English

User Manual

GEN series

Calibration and Verification Software Version 4.06

IMPRINT

Document version 11.0 - February 2025

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TABLE OF CONTENTS

ToC -Table of Contents

1 About this manual. 9
1.1 Symbols used in this manual 9
1.2 Manual conventions. 10

2 Safety Messages 11
2.1 Introduction. 11
2.2 Grounding 14
2.3 Instrument Symbols. 15
2.4 Protection and isolation. 16
2.4.1 Measurement categories 16
2.4.2 Basic insulation versus reinforced. 18
2.4.3 Protection 20
2.4.4 Overvoltage/current protection 21
2.4.5 Isolation. 21
2.5 Environment 22
2.6 Laser Safety. 23
2.7 Manual handling of loads 24
2.8 International safety warnings 25
2.9 Operation of electrical installations 41

3 Normative Documents and Declarations. 42
3.1 Electrical 42
3.1.1 Electrostatic Discharge (ESD). 42
3.1.2 Electromagnetic Compatibility (EMC) 43
3.2 Environment 45
3.2.1 RoHS and WEEE - Waste Electrical and Electronic Equipment. 45
3.2.2 China RoHS. 46
3.3 CE and UKCA Declaration of conformity 47
3.3.1 CE Declaration of conformity 47
3.3.2 UKCA Declaration of conformity. 47
3.4 FCC Class A Notice. 48

4 Getting Started 49
4.1 Introduction. 49
4.2 Required parts. 50
4.3 System requirements. 51
4.4 Supported acquisition hardware. 52
4.5 Supported/Required calibrators 54

TABLE OF CONTENTS

4.6 Calibration system setup . . . 57
4.7 Installing the calibration and verification software . . . 60
4.7.1 Connecting and installing calibrators via GPIB . . . 60
4.7.2 Installing the calibration and verification software . . . 61
4.8 Starting GEN series calibration and verification . . . 62
4.8.1 Start the GEN series calibration and verification software . . . 62
4.8.2 Organization information . . . 64
4.8.3 Mainframe selection . . . 65
4.8.4 Recorder (acquisition card) selection . . . 68
4.8.5 CalStack setup . . . 69
4.8.6 Exit the GEN series calibration and verification software . . . 76

5 Calibration . . . 77
5.1 Introduction . . . 77
5.2 Calibrating cards . . . 80
5.2.1 DC calibration . . . 85
5.2.2 AC calibration (depending on card) . . . 87
5.2.3 Calibration test results . . . 91
5.2.4 Passed test results . . . 92
5.2.5 Failed test results . . . 92
5.2.6 Group selection . . . 94
5.2.7 Remote Probe selection . . . 95

6 Calibration Verification . . . 96
6.1 Introduction . . . 96
6.2 Verifying cards . . . 98
6.2.1 Setting up the Verification test . . . 98
6.2.2 Starting the Verification test . . . 100
6.2.3 During Verification Testing . . . 104
6.2.4 Verification test results . . . 107
6.2.5 Passed test results . . . 108
6.2.6 Failed test results . . . 108
6.2.7 Save results . . . 109
6.2.8 Group selection . . . 110
6.2.9 Remote Probe selection . . . 111

7 Power Verification . . . 112
7.1 Introduction . . . 112
7.2 Verifying Power cards . . . 114
7.2.1 Setting up the Power Verification test . . . 114

TABLE OF CONTENTS

7.2.2 Starting the Verification test . . . 116
7.2.3 During Power Verification Testing . . . 117
7.2.4 Power verification test results . . . 120
7.2.5 Passed test results . . . 121
7.2.6 Failed test results . . . 121
7.2.7 Save results . . . 122

8 Theory of Operation . . . 123
8.1 Range and Span explained . . . 123
8.2 AC Coupling Test . . . 125
8.3 AC Gain (Voltage or Current) Test . . . 126
8.4 AC Probe Test . . . 127
8.5 Balance Test . . . 128
8.6 Bandwidth Test (HV probe BW) . . . 129
8.6.1 Quick Bandwidth Test . . . 129
8.6.2 Full Bandwidth test . . . 130
8.7 Charge AC Gain Test . . . 132
8.8 CMRR (Common Mode Rejection Ratio) Test . . . 133
8.9 Cold Junction Test . . . 134
8.10 Current Transducer Voltage Test . . . 135
8.11 DC Gain (Voltage or Current) Test (HV probe DC) . . . 136
8.11.1 The MIL (Military) standard test . . . 137
8.12 Power (AC) . . . 138
8.13 Power (DC) . . . 139
8.14 Power vs. Frequency . . . 140
8.15 Power vs. Phase . . . 141
8.16 PowerFactor . . . 142
8.17 Excitation Voltage [V] and Excitation Current [A] Test . . . 143
8.18 IEPE AC Gain Test . . . 145
8.19 IEPE Excitation Test . . . 146
8.20 Noise (Voltage or Current) Test . . . 147
8.21 OutDAC Test . . . 148
8.22 Quarter Bridge Resistor Test . . . 149
8.23 Reference Signal Test . . . 150
8.24 Shunt Resistor Test . . . 151
8.25 TEDS Class 3 Data Test . . . 152
8.26 TEDS Data Test . . . 153
8.27 Input Resistor Test . . . 154

TABLE OF CONTENTS

A Log Files and Reports . . . 155
A.1 Introduction . . . 155
A.2 The verification log files . . . 159
A.2.1 The standard verification log file 159
A.2.2 Uncertainty calculation for AC gain verification . . . 161
A.2.3 The Power verification log file (Part1) . . . 163
A.2.4 The Power verification log file (Part2) . . . 164
A.2.5 Uncertainty calculation for power verification . . . 165
A.3 Producing graphical results - DC gain . . . 168
A.3.1 Producing graphical results - Full Bandwidth . . . 169

B Test Fixtures and Cables . . . 170
B.1 Fixture requirements . . . 170
B.2 1-GN-CAL1 calibration and verification software . . . 172
B.3 1-GN-CAL-CABLES . . . 173
B.4 1-GN-CAL2A GEN DAQ Basic/Fast Diff/Uni/HV fixture . . . 174
B.5 1-GN-CAL3 GEN DAQ 1kV DC/AC probe cables . . . 176
B.6 1-GN-CAL5 GEN DAQ bridge 16 pin LEMO fixture . . . 177
B.7 1-GN-CAL6 GEN DAQ 16 channel HDSUB50 fixture . . . 178
B.8 1-GN-CAL7 GEN DAQ 32 channel HDSUB50 fixture . . . 179
B.9 1-GN-CAL-3PWR GEN DAQ Power fixture . . . 180
B.10 1-GN-CAL9 GEN DAQ universal fixture . . . 182
B.11 1-GN-CAL-TEDS GEN DAQ TEDS database BNC fixture . . . 183
B.12 1-GN-CAL-4PWR GEN DAQ 4 channel POWER fixture . . . 184

C Locations for AC Calibration Adjustments . . . 186
C.1 1-GN810-2 Basic 200k, 1-GN811-2 Basic 1M, 1-GN812-2 Basic 1M ISO, 1-GN813-2 Basix XT 1M ISO and 1-GN814-2 Basic XT 200k ISO . . . 186
C.2 1-GN440-2 Uni 200k ISO and 1-GN441-2 Uni 1M ISO . . . 187
C.3 1-GN412-2 HiSpeed 100M and 1-GN413-2 HiSpeed 25M . . . 188
C.4 1-GN310B Power 2M ISO and 1-GN311B Power 200k ISO . . . 189
C.5 1-GN610-2 ISO 1kV 2M and 1-GN611-2 ISO 1kV 200k . . . 190
C.6 1-GN815 Basic/IEPE 2M ISO and 1-GN816 Basic/IEPE 200k ISO . . . 191
C.7 1-GN8101B Basic 250M, 1-GN8102B Basic 100M and 1-GN8103B Basic 25M . . 192
C.8 1-GN110, 1-GN111, 1-GN112 and 1-GN113 Isolated Digitizers . . . 193
C.9 1-GN114 7600 100M Isolated Digitizer . . . 197
C.10 LDS version 100 MS/s Fiber Amplifier Rv0 (Isolated Digitizer MV II) . . . 198
C.11 LDS version 20 MS/s, 25 MS/s and 100 MS/s Basic Amplifier Card . . . 199

TABLE OF CONTENTS

D Legacy Information 200
D.1 Legacy software versions 200
D.2 IOTech RS232 to GPIB interface 203

E Trouble Shooting 204
E.1 Accidentally selected IOTech serial interface 204
E.2 NI GPIB-USB-HS not detected 205
E.2.1 National Instruments MAX software 205
E.3 CalStack equipment maintenance 209
E.3.1 Fluke 5700A and 5720A Multifunction Calibrators 209
E.3.2 Fluke 5730A Multifunction Calibrator 211
E.3.3 Fluke 5730A Multifunction Calibrator 215
E.3.4 Keysight (Agilent, HP) 3458A Multimeter 219
E.4 CalStack equipment (noise) disturbances 222

1 About this manual

1.1 Symbols used in this manual

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

DANGER

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.

Notice

The product or the environment may be damaged.

Important

Read the text to avoid errors with the usage of the GEN DAQ products.

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.

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 housing 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 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.

⚠ DANGER

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

⚠ 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 61010-1:2017) 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.

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

2.3 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.

2.4 Protection and isolation

2.4.1 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 61010-2-030:2017

Electrical equipment, specifically measurement tools, can be assigned into four categories in accordance with IEC 61010-2-030:2017. 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 Fig. 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 Fig. 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 Fig. 2.1).

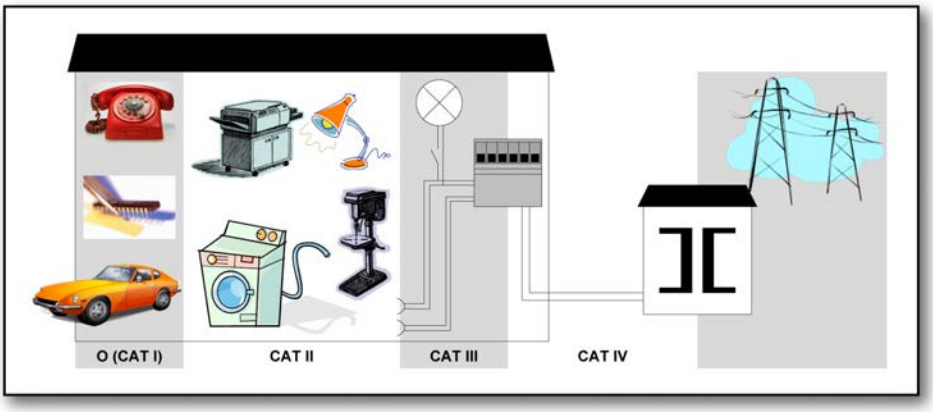


Fig. 2.1 Category indication in accordance with IEC 61010-2-030:2017

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

Nominal Voltage (V RMS or V DC)	IEC 61010-2-030:2017					
	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
> 1000 V DC ≤ 1500 V DC	4260	6600	8250	8000	12000	15000

Tab. 2.1 Insulation test voltages in accordance with IEC 61010-2-030:2017

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 61010-2-030:2017) (e.g. mains measurements), unless specifically stated for the specific input.

2.4.2 Basic insulation versus reinforced

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

Nominal voltage line to neutral AC RMS or DC of MAINS being measured. [V]	Test voltage			
	5 s AC test [V RMS]		Impulse test [V peak]	
	Basic insulation and supplementary insulation	Reinforced insulation	Basic insulation and supplementary insulation	Reinforced insulation
≤ 150	2210	3510	4000	6400
> 150 ≤ 300	3310	5400	6000	9600
> 300 ≤ 600	4260	7400	8000	12800
> 600 ≤ 1000	6600	11940	12000	19200
> 1000 V DC ≤ 1500 V DC	8250	14930	15000	24000

Tab. 2.2 Test voltages for the testing electric strength of solid insulation in measuring circuits in measurement category II (IEC 61010-2-030:2017)

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 insulation 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 Fig. 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 Fig. 2.2.

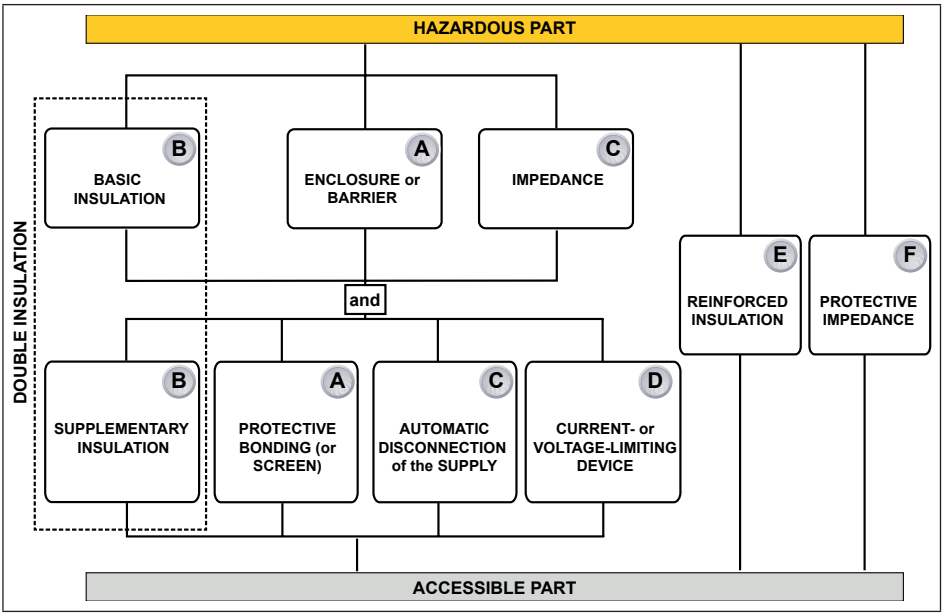


Fig. 2.2 Acceptable arrangement of protective means against electric shock

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.

2.4.3 Protection

⚠ DANGER

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.

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.

⚠ DANGER

This instrument must not be operated in explosive atmospheres.

⚠ DANGER

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.

2.4.4 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.

⚠ DANGER

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.

2.4.5 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.

It is the responsibility of the user to ensure the safety of any accessories used with the current transducer, 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.

2.5 Environment

The instrument should be operated in a clean, dry environment with an ambient temperature between 0 °C and +40 °C, unless noted otherwise.

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.

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

Notice

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

If the instrument has a fan installed, leave space around the equipment for unrestricted ventilation.

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. Before 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 PCBs.

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.

2.6 Laser Safety

Some of the GEN series cards or systems use lasers. All laser products used are classified as a **Class 1 laser product**. The lasers do not emit hazardous light but it is recommended to avoid direct exposure to the beam.

⚠WARNING

Intrabeam viewing of the laser product may produce dazzling visual effects, particularly in low ambient light. Lasers of any wavelength with sufficient output power can cause injury.

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

The GEN series products are certified as Class 1 Laser Products and comply with US FDA regulations. These are certified by TÜV and CSA to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. The devices are for use only under the specifications and ratings specified in the manual and data sheets.

2.7 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.

2.8 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 61010-1:2017)

Dækslerne må ikke fjernes.

Afbryd dette instrument eller dets strømforsyning 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 veiligheidsmassa-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 peak of 70 V DC (IEC 61010-1:2017) dient eveneens een signaalaarding aangesloten te zijn.

De deksels mogen nooit worden verwijderd.

Om dit instrument los te koppelen of van het stroom af te halen, 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 61010-1:2017).

Älä poista suojakansia.

Katkaise laitteen tai sen virtalähteen 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 61010-1:2017).

Ne pas déposer les panneaux de protection.

Pour déconnecter cet instrument ou son alimentation de l'alimentation secteur, débrancher le cordon d'alimentation (CEI). 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).

2 SAFETY MESSAGES

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 Gleichspannung (IEC 61010-1:2017) muss die Signalmasse angeschlossen sein.

Die Schutzabdeckungen nicht entfernen.

Zum Trennen des Gerätes oder seiner Spannungsversorgung 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 61010-1:2017).

Non rimuovere le coperture.

Per disinnestare questo strumento o l'alimentazione dalla corrente alternata, scollegare 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 61010-1:2017).

Ikke fjern dekslene.

For å koble dette instrumentet eller dets strømforsyning 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 61010-1:2017).

Não retirar as tampas.

Para desconectar este instrumento ou a respetiva fonte de alimentação 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 61010-1:2017).

Não retirar as tampas.

Para desconectar este instrumento ou a fonte de alimentação dele 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 61010-1:2017).

No quite las tapas.

Para desconectar este instrumento o su fuente de alimentación de la CA, 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 strömgivaren kan göra strömgivaren farlig. 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 61010-1:2017).

Ta inte bort skydden.

Dra ut IEC-kontakten för att koppla loss instrumentet eller dess strömkälla från strömförsörjningen. 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).

2 SAFETY MESSAGES

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 61010-1:2017).

Do not remove the covers.

To disconnect this instrument or its power-supply 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 33 V RMS、ピーク時に 46.7 V 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 61010-1:2017）。

カバーを外さないでください。

本機器またはその電源供給をAC電源供給から遮断するには、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 61010-1:2017)。

不要取下保护盖。

要将此设备或其电源断开交流电源，请拔下 IEC 接头。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 61010-1:2017).

Не демонтируйте крышки.

Для отключения данного прибора или его блока питания 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 도 체를 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 61010-1:2017) 를 초과하는 경우 신호 접지를 연결해야 합니다.

덮개를 제거하지 마십시오.

AC 공급 전원으로부터 이 기기 또는 전원 공급 장치를 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.)

2.9 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.

⚠ DANGER

High voltage and qualified personnel

For measurements falling within the scope of the EN 50110-1 and EN 50110-2, please note that working with 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 a GEN series 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 - 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 GEN series data acquisition 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 Electromagnetic Compatibility (EMC)

EMC stands for Electromagnetic 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.

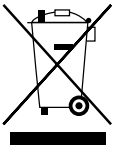
Electrical supply cables, interface cables and probes should be kept as short as practical, preferably a maximum of 1 m. Interface cables should be screened and interface cables longer than 3 m are not acceptable in terms of interference port immunity.

3.2 Environment

3.2.1 RoHS and 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 2011/65/EU and amendment 2015/863) and promotes the collection and recycling of such electrical equipment (Directive 2012/19/EU) 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 2012/19/EU. 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.

3.2.2 China RoHS

The product will comply with general hazardous substances limits for at least 10 years, and will be ecologically safe to use during this period, as well as recyclable. This is documented by the 10 years symbol on the system as statutory mark of compliance with emission limits in electronic equipment supplied to China.

Part Name 部件名称	Hazardous Substances 有害物质					
	Lead 铅 (Pb)	**Mercury** 汞 (Hg)	**Cadmium** 镉 (Cd)	**Hexavalent Chromium** 六价铬 (Cr (VI))	**Polybrominated biphenyls** 多溴联苯 (PBB)	**Polybrominated diphenylethers** 多溴二苯醚 (PBDE)
Main PCB	X	O	O	O	O	O
PSU-module	X	O	X	O	O	O
CPU-module	O	O	O	O	O	O
Metal Parts	O	O	O	O	O	O
Plastic Parts	O	O	O	O	O	O
Cables	O	O	O	O	O	O
This table is prepared in accordance with the provisions of SJ/T 11364. 本表格依照SJ/T 11364 规定的规定编制。						

Tab. 3.1 Hazardous substances

O Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.
表示该有毒有害物质在该部件所有均质材料中的含量均在GB/T 26572规定的限量要求以下。

X Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.
表示该有毒有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572规定的限量要求。

3.3 CE and UKCA Declaration of conformity

3.3.1 CE Declaration of conformity

For information about the CE Declaration of conformity, please refer to
www.hbm.com/fileadmin/mediapool/hbmdoc/technical/ce356.pdf

3.3.2 UKCA Declaration of conformity

The manufacturer declares on its sole responsibility that the product is in conformity with the essential requirements of the applicable UK legislation and that the relevant conformity assessment procedures have been fulfilled.

Manufacturer:

Hottinger Brüel & Kjaer GmbH
Im Tiefen See 45
64293 Darmstadt
Germany

Importer:

Hottinger Bruel & Kjaer UK Ltd.
Technology Centre Advanced Manufacturing Park
Brunel Way Catcliffe
Rotherham
South Yorkshire
S60 5WG
United Kingdom

3.4 FCC Class A Notice

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

Notice

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

Important

Any modifications made to this device that are not approved by HBM may void the authority granted to the user by the FCC to operate this equipment.

4 Getting Started

4.1 Introduction

The GEN series Data Acquisition System is factory calibrated. Swapping, replacing or removing acquisition cards may result in minor deviations to the original calibration.

Always verify and, if necessary, calibrate the GEN series Data Acquisition System:

- After swapping, replacing or removing of acquisition cards.
- In one year intervals.
- After any major event that may effect calibration.

When in doubt, consult your local supplier.

The GEN series calibration and verification software performs tests in accordance with either published (manufacturing), in-field (field) or card swap specifications.

Regardless of whether any remedy set forth herein fails its essential purpose, in no event shall HBM be liable under any theory of recovery for indirect, incidental, special, or consequential damages of any kind. This includes but is not limited to any lost profits or lost data arising out of the use or inability to use the software, even if HBM has been advised of the possibility of such damages. The limited warranty, limited remedies, and limitation of liability are fundamental elements of the bargain between you and HBM, and HBM would not be able to provide the software without such limitations.

⚠CAUTION

Calibration and verification of Genesis High Speed products is not an easy job. This is mostly because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation. This means the product is very capable at measuring very small high frequency disturbances. Calibration of such a system requires an environment and set-up that is free of unwanted disturbances. If a disturbance is there, our system will measure it and, as expected, this can influence a calibration process

4.2 Required parts

To be able to perform all the required steps, several parts are available.

GEN series Parts and Order Numbers	
Order No.	**Article**
1-GN-CAL1	Calibration and verification software
1-GN-CAL2A	GEN DAQ Basic/Fast Diff/Uni/HV fixture
1-GN-CAL3	GEN DAQ 1kV DC/AC probe cables
1-GN-CAL-3PWR	GEN DAQ 3 channel POWER fixture
1-GN-CAL-4PWR	GEN DAQ 4 channel POWER fixture
1-GN-CAL5	GEN DAQ bridge 16 pin LEMO fixture
1-GN-CAL6	GEN DAQ 16 channel HDSUB50 fixture
1-GN-CAL7	GEN DAQ 32 channel HDSUB50 fixture
1-GN-CAL9	GEN DAQ 16 channel universal fixture
1-GN-CAL-TEDS	GEN DAQ TEDS database BNC fixture
1-GN-CAL-CABLES	GEN DAQ calibration basic cable set

Not every part is required for every GEN series card. For more information on which parts are required for each available GEN series card, please refer to appendix “Test fixtures and Cables” on „Fixture requirements“ on page 170.

⚠CAUTION

Inspect your calibration cables, connectors and adapters regularly for wear or damage and replace them if required.
Regular preventive replacement is strongly advisable since the cost involved in an investigating usually is way higher then the cost of replacement. For example, in an intensive usage scenario a half yearly replacement could be advisable.

4.3 System requirements

System requirements - Overview	
Component	**Description**
Software language	English
Manual language	English
Software requirements	
Microsoft® Windows®	Vista™,WIN 7 Business, Ultimate or Enterprise, WIN 8 and WIN 10. Works in 32 bit mode on 64 bit versions of Vista™, WIN 7 and WIN 10.
PC requirements	
Minimum CPU	Intel® Pentium® 4 class PC
Minimum RAM memory	1 GB
Minimum free disk size	200 MB
Minimum graphics card	16 bit color with 64 MB video memory and DirectX 9 hardware support
Minimum screen resolution	1024 x 768 pixels
Free network interface	1; 1 GB recommended (100 Mbit minimum)
Free USB 2.0 port	1; for use with the NI GPIB-USB-HS controller
Others	CD-ROM drive to install the software Internal or external speakers for alerts and warnings

4.4 Supported acquisition hardware

Supported acquisition cards and options						
Acquistion cards and options		V2.96	V2.98	V3.00	V3.02/ V3.04	V4.00/ V4.02/ V4.04/ V4.06
1-G041-2	1kv DC probe	✔	✔	✔	✔	✔
1-G042-2	1kv AC probe	✔	✔	✔	✔	✔
1-G045	Impulse attenuator					
1-GN110	HV6600 100M	✔	✔	✔	✔	✔
1-GN111	HV6600 25M	✔	✔	✔	✔	✔
1-GN112	MV6600 100M	✔	✔	✔	✔	✔
1-GN113	MV6600 25M	✔	✔	✔	✔	✔
1-GN114	7600 100M	✔	✔	✔	✔	✔
1-GN310B	Power 2M ISO					✔
1-GN311B	Power 200k ISO					✔
1-GN610-2	ISO 1kV 2M	✔	✔	✔	✔	✔
1-GN610B	ISO 1kV 2M RTFDB	✔	✔	✔	✔	✔
1-GN611-2	ISO 1kV 200k	✔	✔	✔	✔	✔
1-GN611B	ISO 1kV 200k RTFDB	✔	✔	✔	✔	✔
1-GN815	Basic/IEPE2M ISO	✔	✔	✔	✔	✔
1-GN816	Basic/IEPE200k ISO	✔	✔	✔	✔	✔
1-GN840B	Uni ISO 500k-8		✔	✔	✔	✔
1-GN1202B	Receiver 100M			✔	✔	✔
1-GN1610	HiRes 250k-16	✔	✔	✔	✔	✔
1-GN1611	Basic 20k-16	✔	✔	✔	✔	✔
1-GN1640B	Uni ISO 500k-16		✔	✔	✔	✔
1-GN3210	HiRes 250k-32	✔	✔	✔	✔	✔
1-GN3211	Basic 20k-32	✔	✔	✔	✔	✔
1-GN8101B	Basic 250M				✔	✔
1-GN8102B	Basic 100M				✔	✔
1-GN8103B	Basic 25M				✔	✔

Supported remote probes and options				
Remote probes and options				**V4.06**
1-P101I-4	Voltage RP 2M			✔
1-P201I-4	Voltage RP 20M			✔
1-P111I-4	Current RP 2M			✔
1-P211I-4	Current RP 20M			✔
1-P112I-4	Current RP+ 2M			✔
1-P212I-4	Current RP+ 20M			✔

Supported mainframes			
Mainframes	**V2.96 / V2.98**	**V3.00 / V3.02 / V3.04**	**V4.00 / V4.02 / V4.04 / V4.06**
GEN2tB		✔	✔
GEN4tB			✔
GEN7t	✔	✔	✔
GEN16t	✔	✔	✔
GEN2i	✔	✔	✔
GEN5i	✔	✔	✔
GEN3i/GEN3iA	✔	✔	✔
GEN3t	✔	✔	✔
GEN7i/GEN7iA	✔	✔	✔
GEN7tA	✔	✔	✔
GEN17tA	✔	✔	✔

4.5 Supported/Required calibrators

Supported calibrators					
Calibrators	**V2.96**	**V2.98**	**V3.00**	**V3.02**	**V4.00/ V4.02/ V4.04/ V4.06**
Fluke 5522A					✔
Fluke 5700A	✔	✔	✔	✔	✔
Fluke 5720A	✔	✔	✔	✔	✔
Fluke 5730A	✔(1)	✔(1)	✔	✔	✔
Fluke 5820A	✔	✔	✔	✔	✔
Fluke 9500B	✔	✔	✔	✔	✔
HP 3458A(2)	✔	✔	✔	✔	✔

(1) Fluke 5730A only supported in 5700 emulation mode (see Fluke 5730A manual for this manual setup).

(2) HP 3458A is originally produced by HP and later by Agilent and Keysight.

Required calibrators					
Acquistion cards and options		Fluke 5700A, Fluke 5720A or Fluke 5730A	Fluke 5820A or Fluke 9500B	HP 3458A	Fluke 5522A
1-G041-2	1 kV DC probe	✔		✔	
1-G042-2	2 1 kV AC probe	✔		✔	
1-G045	Impulse attenuator		✔	✔	
1-GN110	HV6600 100M	✔	✔	✔	
1-GN111	HV6600 25M	✔	✔	✔	
1-GN112	MV6600 100M	✔	✔	✔	
1-GN113	MV6600 25M	✔	✔	✔	
1-GN114	7600 100M	✔	✔	✔	
1-GN310B	Power 2M ISO	✔			✔
1-GN311B	Power 200k ISO	✔			✔
1-GN610-2	ISO 1kV 2M	✔		✔	
1-GN610B	ISO 1kV 2M	✔		✔	
1-GN611-2	ISO 1kV 200k	✔		✔	
1-GN611B	ISO 1kV 200k	✔		✔	
1-GN815	Basic/IEPE 2M ISO	✔		✔	
1-GN816	Basic/IEPE 200k ISO	✔		✔	
1-GN840B	Uni ISO 500k-8	✔		✔	
1-GN1202B	Receiver 100M	✔	✔		
1-GN1610	HiRes 250k-16	✔		✔	
1-GN1611	Basic 20k-16	✔		✔	
1-GN1640B	Uni ISO 500k-16	✔		✔	
1-GN3210	HiRes 250k-32	✔		✔	
1-GN3211	Basic 20k-32	✔		✔	
1-GN8101B	Basic 250M	✔	✔	✔	
1-GN8102B	Basic 100M	✔	✔	✔	
1-GN8103B	Basic 25M	✔	✔	✔	

Required calibrators					
Remote probes		Fluke 5700A, Fluke 5720A or Fluke 5730A	Fluke 5820A or Fluke 9500B	HP 3458A	Fluke 5522A(1)
1-P101I-4	Voltage RP 2M	✔	✔		✔
1-P201I-4	Voltage RP 20M	✔	✔		✔
1-P111I-4	Current RP 2M	✔	✔		✔
1-P211I-4	Current RP 20M	✔	✔		✔
1-P112I-4	Current RP+ 2M	✔	✔	✔	✔
1-P212I-4	Current RP+ 20M	✔	✔	✔	✔

(1) Fluke 5522A only needed when doing power verification.

4.6 Calibration system setup

⚠CAUTION

Calibration and verification of Genesis High Speed products is not an easy job. This is mostly because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation. This means the product is very capable at measuring very small high frequency disturbances. Calibration of such a system requires an environment and set-up that is free of unwanted disturbances. If a disturbance is there, our system will measure it and, as expected, this can influence a calibration process.

GPIB interface (IEEE-488) device

To communicate with the calibrators, the GEN series calibration and verification software uses a GPIB interface.

This connection can be made with:

- The NI GPIB-USB-HS controller, included in the shipment
  OR
- Any National Instruments GPIB controller with latest Windows® drivers installed.

Tip

While the software is starting, it will search for the GPIB0 device in the NI device drivers. Ensure that sure the GPIB controller of choice is named GPIB0 or the software will fail to connect to the GPIB controller.

Notice

At the time of this manual's release, the most current version of the software still supports the legacy IOTech serial to GPIB interface.

Connecting the hardware

In order to enable communication between the GEN series calibration and verification software and the GEN series Tower or Rack, you need to connect the Ethernet port of the controlling PC to the GEN series.

This can be accomplished:

- When the PC and the GEN series are nodes on the same network.
- By using an Ethernet cable between the calibration PC and the GEN series.

When running the GEN series calibration and verification software on a GEN series mainframe with a built-in PC as for example a GEN3iA or a GEN7iA, it is recommended to connect an external monitor for ease of use.

For the GEN series calibration and verification software to communicate with and control the calibrator equipment:

- Connect the NI GPIB-USB-HS GPIB port to the calibrator equipment.
- Connect the NI GPIB-USB-H USB cable to the USB port on your computer. For further details, please refer to the NI GPIB-USB-HS GPIB controller manual.

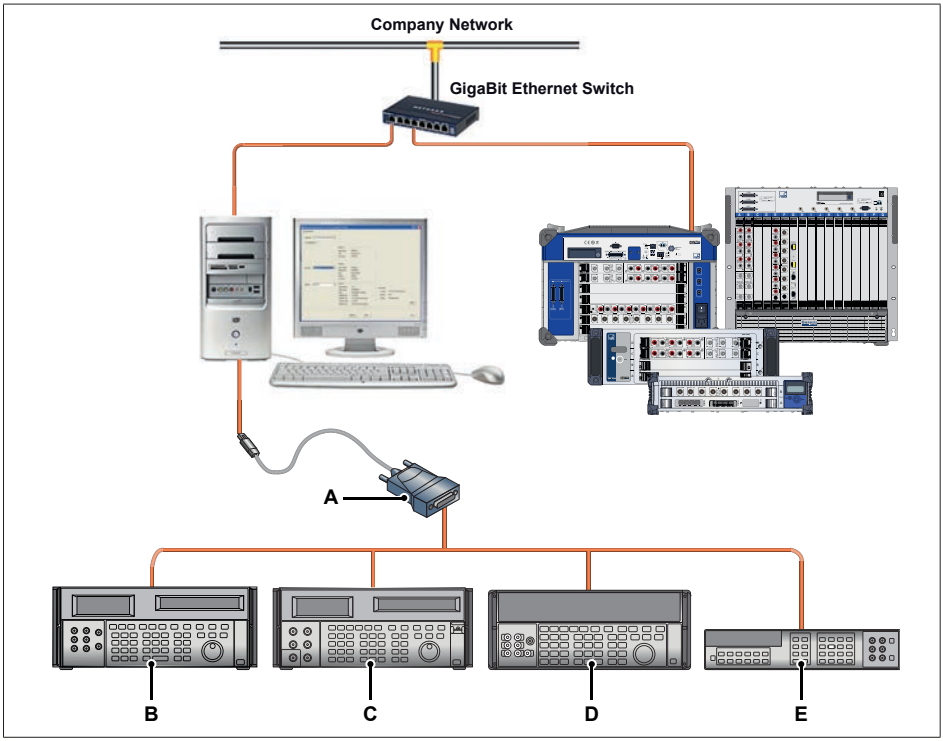


Fig. 4.1 Connection diagram for tethered mainframes

A NI GPIB-USB-H USB controller (GPIB0)
B Calibrator fluke 5522A
C Calibrator fluke 5820A/9500B
D Calibrator fluke 5700A/5720A/5730A
E DVM Hewlett Packard HP 3458A

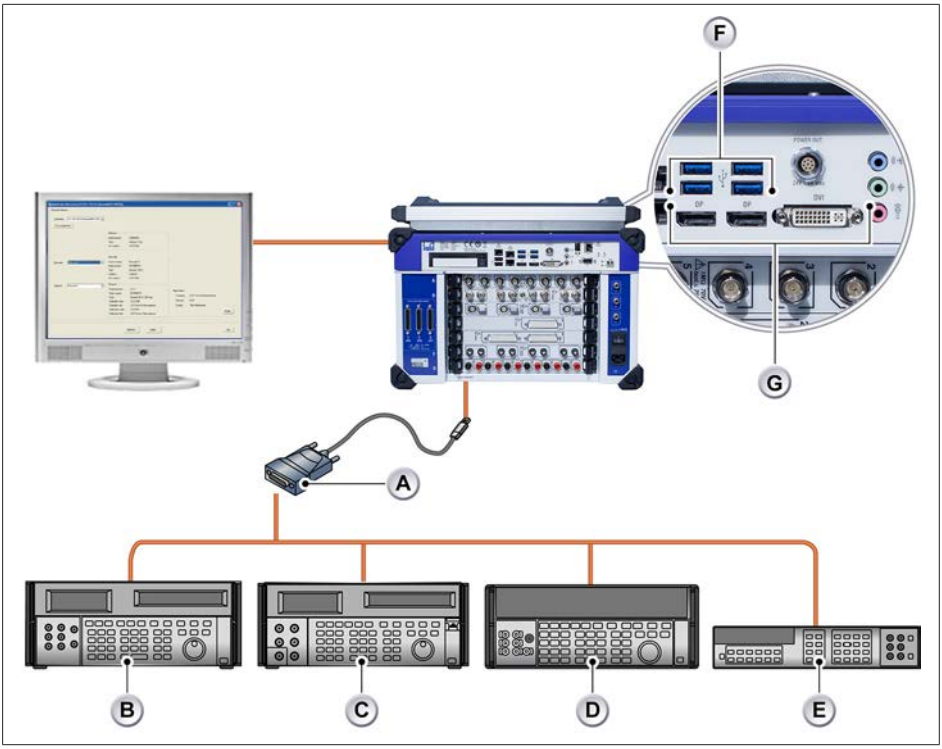


Fig. 4.2 Connection diagram for integrated mainframes

A NI GPIB-USB-H USB controller (GPIB0)
B Calibrator fluke 5522A
C Calibrator fluke 5820A/9500B
D Calibrator fluke 5700A
E DVM Hewlett Packard HP 3458A
F USB connection
G Monitor output

4.7 Installing the calibration and verification software

The GEN series calibration and verification software installation is a Two-Step process:

1. Connecting and installing calibrators via GPIB.
2. Installing the calibration and verification software.

Notice

The calibration and verification software will not work without properly connecting and installing the calibrators.

4.7.1 Connecting and installing calibrators via GPIB

The calibration and verification software controls the calibrators using the GPIB protocol. Generic third party drivers need to be installed to support this. Typically these drivers come bundled with additional diagnostics tooling to check if the devices are properly connected, these diagnostic tools can be used to check if the device setup is compatible with the calibration and verification software.

This paragraph will outline where the required drivers and tools can be found, detail the installation process and explain what some of the additional diagnostic tools can be used for.

1. **Acquiring the driver:** National Instruments® provides a general purpose GPIB driver that is compatible with all calibrators required for the calibration and verification software on the supported Microsoft Windows™ platforms. This driver normally comes with the USB to GPIB adapter on a CD, but can also be downloaded. For downloading the latest version, please refer to the National Instruments® website and search for “GPIB Driver” or “488.2”.
2. **Install the driver:** Install the software on the PC that will be used to run the calibration and verification software following the instructions that were distributed with the software.
3. **Connect the GPIB device and adapter**: Connect the calibrators to the GPIB USB adapter and insert the adapters USB connector to the PC, then power on the calibrators.
4. **Verify that the GPIB device is properly connected:** Once the calibrators are started, the tooling that comes with the National Instruments® driver can be used check if the calibrators are found. These tools can be used to verify that all instrumentation is available on GPIB bus 0, or configure it to use that bus. The addresses on that bus may vary, but the calibration and verification software will only detect devices on bus 0.

Notice

For questions and support about using third party software, please refer to the documentation supplied with that software or contact the software's vendor.

4.7.2 Installing the calibration and verification software

The following section explains how to install the program files in Microsoft® Windows® from the CD.

Notice

You cannot run the software from the CD; you must install the components onto your hard drive and run the software from that drive.

To install the GEN series calibration and verification software:

1. Insert the GEN series calibration and verification CD into the CD-ROM drive.
2. Click Next in the GEN series Calibration & Verification AutoPlay dialogue box.
   If the AutoPlay dialogue box does not appear, select **Start**, **Run**, then type **d:setup.exe** ("D" is the letter of your CD-ROM drive) and click **OK**.
3. Click **GEN series calibration and verification**, read the information in the Setup dialogue box and click **Next.**
4. Click **Next** and follow the on-screen instructions to complete the installation.
   When the process is complete, a message that the GEN series calibration and verification software is installed appears.
5. Click **Finish.**

The GEN series calibration and verification software is installed.

4.8 Starting GEN series calibration and verification

The following section explains how to:

- Start the calibration and verification software.
- Fill in and change the Organization information.
- Select the Mainframe.
- Select the Recorder (card).
- Setup the Calibration standard(s).
- Exit the calibration and verification software.

4.8.1 Start the GEN series calibration and verification software

⚠CAUTION

Before starting a calibration or verification, HBM recommends running the GEN series Data Acquisition System, the installed card(s) and the calibration standards for at least one hour to achieve the best test specifications.

⚠CAUTION

Because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation this product is very capable at measuring very small high frequency disturbances. Therefore it is strongly advised to disconnect all cables that are not required for the calibration in order to avoid bringing external disturbances into the system and so influencing the calibration process.

To start the GEN series calibration and verification software:

1. Switch on the GEN series Data Acquisition System and the calibration standard(s).
2. Select **Start▶ All Programs▶ HBM▶ GEN series▶ Maintenance▶ GEN series calibration and verification**.

A message appears while the software searches for mainframes.

Fig. 4.3 Searching for mainframes message

The list of supported mainframes can be found in chapter „Supported acquisition hardware“ in table "Supported mainframes".

The *GEN series calibration and verification* window appears.

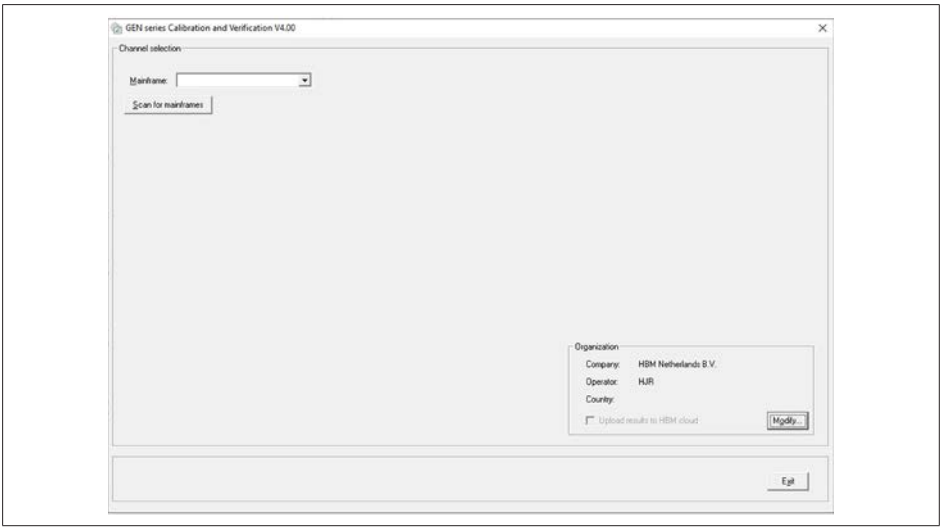


Fig. 4.4 GEN series calibration and verification window

4.8.2 Organization information

The GEN series calibration and verification software lets you specify the name of the calibration lab and the name of the operator.

Tip

This information is stored in the acquisition card during the calibration and verification process. When recording with this card, this information then is stored in the PNRF file for automatic traceability of your calibration information.

Tip

It is possible to sent the calibration and verification reports to the HBM secure Cloud when the controlling computer is connected to the Internet. HBM support can use that data for evaluation of the products over time or in case customer needs assistance.

Enter organization information

When starting the GEN series calibration and verification software the first time, the Organization information is empty and needs to be filled in.

Fig. 4.5 Organization information

1. Fill in the name of the:
   - Company
   - Operator
   - Country
2. Check Yes/No Cloud upload.
3. Then click **Save** to save your information.

Tip

The company name that is entered here also appears in Perception software under Hardware Properties.

Modify organization information

If you want to modify your organization information:

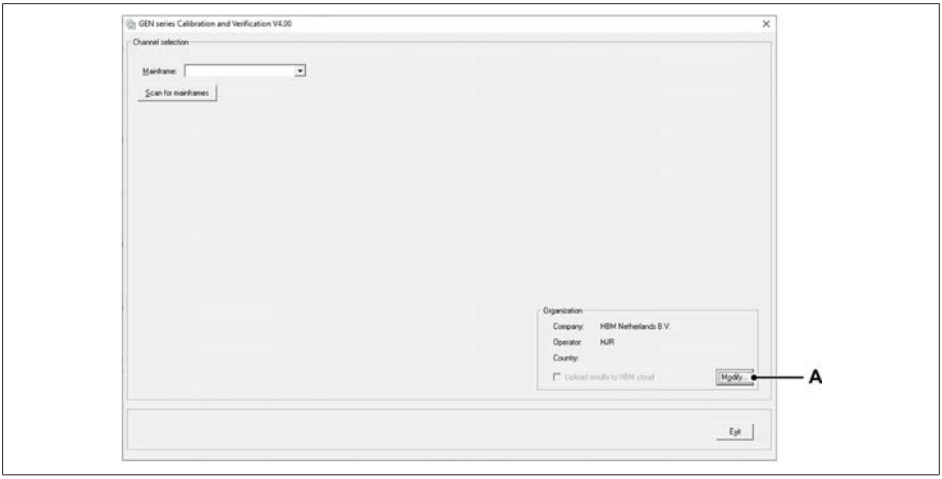


Fig. 4.6 Change organization information

A Modify...

1. Click **Modify...**
2. Make the required changes.

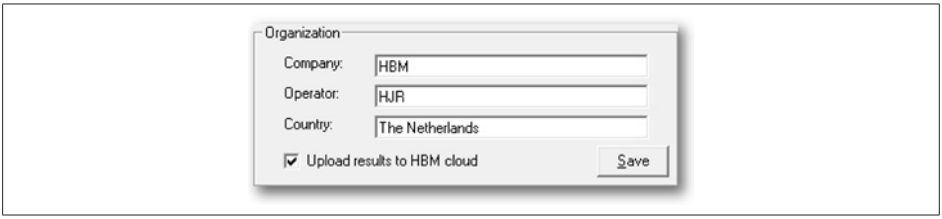


Fig. 4.7 Organization changes

3. Click **Save** to save the changes.

4.8.3 Mainframe selection

When the GEN series calibration and verification software starts running, it will search the connected network for the GEN series Data Acquisition System and the GEN series calibration and verification window appears.

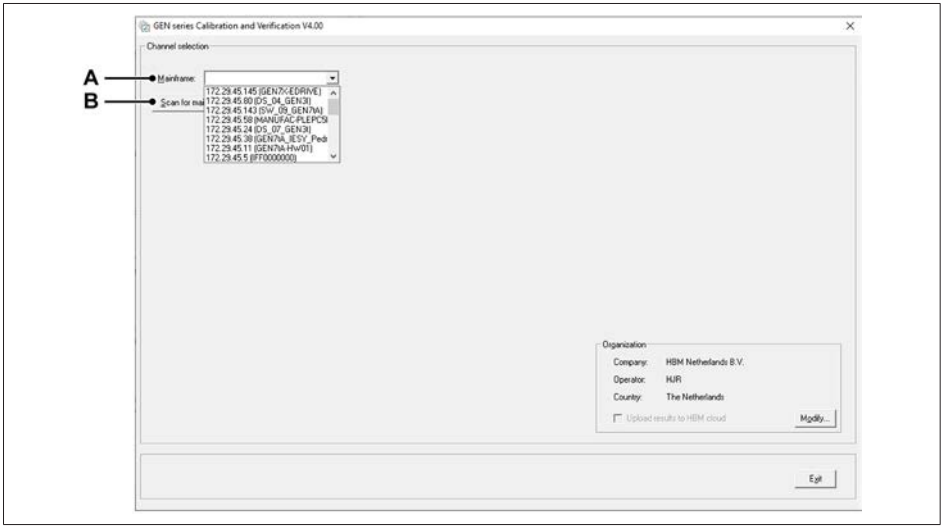


Fig. 4.8 GEN series calibration and verification window

A Mainframe list

B Rescan Network

In the **Mainframe** list, click the GEN series mainframe that contains the card you want to calibrate or verify.
Its network IP address and name uniquely identify each GEN series mainframe.

If no mainframe is recognized, click **Rescan Network**.
It will search the connected network for GEN series Data Acquisition Systems. Once a mainframe has been detected, it will be available in the Mainframe list.

Notice

When performing these operations on a GEN2i/GEN3i/GEN3iA/GEN5i/GEN7i/GEN7iA mainframe that is not connected to a network, the software will find only the mainframe at which the GEN series calibration and verification software is started from.

After a mainframe has been selected, the **Mainframe Selection** window appears.

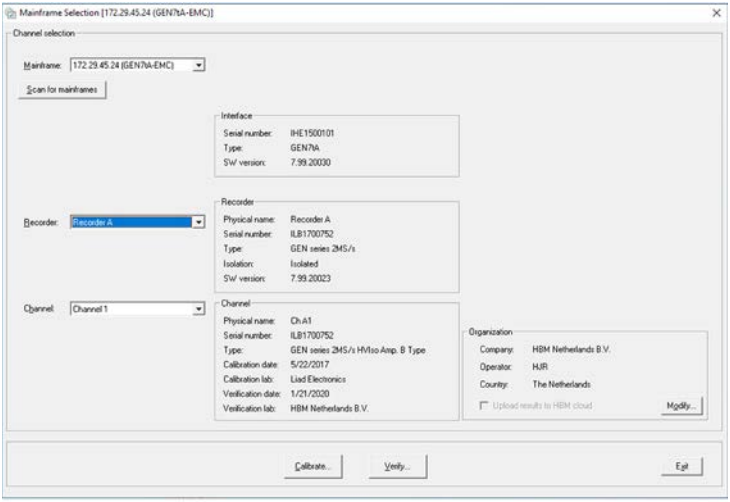


Fig. 4.9 Mainframe Selection window

4.8.4 Recorder (acquisition card) selection

If the mainframe has multiple recorders (cards), select which recorder you want to calibrate or verify.

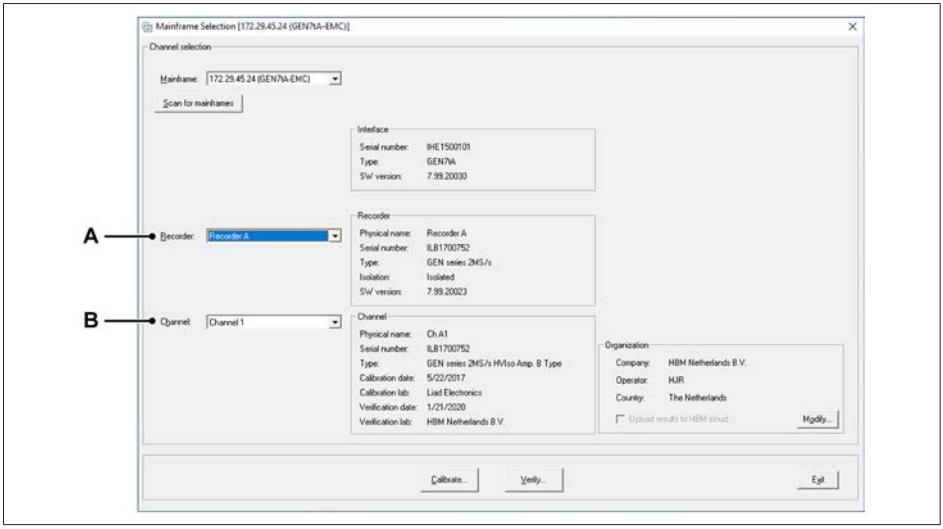


Fig. 4.10 Recorder selection

A Recorder list

B Channel list

In the **Recorder** list, click and select a recorder by its slot location (Recorder A, B, C, etc.).

If there is only one recorder in the mainframe, that recorder is selected automatically.

In the **Channel** list, click a channel to see information about the selected channel (Channel 1, 2, etc.).

4.8.5 CalStack setup

Before starting a calibration or verification, you need to ensure that the GEN series calibration and verification software detects which calibration standard(s) are used.

In the **Mainframe Selection** window:

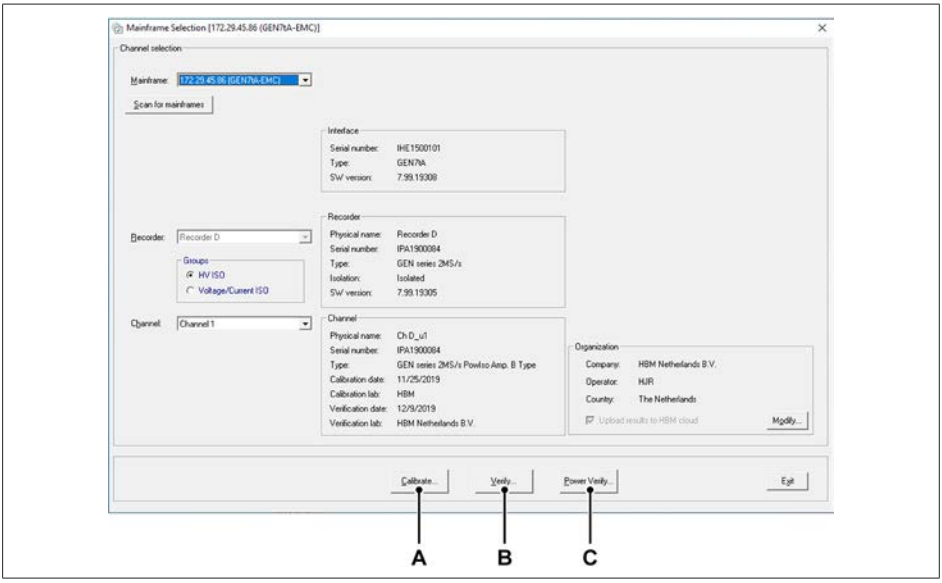


Fig. 4.11 Mainframe Selection window

A Calibrate...
B Verify...
C Power Verify...

1. Click **Calibrate...** to open the Card Calibration window (see Fig. 4.12),
   or
   click **Verify...** to open the Card Verification window (see Fig. 4.13). Click **Power Verify ...** to open the Card Power Verification window (see Fig. 4.14). This button will be hided when the selected card doesn't support power verification.

By selecting **Calibrate...** the Card Calibration window appears:

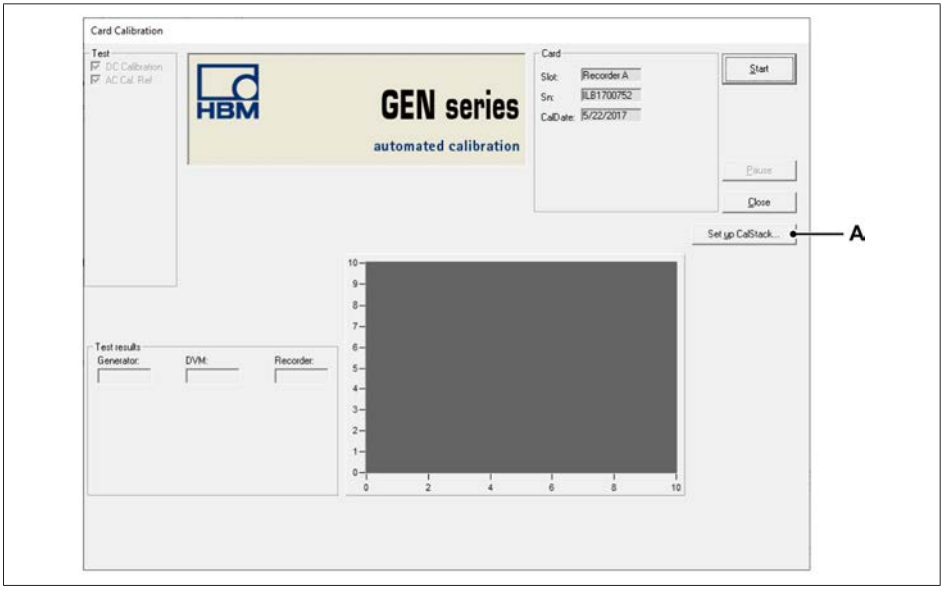


Fig. 4.12 Card Calibration window

A Set up CalStack...

By selecting **Verify...** the **Card Verification** window appears:

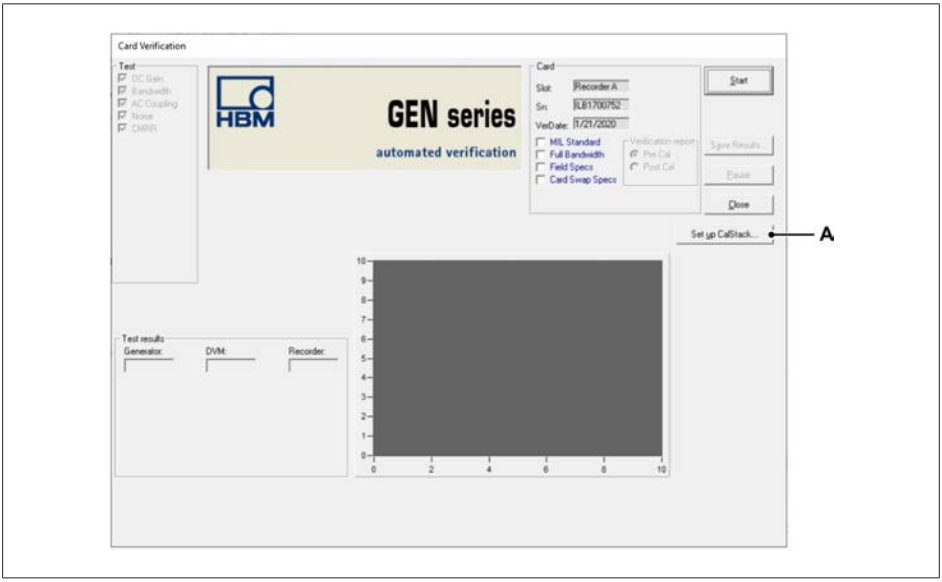


Fig. 4.13 Card Verification window

A Set up CalStack...

By selecting **Power Verify...** the **Card Power Verification** window appears:

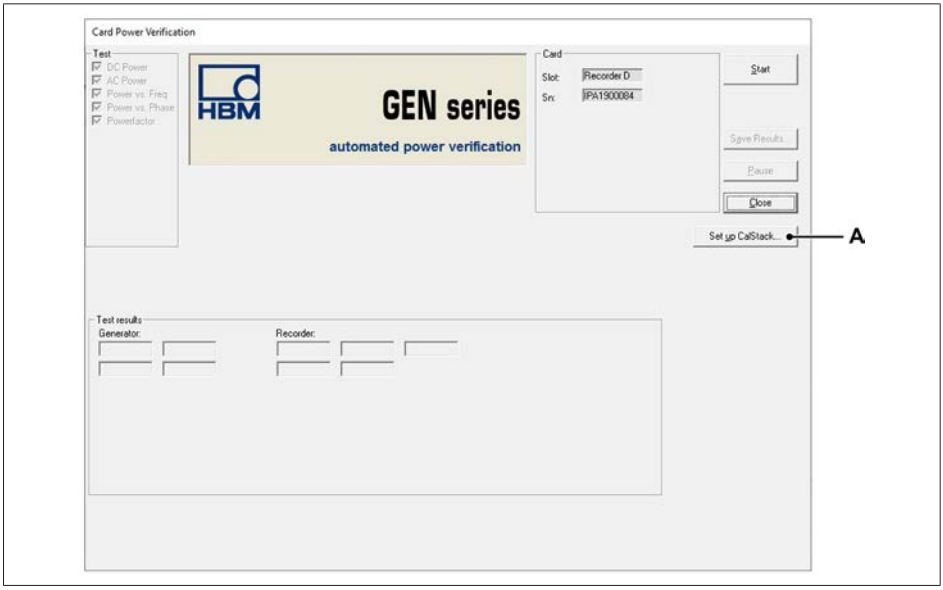


Fig. 4.14 Card Power Verification window

A Set up CalStack...

2. Click Set up **CalStack...** to open the *CalStack Setup* window.

The **CalStack Setup** window appears.

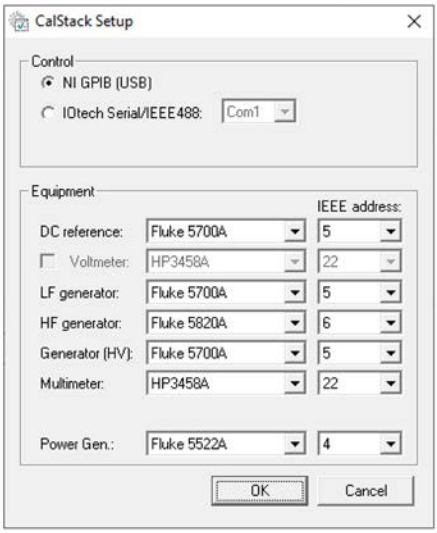


Fig. 4.15 CalStack Setup window

Ensure that:

- The NI GPIB controller is called "GPIB0".
- The IEEE address for each component in the equipment list matches the actual device address of that component.

When using the IOtech Serial/IEEE-488, ensure that:

- The COM port of the IOtech Serial/IEEE-488 controller matches the settings of your IOtech configuration.

For details, please refer to the IOtech specifications.

3. Click **OK** to save the changes you made to the CalStack definition. If you want to exit the CalStack setup, click **Cancel.**

For a few seconds, the GEN series calibration and verification software will attempt to communicate with the instruments in the CalStack.

Notice

If the communication fails, a failure message will appear.

Tip

If the configuration of the CalStack Setup does not detect the instruments, please refer to „Accidentally selected IOTech serial interface“ on page 204 and „NI GPIB-USB-HS not detected“ on page 205.

To check and correct your configuration, click **Set up CalStack...** again.

After setting the CalStack, the GEN series calibration and verification software will return you to the *Card Calibration* or *Card Verification* window.

Notice

When HP 3458A is part of the CalStack a new window can pop up (see Fig. 4.16*).*

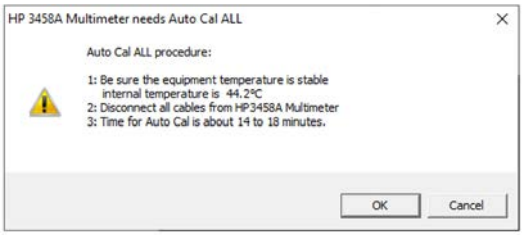


Fig. 4.16 HP 3458A Multimeter Auto Cal window

The HP 3458A should do an Auto Calibrate of the unit on a regular base:

- HP 3458A Auto Cal DCV - every day
- HP 3458A Auto Cal DCV and AC - once a week
- HP 3458A Auto Cal ALL (DCV, AC and OHM) - one time per month

Notice

Before starting the Auto Cal be sure the HP 3458A unit is warmed-up and disconnect all cables from the measurement inputs.

A message is shown during the calibration process, see Fig. 4.17.

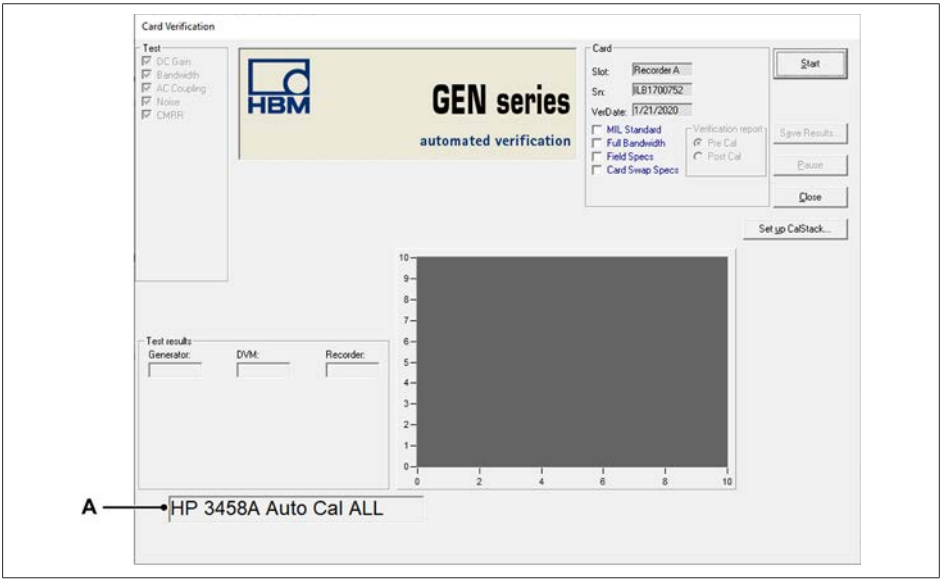


Fig. 4.17 Card verification window during HP3458A auto calibration

A HP 3458A auto calibration status

WARNING

Do not interrupt the Auto Cal process before it is completely finished.

4.8.6 Exit the GEN series calibration and verification software

You can exit the GEN series calibration and verification software in the *GEN series calibration and verification* or **Mainframe Selection** window.

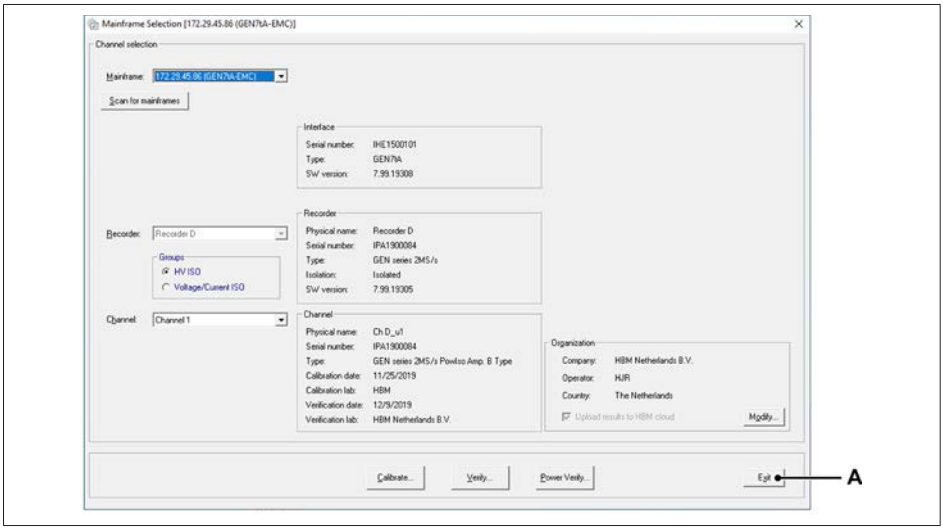


Fig. 4.18 Exit (Mainframe Selection window)

A Exit

Click **Exit** to exit the calibration and verification software.

5 Calibration

5.1 Introduction

The calibration process contains the following tests, depending on which card has been selected:

- AC calibration
- AC calibration CMRR
- Balance
- Charge calibration
- DC calibration
- DC calibration current
- Excitation [A]
- Excitation [V]
- IEPE AC gain
- OutDAC calibration

⚠CAUTION

Calibration and verification of Genesis High Speed products is not an easy job. This is mostly because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation. This means the product is very capable at measuring very small high frequency disturbances. Calibration of such a system requires an environment and set-up that is free of unwanted disturbances. If a disturbance is there, our system will measure it and, as expected, this can influence a calibration process.

⚠CAUTION

Before starting a calibration or verification, HBM recommends running the GEN series Data Acquisition System, the installed card(s) and the calibration standards for at least one hour to achieve the best test specifications.

5 CALIBRATION

⚠CAUTION

Because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation this product is very capable at measuring very small high frequency disturbances. Therefore it is strongly advised to disconnect all cables that are not required for the calibration in order to avoid bringing external disturbances into the system and so influencing the calibration process.

⚠CAUTION

HBM uses state-of-the-art electronic components in its equipment. These electronic components can be damaged by electrostatic discharge (ESD). Therefore, we must emphasize the importance of preventing ESD when removing or installing cards.

Notice

The calibration and verification tests depend on which card has been selected. Therefore, the windows that appear may differ from the illustrations used in this manual.

⚠ DANGER

Connectors and cables

Do not use non-protected or non-shrouded connectors.
The following connectors are not safe to use with this card and must not be used (see Fig. 5.1)

Fig. 5.1 Unsafe connectors

The inputs on the 1kV card are compatible with the following connectors and cables (see Fig. 5.2). All cables used with the 1kV card must support 1000 V DC (or 1000 V AC peak) and 600 V CAT II. All required cables and connectors can be found in the the GN610B/GN611B data sheet specifications.

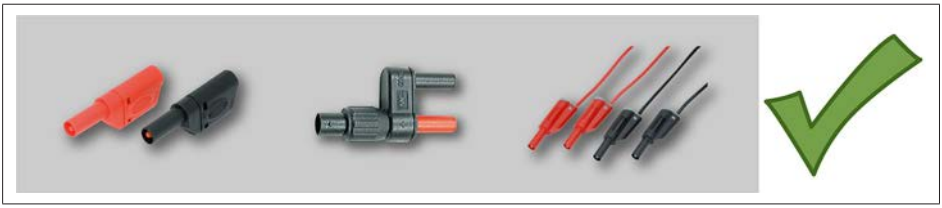


Fig. 5.2 Safe connectors

⚠ CAUTION

Inspect your calibration cables, connectors and adapters regularly for wear or damage and replace them if required.
Regular preventive replacement is strongly advisable since the cost involved in an investigating usually is way higher then the cost of replacement. For example, in an intensive usage scenario a half yearly replacement could be advisable.

5.2 Calibrating cards

In the **Mainframe Selection** window:

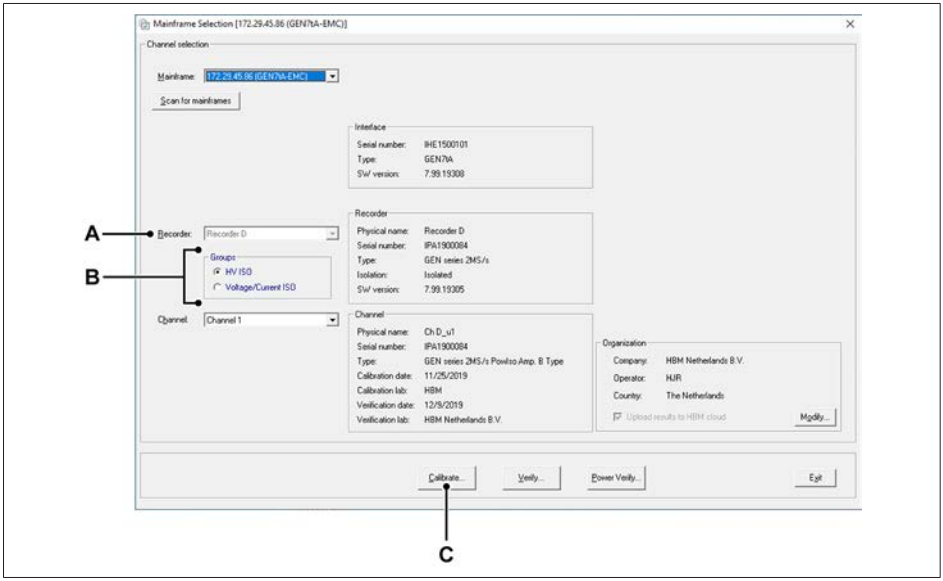


Fig. 5.3 Mainframe Selection window

A Recorder selection
B Group or remote probe selection
C Calibrate...

Select the card system **(Recorder)** you want to calibrate. When available select the **Group** of channels or **Remote Probe** for calibration. **Click Calibrate...** to open the *Card Calibration* window.

The **Card/Remote Probe Calibration** window appears.

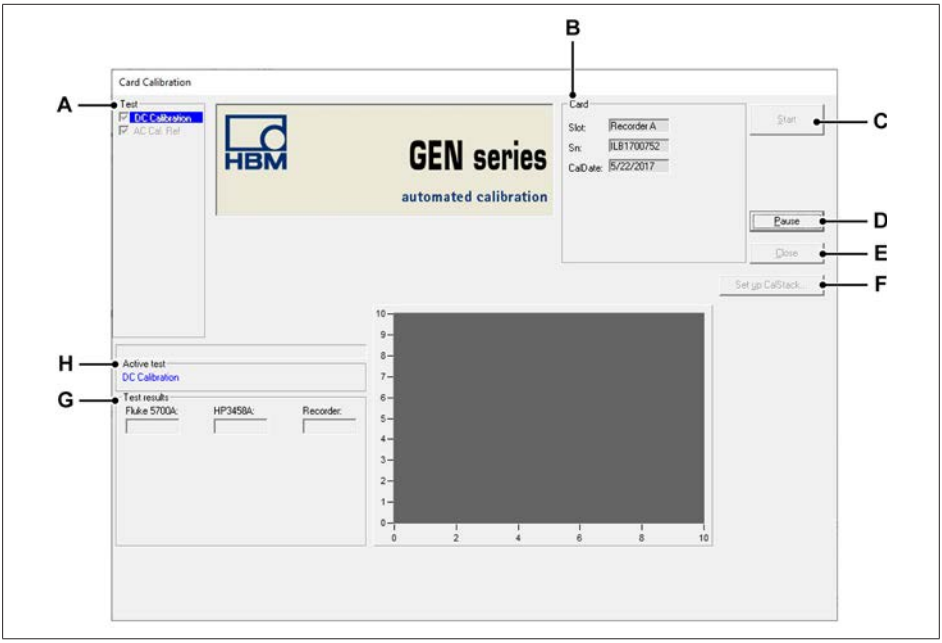


Fig. 5.4 Card/Remote Probe Calibration window overview

A Test: Lists the tests to be performed (depending on the selected card)
B Card: Shows information about the selected card (recorder)
C Start: To start the calibration process
D Pause: To pause or stop while testing
E Close: To end the calibration process
F Set up CalStack...: To open the CalStack Setup window
G Test results: Shows the test results
H Active test: Progress bar (when active)

Notice

Recorder values may differ from the Generator and DVM values and do not compromise the calibration!

5 CALIBRATION

⚠CAUTION

Before starting a calibration or verification, HBM recommends running the GEN series Data Acquisition System, the installed card(s) and the calibration standards for at least one hour to achieve the best test specifications.

⚠CAUTION

Because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation this product is very capable at measuring very small high frequency disturbances. Therefore it is strongly advised to disconnect all cables that are not required for the calibration in order to avoid bringing external disturbances into the system and so influencing the calibration process.

⚠CAUTION

If you have not already done so, set up the CalStack before starting a calibration or verification to ensure that the GEN series calibration and verification software detects which calibration standard(s) you are using.

To begin the calibration process of the selected card:

1. Click **Start**.
2. Connect the testing fixture to the calibration standard(s) as displayed on your screen.

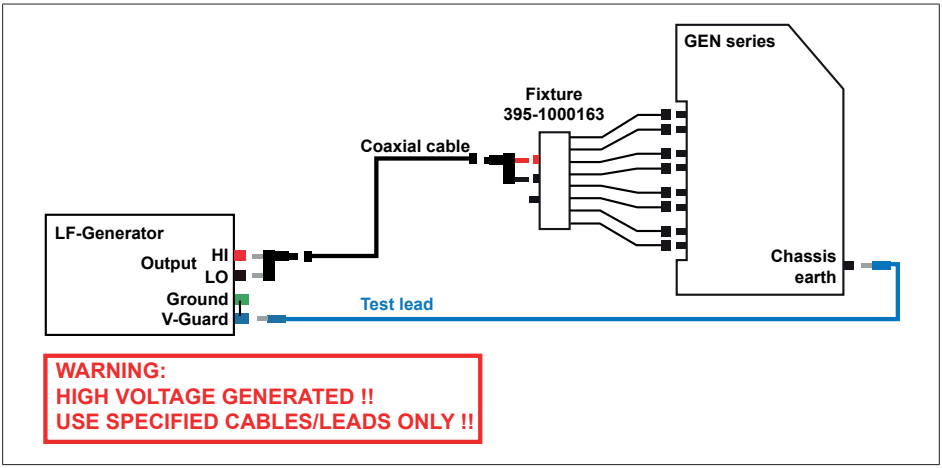


Fig. 5.5 Example of a GEN series connection window

Notice

The color of your cables may differ from the cables that appear on the GEN series connection window.

3. When connected, click **OK** to start testing.

The system starts the calibration process.

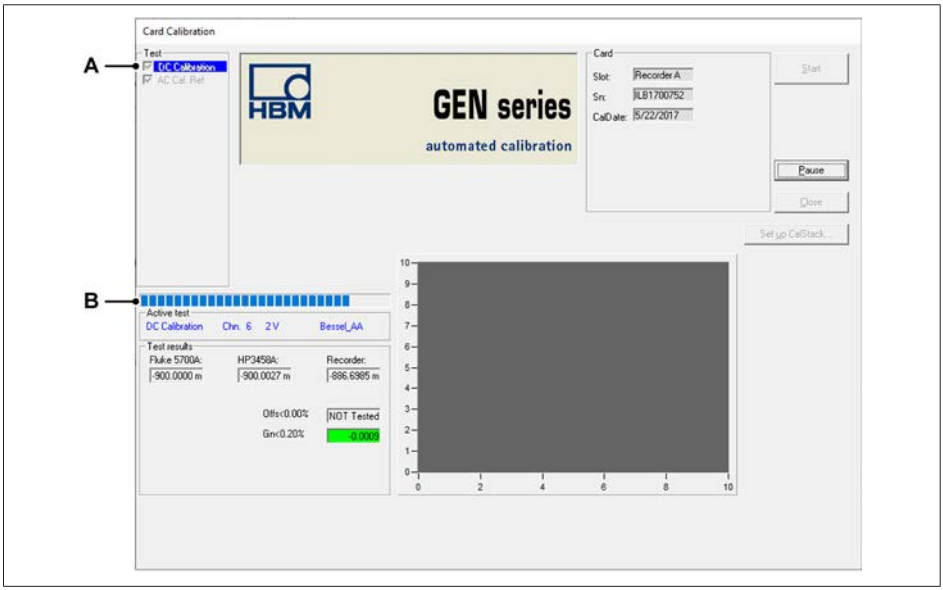


Fig. 5.6 DC calibration

A Test: Indicates the test to be performed
B Active test: Progress bar (when active)

5.2.1 DC calibration

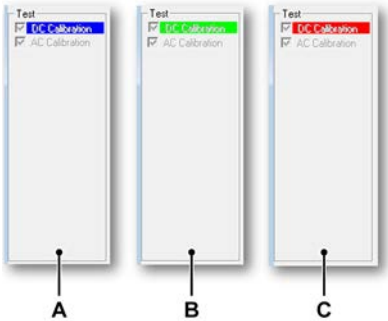


Fig. 5.7 Test being performed

A While the system performs the test **DC Calibration**, the background behind **DC Calibration** is blue.
B When the test is passed, the background behind **DC Calibration** turns green.
C When the test is failed, the background behind **DC Calibration** turns red.

Notice

If a receiver test is performed, only the DC test is available for that selection.

Fig. 5.8 Receiver - Test being performed

The **Active test** progress bar shows information on what is currently happening.

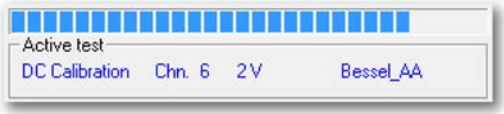


Fig. 5.9 Active test progress bar

5.2.2 AC calibration (depending on card)

⚠CAUTION

Before performing the AC calibration, HBM recommends plugging the card into a center slot in the mainframe. This provides access to both sides of the card to allow for any necessary physical adjustments to AC gain. After AC calibration, the card should be installed into the slot where it will be used for measurement.

When the DC calibration test is finished, the calibration process continues with the AC calibration test:

1. Connect the testing fixture to the calibration standard(s) as displayed on the screen.

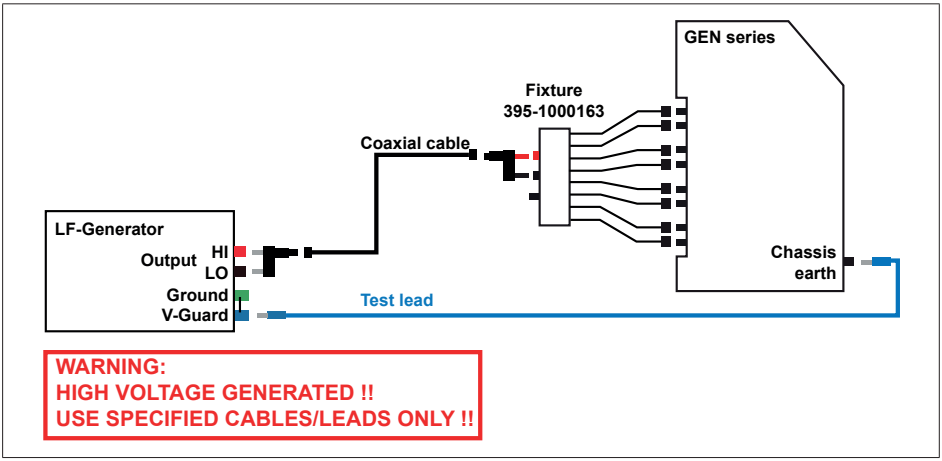


Fig. 5.10 Example of a GEN series connection window

Notice

The color of your cables may differ from the cables that appear on the GEN series connection window.

2. If connected, click **OK** to start testing.

If necessary, adjust the channels of the card.

WARNING

Only use a ceramic or other non-conductive adjustment tool.

CAUTION

HBM uses state-of-the-art electronic components in its equipment. These electronic components can be damaged by electrostatic discharge (ESD). Therefore, we must emphasize the importance of preventing ESD when removing or installing cards.

The position of the adjustments depends on which card has been installed.
Please refer to Appendix „Locations for AC Calibration Adjustments“ on page 186 of this manual.

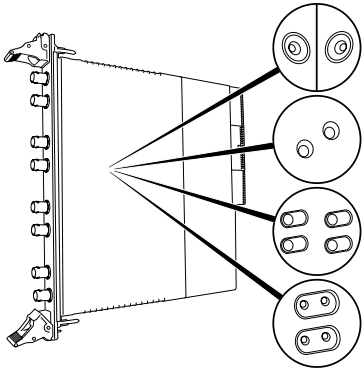


Fig. 5.11 AC calibration adjustments (example)

Tip

The remote probe channels support fully automatic AC calibration. In that case, no manual trimming is necessary and software will continue seamlessly.

Adjust the channel using the adjustment tool until the needle enters the green section. Repeat this adjustment for each channel.
When all channels have been properly adjusted, the **Next Step** or **Ready** button will be enabled (depending on which card has been selected).

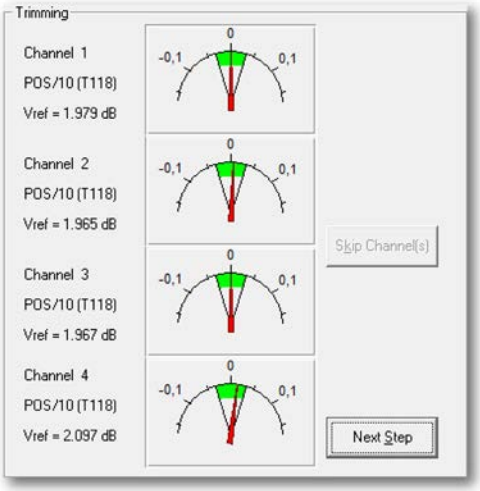


Fig. 5.12 Channel adjustment (T118)

Click **Next Step** to continue the adjustment.

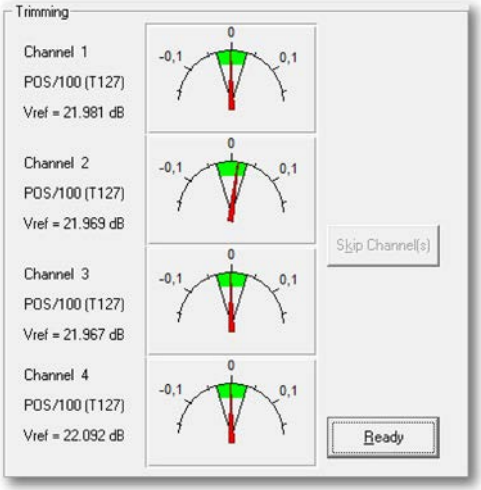


Fig. 5.13 Channel adjustment ready (T127)

Click **Ready** after you have adjusted all channels.

The software will then continue the calibration process.

Notice

*If no particular channel is adjusted or if **Skip Channel(s)** is selected, the calibration process will continue but you will receive failing results.*

5.2.3 Calibration test results

When all calibration tests are passed:

- A “Saving Calibration date.....” message appears.
- The passed tests and results are indicated by a green background.

When one of the calibration tests is failed:

- A "Calibration failed" message appears.
- The failed tests and results are indicated by a red background.

The **Test results** are shown once all tests have been performed.

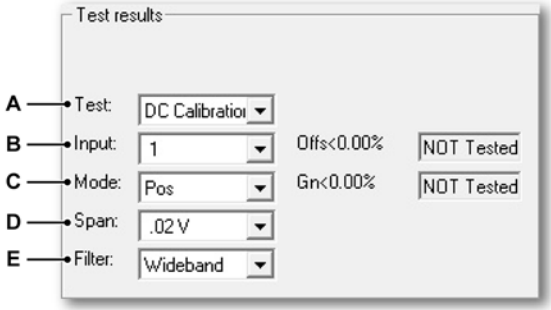


Fig. 5.14 Test results

A Test list
B Input list
C Mode list
D Span list
E Filter list

Click on one of the lists (**A** to **E**) to select the appropriate test and see the result.

5.2.4 Passed test results

Passed tests and results are indicated by a green background. When the calibration process is passed, a **Saving Calibration date.....** message appears in the bottom left-hand corner of the screen.

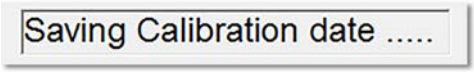


Fig. 5.15 Saving Calibration date message

Tip

The calibration date for the card can be viewed in the Perception software when looking at the Properties of the card.

5.2.5 Failed test results

If one of the tests has failed, a "Calibration failed" message appears.

Fig. 5.16 Calibration failed message

Notice

The new calibration date will not be stored in the channels.

Failed tests and results are indicated by a red background.

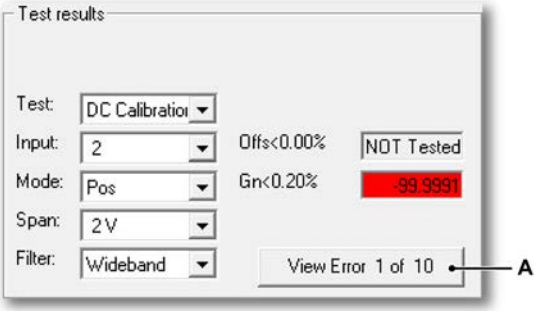


Fig. 5.17 Failed test results

A View Error

Click **View Error** repeatedly to see each failed test result.

After the calibration process is complete, power off the GEN series Data Acquisition System and insert the card into the slot which will be used for measurements.

Once the card is inserted into the appropriate slot, restart the GEN series Data Acquisition System and verify the calibration as outlined in the “Calibration Verification” section of this manual (see „Setting up the Verification test“ on page 98).

5.2.6 Group selection

Notice

When a card has multiple channel groups, all groups must be calibrated individually.

Select another channel group in the **Groups** area and start **Calibrate...** again until all channel groups are calibrated successfully.

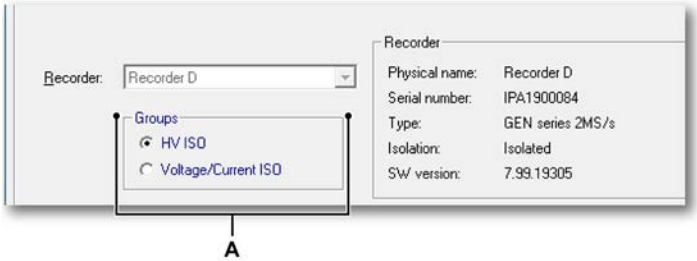


Fig. 5.18 Groups

A Channel group selection

5.2.7 Remote Probe selection

Notice

When a card has remote probes connected, all remote probes must be calibrated individually.

Choose another remote probe from the **Remote Probes** area and start **Calibrate...** again, repeating this until all remote probes have been successfully calibrated.

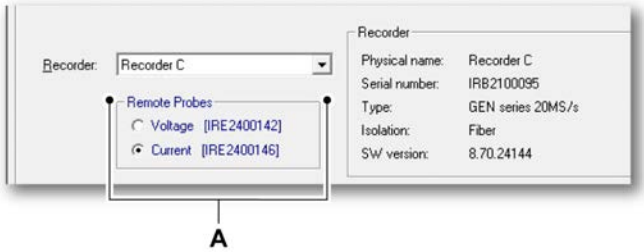


Fig. 5.19 Remote Probes

A Remote probe selection

Important

Remote probes must be connected in the correct sequence, which is:
Voltage remote probe connects to first optical transceiver port at recorder card while Current remote probe is connected to second optical transceiver port at recorder card.

Important

When remote probe has been changed on the fly, rescan GEN series mainframe and recorder to be sure all settings from new remote probe are collected.

6 Calibration Verification

6.1 Introduction

The verification process performs verifications on the current calibration.
The verification process contains the following tests, depending on which card has been installed and selected:

- AC coupling - on page 125
- AC gain - on page page 126
- AC gain [A] - on page page 126
- AC probe - on page 127
- Balance - on page 128
- Bandwidth - on page 129
- Charge AC gain - on page 132
- Common Mode Rejection Ratio - on page 133
- Cold junction - on page 134
- CT voltage - on page page 135
- DC gain - on page 136
- DC gain [A] - on page 136
- Excitation [A] - on page 143
- Excitation [V] - on page 143
- HV probe (BW) - on page 129
- HV probe (DC) - on page 136
- IEPE AC gain - on page 145
- IEPE Excitation - on page 146
- Noise - on page 147
- Noise [A] - on page 147
- OutDAC - on page 148
- Quarter bridge resistors - on page 149
- Reference - on page 150
- Shunt resistors - on page 151
- TEDS Class 3 - on page 152
- TEDS data - on page 153
- Input resistor - on page 154

Notice

The calibration and (power) verification tests depend on which card has been installed and selected. Therefore, the windows that appear in the GEN series Calibration software may differ from the figures shown in this manual.

6 CALIBRATION VERIFICATION

Notice

The calibration and (power) verification tests do not verify the accuracy of the time base.

⚠CAUTION

Calibration and verification of Genesis High Speed products is not an easy job. This is mostly because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation. This means the product is very capable at measuring very small high frequency disturbances. Calibration of such a system requires an environment and set-up that is free of unwanted disturbances. If a disturbance is there, our system will measure it and, as expected, this can influence a calibration process.

⚠CAUTION

Before starting a calibration or verification, HBM recommends running the GEN series Data Acquisition System, the installed card(s) and the calibration standards for at least one hour to achieve the best test specifications.

⚠CAUTION

Because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation this product is very capable at measuring very small high frequency disturbances. Therefore it is strongly advised to disconnect all cables that are not required for the calibration in order to avoid bringing external disturbances into the system and so influencing the calibration process.

⚠CAUTION

Swapping, replacing or removing cards may result in minor deviations in the original calibration. Always verify the calibration after swapping, replacing or removing the card!

6.2 Verifying cards

6.2.1 Setting up the Verification test

In the **Mainframe Selection** window:

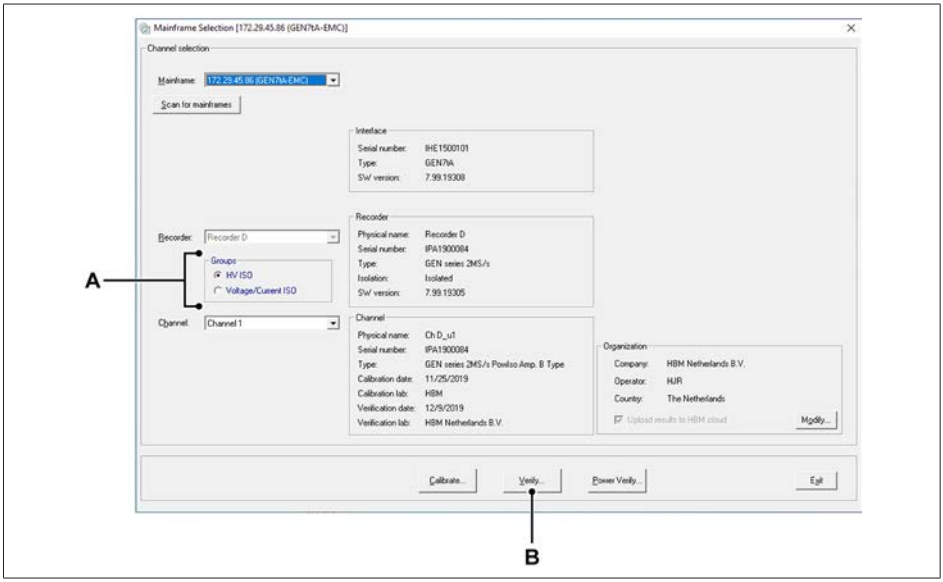


Fig. 6.1 Mainframe Selection window

A Group or remote probe selection

B Verify...

When multiple channel groups are available select **Group** for verification. Click **Verify...** to open the Card Verification window.

Notice

*All ISO Digitizer cards enable the **Recorder** and **Channel** options.*

The **Card/Remote Probe Verification** window appears.

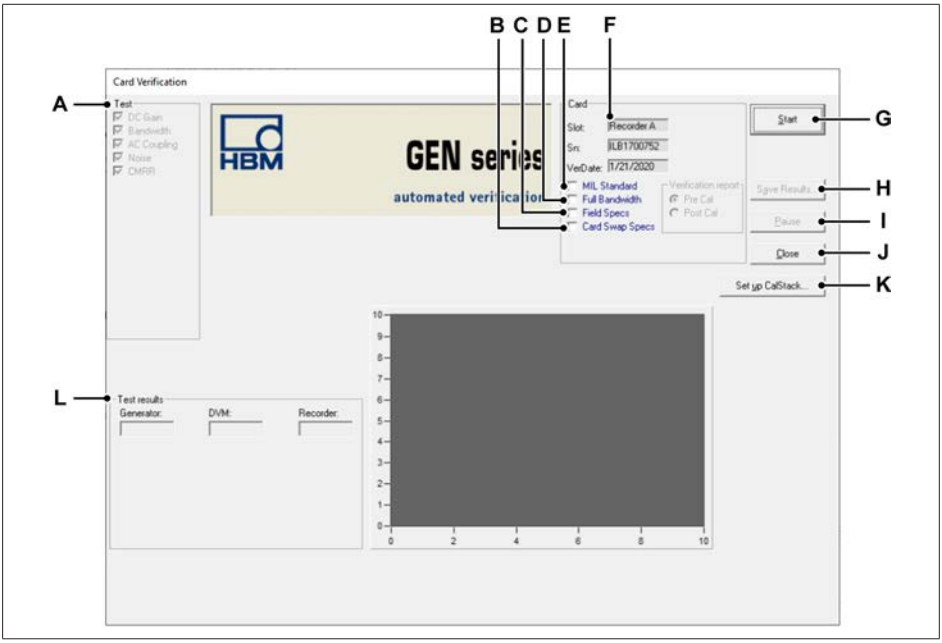


Fig. 6.2 Card/Remote Probe Verification window overview

A Test: Indicates the tests to be performed (depending on the selected card)
B Card Swap Specs (optional)
C Field Specs (optional)
D Bandwidth test (optional)
E MIL standard test (optional)
F Card: Shows information about the selected card
G Start: To start the verification process
H Save Results...: To save the verification test results
I Pause: To pause or stop while testing
J Close: To end the verification process
K Set up CalStack...: To open the CalStack Setup window.
L Test results: Shows the test results

⚠CAUTION

If you have not already done so, set up the CalStack before starting a calibration or verification to ensure that the GEN series calibration and verification software detects which calibration standard(s) you are using.

⚠CAUTION

Before starting a calibration or verification, HBM recommends running the GEN series Data Acquisition System, the installed card(s) and the calibration standards for at least one hour to achieve the best test specifications.

⚠CAUTION

Because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation this product is very capable at measuring very small high frequency disturbances. Therefore it is strongly advised to disconnect all cables that are not required for the calibration in order to avoid bringing external disturbances into the system and so influencing the calibration process.

6.2.2 Starting the Verification test

When selecting bandwidth testing, there are optional tests that can be performed based on the depth of information required.
The basic Bandwidth test is performed by default and will calculate only the -3 db bandwidth value.

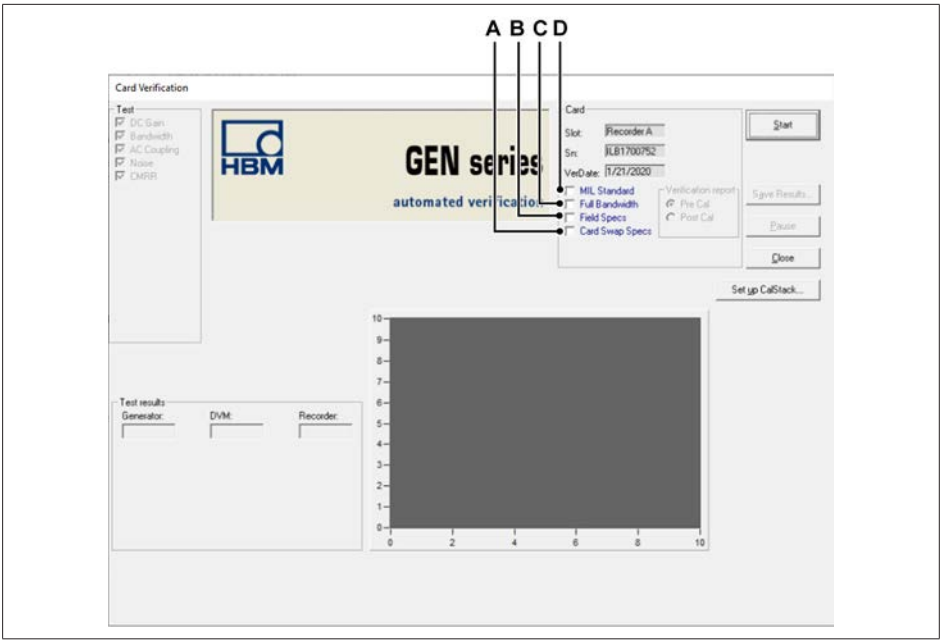


Fig. 6.3 Card Verification window (Bandwidth tests)

A **Card Swap Specs**

Selecting the **Card Swap Specs** check box: This will change the verification fail criteria are adapted according the data sheet statement for adding/removing or swapping cards.
Upon selection of this mode there will be a clear statement made in the report stating:

- Verification results (**Card Swap Specifications**)
  Where in the normal mode the report will state:
- Verification results (**Manufacturing Specifications**)

The effect on the verification:

- DC Gain (Voltage): x2 (Offset, Gain, SinL, MSE)
- DC Gain (Current): x2 (Offset, Gain, SinL, MSE)
- CMRR: +10 dB
- IEPE AC gain: x2

B **Field Specs**

Selecting the **Field Specs** check box: This will change the verification fail criteria to a less demanding level. This function will be used in situations where the equipment is located in a electrically harsh environment where calibration against the standard level is difficult or not possible.
Upon selection of this mode there will be a clear statement made in the report stating:

- Verification results **(Field Specifications**)
  Where in the normal mode the report will state:
- Verification results (**Manufacturing Specifications**)

The effect on the verification:

- DC Gain (Voltage): x2 (Offset, Gain, SinL, MSE)
- DC Gain (Current): x2 (Offset, Gain, SinL, MSE)
- AC Gain (Voltage)
- AC Gain (Current)
- Bandwidth: 0.9*Lower and 1.1*Upper
- Noise (Voltage): x2
- Noise (Current): x2
- CMRR: +10 dB
- IEPE AC gain: x2

C **Full Bandwidth**

Selecting the **Full Bandwidth** check box: This test takes more time than the quick bandwidth test does. It tests more input values to provide a better picture of the bandwidth curve before and after the -3db value. A separate log file is produced.

D **MIL standard**

Selecting the **MIL**itary **standard** check box: This will test all possible DC gain input spans and takes the most time. When selecting **MIL**, you will have the option to select the report to save and display as a pre- or post- Calibration. These will then be separate files.

To begin the verification process of the selected card:

1. Click **Start**
2. Connect the testing fixture to the calibration standard(s) as displayed on-screen.

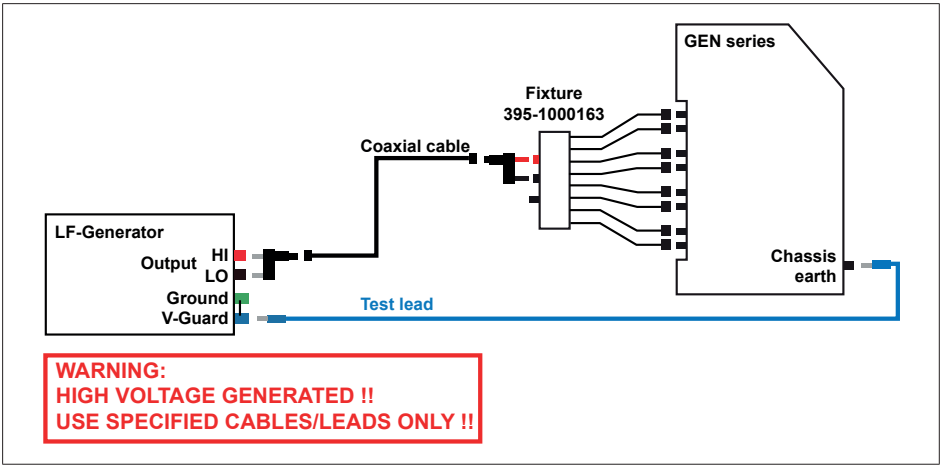


Fig. 6.4 Example of a GEN series connection window

Notice

The color of your cables may differ from the cables that appear on the GEN series connection window.

3. When connected, click **OK** to start testing.

The system starts the verification process.

6.2.3 During Verification Testing

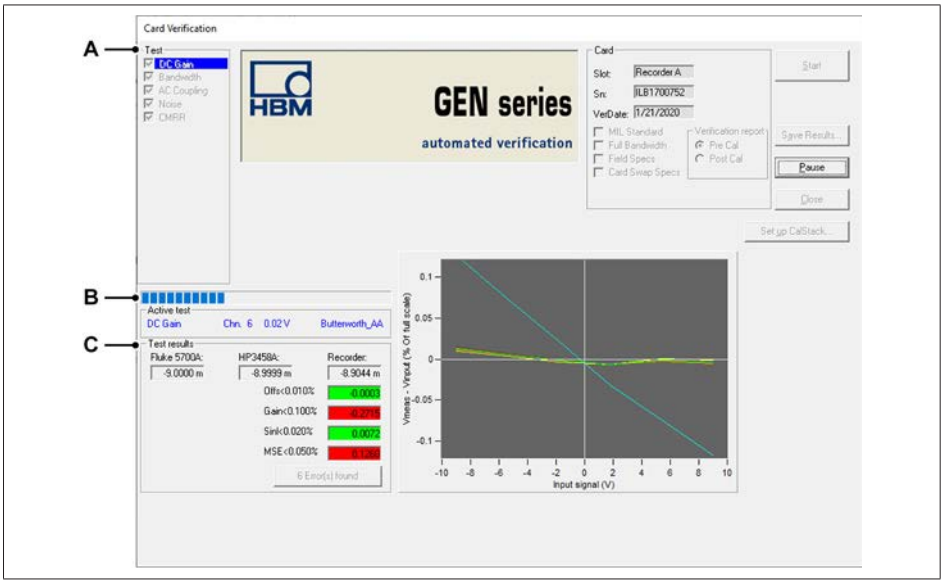


Fig. 6.5 DC gain

A **Test:** Indicates the test to be performed

B **Active test:** Progress bar (when active)

C **Test results**

A **Test** being performed

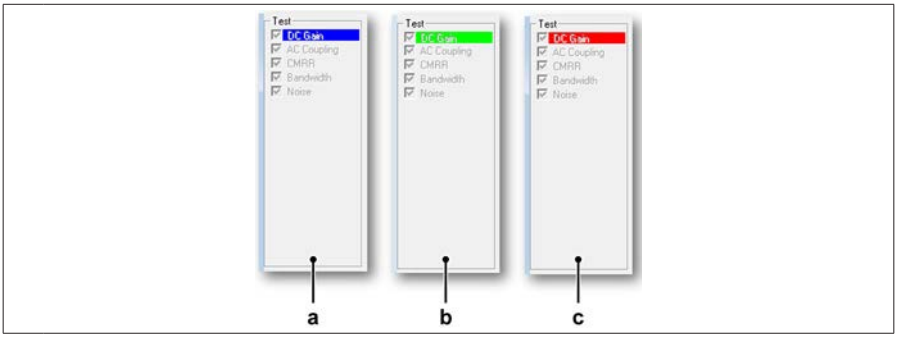


Fig. 6.6 Test being performed

a While the system performs the test **DC Gain**, the background behind the **DC Gain** is blue.

b When the test is passed, the background behind **DC Gain** turns green.

c When the test is failed, the background behind **DC Gain** turns red.

If receiver verification was chosen, the screen has the same layout but it also shows the available tests, as in Fig. 6.7

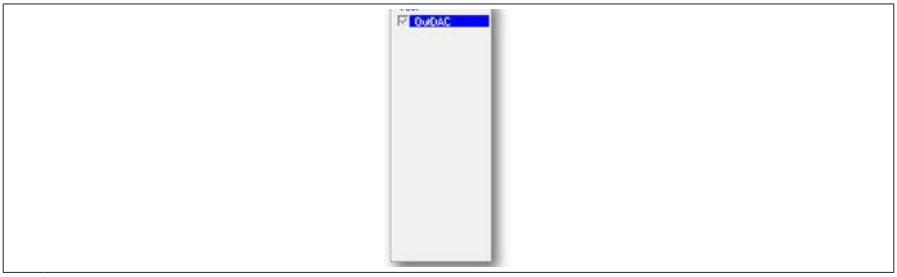


Fig. 6.7 Receiver verification

B **Active test**

The **Active test** progress bar shows information on what is currently happening.

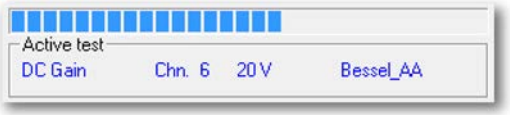


Fig. 6.8 Active test progress ba

C **Test results**

For more information, please refer to chapter „Verification test results“ on page 107.

6.2.4 Verification test results

When all verification tests are passed:

- A “Saving Verification date.....” message appears.
- The passed tests and results are indicated by a green background.

When one of the verification tests is failed:

- A "Verification failed" message appears.
- The failed tests and results are indicated by a red background.

You can see the test results once all tests have been performed.

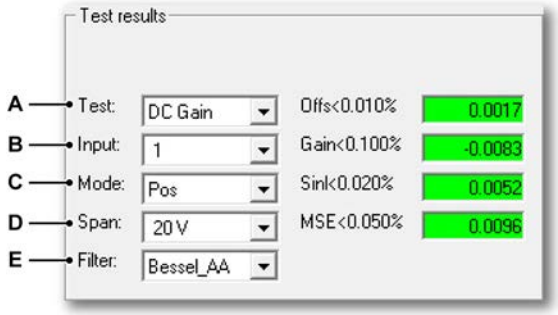


Fig. 6.9 Test results

A Test list
B Input list
C Mode list
D Span list
E Filter list

Click on one of the lists (**A** to **E**) to select the appropriate test and see the result.

6.2.5 Passed test results

Passed tests and results are indicated by a green background. When the verification process is passed, a **Saving Verification date.....** message appears in the bottom left-hand corner of the screen.

Fig. 6.10 Saving Verification date message

Notice

The calibration date for the card can be viewed in Perception software when looking at the properties of the card.

6.2.6 Failed test results

If one of the tests has failed, a Verification failed message appears.

Fig. 6.11 Verification failed message

Notice

The new verification date will not be stored in the channels.

Failed tests and results are indicated by a red background.

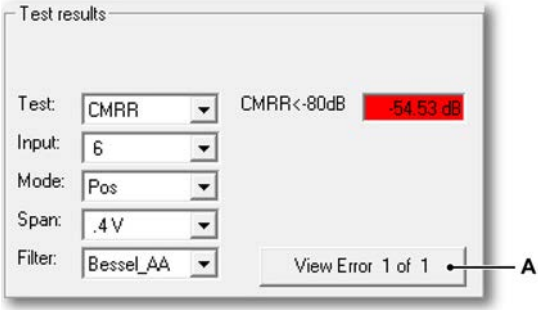


Fig. 6.12 Failed test results

A View Error

Click **View Error** repeatedly to see each failed test result.

6.2.7 Save results

Click **Save Results...** to save the verification test results to a report.

The report is a Word file containing:

- Mainframe information
- Card (recorder) information
- Verification test results for each test on each channel

6.2.8 Group selection

Notice

When a card has multiple channel groups, all groups must be verified individually.

Select another channel group in the **Groups** area and start **Verify...** again until **all** channels groups are verified successfully.

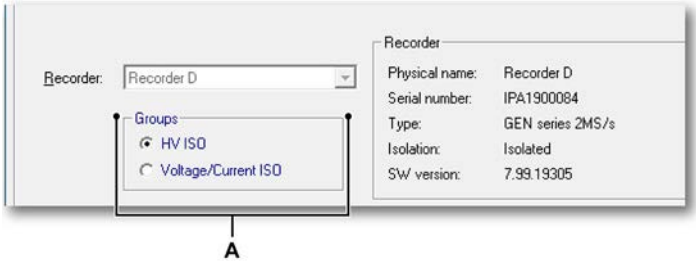


Fig. 6.13 Groups

A Channel group selection

6.2.9 Remote Probe selection

Notice

When a card has remote probes connected, all remote probes must be calibrated individually.

Choose another remote probe from the **Remote Probes** area and start **Calibrate...** again, repeating this until all remote probes have been successfully calibrated.

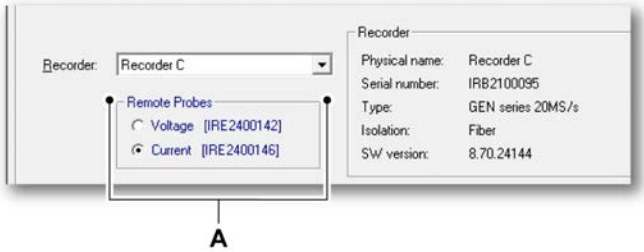


Fig. 6.14 Remote Probes

A Remote probe selection

Important

Remote probes must be connected in the correct sequence, which is:
Voltage remote probe connects to first optical transceiver port at recorder card while Current remote probe is connected to second optical transceiver port at recorder card.

Important

When remote probe has been changed on the fly, rescan GEN series mainframe and recorder to be sure all settings from new remote probe are collected.

7 Power Verification

7.1 Introduction

The **power verification** process performs verifications on the current calibration with respect to power measurements of the card. The power verification process contains the following tests, depending on which card or remote probe has been installed and selected:

- DC Power - on page 139
- AC Power - on page 138
- Power vs. Frequency - on page 140
- Power vs. Phase - on page 141
- PowerFactor - on page 142

Notice

The calibration and (power) verification tests depend on which card or remote probe has been installed and selected. Therefore, the windows that appear in the GEN series Calibration software may differ from the figures shown in this manual.

Notice

The calibration and (power) verification tests do not verify the accuracy of the time base.

⚠CAUTION

Calibration and verification of Genesis High Speed products is not an easy job. This is mostly because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation. This means the product is very capable at measuring very small high frequency disturbances. Calibration of such a system requires an environment and set-up that is free of unwanted disturbances. If a disturbance is there, our system will measure it and, as expected, this can influence a calibration process.

⚠CAUTION

Before starting a calibration or verification, HBM recommends running the GEN series Data Acquisition System, the installed card(s) and the calibration standards for at least one hour to achieve the best test specifications.

7 POWER VERIFICATION

⚠ CAUTION

Because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation this product is very capable at measuring very small high frequency disturbances. Therefore it is strongly advised to disconnect all cables that are not required for the calibration in order to avoid bringing external disturbances into the system and so influencing the calibration process.

⚠ CAUTION

Swapping, replacing or removing cards may result in minor deviations in the original calibration. Always verify the calibration after swapping, replacing or removing the card!

7.2 Verifying Power cards

7.2.1 Setting up the Power Verification test

In the **Mainframe Selection** window:

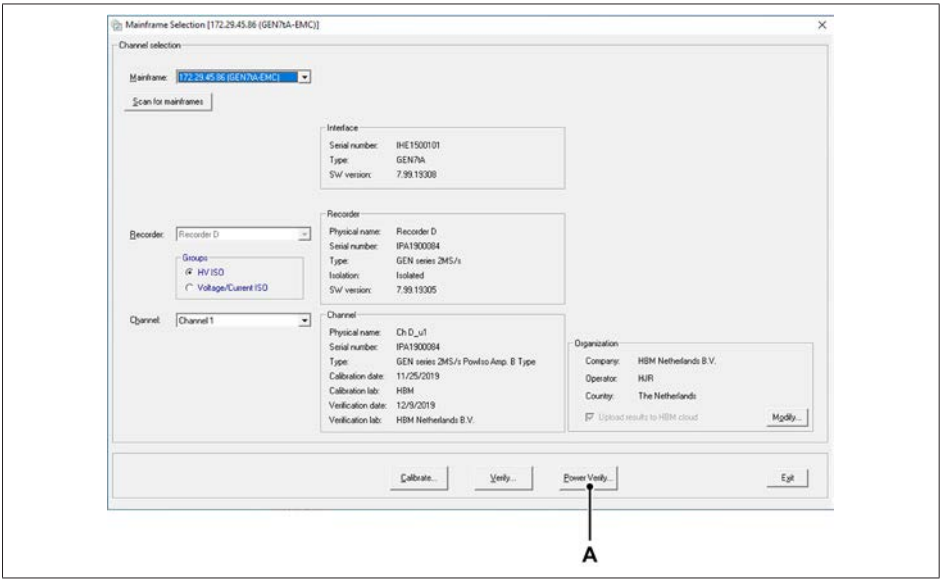


Fig. 7.1 Mainframe Selection window

A Power Verify...

Click **Power Verify...** to open the *Card Power Verification* window.

Notice

The Group or Remote Probe area does not matter at this state of the verification process because the GEN series Calibration and Verification software controls what to test for power verification.

The **Card/Remote Probe Power Verification** windows appears.

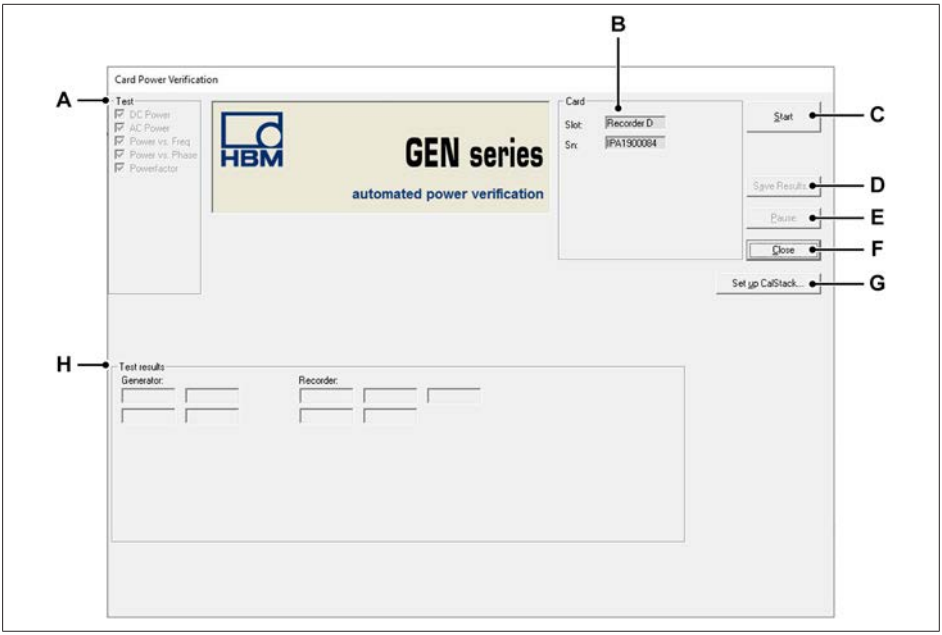


Fig. 7.2 Card/Remote Probe Power Verification window overview

A Test indicates the test to be performed (depending on the selected card)
B Card: Shows information about the selected card
C Start: To start the power verification process
D Save Results...: To save the power verification results
E Pause: To pause or stop while testing
F Close: To end the power verification process
G Set up CalStack...: To open the CalStack Setup window
H Test results: Shows the test results

⚠CAUTION

If you have not already done so, set up the CalStack before starting a calibration or verification to ensure that the GEN series calibration and verification software detects which calibration standard(s) you are using.

⚠CAUTION

Before starting a calibration or verification, HBM recommends running the GEN series Data Acquisition System, the installed card(s) and the calibration standards for at least one hour to achieve the best test specifications.

⚠CAUTION

Because of the product characteristics of high bandwidth in combination with low input ranges and high channel isolation this product is very capable at measuring very small high frequency disturbances. Therefore it is strongly advised to disconnect all cables that are not required for the calibration in order to avoid bringing external disturbances into the system and so influencing the calibration process.

7.2.2 Starting the Verification test

To begin the power verification process of the selected card:

1. Click **Start**
2. Connect the testing fixture to the calibration standard(s) as displayed on the screen.

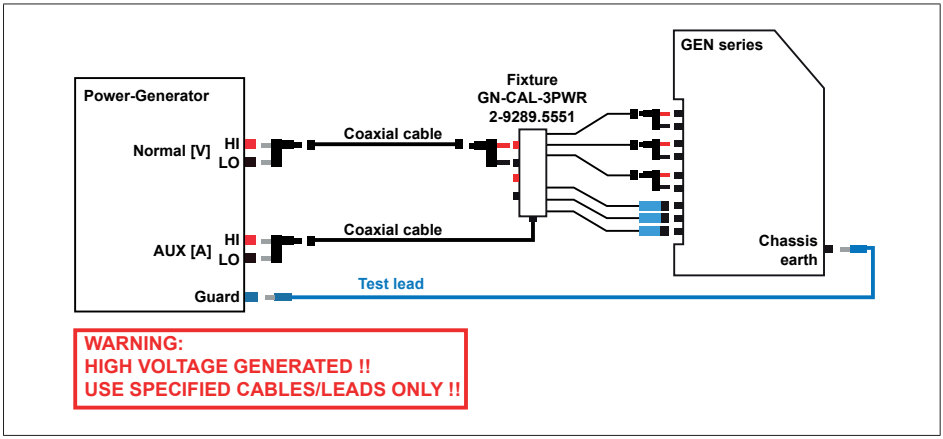


Fig. 7.3 Example of a GEN series power connection window

Notice

The color of your cables may differ from the cables that appear on the GEN series connection window.

3. When connected, click **OK** to start testing.

The system starts the power verification process.

7.2.3 During Power Verification Testing

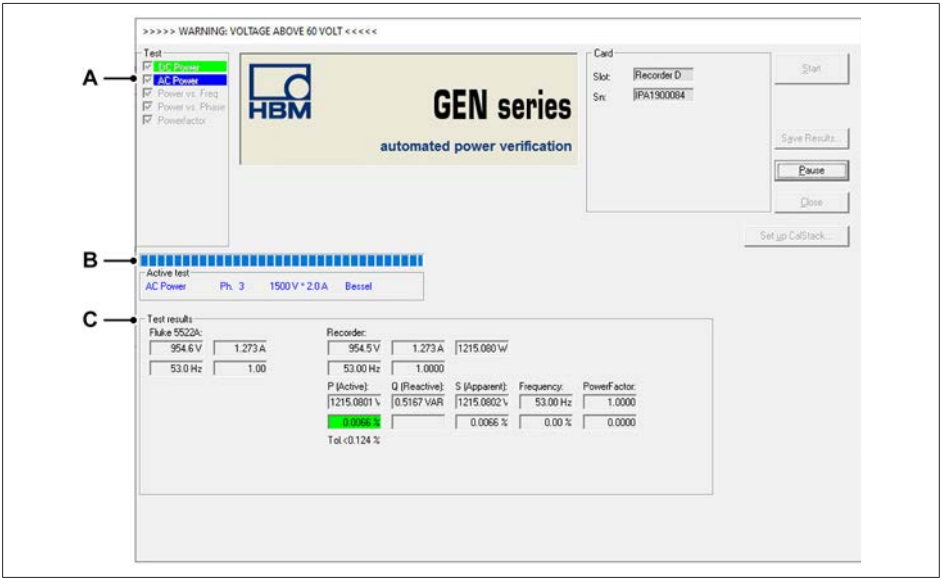


Fig. 7.4 AC Power

A **Test:** Indicates the test to be performed

B **Active test:** Progress bar (when active)

C **Test results**

A **Test** being performed

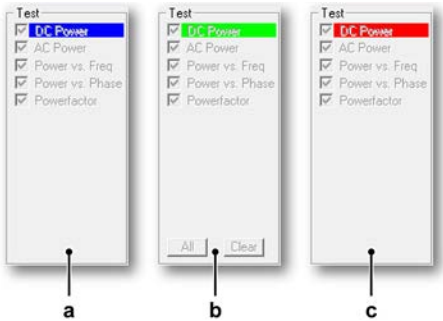


Fig. 7.5 Test being performed

a While the system performs the test **DC Power**, the background behind the **DC Power** is blue.

b When the test is passed, the background behind **DC Power** turns green.

c When the test is failed, the background behind **DC Power** turns red.

B **Active test**

The **Active test** progress bar shows information on what is currently happening.

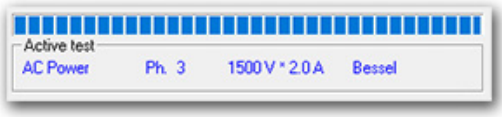


Fig. 7.6 Active test progress bar

C **Test results**

The **Test results** window shows information on what is currently happening during the test (see Fig. 7.7). It shows the generator settings and it lists the measured or calculated values from the recorder card. When generator settings have a blue background the program is waiting for the generator output(s) to settle.

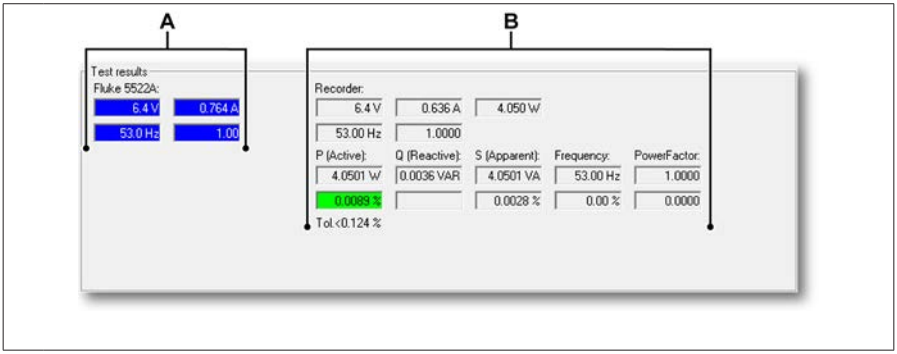


Fig. 7.7 Test results (during the test)

A Generator settings

B Test results

When all tests are done, please refer to chapter „Power verification test results“ on page 120.

7.2.4 Power verification test results

When all verification tests are passed:

- A “Saving Verification date.....” message appears.
- The passed tests and results are indicated by a green background.

When one of the verification tests is failed:

- A "Verification failed" message appears.
- The failed tests and results are indicated by a red background.

You can see the test results once all tests have been performed.

Fig. 7.8 Test results

A Test list
B Phase list
C Voltage span list
D Current span list
E Filter list

Click on one of the lists (**A** to **E**) to select the appropriate test and see the result.

7.2.5 Passed test results

Passed tests and results are indicated by a green background.
When the verification process is passed, a **Saving Power Verification date.....** message appears in the bottom left-hand corner of the screen.

Fig. 7.9 Saving Power Verification date message

Notice

*The power verification date for the card can be viewed in **Perception software** when looking at the properties of the card.*

7.2.6 Failed test results

If one of the tests has failed, a **Power verification failed** message appears.

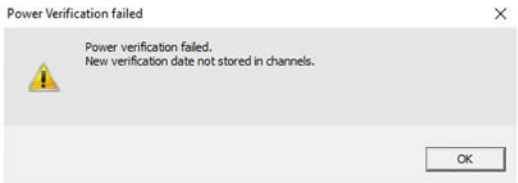


Fig. 7.10 Power verification failed message

Notice

The new power verification date will not be stored in the channels.

Failed tests and results are indicated by a red background.

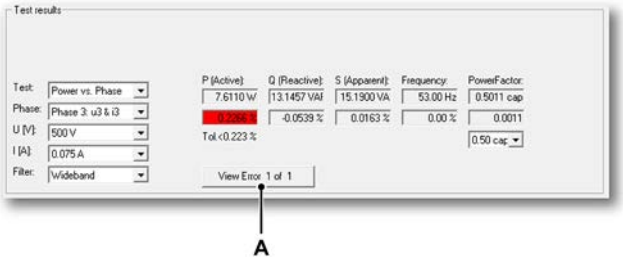


Fig. 7.11 Failed test results

A View Error

Click **View Error** repeatedly to see each failed test result.

7.2.7 Save results

Click **Save Results...** to save the power verification test results to a report.

The report is a Word file containing:

- Mainframe information
- Card (recorder) information
- Power verification test results for each test on each channel

8 Theory of Operation

8.1 Range and Span explained

Datasheets and software use the terms **Range** and **Span** in different situations. It is easy to convert one into the other.

Range

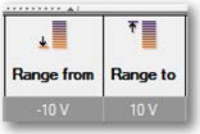


Fig. 8.1 "Range from"/"Range to" columns in Perception settings sheet

Whenever Range is used it identifies an absolute indication of the analog input. In the example for Range, the input can measure voltages from -10 V to +10 V (see Fig. 8.1).

Span

Expressed in **Span** the setting would look like this:

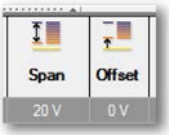


Fig. 8.2 "Span"/"Offset" columns in Perception settings sheet

The same setup shows the **Span** is 20 V. This doesn't immediately tell what input voltage can be used. The second control required is the **Offset**. The example shows the offset to be 0 V. By definition the input is then defined to be bipolar so input voltages can be measured from - 1/2 Span to + 1/2 Span (-10 V to +10 V).

Changing the **Offset** to -10 V would change the measured input voltages to 0 to 20 V. The following block diagram shows the interaction between **Span** and **Offset**.

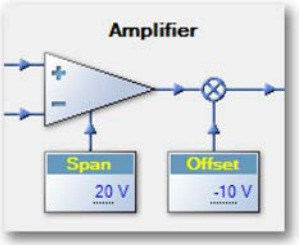


Fig. 8.3 Span/Offset relation

The selected -10 V **Offset** is added to the measured input voltages. If the input voltage is 0 V, the ADC will measure a -10 V voltage, the minimum bi-polar level of the ADC. Raising the input voltage to +20 V, the -10 V **Offset** will reduce the ADC measured voltage to +10 V, the maximum bi-polar value of the ADC.

8.2 AC Coupling Test

General information

Required equipment:

- LF generator

Acquisition settings:

- Sample rate 10 kS/s
- All channels set to AC coupling
- Mode, Filter and Span settings as defined by the verification process

Tip

As the AC coupling does not depend on the filter or Span settings, only a selected combination of these settings is tested to guarantee that AC coupling works in all possible settings combinations.

Procedure:

- A DC signal (90% of Full Scale) is applied.
- 4000 samples are acquired.
- The standard deviation of this data is calculated.
- This value must be < 0.5 * signal value.

- An AC signal (90% of Full Scale (pk-pk)) at 200 Hz is applied.
- 4000 samples are acquired.
- The standard deviation of this data is calculated.
- This value must be > 0.5 * signal value.

The test results are either **pass or fail**. The test does not verify the exact -3 dB point for the AC coupling, as the AC coupling frequency is defined by a single capacitor and is not adjustable.

8.3 AC Gain (Voltage or Current) Test

General information

Required equipment:

- LF generator

Acquisition settings:

- Maximum sample rate
- All channels are DC coupled
- Mode, Filter and Span settings as defined by the verification process

Tip

*The AC Gain test uses a selected set of all Mode Filter and Span settings supported by the **D**evice **U**nder **T**est (DUT). The selection is based on the technical design of the DUT to ensure that all design combinations are tested.*

AC Gain test measures amplitude accuracy over frequency. Generator amplitude is set to 90% of Full Scale or less as of generator limitations. Over at least 5 periods, signal is measured and standard deviation of measured signal is calculated. Compared to the input signal, accuracy in percentage is calculated and reported in verification report. Value is checked if it is within tolerance.

8.4 AC Probe Test

General information

Required equipment:

- LF generator
- GN813 or GN814

Acquisition settings:

- Sample rate 10 kS/s
- All channels set to AC coupling
- Mode, Filter and Span settings as defined by the verification process

Procedure:

- A DC signal (90% of Full Scale) is applied.
- 4000 samples are acquired.
- The standard deviation of this data is calculated.
- This value must be < 0.5 * signal value.

- An AC signal (90% of Full Scale (pk-pk)) at 200 Hz is applied.
- 4000 samples are acquired.
- The standard deviation of this data is calculated.
- This value must be > 0.5 * signal value.

The test results are either **pass or fail**. The test does not verify the exact -3 dB point for the AC coupling, as the AC coupling frequency is defined by a single capacitor and is not adjustable.

8.5 Balance Test

General information

The Balance function adds a DC voltage to the input amplifier to correct unbalance in the input signal.

Required equipment:

- DC reference
- Multimeter
- A fixture is required for easy connections to the bridge amplifier

Acquisition settings:

- All channels set to bridge mode
- Filter and Span settings as defined by the verification process

Procedure:

The balance voltage is set in six steps from -0.25 V to 0.25 V.
The DC reference is also set to the same voltage and is denoted as **$Vset_i$**.

In each step, an average voltage value is measured by the GEN series (please refer to DC gain page 136). This voltage is corrected for the balance voltage and then denoted as **$Vmeas_i$**.

$$SumX = \sum_{i=1}^{6} Vset_i \qquad SumY = \sum_{i=1}^{6} Vmeas_i$$

$$SumX^2 = \sum_{i=1}^{6} Vset_i^{\,2} \qquad SumXY = \sum_{i=1}^{6} Vset_i * Vmeas_i$$

$$MeanX = SumX / 6$$

$$MeanY = SumY / 6$$

$$Slope = \frac{(6*SumXY) - (SumX*SumY)}{(6*SumX^2) - (SumX)^2}$$

$$Intercept = MeanY - (Slope * MeanX)$$

$$BestFit = (Slope * Vset_i) + Intercept$$

Fig. 8.4 Balance test

MS_Balance = Maximum(Absolute(**$Vmeas_i$ - $Vset_i$**) / Span) * 100%

8.6 Bandwidth Test (HV probe BW)

The HV probe (BW) test is identical to the standard bandwidth test with the exception that it expects the HV probes to be attached to the input channels. This creates different bandwidth limit checks.

General information

Required equipment:

- The HF generator
- 50 Ohm termination plug

Acquisition settings:

- All channels set to bridge mode
- Filter and Span settings as defined by the verification process

Tip

*The bandwidth test uses a selected set of all Mode Filter and Span settings supported by the **D**evice **U**nder **T**est (DUT). The selection is based on the technical design of the DUT to ensure that all design combinations are tested.*

There are two types of bandwidth tests:
The **Quick** bandwidth test is always run as the standard test to determine the -3 dB point. If **Full** bandwidth is selected, an enhanced test is also performed on the different signal frequencies.

8.6.1 Quick Bandwidth Test

AC gain is measured using a total of three frequency values to check if the - 3 dB point is within the specifications.

A 90% Full Scale AC signal is input from the HF generator into the device being tested. The initial signal frequency is set either to 500 Hz using Fluke 5700A, 5720A or 5730A or to 50 kHz using Fluke 5820A or 9500B.

4000 samples are acquired and the standard deviation is calculated and stored as **Vref**.

The -3 dB point is calculated as (.7071* Vref) and is denoted as **3dBval**.

The frequency is then incremented to the minimum bandwidth specification value (**$Freq_{lo}$**). 4000 samples are acquired and the standard deviation is calculated and denoted as **$Vmeas_{lo}$**. **$Vmeas_{lo}$** must be higher than **3dBval**.

The frequency is then incremented to the maximum bandwidth specification value (**$Freq_{hi}$**). 4000 samples are acquired and the standard deviation is calculated again and is denoted as **$Vmeas_{hi}$**. **$Vmeas_{hi}$** is compared with Vref and must be lower than **3dBval**.

A fictitious line is drawn between the two measured points. From the point where this line meets the **3dBval**, the frequency is calculated.

$$ACgain_{lo} = 20\log_{10} (Vmeas_{lo} / Vref)$$

$$ACgain_{hi} = 20\log_{10} (Vmeas_{hi} / Vref)$$

$$Bandwidth = ((ACgain_{lo} + 3) / (ACgain_{lo} - ACgain_{hi})) * (Freq_{hi} - Freq_{lo}) + Freq_{lo}$$

8.6.2 Full Bandwidth test

During this test, the amplitude behavior of the amplifier is tested over the frequency range that the amplifier supports.

The start frequency is set to the maximum sample rate of the channel / 2000 and is denoted as Fstart. The end frequency is set to the maximum sample rate of the channel and is denoted as Fstop. The frequency range from Fstart to Fstop is divided into frequency ranges of decades and five steps per decade are tested.

The frequency decades used are:

- 100 Hz to 1 kHz
- 1 kHz to 10 kHz
- 10 kHz to 100 kHz
- 100 kHz to 1 MHz
- 1 MHz to 10 MHz
- 10 MHz to 100 MHz
- etc.

During the test, a sine wave of the selected frequency is applied using 90% peak to peak amplitude of the amplifier Span that is currently being tested.

Notice

The Fluke 5820A or 9500B calibrator only supports a maximum of a 5.5 V peak to peak signal. Therefore, any results of the amplifier span above 50 V will be negatively influenced by the maximum of the 10% Full Scale signal.

The test then starts at Fstart and applies the calibrator amplitude (**Voutput**) and measures the RMS value of the channel (**Vmeasured**).

Notice

*Actual frequencies used during the tests are rounded to the step-size of the calibrator used and are slightly increased to overcome beat-frequency measurements. The results logged in the extra results file is the amplifier attenuation in dB; 20 * log **(Vmeasured/Voutput)**.*

8.7 Charge AC Gain Test

General information

Required equipment:

- LF generator

Acquisition settings:

- Maximum sample rate
- Channels set to Charge Mode
- Mode, Filter and Span settings as defined by the verification process

The charge amplifier measures charge in Coulombs. The 5700A generator does not make charge signals. A capacitor is used to convert the 5700A voltage into a charge:

Q = V * C

Capacitor C is built into the test fixture. Its value is 1 nF.
Example: A sine wave signal with an amplitude of 1 V will give charge on capacitor plates that is a sine wave with 1 nC amplitude. This charge is used as the test signal to test the charge amplifier.

Procedure:

An AC signal of 0.4* Span with a frequency of 250 Hz is attached to the positive input (with C in series). This amplitude in RMS is denoted as **Vin**.

4000 samples are acquired and the standard deviation is calculated and denoted as **Vmeas**.

ChargeError = **((Vmeas / Vin)** – 1) * 100%

8.8 CMRR (Common Mode Rejection Ratio) Test

General information

Required equipment:

- LF generator

Acquisition settings:

- 1 kS/s sample rate
- All channels are DC coupled
- Mode, Filter and Span settings as defined by the verification process

Tip

*The CMRR process uses a selected set of all Mode Filter and Span settings supported by the **D**evice **U**nder **T**est (DUT). The selection is based on the technical design of the DUT to ensure that all design combinations are tested.*

Procedure:

For isolated channels, the AC signal from the LF generator is between the channel input (signal and isolated ground) and system ground.
For non-isolated channels, the CMRR test can only be performed on differential amplifiers and then the AC signal is applied between the channel inputs (positive and negative) and channel/system ground.

The input signal frequency is set to 80 Hz.
The input signal voltage (peak) is set to 3 * Span unless the value is limited by the amplifier specification or the LF generator. In this case, the maximum allowed/available voltage is used.

2000 samples are acquired. The standard deviation of this data is then calculated and denoted as **Vmeas**.
The LF generator RMS output voltage is denoted as **Vin**.

The **CMRR** is calculated in dB as follows:

CMRR = $20\log_{10}$ (**Vmeas** / **Vin**)

8.9 Cold Junction Test

General information

Required equipment:

- GEN DAQ Universal multi channel fixture (1-GN-CAL9)

Acquisition settings:

- Mode, Filter and Span settings as defined by the verification process

Used to test cards that support TEDS class 2 devices. This test uses a known TEDS Class 2 sensor, 1-Wire Digital Thermometer sensor, to verify that the detection and content reading circuitry of the card is operational.

Procedure:

Test fixture is connected to all channels under test. Each channel has an individual TEDS class 2 device connected. TEDS sensor detection is activated and the sensor should be detected within 20 seconds (maximum timeout, typical behavior is faster) for the test to pass. When valid sensor is detected the temperature is readout and checked for valid reading.

The test is passed if all channels detect the temperature sensor (TEDS class 2) AND read temperature is as expected within 20 seconds.

A table with **PASS/FAIL** results for TEDS class 2 sensor detection, measured temperature [°C] and detection time is added to the report.

8.10 Current Transducer Voltage Test

General information

Required equipment:

- Multimeter

Acquisition settings:

- Mode, Filter and Span settings as defined by the verification process

Procedure:

CT Voltage with medium load, used for current transducer power supply, is measured with multimeter and documented in the verification report. With this test, also **CT Status** input is checked for functionality, pass or fail.

8.11 DC Gain (Voltage or Current) Test (HV probe DC)

The HV probe (DC) test is identical to the standard DC gain voltage test with the exception that it expects the HV probes to be attached to the input channels. During the test, the input voltages are higher to test the divider ratio of the HV probes.

General information

Required equipment:

- DC reference
- Multimeter (DVM)
  (Only required when the accuracy of the DC reference is not adequate)

Acquisition settings:

- Maximum sample rate
- All channels DC coupled
- Mode, Filter and Span settings as defined by the verification process

Tip

*The standard DC gain process uses a selected set of all Mode Filter and Span settings supported by the **D**evice **U**nder **T**est (DUT). The selection is based on the technical design of the DUT to ensure that all design combinations are tested..*

Procedure:

Six voltages are input one at a time, using the DC reference. These voltages are equally divided between -45% of Span and +45% of Span.

Each of the six voltages are stored and denoted as $\mathbf{Vin}_i$

For each applied voltage, an average value is calculated.

- For sample rates < 10 MS/s, 100 k samples are averaged.
- For sample rates ≥ 10 MS/s, 10 M samples are averaged.

Each averaged value is denoted as $\mathbf{Vmeas}_i$.

A “least squares regression” line is then calculated as follows:

DC Gain Test

$$\text{SumX} = \sum_{i=1}^{6} \text{Vin}_i \qquad \text{SumY} = \sum_{i=1}^{6} \text{Vmeas}_i$$

$$\text{SumX}^2 = \sum_{i=1}^{6} \text{Vin}_i^{\,2} \qquad \text{SumXY} = \sum_{i=1}^{6} \text{Vin}_i * \text{Vmeas}_i$$

$$\text{MeanX} = \text{Sum X} / 6$$

$$\text{MeanY} = \text{Sum Y} / 6$$

$$\text{Slope} = \frac{(6 * \text{SumXY}) - (\text{SumX} * \text{SumY})}{\left(6 * \text{SumX}^2\right) - (\text{SumX})^2}$$

$$\text{Intercept} = \text{MeanY} - (\text{Slope} * \text{MeanX})$$

$$\text{BestFit} = (\text{Slope} * \text{Vin}_i) + \text{Intercept}$$

- **Gain Err** = (Slope - 1) * 100%
- **Offset Err** = (Intercept / Span) * 100%
- **SINL** = Maximum(Absolute(Vmeas_i - BestFit_i)) / Span * 100%
- **MSE** = Maximum(Absolute(Vmeas_i - Vin_i)) / Span * 100%

8.11.1 The MIL (Military) standard test

This is also a DC gain test and is different from the basic test in several ways. It covers all voltage spans and all filters and it is not a selective test as the basic DC gain test is.

Because this test is fully comprehensive, it generally takes a lot longer to perform the (MIL) standard test than the basic DC gain test.

8.12 Power (AC)

General information

Required equipment:

- Power generator

Acquisition settings:

- Maximum sample rate
- All channels DC coupled
- Filter and Span settings as defined by the verification process

Procedure

The generator makes synchronized sine waves for voltage and current that will be measured by the Genesis system. Voltage and current, amplitudes 45% of Span, are in phase with power factor is 1 and signal frequency is 53 Hz. Power measurement is setup within the RTFDB formulas.

Results are calculated over 5 cycles and actual power, **P (Active)**, will be in the verification report and checked within tolerance. Some more results are calculated and shown during the test process:

- Q (Reactive) power
- S (Apparent) power
- Frequency
- PowerFactor

8.13 Power (DC)

General information

Required equipment:

- Power generator

Acquisition settings:

- Maximum sample rate
- All channels DC coupled
- Filter and Span settings as defined by the verification process

Procedure

The generator makes voltage and current that will be measured by the Genesis system. Voltage and current levels are +45 % of Span. Measurements are average values over 100 k samples (sample rate < 10 MS/s).

Power is calculated as the product; voltage times current. The value **Power** is checked for the specified tolerance.

8.14 Power vs. Frequency

General information

Required equipment:

- Power generator

Acquisition settings:

- Maximum sample rate
- All channels DC coupled
- Filter and Span settings as defined by the verification process

Procedure:

Power versus frequency is almost the same as the AC Power test but this test is done for more frequencies. Starting at 0 Hz (DC) up to 5 kHz signal frequency with power factor is 1, for sine wave signals. In this test, power at 0 Hz (DC) is also calculated with the RTFDB formulas and should have equal results as DC Power test. AC results are calculated over 5 cycles.

Actual power, **P (Active)**, for tested frequencies (including 0 Hz) will be in the verification report and checked within tolerance. Some more results are calculated and shown during the test process:

- Q (Reactive) power
- S (Apparent) power
- Frequency
- PowerFactor

Notice

For some cards, maximum signal frequency can be more than 5 kHz. To calculate power in the RT-FDB (Real-time Formula database), it is necessary to increase the number of cycles. The report will list the specific number of cycles used.

8.15 Power vs. Phase

General information

Required equipment:

- Power generator

Acquisition settings:

- Maximum sample rate
- All channels DC coupled
- Filter and Span settings as defined by the verification process

Procedure:

Power versus phase measures power (P, Q and S) for different phase settings between voltage and current sine waves at 53 Hz. Current can be leading the voltage, or it lags the voltage. This can also be expressed as capacitive (current leads voltage) or inductive (current lags voltage) loads.

Phase is given as power factor with “cap” for capacitive load or “ind” for inductive load.

For example:

PowerFactor = 1.0	:	no phase shift between current and voltage
PowerFactor = 0.5 cap	:	current is leading voltage with 60° → cos(60°) = 0.5

Actual power, **P (Active)**, for tested phases will be in the verification report and checked within tolerance. Some more results are calculated and shown during the test process:

- Q (Reactive) power
- S (Apparent) power
- Frequency
- PowerFactor

8.16 PowerFactor

General information

Required equipment:

- Power generator

Acquisition settings:

- Maximum sample rate
- All channels DC coupled
- Filter and Span settings as defined by the verification process

Procedure:

This test measures the power factor the generator outputs for 53 Hz sine wave signals. Generator is set for power factor from 1.0 to 0.0 (capacitive load), phase from 0° to 90° where current leads voltage signal. The **PowerFactor** value is a result of the RTFDB formulas and checked within tolerance. Some more results are calculated and shown during the test process:

- P (Active) power
- Q (Reactive) power
- S (Apparent) power
- Frequency

8.17 Excitation Voltage [V] and Excitation Current [A] Test

General information

Required equipment:

- Multimeter
- A fixture is required for easy connections to the bridge amplifier

Acquisition settings:

- Bridge amplifier supporting Voltage and Current Excitation.
- All channels set to bridge mode.
- Mode, Filter and Span settings as defined by the verification process

Procedure:

Excitation Voltage is set from 1 V to 15 V in eight steps: **Vset**$_i$.
The Excitation Voltage is measured by the Multimeter and denoted as **Vmeas**$_i$.

$$\text{SumX} = \sum_{i=1}^{8} \text{Vset}_i \qquad \text{SumY} = \sum_{i=1}^{8} \text{Vmeas}_i$$

$$\text{SumX}^2 = \sum_{i=1}^{8} \text{Vset}_i^{\,2} \qquad \text{SumXY} = \sum_{i=1}^{8} \text{Vset}_i * \text{Vmeas}_i$$

$$\text{MeanX} = \text{SumX} / 8$$

$$\text{MeanY} = \text{SumY} / 8$$

$$\text{Slope} = \frac{(8*\text{SumXY}) - (\text{SumX}*\text{SumY})}{(8*\text{SumX}^2) - (\text{SumX})^2}$$

$$\text{Intercept} = \text{MeanY} - (\text{Slope} * \text{MeanX})$$

$$\text{BestFit} = (\text{Slope} * \text{Vset}_i) + \text{Intercept}$$

Fig. 8.5 Excitation Voltage test

MS_Bridge_VExc = Maximum(Absolute(**Vmeas**$_i$ - **Vin**$_i$) / Span) * 100%

Excitation Current is set from 0.002 A to 0.040 A in eight steps: **Iset**$_i$.
The Excitation Current is measured by the Multimeter and denoted as **Imeas**$_i$.

$$\text{SumX} = \sum_{i=1}^{8} \text{Iset}_i \qquad \text{SumY} = \sum_{i=1}^{8} \text{Imeas}_i$$

$$\text{SumX}^2 = \sum_{i=1}^{8} \text{Iset}_i^{\,2} \qquad \text{SumXY} = \sum_{i=1}^{8} \text{Iset}_i * \text{Imeas}_i$$

$$\text{MeanX} = \text{SumX} / 8$$

$$\text{MeanY} = \text{SumY} / 8$$

$$\text{Slope} = \frac{(8*\text{SumXY}) - (\text{SumX}*\text{SumY})}{(8*\text{SumX}^2) - (\text{SumX})^2}$$

$$\text{Intercept} = \text{MeanY} - (\text{Slope} * \text{MeanX})$$

$$\text{BestFit} = (\text{Slope} * \text{Iset}_i) + \text{Intercept}$$

Fig. 8.6 Excitation Current test

MSE_Bridge_IExc = Maximum(Absolute(**Imeas**$_i$ - **Iset**$_i$) / Span) * 100%

8.18 IEPE AC Gain Test

General information

Required equipment:

- LF generator

Acquisition settings:

- Maximum sample rate
- All channels set to IEPE Mode
- Excitation Current 0 mA (off)
- Filter and Span settings as defined by the verification process

Procedure:

An AC signal of 0.4* Span Voltage peak / 1 kHz is attached to the positive input.
The RMS value of AC signal is denoted as **Vin**.

4000 samples are acquired and the standard deviation is calculated and denoted as **Vmeas**.

IEPE_GainError = **((Vmeas / Vin)** – 1) * 100%

8.19 IEPE Excitation Test

General information

Required equipment:

- DC reference
- Multimeter

Acquisition settings:

- Maximum sample rate
- IEPE Mode
- Input Span 10 V

Procedure:

IEPE compliance voltage is tested by measuring the voltage over a 2 kOhm resistor (DC reference load) with the maximum Excitation Current.
The voltage measured is stored as **Comp.IEPE**

For the IEPE current test, the current set by the amplifier is denoted as **Iin**$_i$.
The DC reference is set to 'Resistance mode'. R= 1000 Ohm. The Multimeter measures the voltage over the fixed internal resistance of the DC reference.
This value is divided by 1000 and denoted as **Imeas**$_i$.

$$\mathrm{SumX} = \sum_{i=1}^{15} \mathrm{Iin}_i \qquad \mathrm{SumY} = \sum_{i=1}^{15} \mathrm{Iimeas}_i$$

$$\mathrm{SumX}^2 = \sum_{i=1}^{15} \mathrm{Iin}_i^{\,2} \qquad \mathrm{SumXY} = \sum_{i=1}^{15} \mathrm{Iin}_i * \mathrm{Iimeas}_i$$

$$\mathrm{MeanX} = \mathrm{SumX} / 15$$

$$\mathrm{MeanY} = \mathrm{SumY} / 15$$

$$\mathrm{Slope} = \frac{(15*\mathrm{SumXY}) - (\mathrm{SumX}*\mathrm{SumY})}{(15*\mathrm{SumX})^2 - (\mathrm{SumX})^2}$$

$$\mathrm{Intercept} = \mathrm{MeanY} - (\mathrm{Slope} * \mathrm{MeanX})$$

$$\mathrm{BestFit} = (\mathrm{Slope} * \mathrm{Vin}_i) + \mathrm{Intercept}$$

Fig. 8.7 IEPE excitation test

MSE_IEPE_Exc = Maximum(Absolute(**Imeas**$_i$ - **Iin**$_i$) / Span) * 100%

8.20 Noise (Voltage or Current) Test

General information

Required equipment:

- 50 Ohm termination plug

Acquisition settings:

- Maximum sample rate
- All channels are terminated together with a single external 50 Ohm plug
- Mode, Filter and Span settings as defined by the verification process

Tip

*The noise test uses all Filter and Span settings for default Mode supported by the **D**evice **U**nder **T**est (DUT).*

Procedure:

For each test setting, 4000 samples are taken.
The standard deviation of this data is then calculated and denoted as $\mathbf{Vmeas}_{\mathbf{std}}$

$\mathbf{Noise}_{\mathbf{rms}} = \mathbf{Vmeas}_{\mathbf{std}}$ / Span * 100%

8.21 OutDAC Test

General information

Required equipment:

- Multimeter

Acquisition settings:

- The OutDAC test can be performed without the front end

Procedure:

The output is set to - **Testvoltage**.
The Multimeter measures the voltage denoted as **OutDACmin**.

The output is set to **+ Testvoltage**.
The Multimeter measures the voltage denoted as **OutDACmax**.

GainError = ((OutDACmax - OutDACmin) / (2 * **TestVoltage**) - 1) * 100%

OffsetError = ((OutDACmax + OutDACmin) / (**OutDACSpan**) * 100%

8.22 Quarter Bridge Resistor Test

General information

Required equipment:

- Multimeter
- GEN DAQ Universal single channel fixture (1-GN-CAL9)

Acquisition settings:

- All channels set to half-bridge mode

Procedure:

The GEN series bridge amplifier has one or two quarter bridge completion resistors installed as standard.

This test checks the value of these resistor(s). Therefor the single channel test fixture completes the internal half-bridge and quarter bridge resistors with a known sensor resistor. The voltage deviation is measured and so the quarter bridge resistor can be calculated Value(s) are denoted as **Quarter_1, Quarter_2** in test report.

The test is passed if all quarter bridge resistor(s) are within specifications.

8.23 Reference Signal Test

General information

Required equipment:

- 50 Ohm termination plug

Acquisition settings:

- All channels DC coupled
- Mode, Filter and Span settings as defined by the verification process

Procedure:

The 50 Ohm terminal is connected to the channel input. An internal reference test signal is directly coupled into the amplifier. This reference test signal is a square wave with its frequency and amplitude set as in the Hardware Library specification file.

The sample rate and number of samples are set up so that about five periods of the square wave are recorded. See Fig. 8.8.

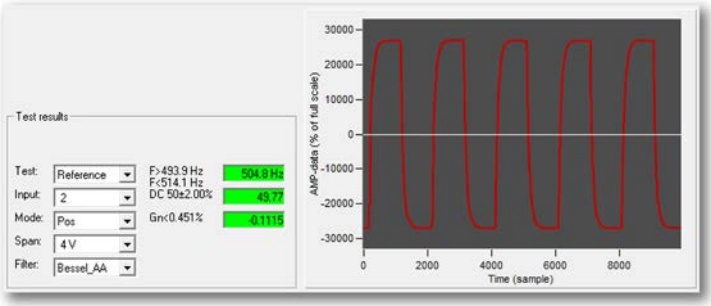


Fig. 8.8 Recorded reference test signal with calculated results

A sweep is taken. Zero crossings of the recorded reference test signal are used to calculate the test signal frequency and duty cycle. These results are saved as **Ref. Freq** and **Ref. DC** respectively.

The high and low voltage levels are used to calculate the reference test amplitude error. When the amplifier DC gain (see „8.11 DC Gain (Voltage or Current) Test (HV probe DC)“ on page 136) has been tested for the corresponding Span and filter settings, the result is compensated for DC gain and stored as Ref. Gain. Otherwise, the **Ref. Gain** result is a combination of the reference test signal amplitude error and DC gain amplifier error.

8.24 Shunt Resistor Test

General information

Required equipment:

- Multimeter or LF generator
- A fixture is required for easy connections to the bridge amplifier

Acquisition settings:

- All channels set to bridge mode

Procedure:

The GEN series bridge amplifier has one or two bridge completion resistors installed as standard and some amplifiers also have one open connection at the bridge completion card. This test checks the value of these resistor(s) and/or the open position.

Two ways to measure the shunt resistor(s):

1. Values are measured by the Multimeter.
2. Values are calculated with two known external resistors (LF generator) and supplied with channel excitation voltage.

Value(s) are denoted as **Shunt_1, Shunt_2**, … in test report.

8.25 TEDS Class 3 Data Test

General information

Required equipment:

- GEN DAQ Universal single channel fixture (1-GN-CAL9)

Acquisition settings:

- Mode, Filter and Span settings as defined by the verification process

Used to test cards that support TEDS Class 3 on bridge amplifiers. This test uses a fixed, known TEDS Class 3 sensor to verify that the detection and content reading circuitry of the card is operational.

Procedure:

Test fixture is connected to channel under test. Channel is set to bridge mode and TEDS class 3 sensor detection is activated. The sensor should be detected within 20 seconds (maximum timeout, typical behavior is faster) for the test to pass. When valid TEDS class 3 sensor is detected database readout starts and is compared with the known definitions of the fixture content. After the channel has been tested, its mode is set to differential basic again.

The test is passed if all channels detect the TEDS class 3 fixture AND read the expected data within 20 seconds.

A table with **PASS/FAIL** results for TEDS class 3 sensor detection and data verification is added to the report.

8.26 TEDS Data Test

General information

Required equipment:

- TEDS database BNC fixture (1-GN-CALTEDS)

Acquisition settings:

- All channels set to Basic mode
- Channel IEPE excitation active

Used to test cards that support TEDS on IEPE amplifiers. This test uses a fixed, known TEDS sensor to verify that the detection and content reading circuitry of the card is operational.

Procedure:

All channels are switched from basic into IEPE mode sequentially and the TEDS database BNC fixture should be detected within 15 seconds (maximum timeout, typical behavior is faster) for the test to pass. Once the TEDS database BNC fixture has been detected, database readout starts and is compared with the known definitions of the fixture content. After the channel has been tested, its mode is set to differential basic again.

The test is passed if all channels detect the TEDS fixture AND read the expected data within 15 seconds.

A table with **PASS/FAIL** results for TEDS sensor detection and data verification is added to the report.

8.27 Input Resistor Test

General information

Required equipment:

- Multimeter and LF generator

Acquisition settings:

- Maximum sample rate
- All channels are DC coupled
- Mode, Filter and Span settings as defined by the verification process

Procedure:

Some GEN series amplifiers have the possibility to terminate the measurement signal with a 50 Ohm input resistance. The resistance of this termination resistor is measured in this test.

Per channel the termination resistor is switched-in and a well known DC current (I) is generated and connected to the input. The voltage over the termination resistance, as result of the current, is measured by the multimeter (V_{multi}) and is also measured by the channel under test (V_{meas}).

- **Input Resistance = V_{multi} / I**
- **Measure Resistance = V_{meas} / I**

Both results are in the test report.

A Log Files and Reports

A.1 Introduction

During the calibration, verification and power verification process, several log files are produced in the default folder.

Below is a matrix of the log files that are produced. These log files can be imported into Microsoft Excel® to create graphical representations of the data contained inside them.

Calibration / Verification log files				
	Test specifications file	**Standard verification report rich text**	**Power verification report rich text**	**Extra report**
Standard verification	Yes	Yes	No	Yes, DC gain test measured values
Full bandwidth verification	Yes	Yes	No	Yes, DC gain test measured values + FULL bandwidth test values
MIL pre-calibration verification	Yes	Yes + pre-cal ver MIL	No	Extended version of full bandwidth
MIL post-calibration verification	Yes	Yes + post-cal ver MIL	No	Extended version of full bandwidth
Power verification	No	No	Yes	Yes, measured values

Acquisition cards (group 1)					
	1-GN1610 1-GN3210	1-GN1611 1-GN3211 1-GN610-2 1-GN611-2 1-GN610B 1-GN611B	1-GN815 1-GN816	1-GN840B 1-GN1640B	1-GN8101B 1-GN8102B 1-GN8103B
DC gain Voltage	✔	✔	✔	✔	✔
DC gain Current				✔	
Bandwidth	✔	✔	✔	✔	✔
Cold Junction				✔	
Excitation Voltage				✔	
Noise	✔	✔	✔	✔	✔
AC coupling	✔	✔	✔	✔	✔
CMRR	✔	✔	✔	✔	
IEPE Excitation	✔		✔	✔	
IEPE AC gain	✔		✔	✔	
Charge AC gain	✔			✔	
TEDS Class 3				✔	
TEDS data	✔		✔	✔	
Shunt resistors				✔	
Quarter resistors				✔	
Input resistance					✔

Acquisition cards (group 2)		
	1-GN310B 1-GN311B	
DC gain Voltage	✔	✔
DC gain Current	✔	✔
Bandwidth	✔	✔
Noise	✔	✔
CMRR	✔	✔
DC Power	✔	✔
IEPE AC gain	✔	✔
AC Power	✔	✔
Power vs. Freq.	✔	✔
Power vs. Phase	✔	✔
PowerFactor	✔	✔

Isolated Digitizers			
	1-GN110 1-GN111 1-GN112 1-GN113	1-GN114	1-GN1202B
DC gain Voltage	✔	✔	
Bandwidth	✔	✔	
Noise	✔	✔	
AC coupling	✔	✔	
CMRR	✔	✔	
Analog Output			
Reference Signal		✔	

Remote probes				
	1-P101I-4 1-P201I-4	1-P111I-4 1-P211I-4	1-P112I-4 1-P212I-4	1-GN800B
DC gain Voltage	✔	✔	✔	
DC gain Current		✔	✔	
AC gain Voltage	✔	✔	✔	
AC gain Current		✔	✔	
Bandwidth	✔	✔	✔	
Noise Voltage	✔	✔	✔	
Noise Current		✔	✔	
CMRR	✔	✔	✔	
CT Voltage			✔	

A.2 The verification log files

A.2.1 The standard verification log file ...

GEN series Calibration and Verification Software : V4.00

Pre Calibration Verification results (Mil Standard, Manufacturing Specifications)
Verification Date : Feb 25, 2020
SPEC-File version : 4.00.20134

A **Mainframe Interface Info**
Serialnumber : IHE1500101
Type : GEN7tA
SW version : 7.99.20055

B **Recorder Info**
Physical Name : Recorder A
Serialnumber : IPA2000124
Type : GEN series 2MS/s
SW version : 7.99.20055
No. channels : 6
Channel Type : PowIso Amplifier B Type

Card Test **PASSED**
Used Equipment for testing card:
DC reference : Fluke 5700A SN#: 7485603
LF generator : Fluke 5700A SN#: 7485603
HF generator : Unspecified (manual)
Generator (HV) : Fluke 5700A SN#: 7485603
Multimeter : HP3458A SN#: 2823A16099

Filter: Wideband
Input: 1

C

Span (V)	Offset (%)	DCGain (%)	SINL (%)	BWdth (kHz)	CMRR (dB)	Noise (%)
100.0	-0.001	-0.001	0.003	1247.3	-73.0	0.009
200.0	-0.002	-0.002	0.003	NA(1)	NA(1)	0.006
1000.0	-0.002	0.000	0.003	1277.5	NA(1)	0.002
2000.0	-0.001	-0.005	0.002	NA(1)	NA(1)	0.002
3000.0	-0.001	-0.001	0.002	NA(1)	NA(1)	0.002

(1) Note: If "NA" appears in the report results, it indicates that the corresponding test for that specific span and filter combination has not been conducted. Only a select subset of all span/filter combinations are assessed. With positive results, it can be inferred by design that the untested span/filter combinations will also meet the specifications listed in the datasheet.

Fig. A.1 Standard verification test result report (example / part 1)

A Mainframe information
B Card (Recorder) information
C Test results

The standard verification test result report includes the results for cards with the active AC gain test (voltage or current).

AC Gain Test

Filter: Wideband
Input: 1

Range: 200 V

Frequency	Input	Actual	Tolerance	Deviation	MU
19.98 Hz	127.28 Vrms	127.28 Vrms	0.041 %	0.000 %	0.10 Vrms
99.9 Hz	127.28 Vrms	127.28 Vrms	0.041 %	0.000 %	0.01 Vrms
499.5 Hz	127.28 Vrms	127.28 Vrms	0.041 %	- 0.001 %	0.01 Vrms
1.998 kHz	127.28 Vrms	127.25 Vrms	0.161 %	- 0.021 %	0.01 Vrms
9.99 kHz	127.28 Vrms	127.13 Vrms	0.441 %	- 0.119 %	0.01 Vrms
49.95 kHz	127.28 Vrms	127.35 Vrms	0.720 %	0.059 %	0.04 Vrms
199.8 kHz	108.70 Vrms	108.50 Vrms	0.964 %	- 0.184 %	0.33 Vrms
499.5 kHz	42.630 Vrms	41.905 Vrms	3.987 %	- 1.700 %	0.395 Vrms
999.0 kHz	18.547 Vrms	17.217 Vrms	9.043 %	- 7.173 %	0.075 Vrms

Fig. A.2 Standard verification test result report (example / part 2)

A.2.2 Uncertainty calculation for AC gain verification

Uncertainty for the AC gain verification depends on the accuracy of the generator.

Notice

Input voltage or current can deviate from perfect behaviour and thus introduce a fault in the AC gain measurement.

The generator used for AC gain verification is a Fluke Multi Product Calibrator. Depending on Fluke type, the specifications can change. Specifications are given for voltage and current, DC or AC.

Detailed specifications, 99 % Confidence Level, AC Voltage for Fluke 5730A					
Range	Resolution	Frequency (Hz)	Absolute Accuracy, tcal ±5 °C		Relative Accuracy, ±1 °C
			90 Days	1 Year	24 Hours
			±(ppm of output + µV)		
22 V	10 µV	10 – 20	270 + 50	**300 + 500**	250 + 500
		20 – 40	100 + 200	**110 + 200**	95 + 200
		40 – 20 k	46 + 70	**48 + 70**	30 + 70
		20 k – 50 k	77 + 120	**80 + 120**	70 + 120
		50 k – 100 k	97 + 250	**100 + 250**	100 + 250
		100 k – 300 k	290 + 800	**300 + 800**	270 + 800
		300 k - 500 k	1100 + 2500	**1200 + 2500**	900 + 2500
		500 k – 1 M	1600 + 4000	**1800 + 4000**	1300 + 4000
			±(ppm of output + mV)		
220 V	100 µV	10 – 20	270 + 5	**300 + 5**	250 + 5
		20 – 40	100 + 2	**110 + 2**	95 + 2
		40 – 20 k	60 + 0.7	**65 + 0.7**	45 + 0.7
		20 k – 50 k	95 + 1.2	**100 + 1.2**	75 + 1.2
		50 k – 100 k	170 + 3	**180 + 3**	140 + 3
		100 k – 300 k	1000 + 20	**1100 + 20**	600 + 20
		300 k - 500 k	5200 + 50	**5400 + 50**	4500 + 50
		500 k – 1 M	9000 + 100	**10000 + 100**	8000 + 100

With these numbers, from the specifications document for Fluke 5730A, it is possible to calculate the voltage input uncertainty. For AC gain verification, the **1 year absolute uncertainty** numbers are used. The probability is 99% that the generator output lies within the error band.

For example:

Output	:	108.70 Vrms @ 200 kHz
Generator range	:	22 to 220 V
Absolute uncertainty	:	±(1100 ppm of output + 20 mV
		±(1100 x 10^{-6} x 108.70 + 20.10^{-3})
		±(0.1396 Vrms)
		±0.1396/108.7 x 100%
		±0.128% (voltage uncertainty in respect to 108.7 Vrms output at 200 kHz)

The uncertainties of Fluke 5730A are absolute; probability has a rectangular distribution and thus the uncertainty calculation should be multiplied by 0.58x
Final error is then multiplied by the ***coverage factor k=2***, which, for a normal distribution, corresponds to a coverage probability of approximately 95%. The uncertainty in percentage is used to calculate the voltage uncertainty in Volt and that value is listed in the report as ***MU, measurement uncertainty***.

For example:

Voltage Uncertainty	:	Uv = 0.128%
Total Uncertainty	:	U = 2 x 0.58 x 0.128% U = 0.148%
Voltage	:	108.7 Vrms
MU	:	MU = 108.7 x 0.148 / 100 MU = 0.161 Vrms

AC Gain Test

Filter: Wideband
Input: 1

Range: 200 V

Frequency	Input	Actual	Tolerance	Deviation	MU
19.98 Hz	127.28 Vrms	127.28 Vrms	0.041 %	0.000 %	0.05 Vrms
99.9 Hz	127.28 Vrms	127.28 Vrms	0.041 %	0.000 %	0.01 Vrms
499.5 Hz	127.28 Vrms	127.28 Vrms	0.041 %	- 0.001 %	0.01 Vrms
1.998 kHz	127.28 Vrms	127.25 Vrms	0.161 %	- 0.021 %	0.01 Vrms
9.99 kHz	127.28 Vrms	127.13 Vrms	0.441 %	- 0.119 %	0.01 Vrms
49.95 kHz	127.28 Vrms	127.35 Vrms	0.720 %	0.059 %	0.02 Vrms
199.8 kHz	**108.70 Vrms**	**108.50 Vrms**	**0.964 %**	**- 0.184 %**	**0.16 Vrms(1)**
499.5 kHz	42.630 Vrms	41.905 Vrms	3.987 %	- 1.700 %	0.325 Vrms
999.0 kHz	18.547 Vrms	17.217 Vrms	9.043 %	- 7.173 %	0.048 Vrms

(1) Measurement uncertainty (MU) = 0.16 Vrms

Fig. A.3 AC gain test results (example)

A.2.3 The Power verification log file (Part1)

GEN series Calibration and Verification Software : V4.00

Power verification results (Manufacturing Specifications)
Verification Date : Feb 25, 2020
SPEC-File version : 4.00.20048

A **Mainframe Interface Info**
Serialnumber : IHE1500101
Type : GEN7tA
SW version : 7.99.20055

B **Recorder Info**
Physical Name : Recorder A
Serialnumber : IPA2000124
Type : GEN series 2MS/s
SW version : 7.99.20055
No. channels : 6
Channel Type : PowIso Amplifier B Type

Test Info
Sample rate : 2.0 MS/s
Cycle average : 5 cycles (for AC power measurements)
Filter : see details in result table(s)

Card Test **PASSED**

Used Equipment for testing card:

DC reference	: Fluke 5700A	SN#: 7485603
LF generator	: Fluke 5700A	SN#: 7485603
HF generator	: Unspecified (manual)	
Generator (HV)	: Fluke 5700A	SN#: 7485603
Multimeter	: HP3458A	SN#: 2823A16099
Power generator	: Fluke 5522A	SN#: 4544901

Uncertainty: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %. The standard uncertainty of measurement has been determined in accordance with EA publication EA-4/02.

AC Power

Filter: Bessel (IIR) @ 200 kHz
Phase 1: u1 & i1

C

Range	Frequency	Input	Power factor	Nominal power	Actual power	Tolerance	Deviation	MU
50 V / 0.075 A	53 Hz	31.82 V / 0.0477 A	1.00	1.5188 W	1.5190 W	0.07 %	0.02 %	0.0015 W
50 V / 0.15 A	53 Hz	31.82 V / 0.0955 A	1.00	3.0375 W	3.0380 W	0.07 %	0.02 %	0.0022 W
50 V / 0.3 A	53 Hz	31.82 V / 0.1909 A	1.00	6.0750 W	6.0757 W	0.07 %	0.01 %	0.0038 W
50 V / 0.6 A	53 Hz	31.82 V / 0.3818 A	1.00	12.150 W	12.151 W	0.07 %	0.01 %	0.011 W
50 V / 1.0 A	53 Hz	31.82 V / 0.6364 A	1.00	20.250 W	20.252 W	0.12 %	0.01 %	0.016 W
50 V / 1.2 A	53 Hz	31.82 V / 0.7637 A	1.00	24.300 W	24.301 W	0.07 %	0.00 %	0.018 W
50 V / 2.0 A	53 Hz	31.82 V / 1.2728 A	1.00	40.500 W	40.503 W	0.12 %	0.01 %	0.033 W

Fig. A.4 Power verification test result report (example part 1)

A Mainframe information
B Card (Recorder) information
C Test results

A.2.4 The Power verification log file (Part2)

Power vs. Freq.

Range	Frequency	Input	Power factor	Nominal power	Actual power	Tolerance	Deviation	MU
1000 V / 0.6 A	0 Hz	900.0 V / 0.54 A		486.00 W	485.89 W	0.04 %	-0.02 %	0.15 W
	53 Hz	636.4 V / 0.3818 A	1.00	243.00 W	243.02 W	0.07 %	0.01 %	0.23 W
	100 Hz	636.4 V / 0.3818 A	1.00	243.00 W	243.02 W	0.07 %	0.01 %	0.23 W
	500 Hz	636.4 V / 0.3818 A	1.00	243.00 W	242.99 W	0.08 %	-0.01 %	0.23 W
	1 kHz	636.4 V / 0.3818 A	1.00	243.00 W	242.93 W	0.10 %	-0.03 %	2.45 W
	5 kHz	636.4 V / 0.3818 A	1.00	243.00 W	242.92 W	0.26 %	-0.03 %	10.79 W
1500 V / 0.6 A	0 Hz	1020.0 V / 0.54 A		550.80 W	550.69 W	0.05 %	-0.02 %	0.18 W
	53 Hz	954.59 V / 0.3818 A	1.00	364.50 W	364.52 W	0.07 %	0.01 %	0.35 W
	100 Hz	954.59 V / 0.3818 A	1.00	364.50 W	364.50 W	0.07 %	0.00 %	0.35 W
	500 Hz	954.59 V / 0.3818 A	1.00	364.50 W	364.48 W	0.08 %	-0.01 %	0.35 W
	1 kHz	954.59 V / 0.3818 A	1.00	364.50 W	364.38 W	0.10 %	-0.03 %	3.67 W
	5 kHz	954.59 V / 0.3818 A	1.00	364.50 W	364.36 W	0.26 %	-0.04 %	16.19 W

Power vs. Phase

Range	Frequency	Input	Power factor	Nominal power	Actual power	Tolerance	Deviation	MU
1000 V / 0.6 A	53 Hz	636.4 V / 0.3818 A	1.00	243.00 W	243.02 W	0.07 %	0.01 %	0.23 W
		636.4 V / 0.3818 A	0.50 ind	121.50 W	121.51 W	0.12 %	0.00 %	0.44 W
		636.4 V / 0.3818 A	0.50 cap	121.50 W	121.57 W	0.12 %	0.06 %	0.44 W
		636.4 V / 0.3818 A	0.10 ind	24.30 W	24.29 W	1.00 %	-0.04 %	0.49 W
		636.4 V / 0.3818 A	0.10 cap	24.30 W	24.39 W	1.00 %	0.39 %	0.49 W
		636.4 V / 0.3818 A	0.05 ind	12.15 W	12.09 W	1.99 %	-0.49 %	0.49 W
		636.4 V / 0.3818 A	0.05 cap	12.15 W	12.22 W	1.99 %	0.58 %	0.49 W
		636.4 V / 0.3818 A	0.01 ind	2.43 W	2.40 W	9.89 %	-1.05 %	0.49 W
		636.4 V / 0.3818 A	0.01 cap	2.43 W	2.49 W	9.89 %	2.31 %	0.49 W
1500 V / 0.6 A	53 Hz	954.59 V / 0.3818 A	1.00	364.50 W	364.54 W	0.07 %	0.01 %	0.35 W
		954.59 V / 0.3818 A	0.50 ind	182.25 W	182.21 W	0.12 %	-0.02 %	0.66 W
		954.59 V / 0.3818 A	0.50 cap	182.25 W	182.37 W	0.12 %	0.07 %	0.66 W
		954.59 V / 0.3818 A	0.10 ind	36.45 W	36.48 W	1.00 %	0.08 %	0.74 W
		954.59 V / 0.3818 A	0.10 cap	36.45 W	36.64 W	1.00 %	0.52 %	0.74 W
		954.59 V / 0.3818 A	0.05 ind	18.23 W	18.18 W	1.99 %	-0.22 %	0.74 W
		954.59 V / 0.3818 A	0.05 cap	18.23 W	18.38 W	1.99 %	0.86 %	0.74 W
		954.59 V / 0.3818 A	0.01 ind	3.65 W	3.62 W	9.89 %	-0.74 %	0.74 W
		954.59 V / 0.3818 A	0.01 cap	3.65 W	3.75 W	9.89 %	2.79 %	0.74 W

PowerFactor

Range	Frequency	Input	Power factor	Act. cosPhi	Tolerance	Deviation	MU
100 V / 0.6 A	53 Hz	63.64 V / 0.3818 A	1.00	1.0000	0.0100	0.0000	0.0000
			0.80	0.8002	0.0100	0.0002	0.0012
			0.60	0.6003	0.0100	0.0003	0.0016
			0.50	0.5003	0.0100	0.0003	0.0018
			0.40	0.4004	0.0100	0.0004	0.0019
			0.20	0.2004	0.0100	0.0004	0.0020
			0.10	0.1006	0.0100	0.0006	0.0020
			0.00	0.0004	0.0100	0.0004	0.0020

Fig. A.5 Power verification test result report (example part 2)

A.2.5 Uncertainty calculation for power verification

Uncertainty for the power verification depends on the accuracy of the generator. Both the voltage and current can deviate from perfect behavior and thus introduce a fault in the power measurement.

Notice

Beside voltage and current, the phase difference between the current and voltage also introduces an error for the AC power measurements. This error should also be considered for the uncertainty calculation.

The power generator used for power verification is the Fluke 5522A Multi-Product Calibrator. Specifications are given for voltage and current, DC or AC, and the uncertainty for phase is given.

Detailed specifications DC Voltage for Fluke 5522A					
Range	**Absolute Uncertainty, tcal ± 5 °C ±(ppm of output +µV)**		**Stability**	**Resolution µV**	**Max. Burden(1)**
	90 days	**1 year**	**24 hours, ± 1 °C ±(ppm of output +µV)**		
0 to 329.9999 mV	15 + 1	**20 + 1**	3 + 1	0.1	65 Ω
0 to 3.299999 V	9 + 2	**11 + 2**	2 + 1.5	1	10 mA
0 to 32.99999 V	10 + 20	**12 + 20**	2 + 15	10	10 mA
30 to 329.9999 V	15 +150	**18 + 150**	2.5 + 100	100	5 mA
100 to 1020.000 V	15 + 1500	**18 + 1500**	3 + 300	10001	5 mA

(1) Remote sensing is not provided. Output resistance is < 5 mΩ for outputs ≥ 0.33 V. The AUX output has an output resistance of < 1 Ω. TC simulation has an output impedance of 10 Ω ±1 Ω.

With these numbers, from the specifications document for Fluke 5522A, it is possible to calculate the two (voltage/current for DC) or three (voltage/current/ phase for AC) independent input uncertainties. For power verification, the **1- year absolute uncertainty** numbers are used. The probability is 99% that the generator output lies within the error band.

For example

Output	:	2 VDC
Generator range	->	0 to 3.299999 V
Absolute uncertainty	->	±(11 ppm of output + 2 µV) $\pm(11 \times 10^{-6} \times 2 + 2.10^{-6})$ ±(24 µV) $\pm 24.10^{-6}/2 \times 100\%$ ±0.0012% (voltage uncertainty in respect to 2 VDC output)

The uncertainties of Fluke 5522A are absolute; probability has a rectangular distribution and thus the uncertainty calculation should be multiplied by 0.58x

Contributions to uncertainties are independent and the individual errors can therefore be added together by the root sum square (rss) method. The final sum is then multiplied by the ***coverage factor k=2***, which, for a normal distribution, corresponds to a coverage probability of approximately 95%. The uncertainty in percentage is used to calculate the active (P) power uncertainty in Watt and that value is listed in the report as MU, ***measurement uncertainty***.

For example

Test	:	Power vs. Phase
Power Range	:	±1800 W (1500 V and 1.2 A)
Frequency	:	53 Hz
PowerFactor	:	0.10 cap (current leads voltage)
Output	:	954.59 V RMS and 0.7637 A RMS
Voltage Uncertainty	:	$U_V = 0.0310\%$
Current Uncertainty	:	$U_C = 0.1000\%$
Phase Uncertainty	:	$U_{PF} = 1.7365\%$
Total Uncertainty	:	$U = 2 \times \sqrt{[(0.58 \times UV)^2 + (0.58 \times UC)^2 + (0.58 \times UPF)^2]}$ U = 1.0090%
Active power (P)	:	P = 954.59 x 0.7637 x 0.1 P = 72.90 W
MU	:	MU = 72.90 x 1.0090 / 100 MU = 1.47 W

Power vs. Phase

Filter: Bessel (IIR) @ 200 kHz
Phase 2: u2 & i2

Range	Frequency	Input	Power factor	Nominal power	Actual power	Tolerance	Deviation	MU
1500 V / 1.2 A	53 Hz	954.59 V / 0.7637 A	1.00	729.00 W	729.04 W	0.07 %	0.01 %	0.59 W
		954.59 V / 0.7637 A	0.50 ind	364.50 W	364.58 W	0.12 %	0.02 %	1.31 W
		954.59 V / 0.7637 A	0. 50 cap	364.50 W	364.56 W	0.12 %	0.02 %	1.31 W
		954.59 V / 0.7637 A	0.10 ind	72.90 W	73.02 W	0.51 %	0.16 %	1.47 W
		954.59 V / 0.7637 A	**0.10 cap**	**72.90 W**	**72.99 W**	**0.51 %**	**0.13 %**	**1.47 W**(1)
		954.59 V / 0.7637 A	0.05 ind	36.45 W	36.50 W	1.00 %	0.13 %	1.47 W
		954.59 V / 0.7637 A	0.05 cap	36.45 W	36.48 W	1.00 %	0.07 %	1.47 W
		954.59 V / 0.7637 A	0.01 ind	7.29 W	7.44 W	4.96 %	2.00 %	1.48 W
		954.59 V / 0.7637 A	0.01 cap	7.29 W	7.34 W	4.96 %	0.70 %	1.48 W

(1) Measurement uncertainty (MU) = 1.47 W

Fig. A.6 Power vs. Phase test result report (example)

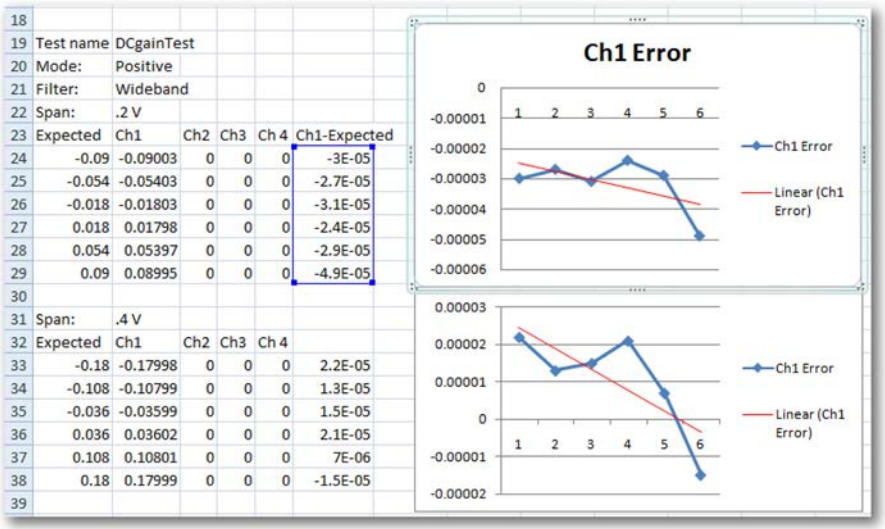
A.3 Producing graphical results - DC gain

The extra log file can be imported into Microsoft Excel® to make a visual plot of the graphical data.

Notice

Be sure to select: Original data type = Delimited ► Delimiter = Semi-colon, to be able to import the data correctly.

Fig. A.7 is an example of the expected graphical output of the DC gain section of a log file-("Test name: DC gain test" Fig. A.7).



18						
19	Test name	DCgainTest				
20	Mode:	Positive				
21	Filter:	Wideband				
22	Span:	.2 V				
23	Expected	Ch1	Ch2	Ch3	Ch 4	Ch1-Expected
24	-0.09	-0.09003	0	0	0	-3E-05
25	-0.054	-0.05403	0	0	0	-2.7E-05
26	-0.018	-0.01803	0	0	0	-3.1E-05
27	0.018	0.01798	0	0	0	-2.4E-05
28	0.054	0.05397	0	0	0	-2.9E-05
29	0.09	0.08995	0	0	0	-4.9E-05
30						
31	Span:	.4 V				
32	Expected	Ch1	Ch2	Ch3	Ch 4	
33	-0.18	-0.17998	0	0	0	2.2E-05
34	-0.108	-0.10799	0	0	0	1.3E-05
35	-0.036	-0.03599	0	0	0	1.5E-05
36	0.036	0.03602	0	0	0	2.1E-05
37	0.108	0.10801	0	0	0	7E-06
38	0.18	0.17999	0	0	0	-1.5E-05
39						

Fig. A.7 Example of a graphical output (DC gain Test)

One extra column (highlighted in blue) has been created to show the difference between the two columns for the expected results and actual results. Doing this will show you the error in the results to which you can add a trendline (shown in red).

A.3.1 Producing graphical results - Full Bandwidth

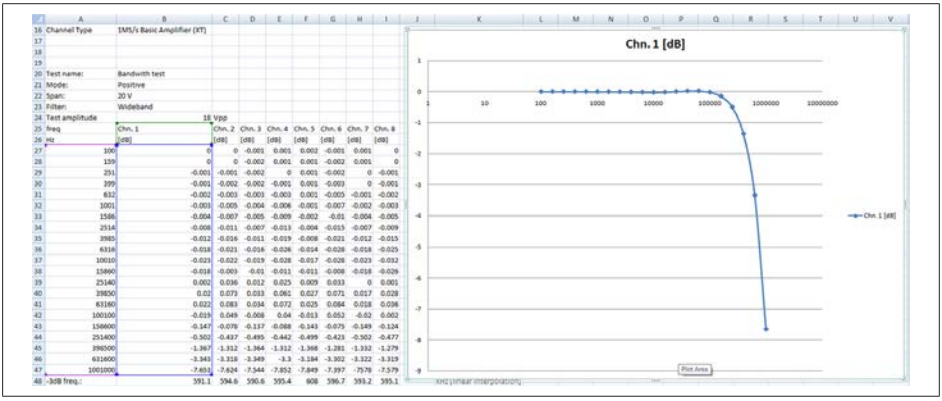
When the Full **(extra)** test is selected, an **extra** log with the Full bandwidth results file will be in the log save folder.

This file can be imported into Microsoft Excel® to make a visual plot of the graphical data.

Notice

Be sure to select: Original data type = Delimited ► Delimiter = Semi-colon, to be able to import the data correctly.

Fig. A.8 is an example of the expected graphical output for a Full bandwidth.



	A	B	C	D	E	F	G	H	I
16	Channel Type	1MS/s Basic Amplifier (XT)							
17									
18									
19									
20	Test name:	Bandwith test							
21	Mode:	Positive							
22	Span:	20 V							
23	Filter:	Wideband							
24	Test amplitude	18 Vpp							
25	freq	Chn. 1	Chn. 2	Chn. 3	Chn. 4	Chn. 5	Chn. 6	Chn. 7	Chn. 8
26	Hz	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]	[dB]
27	100	0	0	-0.001	0.001	0.002	-0.001	0.001	0
28	159	0	0	-0.002	0.001	0.001	-0.002	0.001	0
29	251	-0.001	-0.001	-0.002	0	0.001	-0.002	0	-0.001
30	399	-0.001	-0.002	-0.002	-0.001	0.001	-0.003	0	-0.001
31	632	-0.002	-0.003	-0.003	-0.003	0.001	-0.005	-0.001	-0.002
32	1001	-0.003	-0.005	-0.004	-0.006	-0.001	-0.007	-0.002	-0.003
33	1586	-0.004	-0.007	-0.005	-0.009	-0.002	-0.01	-0.004	-0.005
34	2514	-0.008	-0.011	-0.007	-0.013	-0.004	-0.015	-0.007	-0.009
35	3985	-0.012	-0.016	-0.011	-0.019	-0.008	-0.021	-0.012	-0.015
36	6316	-0.018	-0.021	-0.016	-0.026	-0.014	-0.028	-0.018	-0.025
37	10010	-0.023	-0.022	-0.019	-0.028	-0.017	-0.028	-0.023	-0.032
38	15860	-0.018	-0.003	-0.01	-0.011	-0.011	-0.008	-0.018	-0.026
39	25140	0.002	0.036	0.012	0.025	0.009	0.033	0	0.001
40	39850	0.02	0.073	0.033	0.061	0.027	0.071	0.017	0.028
41	63160	0.022	0.083	0.034	0.072	0.025	0.084	0.018	0.036
42	100100	-0.019	0.049	-0.008	0.04	-0.013	0.053	-0.02	-0.002
43	158600	-0.147	-0.078	-0.137	-0.088	-0.143	-0.075	-0.149	-0.124
44	251400	-0.502	-0.437	-0.495	-0.442	-0.499	-0.423	-0.502	-0.477
45	398500	-1.367	-1.312	-1.364	-1.312	-1.368	-1.281	-1.332	-1.279
46	631600	-3.343	-3.318	-3.349	-3.3	-3.184	-3.302	-3.322	-3.319
47	1001000	-7.651	-7.624	-7.544	-7.852	-7.849	-7.397	-7.578	-7.579
48	-3dB freq.:	591.1	594.6	590.6	559.4	608	596.7	593.2	595.1

Fig. A.8 Example of graphical output (Full Bandwidth Test)

B Test Fixtures and Cables

B.1 Fixture requirements

Input Card Fixture Requirement Overview								
Extensive use of the fixtures impacts the reliability of the results. Yearly preventive inspection and/or testing of the fixtures improves reliability.								
Acquistion cards and options		**1-GN-CAL1**	**1-GN-CAL-CABLES**	**1-GN-CAL2A**	**P1-GN-CAL7**	**1-GN-CAL9**	**1-GN-CAL-3PWR**	**1-GN-CAL-TEDS**
1-G045	Impulse attenuator	✓	✓					
1-GN110	HV6600 100M	✓	✓					
1-GN111	HV6600 25M	✓	✓					
1-GN112	MV6600 100M	✓	✓					
1-GN113	MV6600 25M	✓	✓					
1-GN310B	Power 2M ISO	✓	✓				✓	
1-GN311B	Power 200k ISO	✓	✓				✓	
1-GN610B	ISO 1kV 2M	✓	✓	✓				
1-GN611B	ISO 1kV 200k	✓	✓	✓				
1-GN815	Basic/IEPE 2M ISO	✓	✓	✓				✓
1-GN816	Basic/IEPE 200k ISO	✓	✓	✓				✓
1-GN840B	Uni ISO 500k-8					✓		✓
1-GN1202B	Receiver 100M	✓	✓					
1-GN1640B	Uni ISO 500k-16	✓	✓			✓		✓
1-GN3210	HiRes 250k-32	✓	✓		✓			✓
1-GN3211	Basic 20k-32	✓	✓		✓			
1-GN8101B	Basic 250M	✓	✓	✓				
1-GN8102B	Basic 100M	✓	✓	✓				
1-GN8103B	Basic 25M	✓	✓	✓				

Remote Probes Fixture Requirement				
Extensive use of the fixtures impacts the reliability of the results. Yearly preventive inspection and/or testing of the fixtures improves reliability.				
Remote probes		**1-GN-CAL1**	**1-GN-CAL-CABLES**	**1-GN-CAL-4PWR**
1-P101I-4	Voltage RP 2M	✓	✓	✓
1-P201I-4	Voltage RP 20M	✓	✓	✓
1-P111I-4	Current RP 2M	✓	✓	✓
1-P211I-4	Current RP 20M	✓	✓	✓
1-P112I-4	Current RP+ 2M	✓	✓	✓
1-P212I-4	Current RP+ 20M	✓	✓	✓

⚠ CAUTION

General limitations for all Calibration fixtures:

- Operating temperature range: 5 °C to 40 °C
- Operating relative humidity: 0% to 80%; non-condensing
- Operating altitude: maximum 2000 m above sea level
- Operating environment: indoor, pollution degree.

⚠ WARNING

General limitations for all Calibration fixtures:

- Only connect to equipment with OVC II or less

⚠ CAUTION

Inspect your calibration cables, connectors and adapters regularly for wear or damage and replace them if required.
Regular preventive replacement is strongly advisable since the cost involved in an investigating usually is way higher then the cost of replacement. For example, in an intensive usage scenario a half yearly replacement could be advisable.

B.2 1-GN-CAL1 calibration and verification software

The 1-GN-CAL1 is the basic software and tools required to get started.

1-GN-CAL1 GEN DAQ calibration kit		
Part number	**Quantity**	**Description**
426-033600	1	Software CD incl. manual (V1.10)
869-911800	1	NI converter USB-IEEE
869-923300	1	Tool ceramic adjuster

B.3 1-GN-CAL-CABLES

The 1-GN-CAL-CABLES is the basic cable set and contains the support tools required to work with any of the Genesis High Speed systems. As such, it is required for any calibration kit.

1-GN-CAL-CABLES GHS calibration cable set		
Part number	**Quantity**	**Description**
024-924600	3	Safety adapter BNC-4 mm banana
024-927200	3	Safety adapter BNC-4 mm banana modified
085-997900	2	CBL/BNC safety
024-924700	1	Insulated short connector
085-998100	1	Banana cable 1.50 m red ISO
085-009000	1	Banana cable 1.50 m red ISO modified
085-998300	1	Banana cable 1.50 m black ISO
085-009100	1	Banana cable 1.50 m black ISO modified
085-998200	1	Banana cable 1.50 m blue non-ISO
024-924800	2	Safety adapter BNC-4 mm banana
869-901700	1	50 Ohm term BNC plugsocket
085-998700	1	Short circuit plug
085-999100	1	6600 HV ID AC CAL PWR cable
085-998600	1	BNC t-adapter (Female-Male-Female)
085-977100	1	USB cable A-B 1.8 m (6 ft)

⚠ CAUTION

Inspect your calibration cables, connectors and adapters regularly for wear or damage and replace them if required.
Regular preventive replacement is strongly advisable since the cost involved in an investigating usually is way higher then the cost of replacement. For example, in an intensive usage scenario a half yearly replacement could be advisable.

B.4 1-GN-CAL2A GEN DAQ Basic/Fast Diff/Uni/HV fixture

The 1-GN-CAL2A is a dedicated fixture for most cards that use BNC or 4 mm banana connectors. For information on how to order the fixture as a part of your calibration kits, please refer to appendix „Fixture requirements“ on page 170.

1-GN-CAL2A GEN DAQ Basic/Fast Diff/Uni/HV fixture		
Part number	**Quantity**	**Description**
LD-395-1000163	1	GEN DAQ Basic/Fast Diff/Uni/HV fixture)
LD-024-924600	6	Isolated 4 mm banana to BNC adapter
LD-024-1000345	1	ISO BNC coupler
2-9289.5550	1	HV Cap fixture

Fig. B.1 LD-395-1000163 fixture assembly

Fig. B.2 LD-024-924600 Isolated 4 mm banana pin to BNC adapter

Fig. B.3 LD-024-1000345 ISO BNC coupler

Fig. B.4 2-9289.5550 HV Cap fixture

B TEST FIXTURES AND CABLES

⚠ WARNING

Limitations for HV Cap fixture:

- Voltage rating: ≤ 1000 V DC
- Supply must be free of overvoltages and spikes

⚠ WARNING

This device must be connected in accordance with the instructions from the HBM GEN series calibration software and may not be used in any other configuration or for any other purpose than the calibration of HBM equipment.

B.5 1-GN-CAL3 GEN DAQ 1kV DC/AC probe cables

The 1-GN-CAL3 is a set of cables used for the high voltage DC/AC probes that use 4 mm banana connectors. All cables use safety banana connectors to meet all safety requirements during 1 kV tests.

For information on when to order the probe cables as a part of your calibration kits, please refer to appendix „B.1 Fixture requirements“ on page 170.

1-GN-CAL3 GEN DAQ 1kV DC/AC probe cables		
Part number	**Quantity**	**Description**
LD-085-998100	8	Banana cable 1.5 m red isolated
LD-085-998300	8	Banana cable 1.5 m black isolated

Fig. B.5 Banana cable

WARNING

This high voltage device should be connected in accordance with the instructions from the HBM calibration software and never in any other configuration or used for any other purpose than the calibration of HBM equipment.

B.6 1-GN-CAL5 GEN DAQ bridge 16 pin LEMO fixture

The 1-GN-CAL5 is a dedicated fixture for bridge cards that use a 16 pin LEMO connector.

For information on when to order the fixture as a part of your calibration kits, please refer to appendix „B.1 Fixture requirements“ on page 170.

1-GN-CAL5 GEN DAQ bridge 16 pin LEMO fixture		
Part number	**Quantity**	**Description**
LD-395-912301	1	GEN DAQ bridge 16 pin LEMO fixture
LD-395-913900	1	GEN DAQ bridge 16 pin LEMO sensor fixture

Fixture bridge 4 channel

Fig. B.6 LD-395-912301 fixture bridge 4 channel

Fixture bridge shunt

Fig. B.7 LD-395-913900 Fixture bridge shunt

B.7 1-GN-CAL6 GEN DAQ 16 channel HDSUB50 fixture

The 1-GN-CAL6 is a dedicated fixture for high channel count cards that use a single 50 pin HDSUB50 connector. It should not be used for cards that use two HDSUB50 connectors.

For information on when to order the fixture as a part of your calibration kits, please refer to appendix „B.1 Fixture requirements“ on page 170.

1-GN-CAL6 GEN DAQ 16 channel HDSUB50 fixture		
Part number	**Quantity**	**Description**
LD-395-920600	1	GEN DAQ 16 channel HDSUB50 fixture

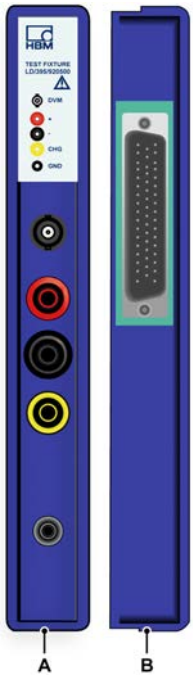


Fig. B.8 D-395-920600 16 channel card fixture assembly

A (16 channel card front)
B (16 channel card back)

B.8 1-GN-CAL7 GEN DAQ 32 channel HDSUB50 fixture

The 1-GN-CAL7 is a dedicated fixture for high channel count cards that use two 50 pin HDSUB50 connectors. It should not be used for cards that use a single HDSUB50 connector, as the fixture will not have enough friction to stay in place.

For information on when to order the fixture as a part of your calibration kits, please refer to appendix „B.1 Fixture requirements“ on page 170.

1-GN-CAL7 GEN DAQ 32 channel HDSUB50 fixture		
Part number	**Quantity**	**Description**
LD-395-920500	1	GEN DAQ 32 channel HDSUB50 fixture

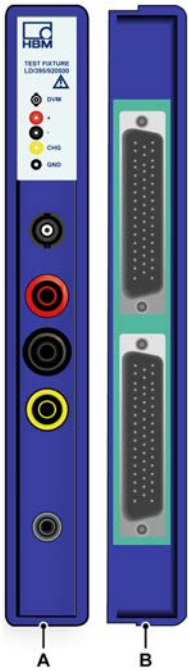


Fig. B.9 LD-920500 32 channel card fixture assembly

A (32 channel card front)
B (32 channel card back)

B.9 1-GN-CAL-3PWR GEN DAQ Power fixture

The 1-GN-CAL-3PWR is a dedicated fixture for the GN31x power analyzer cards. For information on when to order the fixture as a part of your calibration kits, please refer to „B.1 Fixture requirements“ on page 170.

1-GN-CAL-GN31XB PowerCard Calibration fixture		
Part number	**Quantity**	**Description**
2-9289.5551	1	GEN DAQ Power fixture
LD-024–924600	4	Isolated 4 mm banana to BNC adapter

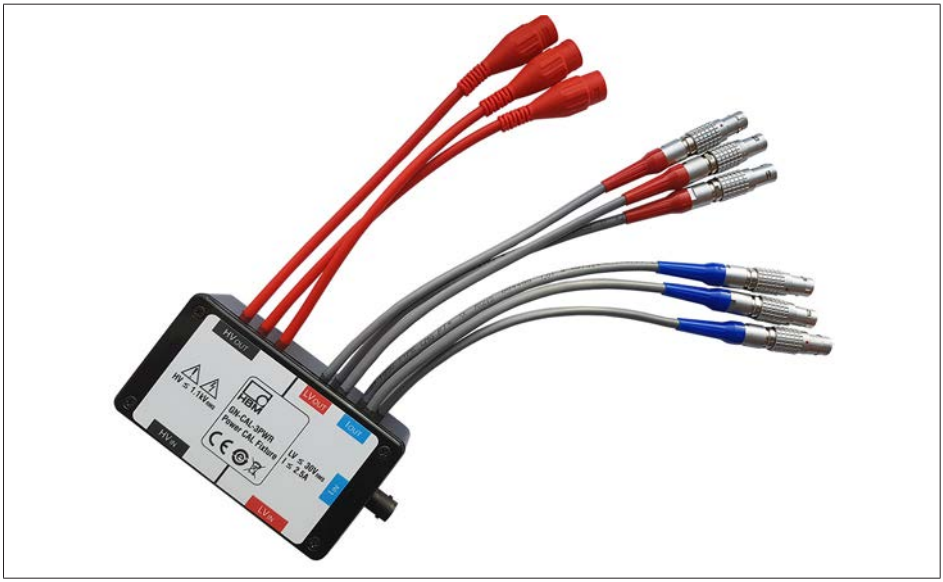


Fig. B.10 2-9289.5551 3 channel Power card fixture assembly

Fig. B.11 LD-024-924600 Isolated 4 mm banana pin to BNC adapter

B TEST FIXTURES AND CABLES

⚠ WARNING

Limitations for GN31xB PowerCard Calibration fixture:

- High voltage channels: ≤ 1100 V RM
- Low voltage channels: ≤ 30 V RMS
- Current channels: ≤ 2.5 A

⚠ WARNING

This high voltage device should be connected in accordance with the instructions from the HBM calibration software and never in any other configuration or used for any other purpose than the calibration of HBM equipment.

B.10 1-GN-CAL9 GEN DAQ universal fixture

The 1-GN-CAL9 is a dedicated fixture for universal cards that use ODU GK2L0C connector. For information on when to order the fixture as a part of your calibration kits, please refer to chapter „B.1 Fixture requirements“ on page 170.

1-GN-CAL9 GEN DAQ universal fixture		
Part number	**Quantity**	**Description**
LD-395-1002090	1	GEN DAQ Universal multi channel fixture
LD-395-1002091	1	GEN DAQ Universal single channel fixture

Fig. B.12 LD-395-1002090 (left) and LD-395-1002091 (right) universal fixtures

B.11 1-GN-CAL-TEDS GEN DAQ TEDS database BNC fixture

The 1-GN-CAL-TEDS is a dedicated fixture for cards that support TEDS (**T**ransducer **E**lectronic **D**ata **S**heet) readouts.

For information on when to order the fixture as a part of your calibration kits, please refer to appendix „B.1 Fixture requirements“ on page 170.

1-GN-CAL-TEDS GEN DAQ TEDS database BNC fixture		
Part number	**Quantity**	**Description**
LD-395-920700	1	GEN DAQ TEDS database BNC fixture

Fig. B.13 LD-395-920700 TEDS sensor data plug

B.12 1-GN-CAL-4PWR GEN DAQ 4 channel POWER fixture

The 1-GN-CAL-4PWR are dedicated fixtures for Remote Probe, Voltage and Current, power analyzer. For information on when to order the fixture(s) as a part of your calibration kits, please refer to „Remote Probes Fixture Requirement“ on page 171.

1-GN-CAL-4PWR GEN DAQ 4 channel POWER fixture		
Part number	**Quantity**	**Description**
2-9289.5625	1	Probe Cal Fixture A
2-9289.5626	1	Probe Cal Fixture B
LD-024-924600	4	Isolated 4 mm banana to BNC adapter

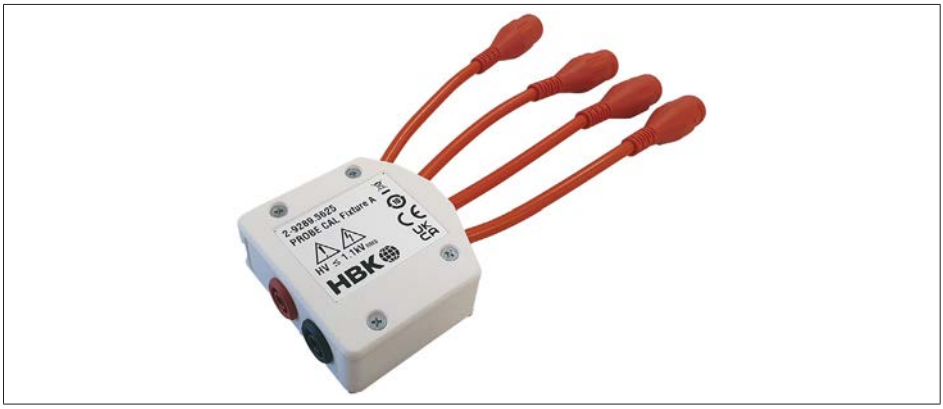


Fig. B.14 2-9289.5625 4 channel Probe Cal Fixture A assembly

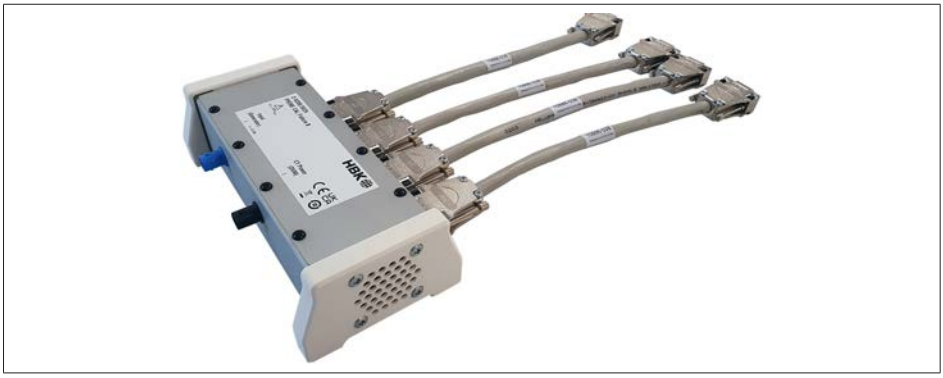


Fig. B.15 2-9289.5626 4 channel Probe Cal Fixture B assembly

Fig. B.16 LD-024-924600 Isolated 4 mm banana pin to BNC adapter

WARNING

Limitations for Remote Probe Calibration fixtures:

- High voltage channels: ≤ 1100 V RMS
- Current channels: ≤ 2.5 A
- Impact energy level: IK06 (<1 J)

WARNING

This high voltage device should be connected in accordance with the instructions from the HBM calibration software and never in any other configuration or used for any other purpose than the calibration of HBM equipment.

DANGER

Input and output of the fixtures do not have any means of galvanic insulation. Voltage at the input is also available at the output. So, it is dangerous to touch open connectors, e.g. BNC connector with middle pin that can be touched, during test.

C Locations for AC Calibration Adjustments

C.1 1-GN810-2 Basic 200k, 1-GN811-2 Basic 1M, 1-GN812-2 Basic 1M ISO, 1-GN813-2 Basix XT 1M ISO and 1-GN814-2 Basic XT 200k ISO

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

- The adjustments for the even-numbered channels are located on the right-hand side of the card.
- The adjustments for the odd-numbered channels are located on the left-hand side of the card.

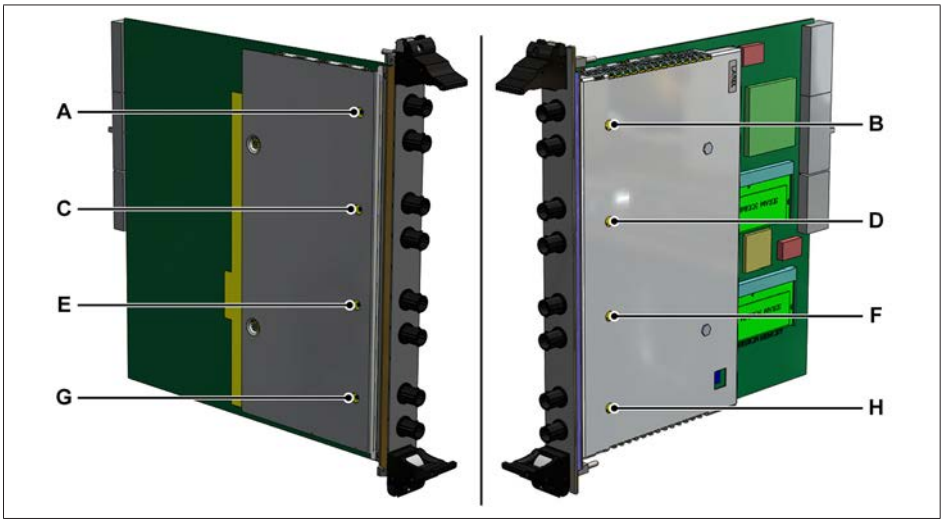


Fig. C.1 1-GN810-2, 1-GN811-2, 1-GN812-2, 1-GN813-2 and 1-GN814-2 adjustment points

A T1500 adjustment point for Channel 1
B T2500 adjustment point for Channel 2
C T3500 adjustment point for Channel 3
D T4500 adjustment point for Channel 4
E T5500 adjustment point for Channel 5
F T6500 adjustment point for Channel 6
G T7500 adjustment point for Channel 7
H T8500 adjustment point for Channel 8

C.2 1-GN440-2 Uni 200k ISO and 1-GN441-2 Uni 1M ISO

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

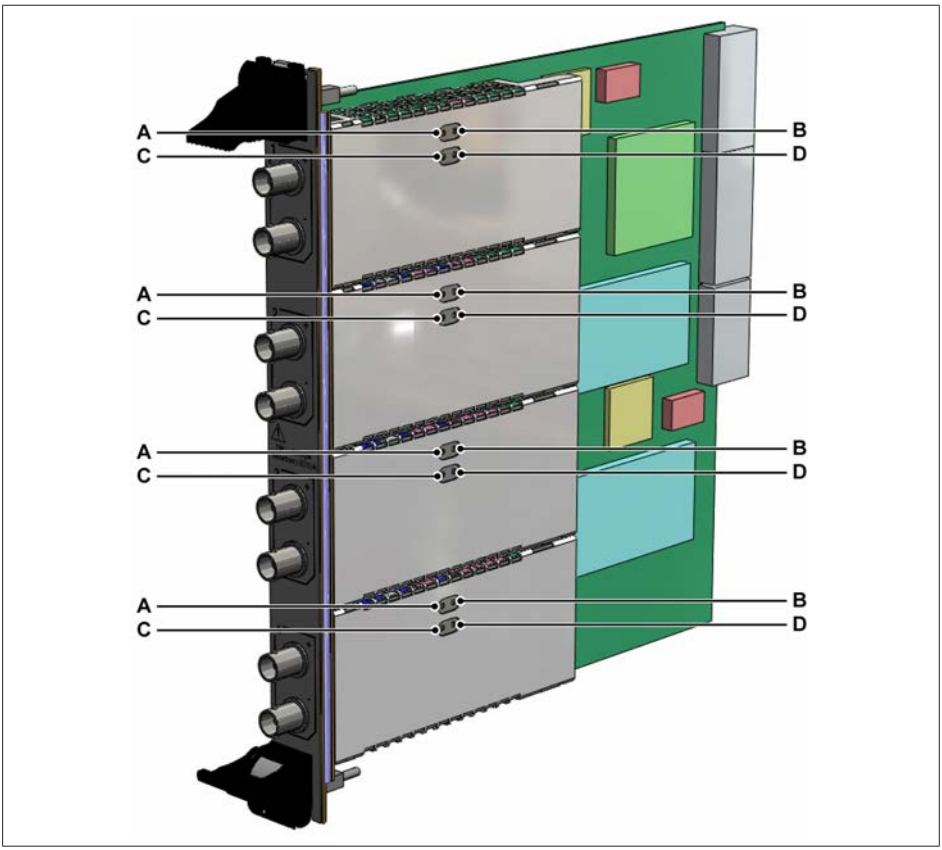


Fig. C.2 1-GN440-2 and 1-GN441-2 adjustment points

A T110 adjustment point for POS/10
B T120 adjustment point for POS/100
C T111 adjustment point for NEG/1
D T121 adjustment point for NEG/100

C.3 1-GN412-2 HiSpeed 100M and 1-GN413-2 HiSpeed 25M

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

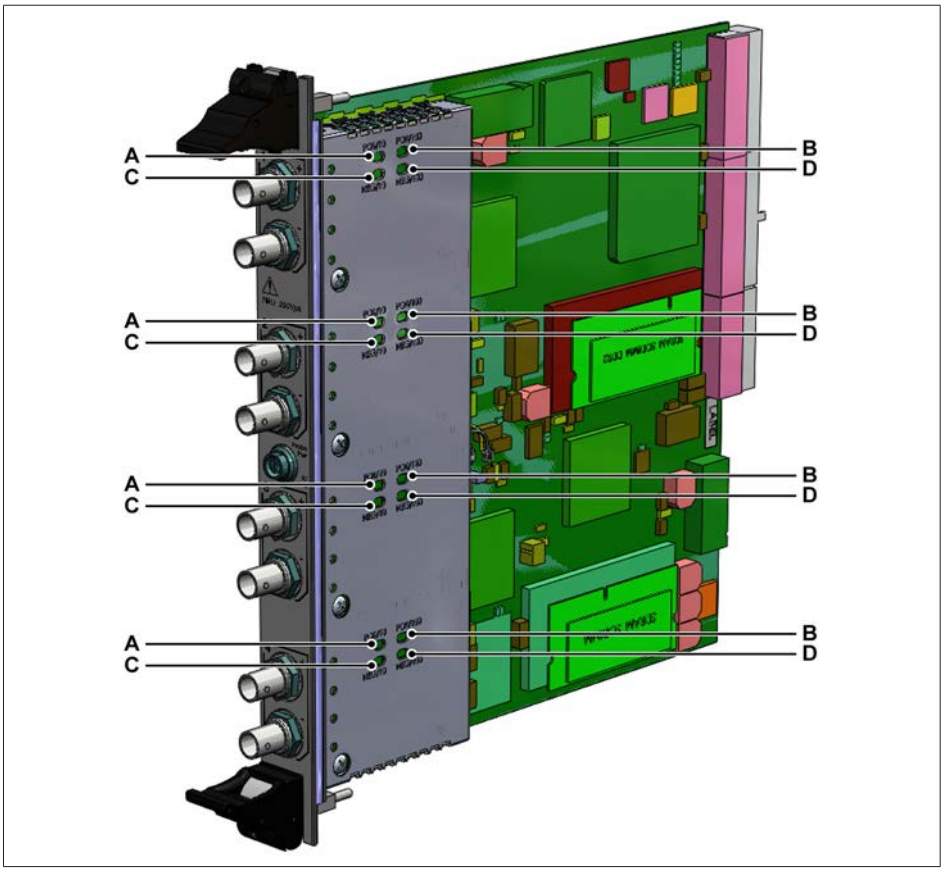


Fig. C.3 1-GN412-2 and 1-GN413-2 adjustment points

A Adjustment point for POS/10
B Adjustment point for POS/100
C Adjustment point for NEG/10
D Adjustment point for NEG/100

C.4 1-GN310B Power 2M ISO and 1-GN311B Power 200k ISO

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

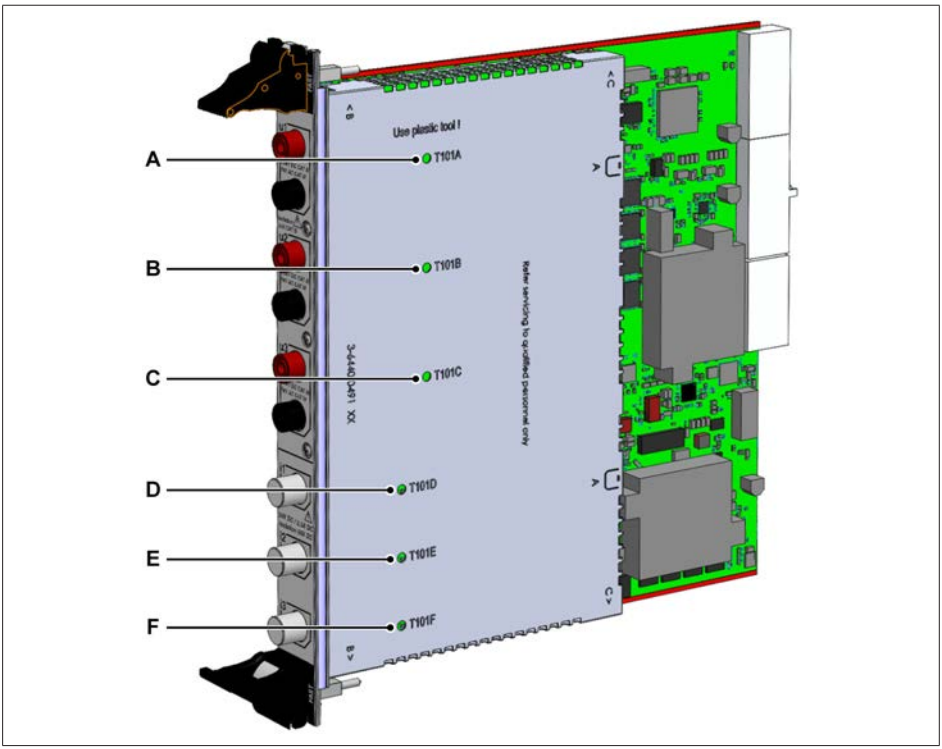


Fig. C.4 1-GN310B and 1-GN311B adjustment points

A T101A adjustment point for Channel 1 (u1)
B T101B adjustment point for Channel 2 (u2)
C T101C adjustment point for Channel 3 (u3)
D T101D adjustment point for Channel 4 (i1)
E T101E adjustment point for Channel 5 (i2)
F T101F adjustment point for Channel 6 (i3)

C.5 1-GN610-2 ISO 1kV 2M and 1-GN611-2 ISO 1kV 200k

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

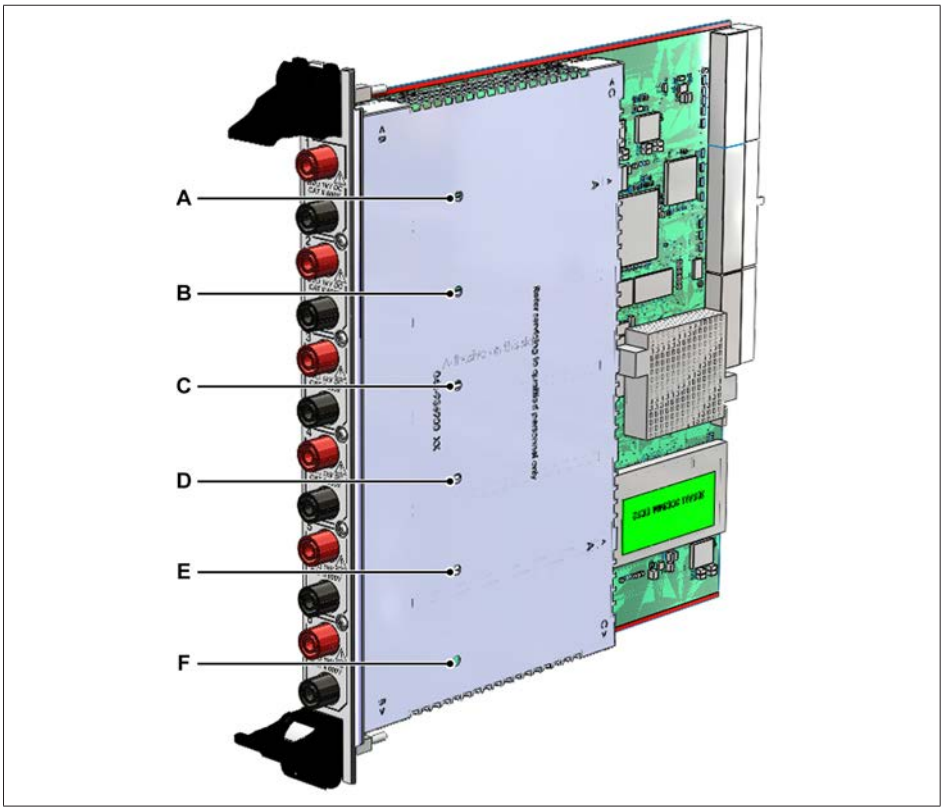


Fig. C.5 1-GN610-2 and 1-GN611-2 adjustment points

A T200 adjustment point for Channel 1
B T200 adjustment point for Channel 2
C T200 adjustment point for Channel 3
D T200 adjustment point for Channel 4
E T200 adjustment point for Channel 5
F T200 adjustment point for Channel 6

C.6 1-GN815 Basic/IEPE 2M ISO and 1-GN816 Basic/IEPE 200k ISO

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

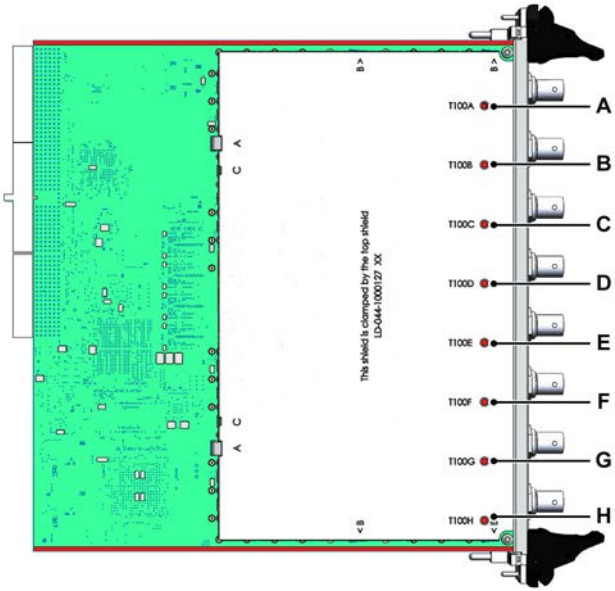


Fig. C.6 1-GN815 and 1-GN816 adjustment points

A T100A adjustment point for Channel 1
B T100B adjustment point for Channel 2
C T100C adjustment point for Channel 3
D T100D adjustment point for Channel 4
E T100E adjustment point for Channel 5
F T100F adjustment point for Channel 6
G T100G adjustment point for Channel 7
H T100H adjustment point for Channel 8

C.7 1-GN8101B Basic 250M, 1-GN8102B Basic 100M and 1-GN8103B Basic 25M

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

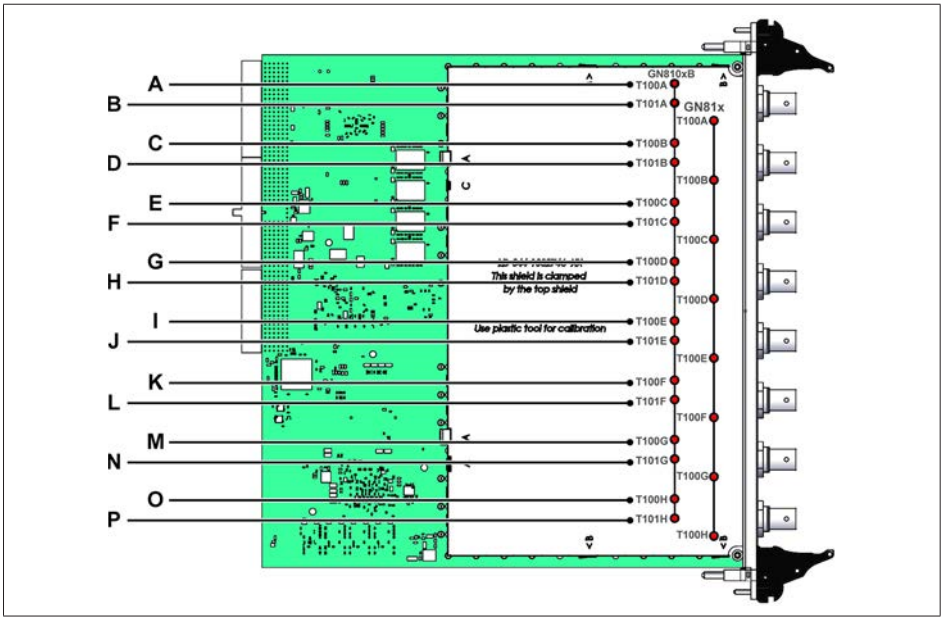


Fig. C.7 1-GN8101B, 1-GN8102B and 1-GN8103B adjustment points

A	T100A adjustment point for CH 1	I	T100E adjustment point for CH 5
B	T101A adjustment point for CH 1	J	T101E adjustment point for CH 5
C	T100B adjustment point for CH 2	K	T100F adjustment point for CH 6
D	T101B adjustment point for CH 2	L	T101F adjustment point for CH 6
E	T100C adjustment point for CH 3	M	T100G adjustment point for CH 7
F	T101C adjustment point for CH 3	N	T101G adjustment point for CH 7
G	T100D adjustment point for CH 4	O	T100H adjustment point for CH 8
H	T101D adjustment point for CH 4	P	T101H adjustment point for CH 8

C.8 1-GN110, 1-GN111, 1-GN112 and 1-GN113 Isolated Digitizers

Opening the Isolated Digitizer

1. Power off the unit by using the power switch and when using the 1-GN112 or 1-GN113 Isolated Digitizers, also remove the power cord.
2. Remove the rubber protectors at each end of the Isolated Digitizer.
3. When working with 1-GN110 and 1-GN111, use a flathead screwdriver to remove the battery screw (one fixed "captive" screw for each battery).
   Pull out the batteries from the casings using the battery handle.
4. Remove the two (top) black plastic cross-head fasteners **and plugs** at each end of the Isolated Digitizer's outer casing.
5. Remove the blue casing lid to reveal the metal battery housing.
6. Carefully lift out the metal battery/power supply casing.

Notice

This might be difficult! At one end of the casing, there is a connector pin and plug assembly which you will have to pull apart.

7. Plug in the supplied cable accessory (CBL/6600 HV ID AC CAL PWR) from the digitizer-base to the bottom of the battery/power supply fixture.
8. When working with 1-GN110 and 1-GN111, re-insert the removed battery/ batteries into the battery casing.
9. Connect the optical fiber communication lead and the power cord when using the 1-GN112 or 1-GN113 Isolated Digitizers.
10. Power on the unit using the power switch.

⚠WARNING

The orientation of the battery should be such that the battery pins connect with the battery-casing plug inside the fixture.
Only use batteries that have been approved by HBM to avoid damaging the unit.

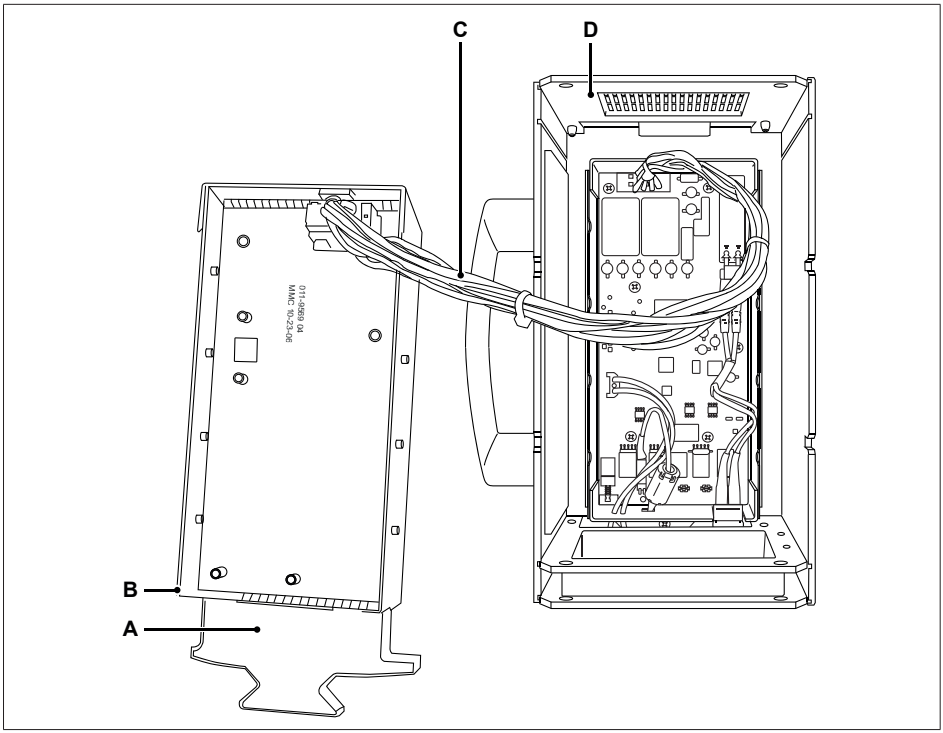


Fig. C.8 Accessing the Isolated Digitizers

A Battery handle (when working with 1-GN110 and 1-GN111)
B Battery/power supply casing
C CBL/6600 HV ID AC CAL PWR
D Isolated Digitizer casing

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

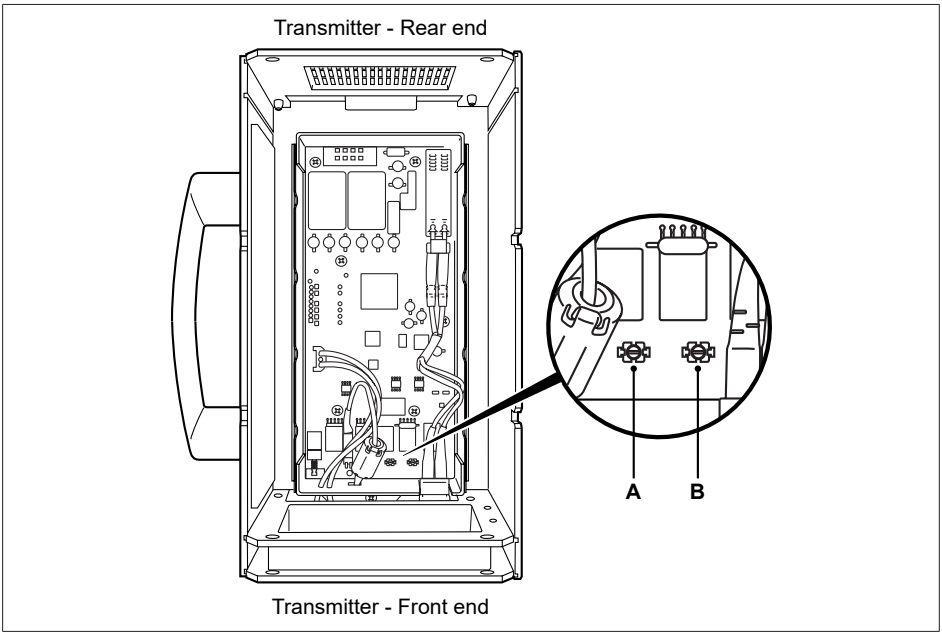


Fig. C.9 1-GN110, 1-GN111, 1-GN112 and 1-GN113 adjustment points

A T118 adjustment point for DIV/10

B T127 adjustment point for DIV/100

Closing the Isolated Digitizers

When the AC calibration is completed, perform the steps to open the Isolated Digitizer in reverse order to reassemble the Isolated Digitizer.

WARNING

Never complete an official unit verification process with an open system.

C.9 1-GN114 7600 100M Isolated Digitizer

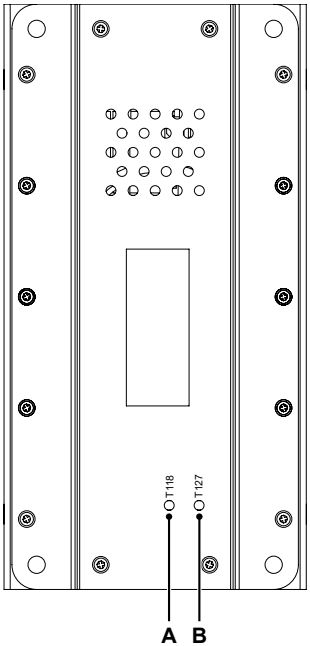


Fig. C.10 1-GN114 7600 100M adjustment points

A T118 adjustment point for DIV/10

B T127 adjustment point for DIV/100

C.10 LDS version 100 MS/s Fiber Amplifier Rv0 (Isolated Digitizer MV II)

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

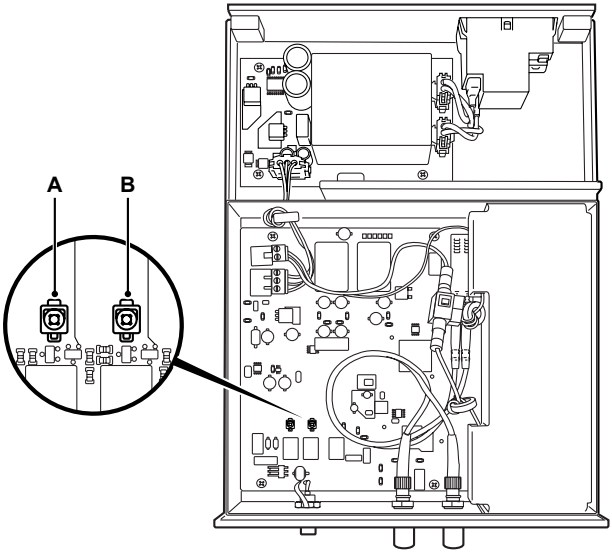


Fig. C.11 100 MS/s Fiber amplifier Rv0 adjustment points

A T118 adjustment point for DIV/10
B T127 adjustment point for DIV/100

C.11 LDS version 20 MS/s, 25 MS/s and 100 MS/s Basic Amplifier Card

Notice

Use plastic adjustment tools only. Metal tools will affect the accuracy.

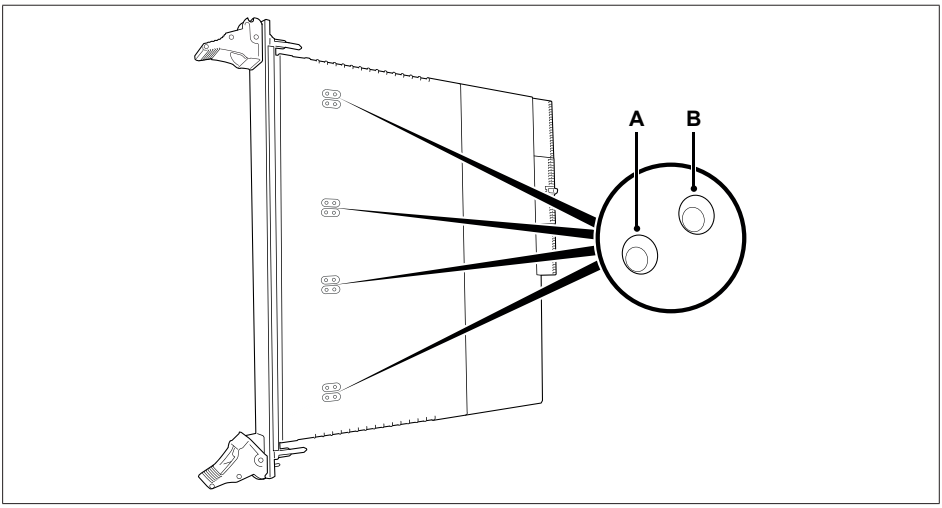


Fig. C.12 20 MS/s, 25 MS/s and 100 MS/s basic amplifier adjustments

A T118 adjustment point for DIV/10

B T127 adjustment point for DIV/100

D Legacy Information

D.1 Legacy software versions

Supported acquisition cards and options							
Acquistion cards and options		V2.00 V2.10 V2.20 V2.30	V2.40 V2.50 V2.60	V2.70 V2.80	V2.82 V2.83 V2.87	V2.90	V2.92 V2.94
1-G041-2	1 kV DC probe		✔	✔	✔	✔	✔
1-G042-2	1 kV AC probe		✔	✔	✔	✔	✔
1-G045	Impulse attenuator						
1-GN110	HV6600 100M	✔	✔	✔	✔	✔	✔
1-GN111	HV6600 25M	✔	✔	✔	✔	✔	✔
1-GN112	MV6600 100M	✔	✔	✔	✔	✔	✔
1-GN113	V6600 25M	✔	✔	✔	✔	✔	✔
1-GN114	7600 100M	✔	✔	✔	✔	✔	✔
1-GN401-2	6600 Receiver	✔	✔	✔	✔	✔	✔
1-GN402-2	7600 Receiver	✔	✔	✔	✔	✔	✔
1-GN410-2	Bridge 200k ISO	✔	✔	✔	✔	✔	✔
1-GN411-2	Bridge 1M ISO	✔	✔	✔	✔	✔	✔
1-GN412-2	HiSpeed 100M	✔	✔	✔	✔	✔	✔
1-GN413-2	HiSpeed 25M	✔	✔	✔	✔	✔	✔
1-GN440-2	Uni 200k ISO	✔	✔	✔	✔	✔	✔
1-GN441-2	Uni 1M ISO	✔	✔	✔	✔	✔	✔
1-GN610-2	ISO 1kV 2M				✔	✔	✔
1-GN611-2	ISO 1kV 200k				✔	✔	✔
1-GN810-2	Basic 200k	✔	✔	✔	✔	✔	✔
1-GN811-2	Basic 1M	✔	✔	✔	✔	✔	✔
1-GN812-2	Basic 1M ISO	✔	✔	✔	✔	✔	✔
1-GN813-2	Basix XT 1M ISO	✔	✔	✔	✔	✔	✔
1-GN814-2	Basic XT 200k ISO	✔	✔	✔	✔	✔	✔
1-GN1610	HiRes 250k-16		✔	✔	✔	✔	✔
1-GN1611	Basic 20k-16			✔	✔	✔	✔
1-GN3210	HiRes 250k-32		✔	✔	✔	✔	✔
1-GN3211	Basic 20k-32			✔	✔	✔	✔

D LEGACY INFORMATION

Supported mainframes						
Mainframes	**V2.00 V2.10 V2.20 V2.30**	**V2.40 V2.50 V2.60**	**V2.70 V2.80**	**V2.82 V2.83 V2.87**	**V2.90**	**V2.92 V2.94**
GEN7t	✓	✓	✓	✓	✓	✓
GEN16t	✓	✓	✓	✓	✓	✓
GEN2i		✓	✓	✓	✓	✓
GEN5i			✓	✓	✓	✓
GEN3i				✓	✓	✓
GEN3t					✓	✓
GEN7i						✓
GEN7tA						✓
GEN17tA						✓

D LEGACY INFORMATION

Supported calibrators				
Calibrators	**V2.00 V2.10**	**V2.20 V2.30 V2.40 V2.50 V2.60**	**V2.70 V2.80 V2.82 V2.83 V2.87**	**V2.90 V2.92 V2.94**
Fluke 5700A	✓	✓	✓	✓
Fluke 5720A		✓	✓	✓
Fluke 5730A(1)			✓	✓
Fluke 5820A	✓	✓	✓	✓
Fluke 9500B			✓	✓
HP 3458A(2)	✓	✓	✓	✓

(1) Fluke 5730A only supported in 5700 emulation mode (see Fluke 5730A manual for this manual setup).

(2) HP 3458A is originally produced by HP and later by Agilent and Keysight.

Required calibrators				
Acquistion cards and options		**Fluke 5700A, Fluke 5720A or Fluke 5730A**	**Fluke 5820A or Fluke 9500B**	**HP 3458A**
1-GN401-2	6600 Receiver	✓	✓	✓
1-GN402-2	7600 Receiver	✓	✓	✓
1-GN410-2	Bridge 200k ISO	✓		✓
1-GN411-2	Bridge 1M ISO	✓		✓
1-GN412-2	HiSpeed 100M	✓	✓	✓
1-GN413-2	HiSpeed 25M	✓	✓	✓
1-GN440-2	2 Uni 200k ISO	✓		✓
1-GN441-2	Uni 1M ISO	✓		✓
1-GN810-2	Basic 200k	✓		✓
1-GN811-2	Basic 1M	✓		✓
1-GN812-2	Basic 1M ISO	✓		✓
1-GN813-2	Basix XT 1M ISO	✓		✓
1-GN814-2	Basic XT 200k ISO	✓		✓

D.2 IOTech RS232 to GPIB interface

Early deliveries of the calibration setup included an IOTech RS232 to GPIB convertor.

Important

Altough the software still supports an IOTech RS232 to GPIB convertor, HBM strongly recommends replacing the IOTech with a USB to GPIB convertor.

- Connect the calibrator equipment to the GPIB side of the IOTech serial to the GPIB interface.
- Connect the serial side of the IOTech interface to a COM port on the PC running the software.
  For further details, please refer to the IOTech manual.

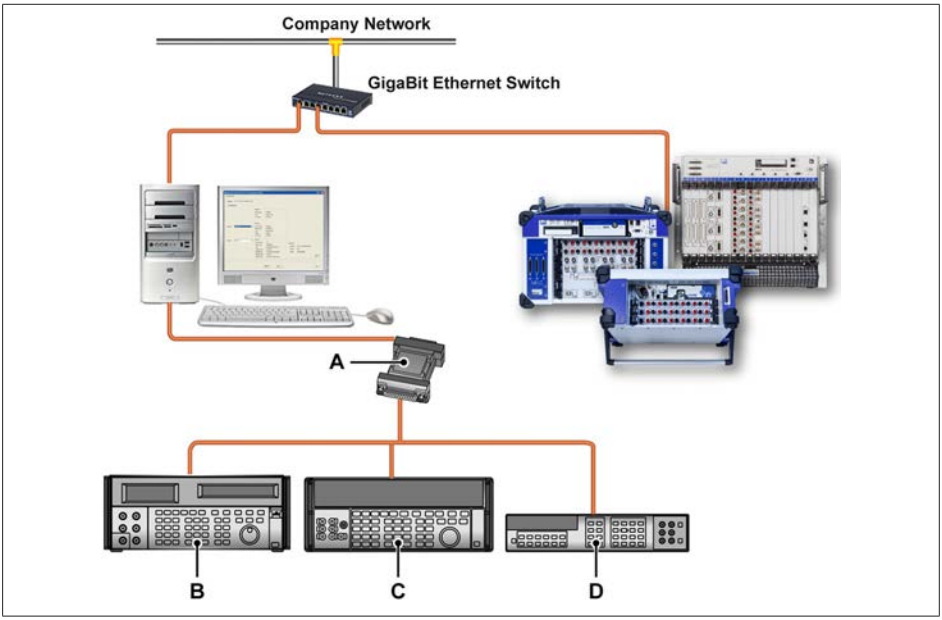


Fig. D.1 Connection diagram using the IOTech serial to GPIB interface

A IOTech serial to GPIB interface (IEEE-488)
B Calibrator fluke 5820A/9500B
C Calibrator fluke 5700A
D DVM Hewlett Packard HP 3458A

E Trouble Shooting

E.1 Accidentally selected IOTech serial interface

If the wrong option for the GPIB controller was selected during initial setup, the software does not support a way to reverse this option.

The options available are:

- IOTech used on a serial port
- USB-GPIB NI adapter

For example, if IOTech has been wrongly selected, an error stating that the 'I/ O Tech adapter is not attached to COM1' is generated.

To correct the problem, edit the ecf32.ini file used by the GEN series calibration software:

1. Locate the "ecf32.ini" file on your computer. It is typically located at:
   "C:\Users\<user>\AppData\Local\VirtualStore\Windows"

Tip

<user>: your Windows® logon user name.
AppData: is a hidden folder (enable show hidden folders in the file browser)

The "AppData" folder location might depend on which version of Windows® is used.

2. The "ecf32.ini" file contains an entry:
   [IOtech] Enable=1
   OR
   [IOtech] Enable=0
3. If set to "1", the legacy IOTech serial port is selected.
   If set to "0", the USB-GPIB NI adapter is selected.

Notice

Do not use an extra space or other characters in this entry. Otherwise, the selection might still fail.

E.2 NI GPIB-USB-HS not detected

In a PC system with multiple National Instruments GPIB-USB-HS adapters or when the PC contains also an internal GPIB interface card it is possible that the GEN series Calibration and Verification software doesn't detect the correct NI GPIB-USB-HS adapter. This also can be the case when different NI GPIB-USB-HS adapters are connected to the PC in the past. The software will only detect the NI GPIB-USB-HS adapter with Interface ID "GPIB0".

Tip

When NI GPIB-USM-HS is connected to the PC with National Instruments drivers installed, and the GPIB to USB adapter is still not detected by the GEN series Calibration and Verification software, the Interface ID can be checked by the NI software (see chapter „National Instruments MAX software")

E.2.1 National Instruments MAX software

To check the Interface ID with National Instruments MAX software do the following:

1. Start the **NI MAX** software (select **National Instruments map** from programs or type "NI MAX" in the Windows® search box.
2. When the **NI Measurement & Automation** window has opened select the **Devices and Interfaces** node to expand the list.

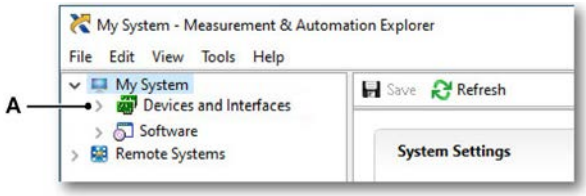


Fig. E.1 National Instruments devices/interfaces tree

A Devices/Interfaces node

3. The expanded list gives an overview of the installed devices and interfaces.

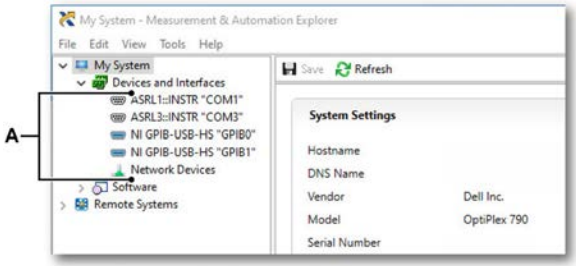


Fig. E.2 Devices/Interfaces tree expanded

A Installed devices/interfaces

Notice

*At least one **NI GPIB-USB-HS** should be detected before the GEN series calibration and verification software can operate..*

Notice

If no GPIB to USB adapter is found, check the connection and ensure that the National Instruments drivers are installed...

4. To identify the **NI GPIB-USB-HS** adapter which should be used with the GEN series calibration and verification software, disconnect the GPIB-USB adapter and see which device disappears in the list.

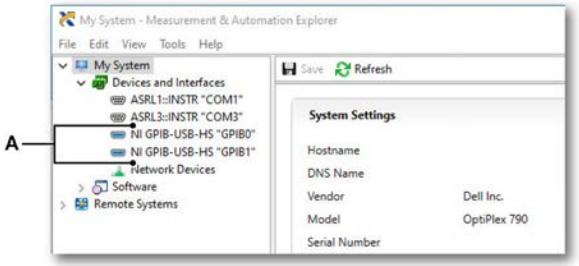


Fig. E.3 NI GPIB-USB-HS adapters

A Detected NI GPIB-USB-HS adapters

5. The NI GPIB-USB-HS adapter that is used with GEN series calibration and verification software should be named **“GPIB0”** in the **Devices and Interfaces** list.

Notice

If the adapter has a different ID than "GPIB0" it should be changed to "GPIB0".

To change the ID of a GBIP interface do the following:

1. Select the **NI GPIB-USB-HS (A)** adapter from the list and the **Settings (B)** area appears. Open the drop-down list for the GPIB Interface ID and select **GPIB0 (C)**.

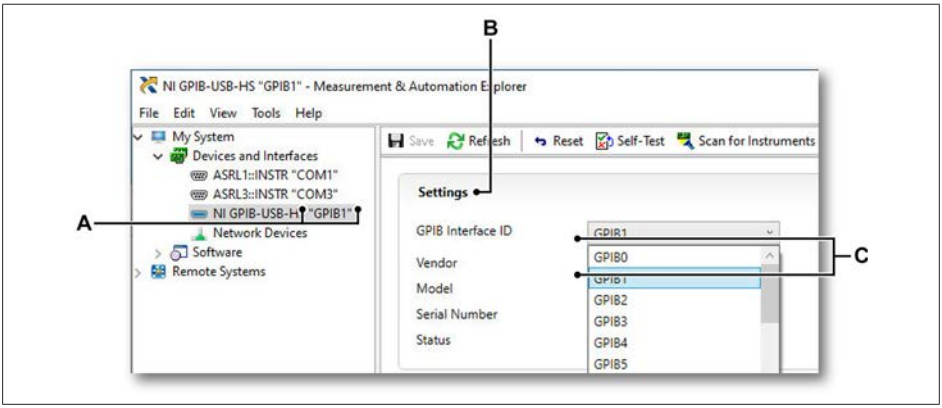


Fig. E.4 Settings area with GPIB Interface IDs drop down list

A Current GBIP Interface ID
B Settings
C GBIP Interface IDs

2. Click the **Save (A)** button to confirm the new GBIP Interface ID.

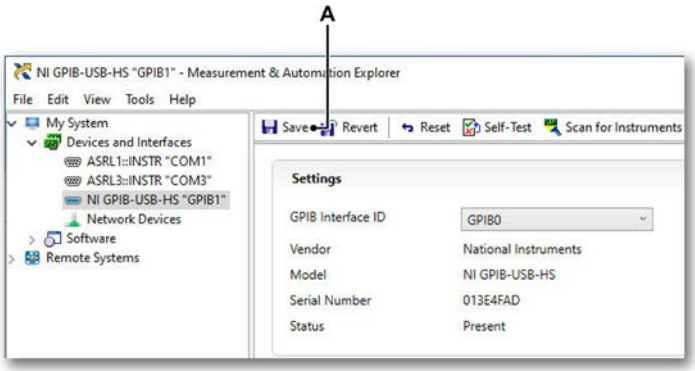


Fig. E.5 Confirming the GBIP Interface ID change

A Save

3. Now the GPIB Interface ID is **"GPIB0" (A)** and the **NI GPIB-USB-HS** adapter works with the GEN series calibration and verification software.

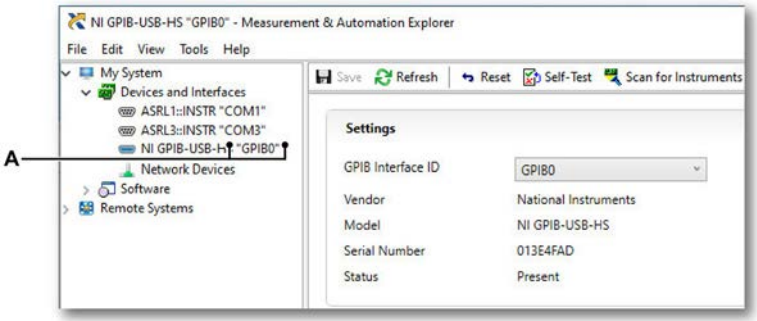


Fig. E.6 Updated GBIP Interface ID

A Changed GPIB interface ID to "GBIP0"

E.3 CalStack equipment maintenance

Notice

*As all high precision calibrators and multimeters, the **CalStack** equipment is sensitive for temperature changes and long term drift.*

Tip

For best performance it is necessary to have the equipment calibrated once a year and to do a regular sub-calibration of the units.

In the following chapters is explained how the calibrators and multimeter can be calibrated (on-site) for best performance.

E.3.1 Fluke 5700A and 5720A Multifunction Calibrators

These calibrators, used for DC voltage and low frequency sine wave signals, have a 30 days' time schedule to perform a so-called **DC Zero** calibration.

Tip

When the ambient temperature has changed for more than ± 5 °C, the DC Zero calibration should be done before the equipment is used for calibration and verification of the Genesis HighSpeed cards.

DC Zero calibration (Fluke 5700A and 5720A)

The DC Zero calibration is a quick, automatic process that removes any offset error on the 11 V and 2.2 V ranges, and removes offset and gain errors on the 220 mV range. This process takes about 2.5 minutes.

To perform a DC Zero calibration do the following:

1. Fluke 5700A / 5720A Multifunction Calibrator is powered on.
2. Press the following sequence of soft keys:
   "Setup Menus" → "Cal" → "Zero"
3. When the process is finished, a message appears that informs you to press any key to continue. Press any key to exit the **DC Zero** display.
4. To return to normal operation, press **PREV/MENU** twice (see Fig. E.7)

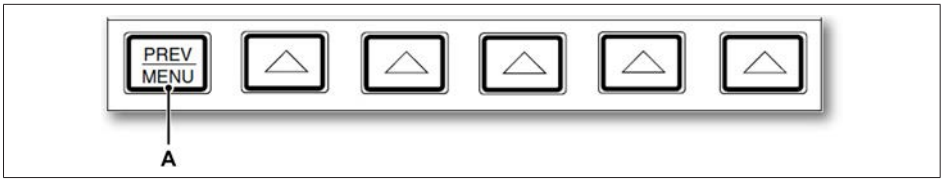


Fig. E.7 Fluke 5700A/5720A Multifunction Calibrators display

A Previous menu button

DC Zero reminder

Notice

The specificatons of the Fluke 5700A and 5720A Multifunction Calibrators require that the DC Zero calibration need to be performed at least every 30 days.

If the 30-day time period elapses and **DC Zero** is not performed, the following message appears on the display when the calibrator is powered on or reset (see Fig. E.8).

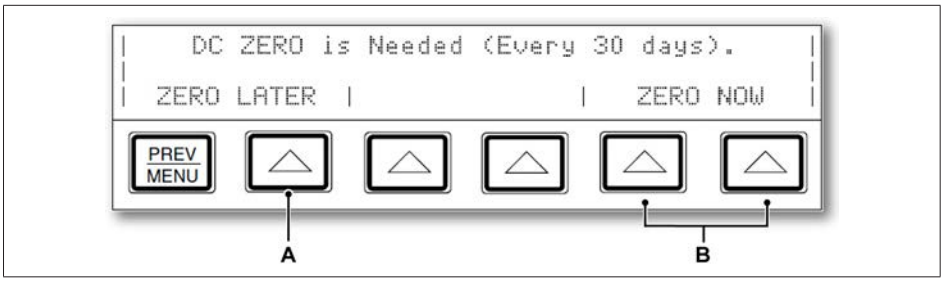


Fig. E.8 DC Zero calibration 30-day reminder

A To perform **DC Zero** calibration later select one of the buttons below **ZERO LATER**.

B To perform **DC Zero** now select one of the buttons below **ZERO NOW**.

Notice

If you receive the 30-day reminder after powering on the calibrator, allow the calibrator to warm-up before performing the DC Zero calibration. Otherwise an error message appears indicating that the calibrator is not warmed-up. To ensure the best performance, the warm-up period should be completed.

E.3.2 Fluke 5730A Multifunction Calibrator

The Fluke 5730A Multifunction Calibrator, used for DC voltage and low frequency sine wave signals, has a 30 days' time schedule to perform a socalled **DC Zero** calibration.

Tip

When the ambient temperature has changed for more than ± 5 °C, the DC Zero calibration should be done before the equipment is used for calibration and verification of the Genesis HighSpeed cards.

DC Zero calibration (Fluke 5730A)

The DC Zero calibration is a quick, automatic process that corrects offset errors which increase over time on several output ranges. This process takes approximately 2.5 minutes.

To perform a DC Zero calibration do the following:

1. Fluke 5730A Multifunction Calibrator is powered on. To ensure the best performance, the warm-up period should be completed.
2. Select the **Setup Menu** button.

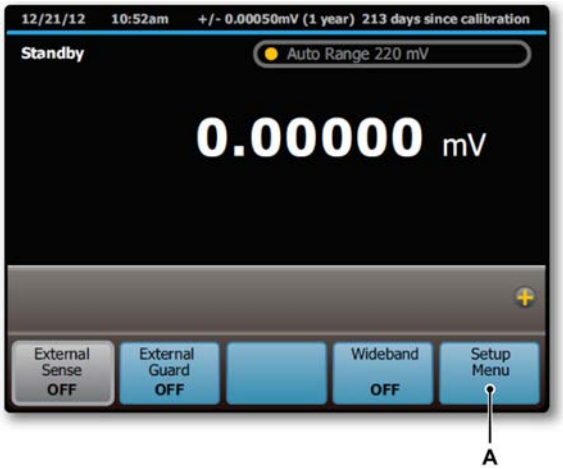


Fig. E.9 Fluke 5730A Standby window

A Setup Menu button

3. The **Setup Menu** menu appears. Select **DC Zero**.

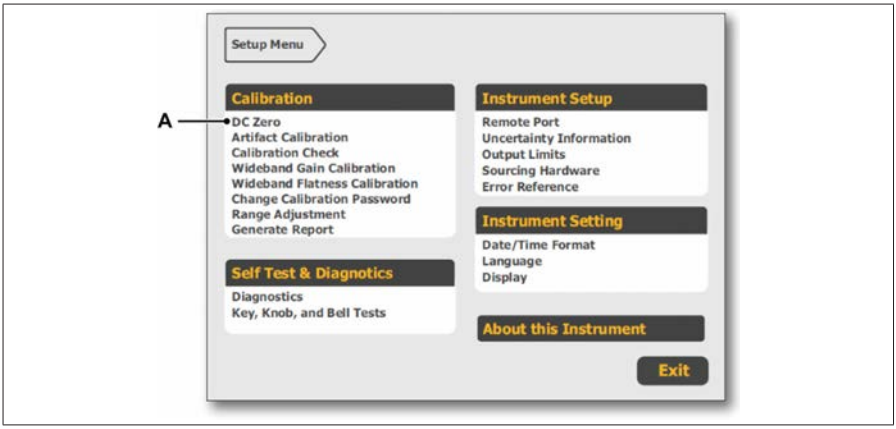


Fig. E.10 Fluke 5730A Setup menu

A DC Zero calibration

4. In the context menu of the Fluke 5730A Setup menu select **Run DC Zero** to the start the DC Zero calibration. The status of the DC Zero calibration is shown during the calibrator run through a series of steps.

Notice

If the Fluke 5730A Calibrator is not warmed-up, the display prompts to continue or to cancel the DC Zero calibration.

Fig. E.11 DC Zero calibration progress message

5. When completed, the “Calibration complete” message appears (see Fig. E.12)

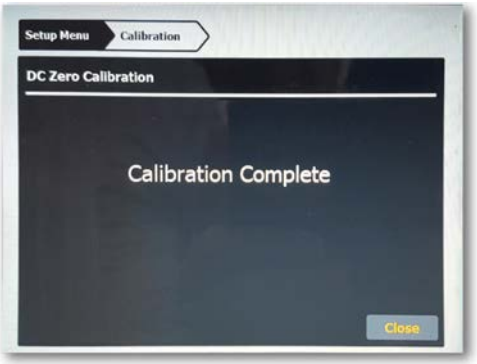


Fig. E.12 DC Zero calibration completed

6. Select **Close** to finish the **DC Zero** calibration process.

DC Zero reminder

Notice

The specificatons of the Fluke 5730A Multifunction Calibrators requires that the DC Zero calibration need to be performed at least every 30 days.

If the 30-day time period elapses and **DC Zero** is not performed, the following message appears on the display when the calibrator is powered on or reset (see Fig. E.13)

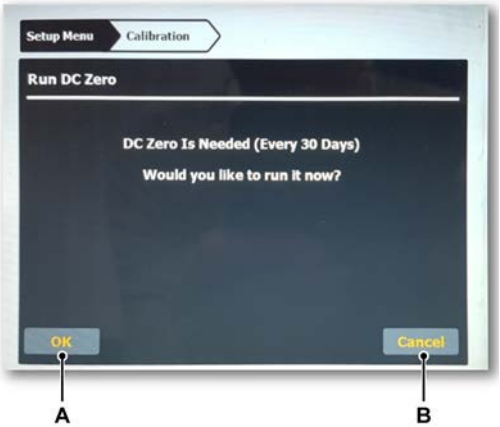


Fig. E.13 DC Zero calibration 30-day reminder

A To perform **DC Zero** now selcet the **OK** button.

B To perform **DC Zero** calibration later select the **Cancel** button.

Notice

If you receive the 30-day reminder after powering on the calibrator, allow the calibrator to warm-up before performing the DC Zero calibration. Otherwise an error message appears indicating that the calibrator is not warmed-up. To ensure the best performance, the warm-up period should be completed.

E.3.3 Fluke 5730A Multifunction Calibrator

The Fluke 5522A Multi-Product Calibrator used for the power generation has a 7 days' time schedule to perform a so-called Zero calibration.

Tip

When the ambient temperature has changed for more than ± 5 °C, the Zero calibration should be done before the equipment is used for calibration and verification of the Genesis HighSpeed cards.

Zeroing re-calibrates internal circuitry, most notably DC offsets in all ranges of operation.

Notice

To meet the Fluke 5522A Multi-Product specifications zeroing is required every seven days, or when the calibrator ambient temperature changes by more than ± 5 °C.

The Fluke 5522A calibrator displays a message when it is time to zero the calibrator. Zeroing is particularly important when your calibration workload has 1 mΩ or 1 µV resolution, and when there has been a significant temperature change in the calibrator work environment. There are two zeroing functions:

- Total instrument zero (ZERO)
- Ω only zero (OHMS ZERO)

To perform a Zero calibration do the following:

CAUTION

The Fluke 5520A calibrator rear panel CALIBRATION switch should not be enabled for this procedure.

1. Power on the Fluke 5522A Calibrator and allow a warm-up period for at least 30 minutes.
2. Select the "RESET" soft key. In the context touch screen, select the "SETUP" soft key.

3. The Fluke 5522A setup menu opens (see Fig. E.14). Select the **CAL** button.

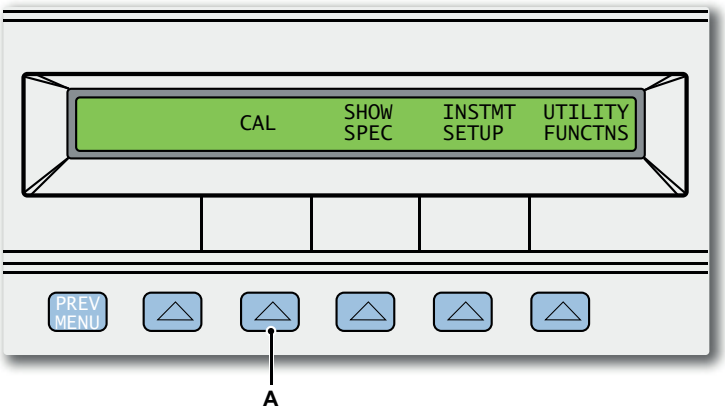


Fig. E.14 Fluke 5522A Setup display

A Fluke 5522A Calibration button

4. The Fluke 5522A Calibration information display appears (see Fig. E.15). Select the **CAL** button.

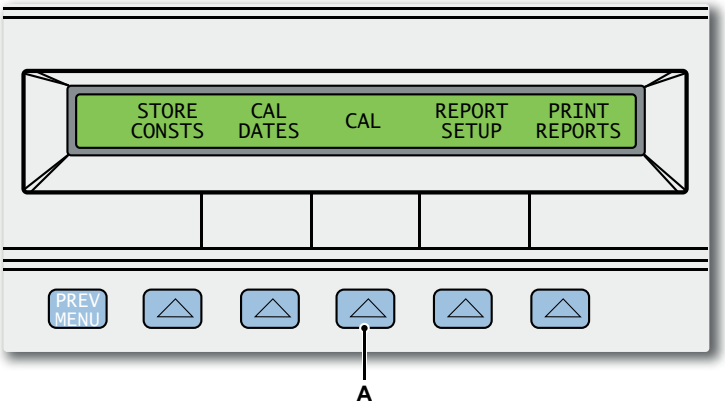


Fig. E.15 Fluke 5522A Calibration information display

A Fluke 5522A Calibration button

5. The Fluke 5522A Calibration activity display appears (see Fig. E.16). Select the **ZERO** button to perform a complete zeroing of the Fluke 5522A Calibrator.

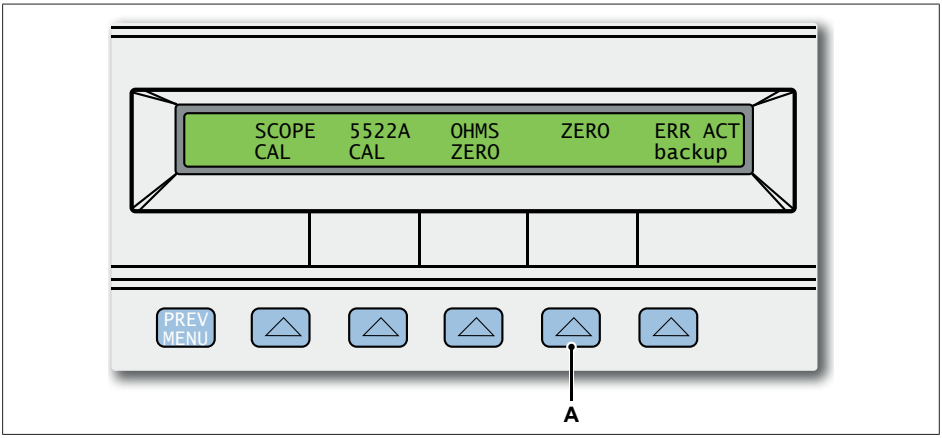


Fig. E.16 Fluke 5522A Calibration activity display

A Fluke 5522A Zero button to perform a Zero calibration

6. For a total Zero calibration, a short circuit capable of passing 20 A needs to be applied between the “20 A” and “AUX LO” terminals.
7. Select the **GO ON** button to continue with the Zero calibration process (see Fig. E.17).

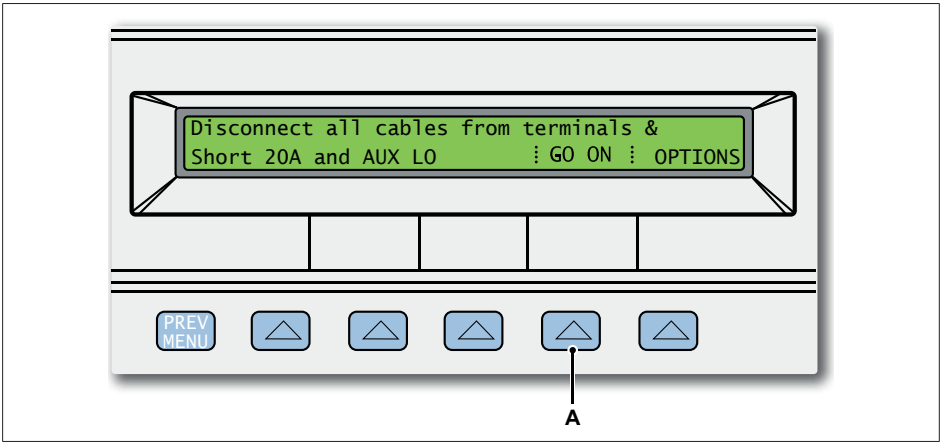


Fig. E.17 Fluke 5522A status message (20 A to be applied)

A Fluke 5522A GO ON button to start the Zero calibration

8. The Fluke 5522A Zeroing status message appears; please wait until Zero calibration is finished (see Fig. E.18).

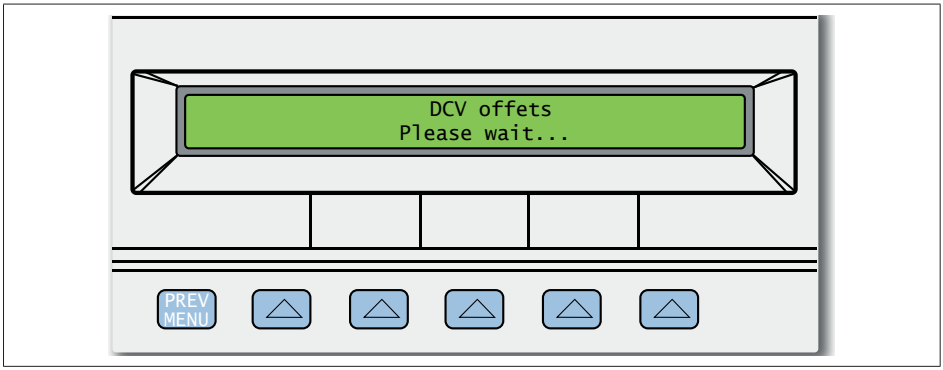


Fig. E.18 Fluke 5522A Zeroing message

9. After the zeroing routine is completed (this take several minutes), select the **GO ON** button to return to normal operation mode of the instrument (see Fig. E.19).

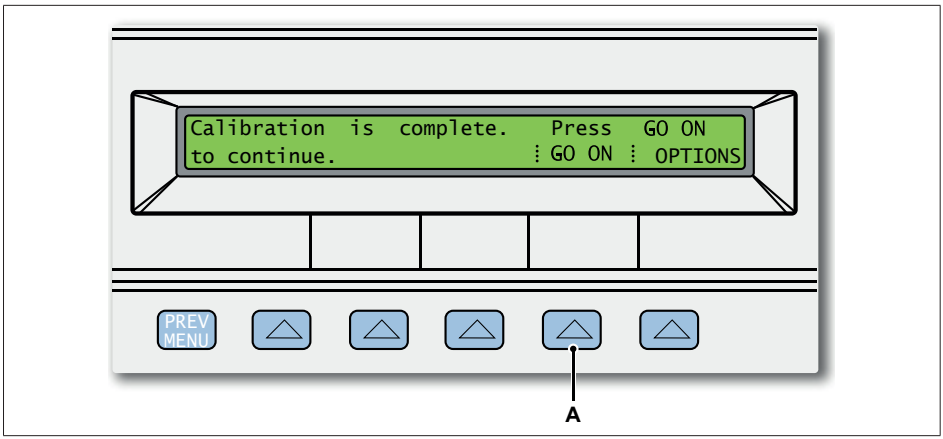


Fig. E.19 Fluke 5522A Calibration is completed

A Fluke 5522A GO ON button to finish Zero calibration

10. Select the **PREV/MENU** button three times to go back to normal operating mode.

E.3.4 Keysight (Agilent, HP) 3458A Multimeter

The calibration of the 3458A Multimeter should be performed with the GEN series calibration and verification software.
The GEN series calibration and verification software keeps track of the multimeter 3458A automatic calibration. There are four types of automatic calibrations of the 3458A Multimeter:

1. DCV calibration enhances all measurement functions.
2. AC calibration performs specific enhancements for AC or AC+DC measurements
3. OHMS performs specific enhancements for 2- or 4-wire Ω measurements
4. ALL three automatic calibrations combined

Recommended calibration of the 3458A Multimeter with the GEN series Calibration and Verification sofware:

- DCV should be performed daily.
- AC should be perfomed weekly.
- DCV; AC; OHMS calibrations combined should be performed monthly.

Notice

During the automatic calibration of the 3458A Multimeter, always disconnect all measurement cables from the instrument.

Tip

When the ambient temperature has changed for more than ± 5 °C perform a minimal DCV automatic calibration. Start the calibration with the front panel buttons of the 3458A Multimeter. Be sure the internal instrumental temperature is constant and the 3458A Multimeter is powered on for at least 30 minutes.

To perform a Zero calibration do the following:

1. The 3458A Multimeter is powered on and allow a warm-up period of at least 30 minutes.

2. Select the **Auto Cal** button (see Fig. E.20)

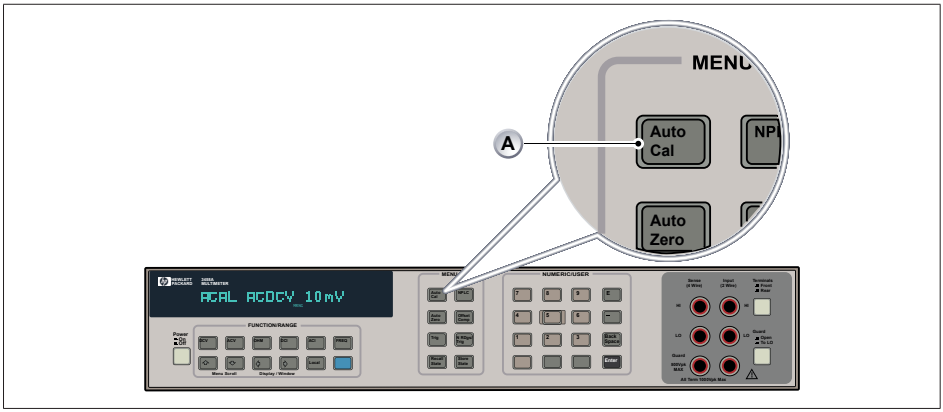


Fig. E.20 HP3458A Multimeter Zero calibration (Part 1)

A Auto calibration button

3. Select automatic calibration type with “Menu Scroll Down” button (see Fig. E.20)

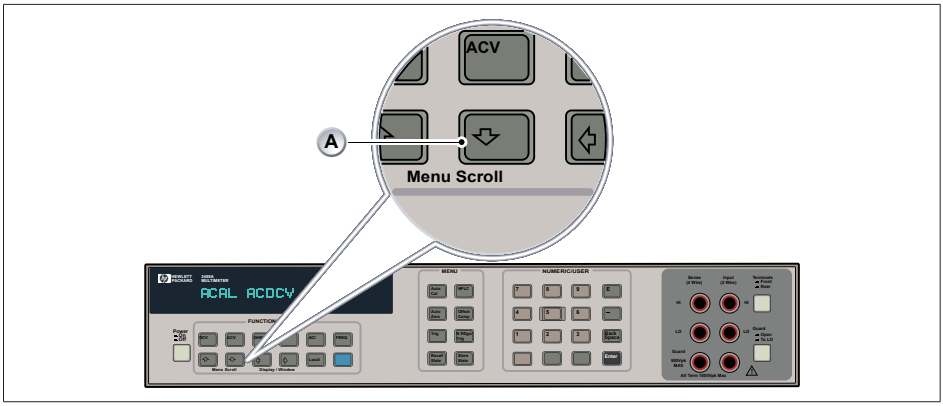


Fig. E.21 HP3458A Multimeter Zero calibration (Part 2)

A Menu Scroll Down button

- one time for **DCV** calibration
- two times for **AC** calibration
- three times for **OHM**S calibration
- four times for **ALL** three automatic calibrations combined

4. Select the **Enter** button (see Fig. E.22). The automatic calibration starts with the status info displayed.

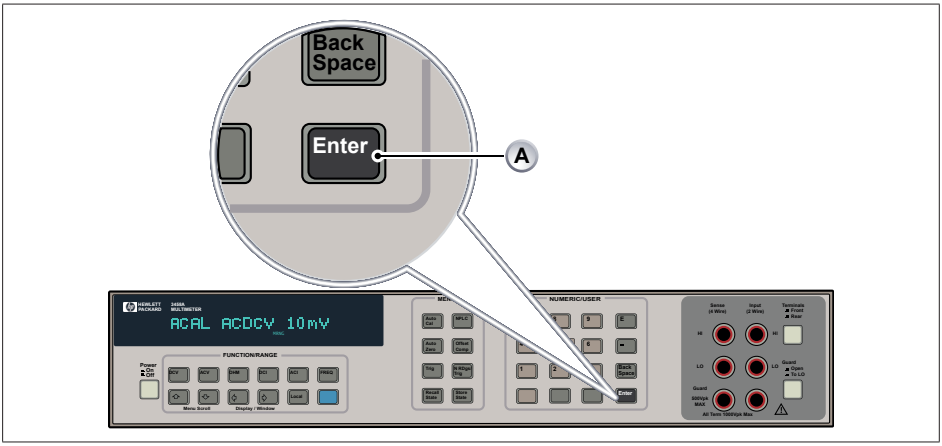


Fig. E.22 HP3458A Multimeter Zero calibration (Part 3)

A Enter button to start the Zero calibration process

5. Wait for automatic calibration to be completed. When done the multimeter goes into measurement mode again.

E.4 CalStack equipment (noise) disturbances

Important

GEN series products, like most precise measurement equipment, can be sensitive to noise.

Within the test system for calibration and verification, **noise** sources can be an issue for bad test results. When measuring too much noise, this can affect all kind of tests. Even DC gain test will be influenced as high frequency noise will be converted in the bandwidth limited amplifiers to an offset voltage.
Beside noise from other equipment in the same room, a well known noise source are **ground loop(s)**.
One of the loops can be the USB to IEEE communication cable between computer, running the CalSW, and the CalStack equipment. Return path for this loop is through mains cable connection for both computer and CalStack.

Tip

To break this loop it's possible to put an USB-isolator between computer and USB to GPIB cable.

As National Instruments NI GPIB-USB-HS Controller needs some power to work, the USB-isolator should have an isolated supply to the secondary side of the isolator.

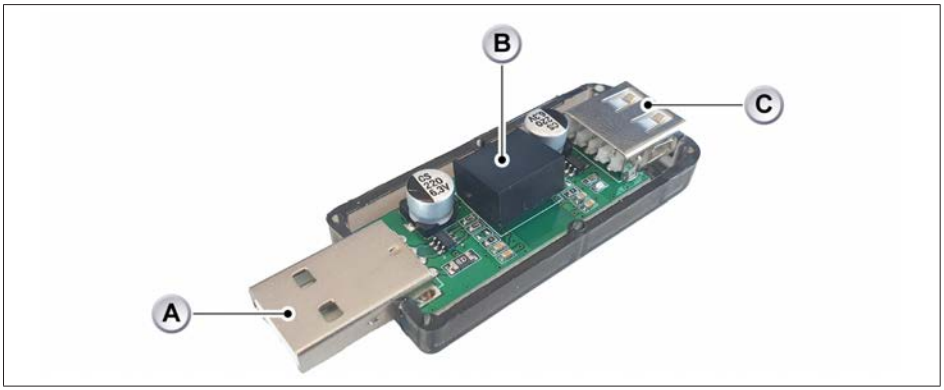


Fig. E.23 USB-isolator

A From PC
B Secondary supply
C To NI GPIB-USB-HS Controller

Index

A

AC Calibration adjustments..... 186
1-GN110, 1-GN111, 1-GN112 and 1-GN113 Isolated Digitizers..... 193
1-GN114 7600 100M Isolated Digitizer 197
1-GN310B Power 2M ISO and 1-GN311B Power 200k ISO..... 189
1-GN412-2 HiSpeed 100M and 1-GN413-2 HiSpeed 25M 188
1-GN440-2 Uni 200k ISO and 1-GN441-2 Uni 1M ISO..... 187
1-GN610-2 ISO 1kV 2M and 1-GN611-2 ISO 1kV 200k 190
1-GN810-2 Basic 200k, 1-GN811-2 Basic 1M, 1-GN812-2 Basic 1M ISO, 1-GN813-2 Basix XT 1M ISO and 1-GN814-2 Basic XT 200k ISO..... 186
1-GN815 Basic/IEPE 2M ISO and 1-GN816 Basic/IEPE 200k ISO 191
1-GN8101B Basic 250M, 1-GN8102B Basic 100M and 1-GN8103B Basic 25M 192
Closing the Isolated Digitizers 195
LDS version 20 MS/s, 25 MS/s and 100 MS/s Basic Amplifier Card 199
LDS version 100 MS/s Fiber Amplifier Rv0 (Isolated Digitizer MV II)..... 198
Opening the Isolated Digitizer..... 193
AC coupling 96
AC gain..... 96
AC gain [A] 96
AC probe 96

B

Balance 96
Bandwidth..... 96

C

Calibrating cards 80
AC calibration..... 87
Calibration test results 91
Card Calibration/Remote Probe window 81
DC calibration..... 85
Failed test results 92
Group selection 94
Passed test results 92
Remote Probes..... 95
Calibration and verification software.... 60
Installing..... 60
Installing calibrators via GPIB..... 60
Calibration system setup..... 57
Calibration/Verification
Introduction..... 96
CE and UKCA Declaration of conformity47
Charge AC gain..... 96
CMRR (Common Mode Rejection Ratio)96
Cold junction 96
Current Transducer voltage..... 96

D

DC gain..... 96
DC gain [A] 96

E

Electrical 42
Electromagnetic Compatibility (EMC)43
Electrostatic Discharge (ESD)..... 42
Environment 21, 45
China RoHS 45
Packaging..... 45
Waste Electrical and Electronic Equipment..... 45
Excitation [A] 96
Excitation [V] 96

G

Getting Started..... 49
GPIB interface (IEEE-488)..... 57
Grounding 14

H

Hardware setup
Connecting the hardware 57
GPIB interface (IEEE-488)..... 57
HV probe (BW)..... 96

HV probe (DC) 96

I

IEPE AC gain 96
IEPE Excitation 96
Input resistor 96

L

Laser Safety 23
Legacy software versions 200
LICENSE AGREEMENT and WARRANTY 3
Log Files and Reports 155
  Graphical results - DC gain 168
  Graphical results - Full Bandwidth .. 169
  Power verification log file 163
  Uncertainty calculation for AC gain verification 161
  Uncertainty calculation for power verification 165
  Verification log files 159

N

Noise [A] (Voltage or Current) Test 96
Noise (Voltage or Current) Test 96

O

OutDAC 96

P

Power Verification 112
  Introduction 112
Protection and isolation 16
  Basic insulation versus reinforced 18
  IEC 61010-2-030:2017 16
  Measurement categories 16
  Overvoltage/current protection 21

Q

Quarter bridge resistors 96

R

Reference 96
Required parts 50

S

Safety
  Instrument Symbols 15
  International safety warnings 24
  Manual handling of loads 24
Safety Messages
  Appropriate use 11
  Conversions and modifications 12
  General dangers 12
  Maintenance and cleaning 12
  Qualified personnel 13
  Residual risks 12
Shunt resistors 96
Supported acquisition hardware 52
Supported/Required calibrators 54
Symbols 9
System requirements 51

T

T
  AC Gain (Voltage or Current) Test ... 126
TEDS Class 3 96
TEDS data 96
Test Fixtures and Cables
  1-GN-CAL1 calibration and verification software 172
  1-GN-CAL2A GEN DAQ Basic/Fast Diff/Uni/HV fixture 174
  1-GN-CAL3 GEN DAQ 1kV DC/AC probe cables 176
  1-GN-CAL-3PWR GEN DAQ Power fixture 180
  1-GN-CAL5 GEN DAQ bridge 16 pin LEMO fixture 177
  1-GN-CAL6 GEN DAQ 16 channel HDSUB50 fixture 178
  1-GN-CAL7 GEN DAQ 32 channel HDSUB50 fixture 179
  1-GN-CAL9 GEN DAQ universal fixture 182
  1-GN-CAL-CABLES 173
  Fixture requirements 170
Theory of Operation 123
  AC Coupling Test 125
  AC Probe Test 127
  Balance Test 128

Bandwidth Test (HV probe BW)..... 129
Charge AC Gain Tes 132
CMRR (Common Mode Rejection Ratio) Test 133
Cold Junction Test 134
Current Transducer Voltage Test 135
DC Gain (Voltage or Current) Test (HV probe DC) 136
Excitation Voltage [V] and Excitation Current [A] Test 143
Full Bandwidth test 130
IEPE AC Gain Test 145
IEPE Excitation Test 146
Input Resistor Test 154
Noise (Voltage or Current) Test..... 147
OutDAC Test 148
Power (AC) 138
Power (DC) 139
PowerFactor 142
Power vs. Frequency 140
Power vs. Phase 141
Quarter Bridge Resistor Test 149
Quick Bandwidth Test 129
Range and Span explained 123
Reference Signal Test 150
Shunt Resistor Test 151
TEDS Class 3 Data Test 152
TEDS Data Test 153
Trouble shooting
CalStack equipment (noise) disturbances 222
Trouble-shooting
Accidentally selected IOTech serial interface 204
CalStack equipment maintenance.. 209
DC Zero reminder 210, 214
Fluke 5700A and 5720A Multifunction Calibrators 209
Fluke 5730A Multifunction Calibrator 211, 215
Keysight (Agilent, HP) 3458A Multimeter 219
National Instruments MAX software 205
NI GPIB-USB-HS not detected 205

V

Verifying cards 98
Failed test results 108
Group selection 110, 111
Passed test results 108
Save results 109
Setting up the Verification test 98
Starting the Verification test 100
Test results 107
Verification Testing 104
Verifying Power cards 114
Power Verification testing 117
Save results 122
Setting up the Power Verification test 114
Starting the Verification test 116
Test results 120

W

Waste Equipment 45

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A02705_11_E00_00 25/02/2025