PCB Rev: **Rev 06**
  PCB Build: **Bld A*****

- The UPS, CPLD and FPGA firmware programmed onto the DECA**Q** which is not remotely upgradable and hence their current version is displayed here (note this information is related to the build number):

  UPS Firmware: **UPS 07**
  CPLD Firmware: **CPLD 01**
  FPGA Firmware: **FPGA 01**

- The PQ serial number (shown without the 'M' character due to lack of space):

  Serial Number: **SrNo 03129032**

10.2.9. Backup Time Setting (BTMx)

The ‘Backup Time Setting’ is the amount of time the DECA**Q** will run from the battery before it powers itself down. This setting is useful if the user doesn’t want the battery to be fully drained before powering down.

To change the Backup Time Setting:

- Ensure the DECA**Q** is switched on (powered up).
- Scroll the menu by pressing the **I** Button until the display shows **BTMx**.
- Press the **OK** Button to select this option.
- Scroll through the options by pressing the **I** Button until you have selected your preferred setting (for example, **BT02**)
- Press the **OK** Button to select this option. The display will show **OK**.

There are seven options for the Backup Time Setting:

- **BTimeOff: Off**
  Backup Time Setting is not active. In this state, the DECA**Q** will immediately power down when external power is disconnected from the chassis.
- **BT01: 1 min**
  Backup Time Setting is set to 1 minute. When backup starts, the battery will provide power for a maximum of 1 minute before it powers down.
- **BT02: 2 min**
  Backup Time Setting is set to 2 minutes.
- **BT05: 5 min**
  Backup Time Setting is set to 5 minutes.
- **BT10: 10 min**
  Backup Time Setting is set to 10 minutes.

- **BT30: 30 min**
  Backup Time Setting is set to 30 minutes.

- **BTMx: Max**
  Backup Time Setting is set to Max. When backup starts the DECA**Q** will run from backup power until the battery power has been fully drained.

Please note
Selecting the **BTimeOff** option disables the system's UPS, making it impossible to use the battery pack as a power source. To turn on the system without external power (using the battery pack), the following steps need to be followed: • Press the **I** Button down for at least 3 seconds. The display will be blank but will thereafter show **RST!** • Press the **OK** Button to confirm. • The **BTimeOff** setting has now been reset to **BTMx**.

10.2.10. Slow Charge (SCH): DECA**Q Switched On**

The Slow Charge setting allows the user to charge the battery while the system is still powered up. This method ensures the system does not overheat, as it only places a small additional power load on the PSU. The drawback is it can take up to 16 hours to fully recharge the battery.

To Slow Charge the battery while the DECA**Q** is switched on:

- If the DECA**Q** is switched off, first switch on the system *(see Switch On for more information)* and then wait for the system to boot (i.e. until the User Interface display shows **Idle**).
- Scroll the menu by pressing the **I** Button until the display shows **SCH?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command. It may take up to 5 minutes before charging commences.
- LEDs 3, 2, 1 will light up in sequence. The sequence will be slow for Slow Charge.
- Continue to use the system.

To end Slow Charge, scroll the menu by pressing the **I** Button until the display shows **eSCH**, then press the **OK** Button to select the option.

10.2.11. Dynamic Charge (DCH)

Selecting Dynamic Charge allows you to charge your battery while the system is running. Unlike Slow Charging, however, with Dynamic Charge the charge current will adapt depending on the amount of system input current available. While this method charges the battery faster than Slow Charge, its additional (up to) 40 W of electrical input power brings extra heat into the system.

To Dynamic Charge the battery while the DECA**Q** is switched on:

- If the DECA**Q** is switched off, first switch on the system *(see Switch On for more information)* and then wait for the system to boot (i.e. until the User Interface display shows **Idle**).
- Scroll the menu by pressing the **I** Button until the display shows **DCH?**
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command. It may take up to 5 minutes before charging commences.
- LEDs 3, 2, 1 will light up in sequence. The Dynamic Charge sequence will be faster than Slow Charge.
- Continue to use the system.

To end Dynamic Charge, scroll the menu by pressing the **I** Button until the display shows **eDCH**, then press the **OK** Button to select.

Input Currents and System Temperature

Dynamic Charge requires the total input current to be less than 15 A before it will start charging. Once the system's input current is less than 15 A, charging will commence. Thereafter, the battery charge current will increase until maximum charge current is reached, or the input current rises to above 15 A.

If the total input current rises to above 16 A during charging, the charge current will be reduced until the input current is below 16 A or until zero charge current has been reached. Once zero charge current has been reached, the charge current will only increase again when input current to the system falls below 15 A. At zero charge current, Dynamic Charge will be “pending” for a maximum of 16 hours.

Dynamic Charge Cycles and Termination

Dynamic Charge will start a charge cycle:

- 100 seconds after system boot.
- 100 seconds after coming out of backup mode.
- 3 minutes after coming out of backup mode, if the charge cycle was previously terminated because the battery had been fully charged.

Dynamic Charge will terminate when:

- The battery is fully charged (the battery reaches a fully charged status).
- The main input power has been lost and the system goes into backup mode.
- The charge cycle time has expired (16 hours).
- A fault is detected in the battery.

Dynamic Charge Deactivation

Once the setting has been changed to Dynamic Charge, the system will use it as the default setting. The setting can then be deactivated via the User Interface or Web Server if necessary and will stay deactivated until the user activates the setting again.

Selecting Slow Charge and Fast Charge before the system boots (DECA**Q** switched off) does not have an effect on Dynamic Charge (which is only applicable once the system is operational (DECA**Q** switched on)).

Dynamic Charge will be deactivated when (summary):

- The user selects to deactivate Dynamic Charge via the User Interface or the Web Server.
- The Slow Charge function is selected after the system has booted (DECA**Q** switched on).

10.2.12. Restore Default Settings (DFLT)

To restore the system to its default boot parameters:

- Scroll the menu by pressing the **I** Button until the display shows **DFLT**.
- Press the **OK** Button to select this option. The display will show **SURE**.
- Press the **OK** Button again to confirm the command.
- The display will show **OK**.

The default boot parameters of the DECA**Q** System board are:

inet on ethernet (e)	: 192.168.100.5
WLAN IP Address	:192.168.2.204
DHCP Mode	: Disabled
Bridged Mode	: Disabled
ftp password (pw)	: password

10.3. Boot-Up Messages displayed on the User Interface

When the DECA**Q** is switched on it will begin to boot-up with firmware stored in its internal Flash memory. There are three stages to booting up correctly:

- Boot-up the System board and begin communications over the internal VMEbus as well as external LAN or Wi-Fi,
- Boot-up each Signal Conditioning board in the system, and
- Boot-up each **Q**Module in the system.

During boot-up the device will show the following messages on the User Interface:

	**DECAQ** The default message displayed at start-up
	**Boot** This message is displayed while the System board is booting
	**PSU** This message is displayed during the Power Supply firmware check
	**36%** This is the progress indicator – it is displayed during the Signal Conditioning and **Q**Module boot-up.
	**Idle** This message will be displayed once the boot-up is complete
	**live** This message is displayed once boot-up is complete and PAK live is running on the DECA**Q** system. Measurements will automatically start after boot-up when PAK live is running on the system.

10.4. User Interface Indicators – Power Supply Firmware Upgrading

The Power Supply firmware is upgradable. If an upgrade is required, it will automatically occur during the boot-up of the DECA**Q** and interrupt the normal boot-up procedure.

The following will be displayed on the User Interface while a Power Supply firmware upgrade is taking place:

- The User Interface display will show **Load** for a few seconds, indicating the Power Supply firmware upgrade is taking place.
- This will be followed by the symbols ***/ / / /*** rotating on the display.
- **LED 1** will also blink on and off.
- Once the upgrade process has completed successfully (this may take up to 1 minute), the message **RST?** will appear on the display.
- Press the **OK** Button to select **RST?**
- Press the **OK** Button again to confirm the command.

If **RST?** doesn't appear after several minutes, power-down and then power-up the DECA**Q** again to re-execute the Power Supply firmware upgrade procedure.

Power Supply firmware upgrades typically take place after the DECA**Q** has been programmed with new firmware.

10.5. User Interface Indicators – Other Firmware Upgrade Messages

Once a DECA**Q** system has booted successfully, PAK software is able to upgrade DECA**Q** firmware over the Ethernet network connection, should this be necessary. DECA**Q** firmware is further subdivided into three sections that each correspond to a target device, i.e. Controller (System board), Signal Conditioning board and MiniTerminal.

During an upgrade, the display will indicate which section is currently being upgraded with the following:

	**SCU** Indicates the Signal Conditioning board, System board and MiniTerminal firmware are being upgraded over the network
	**UGS** Indicates the Signal Conditioning firmware is being upgraded over the network
	**UGI** Indicates the System board firmware is being upgraded over the network.
	**UGR** Indicates RTP firmware is being upgraded over the network
	**UMT** Indicates the MiniTerminal firmware is being upgraded over the network
	**MDU** Indicates **Q**Module firmware is being upgraded from the Signal Conditioning board

11. Understanding the DECA**Q’s LEDs**

The DECA**Q** User Interface provides specific system information and allows the user to perform certain vital commands. It is found on the System board of the chassis and consists of a four-character display, five LEDs (LEDs 1,2,3 and LEDs P and U) and two buttons (the **I** Button and the **OK** Button).

The User Interface’s LEDs indicate when the system is active and provides information about different DECA**Q** Battery and power statuses.

Below find a brief explanation of each LED action and what it represents:

- **LED 1 ON**
  System is running from the DECA**Q** Battery.

- **LED 1 Pulsing Once Every 5 Seconds**
  The system is active.

- **LED 2 Flashing**
  The battery is low. The User Interface display will also indicate **LOW**. Once the capacity of the battery has been exhausted, the system will switch off and valuable data may be lost. It is therefore important to stop all tests as quickly as possible or reconnect to an external power source once this occurs.

- **LED 3 Flashing**
  Battery Error. Possible reasons include:

  - The battery temperature is outside the valid charging range[8].
  - The temperature sensor of the battery is malfunctioning.
  - The maximum cell voltage exceeds 1.8 V.

[8] Charging will start as soon as the battery temperature reaches the valid range.

- The input voltage to the battery charger of the DECA**Q** System board is too low. This can either be caused by a fault on the DECA**Q** System board or by an unstable external input voltage being supplied to the DECA**Q**.
- There is no battery present.

- **LED 3, 2, 1 Flashing in Sequence**
  The battery is being charged. Due to the properties of NiCd or NiMH rechargeable batteries, recharging can only be performed when the battery is between 10 °C and 45 °C.

- **LED 3 and 2 Flash Simultaneously**
  Battery charge is “pending” during a Dynamic Charge cycle.

- **LED P On**
  The polarity of the power input supplied to the DECA**Q** is incorrect.

- **LED U On**
  The power input voltage is above or below the allowed voltage range.

12. Measure: Signal Conditioning

The DECA**Q**'s Signal Conditioning **Q**Modules are housed in the system's Signal Conditioning boards, each board providing signal processing and mechanical infrastructure for up to 4 **Q**Modules.

These boards provide:

- Isolated power for each **Q**Module.
- A DC accurate calibration engine used to calibrate each **Q**Module.
- Sample timing infrastructure.
- Internal communication interfaces used to set parameters for each channel.
- The ability for the user to insert / remove **Q**Modules depending on their measurement need.

12.1. Available Signal Conditioning Channels (**Q**Modules)

The DECA**Q** chassis contains multiple slots that support a variety of interchangeable Signal Conditioning channels (**Q**Modules), which can be purchased separately and then added and/or swapped as the need arises. **Q**Modules are packaged in a robust aluminium casing so as to optimize size and thermal performance, as well as to provide electronic protection.

All **Q**Modules include the following features:

- 50 V galvanic isolation from one **Q**Module to another.
- Automatic internal calibration capability.
- All settings are software configurable.
- Very high channel density.
- Excellent 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 limited continuous over-voltages.

- Strong Electromagnetic Interference (EMI) screening for lower noise floor.
- Firmware protection from excessive external EMI events.
- Low power consumption.

Available Modules and a summary of their features are presented in the following section. More information regarding specific Modules (eg. Specification Sheets) is available in separate documents which can be requested from your supplier.

12.1.1. ICS42

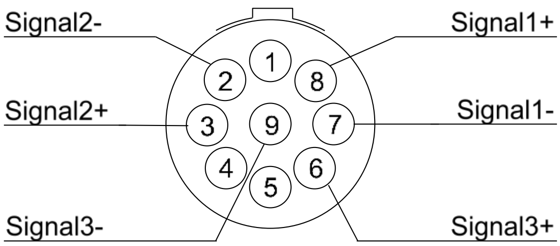
Description

The ICS42 Module can be used with ICP® based accelerometers, force and pressure sensors as well as to measure analog voltages. All 6 channels operate independently of each other, each with their own setting of mode, gain and coupling. The Module can be 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

Front Panel

Connector Information and Pin Definitions



ICS42 with LEMO® 9-way EHG.0B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Features

- 6 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
- ±(100 mV, 1 V, 10 V) input ranges
- Highly configurable to accommodate single-ended and triaxial sensors
- Supports a number of known industry triaxial cables
- 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
- Low power consumption
- LEMO® 9-way EHG.0B connectors

Interface	ICP®	ICP® sensors			
	ALI	For analog source voltages			
Input Coupling	ICP®	AC			
	ALI	DC or AC			
AC Coupling Frequency Response	ICP® / ALI	**Attenuation**	**Min**	**Max**	**Unit**
		-3 dB	-	0.16	Hz
Other Sampling Rates		Available through digital LP filters and decimation			
Optional Programmable Digital IIR Filter		Band pass/stop : 6 dB/octave High/Low pass : 12 dB/octave			
Optional First Order High-Pass Filter		-3 dB @ 1 Hz			
Protection	ICP® / ALI	2 kV ESD			
	ICP®	Short circuit between sensor case and ground			
Galvanic Isolation		50 V			

Specifications

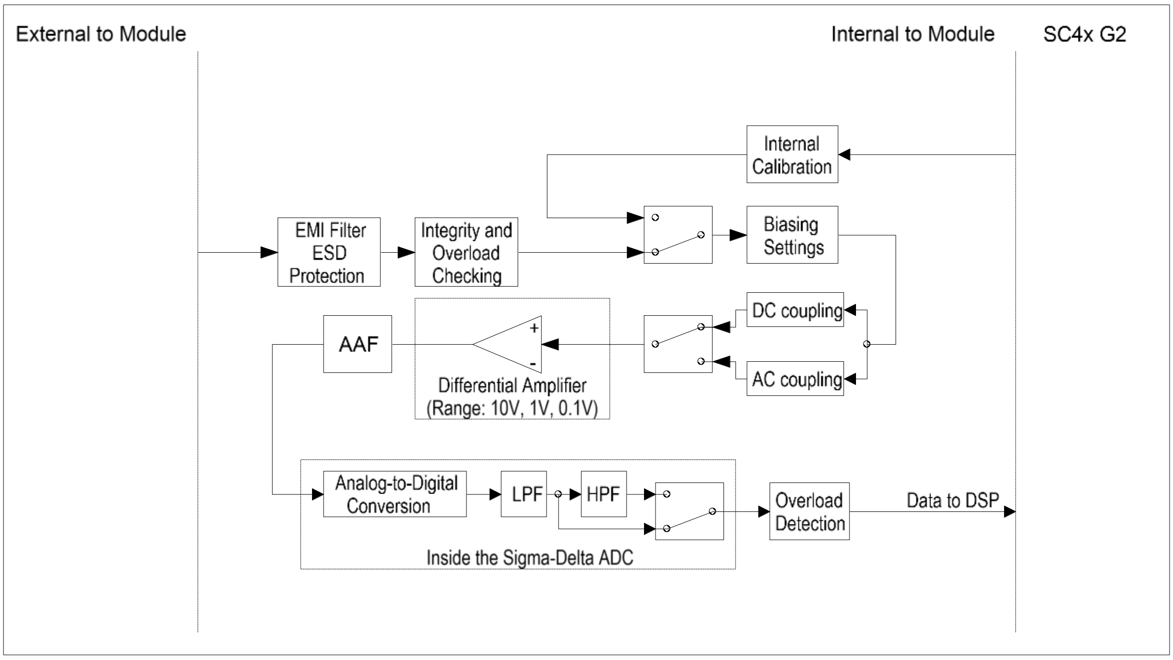
Bandwidth		DC to 49 kHz	
Maximum Sampling Rate (fs) per channel		102.4 kSa/s	
A/D Conversion		24-bit	
Data Transfer		24-bit	
Input Voltage Ranges (Peak)		±100 mV; ±1 V; ±10 V	
ICP® mode		4 mA constant current at ±12 V / 24 V excitation	
Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are connected through 1 MΩ to floating ground	
	Single-Ended Float (Unbalanced Float)	Positive signal input connected through 1 MΩ to floating ground; Negative signal input connected to floating ground	
	Single-Ended GND (Unbalanced GND)	Positive signal input connected through 1 MΩ to ground; Negative signal input connected to ground	
Input Impedance	**Differential**	2 MΩ ‖ 80 pF	
	Single-Ended	1 MΩ ‖ 100 pF	
Digital Low-Pass Filter *Filter scales with sampling rate*		**Passband**	fs x 0.45 Hz
		Stopband	fs x 0.55 Hz
		Passband ripple	±0.005 dB
		Stopband attenuation	100 dB
Phase Accuracy *Channels in similar range*		**Typical**[9]	< 0.2° at 10 kHz

[9] Measured in 10 V range at 102.4 kSa/s

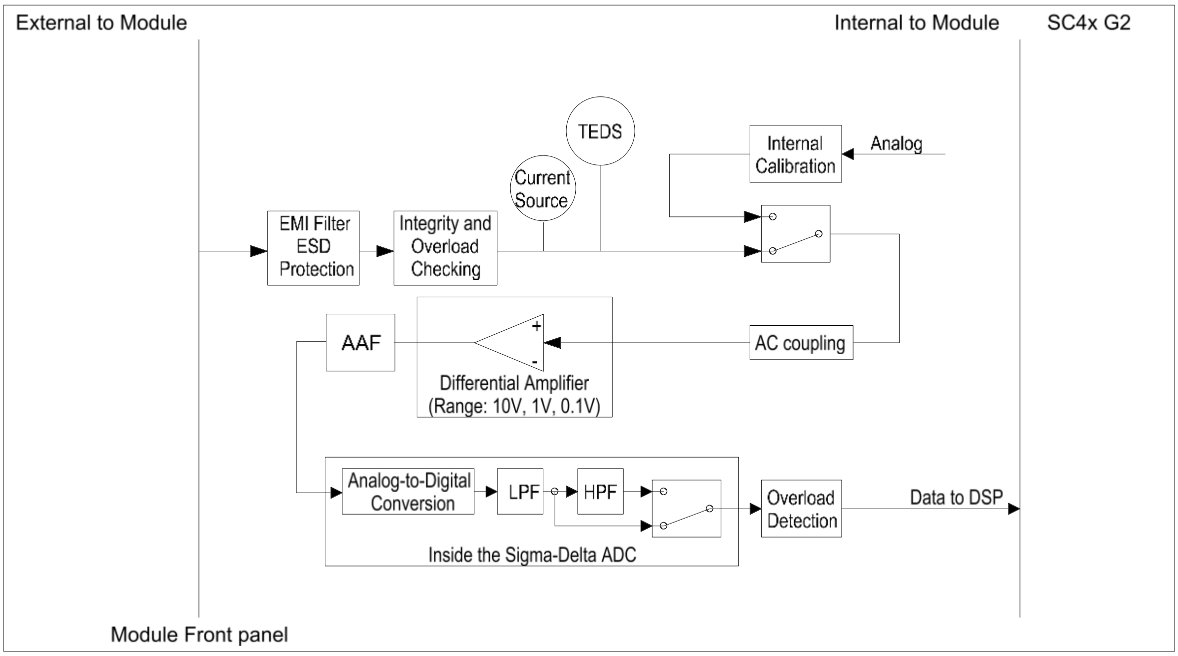
DC Voltage Accuracy		**Input Range (Peak)**	**% Reading + % Range**	
		±100 mV	0.200 % + 0.200 %	
		±1 V	0.068 % + 0.020 %	
		±10 V	0.113 % + 0.015%	
Noise *Input terminated by 50 Ω resistor*		**Input Range (Peak)**	**Guaranteed**	**Typical**
	10 Hz to 23 kHz	±100 mV	< 2.6 µVrms	< 2.2 µVrms
	10 Hz to 49 kHz		< 4 µVrms	< 3 µVrms
	10 Hz to 23 kHz	±1 V	< 9 µVrms	< 6 µVrms
	10 Hz to 49 kHz		< 14 µVrms	< 10 µVrms
	10 Hz to 23 kHz	±10 V	< 45 µVrms	< 40 µVrms
	10 Hz to 49 kHz		< 113 µVrms	< 84 µVrms
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	**Sampling Rate (fs)**	**Input Range (Peak)**	**Attenuation (Input signal level 100 % of full range)**	
	51.2 kSa/s	±100 mV	- 0.06 dB	
	102.4 kSa/s		- 0.10 dB	
	51.2 kSa/s	±1 V	- 0.04 dB	
	102.4 kSa/s		- 0.05 dB	
	51.2 kSa/s	±10 V	- 0.03 dB	
	102.4 kSa/s		- 0.04 dB	
Crosstalk		**Input Range (Peak)**	**Guaranteed**	**Typical**
		±100 mV	113 dB	118 dB
		±1 V	110 dB	115 dB
		±10 V	102 dB	107 dB

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



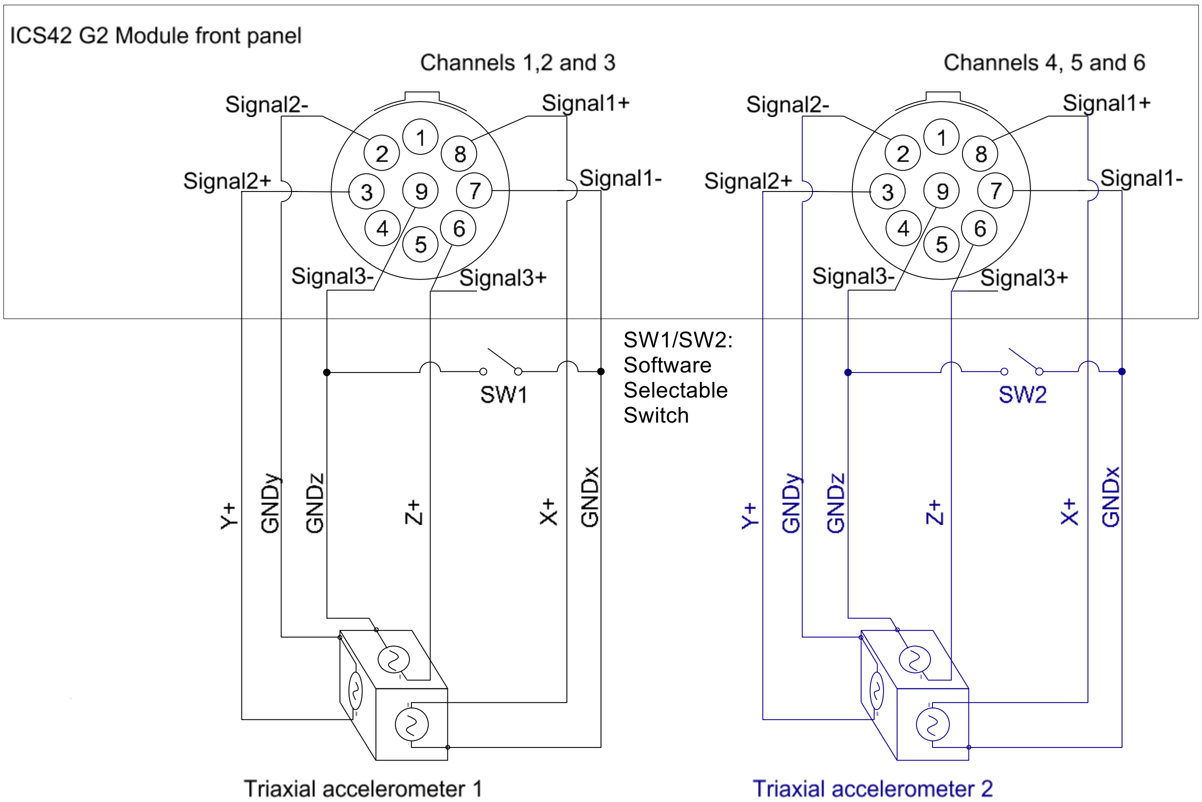
ICS42 ALI mode (per channel)



ICS42 ICP® mode (per channel)

Accelerometer connections per Module

The ICS42 can accept inputs from single ICP® accelerometers as well as triaxial ICP® accelerometers. The connectors on the front panel are ideally designed to connect to two triaxial sensors per Module. The LEMO® 9-way EHG.0B connectors Module Pin Definition indicates where the signal connections of each X, Y and Z and the common return of the triaxial sensor can be connected.



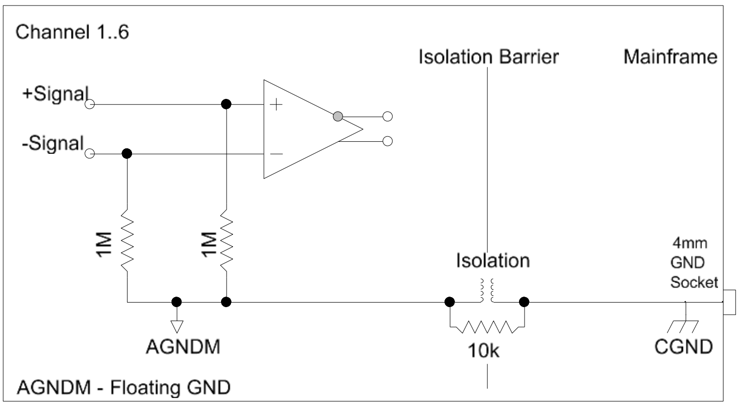
ICS42 front panel connectors with two triaxial accelerometers

Grounding options

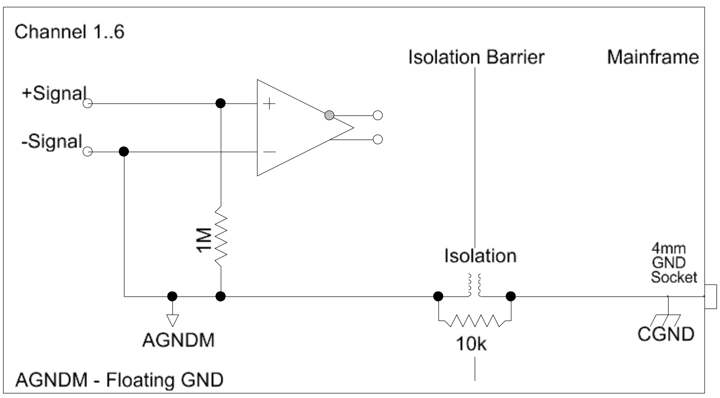
There are four ALI mode grounding options available on the ICS42:

- Differential float (Balanced float):
  - Both inputs connected through 1 MΩ to a floating ground
- Differential ground (Balanced ground):
  - Both inputs connected through 1 MΩ directly to a ground
- Single-Ended float (Unbalanced float):
  - One input connected through 1 MΩ to a floating ground the other directly to the floating ground
- Single-Ended ground (Unbalanced ground):
  - One input connected through 1 MΩ to a floating ground the other directly to ground

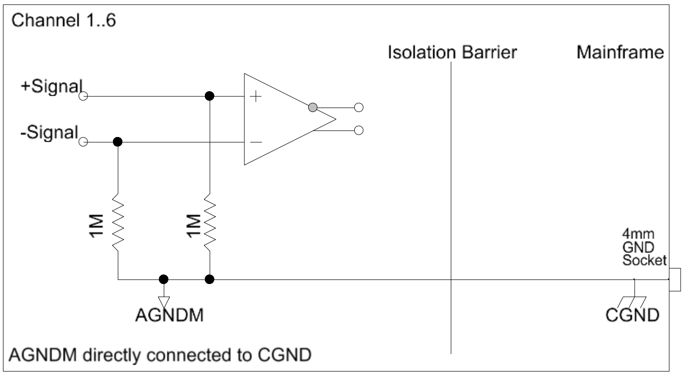
Grounding Diagrams: ALI mode (Voltage Input mode)



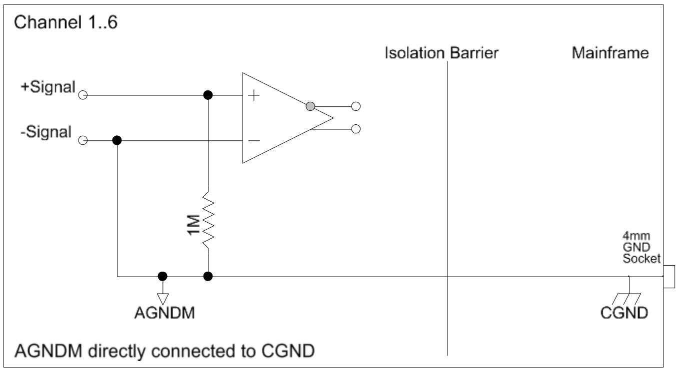
ICS42 in ALI mode with differential float (per channel)



ICS42 in ALI mode with single-ended float (per channel)

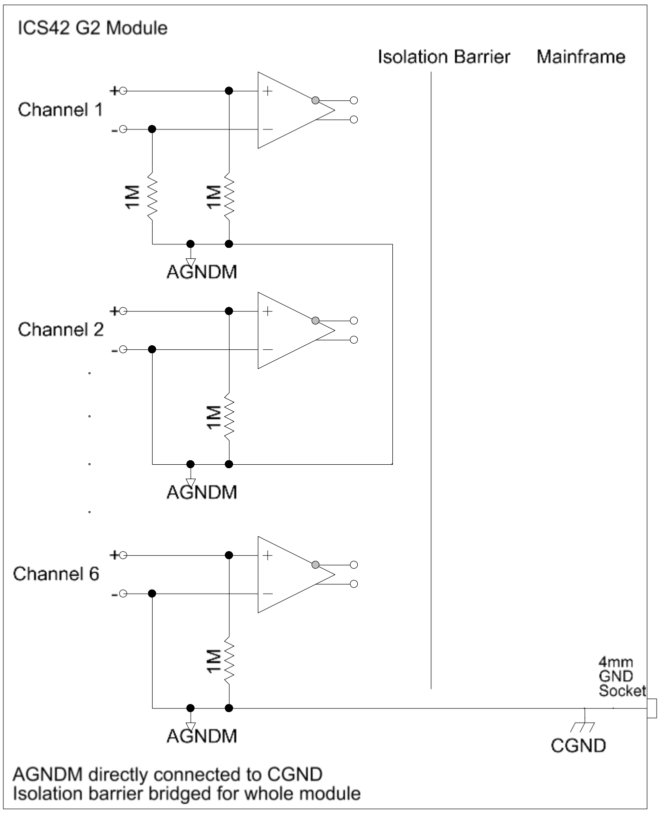


ICS42 in ALI mode with differential ground (will affect the whole Module)



ICS42 in ALI mode single-ended ground (will affect the whole Module)

Although each channel in the ICS42 can be set individually as to its grounding type, enabling the ground option on any one channel will cause the isolation barrier of the module to be bridged (i.e. on all six channels AGNDM will be directly connected to CGND).



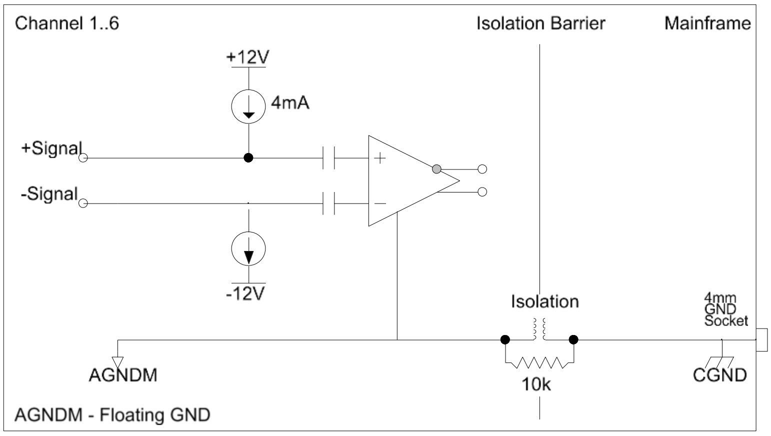
ICS42 Ground setting affects all six channels

Excitation Diagrams: ICP® Mode

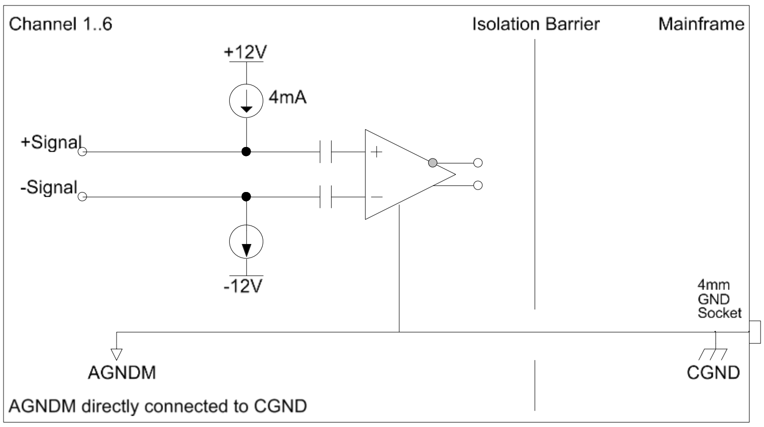
There are two biasing options when using ICP® input mode with 4 mA current excitation. The Biasing settings are independent of the grounding options. The following table shows the different possible settings for the ICS42 Module in ICP® input mode:

Excitation voltage	Biasing settings	Grounding options
±12 V (Symmetrical)	Differential	Ground or Floating ground
24 V (Asymmetrical)	Differential or single-ended	Ground or Floating ground

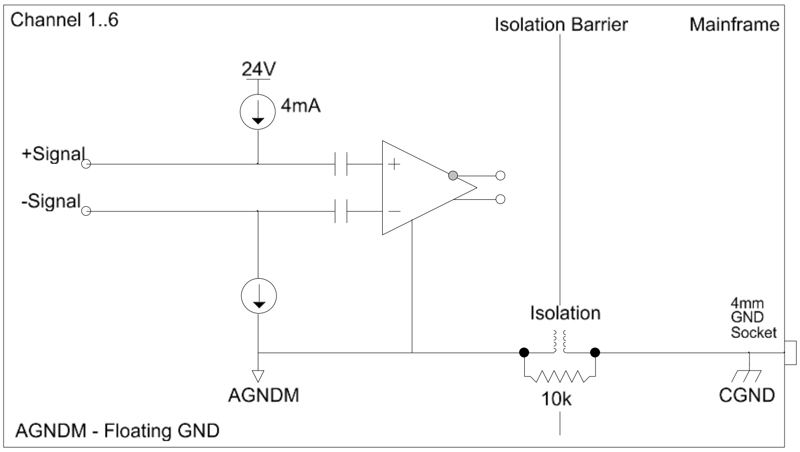
ICS42 Module Settings in ICP® input mode with 4 mA current excitation



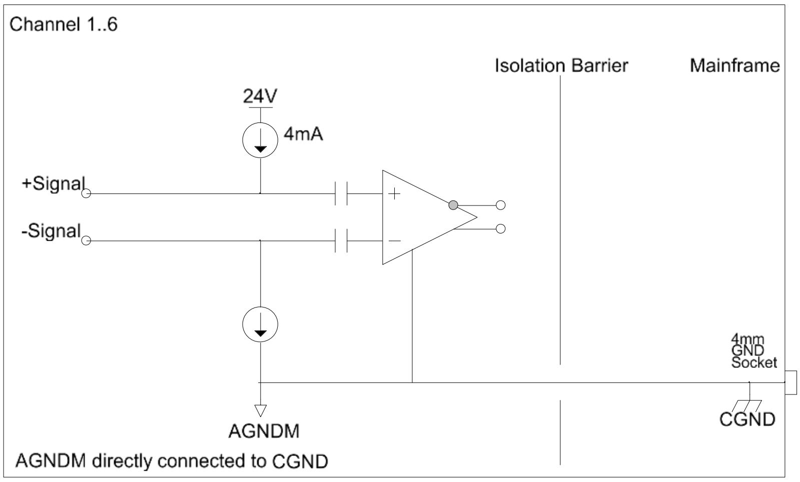
ICS42 in ICP® mode with 4 mA current excitation, ±12 V excitation, differential biasing and floating ground selected



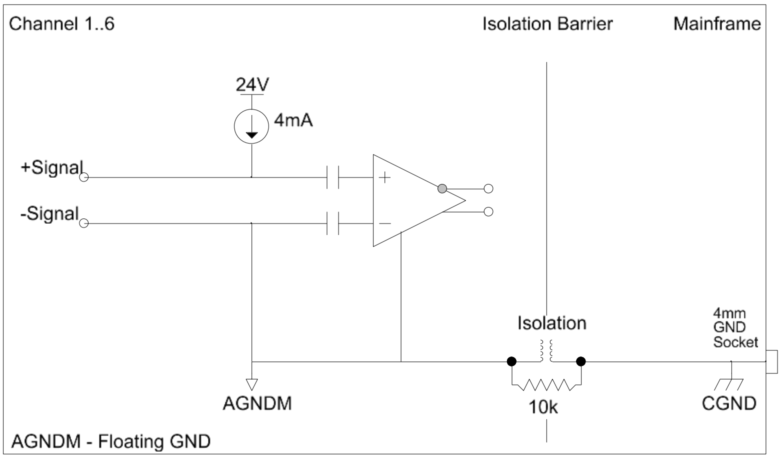
ICS42 in ICP® mode with 4 mA current excitation, ±12 V excitation, differential biasing and ground selected



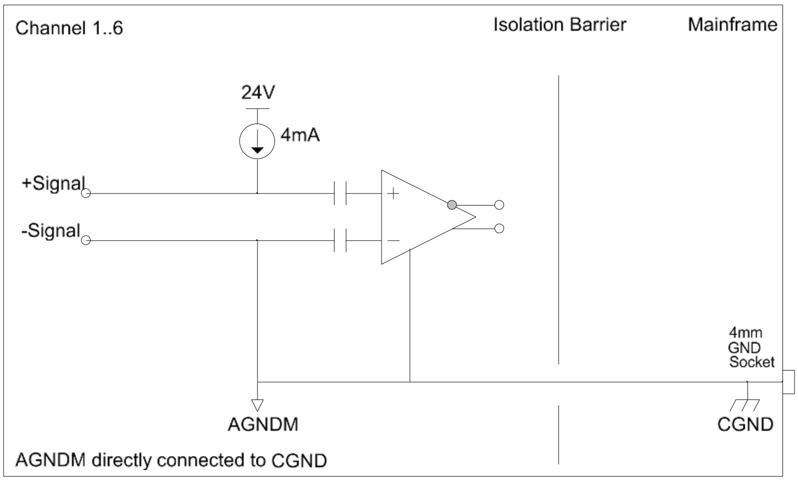
ICS42 in ICP® mode with 4 mA current excitation, 24 V excitation, differential biasing and floating ground selected



ICS42 in ICP® mode with 4 mA current excitation, 24 V excitation, differential biasing and ground selected



ICS42 in ICP® mode with 4 mA current excitation, 24 V excitation, single-ended biasing and floating ground selected



ICS42 in ICP® mode with 4 mA current excitation, 24 V excitation, single-ended biasing and ground selected

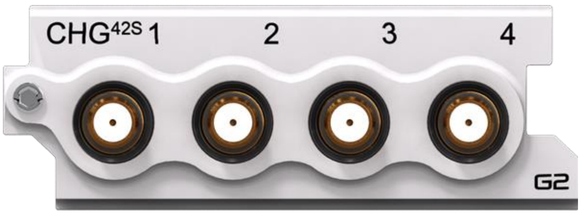
12.1.2. CHG42S

Description

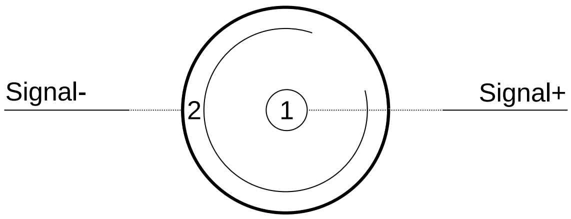
The CHG42S Module has 4 independent input channels for Quartz or Piezoelectric Ceramic sensors. These sensors are typically used when improved signal performance such as low noise and low distortion is required or where high temperature or nuclear radiation prevents the use of ICP® based sensors. Various grounding options allow for low noise measurements regardless of external grounding constraints. The Module can be used:

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

Front Panel



Connector Information and Pin Definitions



CHG42S with 10-32 Microdot connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

ESD WARNING

The CHG42S Module inputs are sensitive to ESD damage. Always take care to discharge any additional static electricity that might have built up on a cable and connector before making contact with the CHG42S Module.

When using Endevco cables it is recommended to remove the rubber o-ring on the CHG42S Module 10-32 connector as this could cause an intermittent electrical connection between the pin on the cable and the Module connector. The o-rings are factory removed on all new CHG42S Modules.

Signal Cable

013K
The 013K is a standard length signal cable that connects a CHG42S Module to a BNC socket.

See the "Cables" section for more information.

Features

- 4 channels
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- Drift is lower than 4 mV/h at any sensitivity and gain
- The cable shield can be connected or disconnected from the module ground
- Selectable low and high pass digital filters
- Overvoltage detection on frontend input signals
- Low power consumption
- High input impedance
- 10-32 Microdot connectors

Interface		For piezoelectric sensors
Input Charge Range (Peak)	**0.1 mV/pC**	±100 000 pC (peak)
	1 mV/pC	±10 000 pC (peak)
	10 mV/pC	±1 000 pC (peak)
-3 dB High Pass Frequency	**0.1 mV/pC**	0.016 Hz
	1 mV/pC	0.016 Hz
	10 mV/pC	0.16 Hz
Other Sampling Rates		Available through digital LP filters and decimation
Optional Programmable Digital IIR Filter		Band pass/stop : 6 dB/octave High/Low pass : 12 dB/octave
Optional First Order High-Pass Filter		-3 dB @ 1 Hz
Module Calibration		Internal amplitude calibration
Protection		1 kΩ series (inline)
Galvanic Isolation		50 V

Specifications

<table>
<tr><td colspan="2">Bandwidth</td><td colspan="2">DC to 90 kHz</td></tr>
<tr><td colspan="2">Maximum Sampling Rate (fs) per Channel</td><td colspan="2">204.8 kSa/s</td></tr>
<tr><td colspan="2">A/D Conversion</td><td colspan="2">24-bit</td></tr>
<tr><td colspan="2">Data Transfer</td><td colspan="2">16/24-bit</td></tr>
<tr><td rowspan="4">Input Biasing Settings</td><td rowspan="2">Single-Ended Float</td><td>Cable Shield Disconnected</td><td>Negative signal input (cable shield) connected to floating ground through 1 MΩ</td></tr>
<tr><td>Cable Shield Connected</td><td>Negative signal input (cable shield) connected to floating ground</td></tr>
<tr><td rowspan="2">Single-Ended GND</td><td>Cable Shield Disconnected</td><td>Negative signal input (cable shield) connected to ground through 1 MΩ</td></tr>
<tr><td>Cable Shield Connected</td><td>Negative signal input (cable shield) connected to ground</td></tr>
<tr><td colspan="2" rowspan="4">Digital Low-Pass Filter
Filter scales with sampling rate</td><td>Passband</td><td>fs x 0.45 Hz</td></tr>
<tr><td>Stopband</td><td>fs x 0.55 Hz</td></tr>
<tr><td>Passband Ripple</td><td>±0.005 dB</td></tr>
<tr><td>Stopband Attenuation</td><td>100 dB</td></tr>
<tr><td colspan="2">Phase Accuracy
Channels in similar range</td><td>Typical[10]</td><td>< 0.5° at 10 kHz</td></tr>
</table>

[10] Measured in 10 V range at 204.8 kSa/s

	Input Range (Peak)	Sensitivity Range	% Range Typical
AC Voltage Accuracy *Measured at 1 kHz*	±100 mV	0.1 mV/pC	3.1 %
		1 mV/pC	2.7 %
		10 mV/pC	2.7 %
	±1 V	0.1 mV/pC	2.7 %
		1 mV/pC	1.9 %
		10 mV/pC	2.5 %
	±10 V	0.1 mV/pC	2.6 %
		1 mV/pC	2.1 %
		10 mV/pC	2.6 %

		Input Range (Peak)	Guaranteed	Typical
Noise *Measured open input with 0.1 mV/pC sensitivity range*	10 Hz to 23 kHz	±100 mV	< 50 µVrms	< 46 µVrms
	10 Hz to 49 kHz		< 73 µVrms	< 68 µVrms
	10 Hz to 90 kHz		< 160 µVrms	< 144 µVrms
	10 Hz to 23 kHz	±1 V	< 109 µVrms	< 81 µVrms
	10 Hz to 49 kHz		< 140 µVrms	< 116 µVrms
	10 Hz to 90 kHz		< 1,085 µVrms	< 924 µVrms
	10 Hz to 23 kHz	±10 V	< 460 µVrms	< 409 µVrms
	10 Hz to 49 kHz		< 1,175 µVrms	< 859 µVrms
	10 Hz to 90 kHz		< 10,816 µVrms	< 9,114 µVrms

		Input Range (Peak)	Guaranteed	Typical
Noise *Measured open input with 1 mV/pC sensitivity range*	10 Hz to 23 kHz	±100 mV	< 8.8 µVrms	< 6.2 µVrms
	10 Hz to 49 kHz		< 10 µVrms	< 8 µVrms
	10 Hz to 90 kHz		< 17.8 µVrms	< 15.3 µVrms
	10 Hz to 23 kHz	±1 V	< 11.4 µVrms	< 8.5 µVrms
	10 Hz to 49 kHz		< 14.9 µVrms	< 12.1 µVrms
	10 Hz to 90 kHz		< 107 µVrms	< 92 µVrms
	10 Hz to 23 kHz	±10 V	< 46 µVrms	< 41 µVrms
	10 Hz to 49 kHz		< 125 µVrms	< 89 µVrms
	10 Hz to 90 kHz		< 1,077 µVrms	< 910 µVrms

		Input Range (Peak)	Guaranteed	Typical
Noise *Measured open input with 10 mV/pC sensitivity range*	10 Hz to 23 kHz	±100 mV	< 9.1 µVrms	< 4.4 µVrms
	10 Hz to 49 kHz		< 9 µVrms	< 4.6 µVrms
	10 Hz to 90 kHz		< 9.1 µVrms	< 5.1 µVrms
	10 Hz to 23 kHz	±1 V	< 8.9 µVrms	< 4.4 µVrms
	10 Hz to 49 kHz		< 8.8 µVrms	< 4.6 µVrms
	10 Hz to 90 kHz		< 8.2 µVrms	< 7.3 µVrms
	10 Hz to 23 kHz	±10 V	< 8.6 µVrms	< 5.8 µVrms
	10 Hz to 49 kHz		< 13.2 µVrms	< 9.3 µVrms
	10 Hz to 90 kHz		< 108 µVrms	< 91 µVrms

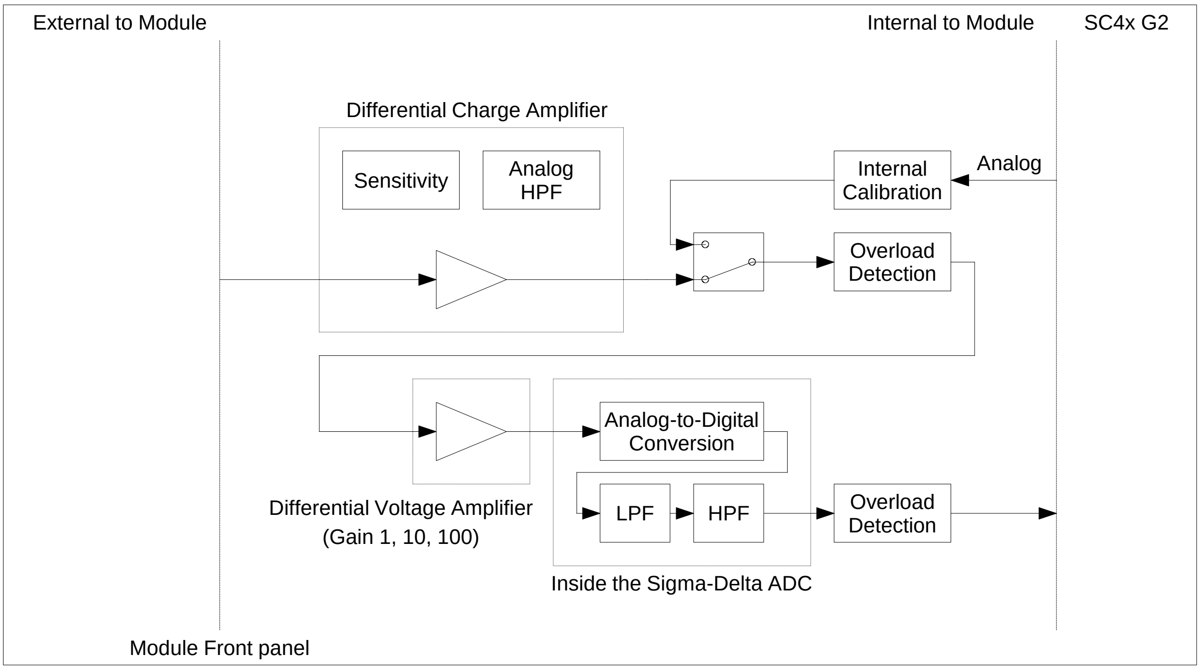
	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)		
			0.1 mV/pC sensitivity range	1 mV/pC sensitivity range	10 mV/pC sensitivity range
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±100 mV	- 0.12 dB	- 0.19 dB	- 0.88 dB
	102.4 kSa/s		- 0.44 dB	- 0.70 dB	- 2.88 dB
	204.8 kSa/s		- 1.91 dB	- 2.40 dB	- 7.43 dB
	51.2 kSa/s	±1 V	- 0.15 dB	- 0.14 dB	- 0.86 dB
	102.4 kSa/s		- 0.47 dB	- 0.52 dB	- 2.82 dB
	204.8 kSa/s		- 1.57 dB	- 1.86 dB	- 7.07 dB
	51.2 kSa/s	±10 V	- 0.14 dB	- 0.14 dB	- 0.79 dB
	102.4 kSa/s		- 0.45 dB	- 0.51 dB	- 2.66 dB
	204.8 kSa/s		- 1.50 dB	- 2.81 dB	- 6.84 dB

Crosstalk

	Input Range (Peak)	Guaranteed	Typical
Crosstalk *Measured with 0.1 mV/pC sensitivity range*	±100 mV	83 dB	88 dB
	±1 V	93 dB	98 dB
	±10 V	90 dB	95 dB
	Input Range (Peak)	**Guaranteed**	**Typical**
Crosstalk *Measured with 1 mV/pC sensitivity range*	±100 mV	60 dB	65 dB
	±1 V	83 dB	88 dB
	±10 V	85 dB	90 dB
	Input Range (Peak)	**Guaranteed**	**Typical**
Crosstalk *Measured with 10 mV/pC sensitivity range*	±100 mV	41 dB	46 dB
	±1 V	62 dB	67 dB
	±10 V	67 dB	72 dB

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



Functional overview of one CHG42S channel

WARNING

When using Endevco cables it is recommended to remove the rubber O-ring on the CHG42S Module 10-32 connector as this could cause an intermittent electrical connection between the pin on the cable and the Module connector.

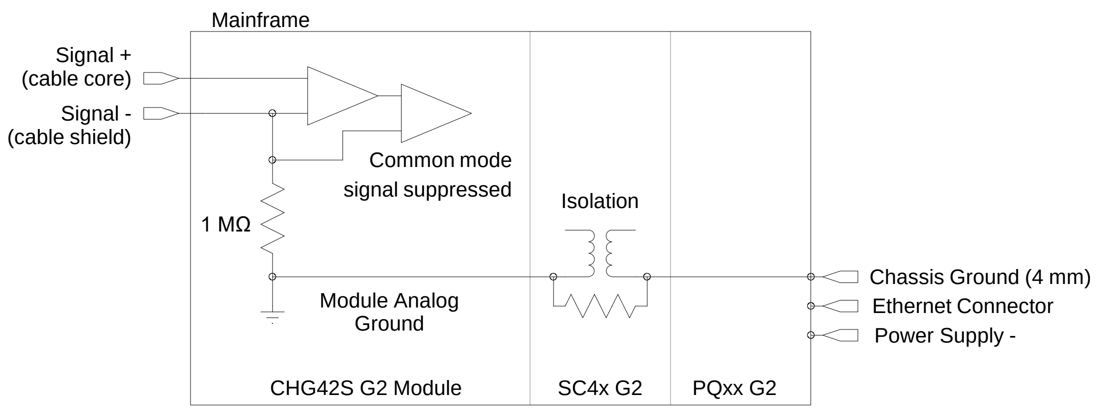
Grounding Diagram

The CHG42S offers 4 grounding options. The grounding options are provided for reducing electromagnetic interference (EMI) that might be present on the sensor cables.

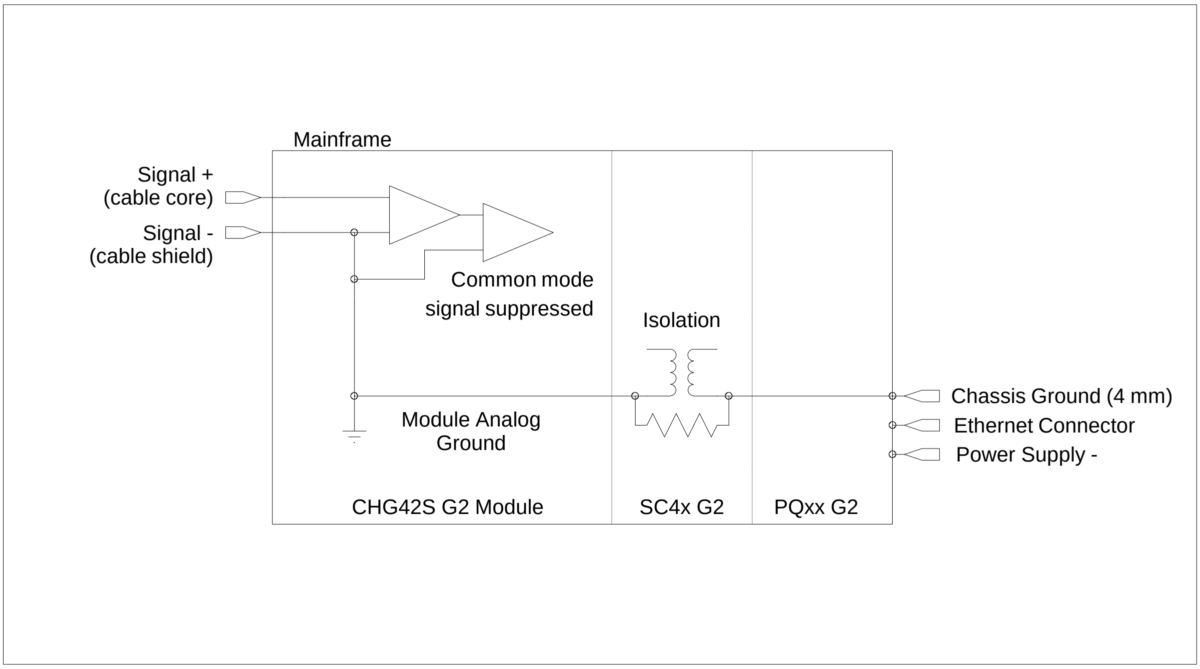
Module	Cable Shield Connected	Industry Name	Shield to Chassis
*Floating	*No	Floating	1 MΩ + 10 kΩ
Floating	Yes	-	10 kΩ
Grounded	No	-	1 MΩ
Grounded	Yes	Single-Ended	~20 Ω

Grounding options

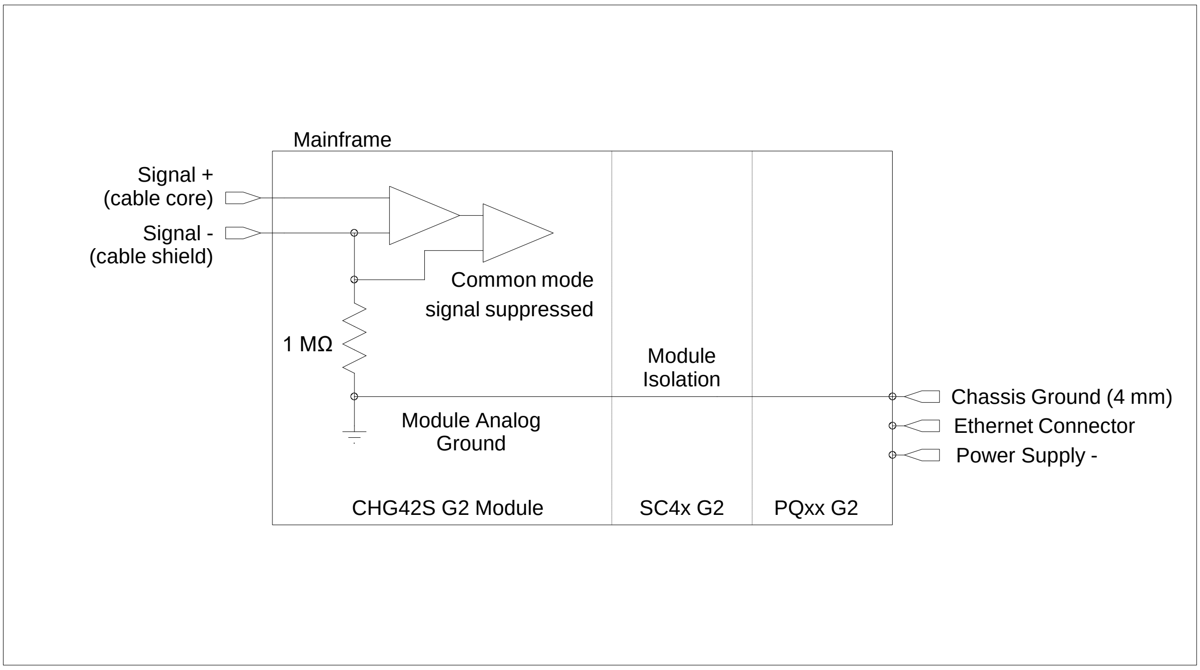
*Default setting on Module startup. This combination provides a path for Electrostatic Discharge (ESD) to slowly discharge and will provide some protection against rapid ESD events that could damage the sensitive charge inputs.



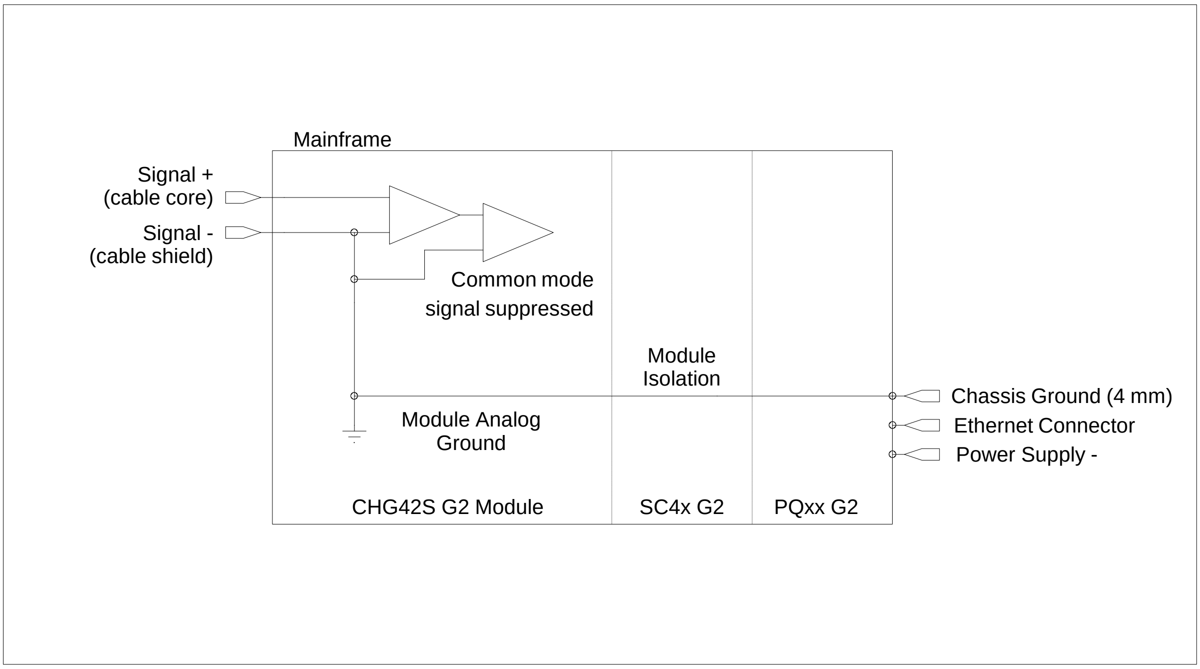
CHG42S Grounding Diagram: Module floating and cable shield disconnected



CHG42S Grounding Diagram: Module floating and cable shield connected



CHG42S Grounding Diagram: Module grounded and shield disconnected



CHG42S Grounding Diagram: Module grounded and shield connected

12.1.3. THM42

Description

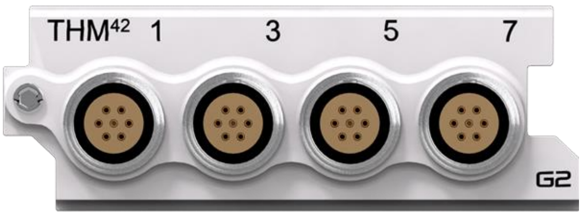
The THM42 Module contains 8 channels for use with any thermocouple type as well as Pt100 sensors. Remote cold junction compensation is provided through a SubModule (which is thermocouple type specific) whilst linearization is provided in the signal conditioning board. The Module also includes a calibrated 0.2 mA current source for Pt100 sensor excitation.

SubModules are used with the Module which contains a pair of commonly used miniature E, J, K, and T 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 Module.

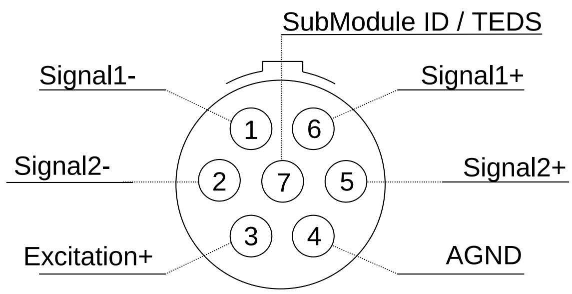
The THM42 Module also includes 8 channels for measuring voltage inputs up to ±10 V. The Module can be used:

- When measuring E, J, K, and T 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

Front Panel



Connector Information and Pin Definitions



THM42 with LEMO® 7-way EHG.0B Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Features

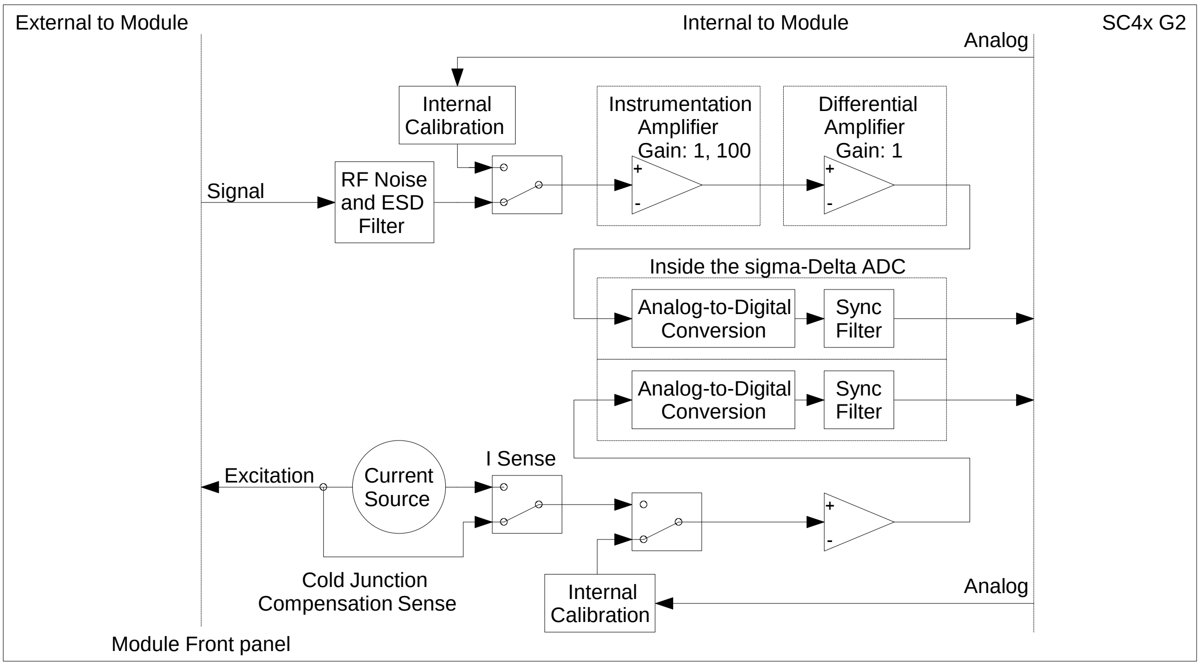
<table>
<tr><td colspan="3">

- 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, 6.4 kSa/s sampling rate per channel, 2.5 kHz bandwidth
- ±(100 mV and 10 V) 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 MΩ differential input resistance
- LEMO® 7-way EHG.0B connectors with 2 channels sharing one connector

</td></tr>
<tr><td>Input Modes</td><td colspan="2">Thermocouple and Pt100</td></tr>
<tr><td>Sensors</td><td colspan="2">Any combination of thermocouple and Pt100 but the same type of sensor must be used for each channel pair</td></tr>
<tr><td>Linearization</td><td colspan="2">Thermocouple linearization for types:
• Chromel®/Constantan (E, NiCr-CuNi)
• Iron/Constantan (J, Fe-CuNi)
• Chromel®/Alumel® (K, NiCr-NiAl)
• Copper/Constantan (T, Cu-CuNi)</td></tr>
<tr><td>Excitation</td><td colspan="2">0.2 mA Excitation current for Pt100 and cold-junction-compensation. Monitored internally for drift and offset errors.</td></tr>
<tr><td>Maximum Common Mode Voltage</td><td colspan="2">±7 V</td></tr>
<tr><td>Other Sampling Rates</td><td colspan="2">Available through digital LP filters and decimation</td></tr>
<tr><td>SubModules</td><td colspan="2">Cable between Module and sensor wire with housing containing TEDS, cold-junction-compensation and sensor connector. Colour-coded according to thermocouple type.</td></tr>
<tr><td>Module Calibration</td><td colspan="2">Internal amplitude and phase calibration</td></tr>
<tr><td>Phase Accuracy
Channels in similar range</td><td>Typical[11]</td><td>< 1.5° at 1 kHz</td></tr>
<tr><td>Protection</td><td colspan="2">2 kV ESD</td></tr>
<tr><td>Galvanic Isolation</td><td colspan="2">50 V</td></tr>
</table>

[11] Measured in 10 V range at 6.4 kSa/s

Functionality per Channel



THM42 Module Functionality

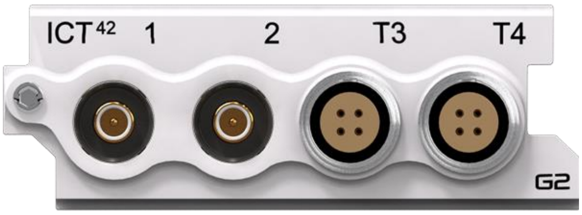
12.1.4. ICT42

Description

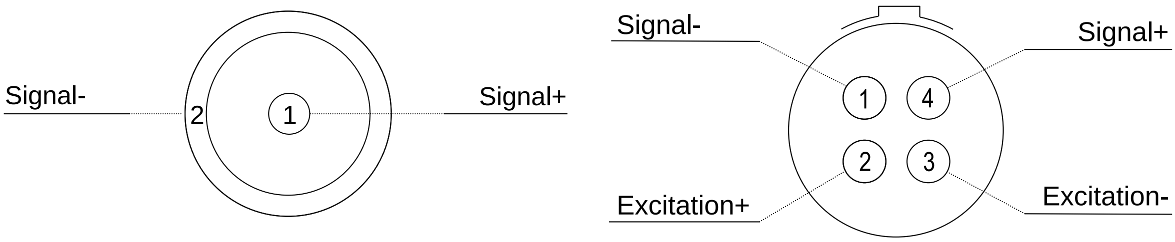
The ICT42 Module is a hybrid Module which combines 2 channels from the ICP42 Module with 2 Tacho input channels. The Tacho channels provide Tacho period measurements with a 20 ns resolution, sampled where the signal intersects its trigger level settings. Triggering of Tacho signals can be set for rising 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. The Module can be 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

Front Panel



Connector Information and Pin Definitions



ICT42 with male SMB and LEMO® 4-way EHG.0B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Signal Cable

025K

The 025K is a standard length signal cable that converts the SMB output of a Module to a BNC output.

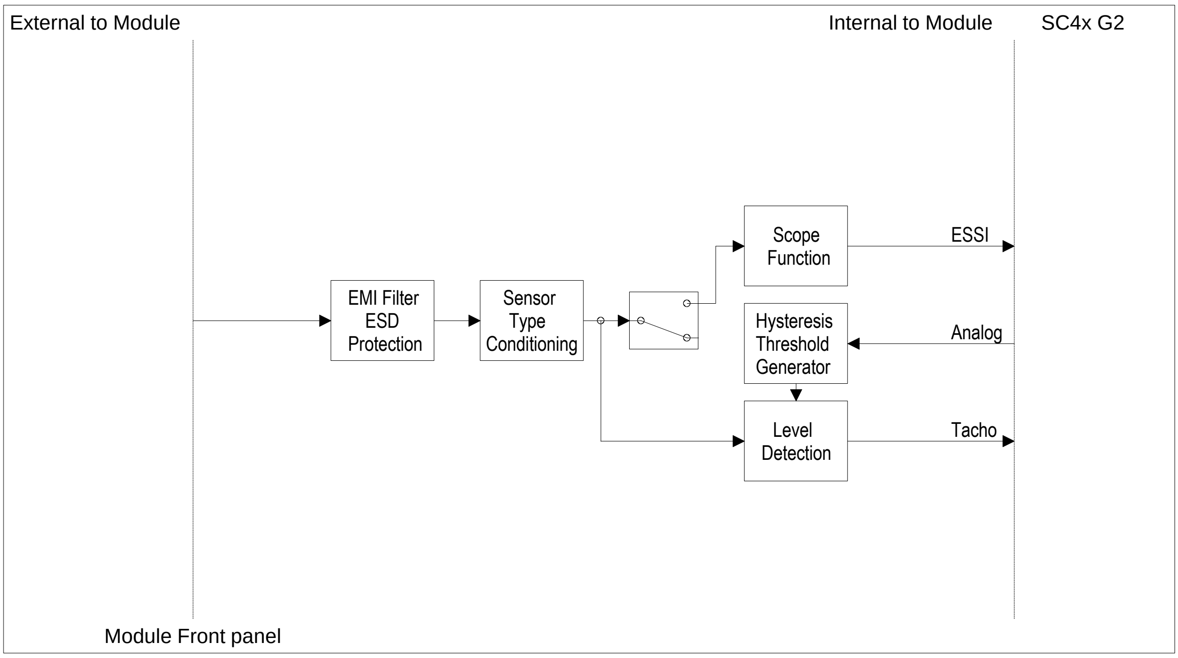
See the "Cables" section for more information.

Features

- 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
- ±(2 V, 12 V, 30 V and 60 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

Tacho Sensor	Voltage (Single-Ended or Differential)
Excitation Voltage Level	Single-Ended Isolated (0 to 12 V) Differential (±12 V)
Excitation Maximum Current	140 mA (fused)
Coupling	DC or AC
Input Resistance	Single-Ended 120 kΩ Differential 240 kΩ
Over-voltage range	±60 V
Trigger Accuracy	Threshold detection with hysteresis; 16-bit resolution
Minimum Pulse Width	800 ns
Scope Mode	2.048 kHz < fs < 204.8 kHz
Module Calibration	Internal amplitude and phase calibration
Protection	ESD 2 kV
Galvanic Isolation	50 V

Functionality per Tacho input channel



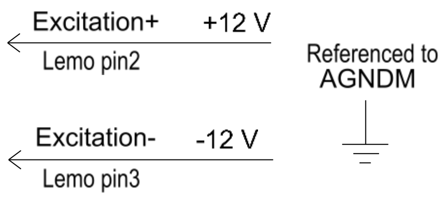
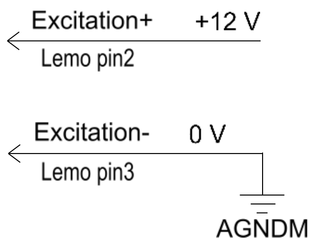
ICT42 functionality per Tacho input channel

Channels 1 and 2 have the same performance parameters as each channel of the ICP42 Module.

Note: Please refer to the ICP42 Module for further details.

Channels 3 and 4 of the ICT42 Module are both Tacho as well as scope input channels. Each Tacho channel functions separately and is connected to its own Tacho sensor. Each scope channel displays the input of the Tacho channels. The scope channels can be configured to display a single Tacho channel.

As a standard, the ICT42 has a 4-pin LEMO® connector for each Tacho input at the Module front panel. Two of the LEMO® connector pins are for the Tacho signal. The two additional pins provide an excitation voltage that may be used as a power supply to external Tacho sensors. The Excitation+ and Excitation- lines are each protected against a current overload by a 140 mA self-resetting fuse. There are two options for the excitation output as shown in table below.

Excitation Mode	Description	Diagram
Differential excitation	The Excitation+ and Excitation- lines are connected to +12 V and -12 V respectively, both positive and negative rails use AGNDM as 0 V reference	
Single-Ended isolated excitation	Excitation+ is connected to +12 V and Excitation- to an isolated ground	

ICT42 Excitation description

Grounding options per Tacho input channel

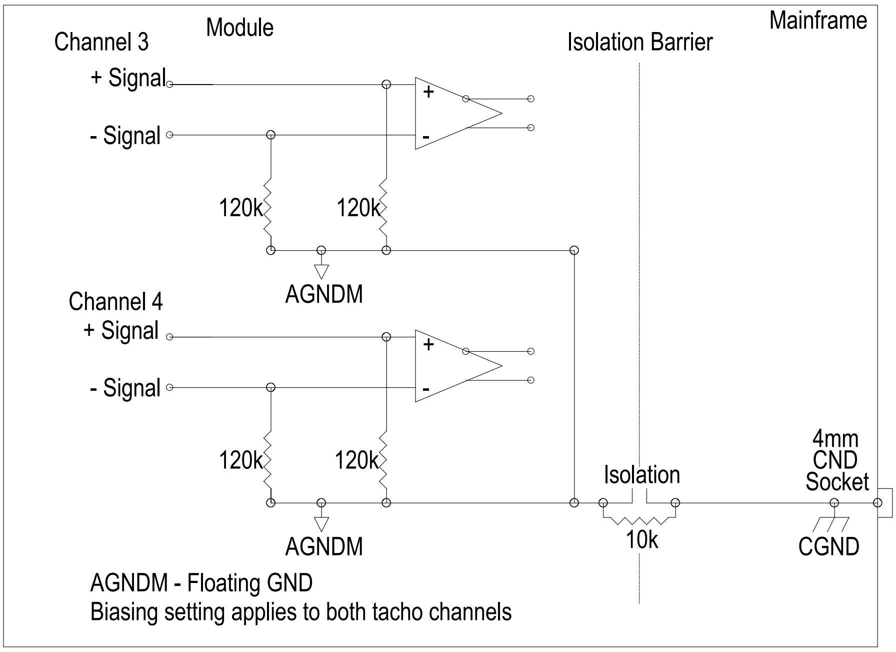
Each Tacho input channel of the ICT42 Module has the following grounding options:

- Differential float (Balanced float):
  - Both inputs connected through 120 kΩ to a floating ground

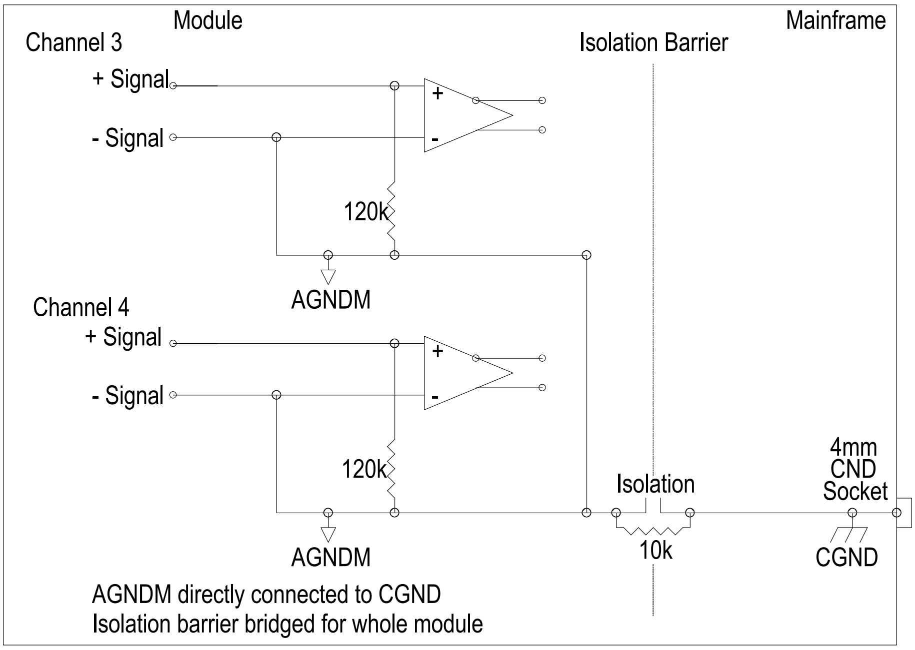
- Single-Ended float (Unbalanced float):
  - One input connected through 120 kΩ to a floating ground the other directly to the floating ground

- Single-Ended ground (Unbalanced ground):
  - One input connected through 120 kΩ to a floating ground the other directly to ground

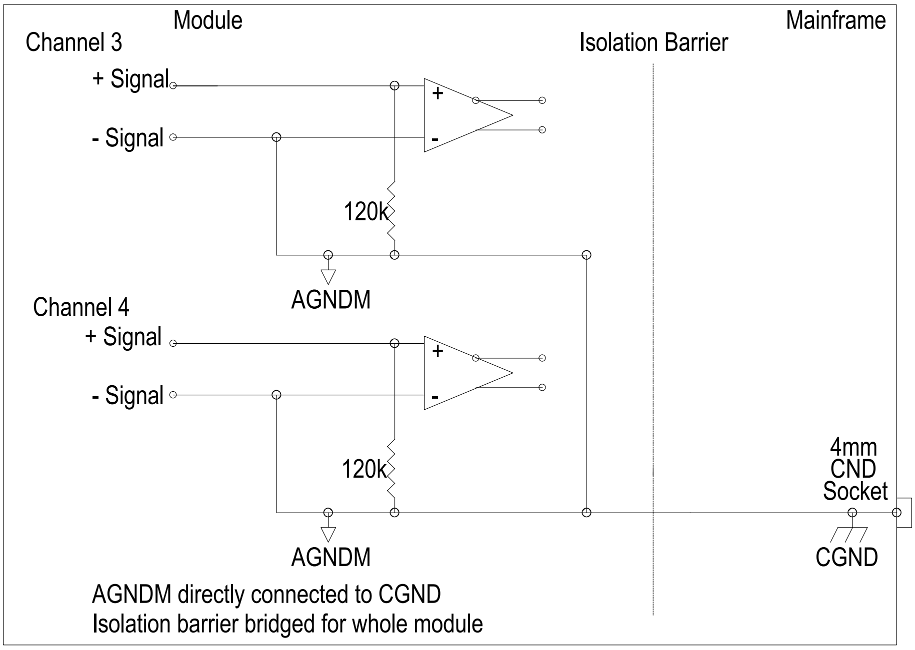
Grounding diagrams



Differential float (Balanced float)



Single-Ended float (Unbalanced float)



Single-Ended ground (Unbalanced ground)

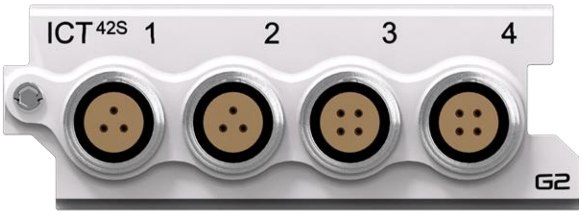
12.1.5. ICT42S

Description

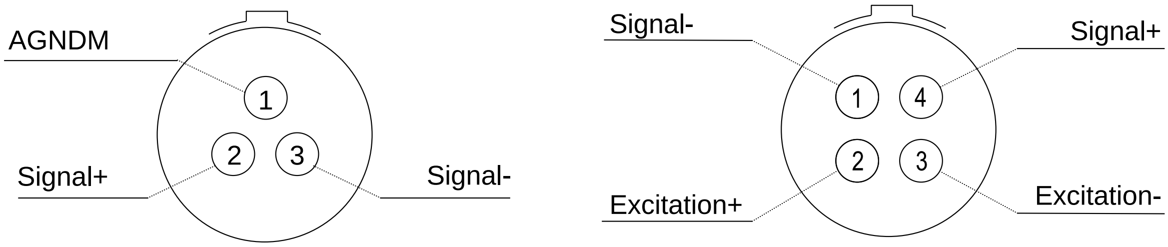
The ICT42S Module is a hybrid Module which combines 2 channels from the advanced ICP42S Module with 2 advanced Tacho input channels. The Tacho channels provide Tacho period measurements with a 20 ns resolution, sampled where the signal intersects its trigger level settings. Triggering of Tacho signals can be set for rising or falling edges with adjustable hysteresis whilst additionally providing AC coupling for sensors with varying DC voltage offsets. A 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. The Module can be 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

Front Panel



Connector Information and Pin Definitions

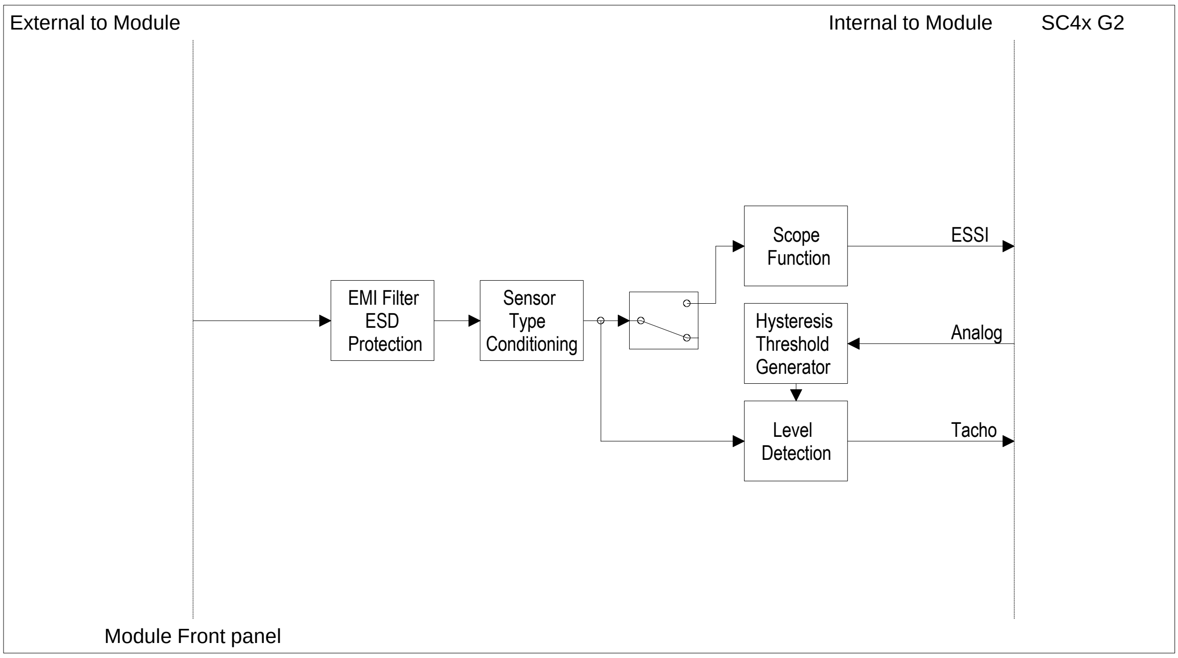


ICT42S with LEMO® 3-way and 4-way EHG.0B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Features

• 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 • ±(2 V, 12 V, 30 V and 60 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
Tacho Sensor	Voltage (Single-Ended or Differential)
Excitation Voltage Level	Single-Ended Isolated (0 to 12 V) Differential (±12 V)
Excitation Maximum Current	140 mA (fused)
Coupling	DC or AC
Input Resistance	Single-Ended 120 kΩ Differential 240 kΩ
Over-voltage range	±60 V
Trigger Accuracy	Threshold detection with hysteresis; 16-bit resolution
Minimum Pulse Width	800 ns
Scope Mode	2.048 kHz < fs < 4.9 MHz
Module Calibration	Internal amplitude and phase calibration
Protection	ESD 2 kV
Galvanic Isolation	50 V

Functionality per Tacho input channel



ICT42S functionality per Tacho Input channel

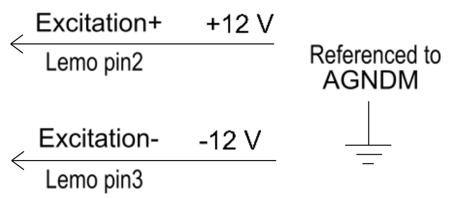
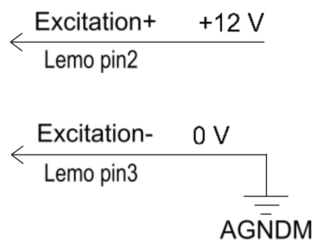
Channels 1 and 2 have the same performance parameters as the first 2 channels of the ICP42S Module.

NOTE

Please see the ICP42S Module for more details about the two ICP® or voltage input mode channels.

Channels 3 and 4 of the ICT42S Module are both Tacho as well as scope input channels. Each Tacho channel functions separately and is connected to its own Tacho sensor. Each scope channel displays the input of the Tacho channels. The scope channels can be configured to display a single Tacho channel.

As a standard, the ICT42S has a 4-pin LEMO® connector for each Tacho input at the Module front panel. Two of the LEMO® connector pins are for the Tacho signal. The two additional pins provide an excitation voltage that may be used as a power supply to external Tacho sensors. The excitation+ and excitation- lines are each protected against a current overload by a 140 mA self-resetting fuse. There are two options for the excitation output as shown in table below.

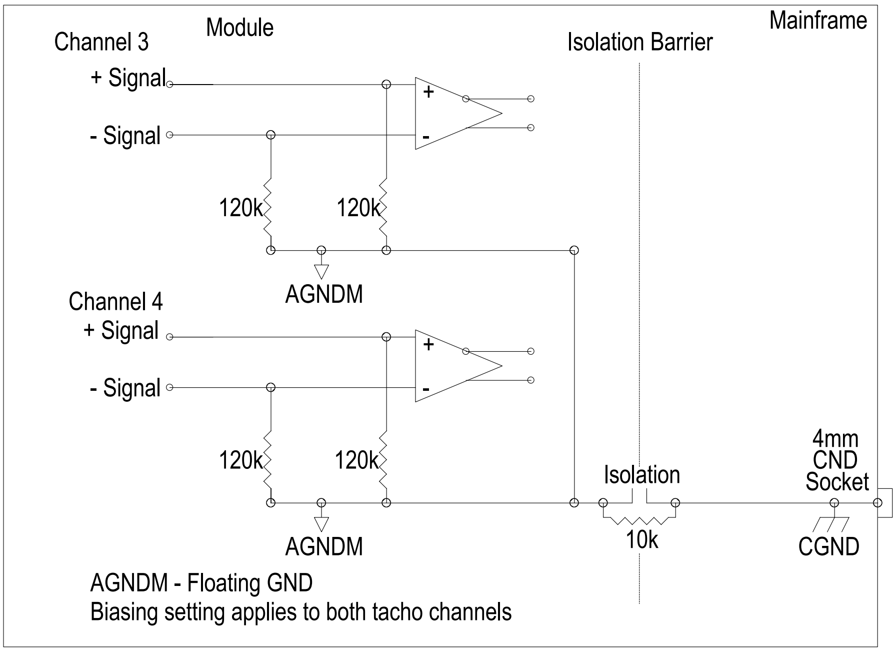
Excitation Mode	**Description**	**Diagram**
Differential excitation	The Excitation+ and Excitation- lines are connected to +12 V and -12 V respectively, both positive and negative rails use AGNDM as 0 V reference	
Single-Ended isolated excitation	Excitation+ is connected to +12 V and Excitation- to an isolated ground	

Grounding options per Tacho input channel

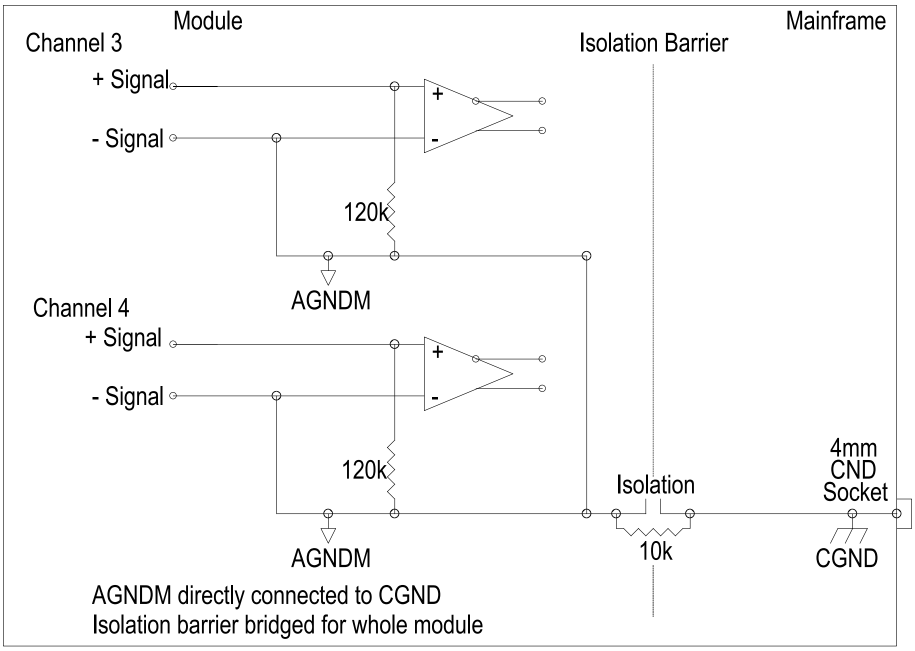
Each Tacho input channel of the ICT42S Module has the following grounding options:

- Differential float (Balanced float):
  - Both inputs connected through 120 kΩ to a floating ground
- Single-Ended float (Unbalanced float):
  - One input connected through 120 kΩ to a floating ground the other directly to the floating ground
- Single-Ended ground (Unbalanced ground):
  - One input connected through 120 kΩ to a floating ground the other directly to ground

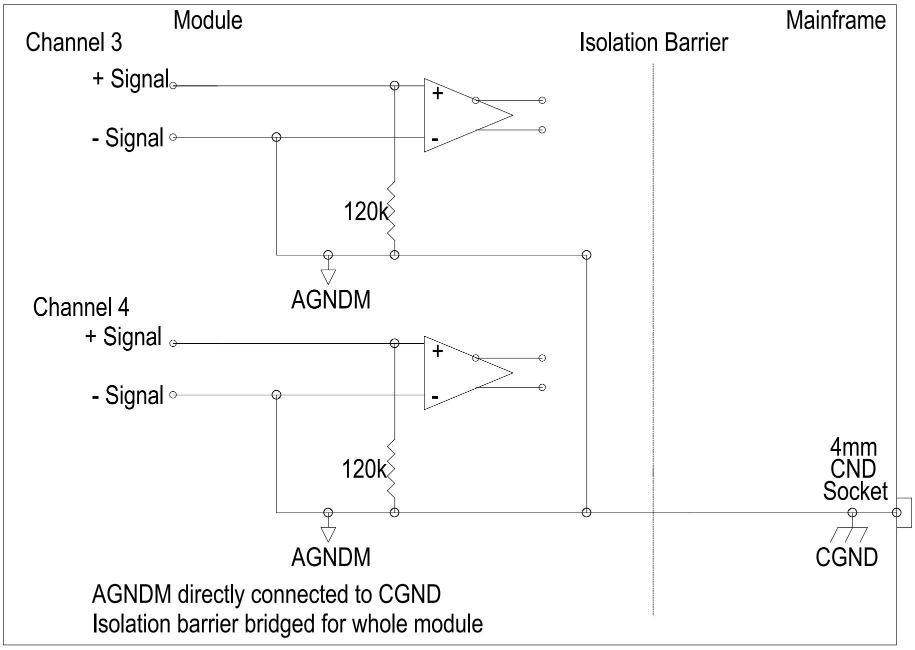
Grounding diagrams



Differential float (Balanced float)



Single-Ended float (Unbalanced float)



Single-Ended ground (Unbalanced ground)

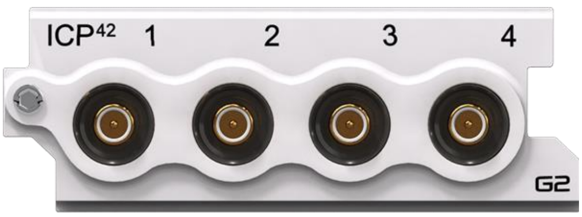
12.1.6. ICP42

Description

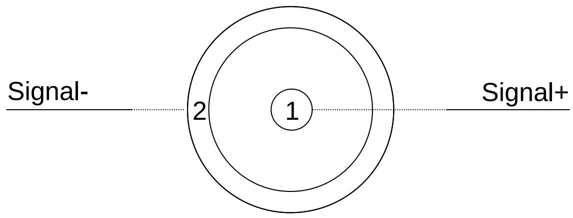
The ICP42 Module can be used with ICP® based accelerometers, force and pressure sensors as well as to measure analog voltages. All 4 channels operate independently of each other, each with their own setting of mode, gain and coupling. The Module can be used with:

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

Front Panel



Connector Information and Pin Definitions



ICP42 with male SMB connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Signal Cable

025K

The 025K is a standard length signal cable that converts the SMB output of a Module to a BNC output.

See the "Cables" section for more information.

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
- ±(100 mV, 1 V and 10 V) 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 MΩ differential and 1 MΩ single-ended input resistance
- Low power consumption
- SMB connectors

<table>
<tr><td rowspan="2">Interface</td><td>ICP®</td><td colspan="4">ICP® sensors</td></tr>
<tr><td>ALI</td><td colspan="4">For analog source voltages</td></tr>
<tr><td rowspan="2">Input Coupling</td><td>ICP®</td><td colspan="4">AC</td></tr>
<tr><td>ALI</td><td colspan="4">DC or AC</td></tr>
<tr><td rowspan="2">AC Coupling Frequency Response</td><td rowspan="2">ICP® / ALI</td><td>Attenuation</td><td>Min</td><td>Max</td><td>Unit</td></tr>
<tr><td>-3 dB</td><td>-</td><td>0.16</td><td>Hz</td></tr>
<tr><td colspan="2">Other Sampling Rates</td><td colspan="4">Available through digital LP filters and decimation</td></tr>
<tr><td colspan="2">Optional Programmable Digital IIR Filter</td><td colspan="4">Band pass/stop : 6 dB/octave
High/Low pass : 12 dB/octave</td></tr>
<tr><td colspan="2">Optional First Order High-Pass Filter</td><td colspan="4">-3 dB @ 1 Hz</td></tr>
<tr><td colspan="2">Module Calibration</td><td colspan="4">Internal amplitude and phase calibration</td></tr>
<tr><td rowspan="2">Protection</td><td>ICP® / ALI</td><td colspan="4">2 kV ESD</td></tr>
<tr><td>ICP®</td><td colspan="4">Short circuit between sensor case and ground</td></tr>
<tr><td colspan="2">Galvanic Isolation</td><td colspan="4">50 V</td></tr>
</table>

Specifications

<table>
<tr><td colspan="2">Bandwidth</td><td colspan="2">DC to 49 kHz</td></tr>
<tr><td colspan="2">Maximum Sampling Rate (fs) per Channel</td><td colspan="2">102.4 kSa/s</td></tr>
<tr><td colspan="2">A/D Conversion</td><td colspan="2">24-bit</td></tr>
<tr><td colspan="2">Data Transfer</td><td colspan="2">16/24-bit</td></tr>
<tr><td colspan="2">Input Voltage Ranges (Peak)</td><td colspan="2">±100 mV; ±1 V; ±10 V</td></tr>
<tr><td colspan="2">ICP® mode</td><td colspan="2">4 mA constant current at ±12 V / 24 V excitation</td></tr>
<tr><td rowspan="3">Input Biasing Settings</td><td>Differential Float (Balanced Float)</td><td colspan="2">Both the positive and negative signal inputs are connected through 1 MΩ to floating ground</td></tr>
<tr><td>Single-Ended Float (Unbalanced Float)</td><td colspan="2">Positive signal input connected through 1 MΩ to floating ground; Negative signal input connected to floating ground</td></tr>
<tr><td>Single-Ended GND (Unbalanced GND)</td><td colspan="2">Positive signal input connected through 1 MΩ to ground; Negative signal input connected to ground</td></tr>
<tr><td rowspan="2">Input Impedance</td><td>Differential</td><td colspan="2">2 MΩ ॥ 200 pF</td></tr>
<tr><td>Single-Ended</td><td colspan="2">1 MΩ ॥ 300 pF</td></tr>
<tr><td colspan="2" rowspan="4">Digital Low-Pass Filter
Filter scales with sampling rate</td><td>Passband</td><td>fs x 0.45 Hz</td></tr>
<tr><td>Stopband</td><td>fs x 0.55 Hz</td></tr>
<tr><td>Passband Ripple</td><td>±0.005 dB</td></tr>
<tr><td>Stopband Attenuation</td><td>100 dB</td></tr>
<tr><td colspan="2">Phase Accuracy
Channels in similar range</td><td>Typical[12]</td><td>< 0.2° at 10 kHz</td></tr>
</table>

[12] Measured in 10 V range at 102.4 kSa/s

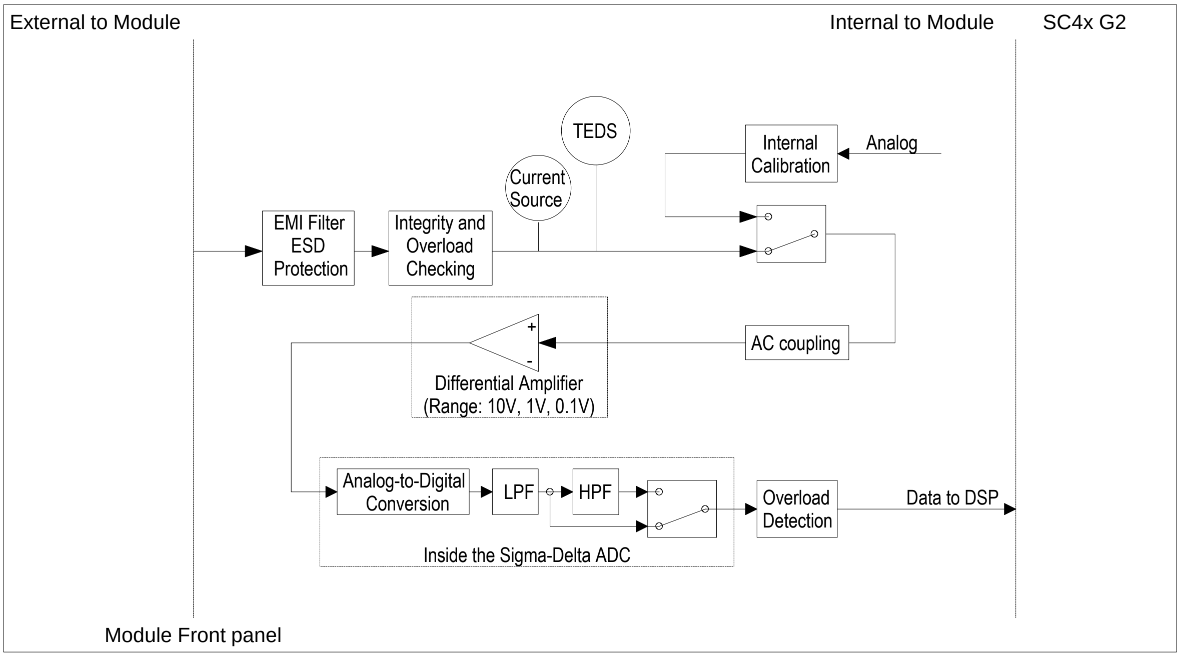
		Input Range (Peak)	% Reading + % Range	
DC Voltage Accuracy		±100 mV	0.275 % + 0.275 %	
		±1 V	0.062 % + 0.023 %	
		±10 V	0.089 % + 0.006 %	
		Input Range (Peak)	**Guaranteed**	**Typical**
Noise *Input terminated by 50 Ω resistor*	10 Hz to 23 kHz	±100 mV	< 3.5 µVrms	< 2.5 µVrms
	10 Hz to 49 kHz		< 4 µVrms	< 3 µVrms
	10 Hz to 23 kHz	±1 V	< 10 µVrms	< 7 µVrms
	10 Hz to 49 kHz		< 14 µVrms	< 10 µVrms
	10 Hz to 23 kHz	±10 V	< 50 µVrms	< 41 µVrms
	10 Hz to 49 kHz		< 85 µVrms	< 74 µVrms
	Sampling Rate (fs)	**Input Range (Peak)**	**Attenuation (Input signal level 100 % of full range)**	
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±100 mV	- 0.04 dB	
	102.4 kSa/s		- 0.10 dB	
	51.2 kSa/s	±1 V	- 0.05 dB	
	102.4 kSa/s		- 0.07 dB	
	51.2 kSa/s	±10 V	- 0.04 dB	
	102.4 kSa/s		- 0.05 dB	

Crosstalk

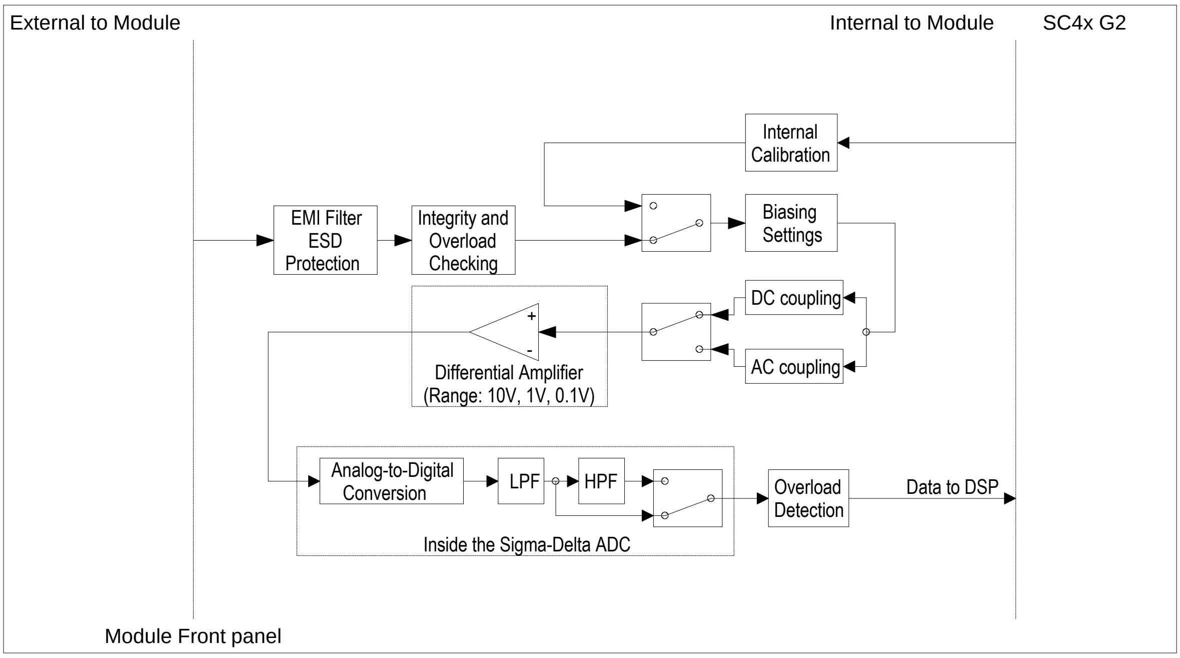
	Input Range (Peak)	Guaranteed	Typical
Crosstalk	±100 mV	113 dB	118 dB
	±1 V	110 dB	115 dB
	±10 V	102 dB	107 dB

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



ICP42 ICP® mode (per channel)



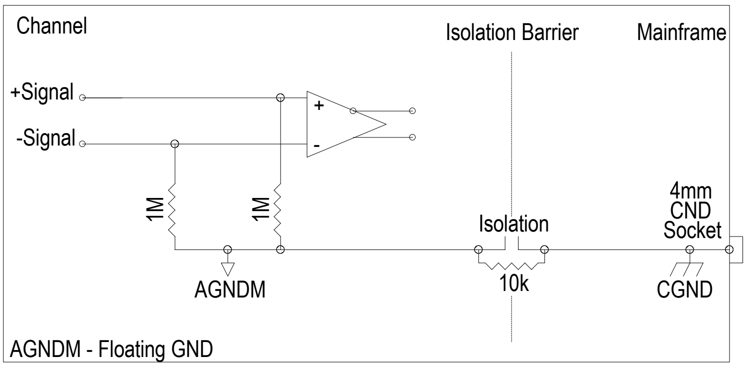
ICP42 ALI mode (per channel)

Grounding options

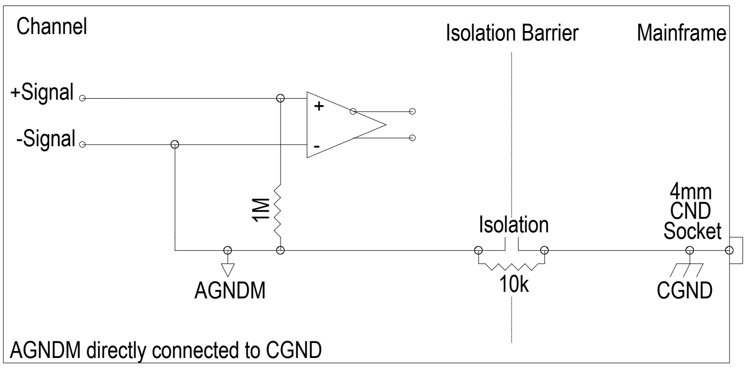
The addition of a 24 V power rail to the ICP42 assures advancement in the overall grounding of the Module:

- Differential float (Balanced float):
  - -12 V to 12 V excitation
  - Both inputs connected through 1 MΩ to a floating ground
- Single-Ended float (Unbalanced float):
  - 0 to 24 V excitation
  - One input connected through 1 MΩ to a floating ground the other directly to the floating ground
- Single-Ended ground (Unbalanced ground):
  - 0 to 24 V excitation
  - One input connected through 1 MΩ to a floating ground the other directly to ground

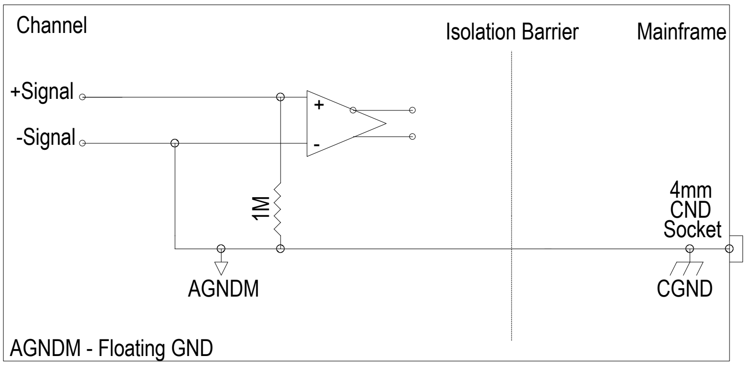
Grounding Diagrams: ALI mode (Voltage Input mode)



ICP42 in ALI mode with differential float (per channel)

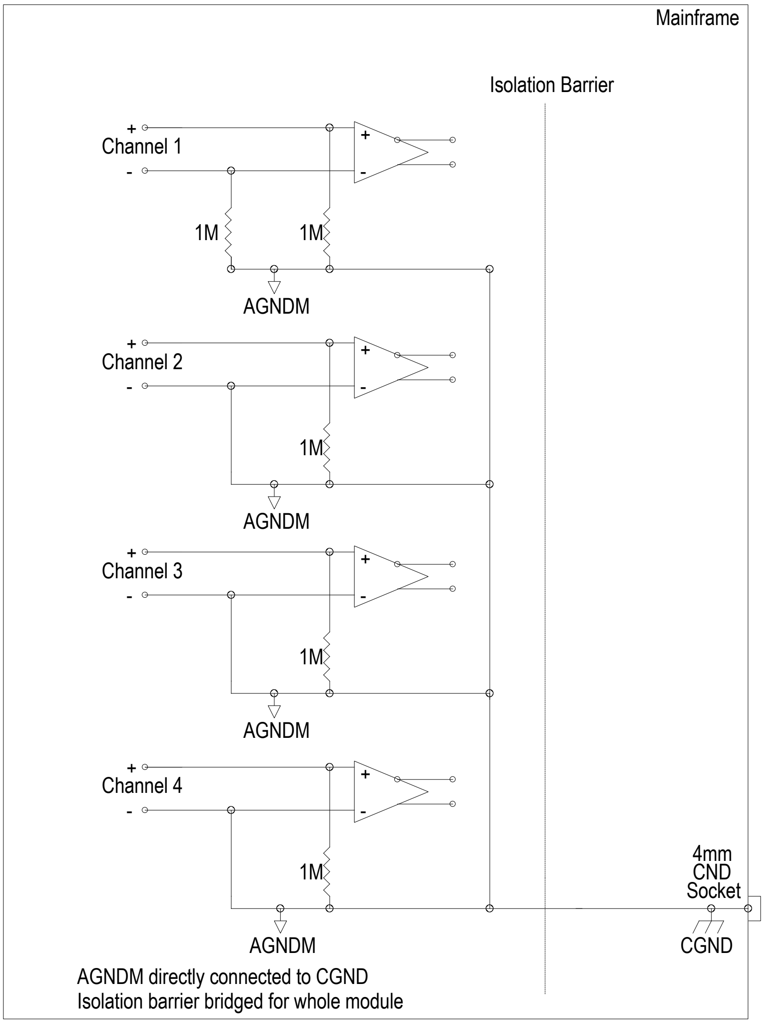


ICP42 single-ended float (per channel)



ICP42 single-ended ground (will affect the whole Module)

Although each channel in the ICP42 can be set individually as to its grounding type, enabling the single-ended ground option on any one channel will cause all four channels to be connected directly to ground. The PAK software will automatically set the grounding type to single-ended ground when one of the channels has been configured in this way.

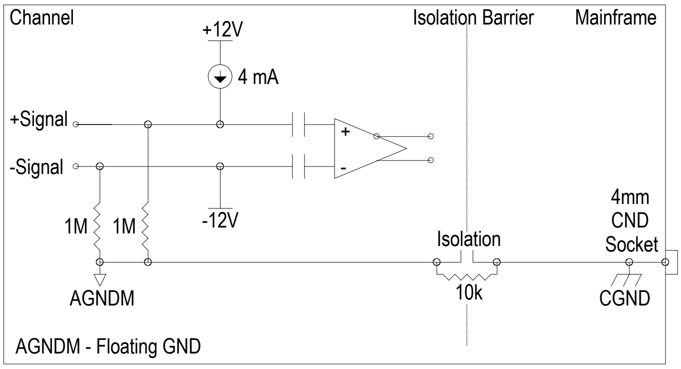


ICP42 Single-ended ground affects all four channels

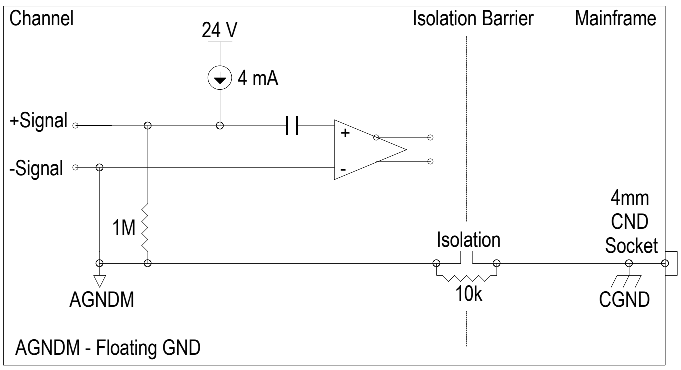
As with ALI mode, there are again three grounding types when using ICP® input mode:

- ICP42 functionality in ICP® mode with 4 mA current excitation and differential float selected as grounding type
- ICP42 functionality in ICP® mode with 4 mA current excitation and single-ended float selected as grounding type
- ICP42 functionality in ICP® mode with 4 mA current excitation and single-ended ground selected as grounding type

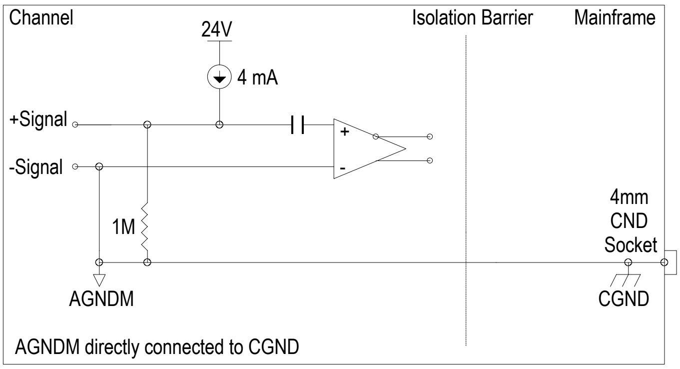
Grounding Diagrams: ICP® mode



ICP42 in ICP® mode with 4 mA current excitation and differential float



ICP42 in ICP® mode with 4 mA current excitation and single-ended float



ICP42 in ICP® mode with 4 mA current excitation and single-ended ground

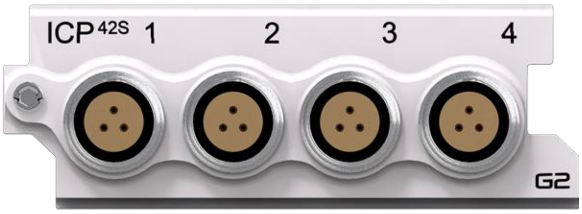
12.1.7. ICP42S

Description

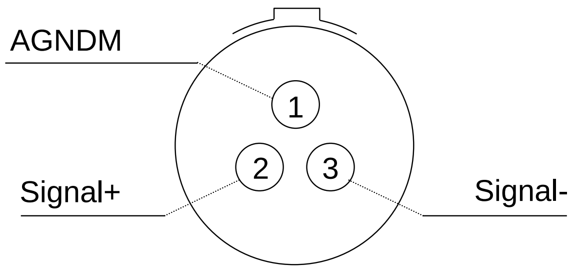
The ICP42S Module can be used with ICP® based accelerometers, force and pressure sensors as well as to measure analog voltages. All 4 channels operate independently of each other, each with their own setting of mode, gain and coupling. The ICP42S furthers the ICP42 by sharing many of the same features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

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

Front Panel



Connector Information and Pin Definitions



ICP42S with LEMO® 3-way EHG.0B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

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
- ±(100 mV, 1 V, 10 V and 60 V) 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 MΩ differential and 1 MΩ single-ended input resistance
- Low power consumption
- LEMO® 3-way EHG.0B connectors

<table>
<tr><td rowspan="2">Interface</td><td>ICP®</td><td colspan="4">ICP® sensors</td></tr>
<tr><td>ALI</td><td colspan="4">For analog source voltages</td></tr>
<tr><td rowspan="2">Input Coupling</td><td>ICP®</td><td colspan="4">AC</td></tr>
<tr><td>ALI</td><td colspan="4">DC or AC</td></tr>
<tr><td rowspan="2">AC Coupling Frequency Response</td><td rowspan="2">ICP® / ALI</td><td>Attenuation</td><td>Min</td><td>Max</td><td>Unit</td></tr>
<tr><td>-3 dB</td><td>-</td><td>0.16</td><td>Hz</td></tr>
<tr><td colspan="2">Other Sampling Rates</td><td colspan="4">Available through digital LP filters and decimation</td></tr>
<tr><td colspan="2">Optional Programmable Digital IIR Filter</td><td colspan="4">Band pass/stop : 6 dB/octave
High/Low pass : 12 dB/octave</td></tr>
<tr><td colspan="2">Optional First Order High-Pass Filter</td><td colspan="4">-3 dB @ 1 Hz</td></tr>
<tr><td colspan="2">Module Calibration</td><td colspan="4">Internal amplitude and phase calibration</td></tr>
<tr><td rowspan="2">Protection</td><td>ICP® / ALI</td><td colspan="4">2 kV ESD</td></tr>
<tr><td>ICP®</td><td colspan="4">Short circuit between sensor case and ground</td></tr>
<tr><td colspan="2">Galvanic Isolation</td><td colspan="4">50 V</td></tr>
</table>

Specifications

Bandwidth		DC to 100 kHz	
Maximum Sampling Rate (fs) per Channel		204.8 kSa/s	
A/D Conversion		24-bit	
Data Transfer		16/24-bit	
Input Voltage Ranges (Peak)		±100 mV; ±1 V; ±10 V; ±60 V	
ICP® Mode		4 mA; 8 mA or 12 mA constant current at ±12 V / 24 V excitation	
Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are connected through 1 MΩ to floating ground	
	Single-Ended Float (Unbalanced Float)	Positive signal input connected through 1 MΩ to floating ground; Negative signal input connected to floating ground	
	Single-Ended GND (Unbalanced GND)	Positive signal input connected through 1 MΩ to ground; Negative signal input connected to ground	
Input Impedance	**Differential**	2 MΩ ‖ 200 pF	
	Single-Ended	1 MΩ ‖ 300 pF	
Digital Low-Pass Filter *Filter scales with sampling rate*		**Passband**	fs x 0.45 Hz
		Stopband	fs x 0.55 Hz
		Passband Ripple	±0.005 dB
		Stopband Attenuation	100 dB
Phase Accuracy *Channels in similar range*		**Typical**[13]	< 0.2° at 10 kHz

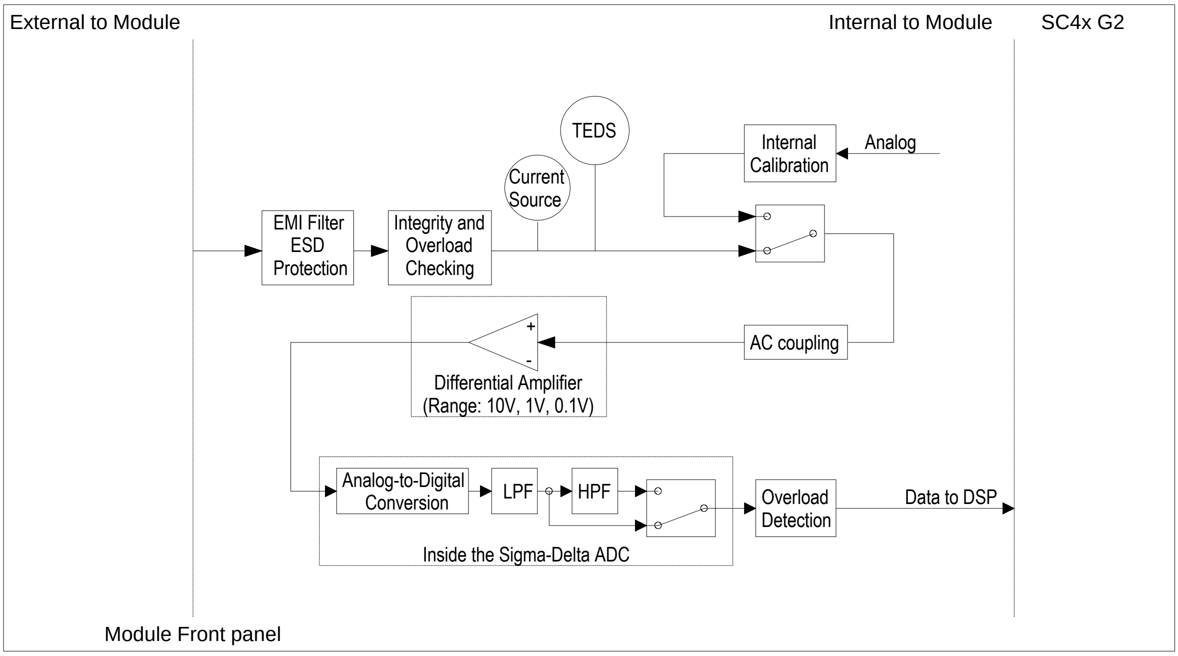
[13] Measured in 10 V range at 204.8 kSa/s

		Input Range (Peak)	% Reading + % Range	
DC Voltage Accuracy		±100 mV	0.275 % + 0.275 %	
		±1 V	0.062 % + 0.023 %	
		±10 V	0.089 % + 0.006 %	
		± 60 V	1.187 % + 0.013 %	
Noise *Input terminated by 50 Ω resistor*		**Input Range (Peak)**	**Guaranteed**	**Typical**
	10 Hz to 23 kHz	±100 mV	< 3.5 µVrms	< 2.5 µVrms
	10 Hz to 49 kHz		< 4 µVrms	< 3 µVrms
	10 Hz to 100 kHz		< 12 µVrms	< 10 µVrms
	10 Hz to 23 kHz	±1 V	< 10 µVrms	< 7 µVrms
	10 Hz to 49 kHz		< 14 µVrms	< 10 µVrms
	10 Hz to 100 kHz		< 90 µVrms	< 85 µVrms
	10 Hz to 23 kHz	±10 V	< 50 µVrms	< 41 µVrms
	10 Hz to 49 kHz		< 85 µVrms	< 74 µVrms
	10 Hz to 100 kHz		< 870 µVrms	< 840 µVrms
	10 Hz to 23 kHz	± 60 V	< 580 µVrms	< 470 µVrms
	10 Hz to 49 kHz		< 780 µVrms	< 660 µVrms
	10 Hz to 100 kHz		< 4500 µVrms	< 4300 µVrms

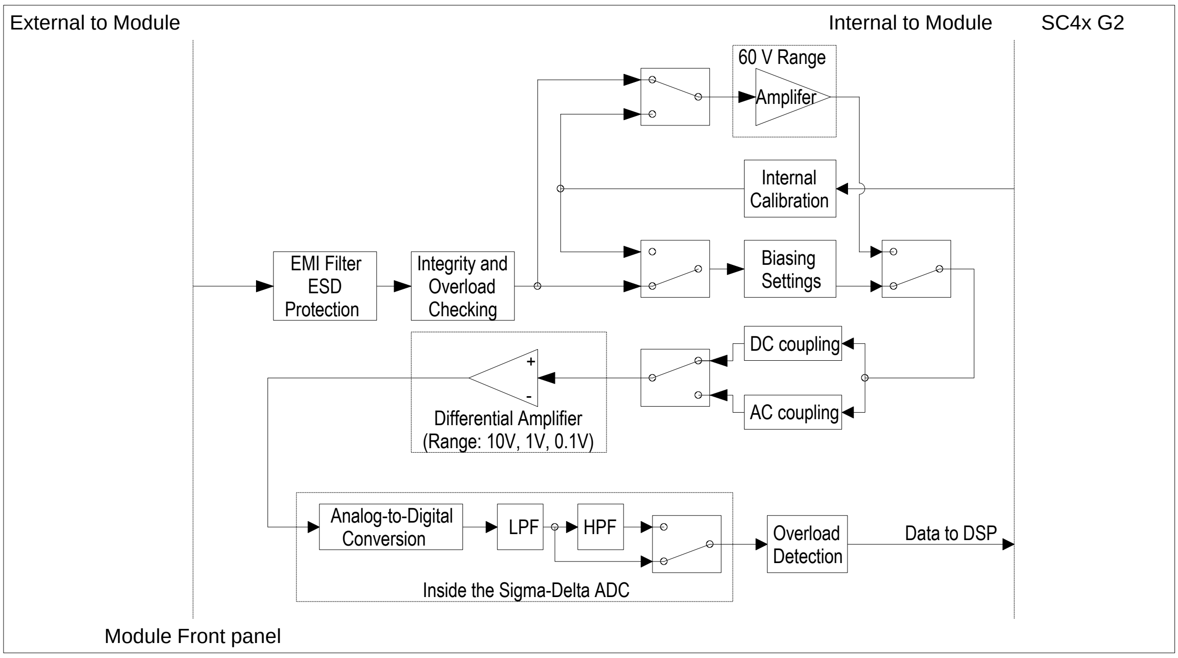
	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)	
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±100 mV	- 0.04 dB	
	102.4 kSa/s		- 0.10 dB	
	204.8 kSa/s		- 0.32 dB	
	51.2 kSa/s	±1 V	- 0.05 dB	
	102.4 kSa/s		- 0.07 dB	
	204.8 kSa/s		- 0.18 dB	
	51.2 kSa/s	±10 V	- 0.04 dB	
	102.4 kSa/s		- 0.05 dB	
	204.8 kSa/s		- 0.10 dB	
	51.2 kSa/s	± 60 V	- 0.05 dB	
	102.4 kSa/s		- 0.09 dB	
	204.8 kSa/s		- 0.26 dB	
Crosstalk		**Input Range (Peak)**	**Guaranteed**	**Typical**
		±100 mV	113 dB	118 dB
		±1 V	110 dB	115 dB
		±10 V	102 dB	107 dB
		± 60 V	84 dB	89 dB

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



ICP42S ICP® mode (per channel)



ICP42S ALI mode (per channel)

Grounding options

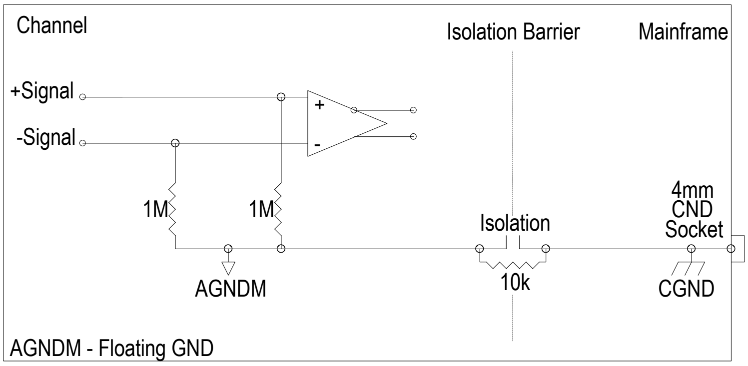
The addition of a 24 V power rail to the ICP42S assures an advanced overall grounding of the Module:

- Differential float (Balanced float):
  - -12 V to 12 V excitation
  - Both inputs connected through 1 MΩ to a floating ground

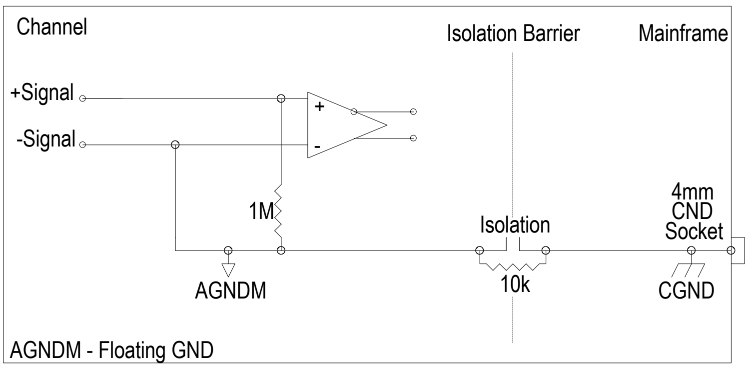
- Single-Ended float (Unbalanced float):
  - 0 V to 24 V excitation
  - One input connected through 1 MΩ to a floating ground the other directly to the floating ground

- Single-Ended ground (Unbalanced ground):
  - 0 V to 24 V excitation
  - One input connected through 1 MΩ to ground the other directly to ground

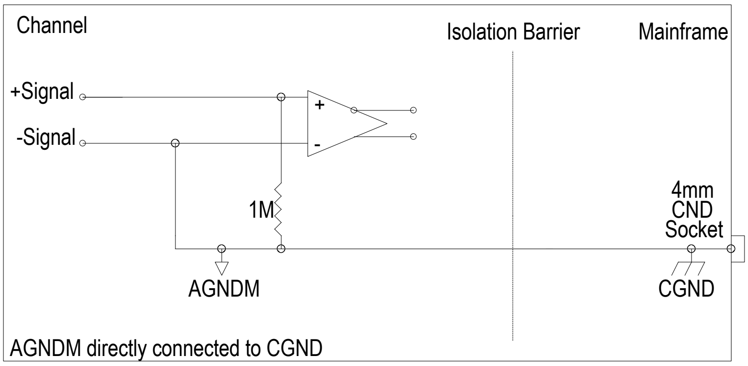
Grounding Diagrams: ALI mode (Voltage input mode)



ICP42S in ALI mode with differential float (per channel)

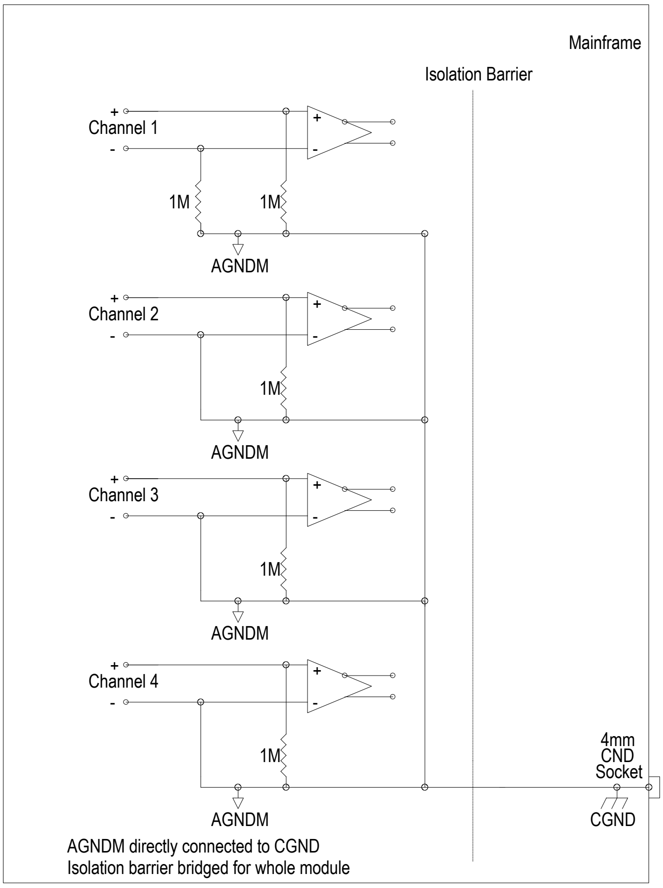


ICP42S single-ended float (per channel)



ICP42S single-ended ground (will affect whole Module)

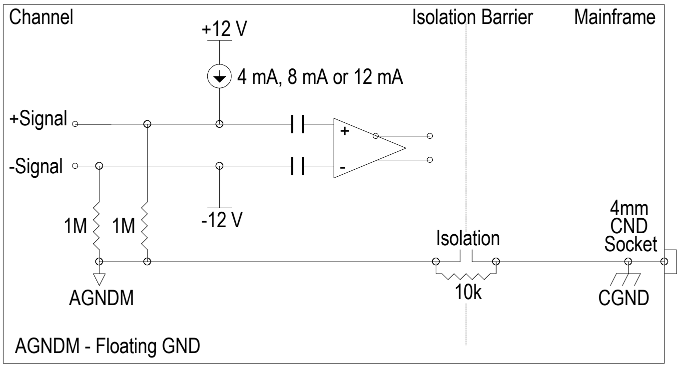
Although each channel in the ICP42S can be set individually as to its grounding type, enabling the single-ended ground option on any one channel will cause all four channels to be connected directly to ground. The PAK software will automatically set the grounding type to single-ended ground when one of the channels has been configured in this way.



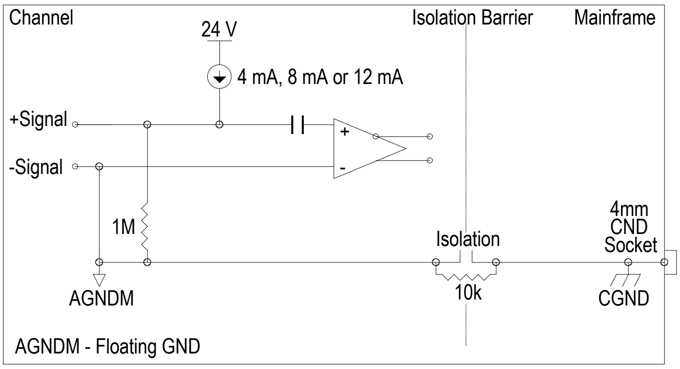
ICP42S Single-ended ground affects all four channels

Similar to the ALI mode there are again three grounding types in ICP® input mode. With ICP® Input mode there is another configuration option, namely the amount of current excitation which can be provided to an attached sensor.

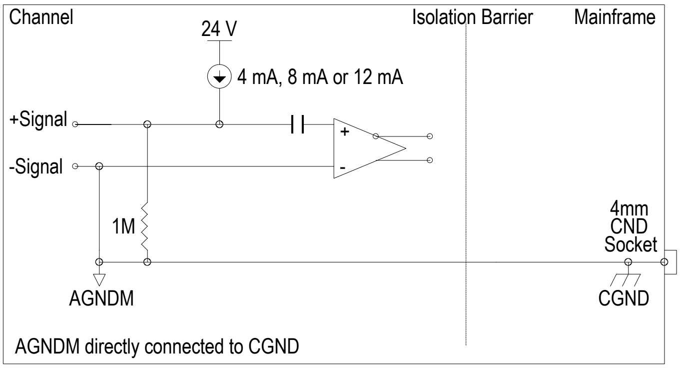
Grounding Diagrams: ICP® mode



ICP42S in ICP® mode with 4 mA, 8 mA or 12 mA current excitation and differential float



ICP42S in ICP® mode with 4 mA, 8 mA or 12 mA current excitation and single-ended float



ICP42S in ICP® mode with 4 mA, 8 mA or 12 mA current excitation, single-ended ground

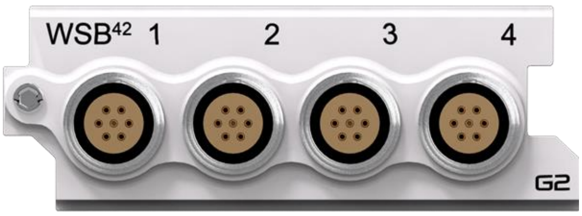
12.1.8. WSB42

Description

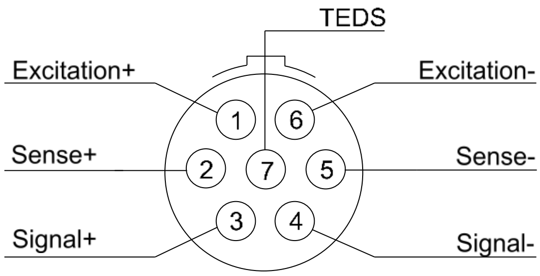
The WSB42 Module is used with AC and DC bridge measurements including strain gauges configured as full, half or quarter bridges and inductive displacement transducers (LVDT). The Module offers numerous software selectable features such as constant voltage excitation (AC or DC), bridge sensing, bridge completion resistors and shunt calibration. The bridge can be balanced on command or a previous balance value can be recalled. The Module can be used with:

- Any strain gauge in quarter, half and full bridge, load cell and pressure transducer
- Inductive displacement transducer (LVDT)

Front Panel



Connector Information and Pin Definitions



WSB42 with LEMO® 7-way EHG.0B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Sensor cables

001K

The 001K is a standard length sensor cable used to connect deflection bridge sensors to WSB42 and WSB42X Modules.

008K

The 008K is a variable length sensor cable used to connect deflection bridge sensors to WSB42 and WSB42X Modules.

See the "Cables" section for more information.

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
- ±(2 mV, 20 mV, 200 mV) input ranges for bridge mode
- ≤ 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 kΩ internal shunt calibration resistor
- Pre- and post-filter overflow monitoring
- Selectable low and high pass digital filters
- LEMO® 7-way EHG.0B connectors

Bridge Type	Resistive or inductive

	Bridge Resistance	**Excitation Voltage**	**Minimum Resistance**	**Maximum Resistance**
Bridge Balancing Ranges for Voltage Excitation *Represents minimum or maximum resistance of a single element if other three bridge elements remain at their nominal value*	**120 Ω**	1 V	40 Ω	360 Ω
		2 V	72 Ω	200 Ω
		3 V	86 Ω	168 Ω
		4 V	93 Ω	154 Ω
		5 V	98 Ω	147 Ω
	350 Ω	1 V	117 Ω	1050 Ω
		2 V	210 Ω	583 Ω
		3 V	250 Ω	490 Ω
		4 V	272 Ω	450 Ω
		5 V	286 Ω	428 Ω

	Excitation Voltage	**Maximum Load Current**	**Voltage Resolution**	**Polarity**
Constant Voltage Excitation	0-5 V	< 90 mA	1.3 mV	Bipolar (Balanced)

Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are referenced to floating ground
Other Sampling Rates	Available through digital LP filters and decimation	
Optional Programmable Digital IIR Filter	Band pass/stop : 6 dB/octave High/Low pass : 12 dB/octave	
Optional First Order High-Pass Filter	-3 dB @ 1 Hz	
Protection	2 kV ESD on all lines	
	Short circuit between excitation lines	
Galvanic Isolation	50 V	

Specifications

Bandwidth	DC to 49 kHz		
Maximum Sampling Rate (fs) per Channel	102.4 kSa/s		
A/D Conversion	24-bit		
Data Transfer	16/24-bit		
Input Voltage Ranges (Peak)	±2 mV; ±20 mV; ±200 mV		
Input Impedance	1 GΩ ll 60 pF		
	Resistance	**Tolerance**	**Temperature Drift**
Shunt Calibration Resistor *Between Signal- and Excitation+ / Sense+*	100 kΩ	0.1 %	5 ppm/°C
Internal Bridge Completion Resistors	120 Ω or 350 Ω	0.02 %	0.2 ppm/°C

<table>
<tr><td rowspan="4">Digital Low-Pass Filter
Filter scales with sampling rate</td><td colspan="2">Passband</td><td colspan="2">fs x 0.45 Hz</td></tr>
<tr><td colspan="2">Stopband</td><td colspan="2">fs x 0.55 Hz</td></tr>
<tr><td colspan="2">Passband Ripple</td><td colspan="2">±0.005 dB</td></tr>
<tr><td colspan="2">Stopband Attenuation</td><td colspan="2">100 dB</td></tr>
<tr><td>Phase Accuracy
Channels in similar range</td><td colspan="2">Typical[14]</td><td colspan="2">< 0.2° at 10 kHz</td></tr>
<tr><td rowspan="2">Wheatstone Bridge Voltage-Excitation</td><td colspan="2">Excitation Voltage</td><td colspan="2">% Excitation Voltage</td></tr>
<tr><td colspan="2">0 to 5 V</td><td colspan="2">0.34 %</td></tr>
<tr><td rowspan="4">DC Voltage Accuracy</td><td colspan="2">Input Range (Peak)</td><td colspan="2">% Range</td></tr>
<tr><td colspan="2">±2 mV</td><td colspan="2">To be determined</td></tr>
<tr><td colspan="2">±20 mV</td><td colspan="2">0.54 %</td></tr>
<tr><td colspan="2">±200 mV</td><td colspan="2">0.30 %</td></tr>
<tr><td rowspan="7">Noise
Input terminated by
50 Ω resistor</td><td></td><td>Input Range (Peak)</td><td>Guaranteed</td><td>Typical</td></tr>
<tr><td>10 Hz to 23 kHz</td><td rowspan="2">±2 mV</td><td>< 0.05 µVrms</td><td>< 0.04 µVrms</td></tr>
<tr><td>10 Hz to 49 kHz</td><td>< 0.06 µVrms</td><td>< 0.05 µVrms</td></tr>
<tr><td>10 Hz to 23 kHz</td><td rowspan="2">±20 mV</td><td>< 0.5 µVrms</td><td>< 0.4 µVrms</td></tr>
<tr><td>10 Hz to 49 kHz</td><td>< 0.6 µVrms</td><td>< 0.5 µVrms</td></tr>
<tr><td>10 Hz to 23 kHz</td><td rowspan="2">±200 mV</td><td>< 3.8 µVrms</td><td>< 3.3 µVrms</td></tr>
<tr><td>10 Hz to 49 kHz</td><td>< 5.5 µVrms</td><td>< 4.8 µVrms</td></tr>
</table>

[14] Measured in 200 mV range at 102.4 kSa/s

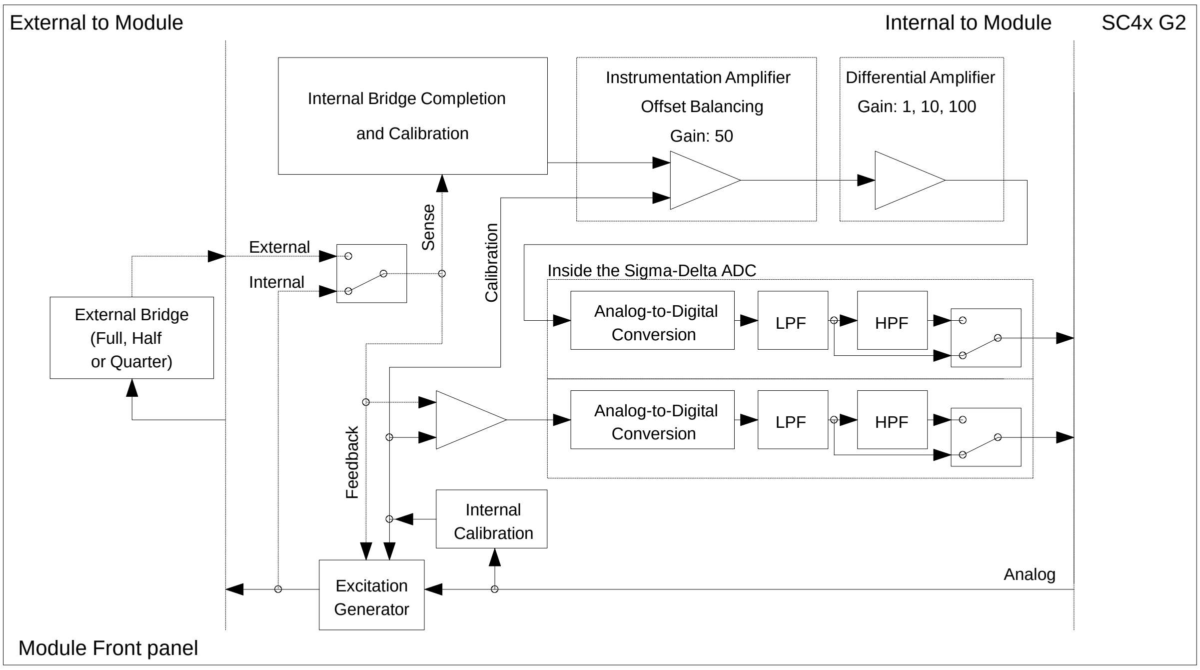
	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±2 mV	To be determined
	102.4 kSa/s		-
	51.2 kSa/s	±20 mV	- 0.04 dB
	102.4 kSa/s		- 0.13 dB
	51.2 kSa/s	±200 mV	- 0.04 dB
	102.4 kSa/s		- 0.13 dB

	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)
Amplitude Flatness *Relative to 1 kHz* *with 1 kΩ source* *Measured up to 0.39 x fs*	51.2 kSa/s	±2 mV	To be determined
	102.4 kSa/s		-
	51.2 kSa/s	±20 mV	- 0.11 dB
	102.4 kSa/s		- 0.35 dB
	51.2 kSa/s	±200 mV	- 0.11 dB
	102.4 kSa/s		- 0.35 dB

	Input Range (Peak)	Guaranteed	Typical
Crosstalk	±2 mV	64 dB	69 dB
	±20mV	86 dB	91 dB
	±200 mV	105 dB	110 dB

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



WSB42 Module Functionality

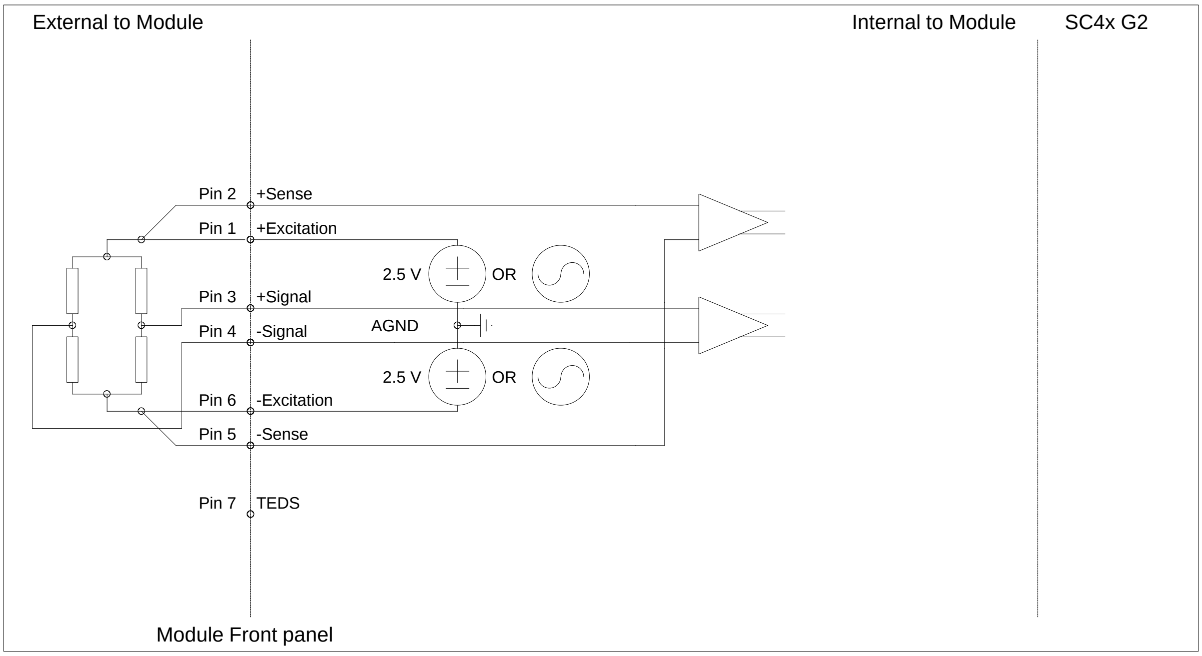
- The sense signals can be used internal to the system to fine tune the excitation voltage.
- The excitation frequency must be the same for all channels of a WSB Module that utilizes AC excitation.
- The different modes and parameter values mentioned in the specifications table are all software-selectable.

Operational Modes

The figures below show full, half and quarter bridge configurations for the WSB42 Module and a bridge located externally to the Module.

Full Bridge Functionality

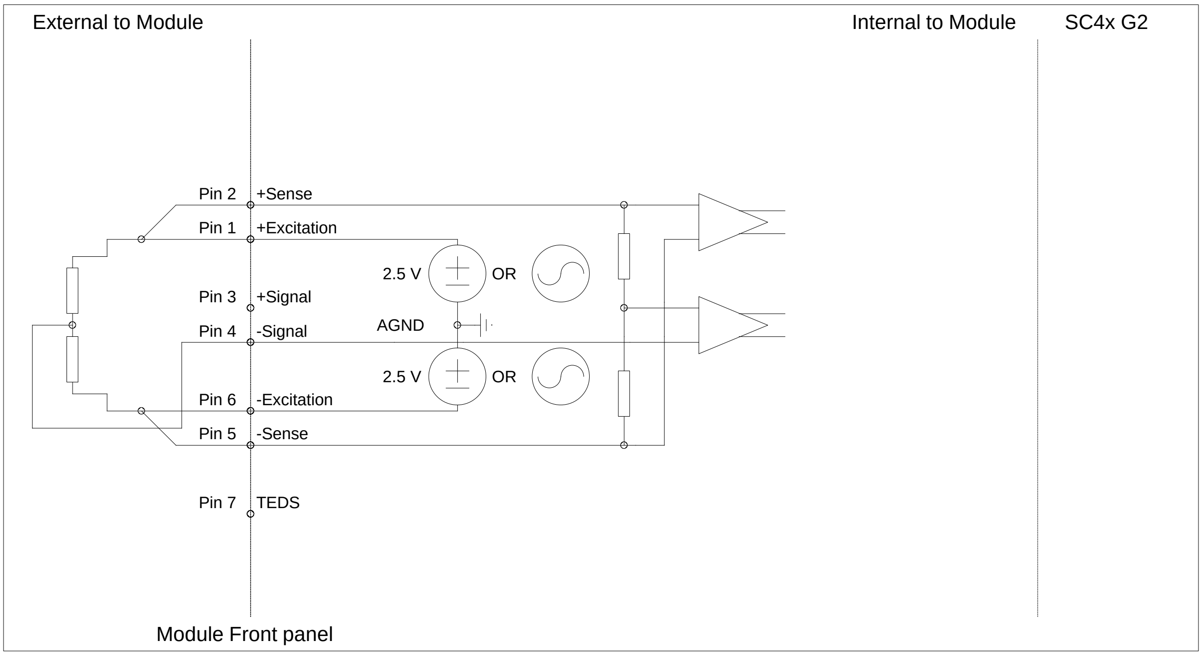
External connections and internal full bridge completion per WSB Module channel (6-wire bridges can be used with external sensing and 4-wire bridges with internal sensing).



Full bridge functionality

Half Bridge Functionality

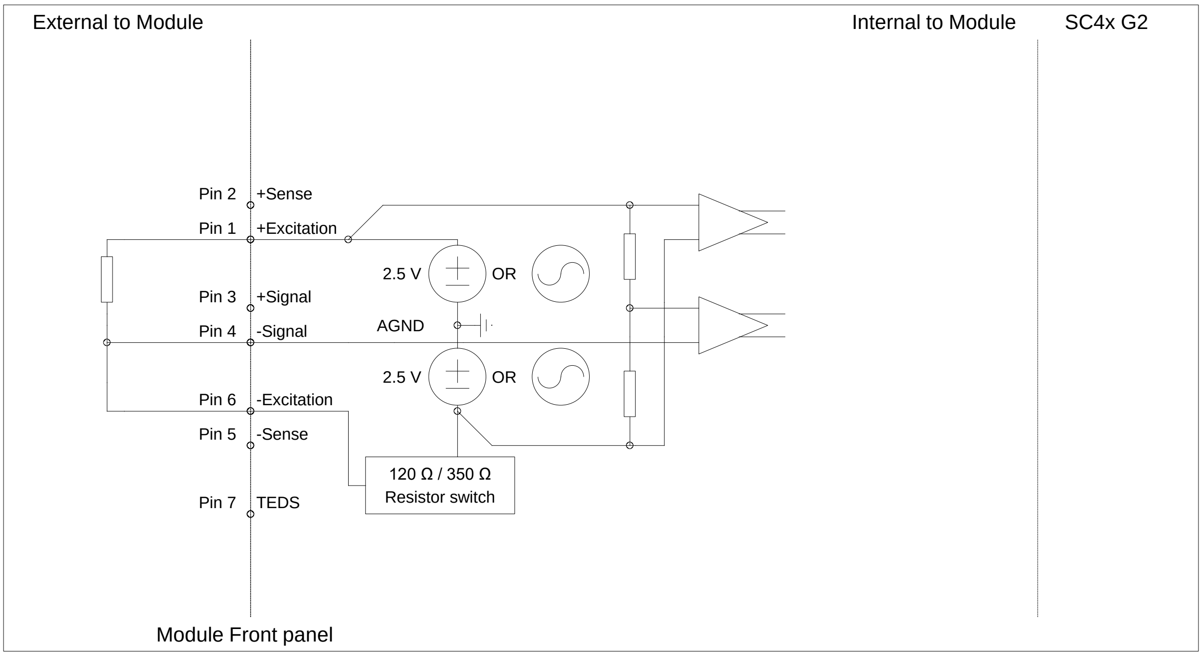
External connections and internal half bridge completion per WSB Module channel (5-wire bridges can be used with external sensing and 3-wire half bridges with internal sensing).



Half bridge functionality

Quarter Bridge Functionality

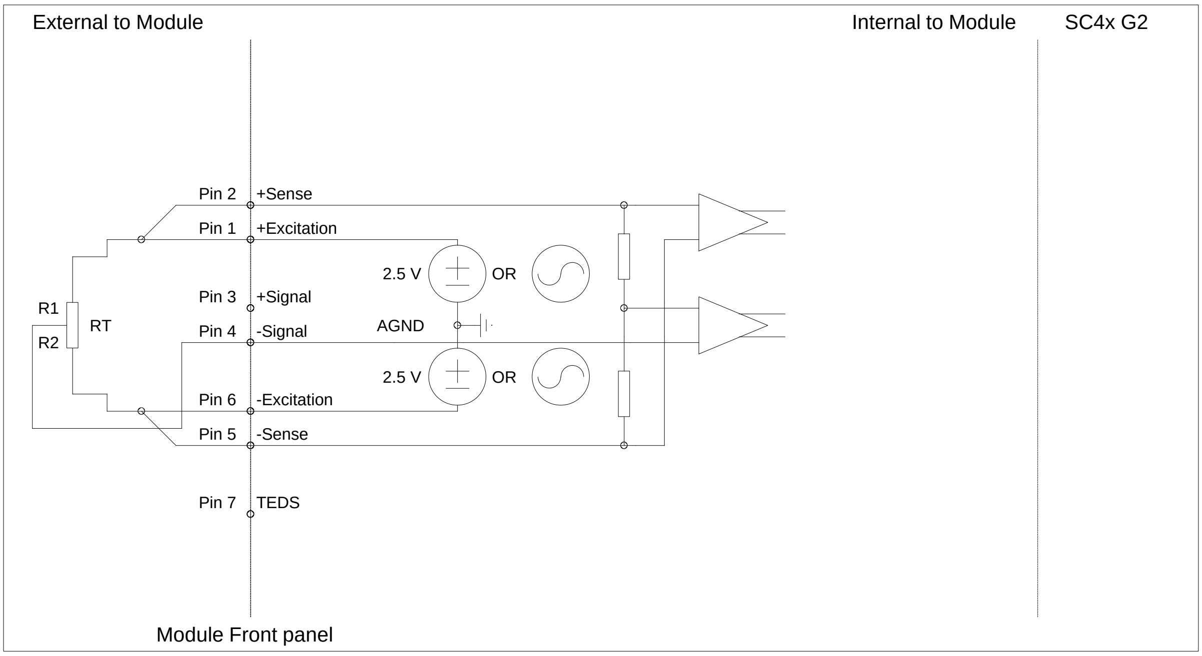
External connections and internal quarter bridge completion per WSB Module channel (3-wire quarter bridges can be used with internal sensing).



Quarter bridge functionality

Using a rope transducer

External connections to a rope transducer and internal half bridge completion per WSB Module channel (5-wire and 3-wire rope transducers).



Rope transducer functionality

The rope transducer's potentiometer is such that RT = R1 + R2.
In terms of displacement, this is equal to LT = L1 + L2. Also .... L1/LT = R1/RT (1)

Now for the bridge above: if Vin is defined as the voltage difference between Signal+ and Signal- and Vexc is defined as the voltage difference between Excitation+ and Excitation- (in other words, the excitation voltage), then the following equation holds: ....Vin = Vexc (R1/RT - ½) (2)

When (1) is substituted into (2), we get .... L1/LT = Vin/Vexc + ½ (3)

The only restriction with the above configuration is that Vin must stay within range of the input amplifier. Hence Vexc is limited as follows:
WSB42 Modules: Vexc = 500 mV

Shunt Calibration

Shunt calibration is a means of simulating strain in a bridge. It is an accepted and useful way of checking the gain and accuracy of instrumentation without the need to expose the transducer to known physical input values.

Shunt calibration works by shunting a known resistor across one arm of a Wheatstone bridge. The resulting deviation in bridge output is expressed in mV/V of excitation or mV/mA of excitation.

Practically, data obtained from a shunt calibration can be used to check that the instrumentation is operating as expected, that the correct input range is selected and that the correct gauge and scaling factors are used in subsequent calculations.

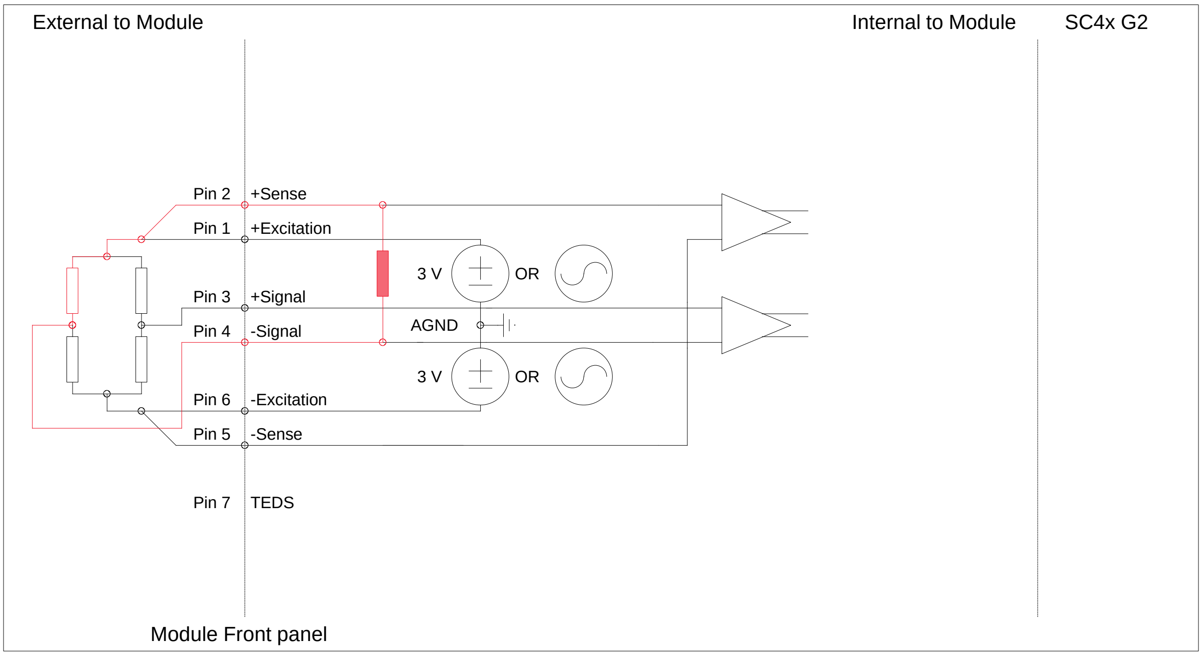
Shunt calibration can be performed for any bridge setup.

The table below summarizes the shunt calibration outputs for unloaded bridges with negligible lead wire resistance and gauge factor equal to 2.

Nominal Bridge Resistance (Ω)	Shunt Resistor (kΩ)	Voltage Excited Bridge Output (mV/V)	Current Excited Bridge Output (mV/mA)	Equivalent Microstrain	Simulation Type
120	100	0.30	0.04	599	Compression
350	100	0.87	0.31	1744	Compression
1000	100	2.49	2.49	4950	Compression

Shunt calibration outputs

The equivalent shunt calibration circuit is illustrated in the figure below. The shunt resistor path is highlighted in red.



Shunt calibration for 6-wire bridge configuration with 4 external bridge elements

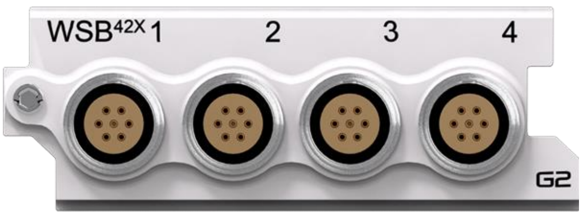
12.1.9. WBS42X

Description

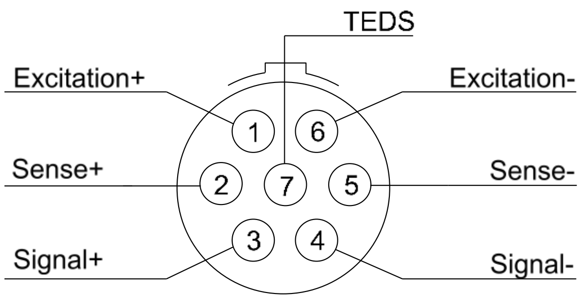
The WSB42X Module is used with AC and DC bridge measurements including strain gauges configured as full, half or quarter bridges and inductive displacement transducers (LVDT). The Module offers numerous software selectable features such as constant voltage (AC or DC) and constant current excitation (DC), bridge sensing, bridge completion resistors, shunt calibration, dynamic strain mode and ICP® sensor support. The bridge can be balanced on command or a previous balance value can be recalled. The Module can be used with:

- Any strain gauge in quarter, half and full bridge, load cell and pressure transducer
- Inductive displacement transducer (LVDT)
- Any voltage source up to ±10 V in voltage input mode
- Current-excited sensors in 4-wire mode (Full bridge or 1 external element, DC and AC)
- Current-excited sensors in 2-wire mode (Dynamic strain only)
- Any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure

Front Panel



Connector Information and Pin Definitions



WSB42X with LEMO® 7-way EHG.0B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Sensor cables

001K

The 001K is a standard length sensor cable used to connect deflection bridge sensors to WSB42 and WSB42X Modules.

008K

The 008K is a variable length sensor cable used to connect deflection bridge sensors to WSB42 and WSB42X Modules.

See the "Cables" section for more information.

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 350 Ω full bridges
      - for 120 Ω and 350 Ω half or quarter bridges
    - 0-4 V (AC or DC) for 120 Ω full bridges
  - Bridge voltage-excitation mode:
    - 8-10 V (DC) for 1 kΩ bridges
  - Bridge current-excitation mode:
    - 4, 8 or 12 mA (DC)
  - 2 and 4 wire current-excitation 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
- ±(10 mV, 100 mV, 1 V, 10 V) input ranges for all modes
- ≤ 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 kΩ internal shunt calibration resistor
- Pre- and post-filter overflow monitoring
- Selectable low and high pass digital filters
- LEMO® 7-way EHG.0B connectors

Bridge Type		Resistive or inductive			
Interface	ICP®	ICP® sensors			
	ALI	For analog voltage sources			
	WSB	Wheatstone bridge sensors			
Input Coupling	ICP®	AC			
	ALI / WSB	DC or AC			
AC Coupling Frequency Response	ICP® / ALI / WSB	**Attenuation**	**Min**	**Max**	**Unit**
		-3 dB	-	1.5	Hz

	Bridge Resistance	Excitation Voltage	Minimum Resistance	Maximum Resistance
Bridge Balancing Ranges for Voltage Excitation *Represents minimum or maximum resistance of a single element if other three bridge elements remain at their nominal value*	**120 Ω**	0.5 - 5 V	0 Ω	Unlimited
		5.5 V	6 Ω	2520 Ω
		6 V	11 Ω	1320 Ω
	350 Ω	0.5 - 5 V	0 Ω	Unlimited
		5.5 V	17 Ω	7350 Ω
		6 V	32 Ω	3850 Ω
	1 kΩ	8.5 V	850 Ω	3850 Ω
		9 V	850 Ω	3500 Ω
		9.5 V	850 Ω	3220 Ω
		10 V	850 Ω	3000 Ω

	Bridge Resistance	Excitation Current	Minimum Resistance (2-wire and 4-wire)	Maximum Resistance (2-wire)	Maximum Resistance (4-wire)
Bridge Balancing Ranges for Current Excitation *Represents minimum or maximum resistance of a single element if other three bridge elements remain at their nominal value*	**120 Ω**	4 mA	0 Ω	Unlimited	Unlimited
		8 mA	0 Ω	Unlimited	Unlimited
		12 mA	0 Ω	Unlimited	Unlimited
	350 Ω	4 mA	0 Ω	Unlimited	Unlimited
		8 mA	0 Ω	12000 Ω	12000 Ω
		12 mA	0 Ω	2400 Ω	2400 Ω
	1 kΩ	4 mA	0 Ω	7660 Ω	7660 Ω
		8 mA	48 Ω	2810 Ω	2810 Ω
		12 mA	310 Ω	2050 Ω	1360 Ω

	Excitation Current	Voltage Compliance	Maximum Sensor Resistance
Constant Current Excitation 2-Wire *Signal± carries both signal and excitation* *AC coupled* *No current monitoring*	4 mA	20 V	5000 Ω
	8 mA	20 V	2500 Ω
	12 mA	20 V	1660 Ω

Constant Current Excitation 4-Wire *Signal± carries signal and Excitation± carries excitation* *AC or DC coupled* *Current monitoring across ultra-precision resistor*	4 mA	13 V	3250 Ω	
	8 mA	13 V	1620 Ω	
	12 mA	13 V	1080 Ω	
Constant Voltage Excitation	**Excitation Voltage**	**Maximum Load Current**	**Voltage Resolution**	**Polarity**
	< 6 V	< 90 mA	0.2 mV	Bipolar (Balanced)
	8 to 10 V	< 12 mA	0.1 mV	Unipolar (Unbalanced)
Other Sampling Rates	Available through digital LP filters and decimation			
Optional Programmable Digital IIR Filter	Band pass/stop : 6 dB/octave High/Low pass : 12 dB/octave			
Optional First Order High-Pass Filter	-3 dB @ 1 Hz			
Protection	ICP® / ALI / WSB	2 kV ESD on all lines		
		Overvoltage on signal lines		
	ICP®	Short circuit between sensor case and ground		
	WSB	Short circuit between excitation lines		
Galvanic Isolation	50 V			

Specifications (All builds preceding Build R)

Bandwidth		DC to 100 kHz		
Maximum Sampling Rate (fs) per Channel		204.8 kSa/s		
A/D Conversion		24-bit		
Data Transfer		16/24-bit		
Input Voltage Ranges (Peak)		±10 mV; ±100 mV; ±1 V; ±10 V		
ICP® Mode		4 mA; 8 mA or 12 mA constant current at ±12 V excitation		
Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are connected through 1 MΩ to floating ground		
Input Impedance		2.1 MΩ ‖ 1200 pF		
		Resistance	**Tolerance**	**Temperature Drift**
Shunt Calibration Resistor *Between Signal- and Excitation+ / Sense+*		100 kΩ	0.1 %	5 ppm/°C
Internal Bridge Completion Resistors		120 Ω or 350 Ω	0.02 %	0.2 ppm/°C
Digital Low-Pass Filter *Filter scales with sampling rate*		**Passband**	fs x 0.45 Hz	
		Stopband	fs x 0.55 Hz	
		Passband Ripple	±0.005 dB	
		Stopband Attenuation	100 dB	
Phase Accuracy *Channels in similar range*		**Typical**[15]	< 0.2° at 10 kHz	
Wheatstone Bridge Current-Excitation		**Excitation Mode**	**% Excitation Mode + mA**	
	2-wire	4 mA	0.58 % + 0.025 mA	
		8 mA	0.38 % + 0.031 mA	
		12 mA	0.36 % + 0.042 mA	
	4-wire	4 mA	0.58 % + 0.011 mA	
		8 mA	0.38 % + 0.018 mA	
		12 mA	0.36 % + 0.029 mA	

[15] Measured in 10 V range at 204.8 kSa/s

Wheatstone Bridge Voltage-Excitation		**Excitation Voltage**	**Maximum Error Voltage**	
		< 6 V	± 4 mV	
		8 to 10 V	± 4 mV	
DC Voltage Accuracy		**Input Range (Peak)**	**% Range**	
		±10 mV	To be determined	
		±100 mV	0.30 %	
		±1 V	0.15 %	
		±10 V	0.15 %	
Noise *Input terminated by 50 Ω resistor*		**Input Range (Peak)**	**Guaranteed**	**Typical**
	10 Hz to 23 kHz	±10 mV	< 3.6 µVrms	< 2.9 µVrms
	10 Hz to 49 kHz		< 5.8 µVrms	< 4.3 µVrms
	10 Hz to 100 kHz		< 6.9 µVrms	< 5.6 µVrms
	10 Hz to 23 kHz	±100 mV	< 5.0 µVrms	< 4.4 µVrms
	10 Hz to 49 kHz		< 10 µVrms	< 7.8 µVrms
	10 Hz to 100 kHz		< 82 µVrms	< 72 µVrms
	10 Hz to 23 kHz	±1 V	< 5.0 µVrms	< 4.4 µVrms
	10 Hz to 49 kHz		< 10 µVrms	< 7.8 µVrms
	10 Hz to 100 kHz		< 86 µVrms	< 74 µVrms
	10 Hz to 23 kHz	±10 V	< 41 µVrms	< 37 µVrms
	10 Hz to 49 kHz		< 86 µVrms	< 68 µVrms
	10 Hz to 100 kHz		< 755 µVrms	< 700 µVrms

	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±10 mV	- 0.03 dB
	102.4 kSa/s		- 0.07 dB
	204.8 kSa/s		- 0.18 dB
	51.2 kSa/s	±100 mV	- 0.02 dB
	102.4 kSa/s		- 0.06 dB
	204.8 kSa/s		- 0.15 dB
	51.2 kSa/s	±1 V	- 0.02 dB
	102.4 kSa/s		- 0.06 dB
	204.8 kSa/s		- 0.11 dB
	51.2 kSa/s	±10 V	- 0.02 dB
	102.4 kSa/s		- 0.05 dB
	204.8 kSa/s		- 0.11 dB

	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)
Amplitude Flatness *Relative to 1 kHz with 1 kΩ source* *Measured up to 0.39 x fs*	51.2 kSa/s	±10 mV	- 0.40 dB
	102.4 kSa/s		- 1.10 dB
	204.8 kSa/s		- 3.50 dB
	51.2 kSa/s	±100 mV	- 0.31 dB
	102.4 kSa/s		- 1.06 dB
	204.8 kSa/s		- 3.20 dB
	51.2 kSa/s	±1 V	- 0.30 dB
	102.4 kSa/s		- 1.06 dB
	204.8 kSa/s		- 3.21 dB
	51.2 kSa/s	±10 V	- 0.30 dB
	102.4 kSa/s		- 1.05 dB
	204.8 kSa/s		- 3.18 dB

	Input Range (Peak)	Guaranteed	Typical
Crosstalk	±10 mV	68 dB	73 dB
	±100 mV	62 dB	67 dB
	±1 V	102 dB	107 dB

	±10 V	83 dB	88 dB

WSB42X Module (All builds preceding Build R) Specifications

The Module settings and measurement conditions that were used during specification measurements are available on request.

Low Capacitance (Build R onwards) Specifications

Bandwidth		DC to 100 kHz		
Maximum Sampling Rate (fs) per Channel		204.8 kSa/s		
A/D Conversion		24-bit		
Data Transfer		16/24-bit		
Input Voltage Ranges (Peak)		±10 mV; ±100 mV; ±1 V; ±10 V		
ICP® Mode		4 mA; 8 mA or 12 mA constant current at ±12 V excitation		
Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are connected through 1 MΩ to floating ground		
Input Impedance		2.1 MΩ ll 80 pF		
		Resistance	**Tolerance**	**Temperature Drift**
Shunt Calibration Resistor *Between Signal- and Excitation+ / Sense+*		100 kΩ	0.1 %	5 ppm/°C
Internal Bridge Completion Resistors		120 Ω or 350 Ω	0.02 %	0.2 ppm/°C

Digital Low-Pass Filter *Filter scales with sampling rate*		**Passband**	fs x 0.45 Hz
		Stopband	fs x 0.55 Hz
		Passband Ripple	±0.005 dB
		Stopband Attenuation	100 dB
Phase Accuracy *Channels in similar range*		**Typical**[16]	< 0.2° at 10 kHz
Wheatstone Bridge Current-Excitation		**Excitation Mode**	**% Excitation Mode + mA**
	2-wire	4 mA	0.58 % + 0.025 mA
		8 mA	0.38 % + 0.031 mA
		12 mA	0.36 % + 0.042 mA
	4-wire	4 mA	0.58 % + 0.011 mA
		8 mA	0.38 % + 0.018 mA
		12 mA	0.36 % + 0.029 mA
Wheatstone Bridge Voltage-Excitation		**Excitation Voltage**	**Maximum Error Voltage**
		< 6 V	± 4 mV
		8 to 10 V	± 4 mV

[16] Measured in 10 V range at 204.8 kSa/s

		Input Range (Peak)	% Range	
DC Voltage Accuracy		±10 mV	To be determined	
		±100 mV	0.30 %	
		±1 V	0.15 %	
		±10 V	0.15 %	
Noise *Input terminated by 50 Ω resistor*		**Input Range (Peak)**	**Guaranteed**	**Typical**
	10 Hz to 23 kHz	±10 mV	< 3.6 µVrms	< 2.9 µVrms
	10 Hz to 49 kHz		< 5.8 µVrms	< 4.3 µVrms
	10 Hz to 100 kHz		< 6.9 µVrms	< 5.6 µVrms
	10 Hz to 23 kHz	±100 mV	< 5.0 µVrms	< 4.4 µVrms
	10 Hz to 49 kHz		< 10 µVrms	< 7.8 µVrms
	10 Hz to 100 kHz		< 82 µVrms	< 72 µVrms
	10 Hz to 23 kHz	±1 V	< 5.0 µVrms	< 4.4 µVrms
	10 Hz to 49 kHz		< 10 µVrms	< 7.8 µVrms
	10 Hz to 100 kHz		< 86 µVrms	< 74 µVrms
	10 Hz to 23 kHz	±10 V	< 41 µVrms	< 37 µVrms
	10 Hz to 49 kHz		< 86 µVrms	< 68 µVrms
	10 Hz to 100 kHz		< 755 µVrms	< 700 µVrms

	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±10 mV	- 0.03 dB
	102.4 kSa/s		- 0.05 dB
	204.8 kSa/s		- 0.13 dB
	51.2 kSa/s	±100 mV	- 0.02 dB
	102.4 kSa/s		- 0.03 dB
	204.8 kSa/s		- 0.08 dB
	51.2 kSa/s	±1 V	- 0.02 dB
	102.4 kSa/s		- 0.03 dB
	204.8 kSa/s		- 0.08 dB
	51.2 kSa/s	±10 V	- 0.02 dB
	102.4 kSa/s		- 0.03 dB
	204.8 kSa/s		- 0.07 dB

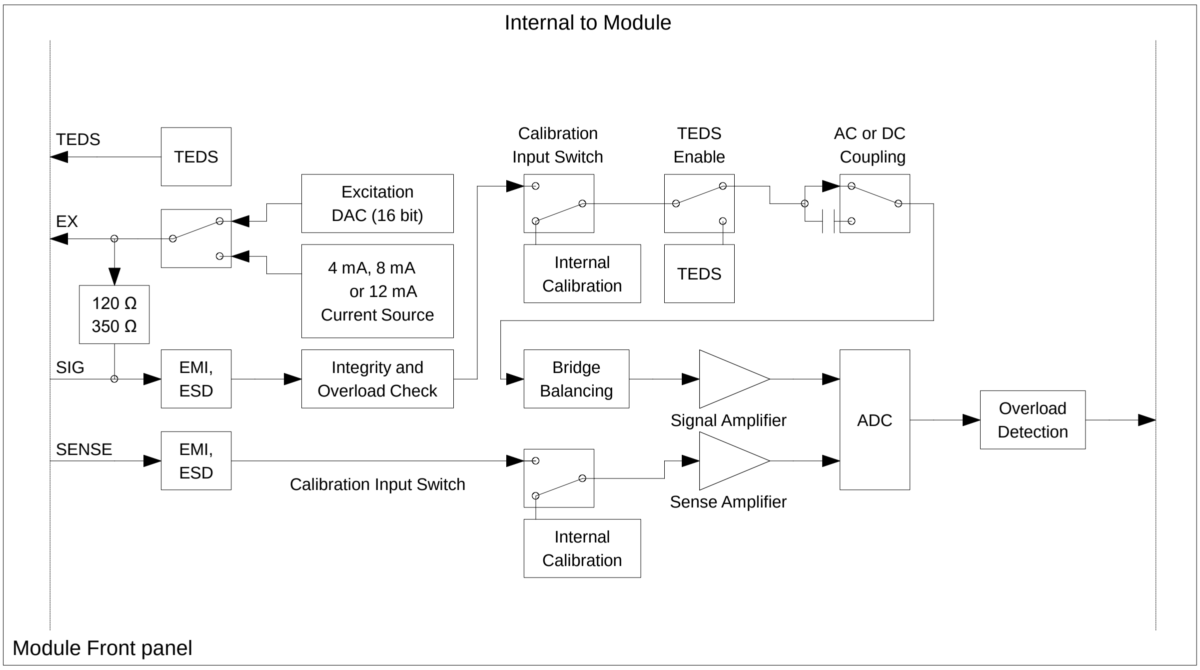
	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)
Amplitude Flatness *Relative to 1 kHz* *with 1 kΩ source* *Measured up to 0.39 x fs*	51.2 kSa/s	±10 mV	- 0.20 dB
	102.4 kSa/s		- 0.50 dB
	204.8 kSa/s		- 0.85 dB
	51.2 kSa/s	±100 mV	- 0.11 dB
	102.4 kSa/s		- 0.34 dB
	204.8 kSa/s		- 1.00 dB
	51.2 kSa/s	±1 V	- 0.12 dB
	102.4 kSa/s		- 0.35 dB
	204.8 kSa/s		- 1.00 dB
	51.2 kSa/s	±10 V	- 0.11 dB
	102.4 kSa/s		- 0.34 dB
	204.8 kSa/s		- 1.00 dB

	Input Range (Peak)	Guaranteed	Typical
Crosstalk	±10 mV	68 dB	73 dB
	±100 mV	62 dB	67 dB
	±1 V	102 dB	107 dB
	±10 V	83 dB	88 dB

WSB42X Module Low Capacitance (Build R onwards) Specification

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



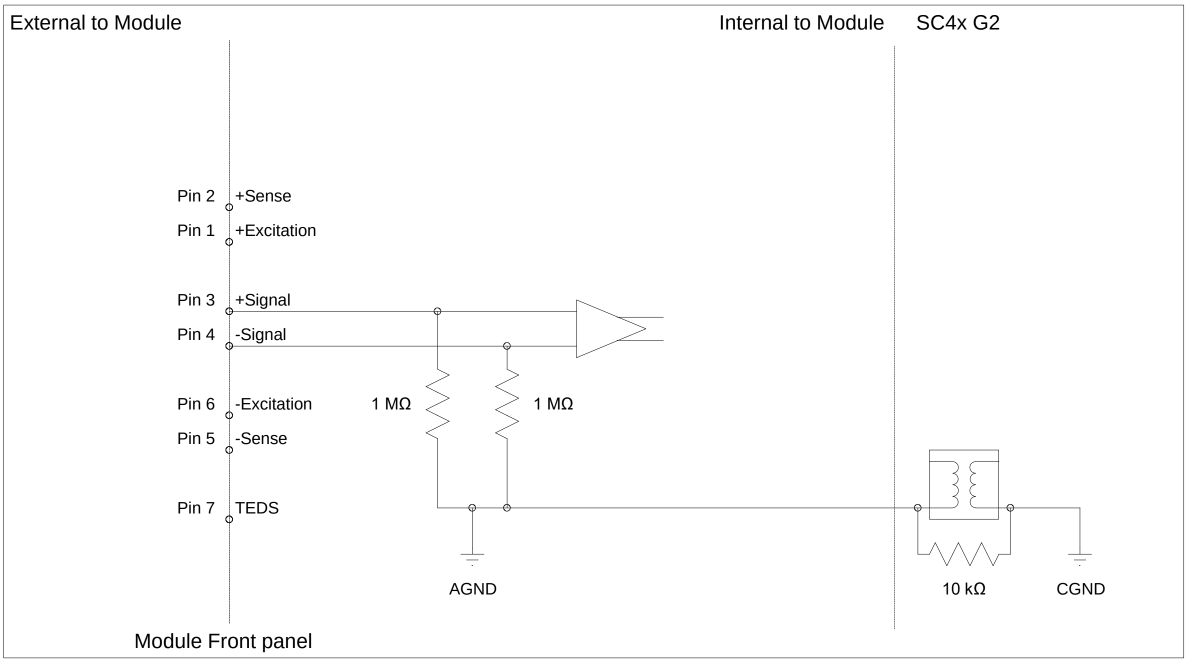
WSB42X functionality

Module grounding

Input signals on the WSB42X are referenced to the Module's internal ground only. In the figure below the Module's internal ground is labeled as AGND and the chassis ground of the system is labeled as CGND. A potential difference of up to 50 V may exist between AGND and CGND. Differences in excess of 50 V will activate the Module's protection circuits and clamp voltage differentials to within safe levels.

For shielded sensors connected to CGND, the positive and negative Signal lines can float to a maximum of 50 V above or below CGND.

A simplified diagram of the signal grounding is shown in the figure on the next page.



Differential float (balanced float) grounding

This grounding method is applicable to all interface modes, ALI, ICP® and WSB and their individual sub modes.

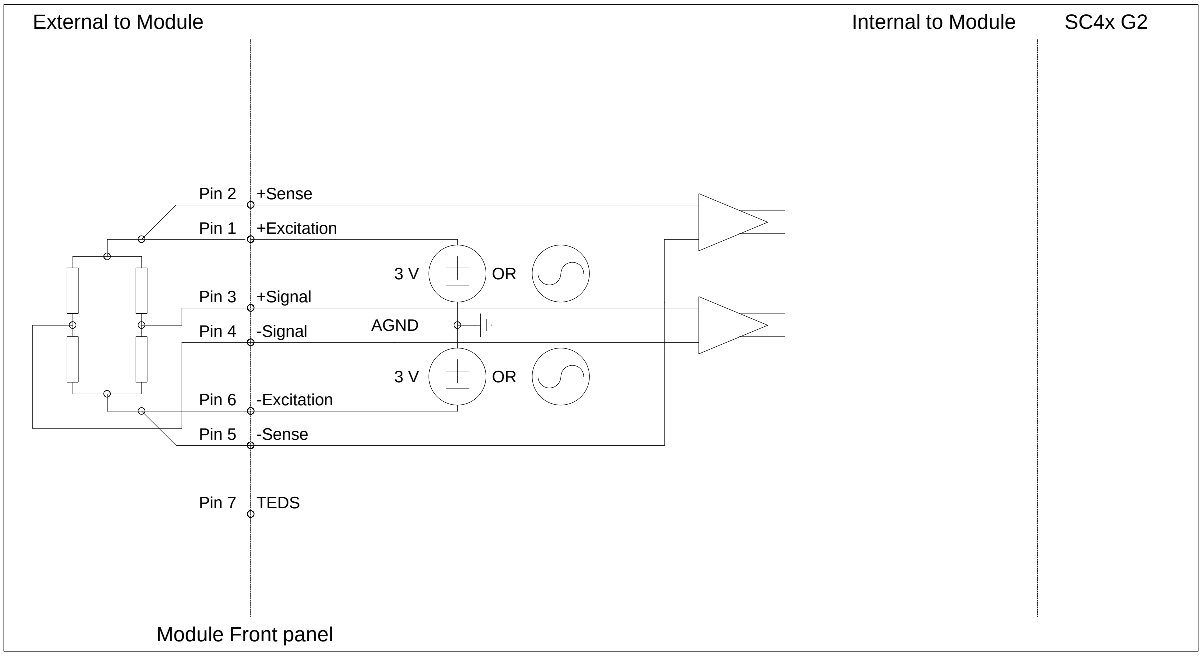
Voltage sensing

Voltage excitation can be sensed using the sense lines (+Sense and -Sense). Sensing can be performed externally by connecting two dedicated sense lines from the Module to the bridge. Internal sensing refers to the measurement of the excitation voltage within the Module, without the need for external sense wires.

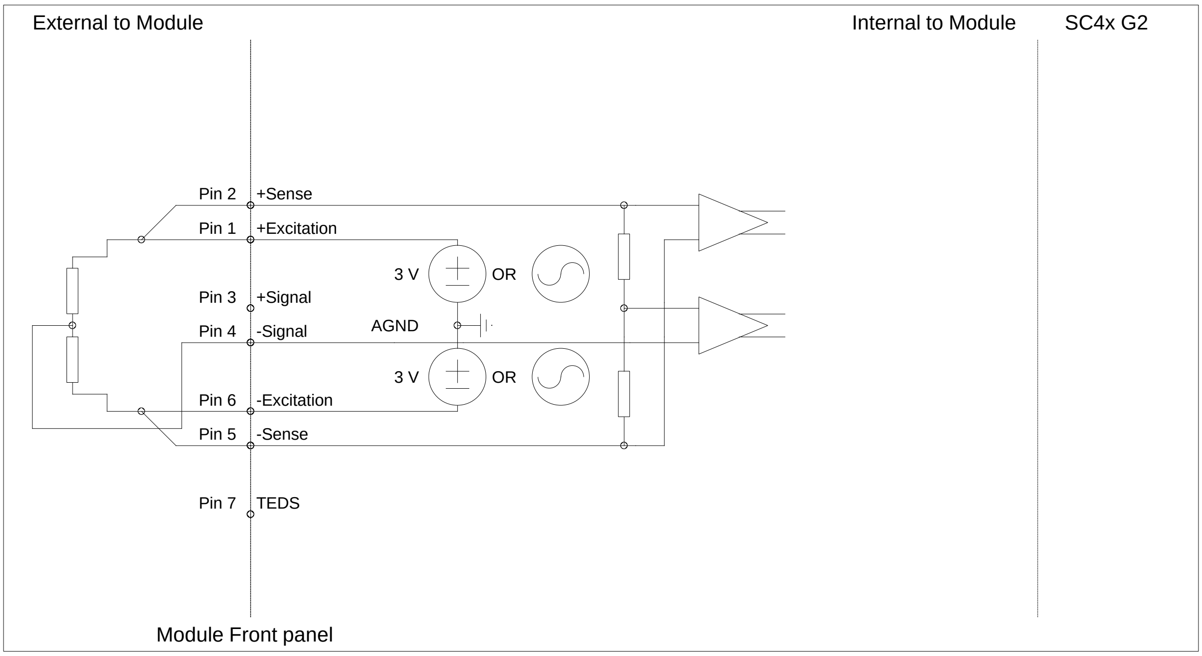
Voltage excitation is measured and digitized to 24-bit resolution using a dedicated ADC. The maximum sampling rate for the sense channel is 204.8 kSa/s under most conditions and generally mirrors the sample rate set for the signal channels.

Voltage excitation sensing allows for accurate initial setting of the excitation voltage.

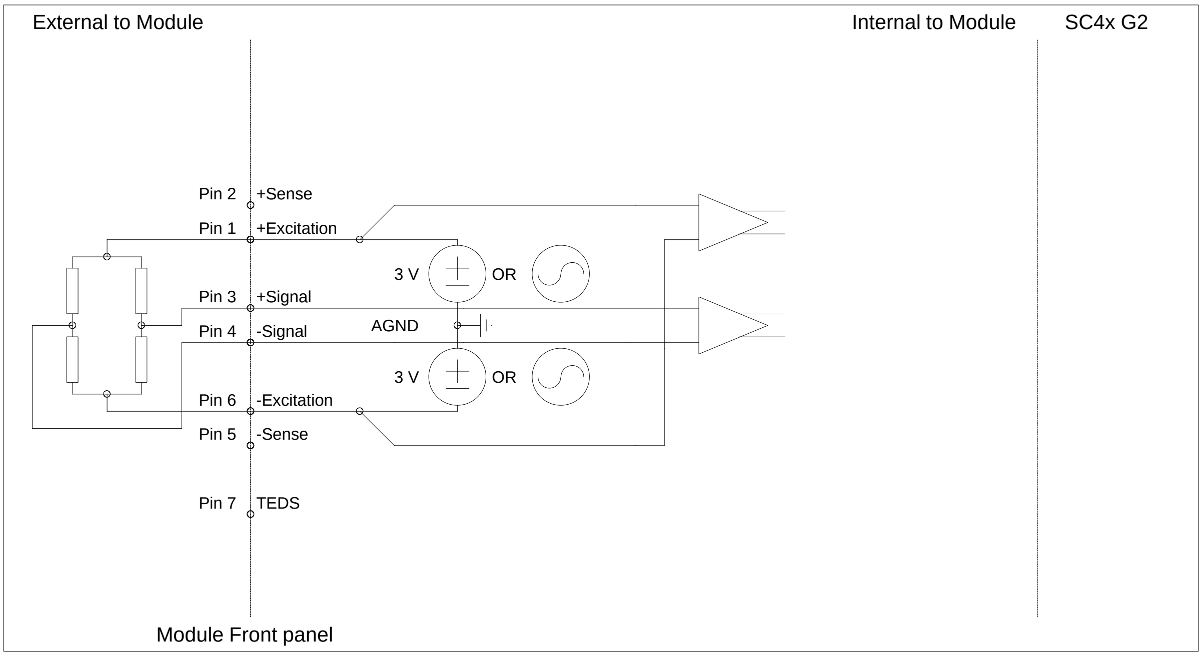
The following diagrams illustrate voltage excited Wheatstone bridges with external and internal sensing for full, half and quarter bridges.



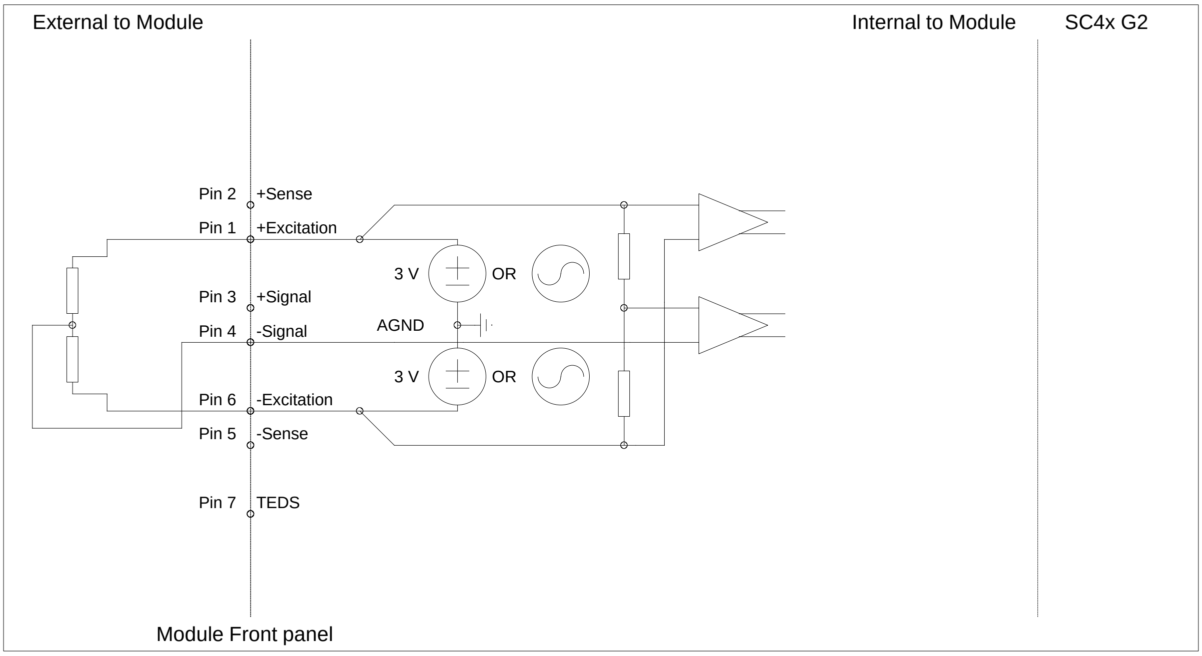
6-wire bridge configuration with 4 external bridge elements (external sense)



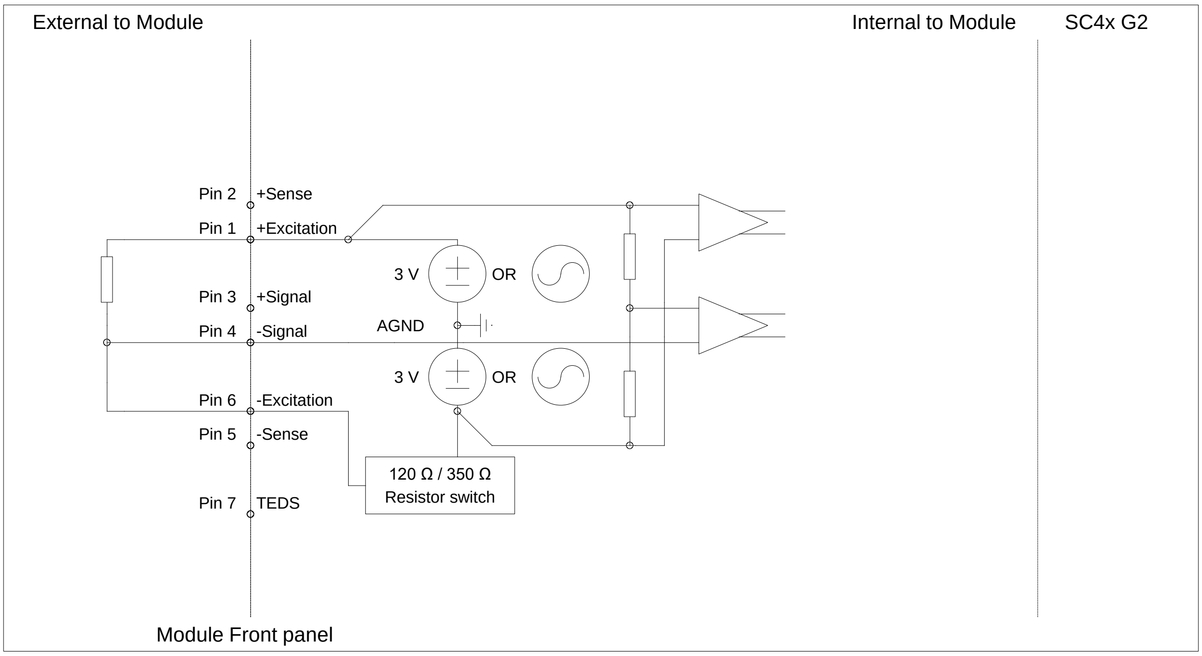
5-wire bridge configuration with 2 external bridge elements (external sense)



4-wire bridge configuration with 4 external bridge elements (internal sense)

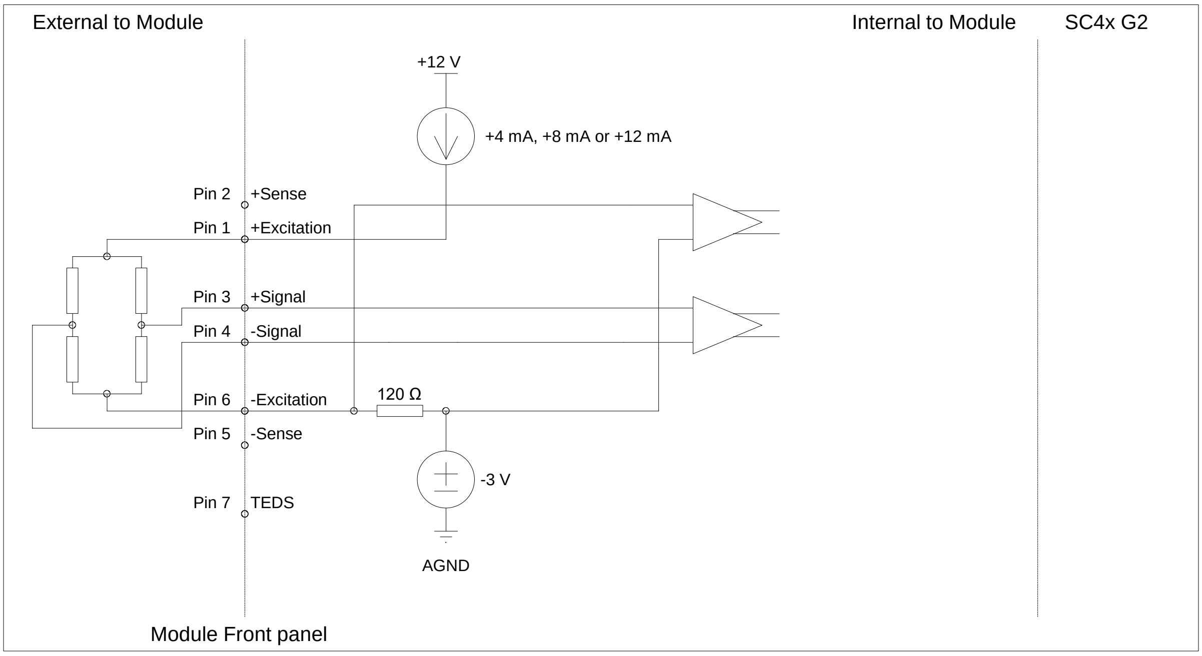


3-wire bridge configuration with 2 external bridge elements (internal sense)

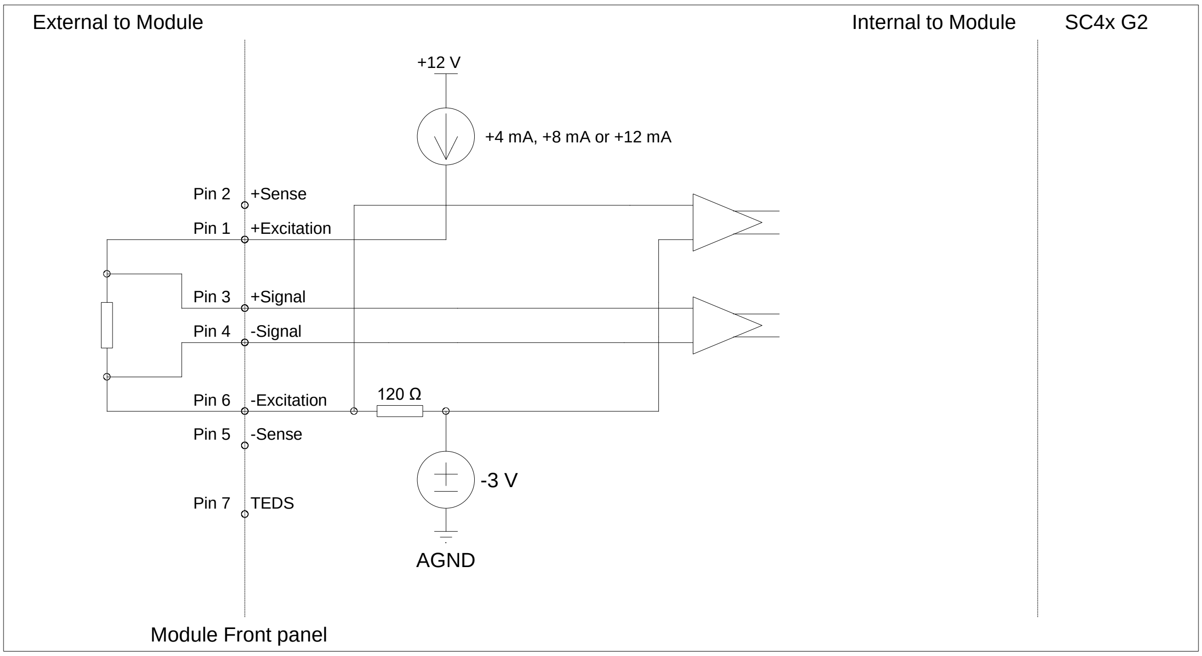


3-wire bridge configuration with 1 external bridge element (always internal sense)

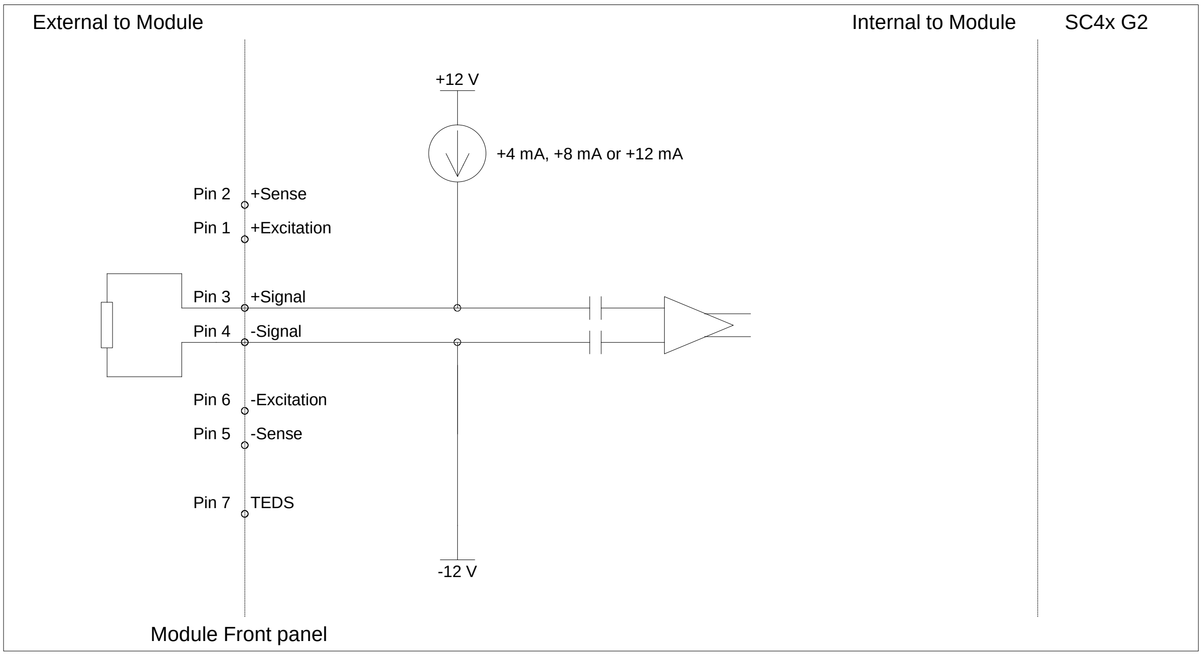
Constant current excitation



4-wire bridge configuration with 4 external elements



4-wire configuration with 1 external element



2-wire configuration with 1 external element (no current monitoring)

Exciting sensors with 12 mA from ±12 V supplies will add substantially to the Module power consumption. It is recommended that 12 mA excitation only be used to drive long cables in cases where high signal bandwidth is required. The diagrams illustrate typical connection setups for constant current excitation.

Shunt Calibration

Shunt calibration is a means of simulating strain in a bridge. It is an accepted and useful way of checking the gain and accuracy of instrumentation without the need to expose the transducer to known physical input values.

Shunt calibration works by shunting a known resistor across one arm of a Wheatstone bridge. The resulting deviation in bridge output is expressed in mV/V or mV/mA of excitation.

Practically, data obtained from a shunt calibration can be used to check that the instrumentation is operating as expected, that the correct input range is selected and that the correct gauge and scaling factors are used in subsequent calculations.

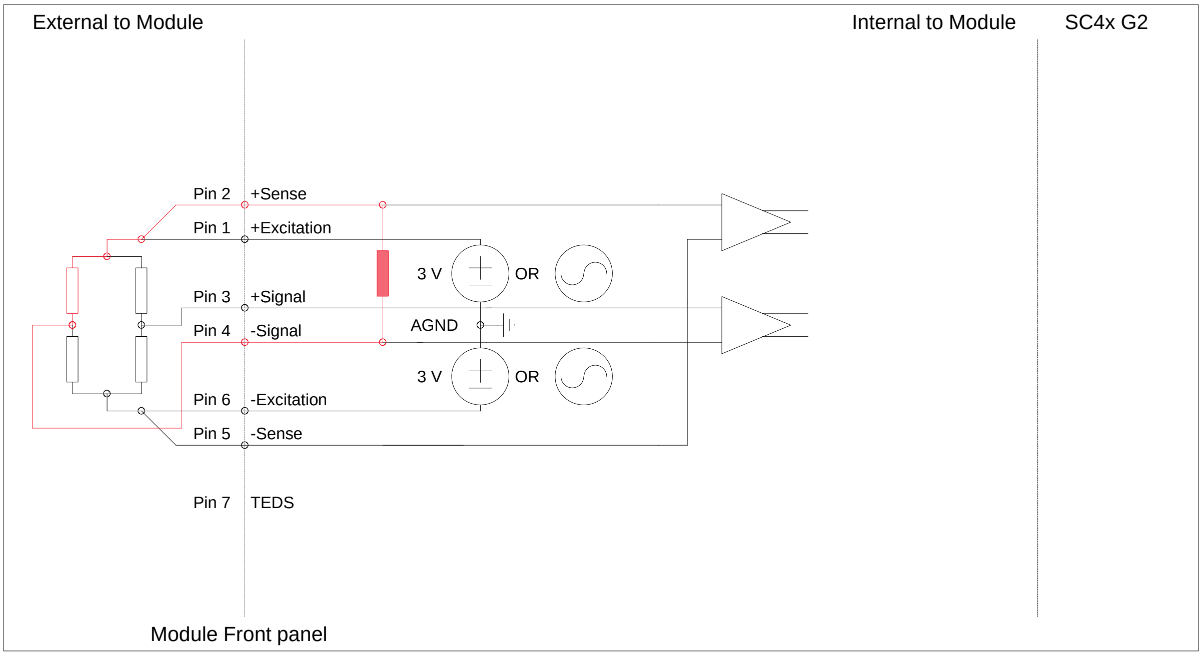
Shunt calibration can be performed for any bridge setup.

The table below summarizes the shunt calibration outputs for unloaded bridges with negligible lead wire resistance and gauge factor equal to 2.

Nominal Bridge Resistance (Ω)	Shunt Resistor (kΩ)	Voltage Excited Bridge Output (mV/V)	Current Excited Bridge Output (mV/mA)	Equivalent Microstrain (For a Bridge Factor of 1)	Simulation Type
120	100	0.30	0.04	599	Compression
350	100	0.87	0.31	1744	Compression
1000	100	2.49	2.49	4950	Compression

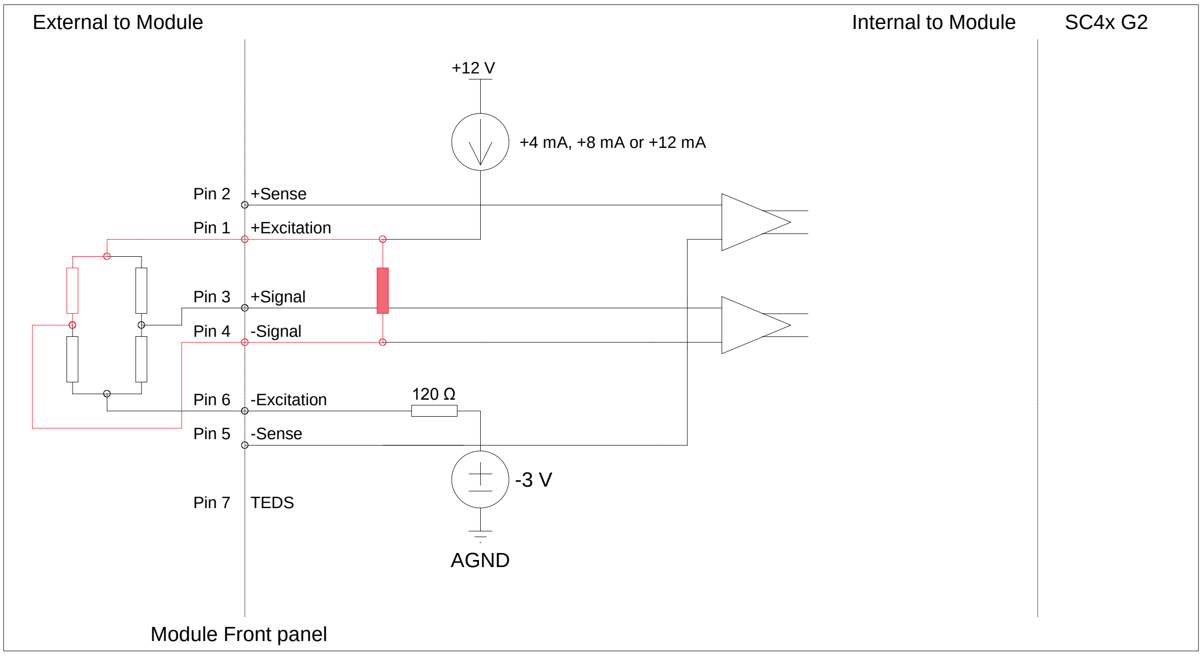
Shunt calibration outputs

An equivalent shunt calibration circuit for voltage excitation is illustrated in the figure below. The shunt resistor path is highlighted in red.



Shunt calibration for the case of a 6-wire bridge configuration with 4 external bridge elements in voltage excitation mode

An equivalent shunt calibration circuit for current excitation is illustrated in the figure below. The shunt resistor path is highlighted in red.



Shunt calibration for the case of a 4-wire bridge configuration with 4 external bridge elements in current excitation mode

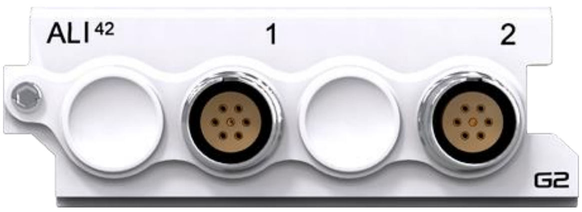
12.1.10. ALI42

Description

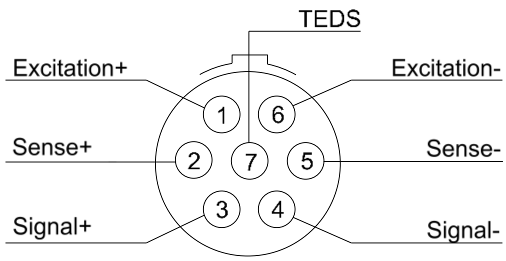
The ALI42 Module is a 2 channel high speed Module with sample rates up to 819.2 kSa/s and a bandwidth of 390 kHz. Both channels operate independently of each other, each with its own mode, gain, coupling, etc and with all settings done in software. The ALI42 has two 7-pin LEMO® connectors and can be used for both high bandwidth analog input as well as full bridge measurement applications. The Module can be used:

- With any voltage source up to ±10 V
- With any pressure transducer, load cell, strain gauge and other bridge-based sensors

Front Panel



Connector Information and Pin Definitions



ALI42 with LEMO® 7-way connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Features

- 2 channels
- Operation modes include:
  - Analog input (ALI) mode
  - Bridge voltage-excitation mode:
    - 0-6 V (DC) for -350 Ω full bridges
    - 0-4 V (DC) for 120 Ω full bridges
    - 8-10 V (DC) for 1 kΩ full bridges
- Supports TEDS IEEE 1451.4 V0.9, V1.0 (Class 1 & 2)
- 24-bit resolution
- ±(100 mV, 1 V, 10 V) input ranges for all modes
- DC or AC coupling
- Balanced differential signal input
- Sensors and bridges providing a full bridge only are supported
  - Local and Remote Sense options
  - 100 kΩ internal shunt calibration resistor
  - Differential voltage-excitation output and balanced sense input
- 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
- LEMO® 7-way EHG.0B connectors

Bridge Type		Resistive or inductive			
Interface	ALI	For analog voltage sources			
	WSB	Wheatstone bridge sensors			
Input Coupling	ALI / WSB	DC or AC			
AC Coupling Frequency Response	ALI / WSB	**Attenuation**	**Min**	**Max**	**Unit**
		-3 dB	-	1.5	Hz

<table>
<tr><td rowspan="14">Bridge Balancing Ranges for Voltage Excitation
Represents minimum or maximum resistance of a single element if other three bridge elements remain at their nominal value</td><th>Bridge Resistance</th><th>Excitation Voltage</th><th>Minimum Resistance</th><th>Maximum Resistance</th></tr>
<tr><td rowspan="3">120 Ω</td><td>0.5 - 5 V</td><td>0 Ω</td><td>Unlimited</td></tr>
<tr><td>5.5 V</td><td>6 Ω</td><td>2520 Ω</td></tr>
<tr><td>6 V</td><td>11 Ω</td><td>1320 Ω</td></tr>
<tr><td rowspan="3">350 Ω</td><td>0.5 - 5 V</td><td>0 Ω</td><td>Unlimited</td></tr>
<tr><td>5.5 V</td><td>17 Ω</td><td>7350 Ω</td></tr>
<tr><td>6 V</td><td>32 Ω</td><td>3850 Ω</td></tr>
<tr><td rowspan="4">1 kΩ</td><td>8.5 V</td><td>850 Ω</td><td>3850 Ω</td></tr>
<tr><td>9 V</td><td>850 Ω</td><td>3500 Ω</td></tr>
<tr><td>9.5 V</td><td>850 Ω</td><td>3220 Ω</td></tr>
<tr><td>10 V</td><td>850 Ω</td><td>3000 Ω</td></tr>
</table>

<table>
<tr><td rowspan="3">Constant Voltage Excitation</td><th>Excitation Voltage</th><th>Maximum Load Current</th><th>Voltage Resolution</th><th>Polarity</th></tr>
<tr><td>< 6 V</td><td>< 90 mA</td><td>0.2 mV</td><td>Bipolar
(Balanced)</td></tr>
<tr><td>8 to 10 V</td><td>< 12 mA</td><td>0.1 mV</td><td>Unipolar
(Unbalanced)</td></tr>
<tr><td colspan="2">Other Sampling Rates</td><td colspan="3">Available through digital LP filters and decimation</td></tr>
<tr><td colspan="2">Optional Programmable Digital IIR Filter</td><td colspan="3">Band pass/stop : 6 dB/octave
High/Low pass : 12 dB/octave</td></tr>
<tr><td colspan="2">Optional First Order High-Pass Filter</td><td colspan="3">-3 dB @ 1 Hz</td></tr>
<tr><td colspan="2">Module Calibration</td><td colspan="3">Internal amplitude and phase calibration</td></tr>
<tr><td colspan="2" rowspan="3">Protection</td><td rowspan="2">ALI / WSB</td><td colspan="2">2 kV ESD on all lines</td></tr>
<tr><td colspan="2">Overvoltage on signal lines</td></tr>
<tr><td>WSB</td><td colspan="2">Short circuit between excitation lines</td></tr>
<tr><td colspan="2">Galvanic Isolation</td><td colspan="3">50 V</td></tr>
</table>

ALI42 Module Features

Specifications

Bandwidth	**Using only 1 channel**	DC to 390 kHz
	Using 2 channels	DC to 195 kHz
Maximum Sampling Rate (fs) per channel	**Using only 1 channel**	819.2 kSa/s
	Using 2 channels	409.6 kSa/s
A/D Conversion	24-bit	
Data Transfer	16/24-bit	
Input Voltage Ranges (Peak)	±100 mV; ±1 V; ±10 V	
Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are connected through 1 MΩ to floating ground
Input Impedance	2 MΩ ǁ 100 pF	
Digital Low-Pass Filter *Filter scales with sampling rate*	**Passband**	fs x 0.424 Hz
	Stopband	fs x 0.576 Hz
	Passband ripple	±0.005 dB
	Stopband attenuation	100 dB
Phase Accuracy *Channels in similar range*	**Typical**[17]	< 0.3° at 10 kHz

[17] Measured in 10 V range at 204.8 kSa/s

	Input Range (Peak)	% Range	
DC Voltage Accuracy	±100 mV	To be determined	
	±1 V	0.16 %	
	±10 V	0.15 %	

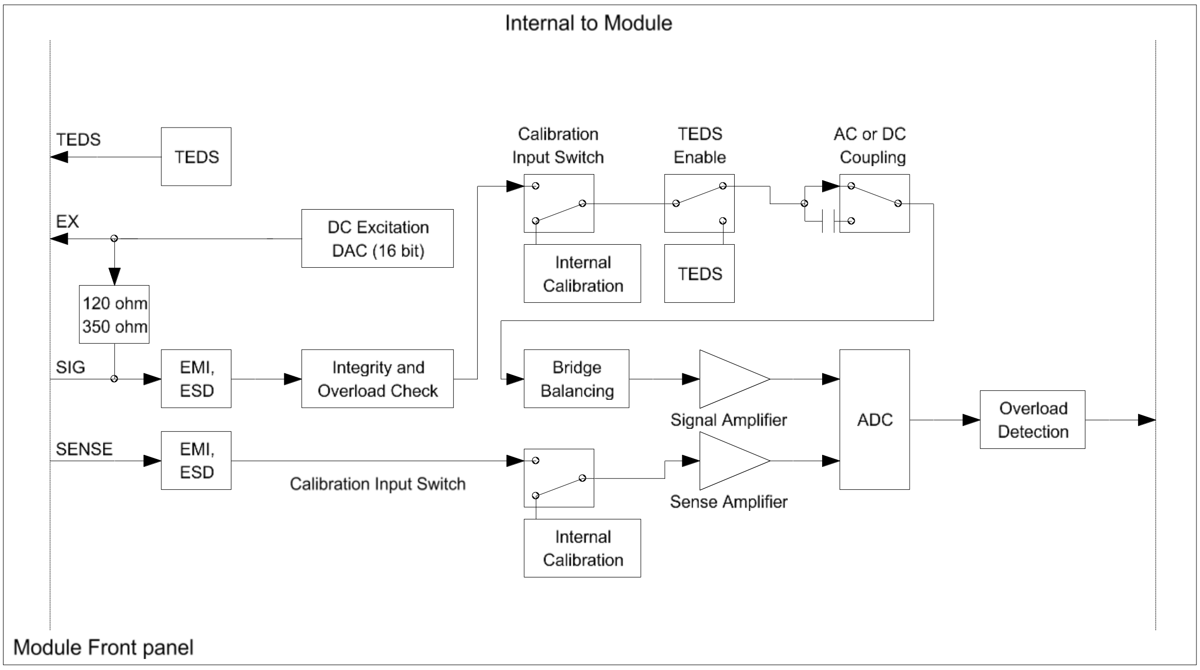
		Input Range (Peak)	Guaranteed	Typical
Noise *Input terminated by 50 Ω resistor*	10 Hz to 24 kHz	±100 mV	< 6.1 µVrms	< 4.5 µVrms
	10 Hz to 49 kHz		< 6.7 µVrms	< 5.6 µVrms
	10 Hz to 99 kHz		< 8.0 µVrms	< 7.3 µVrms
	10 Hz to 195 kHz		< 10.5 µVrms	< 9.9 µVrms
	10 Hz to 390 kHz		< 25.6 µVrms	< 18.9 µVrms
	10 Hz to 24 kHz	±1 V	< 5.9 µVrms	< 4.5 µVrms
	10 Hz to 49 kHz		< 6.5 µVrms	< 5.5 µVrms
	10 Hz to 99 kHz		< 8.2 µVrms	< 7.3 µVrms
	10 Hz to 195 kHz		< 11.3 µVrms	< 10.2 µVrms
	10 Hz to 390 kHz		< 25.0 µVrms	< 18.7 µVrms
	10 Hz to 24 kHz	±10 V	< 56 µVrms	< 40 µVrms
	10 Hz to 49 kHz		< 64 µVrms	< 49 µVrms
	10 Hz to 99 kHz		< 72 µVrms	< 61 µVrms
	10 Hz to 195 kHz		< 90 µVrms	< 81 µVrms
	10 Hz to 390 kHz		< 117 µVrms	< 111 µVrms

	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)	
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±100 mV	- 0.02 dB	
	102.4 kSa/s		- 0.02 dB	
	204.8 kSa/s		- 0.02 dB	
	409.6 kSa/s		- 0.07 dB	
	819.2 kSa/s		- 0.21 dB	
	51.2 kSa/s	±1 V	- 0.02 dB	
	102.4 kSa/s		- 0.03 dB	
	204.8 kSa/s		- 0.03 dB	
	409.6 kSa/s		- 0.08 dB	
	819.2 kSa/s		- 0.24 dB	
	51.2 kSa/s	±10 V	- 0.02 dB	
	102.4 kSa/s		- 0.02 dB	
	204.8 kSa/s		- 0.05 dB	
	409.6 kSa/s		- 0.07 dB	
	819.2 kSa/s		- 0.20 dB	
Crosstalk		**Input Range (Peak)**	**Guaranteed**	**Typical**
		±100 mV	62 dB	67 dB
		±1 V	99 dB	104 dB
		±10 V	83 dB	88 dB

ALI42 Module Specification

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



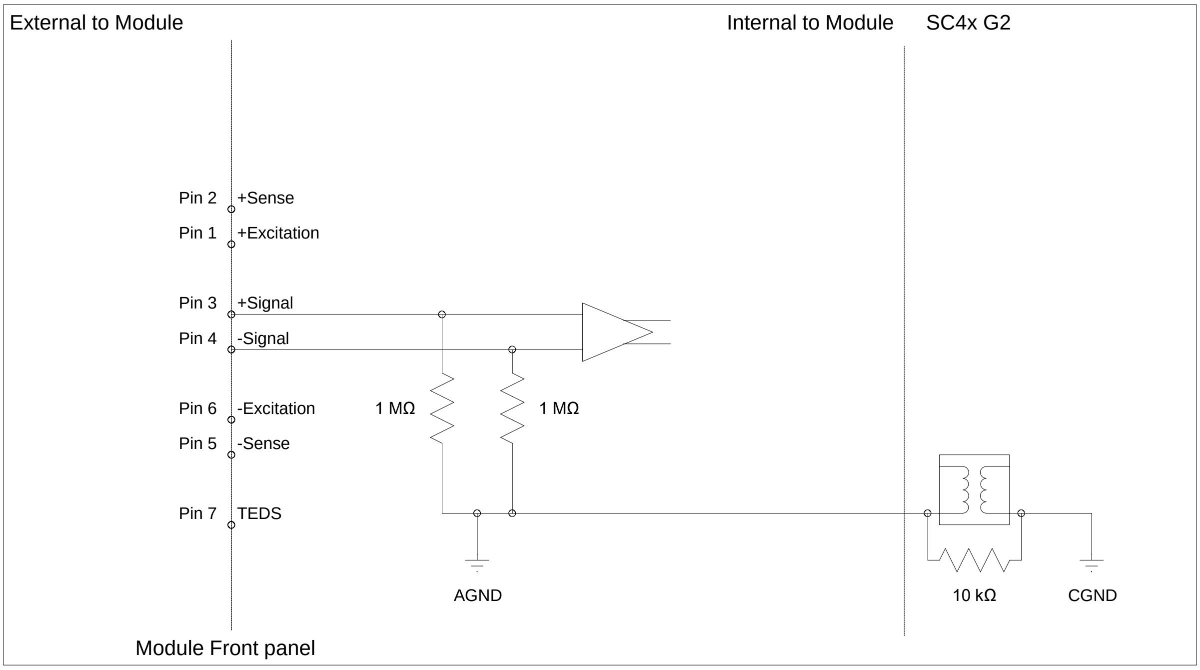
ALI42 functionality

Module grounding

Input signals on the ALI42 are referenced to the Module's internal ground only. In the figure below the Module's internal ground is labeled as AGND and the chassis ground of the system is labeled as CGND. A potential difference of up to 50 V may exist between AGND and CGND. Differences in excess of 50 V will activate the Module's protection circuits and clamp voltage differentials to within safe levels.

For shielded sensors connected to CGND, the positive and negative Signal lines can float to a maximum of 50 V above or below CGND.

A simplified diagram of the signal grounding is shown on the next page.



Differential float (balanced float) grounding

This grounding method is applicable to all interface modes, ALI and WSB and their individual sub modes.

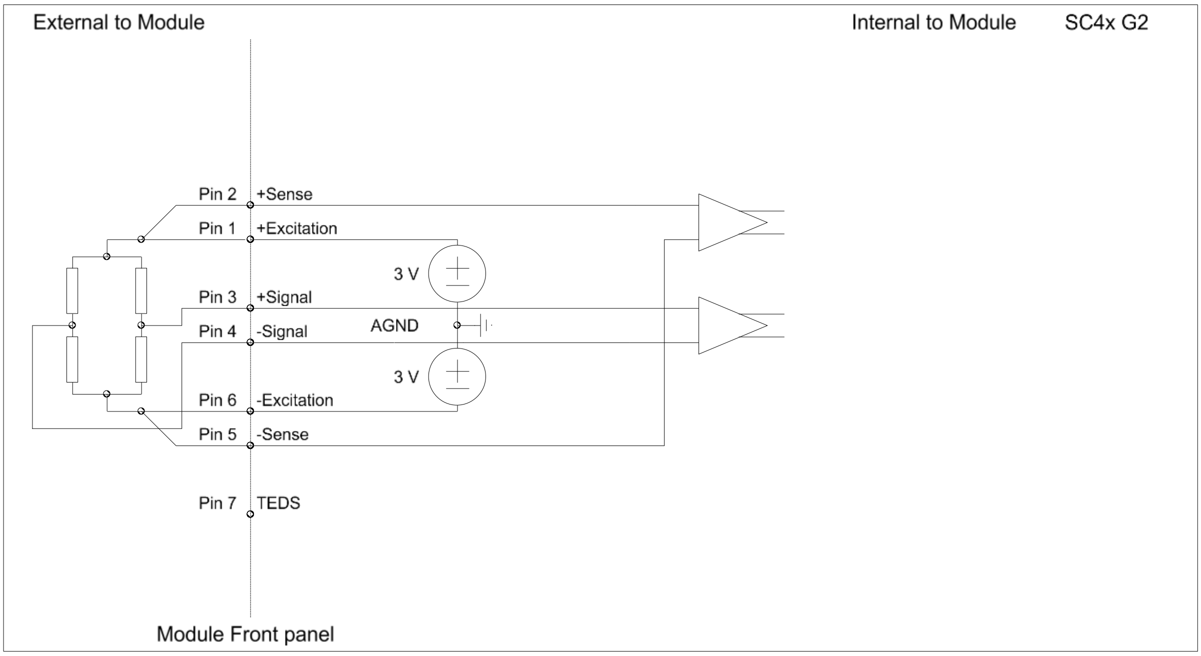
Voltage sensing

Voltage excitation can be sensed using the sense lines (+Sense and -Sense). Sensing can be performed externally by connecting two dedicated sense lines from the Module to the bridge. Internal sensing refers to the measurement of the excitation voltage within the Module, without the need for external sense wires.

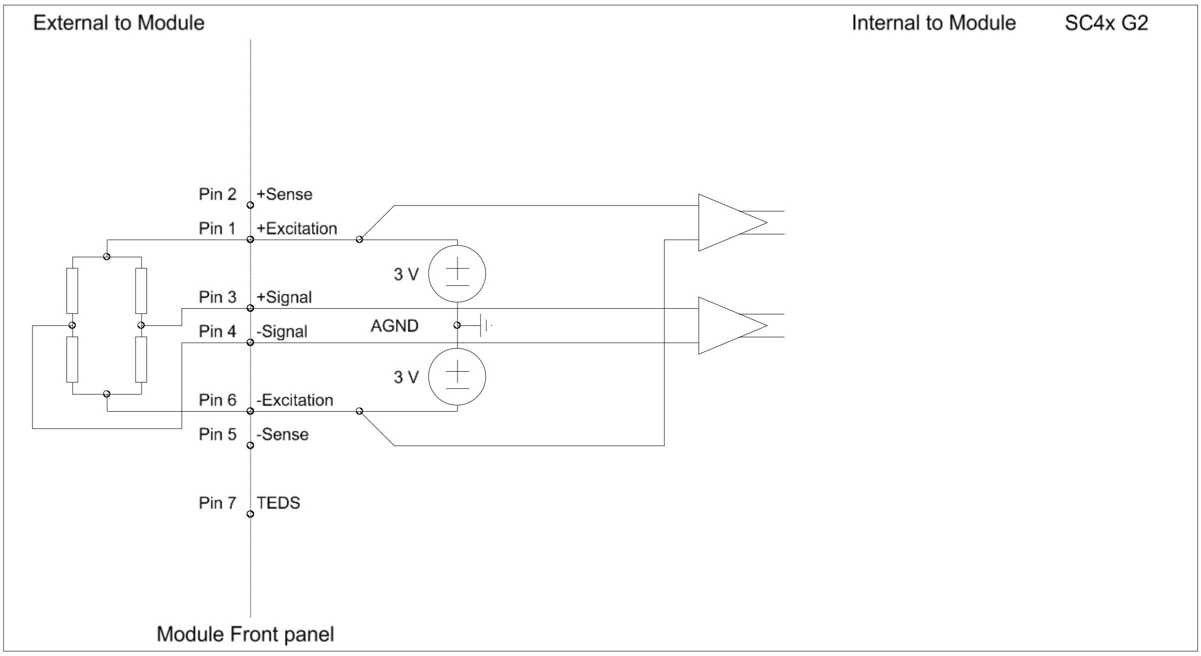
Voltage excitation is measured and digitized to 24-bit resolution using a dedicated ADC. The maximum sampling rate for the sense channel is 204.8 kSa/s under most conditions.

Voltage excitation sensing allows for accurate initial setting of the excitation voltage

The following diagrams illustrate voltage excited Wheatstone bridges with external and internal sensing for full bridges.



6-wire bridge configuration with 4 external bridge elements (external sense)



4-wire bridge configuration with 4 external bridge elements (internal sense)

Shunt Calibration

Shunt calibration is a means of simulating strain in a bridge. It is an accepted and useful way of checking the gain and accuracy of instrumentation without the need to expose the transducer to known physical input values.

Shunt calibration works by shunting a known resistor across one arm of a Wheatstone bridge. The resulting deviation in bridge output is expressed in mV/V of excitation.

Practically, data obtained from a shunt calibration can be used to check that the instrumentation is operating as expected, that the correct input range is selected and that the correct gauge and scaling factors are used in subsequent calculations.

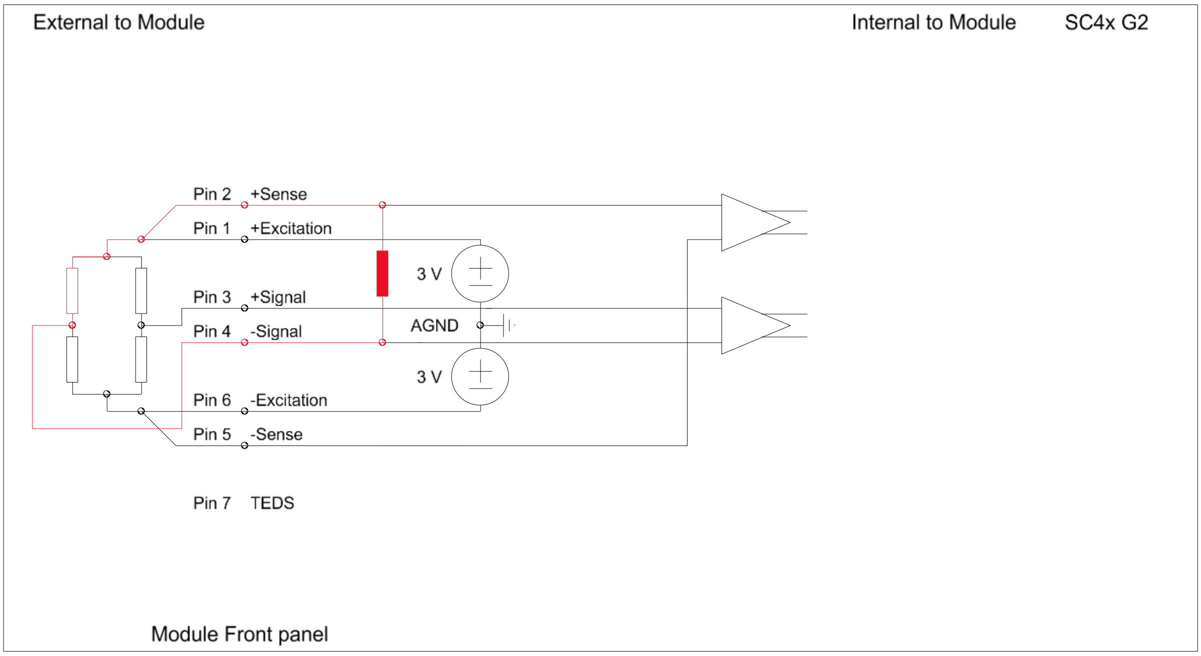
Shunt calibration can be performed for any bridge setup.

The table below summarizes the shunt calibration outputs for unloaded bridges with negligible lead wire resistance and gauge factor equal to 2.

Nominal Bridge Resistance (Ω)	**Shunt Resistor (kΩ)**	**Voltage Excited Bridge Output (mV/V)**	**Equivalent Microstrain (For a Bridge Factor of 1)**	**Simulation Type**
120	100	0.30	599	Compression
350	100	0.87	1744	Compression
1000	100	2.49	4950	Compression

Shunt calibration outputs

An equivalent shunt calibration circuit for voltage excitation is illustrated in the figure below. The shunt resistor path is highlighted in red.



Shunt calibration for the case of a 6-wire bridge configuration with 4 external bridge elements in voltage excitation mode

12.1.11 ALI42B

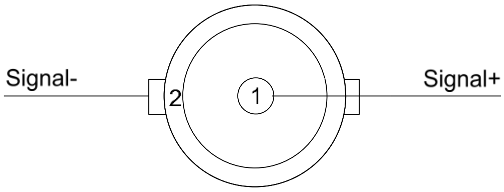
Description

The ALI42B Module is a 2 channel high speed Module with sample rates up to 819.2 kSa/s and a bandwidth of 390 kHz. Both channels operate independently of each other, each with its own mode, gain, coupling, etc. and with all settings done in software. The ALI42B has two BNC connectors and is specifically targeted to high bandwidth analog input applications requiring terminated or unterminated inputs. An option of the Module is available ideally for pyroshock or similar testing. The Module can be used:

- With any voltage source up to ±10 V
- With Signal sources requiring 50 Ω termination
- With Signal sources requiring high input resistance

Front Panel

Connector Information and Pin Definitions



ALI42B with BNC connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Features

- 2 channels
- Operation modes include:
  - Analog input (ALI) mode, terminated with 50 Ω
  - Analog input (ALI) mode, unterminated
- 24-bit resolution
- ±(100 mV, 1 V, 10 V) input ranges for all modes
- Input resistance: Software switchable between 50 Ω or 2 MΩ
- DC or AC coupling
- Balanced differential signal input
- 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
- 50 Ω BNC connectors

Other Sampling Rates	Available through digital LP filters and decimation
Optional Programmable Digital IIR Filter	Band pass/stop : 6 dB/octave High/Low pass : 12 dB/octave
Optional First Order High-Pass Filter	-3 dB @ 1 Hz
Module Calibration	Internal amplitude and phase calibration
Protection	2 kV ESD
Galvanic Isolation	50 V

ALI42B Module Features

Specifications (All builds preceding Build N)

Bandwidth	**Using only 1 channel**	DC to 390 kHz
	Using 2 channels	DC to 195 kHz
Maximum Sampling Rate (fs) per channel	**Using only 1 channel**	819.2 kSa/s
	Using 2 channels	409.6 kSa/s
A/D Conversion	24-bit	
Data Transfer	16/24-bit	
Input Voltage Ranges (Peak)	±100 mV; ±1 V; ±10 V	
Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are connected through 1 MΩ to floating ground
Input Impedance	2 MΩ or 50 Ω ǁ 100 pF	
Digital Low-Pass Filter *Filter scales with sampling rate*	**Passband**	fs x 0.424 Hz
	Stopband	fs x 0.576 Hz
	Passband ripple	±0.005 dB
	Stopband attenuation	100 dB
Phase Accuracy *Channels in similar range*	**Typical**[18]	< 0.3° at 10 kHz

[18] Measured in 10 V range at 204.8 kSa/s

		Input Range (Peak)	% Range	
DC Voltage Accuracy		±100 mV	To be determined	
		±1 V	0.16 %	
		±10 V	0.15 %	
Noise *Input terminated by 50 Ω resistor*		**Input Range (Peak)**	**Guaranteed**	**Typical**
	10 Hz to 24 kHz	±100 mV	< 6.1 µVrms	< 4.5 µVrms
	10 Hz to 49 kHz		< 6.7 µVrms	< 5.6 µVrms
	10 Hz to 99 kHz		< 8.0 µVrms	< 7.3 µVrms
	10 Hz to 195 kHz		< 10.5 µVrms	< 9.9 µVrms
	10 Hz to 390 kHz		< 25.6 µVrms	< 18.9 µVrms
	10 Hz to 24 kHz	±1 V	< 5.9 µVrms	< 4.5 µVrms
	10 Hz to 49 kHz		< 6.5 µVrms	< 5.5 µVrms
	10 Hz to 99 kHz		< 8.2 µVrms	< 7.3 µVrms
	10 Hz to 195 kHz		< 11.3 µVrms	< 10.2 µVrms
	10 Hz to 390 kHz		< 25.0 µVrms	< 18.7 µVrms
	10 Hz to 24 kHz	±10 V	< 56 µVrms	< 40 µVrms
	10 Hz to 49 kHz		< 64 µVrms	< 49 µVrms
	10 Hz to 99 kHz		< 72 µVrms	< 61 µVrms
	10 Hz to 195 kHz		< 90 µVrms	< 81 µVrms
	10 Hz to 390 kHz		< 117 µVrms	< 111 µVrms

	Sampling Rate (fs)	Input Range (Peak)	Attenuation (Input signal level 100 % of full range)
Amplitude Flatness *Relative to 1 kHz* *Measured up to 0.39 x fs*	51.2 kSa/s	±100 mV	- 0.02 dB
	102.4 kSa/s		- 0.02 dB
	204.8 kSa/s		- 0.02 dB
	409.6 kSa/s		- 0.07 dB
	819.2 kSa/s		- 0.21 dB
	51.2 kSa/s	±1 V	- 0.02 dB
	102.4 kSa/s		- 0.03 dB
	204.8 kSa/s		- 0.03 dB
	409.6 kSa/s		- 0.08 dB
	819.2 kSa/s		- 0.24 dB
	51.2 kSa/s	±10 V	- 0.02 dB
	102.4 kSa/s		- 0.02 dB
	204.8 kSa/s		- 0.05 dB
	409.6 kSa/s		- 0.07 dB
	819.2 kSa/s		- 0.20 dB

	Input Range (Peak)	Guaranteed	Typical
Crosstalk	±100 mV	62 dB	67 dB
	±1 V	99 dB	104 dB
	±10 V	83 dB	88 dB

ALI42B Module Specifications (All builds preceding Build N)

The Module settings and measurement conditions that were used during specification measurements are available on request.

ALI42B Specifications (Build N onwards)

The second order anti-aliasing filter is an option of the ALI42B Module. This option is ideally suitable to use for pyroshock and similar testing.

Bandwidth	**Using only 1 channel**	DC to 390 kHz
	Using 2 channels	DC to 195 kHz
Maximum Sampling Rate (fs) per channel	**Using only 1 channel**	819.2 kSa/s
	Using 2 channels	409.6 kSa/s
A/D Conversion	24-bit	
Data Transfer	16/24-bit	
Input Voltage Ranges (Peak)	±100 mV; ±1 V; ±10 V	
Input Biasing Settings	**Differential Float (Balanced Float)**	Both the positive and negative signal inputs are connected through 1 MΩ to floating ground
Input Impedance	2 MΩ or 50 Ω ‖ 100 pF	
Digital Low-Pass Filter *Filter scales with sampling rate*	**Passband**	fs x 0.424 Hz
	Stopband	fs x 0.576 Hz
	Passband ripple	±0.005 dB
	Stopband attenuation	100 dB
Anti-Aliasing Filter *Second order Low-Pass filter* *>50 dB Attenuation of frequencies that can cause aliasing* *Ideal for Pyroshock sensors in accordance with MIL-STD-810G*	**Attenuation**	-0.1 dB @ 25.6 kHz
		-3 dB @ 390 kHz
	Passband flatness	±0.7 dB @ < 100 kHz
Phase Accuracy *Channels in similar range*	**Typical**[19]	< 0.3° at 10 kHz

[19] Measured in 10 V range at 204.8 kSa/s

		Input Range (Peak)	% Range	
DC Voltage Accuracy		±100 mV	To be determined	
		±1 V	0.15 %	
		±10 V	0.09 %	
		Input Range (Peak)	**Guaranteed**	**Typical**
Noise *Input terminated by 50 Ω resistor*	10 Hz to 24 kHz	±100 mV	< 2.2 µVrms	< 2.1 µVrms
	10 Hz to 49 kHz		< 3.0 µVrms	< 3.2 µVrms
	10 Hz to 99 kHz		< 4.2 µVrms	< 4.1 µVrms
	10 Hz to 195 kHz		< 5.9 µVrms	< 5.7 µVrms
	10 Hz to 390 kHz		< 55.4 µVrms	< 45.9 µVrms
	10 Hz to 24 kHz	±1 V	< 5.0 µVrms	< 4.0 µVrms
	10 Hz to 49 kHz		< 6.1 µVrms	< 5.2 µVrms
	10 Hz to 99 kHz		< 8.1 µVrms	< 7.0 µVrms
	10 Hz to 195 kHz		< 10.6 µVrms	< 9.5 µVrms
	10 Hz to 390 kHz		< 55.5 µVrms	< 46.0 µVrms
	10 Hz to 24 kHz	±10 V	< 42.7 µVrms	< 32.7 µVrms
	10 Hz to 49 kHz		< 57.1 µVrms	< 43.6 µVrms
	10 Hz to 99 kHz		< 56.4 µVrms	< 51.2 µVrms
	10 Hz to 195 kHz		< 76.0 µVrms	< 69.7 µVrms
	10 Hz to 390 kHz		< 110.8 µVrms	< 104.0 µVrms

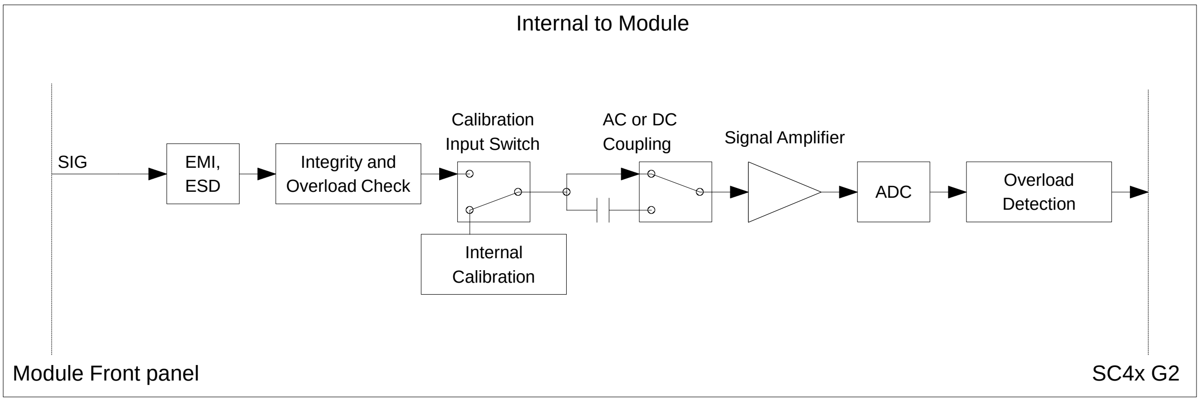
Crosstalk

	Input Range (Peak)	Guaranteed	Typical
Crosstalk	±100 mV	62 dB	67 dB
	±1 V	99 dB	104 dB
	±10 V	83 dB	88 dB

ALI42B Specifications (Build N onwards)

The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel



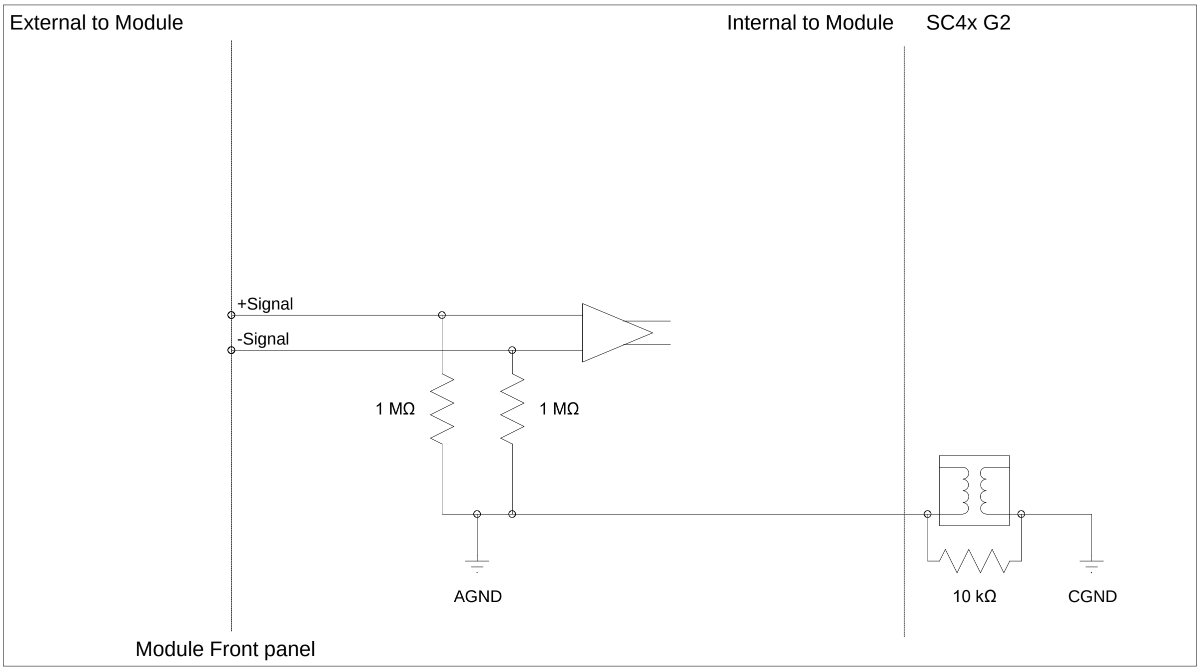
Signal flow of the ALI42B Module

Grounding Diagram

Input signals on the ALI42B are referenced to the Module's internal ground only. In the figure below the Module's internal ground is labeled as AGND and the chassis ground of the system is labeled as CGND. A potential difference of up to 50 V may exist between AGND and CGND. Differences in excess of 50 V will activate the Module's protection circuits and clamp voltage differentials to within safe levels.

For shielded sensors connected to CGND, the positive and negative SIG lines can float to a maximum of 50 V above or below CGND.

A simplified diagram of the signal grounding is shown below.



Differential Float (Balanced Float)

12.1.12. MIC42X

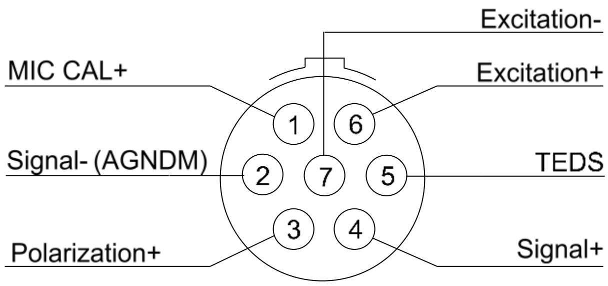
Description

In addition to providing microphone measurements, the MIC42X Module also offers ICP® and voltage input modes. The Module can be 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

Front Panel

Connector Information and Pin Definitions



MIC42X with LEMO® 7-way EGG.1B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Signal Cable

010K

The 010K is a standard length signal cable that disconnects the shield of an MIC42X Module.

See the "Cables" section for more information.

Features

- 2 channels
- 3 input modes of operation
  - Microphone mode with 200 V or self-polarized microphone capsules with pre-amplifier
  - 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
- ±(120 mV, 1.2 V, 12 V) input ranges
- ±14.5 V microphone pre-amplifier excitation voltage
- 0 or 200 V polarization output
- Microphone calibration output to inject test signals into microphone pre-amplifiers
- 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 CGND
- 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
- Pre-amplifier Excitation Short Circuit protection

Interface	ICP®	ICP® sensors			
	ALI/ MIC	For analog source voltages or Microphones			
Input Coupling	ICP®	AC			
	ALI/ MIC	DC or AC			
AC Coupling Frequency Response	ICP®/ ALI/ MIC	**Attenuation**	**Min**	**Max**	**Unit**
		-3 dB	-	0.16	Hz
Other Sampling Rates		Available through digital LP filters and decimation			
Optional Programmable Digital IIR Filter		Band pass/stop : 6 dB/octave High/Low pass : 12 dB/octave			
Optional First Order High-Pass Filter		-3 dB @ 1 Hz			
Module Calibration		Internal amplitude and phase calibration			
Protection		2 kV ESD			
Galvanic Isolation		50 V			

Specifications

<table>
<tr><td colspan="2">Bandwidth</td><td colspan="3">DC to 100 kHz</td></tr>
<tr><td colspan="2">Maximum Sampling Rate (fs) per channel</td><td colspan="3">204.8 kSa/s</td></tr>
<tr><td colspan="2">A/D Conversion</td><td colspan="3">24-bit</td></tr>
<tr><td colspan="2">Data Transfer</td><td colspan="3">16/24-bit</td></tr>
<tr><td colspan="2">Input Voltage Ranges (Peak)</td><td colspan="3">±120 mV; ±1.2 V; ±12 V</td></tr>
<tr><td colspan="2">ICP® mode</td><td colspan="3">4 mA; 8 mA or 12 mA constant current at
±12 V / 24 V excitation</td></tr>
<tr><td rowspan="3">Input Biasing Settings</td><td>Differential Float (Balanced Float)</td><td colspan="3">Both the positive and negative signal inputs are connected through 1 MΩ to floating ground</td></tr>
<tr><td>Single-Ended Float (Unbalanced Float)</td><td colspan="3">Positive signal input connected through 1 MΩ to floating ground;
Negative signal input connected to floating ground</td></tr>
<tr><td>Single-Ended GND (Unbalanced GND)</td><td colspan="3">Positive signal input connected through 1 MΩ to ground;
Negative signal input connected to ground</td></tr>
<tr><td rowspan="2">Input Impedance</td><td>Differential</td><td colspan="3">2 MΩ ǁ 570 pF</td></tr>
<tr><td>Single-Ended</td><td colspan="3">1 MΩ ǁ 290 pF</td></tr>
<tr><td colspan="2" rowspan="6">Digital Low-Pass Filter
Filter scales with sampling rate</td><td>Passband</td><td colspan="2">fs x 0.46 Hz</td></tr>
<tr><td>Stopband</td><td colspan="2">fs x 0.54 Hz</td></tr>
<tr><td rowspan="3">Passband ripple</td><td>fs = 48 kHz</td><td>±0.001 dB</td></tr>
<tr><td>fs = 96 kHz</td><td>±0.003 dB</td></tr>
<tr><td>fs = 192 kHz</td><td>±0.007 dB</td></tr>
<tr><td>Stopband attenuation</td><td colspan="2">120 dB</td></tr>
<tr><td colspan="2">Phase Accuracy
Channels in similar range</td><td>Typical[20]</td><td colspan="2">< 0.2° at 10 kHz</td></tr>
</table>

[20] Measured in 12 V range at 204.8 kSa/s

		Input Range (Peak)	% Reading + % Range	
DC Voltage Accuracy		±120 mV	0.375 % + 0.125 %	
		±1.2 V	0.065 % + 0.020 %	
		±12 V	0.074 % + 0.024 %	
Noise *Input terminated by 50 Ω resistor*		**Input Range (Peak)**	**Guaranteed**	**Typical**
	10 Hz to 23 kHz	±120 mV	< 1.9 µVrms	< 1.6 µVrms
	10 Hz to 49 kHz		< 2.4 µVrms	< 2.1 µVrms
	10 Hz to 100 kHz		< 3.1 µVrms	< 2.8 µVrms
	10 Hz to 23 kHz	±1.2 V	< 6.9 µVrms	< 4.8 µVrms
	10 Hz to 49 kHz		< 7.8 µVrms	< 5.9 µVrms
	10 Hz to 100 kHz		< 8.8 µVrms	< 7.3 µVrms
	10 Hz to 23 kHz	±12 V	< 19.7 µVrms	< 16.3 µVrms
	10 Hz to 49 kHz		< 26.2 µVrms	< 22.4 µVrms
	10 Hz to 100 kHz		< 48.0 µVrms	< 37.4 µVrms

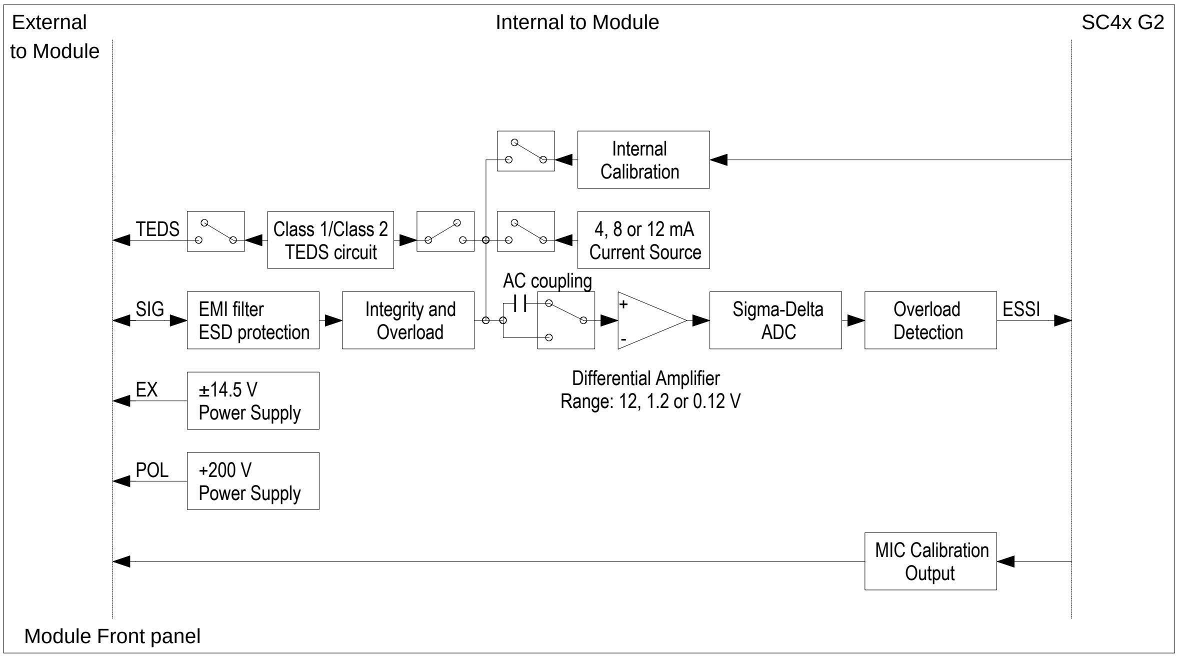
<table>
<tr><td rowspan="10">Amplitude Flatness
Relative to 1 kHz

Measured up to 0.39 x fs</td><td>Sampling Rate (fs)</td><td>Input Range (Peak)</td><td colspan="2">Attenuation
(Input signal level 100 % of full range)</td></tr>
<tr><td>51.2 kSa/s</td><td rowspan="3">±120 mV</td><td colspan="2">- 0.03 dB</td></tr>
<tr><td>102.4 kSa/s</td><td colspan="2">- 0.10 dB</td></tr>
<tr><td>204.8 kSa/s</td><td colspan="2">- 0.35 dB</td></tr>
<tr><td>51.2 kSa/s</td><td rowspan="3">±1.2 V</td><td colspan="2">- 0.03 dB</td></tr>
<tr><td>102.4 kSa/s</td><td colspan="2">- 0.10 dB</td></tr>
<tr><td>204.8 kSa/s</td><td colspan="2">- 0.35 dB</td></tr>
<tr><td>51.2 kSa/s</td><td rowspan="3">±12 V</td><td colspan="2">- 0.03 dB</td></tr>
<tr><td>102.4 kSa/s</td><td colspan="2">- 0.10 dB</td></tr>
<tr><td>204.8 kSa/s</td><td colspan="2">- 0.35 dB</td></tr>
<tr><td colspan="2" rowspan="4">Crosstalk</td><td>Input Range (Peak)</td><td>Guaranteed</td><td>Typical</td></tr>
<tr><td>±120 mV</td><td>101 dB</td><td>106 dB</td></tr>
<tr><td>±1.2 V</td><td>113 dB</td><td>118 dB</td></tr>
<tr><td>±12 V</td><td>117 dB</td><td>122 dB</td></tr>
</table>

MIC42X Module Specification

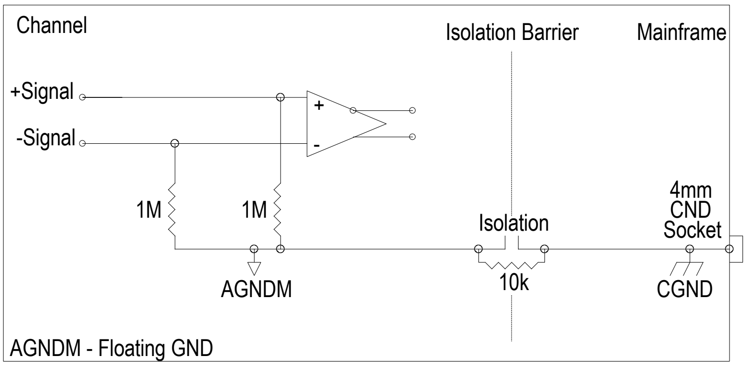
The Module settings and measurement conditions that were used during specification measurements are available on request.

Functionality per Channel

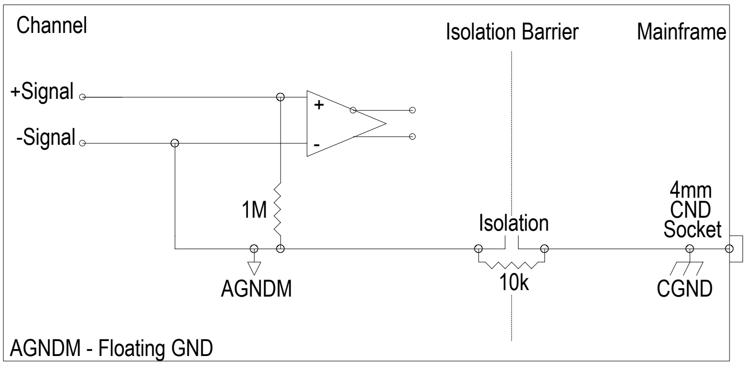


Signal flow of the MIC42X

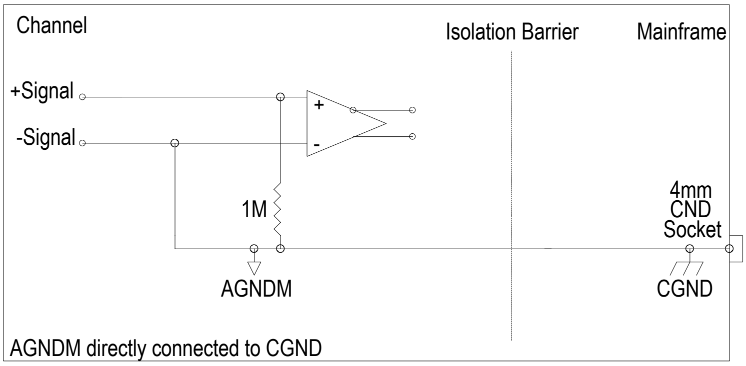
Grounding diagrams for ALI mode



Differential float (balanced float)

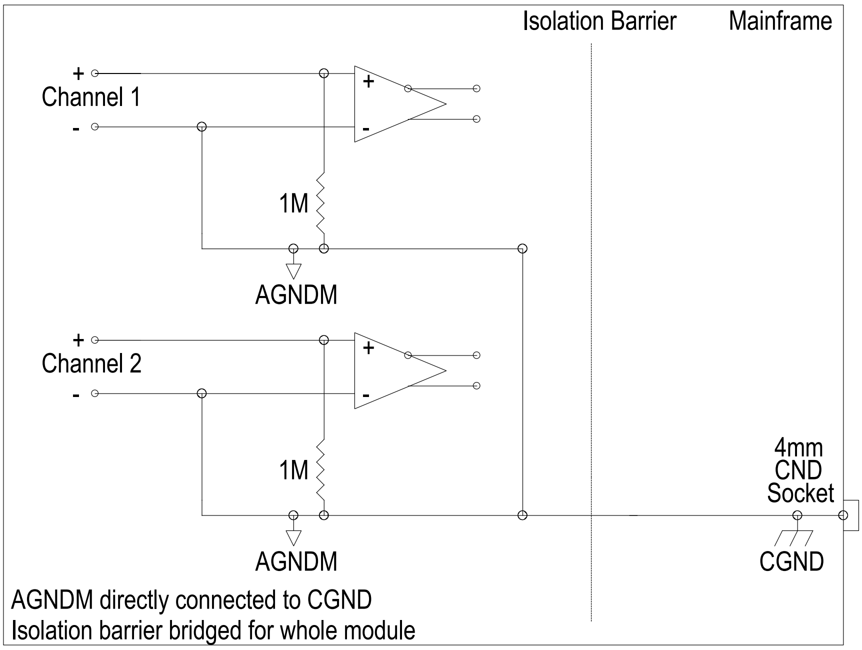


Single-Ended float (unbalanced float)



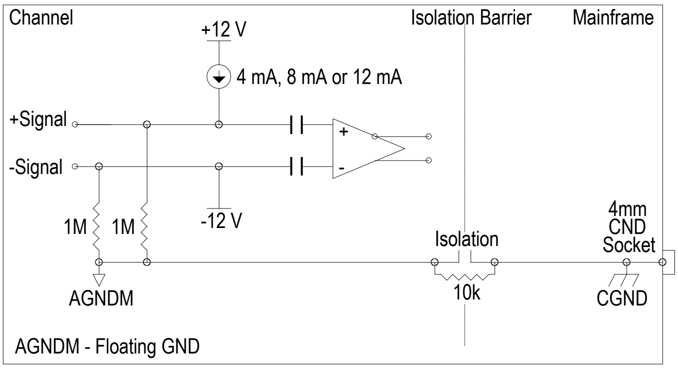
Single-Ended ground (unbalanced ground)

The figure below shows the effect on the Module input mode options when the CGND switch is closed. The isolation barrier will be bridged for the entire Module. Therefore, any channel connected in differential coupling will measure 1 MΩ to CGND and any channel connected in single-ended coupling will be connected with the single-ended GND (unbalanced GND) option.

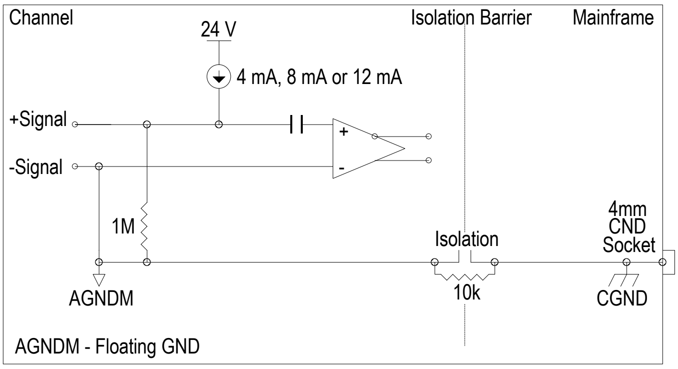


Input mode effect on the Module

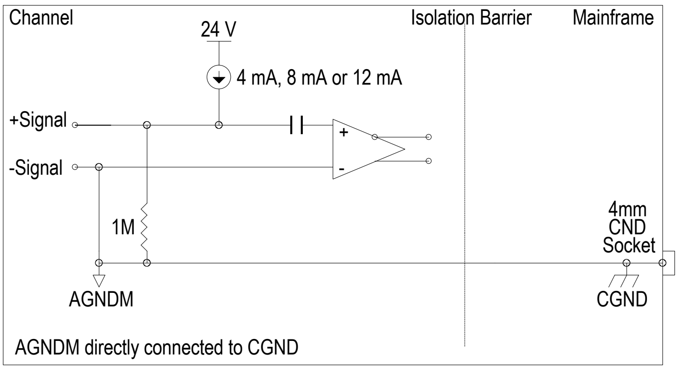
Grounding diagrams for ICP® mode



ICP® mode: Differential float with 4 mA, 8 mA or 12 mA current excitation



ICP® mode: Single-ended float with 4 mA, 8 mA or 12 mA current excitation



ICP® mode: Single-ended ground with 4 mA, 8 mA or 12 mA current excitation

12.1.13. DCH42S

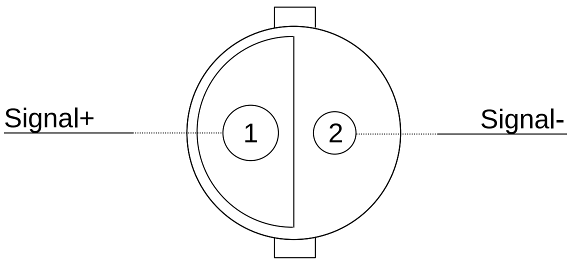
Description

The DCH42S Module has 2 independent differential input channels for Quartz or Piezoelectric Ceramic sensors. 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. The Module can be 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

Front Panel

Connector Information and Pin Definitions



DCH42S with 31-2225 twin BNC connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

ESD WARNING

The DCH42S Module inputs are sensitive to ESD damage. Always take care to discharge any additional static electricity that might have built up on a cable and connector before making contact with the DCH42S Module.

Features

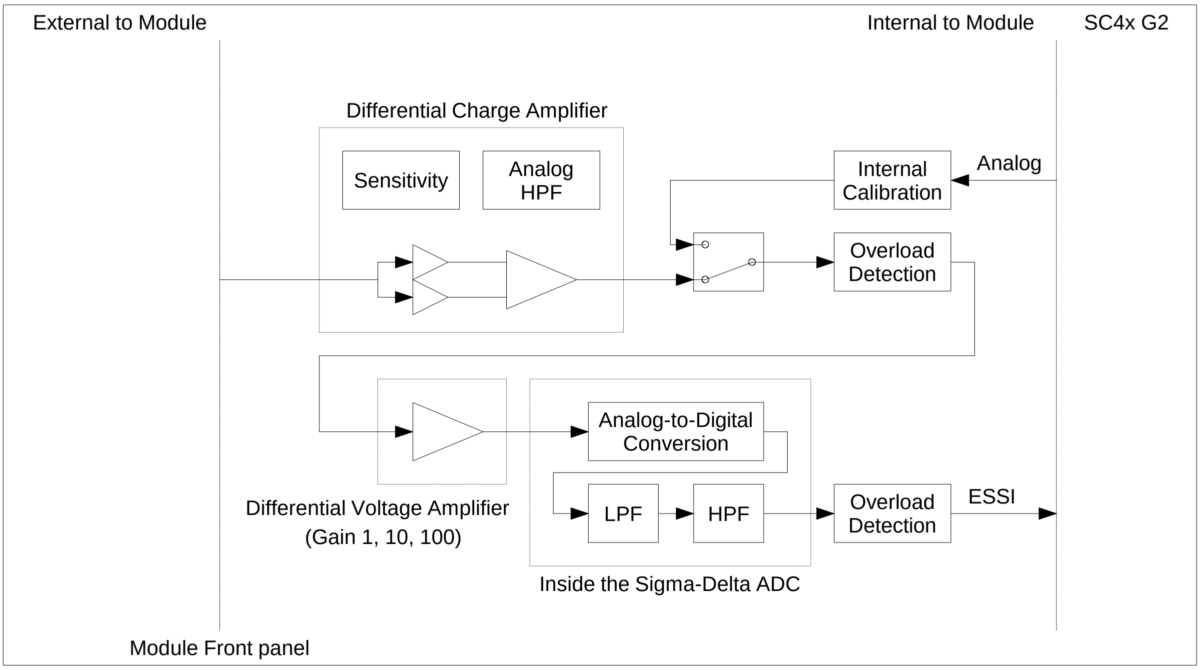
- 2 channels
- 24-bit resolution, 204.8 kSa/s sampling rate per channel, 90 kHz bandwidth
- 2 Sensitivity settings of 0.1 mV/pC and 1 mV/pC when in single-ended mode
- 2 Sensitivity settings of 0.2 mV/pC and 2 mV/pC when in differential mode
- 3 voltage gain ranges
- There are 2 distinctive input mode options:
  - Single-Ended
  - Differential
- Selectable low and high pass digital filters
- Overvoltage detection on frontend input signals
- Low power consumption
- Amphenol 31-2225 Twin BNC connectors

Interface		For piezoelectric sensors	
Input Charge Ranges	**Single-Ended Mode**	0.1 mV/pC	±100 000 pC (peak)
		1 mV/pC	±10 000 pC (peak)
	Differential Mode	0.2 mV/pC	±5 000 pC (peak)
		2 mV/pC	±50 000 pC (peak)
-3dB High Pass Frequency	**Single-Ended Mode**	0.1 mV/pC	0.16 Hz or 0.016 Hz
		1 mV/pC	1.6 Hz or 0.16 Hz
	Differential Mode	0.2 mV/pC	0.16 Hz or 0.016 Hz
		2 mV/pC	1.6 Hz or 0.16 Hz
Phase Accuracy *Channels in similar range*		**Typical**[21]	< 0.5° at 10 kHz
Other Sampling Rates		Available through digital LP filters and decimation	
Optional Programmable Digital IIR Filter		Band pass/stop : 6 dB/octave High/Low pass : 12 dB/octave	
Optional First Order High-Pass Filter		-3 dB @ 1 Hz	
Module Calibration		Internal amplitude calibration	
Protection		1 kΩ series (inline)	
Galvanic Isolation		50 V	
Digital Low-Pass Filter *Filter scales with sampling rate*		**Passband**	fs x 0.45 Hz
		Stopband	fs x 0.55 Hz
		Passband Ripple	±0.005 dB
		Stopband Attenuation	100 dB

DCH42S Module features

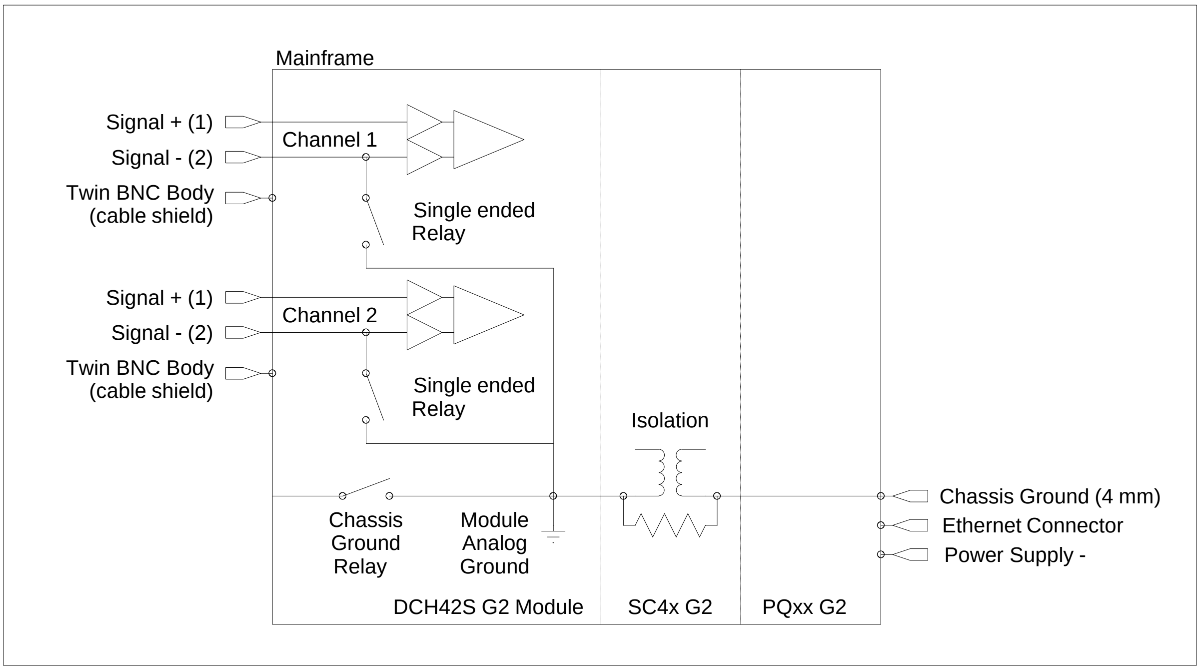
[21] Measured in 10 V range at 204.8 kSa/s

Functionality per Channel



DCH42S functionality per channel

Grounding diagram



DCH42S grounding

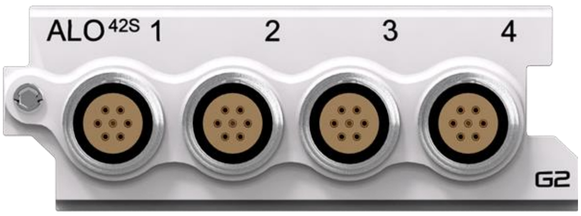
12.1.14. ALO42S

Description

The ALO42S Module provides four independent output channels for the generation of analog signals. Each channel also incorporates Status Input and Output signals, enabling further communication with external equipment for applications such as test supervision or workflow control. The ALO42S Module can be used for applications such as:

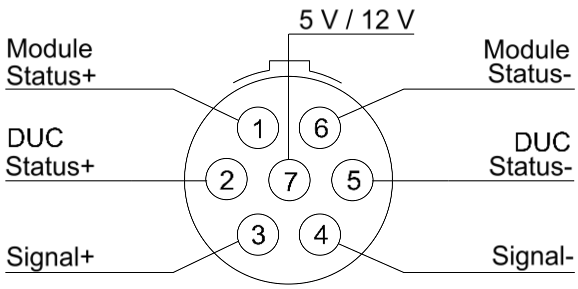
- Excitation signals for shaker / modal testing;
- Drive signals for acoustic testing;
- Arbitrary analog signals to feed into other circuits requiring ±10 V static or dynamic signals

Front Panel



The ALO42S

Connector Information and Pin Definitions



ALO42S with LEMO® 7-way EHG.0B connectors Module Pin Definition (when looking into the front panel's connector or at the rear of the cable's connector)

Signal Cable:

023K

The 023K is a standard length signal cable that connects an ALO42S Module to an ALOP10 SubModule.

For more information, see "Cables".

Features

- 4 channels each with:
  - Analog Signal Output
  - Module Status Output
  - Device Under Control Status Input
  - 5 V or 12 V DC Voltage Output
- 24-bit resolution
- 20 kHz 0.1 dB pass band flatness
- Low noise and distortion performance
- DC gain and offset stability
- ±10 V @ 30 mA output
- Automatic safe shutdown upon fault condition
- 10 Ω output impedance
- LEMO® 7-way EHG.0B connectors

<table>
<tr><td rowspan="4">Signal Pairs</td><td colspan="2">Module Status+</td><td colspan="2">Module Status-</td></tr>
<tr><td colspan="2">DUC Status+</td><td colspan="2">DUC Status-</td></tr>
<tr><td colspan="2">Signal+</td><td colspan="2">Signal-</td></tr>
<tr><td colspan="2">5 V or 12 V DC</td><td colspan="2">Signal-</td></tr>
<tr><td rowspan="2">Device Under Control Status Input
Input voltage range: 0 V to 24 V</td><td colspan="2">Sampling Rate</td><td colspan="2">15.6 kSa/s</td></tr>
<tr><td colspan="2">Resolution</td><td colspan="2">12 bits</td></tr>
<tr><td rowspan="3">Module Status Output Options</td><td>Status</td><td colspan="2">Relay
(max 24 V input)</td><td>DC Voltage Output
(5 or 12 V)</td></tr>
<tr><td>Good</td><td colspan="2">Closed relay</td><td>DC voltage output</td></tr>
<tr><td>Bad</td><td colspan="2">Open relay</td><td>No voltage output</td></tr>
<tr><td rowspan="2">DC Voltage Output</td><td>Output Voltage</td><td colspan="3">5 V or 12 V</td></tr>
<tr><td>Output Current</td><td colspan="3">15 mA (max)</td></tr>
</table>

SubModules	The Quad BNC (QBNC11) SubModule is used to split signals from a 7-way LEMO® connector to 4 BNC connectors.
	The ALOP10 is a rack-mountable SubModule for routing the analog output signals from up to 8 ALO42S Modules to individual male SMB connectors.
Other Sampling Rates	Available through digital LP filters and decimation
Module Calibration	Internal amplitude calibration
Output Biasing Settings	Single-Ended Float or Single-Ended GND (per Module)
Protection	2 kV ESD
Galvanic Isolation	50 V

ALO42S Module Features

Specifications

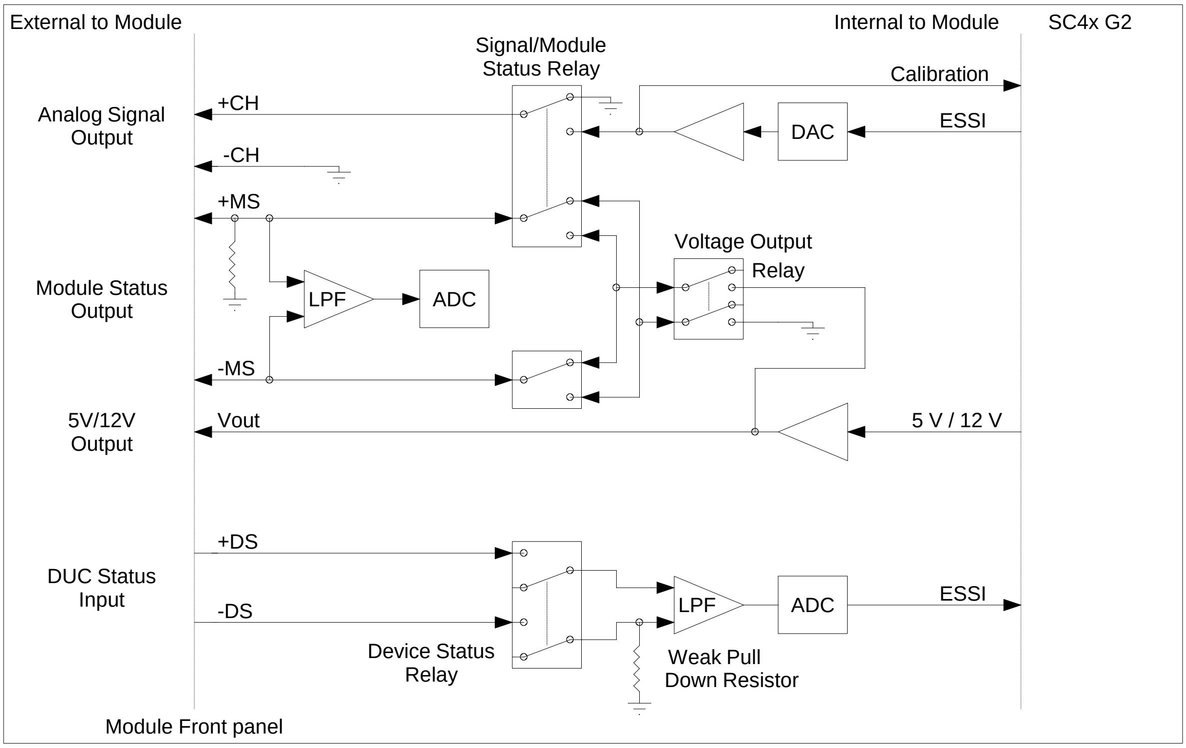
Maximum Sampling Rate (fs) per channel	204.8 kSa/s	
D/A Conversion	24-bit	
Output Voltage Ranges (Peak)	±10 V	
Phase Accuracy *Channels in similar range*	**Typical**[22]	< 0.5° at 10 kHz
DC Voltage Accuracy	**Output Range (Peak)**	**% Range**
	±10 V	0.27 %
Frequency Accuracy	**Output Frequency**	**% Output Frequency**
	> 100 Hz	0.025 %

ALO42S Module Specification

The Module settings and measurement conditions that were used during specification measurements are available on request.

[22] Measured in 10 V range at 204.8 kSa/s

Functionality per Channel

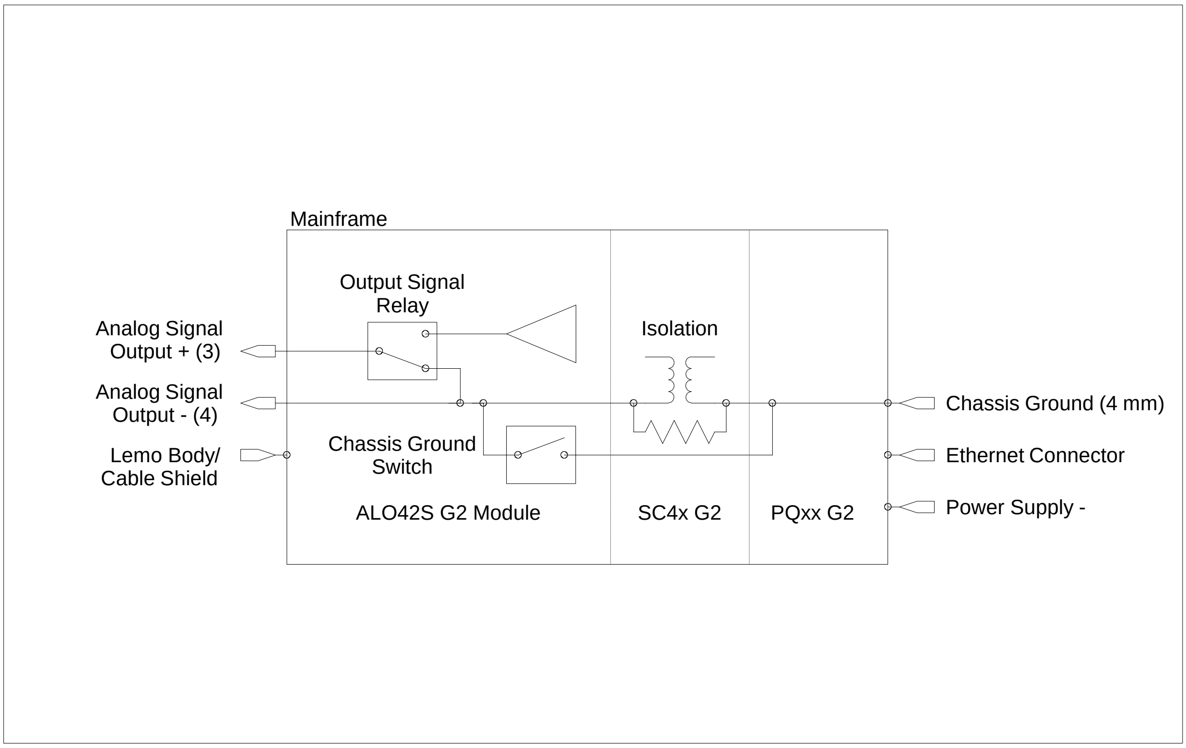


ALO42S functionality per channel

The Device Under Control (DUC) is connected to the ALO42S through a 7-pin LEMO® connector.

- Two Analog Signal Output lines (+CH and -CH) provide analog information,
- Two Module Status Output lines (MS+ and MS-) provide the DUC with information from the ALO42S, and
- Two DUC Status Input lines (DS+ and DS-) provide the ALO42S with information from the DUC
- 5 V / 12 V DC output

Grounding Diagram



ALO42S grounding

The LEMO® connector on the ALO42S makes contact with the cable shield connecting the DUC. Due to this fact, the shield should be broken on the DUC side, so that the DUC is not connected to the system Chassis Ground.

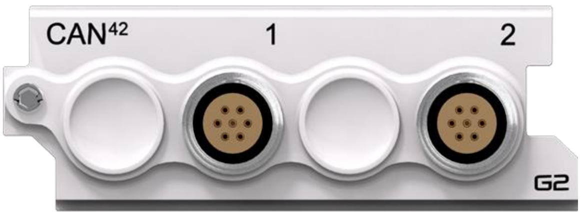
This LEMO® connector is also connected to the 4 mm Chassis Ground socket on the front right foot of the DECA**Q**, the Ethernet connector shield and the negative DECA**Q** power supply pin.

12.1.15. CAN42

Description

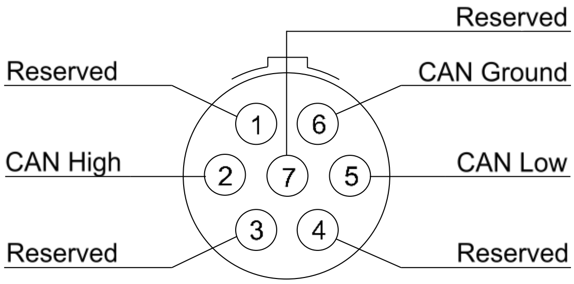
The CAN42 Module provides interfaces to 2 independent Controller Area Networks or CAN. Messages received from CAN are time-stamped to synchronize their reception with analog and digital measurements from other Modules in the system. Features include Listen-Only mode, Self-Reception of CAN messages and transmission of Remote Frames. The CAN42 Module provides independent channel filtering. The Module can be used when monitoring CAN based messages and when controlling CAN based devices.

Front panel



The CAN42

Connector Information and Pin Definitions



The CAN42 with LEMO® 7-way EHG.0B connectors Module pin definition (when looking into the front panel's connector or at the rear of the cable's connector)

Note: Pin 6 – CAN Ground Channel 1 and CAN Ground Channel 2 are isolated from each other.

The CANC10 SubModule can be used to connect a CAN42 Module to a CANbus network. Here it provides the interface between the 7-pin LEMO® connector on the CAN42 Module and the 9-pin D-sub connector on the CANbus network.

Two cable lengths are available when connecting to a CANbus network:

- 3000 mm cable length, or
- 300 mm cable length

Features

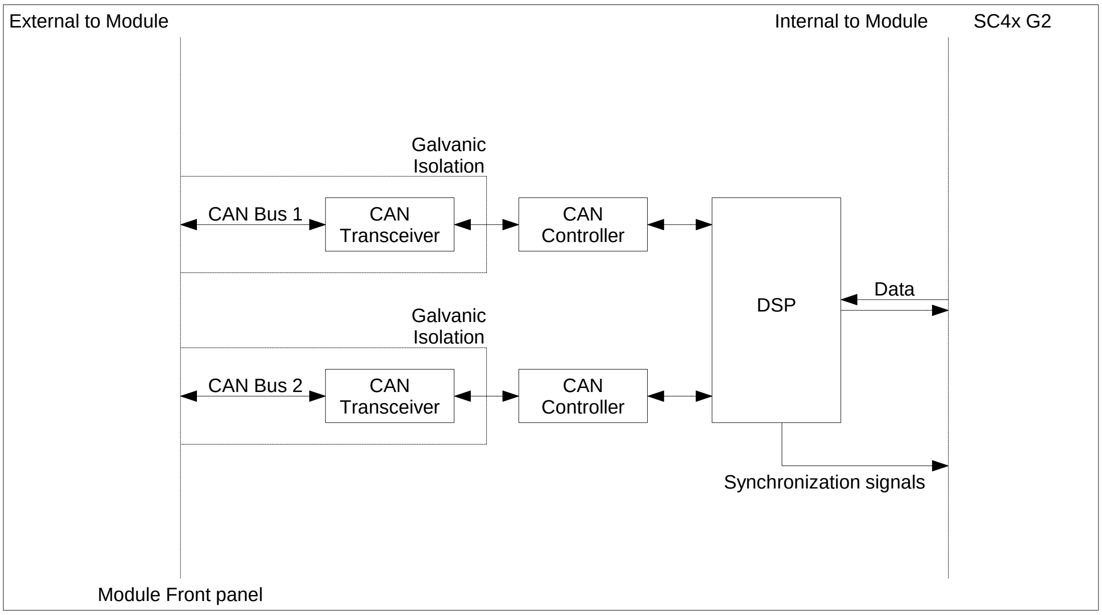
- Compatible with ISO 11898-2 (High Speed) physical layer standard and with CAN 2.0B protocol (supports both 11-bit and 29-bit identifiers)
- Software selectable 120 Ω termination per Channel
- Individually configurable identifier list per channel provides acceptance filtering
- 2 modes of operation:
    - Participate – transmit and receive CAN messages (active)
    - Listen only mode – only receive CAN messages (passive)
- Received CAN messages are time stamped with a sub-microsecond resolution
- Each channel has protection against ESD and other harmful transients
- Data and remote frames are supported
- 2 independent CAN channels each at 10 kbit/s to 1 Mbit/s data rate CAN messages are time stamped with a resolution of 62.5 ns
- LEMO® 7-way EHG.0B connectors
- 9-way D-sub connectors are provided with CANC10 SubModules

CAN Bus Bit Rate	Bus Timing Registers		Description	
	BTR0	BTR1		
10 kbit/s	0x31	0x1C	SJW BRP TSEG1 TSEG2 Single sample point at 87.5%	= 0x0 (1 $tscl$) = 49 ($fclk$ = 16 MHz) = 0xC (13 $tscl$) = 0x1 (2 $tscl$)
33.33 kbit/s	0x4E	0x1C	SJW BRP TSEG1 TSEG2 Single sample point at 87.5%	= 0x1 (2 $tscl$) = 14 ($fclk$ = 16 MHz) = 0xC (13 $tscl$) = 0x1 (2 $tscl$)
50 kbit/s	0x09	0x1C	SJW BRP TSEG1 TSEG2 Single sample point at 87.5%	= 0x0 (1 $tscl$) = 9 ($fclk$ = 16 MHz) = 0xC (13 $tscl$) = 0x1 (2 $tscl$)

83.33 kbit/s	0x05	0x1C	SJW BRP TSEG1 TSEG2 Single sample point at 87.5%	= 0x0 (1 $tscl$) = 5 ($fclk$ = 16 MHz) = 0xC (13 $tscl$) = 0x1 (2 $tscl$)
100 kbit/s	0x03	0x2F	SJW BRP TSEG1 TSEG2 Single sample point at 85.0%	= 0x0 (1 $tscl$) = 3 ($fclk$ = 16 MHz) = 0xF (16 $tscl$) = 0x2 (3 $tscl$)
125 kbit/s	0x03	0x1C	SJW BRP TSEG1 TSEG2 Single sample point at 87.5%	= 0x0 (1 $tscl$) = 3 ($fclk$ = 16 MHz) = 0xC (13 $tscl$) = 0x1 (2 $tscl$)
250 kbit/s	0x01	0x1C	SJW BRP TSEG1 TSEG2 Single sample point at 87.5%	= 0x0 (1 $tscl$) = 1 ($fclk$ = 16 MHz) = 0xC (13 $tscl$) = 0x1 (2 $tscl$)
500 kbit/s	0x00	0x1C	SJW BRP TSEG1 TSEG2 Single sample point at 87.5%	= 0x0 (1 $tscl$) = 0 ($fclk$ = 16 MHz) = 0xC (13 $tscl$) = 0x1 (2 $tscl$)
666 kbit/s	0x80	0xB6	SJW BRP TSEG1 TSEG2 Triple sample point	= 0x2 (1 $tscl$) = 0 ($fclk$ = 16 MHz) = 0x6 (7 $tscl$) = 0x2 (3 $tscl$)
800 kbit/s	0x40	0x16	SJW BRP TSEG1 TSEG2 Single sample point at 80%	= 0x1 (2 $tscl$) = 0 ($fclk$ = 16 MHz) = 0x6 (7 $tscl$) = 0x1 (2 $tscl$)
1000 kbit/s	0x00	0x14	SJW BRP TSEG1 TSEG2 Single sample point at 75.0%	= 0x0 (1 $tscl$) = 0 ($fclk$ = 16 MHz) = 0x4 (5 $tscl$) = 0x1 (2 $tscl$)

CAN42 Module CAN bus bitrates

Functionality per Channel

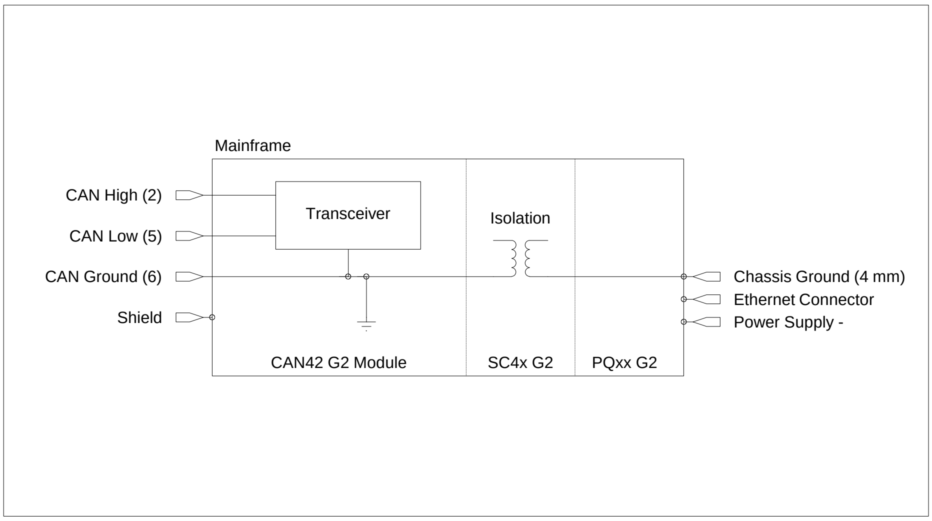


Functional block diagram of the CAN42 Module

The CAN Module contains two channels that are implemented by its firmware to act as inputs or outputs (channel 1 – input/output 1; channel 2 – input/output 2).

The CAN42 conforms to ISO 11898 and to CAN 2.0 A and B (with support for 11-bit and 29-bit identifiers). Time stamping is executed on each message received which allows CAN messages to be synchronized with the rest of the measurement data.

Grounding Diagram



Grounding diagram of the CAN42 Module (only one channel)

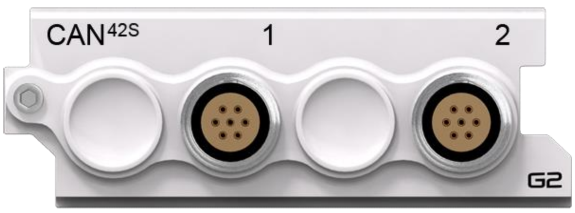
12.1.16. CAN42S

Description

The CAN42S Module provides interfaces to two CAN or CAN FD (CAN with Flexible Data-Rate) busses. CAN FD is an extension of the original CAN (Controller Area Network) protocol, which allows for higher data bandwidth. Messages received from CAN are time-stamped to synchronize their reception with analog and digital measurements from other Modules in the system. A self-reception of sent messages is provided as well as three operational modes, including Participate mode, Listen-Only mode, Self-Reception of sent messages and Loopback mode. The CAN42S Module features independent channel filtering and can be used:

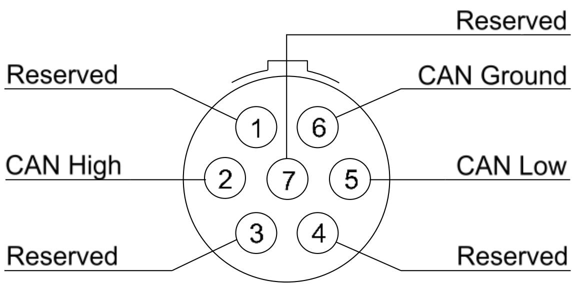
- When monitoring CAN and CAN FD based messages
- When controlling CAN and CAN FD based devices

Front panel



CAN42S

Connector Information and Pin Definitions



CAN42S with LEMO® 7-way EHG.0B connectors Module pin definition (when looking into the front panel's connector or at the rear of the cable's connector)

Note: Pin 6 – CAN Ground Channel 1 and CAN Ground Channel 2 are isolated from each other.

The CANC10 SubModule can be used to connect a CAN42S Module to a CAN or CAN FD network. It provides the interface between the 7-pin LEMO® connector on the CAN42S Module and the 9-pin D-sub connector on the CAN or CAN FD network.

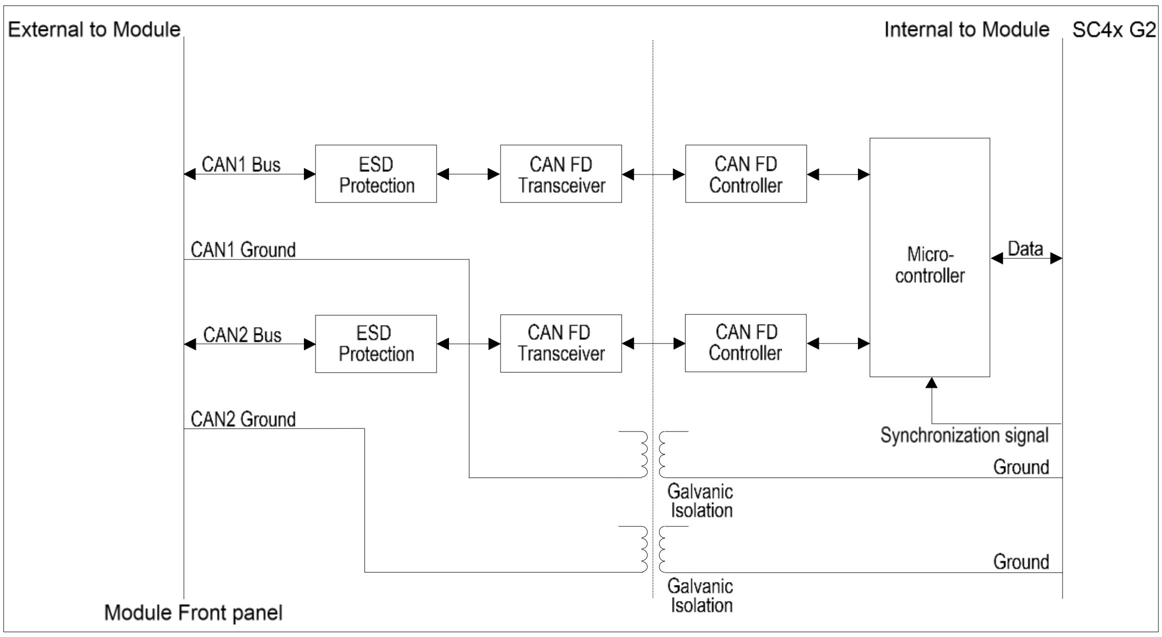
Two cable lengths are available when connecting to a CAN FD network:

- 3000 mm cable length, or
- 300 mm cable length

Features

- Conforms to ISO 11898-1:2015 ("ISO CAN FD")
- Supports Arbitration Bit Rates from 14.4 kbit/s to 1000 kbit/s
- Supports Data Bit Rates from 14.4 kbit/s to 8000 kbit/s (single channel only), or 2000 kbit/s (both channels simultaneously)
- Supports Sample Point configuration for the arbitration phase
- Software selectable 120 Ω bus termination per Channel
- 3 modes of operation:
    - Participate – actively acknowledges messages on the bus and sends messages
    - Listen only – passively interprets messages that are sent between other nodes on the bus
    - Loopback – forms an internal virtual bus that only receives its own sent messages
- Each CAN message received and accepted by the Module is time stamped in order to synchronize the received CAN messages with the rest of the measurement data
- Individually configurable identifier list per channel to provide acceptance filtering for all CAN messages received from the CAN bus
- Individually configurable CAN message transmission
- Each channel has protection against ESD and other harmful transients
- LEMO® 7-way EHG.0B connectors
- 9-way D-sub connectors are provided with the CANC10 SubModule

Functionality per Channel

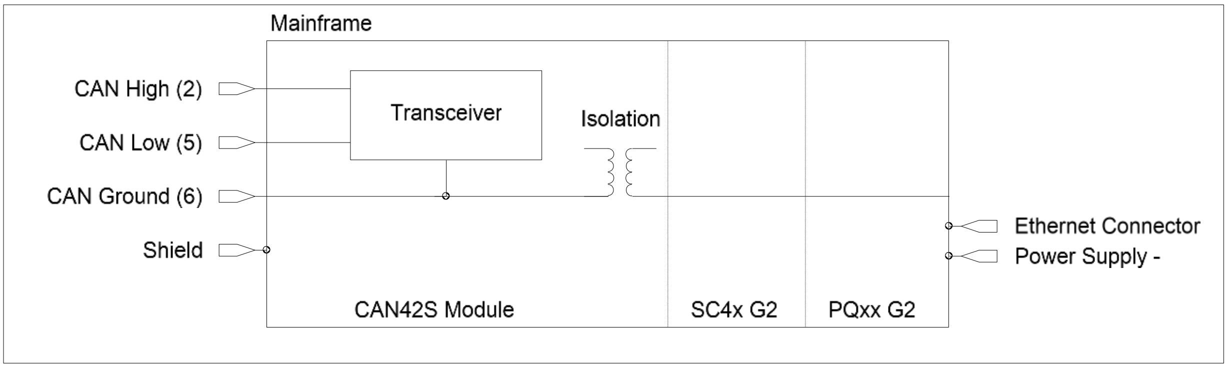


Functional block diagram of the CAN42S Module

The CAN Module contains two channels that are implemented by its firmware to act as inputs or outputs (channel 1 – input/output 1; channel 2 – input/output 2).

The CAN42S conforms to ISO 11898-1:2015 and to CAN 2.0 B (with support for 11-bit and 29-bit identifiers). Time stamping is executed on each message received which allows CAN messages to be synchronized with the rest of the measurement data.

Grounding Diagram



Grounding diagram of CAN42S Module (only one channel)

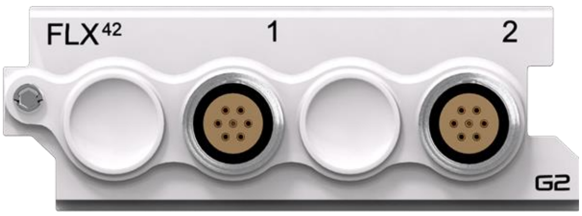
12.1.17. FLX42

Description

The FLX42 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 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 Module provides independent channel filtering and provides status and error information to the user. The Module can be used:

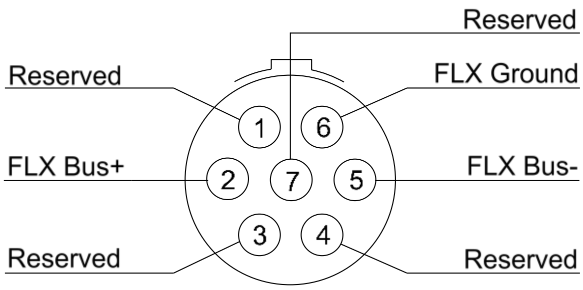
- When monitoring FlexRay™ based messages
- When interfacing with FlexRay™ based sensors

Front Panel



FLX42

Connector Information and Pin Definitions



FLX42 with LEMO® 7-way EHG.0B connectors Module pin definition (when looking into the front panel's connector or at the rear of the cable's connector)

The FLXB20 SubModule can be used to connect the FLX42 Module to a FlexRay™ network.

Two cable lengths are available when connecting to a FlexRay™ network network:

- 3000 mm cable length (for higher bit rates), or
- 300 mm cable length (for lower bit rates)

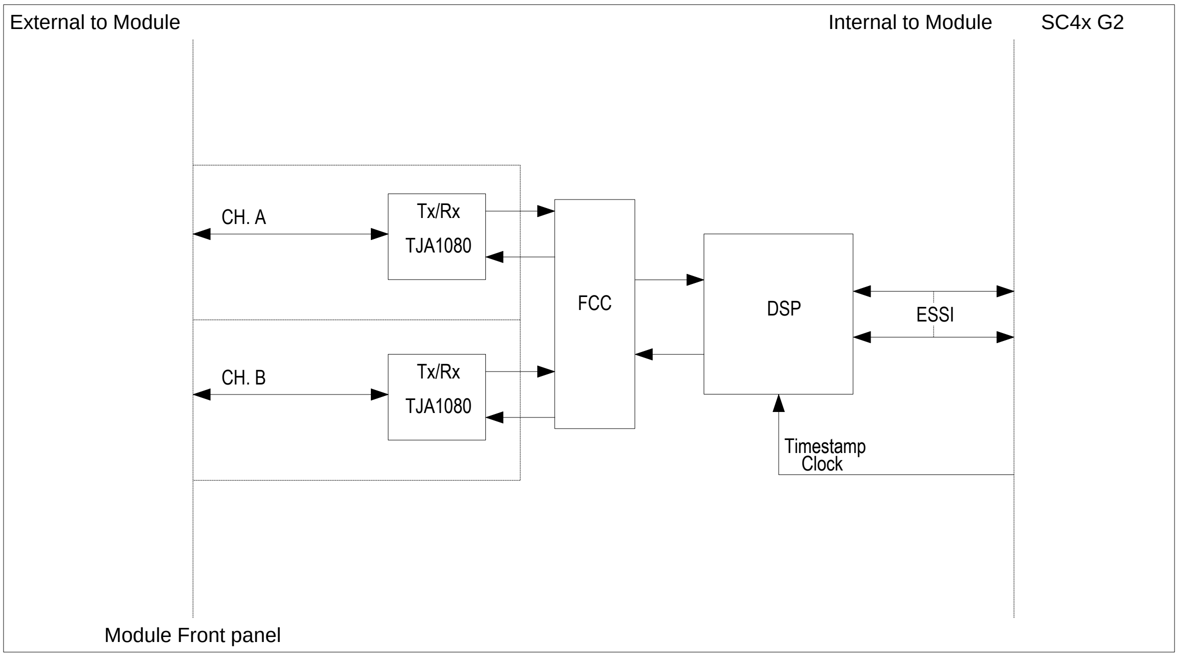
Features

- 2 dependent channels configured as:
  - Dual Channel Device or
  - Single Channel Device (connector 2 disabled)
- Configurable cold start
- FlexRay™ Bit Rate Range of 2.5, 5, 8 or 10 Mbit/s
- 2 modes of operation:
  - Participate 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)
- FlexRay™ messages are time-stamped with a sub-microsecond resolution
- Configurable FlexRay™ message acceptance filtering
- Software selectable 110 Ω termination per channel
- Each channel has protection against ESD and other harmful transients
- LEMO® 7-way EHG.0B connectors
- 9-way D-sub connectors are provided with FLXB20 SubModules
- Compatible with FlexRay™ Protocol Specification V2.1A and FlexRay™ Electrical Physical Layer Specification V2.1A

Module Connectors	LEMO® EHG.0B.307
Channel Configuration	2 dependent channels – Dual Channel Device or Single Channel Device (connector 2 disabled)
Operational Modes	Listen-Only Mode / Participate Mode
FlexRay™ Compliance	FlexRay™ Protocol Specification V2.1A. FlexRay™ Electrical Physical Layer Specification V2.1A
Termination	Software selectable 110 Ω termination per channel
FlexRay™ Transceivers	NXP TJA1080
FlexRay™ Controller	Freescale MFR4310
FlexRay™ Controller Clock Frequency	40 MHz
FlexRay™ Bit Rate Range	2.5, 5, 8 or 10 Mbit/s (bandwidth limited at 10 Mbit/s in dual channel mode)
Timestamp Resolution	38.1 ns to 59.6 ns
Galvanic Isolation	50 V
Operational Temperature	-25 °C to 80 °C

FLX42 Module Features

Functionality per Channel



FLX42 functionality

The FLX42 Module contains two dependent FlexRay™ channel interfaces to support either the single or dual channel topologies.

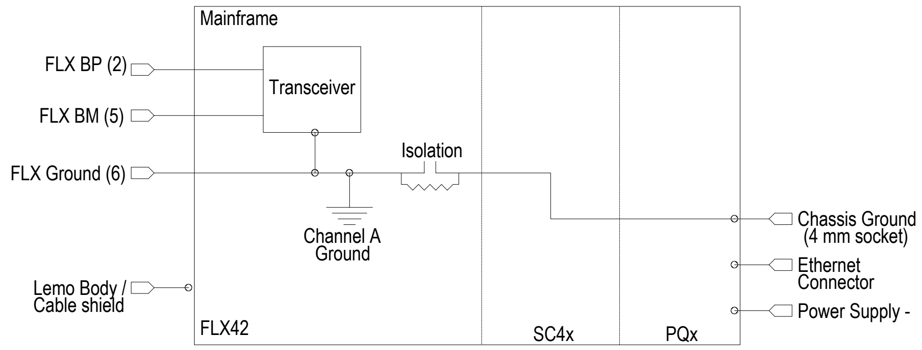
The MFR4310 communication controller and TJA1080 transceivers are used on the FLX42 Module. They support the transmission and reception of FlexRay™ messages over a FlexRay™ network with selectable bit rates of 2.5, 5, 8 or 10 Mbit/s.

The FLX42 Module supports independent channel filtering and provides status and error information to the User.

The FLX42 has:

- Conformance with FlexRay™ Protocol Specification V2.1A
- FlexRay™ Electrical Physical Layer Specification V2.1A
- Each FLX42 interface is galvanically isolated from the DECA**Q** system
- Each message received and accepted by the FLX42 Module will be time stamped in order to synchronize the received messages with the rest of the measurement data
- Individually configurable FlexRay™ Frame ID, Channel ID and Cycle Count filtering per channel

Grounding Diagram



FLX42 grounding

12.1.18. GPS42S

Description

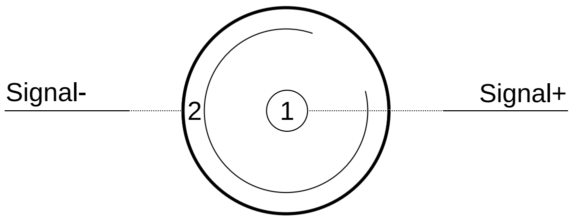
The GPS42S provides accurate GPS time and position data to **QuantusSeries** systems. Accurate timing information is in the form of a pulse per second (pps) logical signal. The GPS42S can also be used for synchronization purposes. Here the GPS42S Module provides the System Controller with the pps signal to align its internal clock. Systems with this capability are able to synchronize with one another without limitations as to their position or the total number of systems. The Module can be used when:

- Synchronization of numerous channels over multiple systems
- Requiring accurate time and position information

Front Panel

GPS42S

Connector Information and Pin Definitions



GPS42S with an SMA connector Module pin definition (when looking into the front panel's connector or at the rear of the cable's connector)

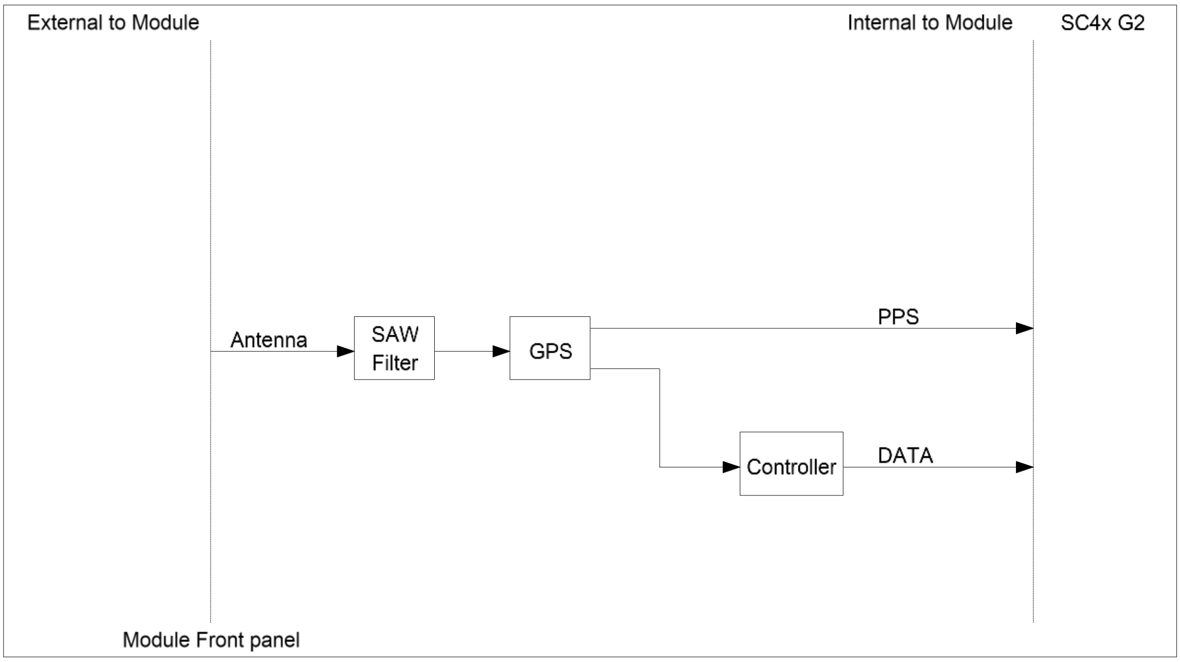
Features

• Antenna Voltage: 3.3 V • Receiver type: 56 channels GPS L1C/A SBAS L1C/A QZSS L1C/A GALILEO E1B/C • Position updates: 1 Hz and 4 Hz • Position accuracy: autonomous 2.5 m, SBAS 2.0 m • Acquisition time: Cold Start 29 s; Warm Start 28 s; Hot Start 1 s	• Available protocols: NMEA and UBX • Time-Pulse RMS accuracy: 30 ns • Operations limits: altitude < 50 000 m; velocity < 500 m/s • Specified antenna: ANN-ST-O-005-0 antenna from U-BLOX AG, Switzerland • Time stamping of received GPS time and position data up to 5 μs resolution • 1 channel SMA connector
Number of Channels	1
Antenna Voltage	3.3 V
Input Connector	SMA
Receiver Type	56 channels GPS L1C/A SBAS L1C/A QZSS L1C/A GALILEO E1B/C
Max Update Rate	4 Hz
Position Accuracy	Autonomous 2.5 m CEP[23], SBAS 2.0 m CEP
Acquisition Time	Cold Start: 29 s; Warm Start: 28 s; Hot Start: < 1 s
Available Protocols	NMEA and UBX
Operational Limits	Altitude: < 50 000 m, Velocity < 500 m/s
Specified Antenna	ANN-ST-O-005-0 GPS antenna from U-BLOX AG, Switzerland
Time stamping of received GPS time and position data	5 μs

GPS42S Module Features

[23] CEP: Circular Error Probability, the radius of a horizontal circle, centered at the antenna's true position, containing 50% of the fixes

Functionality



GPS42S Functionality

The GPS42S is specified for use with the ANN-ST-0-005-0 GPS antenna[24]. This antenna is an active GPS antenna with a 5 m cable and an SMA Male connector.

The GPS42S implements a real-time differential correction method known as SBAS (or Satellite-Based Augmentation System). SBAS provides correction data for visible satellites as follows:

- Corrections are computed from ground station observations and then uploaded to geostationary satellites
- This data is then cast on the L1 frequency and is tracked using a channel on the GPS receiver

Using SBAS will allow the GPS42S to achieve an accuracy of < 2.0 m when using circular error probability (CEP). CEP is the probability that 50% of the corrections to the position are within the radius of a horizontal circle centered on the antenna's true position.

The GPS42S supports drift compensation as well as synchronized start over GPS.

[24] ANN-ST-O-005-0 GPS antenna from U-BLOX AG, Switzerland

12.1.19. IRG42

Description

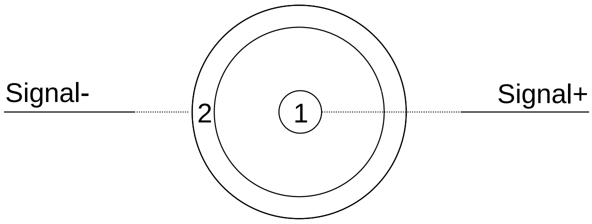
In addition to the same internal GPS functionality as described in the GPS42, the IRG42 Module provides an additional functional unit of being able to interface to IRIG. Here IRIG-A and IRIG-B data (both analog and digital formats) are digitized by a high-speed ADC and decoded. The external IRIG data is time-stamped to synchronize its data with other Modules in the same system. The IRG42 can also be used for synchronization purposes. Here the IRG42 Module provides the System Controller with a signal to align its internal clock. Systems with this capability are able to synchronize with one another (limited only by the customer's installed IRIG facility). The Module can be used when:

- Synchronization of numerous channels over multiple systems
- Requiring time and other IRIG based information to synchronize other measurements

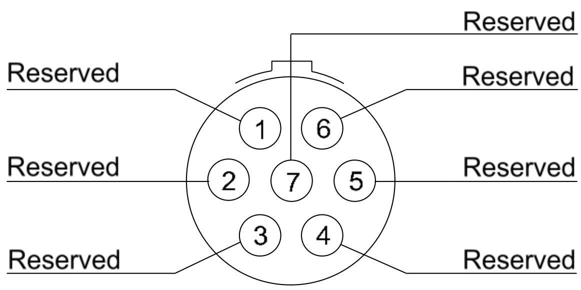
Front Panel

IRG42 Module

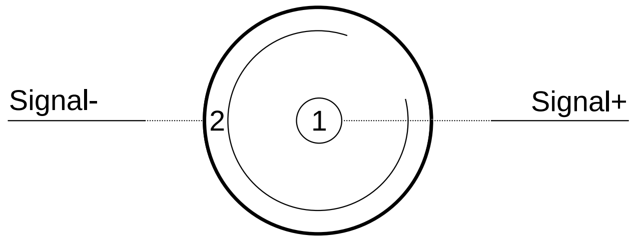
Connector Information and Pin Definitions



IRG42 Module with male SMB connector for IRIG pin definition (when looking into the front panel's connector or at the rear of the cable's connector)



IRG42 Module with LEMO® 7-way EHG.0B connector External GPS pin definition (when looking into the front panel's connector or at the rear of the cable's connector). The LEMO® connector is reserved for later use.



IRG42 Module with SMA connector for Antenna pin definition (when looking into the front panel's connector or at the rear of the cable's connector)

Features

- Internal GPS channel
- All settings configurable via software
- Available protocols in GPS mode: NMEA
- Available update rates in GPS mode: 1 Hz and 4 Hz
- Time stamping of received GPS time and position data to 5 µs resolution
- GPS antenna voltage: 3.3 V or 5 V
- SMA connector for GPS antenna
- Operation modes include:
    - Internal IRIG receiver mode
    - GPS receiver mode
- IRIG Formats supported:
    - A003
    - A133
    - B003
    - B123
- Time stamping of IRIG messages to 5 µs resolution
- SMB connector for IRIG
- The IRG42 can function in either GPS mode or IRIG mode

Features in internal GPS receiver mode	
Number of Channels	1
Antenna Voltage	3.3 V or 5 V
Input Connector	SMA
Receiver Type	L1 frequency, C/A Code, 16 Channels
Max Update Rate	4 Hz

Accuracy (SA off)[25]	Position: 4.0 m CEP[26], 5.0 m SEP[27] Position DGPS/SBAS: < 2.0 m CEP, 3.0 m SEP	
Acquisition Time	Cold Start: 45 s; Warm Start: 38 s; Hot Start: < 8 s	
Available Protocols	NMEA	
Operational Limits	Altitude: < 18000 m, Velocity: < 515 m/s	
Specified Antenna	ANN-ST-O-005-0 GPS antenna from U-BLOX AG, Switzerland	
Time Stamping of received GPS time and position data	5 µs	
Features in internal IRIG mode		
Number of Channels	1	
Input Connector	SMB	
IRIG Format Support	A003	PWM DC Signal; No carrier BCD time of year; SBS time of day
	A133	AM Sine Wave Signal; 10 kHz carrier frequency BCD time of year; SBS time of day
	B003	PWM DC Signal; No carrier BCD time of year; SBS time of day
	B123	AM Sine Wave Signal; 1 kHz carrier frequency BCD time of year; SBS time of day
DC Input Impedance	100 Ω	

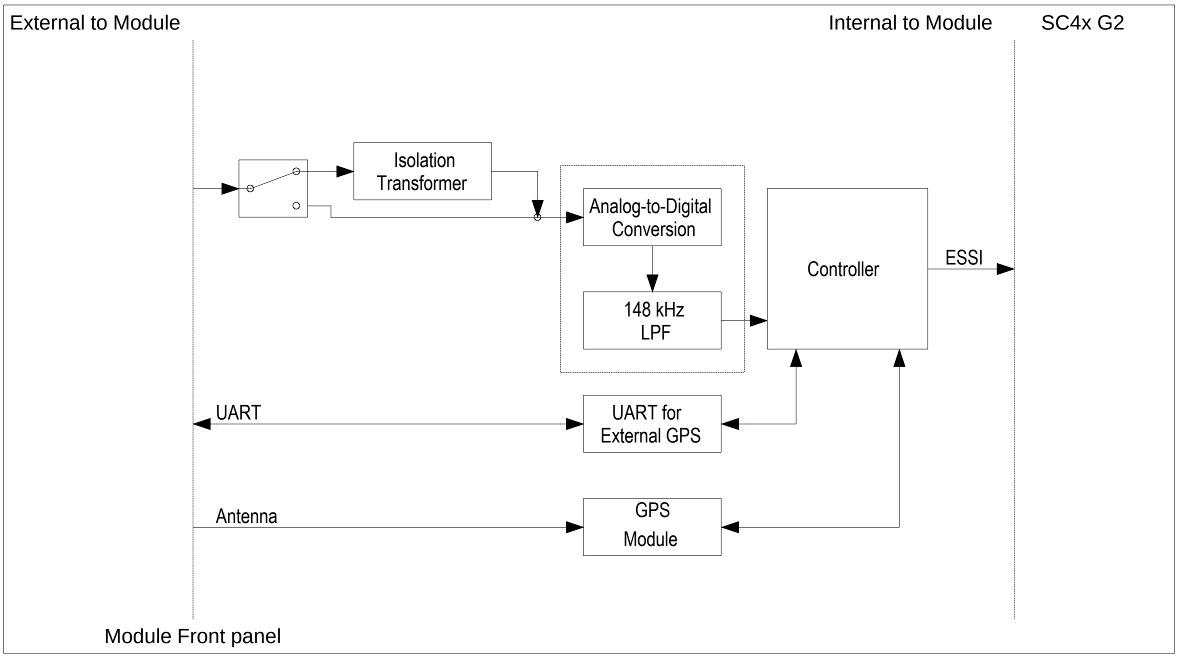
IRG42 Module Features

[25] SA: Selective Availability

[26] CEP: Circular Error Probability, the radius of a horizontal circle, centered at the antenna's true position, containing 50 % of the fixes

[27] SEP: Spherical Error Probability, the radius of a sphere, centered at the true position, contains 50 % of the fixes

Functionality



IRG42 functionality

The IRG42 has:

- An SMB Male connector - for use with the internal IRIG receiver. An external IRIG timing source is connected through the SMB connector
- An SMA Female connector - for use with the internal GPS receiver
- Supported IRIG expressions:
  - Binary Coded Decimal (BCD) to display ‘time of year’ as well as ‘year’
  - Straight Binary Seconds (SBS) to display the’ time of day’ information
- IRIG accuracy in mode A of 1000 pps and mode B of 100 pps
- GPS accuracy < 2.0 m when using the Satellite Based Augmentation System (SBAS)
- Time Stamping ≥ 5 μs on received GPS time and position data

12.1.20. ECT42

Description

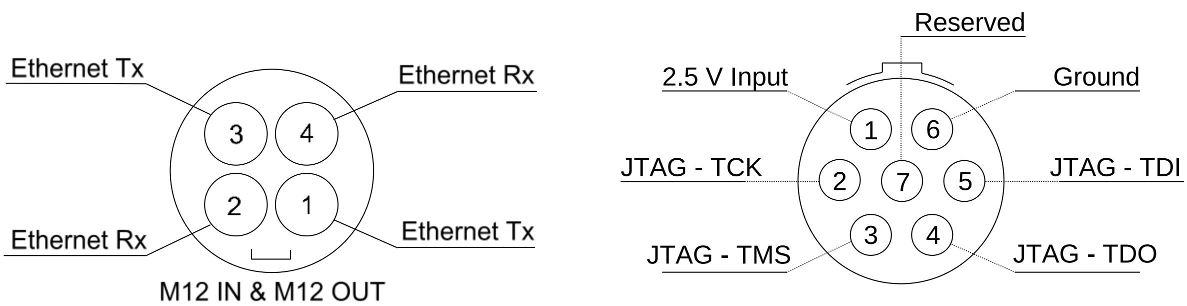
Data which is acquired in any **QuantusSeries** system can be shared synchronously with other EtherCAT® devices via the high-speed Ethernet backbone using the EtherCAT® protocol and EtherCAT® system time. This data is presented along with miscellaneous parameters including units and scaling factors. The Module can be used to:

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

Front Panel

ECT42

Connector Information and Pin Definitions



ECT42 with ERNI M12 and LEMO® 7-way EHG.0B connectors Module pin definitions (when looking into the front panel's connectors or at the rear of the cable's connector)

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
Module Connectors	2 x ERNI M12 Connectors (IP67 compliant)
Physical Channel Configuration	Flexible, topology-dependent
Logical Channel Configuration	Flexible; provision for up to forty 32-bit Float input channels
EtherCAT® Compliance	IEC 61158, ISO 15745-4, SEMI E54.20
Operational Modes	Passive Mode data acquisition. Full EtherCAT® state machine
EtherCAT® Controller	ET1100
EtherCAT® Clock Accuracy	15 ppm (Rx queue delay of 0)
Typical Synchronization Accuracy	10-20 ns
Effective Data Rate	135-400 kB/s (dependent on input configuration)

ECT42 Module Features

12.1.21. DAR42

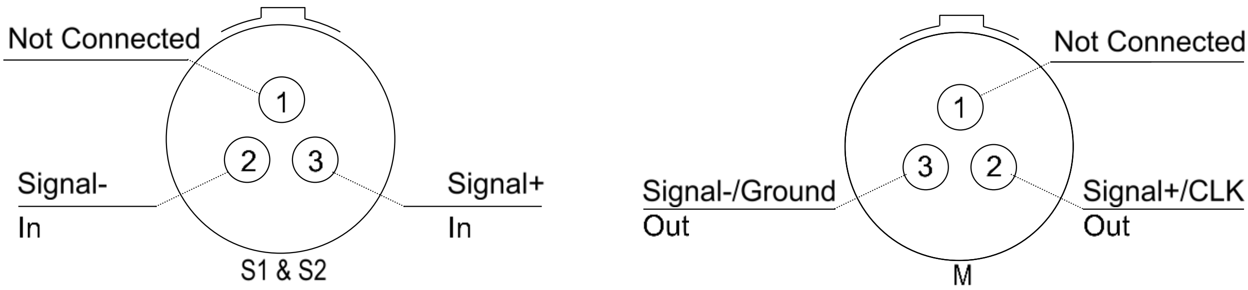
Description

The DAR42 Module provides interfaces to receive two stereo AES3 digital audio streams. For synchronization between the DAR42 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) (default) or word clock signal. The Module can be used to measure devices which provide an AES3 based digital audio signal, such as a digital artificial head.

Front panel

DAR42

Connector Information and Pin Definitions



DAR42 with LEMO® 3-way EGG.0B and FAG.0B connectors Module pin definition (when looking into the front panel's connectors or at the rear of the cable's connector)

Features

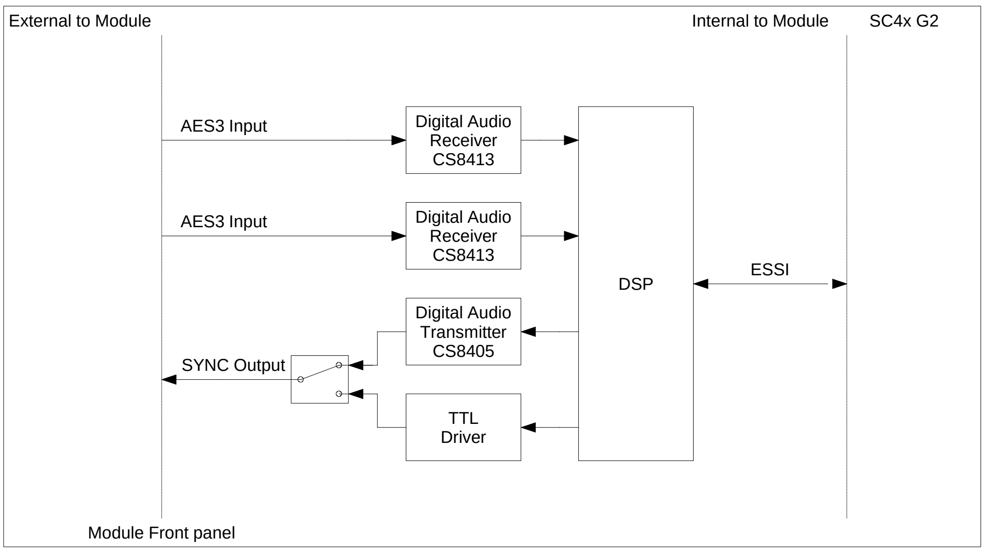
• Two stereo input channels • Frame rates of 44.1, 48.0, 88.2 and 96.0 kHz • Single AES3 output signal (data at digital zero) (default) or master word clock output	• LEMO® 3-way EGG.0B connectors for AES3 input and LEMO® 3-way FAG.0B connector for synchronization output

DAR42 Module AES3 Input Features		
Module Connector		LEMO® EGG.0B.303.CLN
Channel		2 inputs
Interface		AES3
Termination		110 Ω
Differential Input Voltage Range		200 mV p-p minimum
Common Mode Input Range		±7 V
Frame Rate	**4 CH mode**	44.1, 48 kHz
	2 CH mode	44.1, 48, 88.2, 96 kHz
Sample Width		16 / 20 / 24-bit
Protection		2 kV ESD
Galvanic Isolation		50 V, through capacitive coupling
Word Clock Delay		30 ns (maximum)
AES3 Delay		600 ns (typical)

DAR42 Module SYNC Output Features		
Module Connector		LEMO® FAG.0B.303.CLA
Channel		1
Interface	**Word Clock**	TTL low-impedance output, single-ended
	AES3	AES transformer-coupled
Voltage Output	**Word Clock**	5.5 V (peak-to-peak, cable unterminated)
	AES3	3.5 V (peak-to-peak, cable unterminated)
Termination	**Word Clock**	75 Ω
	AES3	110 Ω
Frequency Range	**Word Clock**	44.1, 48, 88.2, 96 kHz
	AES3	44.1, 48 kHz
Protection		2 kV ESD
Galvanic Isolation	**Word Clock**	No
	AES3	50 V, through transformer coupling

DAR42 Module Features

Functionality per Channel



DAR42 Module Functionality

12.2. Inserting and Removing **Q**Modules

12.2.1. Inserting a **Q**Module

- Ensure the DECA**Q** is switched off *(see Switch Off for more information)* before inserting a **Q**Module. Merely disconnecting the external power supply is not sufficient. Inserting a **Q**Module while the DECA**Q** is running will cause damage to the **Q**Module and the system.
- Put on an antistatic wrist strap connected to an earthed antistatic mat.
- Take extra care when fitting a **Q**Module into a **Q**Module slot on the DECA**Q** front panel for the first time.
- Only handle **Q**Modules by their front panels or board edges and always store them in their antistatic bags. Do not touch the **Q**Module connectors.
- Lightly flatten the EMC strip (use a clean finger to do this).
- Take the **Q**Module out of its antistatic bag and push it into the empty **Q**Module slot, until the left-hand jacking screw engages its thread. If necessary, use a screwdriver to further flatten the EMC strips.
- Fasten the screw with a 2.0 mm hex key. The **Q**Module gets pulled in as you turn the screw.
- On the next power-up, the DECA**Q** will automatically detect the newly installed **Q**Module/s.

12.2.2. Removing a **Q**Module

- Ensure the DECA**Q** is switched off *(see Switch Off the DECA**Q** for more information)* before removing a **Q**Module. Merely disconnecting the external power supply is not sufficient. Removing a **Q**Module while the DECA**Q** is running will cause damage to the **Q**Module and the system.
- Put on an antistatic wrist strap connected to an earthed antistatic mat.
- Disconnect all sensors and cables connected to the **Q**Module (see the section below).
- Before the **Q**Module can be removed it must have cooled down to below 40 °C. This is important as the permanent screw retainer used between the jacking screw and its nut could fail at high temperatures.

- Have an antistatic bag ready for the **Q**Module being removed.
- Loosen the screw with a 2.0 mm Allen key. As the screw loosens, the **Q**Module will be pulled out of its slot automatically.
- Once the jacking screw has been completely loosened, simultaneously hold onto the front panel and pull the **Q**Module out of its slot and immediately place it in its antistatic bag.
- All empty **Q**Module slots of the DECA**Q** must be covered using a blank panel (MBL). Failure to do so may allow dust or other objects to damage the DECA**Q**.

12.3. Plugging-in and Unplugging LEMO® Connectors

The DECA**Q**'s S-Port and power connector, as well as most **Q**Modules, use LEMO® connectors.

When plugging-in and unplugging LEMO® connectors, please make sure to use the latching sleeve (rough metallic cover) when pulling and pushing in the connector. Do not plug or unplug the LEMO® connectors by pulling on the cable itself. This will damage the cable, affecting measurements.

The following images show how to plug / unplug the LEMO® connector using the latching sleeve provided:

✓

The images below show the incorrect way to plug / unplug the LEMO® connector (by pushing and pulling on a cable). Please take care *not* to do this:

✕

12.4. Recommended QModule Mating Connectors

12.4.1. Digital Modules

Product Name	Part Number	Recommended Mating Connector
CAN42	LEMO® EHG.0B.307.CLN	7-pin LEMO® straight plug FGG.0B.307
CAN42S	LEMO® EHG.0B.307.CLN	7-pin LEMO® straight plug FGG.0B.307
FLX42	LEMO® EHG.0B.307.CLN	7-pin LEMO® straight plug FGG.0B.307
GPS42S	SMA FR Molex 0732512200	50 Ω Male SMA

12.4.2. Analog Modules

Product Name	Part Number	Recommended Mating Connector
ALI42	LEMO® EHG.0B.307.CLN	7-pin LEMO® straight plug FGG.0B.307
ALI42B	BNC BULKHEAD SOCKET SOLDER POT (TEFLON)	50 Ω BNC plug
ALO42S	LEMO® EGG.0B.307.CLN	7-pin LEMO® straight plug FGG.0B.307
CHG42S (1)	MICRODOT JACK	Microdot screw-on plug
CHG42S (2)	LEMO® EHG.0B.309 CLN with 0.9 shorter shell	9-pin LEMO® straight plug FGG.0B.309
DCH42S	TWIN BNC RECEPTACLE	Amphenol Twin-BNC clamp plug 31-224 or 31-2226
ICP42	SMB MS PCB R114426000	50 Ω Radiall SMB plug

ICS42	LEMO® EHG.0B.309.CLN with 0.9 shorter shell	9-pin LEMO® straight plug FGG.0B.309
ICT42	SMB MS PCB (RADIALL R114426000)	50 Ω Radiall SMB plug
ICT42S (1)	LEMO® EHG.0B.303.CLN	3-pin LEMO® straight plug FGG.0B.303
ICT42S (2)	LEMO® EHG.0B.304.CLN	4-pin LEMO® straight plug FGG.0B.304
MIC42X	LEMO® EGG.1B.307.CLN	7-pin LEMO® straight plug FGG.1B.307
THM42	LEMO® EHG.0B.307.CLN	7-pin LEMO® straight plug FGG.0B.307
WSB42	LEMO® EGG.1B.307.CLN	7-pin LEMO® straight plug FGG.1B.307
WSB42X	LEMO® EGG.1B.307.CLN	7-pin LEMO® straight plug FGG.1B.307

13. Specifications and Dimensions

The following section provides mechanical specification overviews and dimensions of the DECA**Q**'s 2-slot, 3-slot, 4-slot, 6-slot and 10-slot chassis.

13.1. DECA**Q 2-slot**

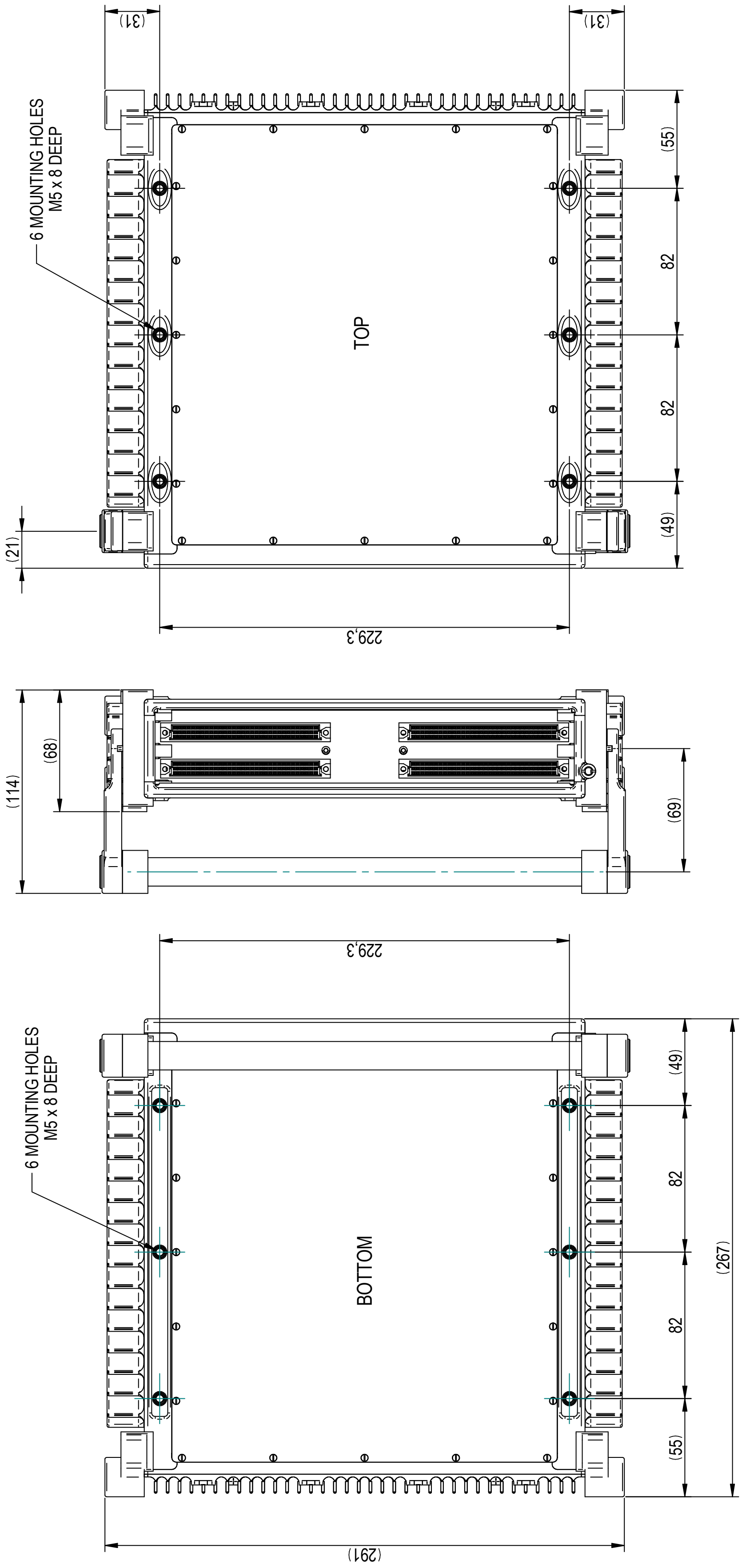
13.1.1. Mechanical Specifications Overview

DECA**Q** 2-slot chassis	Slot 1	**PQ System Board** Combined System Controller and Power Supply
	Slot 2	**SC Signal Conditioning Board:** Data Acquisition
	Number of Channels (if 6 Channels per **Q**Module)	24 Channels
	Fan	No
	External Surface Cooling System	Natural Convection
	Internal Board's Cooling System	Conduction
	Dimensions (W H D)	291 x 68 x 267 mm 11.46 x 2.68 x 10.51 "
	Volume	5.3 L 1.4 gal
	Mass Fully Populated with Battery	5.1 kg 11.24 lb
	Mass Fully Populated without Battery	4.8 kg 10.58 lb

<table>
<tr><td rowspan="11">DECAQ
2-slot chassis</td><td>Battery Type</td><td>NiMh</td></tr>
<tr><td>Number of Battery Cells</td><td>8</td></tr>
<tr><td>Battery Capacity</td><td>20 Wh</td></tr>
<tr><td>Minimum Ambient Temperature</td><td>-20 °C
-4 °F</td></tr>
<tr><td>Maximum Ambient Temperature</td><td>62 °C
143.6 °F</td></tr>
<tr><td>Humidity (non-condensing)</td><td>90% RH</td></tr>
<tr><td>Shock[28] (11 ms duration)</td><td>40 g
1.41 oz</td></tr>
<tr><td>Random Vibration[29] (10 to 2000 Hz)</td><td>0.1 g^2/Hz</td></tr>
<tr><td>Power Input Source[30]</td><td>External DC supply with an
Internal Battery Pack</td></tr>
<tr><td>Power Consumption with Most Demanding QModules</td><td>30 W</td></tr>
<tr><td>Power Consumption with Most Demanding QModules and Dynamic Charge On</td><td>70 W</td></tr>
</table>

[28] According to MIL-STD-810G Method 516.6, Procedure I. 1 g = 9.8 m/s^2
[29] According to MIL-STD-810G Method 514.6, Procedure I. 1 g = 9.8 m/s^2
[30] These values are an indication of the power consumption for typical chassis configurations and are not intended as an explicit specification for the external power supply.

13.1.2. Dimensions



GENERAL SIZES AND MOUNTING DETAIL - MF02 (M515)

13.2. DECA**Q 3-slot**

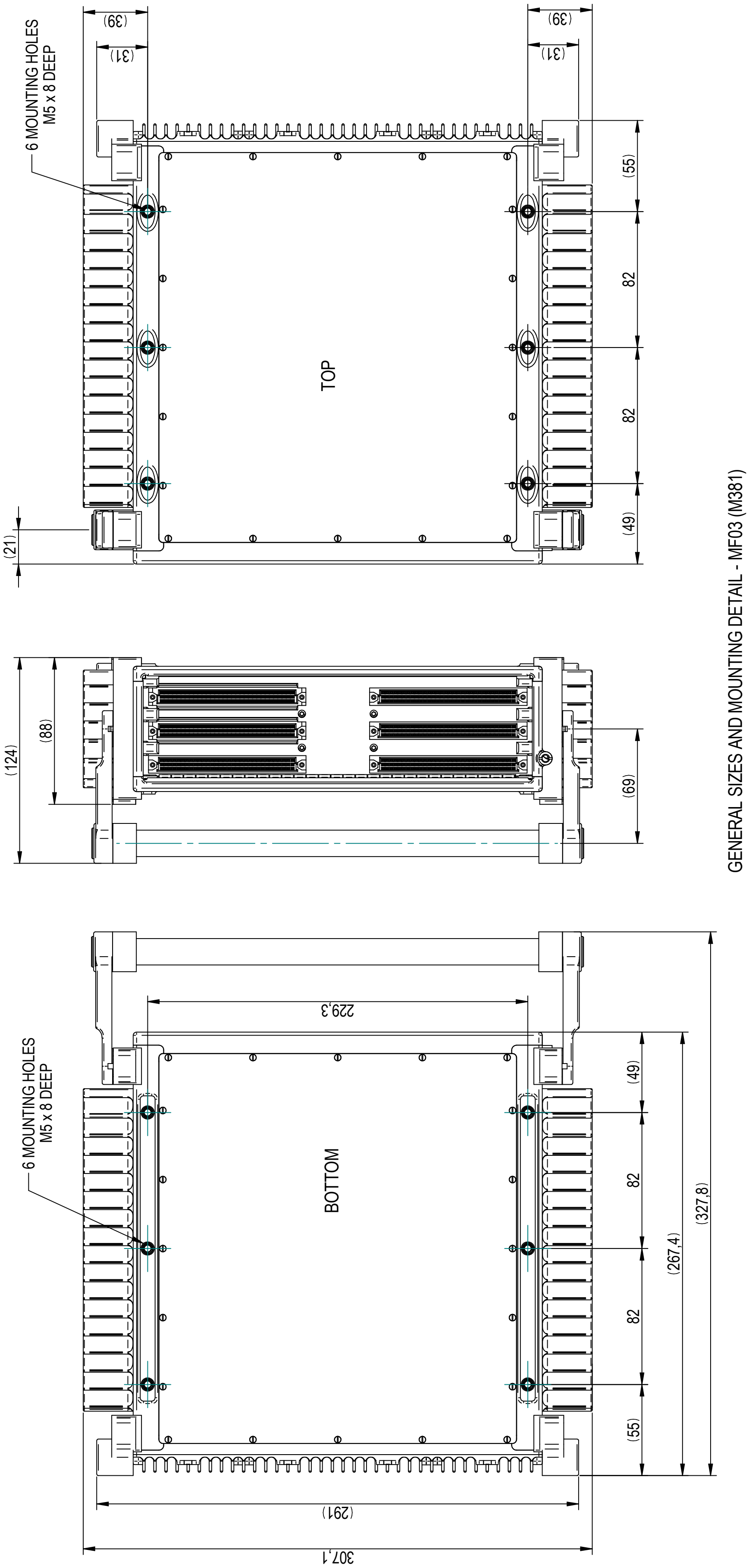
13.2.1. Mechanical Specifications Overview

DECA**Q** 3-slot chassis	Slot 1	**PQ System Board** Combined System Controller and Power Supply
	Slot 2 - 3	**SC Signal Conditioning Board:** Data Acquisition
	Number of Channels (if 6 Channels per **Q**Module)	48 Channels
	Fan	No
	External Surface Cooling System	Natural Convection
	Internal Board's Cooling System	Conduction
	Dimensions (W H D)	307 x 88 x 267 mm 12.09 x 3.46 x 10.51 "
	Volume	7.2 L 1.9 gal
	Mass Fully Populated with Battery	7.1 kg 15.65 lb
	Mass Fully Populated without Battery	6.3 kg 13.89 lb
	Battery Type	NiMh
	Number of Battery Cells	12

DECA**Q** 3-slot chassis	Battery Capacity	40 Wh
	Minimum Ambient Temperature	-20 °C -4 °F
	Maximum Ambient Temperature	60 °C 140 °F
	Humidity (non-condensing)	90% RH
	Shock[31] (11 ms duration)	40 g 1.41 oz
	Random Vibration[32] (10 to 2000 Hz)	0.1 g^2/Hz
	Power Input Source[33]	External DC supply with an Internal Battery Pack
	Power Consumption with Most Demanding **Q**Modules	50 W
	Power Consumption with Most Demanding **Q**Modules and Dynamic Charge On	90 W

[31] According to MIL-STD-810G Method 516.6, Procedure I. 1 g = 9.8 m/s^2
[32] According to MIL-STD-810G Method 514.6, Procedure I. 1 g = 9.8 m/s^2
[33] These values are an indication of the power consumption for typical chassis configurations and are not intended as an explicit specification for the external power supply.

13.2.2. Dimensions



13.3. DECA**Q** 4-slot

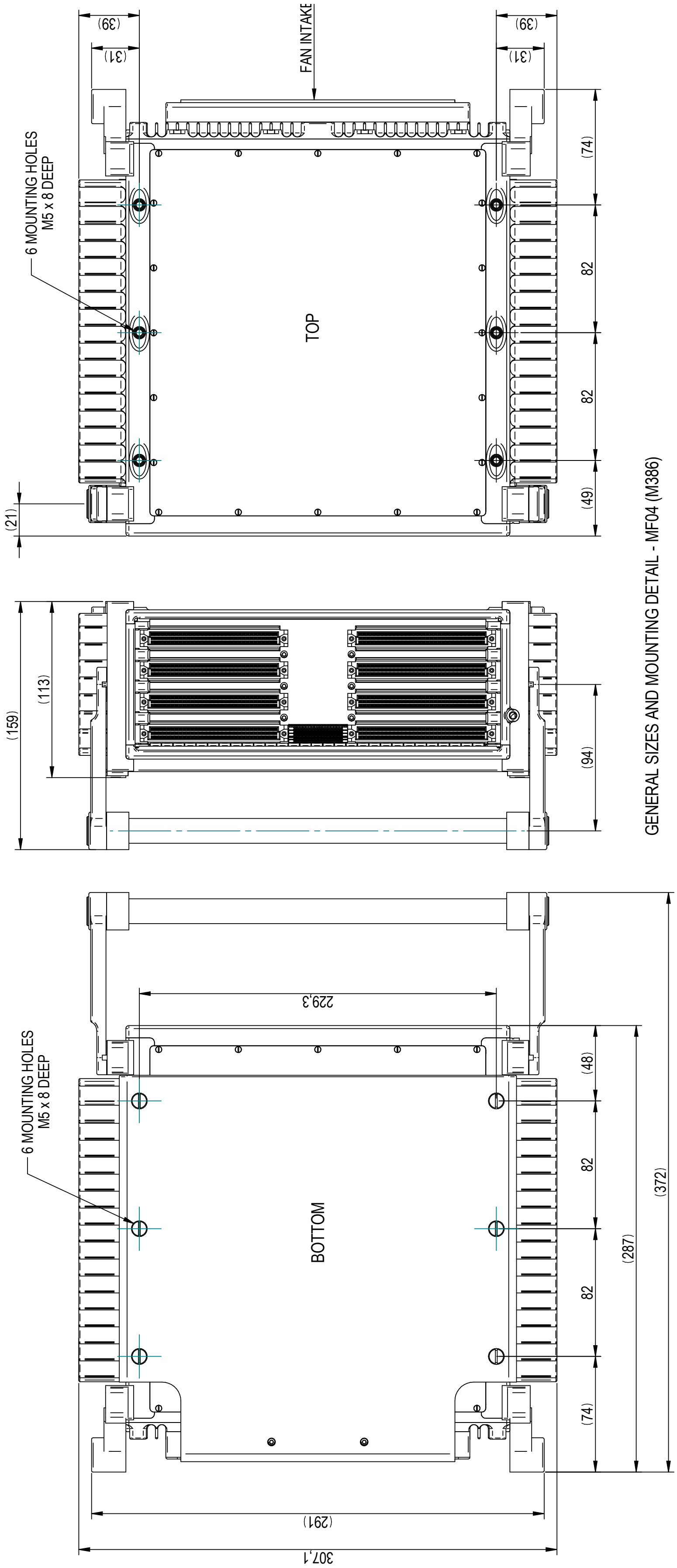
13.3.1. Mechanical Specifications Overview

DECA**Q** 4-slot chassis	Slot 1	**PQ System Board** Combined System Controller and Power Supply
	Slot 2 - 4	**SC Signal Conditioning Board:** Data Acquisition
	Number of Channels (if 6 Channels per **Q**Module)	72 Channels
	Fan	No
	External Surface Cooling System	Natural Convection
	Internal Board's Cooling System	Conduction
	Dimensions (W H D)	307 x 109 x 287 mm 12.09 x 4.29 x 11.3 "
	Volume	9.6 L 2.54 gal
	Mass Fully Populated with Battery	9.92 kg 21.83 lb
	Mass Fully Populated without Battery	9.12 kg 20.06 lb
	Battery Type	NiMh
	Number of Battery Cells	12

DECA**Q** 4-slot chassis	Battery Capacity	40 Wh
	Minimum Ambient Temperature	-20 °C -4 °F
	Maximum Ambient Temperature	58 °C 136.4 °F
	Humidity (non-condensing)	90% RH
	Shock[34] (11 ms duration)	40 g 1.41 oz
	Random Vibration[35] (10 to 2000 Hz)	0.1 g^2/Hz
	Power Input Source[36]	External DC supply with an Internal Battery Pack
	Power Consumption with Most Demanding **Q**Modules	75 W
	Power Consumption with Most Demanding **Q**Modules and Dynamic Charge On	115 W

[34] According to MIL-STD-810G Method 516.6, Procedure I. 1 g = 9.8 m/s^2
[35] According to MIL-STD-810G Method 514.6, Procedure I. 1 g = 9.8 m/s^2
[36] These values are an indication of the power consumption for typical chassis configurations and are not intended as an explicit specification for the external power supply.

13.3.2. Dimensions



13.4. DECAQ 6-slot

13.4.1. Mechanical Specifications Overview

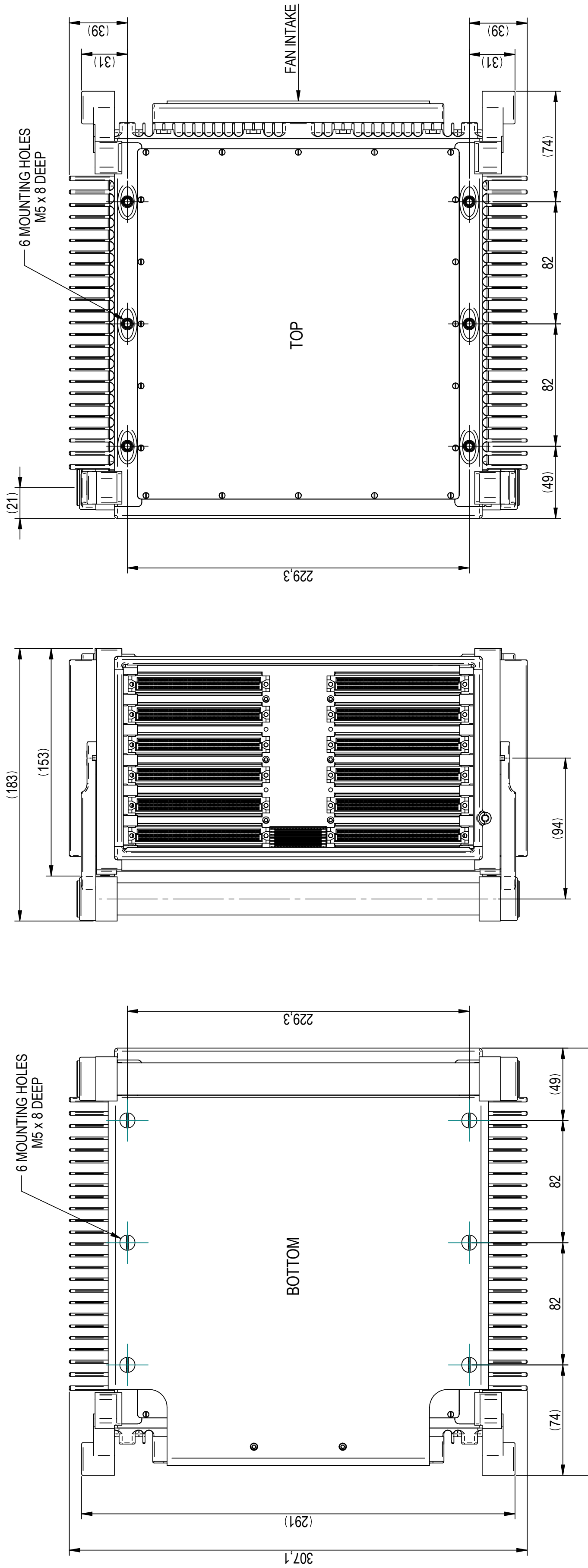
DECA**Q** 6-slot chassis	Slot 1	**PQ System Board** Combined System Controller and Power Supply
	Slot 2 - 6	**SC Signal Conditioning Board:** Data Acquisition
	Number of Channels (if 6 Channels per **Q**Module)	120 Channels
	Fan	Yes[37]
	External Surface Cooling System	Natural/Forced Convection
	Internal Board's Cooling System	Conduction
	Dimensions (W H D)	307 x 151 x 287 mm 12.09 x 5.94 x 11.3 "
	Volume	13.3 L 3.51 gal
	Mass Fully Populated with Battery	15.2 kg 33.51 lb
	Mass Fully Populated without Battery	12.6 kg 27.78 lb
	Battery Type	NiMh
	Number of Battery Cells	12

[37] For optimal cooling, see Chassis Handling below

DECA**Q** 6-slot chassis	Battery Capacity	72 Wh
	Minimum Ambient Temperature	-20 °C -4 °F
	Maximum Ambient Temperature	56 °C 132.8 °F
	Humidity (non-condensing)	90% RH
	Shock[38] (11 ms duration)	40 g 1.41 oz
	Random Vibration[39] (10 to 2000 Hz)	0.1 g^2/Hz
	Power Input Source[40]	External DC supply with an Internal Battery Pack
	Power Consumption with Most Demanding **Q**Modules	120 W
	Power Consumption with Most Demanding **Q**Modules and Dynamic Charge On	160 W

[38] According to MIL-STD-810G Method 516.6, Procedure I. 1 g = 9.8 m/s^2
[39] According to MIL-STD-810G Method 514.6, Procedure I. 1 g = 9.8 m/s^2
[40] These values are an indication of the power consumption for typical chassis configurations and are not intended as an explicit specification for the external power supply.

13.4.2. Dimensions



GENERAL SIZES AND MOUNTING DETAIL - MF06 (M382)

13.5. DECA**Q 10-slot**

13.5.1. Mechanical Specifications Overview

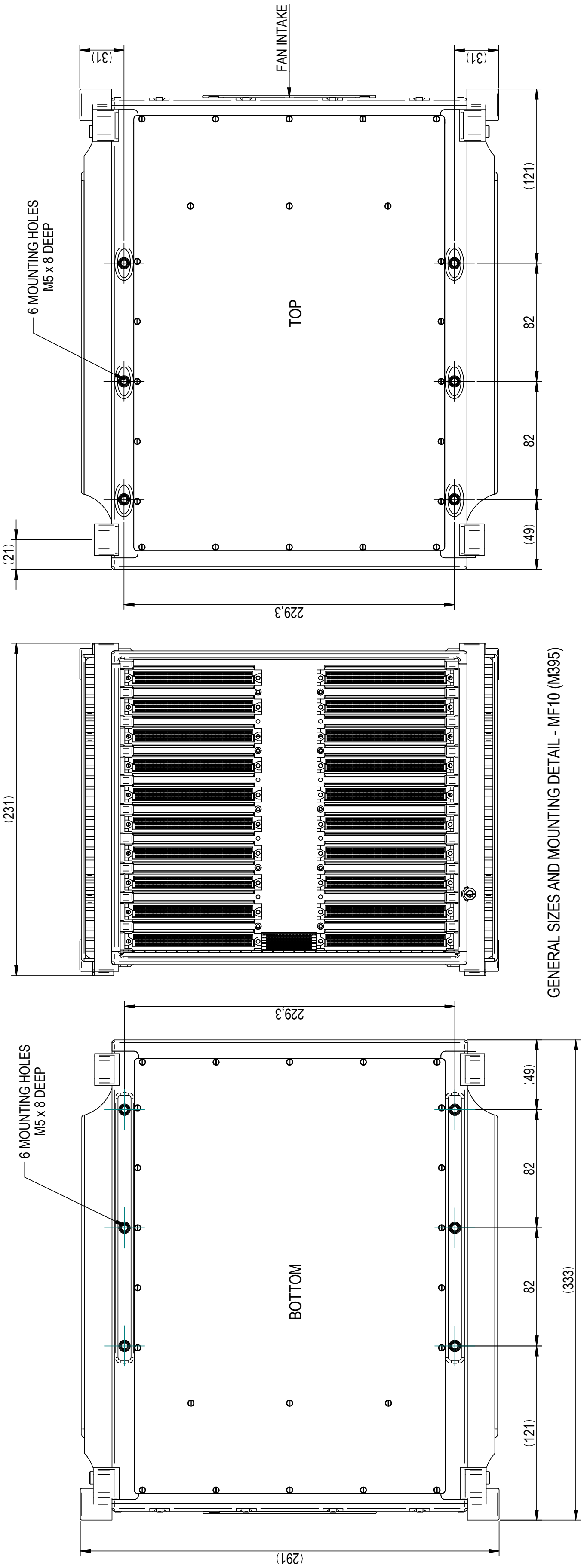
DECA**Q** 10-slot chassis	Slot 1	**PQ System Board** Combined System Controller and Power Supply
	Slot 2 - 9	**SC Signal Conditioning Board:** Data Acquisition
	Slot 10	**SL SyncLink Board** Synchronization Option **[Option for all chassis sizes]**
	Number of Channels (if 6 Channels per **Q**Module)	192[41] Channels
	Fan	Yes[42]
	External Surface Cooling System	Forced Convection
	Internal Board's Cooling System	Conduction
	Dimensions (W H D)	291 x 231 x 333 mm 11.46 x 9.09 x 13.11 "
	Volume	22.3 L 5.89 gal
	Mass Fully Populated with Battery	22.7 kg 50.04 lb
	Mass Fully Populated without Battery	20.2 kg 44.53 lb

[41] Measured with an ICS42 **Q**Module, ICP®/IEPE sensors and an external DC power supply of 12 - 30 V
[42] For optimal cooling, see Chassis Handling below

DECA**Q** 10-slot chassis	Battery Type	NiMh
	Number of Battery Cells	12
	Battery Capacity	72 Wh
	Minimum Ambient Temperature	-20 °C -4 °F
	Maximum Ambient Temperature	55 °C 131 °F
	Humidity (non-condensing)	90% RH
	Shock[43] (11 ms duration)	40 g 1.41 oz
	Random Vibration[44] (10 to 2000 Hz)	0.1 g^2/Hz
	Power Input Source[45]	External DC supply with an Internal Battery Pack
	Power Consumption with Most Demanding **Q**Modules	200 W
	Power Consumption with Most Demanding **Q**Modules and Dynamic Charge On	240 W

[43] According to MIL-STD-810G Method 516.6, Procedure I. 1 g = 9.8 m/s^2
[44] According to MIL-STD-810G Method 514.6, Procedure I. 1 g = 9.8 m/s^2
[45] These values are an indication of the power consumption for typical chassis configurations and are not intended as an explicit specification for the external power supply.

13.5.2. Dimensions



13.6. Chassis Handling

This section contains information about DECA**Q** chassis handling, from chassis fastening points to effective positioning to ensure your chassis does not overheat.

13.6.1. Fastening Points

DECA**Q** chassis contain six threaded female fastening points on both the top and the bottom faces of the chassis enclosures (the bottom face refers to the face closest to slot 1 of the DECA**Q** chassis).

The table below provides a summary of information regarding these fastening points:

Parameter	Value
Hole Size	M5 x 8 mm deep
Spacing between holes running from front to rear (uniform)	82 mm
Spacing between the right and left sets of holes	229.3 mm
Maximum shear / normal force applied to any screw	500 N

Note: The Numbering of VMEbus slots starts at the bottom.

For more information about the chassis bottom and top views/faces, see Views.

13.6.2. Effective Chassis Cooling

13.6.2.1. Handling Guidelines for Effective Cooling

Adhering to the following guidelines is strongly advised to ensure optimal cooling of your system:

- Place the DECA**Q** in an area that has a free flow of cool air.

- Ensure the inlet of the cooling fan is at least 50 mm away from any large obstruction such as a wall. A small obstruction is permitted (a cable, for example) if absolutely necessary, provided the obstructed area covers less than 20% of the fan's opening and is at least 25 mm away from the inlet of the cooling fan(s).

- Let the DECA**Q** chassis stand horizontally to allow optimal airflow through the fins on the left- and right-hand sides of the chassis.

- Do not cover the DECA**Q**'s fins or cooling fans.

- Do not let the DECA**Q** chassis rest on a carpet or any other thermal-insulating material.

- Protect the DECA**Q** chassis from direct sunlight.

- Take note that charging the DECA**Q** Battery induces additional heat – ensure the system is taking all precautions against unnecessarily accumulating heat while this is taking place.

13.6.2.2. Firmware Temperature Protection and Cooling

The DECA**Q**'s firmware includes an over-temperature shutdown procedure to protect the system from overheating. Over-temperature protection in the firmware periodically measures the temperature of each **Q**Module and VMEbus board present in the system to determine the maximum overall temperature (MaxTemp or Max) inside the chassis.

The firmware will execute the following actions, depending on the MaxTemp value:

MaxTemp Value	Action
MaxTemp <83 °C	No action
83 °C < MaxTemp < 85 °C	Fan action: The fan speed will automatically operate at full speed, overriding the user's speed setting. Once the MaxTemp falls below 80 °C the speed will return to the user's speed setting.
85 °C < MaxTemp <86 °C	5-minute countdown. The DECA**Q**'s firmware will begin a 5-minute countdown and thereafter switch off the system if the MaxTemp fails to fall below 85 °C within this time. The User Interface display will provide information concerning the countdown on a continuous basis.
86 °C < MaxTemp	Shutdown. Even if the 5-minute countdown has not yet been completed, the DECA**Q** will switch off immediately. During shutdown the User Interface display will show **SYSOFF** or **OFF** for a few seconds before shutting down completely.

Please note
TMP? **TMP?** in the display only shows the temperature of the System board. This temperature is typically between 2 °C and 10 °C lower than MaxTemp (or Max), depending on the system's configuration. **Dynamic Speed (Fan)** The Dynamic Speed option on the System board continuously evaluates the system's temperature in relation to a reference value and adjusts the fan's speed accordingly. If the system's temperature is 3 °C higher than the reference value, it will set the fan to full speed; if it is 3 °C lower than the reference value, the fan will stop. For temperatures between these two extremes the fan will adjust its speed according to how much higher / lower the system's temperature is in relation to the reference value. The user can determine the reference value by selecting either "Lower Temperature" (reference value 55 °C), or "Lower Speed" (reference value 65 °C).

13.6.2.3. Ensuring Efficient Heat Transfer

Efficient heat transfer from each **Q**Module / VMEbus board into the chassis is extremely important to maintain the system's optimal functionality.

In order to do that, the user should ensure:

- All VMEbus board expanders are fastened properly.
- All **Q**Module screws are fastened properly.

This is particularly important if any **Q**Modules or VMEbus boards have been recently removed or inserted.

13.6.2.4. Cooling in Measurement Towers

When using RackMounts (to secure 4-, 6- and 10-slot DECA**Q** chassis in measurement towers), do not obstruct the sides and rear of the RackMount as they have been left open to allow air circulating from the bottom of the rack to cool each chassis sufficiently.

14. Synchronization

The DECA**Q** acquires data from its input channels in real-time for subsequent analysis on the data. It offers two methods to synchronize its local clock with an external clock source in order to share a common time base with other systems:

- Precision Time Protocol (PTP) over its Ethernet interface.
- A Global Positioning System (GPS) pulse-per-second (pps) signal from a GPS **Q**Module to train the local clock in each DECA**Q** to compensate for drift.
- Using fiber optics to provide a common clock between the chassis (SyncLink)

Clock Tuning Synchronization

The DECA**Q** uses Clock Tuning Synchronization instead of Common Clock Synchronization.

A control loop uses the GPS pps signal (or PTP timing information) to train the local oscillator in each DECA**Q**. After a few cycles, the control loop will lock. Once locked, synchronization requires the control loop to continuously train the local oscillator with small increments.

Two parameters are extracted from these timing protocols, namely ‘Absolute Time’ and ‘Relative Time’. These parameters allow DECA**Q** systems (and other **QuantusSeries** systems) to be synchronized. The control loop compares ‘Relative Time’ values to corresponding values of the tunable oscillator. Over time, the difference between those values is brought as close to zero as possible.

14.1. Synchronize with PTP

PTP (Precision Time Protocol)

Precision Time Protocol (PTP IEEE 1588-2008) synchronization achieves clock frequency and phase synchronization between multiple DECA**Q**s on the same network. The IEEE 1588-2008 standard ensures high precision, accuracy and robustness, making it perfect for synchronizing measurement systems.

PTP switch on the DECA**Q**

To synchronize DECA**Q**s using PTP, use the Ethernet interface on the front panel of the DECA**Q**. Make sure the Ethernet switch is PTP-aware and an external PTP Master Clock is being used.

The SP20

The SP20 is an Ethernet switch (PTP aware) that can be used in a PTP synchronized network of chassis. A PTP aware Ethernet switch minimizes the variability of the latency of PTP timestamp packets that traverse through the switch.

The SP20, a PTP aware Ethernet Switch

The figure above shows the front panel of the SP20:

- A five port Gigabit Ethernet switch (4 to connect to chassis and 1 to the network)

Starting from the left-hand side of the board:

- The first port is the Gigabit Ethernet Upload port and is marked with a 'U'. This is to attach the SP20 to an existing Gigabit Ethernet network (e.g. the laboratory network) or to a PTP Master Clock source.

- The next four ports are Ethernet ports and are marked with '1…4'. These ports are used to connect chassis #1, #2, #3 and #4 to the SP20

Synchronizing with PTP

PTP synchronization connects all DECA**Q**s to a single network with Ethernet as the communication medium. The PTP Master Clock is identified using the best master algorithm, whereafter all other clocks synchronize directly to the master clock.

Any number of DECA**Q**s can form part of the same system using PTP synchronization. The only criterion is that each DECA**Q** be connected to the same PTP-enabled network via its Ethernet interface. Network congestion and availability of Ethernet connections dictate the number of DECA**Q**s that can form part of a synchronized Cluster.

PTP synchronization is best suited when DECA**Q**s need to be synchronized no more than 100 m apart from each other.

Advantages of PTP synchronization

- There's no need for special cables to transport a common clock.

14.2. Synchronize with GPS

GPS synchronization

In a GPS synchronized system, each DECA**Q** synchronizes using a GPS **Q**Module (either an optional built-in GPS **Q**Module, or an optional tethered SGPS **Q**Module). The **Q**Module provides timing parameters used by the DECA**Q** to train the local clock to compensate for drift. The GPS's set of satellites send the common PPS signal, as well as time and position data, to the DECA**Q**. Once the internal clock has been aligned to the PPS signal, it is continuously monitored and adjusted to maintain lock.

Please note
The process of achieving GPS signal lock and training a local clock to the PPS signal takes some time. Depending on environmental factors, this can take up to two minutes or longer.

Any number of DECA**Q**s can form part of the same synchronized Cluster using GPS synchronization. For DECA**Q**s to form part of the Cluster, they need to be connected to the same network and able to get a good GPS signal (a clear line of sight to the satellites).

Advantages of GPS synchronization

- Chassis do not need to be in close proximity of one another. They only need to be able to connect to the GPS network of satellites
- There's no need for cables or SL21 boards in the system

14.3. Synchronize with SyncLink

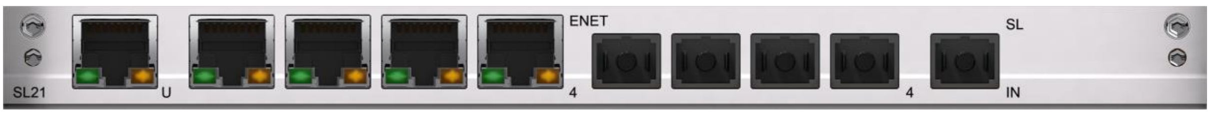
Fiber Optic (SyncLink) Synchronization

In a fiber optic system, one of the chassis is selected to contain a Synchronization Engine which provides the clocks to all the other chassis. This SL21 board contains an accurate clock and four fiber optic outputs. Fiber optic cables are then used to connect the SyncLink outputs with the Combined Controller and Power Supply board in each chassis. More than four chassis can be synchronized by using multiple SL21 boards.

A group of up to four chassis is termed a "cluster". A single SL21 can provide the clock sources and Gigabit Ethernet for this cluster.

SyncLink

SyncLink uses fiber optics to provide the common clock between multiple chassis.



The figure above shows the front panel of the SL21. The SL21 is a combined Gigabit Ethernet hub and fiber optic clock source which can provide the Ethernet and clocks for four chassis:

- A five port Gigabit Ethernet hub (four to connect to chassis and one to the network), and
- A five port SyncLink hub (four clock outputs and one clock output)

Starting from the left-hand side of the board:

- The first port is the Gigabit Ethernet Upload port and is marked with a “U”. This is to attach the SL21 to an existing Gigabit Ethernet network (e.g. the laboratory network)

- The next four ports are Ethernet ports and are marked with “ENET”. These ports are used to connect chassis #1, #2, #3 and #4 to a Gigabit Ethernet network

- The next four ports are SyncLink output ports. These are intended to provide the fiber optic clocks to chassis #1, #2, #3 and #4

- The final port is the “SL IN” port. This is a SyncLink input port and is to attach the SL21 to a larger SyncLink network

It is important to note that although there are five SyncLink ports, only four of them are output ports. The fifth is an input port and cannot be used as a SyncLink clock source. It is intended to be used when more than four chassis need to be connected together.

If there are more than four chassis in a system, then multiple SL21 boards will need to be used.

Note: When using multiple SL21 boards, it is important to keep cable length in mind. The length of fiber optic cable from the initial SL21 board to each chassis should be kept to within 10 m. The table below shows the recommended number of SL21 boards to be used in a SyncLink system.

Chassis	SL21 Boards	Configuration
1-4	1	Main SL21 feeds all chassis
5-8	3	Main SL21 feeds two SL21 boards below
9-12	4	Main SL21 feeds three SL21 boards below
13-16	5	Main SL21 feeds four SL21 boards below

Number of SL21 boards to be used per chassis

Note: The maximum number of chassis that can be connected together using SyncLink is 16.

SyncLink Cables:

003K

The 003K is a standard length Fiber Optic cable used for SyncLink. It connects all power supply and controller boards to a synchronization engine (the SL21). The 003K can also be used to connect an SL21 to nother SL21 in a cluster.

004K

The 004K is a standard length Fiber Optic cable used for SyncLink. It connects all power supply and controller boards to a synchronization engine (the SL21). The 004K can also be used to connect an SL21 to another SL21 in a cluster.

For more information about SyncLink cables, go to “Cables”.

15. Troubleshooting

If you are experiencing any problems with your system, please send a web read to support@quantusseries.com or hello@quantusseries.com and our Product Experts will get back to you as soon as possible.

16. **Q**Accessories

16.1. SubModules

Overview

An overview of SubModules providing enhanced functionality to corresponding **Q**Modules can be found below:

ALOP10	A 32 channel SubModule used with 8 ALO42S Module. Each channel is routed to SMB connectors
ICPM10	A 32 channel SubModule used with 8 ICP42 Modules. Each channel is routed to one of two 50-pin D-sub connectors
ICPM10S	A 32 channel SubModule used with 8 ICP42S Modules. Each channel is routed to one of two 50-pin D-sub connectors
TBNC10	The Tri-BNC10 SubModule is used to split signals from a 9-way LEMO® FGG.0B connector to a single triangular prism with 3 BNC connectors
TBNC30	The Tri-BNC30 SubModule is used to split signals from a 9-way LEMO® FGG.0B connector to 3 single BNC Jack connectors to easily connect sensors
TBNC40	The Tri-BNC40 SubModule is used to split signals from a 9-way LEMO® FGG.0B connector to 3 single BNC Plug connectors to easily connect sensors
TSMB10	The Tri-SMB SubModule is used to split signals from a 9-way LEMO® connector to 3 SMB connectors
ICTV11	A single channel SubModule used with an ICT42 or ICT42S Module. It protects a Tacho channel from high voltages
FLXB20	A SubModule which connects a FLX42 Module to a FlexRay™ network, or a CAN42 Module to a CANbus network

CANC10	A SubModule which connects a CAN 42 or CAN42S Module to a CAN or CAN FD bus network
SMRM10	A panel designed to house SubModules
PSDP10	A multiport power panel used to supply power for up to 12 DECA**Q** Chassis
PSDP20	A multiport power panel used to supply power for up to 12 ALOP10s
THMx10	A single channel SubModule used with a THM42 Module. It is used to connect two thermocouples to a single channel
THMP10	A single channel SubModule used with a THM42 Module. It is used to connect two Pt100 sensors to a single channel
THMS10	A single channel SubModule used with a THM42 Module. It provides 2 sets of 4-way general purpose screw terminals to connect to a pair of E, J, K or T thermocouples or a pair of Pt100 sensors
THMS10/250	The THMS10/250 SubModule is used in conjunction with a THM42 Module. It converts constant current signals between 4 mA and 20 mA to voltages between 1 V and 5 V
QBNC11	A single channel SubModule used with an ALO42S Module. It is used to expand the capacity of the Modules

16.1.1. ALOP10

The ALOP10 is a rack mountable SubModule for routing the analog output signals from up to eight ALO42S Modules to individual male SMB connectors. The four 7-pin LEMO® connectors of one ALO42S Module is connected to a 023K cable, which is in turn plugged into the ALOP10 by means of a 37-pin D-sub connector. The analog output signals are routed to a corresponding section of the ALOP10 front panel. Reprogrammable channel numbering is provided for every eighth channel.

Where used:

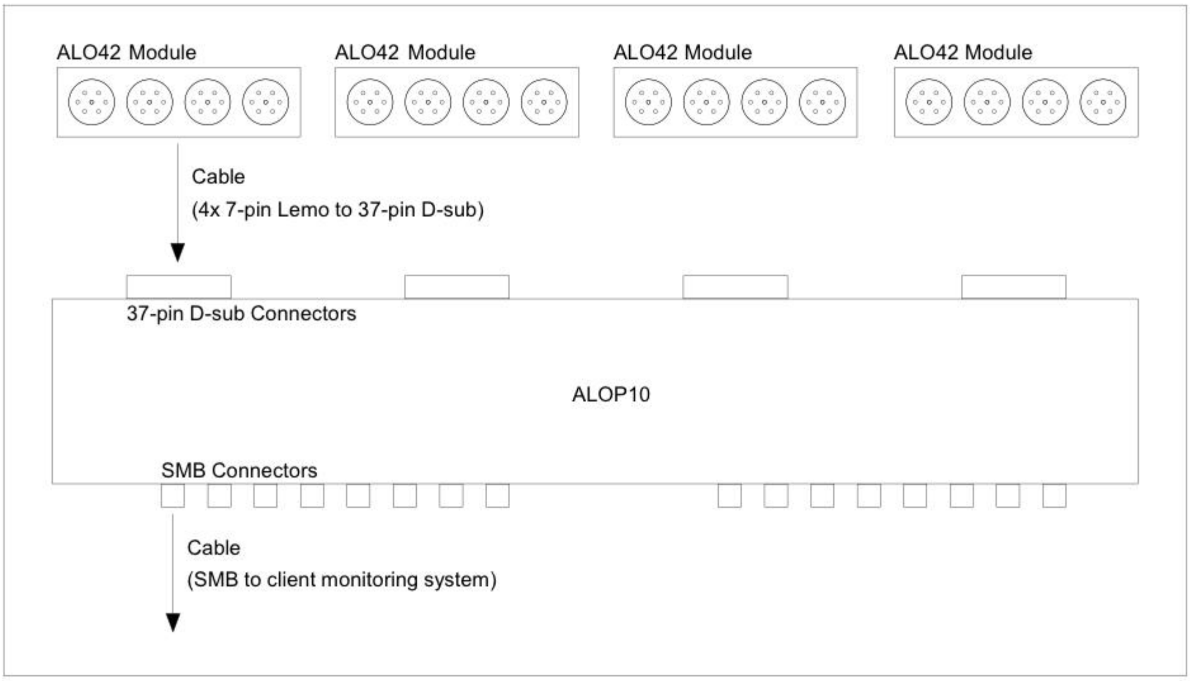
- One ALOP10 can support the outputs of up to eight ALO42S Modules
- Designed according to a 1.5 U form factor for rack-mounting in 19" racks
- Accepts eight 37-pin D-sub connector inputs
- Provides outputs in the form of 32 male SMB connectors

Signal Cable:

023K

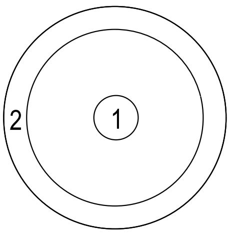
The 023K is a standard length signal cable that connects an ALO42S Module to an ALOP10 SubModule

Connection diagram per channel



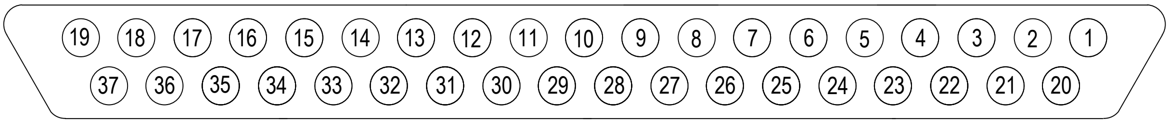
Implementing the ALOP10

Connector Information and Pin Definitions



Pinout of the SMB connector

- Pin 1: Signal+
- Pin 2: Signal-



Pinout of the 37-pin D-sub connectors

- Pin 1: Signal 1+
- Pin 2: Reserved
- Pin 3: Reserved
- Pin 4: Reserved
- Pin 5: Signal 2+
- Pin 6: Reserved
- Pin 7: Reserved
- Pin 8: Reserved
- Pin 9: Reserved
- Pin 10: Reserved
- Pin 11: Reserved
- Pin 12: Signal 3+
- Pin 13: Reserved
- Pin 14: Reserved
- Pin 15: Reserved
- Pin 16: Signal 4+
- Pin 17: Reserved
- Pin 18: Reserved
- Pin 19: Reserved
- Pin 20: Signal 1-
- Pin 21: Reserved
- Pin 22: Reserved
- Pin 23: Reserved
- Pin 24: Signal 2-
- Pin 25: Reserved
- Pin 26: Reserved
- Pin 27: Reserved
- Pin 28: Reserved
- Pin 29: Reserved
- Pin 30: Signal 3-
- Pin 31: Reserved
- Pin 32: Reserved
- Pin 33: Reserved
- Pin 34: Signal 4-
- Pin 35: Reserved
- Pin 36: Reserved
- Pin 37: Reserved

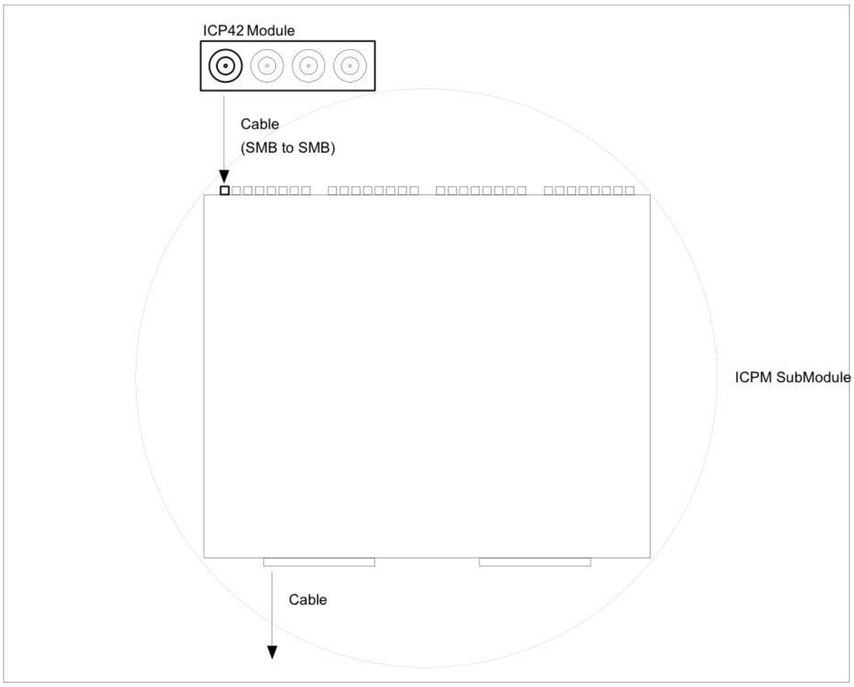
16.1.2. ICPM10 and ICPM10S

The ICPM10 personalizes ICP42 Modules by providing two 50-pin D-sub Connectors. (Similarly, the ICPM10S personalizes ICP42S Modules). As a compound SubModule, it takes the form of a breakout box which is secured on the top of any Chassis. These breakout boxes are stackable with the option to secure two compound Modules on top of each other. The strength of the SubModule concept lies in its flexibility, as the ICPM10 with its 50-pin D-sub Interface may be easily removed if not required for certain tests.

Where used:

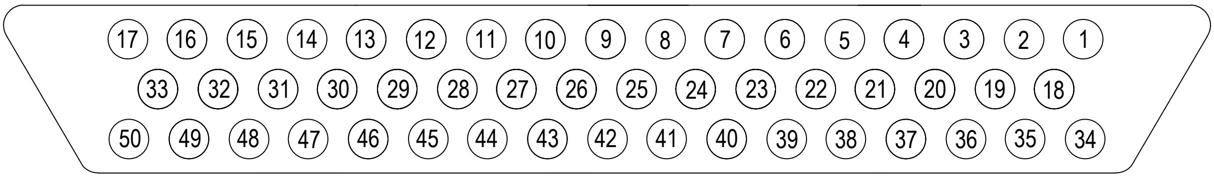
- One ICPM10 can support the outputs of up to 8 ICP42 Modules
- The ICPM10S can support the outputs of up to 8 ICP42S Modules
- Designed in the form of a breakout box which is secured to the top of any Chassis
- Accepts 32 SMB connector inputs
- Provides outputs in the form of two 50-pin D-sub connectors

Connection diagram per channel



Implementing the ICPM SubModule

Connector Information and Pin Definitions



Pinout of each DB50 connector

DB50 1 pin	Description	DB50 2 pin	Description
1	Channel 1+	1	Channel 17+
2	Channel 2-	2	Channel 18-
3	Channel 3+	3	Channel 19+
4	Channel 4-	4	Channel 20-
5	Channel 5+	5	Channel 21+
6	Channel 6-	6	Channel 22-
7	Channel 7+	7	Channel 23+
8	Channel 8-	8	Channel 24-
9	No connect	9	No connect
10	Channel 9 shield	10	Channel 25 shield
11	Channel 10+	11	Channel 26+
12	Channel 11 shield	12	Channel 27 shield
13	Channel 12+	13	Channel 28+
14	Channel 13 shield	14	Channel 29 shield
15	Channel 14+	15	Channel 30+
16	Channel 15 shield	16	Channel 31 shield
17	Channel 16+	17	Channel 32+
18	Channel 1-	18	Channel 17-
19	Channel 2 shield	19	Channel 18 shield
20	Channel 3-	20	Channel 19-
21	Channel 4 shield	21	Channel 20 shield
22	Channel 5-	22	Channel 21-
23	Channel 6 shield	23	Channel 22 shield
24	Channel 7-	24	Channel 23-
25	Channel 8 shield	25	Channel 24 shield

Pinouts (1 to 25) of the ICPM SubModule

DB50 1 pin	Description	DB50 2 pin	Description
26	Channel 9+	26	Channel 25+
27	Channel 10-	27	Channel 26-
28	Channel 11+	28	Channel 27+
29	Channel 12-	29	Channel 28-
30	Channel 13+	30	Channel 29+
31	Channel 14-	31	Channel 30-
32	Channel 15+	32	Channel 31+
33	Channel 16-	33	Channel 32-
34	Channel 1 shield	34	Channel 17 shield
35	Channel 2+	35	Channel 18+
36	Channel 3 shield	36	Channel 19 shield
37	Channel 4+	37	Channel 20+
38	Channel 5 shield	38	Channel 21 shield
39	Channel 6+	39	Channel 22+
40	Channel 7 shield	40	Channel 23 shield
41	Channel 8+	41	Channel 24+
42	No connect	42	No connect
43	Channel 9-	43	Channel 25-
44	Channel 10 shield	44	Channel 26 shield
45	Channel 11-	45	Channel 27-
46	Channel 12 shield	46	Channel 28 shield
47	Channel 13-	47	Channel 29-
48	Channel 14 shield	48	Channel 30 shield
49	Channel 15-	49	Channel 31-
50	Channel 16 shield	50	Channel 32 shield

Pinouts (26 to 50s) of the ICPM SubModule

16.1.3. TBNC10

The TBNC10 is used to connect to the ICS42 Module. It splits signals, from a 9-way LEMO® connector on the Module's front panel, to a single triangular prism with 3 BNC connectors to easily connect sensors. Three BNC connectors are provided on the SubModule to interface to the appropriate triaxial or single axis accelerometer. The SubModule connects to the ICS42 Module through a 300 mm, 500 mm or 1200 mm fly-lead.

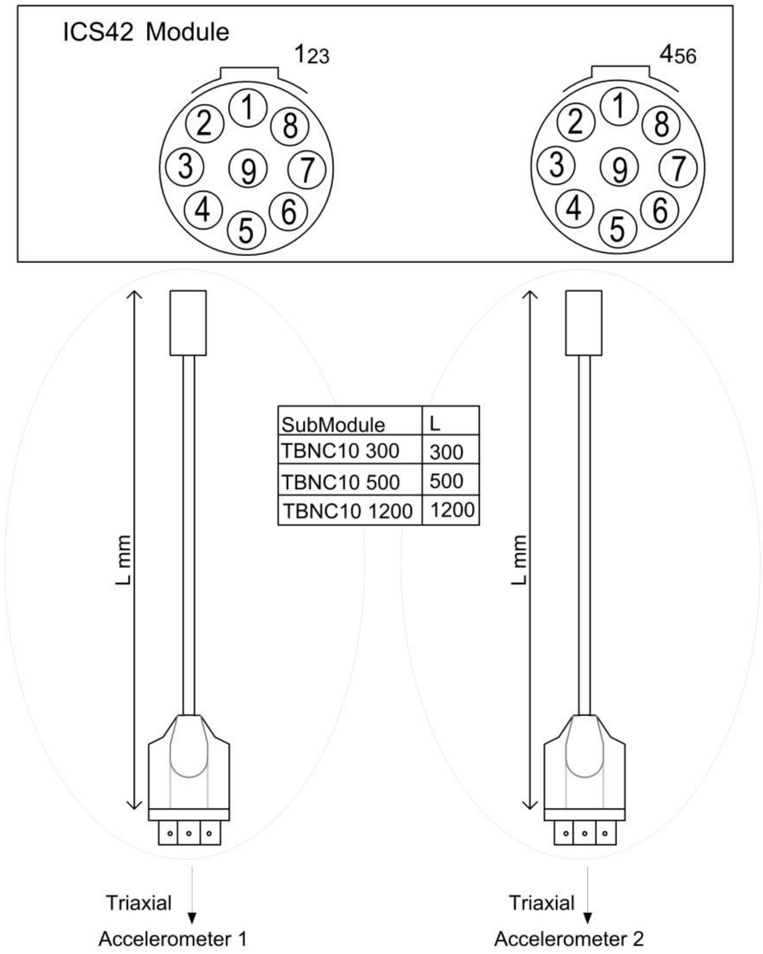
TBNC10 options:

TBNC10 300	The BNC Jack connectors connect to the ICS42 Module with a total cable length of 300 mm
TBNC10 500	The BNC Jack connectors connect to the ICS42 Module with a total cable length of 500 mm
TBNC10 1200	The BNC Jack connectors connect to the ICS42 Module with a total cable length of 1200 mm

Where used:

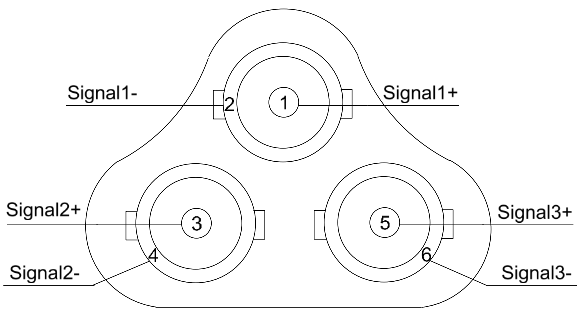
- With any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure
- With any voltage source up to ±10 V in voltage input mode

Connection diagram per channel



Implementing the TBNC10 300 / TBNC10 500 / TBNC10 1200

Connector Information and Pin Definitions



TBNC10 Pinout

Pin Number of TBNC10	Signal name	Channel on ICS42		Triaxial Accelerometer pin
		Left LEMO®	Right LEMO®	
1	Signal 1+	Channel 1+	Channel 4+	X+
2	Signal 1-	Channel 1-	Channel 4-	GNDx
3	Signal 2+	Channel 2+	Channel 5+	Y+
4	Signal 2-	Channel 2-	Channel 5-	GNDy
5	Signal 3+	Channel 3+	Channel 6+	Z+
6	Signal 3-	Channel 3-	Channel 6-	GNDz

Pin descriptions of TBNC10, ICS42 and triaxial accelerometer

16.1.4. TBNC30

The TBNC30 is used to connect to the ICS42 Module. The Tri-BNC30 SubModule splits signals from a 9-way LEMO® FGG.0B, connecting on the Module's front panel, to 3 single BNC Jack connectors to easily connect sensors. Three BNC Jack connectors are crimped on cables to provide a flexible interface to the appropriate triaxial or single axis accelerometer. The SubModule connects to the ICS42 Module through a 500 mm or 1200 mm fly-lead.

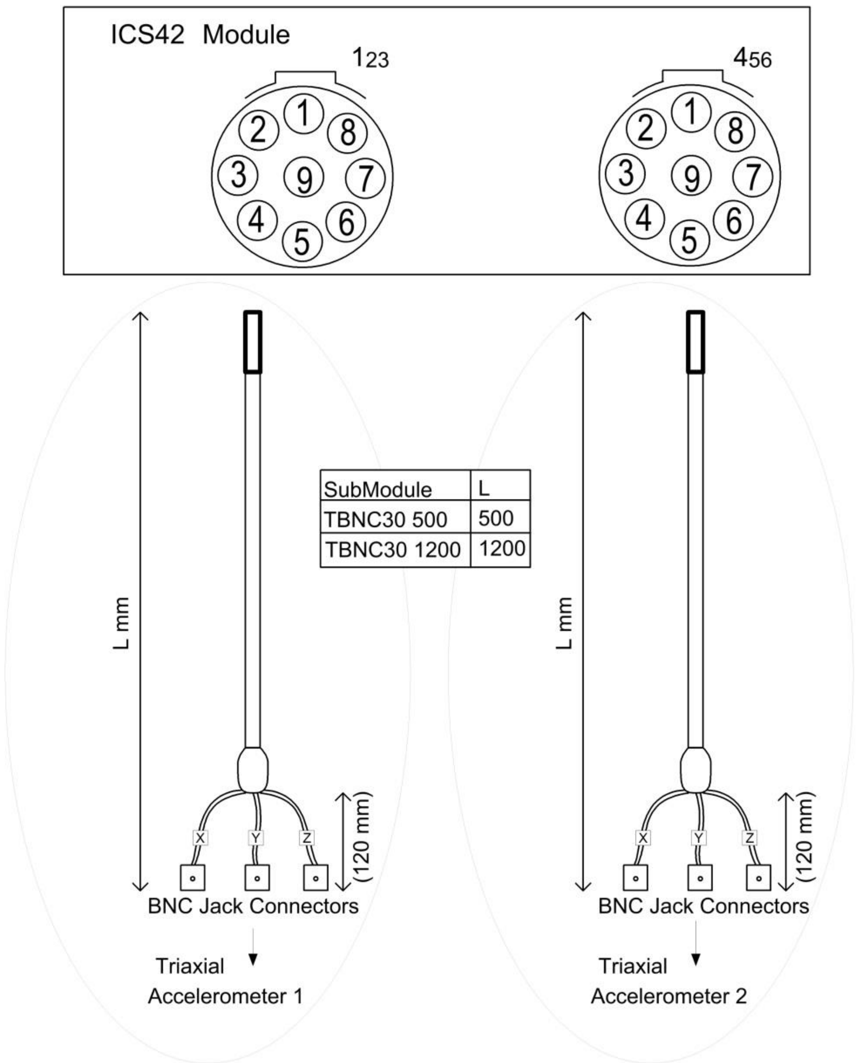
TBNC30 options:

TBNC30 500	The BNC Jack connectors connect to the ICS42 Module with a total cable length of 500 mm
TBNC30 1200	The BNC Jack connectors connect to the ICS42 Module with a total cable length of 1200 mm

Where used:

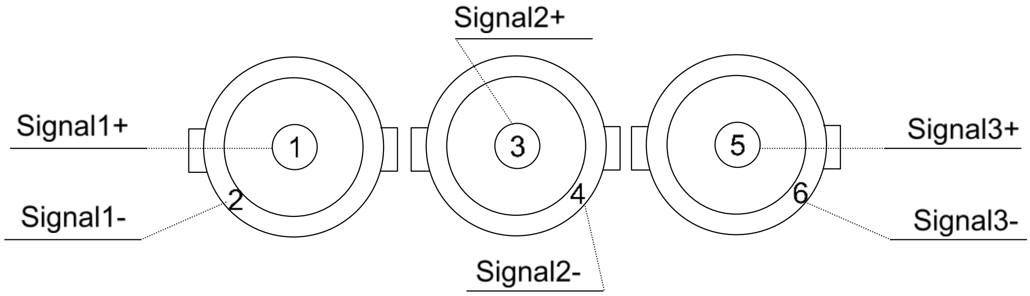
- With any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure
- With any voltage source up to ±10 V in voltage input mode

Connection diagram per channel



Implementing the TBNC30 500, TBNC 30 1200

Connector Information and Pin Definitions



Pinout diagram of TBNC30 BNC Jack Connectors

Pin Number of TBNC30	Signal name	Channel on ICS42		Triaxial Accelerometer pin
		Left LEMO®	Right LEMO®	
1	Signal 1+	Channel 1+	Channel 4+	X+
2	Signal 1-	Channel 1-	Channel 4-	GNDx
3	Signal 2+	Channel 2+	Channel 5+	Y+
4	Signal 2-	Channel 2-	Channel 5-	GNDy
5	Signal 3+	Channel 3+	Channel 6+	Z+
6	Signal 3-	Channel 3-	Channel 6-	GNDz

Pin descriptions of TBNC30, ICS42 and triaxial accelerometer

16.1.5. TNBC40

The TBNC40 is used to connect to the ICS42 Module. The Tri-BNC40 SubModule splits signals from a 9-way LEMO® FGG.0B, connecting on the Module's front panel, to 3 single BNC Plug connectors to easily connect sensors. Three single BNC Plug connectors are crimped on cables to provide a flexible interface to the appropriate triaxial or single axis accelerometer. There are two lengths options available:

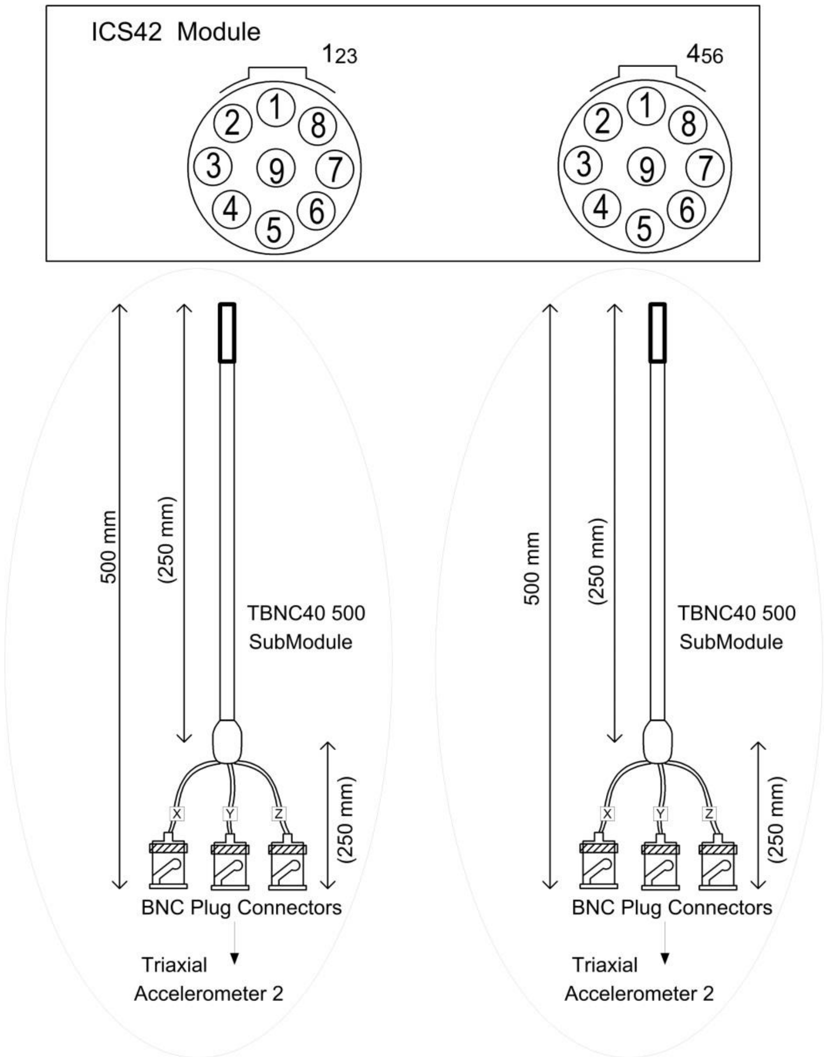
TBNC40 options:

TBNC40 500	The BNC Plug connectors connect to the ICS42 Module with a total cable length of 500 mm
TBNC40 1200	The BNC Plug connectors connect to the ICS42 Module with a total cable length of 1200 mm

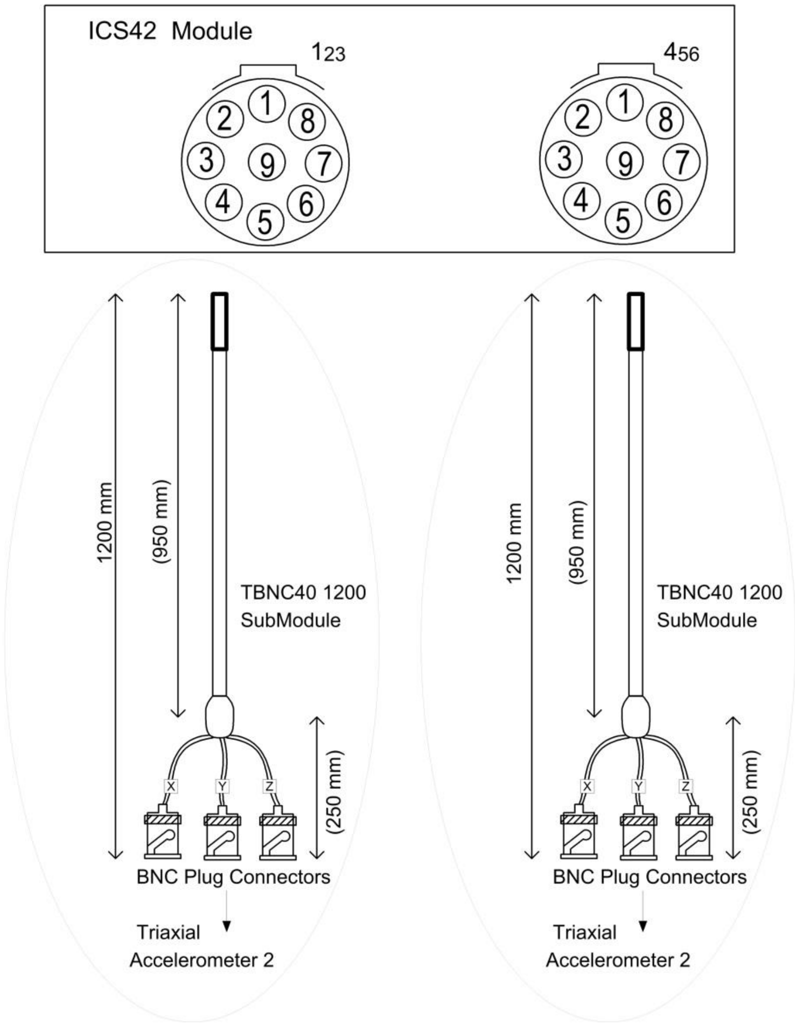
Where used:

- 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

Connection diagram per channel

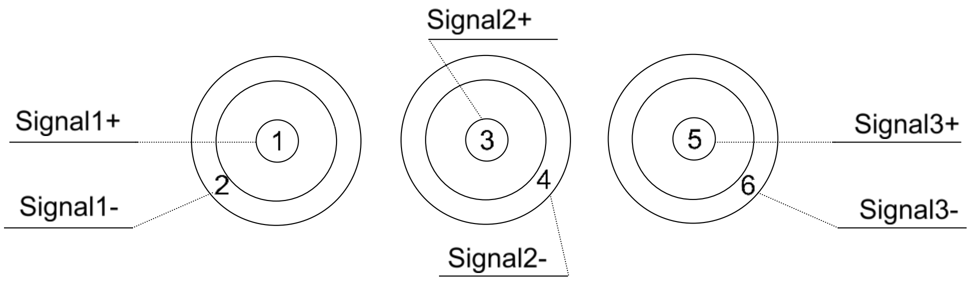


Implementing the TBNC40 500



Implementing the TBNC40 1200

Connector Information and Pin Definitions



Pinout diagram of TBNC40 BNC Plug Connectors

Pin Number of TBNC40	Signal name	Channel on ICS42		Triaxial Accelerometer pin
		Left LEMO®	Right LEMO®	
1	Signal 1+	Channel 1+	Channel 4+	X+
2	Signal 1-	Channel 1-	Channel 4-	GNDx
3	Signal 2+	Channel 2+	Channel 5+	Y+
4	Signal 2-	Channel 2-	Channel 5-	GNDy
5	Signal 3+	Channel 3+	Channel 6+	Z+
6	Signal 3-	Channel 3-	Channel 6-	GNDz

Pin descriptions of TBNC40, ICS42 and triaxial accelerometer

16.1.6. TSMB10

The TSMB10 is used to connect to the ICS42 Module. The Tri-SMB10 SubModule splits signals, from a 9-way LEMO® connector on the Module's front panel, to 3 SMB connectors to easily connect sensors. Three SMB connectors are provided on the SubModule to interface to the appropriate triaxial or single axis accelerometer. The SubModule connects to the ICS42 Module through a 500 mm or 1200 mm fly-lead.

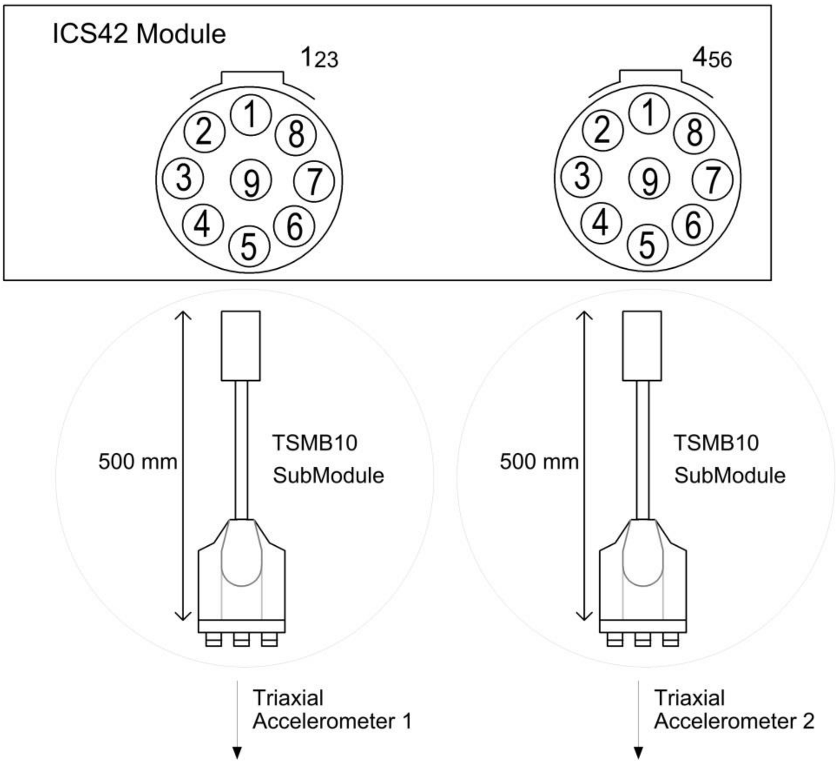
TSMB10 options:

TSMB10 500	The SMB connectors connect to the ICS42 Module with a total cable length of 500 mm
TSMB10 1200	The SMB connectors connect to the ICS42 Module with a total cable length of 1200 mm

Where used:

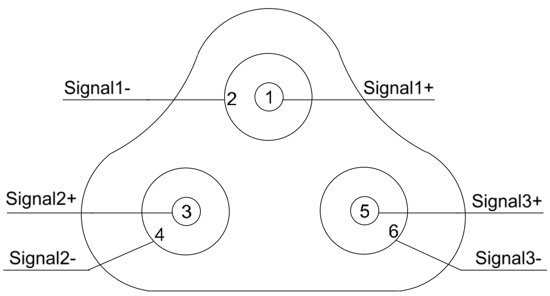
- With any ICP® based sensor commonly used to measure vibration, acceleration, force or pressure
- With any voltage source up to ±10 V in voltage input mode

Connection diagram per channel



Implementing the TSMB10

Connector Information and Pin Definitions



TSMB10 Pinout

Pin Number of TSMB10	Signal name	Channel on ICS42		Triaxial Accelerometer pin
		Left LEMO®	Right LEMO®	
1	Signal 1+	Channel 1+	Channel 4+	X+
2	Signal 1-	Channel 1-	Channel 4-	GNDx
3	Signal 2+	Channel 2+	Channel 5+	Y+
4	Signal 2-	Channel 2-	Channel 5-	GNDy
5	Signal 3+	Channel 3+	Channel 6+	Z+
6	Signal 3-	Channel 3-	Channel 6-	GNDz

Pin descriptions of TSMB10, ICS42 and triaxial accelerometer

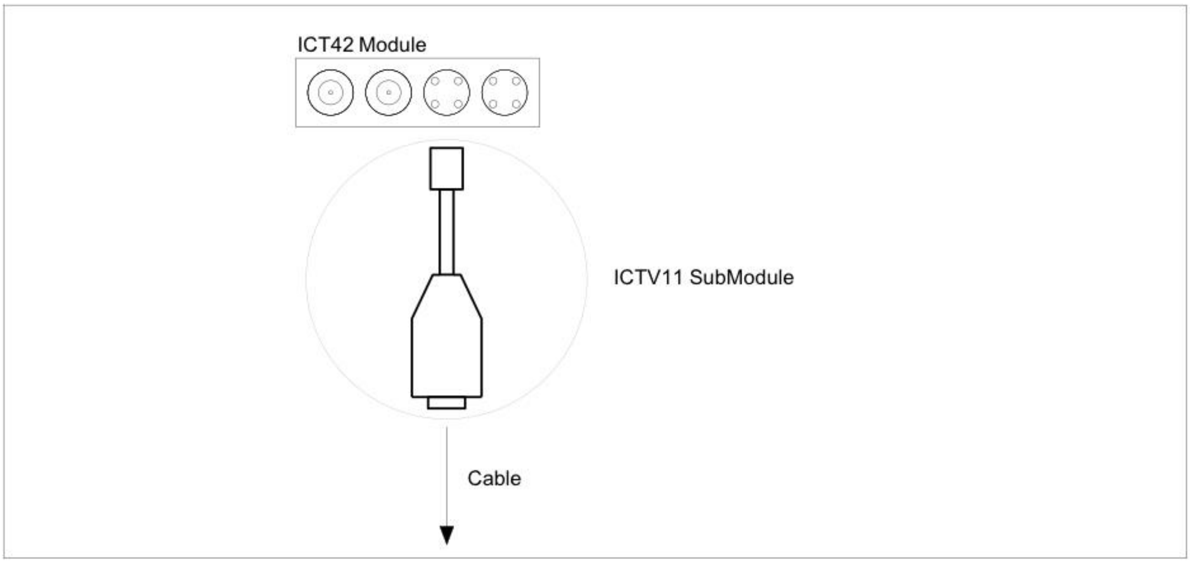
16.1.7. ICTV11

The ICTV11 is used to protect the ICT42 or ICT42S Module's Tacho inputs from excessively high voltages. These may occur when inductive devices are discharged or when measuring close to high voltage circuitry. The SubModule contains high energy over-voltage dissipation devices. These devices limit the output voltage to reasonable values which will not destroy the internal circuitry of the ICT42 and ICT42S Modules. A BNC connector is provided on the SubModule to interface to the appropriate Tacho sensor. The SubModule connects to the ICT42 and ICT42S Module through a 300 mm fly-lead ending with a 4-pin LEMO® FGG.0B connector.

Where used:

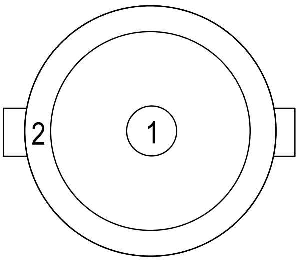
- Supports one Tacho channel on an ICT42 and ICT42S Module
- Designed as a SubModule used to protect a Tacho channel from excessively high voltages
- Accepts one 4-pin LEMO® FGG 0B connector
- Provides a BNC connector to interface to the appropriate Tacho sensor

Connection diagram per channel



Implementing the ICTV11

Connector Information and Pin Definitions



ICTV11 Pinout

- Pin 1: Signal +
- Pin 2: Signal -

16.1.8. FLXB20

The FLXB20 SubModule provides an interface to a 9-pin D-sub connection. The FLXB20 SubModule is used to connect a FLX42 Module to a FlexRay™ network. It provides the interface between the 7-pin LEMO® connector on the FLX42 Module and the 9-pin D-sub connector on the FlexRay™ network.

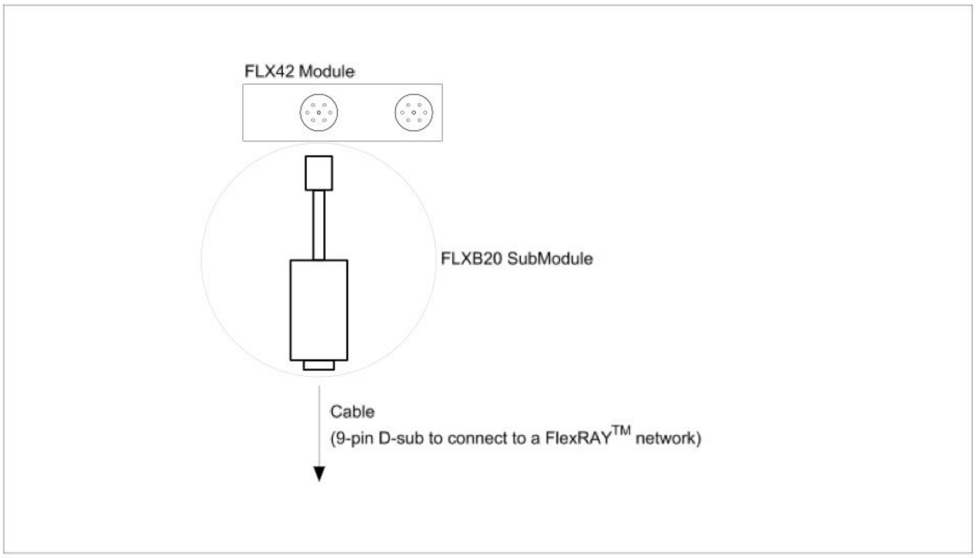
Where used (FlexRay™):

- One FLXB20 SubModule can connect a FLX42 Module to a FlexRay™ network (3000 mm cable length)
- Designed as a SubModule used to connect one channel of a FLX42 Module to a FlexRay™ network
- Accepts a single 7-pin LEMO® FGG 0B connector
- The FLXB20 provides the interface to the 9-pin D-sub connector on the FlexRay™ network over a 3000 mm cable

The FLXB20 SubModule can also be used to connect a CAN42 Module to a CANbus network. Here it provides the interface between the 7-pin LEMO® connector on the CAN42 Module and the 9-pin D-sub connector on the CANbus network. Where Used (CANbus):

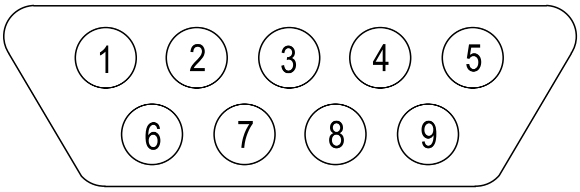
- Connects a CAN42 Module to a CANbus network (over a 300 mm or 3000 mm cable)
- Accepts a single 7-pin LEMO® FGG 0B connector
- Provides the interface to the 9-pin D-sub connector on the CANbus network over a 3000 mm cable

Connection diagram per channel



Implementing the FLXB20

Connector Information and Pin Definitions



Pinout of the 9-pin D-sub connector

- Pin 1: Not connected
- Pin 2: FLX Bus Minus
- Pin 3: FLX Ground (network ground or common ground)
- Pin 4: Not connected
- Pin 5: Chassis ground (cable shield) – not used
- Pin 6: Optional FLX Ground – not used
- Pin 7: FLX Bus Plus
- Pin 8: Not connected
- Pin 9: VBAT – not used

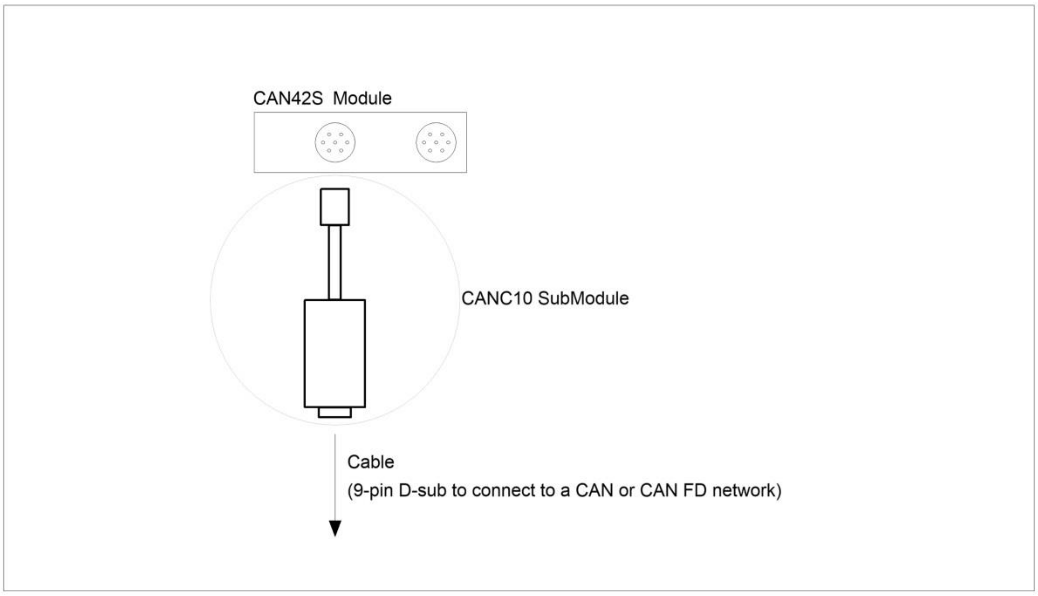
16.1.9. CANC10

The CANC10 SubModule provides an interface to a 9-pin D-sub connection. The CANC10 SubModule is used to connect a CAN42S Module to a CANbus network. It provides the interface between the 7-pin LEMO® connector on the CAN42S Module and the 9-pin D-sub connector on the CANbus network.

Where used (CANbus):

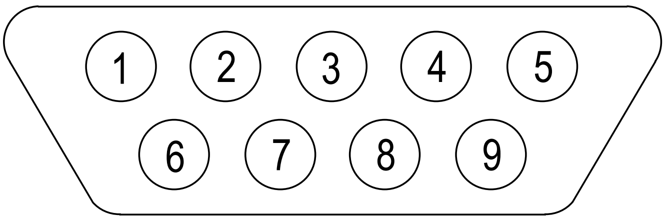
- Connects a CAN42S Module to a CANbus network (300 mm or 3000 mm cable length)
- Accepts a single 7-pin LEMO® FGG 0B connector
- Provides the interface to the 9-pin D-sub connector on the CANbus network over a 3000 mm cable

Connection diagram per channel



Implementing the CANC10

Connector Information and Pin Definitions



Pinout of the 9-pin D-sub connector

- Pin 1: Not connected
- Pin 2: CAN Low
- Pin 3: CAN ground
- Pin 4: Not connected
- Pin 5: Not connected
- Pin 6: Not connected
- Pin 7: CAN High
- Pin 8: Not connected
- Pin 9: Not connected

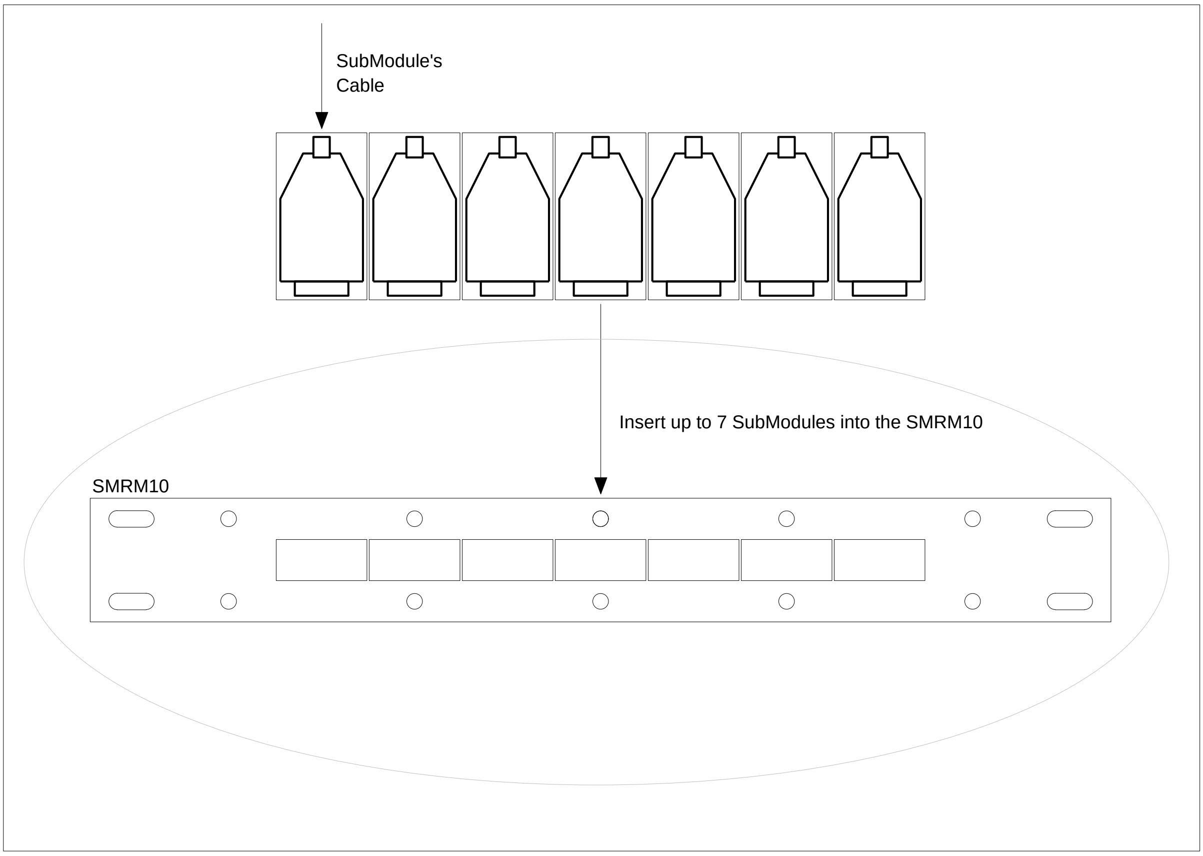
16.1.10. SMRM10

The SMRM10 is a panel designed to house SubModules. It can be used to house any of the various SubModules as all SubModules have the same height. The SMRM10 has been designed to be mounted in a 19-inch rack.

Where used:

- Provides the housing for up to 7 SubModules
- Designed according to a 1.5 U form factor for rack-mounting in 19-inch racks
- Accepts any SubModule type
- Enables a convenient and neat location for where to place SubModules connected to a DECA**Q** Chassis

Connection diagram per channel



Implementing the SMRM10 into a 19" rack

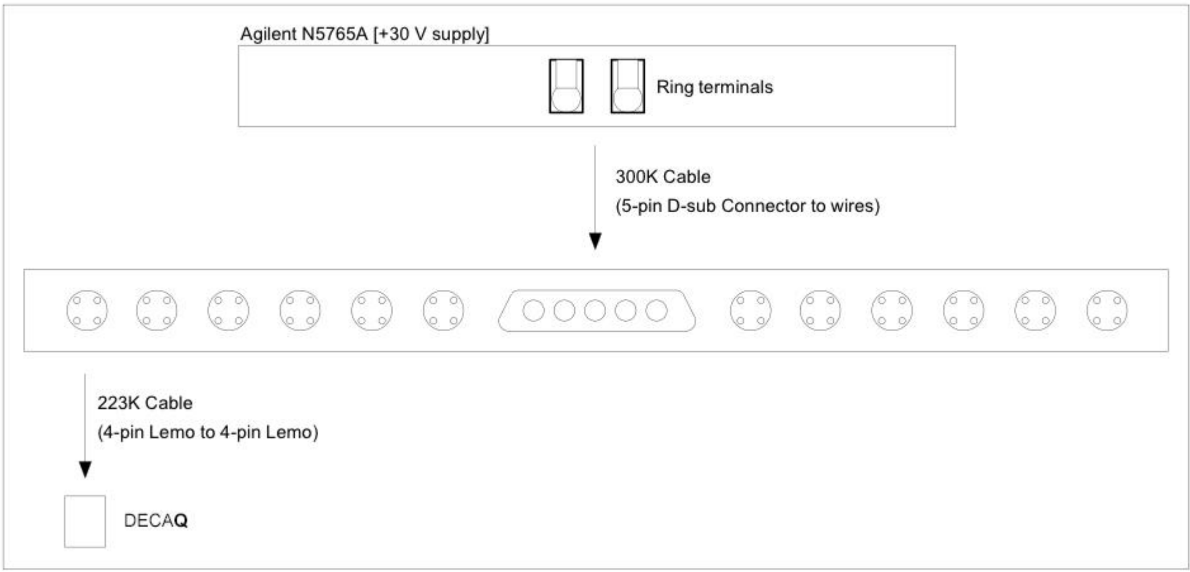
16.1.11. PSDP10

The PSDP10 is a multiport power distribution panel for powering multiple DECA**Q** Chassis. The panel (which is designed to be mounted in a 19-inch rack) is supplied power through a 5-pin high power D-subminiature port and provides power to 12 recipient DECA**Q** Chassis through 4-pin LEMO® connectors.

Where used:

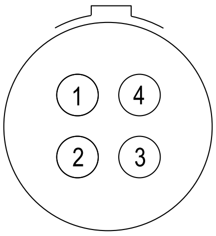
- Supplies the power for up to 12 DECA**Q** Chassis
- Designed according to a 1.5 U form factor for rack-mounting in 19" racks
- Accepts power through a 5-pin high power D-subminiature port
- Provides twelve 4-pin LEMO® connectors

Connection diagram per channel



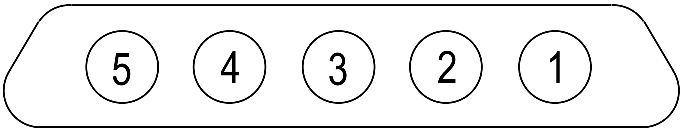
Implementing the PSDP10

Connector Information and Pin Definitions



Pinout of the 4-pin LEMO®

- Pin 1: +ve
- Pin 2: -ve
- Pin 3: -ve
- Pin 4: +ve



Pinout of the 5-pin D-sub power connector

- Pin 1: +ve
- Pin 2: +ve
- Pin 3: Not connected
- Pin 4: -ve
- Pin 5: -ve

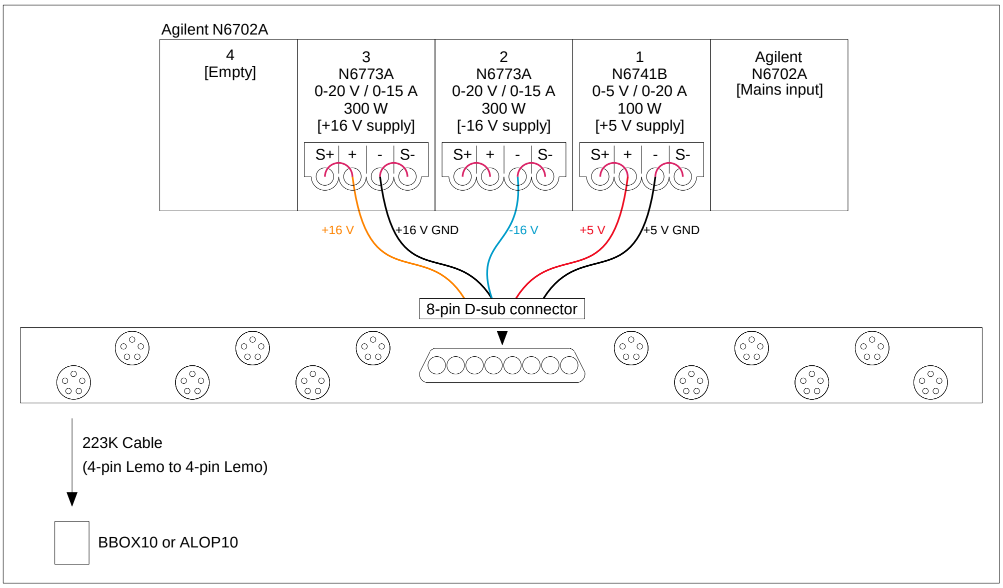
16.1.12. PSDP20

Similarly, the PSDP20 is a multiport power distribution panel for powering multiple ALOP10s. The panel is supplied power through an 8-pin high power D-subminiature port and provides power to the recipient boards through 5-pin LEMO® connectors.

Where used:

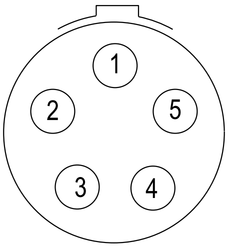
- Supplies the power for up to 12 ALOP10s
- Designed according to a 1.5 U form factor for rack-mounting in 19" racks
- Accepts power through an 8-pin high power D-subminiature port
- Provides twelve 5-pin LEMO® connectors

Connection diagram per channel



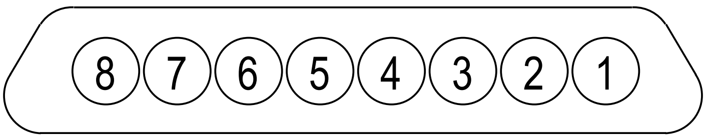
Implementing the PSDP20

Connector Information and Pin Definitions



Pinout of the 5-pin LEMO®

- Pin 1: +16 V
- Pin 2: +5 V
- Pin 3: +5 V GND
- Pin 4: -16 V
- Pin 5: ±16 V GND



Pinout of the 8-pin D-sub power connector

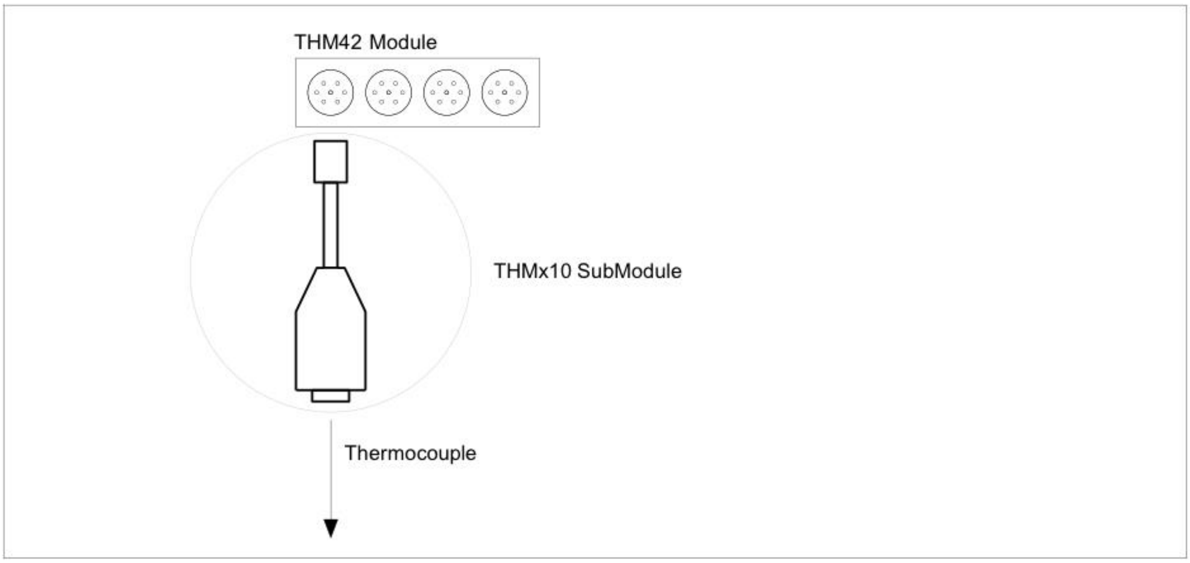
- Pin 1: +5 V
- Pin 2: +5 V GND
- Pin 3: No connect
- Pin 4: No connect
- Pin 5: No connect
- Pin 6: -16 V
- Pin 7: ±16 V GND
- Pin 8: +16 V

16.1.13. THMx10

Seven thermocouple-based SubModules exist, each containing dedicated thermocouple connectors. Each SubModule contains a pair of miniature thermocouple connectors, of the appropriate alloy and color, according to either IEC or ANSI standards. Cold-junction-compensation is facilitated through the use of a 0.5 °C accurate temperature sensor in thermal contact with the connectors' contacts. The SubModule type is identified through a TEDS interface.

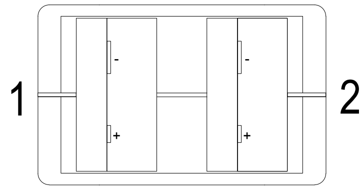
Each SubModule connects to the THM42 Module through a 300 mm fly-lead ending with a 7-way LEMO® FGG 0B connector.

Connection diagram per channel



Implementing the THMx10

Connector Information and Pin Definitions



Pinout for the THMx10 SubModules

Miniature thermocouple connector 1 (and similarly thermocouple connector 2):

- Pin +: Thermocouple +
- Pin -: Thermocouple –

These 7 SubModules can be listed as follows:	
	The THME10 SubModule contains Chromel/Constantan (NiCr/CuNi) alloys and has lilac connectors (IEC 584-3 and ANSI MC 96.1)
	The THMJ10 SubModule contains Iron/ Constantan (Fe/CuNi) alloys and has black connectors (both IEC 584-3 and ANSI MC 96.1)
	The THMK10 SubModule contains Chromel/Alumel (NiCr/NiAl) alloys and has green connectors (IEC 584-3)
	The THMK10 SubModule contains Chromel/Alumel (NiCr/NiAl) alloys and has yellow connectors (ANSI MC 96.1)
	The THMT10 SubModule contains Copper/Constantan (Cu/CuNi) alloys and has blue connectors (ANSI MC 96.1)
	The THMT10 SubModule contains Copper/Constantan (Cu/CuNi) alloys and has brown connectors (IEC 584-3)
	The THMU10 SubModule contains Copper/Copper (Cu/Cu) alloys and has white connectors

Seven thermocouple-based SubModules

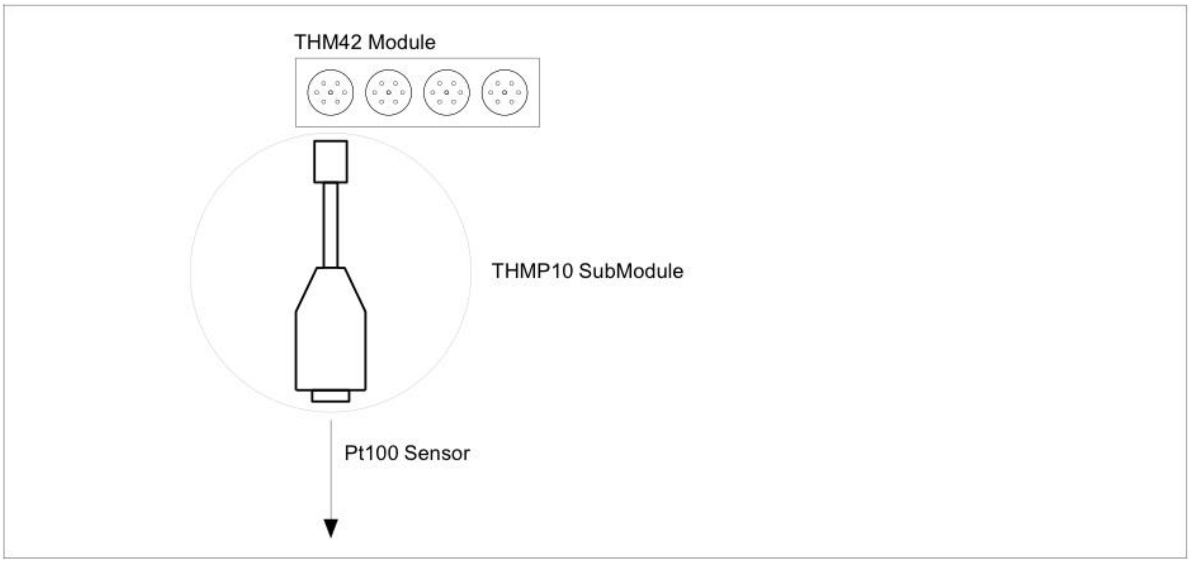
16.1.14. THMP10

The THMP10 SubModule is used in conjunction with a THM42 Module to provide 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. The SubModule type is identified through a TEDS interface. The THMP10 SubModule connects to the THM42 Module through a 300 mm fly-lead ending with a 7-way LEMO® FGG 0B connector.

Where used:

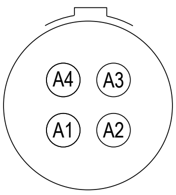
- Supports one channel on a THM42 Module by linking the channel to two sensors
- Designed as a SubModule used to expand the capacity of the THM42 Module
- Accepts one 7-pin LEMO® FGG 0B connector
- Provides two sets of 4-pin LEMO® EGG 0B connectors for use with Pt100 sensors

Connection diagram per channel



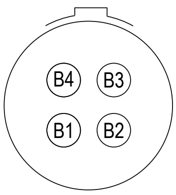
Implementing the THMP10

Connector Information and Pin Definitions



Pinouts for the first 4-pin LEMO®

- Pin A1: Positive current lead of first Pt100
- Pin A2: Positive signal lead of first Pt100
- Pin A3: Negative signal lead of first Pt100
- Pin A4: Negative current lead of first Pt100



Pinouts for the second 4-pin LEMO®

- Pin B1: Positive current lead of second Pt100
- Pin B2: Positive signal lead of second Pt100
- Pin B3: Negative signal lead of second Pt100
- Pin B4: Negative current lead of second Pt100

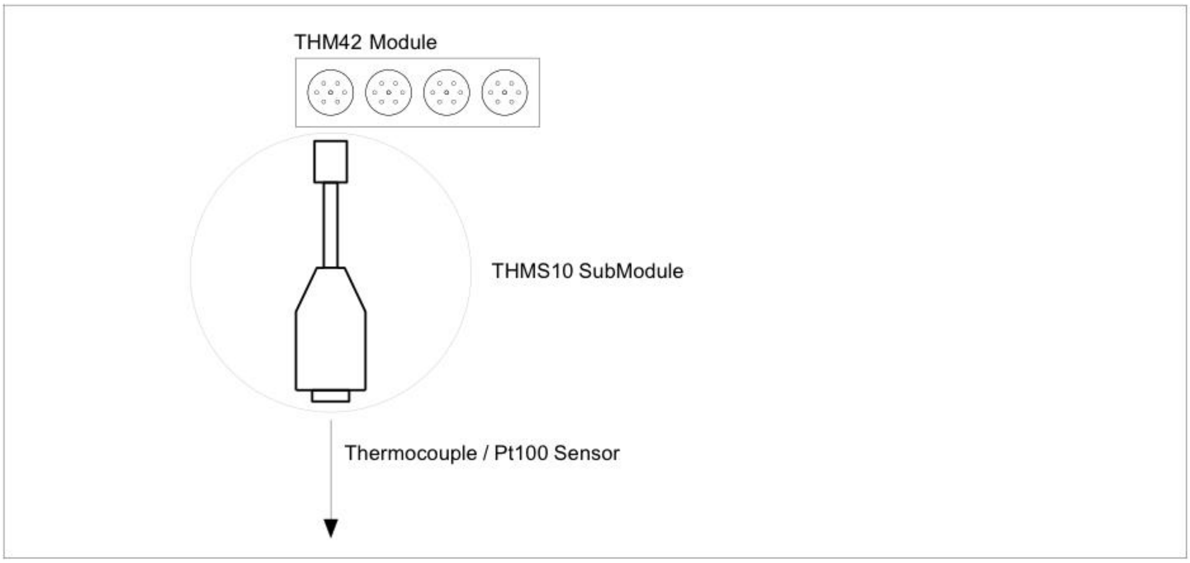
16.1.15. THMS10

The THMS10 SubModule is used in conjunction with a THM42 Module to provide 2 sets of 4-way general purpose screw terminals to connect to a pair of E, J, K or T thermocouples or a pair of Pt100 sensors. Cold-junction-compensation is facilitated through the use of a 0.5 °C accurate temperature sensor in thermal contact with the connectors' contacts. Constant current is provided for Pt100 use. The SubModule type is identified through a TEDS interface. The THMS10 SubModule connects to the or THM42 Module through a 300 mm fly-lead ending with a 7-way LEMO® FGG 0B connector.

Where used:

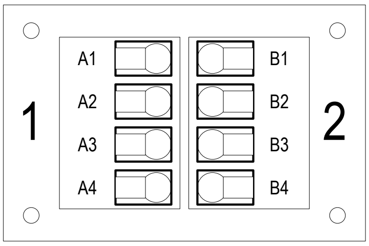
- Supports two channels on a THM42 Module by linking the channel to two sensors
- Designed as a SubModule used to expand the capacity of the THM42 Module
- Accepts one 7-pin LEMO® FGG 0B connector
- Provides two sets of 4-pin general purpose screw terminals to connect to Pt100 or Thermocouple sensors

Connection diagram per channel



Implementing the THMS10

Connector Information and Pin Definitions



THMS10 front panel and screw terminal input connectors

NOTE: The use of 2-wire and 3-wire Pt100 sensors is not recommended due to an increase in measurement errors brought about by the lead resistance.

The table below provides a summary of the connection procedures for thermocouples and Pt100 sensors when 2 sensors are being connected to the THMS10.

Pin Number	Function	Sensor Type			
		Thermocouple	**Pt100 (4-wire)**	**Pt100 (3-wire)**	**Pt100 (2-wire)**
A1	Excitation0+	NC [46]	Positive current lead of first Pt100	Positive current lead of first Pt100	Jumper between pins A1 and A2 [47]
A2	Signal0+	Positive lead of first thermocouple	Positive signal lead of first Pt100	Positive signal lead of first Pt100	Positive signal lead of first Pt100
A3	Signal0-	Negative lead of first thermocouple	Negative signal lead of first Pt100	Negative signal lead of first Pt100	Negative signal lead of first Pt100
A4	Excitation0-	NC	Negative current lead of first Pt100	Jumper between pins A3 and A4	Jumper between pins A3 and A4
B1	Excitation1+	NC	Positive current lead of second Pt100	Positive current lead of second Pt100	Jumper between pins B1 and B2
B2	Signal1+	Positive lead of second thermocouple	Positive signal lead of second Pt100	Positive signal lead of second Pt100	Positive signal lead of second Pt100
B3	Signal1-	Negative lead of second thermocouple	Negative signal lead of second Pt100	Negative signal lead of second Pt100	Negative signal lead of second Pt100
B4	Excitation1-	NC	Negative current lead of second Pt100	Jumper between pins B3 and B4	Jumper between pins B3 and B4

Connections between 2 Thermocouple/Pt100 Sensors and a THMS10

[46] Not connected
[47] The jumper connection is not made by the THMS10 internally and must therefore be made by the user externally

The table below provides a summary of the connection procedures for thermocouples and Pt100 sensors, when 1 sensor is being connected to channel 1 of the THMS10.

Pin Number	**Function**	**Sensor Type**			
		Thermocouple	**Pt100 (4-wire)**	**Pt100 (3-wire)**	**Pt100 (2-wire)**
A1	Excitation0+	NC [48]	Positive current lead of Pt100	Positive current lead of Pt100	Jumper between pins A1 and A2 [49]
A2	Signal0+	Positive lead of thermocouple	Positive signal lead of Pt100	Positive signal lead of Pt100	Positive signal lead of Pt100
A3	Signal0-	Negative lead of thermocouple	Negative signal lead of Pt100	Negative signal lead of Pt100	Negative signal lead of Pt100
A4	Excitation0-	NC	NC	NC	NC
B1	Excitation1+	NC	NC	NC	NC
B2	Signal1+	NC	NC	NC	NC
B3	Signal1-	NC	NC	NC	NC
B4	Excitation1-	NC	Negative current lead of Pt100	Jumper between pins A3 and B4	Jumper between pins A3 and B4

Connections between 1 Thermocouple/Pt100 Sensor and channel 1 of the THMS10

[48] Not connected
[49] The jumper connection is not made by the THMS10 internally and must therefore be made by the user externally

The table below provides a summary of the connection procedures for thermocouples and Pt100 sensors, when 1 sensor is being connected to channel 2 of the THMS10.

Pin Number	Function	Sensor Type			
		Thermocouple	**Pt100 (4-wire)**	**Pt100 (3-wire)**	**Pt100 (2-wire)**
A1	Excitation0+	NC [50]	Positive current lead of Pt100	Positive current lead of Pt100	Jumper between pins A1 and B2 [51]
A2	Signal0+	NC	NC	NC	NC
A3	Signal0-	NC	NC	NC	NC
A4	Excitation0-	NC	NC	NC	NC
B1	Excitation1+	NC	NC	NC	NC
B2	Signal1+	Positive lead of thermocouple	Positive signal lead of Pt100	Positive signal lead of Pt100	Positive signal lead of Pt100
B3	Signal1-	Negative lead of thermocouple	Negative signal lead of Pt100	Negative signal lead of Pt100	Negative signal lead of Pt100
B4	Excitation1-	NC	Negative current lead of Pt100	Jumper between pins B3 and B4	Jumper between pins B3 and B4

Connections between 1 Thermocouple/Pt100 Sensor and channel 2 of the THMS10

[50] Not connected
[51] The jumper connection is not made by the THMS10 internally and must therefore be made by the user externally

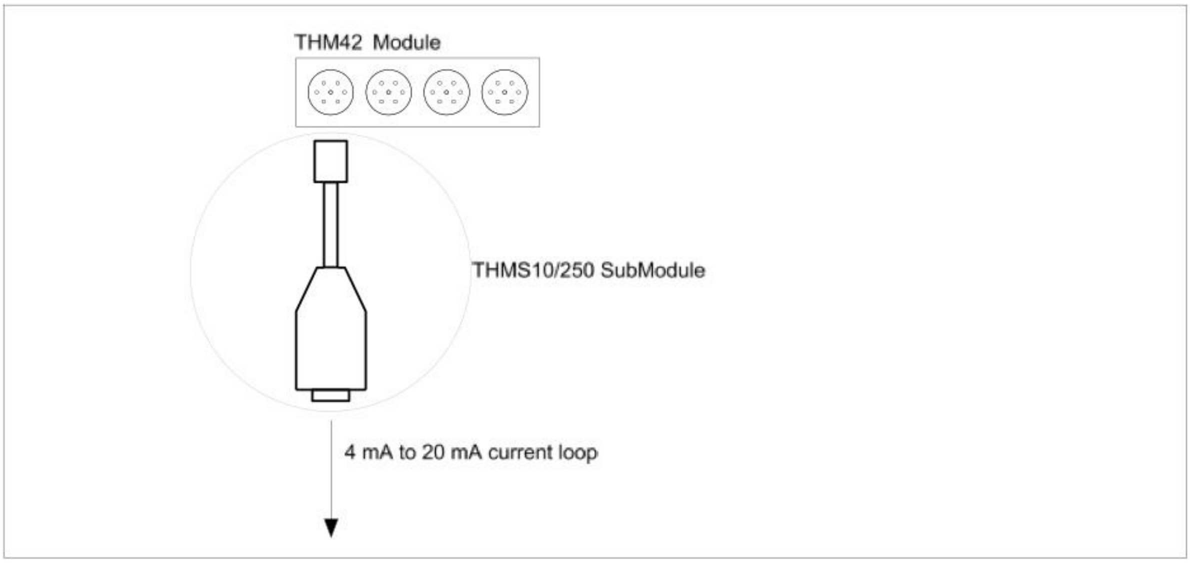
16.1.16. THMS10/250

The THMS10/250 SubModule is used in conjunction with a THM42 Module to provide 2 sets of 4-way general purpose screw terminals to connect to two constant current signals from sensors between 4 mA and 20 mA. Two precision 250 Ω resistors convert the constant current signals to voltage signals between 1 V and 5 V. The SubModule is identified through a TEDS interface. The THMS10/250 SubModule connects to the THM42 through a 300 mm fly-lead ending with a 7-way LEMO® FGG 0B connector.

Where used:

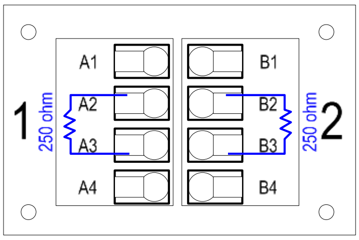
- Supports two channels on a THM42 Module by linking the channel to two sensors
- Designed as a SubModule used to expand the capacity of the THM42 Module
- Accepts one 7-pin LEMO® EHG 0B connector
- Provides two sets of 4-pin general purpose screw terminals to connect to sensors with a 4 mA to 20 mA current output

Connection diagram per channel



Implementing the THMS10/250

Connector Information and Pin Definitions



THMS10/250 front panel and screw terminal input connectors

NOTE: The 250 Ω resistor is internal in the THMS10/250 and the user should not add the resistor to the pins.

The table below provides a summary of the connection procedures for sensors with a 4 mA to 20 mA current output that are being connected to the THMS10/250.

Pin Number	Function	Sensor with 4 mA to 20 mA current output
A1	Excitation0+	NC [52]
A2	Signal0+	Positive lead of first sensor
A3	Signal0-	Negative lead of first sensor
A4	Excitation0-	NC
B1	Excitation1+	NC
B2	Signal1+	Positive lead of second sensor
B3	Signal1-	Negative lead of second sensor
B4	Excitation1-	NC

Connections between two 4mA to 20 mA output current sensors and a THMS10/250

[52] Not connected

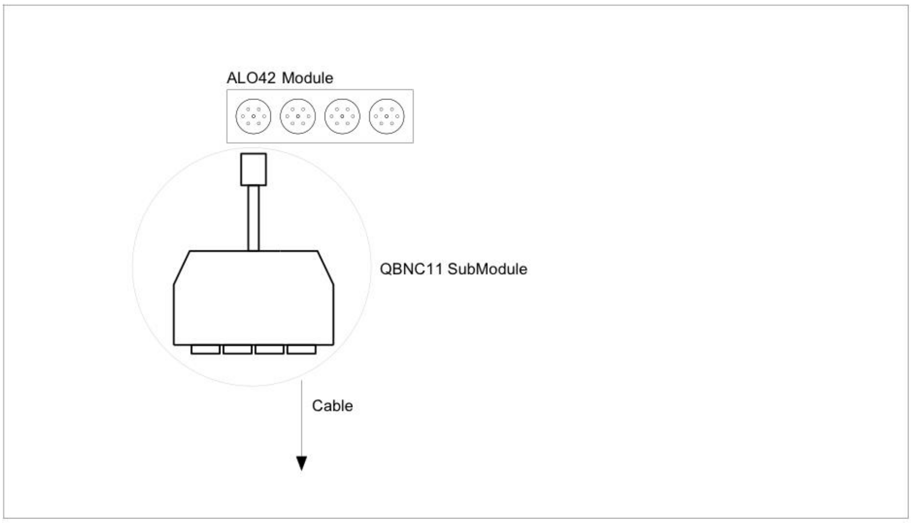
16.1.17. QBNC11

The Quad BNC (QBNC) is a SubModule that is used to split signals from a 7-pin LEMO® connector to 4 BNC connectors. A sticker on top indicates with which Modules the QBNC is compatible, and how the signals are mapped.

Where used:

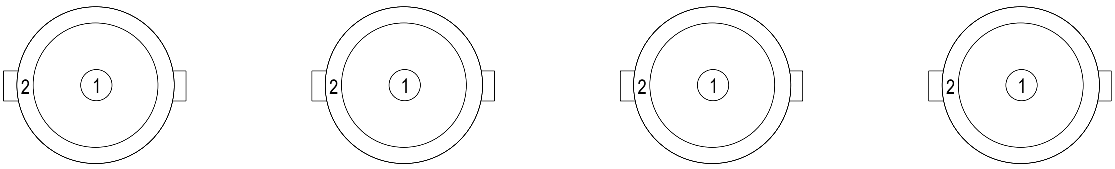
- Splits the signals coming from an ALO42S Module
- Designed as a SubModule used to expand the capacity of an ALOP42S Module
- Accepts one 7-pin LEMO® FGG 0B connector
- Provides 4 BNC connectors to split the signals as follows:
    - For the ALO42S Module, the QBNC11 provides Analog Signal Output, Module Status Output, Device Under Control Input and 5/12 V output

Connection diagram per channel



Implementing the QBNC11

Connector Information and Pin Definitions



BNC1 *BNC2* *BNC3* *BNC4*

Pin 1: Analog Signal Output + Pin 2: Analog Signal Output -	Pin 1: Module Status Output + Pin 2: Module Status Output -	Pin 1: DUC Status Input + Pin 2: DUC Status Input -	Pin 1: 5 V / 12 V Output + Pin 2: 5 V / 12 V Output -

QBNC11 Pinouts when connected to an ALO42S Module

17. Cables

17.1. Chassis Power Cables

17.1.1. 214K

The 214K is a standard length power cable for powering combined power supply and controller boards from a car cigarette lighter.

Length	**Connector 1**	**Connector 2**	**Current Rating**
2 m	4-way LEMO® (FGG.1B.304) with black bend relief.	Cigarette lighter plug.	15 A

17.1.2. 230K

The 230K is a standard length power cable for powering combined power supply and controller boards from a Mean Well power supply.

Length	**Connector 1**	**Connector 2**	**Current Rating**
1 m	4-way LEMO® (FGG.1B.304) with red bend relief.	4-way female DC power supply.	15 A

17.1.3. 231K

The 231K is a variable length power cable for powering combined power supply and controller boards from a Mean Well power supply.

Length	Connector 1	Connector 2	Current Rating
Variable	4-way LEMO® (FGG.1B.304) with red bend relief.	4-way female DC power supply.	15 A

17.1.4. 216K

The 216K is a standard length power cable for powering combined power supply and controller boards from a desktop power supply (e.g. a TDK Lambda UP36-12).

Length	Connector 1	Connector 2	Current Rating
2 m	4-way LEMO® (FGG.1B.304) with black bend relief.	2 stackable banana plugs, 1 red and 1 black.	20 A

17.1.5. 221K

The 221K is a variable length power cable for powering combined power supply and controller boards from a desktop power supply (e.g. a TDK Lambda UP36-12).

Length	Connector 1	Connector 2	Current Rating
Variable	4-way LEMO® (FGG.1B.304) with black bend relief.	2 stackable banana plugs, 1 red and 1 black.	20 A

17.1.6. 223K

The 223K is a standard length power cable for powering combined power supply and controller boards from a PSDP10.

Length	Connector 1	Connector 2	Current Rating
3 m	4-way LEMO® (FGG.1B.304) with black bend relief.	4-way LEMO® (FGG.1B.304) with black bend relief.	20 A

17.2. SyncLink Cables

17.2.1. 003K

The 003K is a standard length Fiber Optic cable used for SyncLink. It connects all power supply and controller boards to a synchronization engine (the SL21). The 003K can also be used to connect an SL21 to nother SL21 in a cluster.

Length	Connector 1	Connector 2	Current Rating
0.5 m	Fiber Optic SC	Fiber Optic SC	N/A

17.2.2. 004K

The 004K is a standard length Fiber Optic cable used for SyncLink. It connects all power supply and controller boards to a synchronization engine (the SL21). The 004K can also be used to connect an SL21 to nother SL21 in a cluster.

Length	Connector 1	Connector 2	Current Rating
5 m	Fiber Optic SC	Fiber Optic SC	N/A

17.3. Sensor and Signal Cables used with QModules and SubModules

17.3.1. 001K

The 001K is a standard length sensor cable used to connect deflection bridge sensors to WSB42 and WSB42X Modules.

Length	Connector 1	Connector 2
2 m	7-way LEMO® (FGG.0B.307) with blue bend relief	7 unconnected wires (brown, red, orange, yellow, green, blue, black)

17.3.2. 008K

The 008K is a variable length sensor cable used to connect deflection bridge sensors to WSB42 and WSB42X Modules.

Length	Connector 1	Connector 2
Variable	7-way LEMO® (FGG.0B.307) with blue bend relief	7 unconnected wires (brown, red, orange, yellow, green, blue, black)

17.3.3. 010K

The 010K is a standard length signal cable that disconnects the shield of an MIC42X Module.

Length	Connector 1	Connector 2
300 mm	7-way LEMO® (FGG.1B.307) with black bend relief	7-way LEMO® (PHG.1B.307) with black bend relief

17.3.4. 013K

The 013K is a standard length signal cable that connects a CHG42S Module to a BNC socket.

Length	Connector 1	Connector 2
1 m	10 - 32 Microdot	BNC plug

17.3.5. 023K

The 023K is a standard length signal cable that connects an ALO42S Module to an ALOP10 SubModule.

Length	Connector 1	Connector 2
3 m	4 7-way LEMO® (FGG.0B.307)	Male 37-way D-sub

17.3.6. 025K

The 025K is a standard length signal cable that converts the SMB output of a Module to a BNC output.

Length	Connector 1	Connector 2
1 m	SMB socket	BNC plug

C. Legal

1. Copyright

2. Conditions of Change

Every precaution has been taken to provide the most relevant and accurate information regarding the products discussed in this manual. However, as MeCalc is constantly improving and updating its products, this information is subject to change without notice.

3. Warranty and Limitations of Liability

- MeCalc's exclusive warranty is that the products are free from defects in materials and workmanship under normal use for a period of at least one year from date of delivery to customer.

- The customer shall be responsible for determining that the product is suitable for the customer's use and that such use complies with any applicable laws.

- The customer shall notify their supplier in writing of any claimed defect in the product immediately upon discovery. Any such product shall be returned without undue delay at the customer's risk to their supplier no later than one year from the original date of delivery.

- If products are found to be defective, MeCalc shall at its discretion:

    - Repair or replace such defective products and MeCalc shall have reasonable time to make such repairs or to replace such products.
    - Grant the customer a fair and proportionate price reduction for the delivery in question.

- Any repair or replacement of the products shall not extend the warranty period.

- MeCalc can only be responsible for warranty, repair or other claims regarding its products if MeCalc confirms the products were properly handled, stored, installed, and maintained and were not at any point subject to contamination, abuse, misuse, or inappropriate modification or repair.

- MeCalc shall not be responsible for consequential damages, loss of profits or commercial loss connected with the use of the products.

- MeCalc's responsibility will not exceed the individual price of the product on which liability has been asserted.

Extended warranty options are available, please contact your supplier for more information.

4. Application Considerations

4.1. Suitability for Use

MeCalc shall not be responsible for conformity with any standards, codes or regulations that may apply to the combination of products in the customer's application or use of the products.

At the customer's request MeCalc can provide applicable certification documents identifying ratings and limitations of use that apply to products. However, this information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system or other application or use.

The following are examples of typical applications. However, this is neither an exhaustive list nor intended to imply that products will always be suitable for use in these instances:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this manual.

- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.

- Systems, machines and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

Please note
Never use the products for an application involving serious risk to life or property without ensuring that the system as a whole has been designed to address the risks, and that the MeCalc products are properly rated and installed for the intended use within the overall equipment or system.

4.2. Programmable Products

MeCalc cannot be responsible for any consequences as a result of the user's programming of a programmable product.

5. Disclaimers

5.1. Performance Data

Performance data given in this manual are provided as a guide for the user in determining suitability and do not constitute a warranty. The data may represent the results of MeCalc's test conditions and users will have to correlate those results with actual application requirements. Actual performance is subject to the MeCalc Warranty and Limitations of Liability.

5.2. Errors and Omissions

The information in this manual has been carefully checked and is believed to be accurate. However, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.

D. Contact

If your Channel Partner is unable to assist you, contact MeCalc directly for any queries concerning the DECA**Q** or related products:

www.quantusseries.com

www.mecalc.com

QUANTUS SERIES™

www.QuantusSeries.com

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Driven to position ourselves at the forefront of new developments and thinking, we research, design, develop and manufacture advanced acquisition and control systems. Used to optimise noise, vibration and structural integrity in prototype or quality control testing, our QuantusSeries hardware are crucial to markets where exceptional development and production quality are essential.

CHARGED TO INNOVATE, we're inspired to create products for those who are as passionate about creating theirs.

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