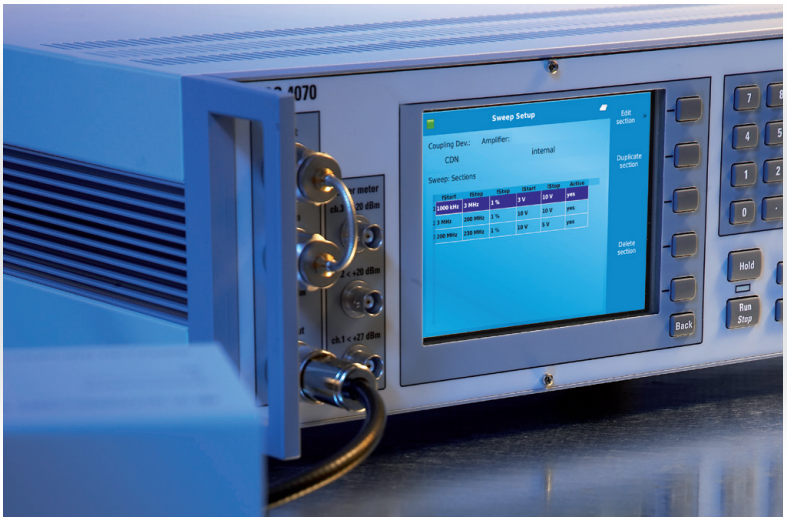
TEST SYSTEM FOR CONDUCTED AND RADIATED IMMUNITY

NSG 4070C

USER MANUAL



AMETEK®
COMPLIANCE TEST SOLUTIONS

TESEQ
Advanced Test Solutions for EMC

TEST SYSTEM FOR CONDUCTED AND RADIATED IMMUNITY

NSG 4070C

USER MANUAL

This manual is written for NSG 4070C. It is based on firmware version 2:31.

CONTENT

FIGURES

TABLES

1. SAFETY ADVICE

Observe all precautions to assure your personal safety. Read the user manual carefully. Pay special attention to safety and operation details!

1.1. Safety and warning symbols

Please take note of the following explanations of the symbols used in order to achieve the optimum benefit from this manual and to ensure safety during operation of the equipment.

		This symbol warns of a potential risk of shock hazard. Use standard safety precautions to avoid personal contact with these voltages.
		This symbol indicates where a caution is required. Refer to the operating instructions located in the manual in order to protect against personal injury or damage the equipment. It calls attention to a procedure, practice or condition which, if not followed, could possibly cause damage to equipment. Such damage may invalidate the warranty. Do not proceed until its conditions are fully understood and met.
		This symbol indicates non-ionizing radiation. Non-ionizing radiation may pose a health hazard to operators. Protective measures such as switching off the RF before entering the Faraday cage, level limitation and/or spatial distance are common measures.
		This symbol indicates access of persons with pacemakers prohibited.
		This symbol indicates the ground terminal.
		This symbol indicates the protective earth terminal.

1.2. Safety Aspects

These operating instructions form an integral part of the equipment and must be available to the operating personnel at all times. The user must obey all safety instructions and warnings.
Neither AMETEK CTS Europe GmbH nor any of its subsidiary sales organizations can accept any responsibility for personal, material or consequential injury, loss or damage that results from improper use of the equipment and accessories.

WARNING

Improper or careless handling can be fatal!
Use of the generator is restricted to authorized and trained specialists

1.3. Connection to the mains and PE

- The instrument conforms to protection class 1. Operation without a protective earth connection is forbidden!
- Before switching on the device, check whether the selected voltage matches the supply voltage. The position of the voltage selector must correspond with the mains. If you change the mains voltage, replace the fuses according the recommended value.
- A proper protective earth connection through the connector of the power cord is essential for safe operation.
- High leakage currents can cause the residual current circuit breaker of the mains to trip. In this case, the use of an isolating transformer is required.
- Handle the power cord carefully. Hold the plug when unplugging the cord.
- Never use the product if the power cord or the plug is damaged.
- Use only power cords and connector specified for your product.
- Do not abuse the cord. Never use the cord for carrying, pulling or unplugging the unit. Keep cord away from heat, oil, sharp edges or moving parts.
- Prevent the device from being switched on or energized unintentionally. Make sure that the switch is in the off position before connecting the device to the mains.
- Disconnect the power plug if you are not going to use the device for a long period of time.

1.4. Connections to other ports with dangerous voltages (AE, EUT, RF port ...)

- Only use the connection cables and plugs specified for your product which enable safe working. They must comply with the required classification and have suitable voltage and current ratings for the application. .
- Handle the connection cable carefully. Hold the plug when unplugging the cable.
- Never use the product if the connection cable or plug is damaged.
- Avoid touching conductive parts unless they have been de-energized by suitable means and secured against being switched on again for the period of handling. Industrial connectors often have insufficient protection against electric shock due to their application.

1.5. Connection to the ground plane or Faraday cage

- Remove the protective foil from under the device and adapter housing to ensure good electrical contact.
- Light equipment should be weighted down, clamped to the base plate or other measures should be taken to ensure good electrical contact over a wide surface area and on a permanent basis.

- Connect the device with the ground plane before using.
- The operation without a second, only with a tool removable earth leakage connection is prohibited.
- Check the ground connection at regular intervals.

- Ensure that a reliable return path for the interference current is provided between the equipment under test (EUT) and the generator. The reference ground plane and the earth connections to the instrument as described in the relevant test standard serve this purpose well.

1.6. Disconnection from the mains, PE, ground and control devices

- Always set the power switch to the "Off" position and wait few seconds before disconnecting the power cord.
- Disconnect the power cord and all connection cords when moving the unit.

1.7. Use proper fuses

- To avoid fire hazard, use only fuses as specified in the parts listing for your product - matching type, voltage and current rating.

1.8. Risk of electric shock

WARNING

- To reduce the risk of electric shock, do not remove parts from the housing.
- There are no user serviceable parts inside the unit. Certain parts inside the instrument work at mains voltage or at high frequency and are not provided with any protection against being touched.
- Only approved accessory items, connectors, adapters, etc. are to be used to ensure safe operation.

WARNING

- Not all lines, especially EUT supply lines, inside the device are protected by a fuse. Therefore, the user must implement the protection of the device against short-circuits by means of suitable fuses / circuit breakers.
- Avoid an overload by taking suitable precautions.
- In the event of a fault, dangerous and unexpected voltages may occur. Avoid touching conductive parts unless they have been de-energized by suitable means and secured against being switched on again for the period of handling.

1.9. Operating Environment

- Operate the equipment only in dry surroundings. Allow any condensation that occurs to evaporate before putting the instrument into operation. Do not exceed the permissible ambient temperature, humidity or altitude above sea level. Operate the unit not in explosive surroundings.
- No objects filled with liquids, such as coffee cups, shall be placed on the unit.
- Do not insert foreign objects in the ventilation holes.
- Do not obstruct the ventilation holes (also on the underside). Ventilation should not be impeded by covering the ventilation openings with items or other equipment.
- Avoid high temperatures. Allow for sufficient heat dispersion when installed in a rack. Do not place the product on radiators or fan heaters. The ambient temperature must not exceed the maximum specified temperature of this product.
- Keep the test area clean and well lit. Cluttered or dark areas invite accidents.

1.10. Test execution

- Check once again that all connections are proper including the ground and protective earth.
- Remove any adjusting key or wrench before switching on or energizing the device.
- The test area must be organized that no unauthorized persons have access during execution of a test.
- Operating the product requires special training and intense concentration. Make certain that persons who use the products are physically, mentally and emotionally fit enough to operate the products; otherwise injuries or material damage may occur.
- EUTs together with all accessories and cables are to be regarded as being live during the execution of a test.
- The safety instructions concerning all the instruments and associated equipment involved in the test setup are to be observed.
- The configuration of the test setup is to be strictly in compliance with the methods described in the relevant standard to ensure that the test is executed in a compliant manner.
- Working with high voltages alone is dangerous and prohibited by law.
- The high voltages must be switched off when nobody is present.

1.11. Dangers concerning the generator

- Local regulations for the protection of radio services must be observed. The interference generated by the generator can cause both conducted and radiated interference.
- If the radiated energy exceeds the permissible level, a shielded chamber with filtering of the supply lines or similar must be used. Decisive for the measures are the used levels, the geometry of the setup, the frequency range and the distance to the neighbor.
- Depending on the level used, the effectiveness of the connected antenna, TEM cell or similar, fields can be generated using appropriate power amplifiers, from which the operating personnel must be protected by suitable measures.
- Localized burning, arcing or ignition of explosive gases.
- Disruption of unrelated electronic, telecommunications or navigational installations or heart pacemakers through intentional and unintentional radiation of RF energy.

WARNING

Persons fitted with a heart pacemaker must not operate the instrument nor approach the test setup while it is in operation.

1.12. Dangers concerning the EUT

- EUTs are frequently simply functional samples that have not previously been subjected to any safety tests. Therefore, in some cases, the EUT is quickly damaged through internal overloads caused by the control electronics being disrupted. The EUT may even begin to burn.
- As soon as the EUT shows signs of damage the test should be stopped and the equipment under test should be switched off.
- Possible erroneous behavior by the EUT for example, a robotic device may misbehave, or a temperature regulator may fail.
- Even when power is off, capacitors may retain an electrical charge.

1.13. Applicable safety standards

- Development and manufacture of the instrument complies with ISO 9001.
- The equipment conforms with the essential requirements of the Low Voltage Directive (LVD) 2014/35/EU based on DIN EN 61010-1.

1.14. Intended use

WARNING

The purpose of this instrument is the generation of defined interferences signals for EMI immunity testing. Depending on the test stand layout, configuration, wiring, and the characteristics of the EUT itself, a significant amount of electromagnetic radiation may be generated that can affect people as well as other equipment and systems.

The device is designed for operation in industrial as well as home environment. For the intended operation, electromagnetic fields are generated by the connection of coupling devices (antennas, clamps, CDN etc.) or by the injection on lines. The operator, persons in the vicinity and the environment must be protected by suitable measures, e.g. Faraday cage.

1.15. Warranty Terms

AMETEK CTS provides this written warranty covering the product stated above, and if the buyer discovers and notifies AMETEK CTS in writing of any defect in material or workmanship within the applicable warranty period stated above, then AMETEK CTS may, at its option: repair or replace the product; or issue a credit note for the defective product; or provide the buyer with replacement parts for the product.

The buyer will, at its expense, return the defective product or parts thereof to AMETEK CTS in accordance with the return procedure specified below. AMETEK CTS will, at its expense, deliver the repaired or replaced product or parts to the buyer. Any warranty of AMETEK CTS will not apply if the buyer is in default under the purchase order agreement or where the product or any part thereof:

- is damaged by misuse, accident, negligence or failure to maintain the same as specified or required by AMETEK CTS;
- is damaged by modifications, alterations or attachments thereto which are not authorized by AMETEK CTS;
- is installed or operated contrary to the instructions of AMETEK CTS;
- is opened, modified or disassembled in any way without AMETEK CTS's consent; or
- is used in combination with items, articles or materials not authorized by AMETEK CTS.

The buyer may not assert any claim that the products are not in conformity with any warranty until the buyer has made all payments to AMETEK CTS provided for in the purchase order agreement.

1.16. Prohibition of unauthorized conversions and modifications

The user is not entitled to the device to perform its own modifications and adaptations. Modifying parts on the generator by unauthorized persons will void the warranty of the device and the correct functioning cannot be guaranteed.

1.17. Specific accessories required for safety reason

Only use accessories approved by AMETEK CTS for these generators and intended as accessories for these devices. Measuring instruments for the measurement of instrument parameters shall be designed for the maximum voltage and current from the generator. Otherwise safety cannot be guaranteed.

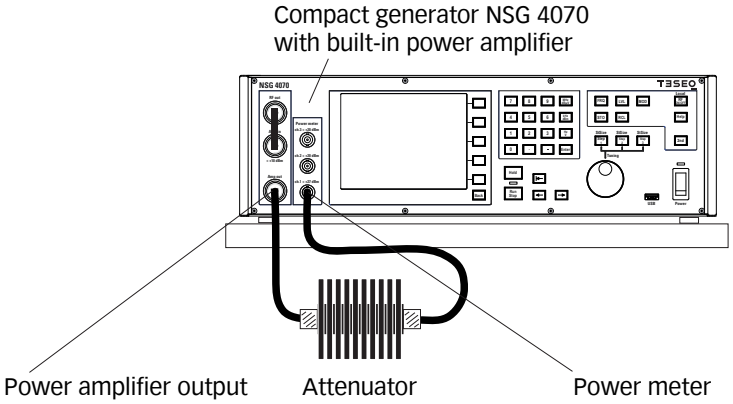
1.18. Procedure in case of hazard

If a hazard could exist due to an unintended condition of the device, the following procedure is recommended: Disconnect the device- and EUT power supplies from the power supply and ensure that the device is always earthed via the supply lines or a different ground connection. Wait at least 15 minutes and ground all outputs via a 10 kΩ, 15 W resistor. Call an AMETEK service center.

1.19. Cautions on handling the power meters

Generator mode, power meter mode

The power meter inputs are very sensitive. Please avoid any direct connection as shown below with careless adjustment of the generator output level. Be careful with low loss attenuators.



Mode Level	Generator mode, power meter mode -30 dBm	Generator mode, power meter mode -10 dBm
Amplifier (e.g. 50 dB)	On	On
Amp output (forward power)	20 dBm	40 dBm
Attenuator	6 dB	6 dB
Power meter ch. 1 limit	27 dBm	27 dBm
Measured on ch. 1	-30+50-6= 14 dBm	-10+50-6= 34 dBm

Caution: **Any input level above the limits of the power meter may damage or destroy the power meter. Such damage will not be handled by warranty.**

Immunity mode

Please avoid any direct connection between power amplifier output and power meter input. Please remove the connection to power meter 1 after the system calibration is finished. The amplitude modulation, as described for IEC/EN 61000-4-6, increases the forward power with 5.1 dB which could damage the connected power meter 1. Certainly a connection is required for e.g. measuring the current with a current probe. Please always respect the power limits of the connected power meters, current probes, attenuators and other hardware.

The operation mode “Probe Calibration” is intended for measuring the insertion loss of attenuators, cables and probes. The direct connection is allowed between power amplifier output and power meter channel 1. It allows a safe operation. The required power is adjusted to the related attenuation and measuring range of the power meters. The maximum output of the power amplifier will be adjusted in case of an interrupted connection to the power meter channel 1. All the connected hardware needs to be suitable for this power. Less qualified hardware may get damaged (e.g. attenuators connected on the calibration jig).

2. UNPACKING, STORAGE AND TRANSPORT

2.1. General

Save all packing materials! They will be needed in order to safely package the equipment for calibration service or repair.

Packaging materials

- Carton: Cardboard
- Padding: CFC-free polystyrene foam
- Plastic bags: Polyethylene

▶ Avoid the risk of condensation!

If a large temperature difference has occurred, allow time for the temperature to stabilize. This may take several hours.

2.2. Storage and transport

- ▶ Do not stack, either packaged or unpacked.
- ▶ Do not stand on end; arrows on the packaging must always point upwards.
- ▶ Protect from dampness, heat, cold and rain.
- ▶ Do not throw.
- ▶ Do not sit or stand on the instrument and packaging.

2.3. Unpacking

- Is the packaging damaged? If YES ☎ transportation company
- Are all the packages present and correct? If NO ☎ transportation company
- Open the packaging, remove the accessories.
- Grip the instrument at the sides and lift it from the packaging.
- Are the instrument or accessories damaged? If YES ☎ transportation company
- Are the contents of the package complete? If NO ☎ Teseq sales office
- Keep the instruction manual with the instrument.
- Keep the packaging.

2.4. Scope of delivery

- NSG 4070 mainframe
- Operating manual
- Spare fuses (2)
- RS232 cable (Nullmodem)
- Mains cable GB
- Mains cable CH
- Mains cable USA / JP
- Mains cable EU
- LAN cable, crossover, 3 m
- Keyboard (English)
- USO 4013 (USB to serial / optical converter with 20 m optical cable)

3. DESCRIPTION OF THE INSTRUMENT

3.1. General

The NSG 4070 is a multi-functional device for carrying out EMC immunity tests to accompany development and conformity testing in accordance to IEC/EN 61000-4-6, IEC/EN 61000-4-3, IEC/EN 61000-4-20, IEC/EN 61000-4-21 and several BCI standards e.g. ISO 11452-4 or MIL-STD-461G CS114.
The NSG 4070 includes signal generator, power meters, several EUT monitoring interfaces and an optional Class A power amplifier module. The flexibility in the EMC lab is given by the wide frequency range of 4 kHz to 1 GHz, several models of internal power amplifiers, the possibility to connect external power amplifiers and directional couplers as well as the variety of interfaces for EUT monitoring.
The NSG 4070C includes extended parameters for the pulse modulation. Up to three pulse modulation settings can be defined in order to create an envelope. NSG 4070C meets the requirements of ISO/DTS 7637-4 Annex C: Test generator for pulsed sinusodial disturbances, pulse A.
The powerful and easy to use firmware makes the NSG 4070 independent from an external PC and control software, however it can also be remote controlled for system operation. A state-of-the-art data transfer of test and measurement data for report generation is provided by USB stick to be plugged into the front panel.

In order to start with predefined parameter settings is recommended the optional test software icd.control. The software offers a large standard database and predefined drives for using external measuring devices. More complex systems including radiated tests can be controlled by using the software solution CIS (Compliance Immunity Software).
The NSG 4070 is supplied with remote interfaces LAN, electrical or optical RS232 and USB.

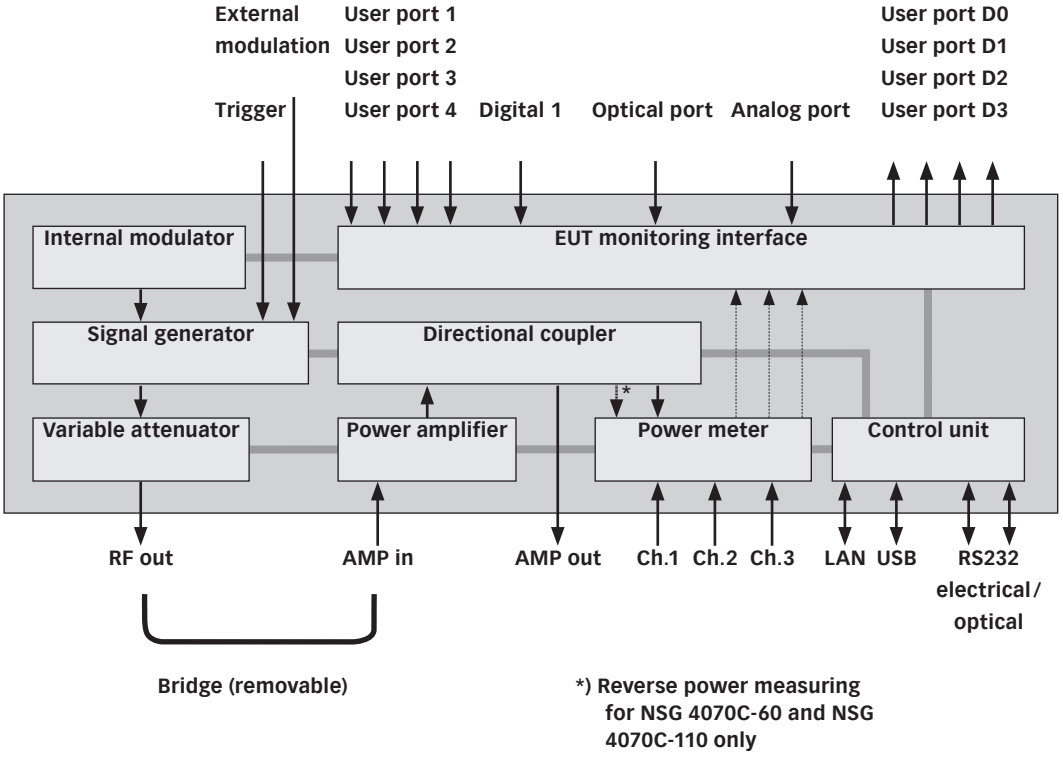


Figure 1: Block diagram of NSG 4070 with internal power amplifier

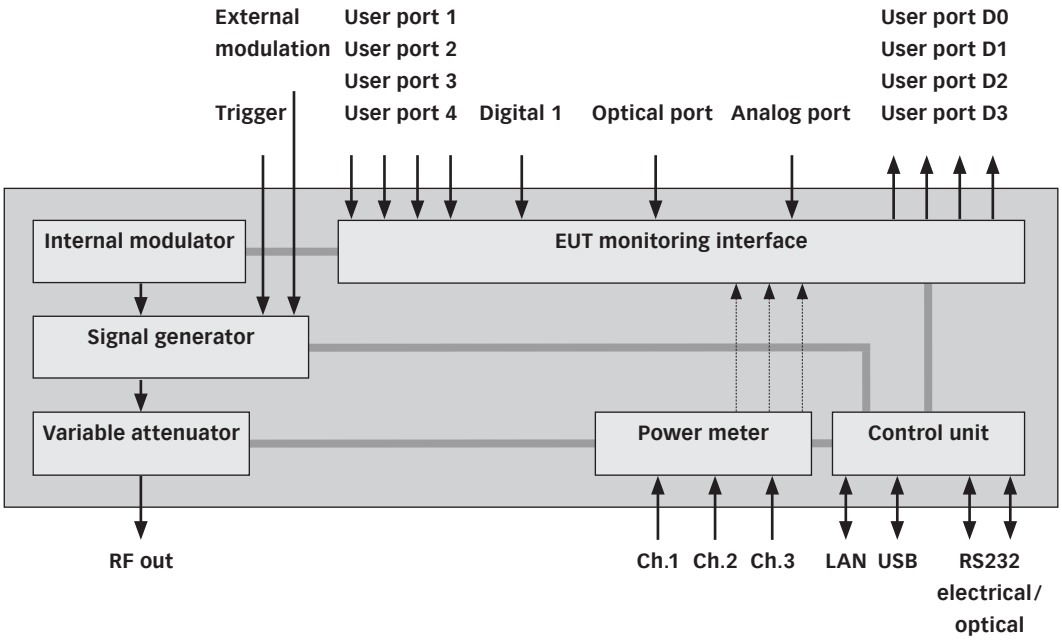


Figure 2: Block diagram of NSG 4070-0

3.2. Operating elements

3.2.1. Front panel

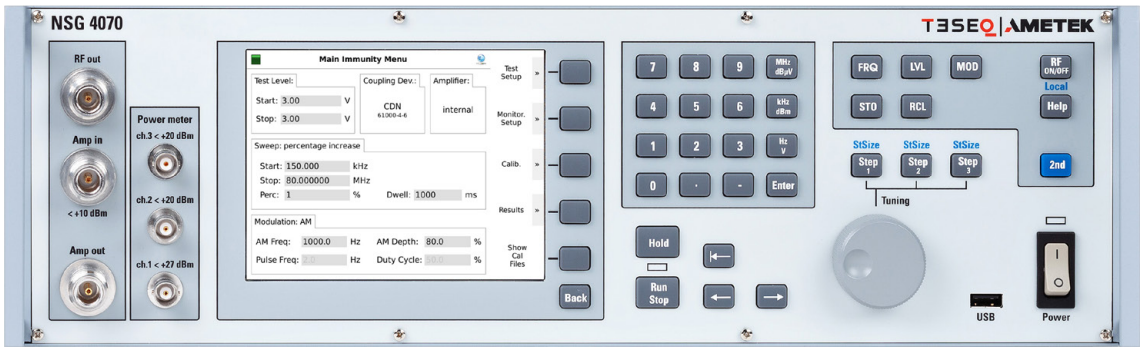
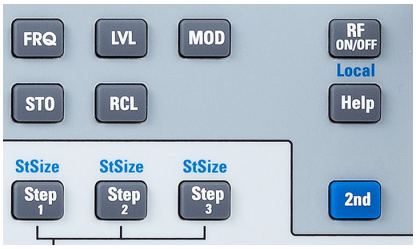
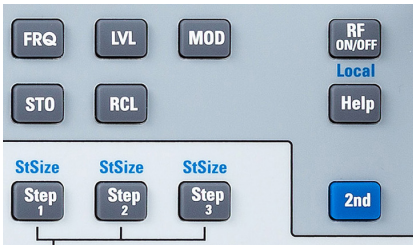
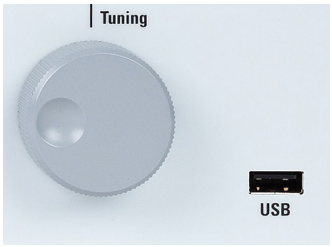
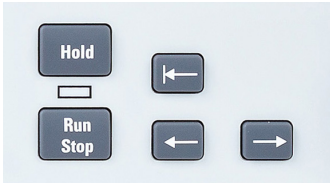
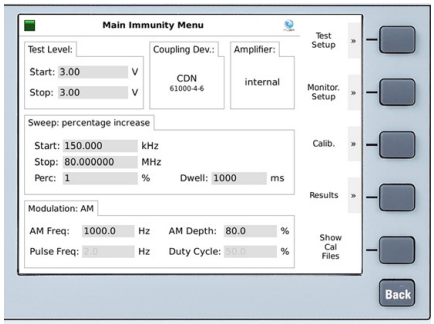


Figure 3: Front view of NSG 4070 with built-in power amplifier

1		**Power**	**Power on key** Hard key, switching takes effect with a short delay The LED next to the switch will turn from yellow to green when the unit is switched on.
2		**FRQ** **LVL** **MOD** **STO** **RCL** **Step 1, Step 2, Step 3**	**FRQ** Opens a softkey menu to change the frequency **LVL** Opens a softkey menu to change the test level **MOD** Opens a softkey menu to change the modulation parameters **STO** Opens a softkey menu to store test data or configurations **RCL** Opens a softkey menu to load test data or configurations **Step 1, Step2, Step 3** Keys to select one of the three step sizes
3		**RF ON/OFF** **Help** **2nd**	**RF ON/OFF** Switches the internal signal generator on/off **Help** Key to call up the help text for all operating conditions. Depending on the current settings, explanations to the help function, explanations to hard and softkeys, and for adjustment facilities within menus will be displayed. **2nd** Additional function: marked in blue color **2nd + Local** Keys to switch from remote control to manual operation **2nd + StSize** Keys to change the step size, affects e.g. the using of the rotary knob

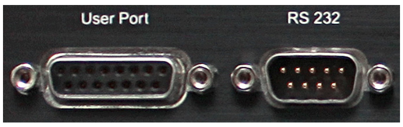
4		**Tuning** **USB**	**Tuning** The rotary knob has magnetic lock-in positions for parameter tuning and selection purposes. **USB** Interface for data exchange with USB stick
5		**0…9** **-** **.** **MHz/dBµV** **kHz/dBm** **Hz/V** **Enter**	**Numeric keyboard** numerical entry keys **Minus sign** **Decimal point** **Input confirmation keys** for the desired unit
6		**Hold** **Run/Stop** ⇤ ← →	**Hold** Interrupts a sweep. The blinking yellow LED indicates the Hold state. There is a RF signal at the output. **Run** Starts the sweep specified in the setup. The blinking red LED indicates the RUN mode. **Stop** Stops a sweep that is currently running. The LED turns to green. **Delete** the character left of the cursor **Moves** the cursor left **Moves** the cursor right

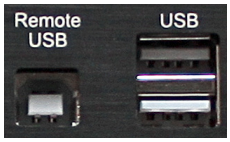
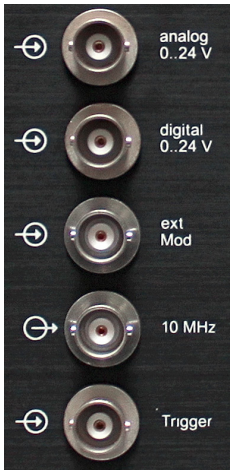
7		**Display** **Softkeys** **Back**	**Display** Displays menus, softkeys and results. **5 Softkeys**, whose individual functions are dependent on the menu context. **Back** Key to return from any operating condition (menu, cancelling of entries, error messages) to the preceding higher-level menu
8		**Power meter channel 1 to 3**	**Power meter inputs** Impedance Z= 50 Ω BNC-socket Caution! Maximum input level +20 dBm for channel 2 and 3. Maximum input level +27 dBm for channel 1. If necessary use voltage limiters or attenuators. Channel 1 is used for calibration.
9		**RF out** **Amp in** **Amp out**	**RF out** Synthesizer output to drive an external amplifier or use the NSG 4070 generator function. **Amp in** Power amplifier input (the power amplifier is optional) Caution! Maximum input level <+10 dBm. **Amp out** Power amplifier output (the power amplifier is optional)

3.2.2. Front panel of NSG 4070C-110

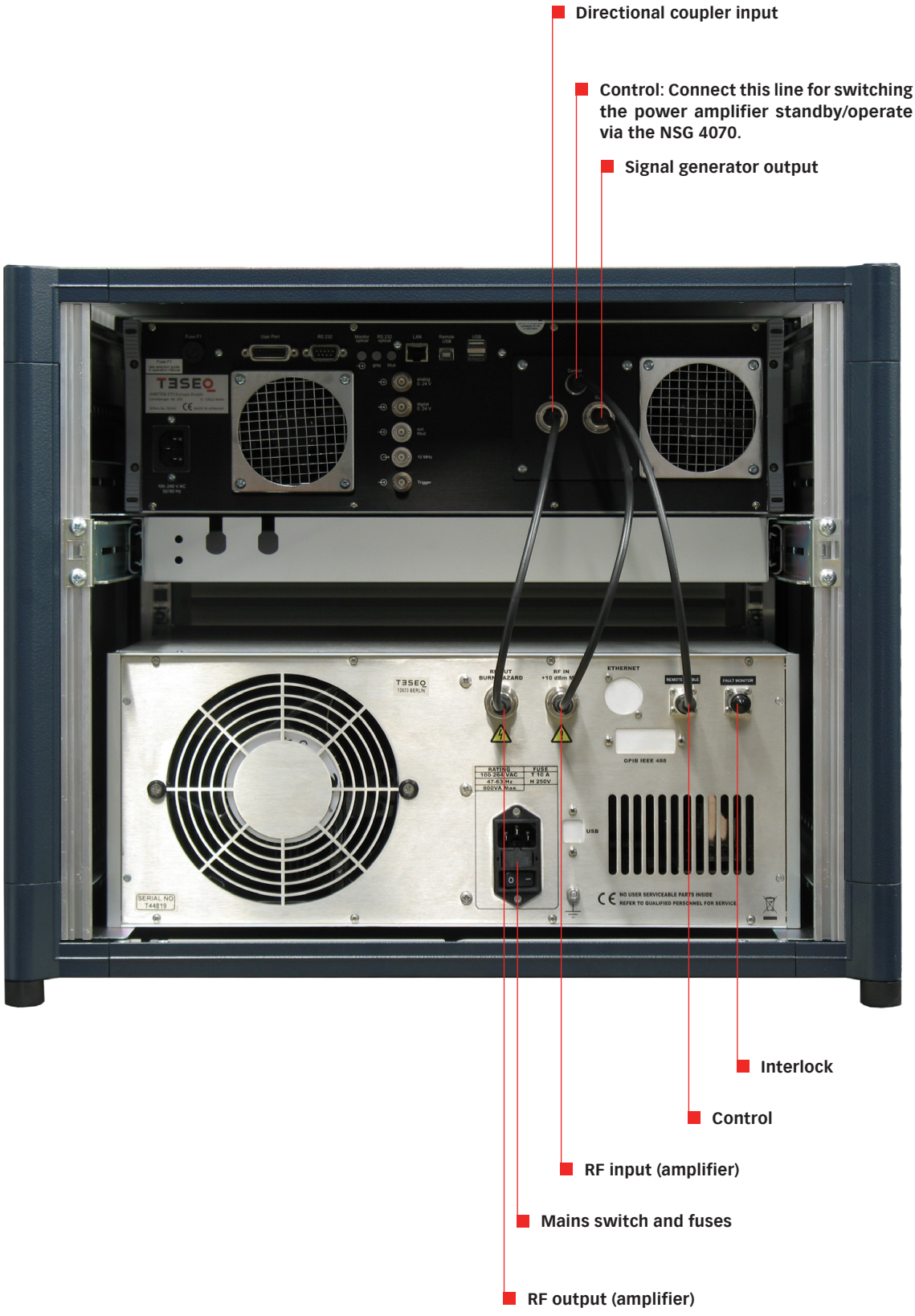
3.2.3. Back panel

Figure 4: Back view of NSG 4070

10		**Power supply**	Power supply connector for wide range supply: 110/230 Volts, 50/60 Hz autoranging
11		**Fuse**	**Fuse F1** See technical specifications for selection guide of fuse F1 in chapter 9.7.
12		**User port**	**User port D-Sub 15 pole** **Port** / **Pin** Digital in 0 — 1 Digital in 1 — 2 Digital in 2 — 3 Digital in 3 — 4 Digital out 0 — 6 Digital out 1 — 7 Digital out 2 — 8 Digital out 3 — 9 +12 V — 15 -12 V — 14 +5 V — 13 GND — 5 and 10
		RS232	RS232 - interface for remote control of the NSG 4070 using a null modem connection

13		**Monitor optical**	Input for optical EUT Monitoring, Fiber optic cable plug, HP versatile link HFBR0501 series 40 kBd
		RS232 optical	optical RS232 - interface for remote control of the NSG 4070 using USO 4013
		LAN	Network connector 10/100 Ethernet
14		**Remote USB**	USB device connector
		USB	USB host connector
15		**Analog input**	Monitoring input analog, BNC socket, 0-24 V Ri=15 kΩ, 6 mV resolution
		Digital input	Monitoring digital input, BNC socket, 0-24 V via optical coupler Ri=1.5 kΩ, switching threshold approx. 2 to 3 V
		Ext. Mod.	External modulation input, BNC socket, Impedance >10 kΩ, Level: 1 Vpp/100% AM, 1 Hz – 50 kHz
		10 MHz	10 MHz reference output, BNC socket, approx. 1 Vpp/50 Ω Please note: The connected signal will be mixed with the selected internal modulation. Disconnect this port for using the internal modulation only.
		Trigger	Trigger input BNC socket, TTL for external triggering
16		**Fans**	3 Fans for cooling the internal parts of the unit

3.2.4. Back panel of NSG 4070C-110



4. EXPLANATION OF THE MENU-CONTROLLED OPERATION

4.1. General

4.1.1. Menu control with softkeys and hardkeys

The function of each softkey is shown on the display, and can be operated using the 5 keys at the right of the screen.

A selection will be terminated either by pressing one of the enter / unit keys or another softkey or automatically.

Menus can be quit using Back. Pressing Back several times will always lead back to the main menu ("Main").

4.1.2. Help function

The Help key enables the display of a help text in most operating situations.

4.1.3. Numerical input using the numerical keyboard

Inputs of numerical values must start with a digit or the minus sign and will be terminated by one of the enter / unit keys for the desired unit. The input value appears in the selected field. Typos can be corrected using backspace ← to delete the digit to the left of the cursor. Mistakes will usually be corrected to the nearest valid value; too many input digits will be rounded.

4.1.4. Secondary functions

The secondary function of some keys is marked above the keys in blue. For calling a secondary function press the 2nd key and then the desired function key.

4.1.5. Level setting, frequency setting, modulation setting and tuning

4.1.5.1. Level setting

Level setting is done using the LVL hard key. The desired level can be set either by typing in a numerical value or by using the rotary knob which sets the level in fixed steps.

4.1.5.2. Frequency setting

Frequency setting is done using the FRQ hard key. The desired frequency can be set either by typing in a numerical value or by using the rotary knob which sets the frequency in fixed steps.

4.1.5.3. Modulation setting

Modulation frequency setting is done using the MOD hard key. The desired modulation parameters, i.e. AM, pulse or external modulation as well as the modulation frequency and depth / duty cycle can be set.

4.1.5.4. Tuning using the rotary knob

The rotary knob is used for frequency or level tuning.
Step 1, Step 2 and Step 3 are user defined step sizes. The step size can be defined by pressing the 2nd key and Step 1, Step 2 or Step 3 and typing in a numerical entry. The desired step size can be selected by pressing the corresponding key (without 2nd key).

4.1.6. Saving and loading of configurations and results

4.1.6.1. General

There are two options for storing or recalling results:
a) Saving / recalling data to / from the internal flash disk.
b) Saving / recalling data to / from the USB stick.

4.1.6.2. Store

The hard key STO opens a menu to save configurations, calibration and measurement results. Menu items include:

Config To save the settings of the current measurement as a configuration file to the internal flash or USB stick.

System Cal. To save the calibration results of the test setup to the internal flash or USB stick.

Probe Cal. To save the calibration results of the monitoring probe to the internal flash or USB stick.

Results To save the measurement results of the current measurement together with the corresponding configuration as a result file to the internal flash or USB stick.

Return from the sub menu with **Back**.

4.1.6.3. Recall

The hard key RCL opens a menu to load configurations, calibration and measurement results. Menu items include:

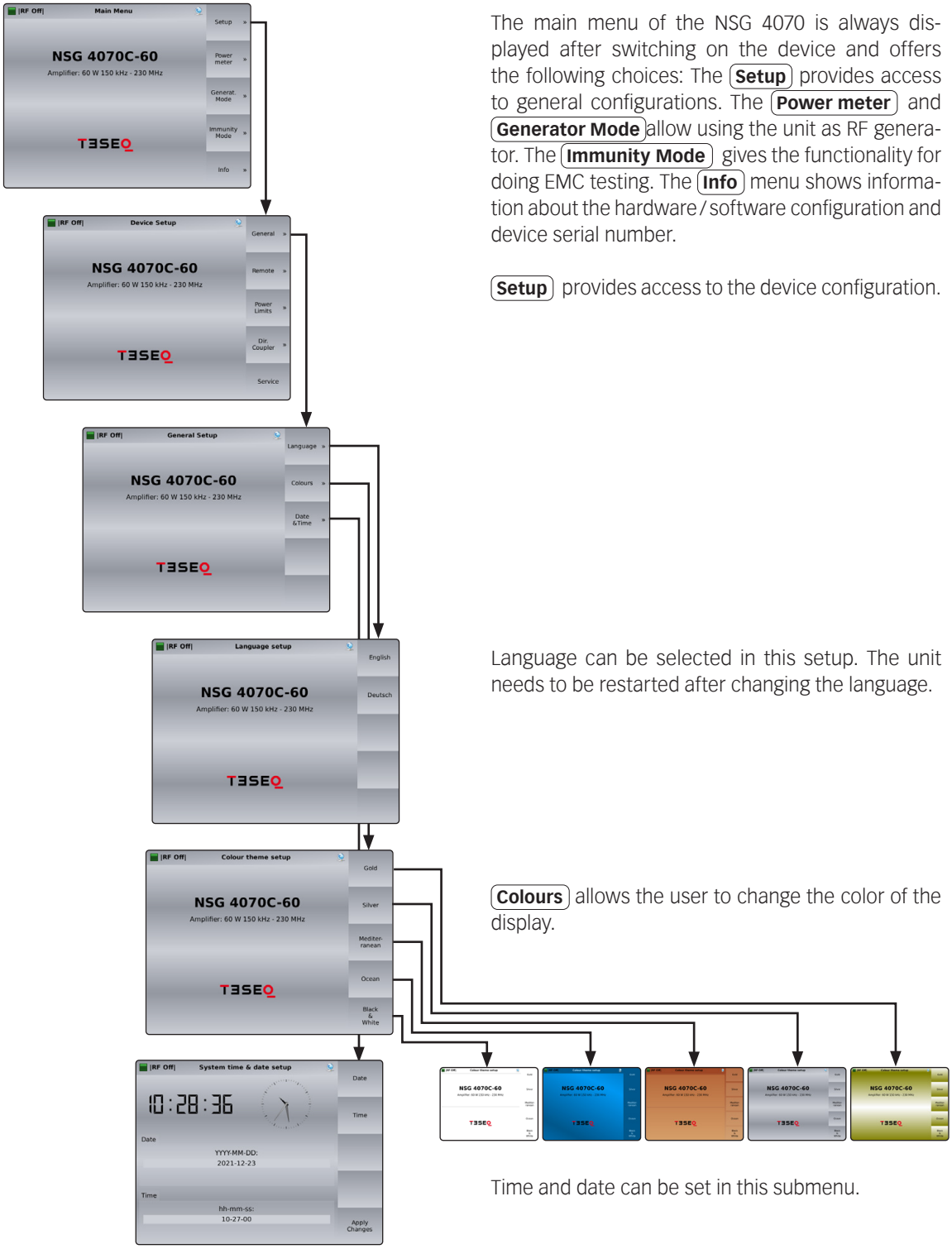
Config To recall the settings from the internal flash or USB stick.

System Cal. To recall the calibration results of the test setup from the internal flash or USB stick.

Probe Cal. To recall the calibration results of the monitoring probe from the internal flash or USB stick

Results To recall the measurement results together with the corresponding configuration from the internal flash or USB stick.

4.2. Setup —> General



The main menu of the NSG 4070 is always displayed after switching on the device and offers the following choices: The **Setup** provides access to general configurations. The **Power meter** and **Generator Mode** allow using the unit as RF generator. The **Immunity Mode** gives the functionality for doing EMC testing. The **Info** menu shows information about the hardware / software configuration and device serial number.

Setup provides access to the device configuration.

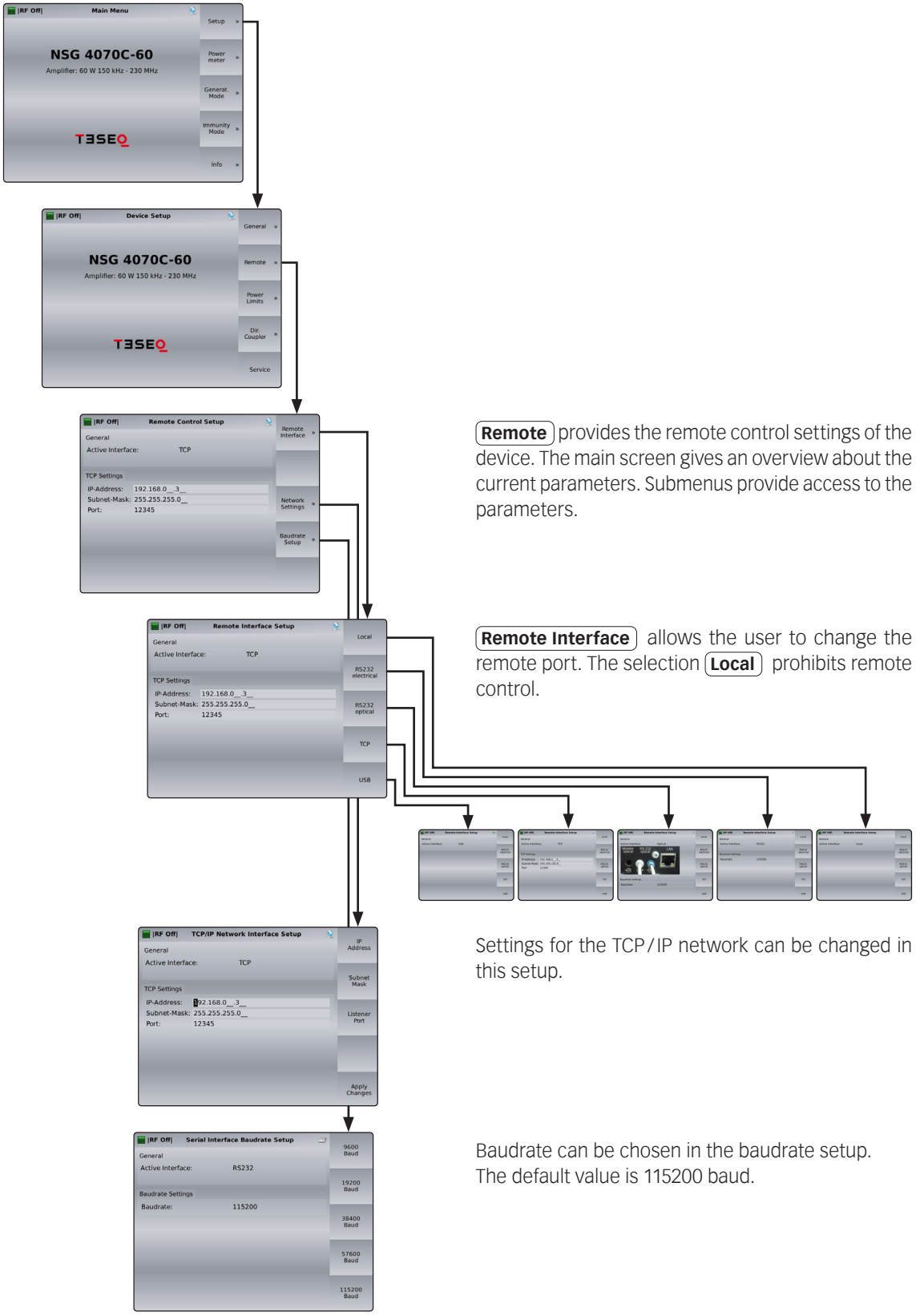
Language can be selected in this setup. The unit needs to be restarted after changing the language.

Colours allows the user to change the color of the display.

Time and date can be set in this submenu.

Advanced Test Solutions for EMC

4.2.1. Setup —> Remote



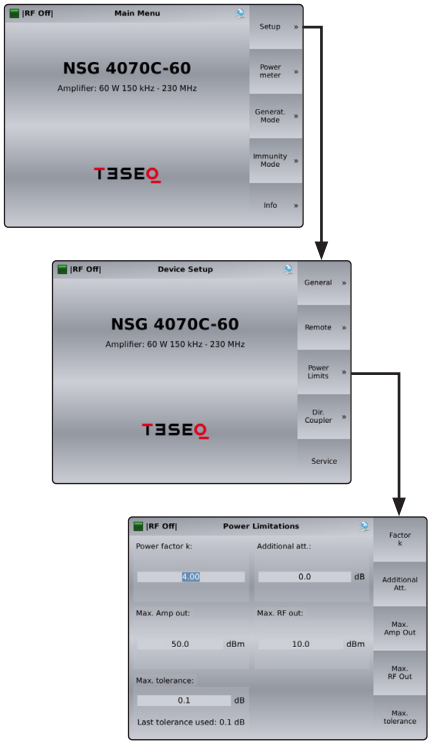
Remote provides the remote control settings of the device. The main screen gives an overview about the current parameters. Submenus provide access to the parameters.

Remote Interface allows the user to change the remote port. The selection **Local** prohibits remote control.

Settings for the TCP/IP network can be changed in this setup.

Baudrate can be chosen in the baudrate setup. The default value is 115200 baud.

4.2.2. Setup —> Power limitations



Power Limits allows the user to set system limits. **Faktor k** is a power limitation factor as described in the ISO 11452-4 standard. The default value is 4. (See chapter 8.3.7 for more information.)

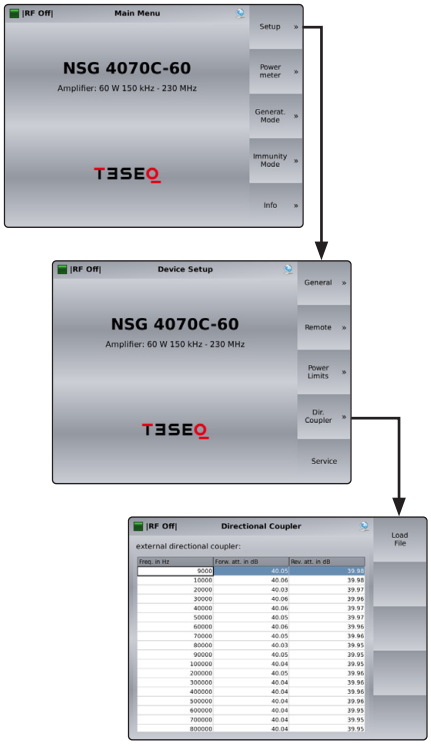
The softkey **Aditional Att.** allows the user to use an additional attenuator to protect power meter 1 against levels above the maximum input power of this channel. Enter 10 for an attenuator of 10 dB.

The softkey **Max. Amp Out** allows the user to set a limit for the maximum forward power.

The softkey **Max. RF Out** allows the user to set a limit for the maximum generator power (RF output of NSG 4070).

The softkey **Max. Tolerance** allows the user to increase the control tolerance of the system as maybe needed for EUTs with nonlinear feedback.

4.2.3. Setup —> Directional coupler

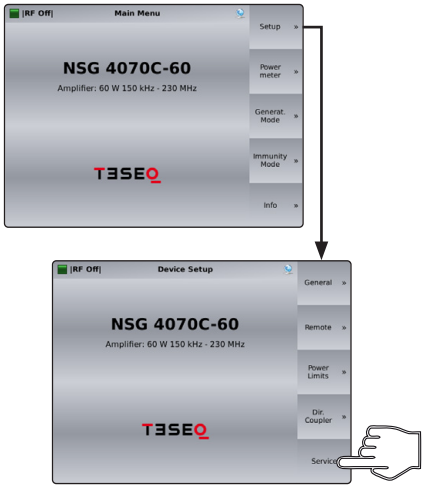


The softkey **Load File** offers the import function for the coupling attenuation calibration factors of the external directional coupler.

The use of an external amplifier also requires an external directional coupler. The coupling attenuation must be imported from the USB stick. The file has to be in ASCII format and must contain 3 columns separated by a comma. The first column is the frequency in Hz, the second represents the forward coupling attenuation and the last column is the reverse coupling attenuation. An example is shown below:

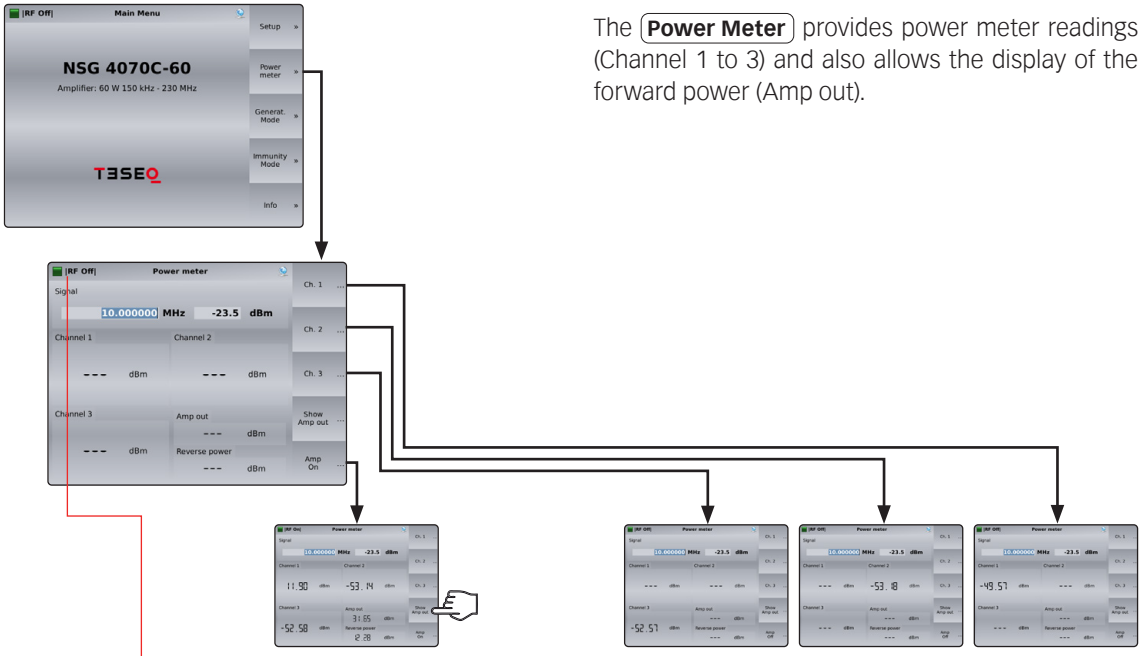
10000,39.9,39.7
100000,39.9,39.7
30000000,39.9,39.8
100000000,40.3,40.2
1000000000,39.9,40.2

4.2.4. Setup —> Service

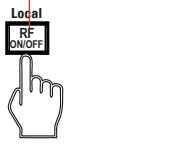


The **Service** is password protected and only accessible by authorized Teseq service personnel.

4.3. Power meter mode



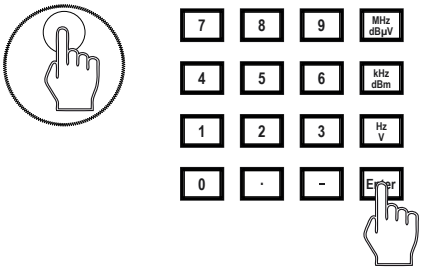
The **Power Meter** provides power meter readings (Channel 1 to 3) and also allows the display of the forward power (Amp out).



The internal power amplifier can be switched on/off with the softkey **Amp off** / **Amp on**.
The generator can be switched on/off with the hardkey **RF ON/OFF**.

The generator frequency and level can also be set of the generator. The hardkey **FRQ** allows the user to change the test frequency with the rotary knob (see chapter 4.1.5.4 for changing the step size) or the numeric keyboard.

The hardkey **LVL** allows the user to change the test level with the rotary knob or the numeric keyboard.



The numeric input has to be terminated with the hardkey **Enter** or with the specified unit key **MHz/dBµV**, **kHz/dBm** or **Hz/V**. The accepted value is displayed with green background color for a short while.

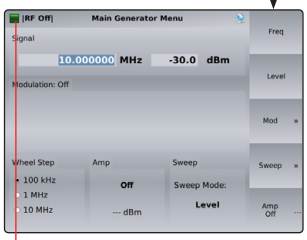
A warning note appears to remind the user for switching off the modulation. Otherwise strange power meter values may occur.

4.4. Generator mode

Caution: **For EMC tests the "Immunity Mode" offers the necessary routines. The "Generator Mode" described in this chapter, on the other hand, permits the NSG 4070s as a signal source with assigned frequency and level.**

4.4.1. Generator —> Frequency, level and RF output on/off

The **Generator Mode** gives an overview about the current settings of the signal generator.

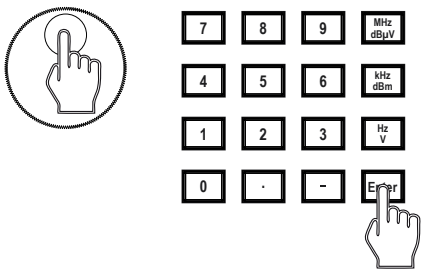


Frequency and level can be set by hard keys or by softkeys in this menu. A selected parameter can be changed by using the rotary key.

The generator can be switched on/off with the hardkey **RF ON/OFF**.

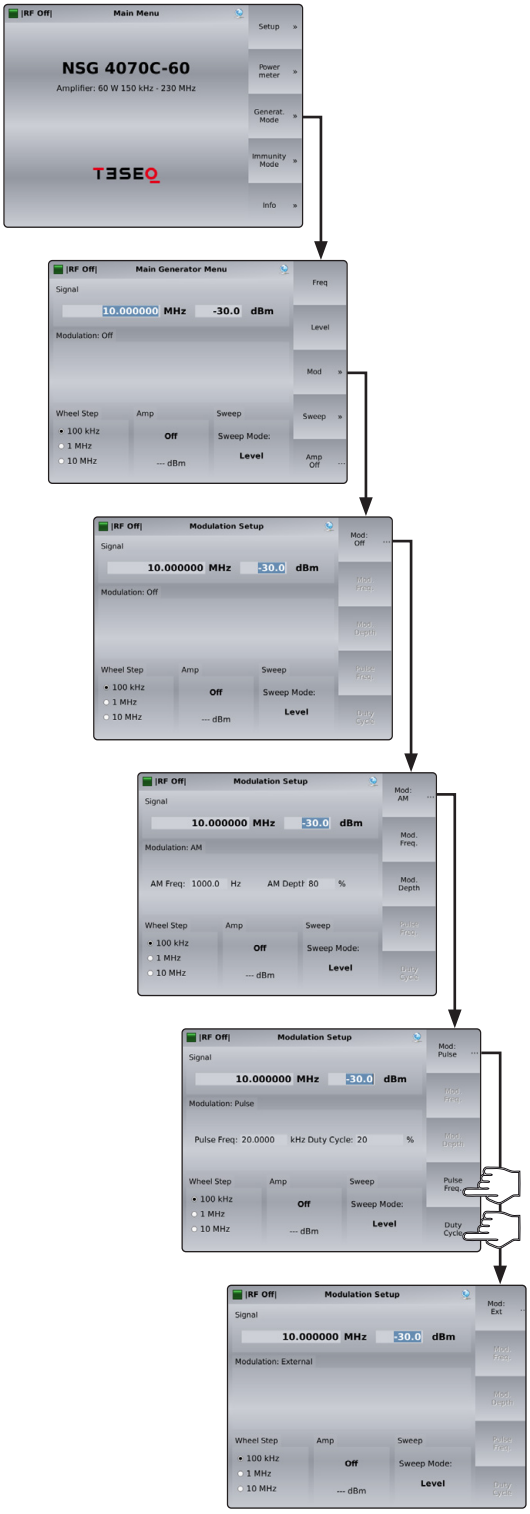
The hardkey **FRQ** allows the user to change the test frequency with the rotary knob (see chapter 4.1.5.4 for changing the step size) or the numeric keyboard.

The hardkey **LVL** allows the user to change the test level with the rotary knob or the numeric keyboard.



The numeric input has to be terminated with the hardkey **Enter** or with the specified unit key **MHz/dBµV**, **kHz/dBm** or **Hz/V**. The accepted value is displayed with green background color for a short while.

4.4.2. Generator —> Modulation



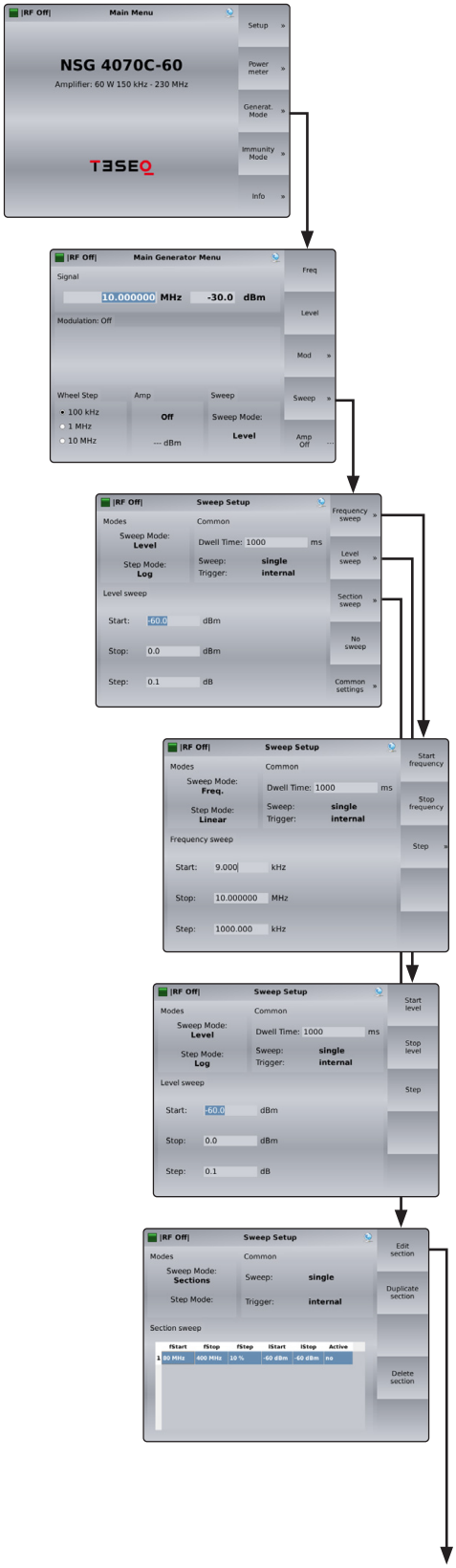
Modulation can be set to AM (amplitude modulation), PM (pulse modulation), external or off.
The modulation can be changed by pressing the upper softkey.
Level profiles can be built with the function **Sections** of the menu **Sweep Mode**. The parameter of the activated sections will be used in case of using this function. The display is changed and shows the sections in a table. The modulation parameter of the menu **Mod** are deactivated.

Press **Mod. Freq.** to change the modulation frequency and **Mod. Depth** to change the depth for the AM.

Three modulators are available for pulse modulation. They can be freely configured so that more complex signals can also be generated. Frequency and duty cycle are set in each case. The next modulator can be selected and configured by pressing the softkey **Pulse Freq.** or **Duty Cycle** again.

Using the modulation input on the rear panel and selecting **Mod: Ext.** allows a sinusoidal signal with 1 V peak to peak to get a modulation factor of 100 %.

4.4.3. Generator —> Sweep



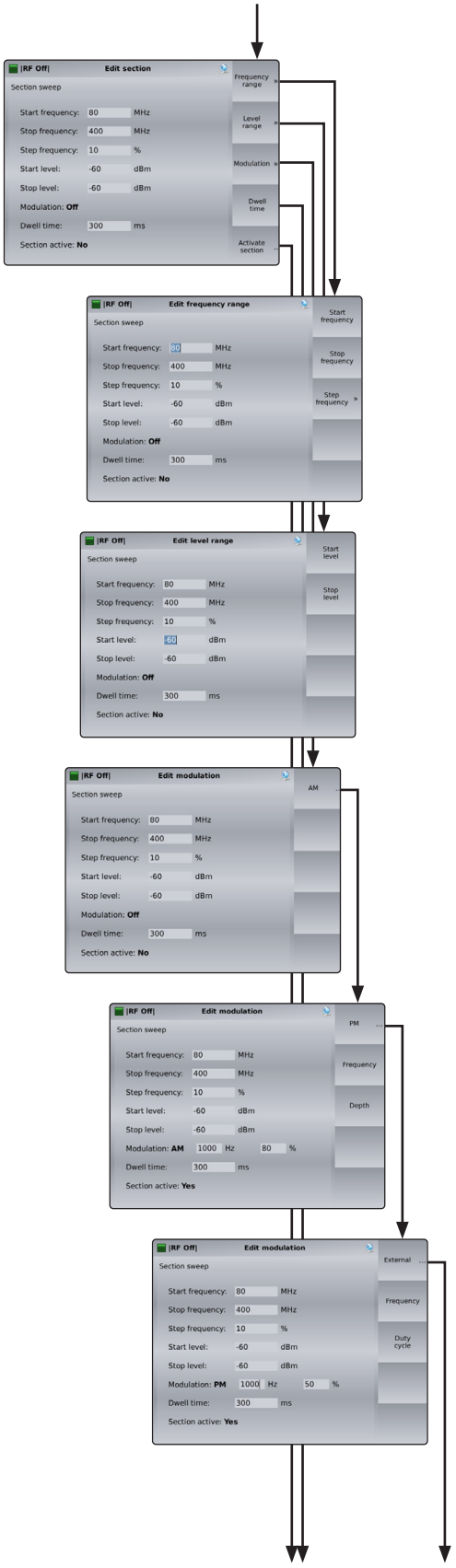
The Generator mode offers frequency, level or section sweep modes.

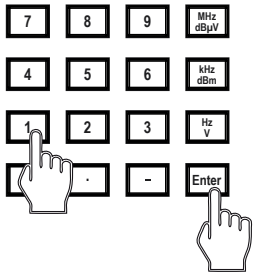
Start, stop and step frequency can be set for the frequency sweep.

Start, stop and step level can be set for the level sweep.

4.4.3.1. Generator —> Sweep —> Section Sweep

The softkey **Section Sweep** and the following sub menus allow to create test profiles. **Edit Section** opens the section for the parameter input or change. **Duplicate Section** creates another sections. Using the rotary knob allows to select the section. **Delete Section** erases the selected section.





Select the desired field with the softkey, do the selection or type in the new parameter with help of the keypad or connected keyboard. Confirm the input with the relevant soft or hardkey.

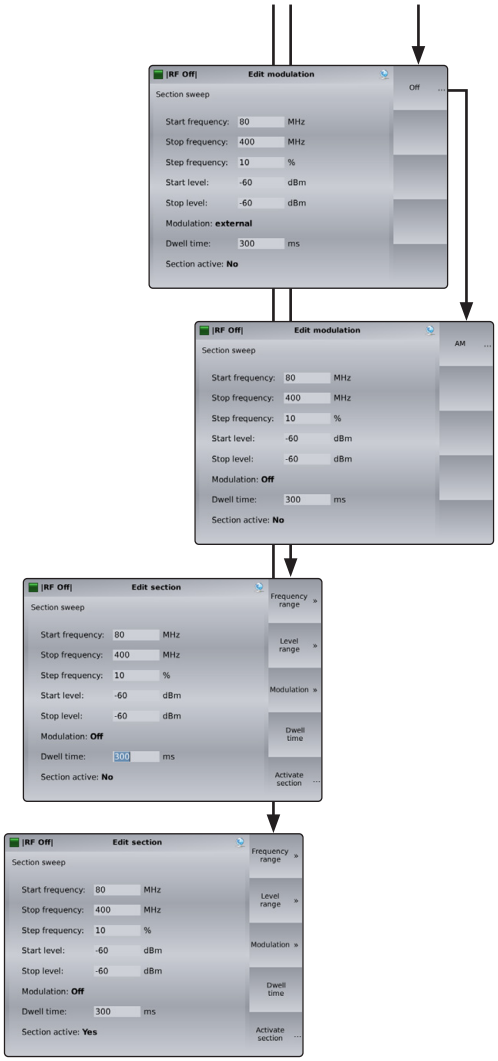
Press **Start Frequency**, **Stop Frequency** and **Step Frequency** to set the start, stop and step frequencies. Using **Step Frequency** allows to define linear, numbers per decade or percent increase of the frequency.

Press **Start Level** and **Start Level** to set the start and stop levels in dBm.

Modulation can be set to AM (amplitude modulation), PM (pulse modulation), external or off. The modulation can be changed by pressing the upper softkey.

Press **Mod. Freq.** to change the modulation frequency and **Mod. Depth** to change the depth for the AM.

Three modulators are available for pulse modulation. They can be freely configured so that more complex signals can also be generated. Frequency and duty cycle are set in each case. The next modulator can be selected and configured by pressing the softkey **Pulse Freq.** or **Duty Cycle** again.



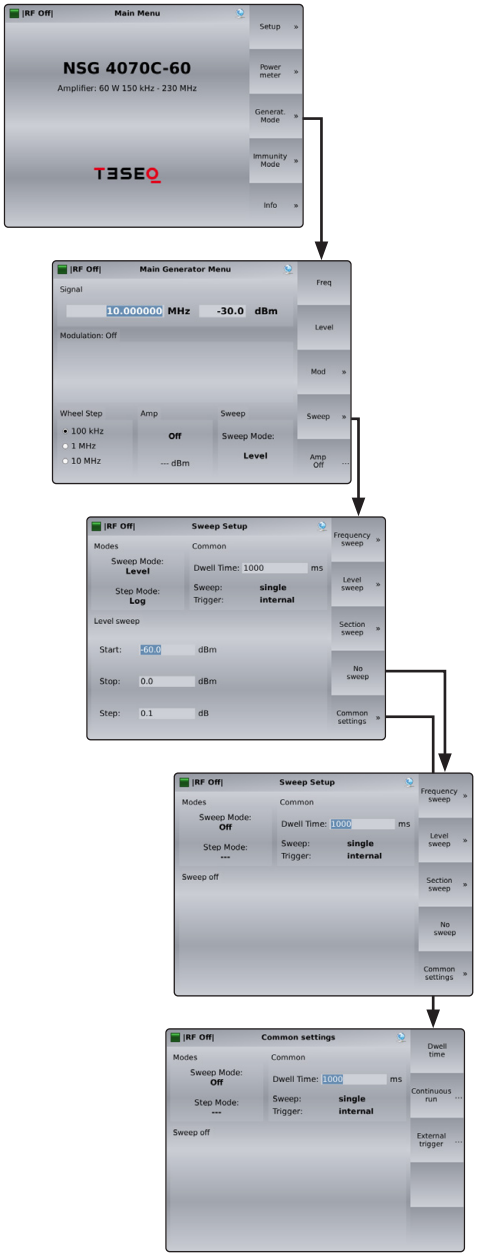
Using the modulation input on the rear panel and selecting **Mod: Ext.** allows a sinusoidal signal with 1 V peak to peak to get a modulation factor of 100 %.

Use **Mod: Off** for testing in the CW mode.

Press **Dwell Time** to set the dwell time.

Press **Activate Section** to activate the section.

4.4.3.2. Generator —> Sweep —> No Sweep / Common Settings



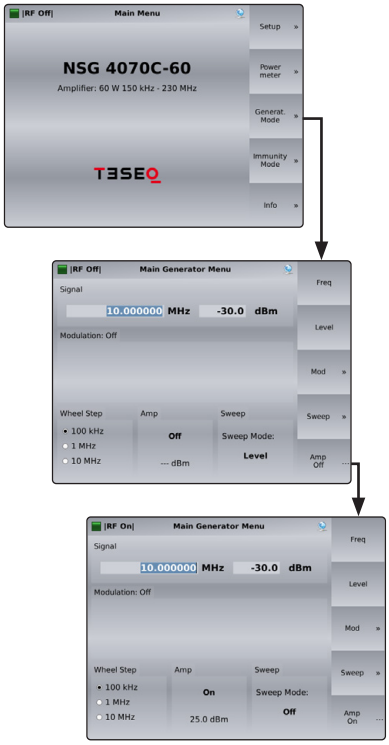
The Generator mode offers frequency, level or section sweep modes.

Single or continuous sweep can be selected in this menu. The trigger can be set to internal (automatic next step after the dwell time) or external (next step after the trigger signal is applied to the external trigger input) via a softkey. For the external trigger, a connection to the trigger input on the rear of the NSG 4070 is required.

4.4.3.3. Generator —> Execute a sweep

The hardkey **Run / Stop** allows the user to start the sweep.

4.4.4. Generator —> Using the power amplifier

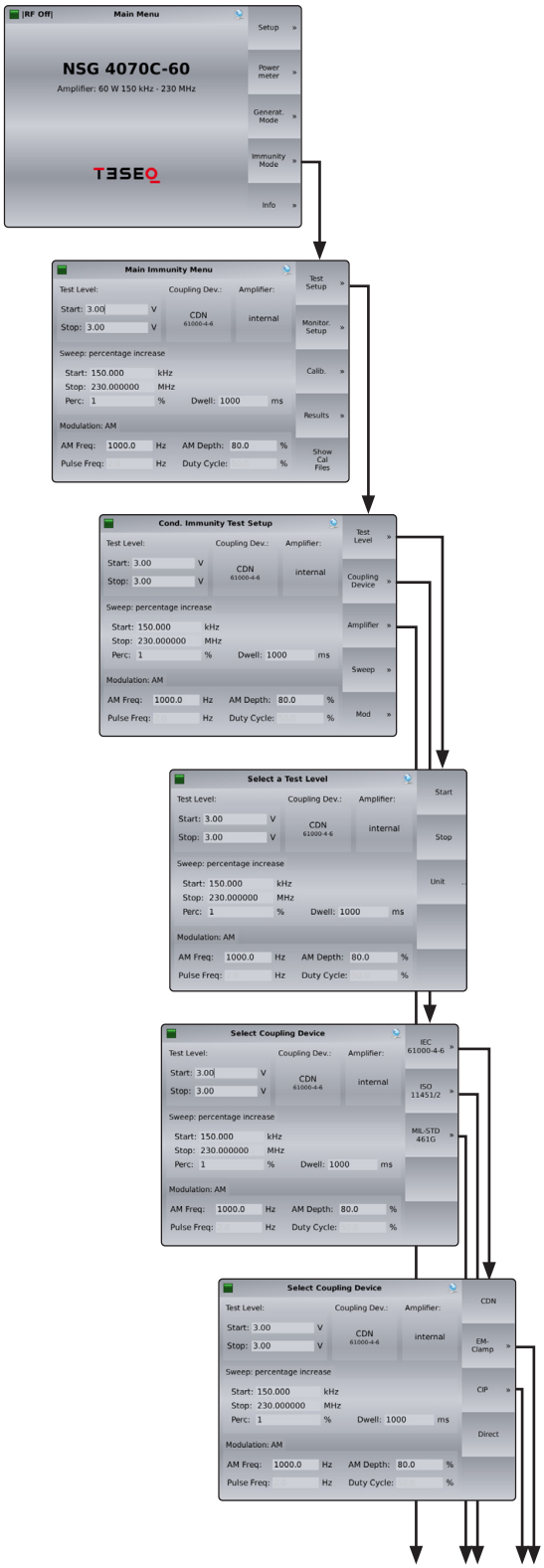


Every NSG 4070 model except the 4070-0 includes an internal amplifier. The amplifier is turned on by pressing the softkey **Amp On** in the Main Generator menu. The drive level, or signal generator output level, is limited to 0 dBm when the amplifier is in use. The amplifier output level (forward power) and the signal generator level (amplifier module drive level) are displayed.

WARNING: The power meter inputs are very sensitive. Please avoid any direct connection of amplifier output and power meter input with a high generator level (under these circumstances a maximum generator level of -30 dBm is recommended).

4.5. Immunity Mode

4.5.1. Immunity —> Test Setup —> Test level, Coupling Device and Amplifier

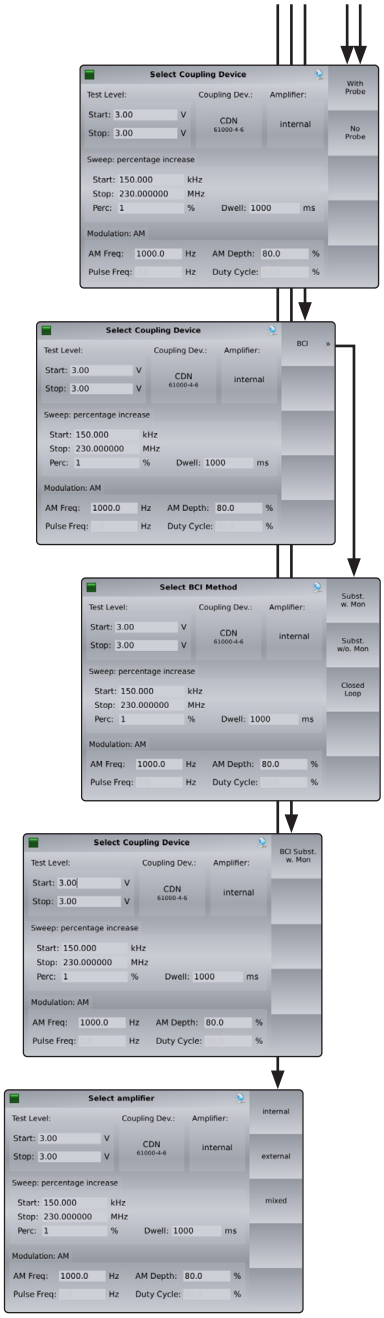


The "Main immunity menu" gives an overview of the test parameters. The example shows a test according IEC/EN 61000-4-6 with following test parameter:
Test level: 3 V, coupling device: CDN, amplifier: internal, start frequency: 150 kHz, stop frequency: 230 MHz, step size: 1%, dwell time: 1000 ms, modulation: AM, modulation frequency: 1000 Hz, modulation depth: 80%. The parameter can be changed in the menu "Test Setup".

Select **Test Setup** and **Test Level** to change with the softkeys **Start** and **Stop** the start and stop levels. The softkey **Unit** is only active for BCI. Then the menu provides a choice of using units of mA or dBµA.

Level profiles, as used in CISPR 35, ISO 11452-4 and for car manufacture standards, can be built with the function **Sections** of the menu **Sweep Mode**. Using the **Sections** sweep mode deactivates sweep paramters outside the activated section. The display is changed and shows the sections in a table.

Coupling Device allows the user to choose a CDN, EM clamp, current clamp (CIP) or direct injection according to IEC/EN 61000-4-6. The test level unit is Volts EMF.
The selection **ISO 11451/2** and **MIL-STD 461G** switches the unit from voltage to current as required for Automotive and military tests.



IEC 61000-4-6

The user can choose whether or not to test with a monitoring current probe in the path to the EUT if using EM clamp or current clamp (CIP). The operation **With Probe** requires a loaded probe calibration file in addition to the system calibration file.

ISO 11451/2 and **BCI**

This menu allows the user to choose Substitution method with or without a monitoring current probe, or Closed loop method. Methods are based on ISO 11451, 11452-1 and 11452-4.

Using **Subst. w. Mon.** and **Closed Loop** method require a probe in the path to the EUT and a loaded probe calibration file in addition to the system calibration file.

The Closed loop methode uses a power limitation factor that can be set in the **Setup** —> **Power Limits** with the softkey **Faktor k** .

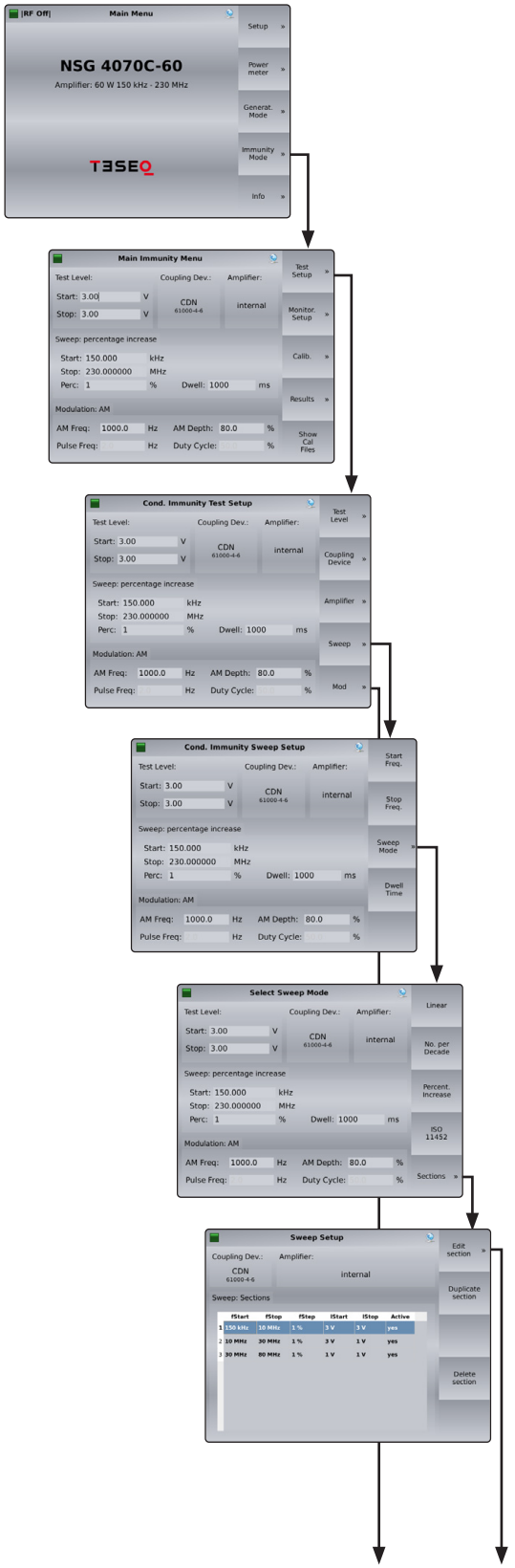
MIL-STD 461G

This method allows the user to test according MIL-STD 461G CS114. It requires to use a monitoring current probe in the path to the EUT and a loaded probe calibration file in addition to the system calibration file.

Amplifier allows the user to select an internal or external power amplifier. **Mixed** allows to use the internal power amplifier with an external directional coupler.

These options are not available for NSG 4070-0.

4.5.2. Immunity —> Test Setup —> Sweep



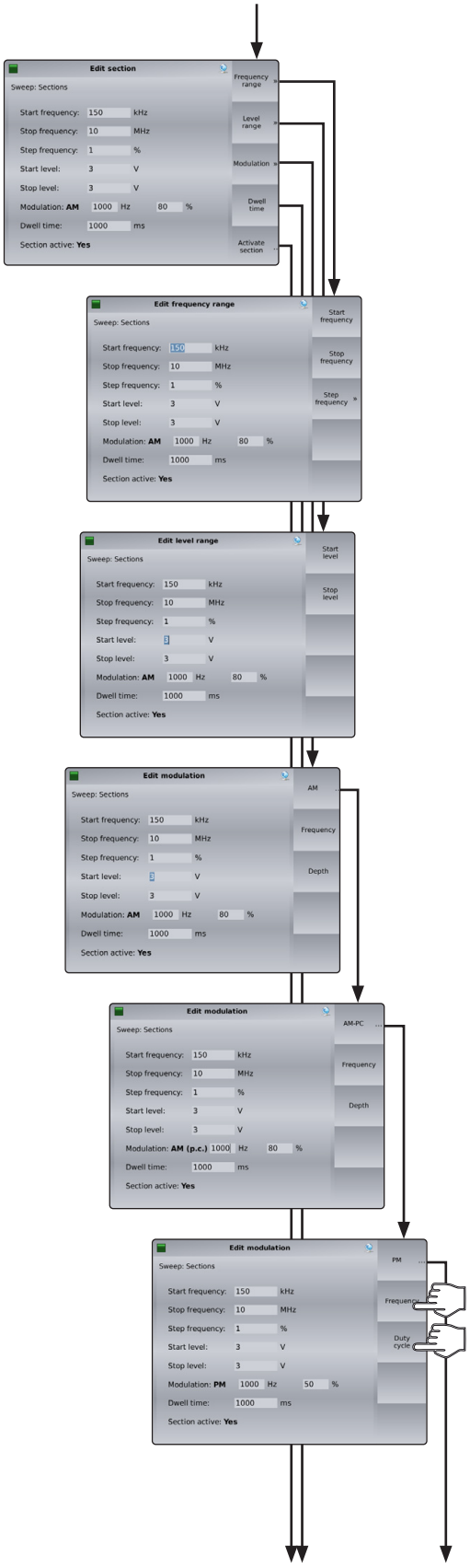
Start and stop frequency, sweep mode and dwell time can be set in the “Conducted immunity sweep setup”.
Level profiles, as used in CISPR 35, ISO 11452-4 and for car manufacture standards, can be built with the function **Sections** of the menu **Sweep Mode**. Using the **Sections** sweep mode deactivates sweep paramters outside the activated section. The display is changed and shows the sections in a table.

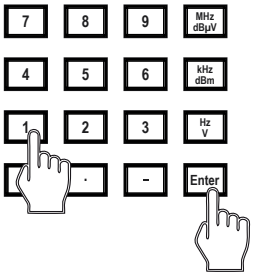
The **Sweep Mode** can be set to linear, numbers per decade or percent increase of the frequency. The option ISO 11452 allows the frequency increase as shown in ISO 11452-1. An additional parameter can be set between 1 and 100 to reduce the step size. See table below.

Frequency range in MHz	max. Step size in MHz according ISO 11452-1	Step size in MHz NSG 4070 parameterset to 1	Step size in MHz NSG 4070 parameterset to 2	Step size in MHz NSG 4070 parameterset to 10	Step size in MHz NSG 4070 parameterset to 100
> 0.01 to ≤ 0.1	0.01	0.01	0.005	0.001	0.0001
> 0.1 to ≤ 1	0.1	0.1	0.05	0.01	0.001
> 1 to ≤ 10	1	1	0.5	0.1	0.01
> 10 to ≤ 200	5	5	2.5	0.5	0.05
> 200 to ≤ 400	10	10	5	1	0.1

Table 1: Step size according ISO 11452-1

The softkey **Section Sweep** and the following sub menus allow to create test profiles. **Edit Section** opens the section for the parameter input or change. **Duplicate Section** creates another sections. Using the rotary knob allows to select the section. **Delete Section** erases the selected section.





Select the desired field with the softkey, do the selection or type in the new parameter with help of the keypad or connected keyboard. Confirm the input with the relevant soft or hardkey.

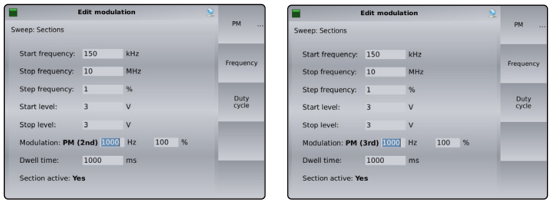
Press **Start Frequency**, **Stop Frequency** and **Step Frequency** to set the start, stop and step frequencies. Using **Step Frequency** allows to define linear, numbers per decade or percent increase of the frequency.

Press **Start Level** and **Start Level** to set the start and stop levels.

Modulation can be set to AM (amplitude modulation), AM PC (amplitude modulation with peak conservation), PM (pulse modulation), external or off. The modulation can be changed by pressing the upper softkey.

Press **Frequency** to change the modulation frequency and **Depth** to change the depth for the AM. Three modulators are available for pulse modulation.

They can be freely configured so that more complex signals can also be generated. Frequency and duty cycle are set in each case. The next modulator can be selected and configured by pressing the softkey **Frequency** or **Duty Cycle** again.



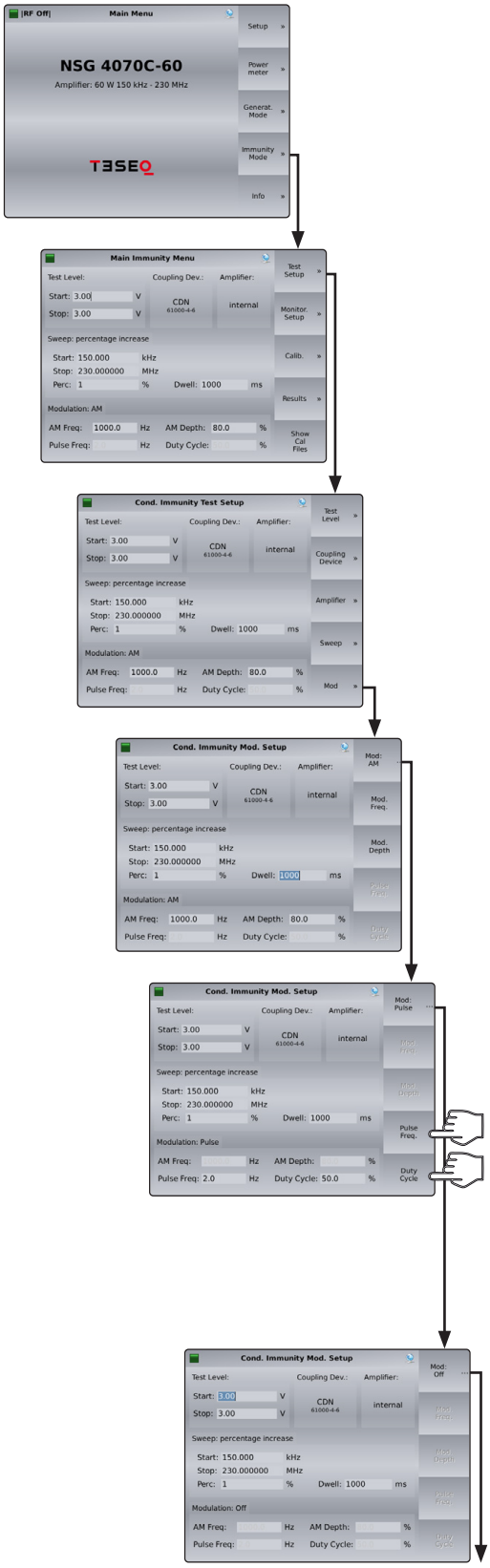
Using the modulation input on the rear panel and selecting **Mod: Ext.** allows a sinusoidal signal with 1 V peak to peak to get a modulation factor of 100 %.

Use **Off** for testing in the CW mode.

Press **Dwell Time** to set the dwell time.

Press **Activate Section** to activate the section.

4.5.2.1. Immunity —> Test setup —> Modulation

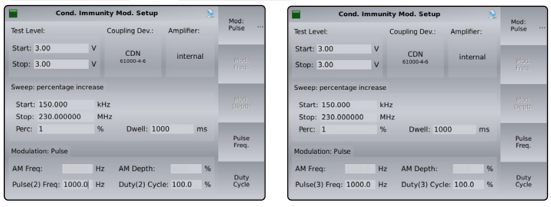


Modulation can be set to AM, AM PC, pulse modulation, external modulation or off. The modulation can be changed by pressing the upper softkey.
Mod: AM Amplitude modulation
Mod: PM Pulse modulation
Mod: Ext. External modulation
Mod: Off Modulation off
Mod: AM PC Amplitude modulation with peak conservation as described in ISO 11452-1

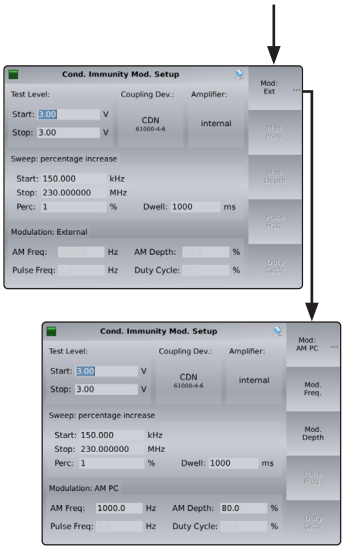
Level profiles, as used in CISPR 35, ISO 11452-4 and for car manufacture standards, can be built with the function **Sections** of the menu **Sweep Mode**. Using the **Sections** sweep mode deactivates sweep paramters outside the activated section. The display is changed and shows the sections in a table.

Press **Mod. Freq.** to change the modulation frequency and **Mod. Depth** to change the depth for the AM. Use this modulation for testing according IEC 61000-4-6.

Three modulators are available for pulse modulation. They can be freely configured so that more complex signals can also be generated. Frequency and duty cycle are set in each case. The next modulator can be selected and configured by pressing the softkey **Pulse Freq.** or **Duty Cycle** again.



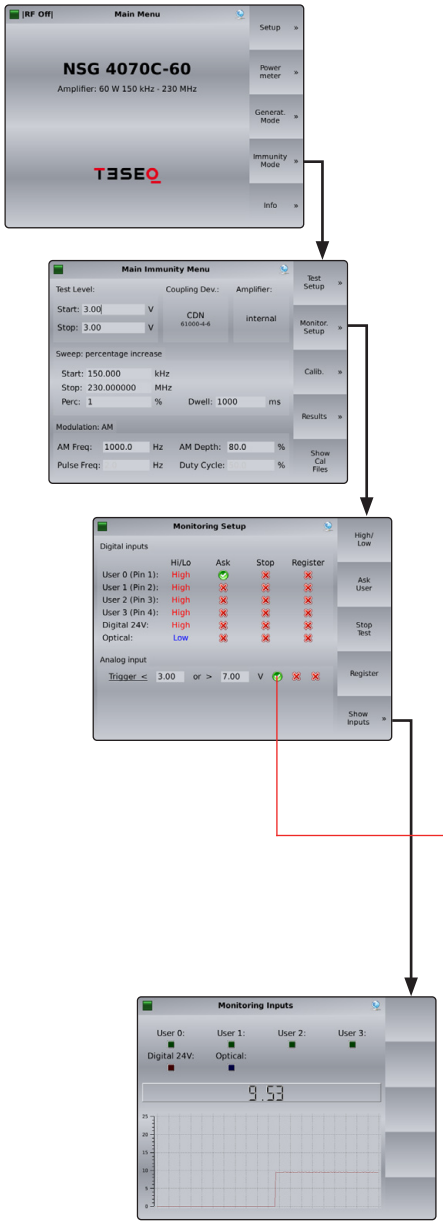
Use **Mod: Off** for testing in the CW mode.



Using the modulation input on the rear panel and selecting **Mod: Ext.** allows a sinusoidal signal with 1 V peak to peak to get a modulation factor of 100 %.

AM PC: Amplitude modulation with peak conservation as described in ISO 11452-1.
Press **Mod. Freq.** to change the modulation frequency and **Mod. Depth** to change the depth for the AM.

4.5.3. Immunity —> Monitoring setup

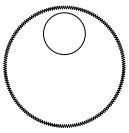


There are several EUT monitoring ports:

- User port input 0 to 3: (4 bit TTL in)
- Digital 24V: up to 24 V
- Optical input
- Analog input: 0-24 V

Each monitoring port can be individually configured. The switching condition can be set to high or low active using the softkey **High/Low**. For analog input a window can be defined which can be used as a threshold or tolerance window.

The action in case of a trigger event (EUT failure) can be set either to register the occurrence of the event (lowest priority), to stop the test, or user decision (highest priority) using the corresponding softkeys. **Register** automatically includes the registration of the event; **Ask User** allows the user to stop or continue the test.

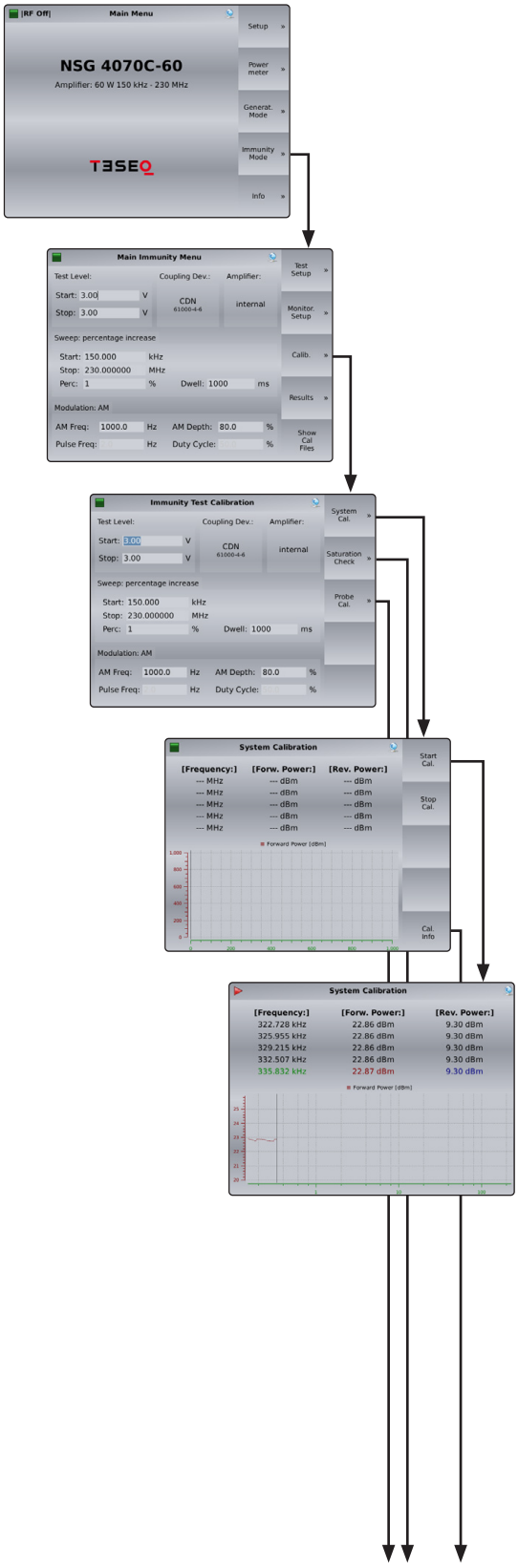


The port can be selected by turning the rotary knob.

- **A green tick indicates that the monitoring port is enabled, a red cross a disabled port.**
  - ✓ **selected**
  - ✗ **not in use**

Show Inputs dispays each monitoring state. The color of each box indicates high or low. The analog port voltage is displayed below the boxes. The graph shows a 10 second history of input activity.

4.5.4. Immunity —> Calibration



Two types of calibration can be performed:

- system calibration for the entire setup
- probe calibration for the monitoring probe.

The "Saturation check" function allows the user to test the necessary power reserve for the testing with modulation.

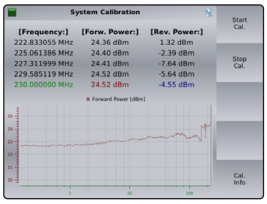
4.5.4.1. Immunity —> Calibration —> System Calibration

During calibration the current frequency and forward power are displayed in the table as well as in the graph. The reverse power is displayed when an external amplifier is selected.

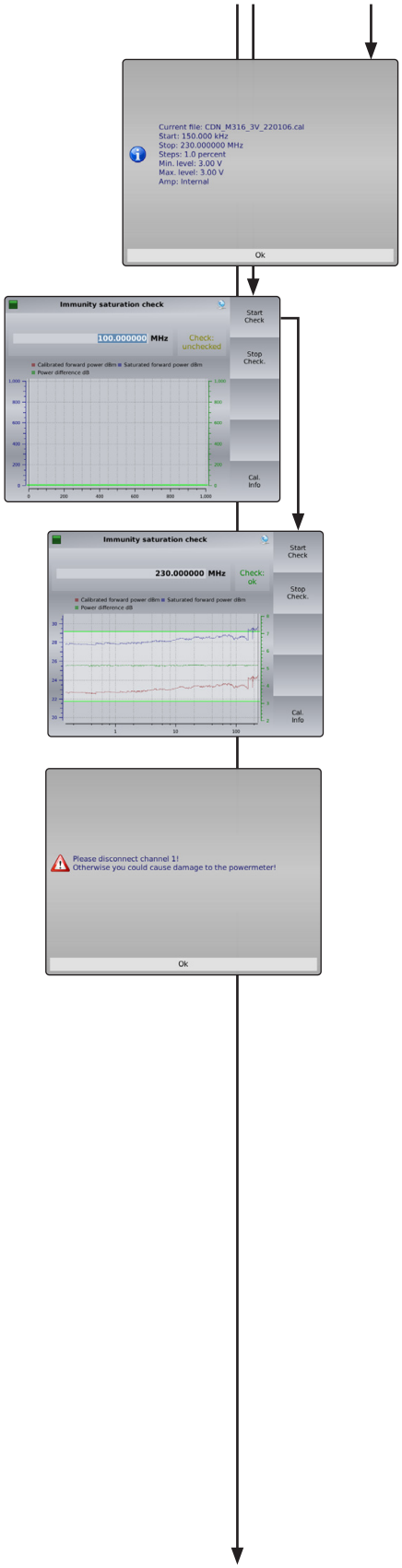
The internal control algorithm provides a maximum deviation of ± 0.1 dB to the target calibration level.

The start frequency, stop frequency, test level, step mode, internal or external amplifier have to be defined in the "Test setup" menu before calibration. The calibration is independent of the selected dwell time and modulation parameters.

The softkey **Start Cal.** starts the calibration and **Stop Cal.** terminates the calibration.



The calibration result can be observed by turning the rotary knob.
The red curve shows the forward power of the calibration which is related to the left axis. The blue curve shows the reverse power (only with NSG 4070C-60 and NSG 4070C-110 or with all NSG 4070s and selection of external amplifier) of the calibration which is related to the right axis.



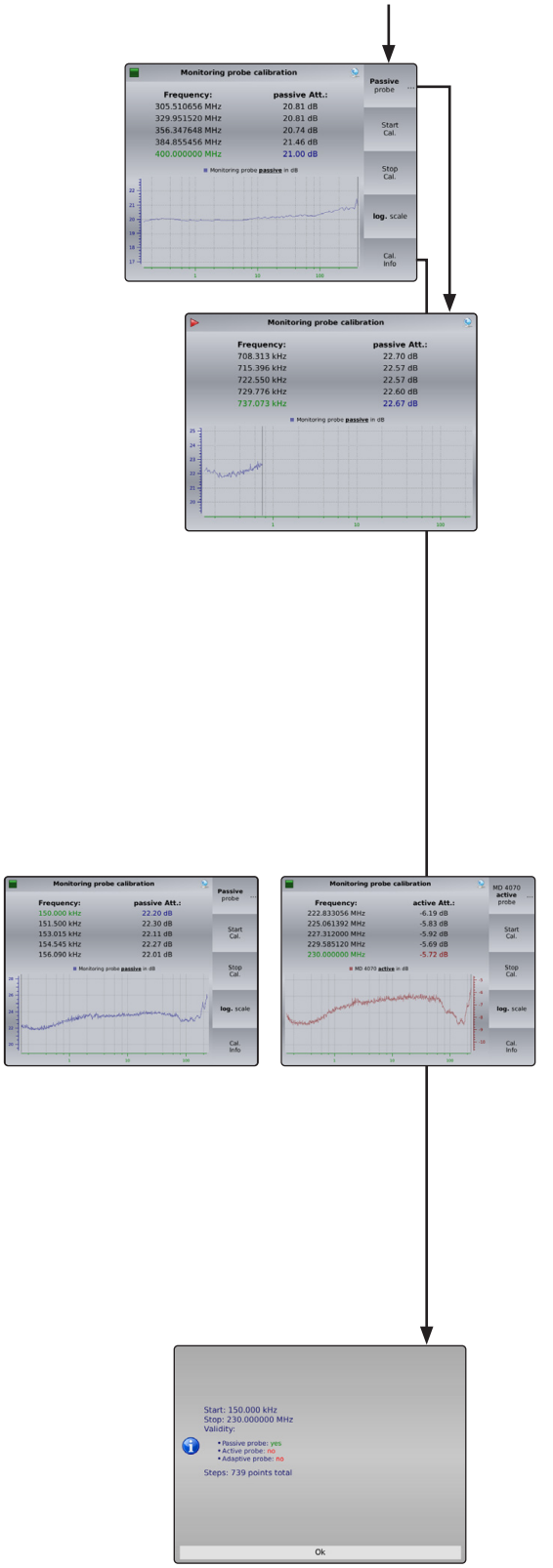
The softkey **Cal. Info** provides the file name, start frequency, stop frequency, steps, start level, stop level and amplifier internal or external.

4.5.4.2. Immunity —> Calibration —> Saturation check

This function allows the user to check whether there is sufficient power available for the selected modulation required, even if the system calibration is always performed without modulation. Special high test levels could bring the power amplifier into saturated range if the modulation (e.g. AM with 80% needs 5.1 dB more power) is switched on during EUT testing. The check requires a loaded calibration file. The forward power of the calibration is increased with 5.1 dB during the check.
The result of the “Saturation check” is provided in a graph. The lower curve shows the calibrated forward power in red. The upper curve shows the increased forward power during the check. Both curves are related to the left axis. The green curve shows the check result (difference) and is related to the right axis. For having the power reserve the check result should be around 5.1 dB.

The softkey **Start Check** starts the check and **Stop Check** terminates the check. The softkey **Cal. Info** provides the file name, start frequency, stop frequency, steps, start level, stop level and internal or external amplifier.

The forward power of the calibration is increased by 5.1 dB during the check. This could damage the power meter channel 1. It is strongly recommended to disconnect the power meter channel 1 for the “Saturation check”. A message box, shown on the left side, reminds the user to follow this advice.



4.5.4.3. Immunity —> Calibration —> Probe calibration

The “Probe calibration” function allows the user to calibrate a current probe in a 50 Ω jig. During the calibration the current frequency and attenuation are displayed in the table as well as in the graph.
The start frequency, stop frequency, step mode, internal or external amplifier have to be defined in the “Test setup” menu before calibration.
The calibration is independent of the selected test level, dwell time and modulation parameters.
The “probe calibration” function can also be used for checking the setup, cable or attenuator.

The softkeys **Passive Probe** / **Active Probe** / **Adaptive Probe** allow the user to switch the probe to passive, active or adaptive. The adaptive mode requires the MD 4070A connected (cable LE 242) with the user port of the NSG 4070. Using the adaptive mode switches the MD 4070A during the probe calibration first to the passive and second to the active mode by the remote connection.

The softkey **Start Cal.** starts the calibration and **Stop Cal.** terminates the calibration.

The calibration result can be observed by turning the rotary knob.
The blue curve shows the probe calibration result in the passive mode, which is related to the left axis.
The red curve shows the result in the active mode, which is related to the right axis.

The softkey **Cal. Info** provides start frequency, stop frequency, calibration points and information of the used mode.

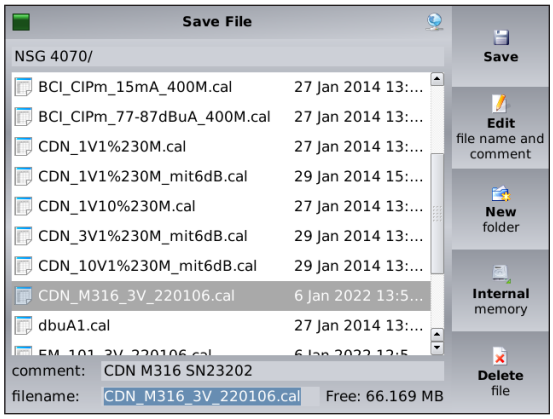
4.5.4.4. Immunity: Store and recall system calibration data

In general, the hard keys STO and RCL allow the user to store and to recall configurations, system calibration data, probe calibration and results.

Store
Pressing the hard key STO followed by the soft key **System Cal.** allows the user to save the calibration results of the test setup to the internal flash or USB stick as file type ".cal".

Included in the calibration file are:

- Start and stop frequency
- Start and stop level
- Amplifier internal / external
- Forward power versus frequency
- "File Comment"



The file comment offers additional information to the calibration file and can be filled out before saving the file.

Recall
Pressing the hard key RCL followed by the soft key **System Cal.** allows the user to recall the calibration results of the test setup from the internal flash or USB stick.

The stored file can be selected by turning the rotary knob followed by the softkey **Load** or hardkey **Enter**.

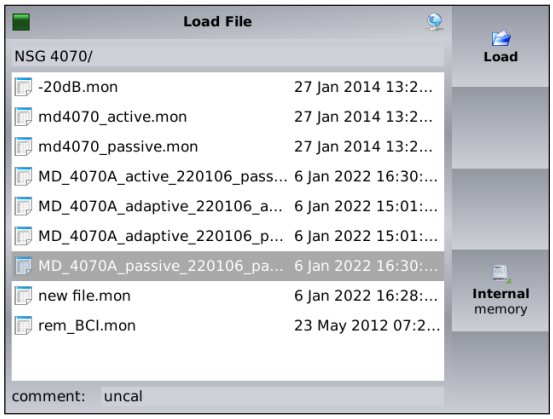
4.5.4.5. Immunity: Store and recall probe calibration data

In general the keys STO and RCL allow the user to store and recall the configurations, calibration data, probe calibration and results.

Store
Pressing the hard key STO followed by the soft key Probe Cal. allows the user to save the probe calibration results to the internal flash or USB stick as file type ".mon".

The probe calibration file includes:
- Start and stop frequency
- Frequency step information
- Insertion loss versus frequency
- "File Comment"

The file comment provides additional information relating to the calibration file and can be filled out by the user before saving the file.



Recall
Pressing the hard key RCL followed by the soft key Probe Cal. allows the user to recall the probe calibration results from the internal flash or USB stick

The stored file can be selected by turning the rotary knob followed by the softkey Load or hardkey Enter.

4.5.5. Immunity: Testing

The hardkey **Run / Stop** allows the user to start the current test independent of the menu selected within the immunity mode.
Pre-conditions:

- loaded system calibration
- selected EUT monitoring functions
- disconnected power meter 1 for testing above 18 V EMF stress level from the calibration setup

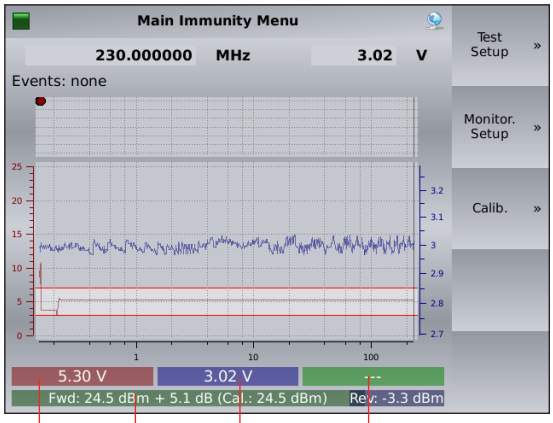
During the test the current frequency, test level and trigger events / analog input voltage on EUT monitoring ports are displayed. The analog input voltage (red curve) is related to the left axis. The test level (blue curve) is related to the right axis.

The internal control algorithm provides a maximum deviation of ± 0.1 dB to the used calibration values.

The hardkey **Run / Stop** allows the user to stop the executed test.

The results can be investigated by turning the rotary knob after the test is finished or aborted.

The softkeys **Test Setup**, **Monitoring Setup** and **Calib.** are described previously and can also be reached with the hardkey **Back**.



Current measured with monitoring probe

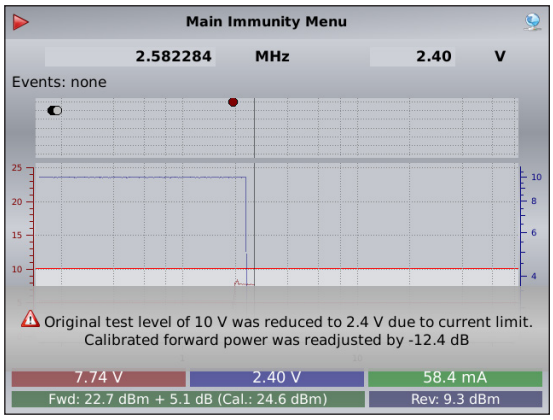
Test level incl. tolerance

Used forward power (Fwd.) additionally the reserve needed for the AM (+5,1 dB)

Calibrated forward power (Cal.)

Voltage on the analog EUT monitoring input

4.5.5.1. Immunity: Testing with monitoring probe



Testing with a monitoring probe requires a coupling device such as an EM clamp or CIP with selected "With probe" BCI testing requires "Substitution with monitoring device" or "Closed loop" for including a monitoring probe.

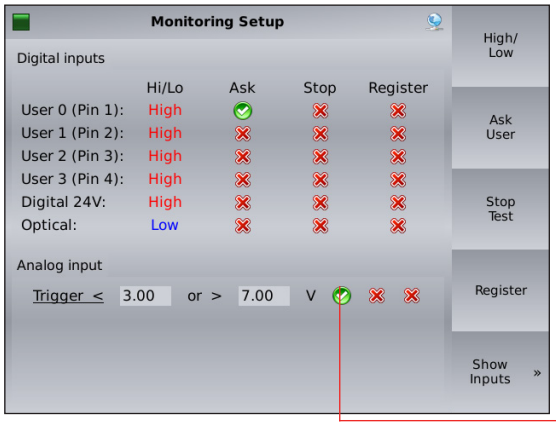
The user must recall a probe calibration file as well as the system calibration file. (chapter 4.5.3.5).

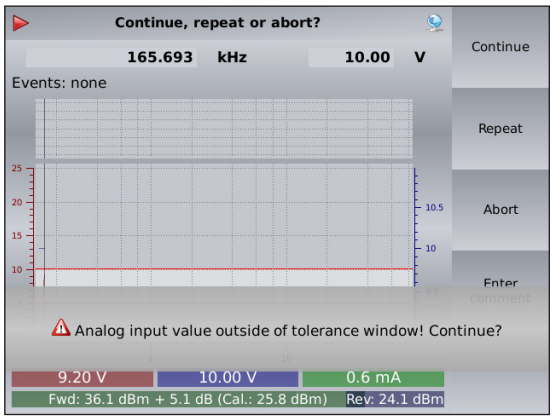
Pre-conditions:

- system calibration loaded
- probe calibration loaded
- EUT monitoring functions selected
- monitor probe on power meter 1 connected

IEC / EN 61000-4-6 requires a limitation of the stress level if the requirements for the asymmetrical impedance cannot be fulfilled. A reduced stress level can be recognized as variance from the standard test level as shown in the blue curve. The test level (blue curve) is related to the right axis.

4.5.5.2. Immunity: Testing with EUT monitoring events



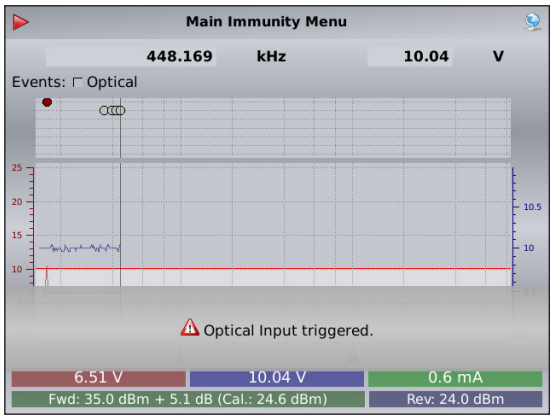


The action in case of a trigger event (EUT failure) can be set either to register the occurrence of the event (lowest priority), to stop the test, or user decision (highest priority) using the corresponding softkeys (see chapter 4.5.2 for details).

Example:

- If **Ask User** is selected and an EUT monitoring event occurs:

A message box and softkeys come up and the test is interrupted. An user action is required.
Press **Continue** to continue testing.
Press **Repeat** to repeat testing on same frequency.
Press **Abort** to stop the test.
Press **Enter Comment** to type in a comment. Press then **Back** to continue testing.

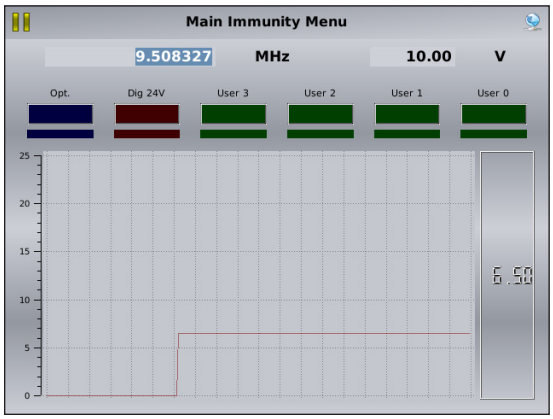


If **Register** is selected, when an EUT monitoring event occurs:
A message box is displayed when the EUT monitoring event has been detected. The test continues.

4.5.5.3. Immunity: Testing with manual change of frequency and level

The key **Run / Stop** allows the user to start the current test and the key **Hold** interrupts the sweep and the display is changed as shown below:
Pre-conditions:

- system calibration loaded
- probe calibration loaded (all test with monitoring device)
- EUT monitoring functions selected
- power meter 1 for testing above 18 V EMF stress level disconnected



During this mode each monitoring port state is displayed. The color indicates high or low. The smaller field shows the history for the past 5 seconds.
The analog port voltage is displayed with the digits. The graph shows the past 10 seconds of history.

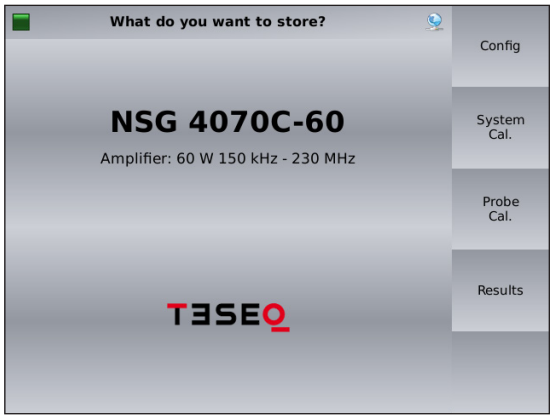
The hardkey **FRQ** allows the user to change the test frequency by the rotary knob. Only the calibrated frequencies can be selected. The hardkey **LVL** allows the user to change the test level with the rotary knob.

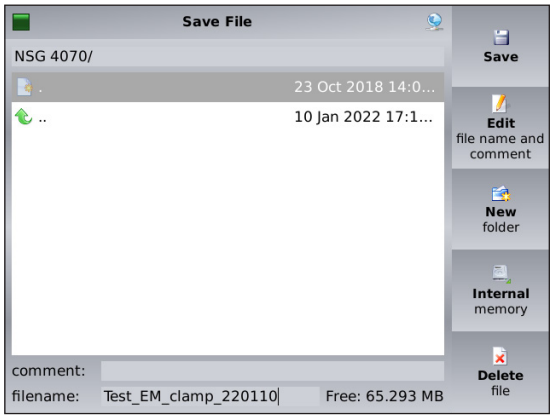
The use of the key **Hold** continues the sweep. The display changes to the previous one.
The key **Run / Stop** allows the user to stop the test.

Warning: **The function "Hold" interrupts only the sweep. The test level is still present on the output.**

4.5.5.4. Immunity: Store and recall results

In general, the hard keys STO and RCL allow the user to store and to recall configurations, system calibration data, probe calibration and results.





Store

Pressing the hard key STO followed by the softkey **Results** allows the user to save the test results (including test setup and calibration data) to the internal flash or USB stick as file type ".res". Using the USB stick saves the results additionally in a ".csv" file format.

The results file includes:

- Start and stop frequency
- Start and stop level
- Sweep parameters
- Coupling device and monitoring probe
- Modulation parameters
- Amplifier internal / external
- EUT monitoring settings
- Forward power versus frequency (calibration data)
- Insertion loss versus frequency (probe calibration data) if probe used
- "File Comment"

Edit file name and comment

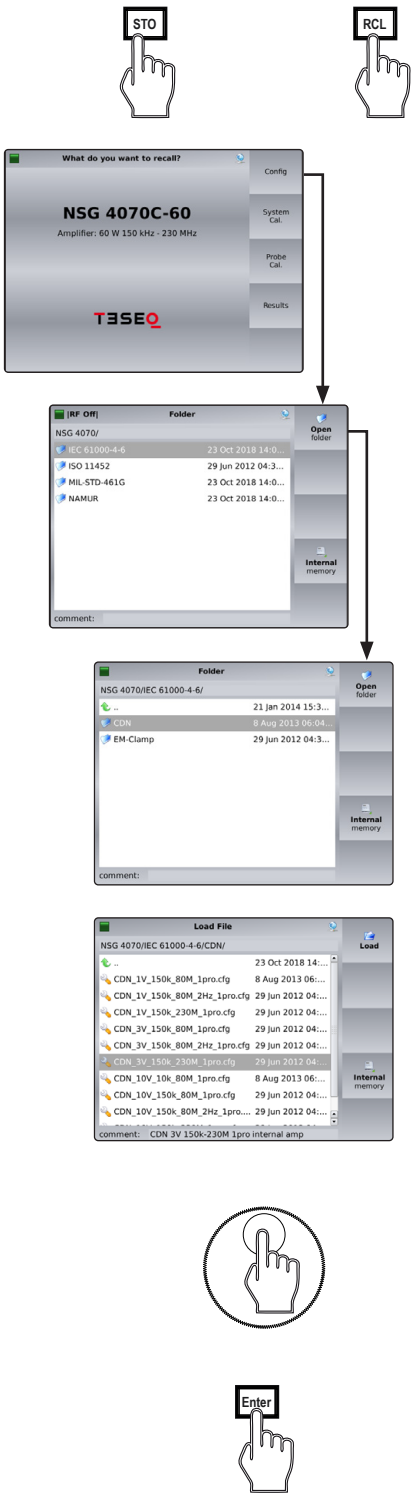
The file comment allows the user to add information to the results and can be filled out before saving the file.

Recall

Pressing the hard key RCL followed by the softkey **Results** allows the user to recall the results from the internal flash or USB stick.

The stored file can be selected by turning the rotary knob followed by the softkey **Load** or hardkey **Enter**.

4.5.5.5. Immunity: Store and recall configurations



In general, the hard keys **STO** and **RCL** allow the user to store and to recall configurations, system calibration data, probe calibration and results.

Store

Pressing the hard key **STO** followed by the softkey **Config** allows the user to save the test configuration to the internal flash or USB stick as file type ".cfg".

The configuration file includes:

- Remote settings
- Generator mode settings
- Step key settings
- Start and stop frequency
- Start and stop level
- Sweep parameters
- Coupling device and monitoring probe
- Modulation parameters
- Amplifier internal / external
- EUT monitoring settings
- "File Comment"

Edit file name and comment

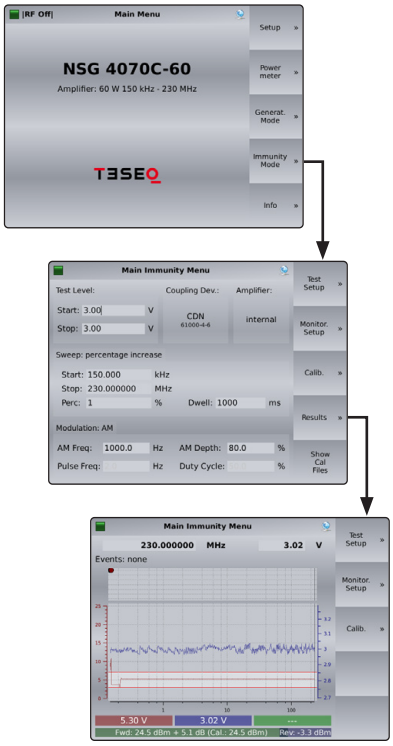
The file comment allows the user to add information to the configuration file and can be filled out before saving the file.

Recall

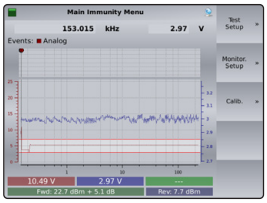
Pressing the hard key **RCL** followed by the softkey **Config** allows the user to recall the configuration from the internal flash or USB stick.

The stored file can be selected by turning the rotary knob followed by the softkey **Load** or hardkey **Enter**.

4.5.6. Immunity —> Results

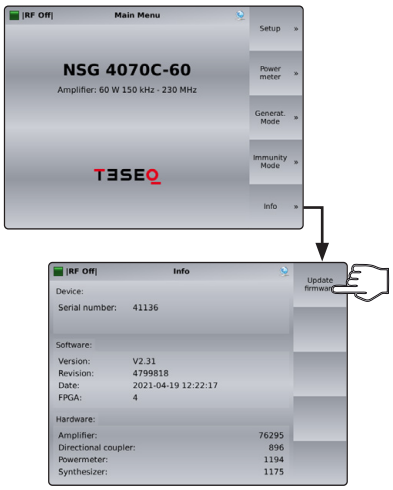


The softkey **Results** shows the current test result which can be investigated by turning the rotary knob.
The red curve shows the voltage on the analog EUT monitoring input, and is related to the left axis. Other EUT monitoring events are displayed above the graph with different colors.
The blue curve shows the test level of the test configuration. It is related to the right axis.
The green curve shows the used current for testing with monitoring probe. It is related to the right axis.



The test result can be observed by turning the rotary knob.

4.6. Device info and firmware update



Info gives general information about serial numbers of the internal components as well as firmware versions.

The softkey **Update Firmware** allows the user to update the firmware. The update file needs to be in the root directory of the USB stick.
The latest firmware is available from:
https://www.ametek-cts.com/support/updates

5. REMOTE CONTROL COMMANDS

5.1. Common commands

In the NSG 4070, the following common commands are implemented:

Command	Description
*IDN?	returns the identification string of the device
*RST	resets the NSG 4070 and loads default values
*GTL	switches the device back to local mode

Table 2: Common commands

5.1.1. *IDN?

This command delivers the device's identification string. This string is comprised of the device name and device type (Amplifier Power), the device's serial number and its software version.

***IDN?**

Teseq NSG 4070-80,000123,V1.0

Teseq NSG 4070A-75,000123,V1.0 (For NSG 4070A only. A NSG 4070 can be upgraded to NSG 4070A by replacement of the power meter.)

5.1.2. *GTL

This command switches the device back to the local mode. Front panel operation is then permitted.

***GTL**

5.1.3. *RST

This command resets the receiver and loads the default values. All currently running sweeps are aborted. The synthesizer output and the amplifier are turned off.

***RST**

5.2. The SOURce subsystem

The SOURce subsystem contains all remote control commands that are necessary to modify the output signal of the NSG 4070 when it is used in generator mode.

5.2.1. Set fixed frequency (SOURce:FREQuency:FIXed|CW)

Set the fixed output frequency in generator mode. Values in Hz, kHz and MHz are accepted.

SOURce:FREQuency:FIXed 123.456 Mhz

5.2.2. Set fixed level (SOURce:POWer:LEVel:AMPLitude)

Set the fixed output level in generator mode if RF is on (SOURce:POWER:LEVel:STATe is set). Values in dBm, dBuV and V are accepted.

SOURce:POWer:LEVel:AMPLitude -2.55 dBm

5.2.3. Output On / Off (SOURce:POWER:LEVel:STATe)

Turns output on / off when in generator mode.

SOURce:POWer:LEVel:STATe on

5.2.4. Sweep parameters

The SOURce:SWEep mode contains all parameters that are required to set up a frequency or a level sweep. Included are the start and stop frequencies/levels, the dwell time for a specific step of a sweep, and the commands to start or abort a sweep.

- Dwell time (SOURce:SWEep:DWELl)
  This sets the dwell time for a frequency or level sweep. The NSG 4070 dwells this time on every step of the sweep. The time can be specified in seconds (s), millisec. (ms) or microsec. (us).
  SOURce:SWEep:DWELl 1.2 s

Bit	Description
0	if 1 then end of sweep is reached
1	if 1 an error occurred
2	if 1 the sweep was aborted by the user

Table 3: Sweep status byte

- Frequency sweep
  The frequency sweep node includes the commands which are necessary to configure and run a frequency sweep.

- Run frequency sweep (SOURce:SWEep:FREQuency:Run)
  This command starts a frequency sweep with the previously configured parameters.
  SOURce:SWEep:FREQuency:Run

- Run frequency sweep query (SOURce:SWEep:FREQuency:Run?)
  This command starts a frequency sweep with the previously configured parameters. Additionally, the current frequency and a status byte are returned for every frequency step. The description of the status byte can be found in table 6.
  SOURce:SWEep:FREQuency:Run?
  9000,0

- Abort frequency sweep (SOURce:SWEep:FREQuency:ABOrt)
  This command aborts the currently running frequency sweep.
  SOURce:SWEep:FREQuency:ABOrt

- Start frequency (SOURce:SWEep:FREQuency:STARt)
  This command sets the start frequency of a sweep. The start frequency can be determined in Hz, kHz or MHz.
  SOURce:SWEep:FREQuency:STARt 9000 Hz
  SOURce:SWEep:FREQuency:STARt 15000 kHz
  SOURce:SWEep:FREQuency:STARt 0.15 MHz

- Stop frequency (SOURce:SWEep:FREQuency:STOP)
  This command sets the stop frequency of a sweep. The stop frequency can be determined in Hz, kHz or MHz.
  SOURce:SWEep:FREQuency:STOP 230000000 Hz
  SOURce:SWEep:FREQuency:STOP 80000 kHz
  SOURce:SWEep:FREQuency:STOP 80 MHz

- Step width parameters
  The steps for a frequency sweep can be determined in either a linear mode with fixed step sizes, in numbers of steps per decade or as a percent increment.

- Linear step width (SOURce:SWEep:FREQuency:STEp:LINear)
  This command configures a linear frequency sweep with a fixed step size. The step size can be configured in Hz, kHz or MHz.
  SOURce:SWEep:FREQuency:STEp:LINear 10000 Hz

- Decade step width (SOURce:SWEep:FREQuency:STEp:DECade)
  This command configures a decade sweep with x steps per frequency decade. The example below shows how to set up a sweep with 11 steps per decade.
  SOURce:SWEep:FREQuency:STEp:DECade 11

- Percental step width (SOURce:SWEep:FREQuency:STEp:PERCent)
  This command configures a percent sweep with a frequency increase of x% per step. The next frequency steps are calculated as follows:

$$f_{next} = f_{current} + x * \frac{f_{current}}{100}$$

  where x stands for the percental increase.
  SOURce:SWEep:FREQuency:STEp:PERCent 2.5

- Level sweep
  The level sweep node includes the commands which are necessary to configure and run a level sweep.

- Run level sweep (SOURce:SWEep:LEVel:Run)
  Use this command to trigger a level sweep.
  SOURce:SWEep:LEVel:Run

- Run level sweep query (SOURce:SWEep:LEVel:Run?)
  This command starts a level sweep with the previously configured parameters. Additionally, the current level and a status byte are returned for every step. The description of the status byte can be found in table 5.6.2.
  SOURce:SWEep:LEVel:Run?
  -30.0,0

- Abort level sweep (SOURce:SWEep:LEVel:ABOrt)
  The ABOrt command cancels a currently running level sweep and switches the synthesizer output back to a continuous wave (if no modulation is selected).
  SOURce:SWEep:LEVel:ABOrt

- Set the start level (SOURce:SWEep:LEVel:STARt)
  This command sets the start level of a level sweep in dBm.
  SOURce:SWEep:LEVel:STARt -40 dBm

- Set the stop level (SOURce:SWEep:LEVel:STOP)
  This command sets the stop level of a level sweep in dBm.
  SOURce:SWEep:LEVel:STOP 5 dBm

- Set the step width (SOURce:SWEep:LEVel:STEp)
  This command sets the step width for each level step during a sweep in dBm.
  SOURce:SWEep:LEVel:STEp 0.5 dBm

- Continuous sweep setup (SOURce:SWEep:CONTinuous)
  If this option is set, the frequency or level sweep is running continuously. After reaching the stop frequency / level the sweep is restarted. The following arguments to this command are accepted:
  • true|false
  • yes|no
  • 1|0
  • on|off
  SOURce:SWEep:LEVel:CONTinuous on

- Trigger setup (SOURce:SWEep:TRIGger)
  There are two ways to trigger each sweep step when running a sweep:
  1. internal trigger (wait for the configured dwell time)
  2. external trigger (use the trigger input on the rear panel)
  The following arguments to this command are accepted:
  • int|ext
  • intern|extern
  • internal|external
  SOURce:SWEep:LEVel:TRIGger external

5.2.5. Modulation parameters (SOURce:MODulation)

The SOURce:MODulation node contains all parameters that are required to set up a modulated output signal. The NSG 4070 supports amplitude modulation, pulse modulation, and external amplitude modulation.

- Modulation mode setup (SOURce:MODulation:MODE)
  This command determines the kind of modulation which is applied to the output signal. The following arguments to this command are accepted:
  AM – Amplitude Modulation
  Pulse – Pulse Modulation
  Ext – External AM
  Off – unmodulated CW signal
  SOURce:MODulation:MODE AM

- AM parameters setup (SOURce:MODulation:AM)
  This mode contains the commands to configure an AM modulated signal.

- AM frequency setup (SOURce:MODulation:AM:FREQuency)
  This command sets the modulation frequency.
  SOURce:MODulation:AM:FREQuency 1 kHz

- AM depth setup (SOURce:MODulation:AM:DEPth)
  This command sets the modulation depth in percent.
  SOURce:MODulation:AM:DEPth 80

- Pulse parameters setup (SOURce:MODulation:PULSE)
  This mode contains the commands to configure a pulse modulated signal.

- Pulse frequency setup (SOURce:MODulation:PULSE:FREQuency)
  This command sets the modulation frequency.
  SOURce:MODulation:PULSE:FREQuency 2 Hz

- Pulse duty cycle setup (SOURce:MODulation:PULSE:DUTY)
  This command sets the duty cycle of the pulse modulation in percent.
  SOURce:MODulation:PULSE:DUTY 50

5.3. The power meter subsystem

The POWERmeter subsystem contains remote control commands to read the power meter channels of the NSG 4070. The device provides 3 external channels and 1 internal channel that is used to measure the forward power on the amplifier output.

5.3.1. Channel 1 (POWERmeter:CHannel1?)

Measures the power on channel 1 of the built in power meter. A value in dBm is returned. There is an optional frequency parameter to this command. It species the frequency of the signal to be measured. If the frequency parameter is omitted, the output frequency of the NSG 4070 signal generator part is used.

POWERmeter:CHannel1? 100 MHz
-12.33 dBm

5.3.2. Channel 2 (POWERmeter:CHannel2?)

Measures the power on channel 2 of the built in power meter.

POWERmeter:CHannel2? 100 MHz
5.23 dBm

5.3.3. Channel 3 (POWERmeter:CHannel3?)

Measures the power on channel 3 of the built in power meter.

POWERmeter:CHannel3? 100 MHz
0.57 dBm

5.3.4. Forward power (POWERmeter:FORWard?)

Measures the forward power on the amplifier output of the NSG 4070. Note that this value does not take the internal directional coupler into account. To get the output level at the Amp out socket you have to add the insertion loss of the internal directional coupler. You can obtain the insertion loss of the internal directional coupler with the command **MISCellaneous:DIRCOUP?**.

POWERmeter:FORWard? 100 MHz
25.23 dBm

5.4. The amplifier subsystem

5.4.1. Amplifier On / Off (AMPlifier)

Turns the internal amplifier on or off when the device is used in generator mode.

AMPlifier on

5.5. The monitor subsystem

The MONitor subsystem contains remote control commands that let the user read in the various monitoring inputs. Additionally the user can set the digital outputs on the user port (user output 0-3) to the desired TTL level.

5.5.1. Analog input (MONitor:ANAlog?)

Reads in the voltage on the analog input on the rear panel of the NSG 4070. A value in Volts is returned.

MON:ANA?
3.33 V

5.5.2. Digital input (MONitor:DIGital?)

Reads all digital inputs on the rear panel of the NSG 4070 and returns a byte with a bit for each input set. Please see Table 7 for the structure of the returned byte. See Chapter 3.2.2 Back panel for the pin assignment of the user port.

MON:DIG?
12

Bit	Input
0	User Input 0
1	User Input 1
2	User Input 2
3	User Input 3
4	-
5	Digital Input 24 V
6	Optical Input

Table 4: Digital monitoring inputs

5.5.3. Digital outputs

The NSG 4070 has 4 digital outputs which can be used for control purposes when the device is embedded in a test bench. These outputs are user output 0-3 on the user port. They can be set to TTL level.
The following arguments are accepted: high/low, on/off, 1/0, true/false, yes/no and auto.
The function Auto is explained in chapter 7. See Chapter 3.2.2 Back panel for the pin assignment of the user port.

- User output 0 (MONitor:UserOUT0)
  Sets the user output 0 to the desired level.
  MON:UOUT0 high

- User output 1 (MONitor:UserOUT1)
  Sets the user output 1 to the desired level.
  MON:UOUT1 high

- User output 2 (MONitor:UserOUT2)
  Sets the user output 2 to the desired level.
  MON:UOUT2 high

- User output 3 (MONitor:UserOUT3)
  Sets the user output 3 to the desired level.
  MON:UOUT3 high

5.6. The MISCellaneous subsystem

The MISCellaneous subsystem contains remote control commands that are useful but may not fit into other subsystems. Most of the commands in this node yield information about files stored on the device.

5.6.1. File information

Some commands that deliver useful information about files stored on the NSG 4070:

- List system calibration files (MISCellaneous:FILES:CALibration?)
  This command returns all calibration files available on the device. The individual file names are separated with a semicolon ";".
  MISCellaneous:FILES:CALibration?
  cdn.cal;emclamp.cal;foo.cal;bar.cal

- List probe calibration files (MISCellaneous:FILES:MONitoring?)
  This command returns all monitoring probe calibration files available on the device. The individual file names are separated with a semicolon ";".
  MISCellaneous:FILES:MONitoring?
  probe1.mon;foo.mon;bar.mon

- List result files (MISCellaneous:FILES:RESult?)
  This command returns all result files available on the device. The individual file names are separated with a semicolon ";".
  MISCellaneous:FILES:RESult?
  foo.res;bar.res

- List config files (MISCellaneous:FILES:CONFig?)
  This command returns all configuration files available on the device. The individual file names are separated with a semicolon ";". Alternatively MISCellaneous:FILES:CFG? can be used.
  MISCellaneous:FILES:CFG?
  foo.cfg;bar.cfg

- Get file comment (MISCellaneous:FILES:COMMent?)
  This command returns the file comment for a particular file.
  MISCellaneous:FILES:COMMent? foo.cfg
  This cfg is for IEC 61000-4-6 Level 1

- Get amplifier frequency response (MISCellaneous:AMPlifier?)
  This command returns the frequency response of the internal amplifier in the following format: frequency[Hz],gain[dB];frequency[Hz],gain[dB]...
  The string ends with a newline character. Note: There is no newline character between the separate nodes.
  MISCellaneous:AMPlifier?
  9000,-19.34;...;1000000,54.12;...;230000000,53.34;new line

- Get directional coupler coupling factor (MISCellaneous:DIRectionalCOUPler?)
  This command returns the coupling factor over frequency of the internal directional coupler in the following format: frequency[Hz],forward loss[dB], reverse loss[dB];frequency[Hz],loss[dB]...
  The string ends with a newline character.
  MISCellaneous:DIRCOUP?
  9000,40.34,40.03;...;1000000,37.12,38.45;new line
  Units without internal reverse power measurement return -99.00. See following example:
  9000,40.34,-99.00;...;1000000,37.12,-99.00;new line

5.7. The Service subsystem

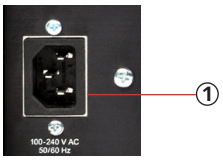
The Service subsystem contains remote control commands that are useful service.

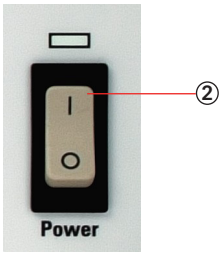
- Outputs the value that actually comes out at the Amp Out. The correction data of the directional coupler are taken into account.
  Service:POWERmeter:AmpOUT?
  Service:POWERmeter:AOUT?

- Outputs the value that is measured as reverse power. The correction data of the directional coupler are taken into account.
  Service:POWERmeter:AmpREV?
  Service:POWERmeter:AREV?

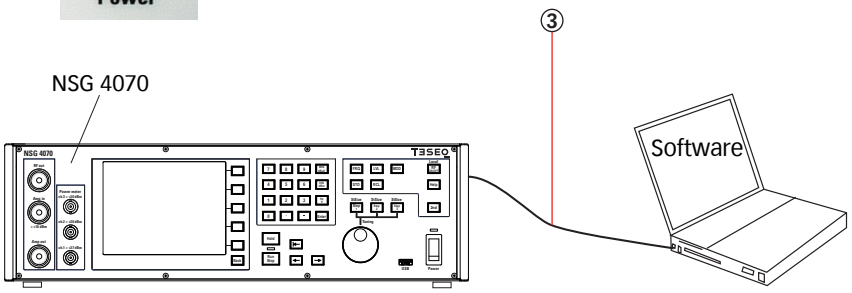
6. ESTABLISHING THE REMOTE CONNECTION

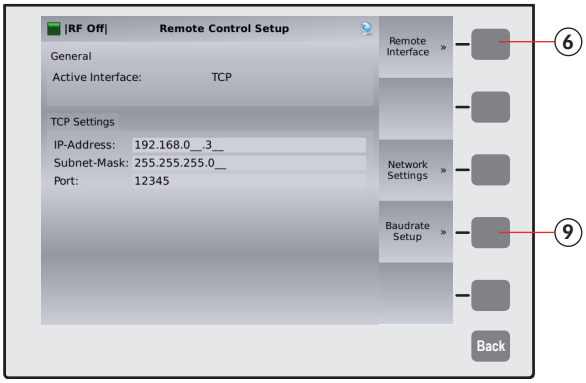
The following example shows how to set up the NSG 4070 for use with the Windows-based remote control program. Further examples are based on the steps shown in this example.



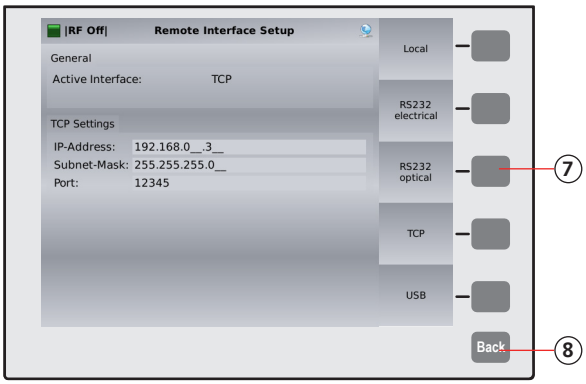


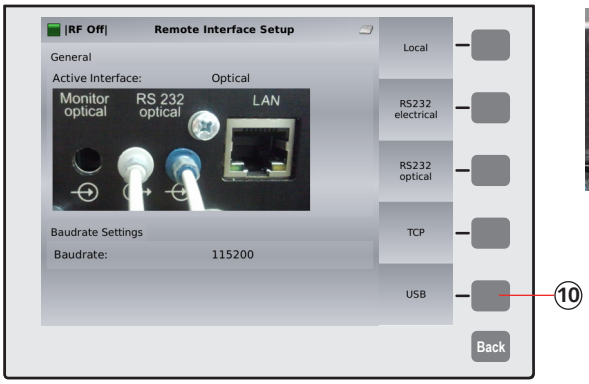
1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect the NSG 4070 and USO 4013 to the PC.
4. Press **Setup**.
5. Press **Remote**.

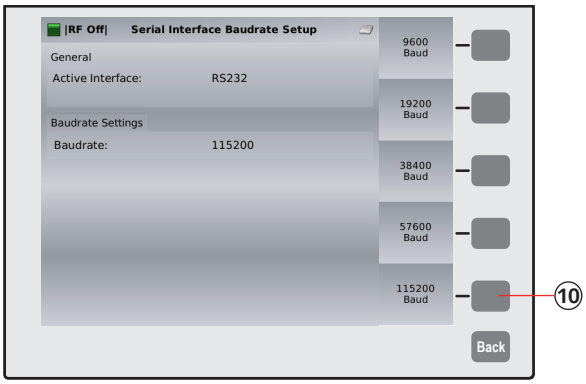


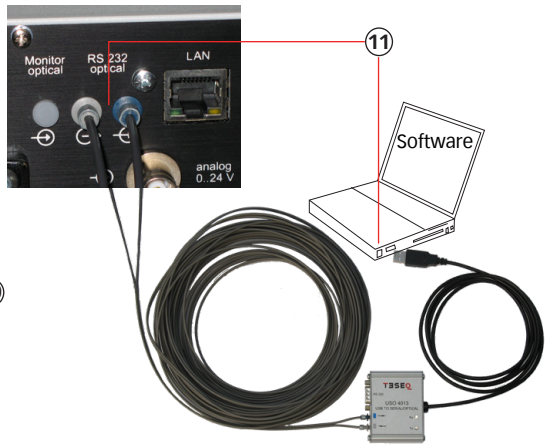


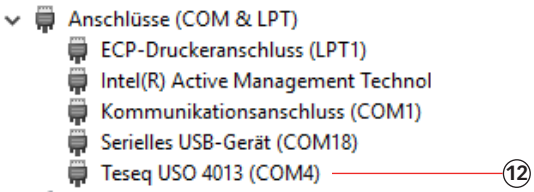
6. Press **Remote Interface**.
7. Press **RS232 optical**.
8. Press **Back**
9. Press **Baudrate Setup**
10. Change the settings as required. (Default value is 11500 Baud)
11. Connect the NSG 4070, USO 4013 and PC as shown in the figure.











12. The device manager under Windows 10 shows the USO 4013 after successful driver installation. The port number, in the example COM 4, must be entered in the application software.

7. ADVANCED USE OF EUT MONITORING PORTS

7.1. Digital outputs

The NSG 4070 has 4 digital outputs which can be used for control purposes when the device is embedded in a EUT monitoring setup. These outputs are supplied on user port pin 6 to 9. In local operation mode the unit works in “auto” mode. A default behavior is applied to these outputs during an immunity test. In remote operation mode the outputs can be set individually. A deactivated User port output D0 works in the “auto” mode.

7.1.1. “Auto” mode

This mode provides a “high” level on User port output D0 during the dwell time and falls to “low” level only during the setting time for the next frequency. The timing is shown in the next figure:

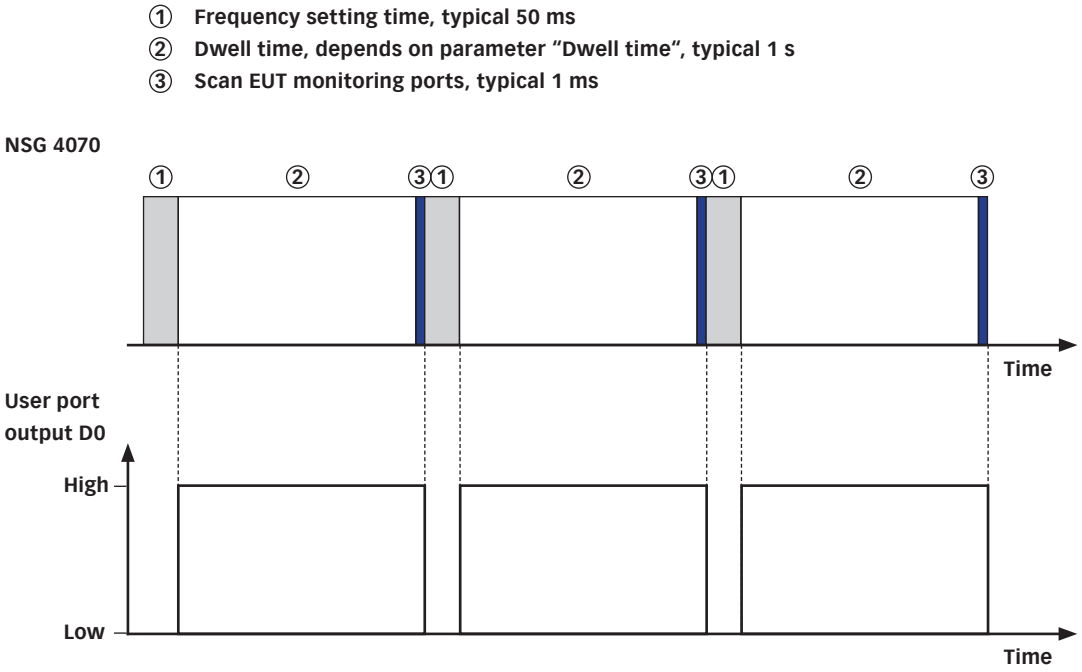


Figure 5: Timing of User port D0 output in “auto“ mode

7.1.2. Monitoring event

The function “Monit. Event” changes the output level for every EUT monitoring event on the selected output port. Available are: “Low“, “High“, “LowImp“ and “HighImp“.

7.1.3. Frequency step

The function “Every step” changes the output level for every frequency step on the selected output port. Available are: “LowImp“ and “HighImp“.

7.1.4. Switching at a defined frequency

The function "at Fr1" / "at Fr2" changes the output level at a defined frequency (frequency in MHz) on the selected output port. Available are: "Low", "High", "LowImp" and "HighImp".
Note:
Use D3 "low" to switch MD 4070 into the passive mode and "high" to switch into the active mode.
Use D2 "low" to switch SW 4070 to path 1 and "high" to switch to path 2.
The function is disabled during performing the system and probe calibration.

7.1.5. Switching at test start

The function "at Test Start" changes the output level at test start on the selected output port. Available are: "LowImp" and „HighImp".

8. APPLICATIONS

8.1. Introduction

The modular setup of the device and its frequency range up to 1 GHz allow a wide variety of applications. The main application is the conducted immunity as described in this chapter. The use of the NSG 4070-45 or the combination with external directional coupler and power amplifier allow conducted and radiated immunity tests up to 1 GHz.

8.2. IEC/EN 61000-4-6 testing

8.2.1. Requirements

IEC 61000-4-6 (EN 61000-4-6) „Immunity to conducted disturbances, induced by radio frequency fields" defines a method for injecting test signals into the equipment under test (EUT). The basic requirement is to inject a known level of RF signal onto the cable of the EUT at each test frequency and to determine whether the EUT continues to function correctly. In order to do this, it is necessary to decouple the auxiliary equipment (AE) from the test signal. If this is not achieved it is difficult to know whether any fault is due to a failure of the EUT or the AE. The basic requirements are shown in the table below.

Frequency range	150 kHz … 80 (230) MHz
Common mode impedance	150 Ω (in exception 50 Ω)
Test level (EMF)	1 V, 3 V, 10 V and level X, tolerance +19%/-16%
Modulation	1 kHz sinus, tolerance ±100 Hz, AM, 80%, tolerance +5%/-20%
Dwell time	1 s
Step size	max. 1% of the preceding frequency value
Method for the system calibration	Set-up the coupling device with the 150 Ω calibration jig, adjust the unmodulated test level (U0/6) and measure on the 50 Ω output of the jig
Test method	Using the signal levels established during the system calibration process, switch on the modulation
Power limitation if the 150 Ω can not be meet	Monitoring of the disturbance current and limiting the signal level as follows: Imax = U0/150 Ω
Attenuator	≥ 6 dB
Output impedance of the test generator	50 Ω
Harmonics and distortion below the carrier level	≥ 15 dB (The harmonics and distortion are measured in continuous wave (CW) at 1.8 times the test level without modulation.)

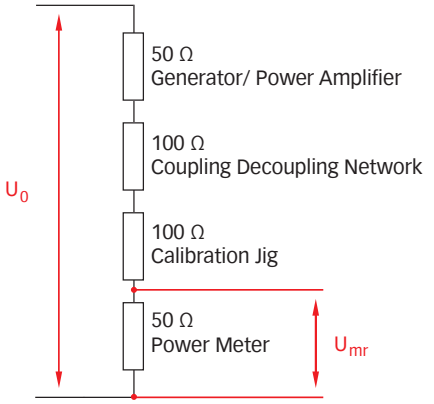
Table 5: Basic requirements of the standard

8.2.2. Test level of IEC / EN 61000-4-6

U_0 the open-circuit test levels (e.m.f.) of the unmodulated disturbing signal, expressed in r.m.s. are 1 V, 3 V or 10 V. The test levels are set at the EUT port of the coupling devices.
For equipment testing, this signal is 80% amplitude modulated with a 1 kHz sine wave to simulate actual threats.

$U_{mr} = U_0/6$ +19% / -16%, in linear quantities, or
$U_{mr} = U_0 - 15.6$ dB ± 1.5 dB in logarithmic quantities.

NOTE 1: U_0 is the unmodulated disturbing signal and U_{mr} is the measured voltage. To minimize testing errors, the output level of the test generator is set by setting U_{mr} loads with 150 Ω and not by setting U_0.
NOTE 2: The factor 6 (15.6 dB) arises from the e.m.f. value specified for the test level. The matched load level is half the e.m.f. level and the further 3:1 voltage division is caused by the 150 Ω to 50 Ω adapter terminated by the 50 Ω measuring equipment.



$$\frac{U_{mr}}{U_0} = \frac{50}{50+100+100+50}$$

$$U_{mr} = \frac{U_0}{6}$$

Figure 6: Equivalent circuit diagram and formula

Test level U_0 in V	Measured voltage U_{mr} in V	Measured power on the 50 Ω power meter in dBm
1	0.1667	-2.55
3	0.5	6.99
10	1.667	17.45
20	3.33	23.47
30	5.00	26.99

Table 6: Test level and measured voltage

8.2.3. Test level setting procedure (example: CDN calibration with 1 V test level)

The test generator is connected via a 6 dB attenuator to the RF port of the coupling device. The EUT port of the coupling device is connected in common mode through the 150 Ω to 50 Ω adapter to a power meter with 50 Ω input impedance. The AE port is terminated with 150 Ω. The setup for level setting (also called system calibration) is shown as an example in the figure below:

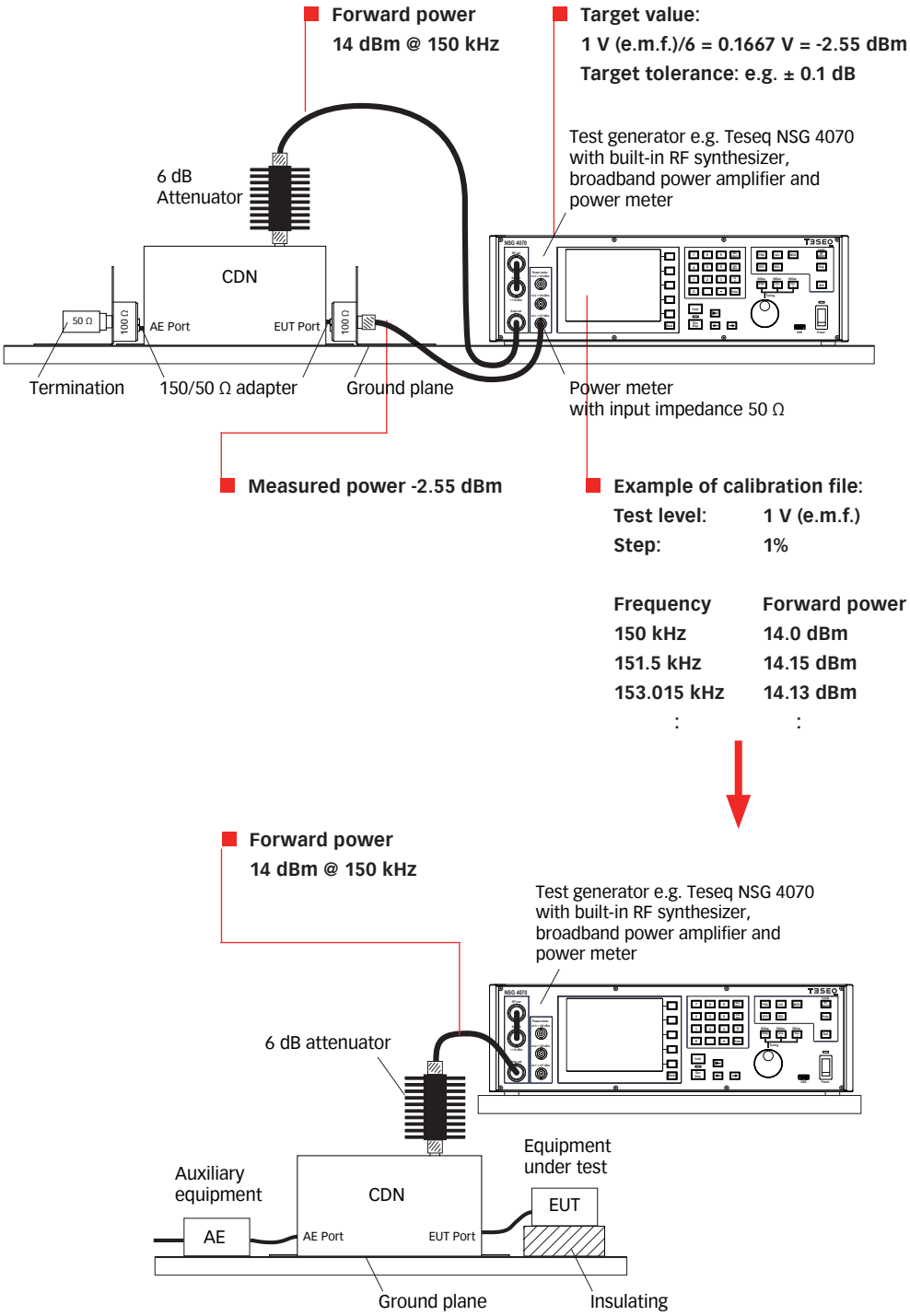


Figure 7: Example for test level setting, relation between test level and measured level (The influence of the modulation is neglected in this sample.)

8.2.4. Modulation

The level setting procedure of IEC / EN 61000-4-6 is done without any modulation. The modulation is switched on during testing. The modulation depth is 80%. The peak value of the envelope of the amplitude modulated signal is increased against the CW signal. See figure 13.
Example: AM with 80% requires 5.1 dB additional power as used for the level setting procedure.

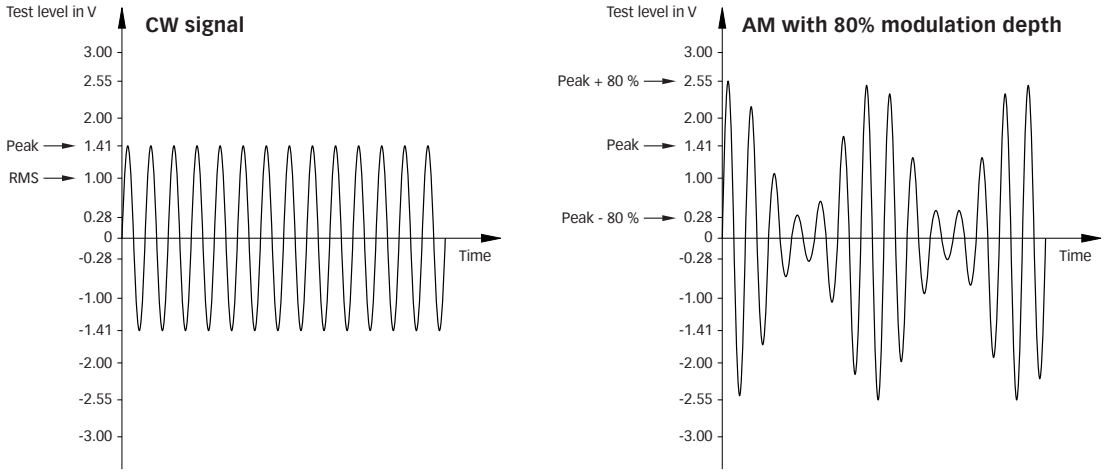


Figure 8: Amplitude modulation

8.2.5. Power requirements

The required forward power is in relation to the desired test level, the insertion loss of the coupling device, the 6 dB attenuator, the cable loss and the reserve for the modulation. The table below shows typical power requirements.

Amplifier module:	**35 W**	**45 W**	**80 W**
CDN:	18 V EMF	22 V EMF	30 V EMF
EM clamp (KEMZ 801A):	14 V EMF	16 V EMF	20 V EMF
Current injection clamp (CIP 9136A):	6 V EMF	8 V EMF	10 V EMF (typ.)

Table 7: Power amplifier recommendation
(Achievable test levels with 6 dB attenuator, 0.5 dB cable loss, max. insertion loss of the coupling device and AM with 80% modulation depth)

8.2.6. Power amplifier

The nominal frequency range of Teseq's power amplifiers is related to the 3 dB band width. The internal used power amplifier modules provide essential more power in specific frequency ranges as given with the value of the nominal power of 35 W, 45 W and 80 W. Further the power amplifier can also be used outside the nominal frequency range with limited performance. The usable frequency range is between 50 kHz and 320 MHz for the 35 W and 80 W models.
Class A amplifiers are the best choice for EMC testing. Only this principle guarantees providing forward power independent of the matching.

8.2.7. Saturation check

This function allows the user to check whether there is sufficient power available for the selected modulation required, even if the system calibration is always performed without modulation. Special high test levels could bring the power amplifier into saturated range if the modulation (e.g. AM with 80% needs 5.1 dB more power) is switched on during EUT testing. The check requires a loaded calibration file. The forward power of the calibration is increased with 5.1 dB during the check.
See chapter 4.5.3.2 for details.

8.2.8. RF switch

Two power amplifiers can be combined with the optional RF switch SW 4070. The SW 4070 has 2 SPDT relays and is powered and controlled by the NSG 4070 user port. The SW 4070 provides a second user port for connecting e.g. the MD 4070. The path switching is defined in the EUT monitoring menu with digital output D2.
See chapter 5.9.3.2 for details.

8.2.9. Coupling devices

The selection of the correct coupling device is defined in IEC/EN 61000-4-6. Below is shown a simplified flow chart which should providing help for the selection. The frequency response of the coupling device is measured during the system calibration. Calibration files e.g. in ASCII can not be imported. For investigation purpose (system check) can be used the probe calibration (next chapter). The result is the insertion loss of the whole setup.

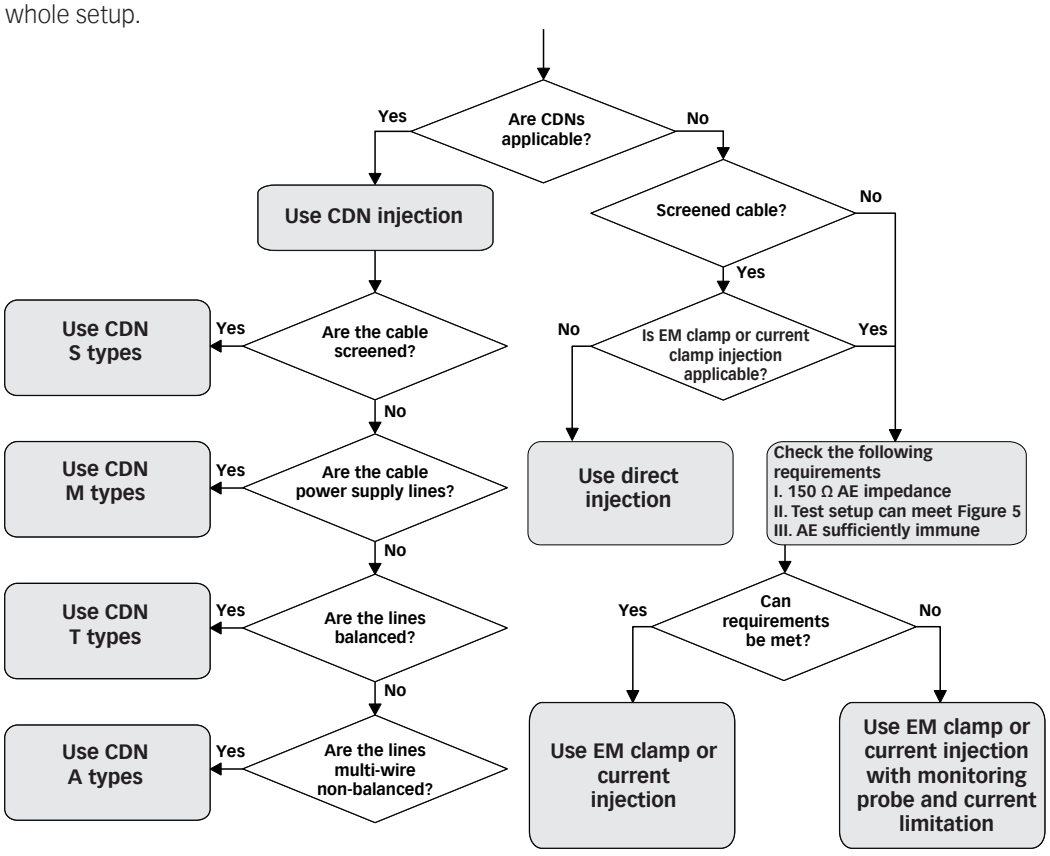


Figure 9: Rules for selecting the injection method (Chapters 7.2 to 7.5 refer to the IEC/EN 61000-4-6 standard.)

8.2.10. Current probe

Teseq recommends using the MD 4070 monitoring probe due to the operating range of the power meter. The active mode of MD 4070 allows also the operation with low stress levels. Details given in Table 8.

Monitor probe	Stress level****
Insertion loss in dB	V EMF
+10*	1 to 3
-22**	1 to 30
-34***	2 to 30

* typical MD 4070 active
** typical MD 4070 passive
*** current probe with transfer impedance 1 Ω (0 dB/Ω)
**** lower limit 1 V EMF and upper limit 30 V EMF are given by the NSG 4070

Table 8: Insertion loss of the probe relative to power meter range and stress level

The active mode requires to connect the power supply with the MD 4070. Using the whole dynamic range requires to calibrate the MD 4070 in the active and passive mode. The remote controlled switching requires connection with the NSG 4070 user port. The probe calibration measures the insertion loss in a 50 Ω system.

The calibration of the MD 4070 in active mode may require using a 10 dB or 20 dB attenuator on power meter channel 1. This is related to the gain of the amplifier and type of the directional coupler. Chapter 4.3.4 describes the entry of the attenuation factor.

See also Figure 12 for the power meter readings using the current probe.

8.2.11. Calibration jig

Test generator and power meter are designed with 50 Ω impedance. Test level and EUT port (coupling device) are related to 150 Ω. The calibration jig supplies the adaptation from 150 Ω to 50 Ω and for the common mode. Some calibration jigs terminate the AE port with 150 Ω.
The current probe needs to be calibrated in a 50 Ω calibration jig.

8.2.12. Power meter

Channel 1 is used for measuring the stress level during the system calibration and measuring the insertion loss during the probe calibration. Also channel 1 is used to connect the current probe during testing. Power meter channel 2 is used in combination with an external directional coupler for measuring the forward power and channel 3 for measuring the reverse power.
See the following figures about the typical levels expected on the power meter.

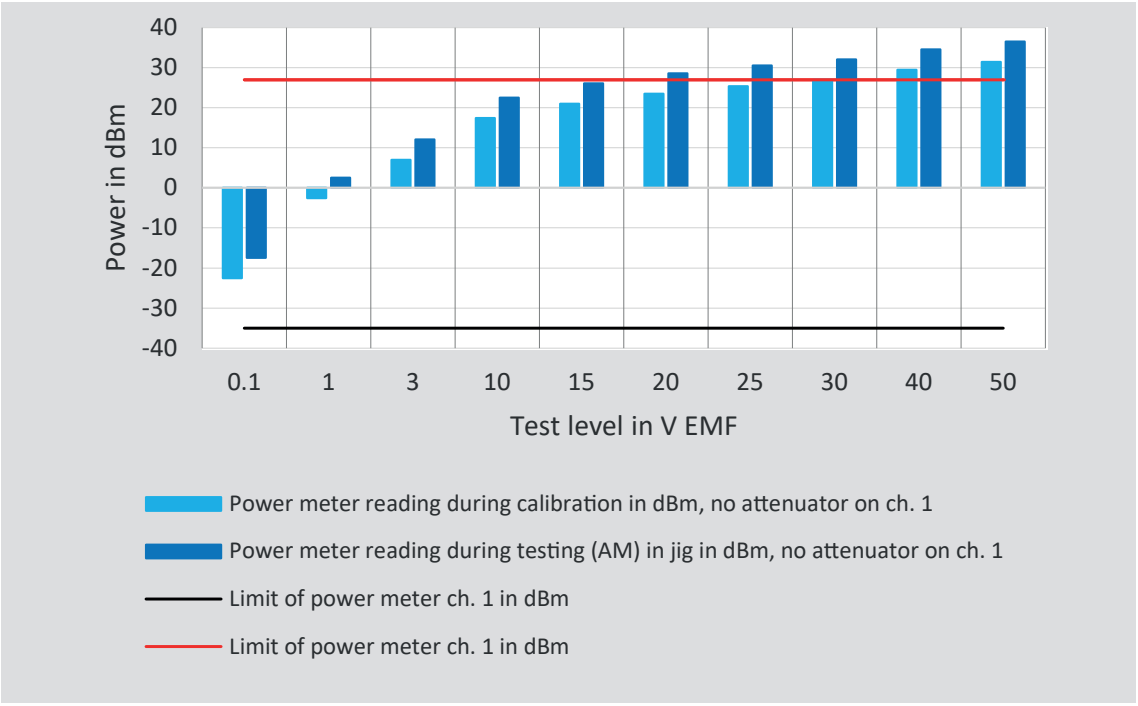


Figure 10: Power meter channel 1 typical readings without attenuator

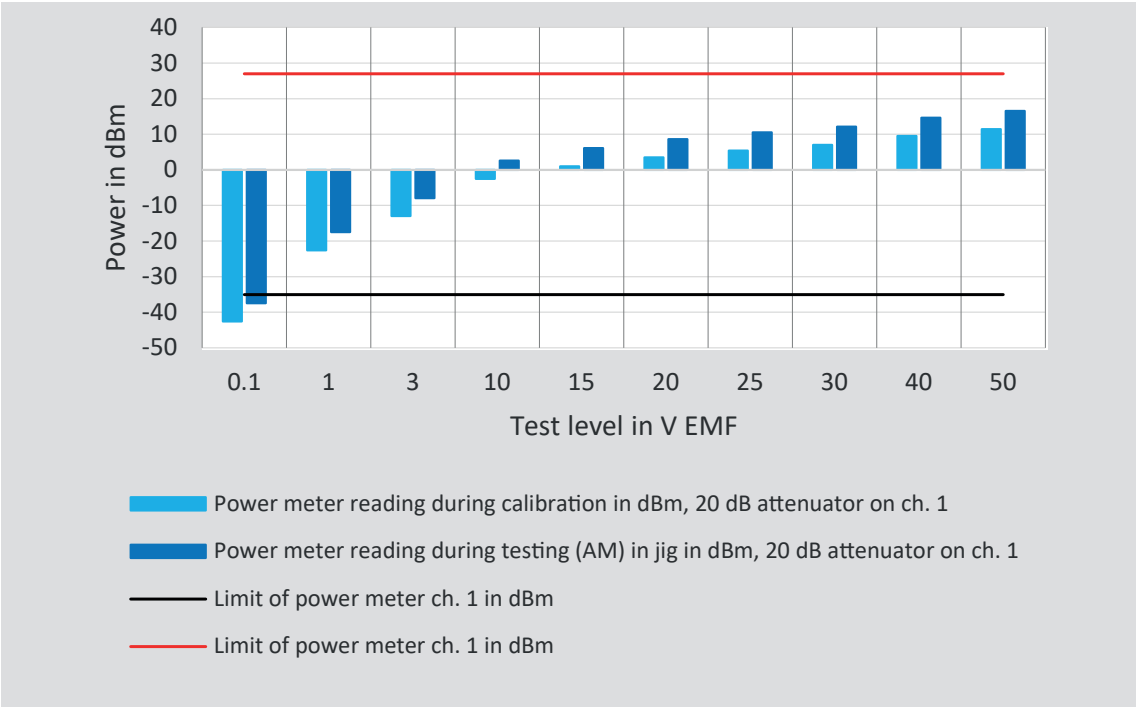


Figure 11: Power meter channel 1 typical readings with 20 dB attenuator

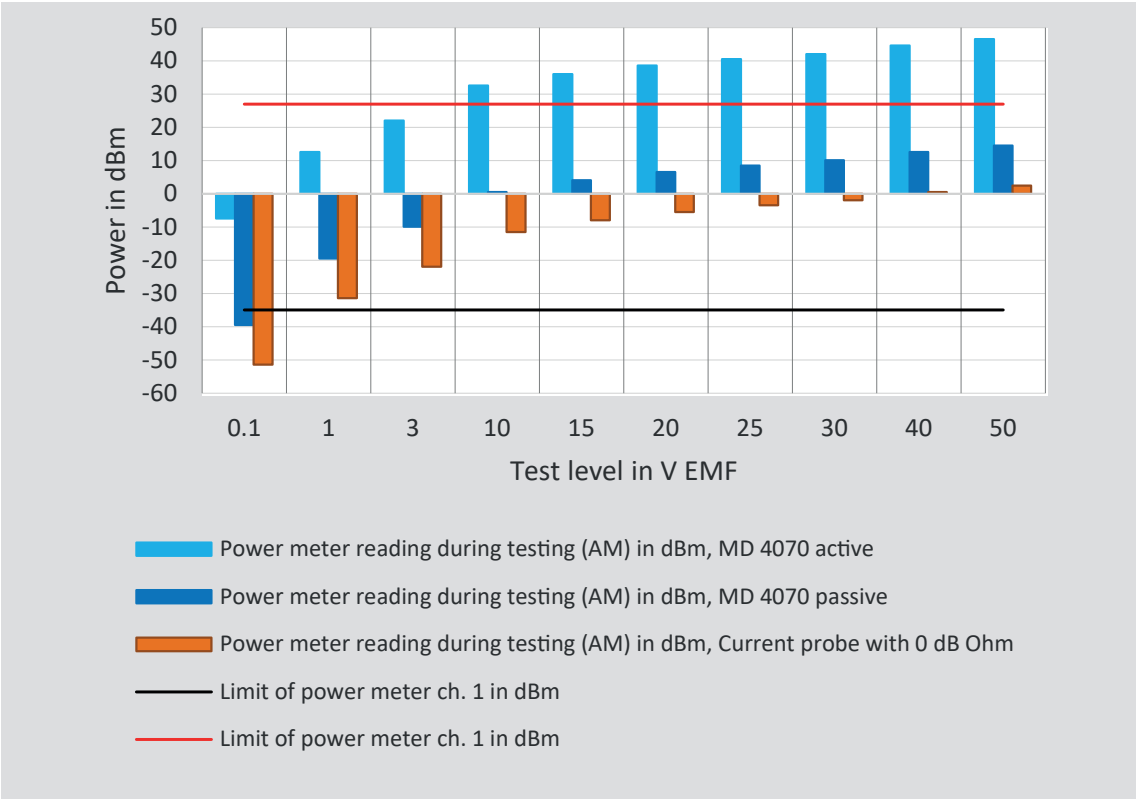


Figure 12: Power meter channel 1 typical readings with using the current probe

8.2.13. Attenuator

The 6 dB attenuator needs to be suitable for the used forward power. Best would be to be suitable for the max. forward power of the used power amplifier.

8.2.14. Optically decoupled remote control

The converter USO 4013 allows the remote control of the NSG 4070 via a 20 m Polymeric Optical Fiber (POF). The USO 4013 connects the optical remote interface of the NSG 4070 with the USB interface of the control PC.

8.2.15. Test setup calibration with a CDN

The calibration setup always refers to the type of CDN. The CDN user manual shows the required setup. Examples for the system calibration of CDN M016 and CDN S are shown in the following figures:

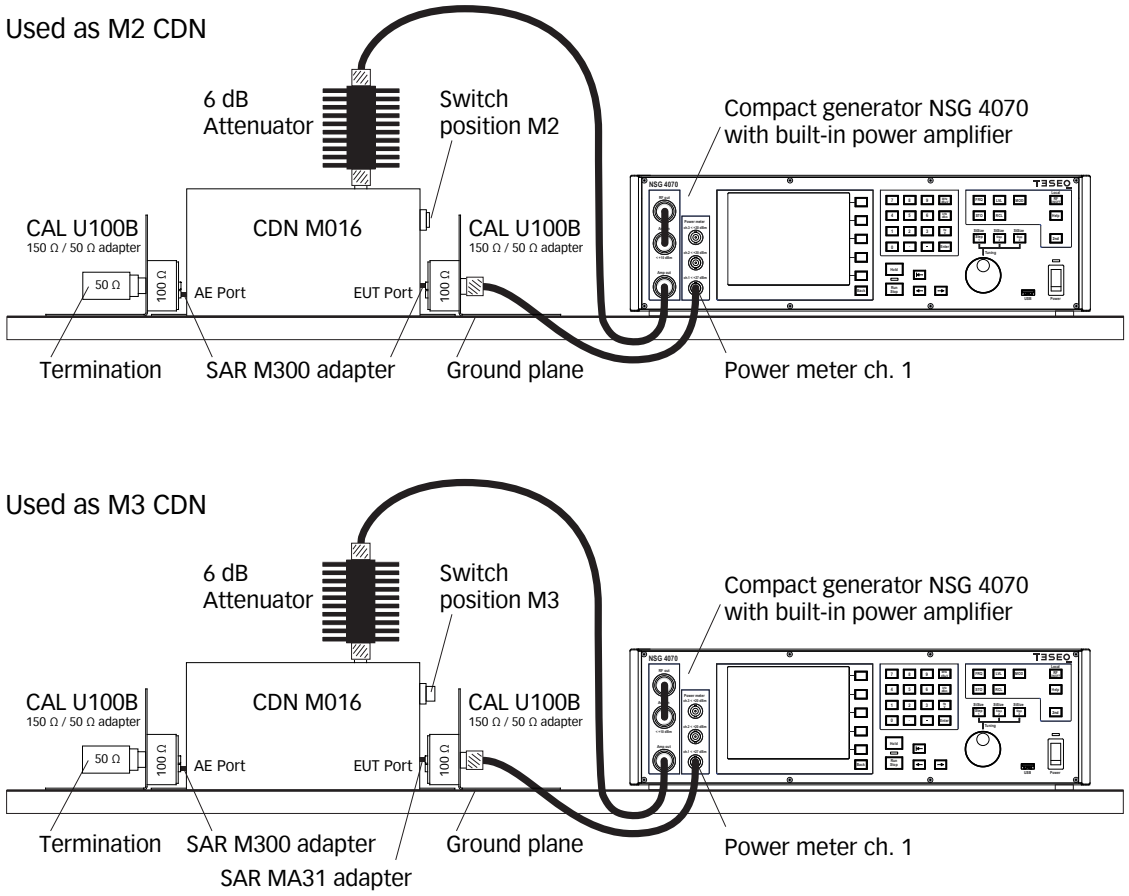


Figure 13: Test setup calibration with CDN M016 (switchable M2 / M3)

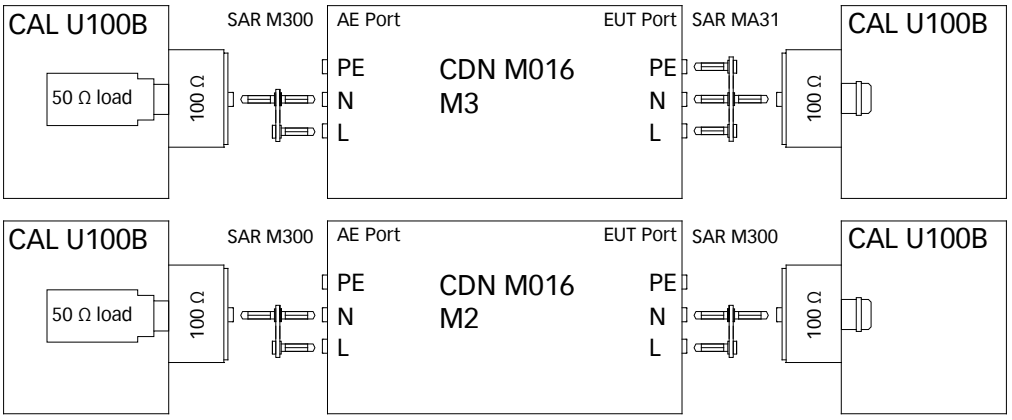


Figure 14: Setup details with CDN M016

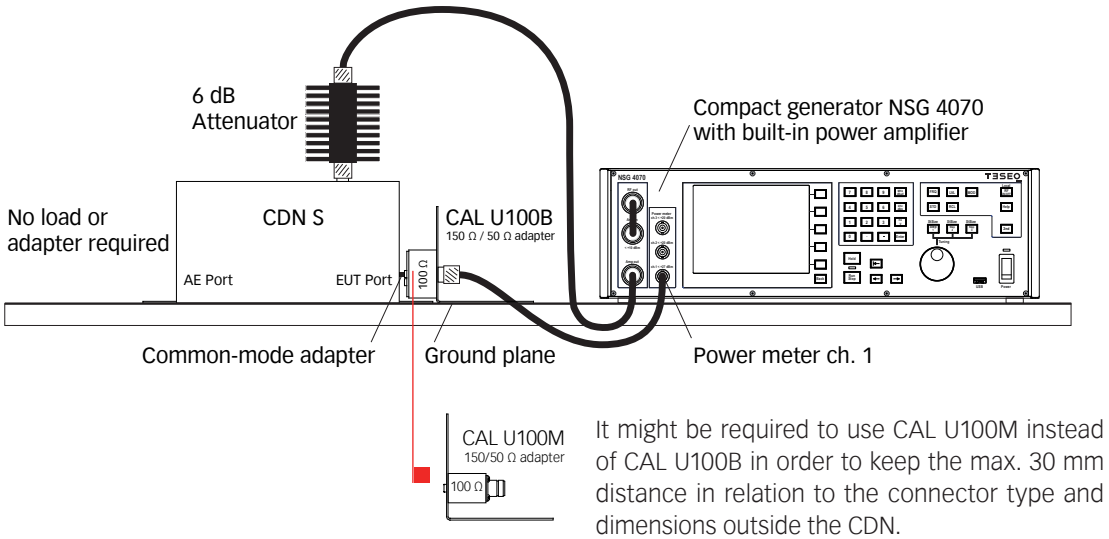


Figure 15: Test setup calibration with CDN S

8.2.16. EUT test setup with CDN

After calibration the calibration adapter has to be removed from the setup. The EUT must be connected through the CDN. One general example for the test setup with EUT is shown below:

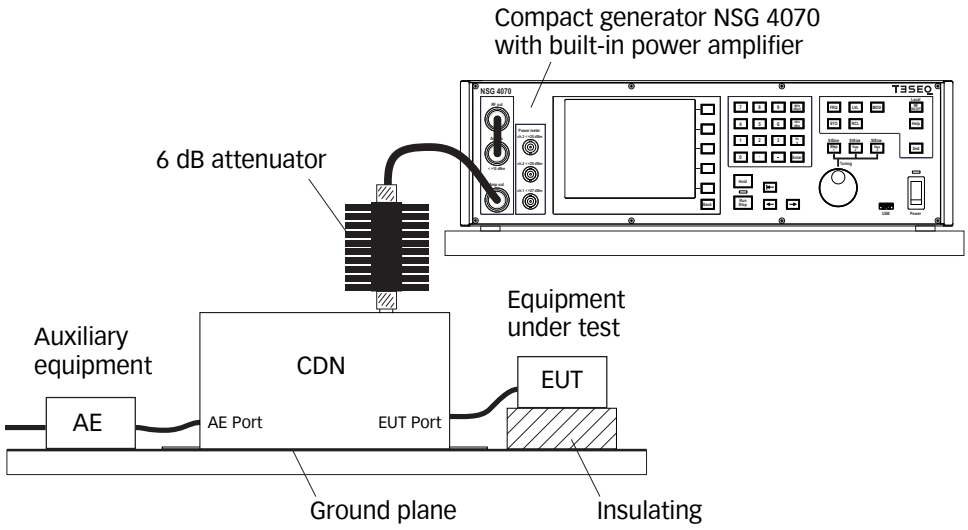


Figure 16: Test setup with EUT

8.2.17. Test setup calibration with EM clamp

The NSG 4070 is connected via a 6 dB attenuator to the RF port of the EM clamp. The EUT port of the EM clamp is connected with a 150 Ω to 50 Ω adapter to power meter channel 1. The AE port is terminated with 150 Ω. Both adapters need to be connected with the supplied cable of the calibration jig. The clamp needs to be clicked on this cable. The setup for the system calibration is shown in figure below:

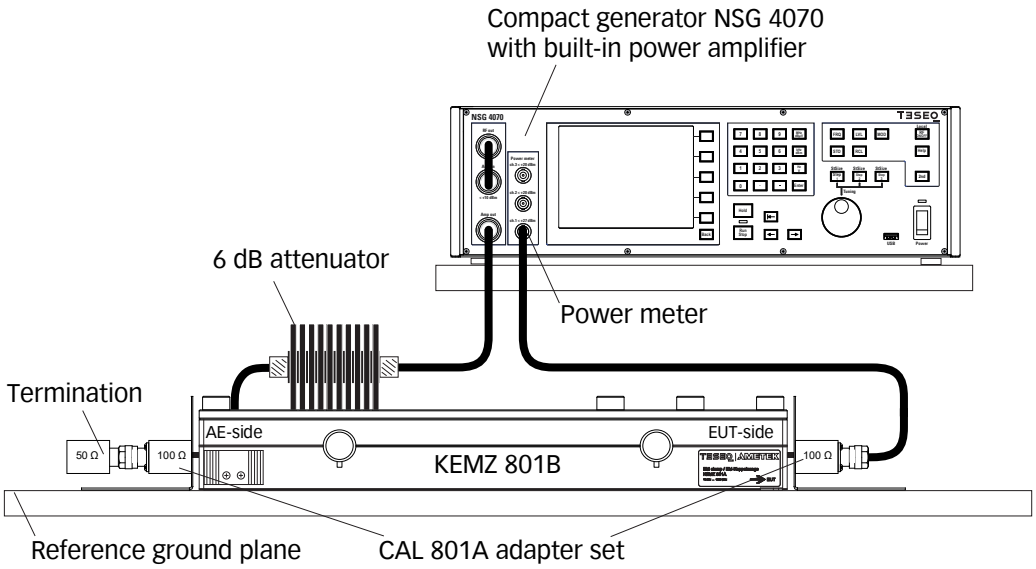


Figure 17: Test setup calibration according IEC / EN 61000-4-6 with EM clamp

8.2.18. EUT test setup with EM clamp

After calibration the 150 Ω to 50 Ω adapter / 150 Ω load has to be removed from the setup. The EUT must be connected through the EM clamp. One general example for the test setup with EUT is shown below:

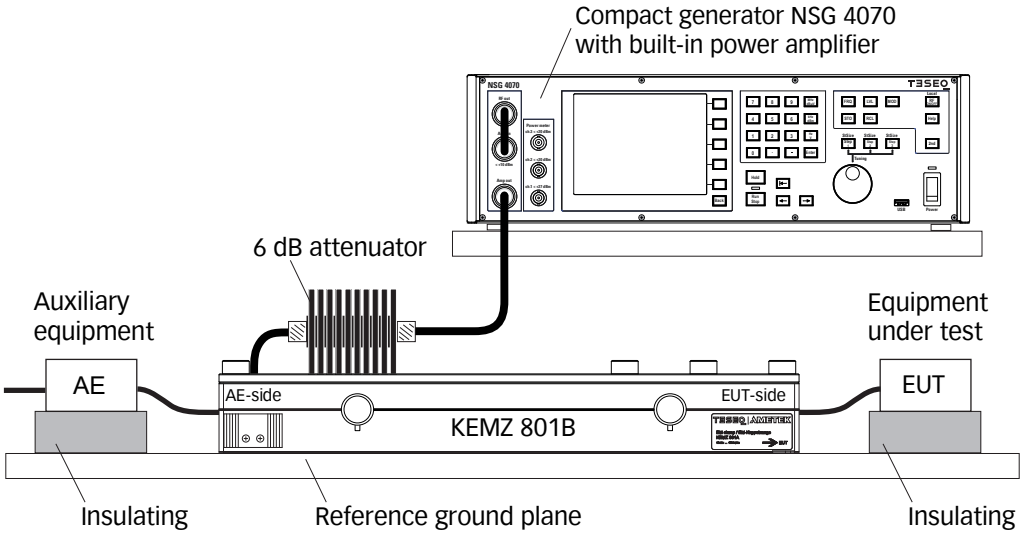


Figure 18: Test setup with EUT according IEC / EN 61000-4-6 with EM clamp

The test setup with using the monitoring probe is shown below.

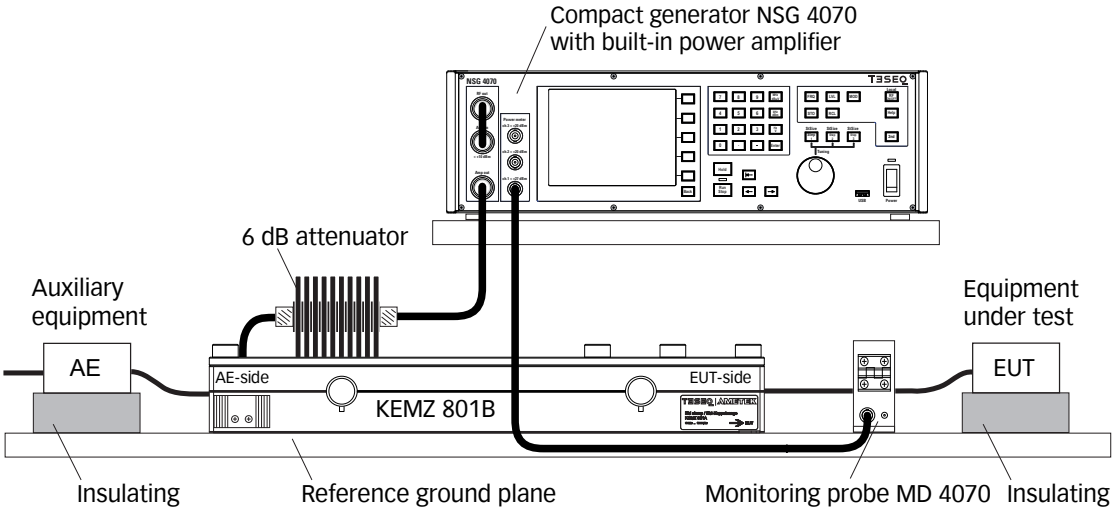


Figure 19: Test setup with EUT according IEC / EN 61000-4-6 with EM clamp and monitoring probe

8.2.19. Test setup calibration with current injection probe (150 Ω system)

The test generator is connected via 6 dB attenuator to the RF port of the current injection probe. The probe is inserted in a 50 Ω jig. The jig is connected with a 150 Ω to 50 Ω adapter to a power meter with 50 Ω input impedance. The other side of the jig is terminated with 150 Ω. The setup for the system calibration is shown in the figure below:

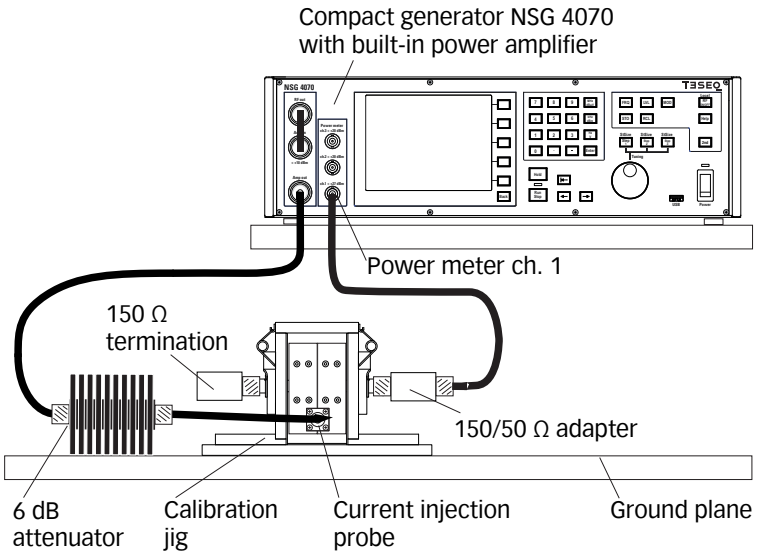


Figure 20: Test setup calibration according IEC / EN 61000-4-6 with current injection probe

8.2.20. Test setup calibration with current injection probe (50 Ω system)

The test generator is connected via 6 dB attenuator to the RF port of the current injection probe. The probe is inserted in a 50 Ω jig. The jig is connected to a power meter channel 1. The other side of the jig is terminated with 50 Ω. All IEC / EN 61000-4-6 setups of the NSG 4070 are based on the 150 Ω. A conversion factor of -9.5 dB is needed because of the 50 Ω to 150 Ω relation. For calibrating in a 50 Ω system is needed to add -9.5 dB as additional attenuation. Test levels of 10 V EMF may require an additional attenuator of 10 or 20 dB. The resultant factor should be used (Example: 20 dB -9.5 dB = 10.5 dB). See chapter 4.3.3 if using the front panel operation of the NSG 4070 or 5.9.3.7 if using the Windows software. The setup is shown in the figure below:

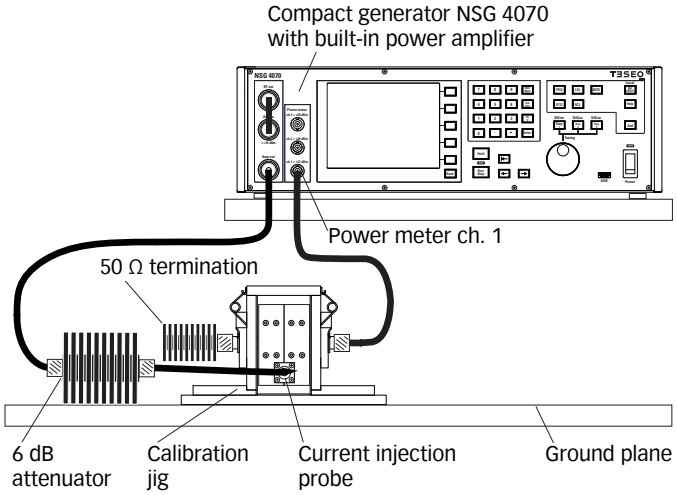


Figure 21: Test setup calibration with current injection probe in a 50 Ω system

The following figure shows the use of internal and external amplifier ("MIXED" mode) for having an extended frequency range.

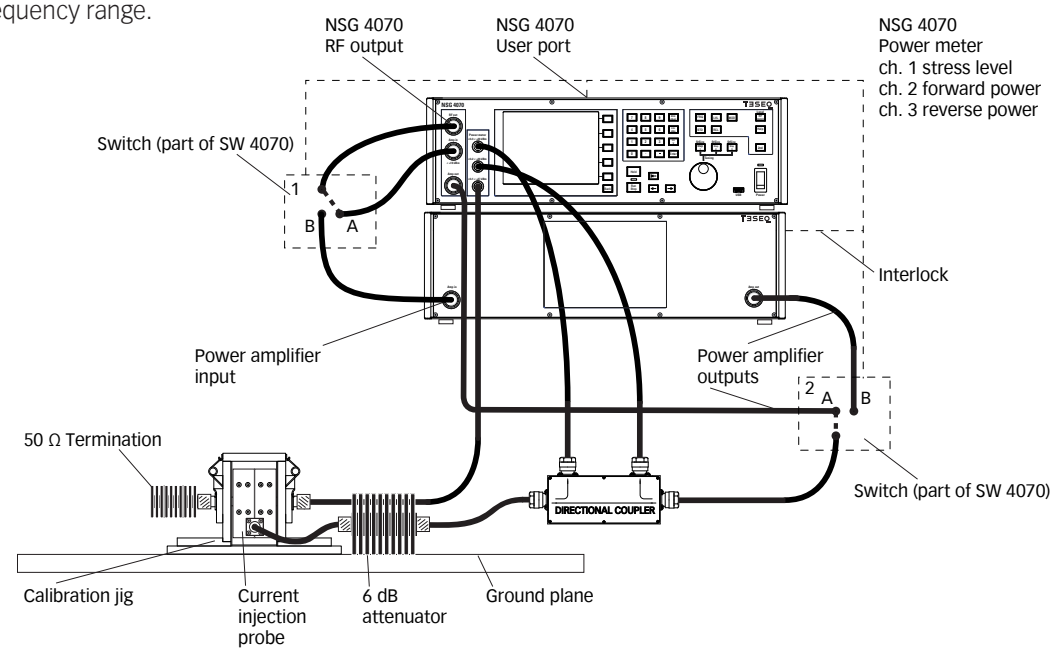


Figure 22: Test setup calibration with current injection probe in a 50 Ω system, 2 amplifiers

8.2.21. EUT test setup with current injection probe

After calibration the jig and the adapters must be removed from the setup. The EUT must be connected through the current injection probe. A general example for the test setup with EUT is shown below:

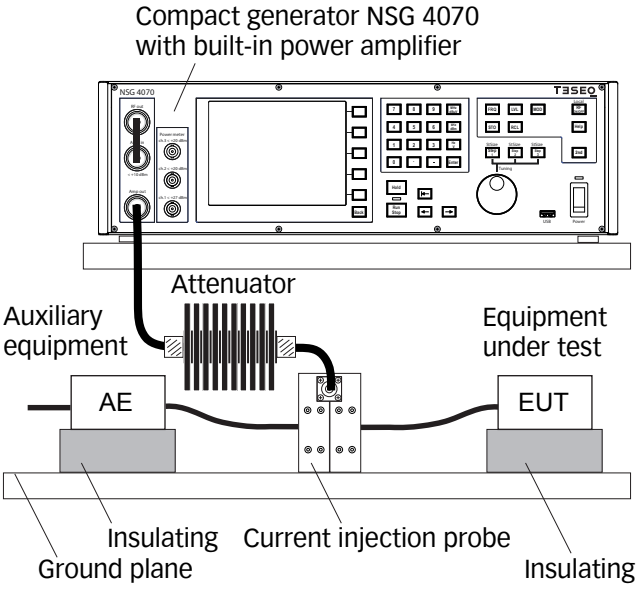


Figure 23: Test setup with EUT according IEC / EN 61000-4-6 with current injection probe

The test setup with using the monitoring probe is shown below.

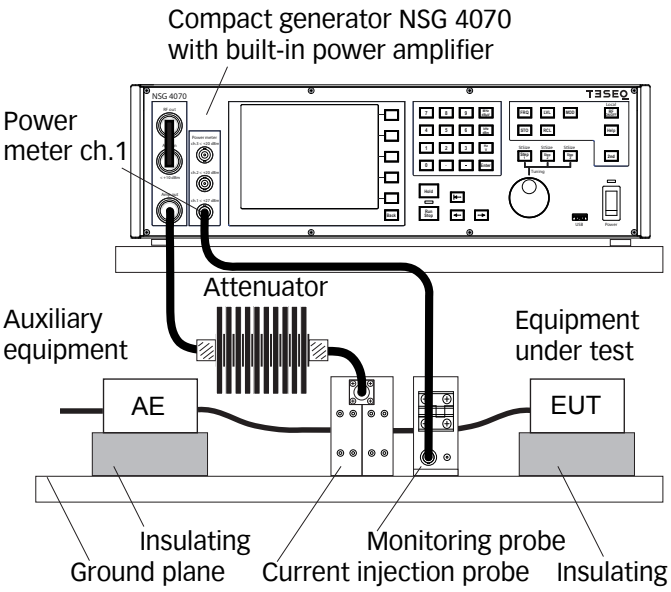


Figure 24: Test setup with EUT according IEC / EN 61000-4-6 with current injection probe and monitoring probe

8.2.22. Calibration of the monitoring probe

Teseq recommends using the MD 4070 monitoring probe due to the operating range of the power meter. The active mode of MD 4070 allows also the operation with low stress levels. Details given in Table 11. The active mode requires to connect the power supply with the MD 4070. Using the whole dynamic range requires to calibrate the MD 4070 in the active and passive mode. The remote controlled switching requires connection with the NSG 4070 user port. The probe calibration measures the insertion loss in a 50 Ω system.

CAUTION: Using power amplifiers with more than 100 Watts requires to protect power meter channel 1 with an attenuator of at least 10 dB.

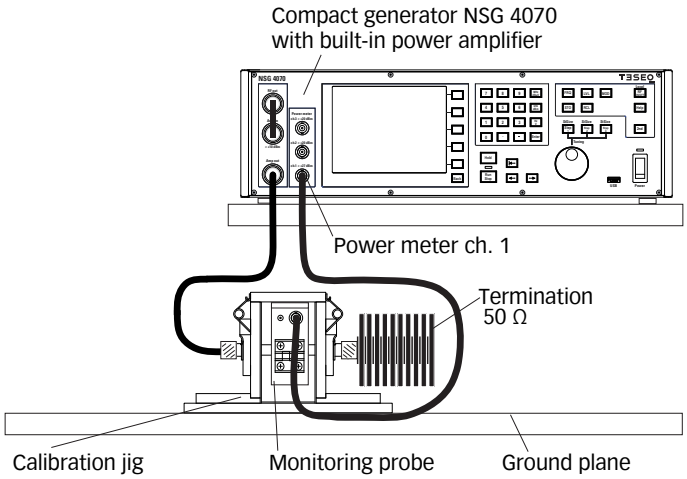


Figure 25: Calibration setup of the monitoring probe

The calibration setup for the monitoring probe with an external power amplifier is shown below.

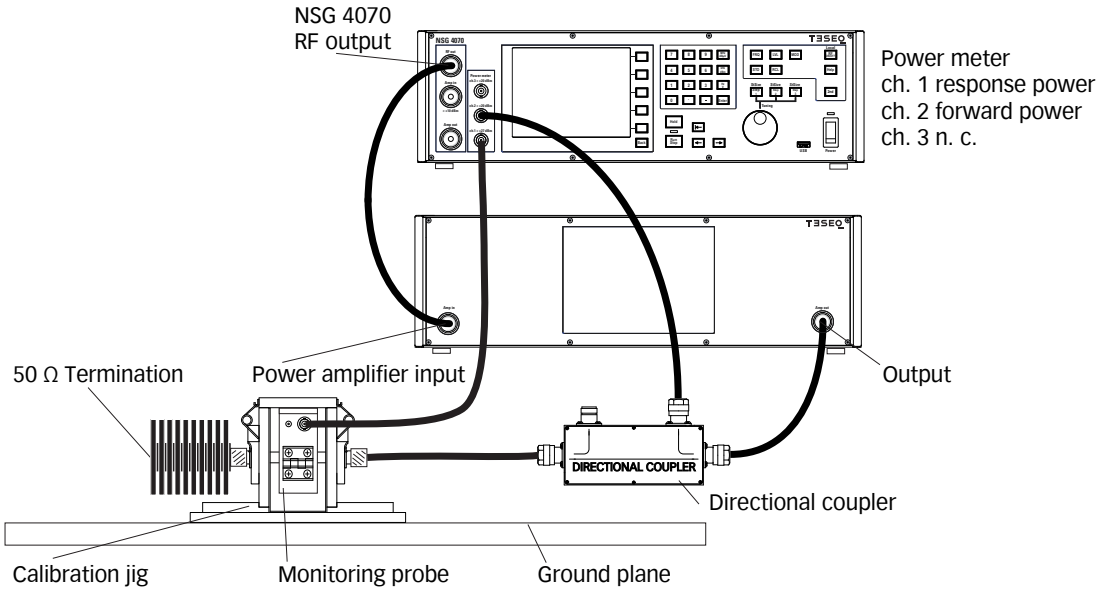


Figure 26: Calibration setup of the monitoring probe with external power amplifier and directional coupler

8.2.23. Setup with external power amplifier and directional coupler

An external power amplifier can be connected to the NSG 4070 as shown in the general example below. An external power amplifier requires always an external directional coupler regardless of the type of NSG 4070 used. For the combination internal and external amplifier is needed the optionally available RF switch SW 4070. A setup is shown in figure 27.

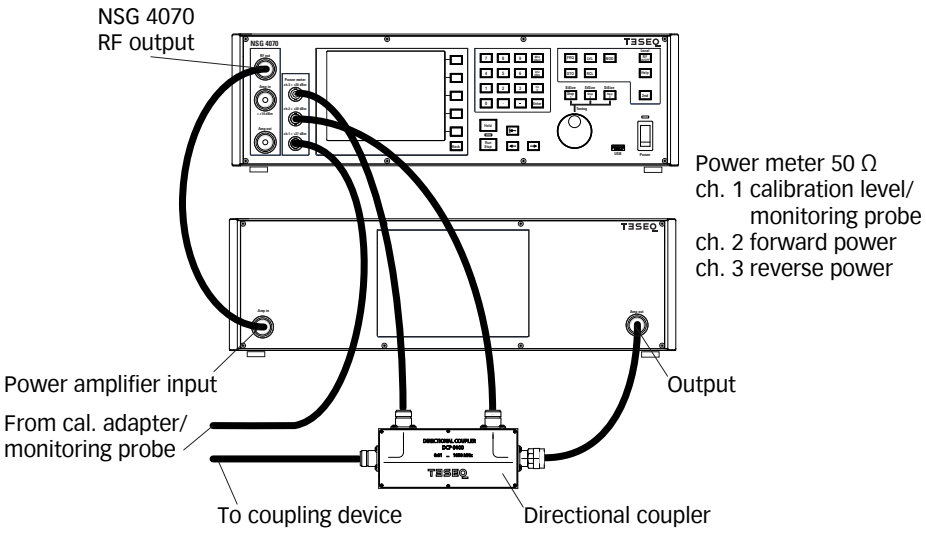


Figure 27: Setup with external power amplifier and directional coupler

8.2.24. Setup with NSG 4070C-110

In principle is the NSG 4070C-110 connected in the similar way as the other NSG 4070 models with internal amplifier. A setup is shown in figure 28.

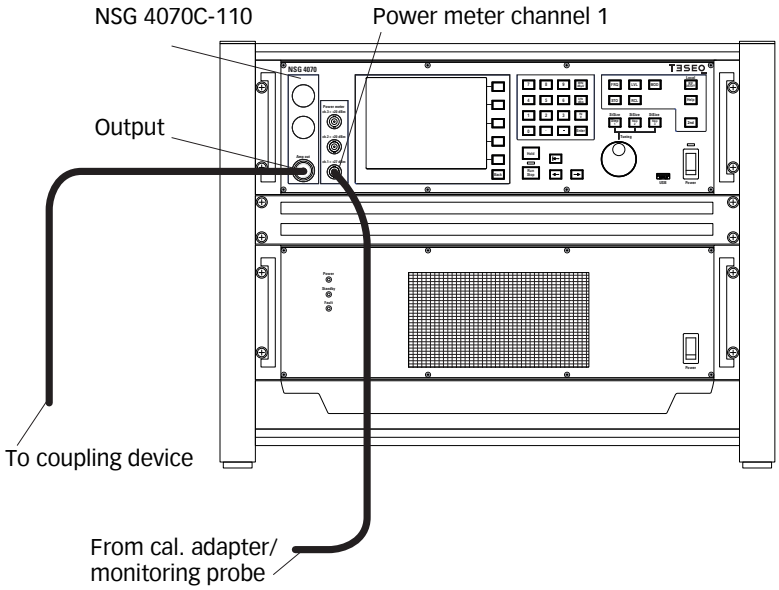


Figure 28: Setup with NSG 4070C-110

8.3. Automotive BCI testing

8.3.1. Standards

The automotive industry has a range of test standards separate from those used in commercial immunity testing. ISO (the International Organization for Standardization) defines the standard in ISO 11452-4: Road vehicles: Component test methods for electrical disturbances from narrowband radiated electromagnetic energy: Part 4: Bulk current injection (BCI). Individual automotive manufacturers use this basic standard as a guide to produce their own individual test standards. Thus each car manufacturer may have some variants to the ISO 11452-4 requirements which are not addressed in this chapter.

8.3.2. Differences between IEC/EN 61000-4-6 and BCI

	IEC/EN 61000-4-6	BCI
Frequency range	150 kHz … 80 (230) MHz	(10 kHz) 1 MHz … 400 (1000) MHz
System	150 Ω (special case 50 Ω)	50 Ω
Stress level	Voltage EMF	Current in mA or dBµA
Modulation	AM	AM PC (Peak conservation)
Frequency step	max. 1% of the preceding frequency value	e.g. as shown in ISO 11452-1 table 2
Test method	Substitution (with power limitation in case the 150 Ω condition cannot be meet)	Substitution Substitution (current measurement probe use is optional) Closed loop with power limitation
Additional equipment	6 dB attenuator	Reverse power measurement

Table 9: Differences between IEC/EN 61000-4-6 and BCI

8.3.3. Stress level

The standard ISO 11452-4 defines the range from 20 to 200 mA. Specific values, also above 200 mA, can be defined by the users of the standard, if necessary.

8.3.4. Modulation

In the automotive standards the peak of the modulation envelope is at the same level as the peak of the CW signal and so no allowance needs to be made for modulation. This kind of modulation is called AM PC (peak conservation) and can be selected in the menu-controlled operation of the NSG 4070 or in the Windows NSG 4070 Control software.

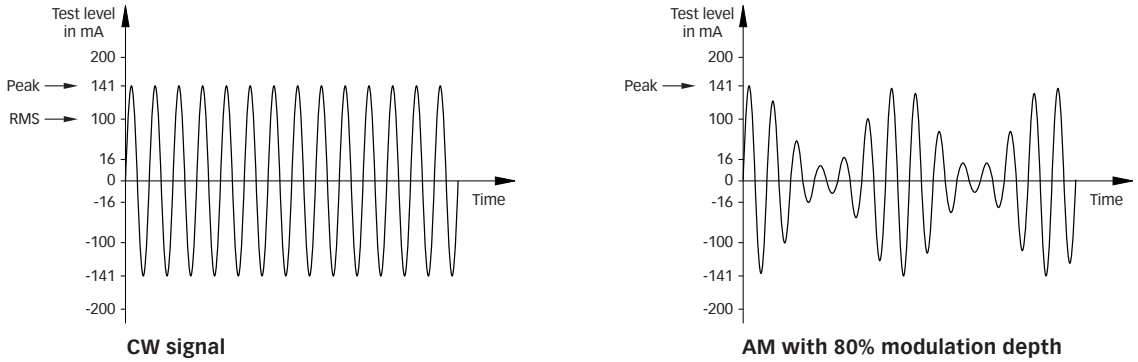


Figure 29: Amplitude modulation with peak conservation

8.3.5. Power requirements

Stress level	Insertion loss CIP 9136A typ. max. value 10 to 100 kHz	Required forward power (CW)	Insertion loss CIP 9136A typ. max. value 100 kHz to 1 MHz	Required forward power (CW)	Insertion loss CIP 9136A typ. max. value 1 to 400 MHz	Required forward power (CW)
dBµA	dB	Watts	dB	Watts	dB	Watts
64	27	0.1	15	0.01	10	0.002
70	27	0.3	15	0.02	10	0.006
89	27	25.1	15	1.6	10	0.5
95	27	100.0	15	6.3	10	2.0
100	27	316.2	15	20.0	10	6.3
106	27	limit	15	79.4	10	25.1
109	27	limit	15	158.5	10	50.1

Table 10: Power requirements for stress levels in dBµA (calculated with 1 dB cable loss)

Stress level	Insertion loss CIP 9136A typ. max. value 10 to 100 kHz	Required forward power (CW)	Required forward power (CW) for k=4	Insertion loss CIP 9136A typ. max. value 100 kHz to 1 MHz	Required forward power (CW)	Required forward power (CW) for k=4	Insertion loss CIP 9136A typ. max. value 1 to 400 MHz	Required forward power (CW)	Required forward power (CW) for k=4
mA	dB	Watts	Watts	dB	Watts	Watts	dB	Watts	Watts
25	27	19.7	78.9	15	1.2	5.0	10	0.4	1.6
50	27	78.9	315.5	15	5.0	19.9	10	1.6	6.3
75	27	177.5	709.8	15	11.2	44.8	10	3.5	14.2
100	27	315.5	limit	15	19.9	79.6	10	6.3	25.2
150	27	709.8	limit	15	44.8	179.1	10	14.2	56.7
200	27	limit	limit	15	79.6	318.5	10	25.2	100.7
250	27	limit	limit	15	124.4	497.6	10	39.3	157.4
300	27	limit	limit	15	179.1	716.6	10	56.7	226.6
400	27	limit	limit	15	318.5	limit	10	100.7	402.9
500	27	limit	limit	15	497.6	limit	10	157.4	629.5

Table 11: Power requirements for stress levels in mA (calculated with 1 dB cable loss)

8.3.6. Power limitation factor

The standard ISO 11452-4 defines a power limit for the Closed loop method. The test procedure used at each frequency is described as follows. Increase the forward power applied to the current injection probe and measure the injected current until either:

- the measured current reaches the specified test level, or
- the forward power reaches the power limit.

The value $P_{for\ cal}$. is known from the calibration procedure. The power limit is shown as:

$$P_{CW\ limit} = kP_{for\ cal}$$

$P_{CW\ limit}$ is the power limit
$P_{for\ cal}$. is the forward power applied to reach the current test signal level in the jig
k limitation factor (default value is 4)

The limitation factor of 4 requires 4 times higher (6 dB) forward power as calibrated. The power amplifier must be able to have this reserve. The connected hardware (directional coupler, power meter, attenuator and BCI probe) should be selected for the maximum level of the power amplifier. (see also table 14)

8.3.7. Power amplifier

The nominal frequency range of Teseq's power amplifiers is related to the 3 dB band width. The internal used power amplifier modules provide essential more power in specific frequency ranges as given with the value of the nominal power. Further the power amplifier can also be used outside the nominal frequency range with limited performance.
Class A amplifiers are the best choice for BCI testing. Only this principle guarantees providing forward power independent of the matching. The maximum linear output power is related to the amplifier model and frequency and in most cases provided already below 0 dBm input power. A further increase of the input power generates not more output power - saturation.

8.3.8. RF switch

Two power amplifiers can be combined with the optional RF switch SW 4070. The SW 4070 has 2 SPDT relays and is powered and controlled by the NSG 4070 user port. The SW 4070 provides a second user port for connecting e.g. the MD 4070. The path switching is defined in the EUT monitoring menu with digital output D2. See chapter 5.9.3.2 for details.

8.3.9. BCI probe

For BCI testing is recommended the CIP 9136A for the frequency range 10 kHz (4 kHz) to 400 MHz. The frequency response of the BCI probe is measured during the system calibration. Calibration files e.g. in ASCII can not be imported. For investigation purpose (system check) can be used the probe calibration (next chapter). The result is the insertion loss of the whole setup.

8.3.10. Current probe

Teseq recommends using the MD 4070 monitoring probe due to the operating range of the power meter. The active mode of MD 4070 allows also the operation with low stress levels. Details given in Table 15.

Monitor probe	Stress level range (calculated with power limitation factor 4)	
Insertion loss in dB	mA	dBµA
+10*	0.03 to 16	30 to 84
-22**	1.1 to 500	60 to 114
-34***	4.5 to 2500****	72 to 128

* typical MD 4070 active
** typical MD 4070 passive
*** current probe with transfer impedance 1 Ω (0 dB/Ω)
**** typical limit at 1000 mA caused by the probe

Table 12: Probe insertion loss relative to power meter range and stress level

The active mode requires to connect the power supply with the MD 4070. Using the whole dynamic range requires to calibrate the MD 4070 in the active and passive mode. The remote controlled switching requires connection with the NSG 4070 user port.
The calibration of the MD 4070 in active mode may require using a 10 dB or 20 dB attenuator on power meter channel 1. This is related to the gain of the amplifier and type of the directional coupler. Chapter 4.3.4 describes the entry of the attenuation factor.

8.3.11. Calibration jig

The calibration jig should be terminated by a 50 Ω load at one end and by a 50 Ω RF power meter at the other end.

8.3.12. Power meter

Channel 1 is used for measuring the stress level during the system calibration and measuring the insertion loss during the probe calibration. Also channel 1 is used to connect the current probe during testing. Power meter channel 2 is used in combination with an external directional coupler for measuring the forward power and channel 3 for measuring the reverse power.
The power meter must be protected by an adequate 50 Ω attenuator in case the stress level plus adjustment tolerance exceeds the power limit of 27 dBm (see the yellow marked range in Table 13).

Stress level			
mA	dBµA	dBm	W
1	60	-13	0.00005
4	72	-1	0.0008
10	80	7	0.005
25	88	15	0.032
45	93	20	0.1
100	100	27	0.5
200	106	33	2.0
317	110	37	5.0
400	112	39	8
502	114	41	12.6

Table 13: Stress level conversion

8.3.13. Termination

The power requirements for the 50 Ω load are on the same level as the stress level (see Table 13). For example: A stress level of 400 mA requires at least a 8 W attenuator.

8.3.14. Optically decoupled remote control

The converter USO 4013 allows the remote control of the NSG 4070 via a 20 m Polymeric Optical Fiber (POF). The USO 4013 connects the optical remote interface of the NSG 4070 with the USB interface of the control PC.

8.3.15. Calibration

All BCI test methods are based upon the use of forward power as the reference parameter. The specific test level (current) shall be calibrated by recording the forward power required to produce a specific current measured on a 50 Ω calibration jig for each test frequency. This calibration shall be performed with an unmodulated sinusoidal wave. An example calibration setup is shown in the figure below:

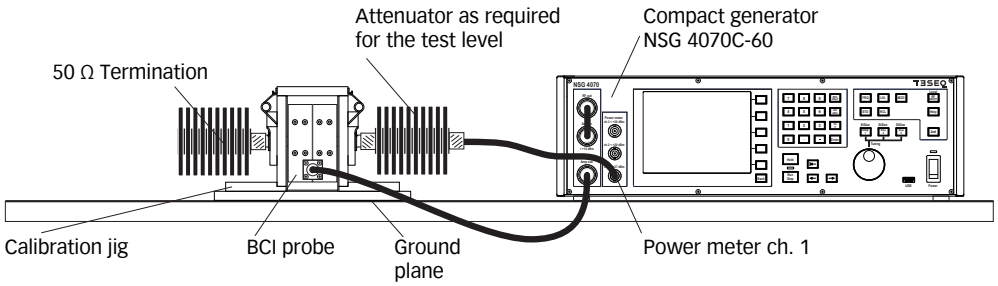


Figure 30: BCI calibration setup with internal power amplifier (e.g. NSG 4070C-60)

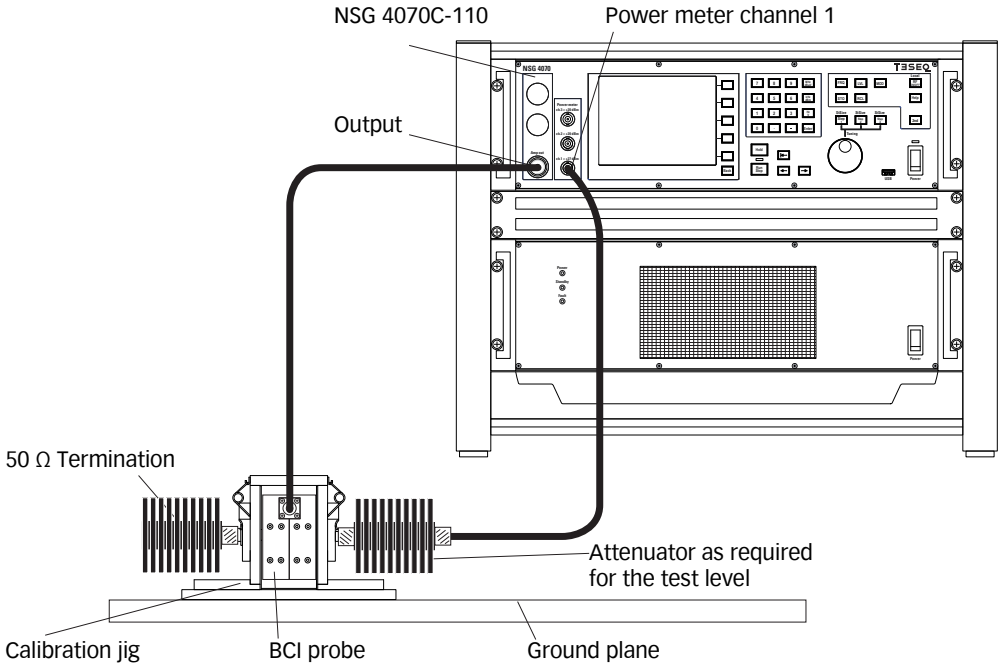


Figure 31: BCI calibration setup with internal power amplifier (e.g. NSG 4070C-110)

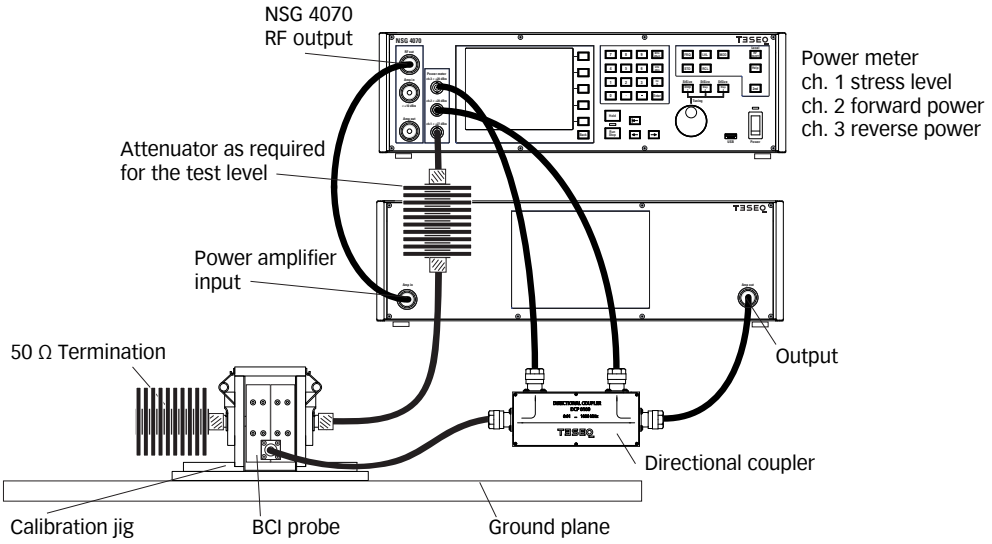


Figure 32: BCI calibration setup with external power amplifier

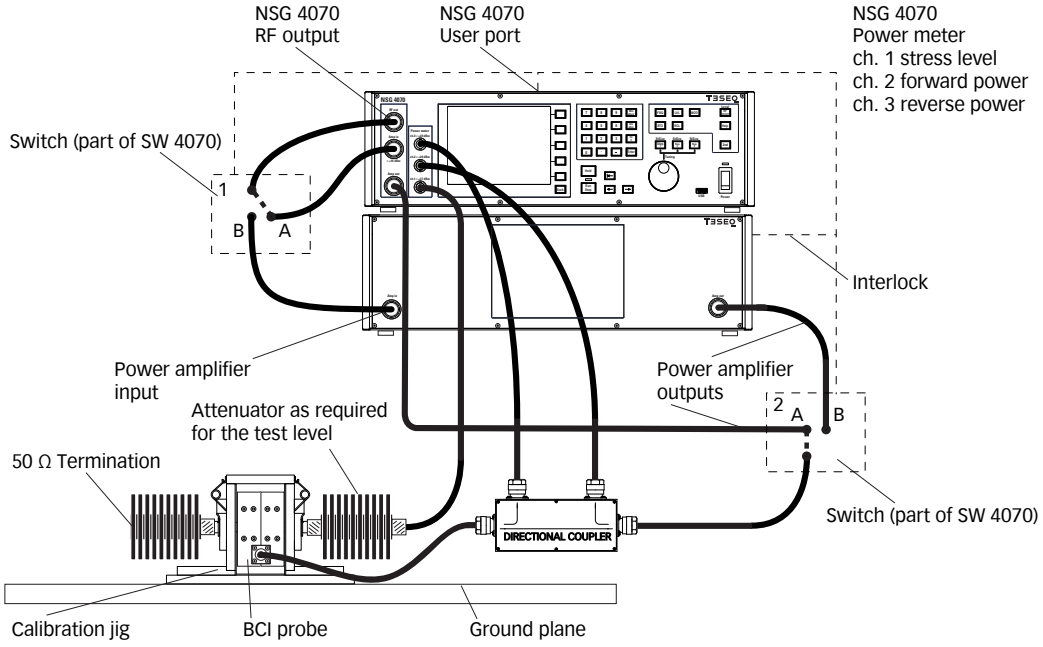


Figure 33: BCI calibration setup with two external power amplifiers

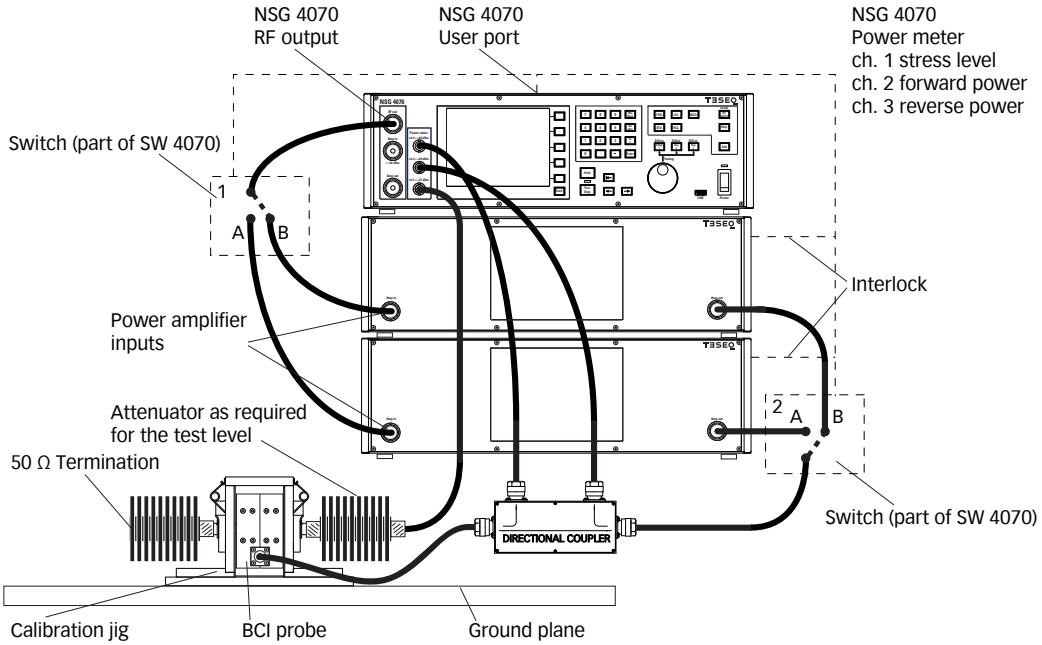


Figure 34: BCI calibration setup with internal and external power amplifier (Mix operation)

8.3.16. Calibration of the monitoring probe

The following figure shows one typical setup for the probe calibration. More opportunities are given with the combination of internal and external or with two external power amplifiers.

CAUTION: Using power amplifiers with more than 100 Watts requires to protect power meter channel 1 with an attenuator of at least 10 dB for example MD 4070 in active mode.

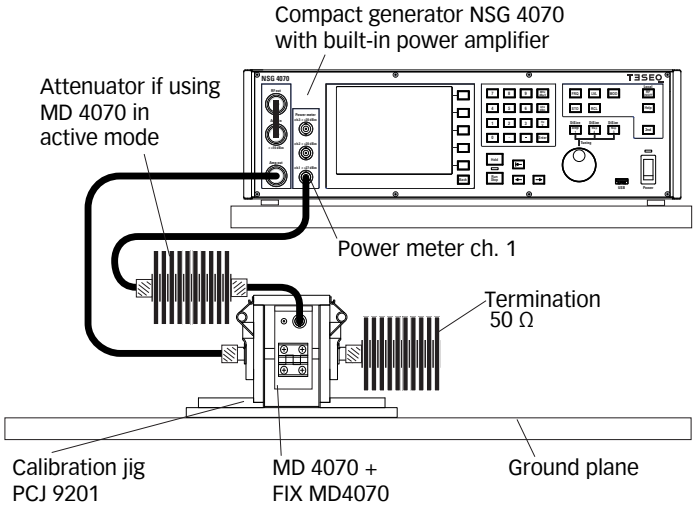


Figure 35: Probe calibration setup with internal power amplifier (e.g. NSG 4070C-60)

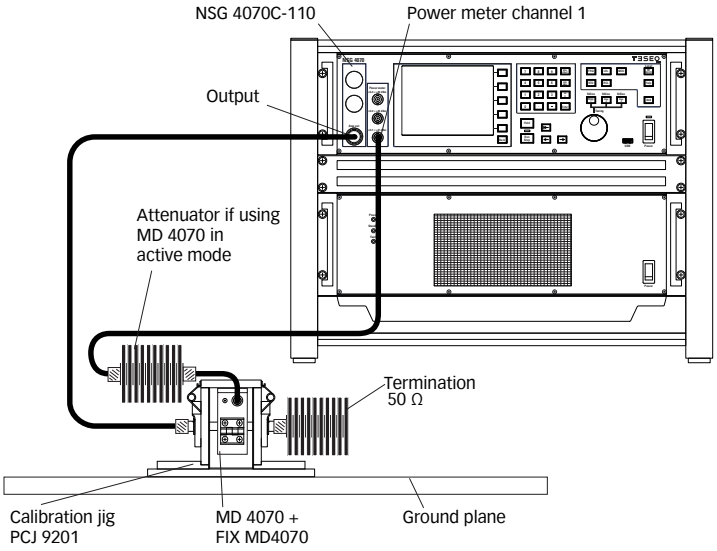


Figure 36: Probe calibration setup with internal power amplifier (e.g. NSG 4070C-110)

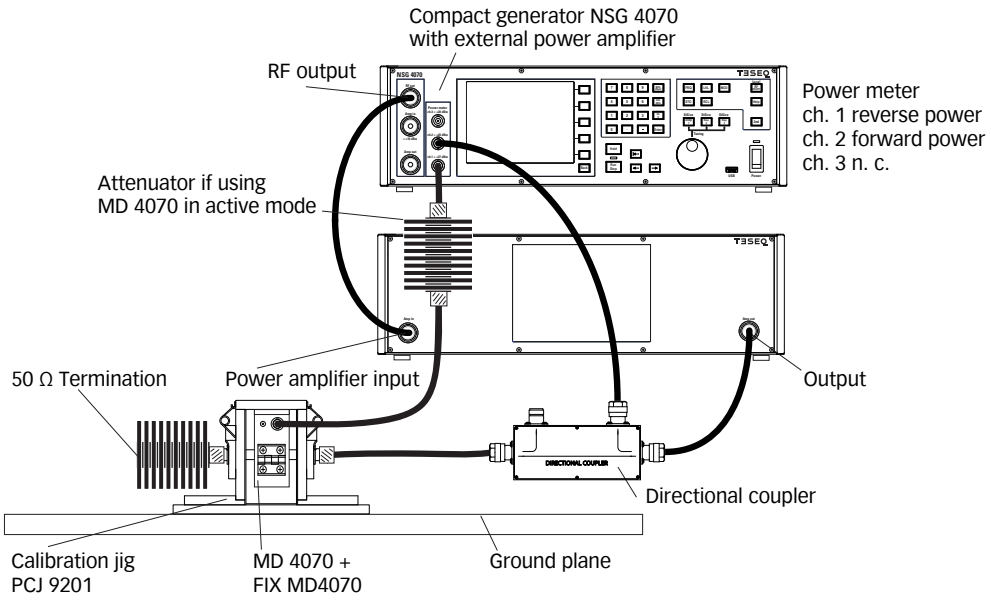


Figure 37: Probe calibration setup with external power amplifier

8.3.17. Test setup

After calibration the jig must be removed from the setup. The EUT must be connected through the BCI probe. A general example of the test setup for the substitution method without current monitoring probe is shown in Figures 38 & 39. Figures 40 to 43 show the setup for the substitution method with current monitoring probe and Closed loop method as well.

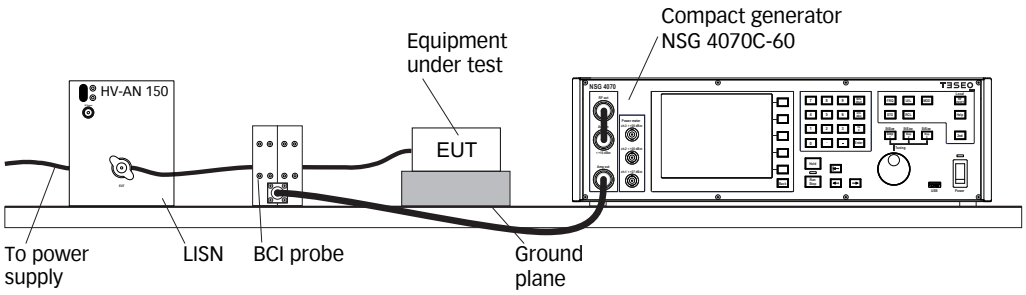


Figure 38: BCI test setup without current monitoring probe with internal amplifier

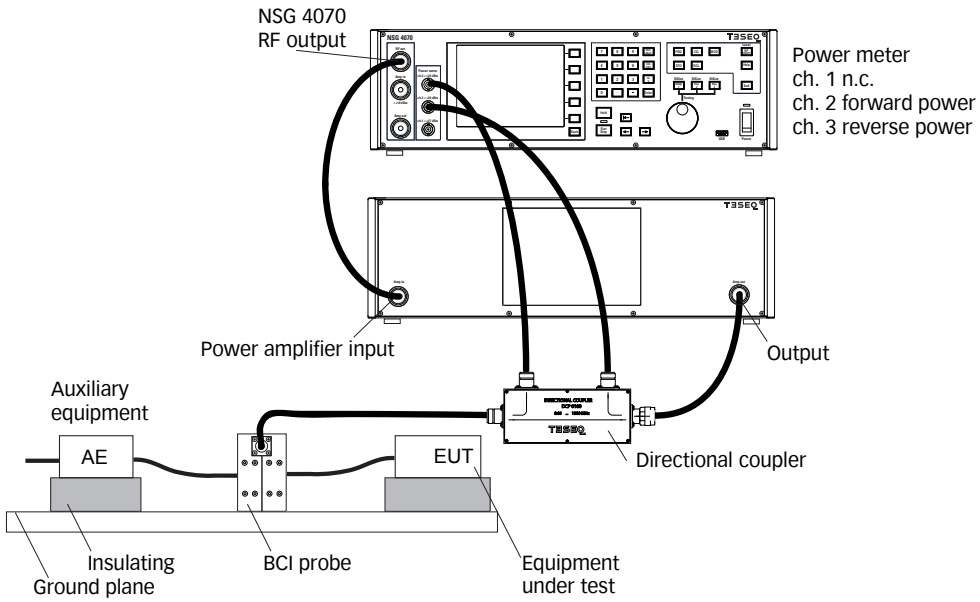


Figure 39: BCI test setup without current monitoring probe with external amplifier

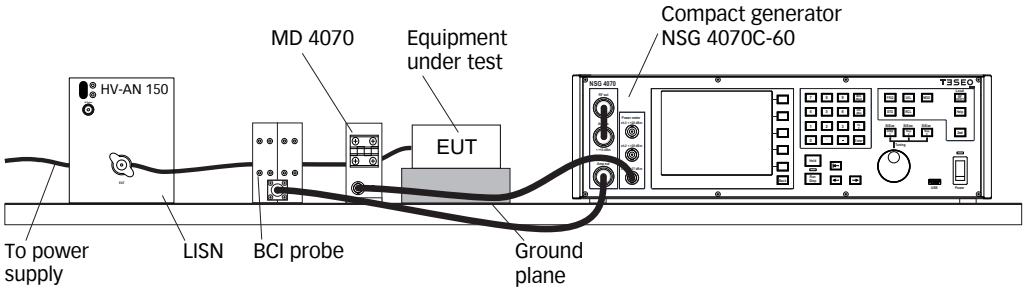


Figure 40: BCI test setup with current monitoring probe with internal amplifier (e.g. NSG 4070C-60)

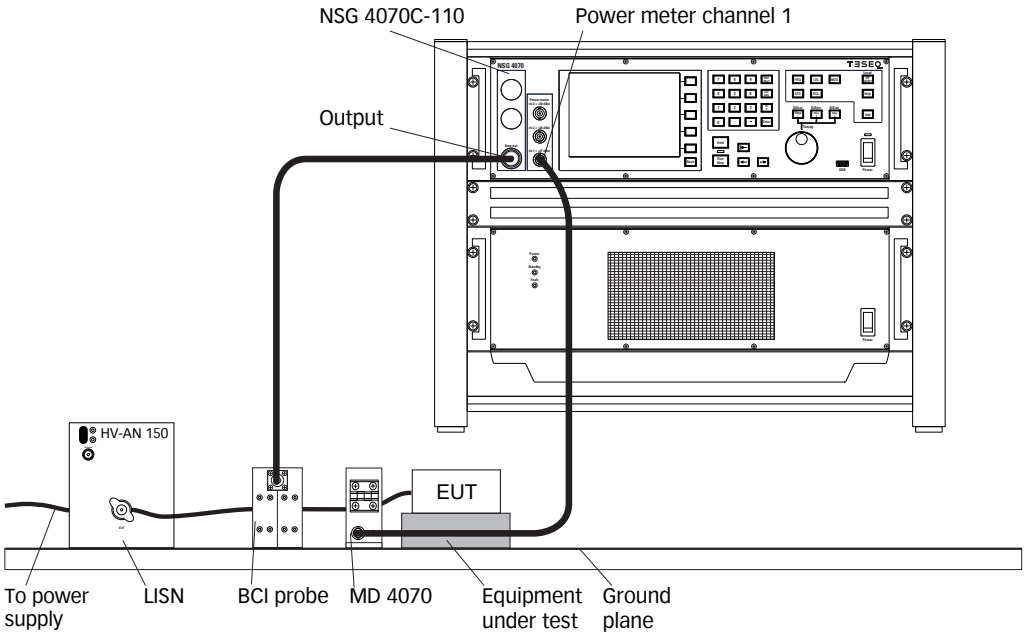


Figure 41: BCI test setup with current monitoring probe with internal amplifier (e.g. NSG 4070C-110)

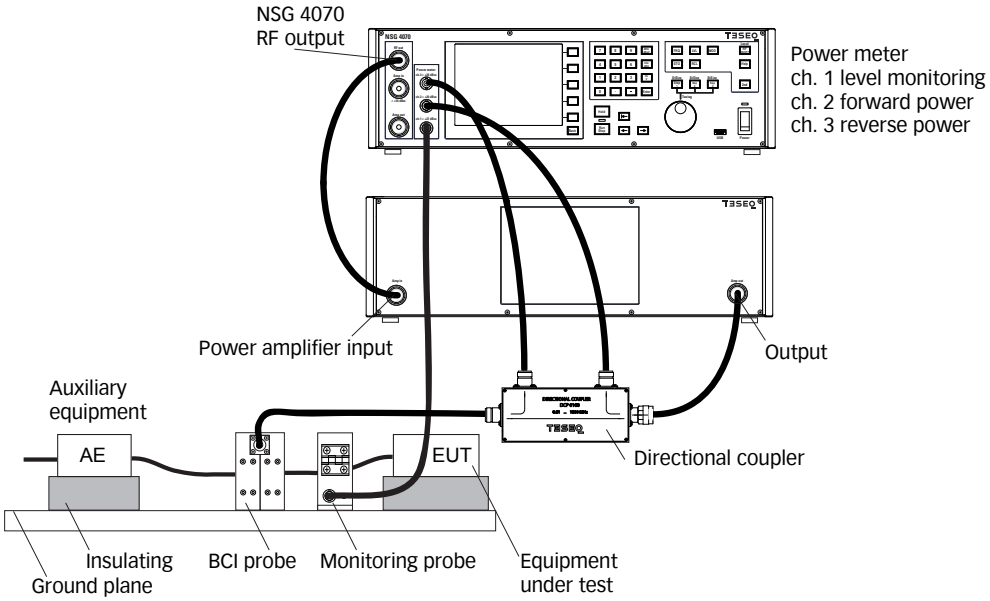


Figure 42: BCI test setup with current monitoring probe with external amplifier

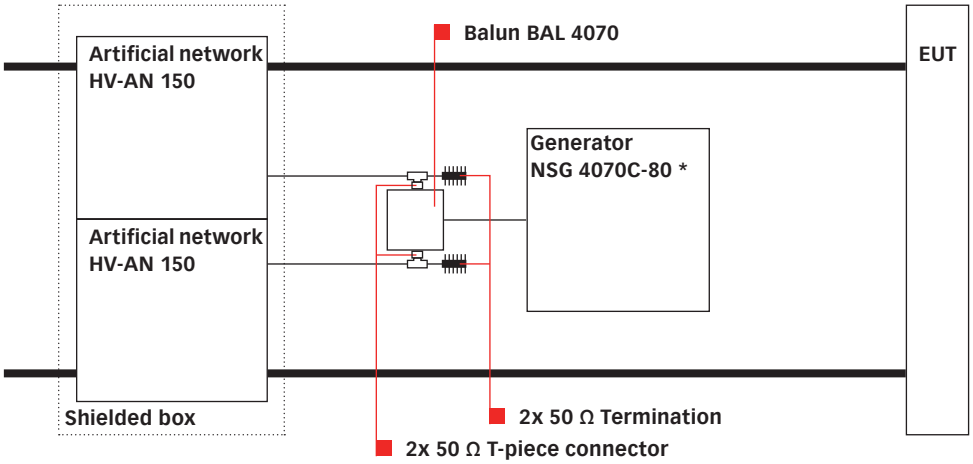
8.4. ISO 7637-4 Pulsed sinusoidal disturbances

8.4.1. Standard and equipment

The ISO/DTS 7637-4 specifies the transient immunity testing for pulsed sinusoidal disturbances. The NSG 4070C includes extended parameters for the pulse modulation. Up to three pulse modulation settings can be defined in order to create an envelope. NSG 4070C meets the requirements of ISO/DTS 7637-4 Immunity test for pulsed sinusoidal disturbances (pulse A). Teseq offers under the name SET 4001 a whole test equipment set consisting of 2x high voltage artificial network HV-AN 150, 2x termination 200 W, 2x T-piece connector, RF cables with N connectors, and balun transformer BAL 4070. The following figures show the test set-ups for line to line and line to ground testing.

8.4.2. Test setups

The standard has two different coupling methods. The high voltage supply of the EUT is established with two artificial networks in a shielded box. Figures 43 and 44 show the disturbance coupling to both supply lines with using a balun. Figure 45 shows the disturbance coupling to one of the supply lines.



*) Example up to test level 4 in ISO/DTS 7637-4.

Figure 43: Example test set-up for pulsed sinusoidal disturbances (“line-to-line”)

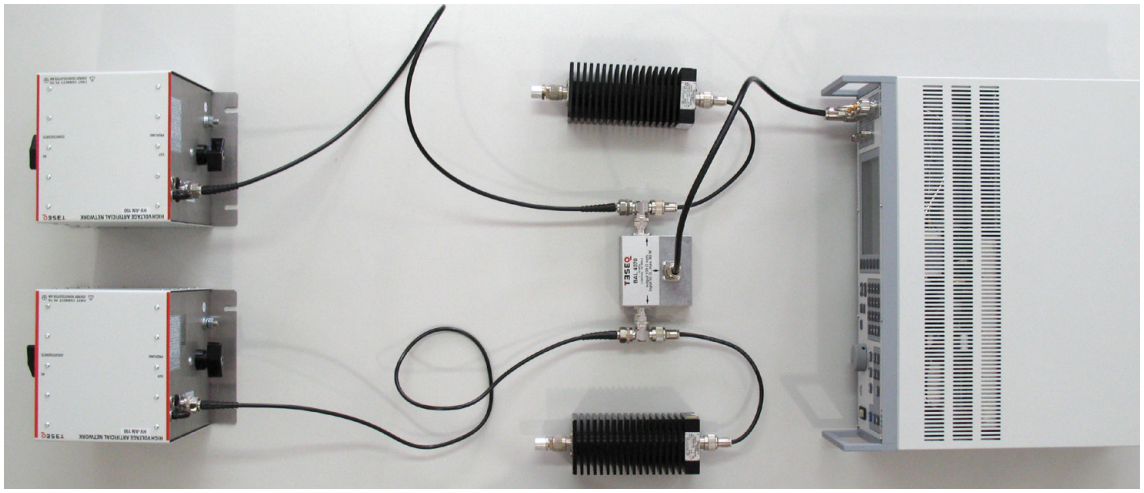
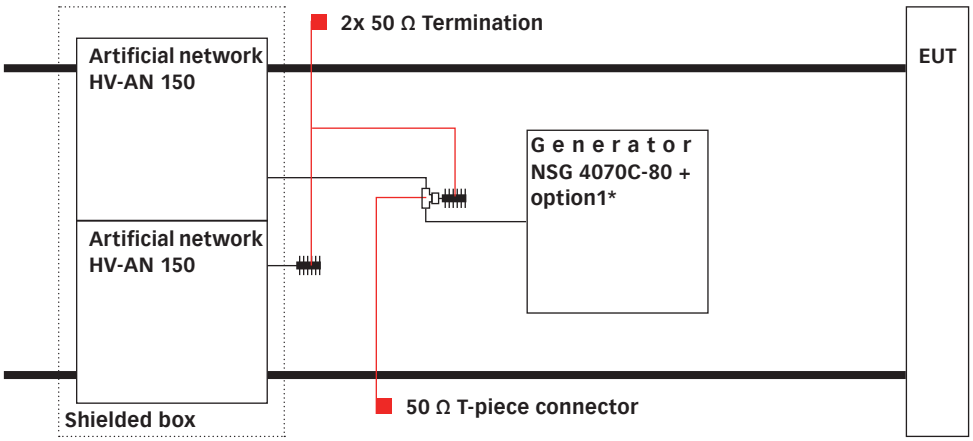


Figure 44: NSG 4070C-80 + SET 4001 (“line-to-line” coupling)



*) Example up to test level 4 in ISO/DTS 7637-4.

Figure 45: Example test set-up for pulsed sinusoidal disturbances ("line-to-ground")

8.4.3. Generator settings

The standard defines pulse frequency values of 1, 2, 5 and 10 MHz with a repetition time of 50, 100 and 200 µs. The following table shows the generator settings in order to meet the required pulse frequencies and repetition times.

Pulse frequency in MHz	Repetition time					
	200 µs		100 µs		50 µs	
	F_{mod} in kHz	Duty cycle in %	F_{mod} in kHz	Duty cycle in %	F_{mod} in kHz	Duty cycle in %
1	5	5	10	10	20	20
2	5	2.5	10	5	20	10
5	5	1	10	2	20	4
10	5	0.5	10	1	20	2

Table 14: Pulse frequency, repetition time, modulation frequency and duty cycle

Level	Vpp in V	Vrms in V	Power in W	Power in dBm
1	10	3.5	0.25	24.0
2	20	7.1	1	30.0
3	50	17.7	6.25	38.0
4	100	35.4	25	44.0
5	300	106.1	225	53.5

The table on the left shows the relation of test level, voltage and power in the 50 Ω system. For example: Test level 4 requires a peak-to-peak-voltage of 100 V, which requires a forward power of 44 dBm.

Table 15: Relation of test level, voltage and power in the 50 Ω system

The picture on the left shows an example of the generator settings for 1 MHz pulse frequency, 5 kHz pulse modulation, duty cycle of 5% with a level of -31.6 dBm (The level depends on the desired test level and connected power amplifier.).

Figure 46: Example of the parameter settings in the NSG 4070 generator menu

8.4.4. Attenuators

Transient disturbances due to fast switching are improved by a better signal-to-noise ratio, if an additional attenuator is connected between the generator output and the amplifier input. The following figure shows the setup as well as the recommended values of the attenuator.

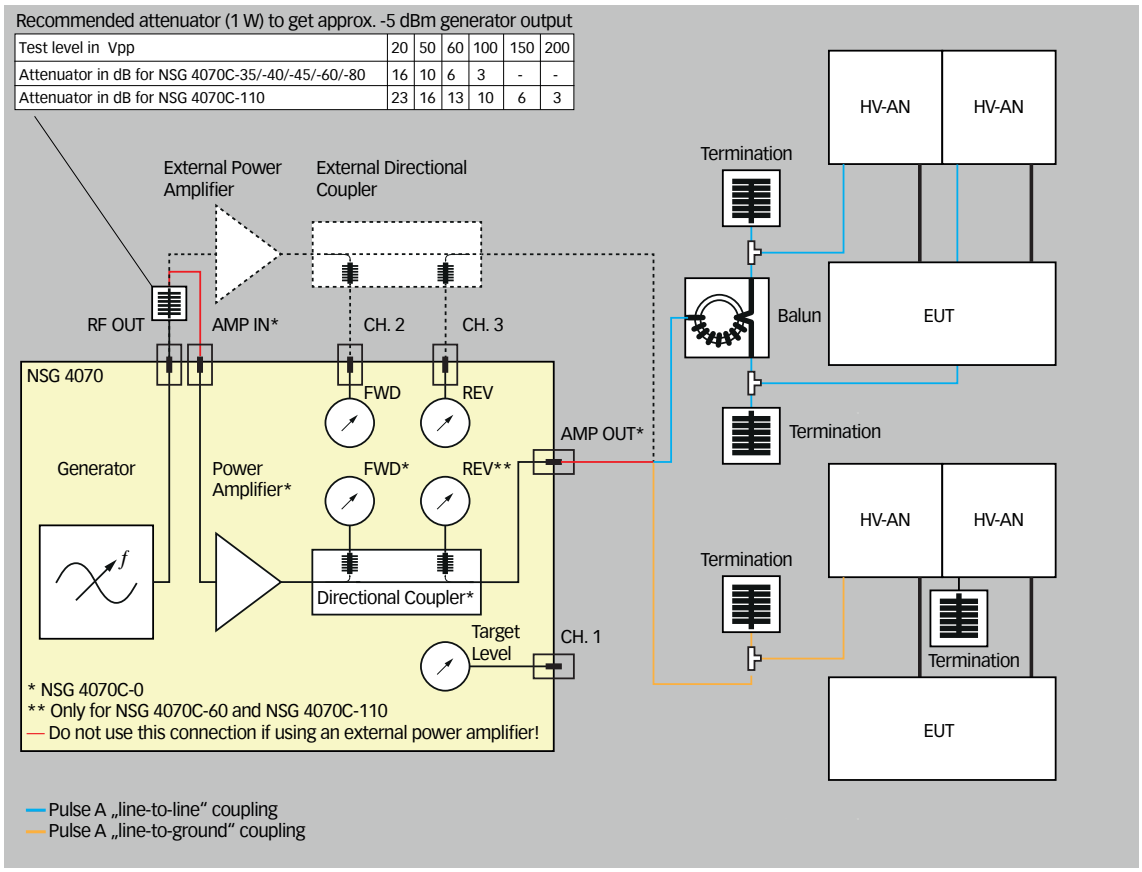


Figure 47: Example test set-up with attenuator on signal generator output

8.5. Radiated testing

8.5.1. General

The NSG 4070's wide frequency range from 4 kHz to 1 GHz allows it to also be used for radiated immunity tests. Its modular setup using external amplifiers and directional couplers enables a large variety of applications, including tests according to IEC / EN 61000-4-3, IEC / EN 61000-4-20, IEC / EN 61000-4-21 and others. The NSG 4070 can be remote controlled with optionally available test house software for convenient and efficient operation.

8.5.2. Setup examples for radiating testing

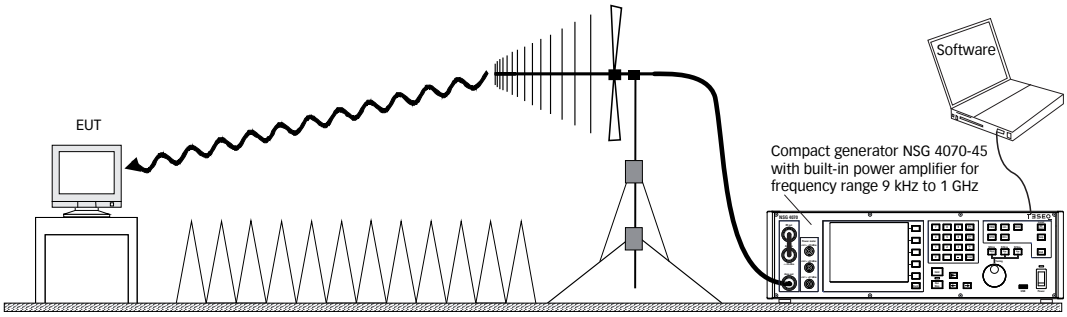


Figure 48: Setup with antenna and NSG 4070-45

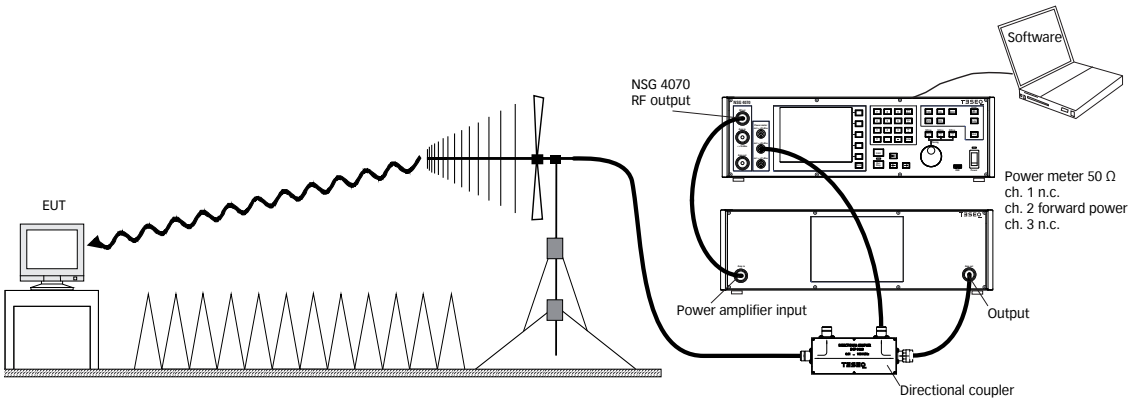


Figure 49: Setup with antenna and NSG 4070 with external power amplifier

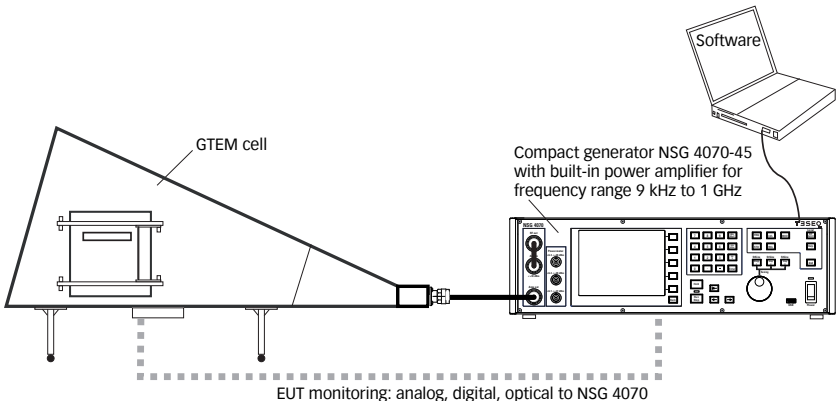


Figure 50: Setup with GTEM cell and NSG 4070-45

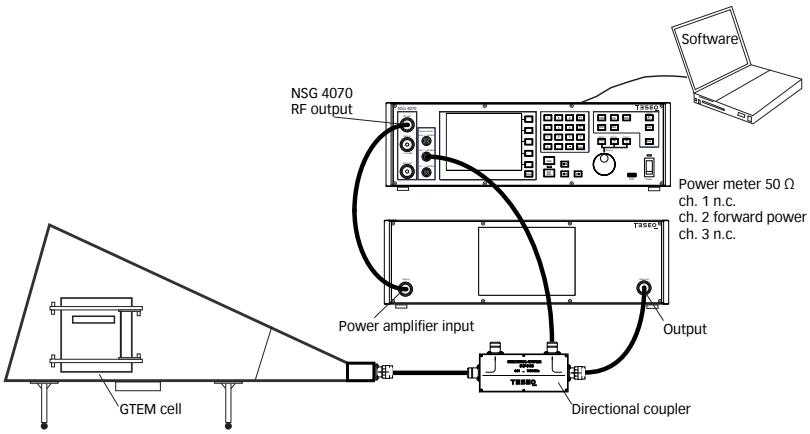


Figure 51: Setup with GTEM cell and NSG 4070 with external power amplifier

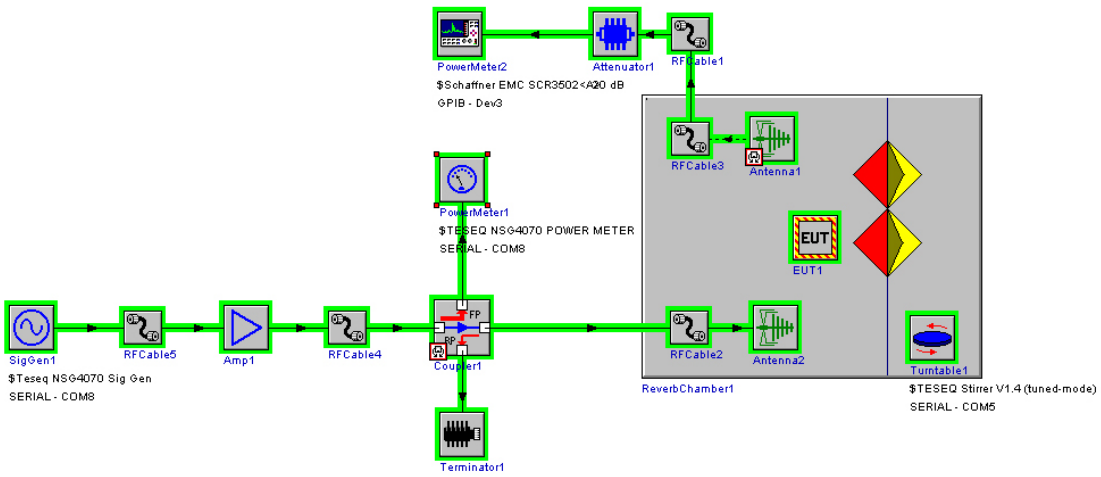


Figure 52: CIS test house software configuration of a reverberation chamber setup with NSG 4070

9. TECHNICAL SPECIFICATIONS

9.1. Generator

RF	
Frequency range:	4 kHz to 1 GHz
Resolution:	1 Hz
Reference frequency:	10 MHz
Aging:	25 ppm
RF Level	
Level range:	-60 dBm to +10 dBm
Resolution:	0.1 dB
Settling time:	10 ms
Amplitude modulation	
Modulation depth:	0 to 100%
Modulation frequency range:	1 Hz to 50 kHz
Frequency resolution:	1 Hz
Pulse modulation (possible to interlace up to three pulse modulations)	
Rise/fall time (10%/90%):	< 1 µs
Modulation frequency range:	0.01 Hz to 1 MHz
Frequency resolution:	0.01 Hz
Duty cycle:	0.1% to 100%
External modulation	
Delay time:	< 1 µs/180°
Period:	min. 20 µs
Pulse width:	min. 10 µs

9.2. Power meter

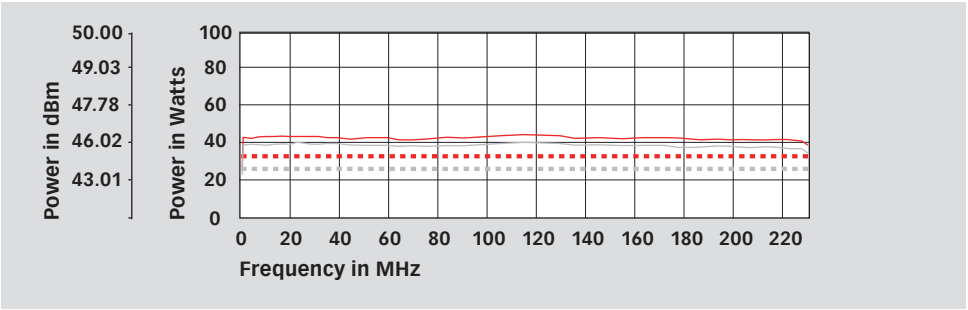
Frequency range:	4 kHz – 1 GHz
Linear measurement range	
channel 1:	-35 dBm to +27 dBm (NSG 4070C-60:-40 dBm to +27 dBm)
channel 2,3:	-45 dBm to +20 dBm
Max. input/no damage	
channel 1-3:	+28 dBm
Noise level:	>5 dB below the measurement range
Input return loss:	>20 dB (below 500 MHz), >17 dB (500 MHz to 1 GHz)
Connector:	BNC socket, 50 Ω
Accuracy 10 to 30°C:	<0.5 dB, typ. <0.3 dB

9.3. Power amplifier

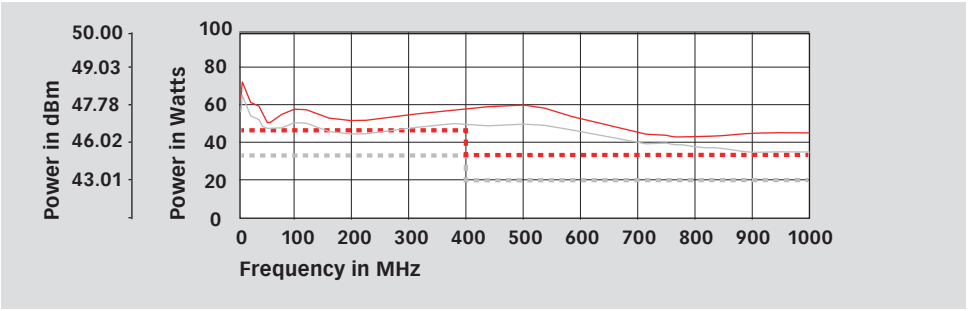
Nominal output power:	**35 W**	**80 W**
Frequency range:	150 kHz - 230 MHz	150 kHz - 230 MHz
Type:	single band, class A	single band, class A
Input / output impedance (nominal):	50 Ω	50 Ω
Input return loss (minimum):	10 dB	10 dB
Output return loss without damage:	0 dB	0 dB
Gain (minimum):	48 dB	50 dB
Gain flatness (maximum):	+/- 3 dB	+/- 3 dB
Saturated output power (minimum):	44.9 dBm	48.5 dBm
Linear output power (minimum):	43.5 dBm	47.5 dBm
Input power without damage (maximum):	+10 dBm	+10 dBm
Harmonic distortion at linear output power (typical):	< -17 dBc	< -20 dBc

Nominal output power:	**45 W**		**60 W**		**110 W**	
Frequency range:	9 kHz to 1 GHz		10 kHz (4 kHz) to 400 MHz		10 kHz (4 kHz) to 400 MHz	
Type:	single band, class A		single band, class A		single band, class A	
Input / output impedance (nominal):	50 Ω		50 Ω		50 Ω	
Input return loss (minimum):	10 dB		10 dB		10 dB	
Output return loss without damage:	0 dB		0 dB		0 dB	
Gain (minimum):	49 dB		4 kHz to 10 kHz 45 dB	10 kHz to 400 MHz 50 dB	4 kHz to 10 kHz 47 dB	10 kHz to 400 MHz 50 dB
Gain flatness (maximum):	+/- 3 dB		+/- 3 dB		+/- 3 dB	
Saturated output power (minimum):	< 400 MHz 46.0 dBm	> 400 MHz 44.3 dBm	4 kHz to 10 kHz 42 dBm	10 kHz to 400 MHz 48.5 dBm	4 kHz to 10 kHz 43 dBm	10 kHz to 400 MHz 49.9 dBm
Linear output power (minimum):	< 400 MHz 44.9 dBm	> 400 MHz 41.9 dBm	4 kHz to 10 kHz 40 dBm	10 kHz to 400 MHz 47.5 dBm	4 kHz to 10 kHz 41 dBm	10 kHz to 400 MHz 48.5 dBm
Input power without damage (maximum):	+10 dBm		+10 dBm		+10 dBm	
Harmonic distortion at linear output power (typical):	< -20 dBc		< -18 dBc		< -20 dBc	

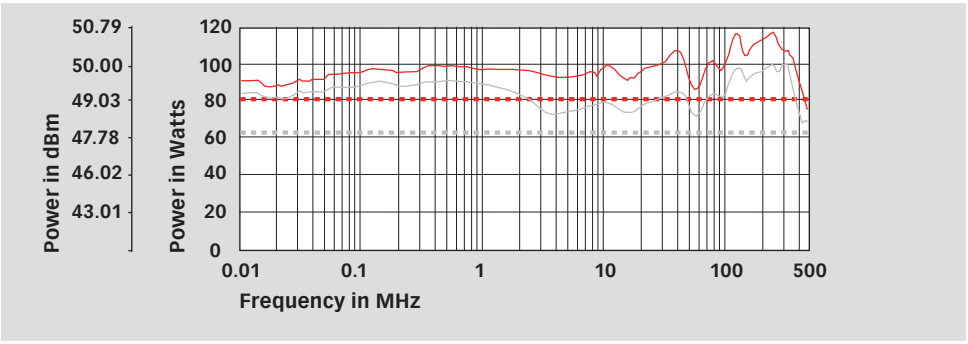
Power amplifier of NSG 4070C-35



Power amplifier of NSG 4070C-45



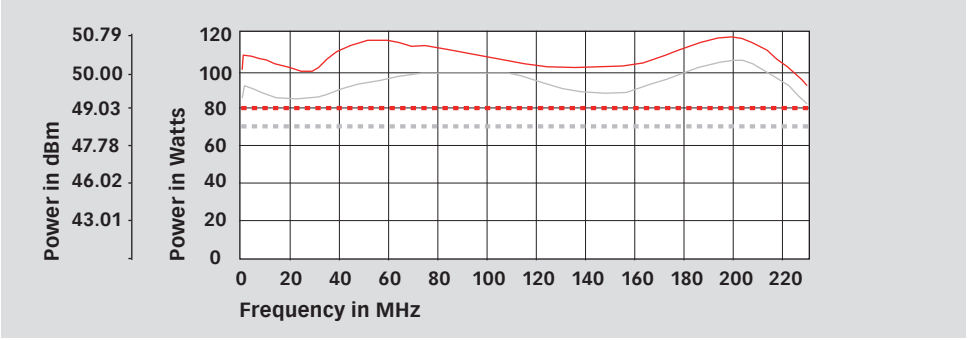
Power amplifier of NSG 4070C-60



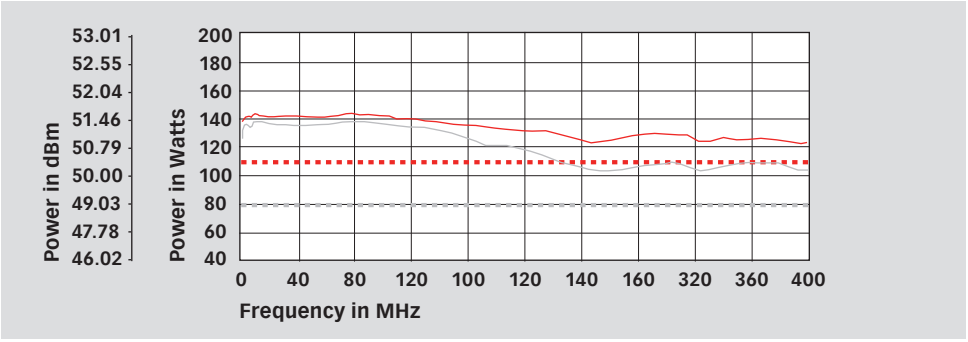
Legend:

typical saturated power,
typical linear power,
specification saturated power,
specification linear power

Power amplifier of NSG 4070C-80



Power amplifier of NSG 4070C-110



Legend:

typical saturated power,
typical linear power,
specification saturated power,
specification linear power

9.4. Test and measurement routines

9.4.1. Generator mode

Sweep:	frequency sweep, level sweep
Modulation:	AM, AM PC (peak conservation), pulse modulation and external
Others:	free parameter setting from 4 kHz to 1 GHz, high power mode using power amplifier

9.4.2. Power meter mode

Level setting:	free generator level setting via numeric input or rotary knob, generator ON/OFF, power amplifier (internal) ON/OFF
Frequency setting:	free frequency setting via numeric input or rotary knob
Power display:	channel 1 to 3, amplifier output (internal)

9.4.3. Immunity mode

Level:	start and stop level or sections can be defiened, max test levels depending on power amplifier or for IEC 61000-4-6 limited to 30 V EMF, for BCI tests levels in units mA or dBµA
Test methods IEC 61000-4-6:	CDN, EM clamp, current clamp and direct injection, clamp injection with test level control using monitoring probe
Test methods BCI:	substitution method with optional use of the monitoring probe, Closed loop method with power limitation (factor adjustable)
Sweep:	frequency or section sweep with linear, steps per decade or percental increase
Modulation:	AM, AM PC (peak conservation), pulse modulation, external or mixed (e.g. 1 kHz AM internal modulated with 1 Hz PM external)
EUT monitoring:	individual port configuration, EUT monitoring setup and check function, EUT monitoring results displayed during test in both results file and test report
Calibration:	test setup and monitoring probe calibration, display, calibration file store and recall function (limitation of file numbers only by the disk space, typical >340 files)
EUT threshold search:	manual search by changing frequency or stress level
Store and recall:	function for test configurations, calibration results and test results (number of files is only limited by the disk space, typical >340 files), supports USB sticks
Component check:	quick system component check, e.g. cable, attenuator max. 52 dB/54 dB/58 dB attenuation for 35 W/45 W/80 W amplifier, max. +16 dB gain at 27 dBm output level
Additional features:	free parameter setting from 4 kHz to 1 GHz, external power amplifier support, directional coupler and attenuator

9.5. Analog ports

Front panel	
Generator output:	N socket 50 Ω, 4 kHz – 1 GHz
Power amplifier input:	N socket 50 Ω, max. +10 dBm
Power amplifier output:	N socket 50 Ω
Power meter channel 1 to 3:	as defined in chapter “Power meter“
Back panel	
Monitoring input analog:	BNC socket, 0-24 V Ri=15 kΩ, 6 mV resolution
External modulation input:	BNC socket, impedance >10 kΩ, level: 1 Vpp to get 100% AM, 1 Hz – 50 kHz
10 MHz reference output:	BNC socket, approx. 1 Vpp / 50 Ω

9.6. Digital ports

Front panel	
USB:	USB host connector for USB stick, keyboard, mouse
Back panel	
User port:	D-Sub 15 pole 4 TTL inputs 4 TTL outputs +12 V / 800 mA, -12 V / 200 mA, +5 V / 800 mA power supply
Monitoring digital input:	BNC socket 0-24 V via optical coupler, Ri=1.5 kΩ, switching threshold approx. 2-3 V
Monitoring optical input:	LWL (Light wave connector), HP versatile link HFBR0501 series 40 kBd, (avoid scattered light on the back panel)
Trigger input:	BNC socket, TTL for external triggering, max. frequency 100 Hz, trigger delay <10 ms
RS232:	D-Sub 9 pole, up to 115200 Bd
RS232 optical:	Connector 2 x HFBRx523 socket for 1 mm fiber optic cable with length between 5 m and 30 m with 115200 Bd, for other distances 38400 Bd, max. 50 m
2x USB	USB host connector for USB stick, keyboard, mouse
USB device connector:	for remote control
Network:	RJ45, Ethernet 10 / 100 BASE-T

9.7. Power supply

Power consumption	100 to 240 VAC 50 / 60 Hz autoranging	Recommended fuse F1 for nominal 110 V	Recommended fuse F1 for nominal 230 V
NSG 4070C-0	approx. 80 W	1 A (slow)	0.5 A (slow)
NSG 4070C-35, -45, -60 and -80	approx. 415 W	6.3 A (slow)	2.5 A (slow)
NSG 4070C-110 Generator: Power amplifier:	 approx. 80 W <1 kW	 1 A (slow) 10 A (slow)	 0.5 A (slow) 10 A (slow)

9.8. General data

Operating temperature range:	0°C to 40°C
Storage temperature range:	-20°C to 60°C
Relative humidity:	95% / 30°C (no moisture condensation)
EMC:	DIN / EN 61326-1:2013
Shock:	DIN / EN 60068-2-27
Vibration:	DIN / EN 60068-2-6
Protection class:	DIN / EN 61010-1 / IEC 61010-1

9.9. Mechanical specifications

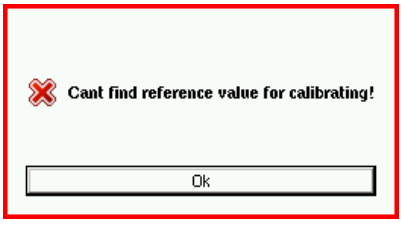
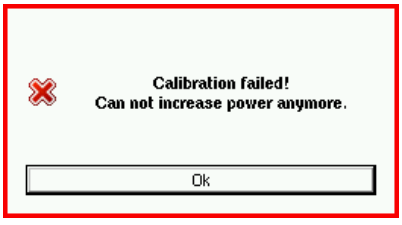
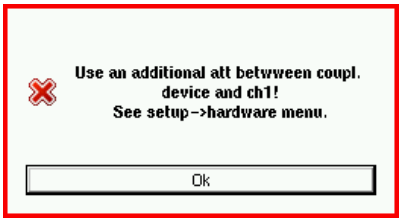
Size (W x H x D) :	45 cm (19“) x 15 cm (3HU) x 42.3 cm (with handle bar and foot) 65 cm x 46 cm x 60 cm (NSG 4070C-110)
Weight:	approx. 15 kg (with internal power amplifier), approx. 8 kg (without internal power amplifier) approx. 44 kg (NSG 4070C-110)
Cardboard box:	80 cm x 61 cm x 34 cm (also for options ATN 60xx and / or LE 4070 additional space available), approx. 8 kg (empty)
Wooden box:	70 cm x 70 cm x 70 cm, approx. 70 kg (with NSG 4070C-110

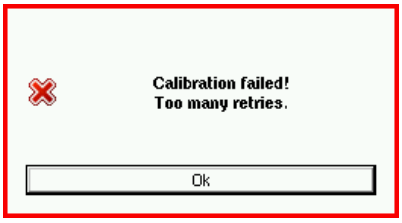
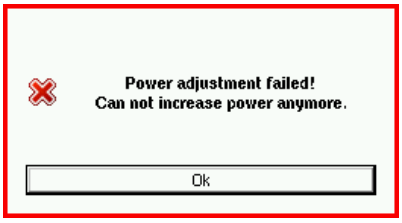
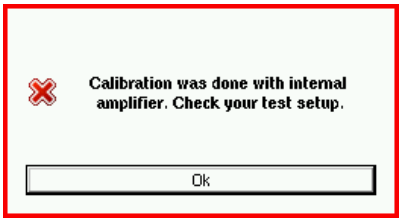
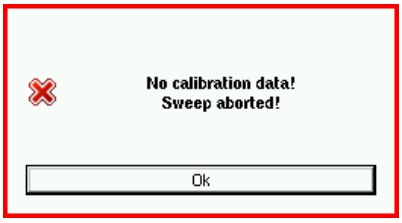
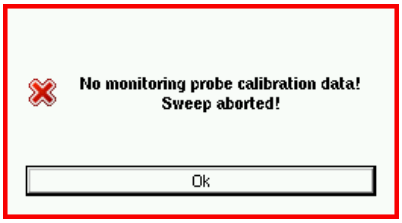
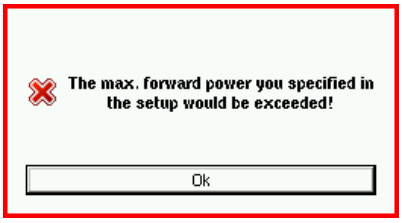
10. TROUBLESHOOTING

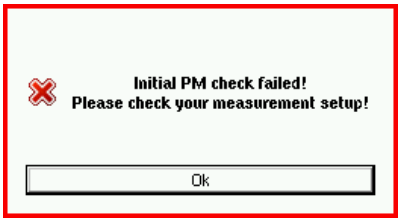
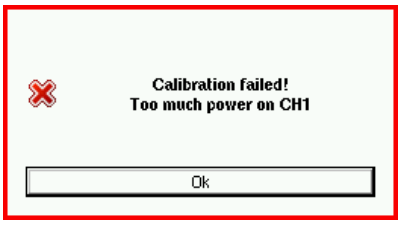
Re-check the unit before beginning troubleshooting

- Are all the connections correct?
- Are you following the instructions in the manual?
- Are the amplifier and connected accessories operating properly?

If the NSG 4070 does not seem to be functioning properly, check the table below. If this does not solve the problem, the NSG 4070 may be damaged. Turn off the power, unplug the power supply cord from the power outlet, and contact your nearest Teseq sales office.

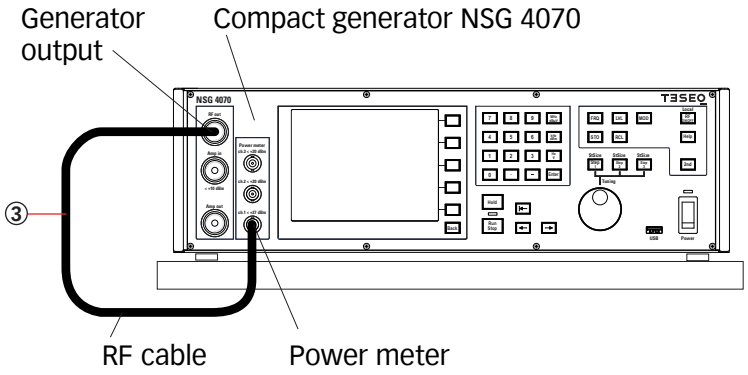
Symptom	Check	Chapter
Power does not turn on.	■ Plug the power supply cord securely into the power outlet. ■ Check if standby LED is on (Orange). ■ Check if the outlet is supplied with power. ■ Check the fuse.	 3.2.1 3.2.2
	Power meter is working below the measuring range. ■ Increase the stress level. ■ Insert an additional attenuator in the path to the coupling device. ■ Reduce the frequency range for calibrating a monitor probe. The insertion loss/amplification might be to high.	 4.5.1.1 8.2.10 4.5.1.4
	Power amplifier limit is reached. ■ Check your setup. ■ Check the connections. ■ Decrease the stress level.	 4.5.1.1
	Power meter ch.1 limit will be exceeded. ■ There is not an attenuator or the used additional attenuator is not enough. Insert an additional attenuator in the path to the power meter channel 1 and put this value in the Setup -> Power Limits menu. ■ Decrease the stress level.	8.3.5 4.3.4

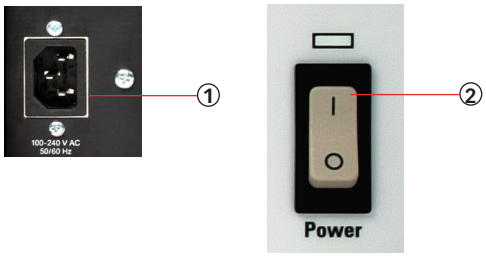
Symptom	Check	Chapter
	Target level cannot be adjusted after 50 retries ■ Check the coupling device (e.g. use the locking system to close the EM clamp or current injection probe correctly) ■ Check the connection to channel 2 if using external directional coupler	8.2.10 8.2.11 8.3.5
	Power amplifier is saturated and not able to have the reserve needed for the modulation ■ Check the connections of power meter ch. 2 if external amplifier / directional coupler is used. ■ Use the saturation check ■ Decrease the stress level.	4.5.3.2 4.5.1.1
	■ Use the same amplifier (internal / external) as used for the calibration.	4.5.1.3
	■ First recall calibration file or perform calibration, then start test.	4.5.3.4 4.5.5
	Tests using of the monitoring probe require recall of both the system calibration file and monitor probe calibration file. ■ Recall system calibration file and monitor probe calibration file, then start test.	4.5.3.4 4.5.3.5 4.5.5
	■ Check the specified limitation of the max. forward power in the Setup -> Power Limits menu. ■ Check the connections ■ Decrease the stress level.	4.3.4 4.5.1.1

Symptom	Check	Chapter
	■ Check the connection. ■ Insertion loss or amplification of the probe calibration setup is out of range.	9.4.2
	Power meter ch.1 limit will be exceeded. ■ Insert an additional attenuator in the path to the power meter channel 1 and put this value in the Setup -> hardware menu. ■ Decrease the stress level.	8.3.5 4.3.4
Error adjusting test level!	Power meter for adjusting the forward power is in the noise or not connected. ■ Establish the connection. ■ Increase the stress level. ■ Increase the start level of the threshold search.	

10.1. Procedure to check the function of the power meters

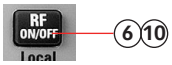
The power meter inputs are very sensitive and can be damaged very easily. The following step-by-step description provides a simple test procedure. A damaged power meter channel shows clear visible differences to the generator level. Please avoid any direct connection of the amplifier output to the power meter inputs. See chapter 1.11 for more details.

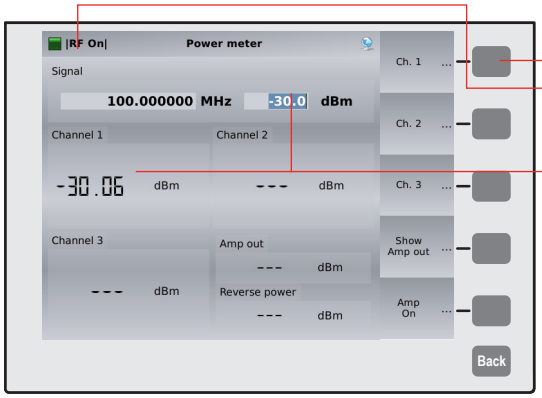




1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect "RF out" (Generator output) with the power meter. (NSG 4070 with built-in poweramplifier are supplied with a bridge between "RF out" and "Amp in". This bridge needs to be removed for this check procedure.) Do not connect "Amp out" with the power meter!
4. Press **Power meter**. Related to the default settings will be used a frequency of 100 MHz and a generator level of -30 dBm. Modulation an RF are switched off.

5. Press **Ch. 1**.





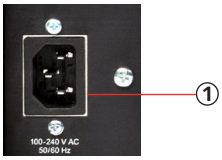
6. Press the hardkey **RF ON/OFF**.
7. The symbol shows the RF is switched on.
8. Compare the generator power level with power meter readings. The example shows a correct power meter channel 1.
9. Change the setup and connect one of the other power meter input. Activate the power meter input by using the specific softkey. Compare the generator power level with power meter readings.
10. Press the hardkey **RF ON/OFF** to turn off the output.

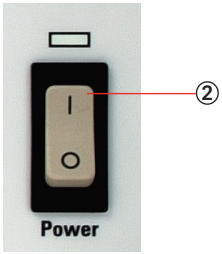
11. EXAMPLES

The following examples show the operation of the NSG 4070. Examples are given for testing IEC / EN 61000-4-6, CISPR 35 / EN 55035 and Automotive BCI.

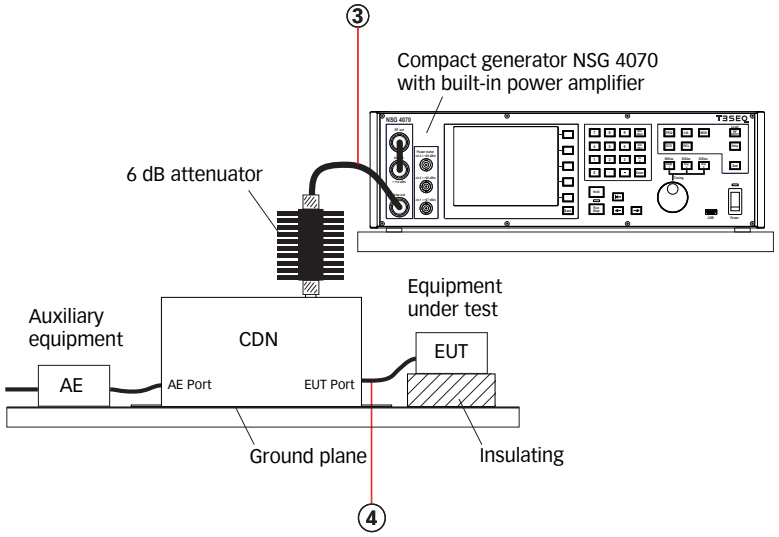
11.1. Example 1: Quick start IEC / EN 61000-4-6 testing with CDN (with existing configuration and system calibration file)

The following example shows the menu-controlled operation of the NSG 4070 for performing tests according to IEC / EN 61000-4-6 with CDNs. This example requires a NSG 4070 with a built-in power amplifier, like the NSG 4070-35, NSG 4070-45 or NSG 4070-80. The example requires existing configuration and system calibration file as well as a CDN connected with 6 dB attenuator and a suitable RF cable to the amplifier output of NSG 4070.

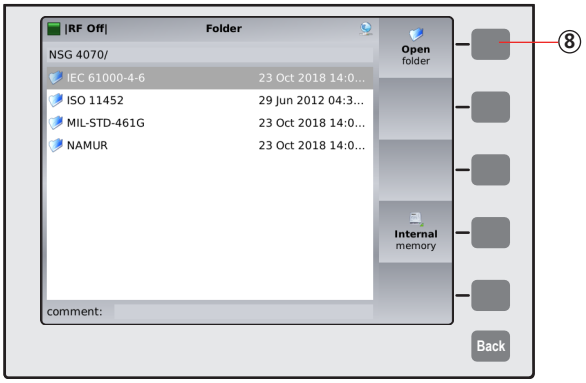


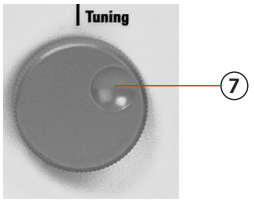


1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect “AMP out“ to the 6 dB attenuator and the CDN.
4. Connect the EUT.

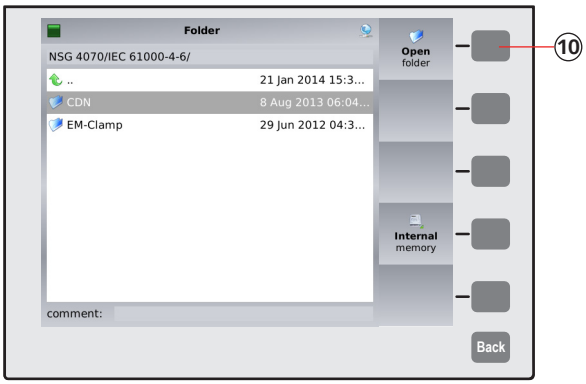


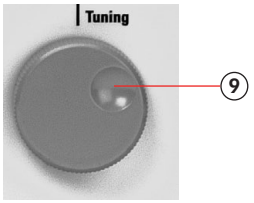
5. Press **RCL** to recall the configuration file.
6. Press **Config**



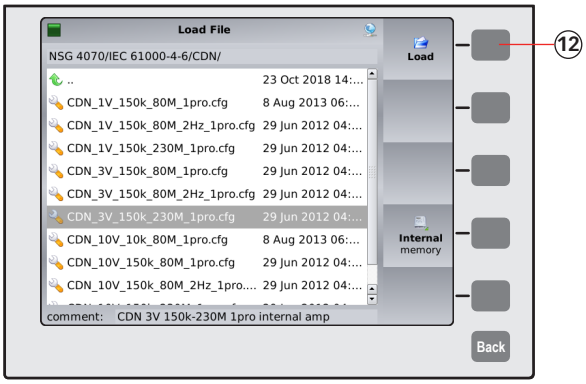


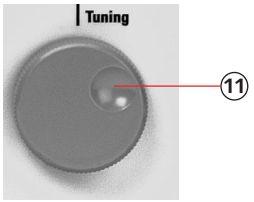
7. Turn the knob to select the folder **IEC 61000-4-6**.
8. Press **Open**





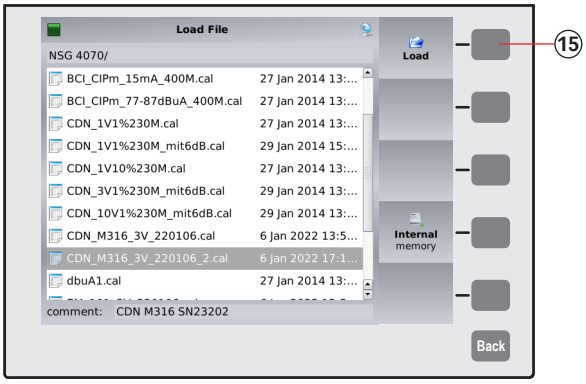
9. Turn the knob to select the folder **CDN**.
10. Press **Open**

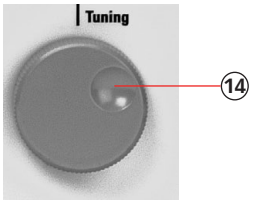




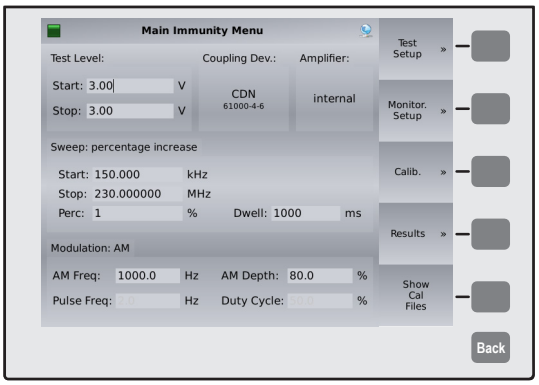
11. Turn the knob to select the file.
12. Press **Load**

13. Press **System Cal.**

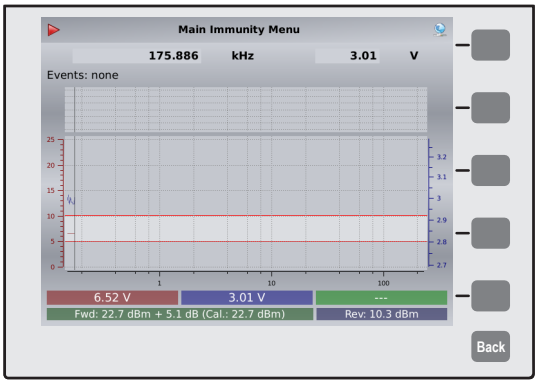


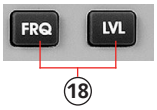


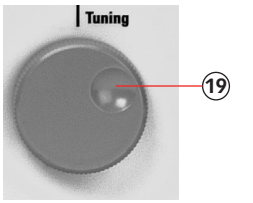
14. Turn the knob to select the file.
15. Press **Load**



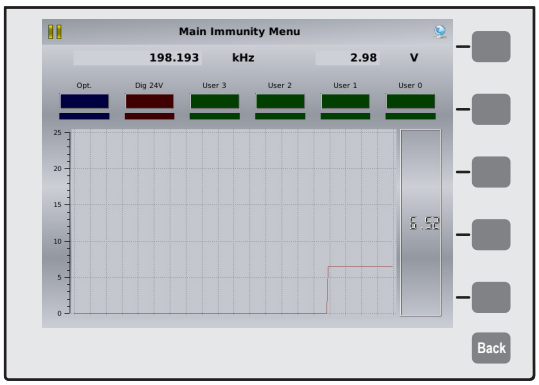
16. Press **Run** to start the test.



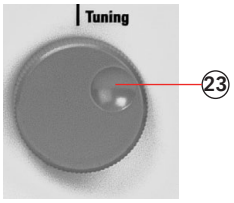


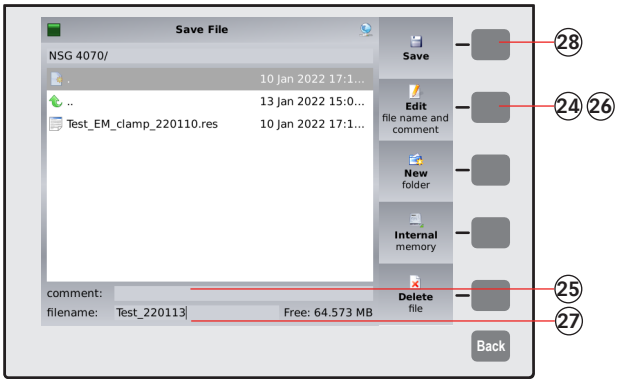


17. Press **Hold** to interrupt the sweep. (Caution! RF level is still present.)
18. Press **FRQ** or **LVL** to select the test frequency or level.
19. Turn the knob to manually change the selected parameter.
20. Press **Hold** to continue the test.

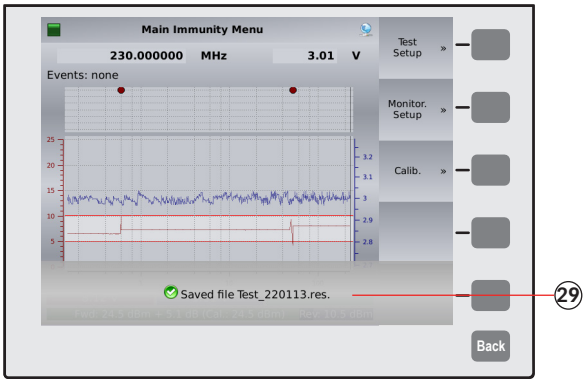


21. Press **STO** to store the result file.
22. Press **Results**





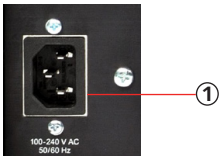
23. Turn the knob to select a similar file comment or name. (optional)
24. Press **Edit**
25. Type the comment on the connected keyboard.
26. Press **Edit**
27. Type the name of the file on the connected keyboard.
28. Press **Save**

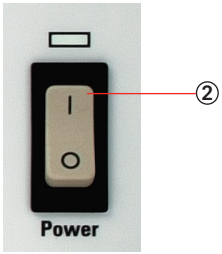


29. A message will be shown with the name of the file.

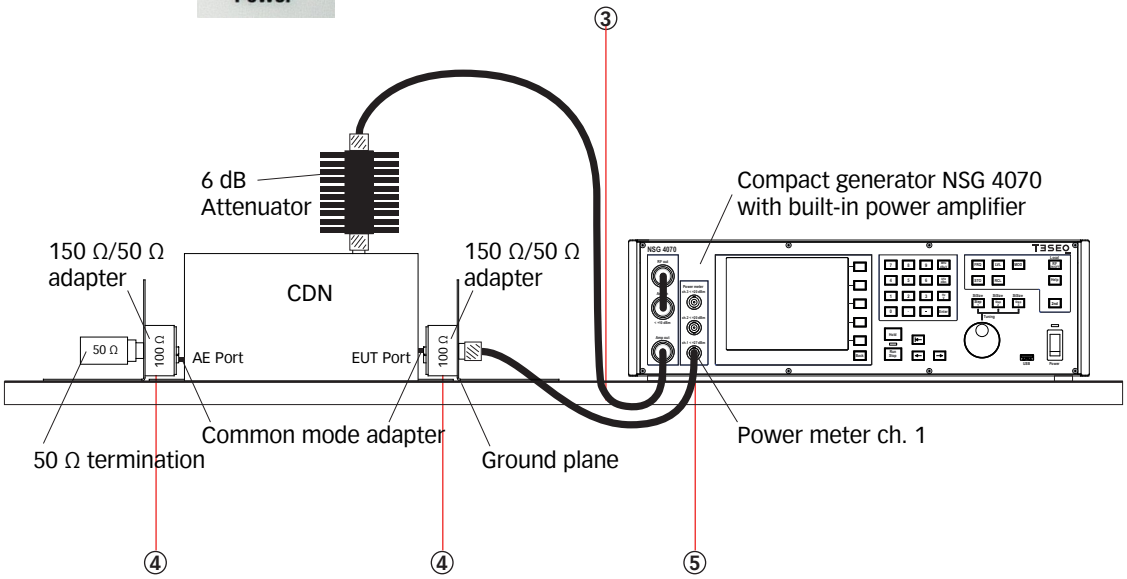
11.2. Example 2: Quick start IEC / EN 61000-4-6 system calibration with CDN

The following example shows the menu-controlled operation of the NSG 4070 for performing a system calibration as required for testing according to IEC / EN 61000-4-6 with CDNs. This example requires a NSG 4070 with a built-in power amplifier, like the NSG 4070-35, NSG 4070-45 or NSG 4070-80. The CDN must be supplied with calibration adapters for level setting. A 6 dB attenuator and some RF cables are also required.

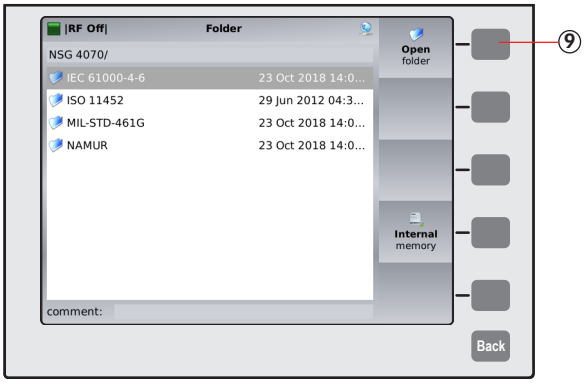


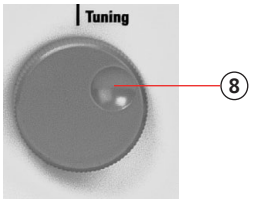


1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect “AMP out“ to the 6 dB attenuator and the CDN.
4. Set up the CDN calibration adapters as shown in the CDN operating instructions.
5. Connect the 150 / 50 Ω adapter to the power meter channel 1.



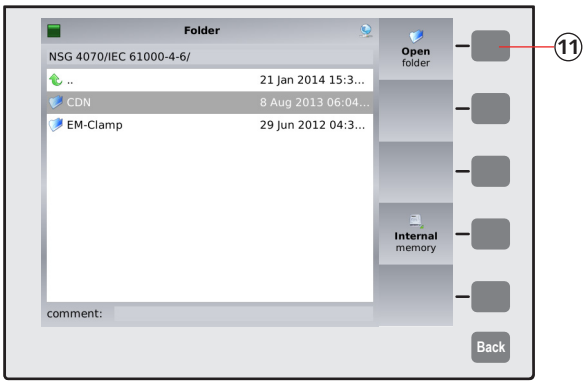
6. Press **RCL** to recall the configuration file.
7. Press **Config**
8. Turn the knob to select the folder

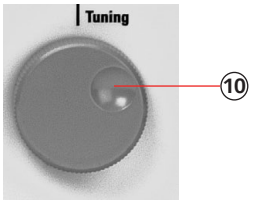




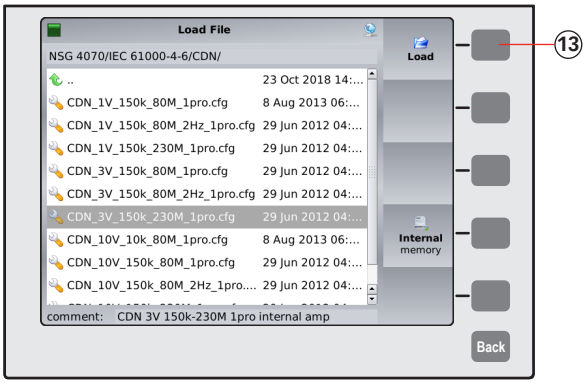
IEC 61000-4-6.

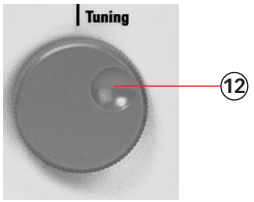
9. Press **Open**
10. Turn the knob to select the folder **CDN**.



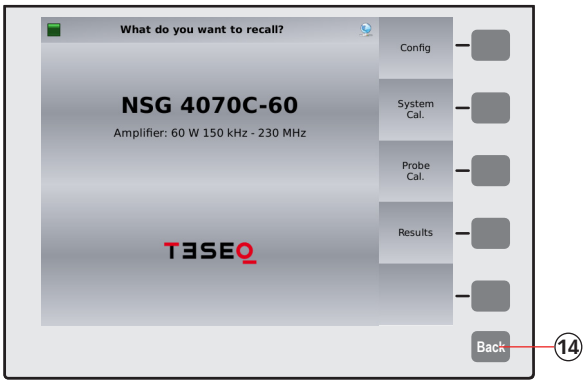


11. Press **Open**
12. Turn the knob to select the file.



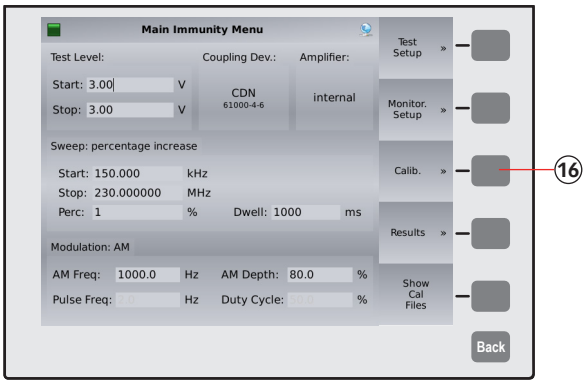


13. Press **Load**
14. Press **Back**

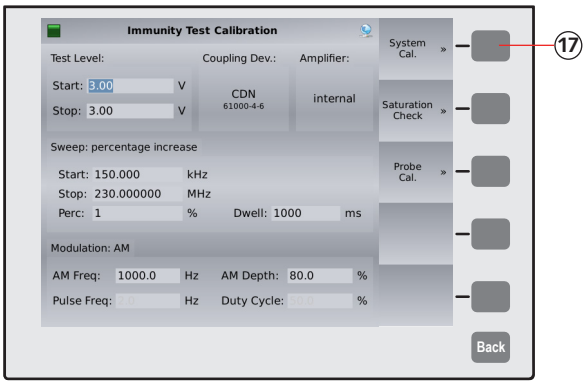


15. Press **Immunity Mode**

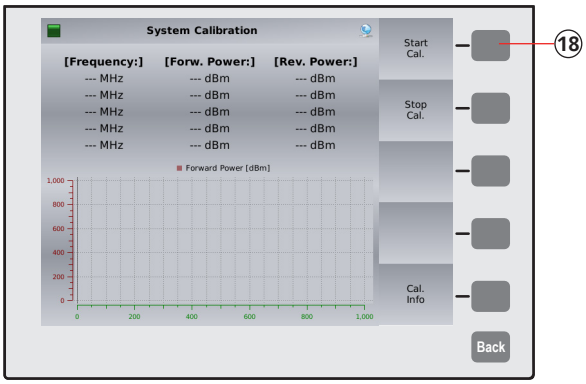
16. Press **Calib.**



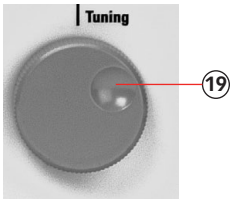
17. Press **System Cal.**



18. Press **Start Cal.** and wait until the system calibration sweep is finished.

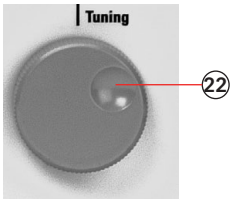


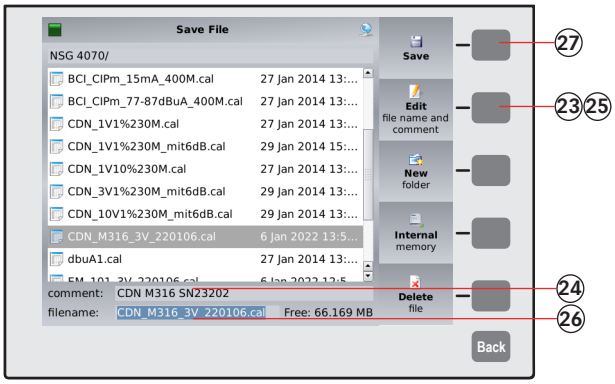
19. Turn the knob to check the calibration results. (optional)



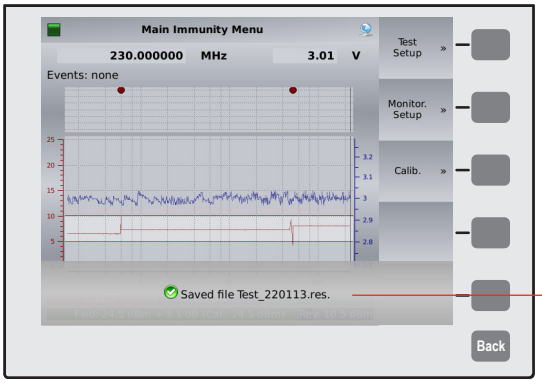
20. Press **STO** to store the calibration file.

21. Press **System Cal.**
22. Turn the knob to select a similar file





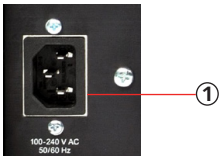
23. Press **Edit**
24. Type the comment on the connected keyboard.
25. Press **Edit**
26. Type the name of the file on the connected keyboard.
27. Press **Save**
28. A message will be shown with the name of the file.

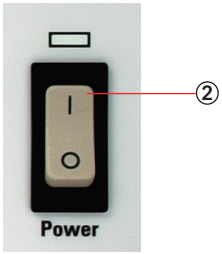


29. Remove the calibration adapters, connect the EUT and perform testing.

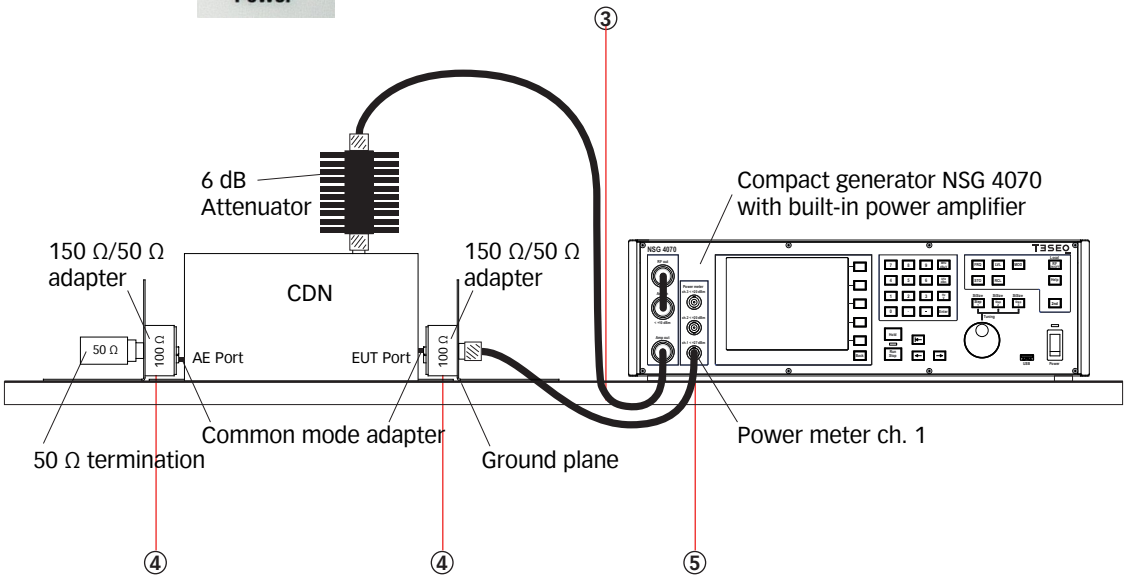
11.3. Example 3: IEC / EN 61000-4-6 testing with CDN

The following example shows the menu-controlled operation of the NSG 4070 for performing tests according to IEC / EN 61000-4-6 with CDNs. This example requires a NSG 4070 with a built-in power amplifier, like the NSG 4070-35, NSG 4070-45 or NSG 4070-80. The CDN must be supplied with calibration adapters for level setting. A 6 dB attenuator and some RF cables are also required.

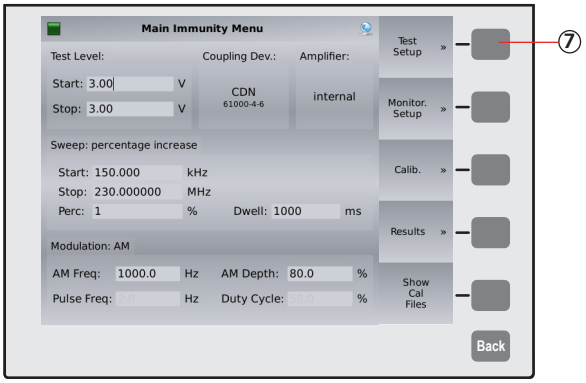




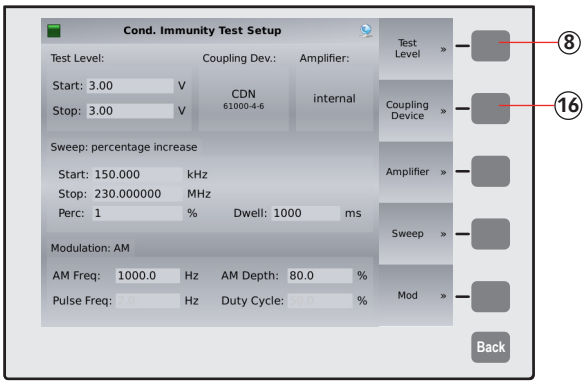
1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect “AMP out“ to the 6 dB attenuator and the CDN.
4. Set up the CDN calibration adapters as shown in the CDN operating instructions.
5. Connect the 150/50 Ω adapter to the power meter channel 1.



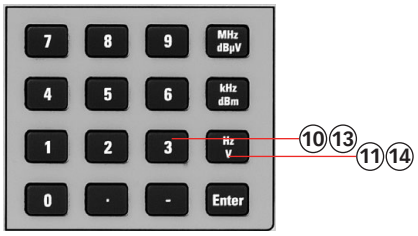
6. Press **Immunity Mode**

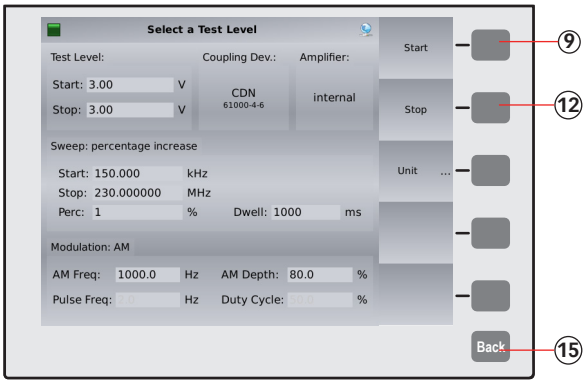


7. Press **Test Setup**

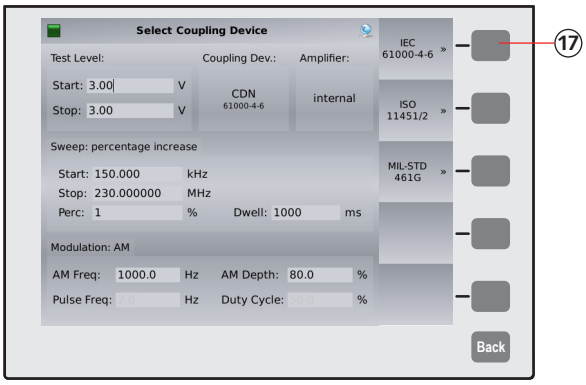


8. Press **Test Level**

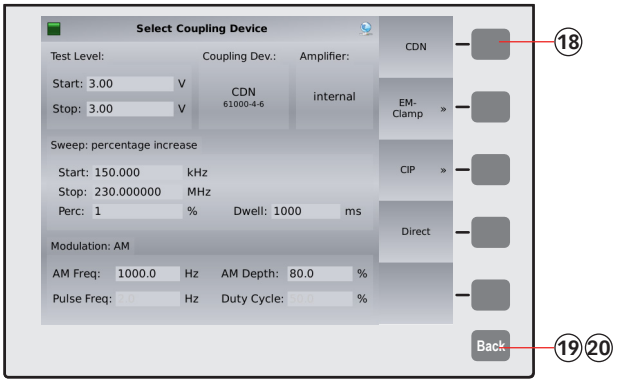




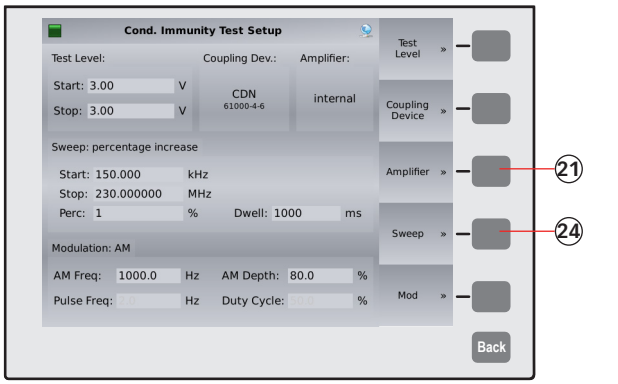
9. Press **Start**
10. Press **3**
11. Press **V** or **Enter**
12. Press **Stop**
13. Press **3**
14. Press **V** or **Enter**
15. Press **Back**
16. Press **Coupling Device**



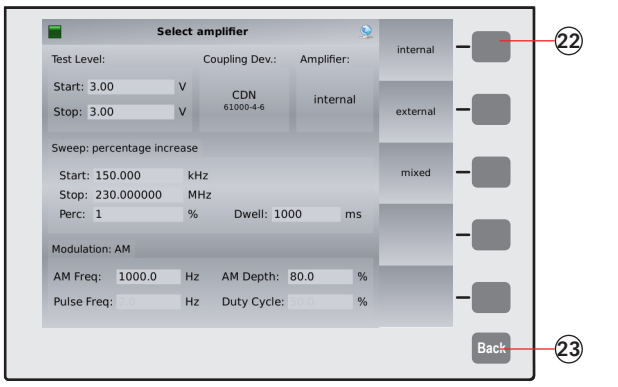
17. Press **IEC 61000-4-6**

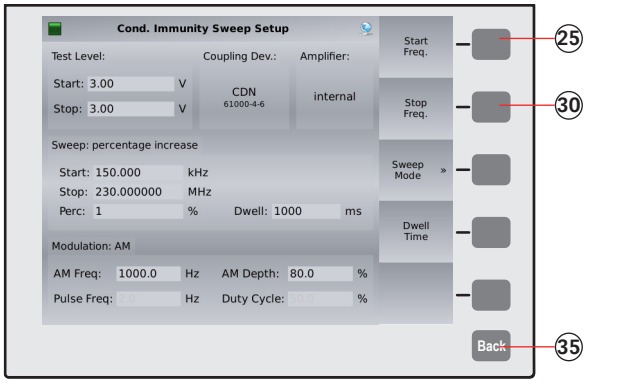


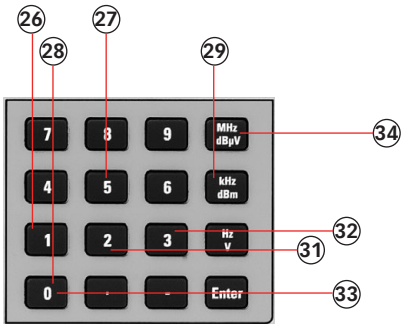
18. Press **CDN**
19. Press **Back**
20. Press **Back**



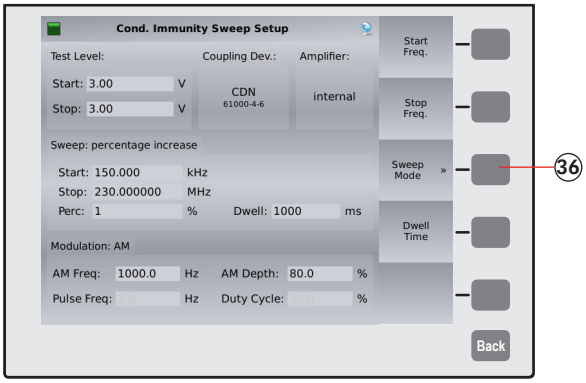
21. Press **Amplifier**
22. Press **internal**
23. Press **Back**
24. Press **Sweep**



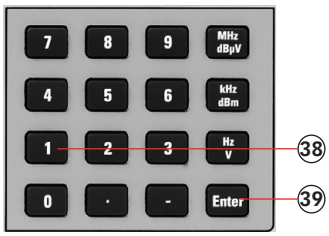


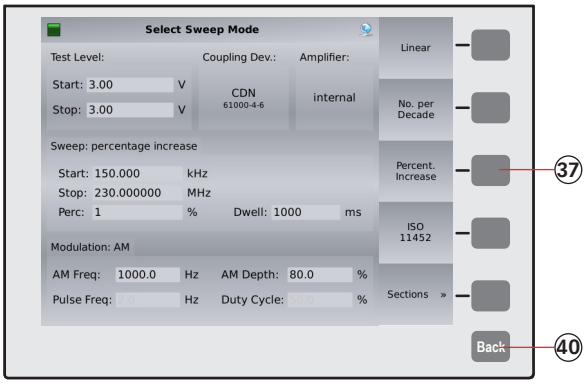


25. Press **Start Freq.**
26. Press **1**
27. Press **5**
28. Press **0**
29. Press **kHz**
30. Press **Stop Freq.**
31. Press **2**
32. Press **3**
33. Press **0**
34. Press **MHz**
35. Press **Back**

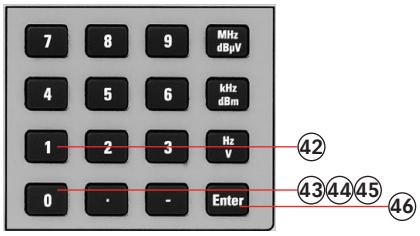


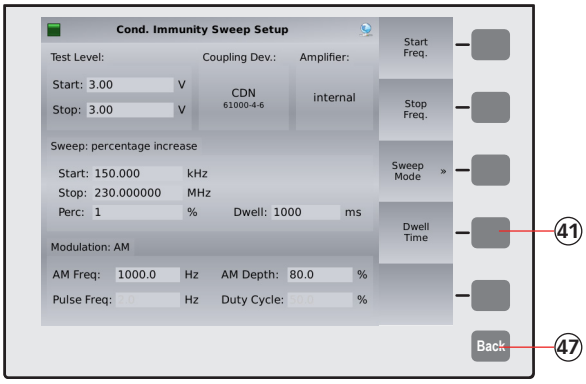
36. Press **Sweep Mode**



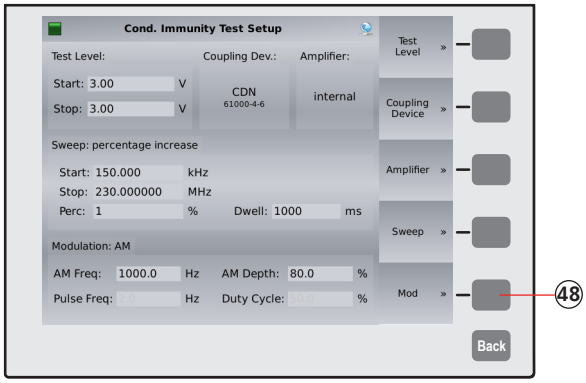


37. Press **Percent. Increase**
38. Press **1**
39. Press **Enter**
40. Press **Back**

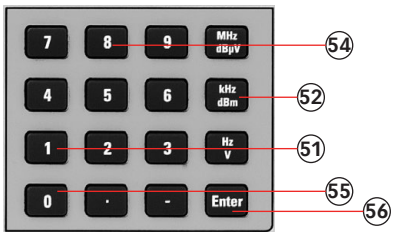


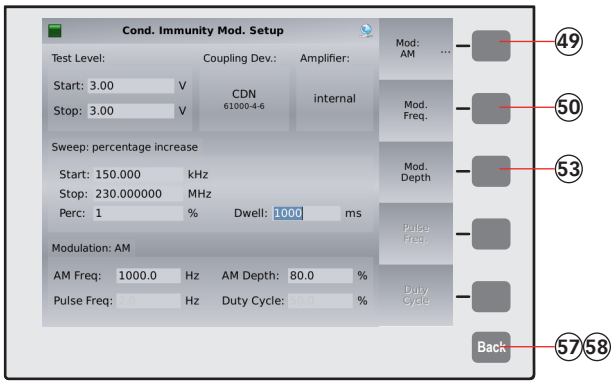


41. Press **Dwell time**
42. Press **1**
43. Press **0**
44. Press **0**
45. Press **0**
46. Press **Enter**
47. Press **Back**

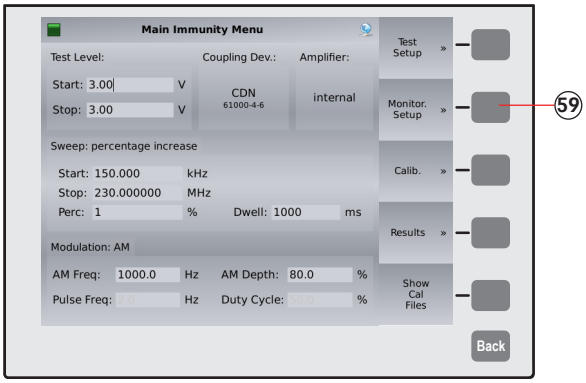


48. Press **Mod.**

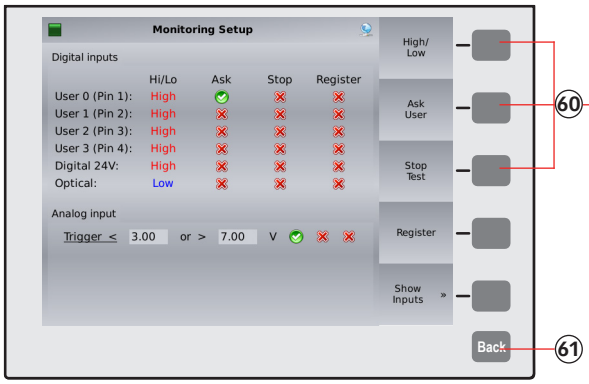


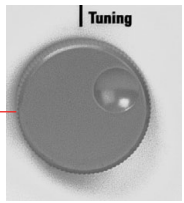


49. Press several times to have finally **Mod: AM** selected.
50. Press **Mod. Freq.**
51. Press **1**
52. Press **kHz**
53. Press **Mod. Depth**
54. Press **8**
55. Press **0**
56. Press **Enter**
57. Press **Back**
58. Press **Back**

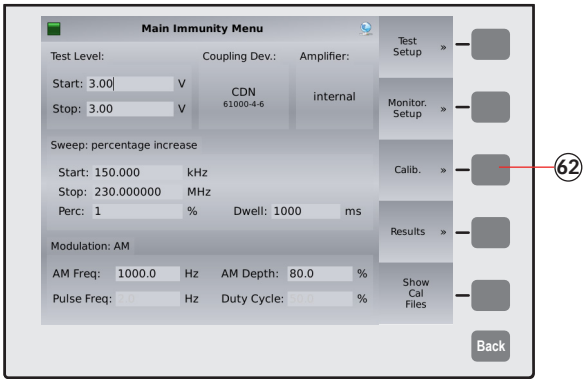


59. Press **Monitor. Setup**

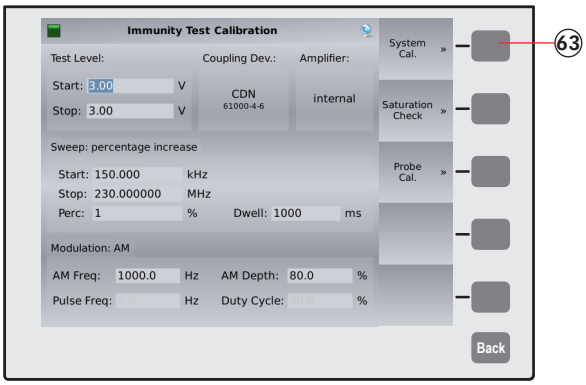




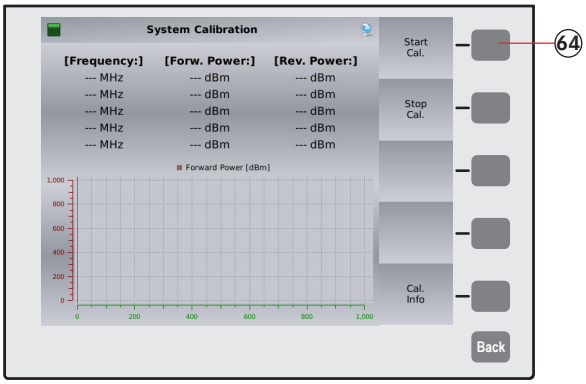
60. Switch off all EUT monitoring ports for this example. Turn the knob to change the port and press the required softkey to select "✕".
61. Press **Back**



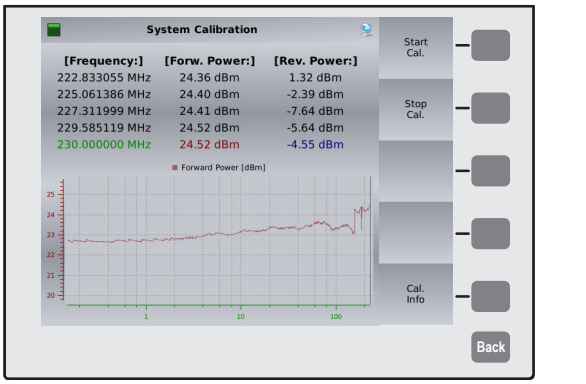
62. Press **Calib.**

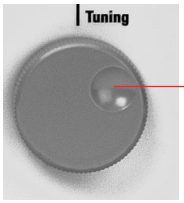


63. Press **System Cal.**



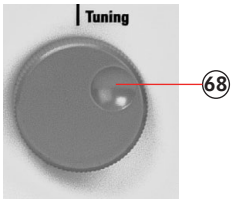
64. Press **Start Cal.** and wait.

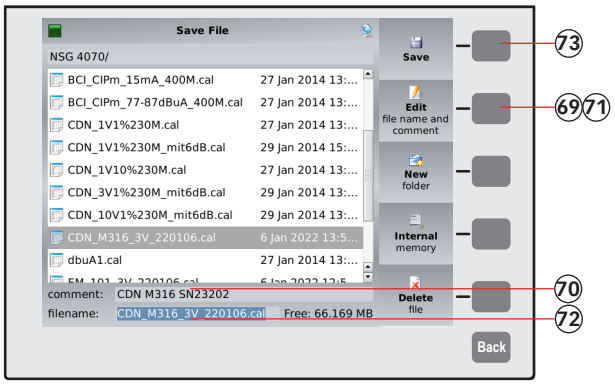




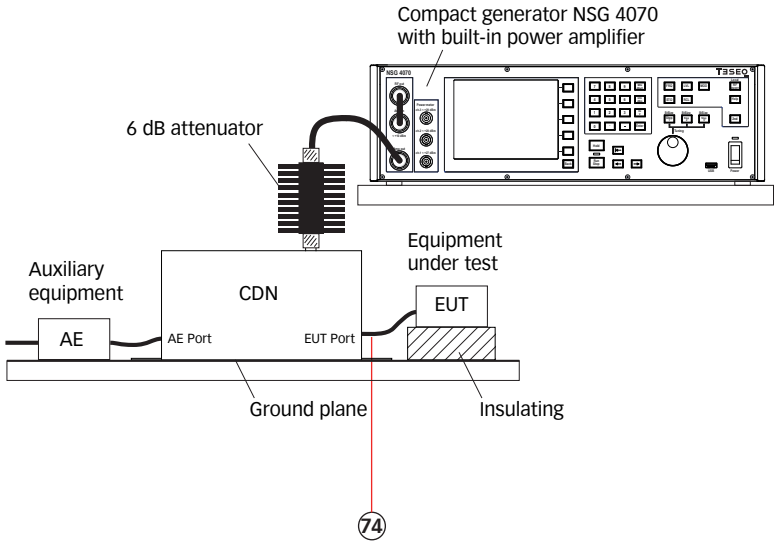
65. Turn the knob to check the calibration results. (optional)

66. Press **STO** to store the calibration file.
67. Press **System Cal.**

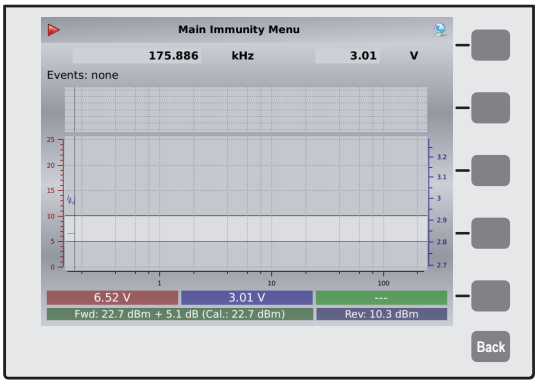


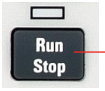


68. Turn the knob to select a similar file comment or name. (optional)
69. Press **Edit**
70. Type the comment on the connected keyboard.
71. Press **Edit**
72. Type the name of the file on the connected keyboard.
73. Press **Save**
74. Remove the calibration adapters and connect the EUT.

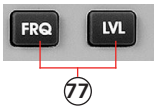


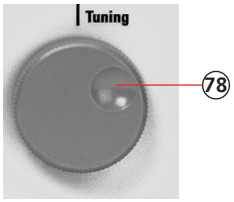
Advanced Test Solutions for EMC

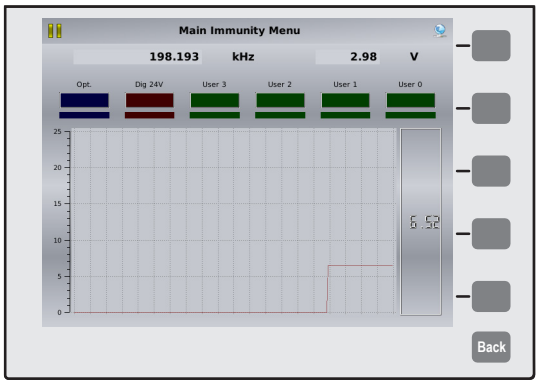




75. Press **Run** to start the test.

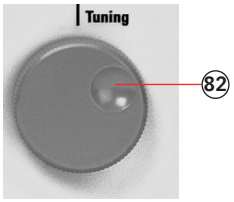


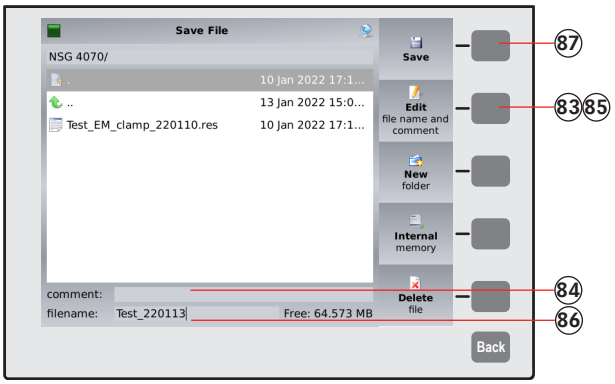




76. Press **Hold** to interrupt the sweep. (Caution! RF level is still present.)
77. Press **FRQ** or **LVL** to select the test frequency or level.
78. Turn the knob to manually change the selected parameter.
79. Press **Hold** to continue the test.

80. Press **STO** to store the result file.
81. Press **Results**

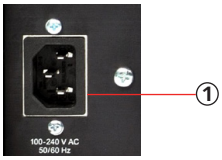


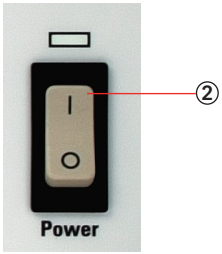


82. Turn the knob to select a similar file comment or name. (optional)
83. Press **Edit**
84. Type the comment on the connected keyboard.
85. Press **Edit**
86. Type the name of the file on the connected keyboard.
87. Press **Save**

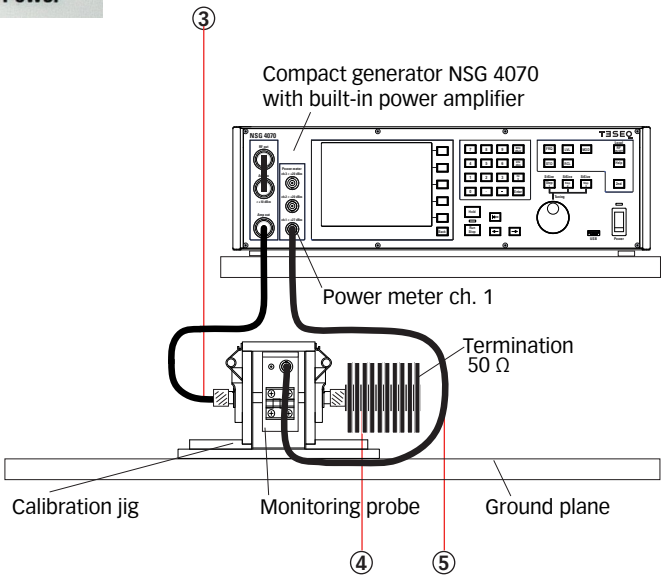
11.4. Example 4: Monitoring probe calibration for IEC / EN 61000-4-6

The following example shows the menu-controlled operation of the NSG 4070 for performing the monitoring probe calibration. This example requires a NSG 4070 with a built-in power amplifier, like the NSG 4070-35, NSG 4070-45 or NSG 4070-80. The probe must be inserted in a 50 Ω calibration jig. A termination and some RF cables are also required.

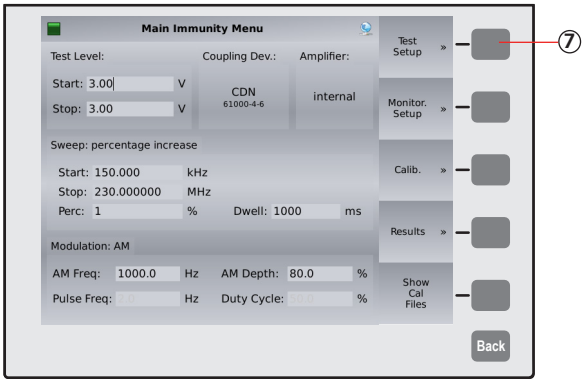




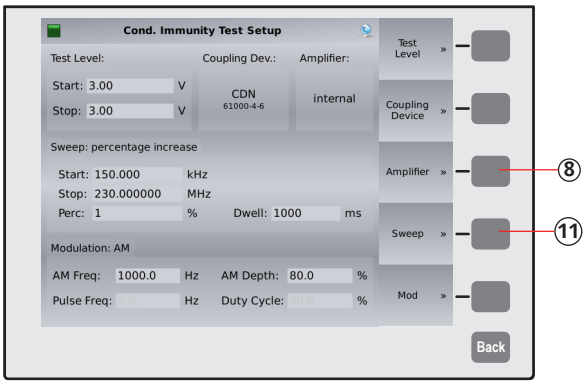
1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect “AMP out“ to the calibration jig.
4. Terminate one side of the calibration jig with 50 Ω.
5. Connect the monitoring probe output to the power meter channel 1.



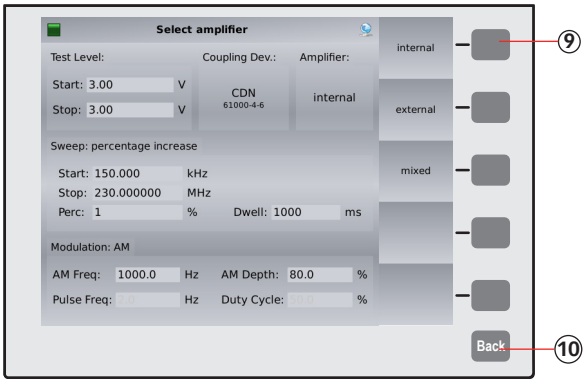
6. Press **Immunity Mode**



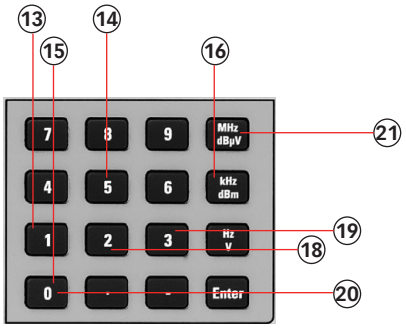
7. Press **Test Setup**

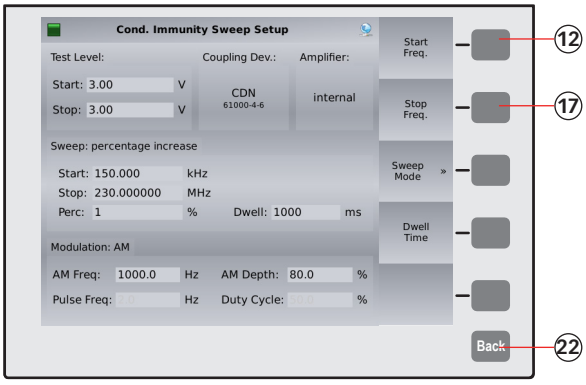


8. Press **Amplifier**

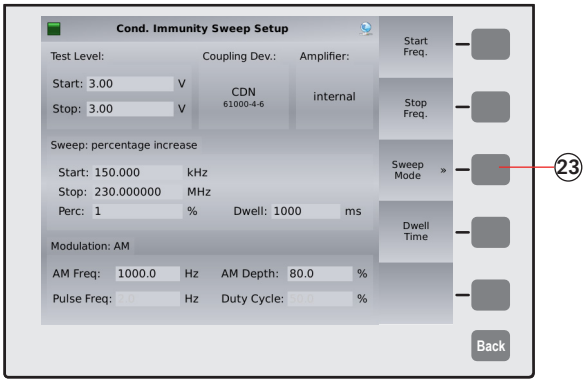


9. Press **internal**
10. Press **Back**

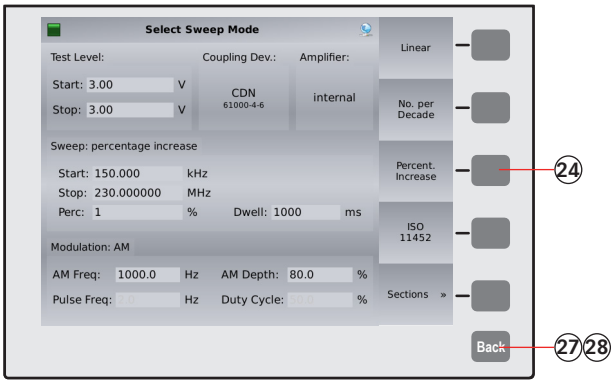


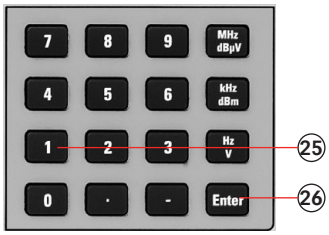


11. Press **Sweep**
12. Press **Start Freq.**
13. Press **1**
14. Press **5**
15. Press **0**
16. Press **kHz**
17. Press **Stop frequency**
18. Press **2**
19. Press **3**
20. Press **0**
21. Press **MHz**
22. Press **Back**



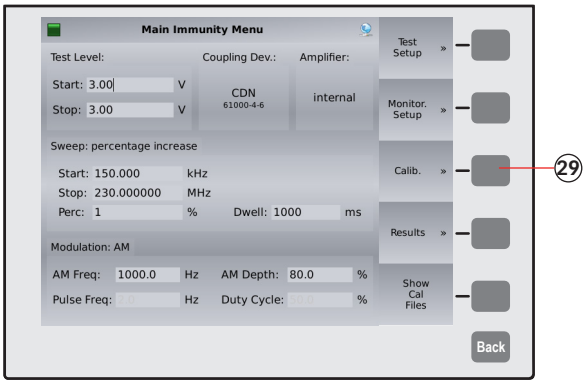
23. Press **Sweep Mode**



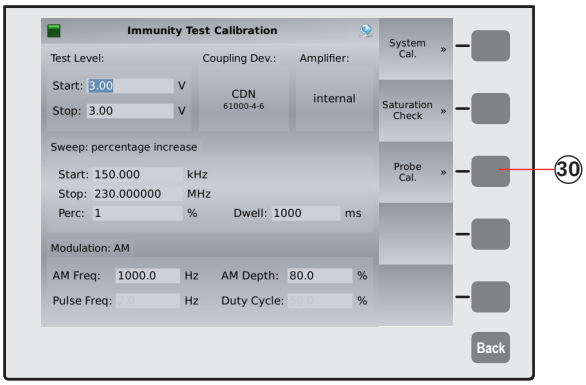


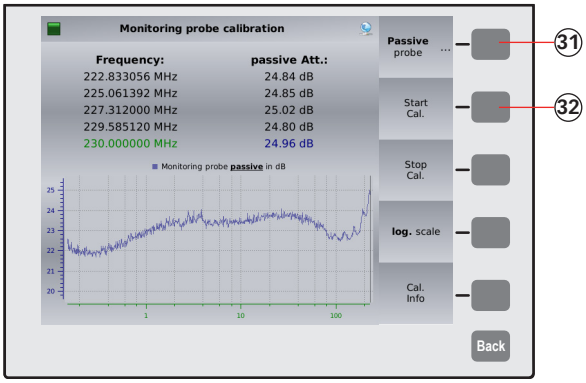
24. Press **Percent. Increase**
25. Press **1**
26. Press **Enter**
27. Press **Back**

28. Press **Back**

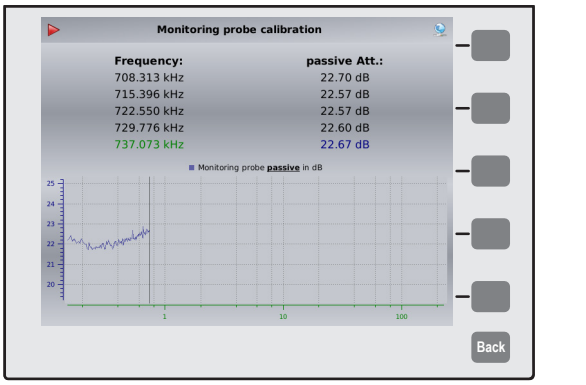


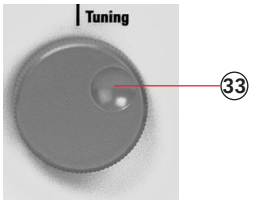
29. Press **Calib.**





30. Press **Probe Cal.**
31. Select **Passive probe** if using MD 4070 passive. Select **Active probe** if using MD 4070 active.

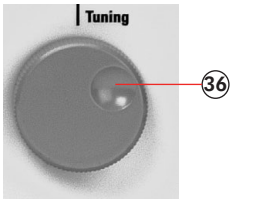




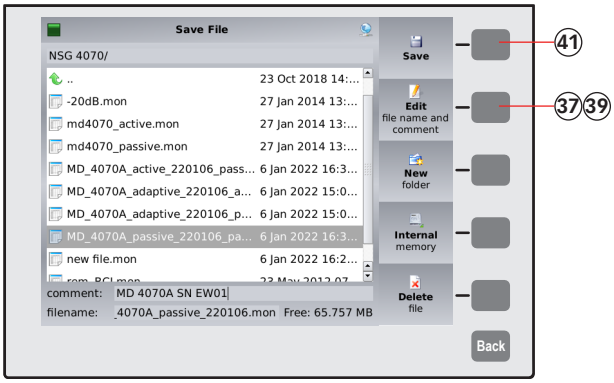
32. Press **Start Cal.** and wait.
33. Turn the knob to check the calibration

results. (optional)

34. Press **STO** to store the calibration file.

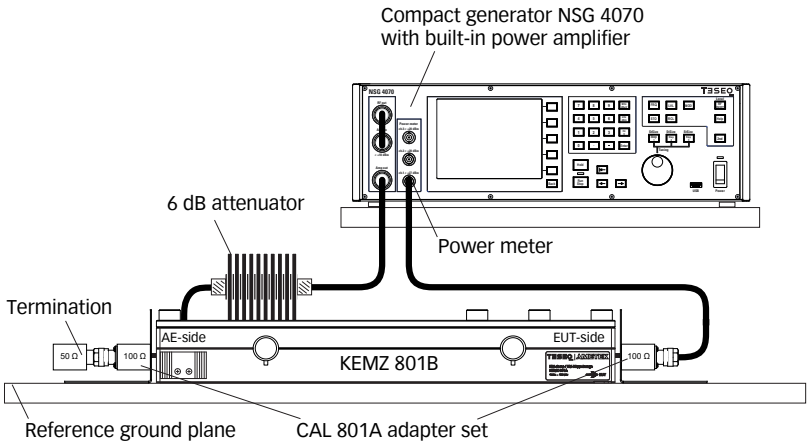


35. Press **Probe Cal.**
36. Turn the knob to select a similar file comment or name. (optional)
37. Press **Edit**
38. Type the comment on the connected keyboard.
39. Press **Edit**
40. Type the name of the file on the connected keyboard.
41. Press **Save**

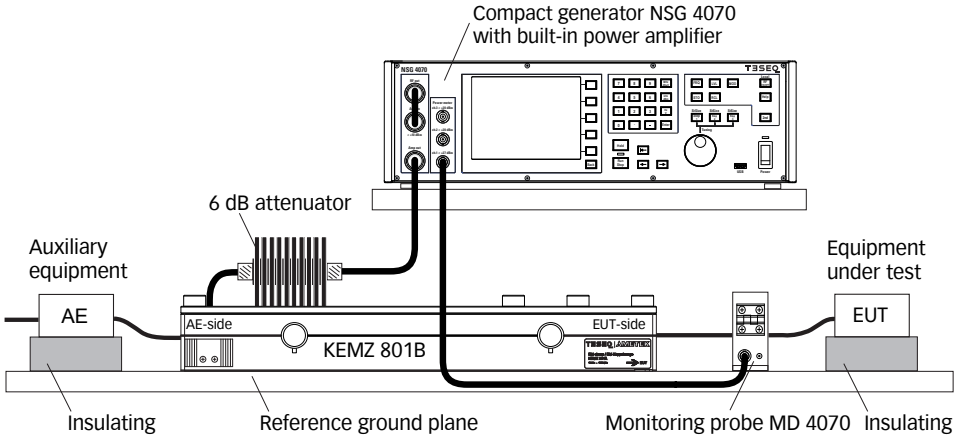


11.5. Example 5: IEC / EN 61000-4-6 testing with EM clamp and monitoring probe

The following example is based on examples 3 and 4 from Chapter 11.3 and 11.4 - only the differences are shown. This example requires a NSG 4070 with a built-in power amplifier, like the NSG 4070-35, NSG 4070-45 or NSG 4070-80. The EM clamp and monitoring probe must be supplied with calibration adapters. Further are required. A 6 dB attenuator and some RF cables are also required.

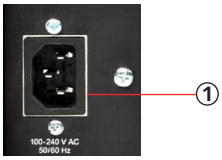


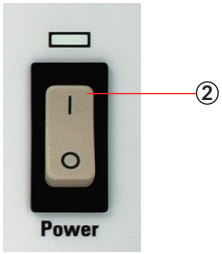
1. Connect the EM clamp as shown in the figure above.
2. Follow example 3 steps #1 to #74 with the exception of step #18. Select **EM Clamp** and **With Probe**.
3. Follow example 4 all steps.
4. Connect the EM clamp and monitoring probe as shown in the figure below.
5. Start the test as shown in example 3 steps #75 to #87. (Please note any test with a coupling device and monitoring probe needs must have calibration files loaded for each unit.)



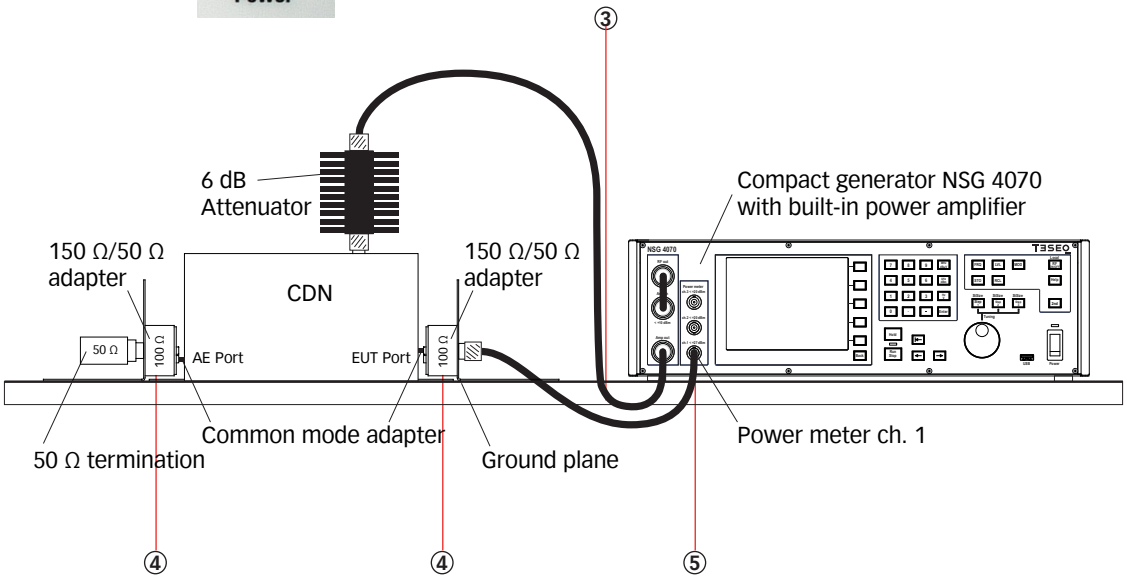
11.6. Example 6: CISPR 35/EN 55035 testing with CDN

The following example shows the menu-controlled operation of the NSG 4070 for performing tests according to CISPR 35/EN 55035 with CDNs. This example requires a NSG 4070 with a built-in power amplifier, like the NSG 4070-35, NSG 4070-45 or NSG 4070-80. The CDN must be supplied with calibration adapters for level setting. A 6 dB attenuator and some RF cables are also required.

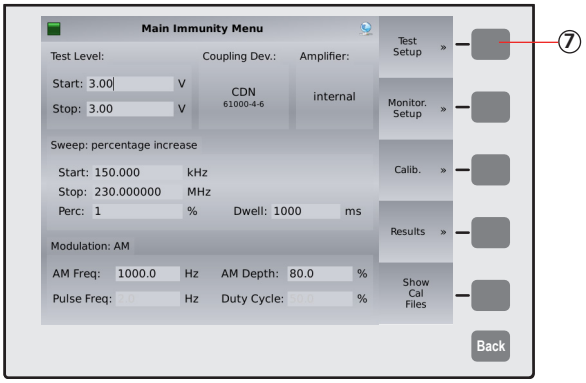




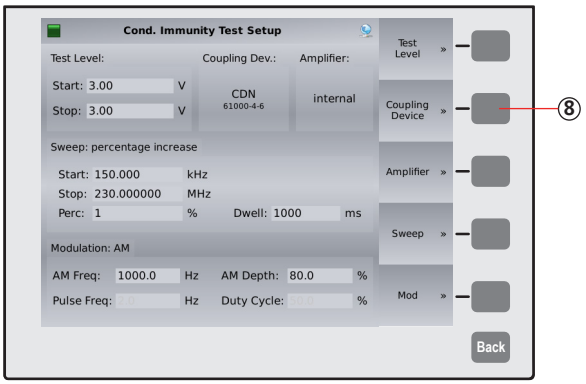
1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect "AMP out" to the 6 dB attenuator and the CDN.
4. Set up the CDN calibration adapters as shown in the CDN operating instructions.
5. Connect the 150/50 Ω adapter to the power meter channel 1.



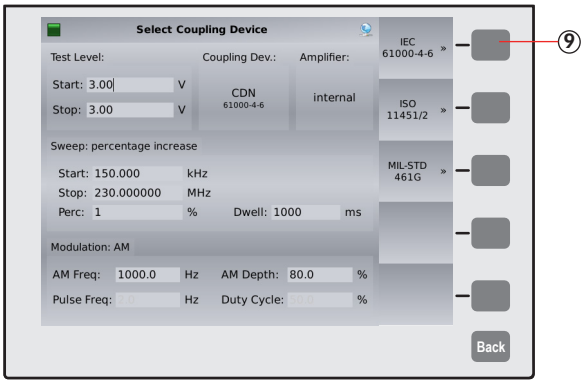
6. Press **Immunity Mode**

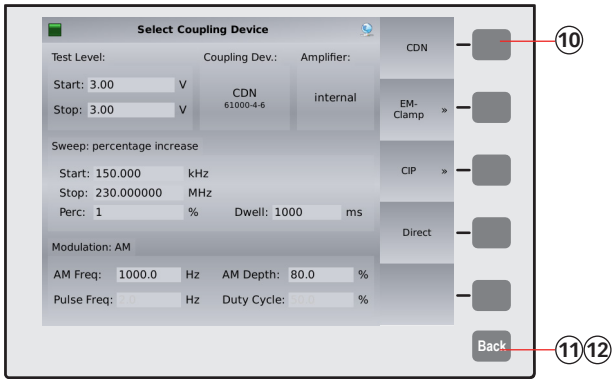


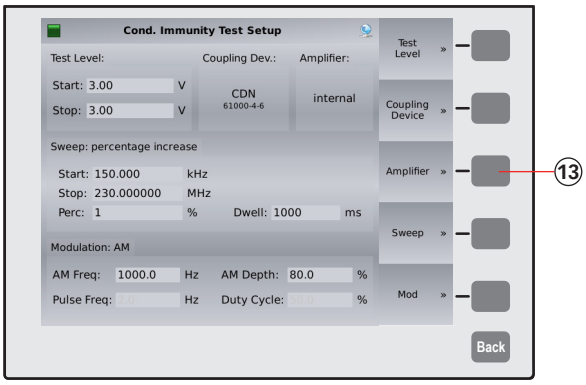
7. Press **Test Setup**



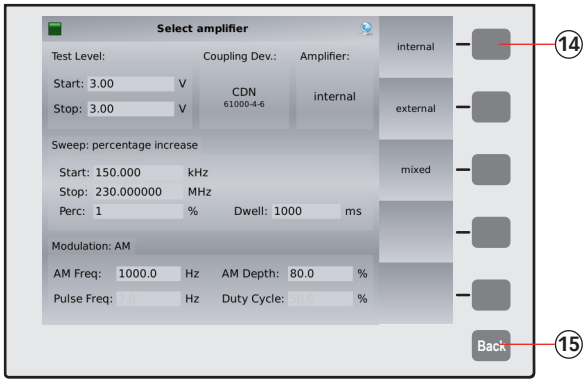
8. Press **Coupling Device**



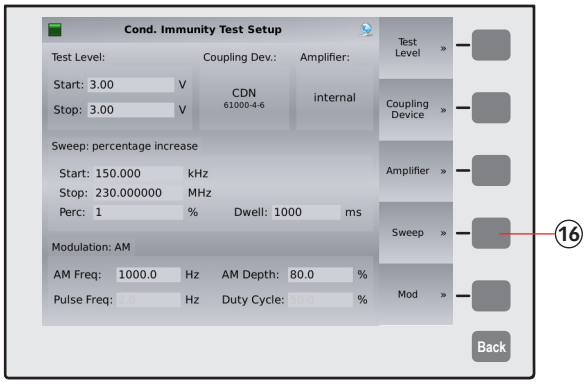




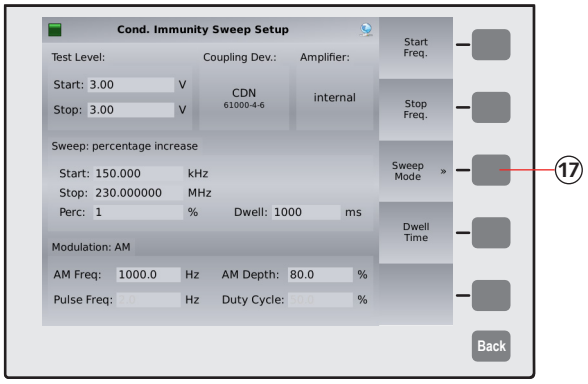
9. Press **IEC 61000-4-6**
10. Press **CDN**
11. Press **Back**
12. Press **Back**
13. Press **Amplifier**



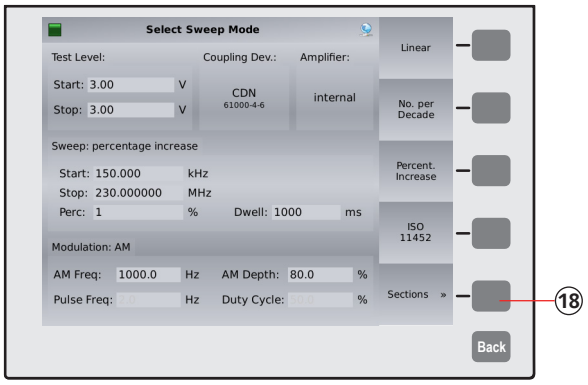
14. Press **internal**
15. Press **Back**



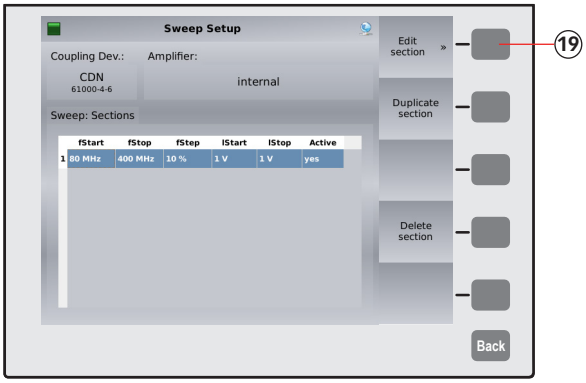
16. Press **Sweep**



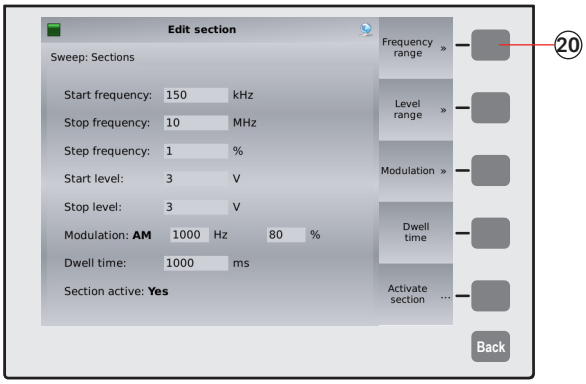
17. Press **Sweep Mode**

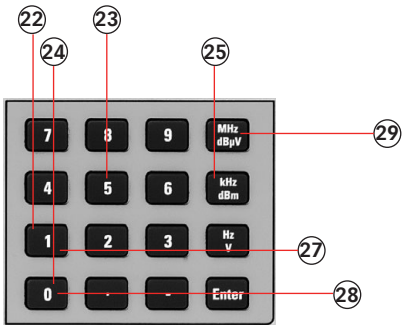


18. Press **Sections**

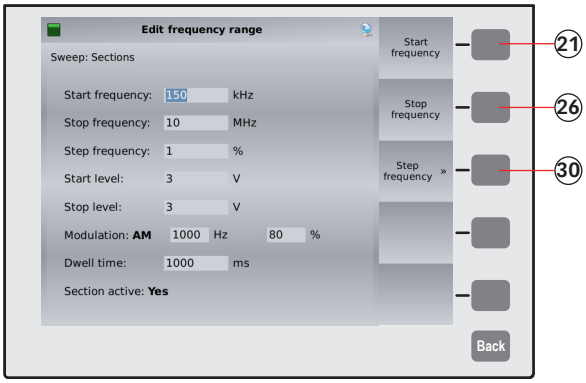


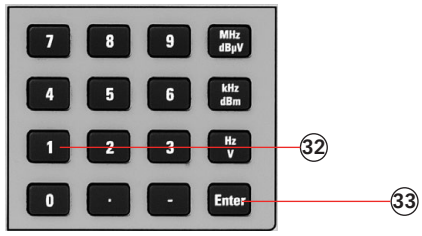
19. Press **Edit Section**



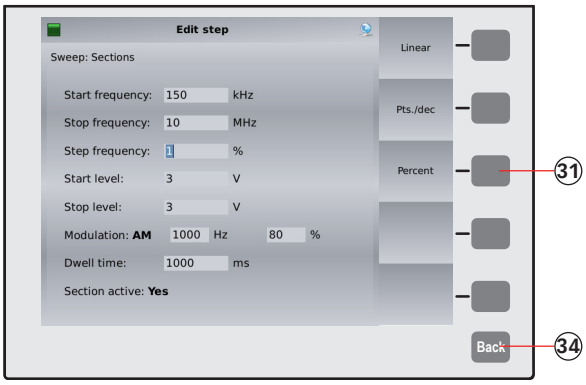


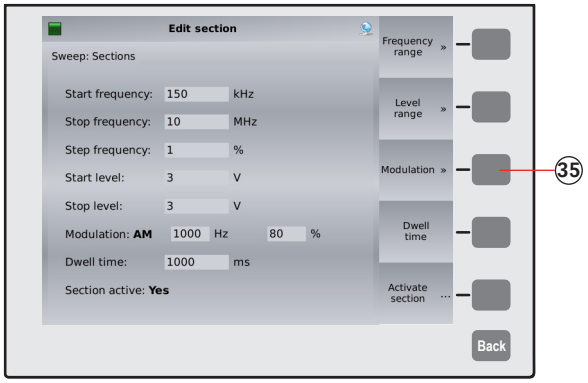
20. Press **Frequency range**
21. Press **Start frequency**
22. Press **1**
23. Press **5**
24. Press **0**
25. Press **kHz**
26. Press **Stop frequency**
27. Press **1**
28. Press **0**
29. Press **MHz**
30. Press **Step frequency**

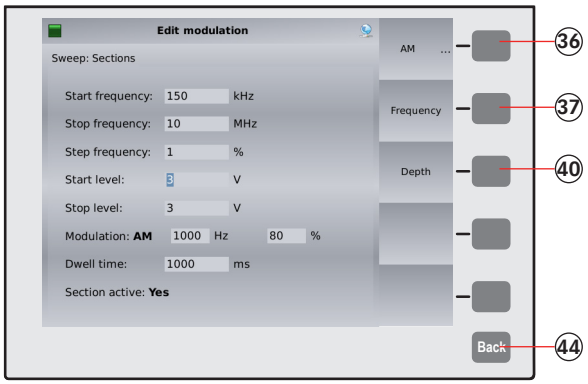


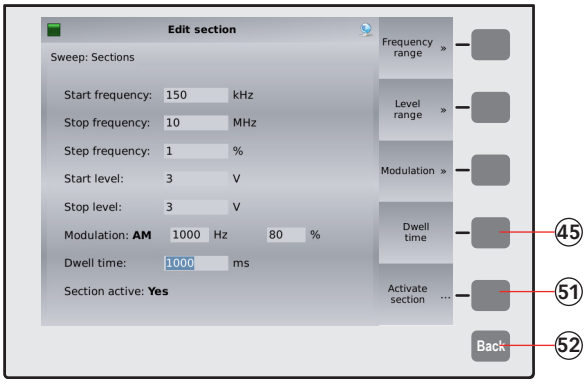


31. Press **Step frequency**
32. Press **1**
33. Press **Enter**
34. Press **Back**

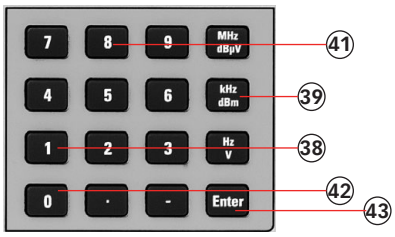




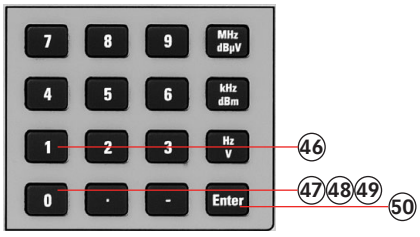




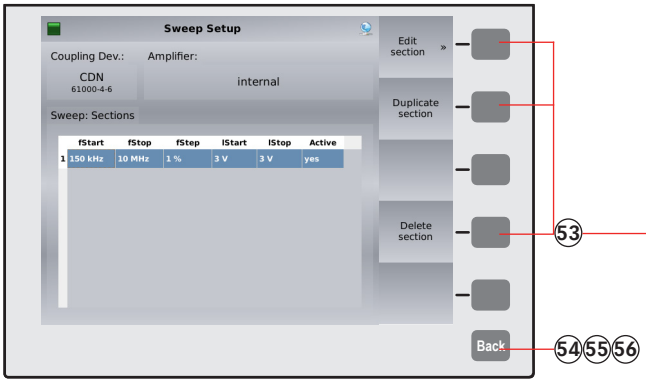
35. Press **Modulation**



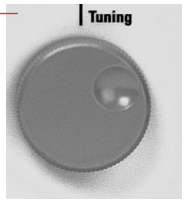
36. Press several times to have finally **AM** selected.
37. Press **Frequency**
38. Press **1**
39. Press **kHz**
40. Press **Depth**
41. Press **8**
42. Press **0**
43. Press **Enter**
44. Press **Back**

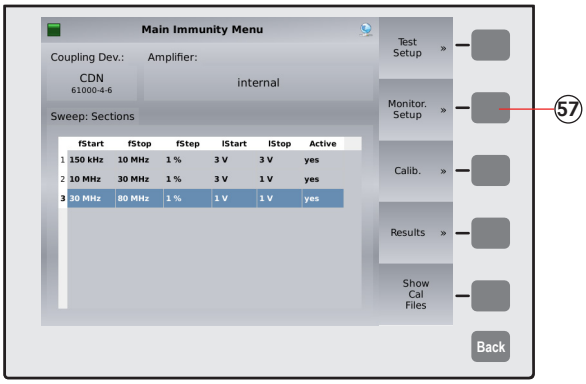


45. Press **Dwell time**
46. Press **1**
47. Press **0**
48. Press **0**
49. Press **0**
50. Press **Enter**
51. Press **Activate Section**
52. Press **Back**

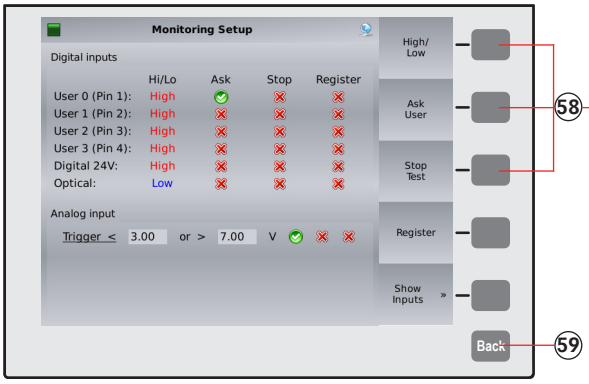


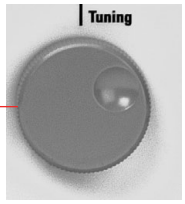
53. Turn the knob to select the section to edit, duplicate or delete. Repeat the steps 18 to 49 for creating or checking another section.
54. Press **Back**
55. Press **Back**
56. Press **Back**



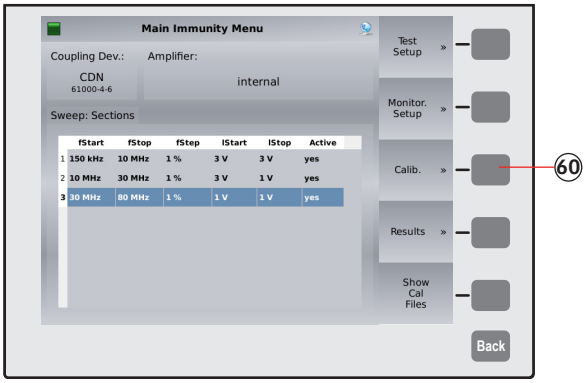


57. Press **Monitor. Setup**

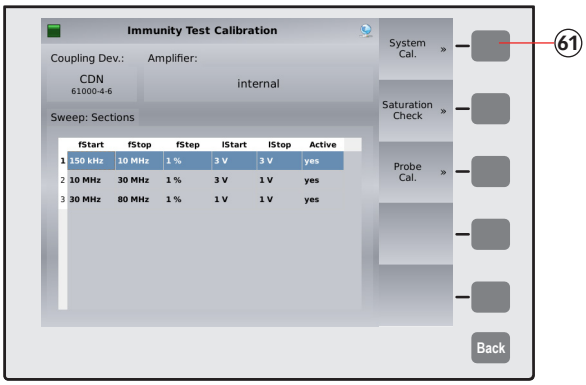




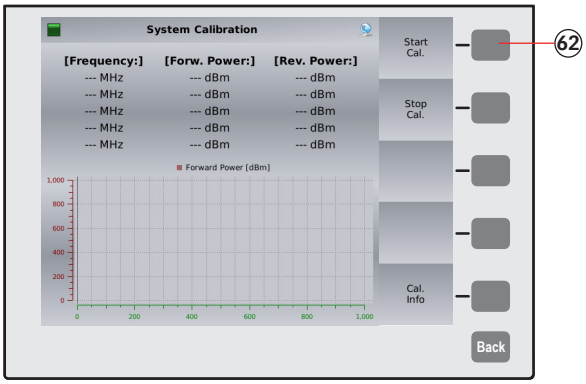
58. Switch off all unused EUT monitoring ports for this example. Turn the knob to change the port and press the required softkey to select "✕".
59. Press **Back**



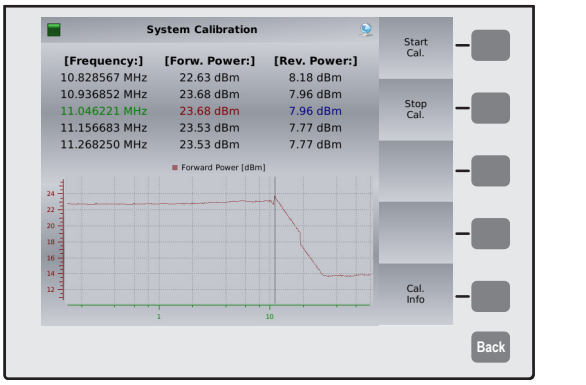
60. Press **Calib.**

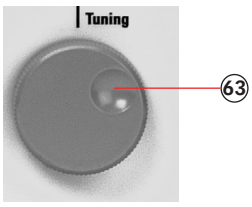


61. Press **System Cal.**



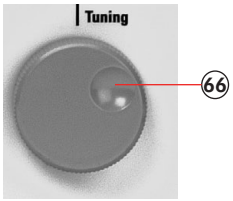
62. Press **Start Cal.** and wait.



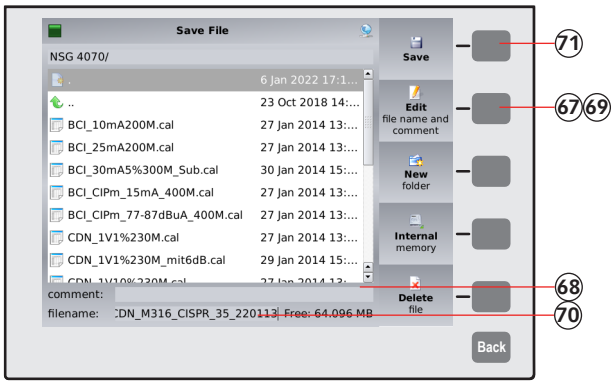


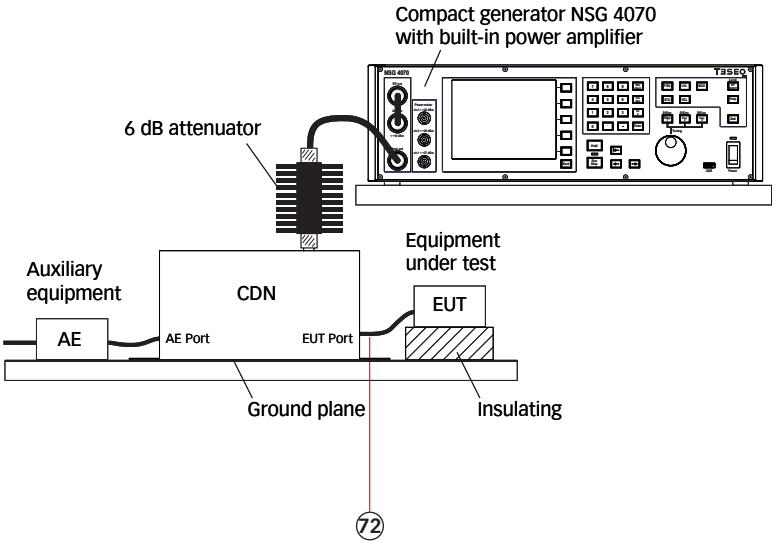
63. Turn the knob to check the calibration results. (optional)

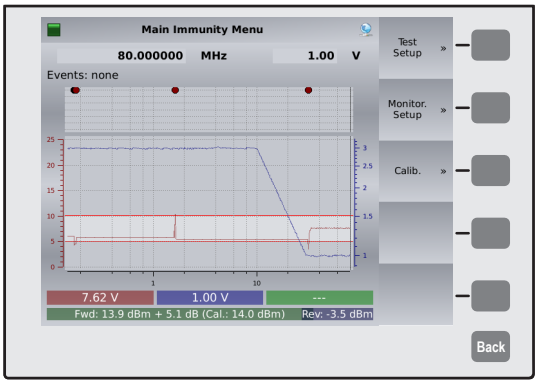
64. Press **STO** to store the calibration file or jump to step 71.
65. Press **System Cal.**

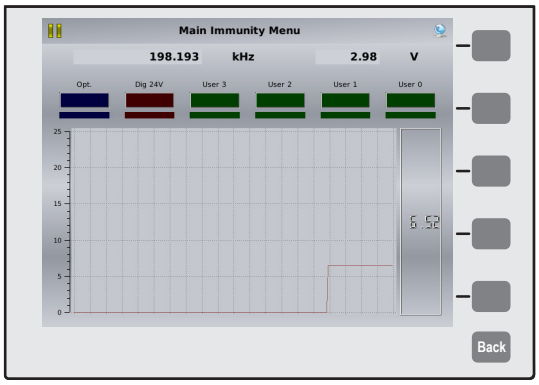


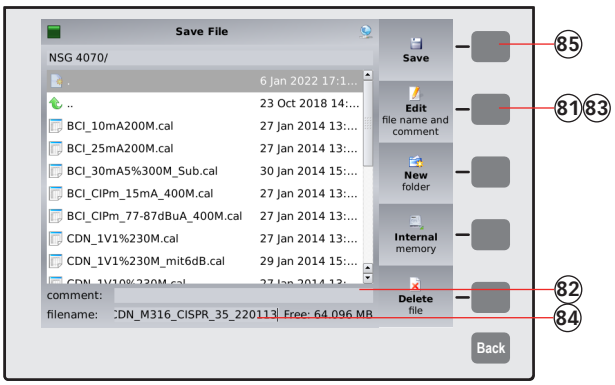
66. Turn the knob to select a similar file comment or name. (optional)
67. Press **Edit**
68. Type the comment on the connected keyboard.
69. Press **Edit**
70. Type the name of the file on the connected keyboard.
71. Press **Save**
72. Remove the calibration adapters and connect the EUT.

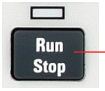




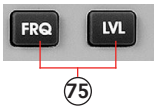


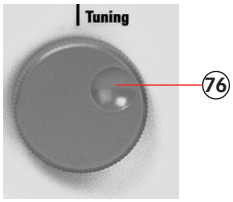






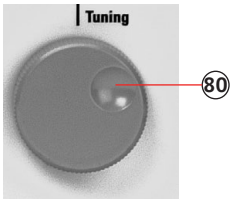
73. Press **Run** to start the test.





74. Press **Hold** to interrupt the sweep. (Caution! RF level is still present.)
75. Press **FRQ** or **LVL** to select the test frequency or level.
76. Turn the knob to manually change the selected parameter.
77. Press **Hold** to continue the test.

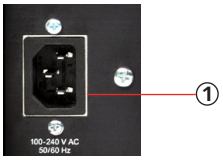
78. Press **STO** to store the result file.
79. Press **Results**

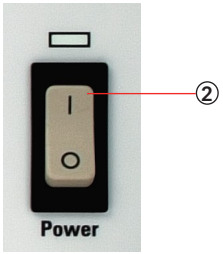


80. Turn the knob to select a similar file comment or name. (optional)
81. Press **Edit**
82. Type the comment on the connected keyboard.
83. Press **Edit**
84. Type the name of the file on the connected keyboard.
85. Press **Save**

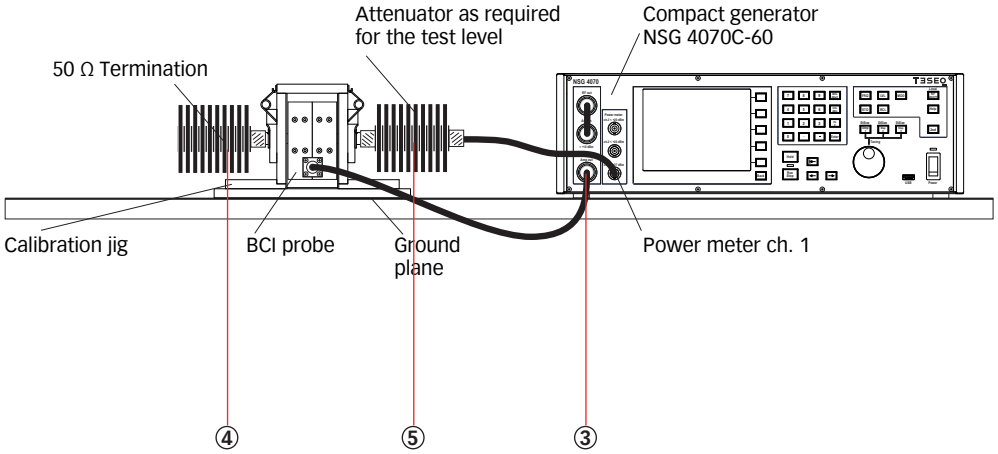
11.7. Example 7: BCI testing (Part 1: without monitoring probe)

The following example shows the menu-controlled operation of the NSG 4070 for performing tests according ISO 11452-4. This example requires a NSG 4070, external directional coupler, external power amplifier, BCI probe and calibration jig. A termination for the calibration jig and an attenuator to protect the power meter are also required.

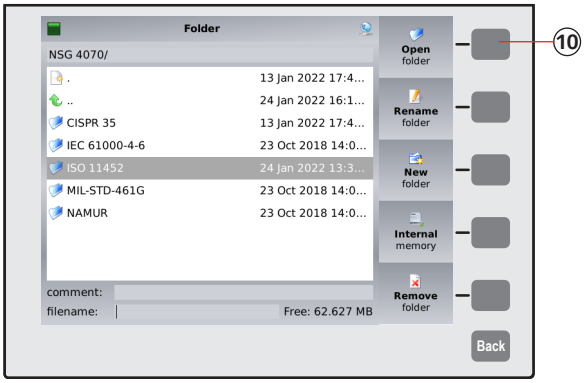


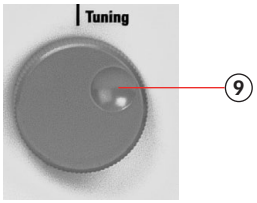


1. Connect the NSG 4070 with a suitable mains socket.
2. Switch the unit on.
3. Connect “RF out“ to the power amplifier input.
4. Connect the amplifier output to the BCI probe.
5. Set up the calibration jig and termination as shown in the figure below.
6. Connect one side of the calibration jig to the power meter channel 1. Use a 20 dB attenuator as required for the test level and this example.

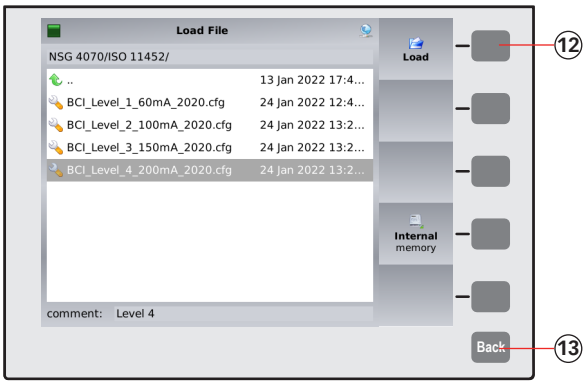


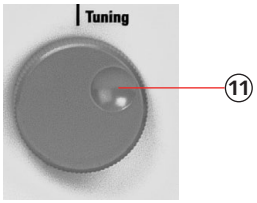
7. Press **RCL** for selecting an existing configuration file.
8. Press **Config**





9. Turn the knob and select **ISO 11452**
10. Press **Open folder**

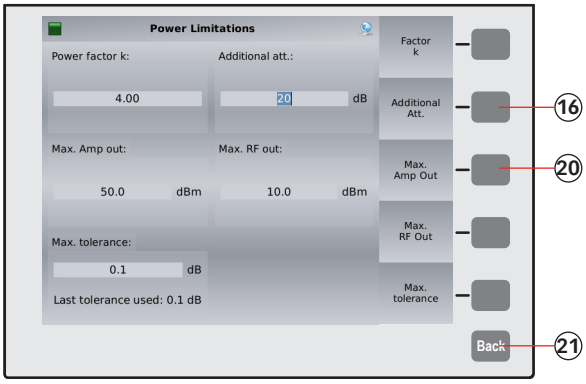


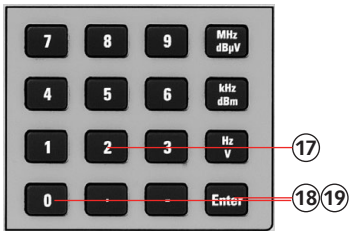


11. Turn the knob and select the configuration file “BCI_Level_4_200.cfg “
12. Press **Load**
13. Press **Back**

14. Press **Setup**

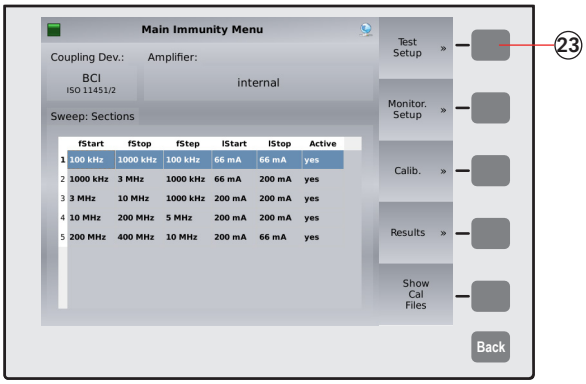
15. Press **Power Limits**



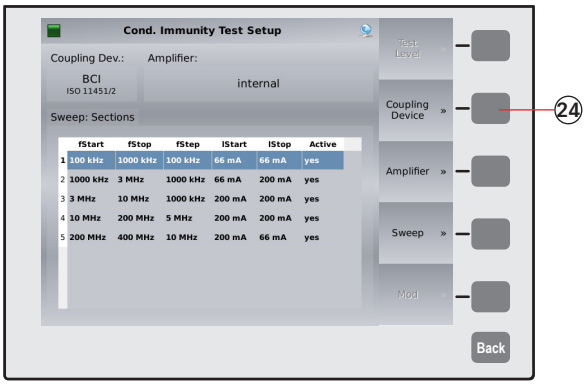


16. Press **Additional Att.**
17. Type in **2**.
18. Type in **0**.
19. Press **Enter** (protection of power meter 1).
20. Press **Max. Amp Out** and change this limit as required by the hardware.
21. Press **Back**

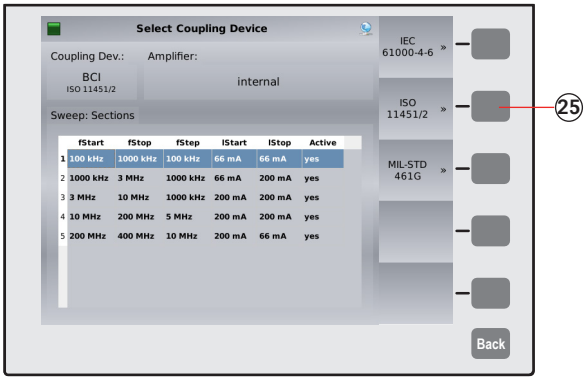
22. Press **Immunity Mode**



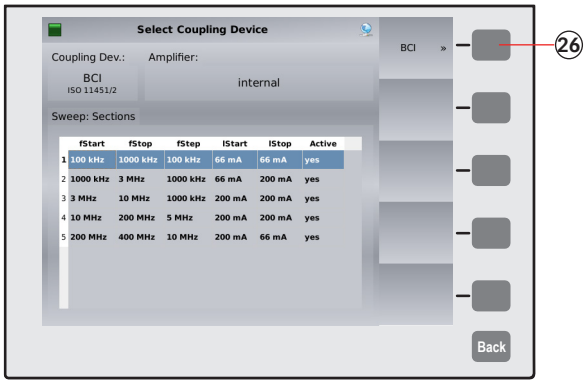
23. Press **Test Setup**



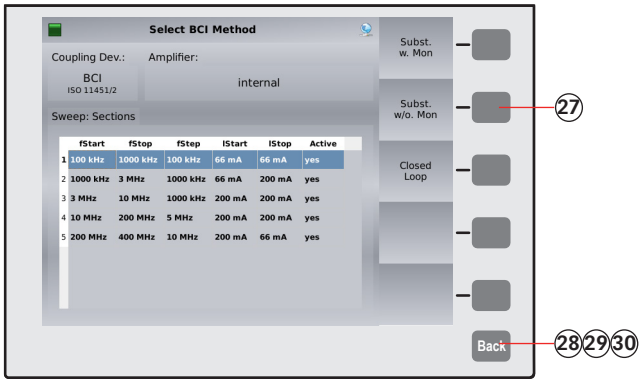
24. Press **Coupling Device**



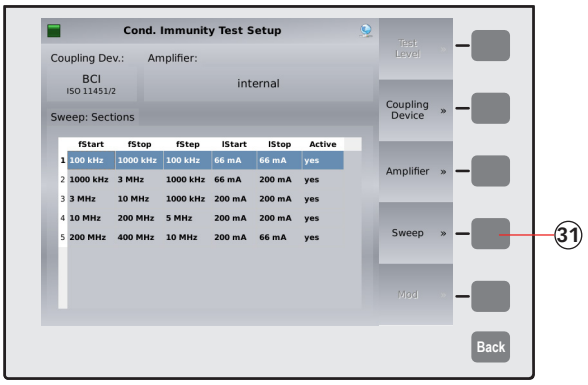
25. Press **ISO 11451/2**



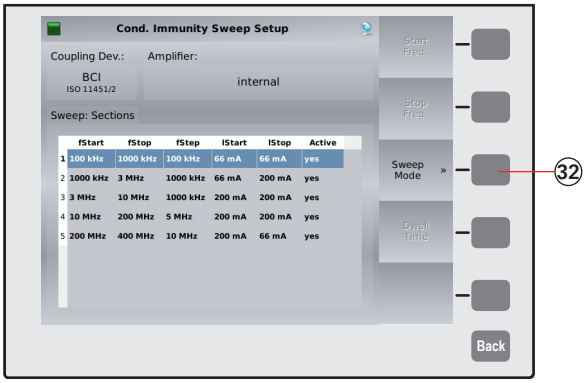
26. Press **BCI**

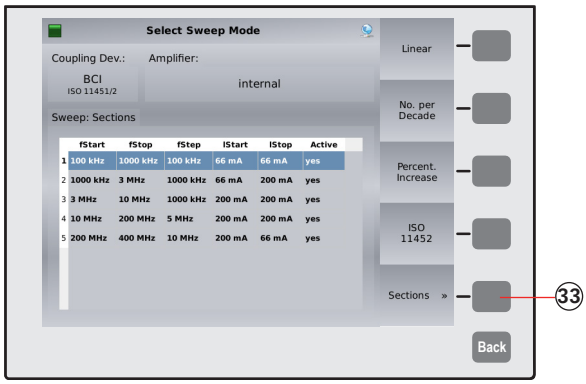


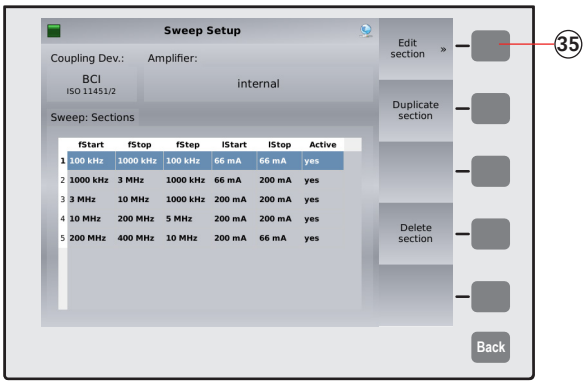
27. Press **Subst. w/o. Mon.** to test without monitoring probe.
28. Press **Back**
29. Press **Back**
30. Press **Back**



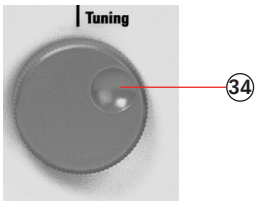
31. Press **Sweep**



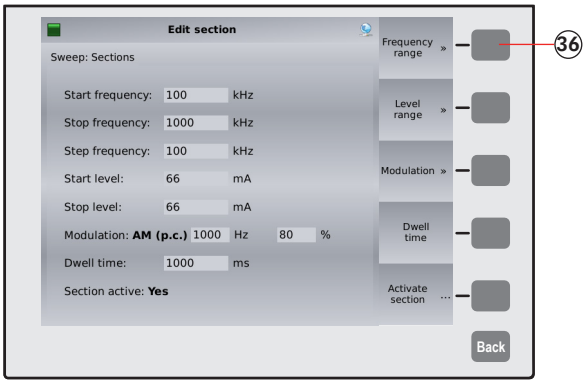




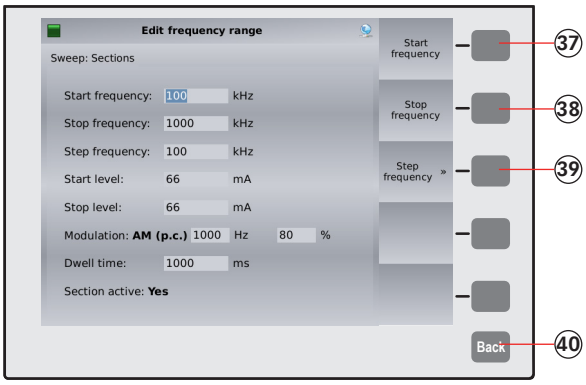
32. Press **Sweep Mode**
33. Press **Sections**



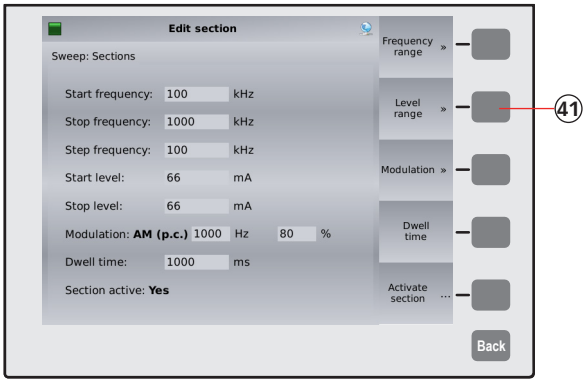
34. Turn the knob to select the section.
35. Press **Edit Section**



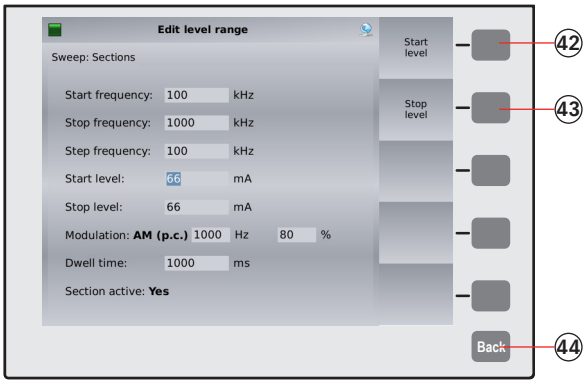
36. Press **Frequency range**



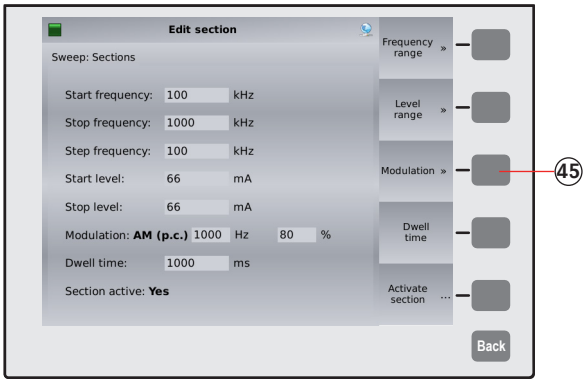
37. Press **Start frequency** and change the value as needed.
38. Press **Stop frequency** and change the value as needed.
39. Press **Step frequency** and change the value as needed.
40. Press **Back**



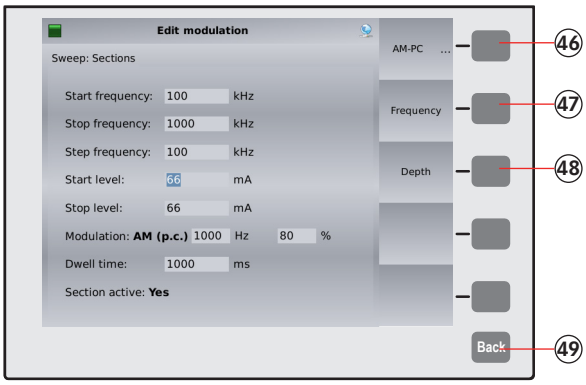
41. Press **Level range**



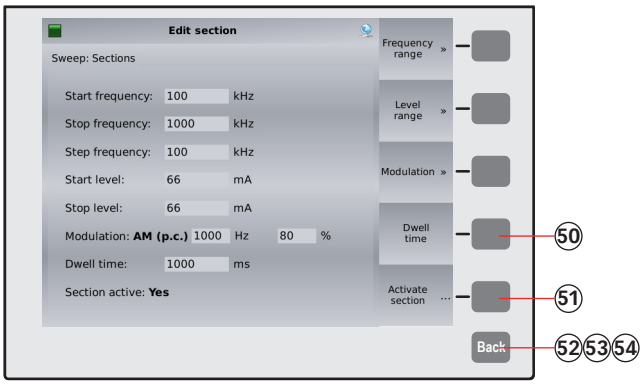
42. Press **Start level** and change the value as needed.
43. Press **Stop level** and change the value as needed.
44. Press **Back**



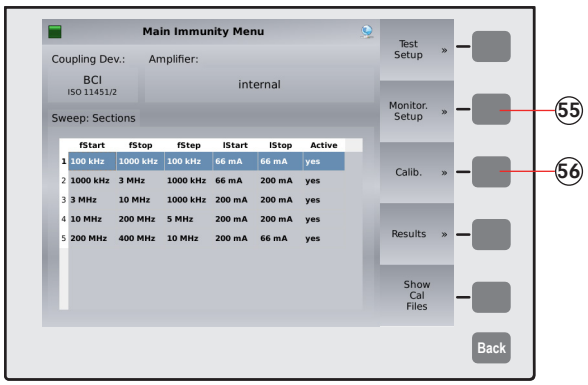
45. Press **Modulation**



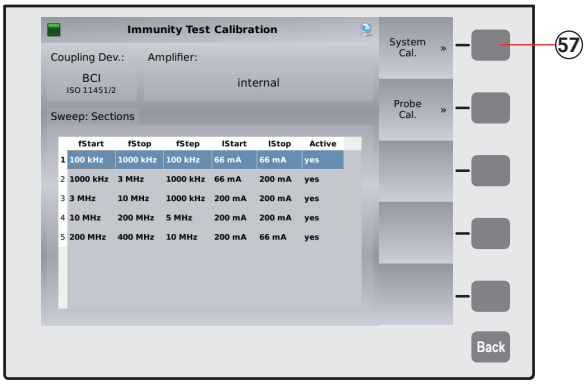
46. Press several times to have finally **AM-PC** selected.
47. Press **Frequency** and change the value as needed.
48. Press **Depth** and change the value as needed.
49. Press **Back**



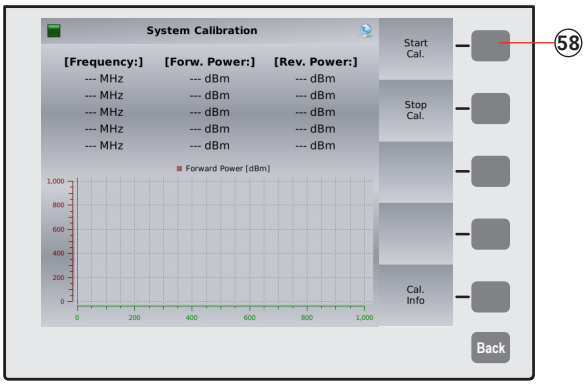
50. Press **Dwell time** and change the value as needed.
51. Press **Activate Section**
52. Press **Back**
53. Press **Back**
54. Press **Back**



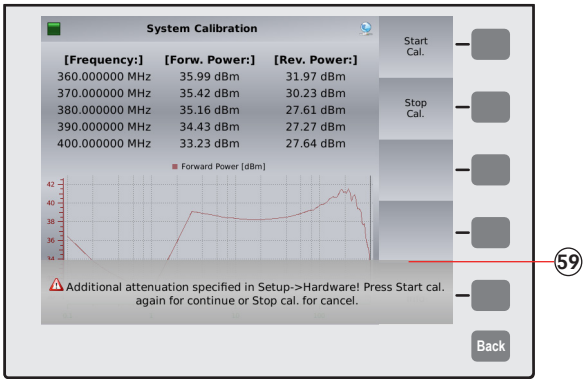
55. Press **Monitor. Setup** and switch off all unused EUT monitoring ports for this example. Turn the knob to change the port and press the required softkey to select "✕". Leave the menu with **Back**.
56. Press **Calib.**



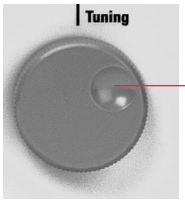
57. Press **System Cal.**



58. Press **Start Cal.** and wait.

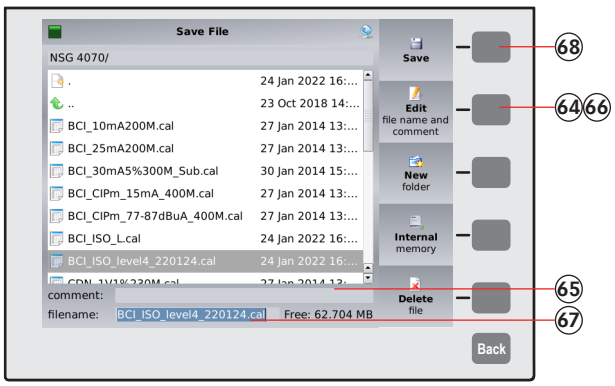


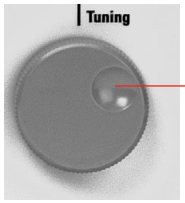
59. The system calibration starts with a message to remind the user that an additional attenuator is specified (step 17).



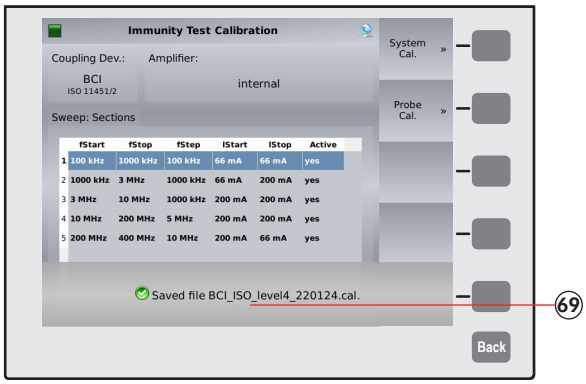
60. Turn the knob to check the calibration results (optional) after finishing the calibration.

61. Press **STO** to store the calibration file or jump to step 80.
62. Press **System Cal.**
63. Turn the knob to select a similar file comment or name. (optional)



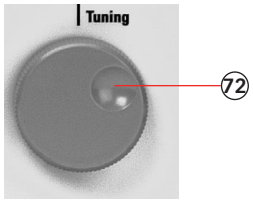


64. Press **Edit**
65. Type in the comment with the connected keyboard.
66. Press **Edit**
67. Type in the name of the file with the connected keyboard.
68. Press **Save**

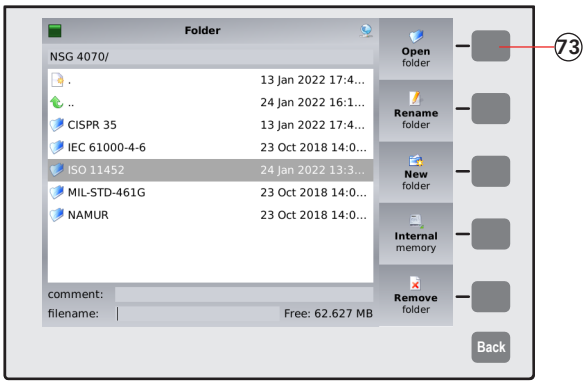


69. A message will be shown with the name of the file.

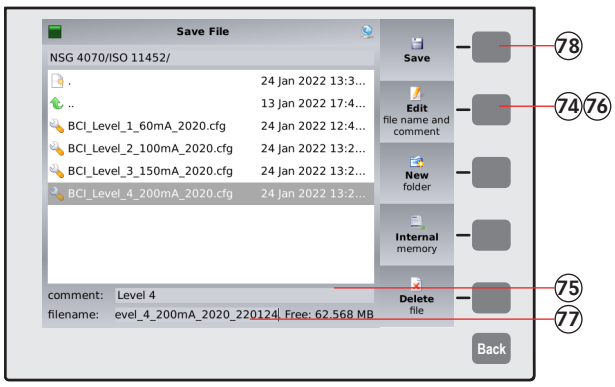
70. Press **STO** to store the configuration file or jump to step 92.
71. Press **Config**



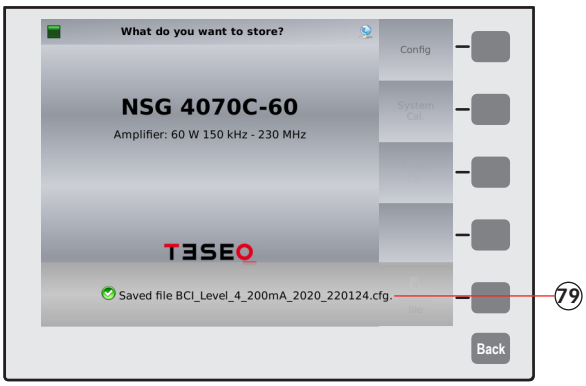
72. Turn the knob to select a similar file comment or name. (optional)
73. Press **Open**

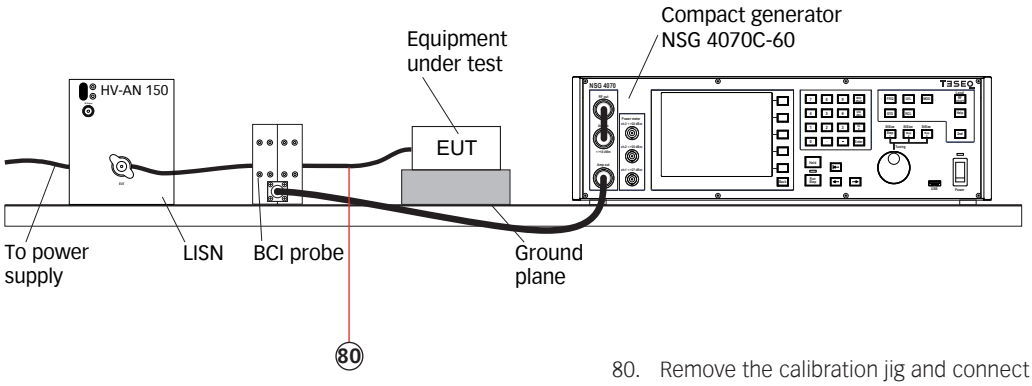


74. Press **Edit**
75. Type in the comment with the connected keyboard.
76. Press **Edit**
77. Type in the name of the file with the connected keyboard.
78. Press **Save**

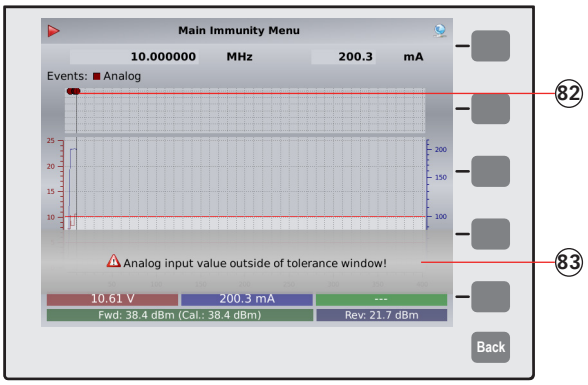


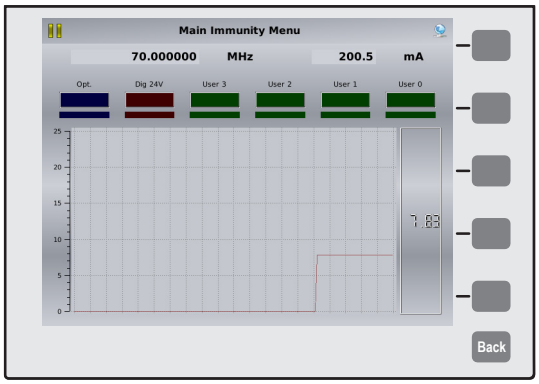
79. A message will be shown with the name of the file.

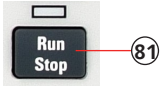




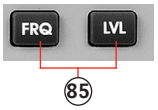
80. Remove the calibration jig and connect the EUT.

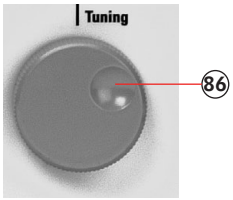






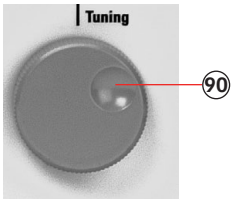
81. Press **Run** to start the test.
82. Example of an EUT monitoring event (Register). Symbol indicates an analog event.
83. Example of an EUT monitoring event (Register). Message indicates an analog event.

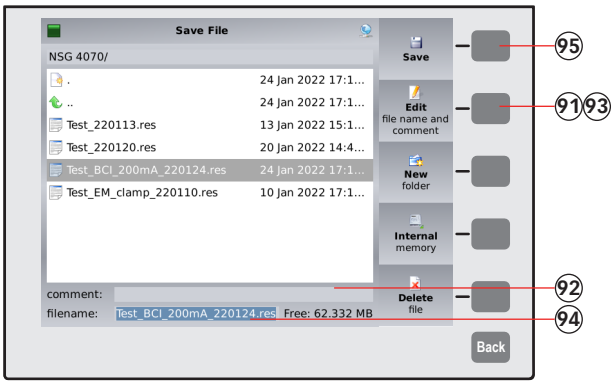




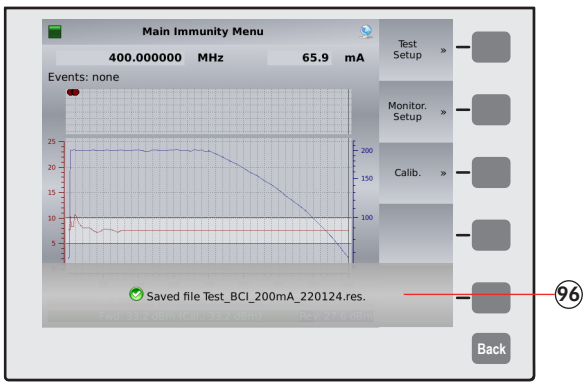
84. Press **Hold** to interrupt the sweep. (Caution! RF level is still present.)
85. Press **FRQ** or **LVL** to select the test frequency or level.
86. Turn the knob to manually change the selected parameter.
87. Press **Hold** to continue the test.

88. Press **STO** to store the result file.
89. Press **Results**





90. Turn the knob to select a similar file comment or name. (optional)
91. Press **Edit**
92. Type in the comment with the connected keyboard.
93. Press **Edit**
94. Type in the name of the file with the connected keyboard.
95. Press **Save**



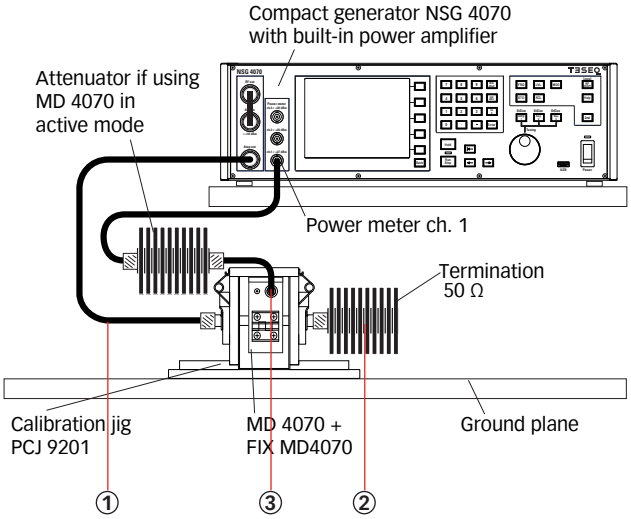
96. A message will be shown with the name of the file.

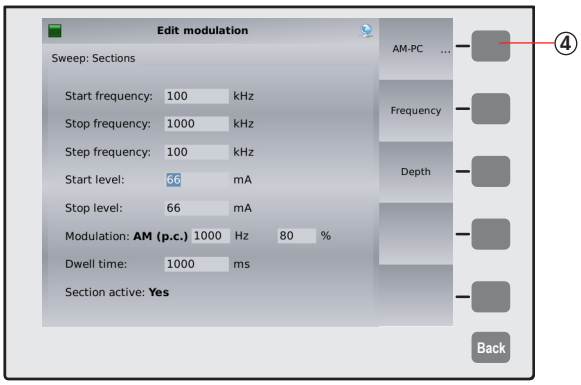
11.8. Example 8: BCI testing (Part 2: Monitoring probe calibration)

The following example shows the menu-controlled operation of the NSG 4070 for performing the monitoring probe calibration. It is based on the example 7. Steps 1 to 69 need to be performed right before. This example requires a NSG 4070, external directional coupler, external power amplifier, monitoring probe and calibration jig. A 50 Ω termination for the calibration jig is also required. The probe must be inserted in a 50 Ω calibration jig.

1. Connect the output of the power amplifier to the calibration jig.
2. Terminate the calibration jig as shown in the figure below.
3. Connect the RF output of the probe to the power meter channel 1.

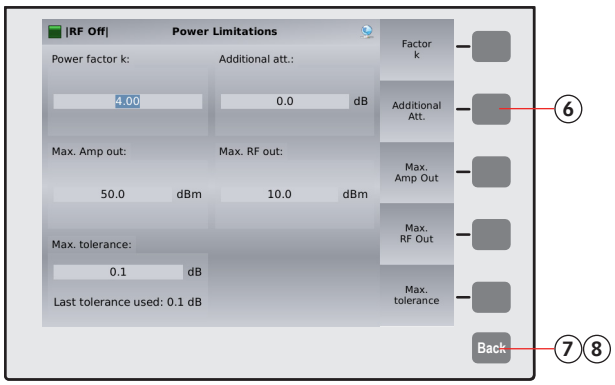
CAUTION: Using power amplifiers with more than 100 Watts requires to protect power meter channel 1 with an attenuator of at least 10 dB for example MD 4070 in active mode.





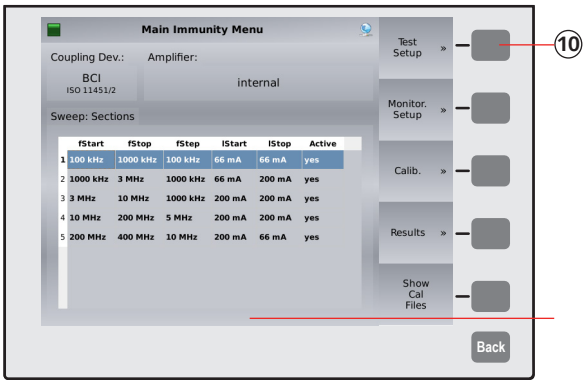
4. Press **Setup**

5. Press **Power Limits**

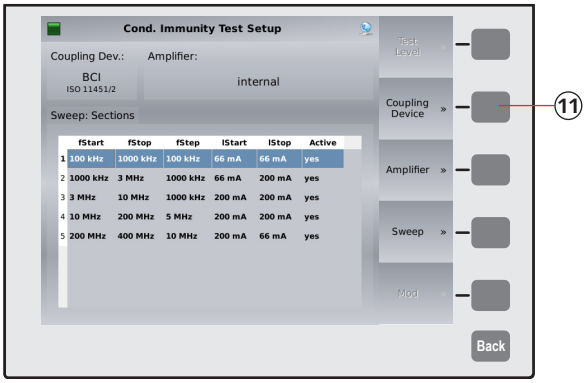


6. Press **Additional Att.** and change this value to 0 dB except the power amplifier is >100 W and MD 4070 is switched to the active mode. This would be require at least 10 dB.
7. Press **Back**
8. Press **Back**

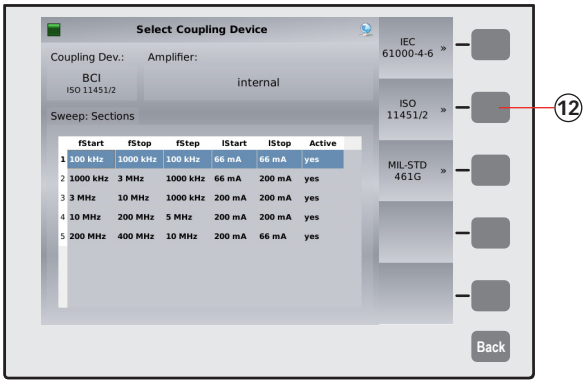
9. Press **Immunity Mode**

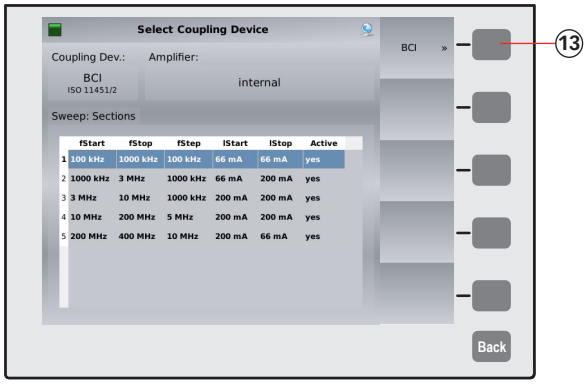


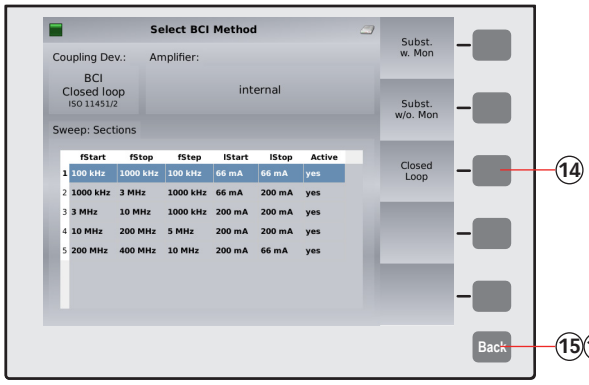
10. Press **Test Setup**



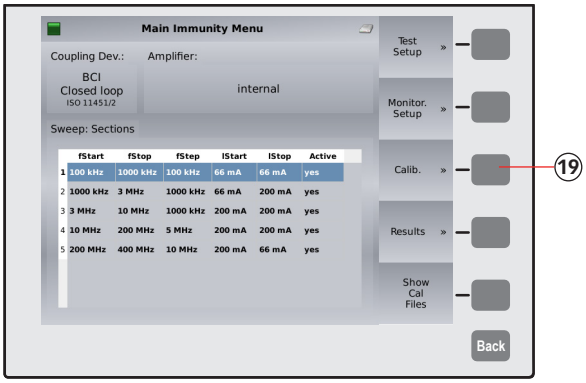
11. Press **Coupling Device**



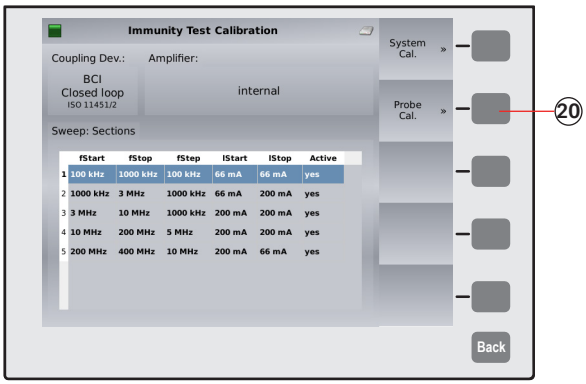




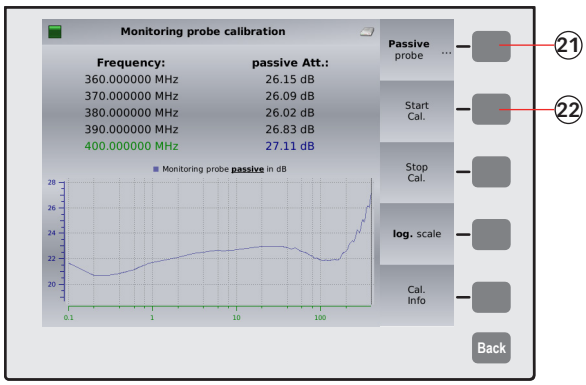
12. Press **ISO 11451/2**
13. Press **BCI**
14. Press **Closed Loop**
15. Press **Back**
16. Press **Back**
17. Press **Back**
18. Press **Back**



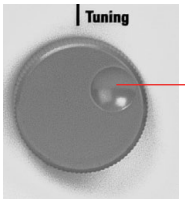
19. Press **Calib.**



20. Press **Probe Cal.**

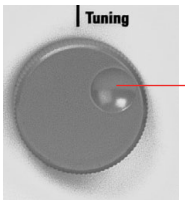


21. Select **Passive probe** if using MD 4070 passive. Select **Active probe** if using MD 4070 active.
22. Press **Start Cal.** and wait.

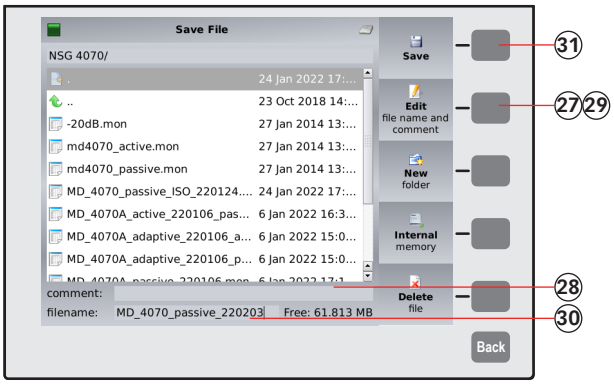


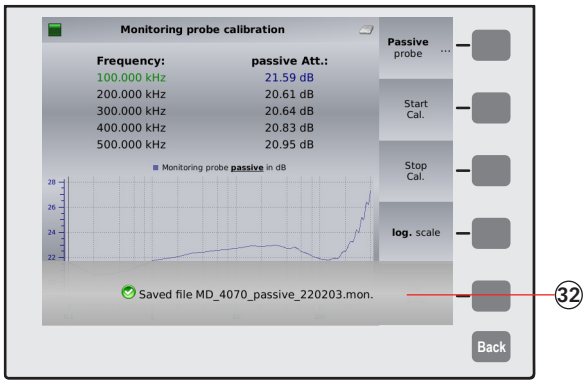
23. Turn the knob to check the calibration results. (optional)

24. Press **STO** to store the calibration file.
25. Press **Probe Cal.**



26. Turn the knob to select a similar file comment or name. (optional)
27. Press **Edit**
28. Enter the comment using the connected keyboard.
29. Press **Edit**
30. Enter the comment using the connected keyboard.
31. Press **Save**

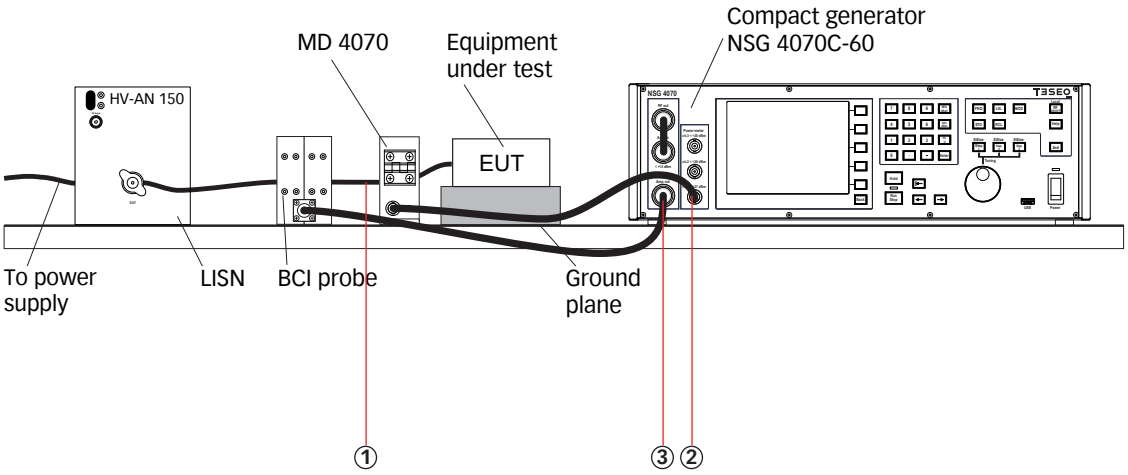




32. A message will be shown with the name of the file.)

11.9. Example 9: BCI testing (Part 3: Closed loop method)

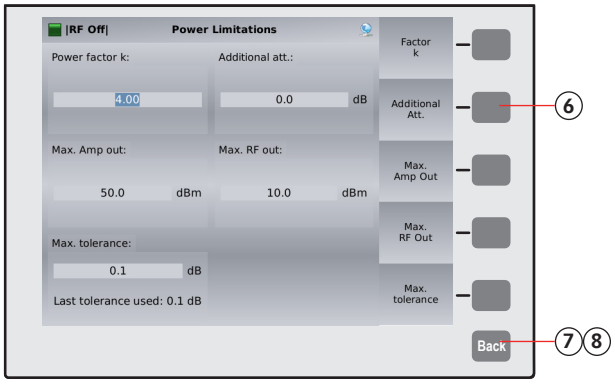
The following example is based on example 7 step #1 to #69 and example 8 (Chapter 11.7 and 11.8). This example requires a NSG 4070, BCI probe and monitoring probe.



1. Remove the calibration jig and connect the EUT.
2. Connect the monitoring probe to the power meter channel 1.
3. Connect the BCI probe as shown in the example above.

4. Press **Setup**

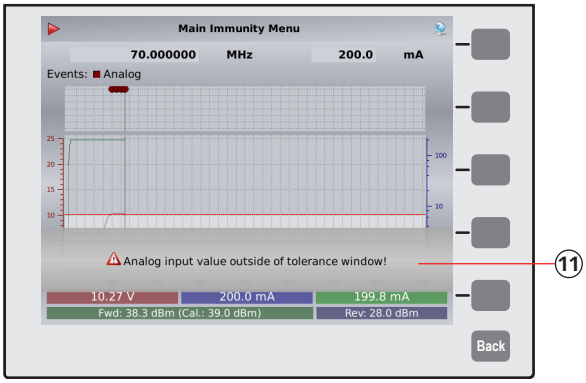
5. Press **Power Limits**



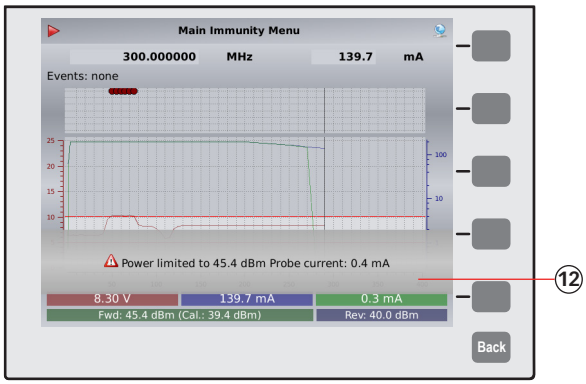
6. Press **Additional Att.** and change this value to 0 dB.
7. Press **Back**
8. Press **Back**

9. Press **Immunity Mode**

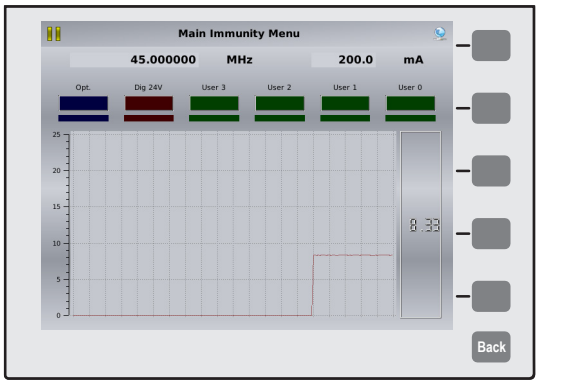
10. Press **Run** to start the test.

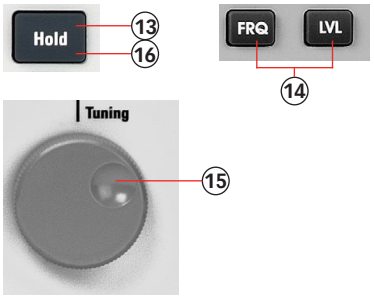


11. Example of an EUT monitoring event (Register).



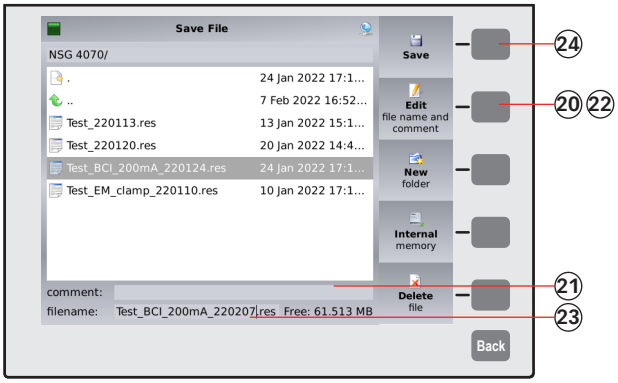
12. Example of a message in case of power limitation (For example means a k factor of 4: An increase to four times the calibrated forward power isn't enough to reach the target level. There will be no increase above this limitation.)

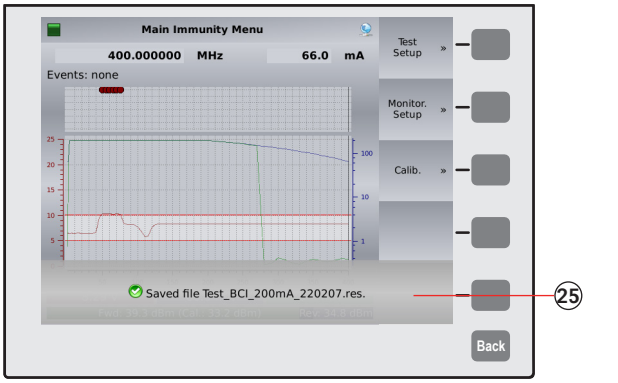


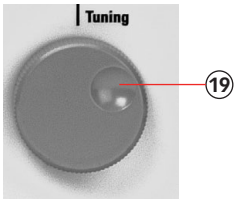


13. Press **Hold** to interrupt the sweep. (Caution! RF level is still present.)
14. Press **FRQ** or **LVL** to select the test frequency or level.
15. Turn the knob to manually change the selected parameter.
16. Press **Hold** to continue the test.

17. Press **STO** to store the result file.
18. Press **Results**







19. Turn the knob to select a similar file comment or name. (optional)
20. Press **Edit**
21. Type the comment on the connected keyboard.
22. Press **Edit**
23. Type the name of the file on the connected keyboard.
24. Press **Save**

25. A message will be shown with the name of the file.

12. MAINTENANCE

12.1. General

The NSG 4070 including the accessories need no special maintenance. Maintenance is limited to cleaning the contacts and air inlets and outlets. The life time of the connectors is limited because of the contact durability. AMETEK CTS can replace the worn out connectors.

No modifications are to be carried out on the NSG 4070 and accessories by the user.

12.2. Cleaning

The cleaning shall be done with dry cloth. If a wet cleaning would become necessary, make sure that no humidity will enter inside of the unit and clean the instrument housing with a damp cloth using a little mild, non-abrasive household cleanser if necessary.

Chemicals must not be used for cleaning purposes

13. DISPOSAL

The unit is constructed that it can be dismantled right down to the component level.

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