

HGT1

User Manual



HGT1 User Manual

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The product information, specifications, and technical data embodied in this manual represent the technical status at the time of writing and are subject to change without prior notice.

We have done our best to ensure that the information given in this manual is useful, accurate and entirely reliable. However, OMICRON does not assume responsibility for any inaccuracies which may be present.

The user is responsible for every application that makes use of an OMICRON product.

OMICRON translates this manual from the source language English into a number of other languages. Any translation of this manual is done for local requirements, and in the event of a dispute between the English and a non-English version, the English version of this manual shall govern.

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About this manual

This User Manual provides information on how to use the *HGT1* test system safely, properly and efficiently. The HGT1 User Manual contains important safety rules for working with *HGT1* and gets you familiar with operating *HGT1*. Following the instructions in this User Manual will help you to prevent danger, repair costs, and avoid possible down time due to incorrect operation.

The HGT1 User Manual always has to be available on the site where the *HGT1* is used. The users of the *HGT1* must read this manual before operating the *HGT1* and observe the safety, installation, and operation instructions therein.

Reading the HGT1 User Manual alone does not release you from the duty to comply with all national and international safety regulations relevant to working on high-voltage equipment.

Safety symbols used

In this manual, the following symbols indicate safety instructions for avoiding hazards.



DANGER

Death or severe injury will occur if the appropriate safety instructions are not observed.



WARNING

Death or severe injury can occur if the appropriate safety instructions are not observed.



CAUTION

Minor or moderate injury may occur if the appropriate safety instructions are not observed.

NOTICE

Equipment damage or loss of data possible

1 Safety instructions

1.1 Operator qualifications

Working on high-voltage assets can be extremely dangerous. Consequently, only personnel qualified, skilled and authorized in electrical engineering and trained by OMICRON are allowed to operate the *HGT1* and its accessories. Before starting to work, clearly establish the responsibilities.

Personnel receiving training, instructions, directions, or education on the *HGT1* must be under constant supervision of an experienced operator while working with the equipment. The operator is responsible for the safety requirements during the whole test.

1.2 Safety standards and rules

1.2.1 Safety standards

Testing with the *HGT1* must comply with the internal safety instructions and additional safety-relevant documents.

In addition, observe the following safety standards, if applicable:

- EN 50191 (VDE 0104) "Erection and Operation of Electrical Test Equipment"
- EN 50110-1 (VDE 0105 Part 100) "Operation of Electrical Installations"
- IEEE 510 "IEEE Recommended Practices for Safety in High-Voltage and High-Power Testing"

Moreover, observe all applicable regulations for accident prevention in the country and at the site of operation.

Before operating the *HGT1* and its accessories, read the safety instructions in this User Manual carefully.

Do not turn on the *HGT1* and do not operate the *HGT1* without understanding the safety information in this manual. If you do not understand some safety instructions, contact OMICRON before proceeding.

Maintenance and repair of the *HGT1* and its accessories is only permitted by qualified experts at OMICRON Service Centers (see "Support" on page 44).

1.2.2 Safety rules

Always observe the five safety rules:

- ▶ Disconnect completely.
- ▶ Secure against re-connection.
- ▶ Verify that the installation is dead.
- ▶ Carry out grounding and short-circuiting.
- ▶ Provide protection against adjacent live parts.

1.2.3 Safety accessories

OMICRON offers a range of accessories for added safety during the operation of our test systems. For further information and specifications, refer to the corresponding Supplementary Sheet or contact OMICRON Support.

1.3 Operating the measurement setup

The operator is responsible for the safety requirements during the whole test.

- ▶ Do not enter the high-voltage area while working with the *HGT1*.
- ▶ Always obey the five safety rules and follow the detailed safety instructions in the respective user manuals.
- ▶ Never connect the *HGT1* to the tablet without using the provided USB isolator.
- ▶ Only use measurement cables with termination providing protection against contact.

Before performing tests, observe the following instructions:

- ▶ Do not insert objects (for example screwdrivers, etc.) into any input/output socket.
- ▶ Do not operate the *HGT1* under ambient conditions that exceed the temperature and humidity limits listed in 8 "Technical specifications" on page 30.
- ▶ Do not operate the *HGT1* in the presence of explosives, gas or vapors.
- ▶ Opening the *HGT1* invalidates all warranty claims.
- ▶ If the *HGT1* does not seem to function properly, do not use it anymore. Please call the OMICRON technical support.

1.4 Orderly measures

The HGT1 User Manual must be read and observed by all users of the *HGT1*. The *HGT1* may be used only as described in this manual. Any other use is not in accordance with the regulations.

The manufacturer and/or distributor is not liable for damage resulting from improper usage. The user alone assumes all responsibility and risk.

Following the instructions provided in this User Manual is also considered part of being in accordance with the regulations.

1.5 Disclaimer

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

1.6 Compliance statement

Declaration of conformity (EU)

The equipment adheres to the guidelines of the council of the European Community for meeting the requirements of the member states regarding the electromagnetic compatibility (EMC) directive, the low voltage directive (LVD) and the RoHS directive.

FCC compliance (USA)

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

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Declaration of compliance (Canada)

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

1.7 Recycling



This test set (including all accessories) is not intended for household use. At the end of its service life, do not dispose of the test set with household waste!

For customers in EU countries (incl. European Economic Area)

OMICRON test sets are subject to the EU Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE directive). As part of our legal obligations under this legislation, OMICRON offers to take back the test set and ensure that it is disposed of by authorized recycling agents.

For customers outside the European Economic Area

Please contact the authorities in charge for the relevant environmental regulations in your country and dispose the OMICRON test set only in accordance with your local legal requirements.

2 Introduction

2.1 Designated use

NTI's FFT voltmeter *HGT1* is primarily designed for professional acoustical test applications. For step and touch voltage and ground impedance measurements, the *HGT1* is delivered with an OMICRON software which allows measuring the frequency-selective voltage level by using a real-time Zoom FFT. The *HGT1* works as an add-on device to the *CPC 100* and *CP CU1*. This User Manual describes in detail the OMICRON-specific *HGT1* functions and measurements.

Using the OMICRON-specific *HGT1* functions, the following measurements can be performed:

- Step an touch voltage without *PTM* (*Primary Test Manager*)
- Step an touch voltage with *PTM* (installed on a Windows tablet connected to the *HGT1* via USB)
Note: In both cases measurements are to be performed according to either EN 50522 or IEEE 81.
- Ground impedance with *PTM* (installed on a Windows tablet connected to the *HGT1* via USB)

Any other use of the *HGT1* but the one mentioned above is considered improper use, and will not only invalidate all customer warranty claims but also exempt the manufacturer from its liability to recourse.

2.2 Warranty

International warranty

NTi Audio guarantees the function of its products and the individual components for a period of one year from the date of sale. During this period, defective products will either be repaired free of charge or replaced.

Limitations

These guarantee provisions do not cover damage caused by accidents, transportation, incorrect use, carelessness, non-original accessories, the loss of parts, operation with non-specified input voltages, adapter types or incorrectly inserted batteries. NTi Audio accepts no responsibility for subsequent damage of any kind. The warranty will be voided by carrying out repairs or services by third parties who are not part of an approved NTi Audio Service Center.

Statutory Rights

Consumers may have legal (statutory) rights under applicable national laws relating to the sale of consumer products. This warranty does not affect your statutory rights. You may assert any legal rights you have at your sole discretion.

2.3 Calibration certificate

Your NTi Audio instrument has been carefully tested during production and corresponds to the specifications listed in 8 "Technical specifications" on page 30. Calibration certificates are included in the delivery.

NTi Audio recommends annual calibration of the products after the purchase. The calibration provides documented and traceable measurement accuracy and confirms that your NTi Audio product meets or exceeds the published specifications. The calibration and adjustment procedures follow the documentation and traceability requirements of the standard EN ISO / IEC 17025.

For calibrations kindly follow the service guidelines at www.nti-audio.com/service.

2.4 Rain protection

In order to protect the *HGT1* from rain it can also be operated in a plastic bag as shown in the image below. OMICRON recommends the A5 Document Bag by Ortlieb (www.ortlieb.de).



Figure 2-1: *HGT1* with waterproof bag

- If you use a waterproof bag, use the navigation buttons instead of the navigation wheel.

2.5 Carrying bag

OMICRON provides a belt bag to carry the *HGT1* while it is used together with a Windows tablet (only relevant when the mobile *PTM (Primary Test Manager)* option is used).



Figure 2-2: *HGT1* carrying bag

3 Hardware overview



Figure 3-1: HGT1 front view

Table 3-1: HGT1 buttons

Button	Description
Escape	Cancel an action or place the cursor on top of the screen
Auto-amplitude	Adapt the voltage range according to the measured voltage
Input impedance selection	Switch between input impedances of the HGT1 Options: <ul style="list-style-type: none"> • 1 kΩ • 1 kΩ + 1 kΩ voltage divider • High impedance
Start/stop measurement	Press to start/stop a measurement <ul style="list-style-type: none"> • Green LED: measurement is running • Orange LED: measurement is stopped and Save Dialog is open (see 6 "Recording and saving data" on page 21)

3.1 Connectors



Figure 3-2: HGT1 connectors, top



Figure 3-3: HGT1 connectors, bottom

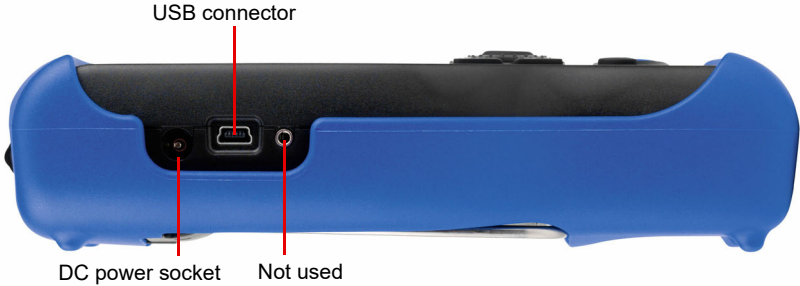


Figure 3-4: HGT1 connectors, left side



Figure 3-5: HGT1 connectors, right side

3.2 USB connection (when using the *HGT1* with *PTM*)

When the *PTM* option for the *HGT1* is used, the *HGT1* needs to be connected to the Window tablet running *PTM* via USB.



Figure 3-6: *HGT1* with USB cable and USB isolator connected

WARNING



Death or severe injury caused by high voltage or current possible

▶ Never connect the *HGT1* to the tablet without using the provided USB isolator.



Figure 3-7: USB isolator

3.3 Power supply

The *HGT1* offers two power supply options:

- A rechargeable lithium polymer (Li-Po) battery
- Four AA batteries (not included)

The new Li-Po battery is charged to approximately 50 % and should be fully charged before use. It can either be charged via the USB connector or the DC power socket (charger not included).

- ▶ Switch off the *HGT1* for faster charging.

WARNING



Severe injury caused by electric discharge and burns possible

- ▶ Do not heat the battery above 60 °C (140 °F).
- ▶ Do not place the battery in or near fire.
- ▶ Do not solder directly on to the battery.
- ▶ Do not disassemble the battery or insert it in reverse polarity
- ▶ Switch off the *HGT1* before opening the battery cover in order to prevent any electric discharges.
- ▶ Avoid short-circuits.
- ▶ Operate and charge the battery between 0 °C (32 °F) and 45 °C (113 °F).

Table 3-2: DC power supply specifications

Characteristic	Rating
Voltage	7.5 V ... 23.0 V
Power	min. 6 W
Connector type	2.1 mm x 5.5 mm x 9.5 mm
Polarity	

4 Using the *HGT1* with *PTM*

The *HGT1* can be connected to a Windows tablet running *PTM* (*Primary Test Manager*). Also see section 3.2 "USB connection (when using the HGT1 with PTM)" on page 13). For further Information on *PTM* refer to the CPC 100 PTM User Manual.

Figure 4-1 below shows an example of a Windows tablet used with the *HGT1*.



Figure 4-1: Example of a Windows tablet

5 System and Firmware Settings

5.1 System Settings


- ▶ To access the **System Settings**, navigate to the left side of the menu bar and select **System Settings**.
- ▶ Confirm by pressing .



Figure 5-1: HGT1 System view

Table 5-1: Items available in the **System** view





Option	Description
Auto power off	If no button has been pressed for the defined time period, the instrument will switch off.
Backlight	Toggle the backlight with the Power/Backlight button and choose from the following options: <ul style="list-style-type: none"> • Auto On/Dimmed: The backlight is dimmed automatically after two minutes. Press  to dim it manually. • Auto On/Off: The backlight is switched off automatically. Press  to switch it off manually. • Manual: The backlight is neither automatically dimmed nor switched off. Press  to manually dim or switch off the backlight.
Date and Time	The date format is yyyy-mm-dd. All measurements are logged with a date and time stamp. Use the navigation wheel to set the date and time and confirm each setting by pressing  .

Table 5-1: Items available in the **System** view

Option	Description
USB mode	The USB mode setting defines how the PC recognizes the connected <i>HGT1</i> : <ul style="list-style-type: none"> • Ask on connect: Select either the Mass storage or COM port mode after connecting the <i>HGT1</i> to the PC. • Mass storage: The PC automatically recognizes the <i>HGT1</i> as a mass storage device. This allows you to download <i>HGT1</i> measurement reports. • COM port: Needs to be activated when the <i>HGT1</i> is connected to a computer (Windows tablet) to enable communication between the devices.
Dec. separator	Set the decimal separator to match the generated measurement reports to the PC settings.
Firmware	Firmware version number
Serial number	Device's serial number

5.2 Firmware Update

Complete the steps below to update the *HGT1* firmware:

- ▶ Set the **USB mode** to **Mass storage** (see **USB mode** in table 5-1).
- ▶ Connect the *HGT1* to a computer using the USB cable included in the delivery.
- ▶ Copy the update file (format .00) from one of the following locations:
 - On the *CPC 100 Toolset* CD-ROM:
_EmbeddedSoftware\HGT1\
 - With Primary Test Manager installed:
C:\Program Files (x86)\Common Files\OMICRON\UpgradeImages\HGT1\
- ▶ Copy the update file to the *HGT1*'s root directory `OMICRONHGT`.
- ▶ Restart the *HGT1*.
The update is automatically executed during the booting process. After the update is complete, the update file is automatically deleted.
- ▶ Enter the **System** view to check if the update was successful (see Figure 5-1: "HGT1 System view" on page 16).

5.3 Uploading a license file to the *HGT1*

To be able to use *HGT1* with *Primary Test Manager* (while it is connected to a tablet running the software) a license is needed. The corresponding license file needs to be stored in the *HGT1*'s root directory.

Complete the steps below to upload license file to the *HGT1*:

- ▶ Set the **USB mode** to **Mass storage** (see **USB mode** in table 5-1).
- ▶ Connect the *HGT1* to a computer using the USB cable included in the delivery.
- ▶ Copy the license file from the location you saved it to.
- ▶ Copy the license file to the *HGT1*'s root directory `OMICRONHGT`.
- ▶ Restart the *HGT1*.

6 Step and touch voltage meter

► To open the **StepTouch** view, navigate to the menu bar and select **StepTouch** on the left.

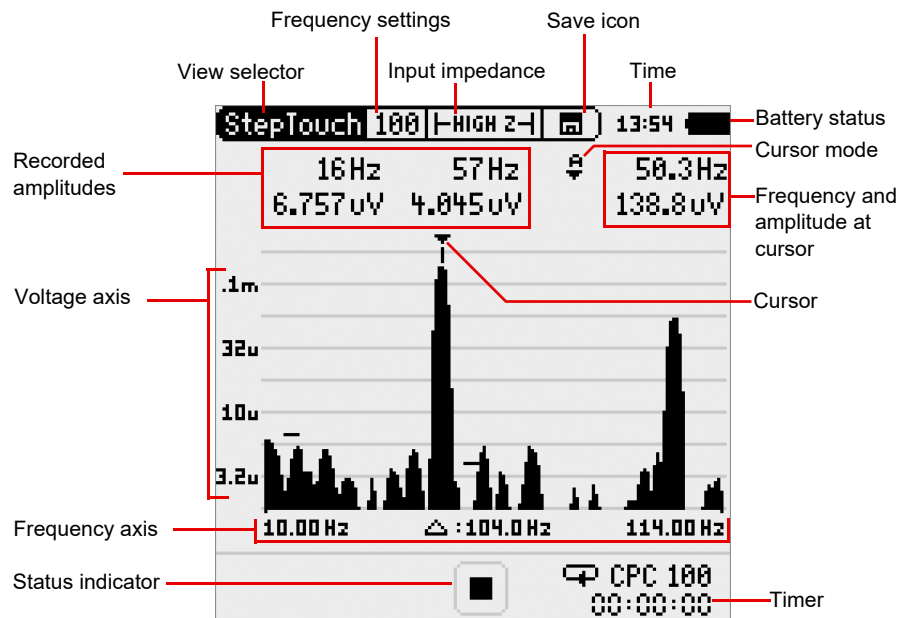


Figure 6-1 HGT1 StepTouch view

Table 6-1: Items available on the **StepTouch** view

Feature	Description
View selector	StepTouch or System Settings
Frequency settings	Switch between frequency ranges See 6.1 "Frequency range selection" on page 19
Input impedance	Change the input impedance of the <i>HGT1</i> See 6.2 "Input Impedance selection" on page 20
Save icon	Start and close datasets; store measurement points See 6 "Recording and saving data" on page 21
Time	Can be changed in the System view
Battery status	Indicates battery status and USB connection
Recorded amplitudes	Recently measured amplitudes of measurement frequencies; Independent from cursor mode, frequency and amplitude at the cursor, and maximum amplitude
Cursor mode	<ul style="list-style-type: none"> • A: automatic search for maximum amplitude • M: manual cursor positioning
Frequency and amplitude at cursor	Click frequency to start frequency zoom mode
Cursor	Positioned automatically or manually See Cursor mode in this list

Table 6-1: Items available on the **StepTouch** view

Feature	Description
Voltage axis	Click top value to enter amplitude zoom mode See 6.4 "Voltage axis" on page 21
Frequency axis	See 6.3 "Frequency axis" on page 20
State indicator	<ul style="list-style-type: none"> Paused: <input type="checkbox"/> Measurement running: <input checked="" type="checkbox"/>
Timer	Starts every time a measurement is finished to help estimate when the <i>CPC 100</i> will execute the next injection

6.1 Frequency range selection

► Change the frequency settings in the menu bar.

Note: The wider the frequency range, the lower the resolution of the FFT. Refer to 8 "Technical specifications" on page 30 for more information.

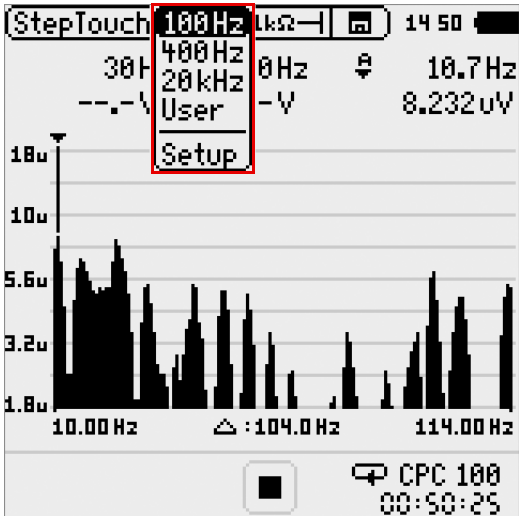


Figure 6-2 Frequency range selection in the **StepTouch** view

► Press **ESC** to confirm and return to the previous screen.

Table 6-2: Frequency range options

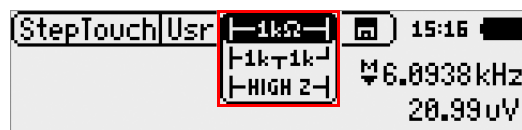
Feature	Description
100 Hz	Default setting for frequency axis: 10 Hz ... 114 Hz
400 Hz	Default setting for frequency axis: 14 Hz ... 430 Hz
20 kHz	Default setting for frequency axis: 484 Hz ... 20.45 kHz
User	The most recent settings applied to the frequency axis are stored and can be re-applied by selecting User .

Table 6-2: Frequency range options

Feature	Description
Setup	<p>The HGT1 allows defining two frequencies at which the maximum value during a measurement is detected. This option is only available for the 100 Hz and 400 Hz selection.</p> <p>In the Setup view the following settings for the two frequencies are available:</p> <ul style="list-style-type: none"> • 50 Hz: default setting for mains frequency at 50 Hz (measurement at 30 Hz and 70 Hz) • 60 Hz: default setting for mains frequency at 60 Hz (measurement at 40 Hz and 80 Hz) • Manual: user-defined setting To change the frequencies using the Manual option, move the marker into the brackets and change the value: <div data-bbox="689 766 1209 1024" style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"> <p>StepTouch Set 1kΩ 15:16</p> <p>Frequencies to scan:</p> <p><input type="radio"/> 50Hz (30/ 70Hz)</p> <p><input type="radio"/> 60Hz (40/ 80Hz)</p> <p><input checked="" type="radio"/> Manual (16/ 61Hz)</p> </div>

6.2 Input Impedance selection

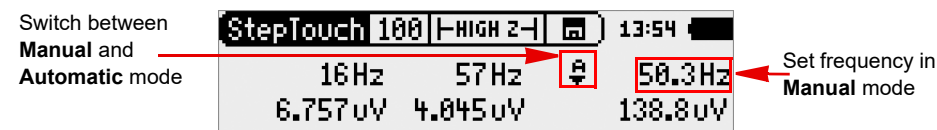
The input impedance selection offers three different settings:





- **1 kΩ**: simulates body resistance
- **1 kΩ + 1 kΩ**: simulates shoe + body resistance; measurement only via body resistance
- **HIGH Z (high impedance)**: no-load measurement; prospective touch voltage

6.3 Frequency axis

The cursor frequency can be set either automatically or manually.



- **Automatic** mode: The cursor switches to the frequency with the highest amplitude. In this mode, the frequency and the corresponding voltage are displayed.

- **Manual** mode: Click the frequency and move the cursor using the navigation wheel. In this mode, the corresponding voltage is displayed.
- ▶ In order to change the frequency, mark the frequency on the right side of the screen and press .
- ▶ Change the value using the navigation wheel.
You can now change the zoom on the frequency axis by holding  and turning the navigation wheel.

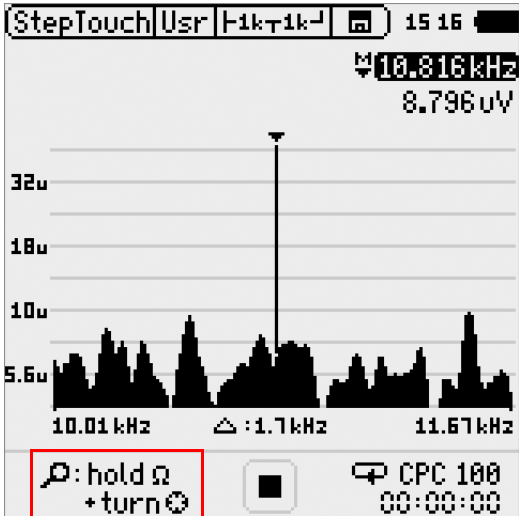


Figure 6-3: StepTouch view with frequency zoom

Note: The zoom is available in both the **Manual** and the **Automatic** mode.

6.4 Voltage axis

- ▶ To activate the amplitude zoom, click the top value of the voltage axis.
- ▶ Choose the zoom mode (20, 10, 5 or 2.5 dB/div) and adjust the axis using the navigation wheel.
- ▶ Press **at** to reset the zoom.

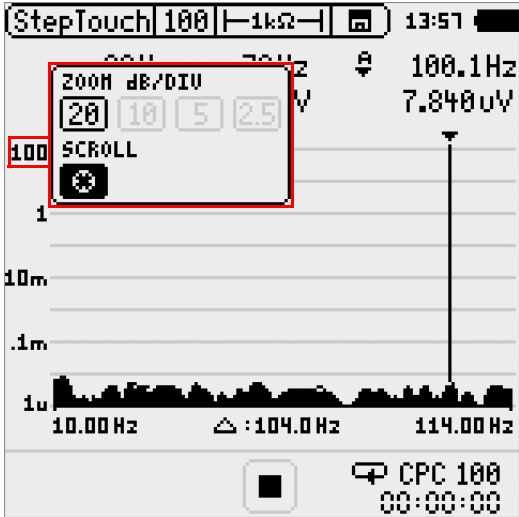


Figure 6-4: Amplitude zoom in the StepTouch view

7 Recording and saving data

The *HGT1* saves measurement points consisting of the amplitudes of two measurement frequencies. Measurement points are saved in datasets (1 dataset = 1 TXT file in the device memory).

7.1 Start new dataset

- ▶ To create a new dataset before starting the measurement, click the **Save** icon and select **Start New Dataset**.

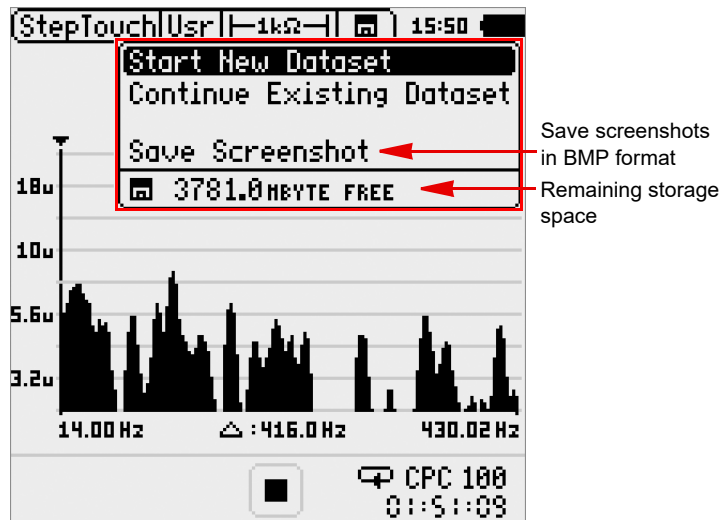


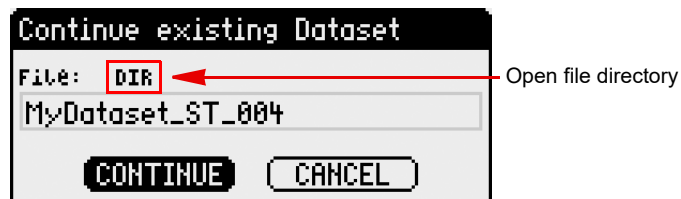
Figure 7-1: **Save** menu

- ▶ Change the suggested dataset name or search existing names and adjust them if necessary:





7.2 Continue existing dataset

- ▶ To continue a dataset, click **Continue Existing Dataset** in the **Save** menu. By default, the most recent dataset is displayed and can be opened by clicking **Continue**.
- ▶ To choose a different dataset, click **DIR**:




7.3 Saving data


- ▶ After opening a dataset, start recording step and touch voltages.
- ▶ Start a measurement point by pressing . Pressing  again will complete the measurement. This will prompt the **Save Data** window:



For each new measurement point, the measurement ID is automatically increased by 1.

- ▶ If you skip a measurement point or would like to use one ID several times, edit the ID by marking **EDIT** and pressing .

Note: If you use a measurement ID more than once, new results will *not* overwrite old results with the same ID (see Figure 7-2: "HGT1 measurement report" on page 24).

Alternatively, datasets can be opened *after* a measurement has been completed. In this case, the  icon indicates unsaved data:

- ▶ Mark the icon using the scroll wheel, press  and save the measurement by starting a new dataset or opening an existing one (see 7.1 "Start new dataset" on page 22 and 7.2 "Continue existing dataset" on page 22).

NOTICE

Loss of data

- ▶ Save every measurement point. Otherwise it will be overwritten by the next measurement you perform.

7.3.1 Close dataset

- ▶ Close a dataset by clicking the **Save** icon and selecting **Close Dataset**:



You can still save measurement points in any dataset by clicking the **Save** icon and selecting **Continue existing Dataset** (see Figure 7-1: "Save menu" on page 22).

7.4 Reports

The folder OMICRONHGT1:\Measurements\StepTouch contains the measured data in TXT and XL2 format, and the screenshots you made in the **Save** menu (see Figure 7-1: "Save menu" on page 22).

Note: This path is only available if the *HGT1* is connected in **USB mode**.

NOTICE

Loss or corruption of data

► The XL2 files saved on the *HGT1* are system files. Do not edit or move them.

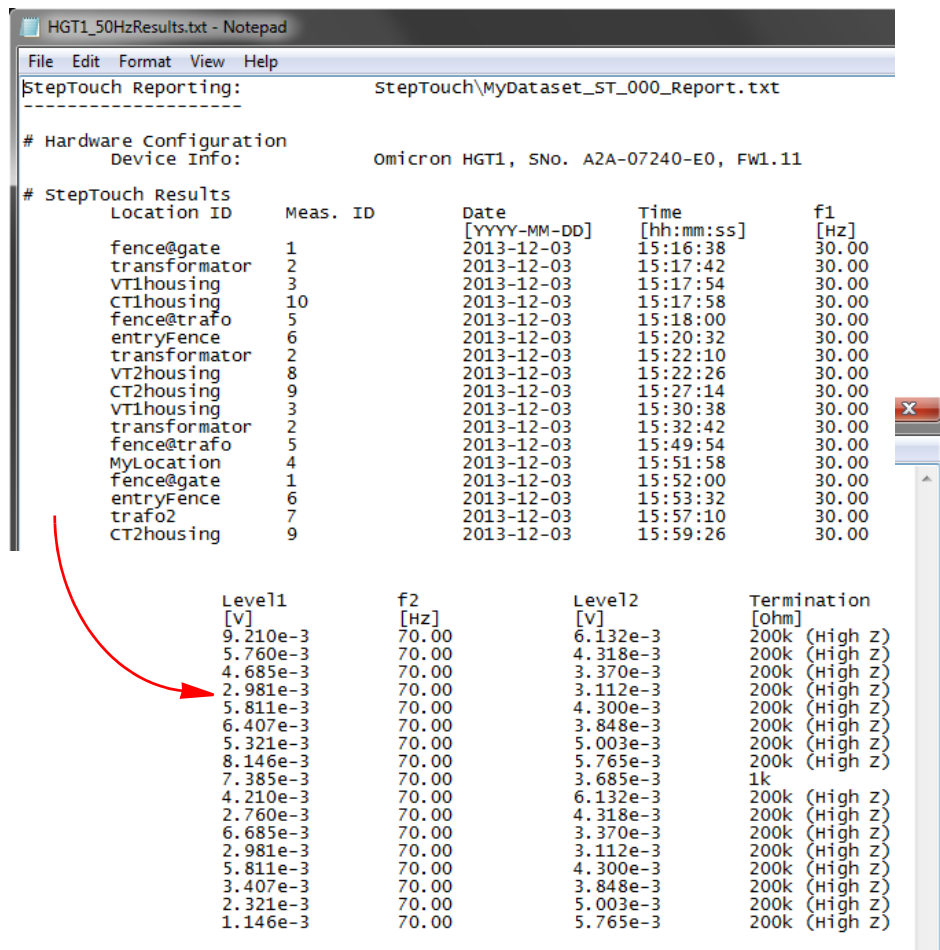


Figure 7-2: *HGT1* measurement report

► To create a Microsoft Excel report containing the data measured with the *HGT1*, use the Excel template "Step&Touch using HGT1.xlt" available on the **CPC Start Page**:

1. Load the "Step & Touch using HGT1" template on the **CPC Start Page**:
Grounding systems > StepTouch using HGT1 > StepTouch HGT1 20A50Hz > Open StepTouch using HGT1.xlt
2. Open a *CPC 100* result file.

3. Open a *HGT1* result file.
4. Click **Test Report** to generate the report.
5. Enter the **Current Reduction Factor r** and the **Maximum Fault Current**.

In the Excel report, the measurement points are arranged in ascending order, according their measurement ID. If there are several measurement points with the same ID, only the latest measurement point is included in the test report. In case a measurement ID has not been used for measuring, it will not be included in the report.

► Refer to the *CPC 100* and *CP CU1* manuals for further information on templates.

	A	B	C	D	E	F	G	H
1	Step & Touch using HGT1							
2	Template:		Step&Touch HGT1					
3	Version:		1.50					
4	Test Execution by:							
5	Omicron electronics GmbH							
6	Oberes Ried 1							
7	A-6833 Klaus							
8	Tel.: +43 59495 4444							
9	support@omicron.at							
10	Test Direction:							
11	Tom Tester							
12	Test Participation:							
13								
14								
15	Test Objects:							
16								
17								
18								
19								
20	Current Reduction Factor r (as specified in CENELEC HD637 or DIN VDE 0101)		1.00					
21	Test Information:							
22	Date of Measurement:							
23	CPC Result File:							
24	Comment:							
25								
26								
27								
28	Current Measurement:		Enter maximum fault current			30.0Hz	70.0Hz	
29	Output Current Measured:					30.03A	30.10A	
30	Maximum Fault Current:		Imported from HGT1					I_G
31								20000A
32	ID	Location	HGT1 Results		Calculated Touch Voltage			
33			30.0Hz	70.0Hz				
34	1	fence@gate	0.00581V	0.00430V	3.36V			
35	2	transformator	0.00276V	0.00432V	2.35V			
36	3	VT1housing	0.00421V	0.00613V	3.44V			
37	4	MyLocation	0.00298V	0.00311V	2.03V			
38	5	fence@trafo	0.00669V	0.00337V	3.34V			
39	6	entryFence	0.00341V	0.00385V	2.41V			
40	7	trafo2	0.00232V	0.00500V	2.44V			
41	8	VT2housing	0.00815V	0.00577V	4.63V			
42	9	CT2housing	0.00115V	0.00577V	2.30V			
43	10	CT1housing	0.00298V	0.00311V	2.03V			

Figure 7-3: "Step & Touch using HGT1" template

8 Step and touch voltage measurements

8.1 Measurements without *PTM* (stand-alone)

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Use a grounding set to ground the power line at the near end whenever you handle the measurement setup inside the danger zone (for example when changing connections at the *CP GB1* between measurement loops).

1. Follow the instructions in chapter 3 "Connecting the CP CU1 to a power line" of the CP CU1 User Manual in order to connect the *CP CU1* to the power line under test.
2. If criterion 3 is met, establish the measurement setup as shown in Figure 8-1 below.

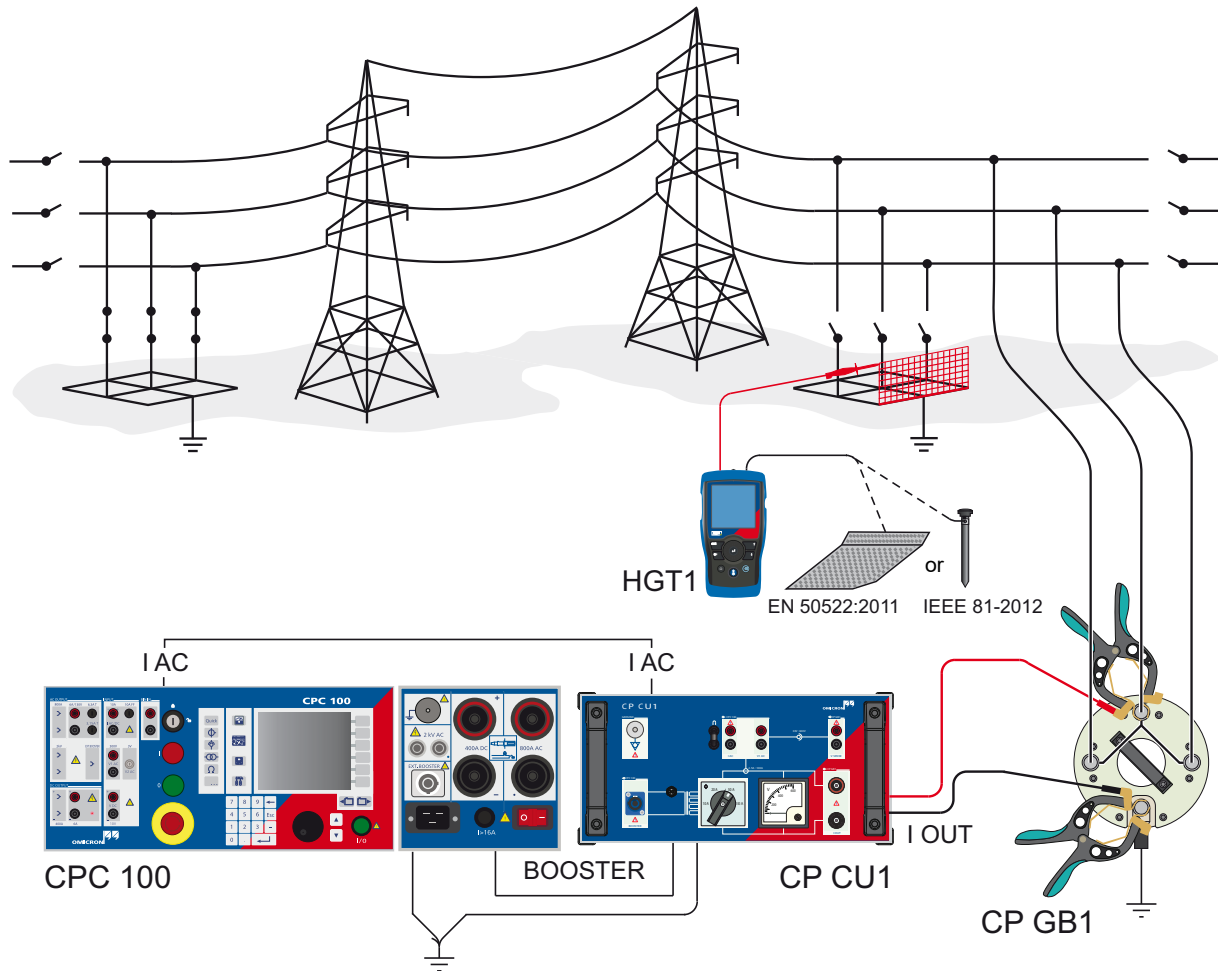


Figure 8-1: Step and touch voltage measurement setup

Note: In order to measure valid step and touch voltage values, the distance between the grounding system under test and the remote substation must be taken into account. IEEE 81 recommends a minimum distance of five times the maximum dimensions of the grounding system to avoid overlapping of the ground potential rise of both the grounding system and the current probe. EN 50522 recommends a minimum distance of 5 km, no matter the size of the grounding system. In general, the setup must represent worst case conditions, which could occur during a single line fault. This must be clarified for each individual grounding system.

3. When checking the fourth criterion, use the dedicated template on the *CPC 100* by following this path in the file operations view:

Templates > Grounding Systems > **Step&Touch using HGT1**

4. Choose the template matching the current range selected on the *CP CU1*.

The template contains the following test cards:

- **Connection** (comment test card, showing the necessary connections)
- **Output** (sequencer test card, used for the injection of the test current)
- **Version** (version check for Excel template)

Connection		Output		Version	
CU1 50A	<input type="checkbox"/>	<input type="checkbox"/>	SOOT	<input checked="" type="checkbox"/>	Repeat
A	Hz	Trigger	Thresh	s	
50.00	30.00	No Trigger	n/a	2.000	
50.00	70.00	No Trigger	n/a	2.000	
0.00	50.00	No Trigger	n/a	56.000	
CT sel	<input type="checkbox"/>	OFF	<input type="checkbox"/>	OFF	<input type="checkbox"/>
A	°				
Assessed:n/a					

Insert Card
 Delete Card
 Rename Card
 Clear Results
 Save As Default
 Settings

Figure 8-2: **Output** test card of the **Step&Touch using HGT1** template on the *CPC 100*

Figure 8-2 above shows settings in the **Output** test card of the **Step&Touch using HGT1** template. The sequence consists of 3 states, which are applied in an endless loop, since **Repeat** is activated in the test card:

- Injection of the test current at 30 Hz for 2 s (measuring touch voltage at a distinct location at 30 Hz)
- Injection of the test current at 70 Hz for 2 s (measuring touch voltage at a distinct location at 70 Hz)
- No injection for 56 s (to be able to move to the next measurement location in the substation)

In order to save time, the injection of the test current can also be remote-controlled by adapting the sequencer test card accordingly as shown in Figure 8-4 below. In the second column, additional measurement of voltage at the DC input is activated.

- **Optional:** Connect a walkie-talkie, which is used as a receiver, to the *CPC 100*'s VDC input, by using an adapter as shown in Figure 8-3 below.

HGT1 User Manual

Note: This is no accessory available from OMICRON!

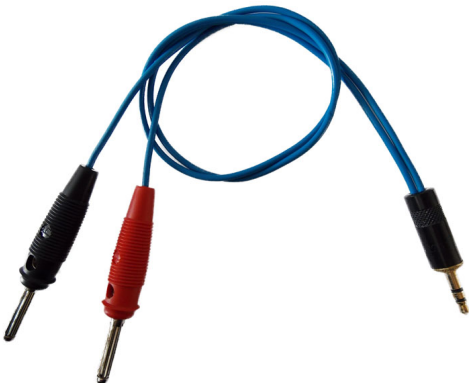


Figure 8-3: Adapter for the connection of a walkie-talkie to the *CPC 100*

- Plug the headphone jack into the walkie-talkie’s headphone socket and connect the banana plugs to the *CPC 100*’s VDC input.

In the example shown in Figure 8-4 below, the voltage at the headphone socket was about 1 V when pressing the talk button on the walkie-talkie that was used as a sender. Hence, a threshold level of 0.5 V is reasonable. By pressing the talk button on the sender walkie-talkie, the measurement sequence starts from the first state again and the voltage at a distinct location can be measured instantly, without waiting for state 3 of the **Output** test card to complete.

Connection		Output		Version		Up
U1 50A		<input type="checkbox"/> SOOT		<input checked="" type="checkbox"/> Repeat		
A	Hz	Trigger	Thresh	s		Enter
50.00	30.00	No Trigger	n/a	2.000		
50.00	70.00	No Trigger	n/a	2.000		Back to Top
0.00	50.00	V DC >0.5000...6000...				
CT sel		V DC		OFF		
A	°	V				
Assessed:n/a						

Figure 8-4: **Output** test card of the **Step&Touch using HGT1** template on the *CPC 100*, adapted for remote-controlled current injection

EN 50522 and IEEE 81 consider different ways of testing step and touch voltage. Table 8-1 below illustrates the differences.

Table 8-1: Step and touch measurements according to EN 50522 and IEEE 81

Standard	Measurement	Ground electrode	Input imped.
EN 50522:2011	Touch voltage	20 cm X 20 cm metal plate loaded with min. 50 kg, 1 m apart from grounded structure. Wetten the soil underneath the plate.	1 kΩ ¹
	Step voltage	This standard assumes that the limits for step voltage are much higher than for touch voltage. Therefore, step voltage measurements are considered obsolete.	-
IEEE 81-2012	Touch voltage	Rod (6 mm diameter) driven 150 mm into moist subsoil, 1 m apart from grounded structure.	High Z
	Step voltage	Two rods (6 mm diameter) each driven 150 mm into moist subsoil, 1 m apart from each other.	High Z

1. This standard also proposes to consider additional resistances for the assessment of the measurement, which requires a high ohmic input impedance.

As an example, Figure 8-5 below shows the touch voltage measurement according to EN 50522.

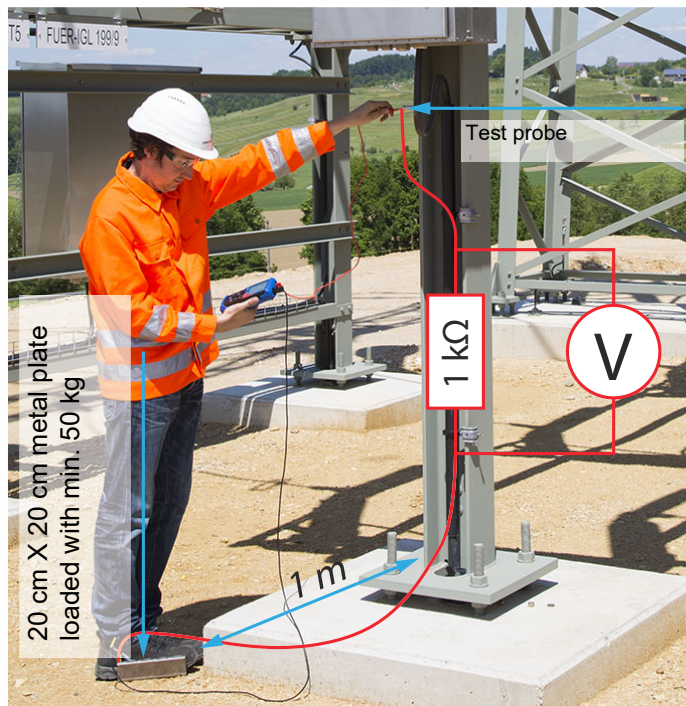


Figure 8-5: Touch voltage measurement according to EN 50522

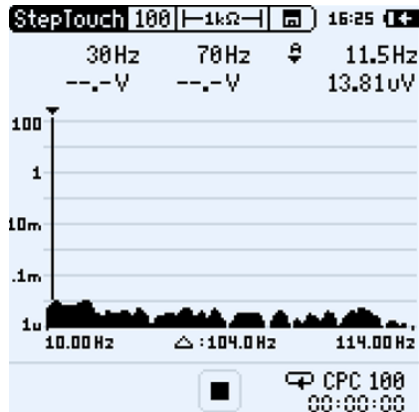


Figure 8-6: HGT1 settings according to EN 50522

Figure 8-6 shows the settings to be considered when measuring step and touch voltage with the *HGT1*: The 100 Hz range (10 – 114 Hz) is recommended, since frequencies higher than 100 Hz are not important for the measurement.

In the above example, 1 kΩ is selected as input impedance according to the EN 50522 recommendation for touch voltage measurements.

- ▶ If required, select an alternative setting, for example **High Z**, in order to measure the prospective touch voltage.

Note: The **High Z** setting is needed for measurements according to IEEE 81.

- ▶ Check if the two settings for the detection frequency equal the frequency of the injected current.
- ▶ Refer to the chapter 5.1 "Frequency range selection" on page 17 for information on how to adapt the frequency.

Now the step and touch voltage at distinct locations can be measured according to Figure 8-5: on page 29. The automatic detection of step and touch voltages requires the following workflow in order to avoid a faulty measurement:

5. Depending on the standard you follow, connect the metal plate (EN 50522) or the ground rod (IEEE 81) to the *HGT1*, using the black banana cable.
6. Connect the probe to the *HGT1*, using the red banana cable.

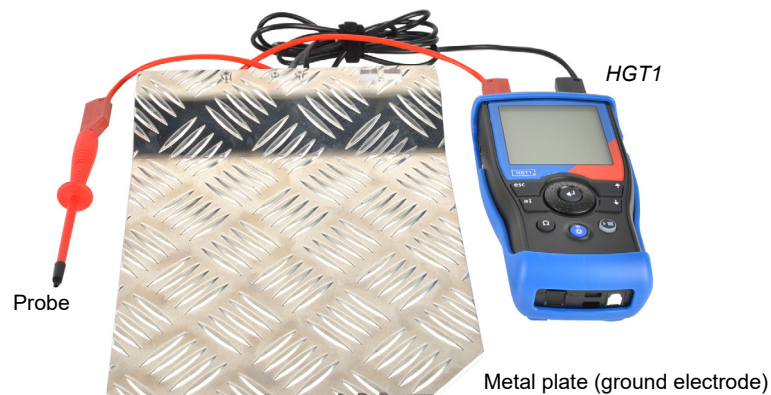


Figure 8-7: *HGT1* hardware setup according to EN 50522

Step and touch voltage measurements

7. Start the current injection loop by pressing the **I/O** button on the front panel of the *CPC 100*.
8. a) If you measure according to EN 50522, place the metal plate on the ground and step on it.
b) If you measure according to IEEE 81, drive the ground rod approximately 150 mm into the ground, one meter away from the object under test.
9. Connect the probe to the object under test.

Note: It is important to establish a good contact to the object. This could sometimes be cumbersome if the object is painted with an insulating layer. One option is to remove the layer with a file. The *HGT1*'s filter adapts to the connected impedance. The adaption results in a temporary increase of the voltage over the entire frequency spectrum. Hence, by starting the measurement BEFORE the probe is connected to the object, faulty values could be measured, since the values during adaption of the filter could be higher than the values actually caused by the injected current.

10. Start the measurement on the *HGT1*.

Note: Make sure that the filter is only being adapted once in the duration of the measurement. A deteriorated probe could cause connection problems, resulting in several adaptations of the filter during the measurement. By using a proper, pointed probe, this problem can be avoided.

11. Either trigger the *CPC 100*'s next current injection with the walkie-talkie as described before or wait for the next current injection loop to begin.

Current is injected for 2 seconds at 30 Hz and 70 Hz respectively. The highest measured value is kept by the *HGT1* for every frequency.

Note: If the mains frequency is 60 Hz, the current is injected at 40 Hz and 80 Hz respectively.

12. Stop the measurement on the *HGT1* as soon as the highest value has been detected at 70 Hz.
13. Remove the probe from the object under test.
14. Save the measurement point on the *HGT1*.
15. Move to the next location and repeat steps 8 to 14.
16. After all tests have been performed, open the *CPC 100* file (xml-file) and the txt-file from the *HGT1* with the corresponding Excel template (Step&Touch using HGT1.xlt) from the *CPC 100* Start Page in the section **Test Templates**. Check the test results carefully. The cell comments in the test report sheet help you to assess the test results.

HGT1 User Manual

Maximum Fault Duration:				300 ms		
Additionally considered resistance:				0 Ω		
Permissible Touch Voltage:				416 V		
Required Input Impedance during measurement:				1 k		
Reduction Factor of Test Current:				1,00		
Frequency of Test Current:				30,0 Hz	70,0 Hz	
Amplitude of Test Current at corresponding Frequency:				30 A	30 A	
Maximum Current to Earth:				10000 A		
ID	Location	Impedance Selection	HGT1 Results / V		Calculated Touch Voltage / V	Assessment
			30,0 Hz	70,0 Hz		
1	fence@gate	1 k	0,00581V	0,00430V	1,68V	OK
2	transformer	1 k	0,00276V	0,00432V	1,18V	OK
3	VT1housing	1 k	0,00421V	0,00613V	1,72V	OK
4	MyLocation	1 k	0,00298V	0,00311V	1,01V	OK
5	fence@trafo	1 k	0,00669V	0,00337V	1,67V	OK
6	entryFence	1 k	0,00341V	0,00385V	1,21V	OK
7	trafo2	1 k	0,00232V	0,00500V	1,22V	OK
8	VT2housing	1 k	0,00815V	0,00577V	2,31V	OK
9	CT2housing	1 k	0,00115V	0,00577V	1,15V	OK
10	CT1housing	1 k	0,00298V	0,00311V	1,01V	OK

Figure 8-8: Step and touch (using *HGT1*) Excel template (with the EN 50522 tab active)

8.2 Measurements with *PTM* (using a Windows tablet)

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Use a grounding set to ground the power line at the near end whenever you handle the measurement setup inside the danger zone (for example when changing connections at the *CP GB1* between measurement loops).

1. Follow the instructions in chapter 3 "Connecting the CP CU1 to a power line" of the CP CU1 User Manual in order to connect the *CP CU1* to the power line under test.
2. If criterion 3 is met, establish the measurement setup as shown in Figure 8-9 below.

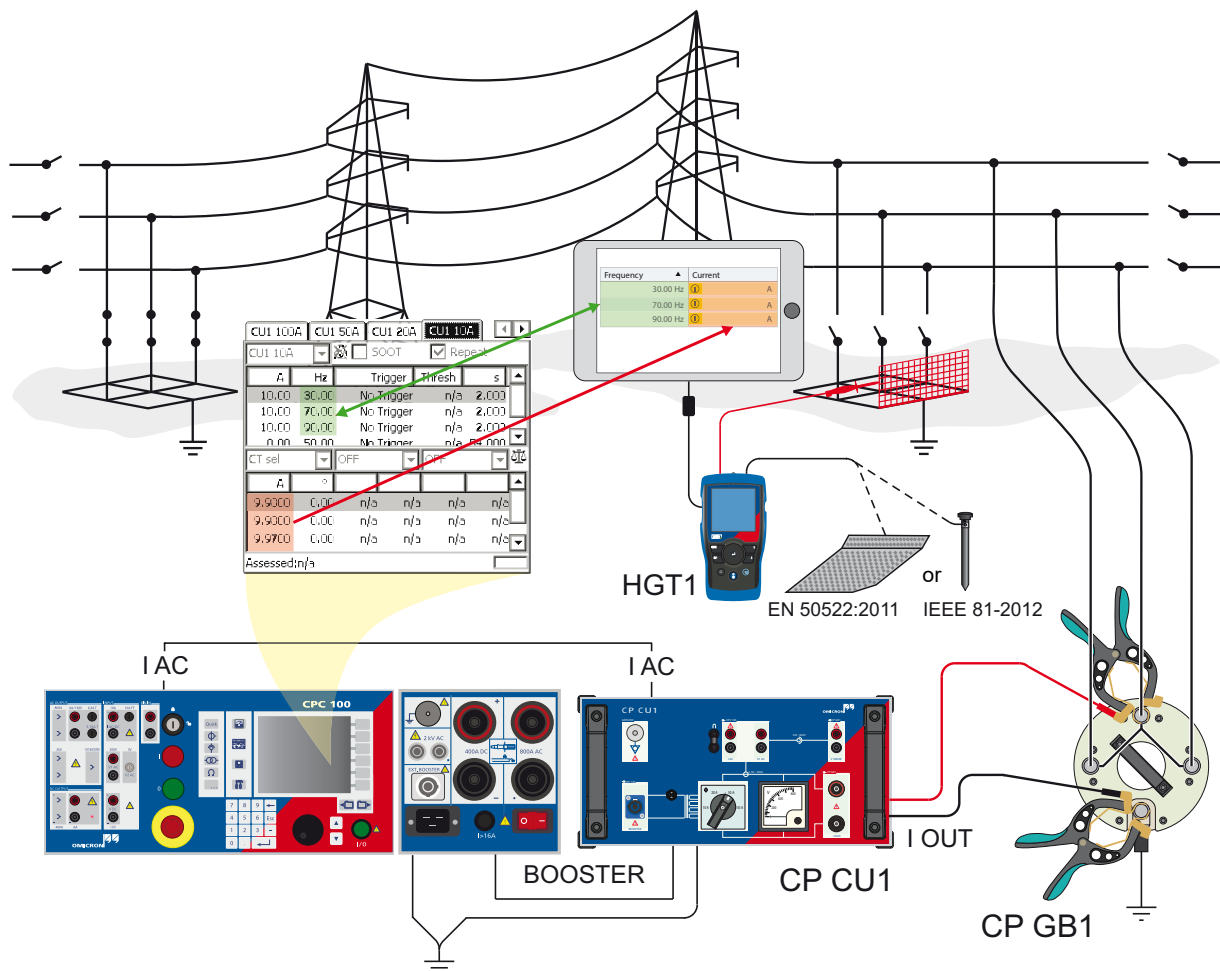


Figure 8-9: Step and touch voltage measurement setup when using *PTM* on a tablet

Note: In order to measure valid step and touch voltage values, the distance between the grounding system under test and the remote substation must be taken into account. IEEE 81 recommends a minimum distance of five times the maximum dimensions of the grounding system to avoid overlapping of the ground potential rise of both the grounding system and the current probe. EN 50522 recommends

a minimum distance of 5 km, no matter the size of the grounding system. In general, the setup must represent worst case conditions, which could occur during a single line fault. This must be clarified for each individual grounding system.

3. When checking the fourth criterion, use the dedicated template on the *CPC 100* by following this path in the file operations view:

Templates > Grounding Systems > **PTM**

4. Open the file corresponding to your power frequency and navigate to the test card matching the current range selected on the *CP CU1*.

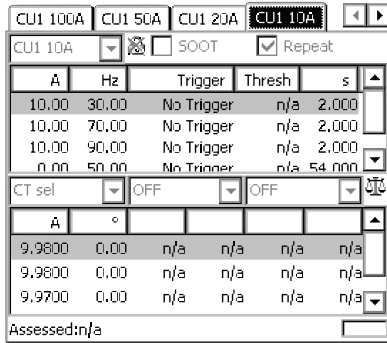


Figure 8-10: **CU1 10** test card of the **PTM** template on the *CPC 100*

Figure 8-10 above shows settings in the **CU1 10** test card of the **PTM** template. The sequence consists of 4 states, which are applied in an endless loop, since **Repeat** is activated in the test card:

- Injection of the test current at 30 Hz for 2 s (measuring touch voltage at a distinct location at 30 Hz)
- Injection of the test current at 70 Hz for 2 s (measuring touch voltage at a distinct location at 70 Hz)
- Injection of the test current at 90 Hz for 2 s (measuring touch voltage at a distinct location at 90 Hz)
- No injection for 54 s (to be able to move to the next measurement location in the substation)

5. Start the injection by pressing the I/O button on the *CPC 100*.

6. Start **PTM** on the tablet and enter the *CPC 100*'s current readings for each defined frequency under **Settings and Conditions**. Also verify that the frequency selections in the sequencer test card and under **Settings and conditions** match.

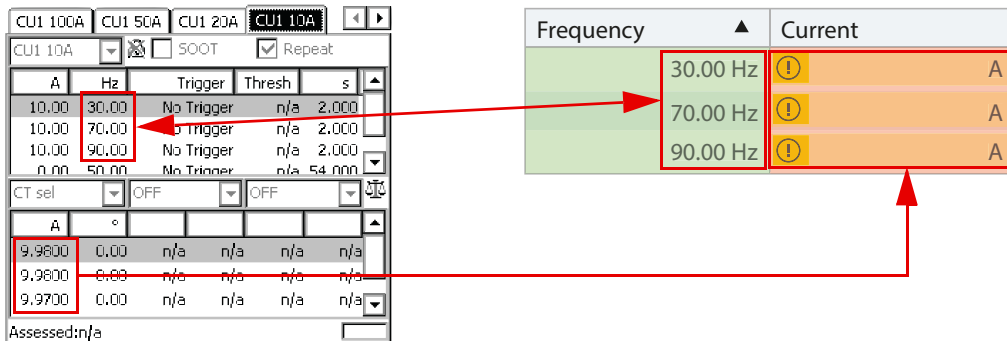


Figure 8-11: Enter the current readings under the **Settings and Conditions** section in **PTM**

EN 50522 and IEEE 81 consider different ways of testing step and touch voltage. Table 8-2 below illustrates the differences.

Table 8-2: Step and touch measurements according to EN 50522 and IEEE 81

Standard	Measurement	Ground electrode	Input imped.
EN 50522:2011	Touch voltage	20 cm X 20 cm metal plate loaded with min. 50 kg, 1 m apart from grounded structure. Wetten the soil underneath the plate.	1 kΩ ¹
	Step voltage	This standard assumes that the limits for step voltage are much higher than for touch voltage. Therefore, step voltage measurements are considered obsolete.	-
IEEE 81-2012	Touch voltage	Rod (6 mm diameter) driven 150 mm into moist subsoil, 1 m apart from grounded structure.	High Z
	Step voltage	Two rods (6 mm diameter) each driven 150 mm into moist subsoil, 1 m apart from each other.	High Z

1. This standard also proposes to consider additional resistances for the assessment of the measurement, which requires a high ohmic input impedance.

As an example, Figure 8-12 below shows the touch voltage measurement according to IEEE 81.



Figure 8-12: Touch voltage measurement with *PTM* (tablet) according to IEEE 81

7. Set the *HGT1*'s **USB mode** to **COM port** to enable communication with the tablet running *PTM*. (Refer to 5.1 "System Settings" on page 16 for more information on how to change the **USB mode**).
8. Connect the *HGT1* to the tablet using the *HGT1*'s USB connector and the delivered USB cable.

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Never connect the *HGT1* to the tablet without using the provided USB isolator.

As soon as the *HGT1* is recognized by *PTM*, it is locked and cannot be operated via its buttons any longer.

Now the step and touch voltage at distinct locations can be measured according to Figure 8-12: on page 35. The automatic detection of step and touch voltages requires the following workflow in order to avoid a faulty measurement:

9. Depending on the standard you follow, connect the metal plate (EN 50522) or the ground rod (IEEE 81) to the *HGT1*, using the black banana cable.
10. Connect the probe to the *HGT1*, using the red banana cable.



Figure 8-13: *HGT1* hardware setup according to EN 50522

11. Start the current injection loop by pressing the **I/O** button on the front panel of the *CPC 100*.
12. a) If you measure according to EN 50522, place the metal plate on the ground and step on it.
b) If you measure according to IEEE 81, drive the ground rod approximately 150 mm into the ground, one meter away from the object under test.
13. Connect the probe to the object under test.

Note: It is important to establish a good contact to the object. This could sometimes be cumbersome if the object is painted with an insulating layer. One option is to remove the layer with a file. The *HGT1*'s filter adapts to the connected impedance. The adaption results in a temporary increase of the voltage over the entire frequency spectrum. Hence, by starting the measurement **BEFORE** the probe is connected to the object, faulty values could be measured, since the values during adaption of the filter could be higher than the values actually caused by the injected current.

14. Start the measurement in *PTM* section **Measurement**.
15. After the measurement is finished, move to the next location and take measurements whenever test current is injected.

9 Ground impedance measurements with PTM

WARNING



Death or severe injury caused by high voltage or current possible

- ▶ Use a grounding set to ground the power line at the near end whenever you handle the measurement setup inside the danger zone (for example when changing connections at the *CP GB1* between measurement loops).

1. Follow the instructions in chapter 3 "Connecting the CP CU1 to a power line" of the CP CU1 User Manual in order to connect the *CP CU1* to the power line under test.
2. If criterion 3 is met, establish the measurement setup as shown in Figure 9-1 below.

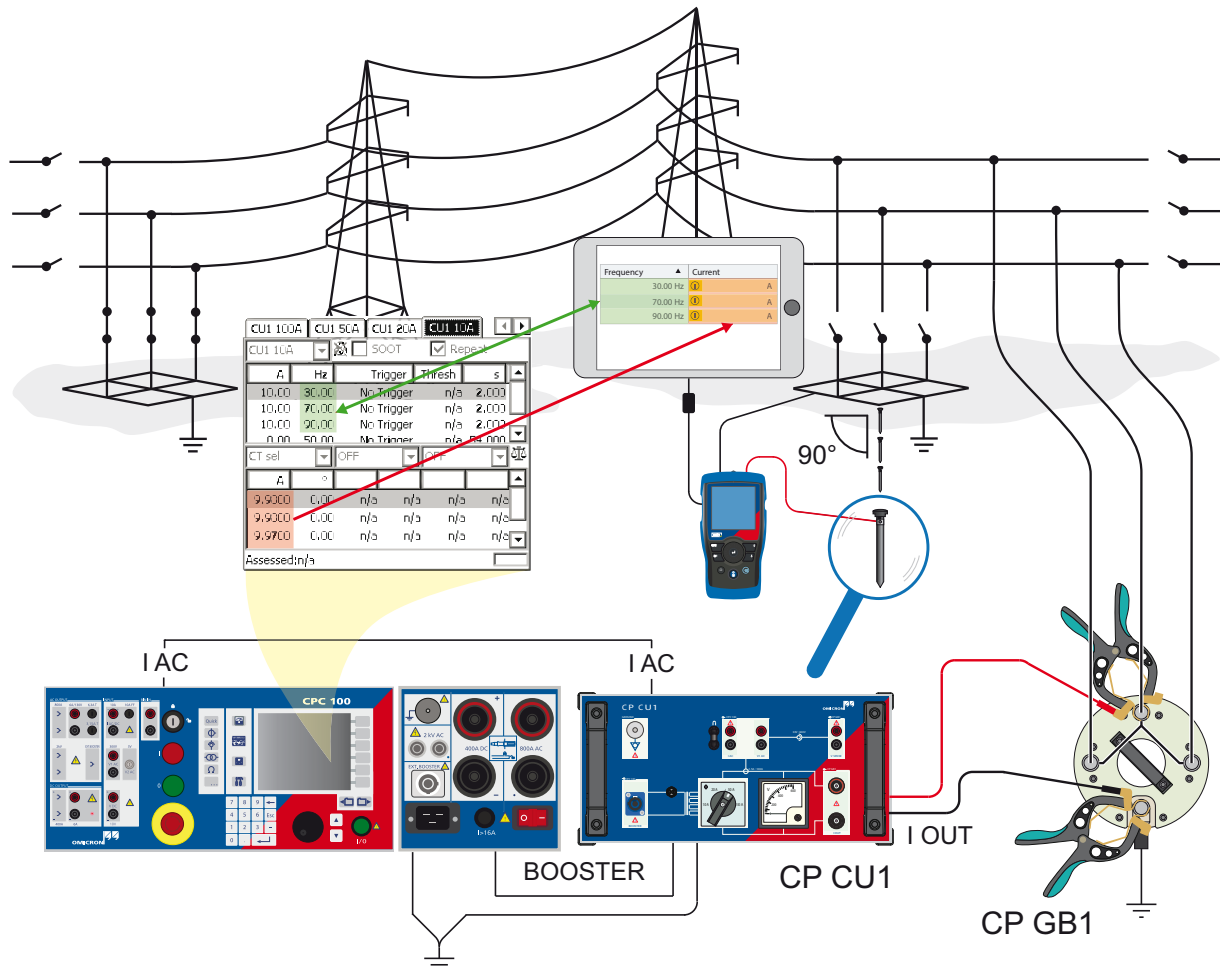


Figure 9-1: Ground impedance measurement setup when using PTM on a tablet

Note: In order to measure valid ground impedance values, the distance between the grounding system under test and the remote substation must be taken into account. IEEE 81 recommends a minimum distance of five times the maximum dimensions of the grounding system to avoid overlapping of the ground potential rise of both the grounding system and the current probe. EN 50522 recommends a distance of minimum 5 km, no matter the size of the grounding system.

In general, the setup must represent worst case conditions, which could occur during a single line fault. This must be clarified for each individual grounding system.

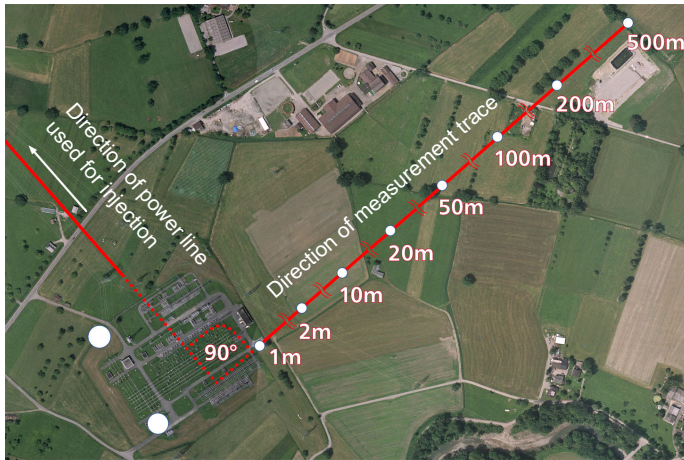


Figure 9-2: Direction of measurement trace

According to EN 50522 and IEEE 81 the angle between the line which is used for injection and the measurement trace must be 90° in order to avoid coupling effects, which might disturb the measurement. In cases this is not possible due to topographical or man-made obstacles in the surroundings of the substation, an angle of at least 60° should be maintained.

The measurement trace is realized by the use of ground rods that are placed at certain distances from the grounding system. The following distances can be taken as a guideline: 1 m, 2 m, 5 m, 10 m, 20 m, 50 m, 100 m, 150 m, 200 m, then increase in increments of 100 m.

3. When checking the fourth criterion, use the dedicated template on the *CPC 100* by following this path in the file operations view:

Templates > Grounding Systems > **PTM**

4. Open the file corresponding to your power frequency and navigate to the test card matching the current range selected on the *CP CU1*.

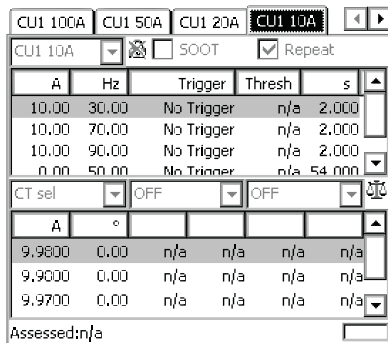


Figure 9-3: **CU1 10** test card of the **PTM** template on the *CPC 100*

Figure 9-3 shows settings in the **CU1 10** test card of the **PTM** template. The sequence consists of 4 states, which are applied in an endless loop, since **Repeat** is activated in the test card:

- Injection of the test current at 30 Hz for 2 s (measuring touch voltage at a distinct location at 30 Hz)
 - Injection of the test current at 70 Hz for 2 s (measuring touch voltage at a distinct location at 70 Hz)
 - Injection of the test current at 90 Hz for 2 s (measuring touch voltage at a distinct location at 90 Hz)
 - No injection for 54 s (to be able to move to the next measurement location in the substation)
5. Start the injection by pressing the I/O button on the *CPC 100*.
 6. Start *PTM* on the tablet and enter the *CPC 100*'s current readings for each defined frequency under **Settings and Conditions**. Also verify that the frequency selections in the sequencer test card and under **Settings and conditions** match.

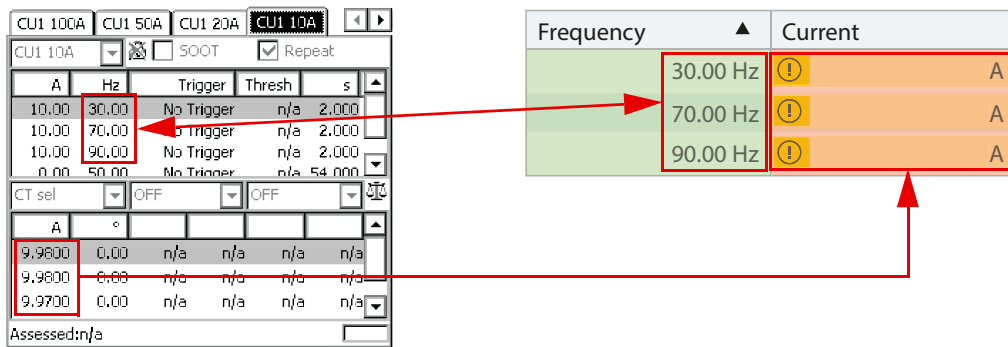


Figure 9-4: Enter the current readings under the **Settings and Conditions** section in *PTM*

7. Set the *HGT1*'s **USB mode** to **COM port** to enable communication with the tablet running *PTM*. (Refer to 5.1 "System Settings" on page 16 for more information on how to change the **USB mode**).
8. Connect the *HGT1* to the tablet using the *HGT1*'s USB connector and the delivered USB cable.

WARNING



Death or severe injury caused by high voltage or current possible
 ► Never connect the *HGT1* to the tablet without using the provided USB isolator.

As soon as the *HGT1* is recognized by *PTM*, it is locked and cannot be operated via its buttons any longer.

9. Follow the examples in Figure 9-2 and Figure 9-1: on page 37, by connecting the black input of the *HGT1* with any grounded part in the substation and the red input with the rod, which is used as test electrode.

WARNING



Death or severe injury caused by high voltage or current possible
 In case of a fault, high voltage can occur at the far end of the measurement cable.
 ► It is recommended to unplug the test lead to the ground rod right at the *HGT1*'s red input if no measurement is performed and the field crew moves to the next location. This is to avoid transferring potential to the remote end of the test lead in the event of a fault in the substation.

10. Place the ground rod at the distance from the grounding system you want to start the measurement from. In the present example this would be 1 m.

CAUTION



Minor or moderate injury caused by tripping on the measurement cable possible

- ▶ If the measurement cable crosses obstacles like roads or walkways, make sure to warn approaching persons about the cable to prevent accidents caused by tripping.

11. Press the **I/O** button on the front panel of the *CPC 100* to start the first injection cycle.
12. Start the measurement in *PTM* section **Measurement**.
13. After the measurement is finished, move to the next location (for example 2 m) and start the next injection cycle and take measurements in *PTM* section **Measurement**.
14. Repeat the previous step until the ground impedance is not changing anymore and the flat part of the profile is reached.

According to EN 50522, the step and touch voltage measurement can be skipped if the ground potential rise is smaller than the permissible touch voltage multiplied by two. This value is also indicated in the template, as shown above. IEEE 80 does not mention any limit for ground potential rise or ground impedance.

10 Technical data

Table 10-1: *HGT1* input

Input impedance selection	Input impedance	Voltage	Accuracy (15 Hz ... 20 kHz)	Residual noise (100 Hz mode)
1 k Ω	1 k Ω	25 V _{RMS}	+0.5 %; -1.0 %	< 10 μ V
1 k Ω + 1 k Ω	2 k Ω	50 V _{RMS}	+0.5 %; -1.0 %	
HIGH Z	200 k Ω	25 V _{RMS}	+0.5 %; -1.0 %	

FFT specifications

The *HGT1* uses zoom FFT with the following parameters:

- FFT size: 512 samples
- FFT resolution: 142 bins
- FFT repetition rate: 187,5 Hz (one FFT per 5.3 ms).
The results of the FFT shown on the *HGT1*'s screen are updated every 50 ms by averaging the individual FFT results.

Table 10-2: FFT parameters for 100 Hz and 400 Hz frequency range selection

Frequency range selection	100 Hz	400 Hz
Frequency range	104 Hz	414 Hz
Frequency resolution	0.73 Hz	2.92 Hz
Window size	1.37 s	342 ms
Overlapping	99.6 %	98.4 %

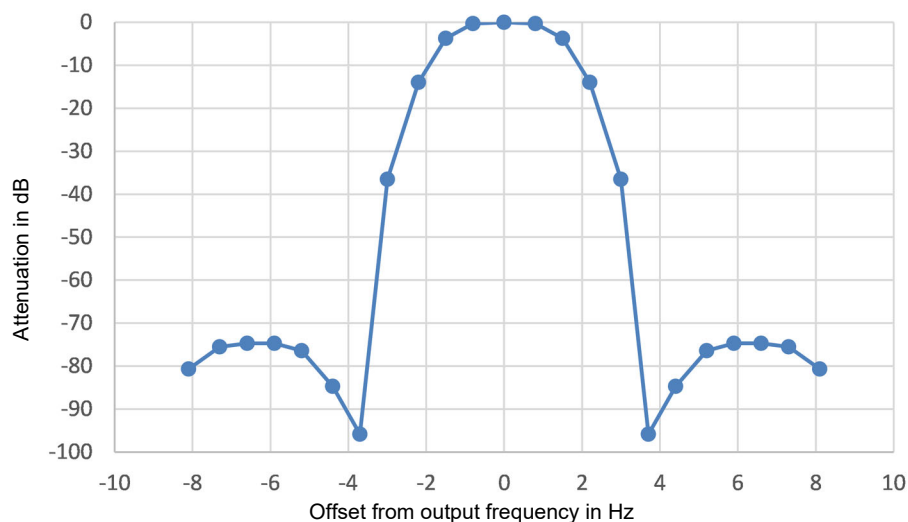


Figure 10-1: Filter selectivity for 100 Hz range

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Table 10-3: Environmental conditions

Characteristic	Rating
Temperature	-10 °C (14 °F) ... +50 °C (122 °F)
Humidity	5 % to 90 % RH, non-condensing

Table 10-4: Mechanical data

Characteristic	Rating
Dimensions (L x W x H)	180 x 90 x 45 mm / 7.1 x 3.5 x 1.8 inch
Weight	480 g (1 lb) including Li-Po battery

10.1 CE declaration of conformity



We, the manufacturer

NTi Audio AG
Im alten Riet 102
9494 Schaan
Liechtenstein, Europe

do hereby declare that the *HGT1*, released in 2013, complies with the following standards or other standard documents:

- EMC: 2004/108/EG
- Harmonized standards: EN 61326-1
- Explosive atmospheres (ATEX): 94/9/EG
- Directive 2011/65/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).
- Directive 2002/96/EC on waste electrical and electronic equipment (WEEE).

This declaration will become invalid if modifications to the instrument are carried out without the written approval of NTi Audio.

Date: 1. February 2013

Signature: 

Position: Technical Director

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