Genesis
HIGH SPEED

User Manual

English

HV Impulse Attenuator

GEN series

HBM

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References made to the Perception software are for version 6.20 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.

WARNING

Indicates a risk of fire 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 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 give 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.

2 Safety Messages

2.1 Introduction

IMPORTANT

Read this section before you start using this product!

This manual contains information and warnings that must be observed to keep the instrument in a safe condition. The instrument should not be used when environmental conditions are damp 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 for measurement and directly related control tasks only. Any other use is not appropriate. To ensure safe operation, the attenuator may only be used as specified in this operating 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.
- There are no user serviceable parts inside!
- This instrument must not be used in life support roles.
- The Blind cover or termination connector must be installed before use.

It is also essential to follow the respective legal and safety regulations for the application concerned 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.
In the event of a fault, these precautions establish safe operating conditions. This can be done, for example, by mechanical interlocking, error signaling, limit value switches, etc.

Maintenance and cleaning
The instrument is a maintenance-free product. Please note the following when 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 labeling on the front panel and the display.
- When cleaning, ensure that no liquid gets into the module or connections.

General dangers of failing to follow the safety instructions
This instrument is a state of the art device and as such is fail-safe. This instrument may give rise to further dangers if it is inappropriately installed and operated by untrained personnel. Any person instructed to carry out installation, commissioning, maintenance or repair of the module must have read and understood the Operating Manuals and in particular the technical safety instructions.

Remaining dangers
The scope of supply and performance of this instrument 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 remaining dangers. Prevailing regulations must be complied with at all times. There must be reference to the remaining dangers connected with measurement technology.

Conversions and modifications
This instrument must not be modified from the design or safety engineering point of view except with our prior express written agreement. Any modification shall exclude all liability on our part for any resultant damage. In particular, any repair or soldering work on motherboards (replacement of components is prohibited. When exchanging complete modules, use only original parts from HBM. The module is delivered from the factory with a fixed hardware and/or software configuration. Changes can only be made within the possibilities documented in this manual.

Qualified personnel
Qualified persons means persons entrusted with the installation, fitting, commissioning and operation of the product who possess the appropriate qualifications for their function. This instrument is only to be installed and used by qualified personnel, strictly in accordance with the specifications and the safety rules and regulations. This includes people who meet at least one of the three following requirements:

- Knowledge in the safety concepts of automation and test and measurement technology is a requirement and as project personnel, you must be familiar with these concepts.
- As automation plant or test and measurement operating personnel, you have been instructed how to handle the equipment and are familiar with the operation of the modules and technologies described in this documentation.
- As commissioning engineers or service engineers, you have successfully completed the training to qualify you to repair the automation systems. You are also authorized to activate, to ground and label circuits and equipment in accordance with safety engineering standards. It is also essential to comply with the legal and safety requirements for the application concerned during use. The same applies to the use of accessories.

2.2 FCC and general

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

WARNING

This instrument 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.

This manual contains information and warnings that must be observed to keep the instrument in a safe condition. The instrument should not be used when environmental conditions are damp 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.

This instrument must not be used in life support roles.

2.3 Protection

WARNING

This instrument must be properly earthed.

This instrument has a location specifically designed for a protective earth connection. When this is in use it should be connected to earth via the protective earth connections.
Please see section 8 on page 30 for further details.

WARNING

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

Disconnecting the protective earth can cause high voltage between this instrument and mains power as a result of a (floating) measurement input signal.

WARNING

Do not remove covers. Refer servicing to qualified individuals.

Proper use of this instrument 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 and should not be directly connected to human subjects or used for patient monitoring.

WARNING

When you need to connect a BNC cable to the attenuator's BNC output you must proceed as follows.

- Make sure that the attenuator is NOT IN USE: there is no active measurement signal connected to the attenuator's input.
- Connect one end of the BNC cable to your measuring device.
- Connect the other end of the BNC cable to the attenuator's BNC output connector.
- Apply the measurement signal to the input of the attenuator.

Do not operate the attenuator with a BNC cable connected only to the attenuator, make sure to connect both ends.

2.4 Overvoltage and current protection, isolation

All signal inputs are protected against overloads of 2 kV RMS. Exceeding these limits, particularly when connected to potentially high-current sources, can cause severe damage that is not covered by the manufacturer's warranty.

2.5 Environment

The instrument should be operated in a clean, dry environment with an ambient temperature of between –15 °C to 50 °C.

The instrument is specified for use in a Pollution Category II environment, which is normally nonconductive 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.

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

Do not store the instrument in hot areas. High temperatures can shorten the life of electronic devices.

Do not store the instrument in cold areas. When the instrument warms up to its normal operating temperature, moisture can form inside the instrument, which may damage the instrument's electronic circuit boards.

Do not drop, knock or shake the instrument. Rough handling can break internal circuit boards.

Do not use harsh chemicals, cleaning solvents or strong detergents to clean the instrument. To clean the instrument, disconnect all power sources and wipe the surfaces lightly with a clean, soft cloth.

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

The IP 20 Standard - Conditions on site

For modules in IP20 protection class, you must:

- Protect the modules from humidity or effects of the weather such as rain, snow, etc.
- The permissible relative humidity at 31 °C is 80 % (non condensing); linear reduction down to 50 % at 40 °C.
- Ensure that if there are ventilation openings they are not covered.

For all modules:

- Do not expose the instrument to direct sunlight.
- Observe the maximum permissible ambient temperatures given in the specifications.

2.6 Electro Static Discharge (ESD)

Electrostatic discharge (ESD) can cause damage to electronic devices if discharged into the device, so you should 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 on the importance of ESD preventions when handling a system, its connections or a plug-in card.

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 - a 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 your electronic devices, including your GEN series Data Acquisition System, from ESD harm. Although HBM has built protections against ESD into its products, ESD unfortunately exists and, unless neutralized, could build up to levels that could harm your 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

Make sure to discharge any built-up static electricity from yourself and your electronic devices before touching an electronic device, before connecting one device to another, or replacing acquisition cards. You can do this in many ways, including the following:

- Connect yourself to ground by touching a metal surface that is at earth/ ground. For example, if your computer has a metal case and is plugged into a standard three-prong grounded outlet, touching the case should discharge the ESD on your body.

- Increase the relative humidity of your environment.
- Install ESD-specific prevention items, such as grounding mats and anti-static wrist straps.

While you should always take appropriate precautions to discharge static electricity, if you are in an environment where you notice ESD events, you may want to take extra precautions to protect your electronic equipment against ESD.

The use of wrist straps

Use anti-static wrist straps whenever you open a chassis, particularly when you will be handling circuit boards and electrical components. In order to work properly, the wrist strap must make good contact at both ends (with your 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.

2.7 Instrument symbols

On the instrument a variety of symbols can be found. Below is a list of symbols and their meaning.

Chassis ground connection
This symbol is used to indicate a Chassis ground connection location.

Protective earth connection
This symbol is used to indicate an earth connection location designed to keep the instrument electrically grounded.

Caution
Caution is required! The user/operator must refer to the Guide/ Manual for further information.

High Voltage
This symbol is used to indicate high voltage locations.

Risk of dangerous electric shock
This symbols location warns the user about the risk of dangerous electric shock that have the possibility to seriously injure or kill.

2.8 International safety warnings

Dansk

SIKKERHEDSADVARSEL
Dækslerne må ikke fjernes.

Nederlands

VEILIGHEIDSWAARSCHUWING
De deksels nooit verwijderen.

Suomi

TURVAOHJEITA
Älä poista suojakansia.

Français

ATTENTION - DANGER!
Ne pas déposer les panneaux de protection.

Deutsch

WARNHINWEIS!
Die Schutzabdeckung nicht entfernen.

Italiano

AVVISO DI SICUREZZA
Non aprire lo strumento.

Norsk

ADVARSEL!
Ikke fjern dekslene.

Português

Aviso de segurança
Não retire o invólucro/capas.

Español

ADVERTENCIA SOBRE SEGURIDAD
No quite las tapas.

Svenska

SÄKERHETSVARNING
Tag ej bort skydden.

English

SAFETY WARNING
Do not remove the covers.

日本語

安全上の警告
カバーは取り外さないでください。

中文

安全警告
不要取下保护盖。

3 Getting Started

3.1 Introduction

This manual describes the HV Impulse Attenuator.

Figure 3.1: HV Impulse Attenuator

Read this section before you start using it.

3.1.1 HV Impulse Attenuator

The HV Impulse Attenuator is combined with the ISOBE5600 transient recorder and the Perception High Voltage Impulse Analysis option (HV-IA) to form an application specific measurement solution.
Together the three components offer a cost effective solution for the HV impulse testing applications (Lightning impulse, Switching impulse and Current impulse).

The HV Impulse Attenuator provides a simple and effective method of interfacing with customer installations (voltage dividers). The LEMO input connector of the HV Impulse Attenuator is designed for the most commonly used output connector of the voltage dividers while the output BNC connector is designed for the ISOBE5600t or 6600HV.

With an input voltage of 2 kV RMS and an attenuation ratio of 50:1, the typical output signals of the voltage divider in the test hall are reduced to more suitable amplitude levels.

The HV Impulse Attenuators high input impedance of 2 MΩ allows the unit to work with capacitive as well as resistive voltage dividers. In cases where the voltage divider needs to feed signal into a low impedance input, the feed through LEMO connector can be used for an appropriate termination.

3.1.2 Features and Benefits

- Designed for HV impulse testing
- Interface between voltage divider and measurement system
- LEMO input; BNC output
- Passive attenuator 50:1
- 2 kV RMS Maximum input voltage
- Output matching with ISOBE5600t and 6600HV

Please see Section "New Test Set-up (a) and Earth Connections" on page 38 and "New Test Set-up (b) and Earth Connections" on page 40 for a detailed functional description of the test setup.

4 Installation and Operation

4.1 Introduction

This section describes how to install and operate the HV Impulse Attenuator, which is the front-end (or transmitter) section. The receiver card(s) should already have been factory installed into the GEN series system.

4.1.1 How to use this manual

This manual has been written to help you to benefit as quickly as possible from the **HV Impulse Attenuator** and gain maximum results from its usage. The next paragraphs tell you where to find the right information when you need it.

IMPORTANT

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 9 for details.

WARNING

This unit can be hazardous if not used in the correct way.

4.1.2 Technical support

Contact your local dealer or HBM directly for technical support, general information and more. Refer to the back of this manual for details of our address.

4.2 Unpacking

For transportation the HV Impulse Attenuator 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.

4.2.1 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.

4.2.2 Equipment checklist

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

- HV Impulse Attenuator instrument
- Coaxial cable (1)
- Trimming tool
- Manual
- Blind cover (2)

(1) This cable is only for use with this HV-IA unit, If the cable is changed other specifications pertinent to the unit may also change.

(2) The blind cover must be installed if no termination is used. See Figure 4.1 on page 26 for more information.

4.3 Connector Locations

This section describes the location of the various connectors on the HV Impulse Attenuator

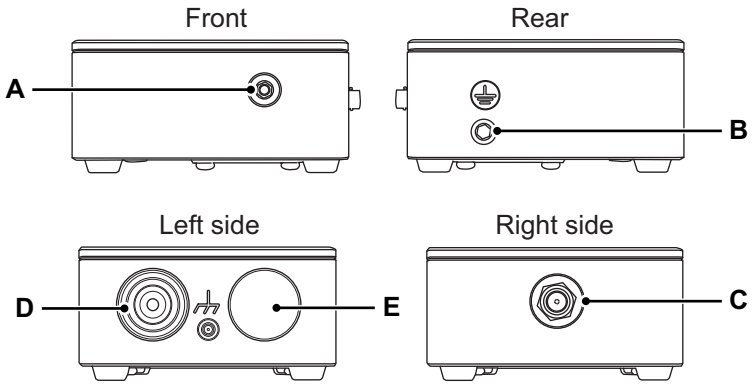


Figure 4.1: HV Impulse Attenuator (all views)

A Front - For use with the Trimmer tool (supplied)

B Rear - Protective Earth

C Right side - BNC Connector

D Input connector

E Termination or blind cover connector

Grounding

IMPORTANT

It is important when operating or handling this unit to make sure it is correctly grounded via the protective earth connection on the rear or the bottom of the unit.

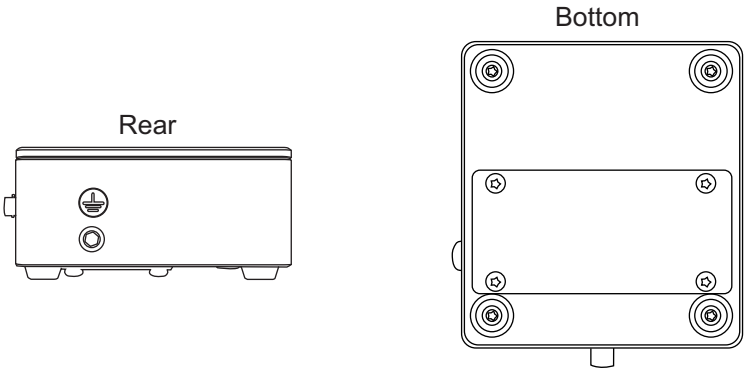


Figure 4.2: HV Impulse Attenuator (rear and bottom view)

Please refer to "Grounding" on page 31 for more detailed information.

The position of the protective earth connection on the HV Impulse Attenuator is located on the rear and the bottom of the instrument as shown in Figure 4.2.
The primary purpose of protective earth connection is to provide adequate protection against electric shock causing possible 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.

Equipment
The unit is supplied with a protective earth connection to be used for protective grounding. This grounding should consist of an assembly of appropriate lengths of copper cable with electrically and mechanically compatible connections and clamps at each end. The Cable should be continuous in length and contain no splices, breaks or junctions.

4.4 Installation

4.4.1 System connections

The connectors are shown on the label on top of the HV Impulse Attenuator instrument. If you are looking at the label the right way up the front surface pointing towards you is the front of the unit.

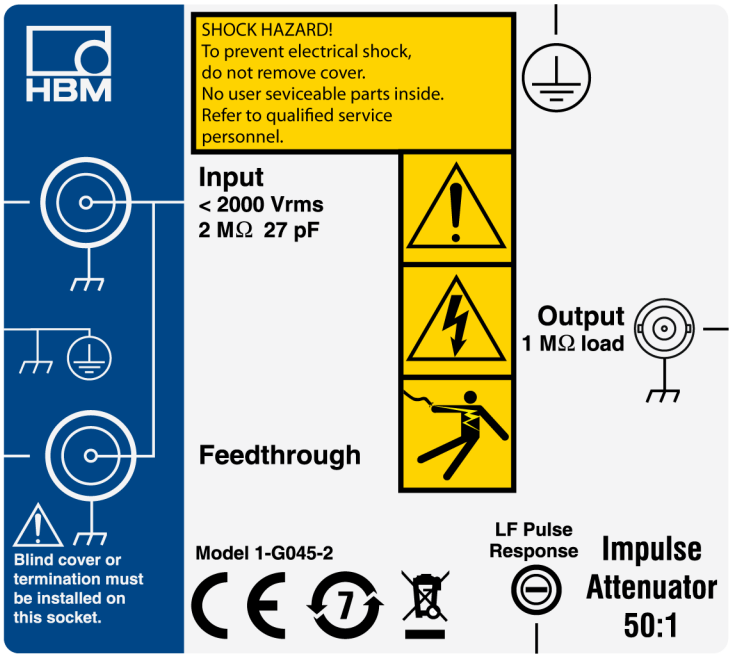


Figure 4.3: HV Impulse Attenuator label

1 Make sure a blind cover or termination is placed on the **Feedthrough** connector.
2 Then connect the BNC connector to the ISOBE5600t or the ISOBE6600HV using the cables supplied.

Note *The Cables supplied by HBM are already correctly configured, using another length of co-ax cable will alter the specifications related to the trimming of the instrument.*

WARNING

Make sure to connect the coaxial cable on both sides BEFORE connecting or turning on the high voltage signal.

Once these steps are complete you may connect the input signal to the LEMO connector. Only when the HV Impulse Attenuator unit is in a complete circuit with the experimental setup, should you activate any high voltage signal going to the device.

For further details in setting up your ISOBE5600 system or GenDAQ with 6600HV please refer to the User Manual of those instruments.

4.4.2 Initial check-out

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

- Check the unit is connected to earth via either of the protective earth connections.
- Check the unit is in a complete circuit with the experimental setup with no free wires.
- Is the GenDAQ mainframe or the ISOBE5600 receiver installed properly: fuses, power selection, power cord connected?

5 HV Impulse Test Set-up

5.1 Introduction

There are several ways to set up experiments for HV-IA analysis. This chapter depicts the difference between the traditional equipment set up versus the newer set ups made possible by the ISOBE5600 series.

5.2 Grounding

CAUTION

It is important when operating or handling this unit to make sure it is correctly grounded via the protective earth connections.

The primary purpose of protective grounding is to provide adequate protection against electric shock causing possible injury or even death 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.

Equipment
The instrument has two methods of protective grounding. The rear side-mounted protective earth should consist of an assembly of appropriate lengths of copper cable with electrically and mechanically compatible connections and clamps at each end which would then connect to the rear of the instrument via the torque screw noted in Figure 5.1. The Cable should be continuous in length and contain no splices, breaks or junctions.
Alternatively for more integrated grounding capabilities the unit has a base-plate with 4 torque screws on the underside (noted in Figure 5.2) which can be attached to an experimental setup.

The location of the protective earth is shown on the instrument by the circled earth symbol on the rear of the unit and on the label on top.

The position of the torque screw for the protective earth connection is located to one side on the rear of the instrument as shown in Figure 5.1.

Note *Torque screwdriver T30 needed.*

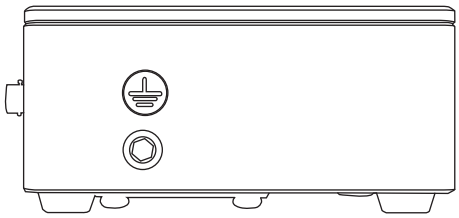


Figure 5.1: HV Impulse Attenuator (rear view)

The actual position of the base-plate for the integrated protective earth connection is located on the under-side of the instrument as shown in Figure 5.2.

Note *Torque screwdriver T20 needed.*

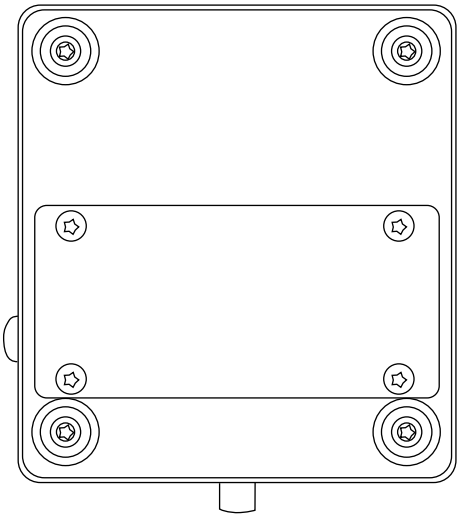


Figure 5.2: HV Impulse Attenuator (bottom view)

WARNING

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

Note *The screws used in the protective earth connections should only be removed in the event that the unit is being fitted to or removed from an experiment setup. Otherwise it should be left fastened in the original and correct position as originally supplied.*

WARNING

When you need to connect a BNC cable to the attenuator's BNC output you must proceed as follows.

- Make sure that the attenuator is NOT IN USE: there is no active measurement signal connected to the attenuator's input.
- Connect one end of the BNC cable to your measuring device.
- Connect the other end of the BNC cable to the attenuator's BNC output connector.
- Apply the measurement signal to the input of the attenuator.

5.3 Technical Problem

Producing HV Impulses up to several MV and dividing these voltages down for measurement purposes is a technology of its own and specialized manufacturers provide solutions to HV labs. To ensure safe operation for the human operators, as well as for the equipment itself, standards from regulatory organizations describe how a proper set-up has to be done. This includes proper grounding with earth pits and conducting mesh in the foundation of the HV lab. This is part of the customer’s installation.

5.3.1 Challenge

The main challenge for any measurement equipment is to operate as safely and accurately as possible in severe electromagnetic environments. High voltages in combination with fast rise/fall times create additional problems. Each piece of wire acts as an antenna. Each series resistor in a connection between two points creates a potential difference and hence a voltage drop, which in turn results in current flow. The higher the voltages and the faster the rise/fall times are, the more serious the effects.

5.3.2 Impulse Generation and Test Object Set-up

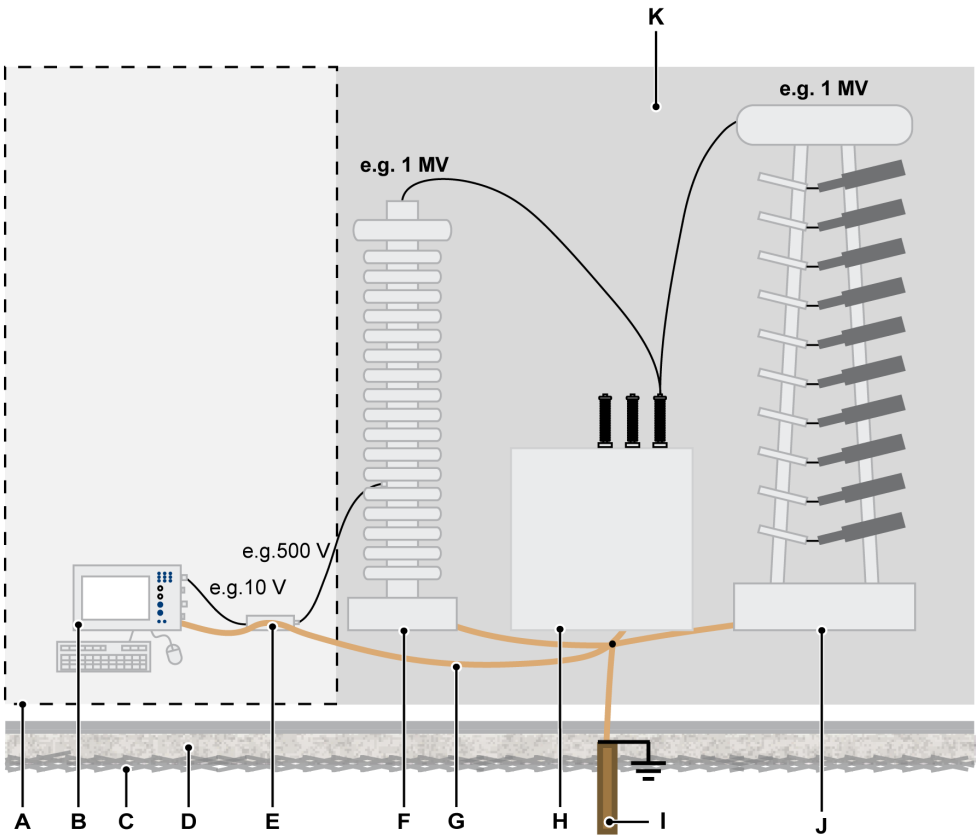
The output of the impulse generator is connected to the test object - here the energy is transferred. From the same terminal of the test object, there is a connection to a voltage divider (either resistive or capacitive), which is used to produce a proportionally smaller signal of the impulse for measurement purpose. All of these three components are connected to the same earth point in the HV lab by a copper strip, ideally in a star connection. The copper strip has two major characteristics: it is low impedance for low frequency energy because of its big sectional area and it has a lot of surface, which results in low impedance for high frequency energy. The high frequency components of the energy are produced by the high rise/fall times (high dU/dt). The voltage divider brings the impulse's voltage down by a known factor. For example a 1 MV impulse is divided by a 2000:1 ratio down to 500 V.

5.4 Measurement Equipment Set-up

The output voltage of the voltage dividers can go up to approximately 1 kV, depending on the manufacturer and the model of the divider. This output voltage is still above the direct input capability of digitizers and the output connectors of the HV dividers are typically LEMO type. To interface between the voltage divider and the digitizer, a for example 50:1 impulse attenuator is used. The impulse attenuator divides the voltage by 50, in the above example from 500 V to 10 V. Additionally, the impulse attenuators input LEMO connection interfaces well with the customer's test setup, while the BNC output cable interfaces well with the digitizer.

5.5 Traditional Test Set-up and Earth Connections

Control room measurement



A Shielded control room
B Sigma 100 HV
C Conducting mesh
D Foundation material
E Impulse attenuator
F Voltage divider
G Earth connections
H Unit under test
I Earth pit
J Impulse generator
K Test cell (Customers installation)

All of the above-mentioned voltages at the generator output, the test object, the voltage divider input and output are the potential difference between the terminal and an earth. To have the impulse attenuator and the digitizer working on the same reference level, they also have to be connected to the same protective earth. For this purpose, the impulse attenuator and the Sigma 100 HV are equipped with protective earth screw terminals, so a proper protective earth connection with a copper strip can be made. The protective earth connection serves additional purposes. First, the metal housing is acting as a Faraday cage and the solid connection to protective earth allows offloading of the energy picked up from electromagnetic fields and keeps the inside free of disturbances.

There are two main disadvantages of such a traditional setup:

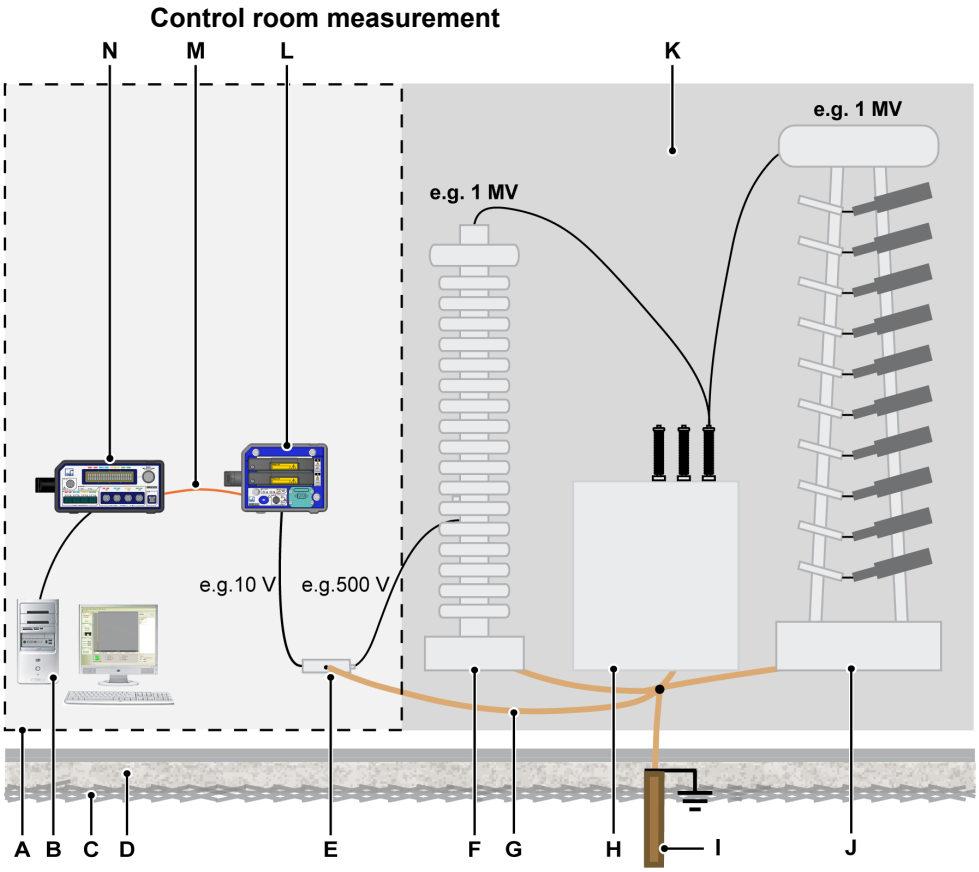
- **Grounding:** The digitizer is powered via mains in the control room. Each mains connection contains also an earth connection and the earth connection of the wall outlet is in most test labs not the same as the test cell earth connection. This may become an issue during impulse testing, as the high energy and the high dU/dt may result in short term potential differences in the earth connections. As a result, there will be equalizing currents, which may damage equipment over time.
- **Lethal voltages in control room:** The output signal of the HV divider can reach values of up to 1.5 kV. In the traditional set-up, these voltages are brought into the control room.

With HBM's battery operated and fiber optic isolated digitizers ISOBE5600t, two new test set-up's can be realized:

- Measurement point in control room
- Measurement point in test cell

For both of these set-up's a few things need to be taken into account.

5.6 New Test Set-up (a) and Earth Connections



A Shielded control room

B PC with Perception (HV-IA)

C Conducting mesh

D Foundation material

E Impulse attenuator

F Voltage divider

G Earth connections

H Unit under test

I Earth pit

J Impulse generator

K Test cell (Customers installation)

L ISOBE5600t (Transmitter)

M Fiber Optic data cable

N ISOBE5600m (Receiver)

In this set-up, all the measurement equipment is still located in the well shielded control room. The PC and the ISOBE5600m (receiver with memory) are mains powered and earthed via this mains connection. The ISOBE5600t (battery operated digitizer) is connected to the ISOBE5600m only by means of fiber optic cables, so there is NO electrical connection between them. The digitizer does get the input signal from the impulse attenuator, which is properly grounded to the test cells earth connection.

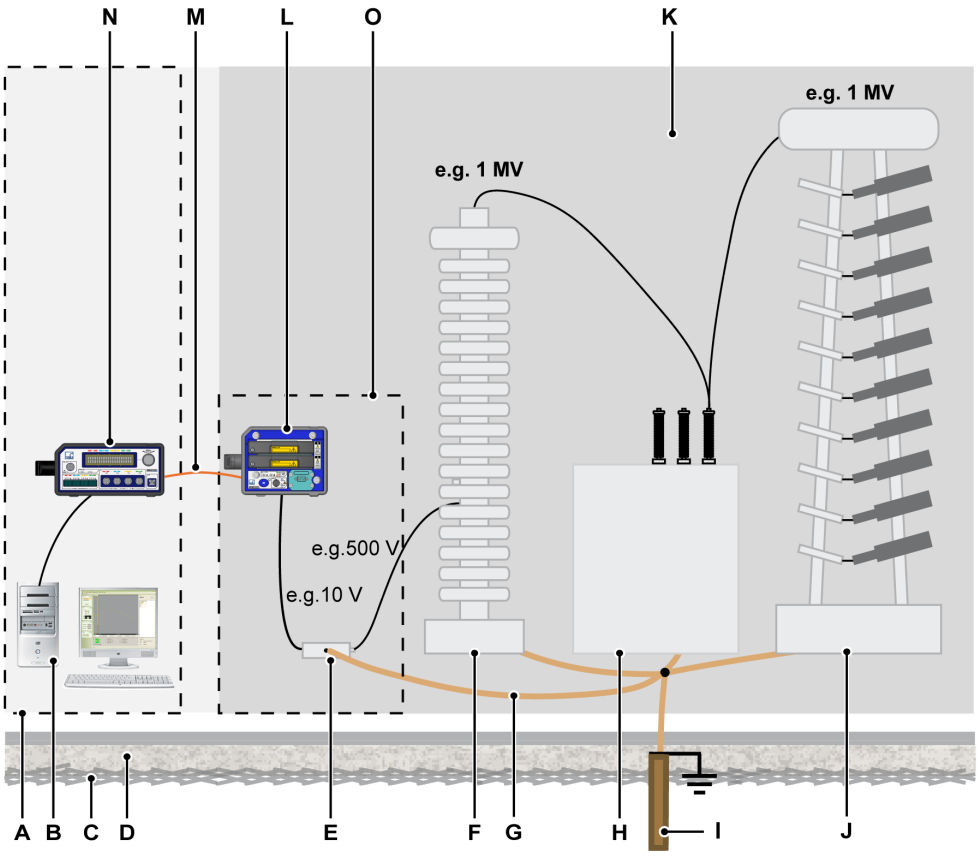
The **advantages** compared to the traditional test set-up:

- NO electrical connection between test cell signals and equipment powered in the control room (measurement system and PC).
- NO equalizing currents between test cell earth connection and mains earth connection.
- Impulse attenuator and battery operated digitizer still placed in the shielded control room, means a minimum exposure to electromagnetic disturbance.

There is no **disadvantage** compared to the traditional test set-up.

5.7 New Test Set-up (b) and Earth Connections

The ISOBE5600 set up with measurements done from inside the test cell



A Shielded control room
B PC with Perception (HV-IA)
C Conducting mesh
D Foundation material
E Impulse attenuator
F Voltage divider
G Earth connections
H Unit under test
I Earth pit
J Impulse generator
K Test cell (Customer installation)
L ISOBE5600t (Transmitter)
M Fiber Optic data cable

N ISOBE5600m (Receiver)

O Shielded compartment in test cell

In this set-up, half of the measurement equipment is still located in the well shielded control room, the PC and the ISOBE5600m (receiver with memory). They are mains powered and earthed via the mains connection.

The ISOBE5600t (battery operated digitizer) is connected to the ISOBE5600m only by means of fiber optic cables, so there is NO electrical connection between them. The digitizer does get the input signal from the impulse attenuator, which is properly grounded to the test cell's earth connection. The ISOBE5600t and the impulse attenuator are placed in the test cell in a shielded box.

The **advantages** compared to the traditional test set-up:

- NO electrical connection between test cell signals and equipment powered in the control room (measurement system and PC).
- NO equalizing currents between test cell earth connection and mains earth connection.
- Impulse attenuator and battery operated digitizer are placed in the test cell, means NO lethal voltages are wired into the well shielded control room.

The **disadvantages** compared to the traditional test set-up:

- The electromagnetic disturbance in the test cell is much higher than in the well shielded control room, means the digitizer may pick unwanted signals and show them superimposed to the real signal. This signal pickup may heavily vary from several factors like distance to source of disturbance, wave shape used, etc.
- The 50:1 impulse attenuators were originally designed only for usage in the well shielded control room. To make them work in the test cell, it is absolutely necessary to place them in a shielded and earthed box or compartment.

Ideally, the ISOBE5600t, the impulse attenuator and the connecting short cable are all placed together in the same shielded and earthed box or compartment. The size and performance of such a box is up to the test cells requirement and part of the users installation. HBM does not offer such boxes.

6 Specifications

6.1 Introduction

The attenuator was developed specifically for high voltage analysis applications. The Attenuator works in combination with the Perception HV Impulse analysis option and the ISOBE5600t or the 6600HV.

The HV Impulse Attenuator is a 50:1 attenuator. It is a voltage divider that converts a maximum 2 kV RMS to the input range of your system. This attenuator has a wide bandwidth and low noise. Complete specifications are listed at the end of this section.

Note *The HV Impulse Attenuator is adjusted at the factory and normally does not require adjustment. As with any equipment, annual calibration is recommended, especially after the first year of operation. If the attenuator is subject to any over-voltage beyond the specified limits, it is recommended that calibration be verified.*

6.1.1 Specifications:

Capabilities Overview	
Model	G045
Attenuator	
Input/output ratio (1)	50:1 Including termination resistor of 1 MΩ ± 2 %; connected to the BNC output
DC gain error (1)	± 0.25 % Including termination resistor of 1 MΩ ± 2 %; connected to the BNC output
Gain error drift	± 10 ppm / °C (± 18 ppm / °F)
Input	
Maximum Voltage	2 kV RMS
Impedance	2.0 MΩ ± 0.1 % // 27 pF ± 10 % Including termination resistor of 1 MΩ ± 2 %; connected to the BNC output
Connector	LEMO - ERA.4S.250.CTL
Termination connector	LEMO - ERA.4S.250.CTL
Output	
Connector	Coaxial BNC adapter
Cable (2)	RG58 Coaxial, 0.25 m length, 50 Ω
Shielding	Aluminum (3)

(1) The **DC gain error** is achieved when the impulse attenuator is connected to any 6600HV or ISOBE5600t unit. As all units have slightly different input impedance this will affect the overall **DC gain error**.
If higher DC accuracy is required, one can combine the impulse attenuator with a 6600HV or ISOBE5600t and measure the attenuation ratio exactly for this given combination. The result may be slightly different to 50:1, for example the result could be 50.035:1. This result is only valid for the given combination of equipment. The accuracy will then mostly depend on the calibration setup and not the possible variation of input impedances.

(2) Use only the cable supplied by HBM. Changing this cable may impact the trimming of the instrument defined in the **Pulse Response Calibration** procedure.

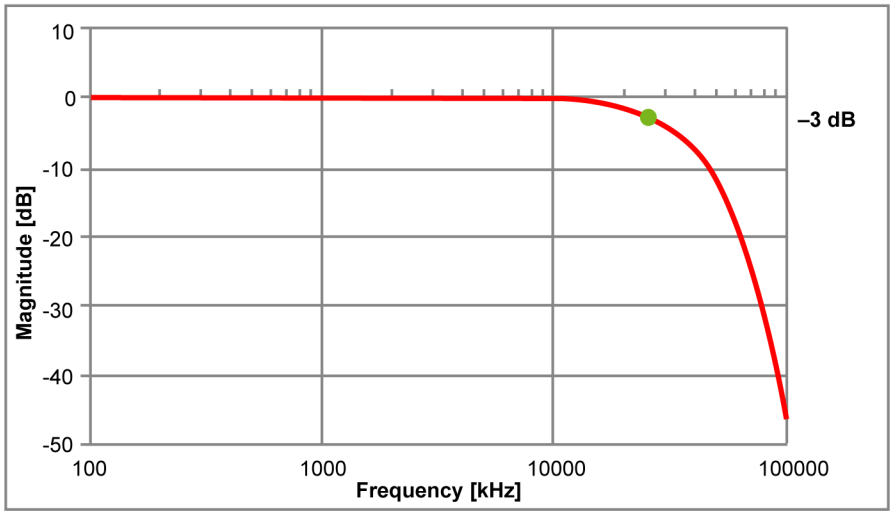
(3) Housing machined out of a solid block of Aluminum, EMI gaskets between bottom part of housing and cover, cover fixed with 18 screws.

Note *The DC accuracy specification is achieved when the impulse attenuator is connected to any 6600HV or ISOBE5600t unit, all of these units have a slightly different input impedance.*
If higher DC accuracy is required, one can combine the impulse attenuator with a 6600HV or ISOBE5600t and measure the attenuation ratio exactly for this given combination. The result may be slightly different to 50:1, for example the result could be 50.035:1. This result is only valid for the given combination of equipment. The accuracy will then mostly depend on the calibration setup and not the possible variation of input impedances.

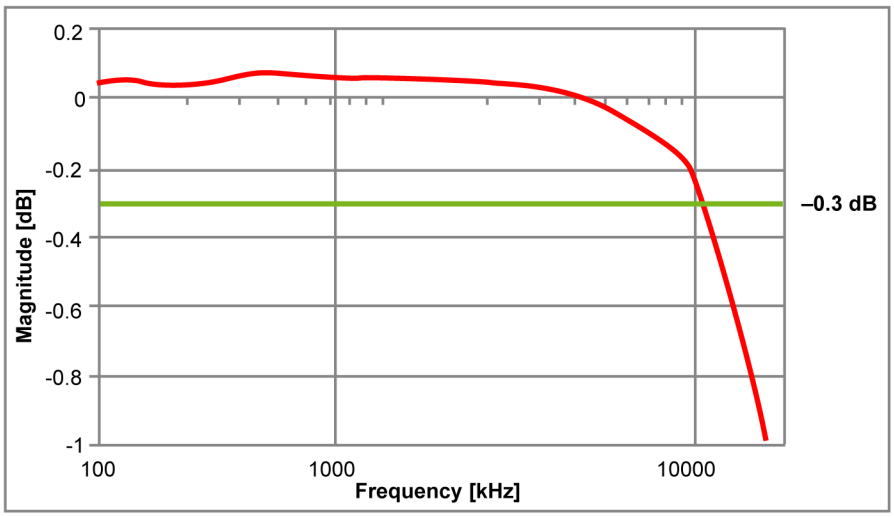
Wideband	
Bandwidth	Between 23 MHz and 27 MHz (- 3 dB)
±0.3 dB (3.5 %) Passband Flatness	11 MHz

Wideband

Bandwidth Overview



Passband Flatness



Dimensions	
Width	113 mm (4.45”)
Depth inc. connector	118 mm (4.64”) 130 mm (5.11”)
Height	56.6 mm (2.22”)
Weight	1150 grams

Dimensions

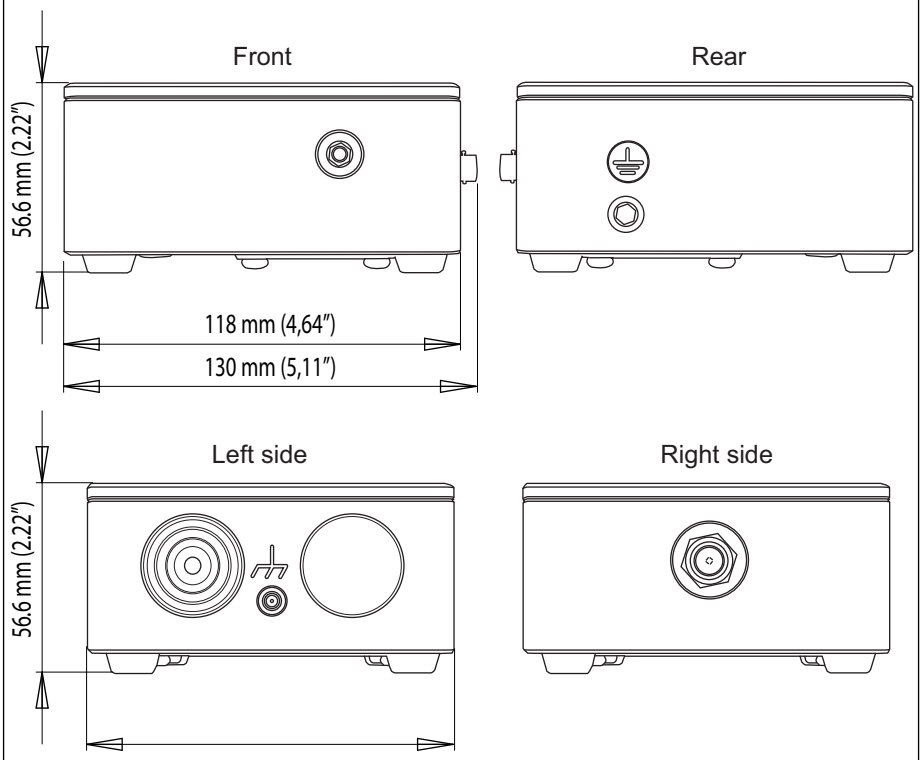


Figure 6.1: Dimensions of the HV Impulse Attenuator

Environmental Specifications	
Shock: Acc. IEC 60068-2-27	
Operational	Half-sine 10 g/11 ms; 3-axis, tested in positive and negative direction
Non-Operational	Half-sine 25 g/6 ms; 3-axis, tested in positive and negative direction
Vibration: Acc. IEC 60068-2-34	
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
Temperature range	
Operational	-15 °C to 50 °C (5 °F to 122 °F)
Non-Operational (Storage)	-20 °C to 60 °C (-4 to 140 °F)
Relative humidity	0 % to 80 %; non-condensing; operational
Protection class	IP20
Altitude	Maximum 2000 m; (6562 feet) operational

Environmental Specifications	
Operational environmental tests	
Cold test IEC60068-2-1 Test Ad	-5 °C (+23 °F) for 2 hours
Dry Heat test IEC-60068-2-2 Test Bd	+40 °C (+104 °F) for 2 hours
Damp Heat test IEC60068-2-3 Test Ca	+40 °C (+104 °F), humidity >93 % RH for 4 days
Non-Operational (Storage) environmental tests	
Cold test IEC-60068-2-1 Test Ab	-25 °C (-13 °F) for 72 hours
Dry Heat test IEC-60068-2-2 Test Bd	+70 °C (+158 °F) humidity <50% RH for 96 hours
Change of Temperature Test IEC60068-2-14 Test Na	-25 °C to +70 °C (-13 °F to +158 °F), 5 Cycles Rate 2 to 3 minutes, Dwell time 3 hours
Damp Heat cyclic test IEC60068-2-30	+25 °C / +40 °C (+77 °F/ +104 °F), humidity >95/90 % RH
Test Db variant 1	6 Cycles, cycle duration 24 hours

Ordering Information			
Article		**Description**	**Order No.**
The High Voltage Impulse Attenuator		50:1 Impulse Attenuator for 6600HV and ISOBE5600t; contains two LEMO ERA.4S. 250 input connectors, Accepts 4S.250 series male plug and offers a parallel feed-through connector for a terminator. Includes a BNC output cable and a blind connector cover.	1-G045-2

6.2 Pulse Response Calibration (6600HV)

1. Connect the output of the HV Impulse Attenuator to the 6600HV.
2. Switch on the GENDAQ and Perception.
3. Set the voltage span of the channel to 400 mV.
4. Apply a 1 kHz (perfectly flat) square wave with 10 V amplitude to the input of the HV Impulse Attenuator.
5. Set the X scale to 100 µs/Div.
6. Go display setup to set up the display, tab traces setup.
7. Set the Y scale to 90 mV to 110mV (See Figure 6.2).

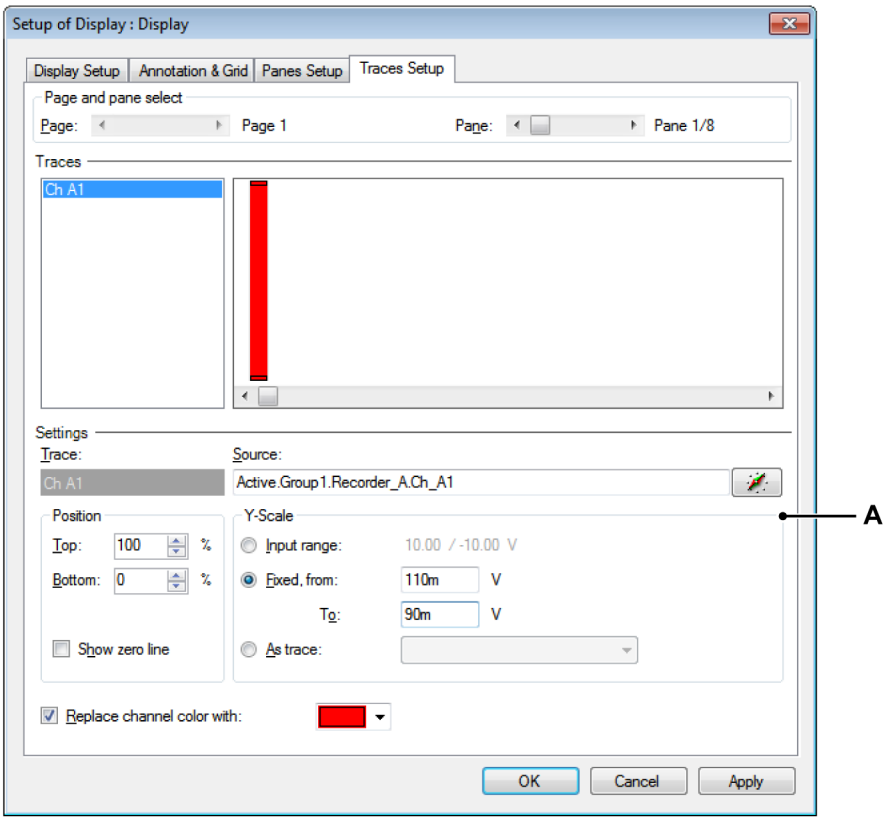


Figure 6.2: Setup of Display dialog - Trace Setup

A Y-Scale group

8. Grid lines can be set for a better view of the flatness.
9. Set Perception to **continuous** operation (**pause** button).

10 Set the trimmer of the HV Impulse Attenuator so that the signal in Perception resembles the input signal (See Figure 6.3).

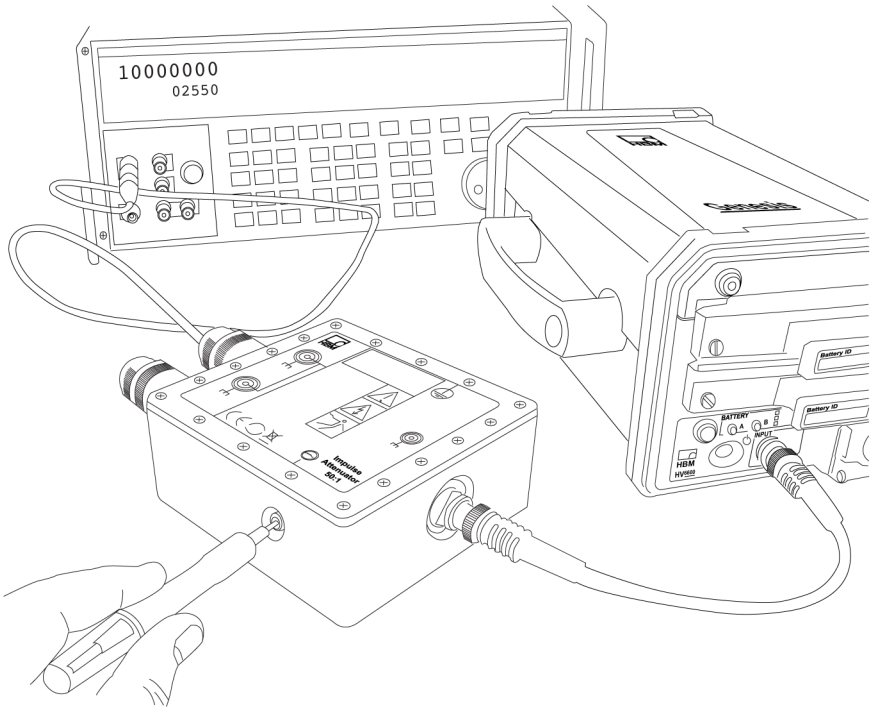


Figure 6.3: Trimmer of the HV Impulse Attenuator

Note *Adjustments made with the nylon trimming tool*

6.3 Pulse Response Calibration (ISOBE5600t)

Note *Please refer to the chapter “Safety Warning” on page 9 before attempting to connect this unit and always use only the cables provided with this unit.*

1. Connect the output of the HV Impulse Attenuator to the ISOBE5600t.
2. Switch on the ISOBE5600 and Perception.
3. Set the trigger of the channel to 10 mV, rising edge.
4. Set the sample rate to 1 MS/s.
5. Set the sample length to 2 kS, pre-trigger to 400 S.
6. Set the voltage span of the channel to 400 mV.
7. Go display setup to set up the display, tab traces setup.
8. Set the Y scale to 90 mV to 110 mV (see Figure 6.4).

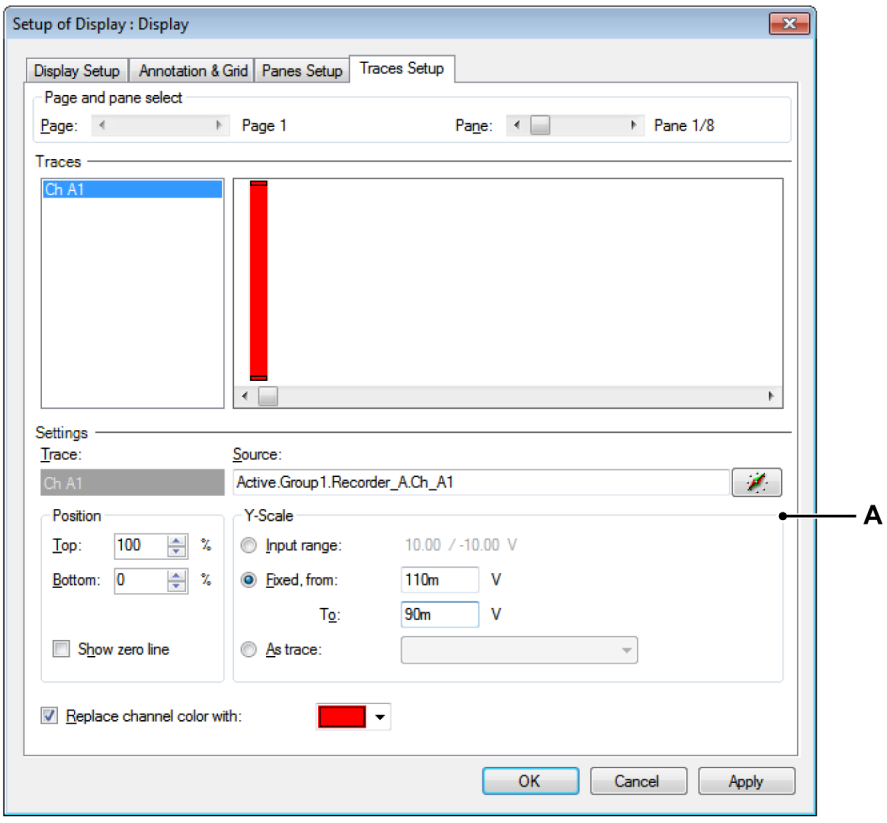


Figure 6.4: Setup of Display dialog - Trace Setup

A Y-Scale group

9 Set the X scale to 100 µs/Div.

10 Grid lines can be set for a better view of the flatness.

11 Set the acquisition to automated restart (timer menu, see Figure 6.5).

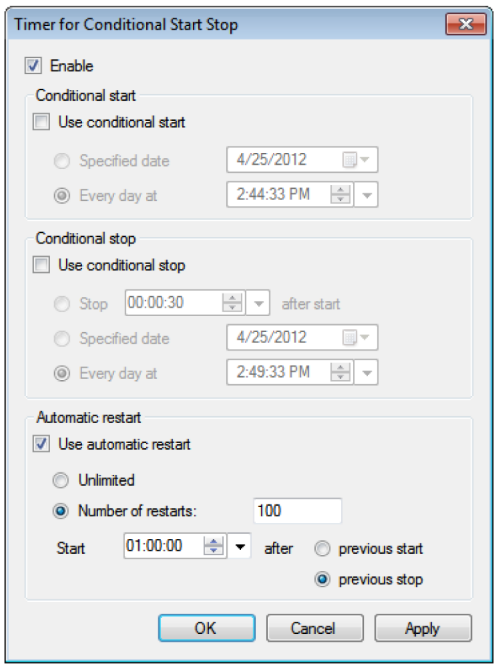


Figure 6.5: Timer for Conditional Start Stop dialog

12 Number of restarts may be set around 100, if more acquisitions are needed the number can be increased.

13 Apply a 1 kHz (perfectly flat) square wave with 5 V peak-to-peak amplitude to the input of the HV Impulse Attenuator.

14 Start the acquisition, 100 recordings will be displayed on the screen with a refresh rate of about 1 second.

15 Set the trimmer of the HV Impulse Attenuator so that he signal in Perception resembles the input signal.
Figure 6.6 below shows how the signal should look like. When the position of the trimmer is not right, undershoot or overshoot is seen in the signal.

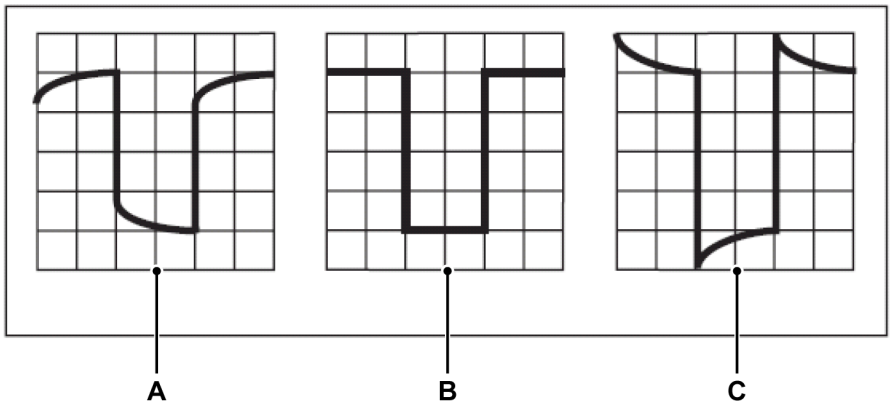


Figure 6.6: Trimming of response - Incorrect and correct waveform responses

A Incorrect - Undershoot

B Correct

C Incorrect - Overshoot

When the input square wave is ideally flat, and the overshoot in Perception is within ±1 mV of the signal, it represents <1 %. The grid in Figure 6.7 is set to 0.5 mV.

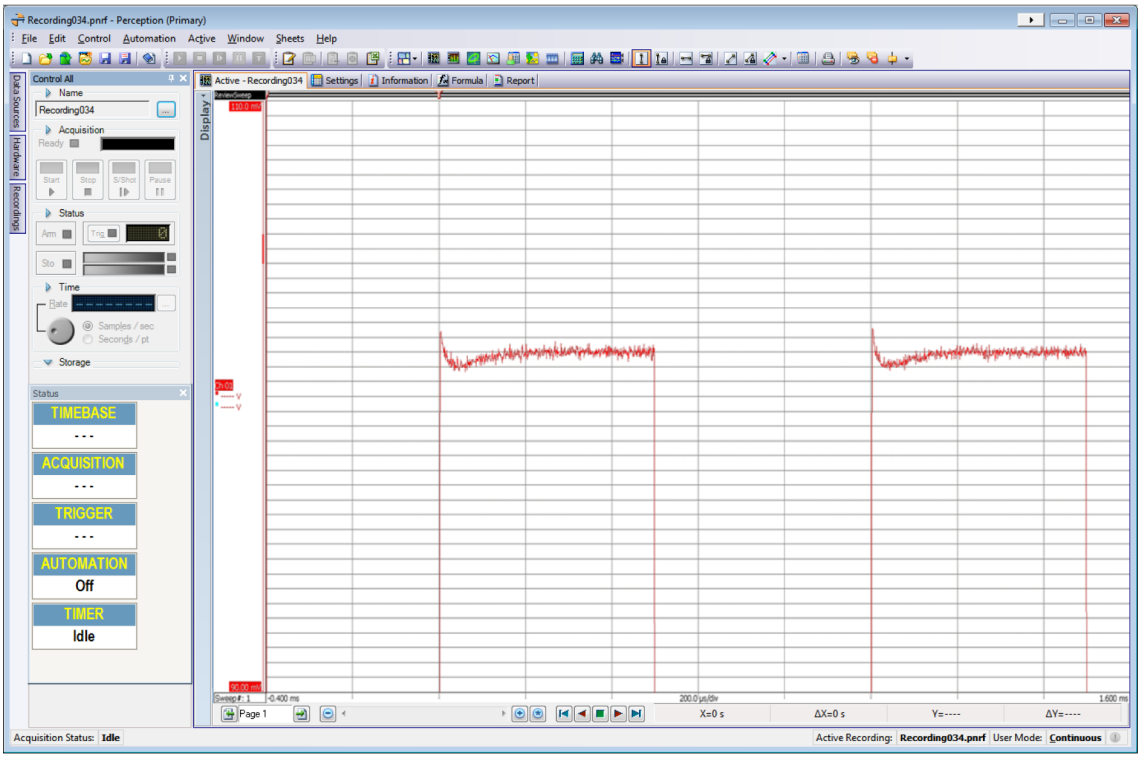


Figure 6.7: HV Impulse Analysis with trimming result of ISOBE5600

Note *Good results are achieved, when the "return to zero" part of a square wave signal from an oscilloscopes cal output is used. Such cal outputs are used to properly adjust the scope probes to match the scopes input.*

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