Genesis
HIGH SPEED

User Manual

English

Fiber Optic Isolated System & Transient Recorder

ISOBE5600 Series

HBM

I2711-4.1 en HBM: public

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References made to the Perception software are for version 6.72 or higher

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1 About this Manual

1.1 Symbols used in this manual

The following symbols are used throughout this manual to indicate warnings and cautions.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

WARNING

Indicates an electrical shock hazard which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury; or alerts against unsafe practices; or alerts against actions which could damage the product or result in a loss of data.

CAUTION

The ESD susceptibility symbol indicates that handling or use of an item may result in damage from ESD if proper precautions are not taken.

HINT/TIP

The info icon indicates sections which provide additional information about the product. This information is not essential for correct operation of the instrument, but provides knowledge to make better use of the instrument.

1.2 Manual conventions

When the wording “Click Start ...” is used, this refers to the Windows® Start button. Compared to Windows® XP, Windows® Vista and Windows® 7, the Start Menu has undergone some significant changes. The taskbar icon is no longer labeled "Start" and is now simply the pearl icon (of the window-frame in an orb).

For clarity and convenience, these conventions are used throughout this manual:

- **Menu names** from the display appear in bold, blue lettering.
- **Settings** within a menu appear in bold, red lettering.
- **Front panel controls** and **control names** appear in bold, black lettering.

2 Safety messages

2.1 Introduction

IMPORTANT

Read this section before using this product!

This instrument is mains powered and protective ground connections are required (unless otherwise specified for certain parts).

This manual contains information and warnings that must be observed to keep the instrument safe. The instrument should not be used when environmental conditions exceed the instrument's specifications (e.g. damp, high humidity) or if the unit is damaged.

For the correct and safe use of this instrument, it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual.

Whenever it is likely that safety protection has been impaired, the instrument must be made inoperative and secured against any unintended operation. Qualified maintenance or repair personnel should be informed. Safety protection is likely to be impaired if, for example, the instrument shows visible damage or fails to operate normally.

Appropriate use
This instrument and the connected transducers may be used only for measurement and directly related control tasks. Any other use is not appropriate. To ensure safe operation, the instrument may only be used as specified in this user manual.

- The covers protect the user from live parts and should only be removed by suitably qualified personnel for maintenance and repair purposes.
- The instrument must not be operated with the covers removed.
- This instrument must not be used in life support roles.
- There are no user serviceable parts inside the instrument.

It is also essential to follow the respective legal and safety regulations for specific applications during use. The same applies to the use of accessories. Additional safety precautions must be taken in setups where malfunctions could cause major damage, loss of data or even personal injury.
Some examples of precautions are: mechanical interlocking, error signaling, limit value switches, etc.

Maintenance and cleaning
The instrument is a maintenance-free product. However, please note the following information about cleaning the housing:

- Before cleaning, disconnect the instrument completely.
- Clean the housing with a soft, slightly damp (not wet!) cloth. Never use solvents, since these could damage the display or the labeling on the front panel.
- When cleaning, ensure that no liquid gets into the housing or connections.

General dangers, failing to follow the safety instructions
This instrument is a state-of-the-art device and as such is fail-safe. Using this instrument may be hazardous if it has been installed incorrectly and is operated by untrained personnel. Any person assigned to install, maintain or repair the unit or to put the unit into operation must have first read and understood the user manual, particularly the technical safety instructions.

Residual risks
This instrument's scope of supply and performance covers only a small area of measurement technology. In addition, equipment planners, installers and operators should plan, implement and respond to the safety engineering considerations of measurement technology in such a way as to minimize any residual risks. Prevailing regulations must be complied with at all times. The residual risks of the measurement technology must be referenced.

Conversions and modifications
Neither the design nor the safety features of this instrument may be modified without our express prior written agreement. Any modification shall exclude all liability on our part for any resultant damage. In particular, any repair or soldering work on cards (replacement of components) is prohibited. When exchanging complete units, use only original parts from HBM. The unit is delivered from the factory with a fixed hardware and/or software configuration. Changes should only be made within the possibilities documented in this manual.

Qualified personnel

People entrusted with the installation, fitting, operation of the instrument and putting the unit into service must have the appropriate qualifications. The instrument may only be installed and used by qualified personnel, in strict accordance with the specifications and the safety rules and regulations. This includes people who meet at least one of the three following qualification levels:

- Project personnel: Have a working knowledge of the safety concepts of automation and test and measurement technology.
- Automation plant or test and measurement operating personnel: Have been instructed on how to handle the equipment and are familiar with the operation of the cards and technologies described in this documentation.
- Commissioning engineers or service engineers: Have successfully completed the training on how to repair the automation systems. They are also authorized to activate, to ground and to label circuits and equipment in accordance with engineering safety standards. It is essential that the legal and safety requirements for the product and any accessories are complied with during use.

2.2 FCC and general

The first WARNING note below is required by the FCC (Federal Communications Commission) and relates only to the interference potential of this equipment. This message is a direct quotation.

WARNING

The equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. As temporarily permitted by regulation, it has not been tested for compliance with the limits for Class A computing devices pursuant to Subpart B or Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

IMPORTANT

The ISOBE5600 Isolated Probe System is a combination of one or more transmitters and a receiver unit. When a reference is made to the complete system (transmitters and receiver), this is referred to as “the equipment”. If not, the transmitter and receiver unit are identified explicitely.

2.3 Grounding

The instrument must be used with a protective ground connection via the protective ground conductor of the supply cable. The protective ground conductor is connected to the instrument before the line and neutral connections are made when the supply connection is made. If the final connection to the supply is made elsewhere, ensure that the ground connection is made before line and neutral connections are made.

WARNING

Any interruption of the ground connection, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited.

For protection against electric shock, all external circuits or equipment need a safe insulation. Therefore, peripheral equipment must not be connected to the system with a power supply without the SELV (Separated Extra Low Voltage) rating unless explicitly mentioned.

Signal connections to the instrument should be connected after the ground connection is made and disconnected before the ground connection is removed, i.e. the supply lead must be connected whenever signal leads are connected.

WARNING

For safety, it is essential that the protective ground connector of the instrument is used whenever voltages greater than 33 V RMS, 46.7 V PEAK or 70 V DC (IEC 61010-1:2010) are connected. This is to prevent the instrument's case becoming live in the event of a protective ground interruption, which could occur if the supply connector is accidentally disconnected from the instrument.

CAUTION

It is important when operating or handling the transmitters ISOBE5600t or ISOBE5600tm, that these units are correctly grounded via the protective ground connections.

The primary purpose of protective grounding is to provide adequate protection against electric shock that could cause death or injury to personnel while working on de-energized equipment. This is accomplished by grounding and bonding to limit the body contact or exposure to voltages at the work-site to a safe value if the equipment were to be accidentally energized from any source of hazardous energy. The greatest source of hazardous energy in most cases is direct energizing of the equipment from a power-system or source.

WARNING

If connection to a protective ground is not possible for any reason, then please refer to the international safety standard EN 50191:2000

2.4 Instrument symbols

A variety of symbols can be found in the system. Below is a list of symbols and their meaning.

This symbol is used to denote the measurement ground connection. This point is not a protective ground connection.

This symbol is used to denote a protective ground connection.

This symbol is used to denote a frame or chassis ground connection. This point is not a protective ground connection.

Where caution is required, this symbol refers to the user manual for further information.

This symbol warns that high voltages are present close to this symbol.

This symbol shows that the switch is a power switch. When pressed, the instrument state toggles between the operating and power-off mode. When the system is in power-off mode, all electronics are disconnected from the power, except for a small circuit used to detect the switch state.

2.5 Protection and isolation

2.5.1 Measurement categories

- The international standards for test equipment safety are IEC 61010-1 and the IEC 61010-2-030.
- IEC 61010-1 defines three overvoltage categories (CAT II, CAT III, and CAT IV) for the power supply of an instrument.
- IEC 61010-2-030 defines three measurement categories (CAT II, CAT III, and CAT IV) for an instrument's input measurements which can be directly connected to mains supply.
- All measurement inputs which are not specified to be connected to the mains power have no CAT rating and are referred to as O (like Others).

Categories in accordance with IEC 61010-2-030:2010
Electrical equipment, specifically measurement tools, can be assigned into four categories in accordance with IEC 61010-2-030:2010. These measurement categories are indicated by the terms O (previously CAT I), CAT II, CAT III and CAT IV. Originally, these categories were used to indicate the overvoltage or surge voltage that was likely to occur and could be sustained by the equipment. Currently, the category indicates the amount of energy that can be released if a short circuit occurs. A higher category number indicates a higher energy level that can occur and can be sustained by the equipment.

O (Other) (previously referred to as **CAT I**): This category is for measurements not directly connected to a mains supply. Measurements for this category are signal levels, regulated low voltage circuits or protected secondary circuits. For this category, there are no defined standard overvoltage or surge impulse levels.

CAT II: This category is for measurements directly connected to a low voltage mains supply. Measurements for this category are mains sockets in household applications or portable tools. This category expects a minimum of three levels of overcurrent protection between the transformer and connection point of the measurement. (See Figure 2.1).

CAT III: This category is for measurements directly connected to the distribution part of a low voltage mains installation. Measurements for this category are circuit breakers, wiring, junction boxes, etc. This category expects a minimum of two levels of overcurrent protection between the transformer and connection point of the measurement. (See Figure 2.1).

CAT IV: This category is for measurements directly connected to the source of a low voltage mains installation. Measurements for this category are overcurrent protection devices, ripple control units, etc. This category expects that there is a minimum of one level of overcurrent protection between the transformer and connection point of the measurement circuit. (See Figure 2.1).

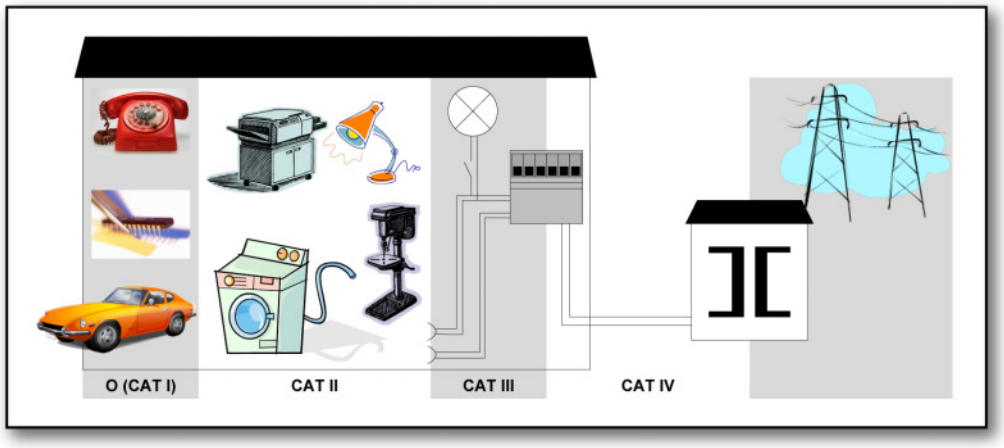


Figure 2.1: Category indication in accordance with IEC 61010-2-030:2010

Example: A measurement device is specified as 600 V CAT II, maximum input voltage 1000 V DC.

Table 2.1: Insulation test voltages in accordance with IEC 61010-2-030:2010

Nominal Voltage (V RMS or V DC)	IEC 61010-2-030:2010					
	5 sec. AC test (V RMS)			Impulse test (V)		
	CAT II	CAT III	CAT IV	CAT II	CAT III	CAT IV
≤ 150	840	1390	2210	1550	2500	4000
> 150 ≤ 300	1390	2210	3310	2500	4000	6000
> 300 ≤ 600	2210	3310	4260	4000	6000	8000
> 600 ≤ 1 000	3310	4260	6600	6000	8000	12000

Using the table above, it can be concluded that this specification informs the user that the device passed the insulation tests; 5 sec at 2210 V RMS and impulse 4000 V. The maximum operating input voltage is 1000 V DC. This device is to be used to measure CAT II circuitry up to 600 V.

WARNING

Measurement inputs of this instrument should not be used to measure high-energy signals of measurement categories CAT II, CAT III or CAT IV (IEC 61010-2-30:2010) (e.g. mains measurements) , unless specifically stated for the specific input.

2.5.2 Basic versus reinforced insulation

For reference, the basic insulation and supplementary insulation and the reinforced insulation test values for CAT II can be found below.

Table 2.2: Test voltages for the testing electric strength of solid insulation in measuring circuits in measurement category II (IEC 61010-2-30:2010)

Nominal voltage line to neutral AC RMS or DC of MAINS being measured. (V)	Test voltage			
	5 s AV test V AC RMS		Impulse test V peak	
	Basic insulation and supplementary insulation	Reinforced insulation	Basic insulation and suplementary insulation	Reinforced insulation
≤ 150	840	1390	1550	2500
> 150 ≤ 300	1390	2210	2500	4000
> 300 ≤ 600	2210	3510	4000	6400
> 600 ≤ 1000	3310	5400	6000	9600

Several means of protection can be used to protect a user from hazardous voltages. As can be seen below, basic insulation and supplementary insulation is one mean of protection, but reinforced isolation is also a means of protection. The test voltages are different for each mean of protection, as can be found in the table above.

Additional means of protection for single fault conditions
Accessible parts shall be prevented from becoming HAZARDOUS LIVE IN SINGLE FAULT CONDITION. The primary means of protection (see Figure 2.2) shall be supplemented by one of **A**, **B**, **C** or **D**. Alternatively, one of the single means of protection **E** or **F** shall be used. See Figure 2.2.

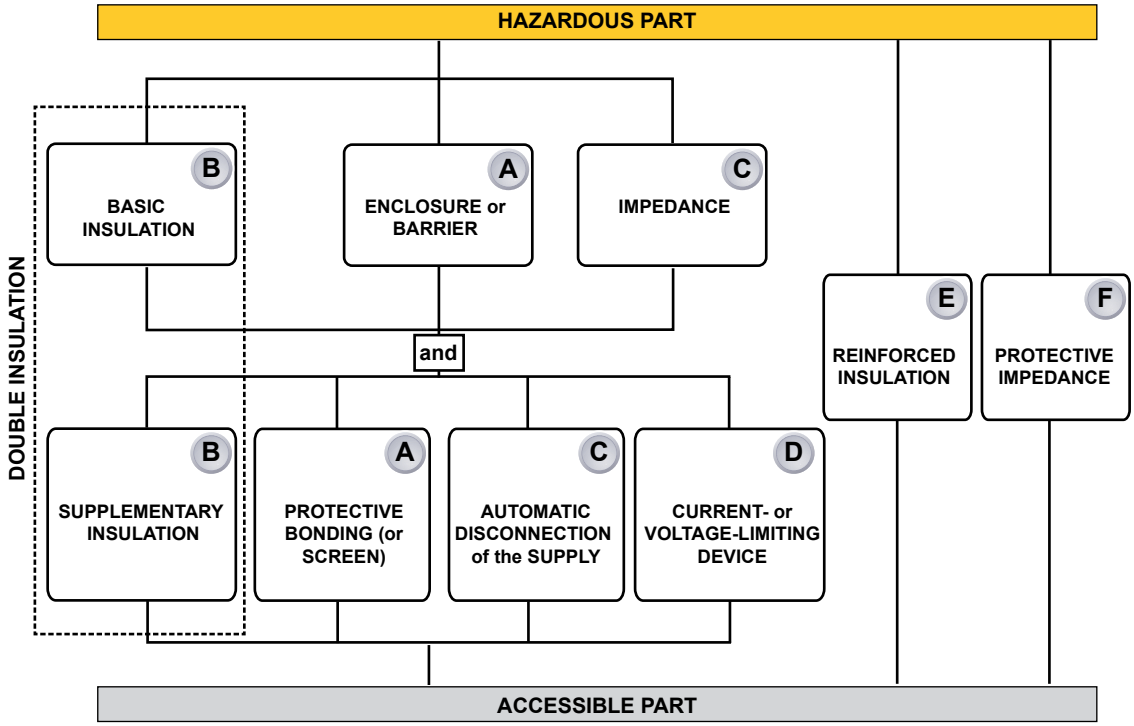


Figure 2.2: Acceptable arrangement of protective means against electric shock

Example: A measurement device is specified as 600 V CAT II reinforced insulation, with a maximum input voltage 1000 V DC.
Using the information above, it can be concluded that this specification informs the user that the measurement device is tested on input to chassis ground for five seconds at 3510 V RMS and impulse 6400 V. The maximum operating input voltage is 1000 V DC. This device is to be used to measure CAT II circuitry up to 600 V.

2.5.3 Protection

WARNING

ELECTRICAL SHOCK HAZARD!
Any interruption of the protective conductor inside or outside the apparatus is likely to make the apparatus dangerous. Intentional interruption is prohibited.
When the apparatus is connected to its supply, terminals may be live, and the opening of covers for removal of parts is likely to expose live parts.

Whenever it is likely that the protection has been impaired, the apparatus must be made inoperative and be secured against any unintended operation.

The protection is likely to be impaired if, for example, the apparatus shows visible damage or has been subjected to severe transport stresses.

It is the responsibility of the user to ensure the safety of any accessories used with the equipment, such as probes.

WARNING

ELECTRICAL SHOCK HAZARD! Do not remove covers. Refer servicing to qualified individuals.

Proper use of this device depends on careful reading of all instructions and labels.

If the instrument is used in a manner not specified by HBM, the protection provided by the instrument can be impaired.

WARNING

This instrument must not be operated in explosive atmospheres.

WARNING

This instrument and related accessories are not designed for biomedical experimentation on humans or animals and should not be directly connected to human or animal subjects or used for patient monitoring.

2.5.4 Overvoltage/current protection

All signal inputs are protected against overloads and transients. Exceeding the limits stated in the specifications, particularly when connected to potentially high-energy sources, can cause severe damage that is not covered by the manufacturer's warranty.

WARNING

Do not remove covers. Refer to qualified individuals for servicing.

The covers protect the user from live parts and should only be removed by suitably qualified personnel for maintenance and repair purposes.

The instrument must not be operated with the covers removed.

There are no user serviceable parts inside.

2.5.5 Isolation

CAUTION

For input channels with plastic BNCs (galvanically isolated from the chassis), the input conductors including the BNC shell may carry hazardous voltages. Only appropriate insulated BNC connectors should be used.

The ISOBE5600t/ISOBE5600tm transmitter is designed to be used in combination with the ISOBE5600r/ISOBE5600m receiver. The fiber optic cables determine the maximum clearance distance and creepage distance between the Isolated Digitizer and the acquisition system.

WARNING

The minimum clearance and creepage distance depends on the position of the ISOBE5600t/ISOBE5600tm transmitter and the ISOBE5600r/ ISOBE5600m receiver. A safety factor of at least twice of the creepage and clearance distance is required.

It is the responsibility of the user to ensure the safety of any accessories used with the instrument, such as probes.

CAUTION

Even low voltage inputs may contain high voltage fast transients (spikes), which could damage the input. For this reason it is not safe, for instance, to make direct connections to an AC line supply, unless specifically stated otherwise for the specific input.

2.6 Environment

The instrument should be operated in a clean, dry environment with an ambient temperature of between 0 °C and +40 °C for the ISOBE5600tm or –15 °C and +50 °C for the ISOBE5600t.

The instrument is specified for use in a Pollution Degree II environment, which is normally non-conductive with temporary light condensation, but it must not be operated while condensation is present. It should not be used in more hostile, dusty or wet conditions, as specified in the Pollution Degree II environment.

The equipment will operate with full specified accuracy between +15 °C and +35 °C.

Humidity should be between 0% and 80%. When moving the device from a cold to a warm environment, the device has to been left off for a period of 30 minutes to avoid short circuits as a result of condensation.

Note *Direct sunlight, radiators and other heat sources should be taken into account when assessing the ambient temperature.*

The ISOBE5600t relies on a convection air-cooling design that does not require a fan. Adequate cooling can usually be achieved by leaving a 12.5 mm (0.5") gap around the transmitter.

The ISOBE5600tm has a fan installed. Leave a space around the equipment for unrestricted ventilation, especially at the front and back of the unit.

Do not store the equipment in hot areas. High temperatures can shorten the life of electronic devices and damage batteries.

Do not store the equipment in cold areas. When the equipment warms up to its normal operating temperature, moisture can form inside the equipment, which may damage the equipment’s electronic circuits.

Do not drop, knock or shake the equipment. Rough handling can break internal electronics and/or PCB's.

Do not use harsh chemicals, cleaning solvents or strong detergents to clean the instrument. To clean the instrument, disconnect all power sources and clean the housing with a soft, slightly damped (not wet!) cloth.

It is the responsibility of the user to ensure the safety of any accessories used with the instrument, such as probes.

2.7 Laser Safety

The system is classified as a **Class 1 laser product**. The ISOBE5600 uses an LC optical transceiver for data and command communication between ISOBE5600r/ISOBE5600m receiver and ISOBE5600t/ISOBE5600tm transmitter. It does not emit hazardous light but it is recommended to avoid direct exposure to the beam.

The built-in laser complies with laser product standards set by government agencies for Class 1 laser products:

- In the USA, the GEN series products are certified as a Class 1 laser product conforming to the requirements contained in the Department of Health and Human Services (DHHS) regulation CDRH 21 CFR, Chapter I Subchapter J Part 1040.10.
- Outside the USA, the GEN Series products are certified as a Class 1 laser product conforming to the requirements contained in IEC/EN 60825-1:1994+A1+A2 and IEC/EN 60825-2.

2.8 Manual handling of loads

The Manual Handling of Loads Directive 90/269/EEC from the European Community lays down the minimum health and safety requirements for the manual handling of loads where there is a risk particularly of back injury to workers.

Before lifting or carrying a heavy object, the following questions should be asked:

- Can one person lift this load safely, or do two people need to lift the load?
- How far will the load have to be carried?
- Is the path clear of clutter, cords, slippery areas, overhangs, stairs, curbs or uneven surfaces?
- Will closed doors that need to be opened be encountered?
- Once the load is lifted, will it block the carrier's view?
- Can the load be broken down into smaller parts?
- Should the carrier wear gloves to get a better grip and to protect hands?

Contact the "Occupational Health and Safety" organization, or equivalent, in your country for more information.

The ISOBE5600t and ISOBE5600tm transmitter weigh approximately 4 kg maximum, the ISOBE5600r and ISOBE5600m receiver approximately 1.5 kg:

2.9 International safety warnings

Dansk

SIKKERHEDSADVARSEL

Dette instrument skal anvendes med en sikkerhedsjordforbindelse, som er tilsluttet via lysnetkablets beskyttelsesjordledning eller via en sikkerhedsjordklemme, hvis instrumentet er forsynet hermed. Hvis sikkerhedsjordforbindelsen afbrydes, inden i eller uden for instrumentet, kan instrumentet udgøre en farekilde. Sikkerhedsjordforbindelsen må ikke afbrydes. Der skal desuden tilsluttet en signaljordforbindelse, hvis et indgangssignal overstiger 33 V RMS, 46,7 V PEAK eller 70 V DC (IEC 61010-1:2010).

Dækslerne må ikke fjernes.

Hvis netsikringen springer som følge af en fejl, er instrumentets vekselstrømsafbryder muligvis blevet beskadiget og skal derfor kontrolleres af en kvalificeret tekniker.

Afbryd instrumentet fra lysnettet ved at fjerne IEC-stikket. Instrumentets vekselstrømsafbryder er kun beregnet til funktionelle formål. Den er ikke beregnet eller egnet til at afbryde instrumentet fra lysnettet.

Hvis målingerne et omfattet af EN 50110-1 og EN 50110-2, skal alle kort med en driftsspænding på mere end 50 V AC RMS eller 120 V DC tilsluttes af en kvalificeret tekniker eller en elektriker, og arbejdet skal kontrolleres af en kvalificeret tekniker. (En kvalificeret tekniker er en person, som i kraft af sin specialuddannelse, sin viden og erfaring samt sit kendskab til relevante bestemmelser kan vurdere omfanget af det arbejde, de skal udføre, og afdække de potentielle risici, og som er blevet udpeget som kvalificeret tekniker af deres arbejdsgiver).

Nederlands

VEILIGHEIDSWAARSCHUWING
Dit instrument mag uitsluitend worden gebruikt als een beschermde massa (aarde) is aangesloten via de beschermde massageleider van de voedingskabel, of indien het instrument daarvan is voorzien via de veiligheids-massa-aansluiting. Als de beschermde massa, binnen of buiten het instrument, wordt onderbroken, dan kan dat hierdoor uitermate gevaarlijk worden. Het opzettelijk onderbreken van de massa is verboden. Indien er een signaal wordt aangeboden van meer dan 33 V RMS, 46.7 V (top-top) of 70 V DC (IEC 61010-1:2010) dient eveneens een signaalaarding aangesloten te zijn.

De deksels mogen nooit worden verwijderd.

Als de zekering doorbrandt als gevolg van een storing of een defect is het mogelijk dat de wisselstroom-schakelaar van het instrument beschadigd is en dient deze door een daarvoor gekwalificeerde en deskundige monteur te worden gecontroleerd.

Om dit instrument los te koppelen van de wisselstroomvoeding dient de IEC-aansluiting er uit te worden getrokken. De wisselstroom-voedingsschakelaar op dit instrument is uitsluitend bestemd voor functionele doeleinden. Het is niet bedoeld of geschikt als een ontkoppelingsapparaat.

Voor metingen die binnen de EN 50110-1 en EN 50110-2 vallen: let op dat alle panelen met bedrijfsspanningen van meer dan 50 V AC RMS of 120 V DC alleen door een gekwalificeerde technicus mogen worden aangesloten of door een persoon die is opgeleid in de elektrotechniek en onder toezicht van een gekwalificeerde technicus staat. (Gekwalificeerde technici zijn personen, die op basis van hun specialistische opleiding, kennis en ervaring als ook hun kennis van de betreffende voorzieningen, in staat zijn om het werk dat aan hen is toevertrouwd te beoordelen en mogelijke gevaren te ontdekken en door hun werkgever zijn aangewezen als gekwalificeerde technici).

Suomi

TURVAOHJEITA

Tätä laitetta käytettäessä sen tulee olla suojamaadoitettu joko verkkojohdon suojajohtimen tai erillisen suojamaadoitusliitännän kautta, mikäli laitteeseen on sellainen asennettu. Suojamaadoituksen katkaiseminen laitteen sisä- tai ulkopuolelta tekevät siitä vaarallisen. Tahallinen katkaisu on kiellettyä. Lisäksi signaalimaa on oltava kytkettynä, jos jokin tulosignaali ylittää tehollisarvon 33 V, huippuarvon 46,7 V tai 70 V DC (IEC 61010-1:2010).

Älä poista suojakansia.

Mikäli laitteen verkkosulake palaa vian seurauksena, on mahdollista, että laitteen verkkokytkin on vaurioitunut ja se tulee tällöin tarkastuttaa ammattihenkilöllä.

Katkaise laitteen käyttöjännite irrottamalla IEC-liitin. Laitteen verkkokytkimellä on ainoastaan toiminnallinen tarkoitus. Sitä ei ole tarkoitettu, eikä se sovellu laitteen erottamiseen käyttöjännitteestä.

Mittauksissa, jotka kuuluvat EN 50110-1- ja EN 50110-2-standardien soveltamisalaan, huomaa, että kortit, jotka toimivat tehollisarvojännitteellä yli 50 V AC tai 120 V DC, saa kytkeä vain pätevä asentaja tai sähköteknisen koulutuksen saanut henkilö pätevän asentajan valvonnassa. (Pätevät asentajat ovat henkilöitä, jotka erikoiskoulutuksensa, tietojensa ja kokemuksensa sekä asiaan kuuluvien määräysten tuntemuksensa ansiosta pystyvät arvioimaan heille annettuja töitä ja havaitsemaan mahdolliset vaarat ja jotka heidän työnantajansa on nimennyt ammattitaitoisiksi asentajiksi).

Français

ATTENTION - DANGER!
Lorsqu'il est en fonctionnement, cet instrument doit impérativement être mis à la masse par le conducteur de terre du câble d'alimentation ou, si l'instrument en comporte une, par la borne de terre. Il peut être dangereux en cas de coupure du circuit de terre, que ce soit à l'intérieur ou à l'extérieur de l'instrument. Il est formellement interdit de couper intentionnellement le circuit de terre. De plus, une masse signal doit être connectée si l'un des signaux d'entrée, quel qu'il soit, dépasse 33 V RMS (valeur efficace), 46,7 V PEAK (valeur de crête) ou 70 V DC (courant continu) (CEI 61010-1:2010).

Ne pas déposer les panneaux de protection.

Le fait que le fusible d'alimentation saute par suite d'une anomalie risque de détériorer l'interrupteur d'alimentation secteur de l'instrument ; dans ce cas , le faire contrôler par un technicien qualifié.

Pour couper l'alimentation secteur de cet instrument, débrancher le cordon secteur. L'interrupteur d'alimentation secteur sur cet instrument est purement fonctionnel. Il ne s'agit pas d'un dispositif de coupure du courant, et n'est pas conçu pour cette fonction.

Pour les mesures entrant dans le champ d'application des normes EN 50110-1 et EN 50110-2, veuillez noter que tous les panneaux avec des tensions de service supérieures à 50 V AC RMS (tension efficace) ou 120 V DC (courant continu) ne peuvent être connectés que par un technicien qualifié ou une personne formée en ingénierie électrique et supervisée par un technicien qualifié. (Les techniciens qualifiés sont des personnes qui, du fait de leur formation, leurs connaissances et leur expérience spécialisées ainsi que leur connaissance des dispositions réglementaires appropriées, sont capables d'évaluer le travail qui leur est confié et détecter les risques possibles, et qui ont été désignées comme techniciens qualifiés par leur employeur).

Deutsch

WARNHINWEIS!
Dieses Gerät muss mit einer Schutzerde betrieben werden, die über den Schutzleiter des Speisekabels oder über die Erdungsklemme des Gerätes (falls vorhanden) anzuschließen ist. Bei einer Unterbrechung der Schutzerde außerhalb oder innerhalb des Gerätes kann eine Gefahr am Gerät entstehen. Eine beabsichtigte Unterbrechung ist nicht zulässig. Achtung! Bei Signalspannungen über 33 V Effektivwert, 46,7 V Spitzenwert oder 70 V Gleichstrom (IEC 61010-1:2010) muss die Signalmasse angeschlossen sein.

Die Schutzabdeckung nicht entfernen.

Wenn die Sicherung der Versorgung infolge eines Defektes durchbrennt, besteht die Möglichkeit einer Beschädigung des Wechselstromversorgungs-Schalters des Gerätes. Der Schalter muss dann von einem qualifizierten Elektriker geprüft werden.

Zum Trennen des Gerätes von der Wechselstromversorgung den IEC-Stecker abziehen. Der Wechselstromversorgungs-Schalter dient bei diesem Gerät nur für Funktionszwecke. Er ist nicht als Trennvorrichtung bestimmt bzw. geeignet.

Für Messungen gemäß EN 50110-1 und EN 50110-2 bitte berücksichtigen, dass alle Platinen mit Betriebsspannungen über 50 V AC RMS oder 120 V DC nur durch einen qualifizierten Elektriker oder einer elektrotechnisch unterwiesenen Person unter Aufsicht eines qualifizierten Technikers durchgeführt werden dürfen. (Qualifizierte Techniker sind aufgrund ihrer fachlichen Ausbildung, Kenntnisse und Erfahrungen sowie Kenntnis der einschlägigen Bestimmungen in der Lage, die ihnen anvertrauten Arbeiten zu beurteilen und mögliche Risiken zu erkennen, sowie Personen, die durch ihren Arbeitgeber zu qualifizierten Technikern ernannt worden sind).

Italiano

AVVISO DI SICUREZZA
Questo strumento deve esser utilizzato con un collegamento protettivo di messa a terra tramite il filo di messa a terra del cavo di alimentazione o tramite il terminale di messa a terra in sicurezza, nel caso in cui lo strumento ne sia dotato. Qualsiasi interruzione della messa a terra di protezione, sia all'interno che all'esterno dello strumento, lo renderà pericoloso. È vietata qualsiasi interruzione causata intenzionalmente. Inoltre, la connessione di terra deve essere collegata se ad uno qualsiasi degli ingressi viene applicato un segnale superiore a 33 V RMS, 46,7 V di picco o 70 V c.c. (IEC 61010-1:2010).

Non aprire lo strumento.

Nel caso in cui il fusibile dell'alimentazione dovesse scattare a causa di un guasto, è possibile che l'interruttore dell'alimentazione a corrente alternata dello strumento possa essere danneggiato e dovrà pertanto essere controllato da un tecnico specializzato e qualificato.

Per disinnestare questo strumento dall'alimentazione a corrente alternata, levare il connettore IEC. L'interruttore dell'alimentazione a corrente alternata di questo strumento viene fornito esclusivamente per scopi operativi e non viene inteso, né è adatto, per essere utilizzato come dispositivo di disinnesto.

Si noti che per le misurazioni che rientrano nell'ambito di applicazione delle norme EN 50110-1 ed EN 50110-2, tutte le schede con tensioni di esercizio superiori a 50 V c.a. RMS o 120 V c.c. possono essere collegate esclusivamente da un tecnico qualificato o da una persona in possesso di una formazione specifica nel campo dell'ingegneria elettrica sotto la supervisione di un tecnico qualificato. (Per tecnico qualificato si intende una persona che, in virtù della propria formazione , preparazione ed esperienza specialistica, nonché conoscenza delle disposizioni di settore, è in grado di valutare il lavoro che gli viene assegnato e di individuare possibili rischi, oltre ad essere stato nominato tecnico qualificato dal proprio datore di lavoro).

Norsk

ADVARSEL!
Dette instrument må betjenes med beskyttelsesjord tilkoblet via beskyttelsesjordlederen til tilførselskabelen eller via beskyttelsesjordklemmen, hvis instrumentet er utstyrt med en slik. Ethvert brudd i beskyttelsesjorden inni eller utenpå instrumentet kan føre til at instrumentet blir farlig. Tiltenkt brudd er tillatt. I tillegg må en signaljord tilkobles hvis et inngangssignal overskrider 33 V RMS, 46,7 V PEAK eller 70 V DC (IEC 61010-1:2010).

Ikke fjern dekslene.

Hvis tilførselssikringen går som følge av en feil, kan det hende at instrumentets AC-tilførselsbryter vil bli skadet, og den må sjekkes av en kvalifisert ingeniør.

For å koble dette instrumentet fra AC-tilførselen trekker du ut IEC-kontakten. AC-tilførselsbryteren på dette instrumentet er kun for funksjonelle formål. Den er ikke beregnet for, eller egnet til frakoblingsenhet.

For målinger som faller innenfor EN 50110-1 og EN 50110-2 må man være oppmerksom på at alle kort med arbeidsspenninger over 50 V AC RMS eller 120 V DC kun kan kobles til av en kvalifisert tekniker eller elektriker og overvåket av en kvalifisert tekniker. (Kvalifiserte teknikere er personer som på grunn av sin spesialistopplæring, kunnskap og erfaring, samt sin kunnskap om relevante bestemmelser, er i stand til å gå inn i arbeidet som de har fått i oppdrag å utføre og detektere mulige farer, og som er blitt utnevnt som kvalifiserte teknikere av sin arbeidsgiver.

Português

AVISO DE SEGURANÇA
Este instrumento deve funcionar com uma terra de proteção conectada através do condutor da terra de proteção do cabo de alimentação ou, caso o instrumento esteja equipado com um, através do terminal da terra de proteção. Qualquer interrupção da terra de proteção, no interior ou no exterior do instrumento, poderá tornar o instrumento perigoso. A interrupção intencional é proibida. Além disso, deve ser conectado um sinal de terra se qualquer sinal de entrada exceder 33 V RMS, 46,7 V PICO ou 70 V CC (IEC 61010-1:2010).

Não retirar as tampas.

Se o fusível de alimentação fundir devido a uma falha, é possível que o interruptor de alimentação CA do instrumento seja danificado, devendo ser verificado por um engenheiro com qualificação adequada.

Para desconectar este instrumento da alimentação CA, retire o conector IEC da ficha. Neste instrumento, o interruptor de alimentação CA é fornecido apenas para fins funcionais. Não se destina a, nem é adequado para, ser utilizado como dispositivo de desconexão.

Para medições abrangidas pelas normas EN 50110-1 e EN 50110-2, tenha em atenção que todos os quadros com tensões de funcionamento superiores a 50 V CA RMS ou 120 V CC apenas poderão ser conectados por um técnico qualificado ou por alguém com formação em engenharia elétrica e supervisionados por um técnico qualificado. (Técnicos qualificados são pessoas que, devido à sua formação especializada, ao conhecimento e à experiência, bem como ao seu conhecimento das disposições relevantes, são capazes de avaliar o trabalho que lhes é confiado e detetar possíveis riscos e são pessoas que foram nomeadas técnicos qualificados pelo seu empregador.)

Português (Brasil)

AVISO DE SEGURANÇA
Este instrumento deve ser operado com um terra de proteção conectado por meio do condutor do terra de proteção do cabo de alimentação ou, se o instrumento estiver equipado com um, por meio do terminal de aterramento de segurança. Qualquer interrupção do terra de proteção, no interior ou no exterior do instrumento, poderá tornar o instrumento perigoso. A interrupção intencional é proibida. Além disso, deve ser conectado um sinal de terra se qualquer sinal de entrada exceder um máximo de 33 V RMS, 46,7 V PICO ou 70 V CC (IEC 61010-1:2010).

Não retirar as tampas.

Se o fusível de alimentação fundir como resultado de uma falha, é possível que o interruptor de alimentação CA do instrumento seja danificado, devendo este ser verificado por um engenheiro com qualificação adequada.

Para desconectar este instrumento da alimentação CA, desconecte o conector IEC. Neste instrumento, o interruptor de alimentação CA é fornecido somente para fins funcionais. Não se destina a, nem é adequado para, ser usado como dispositivo de desconexão.

Para medições no escopo das normas EN 50110-1 e EN 50110-2, note que todos os quadros com tensões de funcionamento superiores a 50 V CA RMS ou 120 V CC poderão somente ser conectados por um técnico qualificado ou por alguém com formação em engenharia elétrica e supervisionados por um técnico qualificado. (Os técnicos qualificados são pessoas que, devido à sua formação acadêmica, conhecimento e experiência, bem como ao seu conhecimento das provisões relevantes, são capazes de avaliar o trabalho que lhes é confiado e detectar possíveis riscos e são pessoas que foram nomeadas técnicos qualificados por seu empregador.)

Español

ADVERTENCIA SOBRE SEGURIDAD
Este instrumento debe utilizarse conectado a tierra a través del conductor de puesta a tierra del cable de alimentación o de la borna de seguridad, si dicho instrumento estuviera equipado con ella. Cualquier interrupción de esta puesta a tierra, dentro o fuera del instrumento, hará que el manejo del mismo resulte peligroso. Queda terminantemente prohibido dejar en circuito abierto dicha puesta a tierra. Además, debe conectarse una señal de tierra si cualquier señal de entrada sobrepasa los 33 V eficaces, los 46,7 V de PICO o los 70 V de CC (IEC 61010-1:2010).

No quite las tapas.

Si se fundiera el fusible de alimentación como consecuencia de una avería, cabe la posibilidad de que el interruptor de encendido del equipo esté dañado y sea necesario comprobarlo por personal técnico especializado y autorizado al efecto.

Para desconectar este instrumento de la red, desenchufe el conector IEC. El interruptor de entrada de CA (encendido) se incluye solo para fines funcionales. No está pensado para utilizarse como medio de desconexión, ni tampoco es adecuado para ello.

En cuanto a las mediciones que se clasifiquen bajo el alcance de las normas EN 50110-1 y EN 50110-2, tenga en cuenta que los cuadros con tensión de funcionamiento por encima de los 50 V de CA eficaces o los 120 V de CC solo puede conectarlos un técnico cualificado o una persona con formación en ingeniería eléctrica y supervisada por un técnico cualificado. (Los técnicos cualificados son personas que, debido a su formación especializada, conocimientos y experiencia, así como por su conocimiento de los suministros pertinentes, son capaces de evaluar el trabajo encomendado y detectar posibles riesgos, al igual que personas nombradas como técnicos cualificados por la empresa contratadora).

Svenska

SÄKERHETSVARNING
Detta instrument måste användas med jordad anslutning via strömkabelns ledare eller, om sådan finns, via en isolerad jordterminal. Avbrott i den isolerande jordningen inuti eller utanför instrumentet kan göra instrumentet farligt. Avsiktligt avbrott är förbjudet. Dessutom måste en signaljordning anslutas om någon ingångssignal överskrider 33 V RMS, 46.7 V PEAK eller 70 V DC (IEC 61010-1:2010).

Ta inte bort höljet.

Om säkringen utlöses som ett resultat av ett fel är det möjligt att instrumentets strömförsörjningsbrytare skadas och ska därför kontrolleras av en kvalificerad ingenjör.

För att kopplas loss detta instrument från strömförsörjningen, dra ut IEC-kontakten. Brytaren för växelströmförsörjningen på detta instrument är endast avsedd för funktionella syften. Den är inte avsedd eller lämplig som frånkopplingsenhet.

För mått inom intervallen som anges i EN 50110-1 och EN 50110-2, observera att alla kort med arbetsspänning över 50 V AC RMS eller 120 V DC kan endast anslutas av en kvalificerad tekniker eller en person som är utbildad i elteknik och övervakas av en kvalificerad tekniker. (Kvalificerade tekniker är personer som på grund av sin specialistutbildning, kunskap och erfarenhet liksom sin kunskap om relevanta enheter kan utvärdera arbetet som tilldelas dem och göra kvalificerade riskbedömningar samt utses av sina arbetsgivare till kvalificerade tekniker).

English

SAFETY WARNING

This instrument must be operated with a protective ground (earth) connection via the protective ground conductor of the supply cable or, if the instrument is fitted with one, via the protective ground terminal. Any interruption of the protective ground, inside or outside the instrument, is likely to make the instrument dangerous. Intentional interruption is prohibited. In addition, a signal ground must be connected if any input signal exceeds 33 V RMS, 46.7 V PEAK or 70 V DC (IEC 61010-1:2010).

Do not remove the covers.

If the supply fuse blows as the result of a fault, the instrument's AC supply switch may be damaged and should be checked by a suitably qualified engineer.

To disconnect this instrument from the AC supply, unplug the IEC connector. The AC supply switch on this instrument is provided for functional purposes only. It is not intended, or suitable, as a disconnecting device.

For measurements falling within the scope of the EN 50110-1 and EN 50110-2, please note that all cards with working voltages above 50 V AC RMS or 120 V DC may only be connected by a qualified technician or a person trained in electrical engineering and supervised by a qualified technician. (Qualified technicians are persons who, due to their specialist training, knowledge and experience as well as their knowledge of the relevant provisions are able to assess the work with which they are entrusted and detect possible risks and who have been nominated as qualified technicians by their employer).

日本語

安全上の警告
本機器の操作は、電源ケーブルの保護接地線で接地（アース）を施した上で行ってください。また、安全接地用端子が存在する場合は、これを経由して本機器を接地してください。機器の内部または外部にある保護接地線が遮断されると、機器が危険な状態に陥る可能性があります。故意に保護接地線を遮断することを禁止します。また、入力信号が33V RMS、ピーク時に46.7V RMS、または70V DCを超える場合は、信号接地線を接続してください（IEC 61010-1:2010）。

カバーは取り外さないでください。

電源ヒューズが故障により飛んだ場合、機器のAC電源スイッチが損傷するおそれがあるため、然るべき認定を受けた適任者による点検を受けてください。

本機器をAC電源から遮断するには、IECコネクターを抜きます。本機器のAC電源スイッチは、機能上の目的のためだけに提供しています。したがって、機器の主電源遮断用として意図されていないか、適応していません。

EN 50110-1とEN 50110-2の適用範囲に該当する測定を行う際、使用電圧が50 V AC RMSまたは120 V DCを超えるすべての基板の接続作業は、適正な資格を持つ技術者が、または電気工学の訓練を受けた者が適正な資格を持つ技術者の監督の下、行わなければなりませんのでご注意ください。(適正な資格を有する技術者とは、専門技術者に向けた訓練を受け、知識と経験を有し、該当する規定についても熟知しているため、委託された作業の内容を評価し、存在する可能性のあるリスクを特定することができ、雇用主により適正な資格を有する技術者として任命されている者を指します。)

中文

安全警告

该仪器必须通过电源电缆的保护接地线连接到保护接地（接地），如果该仪器已配备了安全接地端子，则通过该端子接地。断开仪器内外的任何保护接地可能使设备存在危险。严禁有意断开。此外，若任何输入信号高于 33 V RMS, 46.7 V 峰或 70 V DC，则必须将信号接地 (IEC 61010-1:2010)。

不要取下保护盖。

如果电源保险丝因故障而熔断，则有可能损坏仪器的交流电源开关并应由具备资格的工程师检查。

拔下仪器上的 IEC 接头即可断开交流电源。仪器上的交流电源开关仅用于功能性目的。而不是用于或适用于断开设备。

对于 EN 50110-1 和 EN 50110-2 中的测量，请注意：所有工作电压高于 50 V AC RMS 或 120 V DC 的板卡只能由合格的技术人员或在由受过电气工程培训的人员在合格技术人员的监督下进行连接。(合格技术人员指的是其专业培训、知识和经验以及相关规定的指示能够胜任委托给他们的工作并能检查出可能风险的人，这些人会被其雇主指定为合格技术人员）

РУССКИЙ

ПРЕДУПРЕЖДЕНИЕ
Для эксплуатации данного прибора необходимо использовать защитное заземление, подключенное через проводник заземления кабеля питания или через терминал защитного заземления, если прибор оснащен таковым. В случае прерывания защитного заземления (внутри или снаружи прибора) прибор может стать травмоопасным. Преднамеренное прерывание заземления запрещено. Кроме того, необходимо подключить сигнальное заземление, если напряжение входного сигнала превышает 33 В среднеквадр. знач., 46,7 В пиков. знач. или 70 В пост. тока (IEC 61010-1:2010).

Не снимать крышки.

Если в результате неисправности перегорает предохранитель, существует вероятность повреждения переключателя сети переменного тока прибора. В таком случае переключатель должен быть проверен квалифицированным инженером.

Для отключения данного прибора от сети переменного тока отсоедините разъем IEC. Переключатель питания переменного тока данного прибора предусмотрен только для функциональных целей и не должен использоваться в качестве устройства отключения.

Для проведения измерений в соответствии со стандартами EN 50110-1 и EN 50110-2 следует учесть, что подключение всех плат, рабочее напряжение которых превышает 50 В перемен. тока среднеквадр. знач. или 120 В пост. тока, может выполнять только квалифицированный технический персонал или сотрудники, прошедшие курс обучения по электротехнике, под наблюдением квалифицированного персонала. (Квалифицированным техническим персоналом считаются сотрудники, которые после специальной подготовки, получения требуемых знаний и опыта, а также знакомые с основными процедурами, способны оценить доверенную им работу, определив возможные риски. При этом назначение на должность квалифицированного технического работника осуществляет работодатель.)

안전 경고

안전 경고
본 장비는 반드시 보안용 접지(접지)가 전원 공급 장치 케이블의 보안용 접지 도체를 통해 연결된 상태에서 작동해야 하며, 접지가 장착된 경우에는 보안용 접지 터미널을 통해 작동해야 합니다. 장비 내부 혹은 외부적으로 접지 방해 요인이 있는 경우 사용자에게 위험할 수 있습니다. 고의적인 방해는 금지됩니다. 또한, 입력 신호가 **33 V RMS, 46.7 V** 피크 또는 **70 V DC(IEC 61010-1:2010)**를 초과하는 경우 신호 접지를 연결해야 합니다.

덮개를 제거하지 마십시오.

결함으로 인해 공급 퓨즈가 끊어진 경우, 장비의 **AC** 전원 공급 스위치가 손상될 수 있으므로 반드시 검증된 전문 기사에게 이상 유무를 의뢰하도록 합니다.

AC 공급 전원으로부터 장비를 분리하려면, **IEC** 커넥터를 뽑으십시오. 본 장비의 **AC** 전원 공급 스위치를 장비 작동 외에 다른 용도로 사용하지 마십시오. 본 스위치는 단절 용도로 설계되지 않았으며, 이에 적합하지도 않습니다.

EN 50110-1 및 **EN 50110-2** 범위에 속한 측정값의 경우, **50 V AC RMS** 또는 **120 V DC** 를 초과하는 작동 전압의 모든 보드는 검증된 전문 기사 또는 전기 공학 교육을 받고 검증된 전문 기사의 감독을 받는 사람만이 연결할 수 있습니다. (검증된 전문 기사는 전문가 교육, 지식 및 경험뿐만 아니라 관련 규정의 지식을 보유하고 있어 그들에게 위임된 작업을 수행하고 가능한 위험을 탐지할 수 있으며 고용주가 자격을 갖춘 기술자로 지명한 사람입니다.)

2.10 Operation of electrical installations

Working on, with, or near electrical installations implies certain dangers. These electrical installations are designed for the generation, transmission, conversion, distribution and use of electrical power. Some of these electrical installations are permanent and fixed, such as a distribution installation in a factory or office complex, others are temporary, such as on construction sites, and others are mobile or capable of being moved either while energized or while neither energized nor charged.

The European Standard EN 50110-1 sets out the requirements for the safe operation of and work activity on, with, or near these electrical installations. The requirements apply to all operational, working and maintenance procedures. The European Standard EN 50110-2 is a set of normative annexes (one per country) which specify either the present safety requirements or give the national supplements to these minimum requirements at the time when this European Standard was prepared.

WARNING

High voltage and qualified personnel

For measurements falling within the scope of the EN 50110-1 and EN 50110-2, please note that all cards with working voltages above 50 V AC RMS or 120 V DC may only be connected by a qualified technician or a person trained in electrical engineering and supervised by a qualified technician. (Qualified technicians are persons who, due to their specialist training, knowledge and experience, as well as their knowledge of the relevant provisions, are able to assess the work with which they are entrusted and detect possible risks and who have been nominated as qualified technicians by their employer).

3 Normative Documents and Declarations

3.1 Electrical

3.1.1 Electrostatic Discharge (ESD)

When handling disconnected devices, electrostatic discharge (ESD) can cause damage if discharged into or near sensitive components on the device. Take steps to avoid such an occurrence.

CAUTION

HBM uses state-of-the-art electronic components in its equipment. These electronic components can be damaged by discharge of static electricity (ESD). ESD damage is quite easy to induce, often hard to detect, and always costly. Therefore, we must emphasize the importance of ESD preventions when handling an ISOBE5600 system, or its connections.

Description of ESD

Static electricity is an electrical charge caused by the buildup of excess electrons on the surface of a material. To most people, static electricity and ESD are nothing more than annoyances. For example, after walking over a carpet while scuffing your feet, building up electrons on your body, you may get a shock - the discharge event - when you touch a metal doorknob. This little shock discharges the built-up static electricity.

ESD-susceptible equipment

Even a small amount of ESD can harm circuitry, so when working with electronic devices, take measures to help protect the electronic devices, including the ISOBE5600 system, from ESD harm. Although HBM has built protections against ESD into its products, ESD exists and, unless neutralized, could build up to levels that could harm the equipment. Any electronic device that contains an external entry point for plugging in anything from cables to acquisition cards is susceptible to entry of ESD.

Precautions against ESD

Any built-up static electricity should be discharged from the user and the electronic devices before touching an electronic device, before connecting one device to another, or replacing acquisition cards. This can be done in many ways, including the following:

- Grounding oneself by touching a metal surface that is at earth ground. For example, if the computer has a metal case and is plugged into a standard three-prong grounded outlet, touching the case should discharge the ESD on the body.
- Increasing the relative humidity of the environment.
- Installing ESD-specific prevention items, such as grounding mats and wrist straps.

While appropriate precautions to discharge static electricity should always be taken, the user may want to take extra precautions to protect the electronic equipment against ESD if ESD events are observed in the present environment.

The use of wrist straps
Use an ESD wrist strap whenever you open a chassis, particularly when you will be handling circuit cards and components. In order to work properly, the wrist strap must make good contact at both ends (with the user's skin at one end, and with the chassis at the other).

WARNING

The wrist strap is intended for static control only. It will not reduce or increase your risk of receiving an electric shock from electrical equipment. Follow the same precautions you would use without a wrist strap.

WARNING

Wrist straps should only ever be used in situations where no direct power is connected to the circuit or system being handled.

3.1.2 Electro-Magnetic Compatibility (EMC)

EMC stands for Electro-Magnetic Compatibility. The overall intention is that electronic equipment must be able to co-exist with other electronic equipment in its immediate vicinity and that the electronic equipment does not emit large amounts of electromagnetic energy. Thus, there are two distinct requirements for electromagnetic compatibility: emission and immunity.

This instrument generates, accepts and can radiate radio frequency energy and, if not installed and used in accordance with the operator manual, may cause harmful interference to other equipment. However, there is no guarantee that interference will not occur in a particular installation.

Immunity test: All immunity tests are done with the failure criterion being a change of the instrument's control settings. Any of these tests may produce a spurious trigger. Measurements are not valid during and immediately after the immunity tests.

Whether the instrument causes interference to other equipment can be determined by turning the instrument on and off. If this instrument does cause minor harmful interference to other equipment, the user is encouraged to try reducing the interference by one or more of the following measures:

- Re-orient or relocate the affected equipment.
- Increase the distance between the instrument and the affected equipment.
- Re-orient or relocate interface cables.
- Connect the instrument to an outlet on a different supply circuit to the affected equipment.

Supply cables, interface cables and probes should be kept as short as practical, preferably a maximum of 1 m. Interface cables should be screened and interface cables longer than 3 m are not acceptable in terms of interference port immunity.

3.2 Environment

3.2.1 WEEE - Waste Electrical and Electronic Equipment

Since February 2003, European Union legislation stating that EU members now restrict the use of hazardous substances in electrical and electric equipment (Directive 2002/95/EC) and promotes the collection and recycling of such electrical equipment (Directive 2002/96/EC) has been in force.

Statutory waste disposal mark

The electrical and electronic devices that bear this symbol are subject to the European waste electrical and electronic equipment directive 2002/96/EC. The symbol indicates that the device must not be disposed of as household garbage.

In accordance with national and local environmental protection and material recovery and recycling regulations, old devices that can no longer be used must be disposed of separately and not with normal household garbage. For more information about waste disposal, please contact local authorities or the dealer from whom the product was purchased. As waste disposal regulations may differ from country to country within the EU, please contact the supplier about waste disposal regulations if necessary.

Packaging

The original packaging of HBM devices is made from recyclable material and can be sent for recycling. For ecological reasons, empty packaging should not be returned to us.

Environmental protection

The product will comply with general hazardous substances limits for at least 20 years, and will be ecologically safe to use during this period, as well as recyclable. This is documented by the 20 years symbol on the system as statutory mark of compliance with emission limits in electronic equipment supplied to China.

3.3 Declaration of confirmity

For information about the CE Declaration of conformity, please refer to www.hbm.com/highspeed.

4 Batteries

4.1 General

The ISOBE5600t transmitter operates on removable, rechargeable Li-ion batteries. The ISOBE5600tm has internal rechargeable Ni-MH batteries that are not serviceable.

Battery lifetime

A battery's lifetime depends on how it is handled. High temperature, super-fast charging and harsh discharges are conditions that harm batteries. Repeated full discharge cycles also stress the battery.

Precautions and warnings when using batteries

- Use the battery only for its intended purpose.
- Do not take batteries apart or modify them. The batteries must not be damaged, crushed, pierced or exposed to high temperatures. If a battery is handled inappropriately, it could be a risk of combustion or explosion.
- Do not leave the batteries in hot or cold places, as you will reduce the capacity and lifetime of the batteries. Always try to keep batteries at room temperature. A system with hot or cold batteries may not work temporarily, even if the batteries are fully charged.
- Do not short-circuit the battery. Accidental short-circuit can occur when a metallic object causes a direct connection between the + (plus) and - (minus) terminals of the battery, for example when a spare battery is carried in a pocket or bag. Short-circuiting the terminals may damage the battery or the object that causes the short-circuiting.

WARNING

If leaked battery fluid comes into contact with your eyes, immediately flush out your eyes with water and consult a doctor, as it may result in blindness or other injury. If leaked battery fluid comes in contact with your body or hands, wash thoroughly with water.
If leaked battery fluid comes into contact with the instrument, carefully wipe the instrument, avoiding direct contact with your hands.

WARNING

For protection against electric shock the transmitter may not be operated without both battery bays closed, either by a battery module installed or by a bay cover in place.
Make sure that input signals are detached from the transmitter before a battery module is removed.

4.1.1 Li-ion battery management

The following guidelines apply for optimum Li-ion battery usage.

The most important thing to understand about Li-ion batteries is that they are **always** losing a small amount of their charge. The hotter the temperature, the faster Li-ion batteries lose their charge.

- A Li-ion battery typically provides 300-500 discharge/charge cycles.
- This battery type prefers a partial rather than a full discharge. Frequent full discharges should be avoided when possible. Instead, charge the battery more often, except before a long storage. There is no concern of memory when applying unscheduled charges, the Li-ion battery does not suffer from the "memory effect" at all.
- Li-ion batteries should be kept cool. Ideally they are stored in a refrigerator. Aging will take its toll much faster at high temperatures. The high temperatures found in cars cause Li-ion batteries to degrade rapidly. However, never freeze a battery.
- When using a notebook computer or any other device with Li-ion batteries running from fixed line power over extended periods, the battery can be removed and stored in a cool place so that it is not affected by the heat produced by the device.

Storage temperature and charge

- Store the battery at a 40% charge level. Never fully charge or discharge the battery before storage. The 40% charge assures a stable condition even if self-discharge robs some of the battery's energy.
- Storing a Li-ion battery at the correct temperature and charge makes all the difference in maintaining its storage capacity. The following table shows the amount of permanent capacity loss that will occur after storage at a given charge level and temperature.

Storage Temperature (Permanent Capacity Loss versus Storage Conditions)	**40% Charge**	**100% Charge**
0 °C (32 °F)	**2%** loss after 1 year	**6%** loss after 1 year
25 °C (77 °F)	**4%** loss after 1 year	**20%** loss after 1 year
40 °C (104 °F)	**15%** loss after 1 year	**35%** loss after 1 year
60 °C (140 °F)	**25%** loss after 1 year	**40%** loss after **3 months**

Source: www.BatteryUniversity.com

- It is beneficial to avoid storing a Li-ion battery at full charge. A Li-ion battery stored at 40% charge will last many times longer than one stored at 100% charge, particularly at higher temperatures.
- If a Li-ion battery is stored with too low a charge, there is a risk of allowing the charge to drop below the battery's low-voltage threshold, resulting in an unrecoverably dead battery. Once the charge has dropped to this level, recharging it can be dangerous. An internal safety circuit will therefore open to prevent charging, and the battery cannot be used anymore.
- In circumstances where a second Li-ion battery is available for a given device, it is recommended that the unused battery be discharged to 40% and placed in the refrigerator to prolong its shelf life. **Batteries should be allowed to completely warm to room temperature over up to 24 hours before any discharge or charge.**

Avoid purchasing spare Li-ion batteries for later use. Observe the manufacturing date when purchasing. Do not buy old stock, even if sold at clearance prices.

Contact your battery supplier/manufacturer (or visit their web site) for more details on battery specifications, usage and maintenance.

4.1.2 Ni-MH battery management

The following guidelines apply for optimum Ni-MH battery usage.

The most important thing to understand about Ni-MH batteries is that they are **always** losing an amount of their charge. The hotter the temperature, the faster Ni-MH batteries lose their charge.

- The energy loss in a Ni-MH battery is asymptotical, meaning that the self-discharge is highest right after charge and then tapers off. Nickel-based batteries lose 10 to 15 percent of their capacity in the first 24 hours after charge, then 10 to 15 percent per month.

- The self-discharge on all battery chemistries increases at higher temperature and the rate typically doubles with every 10 °C (18 °F). A noticeable energy loss occurs if a battery is left in a hot environment. High cycle count and aging also increase self-discharge. Nickel-metal-hydride is good for 300-400 cycles before elevated self-discharge starts interfering with performance. The self-discharge on an older nickel-based battery can get so high that the pack loses its energy through leakage rather than normal use.
- Ni-MH batteries can be stored for about three years.
- A Ni-MH battery typically provides 300-500 discharge/charge cycles.
- Ni-MH batteries can lose electrolyte through venting due to excessive pressure during extreme charge or discharge. After repeated venting, the spring-loaded seal of the cells may not seal properly again, and the deposit of white powder around the seal opening is evidence of this. Losses of electrolyte may also occur as part of faulty manufacturing.

Storage temperature and charge

- Store the battery at a 40% charge level. Never fully charge or discharge the battery before storage. The 40% charge assures a stable condition even if self-discharge robs some of the battery's energy.
- Storing a Ni-MH battery at the correct temperature makes all the difference in maintaining its storage capacity. The following table shows the amount of permanent capacity loss that will occur after storage at a given temperature.

Storage Temperature (Permanent Capacity Loss versus Storage Conditions)	
0 °C (32 °F)	**1%** loss after 1 year
25 °C (77 °F)	**3%** loss after 1 year
40 °C (104 °F)	**5%** loss after 1 year
60 °C (140 °F)	**30%** loss after 1 year

- If a Ni-MH battery is stored with too low a charge, there is a risk of allowing the charge to drop below the battery's low-voltage threshold, resulting in an unrecoverably dead battery.

Avoid purchasing spare Ni-MH batteries for later use. Observe the manufacturing date when purchasing. Do not buy old stock, even if sold at clearance prices.

Contact your battery supplier/manufacturer (or visit their web site) for more details on battery specifications, usage and maintenance.

4.2 Remove and replace

ISOBE5600tm
The ISOBE5600tm includes a non-user replaceable battery please contact HBM service if battery replacement is required.

ISOBE5600t
Before you can use the transmitter, a battery module must be installed. When a battery is low and needs to be charged it must be removed.

WARNING

ELECTRICAL SHOCK HAZARD! Remove all cables before proceeding.

Removing a battery module
To remove a battery module do the following:

1 Using a flat blade screwdriver, loosen the multi-turn screw that holds the battery module in place.
2 Pull the battery module gently out of the cabinet.

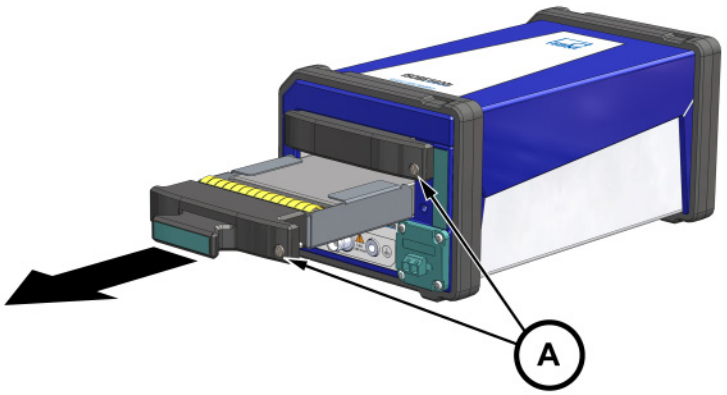


Figure 4.1: Battery module removal

A Screws

Placing a battery module
To place a battery module proceed as follows:

1 Place the battery module in the cabinet.
2 Push it firmly into the connector in the rear of the cabinet until you feel it snap, without using excessive force.
3 Using a flat blade screwdriver fasten the multi-turn screw to hold the battery module in position.

Battery module
The battery module is a battery holder with a standard Li-ion battery. The batteries can be charged and discharged hundreds of times, but will gradually wear out. When the operation time is noticeable shorter than normal, it is time to renew the batteries.

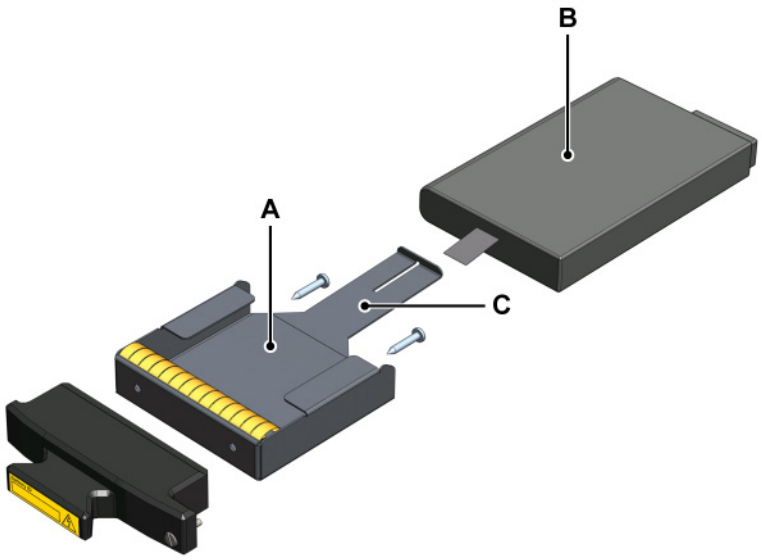


Figure 4.2: Battery module

A Battery holder

B Battery pack

C Lock strip

The battery module is designed to fit in the supplied battery charger, i.e. it is not necessary to remove the battery from its holder when charging. However, when you are using a non-standard charger it may be necessary to remove the battery from its holder before you can place the battery in a charger.

Renewing a battery
To renew a battery in the battery module do the following:

1 Remove the battery module from the cabinet and place it on a flat surface.
2 Remove the battery from the battery holder:
   - Gently bend down the strip that locks the battery into position until the battery is released.
   - Pull the battery out of the holder.
3 Place a new battery in the holder.

Changing handle on Battery holder
Spare batteries with battery holders are delivered in a configuration to fit into the newer transmitter design of the ISOBE5600t and 6600 HV. The same spare battery with battery holder can be reconfigured to work in older transmitters as well. A spare handle is included in the delivery of the optional batteries with holder.

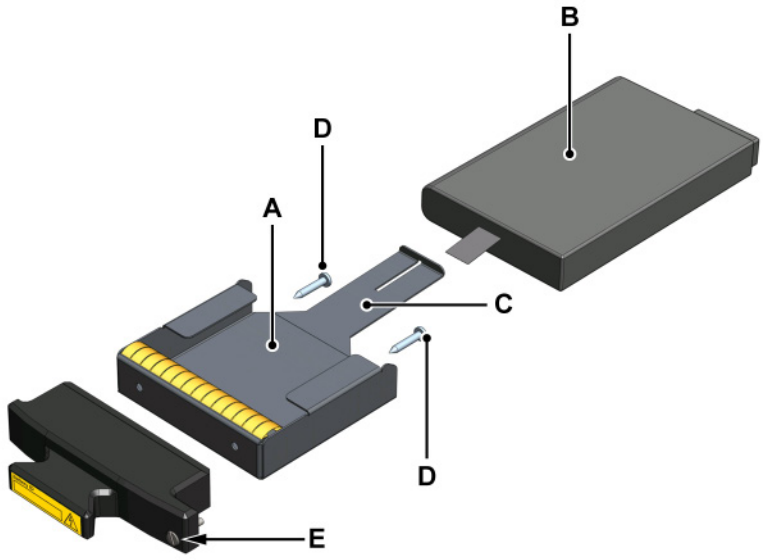


Figure 4.3: Configuration as delivered (new design, locking screw on the right)

A Battery holder
B Battery pack
C Lock strip
D Two fixing screws
E Locking screw

How to change the handle

1 Remove the battery module from the cabinet and place it on a flat surface.

2 Remove the battery from the battery holder:
- Gently bend down the strip that locks the battery into position until the battery is released.
- Pull the battery out of the holder.

3 Remove the two fixing screws.

4 Remove the black handle and replace it by the spare handle with the locking screw hole on the left side.

5 Use the two fixing screws to mount the handle on the holder.

6 Transfer the locking screw from the old handle to the new handle.

7 Place the battery back in the holder.

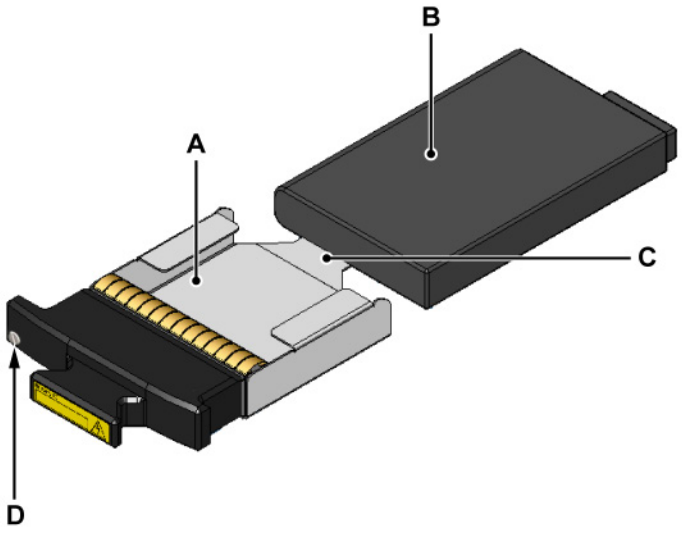


Figure 4.4: Configuration after handle change (locking screw on the left)

A Battery holder

B Battery pack

C Lock strip

D Locking screw

4.3 Recharging

The ISOBE5600t uses rechargeable Li-ion batteries that need to be charged in external charges.

Precaution and warnings when charging batteries

- Never use any charger or battery that is damaged in any way.
- Battery charging time depends on the remaining battery charge and the type of battery and charger used. The batteries can be charged and discharged hundreds of times, but will gradually wear out. When the operation time is noticeably shorter than normal, it is time to buy new batteries.
- If left unused, a fully charged battery will discharge itself over time.
- Use only HBM approved batteries and recharge your batteries only with HBM approved chargers. When a charger is not in use, disconnect it from the power source. Do not leave a battery connected to a charger for more than a week, since overcharging may shorten its life.
- Extreme temperatures will affect the charging capacity of the battery: it may require cooling or warming first.
- Remove the batteries before charging.
- Standard Li-ion batteries cannot be charged below 0 °C (32 °F). Although the packs appear to be charging normally they will be damaged. If done repeatedly, such damage can compromise the safety of the pack. The battery will become more vulnerable to failure if subjected to impact, crush or high-rate charging.

ISOBE5600tm

The internal battery of the ISOBE5600tm is automatically recharged when the transmitter is connected to the mains, also when the system is in operation.

ISOBE5600t

To recharge the batteries of the transmitter you need a suitable charger. HBM provides chargers that are targeted towards the HBM qualified batteries.

Figure 4.5: Example of a battery charger

To (re)charge a battery proceed as follows:

1. Remove all cables from the ISOBE5600t transmitter.
2. Remove the battery as described in "Removing a battery module" on page 55.
3. Place the battery or batteries in the charger:
   - Refer to the documentation that came with your charger for additional information.
   - Depending on the charger in use, the complete battery module may not fit in the charger. If so, remove the battery pack from the battery holder as described in "Renewing a battery" on page 57.
4. When the battery is fully loaded, replace the battery as described in "Placing a battery module" on page 56.

Requirements
Recharging the battery is defined by the battery in use. Check the details of the battery to match the required charge current and voltage.

When the battery is fully exhausted, it will take several hours to reach the 100% capacity again (at the typical charge rate). In practice, however, the battery will not be fully exhausted, reducing the recharge time.

Battery low vs. recharge
The "battery low" indication on the receiver front panel becomes active when the battery capacity has dropped to 1 Ah, and stays active until the battery is depleted. After this the transmitter will not function any more.

4.4 Dispose

Dispose of used batteries only in accordance with local chemical waste regulations. Always recycle.

WARNING

Do not dispose of batteries in a fire.

For more information about waste disposal, please contact the local authorities or the dealer from whom the product was purchased.
As waste disposal regulations may differ from country to country within the EU, please contact the supplier about waste disposal regulations if necessary.

5 Mains Power

5.1 Power and frequency requirements

The **ISOBE5600t** transmitter is battery-powered. Refer to the various sections in this document on batteries, their usage, storage, charging and power management for more information. The ISOBE5600t transmitter uses 6 VA typical, 8 VA maximum.

The **ISOBE5600tm** uses up to 12 VA and operates from line voltages of 115 V AC or 230 V AC at 47-63 Hz.

The power connection of the ISOBE5600tm is via a standard IEC 320 EN 60320 C14 (male) appliance inlet, 2-pole, 3-wire designed for 250 V @ 10A. Access to the AC supply fuse(s) and voltage selector can only be made if the AC supply connector is removed.Two 250 mA fuses must always be used. Refer to "Fuse replacement" on page 63 for details.

To connect or disconnect the instrument from the AC supply, plug or unplug the IEC connector from the instrument. The instrument should be positioned to allow access to the AC connector. The front power switch on the instrument is not a disconnecting device. When the instrument is connected some power will be consumed.

The **ISOBE5600r/ISOBE5600m** receiver uses up to 40 VA and operates from line voltages from 90 V AC to 264 V AC at 47-63 Hz. The power connection of the ISOBE5600r/ISOBE5600m receiver is via a standard IEC 320 EN 60320 C14 (male) appliance inlet, 2-pole, 3-wire designed for 250 V at 10 A. Access to the AC supply fuses can only be made if the AC supply connector is removed. Two 1 A fuses must always be used. Refer to "Fuse replacement" on page 63 for details. To disconnect the receiver from the AC supply, put the switch in the “0” position or unplug the IEC connector on the rear of the receiver.

CAUTION

Do not position the ISOBE5600r/ISOBE5600m receiver so that it is difficult to remove the power input cable.

The ISOBE5600r/ISOBE5600m receiver must be used with a ground connected via the conductor of the supply cable. This is to ensure that all electromagnetic Compatibility (EMC) requirements are met.

5.2 Fuse replacement

The **ISOBE5600tm** is equipped with a replaceable fuse. The fuse arrangement stated here must be followed and, additionally, in the UK a fuse should be fitted in the line supply plug.

The fuse must be a 5 x 20 mm slow blow (T) fuse with a rating of 250 mA.

The **ISOBE5600r/ISOBE5600m** receiver is equipped with a replaceable fuse. The fuse arrangement stated here must be followed and, additionally, in the UK a fuse should be fitted in the line supply plug.

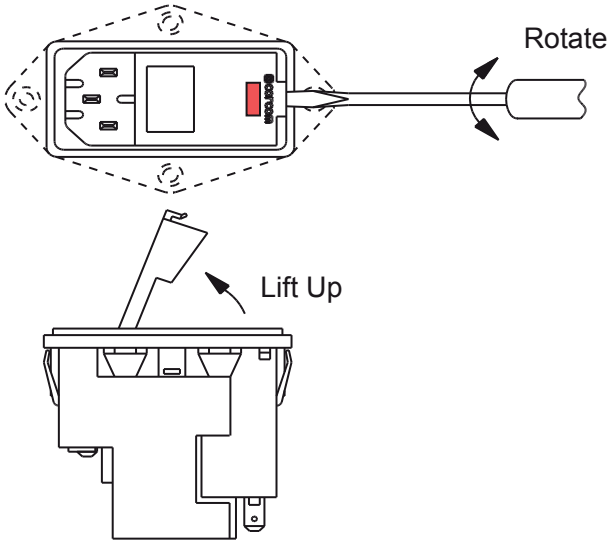
The fuse must be a 5 x 20 mm slow blow (T) fuse with a rating of 1 A.

WARNING

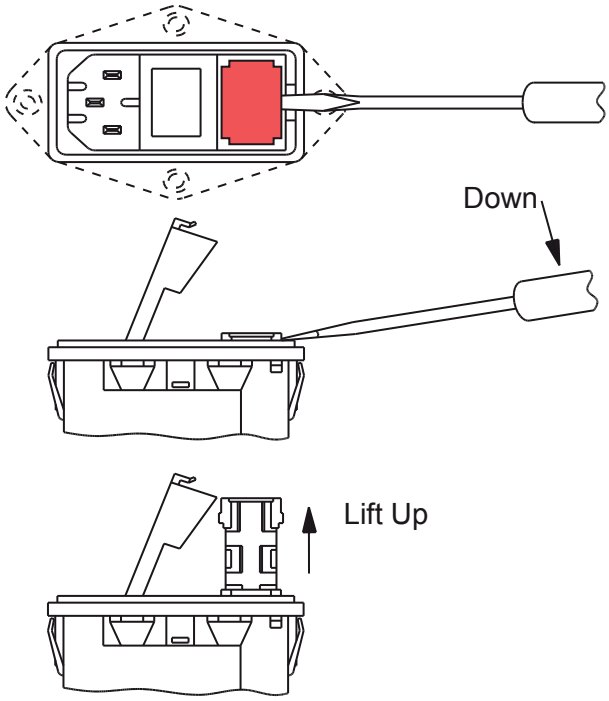
Inspect the voltage selector at the rear of the transmitter cabinet for the correct setting before applying power. If necessary see the section for instructions on changing the voltage selector.

To gain access to the fuses proceed as follows:

1. Unplug the power cord.
2. Using a pocket screwdriver, insert the screwdriver in the slot under the fuse door and gently rotate the screwdriver to unlatch the door. When unlatched, raise the fuse door.



3 With the door in the raised position, gently position the screwdriver at the slot in the end of the fuse holder and gently lever to raise the fuse holder and remove it from the housing.



Replacing the fuses
The fuse holder is equipped with two identical fuses.

WARNING

Replace both fuses at the same time with correct type and rating as indicated on the rear of the ISOBE5600r/ISOBE5600m or ISOBE5600tm and in this manual.

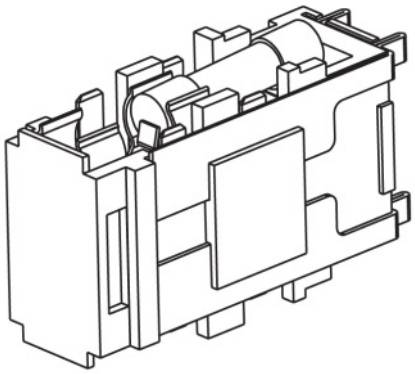


Figure 5.1: Fuse holder shown with 5x20 mm fuse

To replace the fuses proceed as follows:

1 Remove the fuses from their fixture and insert new fuses.
2 When done re-insert the fuse holder and close the fuse door.

Note *The fuse holder has two fuses installed. Replace both fuses at the same time.*

5.3 Mains voltage selector

WARNING

Inspect the voltage selector for the correct setting before applying power. Using a wrong voltage selection could result in unrecoverable internal system damage.

Changing the voltage selection for ISOBE5600tm
To change the voltage selection do the following:

1. Turn the fuse holder.
2. Re-insert the fuse holder and close the fuse door.
3. The correct voltage must now be visible from the outside of the power entry housing.

Re-insertion of the fuse holder should go smoothly. Do not use excessive force. Verify proper placement of fuses as well as the position of the unit if it won't snap into place easily.

6 Introduction

6.1 Introduction the ISOBE5600

Welcome. You have made the right choice: the ISOBE5600 is the third generation of ISOBE optical isolated digitizers designed by HBM. Smaller, less weight and improved performance compared to its predecessors make the ISOBE5600 the leading product for use in the most demanding test lab applications. The digitizer is designed for applications that require high voltage isolation and safe and accurate measurements.

Successful operation of any laboratory, whether independent or manufacturer-owned, relies on disturbance-free and accurate measurements, also when the object under test has a failure: high frequency oscillating currents flow to ground and cause a high potential shift of the ground point. The resulting problems of grounding and power supply connection are less when galvanic isolation from the test area is achieved by means of fiber optic links.

There are two principal ways of transmitting signals via fiber optic links: analog or digital. With a digital link the measured signal is digitized with an A-to-D converter close to the test object, transmitted via the fiber optics, processed directly in digital form, and converted back to an analog signal with a D-to-A converter. Digital fiber optic systems do not have drift or noise problems and surpass their analog counterparts when it comes to dynamic accuracy.

Bringing the A-to-D converters close to the test object, however, means that extra care must be taken to shield the equipment from strong electromagnetic fields. The power for the A-to-D converters must be supplied from batteries to avoid any coupling with the environment.

The ISOBE5600 eliminates the use of floating scopes, protecting both operator and instrument even where high voltage and high EMI are involved. The ISOBE5600 offers remote operation, excellent signal fidelity and elimination of ground problems.

Features and advantages

- Complete single-channel isolated analog input to analog output system
- Rugged enclosure for use in EMI-hostile environments
- Digital fiber optic data transmission for excellent DC stability
- Wide dynamic range and unsurpassed dynamic accuracy

6.1.1 Configuration

The ISOBE 5600 has two mechanical variants, one for use in medium and one for use in high voltage environments.

The ISOBE5600**tm Medium Voltage** version is single-layer shielded and uses AC power with an isolation voltage of 1800 V RMS. The **m** version of the transmitter can be used for isolated measurements up to 1800 V RMS while being powered by AC power. When higher isolation is required, the tm version can be disconnected from the AC power and run from internal battery for 5 minutes. When it is reconnected to AC power, the internal battery will be recharged.

The ISOBE5600**t High Voltage** version is also single layer shielded and exclusively battery powered. The removable batteries run for 24 hours, with a software controlled “standby mode” that extends the standby time significantly. The power consumption in the standby mode is only 25% of the consumption during normal operation. The ISOBE5600t goes automatically into standby mode, when it is not connected to a receiver or the receiver is powered off. Standardized Li-ion batteries are used to ensure proper operation in various environments.

The ISOBE5600**r Receiver** module is the standard stand-alone module for receiving data from the transmitters, it can receive up-to four data signals. These signals are then output to a recorder or to the Perception software. This module is mains-powered and has metal shielding.

The ISOBE5600**m Memory** module is based on the ISOBE5600r (receiver) however it also includes internal memory capabilities as standard. This module is mains-powered and has been designed to run as a stand alone recorder for single-shot recordings, providing a cost effective and portable solution to single-shot recording requirements.

6.1.2 Functional description

For each data channel the system has a transmitter (the ISOBE5600t and tm transmitter), a twin fiber optic link and a data channel receiver unit. The data channel receiver unit can host up to 4 transmitter units.

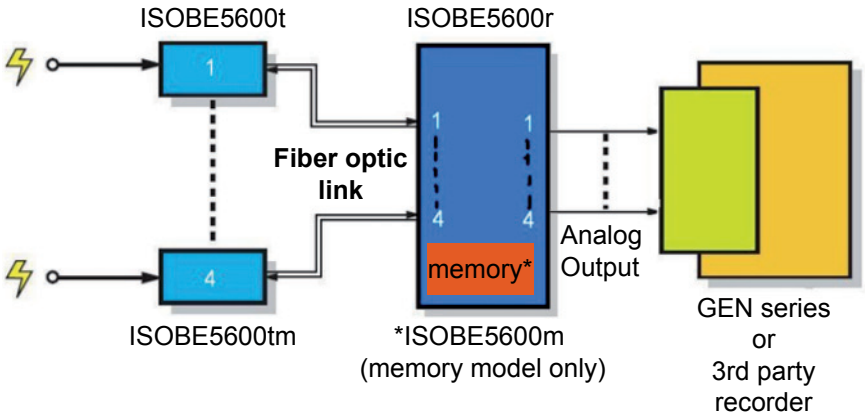


Figure 6.1: System block diagram

The transmitter comprises a high-fidelity programmable amplifier with anti-aliasing (AA) filter, an A-to-D converter, control logic, fiber optic interfacing and a battery power management system.

For technical specifications refer to "B3946-2.1 en (ISOBE5600/ISOBE5600r Analog-in to Analog-out Isolated Systems)" on page 98.

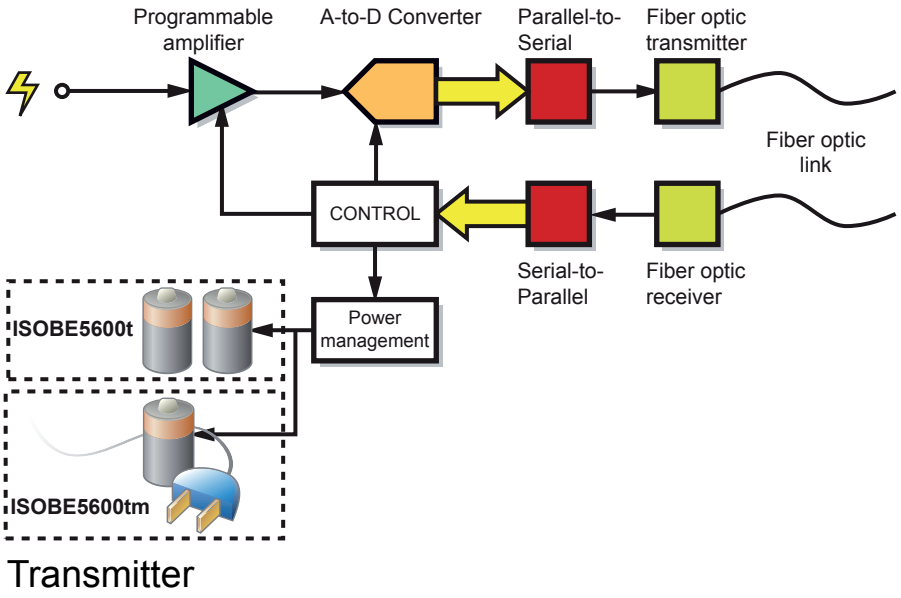


Figure 6.2: ISOBE5600 block diagram - Transmitter

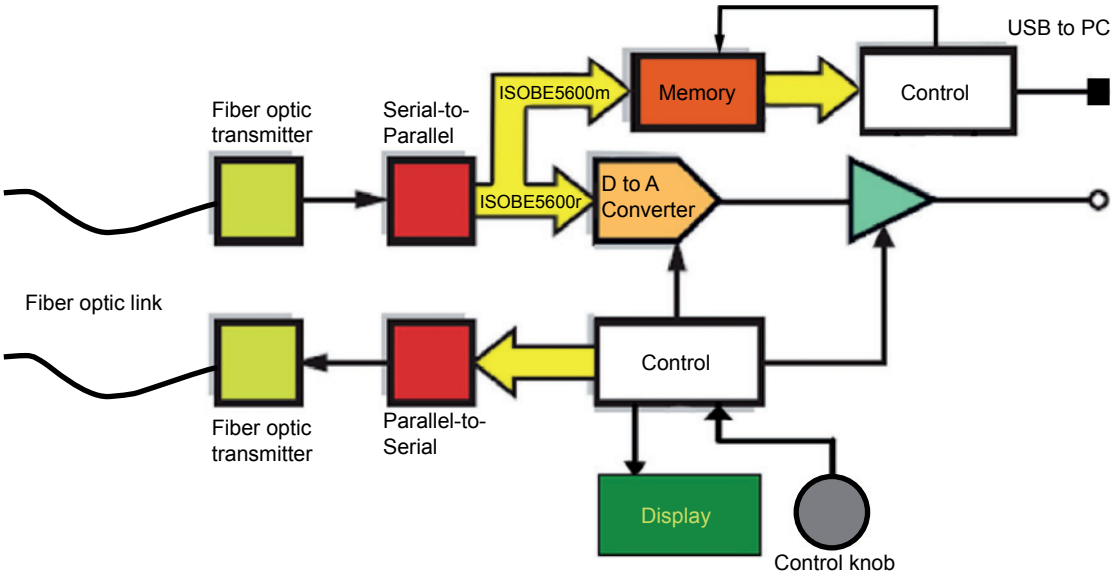


Figure 6.3: ISOBE5600 block diagram - Receiver

Data emerging from the A-to-D converter is serialized before transmission. Therefore only one fiber optic cable is required for data transmission. This approach reduces cost and increases reliability and ease of handling.

The data-receiving end of the system consists of fiber optic interfaces, a deserializing component and a D-to-A converter. The ISOBE5600m includes an on-board memory component for single-shot recordings. The fiber optic isolation is fully transparent to the user.

6.1.3 How to use this manual

This manual has been written to help you to benefit as quickly as possible from the ISOBE5600 and gain maximum results from its usage.

Many people read their user manual only as a last resort. If you are one of those people, the next paragraphs tell you where to find the right information when you need it.

CAUTION

READ THE NEXT SECTION EVEN IF YOU DO NOT READ ANYTHING ELSE.

Safety Messages
Proper and safe use of this instrument depends on careful reading of all safety instructions and labels. Read the chapter “Safety Messages” on page 11 for details.

Installation and Operation
To know how to install this system in the correct way, read the installation section. We do not advise to install the system without reading this section. This section also describes how to use the subsystem, charge batteries, replace batteries, etc. Read the chapter "Installation and Operation" on page 72 for details.

Technical Reference
This section contains additional technical information pertinent to the ISOBE5600. Read the “Specifications” section on page 98 for details.

6.1.4 Technical support

Contact your local dealer or HBM directly for technical support, general information and more. Please use the information in chapter "General - Service Information" on page 128 to get in touch with our support and service teams.

6.2 Installation and Operation

This section describes how to install and operate the ISOBE5600. This system is a combination of one or more ISOBE5600t/ISOBE5600tm transmitters and an ISOBE5600r/ISOBE5600m receiver unit. The ISOBE5600r/ISOBE5600m receiver unit can control and receive data from up to four ISOBE5600t/ ISOBE5600tm transmitters. The ISOBE5600m adds a recording functionality to the receiver module which - when working with Perception - can make single sweep recordings and as a stand alone unit can be used as a measurement device.

6.3 Unpacking

For transportation the ISOBE5600 units are sealed in a polyethylene bag and cushioned in its box by shock-absorbent material. Accessories are separately sealed in polyethylene bags and included in the box.

6.3.1 Unpacking and inspection

Unpack the equipment carefully and examine it thoroughly to ascertain whether or not damage has occurred in transit. Report immediately any such damage to the agent or manufacturer.

Retain the packing materials and box for use if further transportation is necessary. Also be sure to keep all documents supplied with the equipment; some may be addenda or update bulletins applicable to the manual or equipment.

6.3.2 Equipment checklist

Check that the equipment contained in the transportation box complies with the packing list. It typically includes:

- ISOBE5600r/ISOBE5600m receiver(s)
- ISOBE5600t/ISOBE5600tm transmitter(s)
- Fiber optic cables as ordered
- User Manual that you are reading now
- Charger as ordered (ISOBE5600t only)
- Power cords
- USB cable 1 m (ISOBE5600m only)
- Miscellaneous documents

7 Start using the equipment

7.1 Connecting power

7.1.1 Connecting power on an ISOBE5600r/ISOBE5600m receiver

The AC power inlet is located on the rear of the receiver unit.

Figure 7.1: ISOBE5600r/ISOBE5600m rear view with AC power inlet

A Power switch

B Power inlet

A - Power switch: The switch turns on or off the mains supply to the receiver.

B - Power inlet: The power connection of the receiver is via a standard IEC 320 EN 60320 C14 (male) appliance inlet, 2-pole, 3-wire designed for 250 V at 10 A.

The receiver is delivered with a standard power cord that should be inserted into **(B)**, see Figure 7.1, and must be connected to a suitable AC power outlet. According to the standards utilized in your country, you may be required to purchase a different power cord.

To disconnect the instrument from the AC supply, unplug the IEC connector on the rear of the instrument. The instrument should be positioned to allow access to the AC connector.

7.1.2 Connecting power on an ISOBE5600tm transmitter

The AC power inlet of the ISOBE5600tm is located on the rear of the transmitter cabinet.

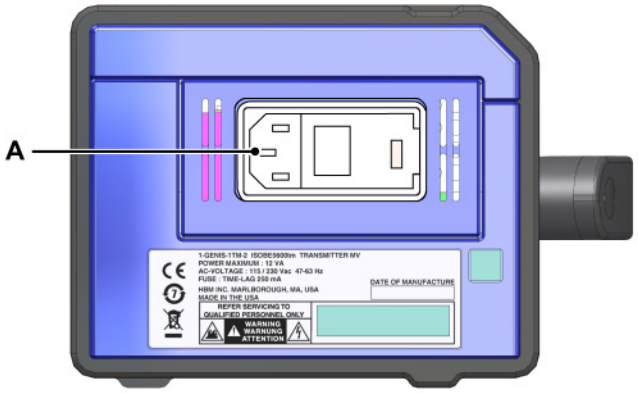


Figure 7.2: ISOBE5600tm rear view with AC power inlet

A - Power inlet The power connection of the ISOBE5600tm is via a standard IEC 320 EN 60320 C14 (male) appliance inlet, 2-pole, 3-wire designed for 250 V @ 10 A.

WARNING

Inspect the voltage selector at the rear of the transmitter cabinet for the correct setting before applying power. If necessary see the section for instructions on changing the voltage selector.

The ISOBE5600tm is delivered with a standard power cord that should be inserted into this socket and must be connected to a suitable AC power outlet. According to the standards utilized in your country, you may be required to purchase a different power cord.

To disconnect the instrument from the AC supply, unplug the IEC connector on the rear of the instrument. The instrument should be positioned to allow access to the AC connector. The front power switch on the instrument is not a disconnecting device. When the instrument is connected some power will be consumed.

7.2 Connecting PC

The ISOBE5600m receiver can be operated in two ways, either as a standalone receiver with analog output or as transient recorder with internal memory and data transfer to the Perception Software running on a PC.

When operating as a standalone receiver, it offers the same capabilities as the ISOBE5600r receiver and will output the signals on the BNC connectors (analog-in to analog-out).

When operating as transient recorder, the ISOBE5600m USB connector needs to be connected to the USB connector of the PC with the provided USB cable.

7.3 Connector locations

This section describes the location of the various connectors on the ISOBE5600t/ISOBE5600tm transmitters.

7.3.1 Transmitter I/O connectors

Refer to the following diagrams for the position of the signal input and fiber optic connectors on the transmitter units.

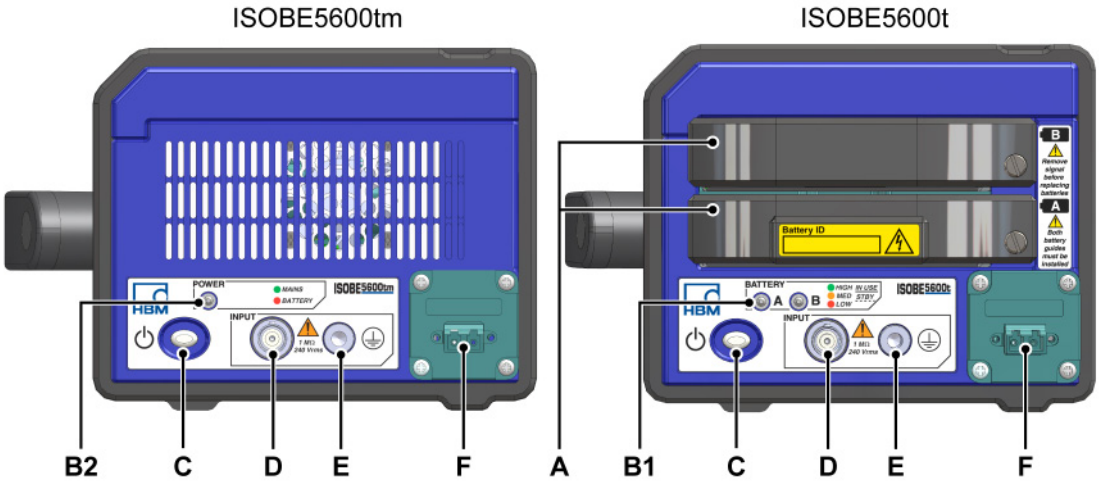


Figure 7.3: transmitter I/O connectors and indicators

A Removable batteries
B1 LED battery status indicators
B2 LED power status indicator
C Standby ON/OFF switch
D Signal input BNC connector
E Protective ground connector
F Fiber optic connector

A - Removable batteries: For more details refer to "Removing a battery module" on page 55.

B1 - LED Power status indicator This indicator shows the power status of the ISOBE5600tm:

- When OFF: system is switched off.

- When ON - GREEN: system is active and working from the mains power supply.
- When ON - RED: system is active and running on internal batteries.

When the LED is GREEN and BLINKING, the system is in use, but there is no valid communication between the transmitter and the Receiver, e.g. the cable is not connected.

B2 - LED battery status indicators: This indicator shows the power status of the ISOBE5600t. There are two LED indicators, one for each battery. The LEDs can have one of the following states:

- OFF: System is switched off, or battery is not installed.
- FLASHING: Battery is not in use.
- ON: Battery is in use.
- GREEN: Battery capacity is high.
- ORANGE: Battery capacity is medium.
- RED: Battery capacity is low. Battery should be charged, or replaced with a fully loaded one.

Any combination of ON/FLASHING and GREEN/ORANGE/RED is possible. e.g. an orange flashing LED indicates that the corresponding battery is not in use and has a medium capacity.

Note *When both LEDs light up GREEN and FLASHING, the system is in use, but there is no valid communication between the transmitter and the ISOBE5600r/ ISOBE5600m receiver, for example the cable is not connected.*

C - Power ON/OFF switch: Use this switch to toggle between the operating and power-off mode. When in power-off mode all electronics are disconnected from the power except for a small circuit used to detect the switch state. When the unit is switched to operating mode and no fiber optic cables are connected, then the unit is in stand-by mode and power consumption is reduced to approximately 25% of normal operation.

D - Signal input BNC connector

E - Protective ground connector: This connector is used to connect the transmitter to protective ground, which will ground the metal parts including the BNC connector.

F - Fiber optic connector: This connector is used in combination with a fiber optic plug connector LC. As seen from the front, the left-most fiber optic link transmits the data (Data Output) and the right-most fiber optic link receives the commands (Command Input).

Both transmitter and receiver units are equipped with an LC duplex connector.

Figure 7.4: Example of an LC duplex connector

The fiber optic link is used to transfer digitized data from the transmitter to the receiver unit and to transfer control commands from the receiver unit to the transmitter.

7.3.2 Receiver connectors and indicators

The receiver is a stand-alone unit. One receiver unit serves up to four transmitters (transmitters). The ISOBE5600r is the standard receiver and comes without memory, the ISOBE5600m receiver comes with on board memory and is capable of making single sweep recordings of data by using the unit in conjunction with the Perception software. This unit is controlled by Perception and once connected will appear in the **Used hardware** section in Perception (see also Figure 9.4 on page 96).

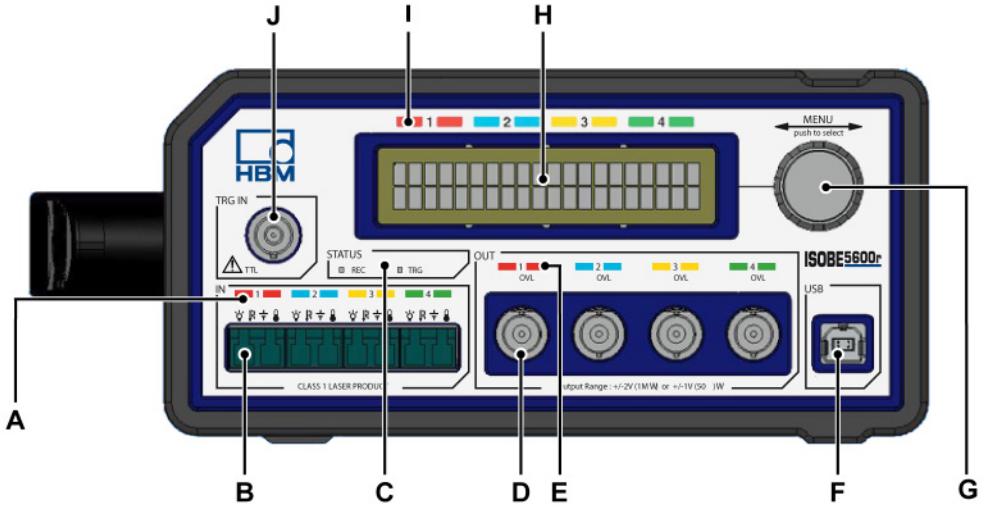


Figure 7.5: Receiver connectors and indicators - Front view

A Status LEDs

B Command output fiber optic and data input fiber optic

C ISOBE5600m: Recording status and trigger status
ISOBE5600r: Only for service and calibration purposes

D Analog monitor output

E OVL LED indicators

F USB connector

G Rotary knob

H Display

I Channel position indication (for display)

J ISOBE5600m: Trigger input
ISOBE5600r: Only for service and calibration purposes

A - Status LEDs: The LED indicators are used to give a visual indication of the fiber optic-link/transmitter status.

The icon is used to identify the signal detect function. The icon is for data/synchronization identification. The icon indicates the status of the battery. The icon identifies the temperature status of the transmitter. When the power of the mainframe is switched on, at least one LED should be ON.

The following table lists the function and possible combinations of the four LEDs.

Table 7.1: Front panel LED indicators

FRONT PANEL LED INDICATORS				
Color				
Off	No power, or boot failure	No optical signal detected	No optical signal detected	No optical signal detected
Red	No optical signal detected	Not synchronized, no valid data	Battery power low	Transmitter internal temperature too high
Orange	N/A	Synchronized, but no valid data	N/A	N/A
Green	Optical signal detected	Synchronized and valid data	Battery power OK	Transmitter internal temperature OK

B - Command output fiber optic: This connector provides the command and timing output and must be connected using a fiber optic cable with the “Optical Link - Command” connector on the transmitter unit.

The command output and data input are combined in a dual LC® connector.

B - Data input fiber optic: This connector is the data input connector and must be connected using a fiber optic cable with the “Optical Link - Data” connector on the transmitter unit.

The command output and data input are combined in a dual LC® connector.

Figure 7.6: Example of a dual LC connector

C - Recording status and trigger status: The recording status and the trigger status have only a meaning for the ISOBE5600m: They indicate when a recording is started from the Perception software and when the trigger happened.
For the ISOBE5600r, these status LEDs have no function during normal operation and are only used during service and calibration work.

D - Monitor output: This is a BNC output. It provides a copy of the analog signal connected to the analog input connector on the transmitter.

E - OVL LED indicators: Are used to give a visual indication of the overload condition of the analog input stage. The detection is done before the digitization and is hence not covered by the calibration and offset removal. The OVL LED will turn on when the analog input is exposed to a voltage of somewhere between 100% and 110% of the rated input range (depends on channel calibration and offset removal). If the input signal is close to 100% and carries noise and spikes on top, these may cross the threshold to turn the OVL LED on.

F - USB Connection: This connection is used for communication with a PC and for firmware upgrade.

- ISOBE5600r: firmware upgrade only
- ISOBE5600m: PC and firmware upgrade

G - Rotary knob: Refer to "Using the displays controls" on page 86 for more information.

H - Display: Refer to "Navigating the display menu" on page 86 for more information.

I - Channel position indication (for display): Refer to "Navigating the display menu" on page 86 for more information.

J - ISOBE5600m trigger input has different functions.

- ISOBE5600r: No function
- ISOBE5600m: Used for external triggering

7.4 System connections

Connect the transmitter and receiver by means of a fiber optic cable. The fiber optic cable must be a dual-core cable. Both units have a dual LC connector. Cables supplied by HBM are already correctly configured.

Figure 7.7: Fiber optic cable with LC connector

LC connector

Insert the plug into the receiver. Refer to "Receiver connectors and indicators" on page 79 for details. Make sure the lock mechanism is positioned correctly. You hear a "click" when the lock mechanism locks the cable. To disconnect the LC connector, push the lock mechanism and gently pull the connector out of the port on the receiver. Do not use excessive force to pull out the plug.

When you are using your own fiber optic cables make sure that the COMMAND and DATA lines are connected correctly: command-out of the receiver to the command-in of the transmitter; data-out of the transmitter to the data-in of the receiver.

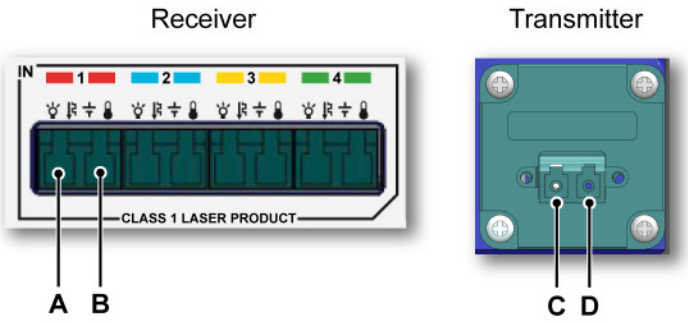


Figure 7.8: Fiber optic connectors (Details)

A Data in

B Command out

C Command in

D Data out

7.5 Initial check-out

For an initial check-out of the system verify as follows:

- ISOBE5600t: Make sure that a battery is in place and charged.
- ISOBE5600tm: Make sure the voltage selector is set to the correct voltage and the power cord is connected.
- Check the fiber optic cabling between the transmitter unit and the receiver unit.
- Is the receiver installed properly: fuses, power cord connected?

Now you can switch on the receiver unit and the transmitter(s).

The LED's on the front panel of the fiber optic receiver unit must indicate that both connections and batteries are OK for each channel installed and connected.

This completes the installation.

For a functional check-out of the system verify as follows:

1. Connect a fiber optic cable from the transmitter to the optical-input '1' on the receiver.
2. Turn power on for both the receiver and the transmitter.
3. Connect a signal generator to the transmitter input.
4. Set input span on receiver to 20 V (See "Settings" on page 89 for details).
5. Set a generator to 10 V(peak-peak) 50 Hz AC.
6. Connect an oscilloscope to the analog output '1' on the receiver.
7. Set the oscilloscope range to approximately ±2 V. The output is scaled. See specifications for details on page 98
8. The oscilloscope should now display a 2 V(peak-peak) 50 Hz AC signal.

8 Using the Front Panel Controls

8.1 Introduction - Using the Front Panel Controls ISOBE5600

The ISOBE5600r/ISOBE5600m receiver comes with firmware installed that allows you to set up the transmitter transmitter unit via the local display and **rotary knob** on the front panel of the receiver unit. In addition to these controls, the front panel contains the indicators for optical link status, transmitter transmitter status, recording and trigger indicators.

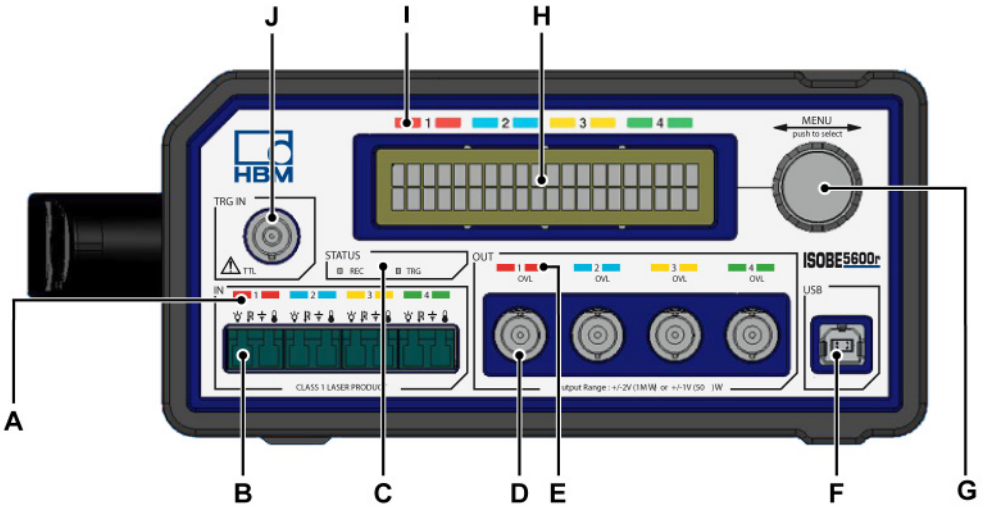


Figure 8.1: ISOBE5600r/ISOBE5600m receiver

A Status LEDs

B Command output fiber optic and data input fiber optic

C ISOBE5600m: Recording status and trigger status
ISOBE5600r: Only for service and calibration purposes

D Analog monitor output

E OUT LED indicators

F USB connector

G Rotary knob

H Display

I Channel position indication (for display)

J ISOBE5600m: Trigger input
ISOBE5600r: Only for service and calibration purposes

Refer to "Receiver connectors and indicators" on page 79 for more information.

8.2 Using the displays controls

The character display is used for transmitter settings and to display system alerts such as over-temperature.

Settings can be made and viewed at any time during normal operation. The **rotary knob** on the front panel next to the display allows you to navigate through the menus and enter settings for your transmitters.

Note *When controlled by Perception software, the **knob** is non functional.*

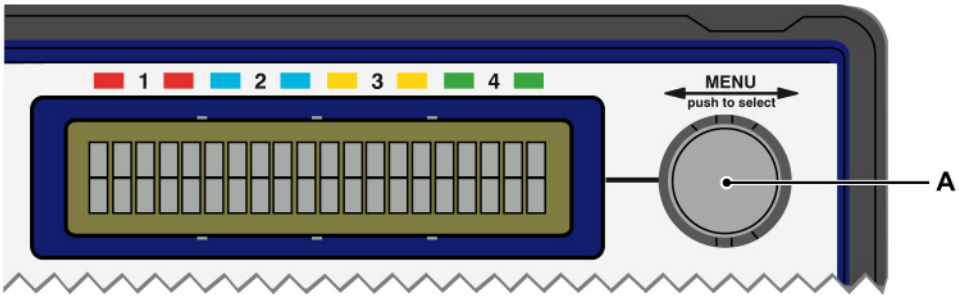


Figure 8.2: Front panel controls - Rotary knob

A Rotary knob

During normal operation the ISOBE5600r/ISOBE5600m receiver displays the current settings for each of the four transmitters that can be connected.

8.2.1 Navigating the display menu

All available settings for each of the attached transmitter units are displayed. The selected menu item is indicated by an arrow following the setting.

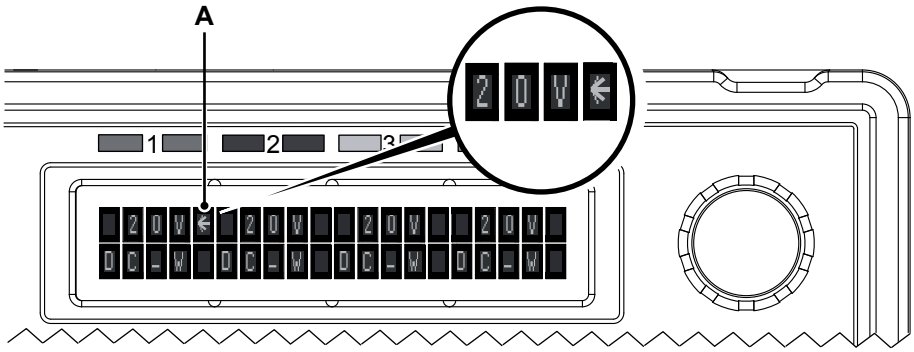


Figure 8.3: ISOBE5600r/ISOBE5600m receiver - First setting

A Selection arrow - First setting

By rotating the **rotary knob** clockwise the next item in the menu is selected, first down, then to the right.

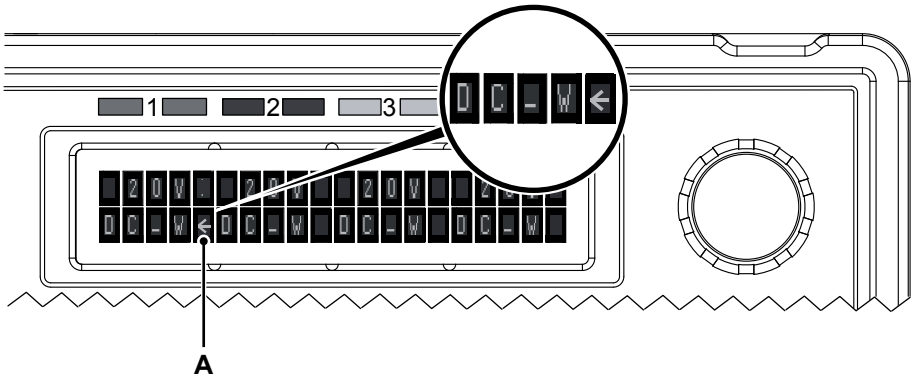


Figure 8.4: ISOBE5600r/ISOBE5600m receiver - Second setting

A Selection arrow - Second setting

By rotating the **rotary knob** counter-clockwise the previous item in the menu is selected, first up, then to the left.

Continuing to rotate the **rotary knob** after the last item will result in a wrap-around back to the first menu item.

8.2.2 Changing transmitter settings

When the required setting in the menu is selected this setting can be altered by pressing the **rotary knob** for a short moment. When the setting in the menu is ready for editing the settings characters will blink.

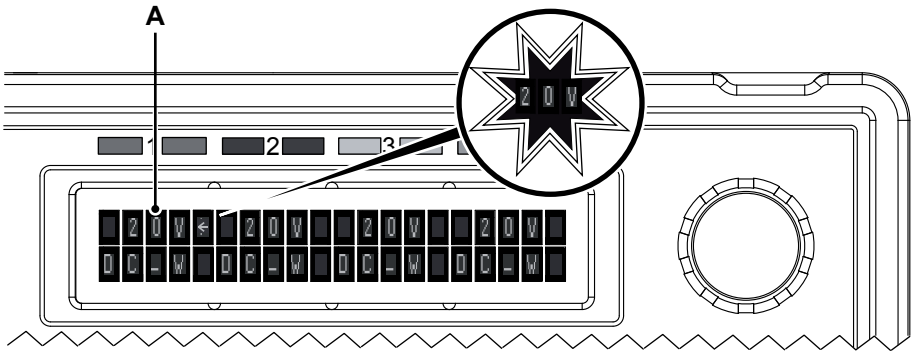


Figure 8.5: ISOBE5600r/ISOBE5600m receiver - Blinking setting

A Selected value will blink

The setting can now be edited by rotating the **rotary knob** clockwise or counter-clockwise until the desired value is reached.

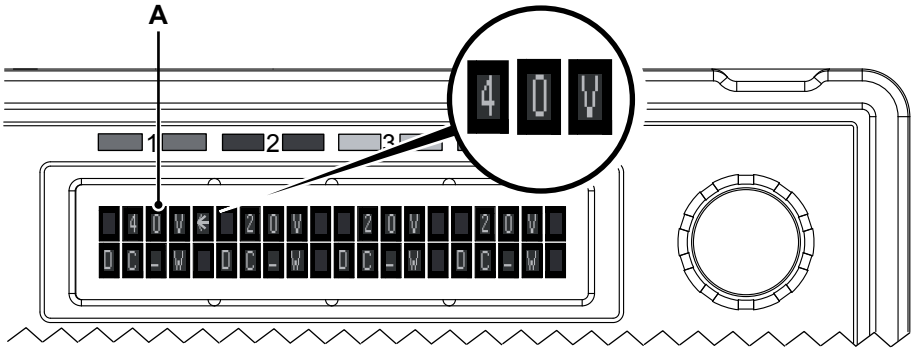


Figure 8.6: ISOBE5600r/ISOBE5600m receiver - New setting

A New setting (e.g. **40 V**)

When you do not use the **knob** in edit mode for more than half a second, the current setting will be applied. The system remains in edit mode.

Press the **rotary knob** briefly again to apply the selected setting and leave the edit mode. When no activity has been detected for five seconds, the system will automatically apply the currently visible setting and return to navigation mode.

8.3 Settings

Available **settings** can be divided into **span, coupling** and **filter** settings. In the top line on the display the span settings can be seen, in the bottom line coupling and filter settings are combined.

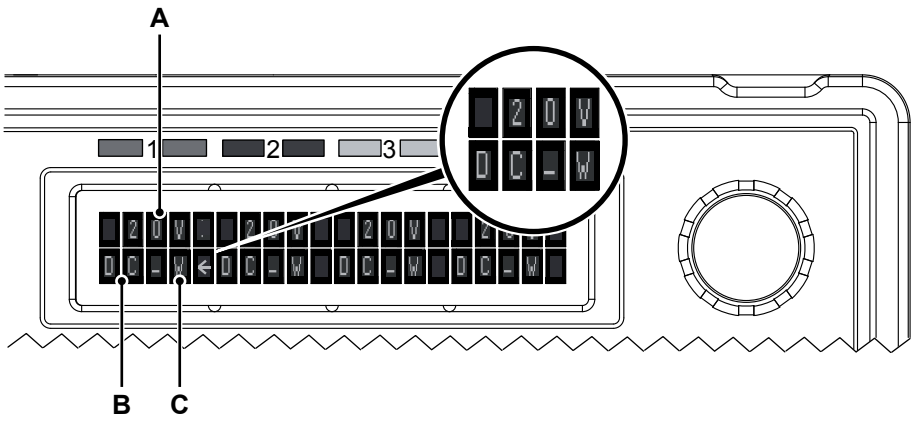


Figure 8.7: ISOBE5600r and ISOBE5600m receiver settings: span, coupling and filter

A Value for span

B Option for coupling

C Option for filter

8.3.1 Span versus input range

The ISOBE5600r and ISOBE5600m have nine voltage spans to select from, see the following table for the relationship between span and input range.

Selected Span in Menu	Input Range set on Front-end	Output (into 1 MΩ)	Gain/attenuation
0.2 V	± 100 mV	± 2 V	X 20
0.4 V	± 200 mV	± 2 V	X 10
1 V	± 500 mV	± 2 V	X 4
2 V	± 1 V	± 2 V	X 2
4 V	± 2 V	± 2 V	X 1
10 V	± 5 V	± 2 V	÷ 2.5
20 V	± 10 V	± 2 V	÷ 5
40 V	± 20 V	± 2 V	÷ 10
100 V	± 50 V	± 2 V	÷ 25

8.3.2 Coupling and filter

The ISOBE5600t/ISOBE5600tm have three types of coupling and two filter types to select from.

Selected Coupling/Filter in Menu	Input Coupling Setting	Input Filter Setting
DC-W	DC coupling	Wideband
DC-F	DC coupling	Bessel Filter
AC-W	AC coupling	Wideband
AC-F	AC coupling	Bessel Filter
GND	Grounded	Last used filter setting*

***** When ground is selected, the filter type is not changed.

Selecting GND when DC-W was the previous setting, the filter setting for GND will be Wideband.
(Turn counter-clockwise trough menu.)

Selecting GND when AC-F was the previous setting, the filter setting for GND will be Bessel Filter. (Turn clock-wise trough menu.)

8.3.3 Menu Structure

Operating the ISOBE5600r and ISOBE5600m receiver menu
The menu is structured as shown in Figure 8.8:

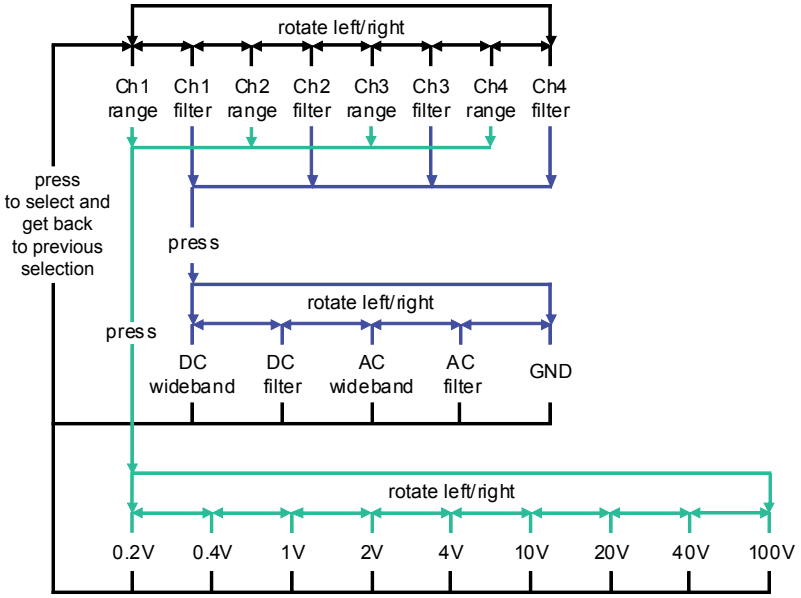


Figure 8.8: ISOBE5600r and ISOBE5600m receiver menu

8.4 Menu: Messages ISOBE5600

The ISOBE5600r/ISOBE5600m can display a number of messages including firmware version and warnings that occurred.

Any message can be discarded by pressing the **knob** briefly; this will return the display to the settings menu.

8.4.1 Firmware version

The current **firmware version** number on the receiver is displayed the first 3 seconds after the receiver unit is powered on.

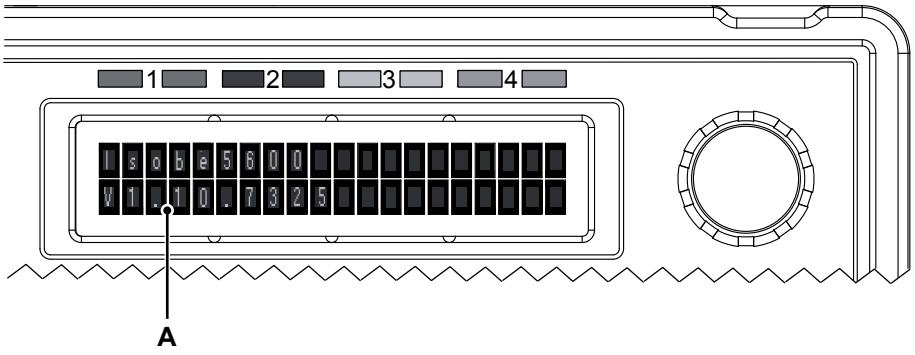


Figure 8.9: ISOBE5600r/ISOBE5600m receiver - Firmware version

A Firmware version number

8.4.2 Warnings

A number of **warning** messages can be shown on the display informing the user of issues that occur on the transmitter or the receiver. With every warning an audio alarm is activated. The alarm is de-activated when the warning is acknowledged.

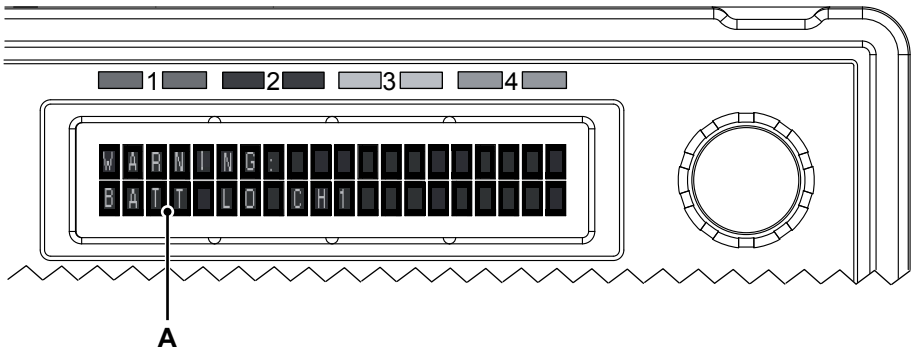


Figure 8.10: ISOBE5600r/ISOBE5600m receiver - Warning message

A Warning message (e.g. BATT LO CH1)

Warning	Description	Comments
TEMP HI CH1	Internal temperature of transmitter 1 too high.	Warning only once when crossing limit, channel will be turned off by Receiver for five minutes.
TEMP HI CH2	Internal temperature of transmitter 2 too high.	Warning only once when crossing limit, channel will be turned off by Receiver for five minutes.
TEMP HI CH3	Internal temperature of transmitter 3 too high.	Warning only once when crossing limit, channel will be turned off by Receiver for five minutes.
TEMP HI CH4	Internal temperature of transmitter 4 too high.	Warning only once when crossing limit, channel will be turned off by Receiver for five minutes.
BATT LO CH1	Battery capacity of channel 1 transmitter low. Consider battery replacement.	Warning only once when crossing limit.
BATT LO CH2	Battery capacity of channel 2 transmitter low. Consider battery replacement.	Warning only once when crossing limit.
BATT LO CH3	Battery capacity of channel 3 transmitter low. Consider battery replacement.	Warning only oncewhen crossing limit.

Warning	Description	Comments
BATT LO CH4	Battery capacity of channel 4 transmitter low. Consider battery replacement.	Warning only once when crossing limit.
HIGH INTERN TEMP	Internal temperature of receiver too high.	Warning persists, warning reoccurs every five minutes.
FAN FAILURE	Receiver cooling fan malfunction	Warning persists, warning reoccurs every five minutes.
MEMORY FAILURE	Receiver memory has failed to initialize.	Warning persists, warning reoccurs every five minutes.

8.4.3 A note on temperature warnings

Within the transmitter a temperature sensor is mounted to observe the internal instrument temperature. When the temperature inside the unit goes above 65 °C, the LED on the front panel of the receiver turns red. Refer to "Receiver connectors and indicators" on page 79 for more information. When the internal temperature raises above 75 °C, a warning is shown on the receiver display and the transmitter unit shuts down after one minute of overheating. After a thermal shutdown the unit will restart automatically after approximately 5 minutes. Ambient room temperature is typically 20 °C less than the internal temperature. The warning for the receiver unit comes up also at 75 °C.

9 Using the ISOBE5600m recorder

9.1 Introduction

The ISOBE5600m can be used as a stand alone measuring device or as a transient recorder when controlled by Perception. To use the ISOBE5600m as a data recorder, plug in the USB cable connector from the ISOBE5600m to a computer.

9.1.1 Getting started

The first time you plug in the ISOBE5600m your computer should attempt to install the correct drivers which will already be installed with Perception, you may need the Perception CD if your computer cannot find the drivers.

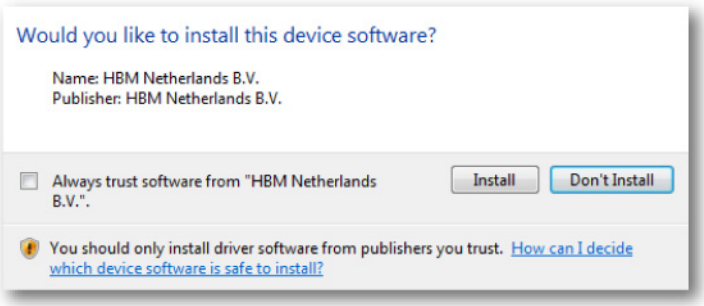


Figure 9.1: ISOBE5600m - Install drivers dialog

Once Perception is running and the ISOBE5600 drivers are installed, the new Hardware will appear in the **Hardware** list.

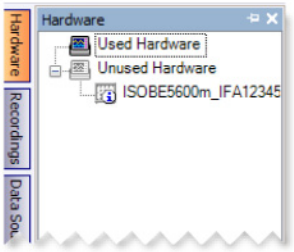


Figure 9.2: Hardware list (Part 1)

To connect to the ISOBE5600m double click on its icon in the Hardware list or drag the ISOBE5600m from **Unused Hardware** into the **Used Hardware list.**

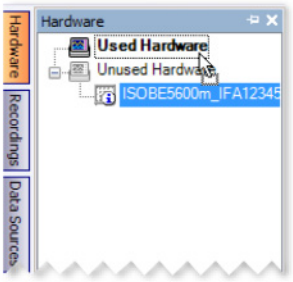


Figure 9.3: Hardware list (Part 2)

You will now be connected to the ISOBE5600m and will see a message appear briefly while you connect to the instrument.

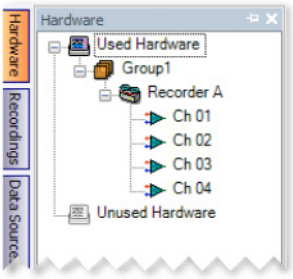


Figure 9.4: Hardware list (Part 3)

When you are connected, a new group will appear in the Used Hardware section, you can expand this to see the **Recorder** and it's individual Recorder Channels, any of these can be dragged and dropped into the main window of Perception to start active viewing.

If you drag and drop in the entire recorder for viewing you will now see 4 color coded data channels each in its own pane with the same color coding as on the front of the ISOBE5600m.

You can now start a recording.

Make a single-shot recording with a manual trigger, this will make a recording of the full stop, if no input signal connected you should see 4 straight lines.

Note *If a cable with no active signal is connected - you may see some interference as shown in Figure 9.5.*

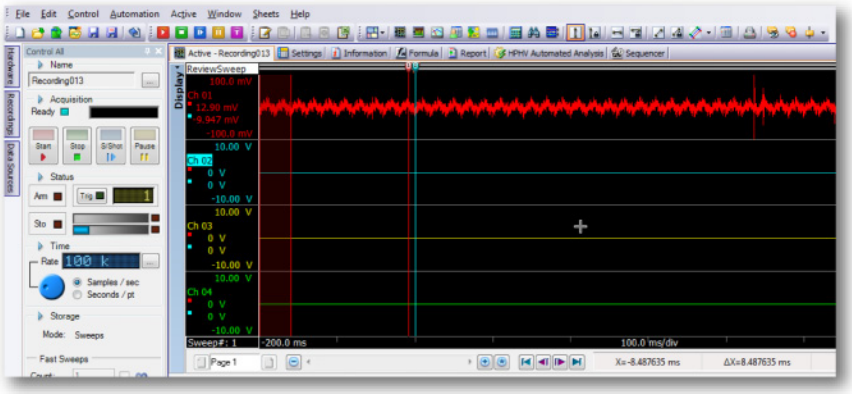


Figure 9.5: Perception work area with recordings

You are now set up and ready to record your data.

In Figure 9.5 there is noise present on one of the channels. The noise is present due to an inactive cable being plugged in which acts as an antenna for background noise.

A Specifications

A.1 B3946-2.1 en (ISOBE5600/ISOBE5600r Analog-in to Analog-out Isolated Systems)

- **4 analog channels**
- **Isolated, unbalanced differential inputs**
- **± 100 mV to ± 50 V input ranges**
- **ISOBE5600t battery powered**
- **ISOBE5600tm continuous power; 1.8 kV RMS isolation**
- **Digital fiber optic link**
- **Metal BNC inputs**
- **Cost-effective**
- **Analog-in to Analog-out**
- **Isolation for existing systems**

Offers external fiber optic isolation for existing measurement systems. The ISOBE5600r isolated system consists of a transmitter unit (ISOBE5600t or ISOBE5600tm) connected via fiber optic cable to the ISOBE5600r receiver.
The input as well as the output are analog signals which makes this system as easy to use as a probe or sensor. There is no software required, no data stored or recorded. Easy to use front panel controls offer complete setup of the probe system.
The ISOBE5600tm offers 1.8 kV RMS continuous powered isolation, while the ISOBE5600t offers higher isolation options using battery power. Using the one battery option, the ISOBE5600t has a 15 hour operation time. Using the optional second battery extends operation time to 30 hours.

Capabilities Overview	
Receiver model	ISOBE5600r
Transmitter models	ISOBE5600t and ISOBE5600tm
Sample rate per channel	100 MS/s (ADC and DAC)
ADC resolution	14 bit (ADC and DAC)
Memory per receiver	0 MB
Analog channels	4 outputs per receiver. One output per transmitter 1 input per transmitter
Isolation	Yes; transmitter to receiver and transmitter to earth
Input type	Isolated, unbalanced differential inputs
Probes	Not supported
Sensors	Not supported
TEDS	Not supported
Real-time calculations	Not supported
Real-time formula database (option)	Not supported
EtherCat®	Not supported
Digital Event/Timer/Counter	Not supported

ISOBE5600 Block Diagram

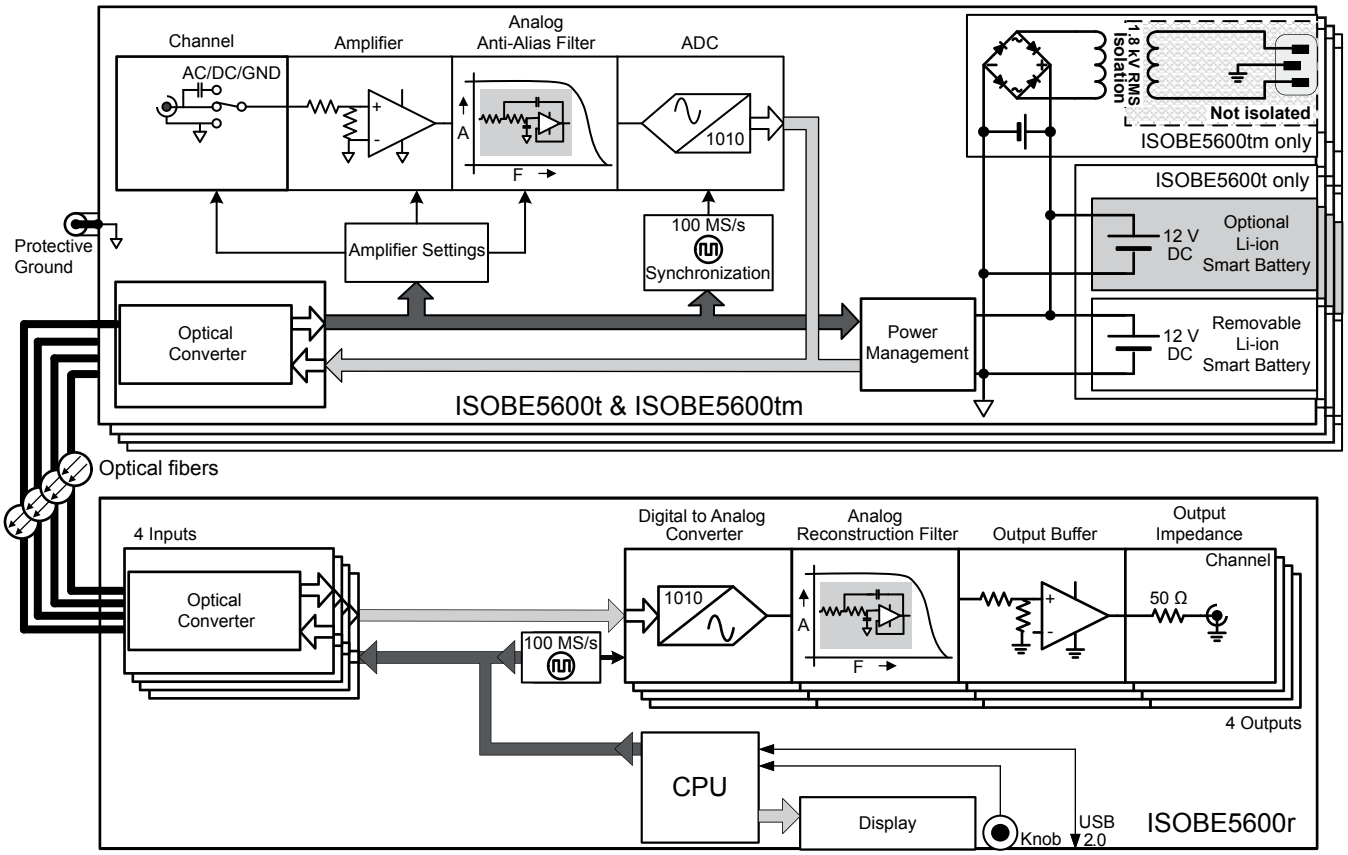


Figure A.1: Block Diagram ISOBE5600

ISOBE5600 Analog-in to Analog-out	
Bandwidth	20 MHz @ – 3 dB (wideband) 10 MHz @ – 3 dB (filtered)
Pass band flatness (wideband)	± 0.3 dB (± 3.4%); DC to 1 MHz ± 1 dB (± 11%); 1 MHz to 10 MHz
Rise time (wideband)	18 ns
CMRR	100 dB @ 80 Hz
MSE	0.3% Full Scale ± 50 µV RTI(1)
Offset error	0.3% Full Scale ± 50 µV RTI(1)
Noise (RMS)	0.07% Full Scale ± 0.1mV RTI(1)
Non-linearity	± 0.05%
Propagation delay	650 ns ± 50 ns from input to output with 1 meter of optical cable 5 ns per added meter of additional cable length

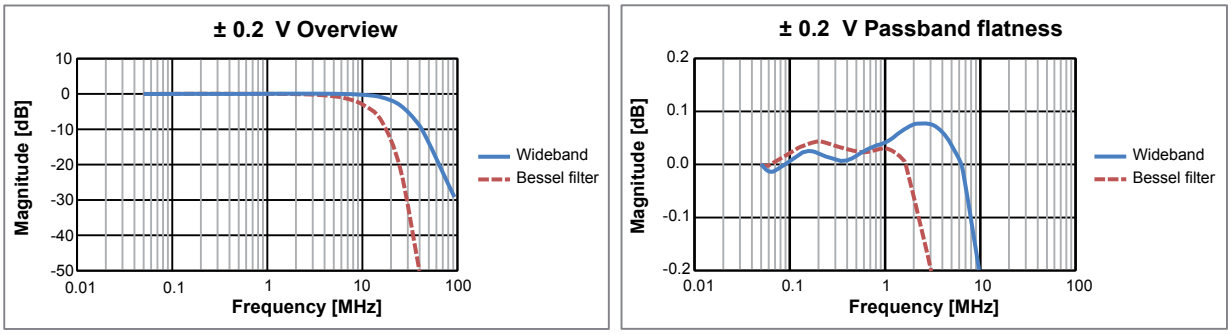


Figure A.2: Typical ± 0.2 V Overview and passband flatness

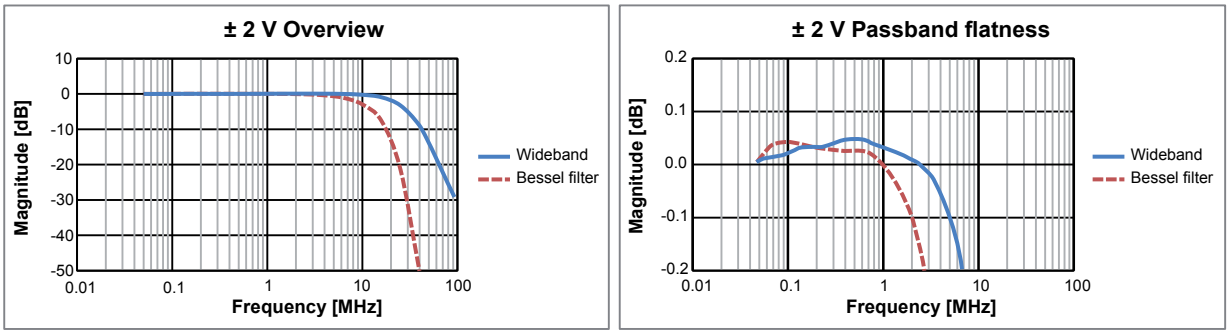


Figure A.3: Typical ± 2 V Overview and passband flatness

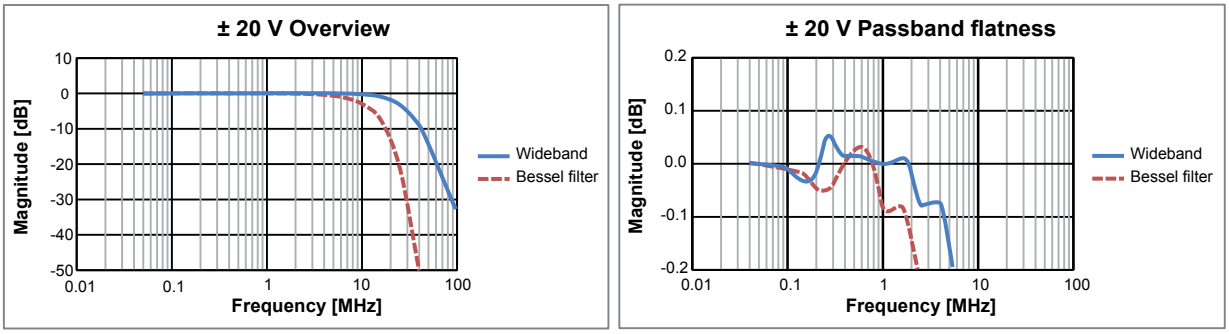


Figure A.4: Typical ± 20 V Overview and passband flatness

(1) RTI: Referred to Input

Analog Input ISOBE5600t & ISOBE5600tm (Transmitter)	
Channels	1
Connector	1; Metal BNC
Input type	Single-ended to isolated common (unbalanced differential)
Input Coupling	
Coupling modes	AC / DC / GND
AC coupling frequency	1.6 Hz (±10%); - 3 dB

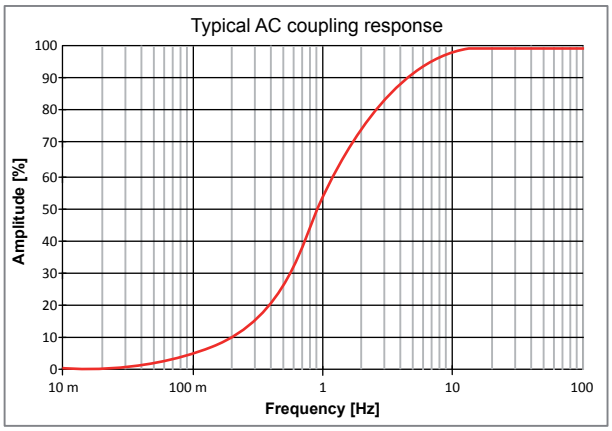


Figure A.5: Typical AC coupling response

Impedance	1 MΩ (± 2%) // 38 pF (± 5%)
Ranges	± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2 V, ± 5 V, ± 10 V, ± 20 V and ± 50 V
DC Offset error	
Wideband	0.1% of Full Scale ± 50 µV
Bessel filter	0.1% of Full Scale ± 50 µV
Offset error drift	ISOBE5600t: ±(60 ppm + 10 µV)/°C (±(36 ppm + 6 µV)/°F) ISOBE5600tm: ±(100 ppm + 10 µV)/°C (±(60 ppm + 6 µV)/°F)
DC Gain error	
Wideband	0.1% of Full Scale ± 50 µV
Bessel filter	0.1% of Full Scale ± 50 µV
Gain error drift	ISOBE5600t: ±100 ppm/°C (± 60ppm/°F) ISOBE5600tm: ±(100 ppm + 10 µV)/°C (±(60 ppm + 6 µV)/°F)
Maximum static error (MSE)	
Wideband	0.1% of Full Scale ± 50 µV
Bessel filter	0.1% of Full Scale ± 50 µV
RMS Noise (50 Ω terminated)	
Wideband	0.05% of Full Scale ± 100 µV
Bessel filter	0.05% of Full Scale ± 100 µV
Bandwidth	> 25 MHz @ – 3 dB
Anti-alias filter	Lowpass at 10 MHz; ± 1 MHz 6th order Bessel
CMRR	100 dB @ 80 Hz
Input Bias current	< 2 nA
Rise time	14 ns
Input overload protection	
Maximum nondestructive voltage	± 125 V DC; Ranges < ± 2 V ± 250 V DC; Ranges ≥ ± 2 V
Overload recovery time	Restored to 0.1% accuracy in less than 50 ns after 200% overload Restored to 10% accuracy in less than 10 ns after 200% overload

Channel to Channel Phase Match	
Using different filter selections (Wideband or Bessel) will lead to phase mismatches between channels	
Channel to Channel phase difference	Maximum 10 ns; using identical optical cable lengths
Cable length compensation	No
Cable delay	5 ns/m

Analog Output ISOBE5600r (Receiver)	
Channels	4; 1 per transmitter channel (ISOBE5600t and/or ISOBE5600tm)
Connector	4; Metal BNC, one BNC per channel on receiver front panel
Conversion	100 MS/s DAC (digital to analog converter) per channel
DAC resolution	14 bit (0.006%)
Outputs	
Output filter	Lowpass 40 MHz @ – 3 dB; 6^{th} order Bessel reconstruction filter
Output impedance	50 Ω ± 2%
Calibrated Full Scale output level	± 2 V; 1 MΩ load
Non calibrated Full Scale output level	± 1 V; 50 Ω load (Additional output error: add 1% + 1/2 of the error of load resistor)

Fiber Optic Link	
Light source	Class 1 laser product
Transfer rate	2 Gbit/s
Wavelength	850 nm
Connector	LC duplex
Cable	
Isolation	10^{15} Ω/m
Maximum length	50 m (164 ft); using ISO/IEC 11801 type OM2, OM3 or OM4 cable and no extra couplers(1).
Type	Duplex Multi Mode, 50/125 µm, ISO/IEC 11801 type OM2

(1) Other fiber cable lengths can be ordered from custom systems at: customsystems@hbm.com

Power requirement (ISOBE5600t)	
Battery	11.1 V @ 6600 mAh; 1x removable, rechargeable, Li-ion (Second battery optional)
Power consumption	6 VA typical, 8 VA maximum
Operation Time	12 hours; 1 battery installed. 24 hours; 2 batteries installed
Battery Recharge	12.6 V DC, 2.5 to 4 Amps @ 25 °C (77 °F)

Power Requirement (ISOBE5600tm)	
Power supply	115/230 V AC @ 47 - 63 Hz (manual voltage selector)
Power consumption	12 VA maximum
Power supply isolation	
Protective ground connected	0 V, both sides grounded
Protective ground not connected	1.8 kV RMS (IEC 61010-1:2010) Requires a protected LAB environment and EN50191:2000 compliant work procedures
Fuse(s)	2 x 250 mA; Slow blow
Battery	12 V @ 300 mAh; Internal, rechargeable, NiMH
Battery back-up time	5 minutes (with new and fully charged battery)

Power Requirement (ISOBE5600r)	
Power supply input	90 - 264 V AC @ 47 - 63 Hz
Power consumption	40 VA maximum
Fuse(s)	2 x 1 A, 5 x 20 mm; Slow blow (T)

Physical, Weight and Dimensions ISOBE5600t	
Weight	4.6 kg (10 lb) including two batteries
Dimensions including handles	175 mm (6.89") x 277 mm (10.91") x 119 mm (4.69") (W x D x H)
Shielding and casing	Single metal shielding in plastic housing. Correct operation has been verified by placing the transmitter cabinet within 1 meter of an EMC field created by a 80 kA current
Cooling Fans	0
Handle	One carrying handle
Protective ground	M6 screw terminal

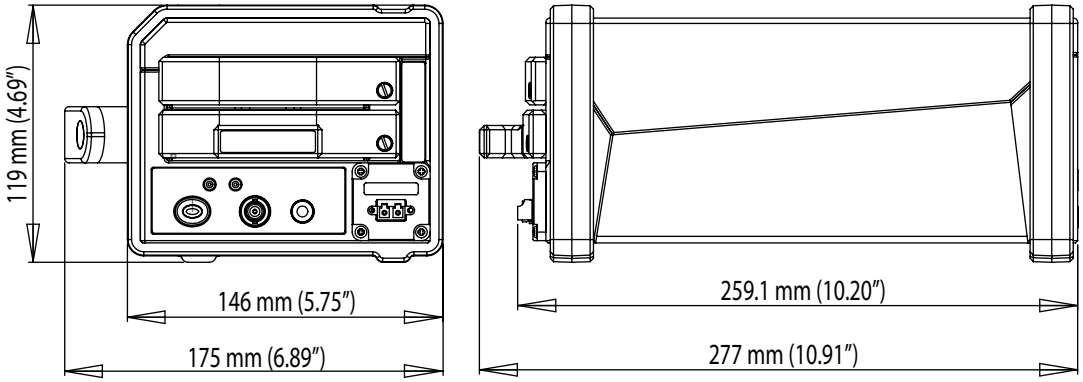


Figure A.6: Dimensions ISOBE5600t transmitter

Physical, Weight and Dimensions ISOBE5600tm	
Weight	3 kg (6.6 lb)
Dimensions including handles	175 mm (6.89”) x 262.6 mm (10.34”) x 119 mm (4.69”) (W x D x H)
Shielding and casing	Single metal shielding in plastic housing. Correct operation has been verified by placing the transmitter cabinet within 1 meter of an EMC field created by a 80 kA current
Cooling Fans	1
Handle	One carrying handle
Protective ground	M6 screw terminal

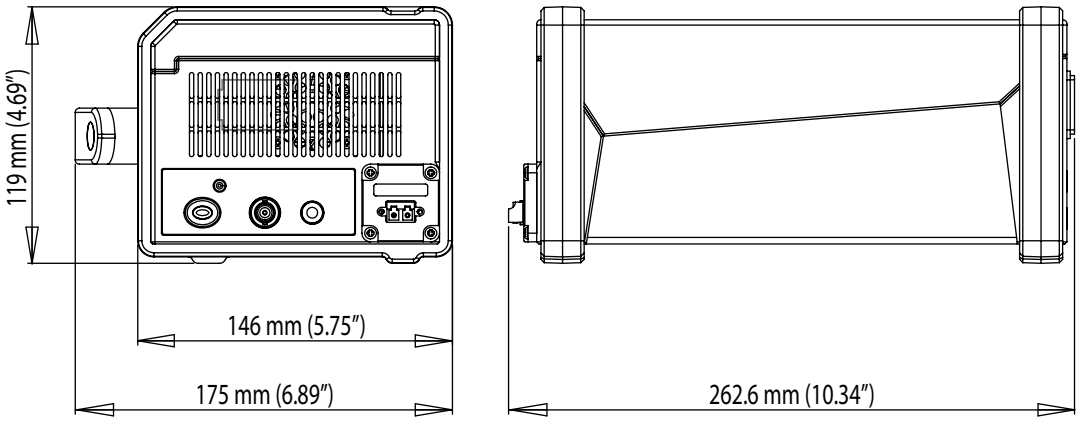


Figure A.7: Dimensions ISOBE5600tm transmitter

Physical, Weight and Dimensions (ISOBE5600r)	
Weight	1.4 kg (3.0 lb)
Dimensions including handles	221 mm (8.70") x 271 mm (10.67") x 91 mm (3.58") (W x D x H)
Casing	Metal housing with rubber band. Rubber band includes feet and stacking holes.
Cooling Fans	1
Handle	One carrying handle
Protective ground	4 mm Banana plug

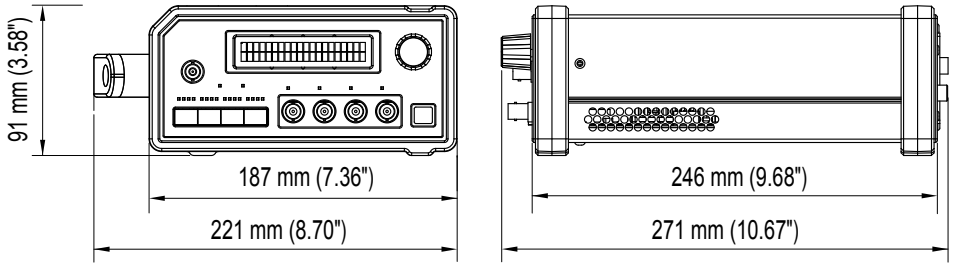


Figure A.8: Dimensions ISOBE5600r/ISOBE5600m receiver

Environmental Specifications	
Temperature Range	
Operational	ISOBE5600t Transmitter: -15 °C to +50 °C (+5 °F to +122 °F) ISOBE5600tm Transmitter: 0 °C to +40 °C (+32 °F to +104 °F) ISOBE5600r receiver: 0 °C to +40 °C (+32 °F to +104 °F) ISOBE5600m receiver: 0 °C to +40 °C (+32 °F to +104 °F)
Non-operational (Storage)	-25 °C to +70 °C (-13 °F to +158 °F)
Thermal protection	Automatic thermal shutdown at 85 °C (+185 °F) internal temperature Audio user warning notifications on receiver at 75 °C (+167 °F)
Relative humidity	0% to 80%; non-condensing; operational
Protection class	IP20
Altitude	Maximum 2000 m (6562 ft) above sea level; operational
Shock: IEC 60068-2-27	
Operational	Half-sine 10 g/11 ms; 3-axis, 1000 shocks in positive and negative direction
Non-operational	Half-sine 25 g/6 ms; 3-axis, 3 shocks in positive and negative direction
Vibration: IEC 60068-2-64	
Operational	1 g RMS, ½ h; 3-axis, random 5 to 500 Hz
Non-operational	2 g RMS, 1 h; 3-axis, random 5 to 500 Hz
Operational Environmental Tests	
Cold test IEC 60068-2-1 Test Ad	-5 °C (+23 °F) for 2 hours
Dry heat test IEC 60068-2-2 Test Bd	+40 °C (+104 °F) for 2 hours
Damp heat test IEC 60068-2-3 Test Ca	+40 °C (+104 °F), humidity > 93% RH for 4 days
Non-Operational (Storage) Environmental Tests	
Cold test IEC 60068-2-1 Test Ab	-25 °C (-13 °F) for 72 hours
Dry heat test IEC 60068-2-2 Test Bb	+70 °C (+158 °F) humidity < 50% RH for 96 hours
Change of temperature test IEC 60068-2-14 Test Na	-25 °C to +70 °C (-13 °F to +158 °F) 5 cycles, rate 2 to 3 minutes, dwell time 3 hours
Damp heat cyclic test IEC 60068-2-30 Test Db variant 1	+25 °C/+40 °C (+77 °F/+104 °F), humidity >95/90% RH 6 Cycles, cycle duration 24 hours

Harmonized Standards for CE Compliance, According to the Following Directives	
Low Voltage Directive (LVD): 2014/35/EU Electromagnetic Compatibility Directive (EMC): 2014/30/EU	
Electrical Safety	
EN 61010-1 (2010)	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
EN 61010-2-030 (2010)	Particular requirements for testing and measuring circuits
Electromagnetic Compatibility	
EN 61326-1 (2013)	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
Emission	
EN 55011	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement Conducted disturbance: class B; Radiated disturbance: class A
EN 61000-3-2	Limits for harmonic current emissions: class D
EN 61000-3-3	Limitation of voltage changes, voltage fluctuations and flicker in public low voltage supply systems
Immunity	
EN 61000-4-2	Electrostatic discharge immunity test (ESD); contact discharge ± 4 kV/air discharge ± 8 kV: performance criteria B
EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test; 80 MHz to 2.7 GHz using 10 V/m, 1000 Hz AM: performance criteria A
EN 61000-4-4	Electrical fast transient/burst immunity test Mains ± 2 kV using coupling network. Channel ± 2 kV using capacitive clamp: performance criteria B
EN 61000-4-5	Surge immunity test Mains ± 0.5 kV/± 1 kV Line-Line and ± 0.5 kV/± 1 kV/± 2 kV Line-earth

Harmonized Standards for CE Compliance, According to the Following Directives	
Low Voltage Directive (LVD): 2014/35/EU Electromagnetic Compatibility Directive (EMC): 2014/30/EU	
EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields 150 kHz to 80 MHz, 1000 Hz AM; 10 V RMS @ mains, 10 V RMS @ channel, both using clamp: performance criteria A
EN 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests Dips: performance criteria A; Interruptions: performance criteria C

G034, G301: Rechargeable Li-ion SM202 Battery (Option, to be ordered separately)

Option G034 is battery only. Option G301 is a combination of the battery (G034) and the battery carrier (see Figure A.9)

Note *Shipment regulations don't allow HBM to import batteries to all countries. These regulations change almost yearly and are increasingly becoming more strict. Check with the local HBM office before ordering the battery from HBM.*
Use only HBM approved batteries to avoid unexpected failures and/or specification deviations.
Standard G034 batteries have almost all world-wide approvals and are available for purchase locally in most countries.
For more information please refer to the following website: www.rrc-ps.com

Chemical system	Lithium Ion (Li-Ion)
Battery voltage	11.25 V
Typical weight	490 g (1.1 lb)
Nominal capacity	8850 mAh
Mechanical form factor	SM202
Dimensions	149 mm (5.86”) x 89 mm (3.50”) x 19.7 mm (0.77”) (D x W x H)
Smart battery	SMbus & SBDS revision 1.1 Compliant
Maximum charge voltage	13.0 V
Recommended charge current	4.0 A
Typical charging time	3 hours @ a charging current of 4 A
Discharge temperature	-20 °C to +55 °C (-4 °F to +131 °F)
Charge temperature	+0 °C to +40 °C (+32 °F to +104 °F)
Storage temperature	-20 °C to +50 °C (-4 °F to +122 °F). Recommended -20 °C to +25 °C (-4 °F to +77 °F)
Original manufacturer's part number	RRC power solutions RRC2020
Compliance information	CE / UL 2054 / UL1642 / FCC / IEC 62133 / EN 60950 / RoHS / UN 38.3 / PSE / RCM / CQC / BIS IS160346
Availability	Available in most countries worldwide
Recycling	Registered with most recycling systems worldwide

Figure A.9: G034 battery (left) and G301 battery with carrier (right)

G109, G033: Li-ion Battery Charger (Option, to be ordered separately)

Li-ion ten-bay and two-bay battery chargers

Smart battery support	SmBus Level 3
Maximum charge current	3 A, or limited by smart battery
Battery recalibration	SmBus 1.2 A @ 12 V
Charge strategy	Simultaneous for two batteries. The ten-bay charger first charges two batteries simultaneously, and then the next two batteries, etc.

Figure A.10: Ten-bay (left) and two-bay (right) Li-ion battery chargers

KAB280: Fiber Cable Standard MM LC-LC (option, to be ordered separately)

Standard fiber optic duplex Multi Mode patch cable

Figure A.11: Block diagram and image

Connector type	LC - LC
Glass rating	OM3; Multi Mode
Core/Cladding diameter	50/125 µm
Jacket size	2 mm (0.08")
Jacket rating	Low-smoke zero-halogen
Attenuation	≤ 2.7 dB/km @ 850 nm
Available lengths	3, 10, 20 and 50 m (10, 33, 66 and 164 ft)
Operating temperature	- 40 °C to +80 °C
Isolation	10^{15} Ω/m

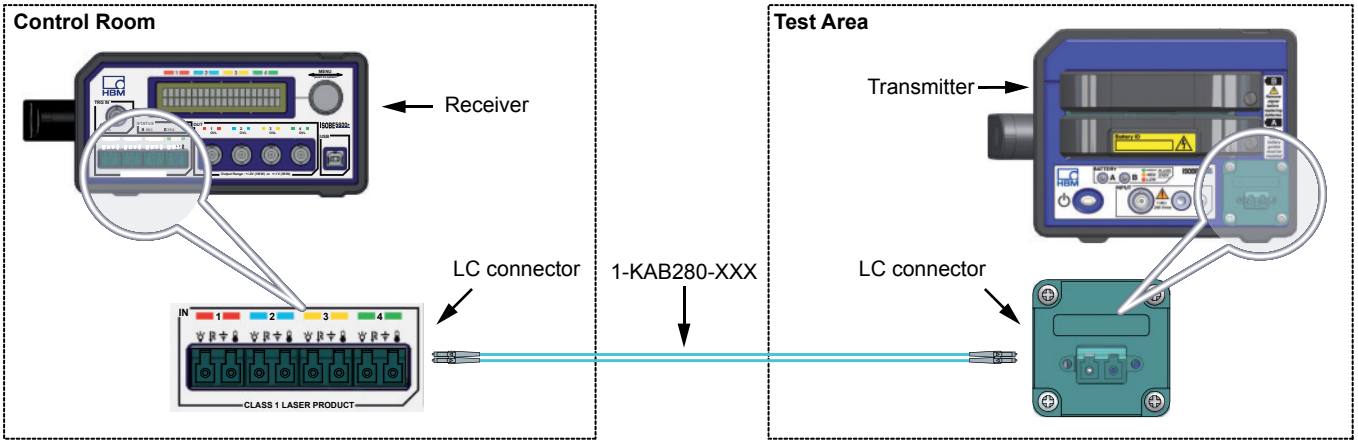


Figure A.12: Application area of a fiber optic duplex cable (Example 1)

Ordering information[1]			
Article		**Description**	**Order No.**
ISOBE5600t 1 ch Transmitter		ISOBE5600t transmitter HV, 100 MS/s, 14 bit, 25 MHz, two Li-ion battery holders, LC connector. **Note** *Batteries need to be ordered separately. Check the import restrictions before ordering batteries from HBM. Use only HBM approved batteries to avoid unexpected failures and/or specification deviations.*	1-GENIS-1T-2
ISOBE5600tm 1 ch Transmitter		ISOBE5600tm transmitter MV, 100 MS/s, 14 bit, 25 MHz, built-in power supply with 1.8 kV RMS isolation, LC connector.	1-GENIS-1TM-2
ISOBE5600r 4 ch Transmitter		ISOBE5600r receiver, 4 channels, 4 x LC in, 4 x BNC out, LCD display for channel setup, overall system BW of transmitter and analog-out 20 MHz.	1-GENIS-4R-2

(1) All ISOBE5600 systems are intended for exclusive professional and industrial use.

Accessories, to be ordered separately			
Article		**Description**	**Order No.**
Li-ion SM202 Battery		Rechargeable Li-ion battery unit for GN110/ GN111 and ISOBE5600t The battery is compliant with CE / UL 2054 / UL1642 / FCC / IEC 62133 / EN 60950 / RoHS / UN 38.3 / PSE / RCM / CQC / BIS IS 160346 **Note** *Check the import restrictions before ordering batteries from HBM.*	1-G034-2
Li-ion SM202 Battery with carrier		Rechargeable Li-ion battery unit with carrier for GN110/GN111 and ISOBE5600t The battery is compliant with CE / UL 2054 / UL1642 / FCC / IEC 62133 / EN 60950 / RoHS / UN 38.3 / PSE / RCM / CQC / BIS IS 160346 **Note** *Check the import restrictions before ordering batteries from HBM.*	1-G301-2
2 bay Li-ion battery charger		Li-ion two bay battery charger for GN110/GN111 and ISOBE5600t batteries. Accepts two batteries without removing the carrier	1-G109-2
10 bay Li-ion battery charger		Li-ion 10 bay battery charger for GN110/GN111 and ISOBE5600t batteries, accepts 10 batteries without removing the carrier	1-G033-2
Fiber cable standard MM LC-LC		GEN DAQ standard zipcord fiber optic duplex Multi Mode 50/125 µm cable, 3.0 dB/km loss, LC-LC connectors, aqua, ISO/IEC 11801 type OM3. Typically used for fixed cable routing or LAB environments. Lengths: 3, 10, 20 and 50 meters (10, 33, 66 and 164 ft) Used with 850 nm optical 1 Gbit or 10 Gbit Ethernet (1-G062-2 and 1-G065-2) and Master/Slave synchronizations.	1-KAB280-3 1-KAB280-10 1-KAB280-20 1-KAB280-50

A.2 B3870-2.1 en (ISOBE5600m Isolated Transient Recorder)

- **4 analog channels**
- **Isolated, unbalanced differential inputs**
- **± 100 mV to ± 50 V input ranges**
- **ISOBE5600t battery powered**
- **ISOBE5600tm continuous power; 1.8 kV RMS isolation**
- **Digital fiber optic link**
- **Metal BNC inputs**
- **Cost-effective**
- **Analog-in to digital storage**
- **Isolated Transient Recorder**

Offers fiber optic isolation for high speed transient recorder applications. The ISOBE5600m isolated transient recorder consists of a transmitter unit (ISOBE5600t or ISOBE5600tm) connected via fiber optic cable to the ISOBE5600m receiver.
Connected to a PC using a USB 2.0 port, full setup and transient recorder control is supported by the proven Perception software.
For optional stand alone operation the receiver unit supports front panel controls and one analog output per transmitter.
The ISOBE5600tm offers 1.8 kV RMS continuous powered isolation, while the ISOBE5600t offers higher isolation options using battery power. Using the one battery option, the ISOBE5600t has a 15 hour operation time. Using the optional second battery extends operation time to 30 hours.

Capabilities Overview	
Receiver model	ISOBE5600m
Transmitter models	ISOBE5600t and ISOBE5600tm
Sample rate per channel	100 MS/s (ADC and DAC)
ADC resolution	14 bit (ADC and DAC)
Memory per receiver	128 MS (256 MB)
Analog channels	4 outputs per receiver. One output per transmitter 1 input per transmitter
Isolation	Yes; transmitter to receiver and transmitter to earth
Input type	Isolated, unbalanced differential inputs
Probes	Not supported
Sensors	Not supported
TEDS	Not supported
Real-time calculations	Not supported
Real-time formula database option	Not supported
EtherCat®	Not supported
Digital Event/Timer/Counter support	Not supported

ISOBE5600 Block Diagram

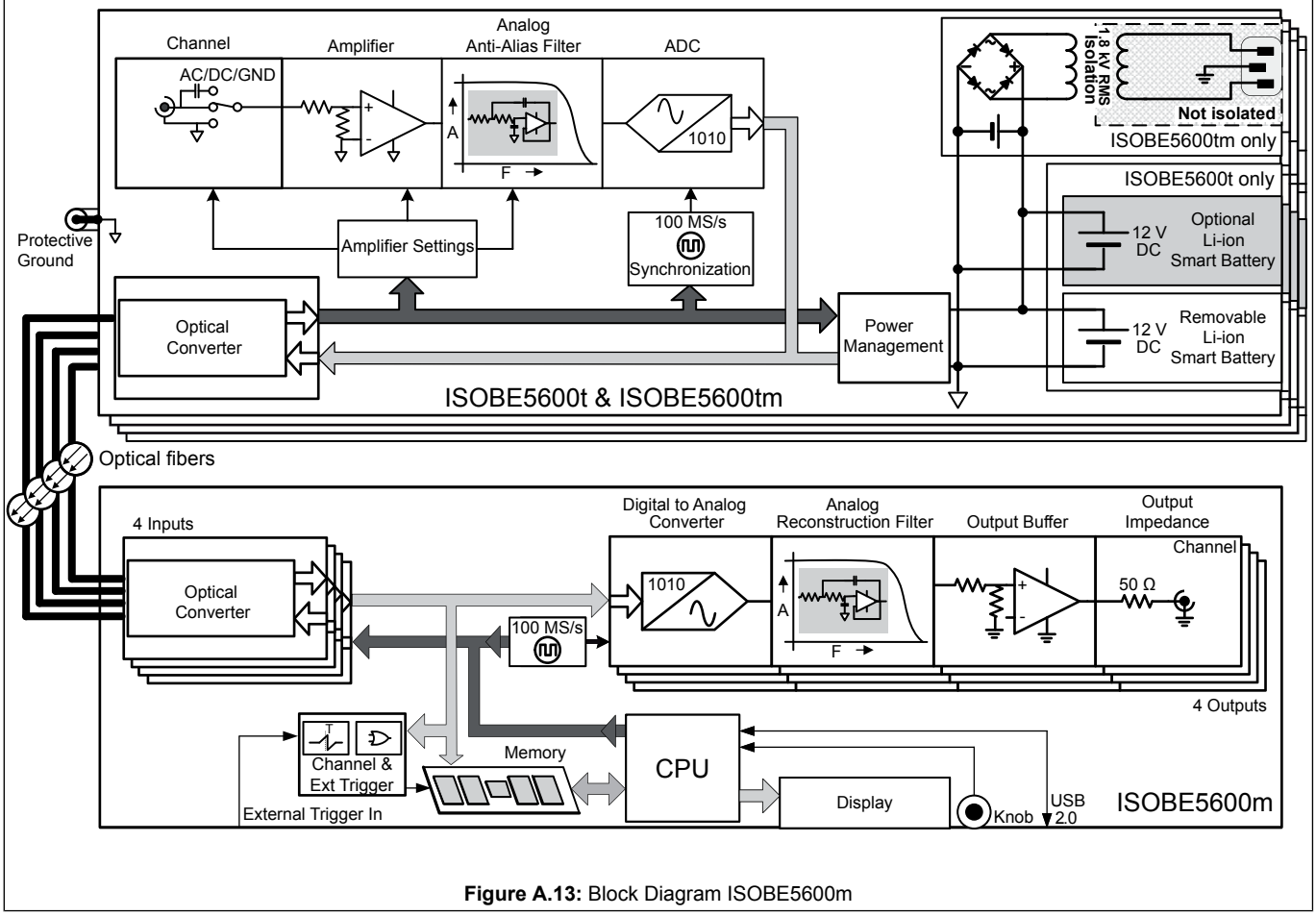


Figure A.13: Block Diagram ISOBE5600m

Analog Input ISOBE5600t & ISOBE5600tm (Transmitter)	
Channels	1
Connector	1; Metal BNC
Input type	Single-ended to isolated common (unbalanced differential)
Input Coupling	
Coupling modes	AC / DC / GND
AC coupling frequency	1.6 Hz (±10%); - 3 dB

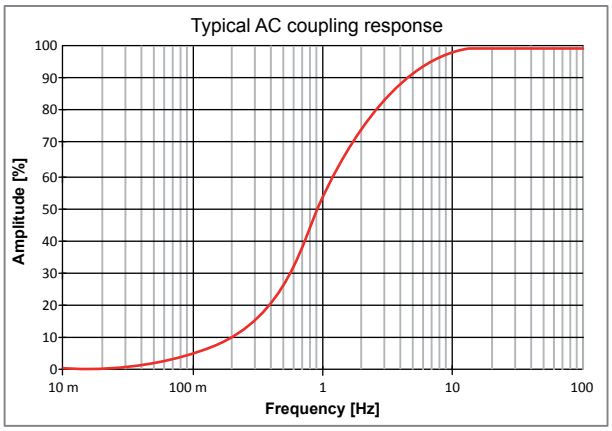


Figure A.14: Typical AC coupling response

Impedance	1 MΩ (± 2%) // 38 pF (± 5%)
Ranges	± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2 V, ± 5 V, ± 10 V, ± 20 V and ± 50 V
DC Offset error	
Wideband	0.1% of Full Scale ± 50 µV
Bessel filter	0.1% of Full Scale ± 50 µV
Offset error drift	ISOBE5600t: ±(60 ppm + 10 µV)/°C (±(36 ppm + 6 µV)/°F) ISOBE5600tm: ±(100 ppm + 10 µV)/°C (±(60 ppm + 6 µV)/°F)
DC Gain error	
Wideband	0.1% of Full Scale ± 50 µV
Bessel filter	0.1% of Full Scale ± 50 µV
Gain error drift	ISOBE5600t: ±100 ppm/°C (± 60ppm/°F) ISOBE5600tm: ±(100 ppm + 10 µV)/°C (±(60 ppm + 6 µV)/°F)
Maximum static error (MSE)	
Wideband	0.1% of Full Scale ± 50 µV
Bessel filter	0.1% of Full Scale ± 50 µV
RMS Noise (50 Ω terminated)	
Wideband	0.05% of Full Scale ± 100 µV
Bessel filter	0.05% of Full Scale ± 100 µV
Bandwidth	> 25 MHz @ – 3 dB
Anti-alias filter	Lowpass at 10 MHz; ± 1 MHz 6th order Bessel
CMRR	100 dB @ 80 Hz
Input Bias current	< 2 nA
Rise time	14 ns
Input overload protection	
Maximum nondestructive voltage	± 125 V DC; Ranges < ± 2 V ± 250 V DC; Ranges ≥ ± 2 V
Overload recovery time	Restored to 0.1% accuracy in less than 50 ns after 200% overload Restored to 10% accuracy in less than 10 ns after 200% overload

Channel to Channel Phase Match	
Using different filter selections (Wideband or Bessel) will lead to phase mismatches between channels	
Channel to Channel phase difference	Maximum 10 ns; using identical optical cable lengths
Cable length compensation	No
Cable delay	5 ns/m

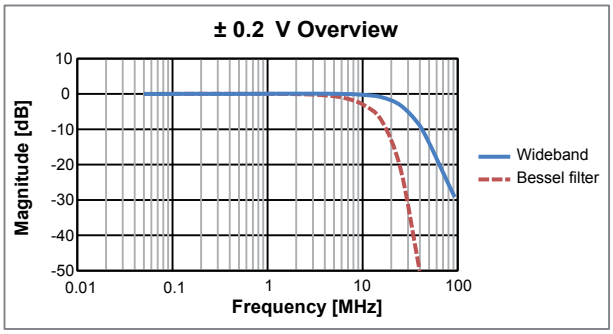
Triggering	
Channel trigger	1 fully independent per channel
Pre- and post-trigger length	0 to full memory
Trigger rate	1 trigger per recording
Manual trigger (Software)	Supported
External Trigger In	
Selectable (Software)	Rising/Falling edge or Off
Minimum pulse width	500 ns
Trigger in delay	± 1 sample period
Analog channel trigger	
Levels	2 level detectors
Resolution	16 bit (0.0015%); for each level
Direction	Rising/Falling; single direction control for both levels based on selected mode
Hysteresis	0.1 to 100% of Full Scale (defines the trigger sensitivity)
Analog channel trigger modes	
Basic	POS or NEG crossing; single level
Dual level	One POS and one NEG crossing; two individual levels, logical OR

Acquisition Mode	
Single sweep	Triggered acquisition to on-board memory without sample rate limitations; for single transients or intermittent phenomena. No aggregate sample rate limitations.
Maximum sweep memory	32 MS/channel
Maximum sweep sample rate	100 MS/s
Pre-trigger segment	0% to 100% of selected sweep length If trigger occurs before pre-trigger segment is recorded, pre-trigger segment is truncated to recorded data only
Sweep stretch	Not supported

Fiber Optic Link	
Light source	Class 1 laser product
Transfer rate	2 Gbit/s
Wavelength	850 nm
Connector	LC duplex
Cable	
Isolation	10^{15} Ω/m
Maximum length	50 m (164 ft); using ISO/IEC 11801 type OM2, OM3 or OM4 cable and no extra couplers(1).
Type	Duplex Multi Mode, 50/125 µm, ISO/IEC 11801 type OM2

(1) Other fiber cable lengths can be ordered from custom systems at: customsystems@hbm.com

ISOBE5600 Analog-in to Analog-out	
Bandwidth	20 MHz @ – 3 dB (wideband) 10 MHz @ – 3 dB (filtered)
Pass band flatness (wideband)	± 0.3 dB (± 3.4%); DC to 1 MHz ± 1 dB (± 11%); 1 MHz to 10 MHz
Rise time (wideband)	18 ns
CMRR	100 dB @ 80 Hz
MSE	0.3% Full Scale ± 50 µV RTI(1)
Offset error	0.3% Full Scale ± 50 µV RTI(1)
Noise (RMS)	0.07% Full Scale ± 0.1mV RTI(1)
Non-linearity	± 0.05%
Propagation delay	650 ns ± 50 ns from input to output with 1 meter of optical cable 5 ns per added meter of additional cable length



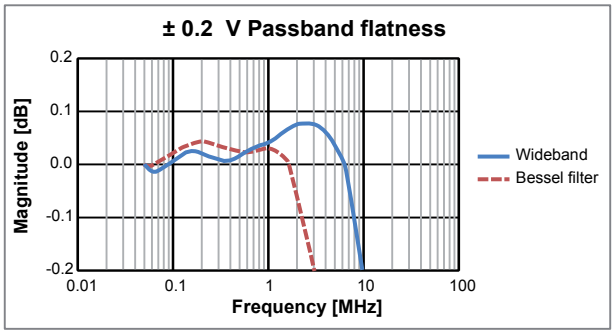
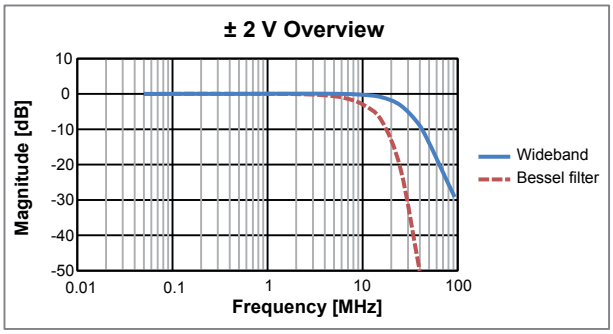


Figure A.15: Typical ± 0.2 V Overview and passband flatness



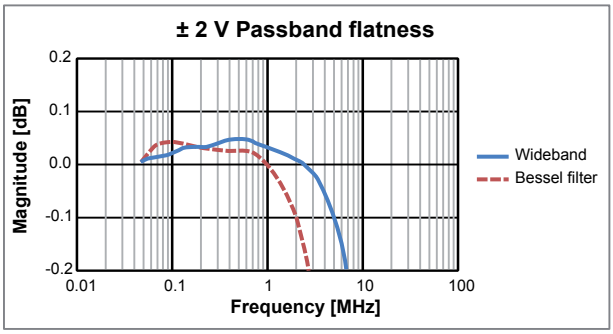
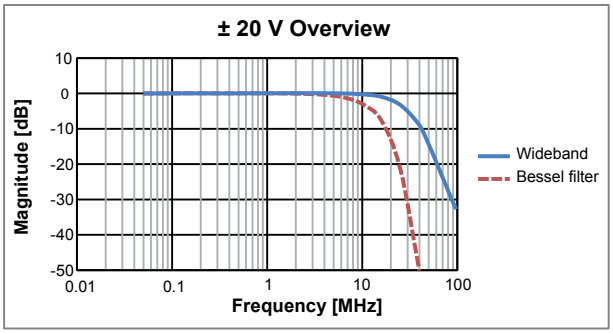


Figure A.16: Typical ± 2 V Overview and passband flatness



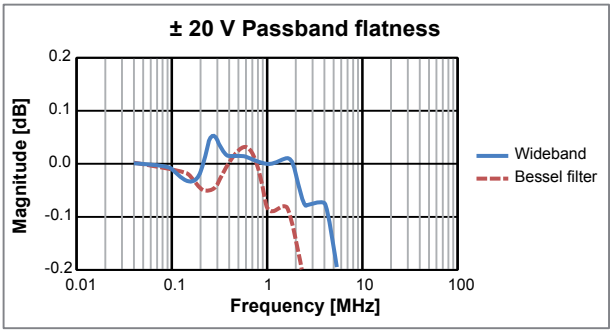


Figure A.17: Typical ± 20 V Overview and passband flatness

(1) RTI: Referred to Input

Analog Output ISOBE5600m (Receiver)	
Channels	4; 1 per transmitter channel (ISOBE5600t and/or ISOBE5600tm)
Connector	4; Metal BNC, one BNC per channel on receiver front panel
Conversion	100 MS/s DAC (digital to analog converter) per channel
DAC resolution	14 bit (0.006%)
Outputs	
Output filter	Lowpass 40 MHz @ – 3 dB; 6th order Bessel reconstruction filter
Output impedance	50 Ω ± 2%
Calibrated Full Scale output level	± 2 V; 1 MΩ load
Non calibrated Full Scale output level	± 1 V; 50 Ω load (Additional output error: add 1% + 1/2 of the error of load resistor)

Power requirement (ISOBE5600t)	
Battery	11.1 V @ 6600 mAh; 1x removable, rechargeable, Li-ion (Second battery optional)
Power consumption	6 VA typical, 8 VA maximum
Operation Time	12 hours; 1 battery installed. 24 hours; 2 batteries installed
Battery Recharge	12.6 V DC, 2.5 to 4 Amps @ 25 °C (77 °F)

Power Requirement (ISOBE5600tm)	
Power supply	115/230 V AC @ 47 - 63 Hz (manual voltage selector)
Power consumption	12 VA maximum
Power supply isolation	
Protective ground connected	0 V, both sides grounded
Protective ground not connected	1.8 kV RMS (IEC 61010-1:2010) Requires a protected LAB environment and EN50191:2000 compliant work procedures
Fuse(s)	2 x 250 mA; Slow blow
Battery	12 V @ 300 mAh; Internal, rechargeable, NiMH
Battery back-up time	5 minutes (with new and fully charged battery)

Power Requirement (ISOBE5600m)	
Power supply input	90 - 264 V AC @ 47 - 63 Hz
Power consumption	40 VA maximum
Fuse(s)	2 x 1 A, 5 x 20 mm; Slow blow (T)

Physical, Weight and Dimensions ISOBE5600t	
Weight	4.6 kg (10 lb) including two batteries
Dimensions including handles	175 mm (6.89") x 277 mm (10.91") x 119 mm (4.69") (W x D x H)
Shielding and casing	Single metal shielding in plastic housing. Correct operation has been verified by placing the transmitter cabinet within 1 meter of an EMC field created by a 80 kA current
Cooling Fans	0
Handle	One carrying handle
Protective ground	M6 screw terminal

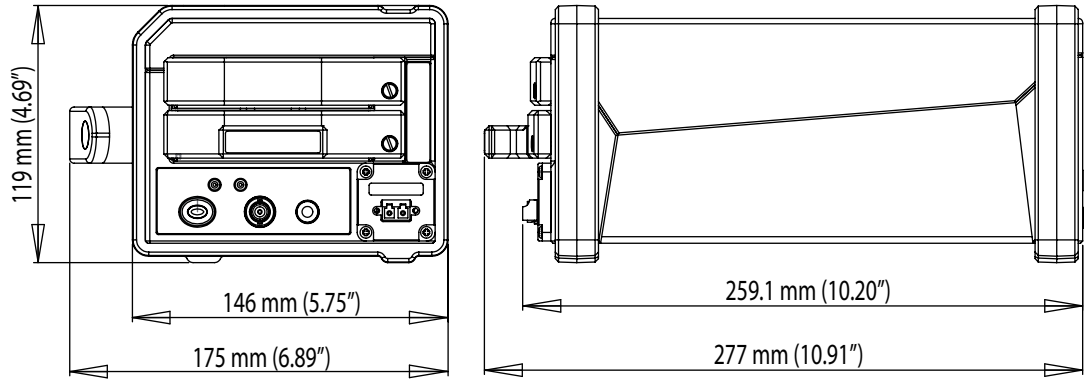


Figure A.18: Dimensions ISOBE5600t transmitter

Physical, Weight and Dimensions ISOBE5600tm	
Weight	3 kg (6.6 lb)
Dimensions including handles	175 mm (6.89”) x 262.6 mm (10.34”) x 119 mm (4.69”) (W x D x H)
Shielding and casing	Single metal shielding in plastic housing. Correct operation has been verified by placing the transmitter cabinet within 1 meter of an EMC field created by a 80 kA current
Cooling Fans	1
Handle	One carrying handle
Protective ground	M6 screw terminal

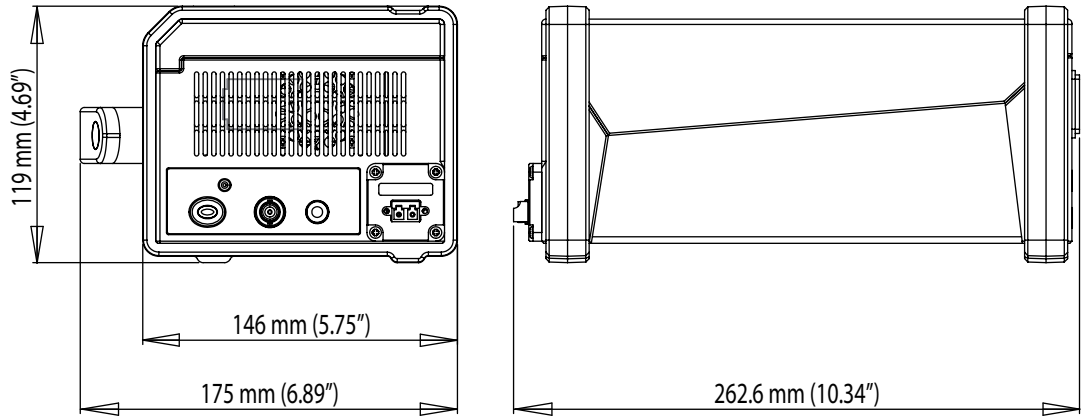


Figure A.19: Dimensions ISOBE5600tm transmitter

Physical, Weight and Dimensions (ISOBE5600m)	
Weight	1.4 kg (3.0 lb)
Dimensions including handles	221 mm (8.70”) x 271 mm (10.67”) x 91 mm (3.58”) (W x D x H)
Casing	Metal housing with rubber band. Rubber band includes feet and stacking holes.
Cooling Fans	1
Handle	One carrying handle
Protective ground	4 mm Banana plug

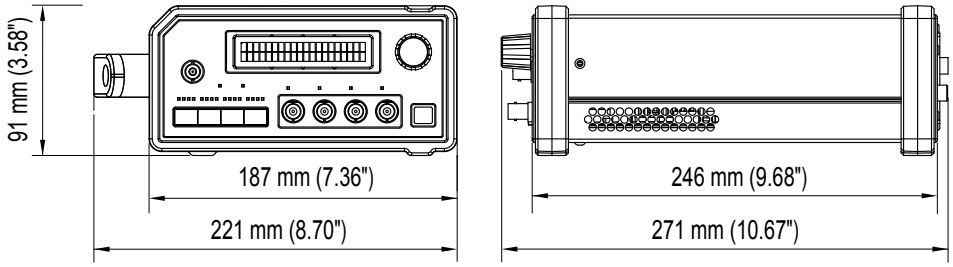


Figure A.20: Dimensions ISOBE5600r/ISOBE5600m receiver

Environmental Specifications	
Temperature Range	
Operational	ISOBE5600t Transmitter: -15 °C to +50 °C (+5 °F to +122 °F) ISOBE5600tm Transmitter: 0 °C to +40 °C (+32 °F to +104 °F) ISOBE5600r receiver: 0 °C to +40 °C (+32 °F to +104 °F) ISOBE5600m receiver: 0 °C to +40 °C (+32 °F to +104 °F)
Non-operational (Storage)	-25 °C to +70 °C (-13 °F to +158 °F)
Thermal protection	Automatic thermal shutdown at 85 °C (+185 °F) internal temperature Audio user warning notifications on receiver at 75 °C (+167 °F)
Relative humidity	0% to 80%; non-condensing; operational
Protection class	IP20
Altitude	Maximum 2000 m (6562 ft) above sea level; operational
Shock: IEC 60068-2-27	
Operational	Half-sine 10 g/11 ms; 3-axis, 1000 shocks in positive and negative direction
Non-operational	Half-sine 25 g/6 ms; 3-axis, 3 shocks in positive and negative direction
Vibration: IEC 60068-2-64	
Operational	1 g RMS, ½ h; 3-axis, random 5 to 500 Hz
Non-operational	2 g RMS, 1 h; 3-axis, random 5 to 500 Hz
Operational Environmental Tests	
Cold test IEC 60068-2-1 Test Ad	-5 °C (+23 °F) for 2 hours
Dry heat test IEC 60068-2-2 Test Bd	+40 °C (+104 °F) for 2 hours
Damp heat test IEC 60068-2-3 Test Ca	+40 °C (+104 °F), humidity > 93% RH for 4 days
Non-Operational (Storage) Environmental Tests	
Cold test IEC 60068-2-1 Test Ab	-25 °C (-13 °F) for 72 hours
Dry heat test IEC 60068-2-2 Test Bb	+70 °C (+158 °F) humidity < 50% RH for 96 hours
Change of temperature test IEC 60068-2-14 Test Na	-25 °C to +70 °C (-13 °F to +158 °F) 5 cycles, rate 2 to 3 minutes, dwell time 3 hours
Damp heat cyclic test IEC 60068-2-30 Test Db variant 1	+25 °C/+40 °C (+77 °F/+104 °F), humidity >95/90% RH 6 Cycles, cycle duration 24 hours

Harmonized Standards for CE Compliance, According to the Following Directives	
Low Voltage Directive (LVD): 2014/35/EU Electromagnetic Compatibility Directive (EMC): 2014/30/EU	
Electrical Safety	
EN 61010-1 (2010)	Safety requirements for electrical equipment for measurement, control, and laboratory use - General requirements
EN 61010-2-030 (2010)	Particular requirements for testing and measuring circuits
Electromagnetic Compatibility	
EN 61326-1 (2013)	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements
Emission	
EN 55011	Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement Conducted disturbance: class B; Radiated disturbance: class A
EN 61000-3-2	Limits for harmonic current emissions: class D
EN 61000-3-3	Limitation of voltage changes, voltage fluctuations and flicker in public low voltage supply systems
Immunity	
EN 61000-4-2	Electrostatic discharge immunity test (ESD); contact discharge ± 4 kV/air discharge ± 8 kV: performance criteria B
EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test; 80 MHz to 2.7 GHz using 10 V/m, 1000 Hz AM: performance criteria A
EN 61000-4-4	Electrical fast transient/burst immunity test Mains ± 2 kV using coupling network. Channel ± 2 kV using capacitive clamp: performance criteria B
EN 61000-4-5	Surge immunity test Mains ± 0.5 kV/± 1 kV Line-Line and ± 0.5 kV/± 1 kV/± 2 kV Line-earth

Harmonized Standards for CE Compliance, According to the Following Directives

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

EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields 150 kHz to 80 MHz, 1000 Hz AM; 10 V RMS @ mains, 10 V RMS @ channel, both using clamp: performance criteria A
EN 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests Dips: performance criteria A; Interruptions: performance criteria C

G034, G301: Rechargeable Li-ion SM202 Battery (Option, to be ordered separately)

Option G034 is battery only. Option G301 is a combination of the battery (G034) and the battery carrier (see Figure A.21)

Note *Shipment regulations don't allow HBM to import batteries to all countries. These regulations change almost yearly and are increasingly becoming more strict. Check with the local HBM office before ordering the battery from HBM.*
Use only HBM approved batteries to avoid unexpected failures and/or specification deviations.
Standard G034 batteries have almost all world-wide approvals and are available for purchase locally in most countries.
For more information please refer to the following website: www.rrc-ps.com

Chemical system	Lithium Ion (Li-Ion)
Battery voltage	11.25 V
Typical weight	490 g (1.1 lb)
Nominal capacity	8850 mAh
Mechanical form factor	SM202
Dimensions	149 mm (5.86”) x 89 mm (3.50”) x 19.7 mm (0.77”) (D x W x H)
Smart battery	SMbus & SBDS revision 1.1 Compliant
Maximum charge voltage	13.0 V
Recommended charge current	4.0 A
Typical charging time	3 hours @ a charging current of 4 A
Discharge temperature	-20 °C to +55 °C (-4 °F to +131 °F)
Charge temperature	+0 °C to +40 °C (+32 °F to +104 °F)
Storage temperature	-20 °C to +50 °C (-4 °F to +122 °F). Recommended -20 °C to +25 °C (-4 °F to +77 °F)
Original manufacturer's part number	RRC power solutions RRC2020
Compliance information	CE / UL 2054 / UL1642 / FCC / IEC 62133 / EN 60950 / RoHS / UN 38.3 / PSE / RCM / CQC / BIS IS160346
Availability	Available in most countries worldwide
Recycling	Registered with most recycling systems worldwide

Figure A.21: G034 battery (left) and G301 battery with carrier (right)

G109, G033: Li-ion Battery Charger (Option, to be ordered separately)	
Li-ion ten-bay and two-bay battery chargers	
Smart battery support	SmBus Level 3
Maximum charge current	3 A, or limited by smart battery
Battery recalibration	SmBus 1.2 A @ 12 V
Charge strategy	Simultaneous for two batteries. The ten-bay charger first charges two batteries simultaneously, and then the next two batteries, etc.

Figure A.22: Ten-bay (left) and two-bay (right) Li-ion battery chargers

KAB280: Fiber Cable Standard MM LC-LC (option, to be ordered separately)

Standard fiber optic duplex Multi Mode patch cable

Figure A.23: Block diagram and image

Connector type	LC - LC
Glass rating	OM3; Multi Mode
Core/Cladding diameter	50/125 µm
Jacket size	2 mm (0.08")
Jacket rating	Low-smoke zero-halogen
Attenuation	≤ 2.7 dB/km @ 850 nm
Available lengths	3, 10, 20 and 50 m (10, 33, 66 and 164 ft)
Operating temperature	- 40 °C to +80 °C
Isolation	10^{15} Ω/m

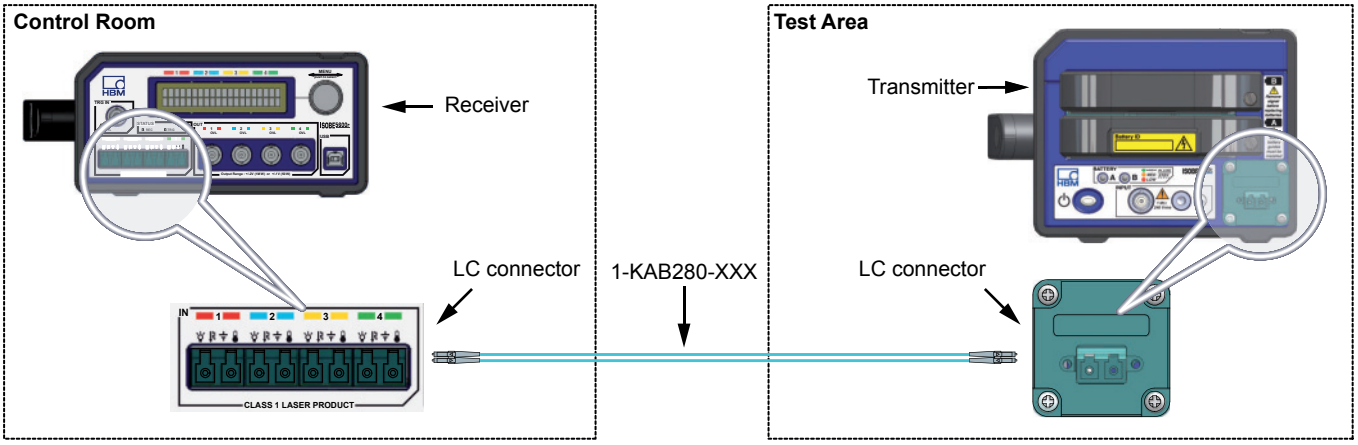


Figure A.24: Application area of a fiber optic duplex cable (Example 1)

Ordering Information[1]			
Article		**Description**	**Order No.**
ISOBE5600t 1 ch Transmitter		ISOBE5600t transmitter HV, 100 MS/s, 14 bit, 25 MHz, two Li-ion battery holders, LC connector. **Note** *Batteries need to be ordered separately. Check the import restrictions before ordering batteries from HBM. Use only HBM approved batteries to avoid unexpected failures and/or specification deviations.*	1-GENIS-1T-2
ISOBE5600tm 1 ch Transmitter		ISOBE5600tm transmitter MV, 100 MS/s, 14 bit, 25 MHz, built-in power supply with 1.8 kV RMS isolation, LC connector.	1-GENIS-1TM-2
ISOBE5600m 4 ch Receiver		ISOBE5600m receiver, 4 channels, 4 x LC in, 4 x BNC out, LCD display for channel setup transient recorder, 32 MB per channel transient memory. Analog bandwidth in transient recorder mode 25 MHz.	1-GENIS-4M-2

(1) All ISOBE5600 systems are intended for exclusive professional and industrial use.

Accessories, to be ordered separately			
Article		**Description**	**Order No.**
Li-ion SM202 Battery		Rechargeable Li-ion battery unit for GN110/ GN111 and ISOBE5600t The battery is compliant with CE / UL 2054 / UL1642 / FCC / IEC 62133 / EN 60950 / RoHS / UN 38.3 / PSE / RCM / CQC / BIS IS 160346 **Note** *Check the import restrictions before ordering batteries from HBM.*	1-G034-2
Li-ion SM202 Battery with carrier		Rechargeable Li-ion battery unit with carrier for GN110/GN111 and ISOBE5600t The battery is compliant with CE / UL 2054 / UL1642 / FCC / IEC 62133 / EN 60950 / RoHS / UN 38.3 / PSE / RCM / CQC / BIS IS 160346 **Note** *Check the import restrictions before ordering batteries from HBM.*	1-G301-2
2 bay Li-ion battery charger		Li-ion two bay battery charger for GN110/GN111 and ISOBE5600t batteries. Accepts two batteries without removing the carrier	1-G109-2
10 bay Li-ion battery charger		Li-ion 10 bay battery charger for GN110/GN111 and ISOBE5600t batteries, accepts 10 batteries without removing the carrier	1-G033-2
Fiber cable standard MM LC-LC		GEN DAQ standard zipcord fiber optic duplex Multi Mode 50/125 µm cable, 3.0 dB/km loss, LC-LC connectors, aqua, ISO/IEC 11801 type OM3. Typically used for fixed cable routing or LAB environments. Lengths: 3, 10, 20 and 50 meters (10, 33, 66 and 164 ft) Used with 850 nm optical 1 Gbit or 10 Gbit Ethernet (1-G062-2 and 1-G065-2) and Master/Slave synchronizations.	1-KAB280-3 1-KAB280-10 1-KAB280-20 1-KAB280-50

B Maintenance

B.1 Upgrading firmware

Your instrument stores its operating instructions in an internal non-volatile flash memory which you can easily upgrade as HBM adds new features and functions. The process is comparable to upgrading the BIOS in your PC. You may check HBM's website www.hbm.com/highspeed for the latest versions, or you may subscribe to an automatic maintenance service that will assure you always receive applicable upgrades. Please contact your HBM representative for details on available subscriptions.

Upgrading the ISOBE5600 firmware requires an application that either came on a CD supplied with your hardware or that you downloaded through the Internet update service. Run Setup to install this software.

To update the firmware proceed as follows:

1. Turn the ISOBE5600r/ISOBE5600m receiver on.
2. Ensure your PC is connected correctly to the instrument by a USB cable.
3. Make sure no other software is active on your PC before using the upgrade software.
4. To start the upgrader on your PC click **Start**, point to **All Programs**, point to **HBM**, point to **ISOBE5600**, point to **Firmware Upgrader** and click **ISOBE5600 Firmware Upgrader**. This will launch the application.
5. Read pop-up messages carefully before continuing. They may contain important information with respect to the upgrade process.
6. Depending on your security settings a confirmation dialog may come up. If so: Select **Unblock** to continue.
7. A dialog appears:

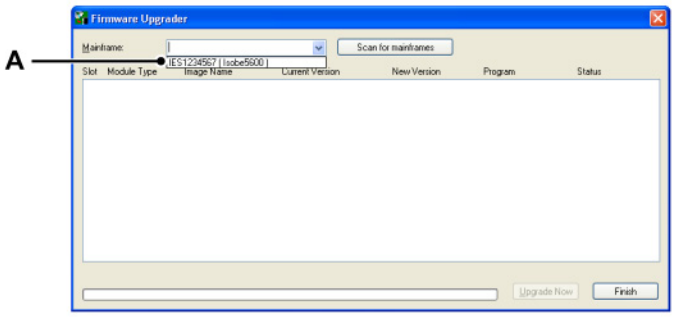


Figure B.1: Image Loader - Drop down list box

A **Mainframe** list

8 Click the down arrow of the **Select mainframe** list. This will give you a list of available units, identified by the serial number ID. You may need to click the Scan network button to update/refresh the list.

9 When connected, the Firmware Upgrader utility checks your unit's current versions and compares them to the upgrade versions to see if an upgrade is necessary:

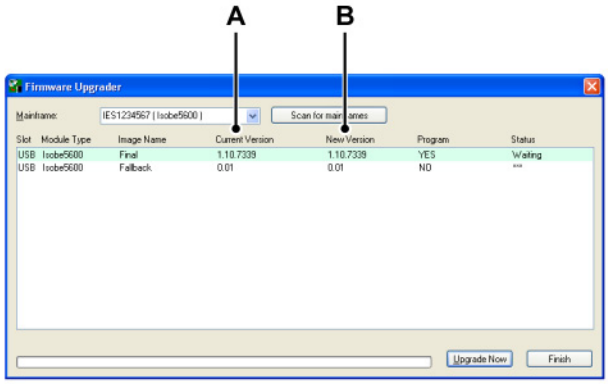


Figure B.2: Image Loader - Firmware versions

A Current version of the installed firmware

B New version which is available for this mainframe

10 Click **Upgrade Now** to start the upgrade process. Allow up to 15 minutes for the upgrade to complete. A progress indicator is shown in the bottom status bar. The receiver unit also shows a progress indicator.

WARNING

DO NOT for any reason switch off your computer, your instrument, or close the upgrade program while an update is in process. Your instrument could be DAMAGED PERMANENTLY and require factory repair if the upgrade is interrupted.

11 When finished, the message **Ready** appears at the bottom of the screen and the receiver unit will display 100% completed. Click the **Close** button to exit. This will force a restart of the instrument.

12 After rebooting, the startup screen will display your new firmware version and the instrument is ready for use. The upgrade is now completed.

B.2 Cleaning

To clean the instrument, disconnect all power sources. Lightly wipe the surfaces with a clean, soft cloth dampened with water.

The ISOBE5600t/ISOBE5600tm transmitter cabinet or the ISOBE5600r/ ISOBE5600m receivers do not require additional routine cleaning.

C Service Information

C.1 General - Service Information

HBM offers comprehensive factory servicing for all HBM Data Acquisition products. Extended warranties for calibration, repair or both are available. Installation, on-site or factory training are also available. Contact the factory or local sales person for more information. For local contact information, visit www.hbm.com/support.

If servicing is needed on the equipment, contact the factory with the model and serial numbers, a description of the problem, and your contact information. A Return Material Authorization (RMA) number will be issued. Attach this number and the accompanying paperwork to the unit.

During the warranty period, the customer pays for shipping to HBM. HBM pays to return the equipment in the same fashion as it was received. Outside of the warranty period, a quote for the shipping costs is issued. A purchase order must be received before work can be performed.

It is recommended that the unit always be shipped in the original shipping container.

For the frequent shipping of some products, HBM offers hard shipping containers specifically designed for frequent transportation.

C.2 Preventive maintenance

Except for the batteries, the instrument is a maintenance-free product; no preventive maintenance is required.

Inspect the instrument's batteries at least twice a year, but preferably every month. Damaged batteries and batteries with reduced capacity should be replaced to meet the batteries' specified capacity and consequently the instrument's specified run-time using the battery. The main benefit of this inspection will result in reliable use of the instrument.

If the instrument has been stored for four weeks or longer, first inspect the battery before putting the instrument back to use.

C.3 Calibration/Verification

C.3.1 Calibration

The ISOBE5600 is factory-calibrated as delivered to the customer. The ISOBE5600t/ISOBE5600tm transmitter and ISOBE5600r/ISOBE5600m receiver are calibrated independently. Therefore a combination of any given transmitter and receiver will give the overall specifications (Analog-In to Analog-Out).

The ISOBE5600 system should be verified and, if necessary, calibrated at one-year intervals or after any major event that may effect calibration. When in doubt consult your local supplier.

Manual verification

This section describes procedures to manually verify the performance of your ISOBE5600 transmitters and to verify if it still complies with published specifications.

Please note that HBM offers a full verification and calibration service for ISOBE5600. HBM also offers a calibration/verification kit, consisting of software and hardware, for this product. However, if the user wants to do a manual verification himself, this is the procedure.

Also note that the procedures described here are NOT the same procedures as used in the HBM calibration/verification process. The procedures used by HBM are more complex, more time-consuming and deliver more accurate results. But as these are too work-intense to be performed manually, this section describes easier, less complex (and less accurate) procedures.

Last but not least, not all the specifications as tested by the HBM calibration/ verification process are re-tested in the manual procedures as described here. Only fundamendal specifications are tested.

The verified specifications are:

- **DC accuracy**
- **AC coupling**
- **Bandwidth**
- **Noise**

Required equipment

For the verification of ISOBE5600 (front end) high accuracy test equipment is required.

HBM uses the following equipment to calibrate and verify the specifications of ISOBE5600:

• Voltmeter:	HP 3458A	(Digital Multimeter)
• LF Generator:	Fluke 5700A	(Multifunction Calibrator)
• HF Generator:	Fluke 5820A	(Oscilloscope Calibrator)
• Oscilloscope	General-purpose oscilloscope with a bandwidth ≥ 50 MHz	

For the manual process, any other equivalent equipment can be used. However, it should be clear that the accuracy of the used equipment influences the measurement process and therefore might impact the final Pass/Fail result.

All error limits provided in this section include the inaccuracy as caused by using the equipment mentioned above. Since less accurate test equipment is likely to result in larger errors, the acceptance boundaries may have to be adjusted if other equipment is used.

In this case, check the accuracy of the equipment you want to use against the equipment recommended by HBM. Consult www.hbm.com/highspeed for more information.

Calibration
If any test indicates that ISOBE5600 is out of specification, the unit has to be sent back for calibration.

IMPORTANT

MANUALLY calibrating ISOBE5600 is not possible.

Automated calibration/verification software is available as an option for the ISOBE5600 system.

ISOBE5600 is a combination of one (or up to four) transmitter(s) and a single receiver. Due to the internal (digital) structure of the system, any transmitter can be connected to any input channel of the receiver unit. The calibration and the overall errors ARE NOT influenced by doing so.

C.3.2 DC Accuracy Test

Required equipment:

- DC source (recommended: Fluke 5700A)
- Digital Voltmeter (DVM) (recommended: Hewlett Packard HP 3458A)

Hardware setup:

- Connect the DC source to the input on the ISOBE5600t/ISOBE5600tm transmitter under test.
- Connect the DVM to the output of the channel under test on the ISOBE5600r/ISOBE5600m receiver.

Procedure:
DC Gain will be determined in every range at +45% and -45% of the set span. The results measured will be compared to the MSE (Maximum Static Error) specification.

$$MSE = \mathbf{0.3\%}FS_{Input} \pm \mathbf{50}\boldsymbol{\mu}\, VRTI \text{ (Analog in to analog out)}$$

The input span of the ISOBE5600t/ISOBE5600tm transmitter is always scaled to a fixed 4 Volt span on the ISOBE5600r/ISOBE5600m receiver output (into 1 MOhm). The ratio between input span and output span is (Span out) / (Span in) or the divider factor.

As the error is measured at the output but is referred to the input (RTI = referred to input), the measured value and error needs to be backscaled to the input.

So the limits of specification for ISOBE5600 are calculated as:

$$V_{Limits} = \left(\frac{Span_{output}}{Span_{input}}\right) \times \left(V_{Input} \pm \left(\frac{0.3 \times Span_{input}}{100} + 50 \times 10^{-6}\right)\right)$$

Verification is carried out according to the following steps:

- Set coupling/filter to DC_W.
- Select input span to be tested.

- Set DC source to +45% of selected span.
- Compare reading of DVM output voltage to corresponding Min/Max value of table 1.

- Set DC source to -45% of selected span.

- Compare reading of DVM output voltage to corresponding Min/Max value of table 1.

- Repeat steps for every span to be tested.

- Set coupling/filter type to DC_F.
- Repeat steps for every span to be tested.

Table C.1: DC accuracy checklist

ISOBE5600 Span	DC Source Set Voltage	Expected Min. Voltage	DVM Reading	Expected Max. Voltage	Pass/ Fail	Calculated Error (%)
0.2 V	90.0 mV	1.787 V		1.813 V		
0.2 V	-90.0 mV	-1.813 V		-1.787 V		
0.4 V	180.0 mV	1.788 V		1.813 V		
0.4 V	-180.0 mV	-1.813 V		-1.788 V		
1 V	0.45 V	1.788 V		1.812 V		
1 V	-0.45 V	-1.812 V		-1.788 V		
2 V	0.90 V	1.788 V		1.812 V		
2 V	-0.90 V	-1.812 V		-1.788 V		
4 V	1.80 V	1.788 V		1.812 V		
4 V	-1.80 V	-1.812 V		-1.788 V		
10 V	4.50 V	1.788 V		1.812 V		
10 V	-4.50 V	-1.812 V		-1.788 V		
20 V	9.00 V	1.788 V		1.812 V		
20 V	-9.00 V	-1.812 V		-1.788 V		
40 V	18.00 V	1.788 V		1.812 V		
40 V	-18.00 V	-1.812 V		-1.788 V		
100 V	45.00 V	1.788 V		1.812 V		
100 V	-45.00 V	-1.812 V		-1.788 V		

In addition to the “within specifications” check you might want to compute the real error for each span. You can do so by comparing the DC voltage reading of the DVM with the applied input voltage using the following formula to correct the divider factor:

Error (in %) = (DVM Reading x (Span input / Span output) - Set Input Voltage) / Span input

To get a correct result, the Set Input Voltage should be very close or equal the Span Input. You might use the 90% (+/-45%) values as in the verification process. The computed error will then be slightly larger than the real error.

C.3.3 AC Coupling Test

Required equipment:

- DC/AC source (recommended: Fluke 5700A)
- Digital Voltmeter (DVM) (recommended: Hewlett Packard HP 3458A)

Hardware setup:

- Connect the DC/AC source to the input on the ISOBE5600t/ISOBE5600tm transmitter under test.
- Connect the DVM to the output of the channel under test on the ISOBE5600r/ISOBE5600m receiver.

Note *As this is a Pass/Fail test only, the limit for the remaining AC Signal is set quite high to allow a Pass despite some noise which might be present but a Fail if no AC coupling was there.*

Procedure:
The AC coupling test determines how much DC signal and how much AC signal pass through the AC coupling. This is calculated by determining the Standard Deviation in both cases.

Verification is carried out according to the following steps:

- Set coupling/filter to DC_W.
- Set input span to 4 V.

- Set DC/AC source to 1 V DC.
- The DVM DC voltage measured should be about 1 V DC.

- Set coupling/filter to AC_W.
- The DVM AC voltage measured has to be less than 0.2 V RMS.

- Set DC/AC source to sine wave; 200 Hz and 1 V RMS (2.8 V PEAK-PEAK).
- The DVM AC voltage measured has to be larger than 0.8 V RMS.

Table C.2: AC coupling checklist

ISOBE5600 Span	DC/AC Source Set Voltage	Expected Min. Voltage	DVM Reading	Expected Max. Voltage	Pass/Fail
4 V DC_W	1.00 V DC	0.900 V		1.100 V	
4 V AC_W	1.00 V DC	-0.200 V		0.200 V	
4 V AC_W	1 V RMS at 200 Hz	0.8 V RMS		1.2 V RMS	

C.3.4 Bandwidth Test

Required equipment:

- HF Generator (recommended: Fluke 5820A)
- Digital Voltmeter (DVM) (recommended: Hewlett Packard HP 3458A)
- Oscilloscope with a bandwidth of ≥ 50 MHz
- 2 x 50 Ohm termination plug

Hardware setup:

- Connect the HF Generator to the input on the ISOBE5600t/ISOBE5600tm transmitter under test. Place 50 Ohm termination on coax cable at Transmitter input.
- Connect the Oscilloscope to the output of the channel under test on the ISOBE5600r/ISOBE5600m receiver. Place 50 Ohm termination on coax cable at Oscilloscope input.

Procedure:
Bandwidth, also called AC Gain, will be measured on one or two frequency values to check if the -3 dB point is within the specifications.

As preparation, a 90% span AC signal from the HF Generator (recommended: Fluke 5820A) is applied to the input under test. The reference signal frequency is set to 50 kHz. The peak-peak value, measured with the oscilloscope, will be required for later calculations (V_{REF}).

For the wideband verification, the signal frequency is set to F_{-3dB}. The peak-peak value of the result is compared to the specification.

For the verification with the Filter ON, the signal frequency is set to two values below/above the specified cutoff frequency. The peak-peak values of the results are compared to the specification.

Note on verification with Filter ON:

- The nominal bandwidth of the switchable input signal filter is 10 MHz.
- The accuracy of this cutoff frequency is ±10%.
- This cutoff frequency, however, cannot be measured seperately.

As this additional filter is always used together with the system bandwidth of 20 MHz (just another filter), both filters work together and superimpose. As a 20 MHz input bandwidth will already expose a (small) effect on a 10 MHz signal, the actual -3 dB point of the system will be lower than the nominal -3 dB point of the 10 MHz filter alone.

C.3.5 Bandwidth Verification - Wideband

Verification is carried out done according to the following steps:

- Set coupling/filter to DC_W.
- Select input span to be tested.

- Set AC source to “LEVEL SINE”, 50 kHz, 90% of selected input span*.
- Read back peak-peak value on oscilloscope.
- Write down peak-peak value (=V_{REF}).

- Set Fluke 5820A to “LEVEL SINE”, 20 MHz, 90% of selected input span*.
- Read back peak-peak value on oscilloscope.
- Write down peak-peak value (=V_{meas}).

- Check if bandwidth is within specification, using the formula:

$$V_{\mathrm{REF}} \geq V_{\mathrm{meas}} \geq 0.707 * V_{\mathrm{REF}}$$

If the equation is correct, bandwidth spec is met.

- Repeat steps for every span.

Note ** At high input voltage ranges the Fluke 5820A will not be able to reach 90% of the input span. Lower voltages are acceptable and will not affect calculations. Use 5.5 Vpp for ranges of 10 V and above.*

Table C.3: Wideband bandwidth checklist

ISOBE5600 Span	AC Source Set Voltage	DVM V_{meas}	DVM V_{REF}	Calculate 0.707 * V_{REF}	Pass/Fail
0.2 V	180.0 mV				
0.4 V	360.0 mV				
1 V	900.0 mV				
2 V	1.80 V				
4 V	3.60 V				
10 V	5.50 V				
20 V	5.50 V				
40 V	5.50 V				
100 V	5.50 V				

C.3.6 Analog Filter Bandwidth Verification

Verification is carried out according to the following steps:

- Set coupling/filter to DC_F.
- Select input span to be tested.

- Set AC source to “LEVEL SINE”, 50 kHz, 90% of selected input span*.
- Read back peak-peak value on oscilloscope.
- Write down peak-peak value (=V_{REF}).

- Set Fluke 5820A to “LEVEL SINE”, 9 MHz, 90% of selected input span*.
- Read back peak-peak value on oscilloscope.
- Write down peak-peak value (=$V_{meas\ lo}$).

- Set Fluke 5820A to “LEVEL SINE”, 11 MHz, 90% of selected input span*.
- Read back peak-peak value on oscilloscope.
- Write down peak-peak value (=$V_{meas\ hi}$).

- Check if bandwidth is within specification, using the formula:

$$V_{\mathrm{meas\ lo}} \geq 0.707 * V_{\mathrm{REF}} \geq V_{\mathrm{meas\ hi}}$$

If the equation is correct, filter cutoff frequency specification is met.

- Repeat steps for every span.

Note ** At high input voltage ranges the Fluke 5820A will not be able to reach 90% of the input span. Lower voltages are acceptable and will not affect calculations. Use 5.5 Vpp for ranges ≥ 10 V.*

Table C.4: Analog filter bandwidth checklist

ISOBE5600 Span	AC Source Set Voltage	DVM $V_{meas\ lo}$	DVM $V_{meas\ hi}$	DVM V_{REF}	Calculate 0.707 * V_{REF}	Pass/ Fail
0.2 V	180.0 mV					
0.4 V	360.0 mV					
1 V	900.0 mV					
2 V	1.80 V					
4 V	3.60 V					
10 V	5.50 V					
20 V	5.50 V					
40 V	5.50 V					
100 V	5.50 V					

C.3.7 Noise Test

Required equipment:

- Digital Voltmeter (DVM) (recommended: Hewlett Packard HP 3458A)
- 50 Ohm termination plug

Hardware setup:

- Terminate the input of the ISOBE5600t/ISOBE5600tm transmitter channel under test with a 50 Ohm plug.
- Connect the DVM to the channel under test on the ISOBE5600r/ ISOBE5600m receiver with a coax cable and set to AC Voltage measurement.

Procedure:
Noise will be determined in every range with the input terminated to 50 Ohm. The results measured (RMS) will be compared to the Noise (RMS) specification. Noise for ISOBE5600 is specified as follows:

$$Noise_{RMS} = 0.07\% FS_{Input} + 0.1 mV RTI \text{ (Analog in to analog out)}$$

The span from the ISOBE5600t transmitter input is always scaled to a 4 V span on the ISOBE5600r/ISOBE5600m receiver output. Therefore the measured results need to be backscaled to the input (RTI = referred to input).

Specified noise limits for the ISOBE5600 output therefore are:

$$Noise_{Limit} = \frac{Span_{Output}}{Span_{Input}} \times \left(\left(Span_{Input} \times \frac{0.07}{100} \right) + 100 \times 10^{-6} \right)$$

Verification is carried out according to the following steps:

- Set coupling/filter to DC_W.
- Select input span to be tested.
- Read back AC RMS voltage value on DVM.
- Repeat steps for every span to be tested.
- Set coupling/filter type to DC_F.
- Repeat steps for every span to be tested.

Table C.5: Noise test checklist

ISOBE5600 Span	DVM Reading	Expected Max. Noise	Pass/Fail
0.2 V		4.80 mV	
0.4 V		3.80 mV	
1 V		3.20 mV	
2 V		3.00 mV	
4 V		2.90 mV	
10 V		2.84 mV	
20 V		2.82 mV	
40 V		2.81 mV	
100 V		2.80 mV	

D Understanding inputs and usage of probes

D.1 GEN series inputs

Note *Every manufacturer uses different names for similar or even identical types of inputs. Some of the terminology used is described in this section.*

Balanced Vs Unbalanced
A balanced input describes an input stage where both input terminals exhibit the same electrical behavior, such as resistance and capacitance. Unbalanced electrical input properties are different.

Symmetrical Vs Unsymmetrical
Symmetrical (similar to **balanced**) describes the input properties; if both input terminals are built up using the same component in a mirrored way, they are **symmetrical** (this will result in a **balanced input**).

Differential
A differential amplifier is a type of electronic amplifier that multiplies the difference between two inputs by a constant factor.
A differential amplifier is often treated as an isolated amplifier, which is incorrect.

Single-ended
A single-ended amplifier is a type of electronic amplifier that has the negative input connected to (measurement) ground.

Note *A differential amplifier can be turned into a single-ended one by connecting the negative input to ground.*

Isolated
An isolated amplifier is a type of electronic amplifier where both inputs are isolated from (earth) ground or which has infinite resistance to ground.

Note *Isolation can be combined with any of the amplifier variations mentioned above.*

D.1.1 Single-ended input

A single-ended input is not isolated and uses unbalanced inputs.

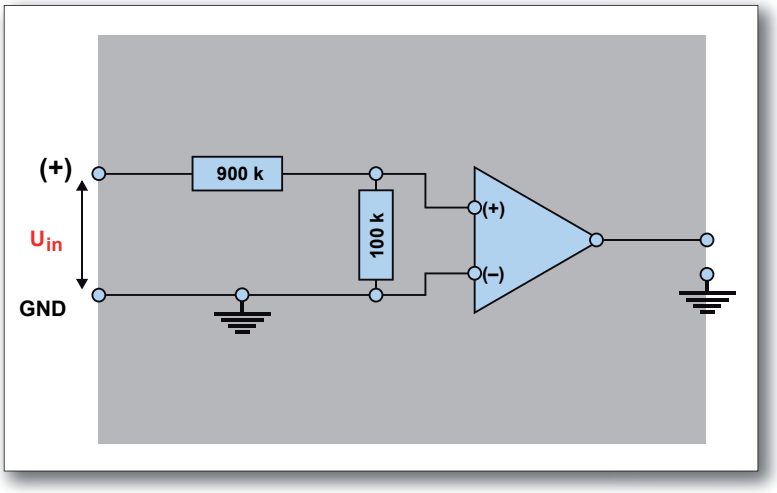


Figure D.1: Single-ended amplifier

- One input is connected to ground
- Resistance / Capacitance from each terminal to ground is different
- Amplifier is typically found in oscilloscopes
  - Also used in GEN DAQ Basic amp, Liberty 8ch DC amp
  - Often identified by the use of a single METAL BNC connector per channel
- Can be used with standard passive probes (as with oscilloscopes)

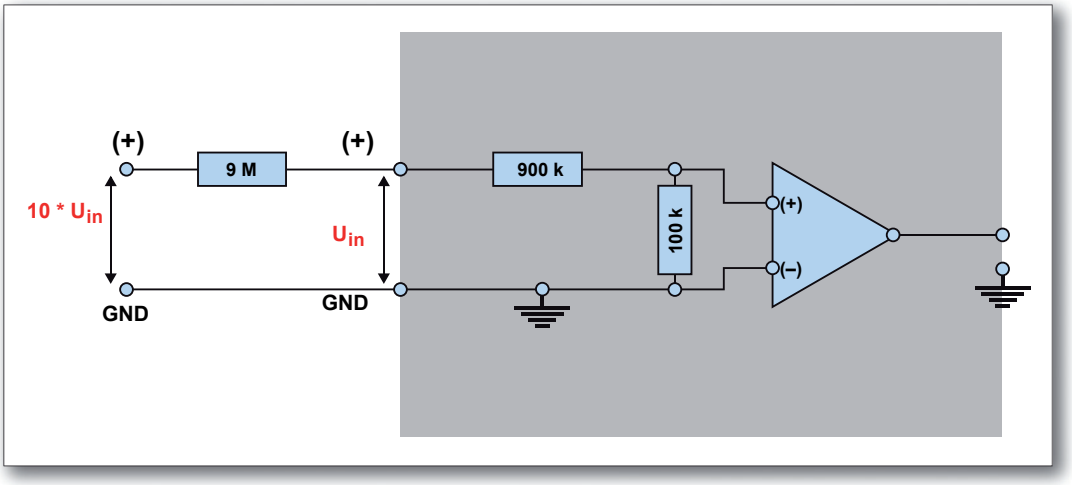


Figure D.2: Single-ended amplifier with passive probe

- An inline resistor acts as a voltage divider using the input resistance of the amplifier
- The amplifier itself measures only $\mathbf{U_{in}}$; the **total** input range is $\mathbf{10 * U_{in}}$
- This can be done with any oscilloscope or the GEN DAQ Basic Amp
  - Oscilloscope probes are typically only +/- 2% to +/- 5% accurate
- The probes used need compensation. The compensation range needs to match the input amplifier's capacitance range.

D.1.2 Balanced differential input

A balanced differential input is not isolated and uses balanced inputs.

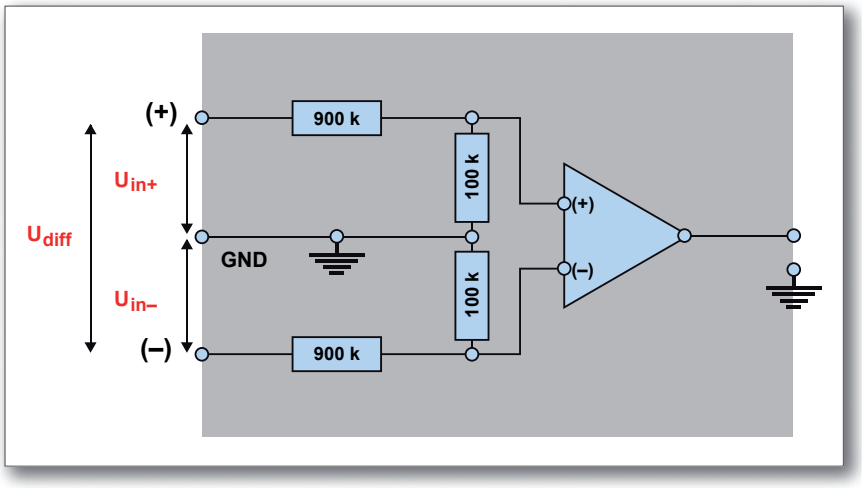


Figure D.3: Balanced differential amplifier

- Resistance / Capacitance from each terminal to ground is identical
- There is NO ISOLATION
  - Used in some of the GEN DAQ acquisition cards
  - Often identified by the use of two METAL BNC connectors per channel
- Can be used with matched pair of probes only
  - Works with the same limitations as single probes, but is more tricky due to the necessary **balance** between probes
- The probes used need compensation. The compensation range needs to match the input amplifier's capacitance range

D.1.3 Isolated single-ended or Isolated unbalanced differential input

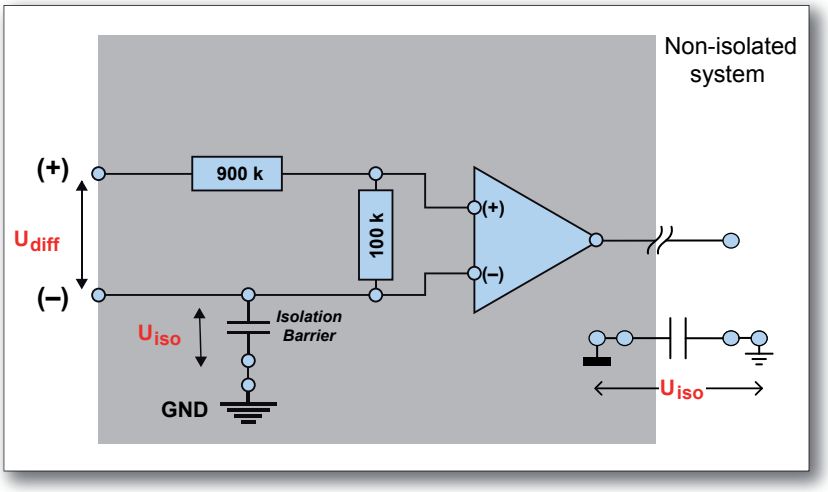


Figure D.4: Isolated single-ended or Isolated unbalanced differential amplifier

- Also referred to as **unbalanced**, **isolated** or **unbalanced differential** amplifier
- None of the inputs are connected to ground for safety and to avoid ground loops
- Typically used in isolated DAQ systems
  - Often identified by the use of a single PLASTIC (isolated) BNC connector
  - Used in GEN DAQ ISOLATED Basic amp
- Can perform *DIFFERENTIAL MEASUREMENTS with different limitations and options, compared to a differential grounded amplifier*.

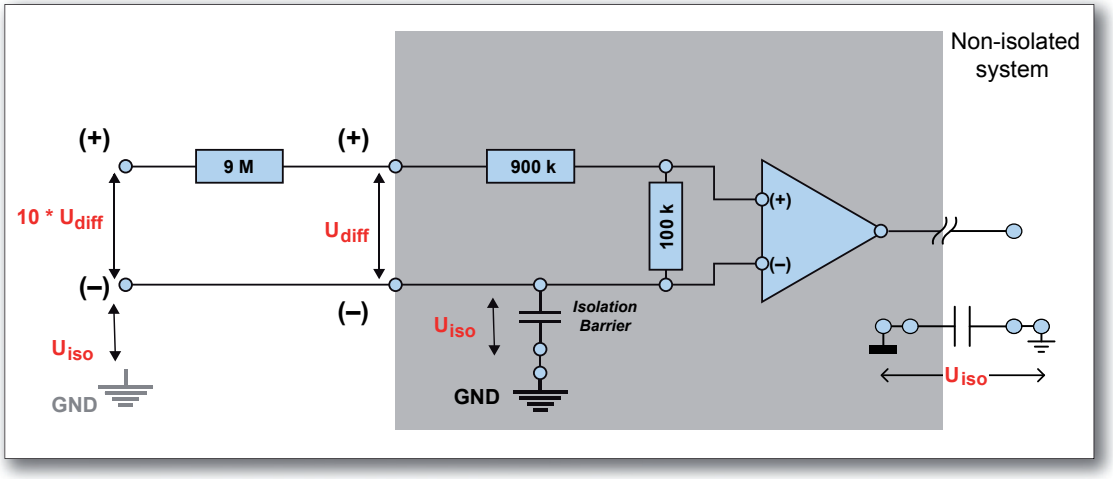


Figure D.5: Isolated single-ended or Isolated unbalanced differential amplifier with passive probe

- Also referred to as **unbalanced**, **isolated** or **unbalanced differential** amplifier with probe
- None of the inputs are connected to ground
- The positive (system) input accepts ten times the input voltage of the amplifier
- The negative input has NOT CHANGED AT ALL
- The measurement range is increased from + to - inputs,
  BUT the isolation voltage from (-) to ground remains unchanged
  - Example is the GEN DAQ Basic XT Iso card with external Isolated passive probe
- The probes used need compensation. The compensation range needs to match the input amplifier's capacitance range

D.1.4 Isolated balanced differential input

An isolated balanced differential input is isolated and uses balanced inputs. Isolated measurement ground is not often available.

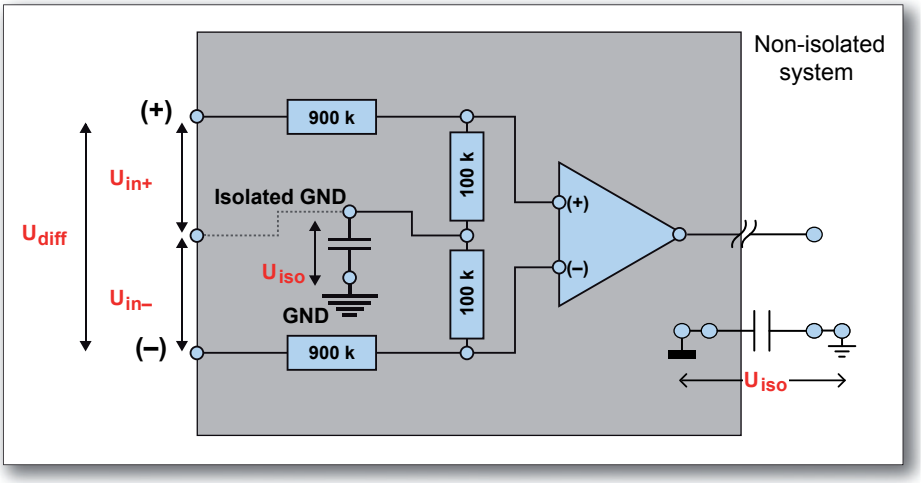


Figure D.6: Isolated balanced differential amplifier

- Resistance / Capacitance from each terminal to isolated measurement ground is identical
- There is an ISOLATED MEASUREMENT GROUND
  - Used in GEN DAQ Universal amplifier
  - Typically identified by using two or three (isolated) connectors per channel

Note *The isolated ground is not accessible in some designs*

- Cannot be used with probes as there is no ground reference for probes to divide the voltage

Different amplifiers – Pros and Cons

Single-ended (to ground) amplifiers

- Cost effective and small
- High bandwidth
- Easy to use with probes
- Potential ground problems
- No safety problems
- No CMRR and no CMV

Single-ended isolated amplifier – unbalanced differential

- Can perform differential measurements
- Expensive and large
- Difficult to use with probes
- Limited CMRR, best CMV
- Avoids ground loops
- High level of safety

Differential amplifier (with common ground)

- Widely used in DAQ
- Good CMRR, limited CMV
- No (safety) isolation and potential ground loops will remain present

Differential amplifier with isolated common

- Safe
- Expensive and large
- Good CMRR, best CMV
- More difficult to use with probes

D.2 GEN series voltage probe types

HBM offers a variety of probes. Which probe is needed depends on the application and which instrument is being used. It is important to match the compensation of the probe to the instrument.

- **Passive, single-ended voltage probes**
  These probes can be used with single-ended or differential non-isolated amplifiers and increase the input range of the amplifier only in single-ended mode. They typically decrease the overall accuracy of the amplifier.
- **Passive, single-ended isolated voltage probes**
  These probes can be used with single-ended or differential isolated amplifiers and increase the input range of an isolated amplifier only in single-ended mode. They typically decrease the overall accuracy of the amplifier.
  It is important to understand that they increase only the range, not the isolation voltage.
- **High accuracy passive, single-ended isolated voltage probes**
  These probes are designed to match specific single-ended amplifiers and increase the input range of an isolated unbalanced amplifier while maintaining accuracy.
  It is important to understand that they increase only the range, not the isolation voltage.
- **Passive, differential matched isolated voltage probes**
  These probes can be used with differential isolated amplifiers and increase the input range of the amplifier in differential mode. They typically decrease the overall accuracy and the CMRR of the amplifier.
  They work with isolated and non-isolated variations of differential amplifiers.
  When used with isolated amplifiers, they increase only the range, not the isolation voltage.
- **Active differential voltage probes**
  These probes are self-contained, differential amplifiers to be used in front of an instrument using any amplifier in single-ended mode.
  The input range and accuracy depend on the type of active differential probe used and have no relation to the amplifier used. They usually operate from batteries; this causes some inconvenience.
- **Current clamps**
  Current clamps function more as transducers than probes, as they convert one physical quantity (current) into another one (usually voltage). They are used to perform non-invasive current measurements. This allows the current in a circuit to be measured without disturbing the circuit.

Note *There are other possibilities to measure current as well (current shunts, or Rogowski coils).*

D.2.1 Passive, single-ended voltage probes

Voltage probes divide a single-ended input signal by a specific factor.

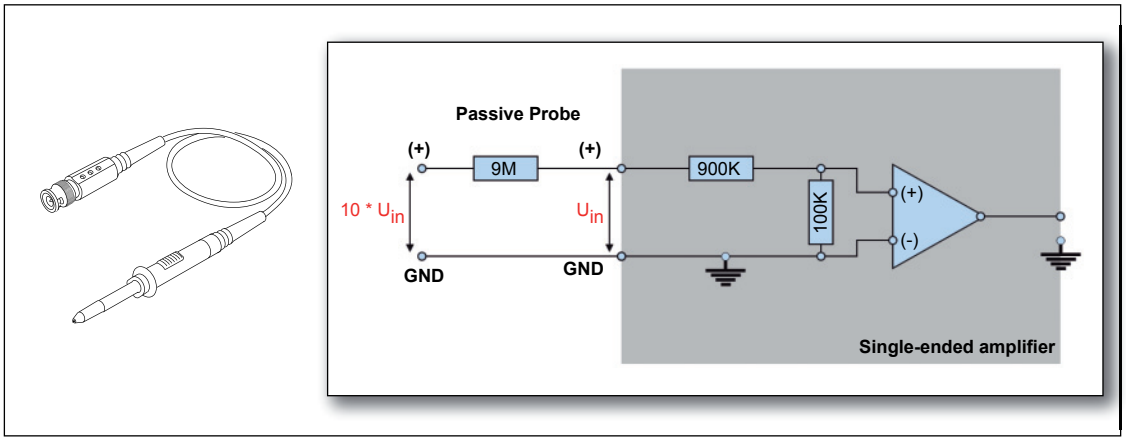


Figure D.7: Typical example of a voltage probe

Theoretically, voltage probes are simply passive in-line resistors in series with the positive input of a single-ended amplifier. Together with the input resistor of the amplifier, they form a voltage divider so that the voltage in series with the amplifier itself is divided. As there is also a capacitive component in this divider, the input capacitance of the amplifier and the so-called “compensation range” of the probe need to match. Otherwise, signal distortion might occur.

By selecting a higher resistance probe, the divider ratio increases so that large input ranges can be achieved. Voltage probes do not provide or add either isolation or common mode voltage rejection. These probes can only be used in series with single-ended amplifiers.

Voltage probes typically decrease the overall accuracy of the system (caused by the inaccuracy of the input divider ratio formed by the external probe resistance and the internal amplifier resistance).

Table D.1: Voltage probes overview table

Part number	Capacitive compensation range	Cable length	Divider factor	Bandwidth	Maximum input voltage
1-G901-2	7 - 75 pF	1.2 m	1 ± 2%	12 MHz	55 V RMS
			10 ± 2%	200 MHz	300 V RMS
1-G902-2	7 - 75 pF	3 m	1 ± 2%	12 MHz	55 V RMS
			10 ± 2%	200 MHz	300 V RMS
1-G903-2	7 - 45 pF	1.2 m	100 ± 2%	400 MHz	1 kV RMS
1-G904-2	10 - 50 pF	2 m	100 ± 2%	300 MHz	2 kV RMS 3 kV DC 3 kV pulse
1-G906-2	10 - 50 pF	3 m	1000 ± 2%	100 MHz	14 kV RMS 20 kV DC 40 kV pulse
1-G027-2	100 – 140 pF	3 m	1 ± 2%	2 MHz	55 V RMS
			10 ± 2%	50 MHz	300 V RMS

Table D.2: Passive, single-ended voltage probe overview

Input card	1-G901-2	1-G902-2	1-G903-2	1-G904-2	1-G906-2	1-G027-2
GN110/GN111	✓	✓	✓	✓	✓	
GN112/GN113	✓	✓	✓	✓	✓	
GN114	✓	✓	✓	✓	✓	
GN410/GN411						
GN412/GN413	✓	✓	✓	✓	✓	
GN440/GN441						✓
GN610/GN611						
GN610B/GN611B						
GN810/GN811	✓	✓				
GN812/GN813/GN814						
GN815/GN816						
GN840B						
GN1610/GN1611	✓	✓				
GN1640B						
GN3210/GN3211	✓	✓				
GENIS-1T/GENIS-1TM	✓	✓	✓	✓	✓	

D.2.2 Passive, single-ended isolated voltage probes

Passive, single-ended isolated voltage probes divide an isolated input signal by a specific factor. They are designed in an “isolated way” (like plastic BNCs to prevent users from touching the connection) so they can be used in series with an isolated unbalanced amplifier. They are called “isolated voltage probes”, although the amplifier and not the probe adds the isolation.

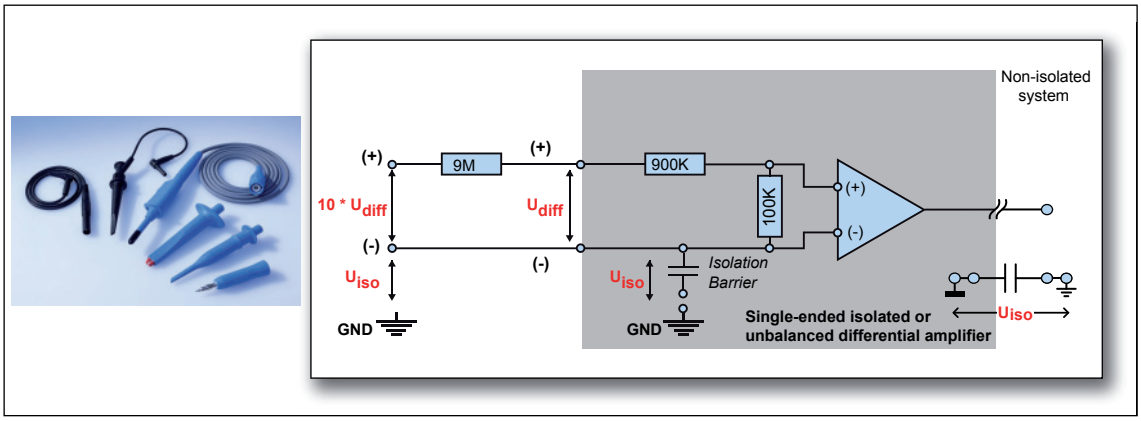


Figure D.8: Typical example of an isolated voltage probe

Theoretically, voltage probes for isolated amplifiers are simply passive in-line resistors in series with the positive input of an isolated unbalanced amplifier as well.

Together with the input resistor of the amplifier, they form a voltage divider so that the voltage in front of the amplifier itself is divided. As there is also a capacitive component in this divider, the input capacitance of the amplifier and the so-called “compensation range” of the probe need to match. Otherwise, signal distortion might occur.

However, as the division only applies to the positive side of the amplifier input, the input range is increased while the isolation voltage remains the same as without a probe.

These probes can only be used in series with isolated unbalanced amplifiers.

Isolated voltage probes typically decrease the overall accuracy of the system (caused by the inaccuracy of the input divider ratio formed by the external probe resistance and the internal amplifier resistance).

Table D.3: Voltage probes for ISOLATED amplifiers overview table

Part number	Capacitive compensation range	Cable length	Divider factor	Bandwidth	Maximum input voltage
1-G057-2	30 - 70 pF	1.2 m	100 ± 2%	50 MHz	3.5 kV RMS 1 kV RMS CAT II 600 V RMS CAT III

See "High accuracy voltage probes for isolated amplifiers overview table" on page 155 for the overview matrix of this probe.

D.2.3 High accuracy passive, single-ended isolated voltage probes

High accuracy passive, single-ended isolated voltage probes divide an isolated input signal by a specific factor. They are designed in an “isolated way" so that they can be used in series with an isolated unbalanced amplifier. They are called “isolated voltage probes”, although the amplifier and not the probe adds the isolation.

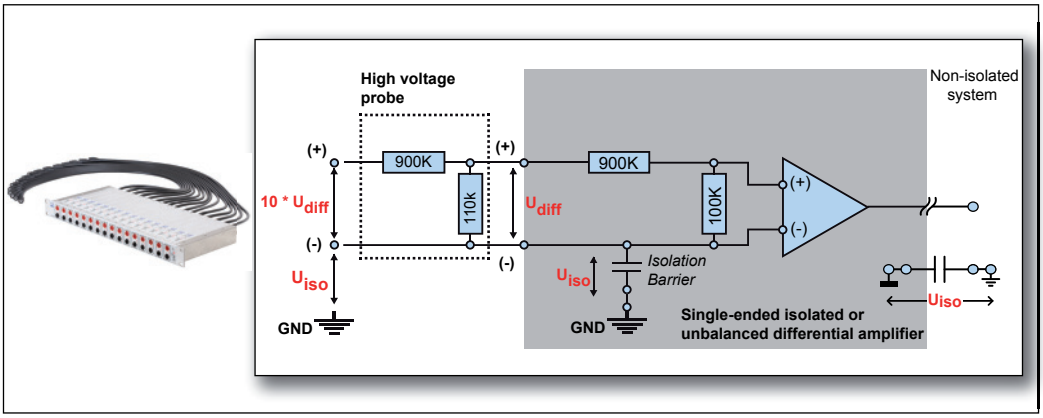


Figure D.9: Typical example of a high accuracy voltage probe for isolated amplifiers – as external divider

High accuracy passive, single-ended isolated voltage probes are designed to overcome the accuracy loss that comes with the use of passive, single-ended isolated voltage probes. To achieve this, they form a complete, high accuracy voltage divider in series and parallel with the amplifier input. The accuracy is therefore mainly by the probe itself and maintained at a high level. There is still a capacitive component in this divider, so the amplifier and the probe need to match. Only a specific combination of probe and amplifier can maintain high overall accuracy using the full pass band of the amplifier and probe. However, as the division only applies to the positive side of the amplifier input, the input range is increased while the isolation voltage remains the same as without a probe. These probes can only be used in series with isolated unbalanced amplifiers. These probes overcome the problems of “standard” passive probes and offer increased input ranges AND high accuracy.

Table D.4: High accuracy voltage probes for isolated amplifiers overview table

Part number	Capacitive compensation range	Cable length	Divider factor	Bandwidth	Maximum input voltage
1-G041-2 DC Coupled	n/a	1.2 m	10 ± 0.1%	250 kHz	1 kV DC
1-G042-2 AC coupled	n/a	1.2 m	1 ± 0.1%	250 kHz	1 kV DC 100 V

Table D.5: Passive, single-ended isolated voltage probe overview

Input card	1-G057-2	1-G041-2	1-G042-2
GN110/GN111			
GN112/GN113			
GN114			
GN410/GN411			
GN412/GN413			
GN440/GN441			
GN610/GN611			
GN610B/GN611B			
GN810/GN811			
GN812	✓		
GN813/GN814	✓	✓	✓
GN815/GN816	✓		
GN840B			
GN1610/GN1611			
GN1640B			
GN3210/GN3211			
GENIS-1T/GENIS-1TM			

D.2.4 Passive, differential matched isolated voltage probes

Passive, differential matched isolated voltage probes are used in series with differential amplifiers and divide a differential input signal by a specific factor.

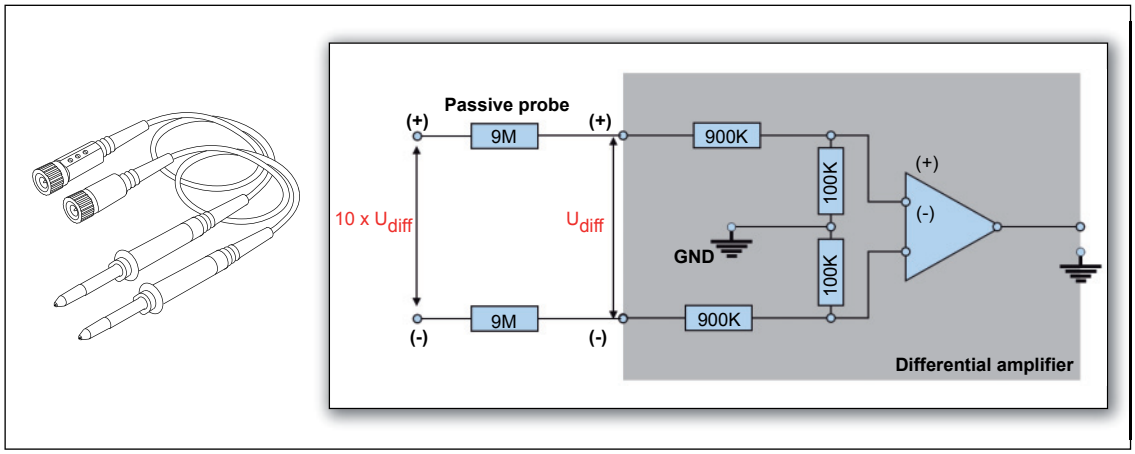


Figure D.10: Typical example of a passive differential voltage probe

Passive, differential matched isolated voltage probes are – in theory – simply a pair of “normal” voltage probes.

They add passive in-line resistors in series with both the positive and the negative inputs of a differential amplifier. Together with the input resistor of the amplifier, they form a voltage divider on each input side so that the voltage in series with the amplifier itself is divided. As there is also a capacitive component in this divider, the input capacitance of the amplifier and the so-called “compensation range” of the probe need to match.

As two of these probes are used, one with each input terminal, the probes themselves need to “match” as closely as possible. Otherwise, the two input terminals are divided differently. Therefore, the probes are typically manufactured (and sold) in pairs and called “matched”. By selecting higher resistance probes, the divider ratio increases so that large input ranges are possible. Passive, differential matched isolated voltage probes typically decrease the overall accuracy and the CMRR of the system.

Table D.6: Passive differential voltage probes overview table

Part number	Capacitive compensation range	Cable length	Divider factor	Bandwidth	Maximum input voltage
1-G025-2	100 – 140 pF	3 m	200 ± 2%	20 MHz	2.8 kV RMS 4 kV DC
1-G026-2	105 – 140 pF	3 m	10 ± 2%	100 MHz	400 V RMS 300 V RMS CAT II
1-G907-2	35 – 70 pF	3 m	10 ± 2%	100 MHz	300 V RMS CAT II

Table D.7: Passive, single-ended isolated voltage probe overview

Input card	1-G025-2	1-G026-2	1-G907-2
GN110/GN111			
GN112/GN113			
GN114			
GN410/GN411			
GN412/GN413			
GN440/GN441	✓	✓	
GN610/GN611			
GN610B/GN611B			
GN810/GN811			
GN812/GN813/GN814			
GN815/GN816			
GN840B			
GN1610/GN1611			✓
GN1640B			
GN3210/GN3211			✓
GENIS-1T/GENIS-1TM			

D.2.5 Active differential voltage probes

Active differential voltage probes are battery-powered, differential amplifiers in series with any input amplifier in single-ended mode.

Figure D.11: Typical example of an active differential voltage probe

The achievable input range and accuracy depends on which active differential probe is used. Active differential probes can be used in series with virtually any amplifier, their performance typically is limited. The fact that they are usually battery-powerd may cause some inconvenience, as battery maintenance is required.

Active differential voltage probes typically decrease the overall accuracy of the system. The active output enables the use of the probe with (almost) any type of input.

Table D.8: Active differential voltage probes

Part number	Capacitive compensation range	Cable length	Divider factor	Bandwidth	Maximum input voltage
1-G909-2	n/a	0.9 m	20 ± 2%	25 MHz	140 V RMS 140 V DC
			200 ± 2%	25 MHz	1.0 kV RMS 1.4 kV DC

D.2.6 LDS probe part number reference table

LDS Part number	HBM Part number	Type
869-923900	1-G901-2	Passive voltage
869-924900	1-G902-2	Passive voltage
869-925000	1-G903-2	Passive voltage
117-901600	1-G904-2	Passive voltage
085-953700	1-G906-2	Passive voltage
n/a	1-G057-2	Isolated
846-948000	1-G041-2	Isolated
846-948100	1-G042-2	Isolated, AC only
869-929500	1-G025-2	Differential, matched
869-929600	1-G026-2	Differential, matched
869-929700	1-G027-2	Passive voltage
869-925100	1-G907-2	Differential, matched
869-926500	1-G909-2	Active differential
085-963200	1-G912-2	Current clamp
222-146100	1-G913-2	Current clamp
085-940900	1-G914-2	Current clamp

D.2.7 Probe accessories

Probe accessories
1-G910-2 (LDS 040-747900)
Probe tip adapters with 4 mm safety-shrouded banana plugs. Include tip and ground lead adapters and two alligator clips with 1" jaw opening.
Use on probes G901 and G902 only.

G911 Probe Accessory Kit
1-G911-2 (LDS 869-925200)
Includes rigid probe tip, spring-loaded probe tip, insulating cap, ground lead, sprung hook, trimmer tool, and BNC adapter.
Use on probes G901 and G902 only.

D.2.8 Probes master list

Table D.9: Genesis Highspeed Probes MASTER list with part number and vendor list

HBM Part number	Type	Vendor	Vendor type name
1-G901-2	passive, single-ended, switchable	PMK	PMK 869-923900
1-G902-2	passive, single-ended, switchable	PMK	PMK 869-924900
1-G903-2	passive, single-ended	PMK	PHV 1000-1-45
1-G904-2	passive, single-ended	PMK	PHV642-L
1-G906-2	passive, single-ended	PMK	PHV4002-3
1-G057-2	passive, single-ended, isolated	Multi-Contact	Isoprobe II 100:1 55pF
1-G041-2	passive, single-ended, isolated	HBM product	
1-G042-2	passive, single-ended, isolated, AC only	HBM product	
1-G025-2	passive differential, matched	PMK	PDD 4263-L-140
1-G026-2	passive differential, matched	PMK	PDD 4013A-140
1-G027-2	passive, single-ended, switchable	PMK	PMTG 323A-140
1-G907-2	passive differential, matched	PMK	PDD 4013A-70
1-G909-2	active differential	Probe Master	Model 4231

D.3 Probe bandwidth calibration

A probe makes a physical and electrical connection between a test point or signal source and the instrument. Depending on the measurement needs, this connection can be made with something as simple as a length of wire or with something as sophisticated as an active differential probe.

For the purpose of this document, we only describe attenuating probes within two categories: 1X Probes and 10X Probes.

D.3.1 1X Probes

1X probes, also known as 1:1 (one-to-one) probes, simply connect the input of the instrument to the circuit being measured. They are designed for minimum loss and easy connection. Figure D.12 shows the circuit diagram for an instrument input connected to a circuit under test. The circuit under test is modeled as a voltage source with a series resistor. The 1X probe (or cable) introduces a significant amount of capacitance that appears in parallel with the input of the instrument. A 1X probe may have around 40 to 60 pF of capacitance.

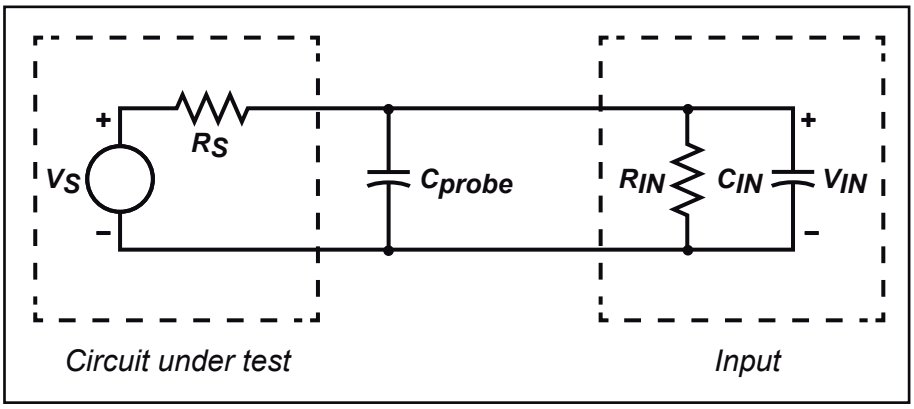


Figure D.12: Input connection using a 1X probe

The impedance of the circuit and the input impedance of the instrument produce a lowpass filter. For very low frequencies, the capacitor acts as an open circuit and has little or no effect on the measurement. For high frequencies, the capacitor's impedance becomes significant and reduces the voltage detected by the instrument. Figure D.13 shows this effect in the frequency domain. If the input is a sine wave, the amplitude tends to decrease with increasing frequency and the phase is shifted.

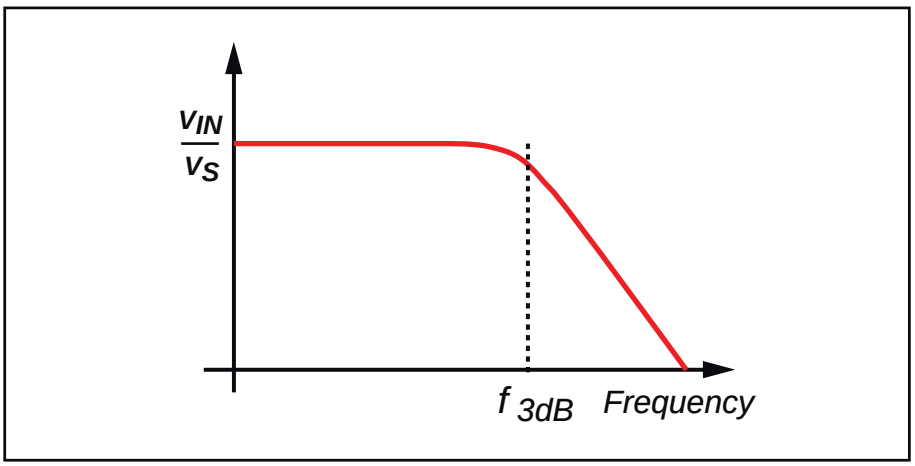


Figure D.13: Frequency response with 1X probe

Example: Assuming that the voltage source has a 1 MΩ resistance and the 1X probe has a 50 pF capacitance (a 1X probe has no resistance by itself), the universal amplifier input would have a 1 MΩ resistance and a 100 pF capacitance.

This yields a -3dB point at:

(EQ1)

$$f(\text{-}3db) = \frac{1}{2\pi(R_s \| R_{IN})\ (C_{IN}+C_{probe})}$$

= 1 / (6.28 x 500 E+3 x 150 E-12) ≈ 2 kHz

The loading due to the input impedance of the instrument and the probe capacitance is twofold: resistive loading and capacitive loading.

The resistive loading actually reduces the voltage delivered to the instrument:

(EQ2)

$$V_{IN} = V_S\left(\frac{R_{IN}}{R_{IN}+R_S}\right)$$

The effect of the capacitive loading is more complex and results in an exponential response in the voltage:

(EQ3)

$$V_{IN}(t) = V_{MAX}\left[1 - e^{-t/(R_S C_{in\ +\ probe})}\right]$$

D.3.2 10X Probes

10X probes (also called 10:1 probes, divider probes, or attenuating probes) have a resistor and capacitor (in parallel) inserted into the probe. Figure D.14 shows the circuit diagram for the 10X probe connected to a high-impedance input of an instrument.

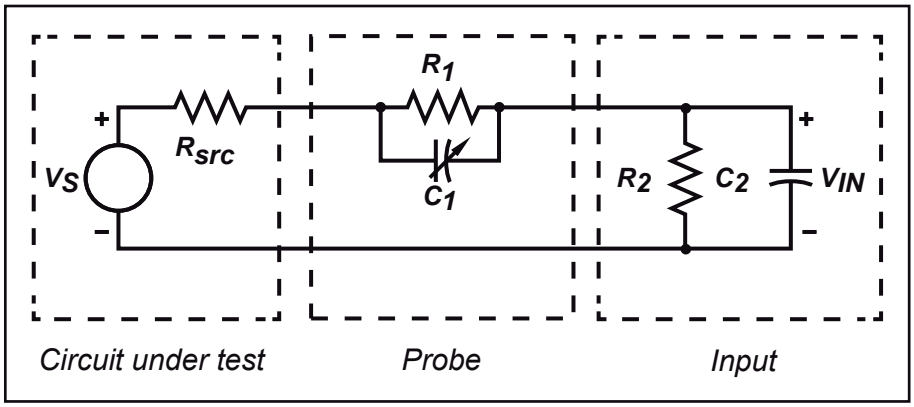


Figure D.14: Input connection using a 10X probe

Assuming that R_{src} is low compared to R_1 and that $R_1 * C_1 = R_2 * C_2$, then the effect of both capacitors cancel each other out in this circuit. The capacitor is usually adjustable and can be tweaked for a nearly perfect match. In these conditions, the relationship of VS to VIN is:

(EQ 4)

$$V_{IN} = V_S\left(\frac{R_2}{R_1 + R_2}\right)$$

R_2 is the input resistance of the instrument's high input impedance (1 MΩ) and $R_1 = 9 * R_2$. Using the previous equation, this results in:

(EQ 5)

$$V_{IN} = \left(\frac{1}{10}\right)V_S$$

The final result is a probe / instrument input combination that has a much wider bandwidth than the 1X probe due to the effective cancellation of the two capacitors. However, the instrument now measures only one-tenth of the original voltage (hence the name 10X probe). The circuit being measured is affected with a load impedance of $R_1 + R_2 = 10$ MΩ, which is much higher than with the 1X probe.

IMPORTANT

To perform the compensation correctly, both impedances must have the same value, i.e. $R_1 * C_1 = R_2 * C_2$. In practice, $R_1 * C_1$ will never be equal to $R_2 * C_2$, but the values can be approximated. The probe's compensation capacitor is usually adjustable somewhere between 10 pF and 50 pF to compensate for the instrument's input capacitance. Since the Universal Amplifier has a 100 pF capacitance, the compensation cannot be performed correctly with standard probes. Therefore, the probe capacitance must be adapted to this situation. Various probe manufacturers offer the possibility to purchase probes with other compensation ranges on request.

D.3.3 Probes and differential measurements

Connecting the differential amplifier or probe to the signal source is generally a major source of error. To maintain the input match, both paths should be as identical as possible. Any cabling should be the same length for both inputs. If individual probes are used for each signal line, they should be the same model and have the same cable length. When measuring low-frequency signals with large common mode voltages, avoid the use of attenuating probes. At high gains, they simply cannot be used as it is impossible to balance their attenuation precisely. When attenuation is needed for high-voltage or high-frequency applications, special passive probes designed specifically for differential applications should be used. These probes have provisions for precisely trimming the DC attenuation and AC compensation. To get the best performance, a set of probes should be dedicated to each specific amplifier and calibrated with that amplifier using the procedure included with the probes.

D.4 Current shunt measurements

Special care must be taken with shunt measurements. Typical shunt measurements generate signals with an amplitude of only a few volts or even mV. To prevent interference from higher voltage signals (up to 100 V), the following guidelines apply:

- Use only coaxial cables for all measurements.
- If possible, place the instrument as close as possible to the test object to reduce the length of the coax cable.
- Physically separate the low voltage signal lines from the high voltage signal lines as much as possible. Do not combine them. When the high voltage signals include high frequency transients, these will easily cross over to the low voltage signals.

CAUTION

Keep in mind that very strong magnetic fields can influence the amplifier setting relays!

HINT/TIP

Note that the ISOBE5600t transmitter has a relatively high bandwidth of 25 MHz. As a result of this high bandwidth, high frequency transients might show that have never been shown before. Use the filter to reduce the bandwidth to a physically relevant value.

E Troubleshooting

E.1 Overview

Unit does not start after firmware upgrade

Symptoms:	Solution
No text on display of receiver, but backlight is on, transmitter does not connect to receiver unit, all LED indicators are off.	The ISOBE5600 has a ‘Minimum Mode’ firmware that can be used when the upgrading process has failed and the previous firmware version does not boot. The Minimum Mode firmware can be activated by powering on the receiver unit while holding down (keeping pressed) the **rotary knob** for 2 to 3 seconds. This boot mode can only be used to reinstall the firmware update loader. It does not support other functionality.

ISOBE5600tm does not start after completely discharged

Symptoms:	Solution
When the ISOBE5600tm was running without mains connection and (nearly) fully discharged the internal battery, the unit becomes inoperable and will not awake when the mains cord is connected again.	This is normal behavior. The ISOBE5600tm needs first to be powered off by the On/OFF switch before you connect the mains power cord. Then turn the unit on again.

If the Troubleshooting tips don't help, use the information in chapter "General - Service Information" on page 128 to get in touch with our support and service teams.

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