SCHLÖDER
EMV-Systeme & Komponenten

Operation Manual

MGA 1033

MAGNETIC FIELD GENERATOR
MAGNETIC FIELD ANALYZER

Distributed by: Reliant EMC LLC, 3311 Lewis Ave, Signal Hill CA 90755, 408-916-5750, www.reliantemc.com

Table of Contents

Important Safety Instructions

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of this instrument.
We assume no liability for the customer´s failure to comply with these requirements.

Before applying power:

- Verify that the product is set to match the available line voltage and that the correct fuse is installed.

Ground the instrument:

- This product is a Safety Class 1 Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited.

Do not remove instrument covers:

- Operating personnel must not remove instrument covers. There are no user serviceable parts inside. Refer servicing to qualified personnel.

The MGA 1033 shall be operated by qualified personnel only.
Extensive knowledge of Basic and Product Standards is mandatory.

Accessories Supplied with the MGA 1033

- This manual
- Power cord
- USB cable
- Application CD

Conception

Your MGA 1033 is a compact apparatus for generation and measurement of magnetic fields in a wide frequency range. It includes a signal generator, a precision power amplifier and a spectrum analyzer in one compact unit. All functional units allow the use as stand-alone devices.

Your MGA 1033 is a computer-based instrument which can be operated via a personal computer or notebook using the operating system Microsoft Windows® NT/2000/XP/Win8 /10. The powerful but easy to operate software is fully expandable for future standard modifications.

Please take the time to study this manual to obtain the best performance from your apparatus.

Features:

- Generator/analyzer for all magnetic field requirements of relevant EMC and military standards.
- Prepared for fully automated test with triaxial tapped Helmholtz coil. Software controlled generation of magnetic field in x-, y- and z-direction; no need to turn the EUT!
- Prepared for connection of external multimeter for EUT control.
- Upgradeable with different power amplifiers.
- Open system concept for easy customized solutions for various test and measurement requirements.
- Advanced protection circuitry guards against shorted outputs and overheating.
- Continuously variable and silent fans optimize cooling efficiency.

Hardware- and Software Requirements

You should have the following hardware and software to work with your MGA 1033:

- PC with Microsoft Windows® NT/2000/XP/Vista operating system, compatible mouse, VGA graphics (min. 1024 x 768 pts.) and USB 2.0 interface.

Installation of MGA 1033 Application Software

- All running applications on your PC must be closed.
- Insert the provided CD into your CD-ROM drive.
- Run **setup.exe** and follow the instructions on your screen.
- The installer creates a directory named **MGA** where you can double-click on **mga.exe** to start the application.
- At the first start of this application, several files need to be copied from the application CD into the installation directory. Please make sure you have the application CD and sufficient rights to copy and create files in this directory.

Remove and Update the MGA 1033 Application Software

- In order to update the program, it is necessary to remove the installed version. All files need to be removed and the directory (e.g. **C:\Program files\MGA**) should be deleted. *Therefore all user created data should be backed up beforehand*.
- All running applications must be closed including MGA 1033 application software.
- Back-up your data!! A software update installs new files which will overwrite any changes in the calibration and standard files! To keep your changes, all files altered after the last installation need to be saved! See **Directory structure** below to locate these files.
- Choose Start->Settings->System control->Software and click on MGA. Select **remove** and follow the instructions on your screen.
- Delete your directory where the software was installed (usually **C:\Program files\MGA**.
- Insert your new application CD into your CD-ROM drive and run **setup.exe**. The routine will create a new directory and install all necessary files.
- Optional: Copy your backup files into the corresponding directories. See **Directory structure** for further information.

Directory Structure

Your MGA1033 application creates a directory structure which should not be changed. To find your user-created and altered files, here is a brief description of the directory:

MGA1033	Main directory (usually C:\Program files\MGA)
○ **CAL**	Calibration data for MGA 1033
○ **COILS**	Calibration data: radiating coils (**RLCAL** files) and loop sensors (**LSCAL** files)
○ **DOC**	Test protocols which are created during tests and measurements and PRN files (See chapter 5.5 for further information)
○ **DATA**	Default directory for saving measured data
○ **STD**	Directory with predefined standards. User-defined standards are save in this directory as well. Filename extension are **GSTD** (generation standard for immunity tests) and **MSTD** (measurement standard for radiation tests).Further file extensions are **416STD**, **CE101STD**, **CS101STD**, **CS109STD** and **43STD**.

Front Panel Features

[1]: **POWER switch** Turns the MGA 1033 on and off.
READY LED (green) Indicates ready for operation (approx. 5 sec after power on).

[2]: **PROTECTION LED (r**ed)

LED shines continuously: Thermal overload of the power amplifier.
Cooling down resets the amplifier automatically.

LED flashes slowly (~1/sec): Overload of the power amplifier.
Device has to be switched off and on again for reset.
Between off and on you should wait for at least 10 sec.

LED flashes fast (~3/sec): Defective hardware.
The device has to be sent to factory for repair.

The MGA 1033 is prepared for operation with tapped triaxial Helmholtz coils, i.e. the amplifier output may be switched to 6 different sets of output jacks.
A single radiating loop or standard Helmholtz coil is always connected to output X-Coil

[3]: **X-OUTPUT 1 / OUTPUT 2**
Amplifier output jacks for magnetic field immunity tests.
For connection of radiating loop or Helmholtz coil [X-OUTPUT 1].
In case of coils with two separate windings use both pairs [X-OUTPUT 1] and [X-OUTPUT 2].
The shining LED indicates that the corresponding relay has been switched.

[4]: **Y-OUTPUT 1 / OUTPUT 2** Set of output jacks for Y-Coil
(For use with triaxial Helmholtz coils only)

[5]: **Z-OUTPUT 1 / OUTPUT 2** Set of output jacks for Z-Coil.
(For use with triaxial Helmholtz coils only)

[6]: **Output 50 Ohm** Amplifier output jack,
only for applications with 50 Ohm impedance

[7]: **SHUNT** Input jacks for external current measurement

[8]: **LOOP SENSOR** XLR-Input jack for loop sensor. For user-defined plugs

the pin configuration is shown here:
1: shield 2: + 3: -

[9]: **Earth terminal** System earth Back Panel Features

[10]: **Power cord connector**
Input for the line power source

[11]: **Line fuse**
Replace only with a fuse of the same rating. See the label on rear pan

[12]: **USB**
USB interface for data communication. An established connection to a computer is shown by
the USB READY LED below the USB plug.

[13]: **MULTIMETER**
RS-232 jack for connection of external measuring device (e.g. multimeter) for EUT control.

[14]: **EXTERNAL INPUT**
Input jacks for external amplifier or transformer.

[15]: **AMP IN**
Amplifier input. This input is connected to generator out [16] (default).

[16]: **GENERATOR OUT 1**
Generator output. This output is connected to amplifier input [15] (default).

[17]: **GENERATOR OUT 2**
Same as [16], but no standard connection.

[18]: **TRIGGER IN**
CMOS/TTL input level

[19]: **EUT FAIL IN**
CMOS/TTL input level

3.0 Operation 1: Magnetic Field Measurements and Tests

This chapter deals with the capability of your MGA 1033 to measure and generate magnetic fields. It has an internal generator which is connected to the internal amplifier via [15] and [16]. The output signal of the amplifier can be used at the 50 Ohms output [6] at the front panel or at the coil socket [3],[4] and [5].
In chapter 3.1 the main controls are described.

How to measure magnetic field strength and compare it with values defined in various EMC standards is explained in chapter 3.2. The main program allows also the creation of user-defined standards.

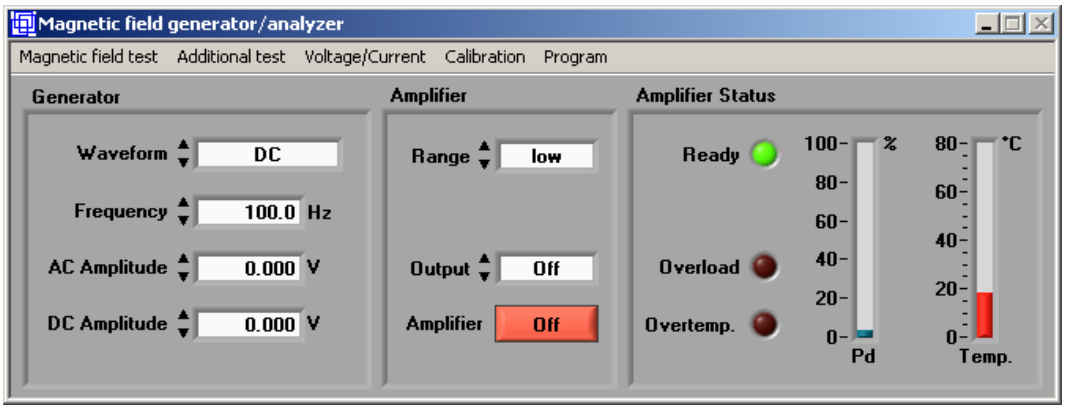
In chapter 3.3 the generation of magnetic fields using your MGA 1033 is shown. Software modules allow you to generate magnetic fields in any radiating loop, e.g. a Helmholtz coil, with up to three axes. Functions to use your apparatus for short term and continuous magnetic field are also available.

Before the start of the application software please make sure that the following steps are prepared:

- Connect the power cord at [10] to the AC-line.
- Connect the USB cable at [12] to your computer.
- Connect the loop sensor to input jack [8].
- Connect radiating loop or Helmholtz coil to output [3].
- Switch on your MGA 1033.
- Wait until the Ready LED [1] shines which takes approx. 5 sec.
- Double-click on **mga.exe** (Directory **MGA**).

3.1 Generator/Amplifier Control Panel

The following window is displayed showing the main control panel for setting the generator and controlling the amplifier. In this manual it is often called the **main window**:



Main window

Generator Settings

- Choose the **Signal**: either a **sine wave** or **square wave** can be generated.
- Choose the **Frequency** between 0.1 Hz and 250 kHz; the resolution is 0.1 Hz.
- Choose an **AC Amplitude** from 0 V to 10 V. The resolution is 1 mV at less than 1 V. Otherwise it is 2.5 mV.
- Choose a **DC Amplitude** from 0 V to 10 V; resolution is 2.5 mV.

Amplifier Controls and Status

- Switch the amplifier between low and high **Range**.
a: Choose **low** (low supply voltage) for low impedance loads
b: Choose **high** (high supply voltage) for high impedance loads
- Choose the required **Output** path (Off, X1, X2, Y1, Y2, Z1, Z2).
Output sockets [3], [4] and [5].
- Switch the **Amplifier** either **On** or **Off**.
- **Ready**: indicates amplifier is ready for operation (on=ready)
- **Overload**: indicates overload of the power amplifier - dissipation loss too high.
Device has to be switched off and on again for reset. Wait for at least 10 sec after switching off.
- **Overtemp.**: thermal overload of the power amplifier. Overtemperature is reached at 70°C. Cooling down resets the amplifier at 59°C automatically.
- Bar graph indicates dissipation loss **Pd** (integration time is 100 ms) in percent.
- Bar graph indicates the actual **Temp.** of the amplifier block.

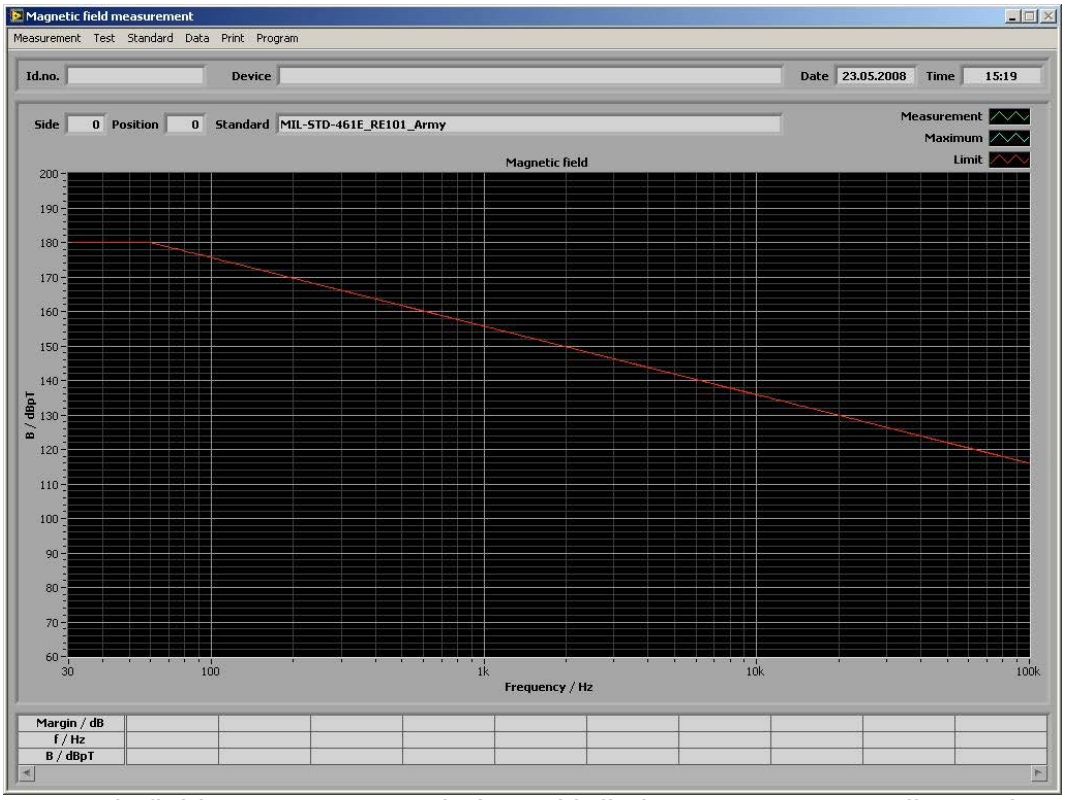
Menu Overview

The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

Magnetic Field Generator/Analyzer			
Menu	***Item***	***Shortcut***	***Function***
Magnetic field test	Standard measurement		Open the **Magnetic field measurement window** for spectrum analyzer measurements according to predefined standards
	Standard generation		Open the **Magnetic field standard generation** window for susceptibility tests according to predefined standards
	Continuous generation		Open the **Magnetic Field Continuous generation** window for long term magnetic field tests
	Short term generation (plug-in)		Open the **Short term generation** window for short term magnetic field tests (optional)
Additional test (only seen when the plug-ins are installed)	MIL-STD461E/F CE101		Perform a test according to MIL-STD461E/F CE101
	MIL-STD461E/F CS101		Perform a test according to MIL-STD461E/F CS101
	MIL-STD461E/F CS109		Perform a test according to MIL-STD461E/F CS109
	IEC/EN 61000-4-16		Perform a test according to IEC/EN 61000-4-16
	IEC/EN 61543 T2.6		Perform a test according to IEC/EN 61543 T2.6
Voltage/Current	Scope		Open the Scope mode window
	Spectrum analyzer		Open the Spectrum analyzer window
Calibration	Coil factor calibration		Determine the coil factor of an unknown coil
	Self calibration		Perform a self calibration of the MGA 1033
Program	Info		Show program version
	Quit		Exit the software

3.2 Magnetic Field Measurement

- Connect the loop sensor to XLR-Input jack [8] at the front panel.
- Click on **Magnetic field test/Standard measurement** at the Generator/Amplifier control panel to open the **Magnetic field measurement** window.
- Verify that the correct loop sensor calibration file is loaded at **Standard/Edit Standard/Loop sensor calibration file**.



Magnetic field measurement window with limit curve corresponding to the standard file loaded

Main Controls

- **Id.no** and **Device** display the information that was entered at **Print/General statements**.

Date and **Time** display the operating system's date and time when a measurement is started. When a saved measurement is loaded by **Data/Load data** the original date and time are displayed.

- **Side** indicates the EUT side where the measurement is performed.
  Each time you click on **Test/New side** the displayed number is increased by one.
- **Position** indicates the number of loop sensor positions at the corresponding side.
  Press **Test/Start test** to prepare the system for measurement. Press **Enter** on your keyboard to activate the measurement. Each time you press **Enter** (with each new position of the loop sensor) the displayed number is increased by one.
- **Standard** displays the predefined standard file.
  To change the standard file enter **Standard/Load standard**.

Menu Overview

The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

Magnetic field measurement			
Menu	***Item***	***Shortcut***	***Function***
Measurement	Acquire once		Start a single measurement
	Acquire on		Start a continuous measurement
	Acquire off		Stop the current measurement
	Reset maximum		Delete Maximum curve (blue) and table
	Internal trigger		Enable internal trigger
	External trigger		Enable external trigger (Firmware ≥ 1.3)
Test	Start test		Start tests according to predefined standard
	Step back		Measure the last measure point again
	Stop test		Stop tests
	New side		Increase displayed side number by one
Standard	Load standard		Load a predefined standard
	Edit standard		Open the **Edit standard measurement** window for editing of predefined standard files and creating new ones
	Analyzer check		Verification of analyzer function
Data	Load data		Load already saved measurements from a file
	Save data		Save the current measurement to a file
Print	General statements		Enter general data that appear on the printout afterwards
	Print to file		Create a doc-file and a jpg-file with the graph
	Print to printer		Print measurement to printer
	Printer selection		Choose the desired printer

Program	Info		Show program version
	Main menu		Return to main menu (Generator/Amplifier control panel)
	Quit		Exit the software

The menu items **Measurement** and **Test** both allows the user to analyze the spectrum measured by a loop sensor. If you choose **Start test**, a new test is started after a user interaction. Every test increases the number in **Position**. **New side** increases the value in **Side** which correspond to a different EUT position.

If an external trigger is used, the program waits for this trigger and will only abort the measurement if ESC is pressed.

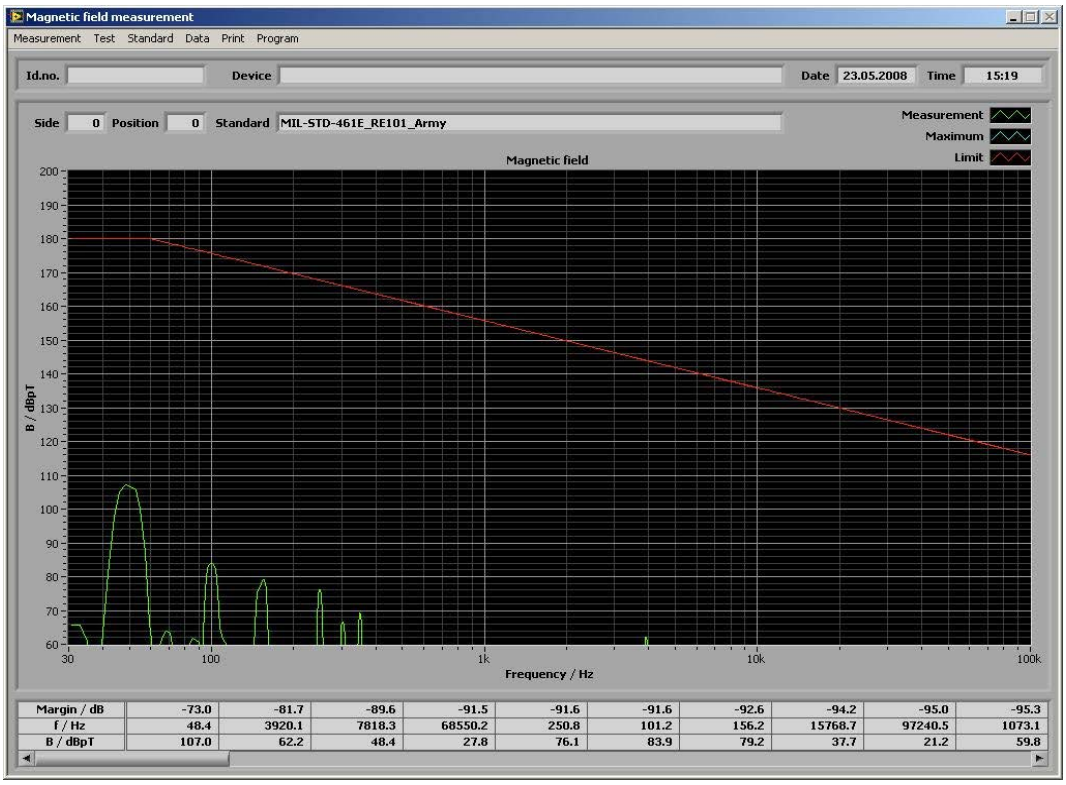
Plotting of Measurement Results

The results of some magnetic field measurements (Magnetic Flux Density versus Frequency) are displayed in the subsequent picture.

The *red* graph is the limit as defined in the standard file.

The *green* graph is the current measurement.

The *blue* graph is the maximum curve, overall maximums of all preceding measurements.



Measurement results

The table shows 50 data points which are the closest to the limit values. All values are available via the scroll bar. The table contains the following lines:

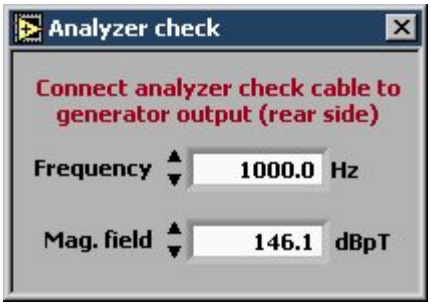
in **%** for **A/m** **Margin / %**	**Margin / dB** or Margin to the limits in **dB** for **dBpT** or (see **Standard/Edit standard** for details) positive values = limits are exceeded
	f / Hz Frequency in Hertz
	B / dBpT Magnetic Field Strength dBpT (Results may as well be displayed as H / A/m. See **Standard/Edit standard** for details)

Analyzer Check

Some standards demand an analyzer check before a measurement can be performed – this procedure is described below:

- The test system will connect the generator to the voltage input internally . Any generated value will be measured using the analyzer module.
- Select **Standard/Analyzer check** in the **Magnetic field measurement** window. The **Analyzer check** window will pop up. This is shown in the figure below.

Analyzer check window



- Choose any frequency and magnetic field value. Due to unit conversions, the amplitude is to be chosen in **dBpT** or **A/m**. These values can be measured in the **Magnetic field measurement** window by selecting **Acquire on** or **Acquire once**. The measured value and the selected value should be the same (slight variations are possible due to cable characteristics).

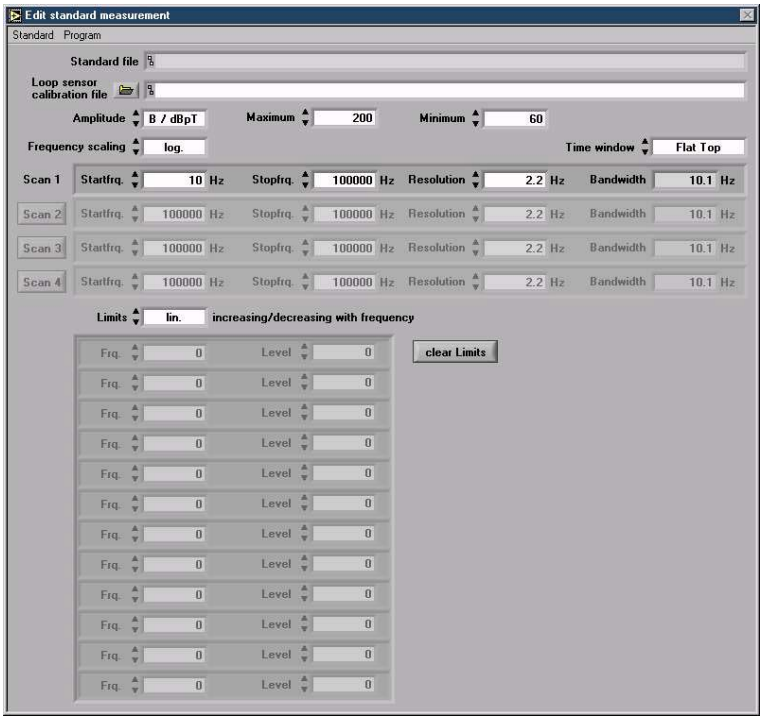
How to edit a predefined Measurement Standard (or Create a New One)

Besides the measurement according to predefined standard files, it is possible to edit or create an infinite number of files with company standards or special purpose requirements.

The procedure is described hereafter.

- Click on **Standard/Edit standard** at the Magnetic field measurement window

A window similar to the following is displayed:

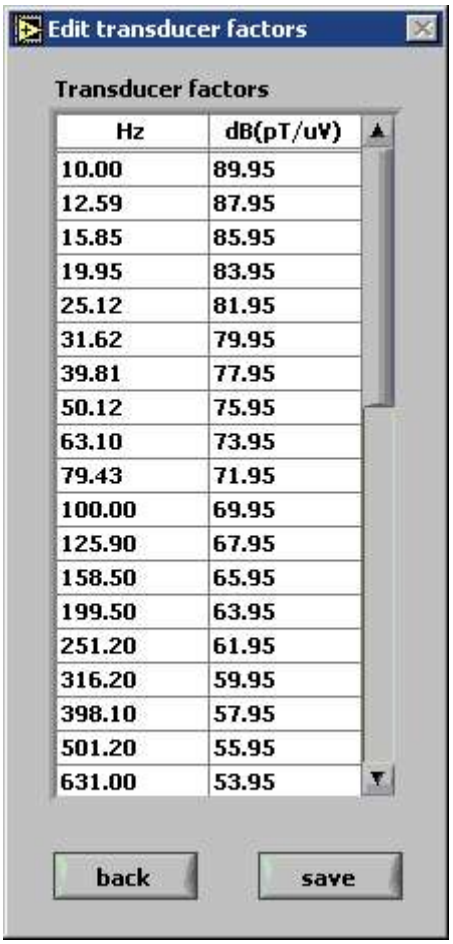


Edit standard measurement window for limit curve generation

Standard file: 1) leave this box empty if a new standard file is created
2) load the file you want to edit by clicking on **Standard/Load**

- Choose the corresponding loop sensor file at **Loop sensor calibration file**.

- **Loop sensor cal. data** allows to open the loop sensor calibration data. All values can be changed and saved by clicking on **save. Back** discards all changes. Only change any values if you have to! Always back-up your LSCAL file before you edit it!



Sensor loop calibration file is editable in this window

These values can be changed in **Measurement Window Parameter**:

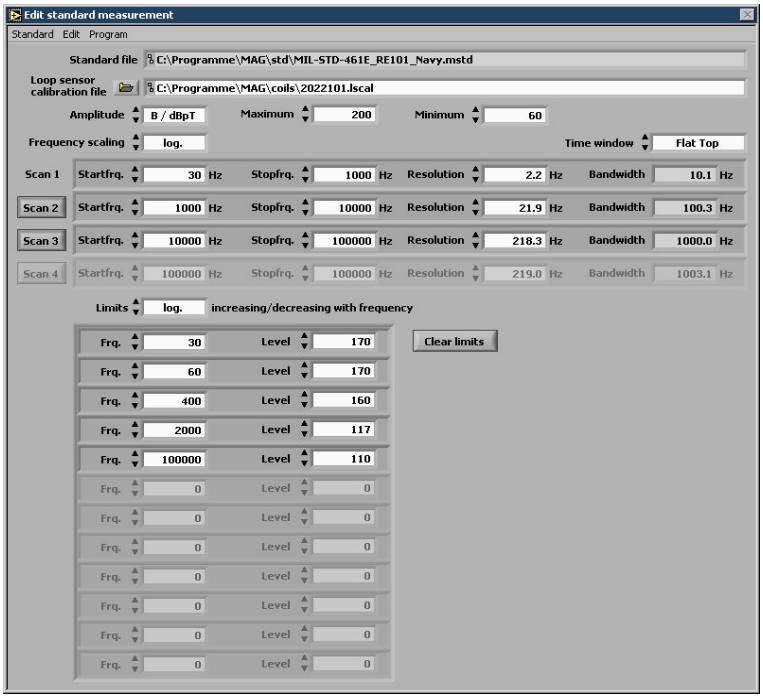
- Enter the units of the **Amplitude** of the magnetic field (Y-coordinate) **B / dBpT** or **H / A/m**.
- magnetic field range: Enter the **Maximum** of the
  0 to 1000 **dBpT**
  0.0001 to 1000 **A/m**
- magnetic field range: Enter the **Minimum** of the
  0 to 1000 **dBpT**
  0.0001 to 1000 **A/m**
- Enter the type of **Frequency scaling** (X-coordinate): linear (**lin.**) or logarithmic (**log.**)

Spectrum Analyzer Parameter:

- Enter **Time window** for FFT analysis. Recommended is the **Flat top** window for best amplitude response.
- It is possible to enter up to 4 different frequency sections named **Scan 1** to **Scan 4** with different frequency resolutions. Enter start frequency (**Startfrq.**) and stop frequency (**Stopfrq.**) for the first section **Scan 1**. Choose the frequency **Resolution** to receive a **Bandwidth** which complies to the requirements of the standard. If **Stopfrq.** is less than than maximum frequency, i.e. 100000 Hz, it is possible to enter another resolution for a higher frequency range.

Limit Curve Parameter:

- Enter whether the **Limits** should increase/decrease **lin.** or **log.** with frequency.
- Enter up to 12 sets of frequency (**Frq.**) and limit **Level** values. Lowest valid frequency is equal to **Resolution**, the highest frequency is 250 kHz.
  The entries are sorted by frequency. Entry of Frq. = 0 clears one line.
- Press the **clear Limits** button to clear all values at once.
- Save the edited or new created standard file by clicking on **Standard/Save**.



Example standard file for MIL-STD-461E/F / RS101_Navy

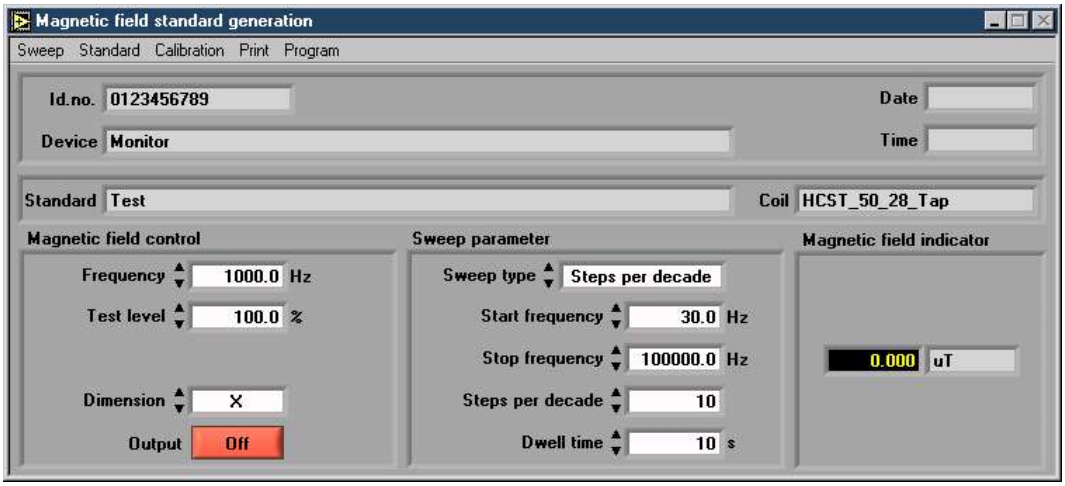
The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

Edit Standard Measurement			
Menu	***Item***	***Shortcut***	***Function***
Standard	Load		Load a predefined standard file
	Save		Save the current standard file
Edit	Loop sensor cal. data		Edit loop sensor data
Program	Info		Show program version
	Back to test		Return to Magnetic Field Measurement window

3.3 Magnetic Field Standard Generation

How to generate magnetic fields for immunity tests with radiating coils or Helmholtz coils according to various standards is described hereafter.

- Connect the radiating loop, Helmholtz coil or triaxial Helmholtz coil to the corresponding safety sockets [3] to [5] on the front panel.
- Choose **Magnetic field/Standard generation** at the amplifier control panel. The following window appears:



Magnetic field standard generation window

Main Controls

- **Id.no** and **Device** display the information that was entered at **Print/General statements**.
- **Date** and **Time** display date and time when a test is started.
- **Standard** shows the predefined standard file.
- **Coil** displays the corresponding coil.

Options in **Magnetic field control**:

- Enter a **Frequency** in Hz from 10 Hz to 250 kHz.
(While a sweep is running, the current frequency is displayed in this box)
- Enter the **Test level** in % from 10 to 1000 %. Some levels can not be achieved due to limitations of the coils. Maximum and minimum levels are applied, if necessary.
- Choose the required **Dimension X, Y** or **Z** for the corresponding output sockets [3], [4] or [5]. In case of one-dimensional coils the dimensions **Y** and **Z** are disabled.
- Switch the Amplifier **Output** either **On** or **Off**.

This different settings are available in **Sweep Parameter:**

- Enter a **Sweep type** in **Steps per decade** or choose a file in **Frequency list**.
- Enter a **Start frequency** in Hz from 0 Hz.
- Enter a **Stop frequency** in Hz up to 250 kHz.
- Enter the **Steps per decade** from 1 to 1000.
- Enter a **Dwell time** in s from 1 to 3600 s.

Magnetic Field Indicator:

- Displays the *calculated* magnetic field strength while the test is running.

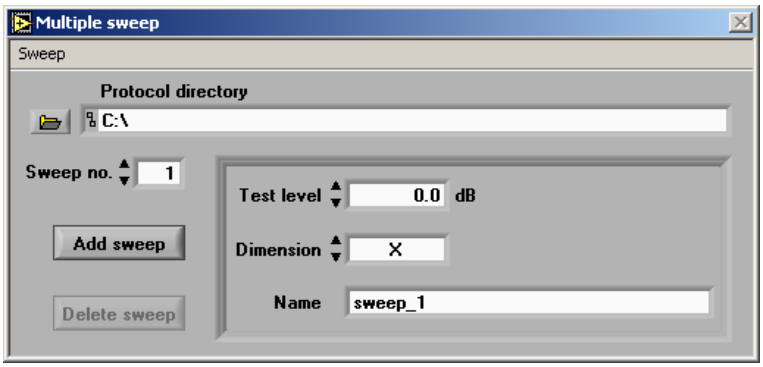
Menu Overview

The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

Magnetic field standard generation			
Menu	***Item***	***Shortcut***	***Function***
Sweep	Start sweep		Start the sweep according to the sweep parameter
	Break sweep		Break the sweep - open the **Sweep break** window
	Multiple sweep		Multiple sweeps are performed - open the **Multiple sweep** window
	Abort sweep		Abort the sweep
	Edit freq. list		Open a frequency list file and edit it
	EUT monitor		Open the **EUT monitor parameter** window
Standard	Load standard		Load a predefined standard
	Edit standard		Open the **Edit standard generation** window
Calibration	Field verification		Verifies the generated field of a radiating coil with a loop sensor
	Loop sensor		Choose the corresponding loop sensor for the field verification
Print	General statements		Enter general data that appear on the printout afterwards
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit		Exit the software

Multiple Sweep Window

Due to outputs for all three Cartesian dimensions any test can be performed in three different ways. Therefore it is useful to define a series of sweeps. Those multiple sweeps are defined by choosing **Sweep/Multiple sweep** in the **Magnetic Field Standard Generation** window. This window will pop up:



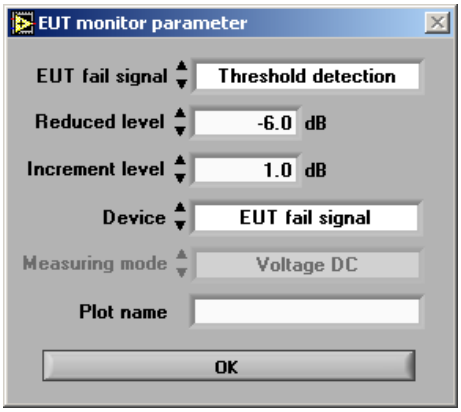
Multiple sweep window

- Enter a **Protocol directory** in the first line. All protocols will be save within this directory.
- When a window is opened, only one sweep is defined. Its **Test level** and the **Dimension** are defined. To identify any sweep type, a user-defined **Name** can be entered as well.
- A new sweep is created by choosing **Add sweep**. **Delete sweep** removes a sweep from the series of sweeps. Every sweep is assigned a number which is also the chronological order of the sweeps.
- To start the series of sweeps, choose **Sweep/Start multiple sweep** in the menu. **Abort multiple sweeps** stops the sweeps and closes the window.

Multiple sweep			
Menu	***Item***	***Shortcut***	***Function***
Sweep	Start multiple sweep		Start the defined sweep series
	Abort multiple sweep		Abort the sweep series

EUT Monitor

- Click on **Sweep/EUT monitor** to display the following window:

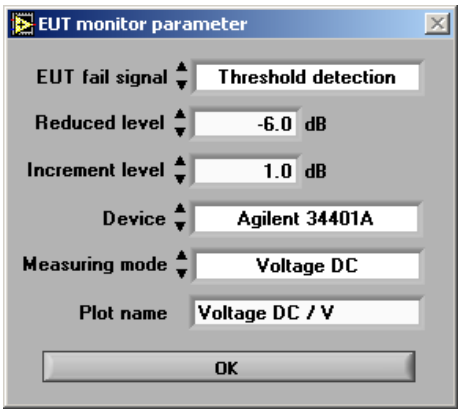


- **EUT fail signal** indicates how the program shall react if a high level is connected to terminal [19] on the instruments back panel (Press function key F10 to simulate the EUT fail signal).
Test stop means, the frequency sweep stops if a “high” level is recognized.
No test stop sets a frequency mark without interruption of the test.
Threshold detection enables an automatic way of detection which value correspond to an EUT failure. Therefore a **Reduced level** is defined which will rise according to the **Increment** setting. Those two settings depend on the chosen standard.

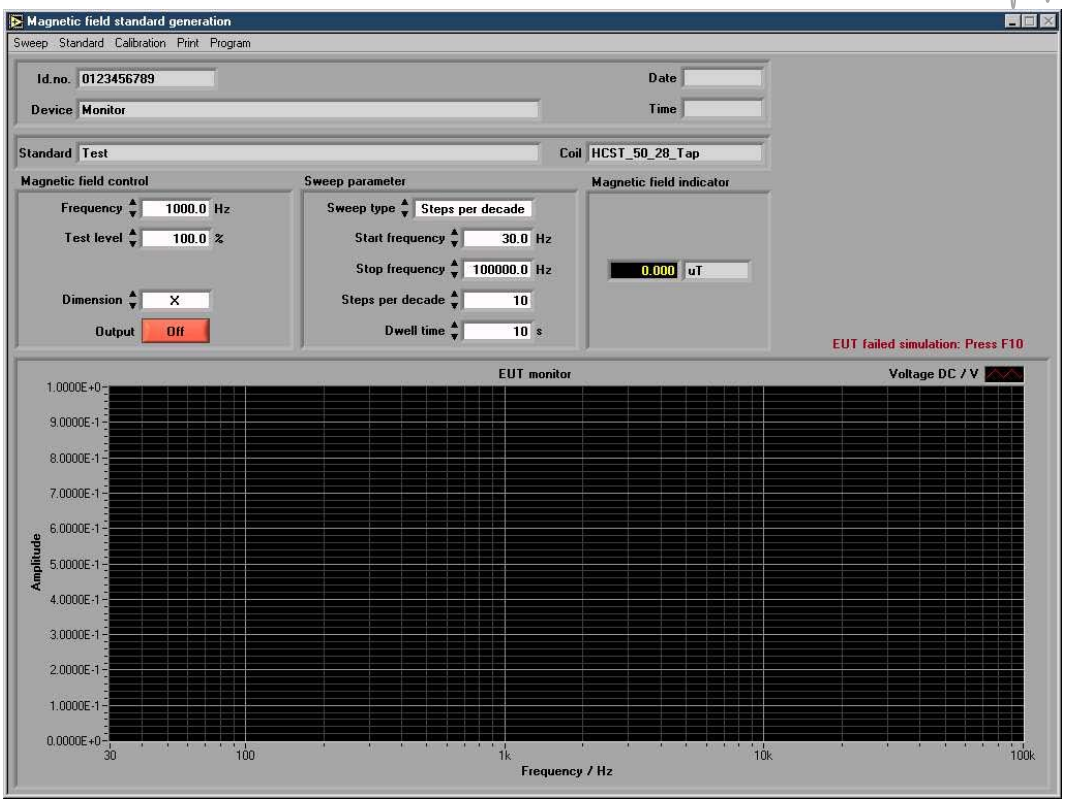
- Choose **Device EUT fail signal** or external multimeter like **Agilent 34401A** or **Keithley 2000** for EUT control. **DLL measurement** allows the usage of any measurement device by customized DLL. See the appendix for further information.

- Choose **Measuring mode** for the external multimeter (disabled if Device = EUT fail signal): **Voltage DC** / **Voltage AC** / **Current DC** / **Current AC** / **Resistance** / **Frequency**

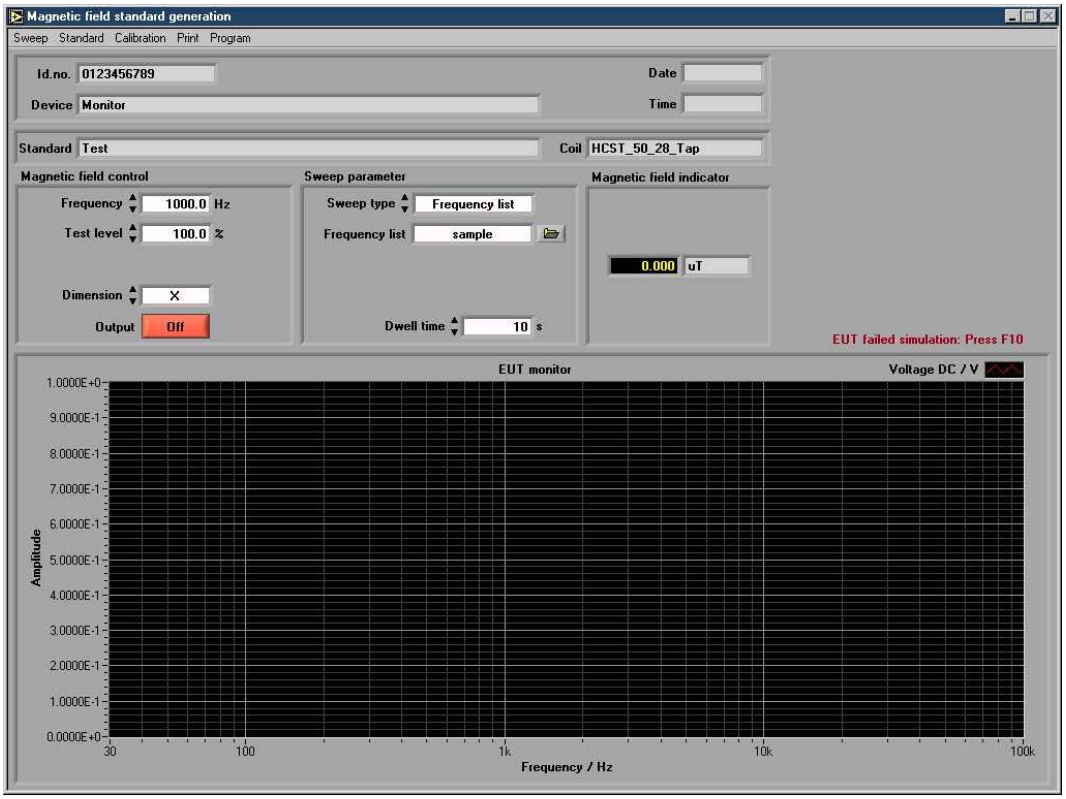
- Enter **Plot name** e.g. „Voltage DC / V“. The entry of this box is displayed above the graph afterwards.



- Click **OK** to close the **EUT monitor parameter** window and view the **Magnetic field standard generation** window expanded by the EUT monitor graph.



Magnetic field standard generation window with EUT monitor graph.
Sweep type: Steps per decade.

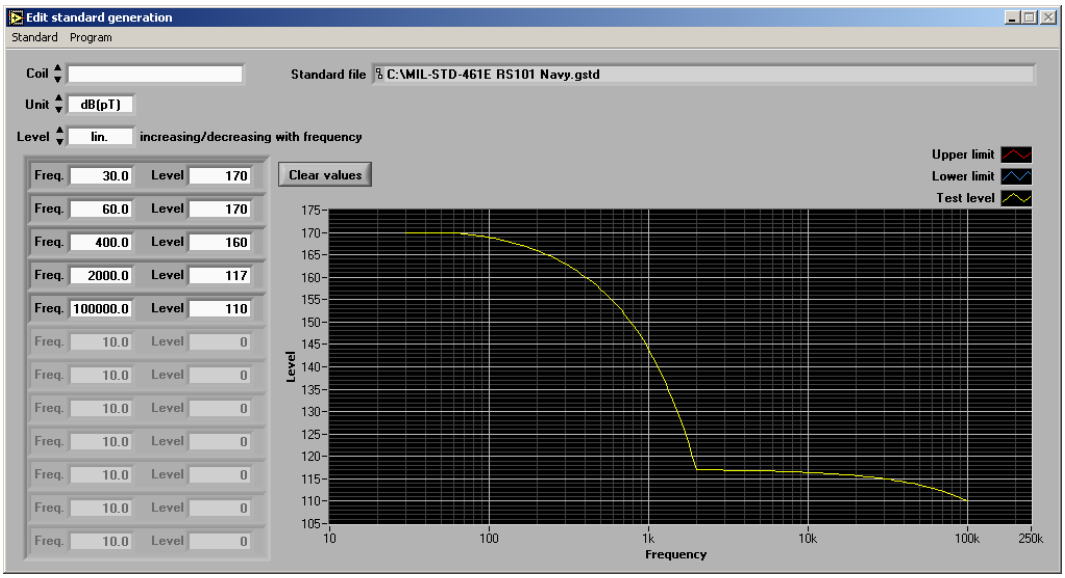


Magnetic field standard generation window with EUT monitor graph.
Sweep type: Frequency list.

How to Edit a Predefined Generation Standard (or Create a New One)

The following chapter explains how to edit or create standard files for magnetic field immunity tests.

- Choose **Standard/Edit standard** at the menu bar. The following window appears:



- Choose the required radiating **Coil**.
The box **Coil** displays all available coils having a calibration file in the directory MGA1033/Coils.
How to create a calibration file for an unknown radiating coil is explained in chapter 4.4

Standard file: 1) leave this box empty if a new standard file is created
2) load the file you want to edit by clicking on **Standard/Load**

- Choose **Unit** in **A/m**, **dB(µA/m)**, **µT** or **dB(pT)**.

Level Curve Parameter:

- Enter whether the **Level** should increase/decrease **lin.** or **log.** with frequency.
- Enter up to 12 sets of frequency (**Frq.**) and **Level** values. The entries are sorted automatically by frequency. **Frq.** = 0 clears the line.
- Press the **Clear values** button to clear all values at once.
- Save the edited or new created standard file by clicking on **Standard/Save**.
- Return to the **Magnetic field standard generation** window by clicking on **Program/Back to test**.

The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

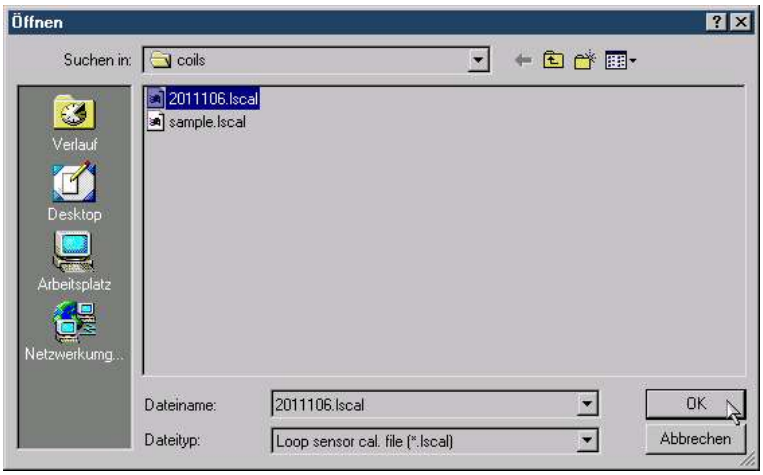
Edit standard generation			
Menu	***Item***	***Shortcut***	***Function***
Standard	Load		Load a predefined standard file
	Save		Save the current standard file
Program	Info		Show program version.
	Back to test		Return to **Magnetic field standard generation** window

Field Verification

Sometimes it may be useful to verify the generated magnetic field of any radiating coil with a loop sensor.

Define the loop sensor first:

- Click on **Calibration/Loop sensor** to display the following file selector box:



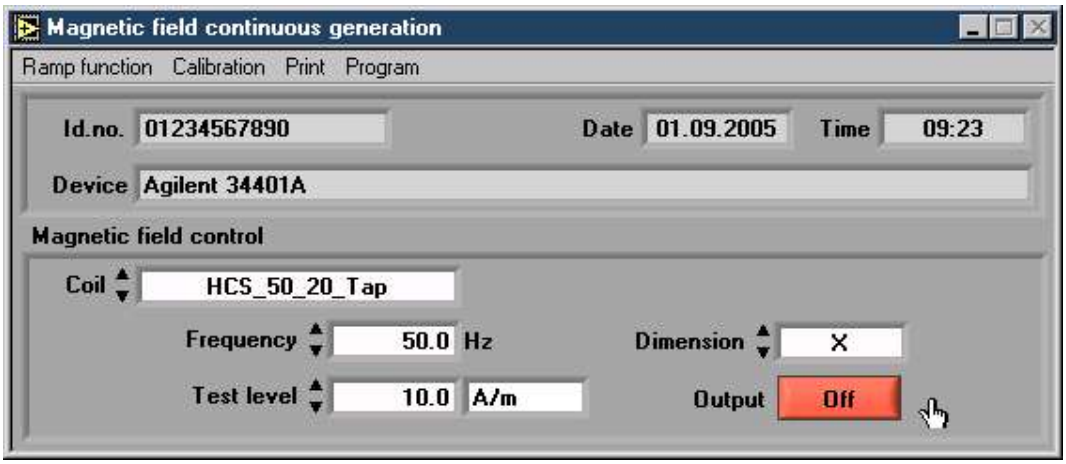
- Choose the loop sensor calibration file (LSCAL file) and click **OK**.
- Take care of the exact mechanical placement of the loop sensor in front of the radiating loop or in the middle of a Helmholtz coil!
- Click on **Calibration/Field verification** to start this operation.

The measured value of the magnetic field is displayed - click **OK** to stop this operation.

3.4 Continuous Generation

The MGA 1033 is able to generate a continuous magnetic field. This application is described hereafter:

- Connect the radiating loop, Helmholtz coil or triaxial Helmholtz coil to the corresponding safety sockets [3] to [5] on the front panel.
- Choose **Magnetic field/Continuous generation** at the amplifier control panel. The following window appears:



Main Controls

- **Id.no** and **Device** display the information that was entered at **Print/General statements**.
- **Date** and **Time** display the operating system date and time when a test is started.
- Choose the required radiating **Coil**.

The box **Coil** displays all available coils corresponding with a calibration file in the directory **MGA1033/Coils**.
How to create a calibration file for an unknown radiating coil is explained in chapter 5.3.

- Enter **Frequency** in Hz. Valid frequencies are 10 Hz to 250 kHz.
- Enter **Test level** in **A/m**, **dB(µA/m)**, **µT** or **dB(pT)**.
- Choose the required **Dimension X, Y** or **Z** for the corresponding output sockets [3], [4] or [5]. In case of one-dimensional coils the dimensions **Y** and **Z** are disabled.
- Switch the Amplifier **Output On** or **Off**.

While the **Output** is **On** it is impossible to change **Coil** and **Dimension**.

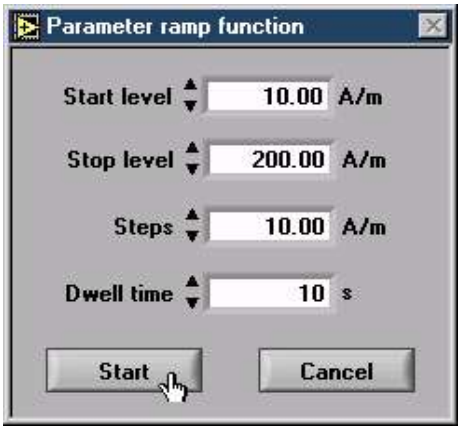
Menu Overview

The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

Magnetic field continuous generation			
Menu	***Item***	***Shortcut***	***Function***
Ramp function	Start ramp		Open a dialog to define a ramp function
	Stop ramp		Stop the user defined ramp function
Calibration	Field verification		Verify the generated field of a radiating coil with a loop sensor
	Loop sensor		Choose the corresponding loop sensor for the field verification
Print	General statements		Enter general data that appear on the printout
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit		Exit the software

Ramp Function

With **Ramp function** you can sweep from a start level to a stop level at fixed frequency. Follow this description to start a ramp function:



- Click on **Ramp function/Start Ramp** to display the following window:
  - Enter **Start level**, **Stop level**, **Steps** and **Dwell time**

- Click on **Start** to start the programmed ramp function. After reaching the stop level the disturbing signal is stopped automatically.

- While the ramp function is running all functions of the magnetic field continuous generation window are disabled. Click on **Ramp function/Stop ramp** to abort the ramp function.

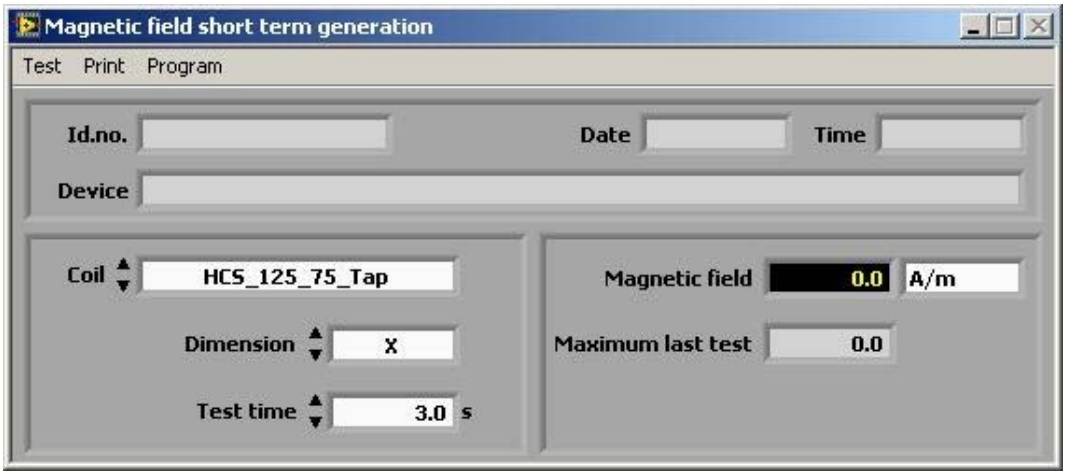
3.5 Short Term Generation (Option)

For some standards it is necessary to generate high field strength for a short period of time. Therefore a variable transformer which is connected to the voltage mains is used. How to generate these high field strength with your MGA 1033 is described in this chapter. This will only be available, if the option is installed:

- Connect the Helmholtz coil to the safety jacks [3] (blue and black sockets) on the front panel.

- Connect the external transformer to the safety jacks [14] on the back panel.

- Choose **Magnetic field/Short term generation** at the **Generator/Amplifier control panel**. A window similar to the following is displayed:



Short term generation of magnetic fields

- **Id.no** and **Device** display information that was entered at **Print/General statements**.

- **Date** and **Time** display the operating system's date and time.

- Choose the required radiating **Coil** (RLCAL files).
The box **Coil** displays all available coils having a calibration file in the directory **MGA1033/Coils**.
How to create a calibration file for an unknown radiating coil is explained in chapter 5.3.

- **Dimension** defines the output port (here X is equal to X-Coil [3]).

- Enter **Test time** in s from 0.2 to 10 according to the standard.

- The box **Magnetic field** displays the resulting level in **A/m**, **dB(µA/m)**, **µT** or **dB(pT)**.

The box **Maximum last test** displays the highest value that occurred during the last test. Click on **Test/Start test** to start the test.
The resulting H-field (displayed in the box **Magnetic field**) is depending on the setting of the variable transformer. Readjust the variable transformer to get the desired H-field.Please Notice:
Each time a test is performed the **Test/Start test** command is disabled for 5 x **Test time** in seconds, i.e. after a test with **Test time** = 3 s the **Test/Test start** command is disabled for 5x3s = 15s. This procedure is for cooling down of the radiating coil or transformer.

The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

Short term generation			
Menu	***Item***	***Shortcut***	***Function***
Test	Start test	Ctrl+S	Start the test
	Abort test	Ctrl+A	Abort the test
Print	General statements		Enter general data that appear on the printout afterwards
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit	Ctrl+q	Exit the software

4.0 Operation 2: Additional Tests and Measurements

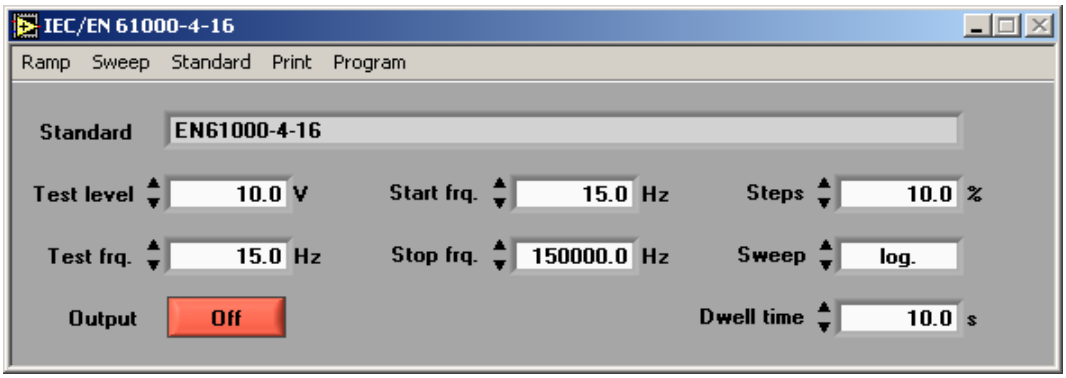
This chapter deals with non-magnetic field tests which are able to be performed using the MGA 1033. The additional tests are optional and not available in the standard edition. In order to use one of those software modules, a suitable license is needed. Any available test will appear in the main menu under **Additional Tests**.

4.1 Conducted Immunity Test According to IEC/EN 61000-4-16

This standard deals with immunity tests at low frequencies from 15 Hz to 150 kHz. For unscreened conductors a disturbing signal, a sine wave signal with voltage levels up to 30 V and more, is induced in the line via a coupling device. A further decoupling device needs to be connected in order to couple only into the EUT and protect any connected equipment. For screened cable no decoupling device is needed and the disturbing signal is coupled directly into the screen. The MGA 1033 is capable of fulfilling this standard. All equipment has to be grounded at any time.

- Connect the 50 Ω Output [6] of your MGA 1033 with your coupling device. The coupling device has one output for the EUT and one input for auxiliary equipment.

- Choose **Additional Tests/ IEC/EN 61000-4-16** in main menu. The shown window will open:

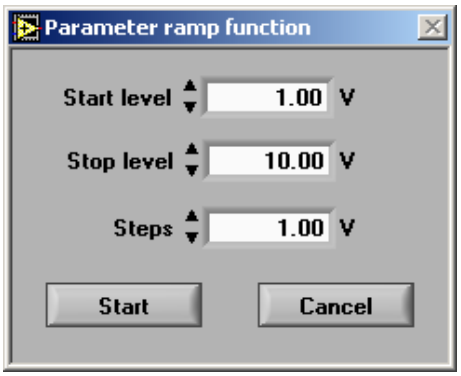


IEC/EN 61000-4-16 window

Main Controls

- This window has several selections. The sweep signal can be determined by choosing the **Test level** which can be chosen from these values: 0.1 V up to 50 V
- Also the frequency range from 10 Hz up to 250 kHz for the sweep can be selected. **Startfrq.** sets the lowest frequency, **Stopfrq.** defines the highest frequency.
- **Sweep** assigns the sweep type which can be logarithmic or linear. **Steps** defines the size in percentage.
- A **Dwell time** can also be set from 1 s up to 3600 s.
- **Standard** allows a user to choose from several, even user-defined standards. If IEC 61000-4-16 is chosen, all settings are made automatically.

- A **ramp** can be generated by choosing Ramp/Start Ramp in the menu. The following window will appear:



Ramp function window

- Parameters are **Start level** and **Stop level**, valid values are 0 V to 50 V. Step size is defined in **Steps**. A ramp function is started by clicking on **Start**, this window will close and the current values are shown in the IEC / EN 61000-4-16 window. To stop a running ramp function, either the **output** box has to be clicked or the menu item Ramp/Abort ramp has to be chosen.
- To start a sweep, choose **Sweep/Start sweep** in the menu. A new window will appear and ask for the test level at the lowest frequency. All further values are normalized in respect of this value.

Break sweep window

- During a frequency sweep current values for the frequency and the voltage level are shown at the **Frequency** and **Level** box on the right side. To re-check a certain frequency, select **Sweep/Break sweep** in the menu while a sweep is running. A window will pop up and allows to step through the frequency spectrum manually. **Frequency** and **Level** indicate the current values. **Amplifier** allows to switch the internal amplifier on or off. **Step down** decreases the frequency, as **Step up** increases it. **Abort** avoids further sweeping through the given frequency range, **ok** resumes the sweep.

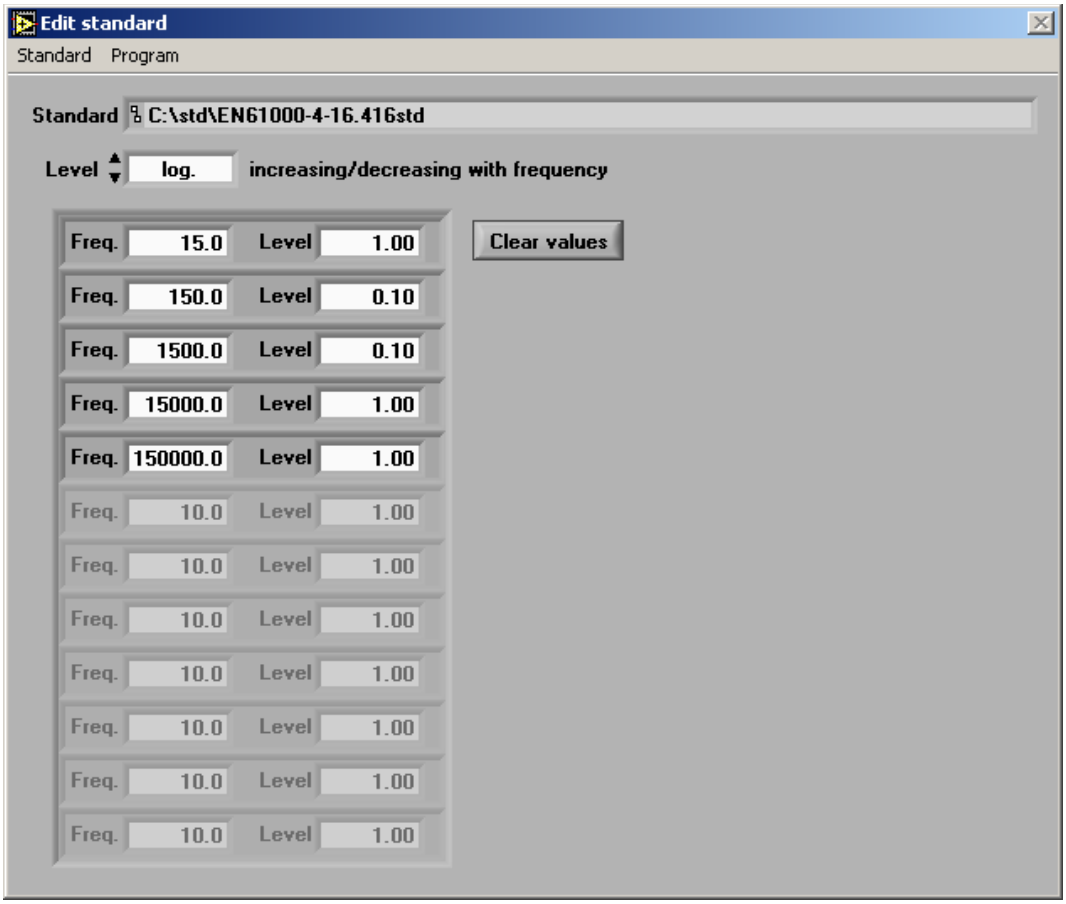
Menu Overview

IEC/EN 61000-4-16			
Menu	**Item**	**Shortcut**	**Function**
Ramp	Start ramp		Start a ramp function - open the **Ramp** window
	Abort ramp		Stop a ramp
Sweep	Start sweep		Start a frequency sweep
	Break sweep		Break the sweep - open the **Sweep break** window
	Abort sweep		Abort the sweep
Standard	Load standard		Load a predefined standard
	Edit standard		Open the **Edit standard** window for editing of predefined standard files and creating new ones
Print	General statements		Enter general data that appear on the printout
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit		Exit the software

How to Edit a IEC/EN 61000-4-16 Standard file (or Create a New One)

The induced voltage which is injected into an EUT is defined in a IEC/EN 61000-4-16 standard file. All values can be adjusted to user-defined values over the given frequency range. How to change a standard file is shown in this paragraph:

- By clicking on **Standard/Edit standard** in the menu of the window **IEC/EN 61000-4-16** this window will open itself:



Edit 416std standard file

- A standard file with the file extension **416std** can be loaded by choosing **Standard/Load** in the menu. The file name will be shown in the box **Standard**.
- Whether the **Level** should increase or decreased linear (**lin.**) or logarithmic (**log.**) is set in the next line.
- The curve which determines the level at any frequency is adjusted in the table below. It contains a frequency (**Freq.**) in **Hz** and a corresponding **Level**. Level values are normalized values of the chosen test level in the IEC / EN 61000-4-16 window, e.g. 0.10 will generate an output voltage of 1 V, if a test level of 10 V is chosen. Every new value will be sorted automatically in an ascending order. To delete a single value, set the frequency to 0. All values are cleared by choosing **Clear values**.

Several menu items are available:

Edit IEC / EN 61000-4-16 standard			
Menu	***Item***	***Shortcut***	***Function***
Standard	Load		Load a predefined standard file
	Save		Save the current standard file
Program	Info		Show program version
	Back to test		Return to **IEC / EN 61000-4-16** window

4.2 Conducted Emissions Test According to MIL-STD-461E/F CE101

Any power lead may emit a signal. According to the standard MIL-STD-461E/F CE101 the signal strength in the frequency range from 30 Hz to 10 kHz should not exceed certain limits. These limits depend on the load current and the fundamental current, respectively, of the EUT. Higher currents result in higher maximum allowed emission.

Measurement according to the standard requires a calibration which checks the system capability of measuring a predefined current at different frequencies.

Every measurement of the conducted emissions uses a current probe while the EUT is operating normally. The current probe measures one power lead at one time. Every lead including returns has to be measured independently. Any emission is checked against the limit over the whole frequency range. The standard MIL-STD-461E/F CE101 is divided in different limits for *Aircraft* and *Submarine*. The definitions for aircrafts distinguish between low voltage EUTs (28 Volts and lower) which are allowed to emit 100 dBµA at 30 Hz to 1 kHz and high voltage EUTs (over 28 Volts). These EUTs may emit signal up to 110 dBµA at 30 Hz to 1 kHz. The maximum allowed emission decreases with 20 dB per decade for higher frequencies.

The current limit for submarine applications depends on the type of power supply. Supplied power can either be obtained as a DC current or an AC current at different line frequencies (50 Hz, 60 Hz and 400 Hz). Maximum emissions also depends on the load current of an EUT, as DC current applications with a load current equal or less than 3 A have a 35 dB lower limit than applications with a load current higher than 185 A. The limits in between those load currents are calculated by this formula:

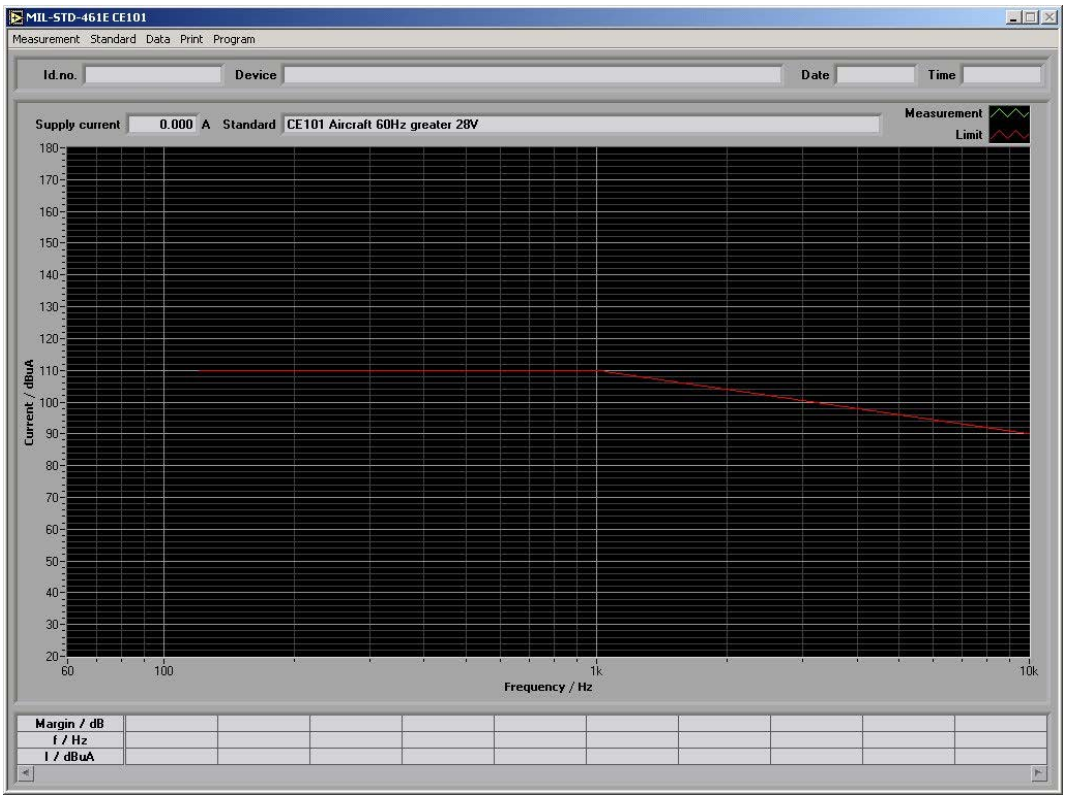
Limiting curve I_{LOAD} = limiting curve for $I_{LOAD} \leq 3A + 20 * \log \frac{I_{LOAD}}{3}$ in dB.

For AC currents the applied limits depend on the power consumption and the fundamental current. Higher load currents result in limit relaxation of $20 * \log I_{LOAD}$, when power consumption is higher than 1kVA at 50 or 60 Hz or 0.2 kVA at 400 Hz.

How to measure conducted emission with your MGA 1033 is explained hereafter:

Measurement according to MIL-STD-461E/F CE101 require a system check first. Therefore the 50 Ω Output [6] needs to be connected to an optional 0.5 Ω shunt. One conducting line should be used for measuring with the current probe which is connected to the XLR Input [8].

The following window can be opened by choosing **Additional test/MIL-STD-461E/F CE101** in the main menu.



Window MIL-STD-461E/F CE101

Main Controls

- **Id.no** and **Device** correspond to the values entered at **Print/General Statements**. **Date** and **Time** will be updated whenever the measurement is started.

- The standard which should be used for the test is shown in **Standard**. Another standard file can be loaded by selecting **Standard/Load standard**. To check and/or change a limit at any frequency, you can choose **Standard/Edit Standard**.

- If emission of a power lead with AC power supply is measured, the measured **Supply current** will be displayed. The right line frequency needs to be set in the standard file. For DC power supply the supply current has to be entered manually because the current probe cannot measure any DC current signals. If the value is within a range where the limits shall be relaxed, the relaxation is applied. This setting can be altered in the standard file.

- The graph below shows the measured data over the whole frequency range.

The *red curve* shows the limit curve.

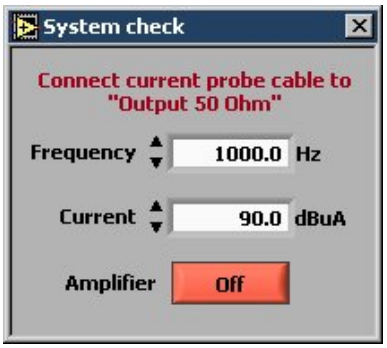
The *green curve* displays the measured data.

The table below the graph shows 50 data points which are the closest to the limit curve or even exceed the limits. It starts with the most critical values. The **Margin** in **dB** is calculated. The data points are displayed as current **I** in **dBµA** and **f** in **Hz**.

Before the system check and / or the measurement can be started, the transducer factors of the current probe need to be checked first. A window where these factors can be edited is opened by clicking on **Standard/Edit transducer factors**. All factors are in dB(µV/µA) which is equal to dBΩ and are sorted by frequency.

The system check is started by opening the following window via the menu function **Standard/System check**:

System check window



An output sine wave can be generated at a certain **Frequency**. The setting **Current** defines the applied current when the **Amplifier** is switched **On**. **Off** switches the signal off again. The generated signal may be measured by choosing **Measurement/Acquire once** for one measurement or **Measurement/Acquire on** for continuous measurement.

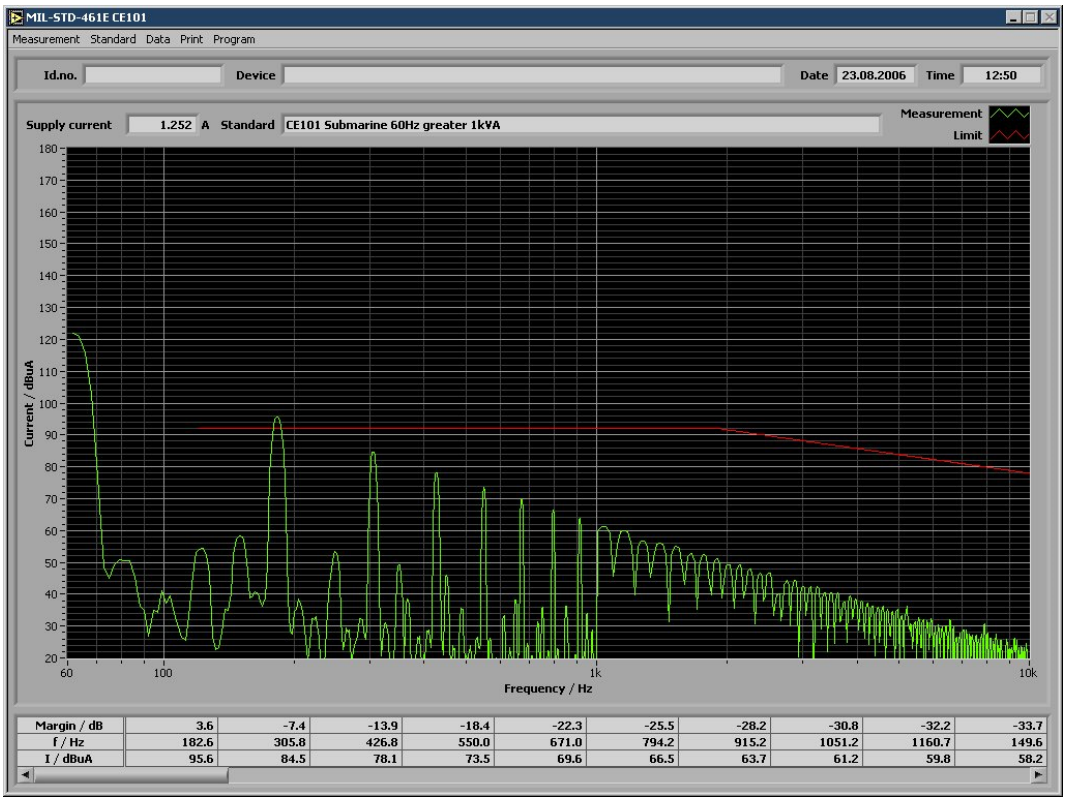
After a successful system check, apply the test setup as follows. The 50 Ω output is not needed any longer, so disconnect. Connect your EUT with the mains and install your current probe on one of the power leads. Please note that the MGA 1033 can measure up to 1000 A.

Check if the right standard file is loaded. The type of power supply of the EUT and in the standard file has to be the same.

If your EUT is driven by DC current, apply the load current in the box **Supply current** manually. AC current driven equipment will not need any user interaction because the value will be measured.

There are different ways of data acquisition. All measurement functions are found in the menu **Measurement**. To measure once, choose **Acquire once**. Continuous measurement is started by choosing **Acquire on**. Each measurement is triggered due to an **internal trigger** or an **external trigger**. The CMOS signal for an external trigger has to be applied at the external trigger port [18]. **Acquire off** stops the continuous data acquisition.

Measurement of DC driven equipment with 3.22 A load current



Measurement of AC driven equipment with relaxed limit curve

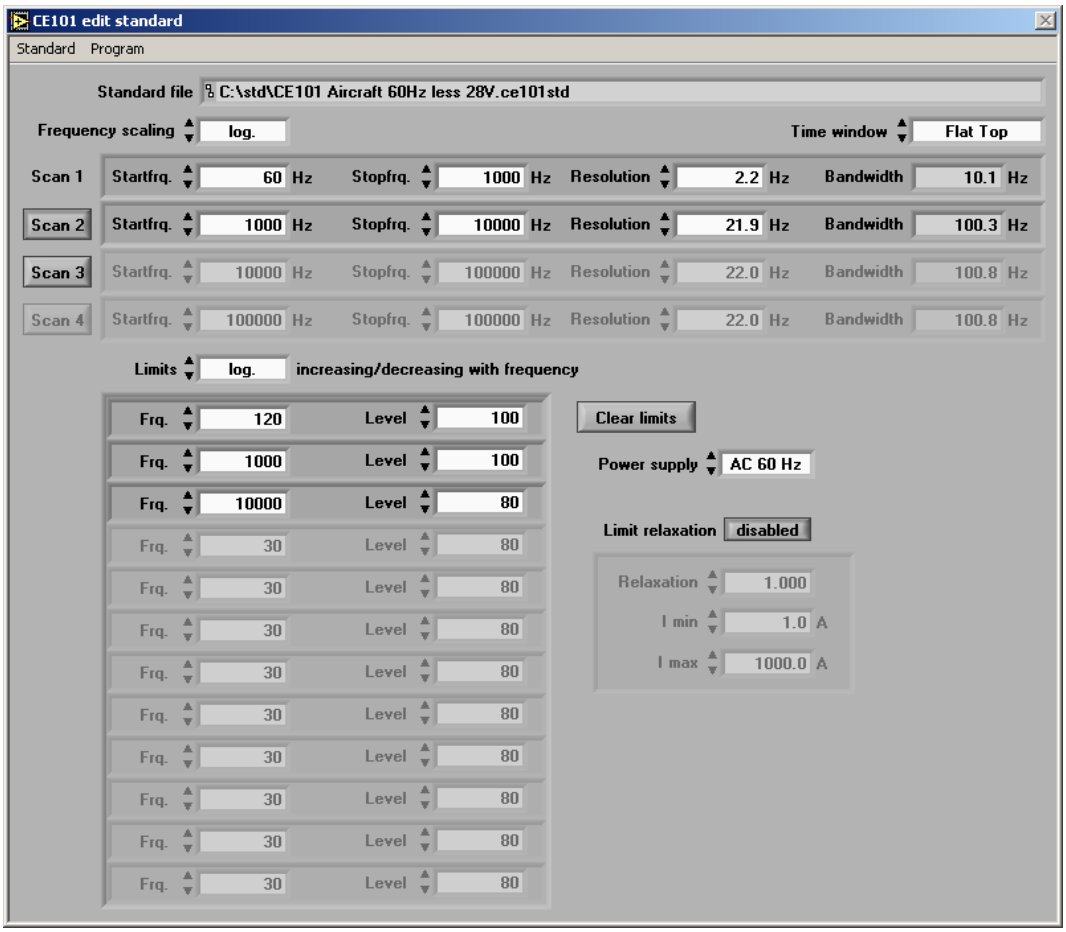
Menu Overview

MIL-STD-461E/F CE101			
Menu	***Description***	***Shortcut***	***Function***
Measurement	Acquire once		Start a single measurement
	Acquire on		Start a continuous measurement
	Acquire off		Stop the current measurement
	Internal trigger		Enable internal trigger
	External trigger		Enable external trigger (Firmware ≥ 1.3)
Standard	Load standard		Load a predefined standard file
	Edit standard		Open the window **Edit standard** Customize a standard file
	System check		Open the window **System check**
	Edit transducer factors		Change the current probe calibration data
Data	Load data		Load already saved measurements from a file
	Save data		Save the current measurement to a file
Print	General statements		Enter general data that appear on the printout afterwards
	Print to file		Create a doc-file and a jpg-file with the graph
	Print to printer		Print measurement to printer
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu (Generator/Amplifier control panel)
	Quit		Exit the software

How to Edit a CE101 Standard file (or Create a New One)

The following chapter explains how to edit or create CE101 standard files.

- Choose **Standard/Edit standard** at the menu bar. The following window appears:



- **Standard file**: 1) leave this box empty if a new standard file is created
  2) load the file you want to edit by clicking on **Standard/Load**

- Enter the type of **Frequency scaling** (X-coordinate): either linear (**lin.**) or logarithmic (**log.**)

Spectrum Analyzer Parameter:

- Enter **Time window** for FFT analysis. Recommended is the **Flat top** window for best amplitude response.

- It is possible to enter up to 4 different frequency sections named **Scan 1** to **Scan 4** with different frequency resolutions. Enter start frequency (**Startfrq.**) and stop frequency (**Stopfrq.**) for the first section in **Scan 1**. Choose the frequency **Resolution** to receive a **Bandwidth** which complies to the requirements of the standard. If **Stopfrq.** is less than than maximum frequency (250 kHz), it is possible to enter more frequency resolutions till this limit is reached.

Limit Curve Parameter:

- Enter whether the **Limits** should increase/decrease **lin.** or **log.** with frequency.
- Enter up to 12 sets of frequencies (**Frq.**) and limiting **Level** values. The frequency range starts at 10 Hz and ends at 250 kHz. Minimum limit is 20 dBµA, maximum limit is 180 dBµA. The entries are sorted by frequency. Entry of Frq. = 0 clears one line.
- Press the **clear Limits** button to clear all values at once.
- Choose the type of **Power supply**. The value can either be **DC**, **AC 50 Hz**, **AC 60 Hz** or **AC 400 Hz**.
- According to the standard the limit curve can be relaxed by a certain factor. **Limit relaxation** is applied, if **enabled** is chosen. Otherwise it is **disabled**. Relaxation depends on the load current I_{LOAD} and a factor, the **Relaxation** k. The following formula defines relaxation: $20 * \log(k * I_{LOAD})$. CE101 uses a DC value of k=0.333 and an AC value of k=1.
- The range where the relaxation should be applied is determined by the minimum current (**I min**) and maximum current (**I max**).
- Save the edited or new created standard file by clicking on **Standard/Save**.

Edit CE101 standard			
Menu	***Description***	***Shortcut***	***Function***
Standard	Load		Load a predefined standard file
	Save		Save the current standard file
Program	Info		Show program version
	Back to test		Return to **MIL-STD-461E/F CE101** window

4.3 Conducted Susceptibility Test According to MIL-STD-461E/F CS101

The standard MIL-STD-461E/F CS101 deals with conducted susceptibility. A sine wave is used as a disturbing signal in a frequency range from 30 Hz up to 150 kHz. It is coupled into the power leads via a coupling transformer. Its maximum signal level varies from 2 V (126 dBµV) for low voltage application (≤ 28 V) and 6.3 V (136 dBµV) for voltage supplies greater than 28 V. With increasing frequency the signal levels are reduced.

The lowest test frequency is determined by its operation mode; if it is DC operated, the lowest frequency will be 30 Hz. For AC operating equipment the lowest frequency is determined by the second harmonic of the power frequency. During a susceptibility test the disturbing signal on the power leads has to be monitored and adjusted to the voltage levels demanded by the standard.

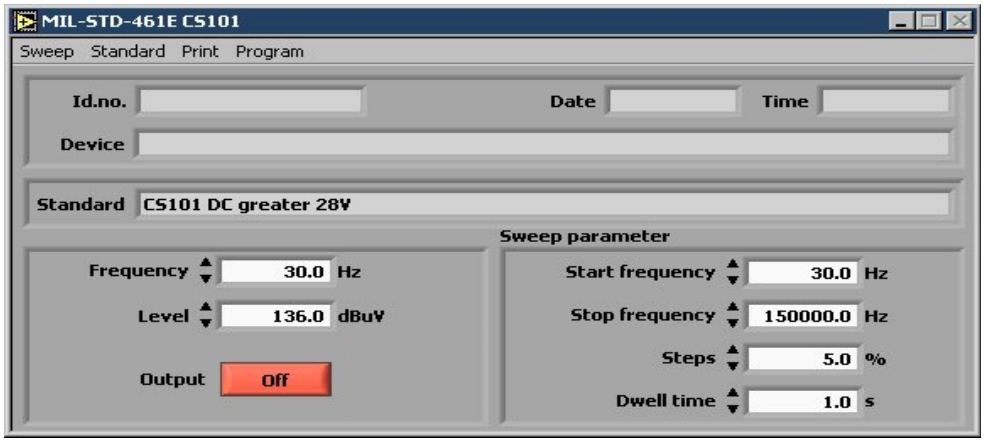
The voltage level of the disturbing signals are calibrated via a 0.5 Ω resistance connected with the secondary winding of the coupling transformer. A generator and power amplifier which generate the disturbing signal are connected to the primary windings. During the calibration the current level at each frequency is recorded.

During a test the power leads are connected in series with the secondary windings of the coupling transformer. The disturbing signal is measured on the power leads and adjusted to its desired level if possible. The signal power is limited to the current value measured during the calibration.

How to perform this susceptibility test with your MGA 1033 is described hereafter. Please note that a coupling transformer with a differential amplifier has to be used which can be ordered from our company.

❾ The calibration setup needs the primary windings of the coupling transformer connected to the X-Output 1 sockets [3]. The secondary windings are connected to a 0.5 Ω resistance. In order to measure the voltage levels at the secondary windings, connect the differential amplifier to the XLR Input [8].

❾ Select **Additional Test/MIL-STD-461E/F / CS101** in the main window. The following



window will appear:

Window for testing according to MIL-STD-461E/F CS101

Main Controls

- **Id.no** and **Device** correspond to the values entered at **Print/General Statements**. **Date** and **Time** will be updated whenever a test is started.

- The standard which should be used for the test is shown in **Standard**. Another standard file can be loaded by selecting **Standard/Load standard**. To check and/or change a level at any frequency, you can choose **Standard/Edit Standard**.

- The disturbing signal is a sine wave signal. Its **Frequency** and **Level** are determined by applying the desired values. To switch on the output relay, **Output** has to be changed to **On. Off** deactivates the output. If the coupling transformer is connected, it will be in open-loop mode at the primary coil. All these settings will be overridden if a frequency sweep should be performed.

- In **Sweep parameter** the **Start frequency** and **Stop frequency** can be changed. If a standard file is loaded, those values are the same like in the standard. The available frequency varies from 10 Hz to 250 kHz. Apart from the frequency the size of the frequency **Steps** has to be determined. Also the **Dwell time** can be adjusted.

- Before starting a test, a calibration is needed. Select **Standard/Calibration** in the menu. The current values to achieve the disturbing signal levels is recorded internally.

- After the calibration a test can be started. Therefore connect your primary windings of the coupling transformer with X-output 1 [3], the secondary winding are connected in series with one power lead. The differential amplifier of the transformer has to be connected to the XLR input [8] which allows you to measure the current voltage level of the disturbing signal on the power lead.

- A whole frequency sweep is started by clicking on **Sweep/Start sweep** in the menu. To abort click on **Sweep/Abort sweep** or **Output** (equals **Off**) in the menu.

- According to the standard, every abnormal reaction of the EUT needs to be recorded for the test report. The voltage level has to be determined which does not affect the normal operation of the EUT. The function **Sweep/Break sweep** in the menu allows to increase and decrease the signal level. The following window will open itself:

Sweep break window

- The current **Frequency** is shown in the first line of the window. **Step down** and **Step up** let the user change the frequency in the same intervals as defined in steps.

- The voltage **Level** can be adjusted in the second line. The box **Output** toggles the output **On** and **Off**.

- To continue a frequency sweep, click on ok. Abort will stop the whole sweep.

Menu Overview

All function which can be chosen in the menu are shown in this table:

MIL-STD-461E/F CS 101			
Menu	***Item***	***Shortcut***	***Function***
Sweep	Start sweep		Start the sweep according to the sweep parameter
	Break sweep		Break the sweep - open the **Sweep break** window
	Abort sweep		Abort the sweep
Standard	Load standard		Load a predefined standard
	Edit standard		Open the window **Edit CS101 standard** Several changes in the standard are possible
	Calibration		Calibrate the maximum output current
Print	General statements		Enter general data that appear on the printout
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit		Exit the software

MGA 1033

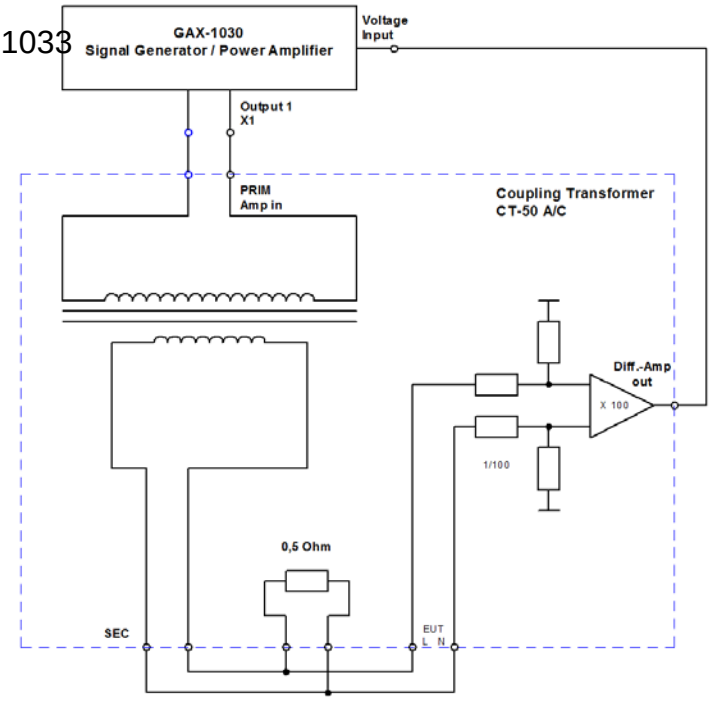


FIGURE CS101-3. Calibration

MGA 1033

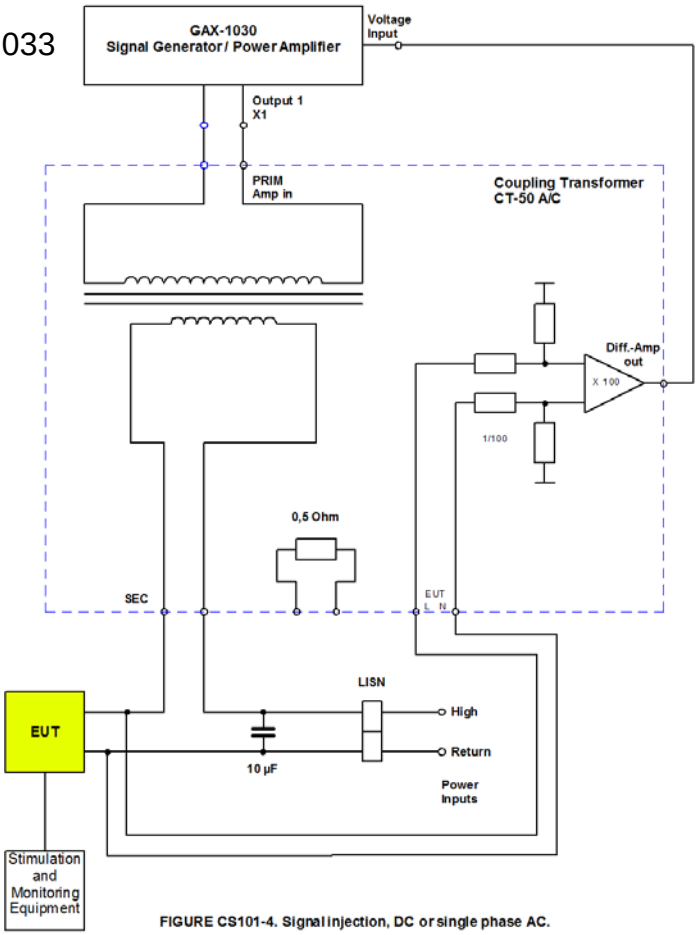


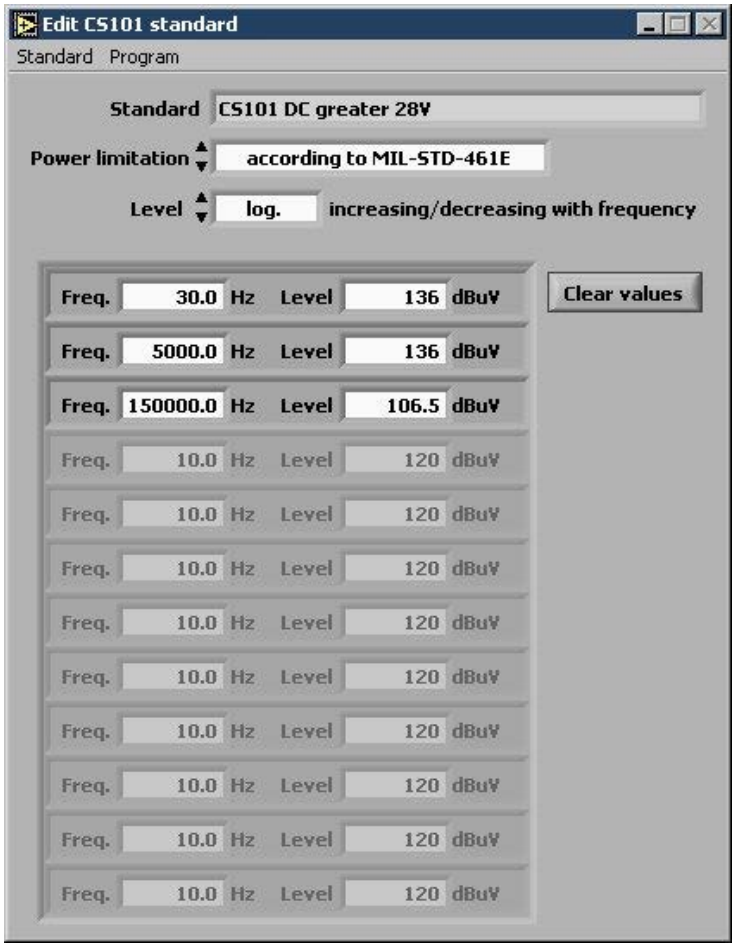
FIGURE CS101-4. Signal injection, DC or single phase AC.

How to Edit a CS101 Standard File (or Create a New One)

Sometimes different levels are needed for a susceptibility test. Therefore an existing standard file can be edited or a new one can be created. The following paragraph explains how to do this.

The **Standard/Edit standard** menu item in the window **MIL-STD-461E/F CS101** will open the following window:

Edit a standard file



A standard file with the file extension CS101 can be loaded by choosing **Standard/Load** in the menu. The file name will be shown in the box **Standard**.

- The next option is **Power limitation**. This value determines the maximum power which can be used to produce the disturbing signal. If the maximum current is limited to the calibrated value, the power limitation is **according to MIL-STD-461E/F**. **Due to max. amplifier current** allows to use the maximum power of the internal amplifier.
- Whether the **Level** should increase or decreased linear (**lin.**) or logarithmic (**log.**) is set in the next line.
- The curve which determines the level at any frequency is adjusted in the table below. It contains a frequency (**Freq.**) in **Hz** and a corresponding voltage level (**Level**) in dBµV. Every new value will be sorted automatically in an ascending order. To delete a single value, set the frequency to 0. All values are cleared by choosing **Clear values**. The frequency range is from 10 Hz up to 250 kHz. Low frequencies (< 25 Hz) result in low disturbing levels due to the coupling transformer.

The following menu items are available:

Edit CS 101 standard			
Menu	**Item**	**Shortcut**	**Function**
Standard	Load		Load a predefined standard file
	Save		Save the current standard file
Program	Info		Show program version
	Back to test		Return to **MIL-STD-461E/F CS101** window

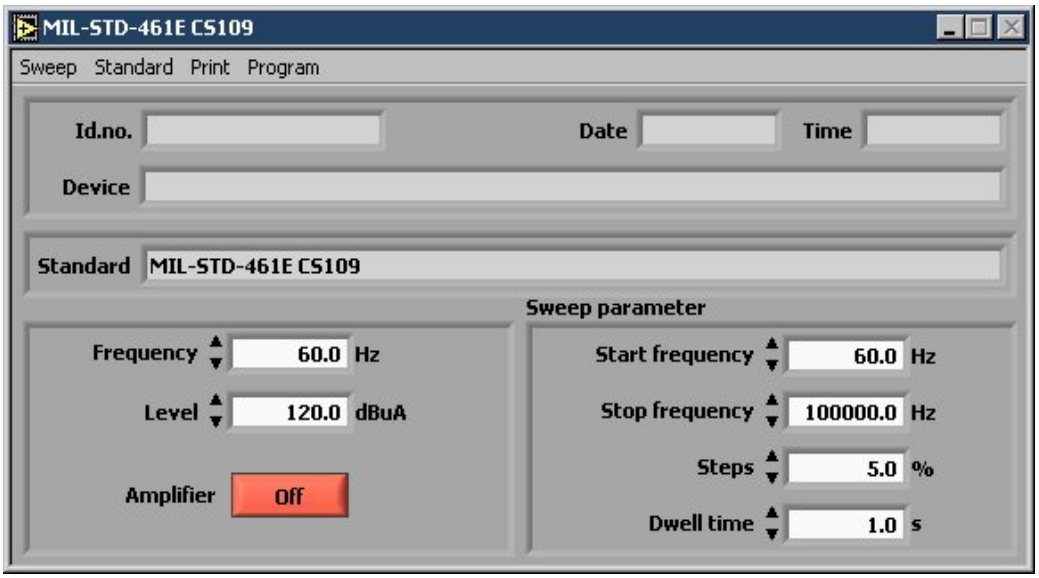
4.4 Conducted Susceptibility According to MIL-STD-461E/F CS109

This test applies to equipment which have an operating frequency range of 100 kHz or less and an operating sensitivity of 1 µV or less. The susceptibility is tested against structure current in a frequency range from 60 Hz to 100 kHz. The maximum current is 1 A (120 dBµA).

The test setup needs no special calibration. A defined current through a 0.5 Ω resistance is injected into the chassis of an EUT. EUT's power supply is isolated from any ground connection by a isolation transformer. The EUT itself is grounded via a single-point.

The EUT is in its normal operation mode while the test starts at the lowest frequency. A complete frequency sweep is performed and the EUT reactions are checked. This susceptibility test is performed with your MGA 1033 as follows:

- Connect the 50 Ω Output [6] with a 0.5 Ω resistance and the EUT.
- Choose **Additional test/MIL-STD-461E/F CS109** in the main menu of the main window. The following window will pop up:



Window for testing according to MIL-STD-461E/F CS109

Main Controls

Id.no and **Device** correspond to the values entered at **Print/General Statements**. **Date** and **Time** will be updated whenever a test is started.

The standard which should be used for the test is shown in **Standard**. Another standard file can be loaded by selecting **Standard/Load standard**. To check and/or change a level at any frequency, you can choose **Standard/Edit Standard**.

The disturbing signal is a sine wave signal. Its **Frequency** and **Level** are determined by applying the desired values. **Output** has to be changed to **On. Off** deactivates the output.

In **Sweep parameter** the **Start frequency** and **Stop frequency** can be changed. If a standard file is loaded, values defined in the standard are applied. The available frequency varies from 60 Hz to 100 kHz. Apart from the frequency the size of the frequency **Steps** has to be determined. Also the **Dwell time** can be adjusted.

- A whole frequency sweep is started by clicking on Sweep/Start sweep in the menu. To abort, Sweep/Abort sweep in the menu or Output (equals Off) .

Menu Overview

MIL-STD-461E/F CS 109			
Menu	***Item***	***Shortcut***	***Function***
Sweep	Start sweep		Start a frequency sweep
	Break sweep		Break the sweep - open the **Sweep break** window
	Abort sweep		Abort the sweep
Standard	Load standard		Load a predefined standard
	Edit standard		Open the **Edit standard** window for editing of predefined standard files and creating new ones
Print	General statements		Enter general data that appear on the printout
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit		Exit the software

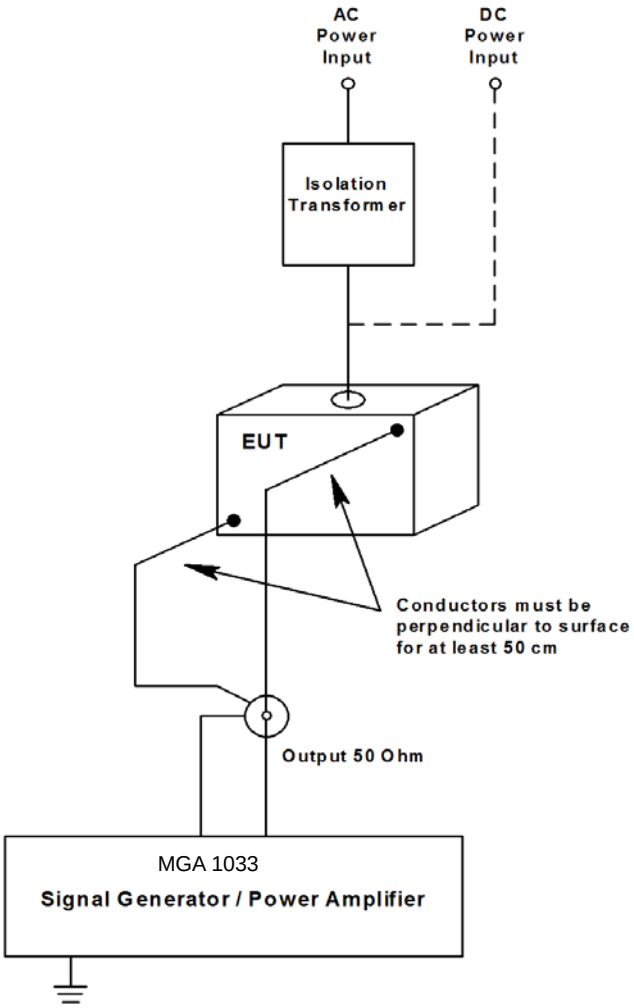
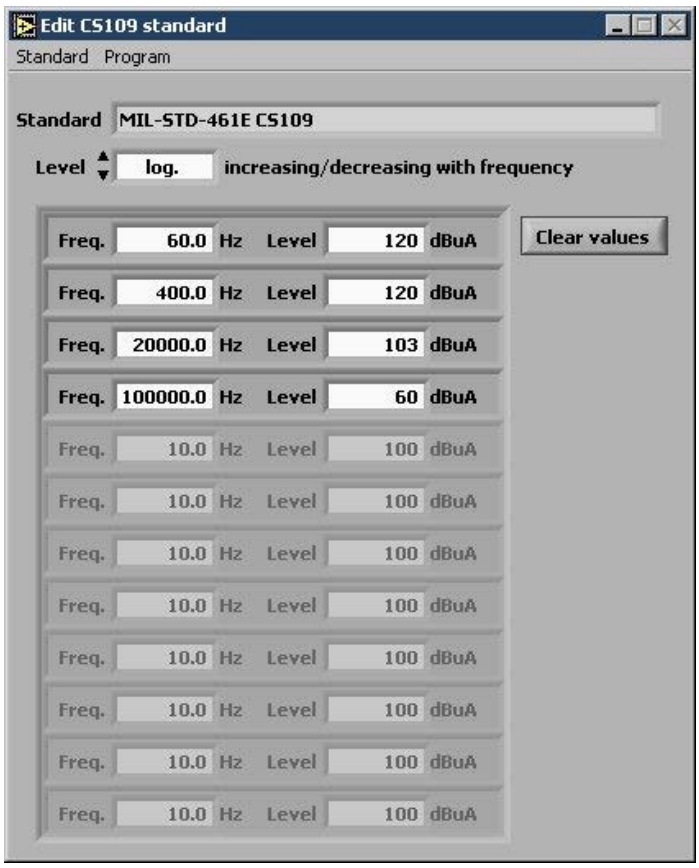


FIGURE CS109-2. Test configuration.

How to Edit a CS109 Standard file (or Create a New One)

The current which is injected into the EUT is defined in a CS109 standard file. All values can be adjusted to user-defined values over the given frequency range. How to change a standard file is shown in this paragraph:

- By clicking on **Standard/Edit standard** in the menu of the window **MIL-STD-461E/F CS109** this window will open itself:



Edit CS109 standard file

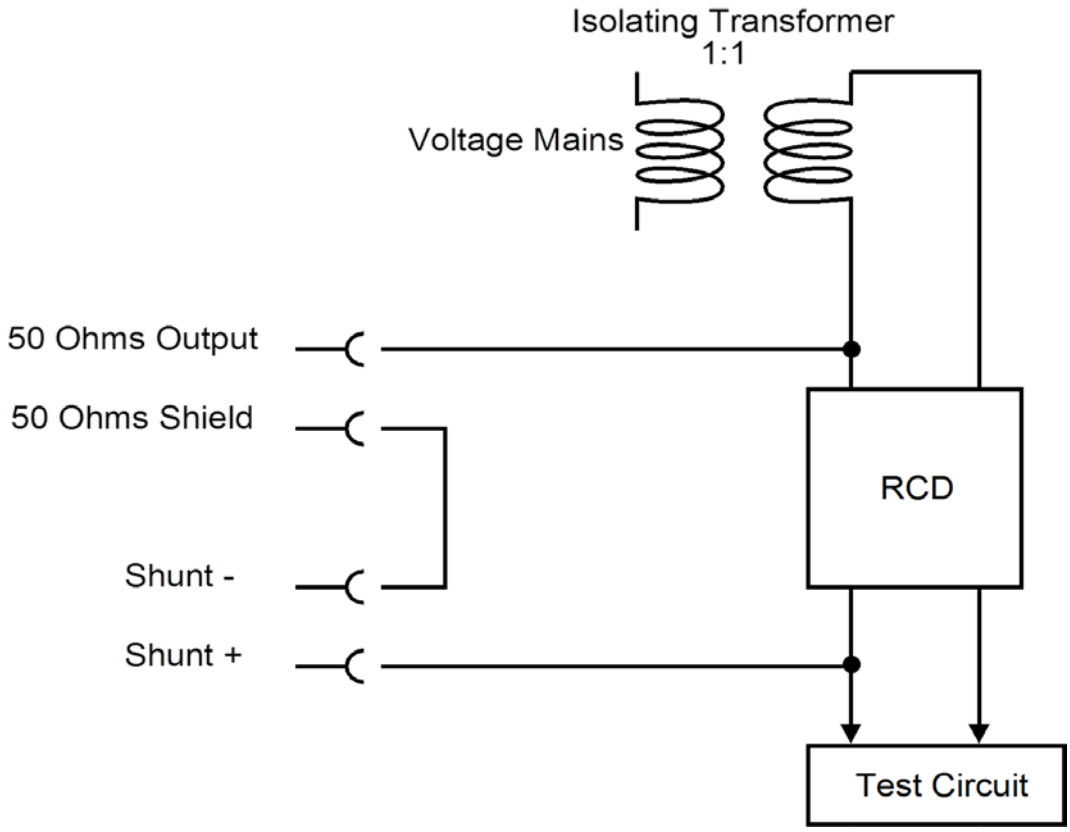
- A standard file with the file extension CS109 can be loaded by choosing **Standard/Load** in the menu. The file name will be shown in the box **Standard**.
- Whether the **Level** should increase or decreased linear (**lin.**) or logarithmic (**log.**) is set in the next line.
- The curve which determines the level at any frequency is adjusted in the table below. It contains a frequency (**Freq.**) in **Hz** and a corresponding **Level** in **dBµA**. Every new value will be sorted automatically in an ascending order. To delete a single value, set the frequency to 0. All values are cleared by choosing **Clear values**. Several menu items are available:

Edit CS 109 standard			
Menu	***Item***	***Shortcut***	***Function***
Standard	Load		Load a predefined standard file
	Save		Save the current standard file
Program	Info		Show program version
	Back to test		Return to **MIL-STD-461E/F CS109** window

4.5 Conducted Immunity Test According to IEC/EN 61543 T2.6

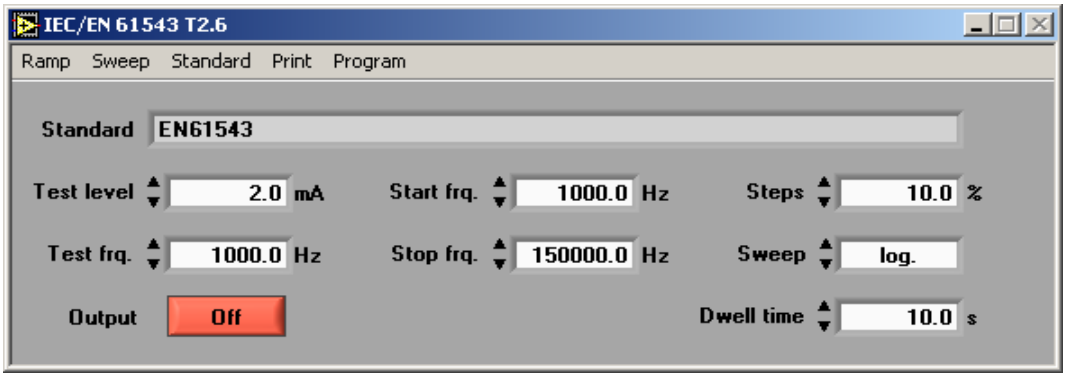
This standard deals with a conducted immunity tests at low frequencies from 10 Hz to 150 kHz. The main difference between this standard and IEC/EN 61000-4-16 is that current instead of a voltage level is induced into an RCD (residual current device). The MGA 1033 measures the actual current and controls the output current level.

❾ Connect the 50 Ω Output [6] of your MGA 1033 with your RCD. To measure the actual current, the current shunt [7] is used. It has to be connected in series to the RCD. The current will flow from the 50 Ω output into the RCD. Behind the RCD it has to be connected to the positive shunt input. The negative shunt input has to be connected to the shield of the 50 Ω output in order to close the electric circuit. Please note that a isolating transformer has to be used. The following pictures describes the right set-up:



EN 61543 Set-up

❾ Choose **Additional Tests / IEC/EN 61543 T2.6** in main menu. The shown window will open:



IEC/EN 61543 T2.6 window

Main Controls

- This window has several selections. The sweep signal can be determined by choosing the **Test level** which can be chosen from these values: 1 mA up to 500 mA
- Also the frequency range from 10 Hz up to 150 kHz for the sweep can be selected. **Startfrq.** sets the lowest frequency, **Stopfrq.** defines the highest frequency.
- **Sweep** assigns the sweep type which can be logarithmic or linear. **Steps** defines the size in percentage.
- A **Dwell time** can also be set from 1 s up to 3600 s.
- **Standard** allows a user to choose from any saved standard, even user-defined standards. If EN 61543 is chosen, all settings are made automatically according to this standard.
- Two different modes of tests are possible: Either set all output signals manually or start a sweep. During a manual test a setting list is created which are stored as long until
  Print/Reset setting list is chosen. Those values will be displayed in the report, if a report is generated by choosing **Print/Print to printer** or **Print/Print to file**.
- To start a sweep, choose **Sweep/Start sweep** in the menu. A new window will appear and ask for the test level at the lowest frequency. All further values are normalized in respect of this value.
- A sweep can be interrupted by choosing **Sweep/Break sweep** in the menu. Several steps can be performed which are similar to the IEC/EN 61000-4-16 module.

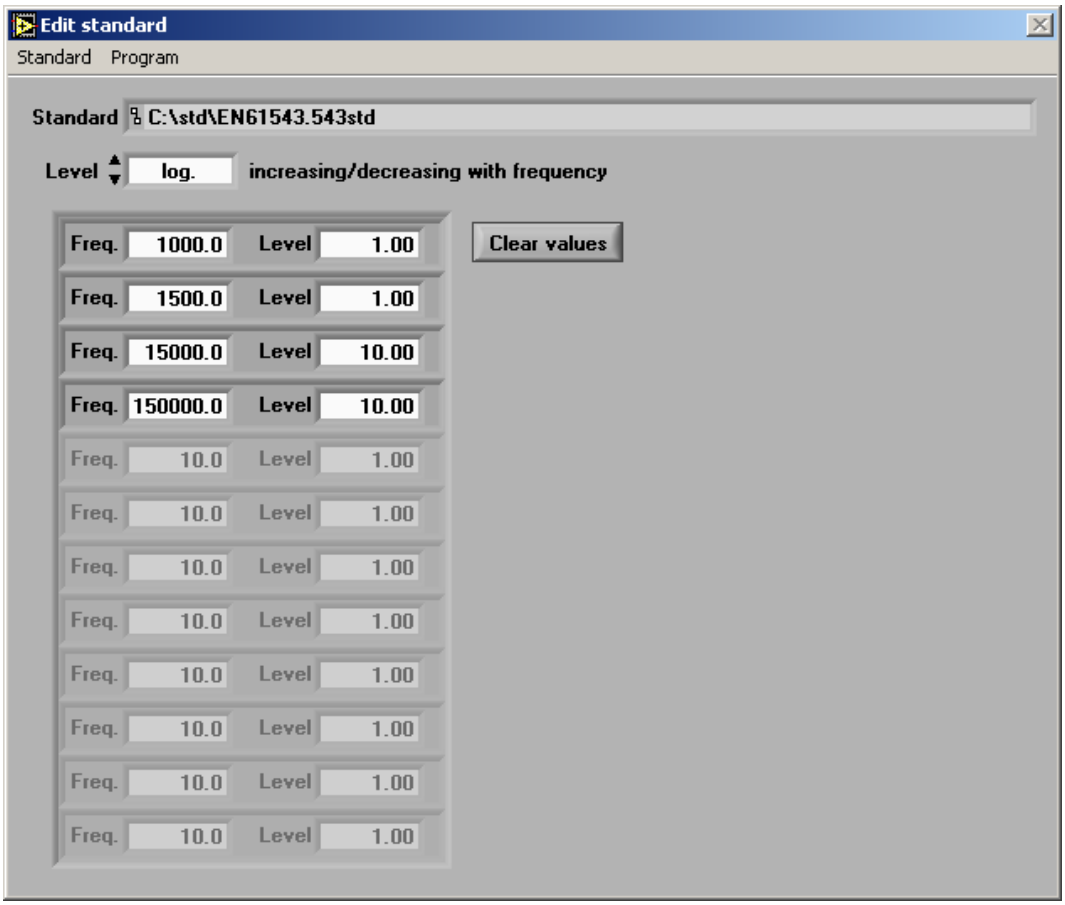
Menu Overview

IEC/EN 61543 T2.6			
Menu	**Item**	**Shortcut**	**Function**
Ramp	Start ramp		Start a ramp function - open the **Ramp** window
	Abort ramp		Stop a ramp
Sweep	Start sweep		Start a frequency sweep
	Break sweep		Break the sweep - open the **Sweep break** window
	Abort sweep		Abort the sweep
Standard	Load standard		Load a predefined standard
	Edit standard		Open the **Edit standard** window for editing of predefined standard files and creating new ones
Print	General statements		Enter general data that appear on the printout
	Reset setting list		Reset a setting list
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit		Exit the software

How to Edit a IEC/EN 61543 T2.6 Standard file (or Create a New One)

The induced voltage which is injected into an EUT is defined in a IEC/EN 61543 standard file. All values can be adjusted to user-defined values over the given frequency range. How to change a standard file is shown in this paragraph:

- By clicking on **Standard/Edit standard** in the menu of the window **IEC/EN 61543** this window will open itself:



Edit 543std standard file

- A standard file with the file extension **543std** can be loaded by choosing **Standard/Load** in the menu. The file name will be shown in the box **Standard**.
- Whether the **Level** should increase or decreased linear (**lin.**) or logarithmic (**log.**) is set in the next line.
- The curve which determines the level at any frequency is adjusted in the table below. It contains a frequency (**Freq.**) in **Hz** and a corresponding **Level**. Level values are normalized values of the chosen test level in the EN61543 window, e.g. 0.10 will generate an output voltage of 1 mA, if a test level of 10 mA is chosen. Every new value will be sorted automatically in an ascending order. To delete a single value, set the frequency to 0.
  All values are cleared by choosing **Clear values**.

Several menu items are available:

Edit IEC/EN 61543 T2.6			
Menu	***Item***	***Shortcut***	***Function***
Standard	Load		Load a predefined standard file

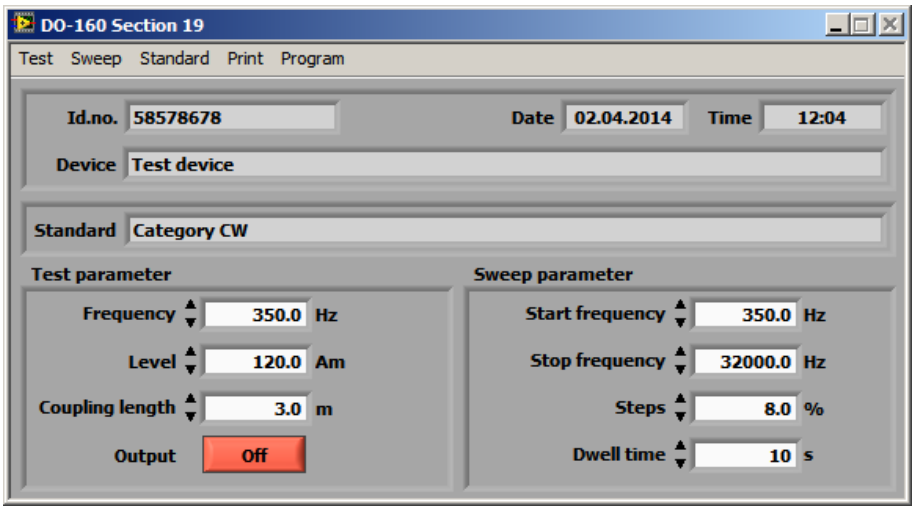
Edit IEC/EN 61543 T2.6			
	Save		Save the current standard file
Program	Info		Show program version
	Back to test		Return to **IEC/EN 61543 T2.6** window

4.6 Induced Signal Susceptibility (DO-160 Section 19) with ISS-19 test device (Option)

Magnetic Fields Induced Into Interconnecting Cables / Equipment

Subject the interconnecting wire bundle of the equipment under test or the equipment under test to an audio frequency magnetic field as illustrated in the corresponding figures of DO-160 Section 19.

- Connect the ISS-19 coupling device to your GAX-1030
- Choose **Additional test/DO-160 Section 19** at the amplifier control panel. The following window appears.
- Choose **Test/Magnetic field**



Main Controls

- **Id.no** and **Device** display the information that was entered at **Print/General statements**.
- **Date** and **Time** display date and time when a test is started.
- **Standard** shows the predefined standard file.

Options in **Test parameter**:

- Enter a **Frequency** in Hz from 350 Hz to 32 kHz.
(While a sweep is running, the current frequency is displayed in this box)
- Enter the **Level** from 0,3 to 120 Am @ 3m coupling length.
- Choose the **Coupling length** from 1 – 10m
(For coupling length = 1 level units change from Am to A)

- Switch the Amplifier **Output** either **On** or **Off**.

These different settings are available in **Sweep Parameter:**

- Enter a **Start frequency** in Hz from 350 Hz.
- Enter a **Stop frequency** in Hz up to 32 kHz.
- Enter the **Steps** from 0,1% to 100%
- Enter a Dwell time in s from 1 to 3600 s.

Menu Overview

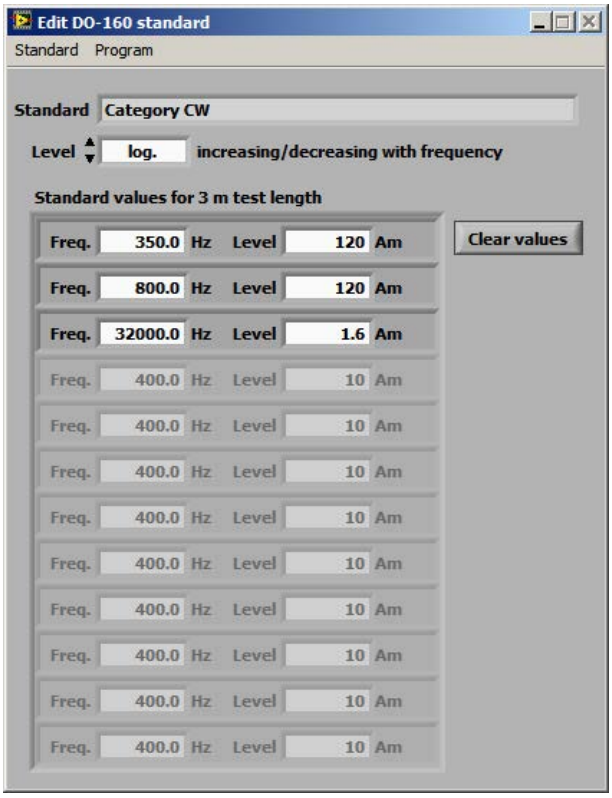
The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

Magnetic field measurement		
Menu	**Item**	**Function**
Test	Magnetic field	Magnetic field test
	Electric field	Electric field test
Sweep	Start sweep	Start the sweep according to the sweep parameter
	Break sweep	Break the sweep - open the **Sweep break** window
	Abort sweep	Abort the sweep
Standard	Load standard	Load a predefined standard
	Edit standard	Open the **Edit standard measurement** window for editing of predefined standard files and creating new ones
Print	General statements	Enter general data that appear on the printout afterwards
	Test level graph	Print Test level graph
	Print to file	Create a doc-file and a jpg-file with the graph
	Print to printer	Print measurement to printer
	Printer selection	Choose the desired printer
Program	Info	Show program version
	Main menu	Return to main menu (Generator/Amplifier control panel)
	Quit	Exit the software

How to Edit a Predefined Standard (or Create a New One)

The following chapter explains how to edit or create standard files for DO-160 Section 19 tests.

- Choose **Standard/Edit standard** at the menu bar. The following window appears:



- **Standard file**:

1) leave this box empty if a new standard file is created
2) load the file you want to edit by clicking on **Standard/Load**

Level Curve Parameter:

- Enter whether the **Level** should increase/decrease **lin.** or **log.** with frequency.
- Enter up to 12 sets of frequency (**Frq.**) and **Level** values. The entries are sorted automatically by frequency. **Frq.** = 0 clears the line.
- Press the **Clear values** button to clear all values at once.
- Save the edited or new created standard file by clicking on **Standard/Save**.
- Return to the **DO-160 Section 19** window by clicking on **Program/Back to test**.

The menu bar contains the main commands. The following table explains each menu item on the menu bar in order from left to right:

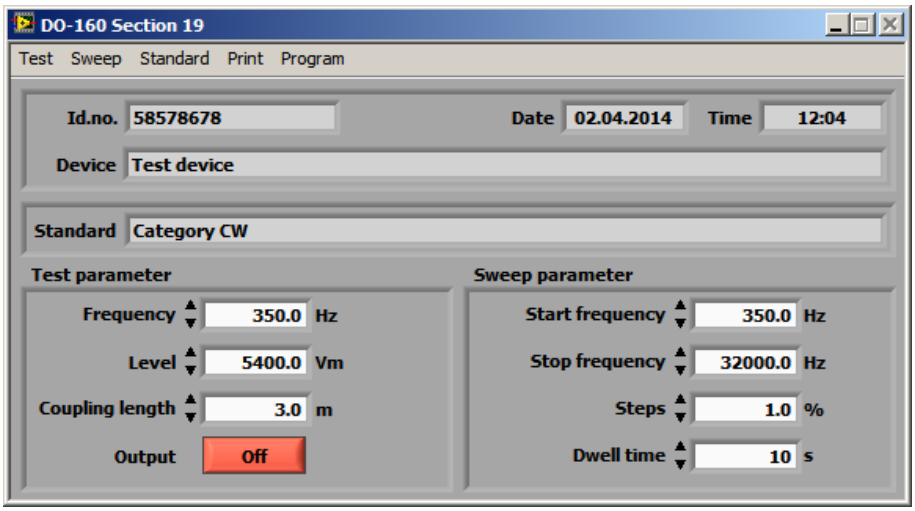
Edit standard generation			
Menu	**Item**	**Shortcut**	**Function**
Standard	Load		Load a predefined standard file
	Save		Save the current standard file

Edit standard generation			
Program	Info		Show program version.
	Back to test		Return to **DO-160 Section 19** window

Electric Fields Induced Into Interconnecting Cables / Equipment

Subject the interconnecting wire bundle of the equipment under test or the equipment under test to an audio frequency electric field as illustrated in the of DO-160 Section 19.

- Connect the ISS-19 coupling device to your GAX-1030
- Choose **Additional test/DO-160 Section 19** at the amplifier control panel. The following window appears.
- Choose **Test/Electric field**



Main Controls

- **Id.no** and **Device** display the information that was entered at **Print/General statements**.
- **Date** and **Time** display date and time when a test is started.
- **Standard** shows the predefined standard file.

Options in **Test parameter**:

- Enter a **Frequency** in Hz from 350 Hz to 32 kHz.
(While a sweep is running, the current frequency is displayed in this box)
- Enter the **Level** from 30 to 6000 Vm @ 3m coupling length.
- Choose the **Coupling length** from 1 – 10m
(For coupling length = 1 level units change from Vm to V)
- Switch the Amplifier **Output** either **On** or **Off**.

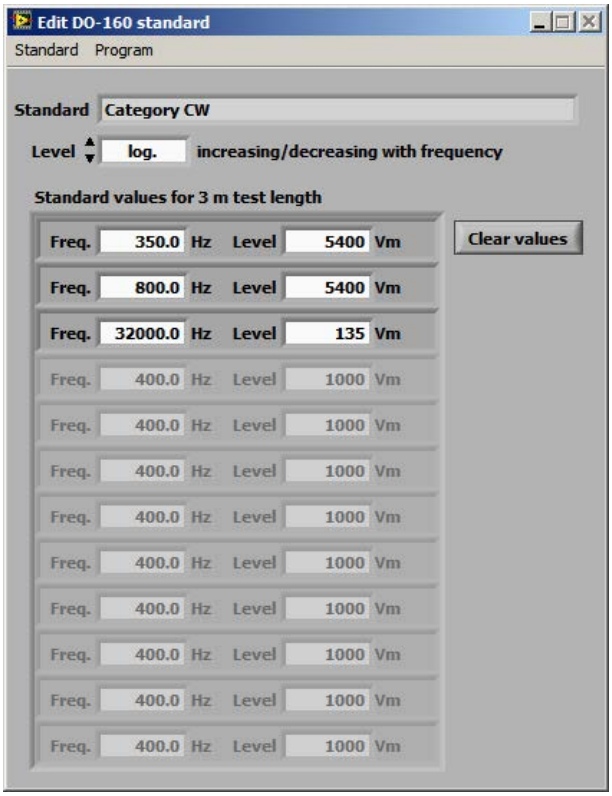
These different settings are available in **Sweep Parameter:**

- Enter a **Start frequency** in Hz from 350 Hz.
- Enter a **Stop frequency** in Hz up to 32 kHz.
- Enter the **Steps** from 0,1% to 100%
- Enter a **Dwell time** in s from 1 to 3600 s.

How to Edit a Predefined Standard (or Create a New One)

The following chapter explains how to edit or create standard files for DO-160 Section 19 tests.

- Choose **Standard/Edit standard** at the menu bar. The following window appears:



Standard file: 1) leave this box empty if a new standard file is created
2) load the file you want to edit by clicking on **Standard/Load**

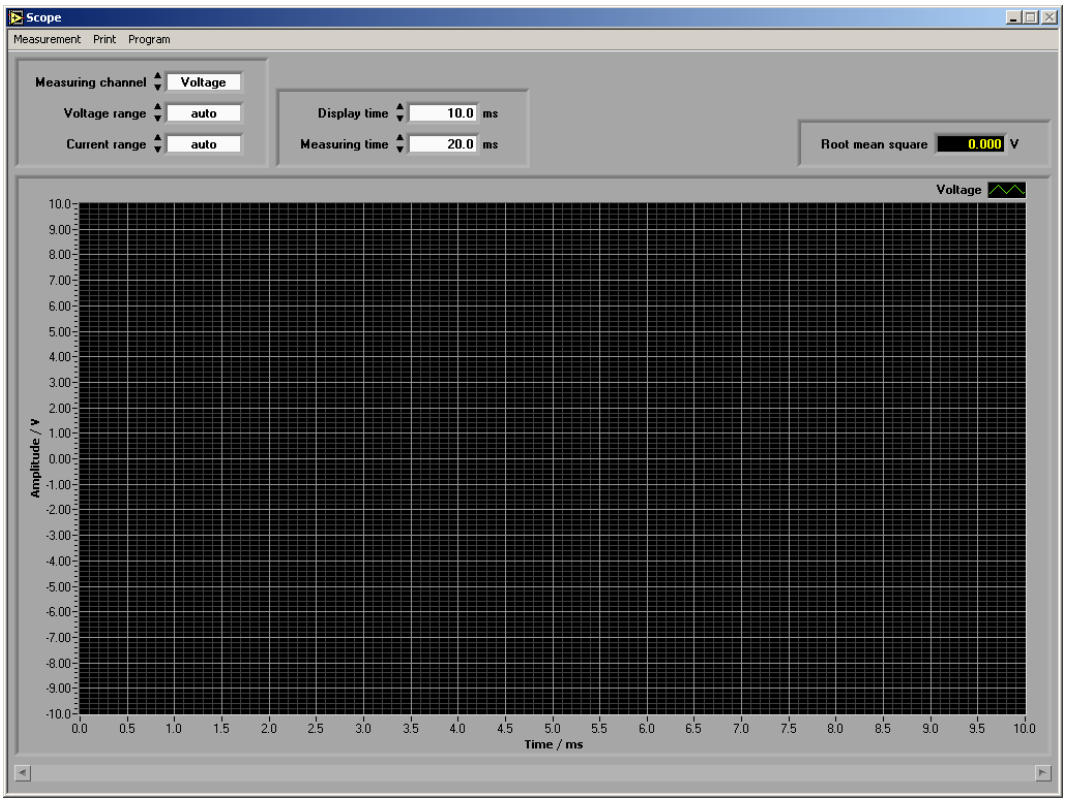
Level Curve Parameter:

- Enter whether the **Level** should increase/decrease **lin.** or **log.** with frequency.
- Enter up to 12 sets of frequency (**Frq.**) and **Level** values. The entries are sorted automatically by frequency. **Frq.** = 0 clears the line.
- Press the **Clear values** button to clear all values at once.
- Save the edited or new created standard file by clicking on **Standard/Save**.
- Return to the **DO-160 Section 19** window by clicking on **Program/Back to test**.

5.1 How to Use The Scope Mode

The scope mode allows you to use the internal oscilloscope as a stand-alone device. How to use this mode is described in this chapter.

- Connect your measuring device to the XLR input jack [8] for voltage measurements or the current shunt [7] for current measurements.
- Choose **Voltage/Current /Scope mode** in the main window to open the scope window.



Scope window measuring a sine wave

- **Measuring channel** is used for choosing between measuring either **Voltage** or **Current**.
- Choose the **Voltage range** for voltage measurements. This can be one of these ranges:
  100V, 10V, 1V, 100mV, 10mV.
  A **auto** range is also available. This will try to determine the range by starting a pretest. No further adjustments are done later. The range determines the maximum amplitude.
- For measuring current the **Current range** needs to be chosen. Like the voltage range, the program can choose a suitable range using **auto** or between these maximum amplitudes:
  20A, 10A, 1A, 100mA, 10mA, 1mA. Three shunts are available for those ranges: current measurements for 20A and 10A use a 10 mΩ shunt, 1A and 100 mA a 1Ω shunt and lower ranges a 100Ω shunt.
- All measured data will be displayed in the graph.

- The **Measuring time** determines the measured time span of the signal. The **Display time** allows a user to change the displayed time window, though all measured data is available by using the bottom scroll bar (only when Display time < Measuring time).
- On the upper right the **Root mean square** over the measured time is shown.
- After selecting all values, measurement is started by choosing **Measurement/Acquire once**. The measured values are display in the window. If **Measurement/Acquire on** is selected, the display needs a trigger and the values are updated synchronous to this trigger. This can either be internal or external. An external trigger is connected to the TTL/CMOS input [18]. The program will wait for an external trigger indefinetly because there is no time-out. By choosing **Measurement/Acquire off** or pressing ESC the measurement is stopped.

Menu Overview

All menu items are described in the following table:

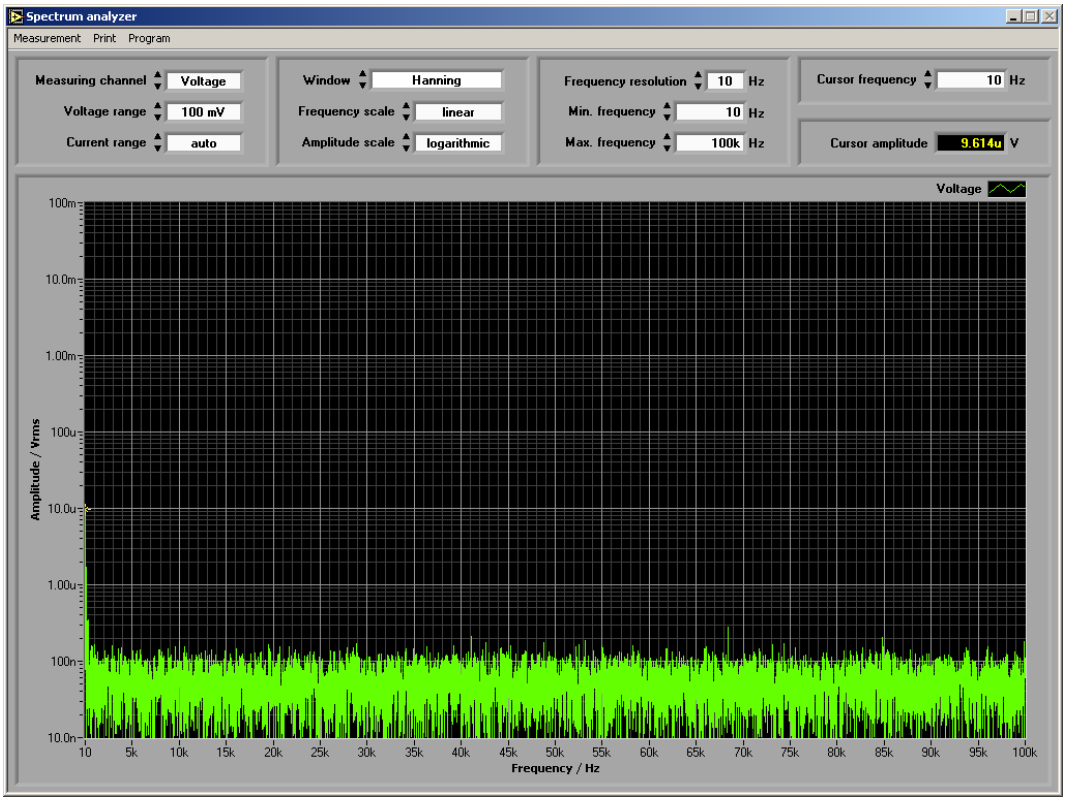
Scope mode			
Menu	***Item***	***Shortcut***	***Function***
Measurement	Acquire once		Scope measures once and displays data
	Acquire on		Scope measures continuously using a trigger signal
	Acquire off		Stop the continuous measurement
	Internal trigger		Internal trigger (default setting, external trigger disabled)
	External trigger		Choose External trigger if an external trigger is connected; Disables internal trigger
Print	General statements		Enter general data that appear on the printout afterwards
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit	Ctrl+q	Exit the software

5.2 How to Use The Spectrum Analyzer Mode

Another feature of the MGA 1033 is a built-in spectrum analyzer. How to use the spectrum analyzer mode is described hereafter.

- Connect your measuring device to the XLR input jack [8] for voltage measurements or the current shunt [7] for current measurements..
- Choose **Voltage/Current /Spectrum analyzer** in the main window to open the spectrum analyzer window.
- **Measuring channel** is used for choosing between measuring either **Voltage** or **Current**. The **Voltage range** and **Current range** provides the same functionality like in scope mode.

Spectrum analyzer window with maximum measured at 10kHz



- The analyzer uses a FFT to calculate the spectrum. Therefore a window function can be applied. The following window functions are available: **Hanning, Hamming, Blackman-Harris, Exact Blackman, Blackman, Flat top, 4 Term B-Harris, 7 Term B-Harris, Low Sideglobe**. It is also possible to select **none** of these.
- **Frequency scale** and **Amplitude scale** are both changeable between **linear** and **logarithmic**.
- The frequency range can be determined by **Min. frequency**, **Max. frequency** and **Frequency resolution**. The resolution can vary between these values: **1, 2, 5, 10, 20, 50, 100** Hz. The lowest frequency is determined by the frequency resolution, the upper frequency can be 250 kHz.
- As in the scope mode, measurement is started once using **Measurement/Acquire once**. Continuous measurement starts choosing **Measurement/Acquire on**. The needed trigger can either be internal or external. The program will wait for an external trigger because there is no time-out. By choosing **Measurement/Acquire off** or pressing ESC the measurement is

stopped.

- All measured data is displayed in the graph.
- ❾ After every measurement the cursor is shifted to the highest amplitude over the frequency range. This cursor can be sweep through the frequency range changing values at **Cursor frequency**. The actual amplitude is shown in **Cursor amplitude**.

Menu Overview

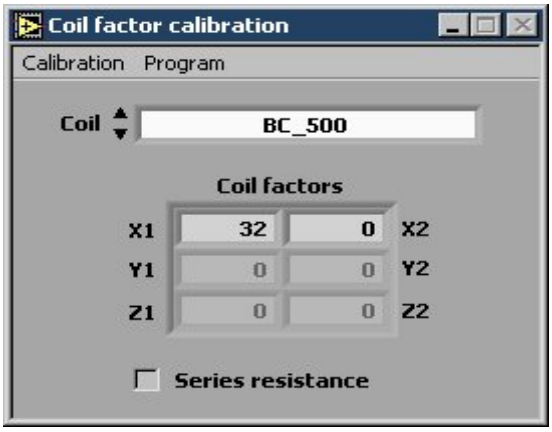
Spectrum analyzer mode			
Menu	***Item***	***Shortcut***	***Function***
Measurement	Acquire once		Analyzer measures once and displays data
	Acquire on		Analyzer measures continuously using a trigger signal
	Acquire off		Stop the continuous measurement
	Internal trigger		Internal trigger (default setting, external trigger disabled)
	External trigger		Choose External trigger if an external trigger is connected; Disables internal trigger (Firmware ≥ 1.3)
Print	General statements		Enter general data that appear on the printout afterwards
	Print to printer		Print measurement to printer
	Print to file		Create a doc-file
	Printer selection		Choose the desired printer
Program	Info		Show program version
	Main menu		Return to main menu
	Quit	Ctrl+q	Exit the software

5.3 How to Determine the Coil Factor of an Unknown Radiating Coil

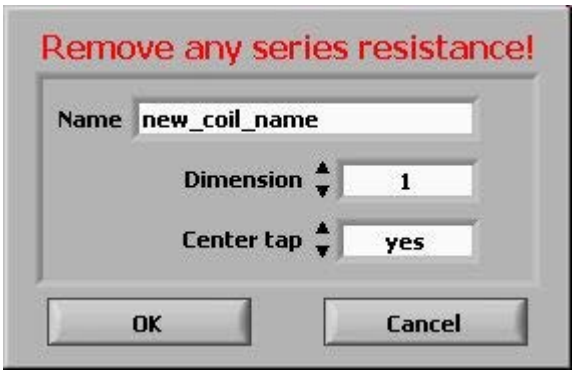
This function can determine the coil factor of an unknown radiating coil. In order to measure a coil factor a loop sensor and a corresponding LSCAL file are required. Factory calibrated coils are already factory calibrated, a calibration file is provided. Please note that the accuracy of those values is better than using the MGA 1033 due to high precision measurement equipment.

- Choose **Calibration/Coil factor calibration** in main menu.
  The following window will pop up.

Main window for coil factor calibration



- Connect the coil with MGA 1033. If the coil has only one axis and no mid-tap point, connect to X-output 1 socket [3] without using the mid-point tap. If it has more than one axis and mid-point taps, use also the Y-output 1 socket [4] and the Z-output 1 socket [5] including taps (if possible). Do not connect any further series resistance because it would falsify the measured coil factors.
- Connect a suitable loop sensor to XLR input jack [8]. If the radiating coil is a Helmholtz coil, the loop sensor needs to be placed exactly in the middle of the coil. For any other coil, refer to the handbook of the loop sensor and the radiating coil. In any case the loop sensor has to be smaller than the radiating coil.
- Select **Calibration/Loop sensor** and choose the calibration data for the connected loop sensor.



Define name and coil parameters here

- Select **Calibration/Coil factor calibration** and a new window opens. The coil factor determination needs information about the number of axes (**Dimension**) and whether a **center tap** is available or not. The first line **Name** determines the name of the coil and its corresponding calibration file. A new file will be created, if a calibration file does not exist. By clicking **OK** the coil factor and maximum field strength are determined and saved in a calibration file. For more than one axis several user actions are required. Follow the instructions on the

screen.

- Sometimes very low magnetic field strengths have to be generated. Therefore it is possible to use a series resistance. If a radiating coil without a mid-point tap should be used with a series resistance, the option **Series resistance** should be selected. The resistance should be connected to the X-output 2 jacks (see figure 1). The calibration setup for coils with a mid-point tap is shown in figure 2. To generate a corresponding calibration file, choose **Calibration/Determine field range**. The program will determine the field range and allow to save the data in a new RLCAL file.
- All radiating coils with a corresponding calibration file can be checked in the **Coil factor calibration** window. Choose the desired coil in **Coil** and the measured values are displayed in **Coil factors.**

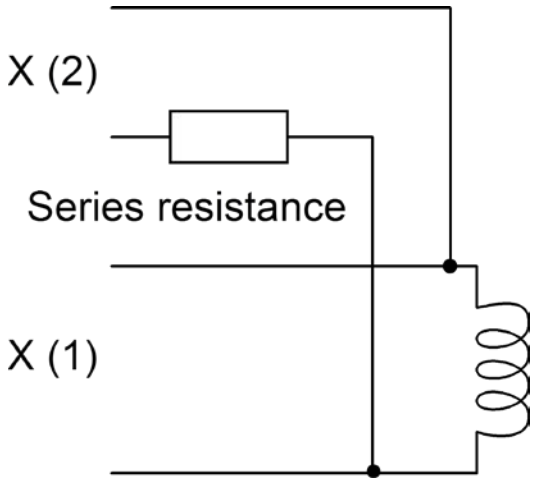


Figure 1: Series resistance without mid-point tapped coil

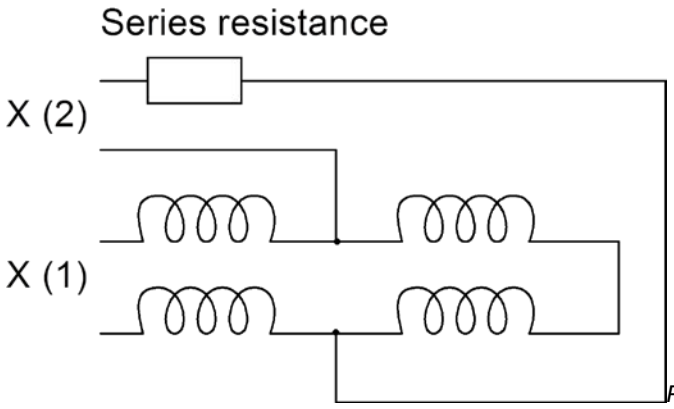


Figure 2: Series resistance with mid-point tapped coil

All menu commands are listed in the following table:

Coil calibration			
Menu	***Item***	***Shortcut***	***Function***
Calibration	Loop Sensor		Select loop sensor
	Coil factor calibration		Determine coil factor
	Determine field range		Determine maximum field strength

Coil calibration			
Program	Info		Show program version
	Main menu		Return to main menu
	Quit	Ctrl+q	Exit the software

5.4 Self Calibration of The MGA 1033

Your MGA 1033 is delivered factory calibrated. Self calibration is usually not necessary.

It may be useful to recalibrate the device after large variations of temperature.

- The MGA 1033 shall warm up approx. 30 min.
- Choose **Calibration/Self-Calibration** at the Magnetic field measurement window. (The self calibration process takes approx. 1 min).

Self calibration determines offset and frequency response of the generator, voltage inputs and anti-aliasing filter. All values are saved into EEPROM. Subsequent self calibrations will overwrite these data. Only a factory calibration will change any current measurement calibration data.

5.5 How to Format the Printout

In each part of the program you choose **Print/Print to Printer** to receive a hardcopy of your measurements (or **Print/Print to file** to receive a file). Before the data is sent to the printer a preview appears on your monitor. You may edit this preview, i.e. you may add additional text, add or delete lines etc.

For permanent amendments of the printout you may edit the PRN-files in the directory **MGA1033/doc** with any editor. The PRN-files represent templates for the printout.

It is recommended to save a copy of each PRN-file before editing.

Variables are set into pointed brackets, e.g. the variable <Date> represents the date of the day.

For the printout of magnetic field measurement the following variables may be used:

Printout of magnetic field measurement	
Variable	**Explanation**
<Id-no>	Identity number
<Device>	Name of the device
<Company>	Name of the company
<Test_engineer>	Name of the test engineer
<Operating_mode>	Operating mode of the EUT
<Time>	System time at test
<Date>	System date at test
<Standard>	Name of the standard file
<Standard_path>	Path of the standard file
<Loop_sensor>	Name of the loop sensor file
<Loop_sensor_path>	Path to the loop sensor file
<Time_window>	Description of the time window
<Scans>	Prints a table of scans
<Limits>	Prints a table of the limits
<Results_x>	Prints a table with x results; x may vary from 1 to 50

Printout of magnetic field continuous generation	
Variable	***Explanation***
<Id-no>	Identity number
<Device>	Name of the device
<Company>	Name of the company

Printout of magnetic field continuous generation	
<Test_engineer>	Name of the test engineer
<Operating_mode>	Operating mode of the EUT
<Time>	System time at test
<Date>	System date at test
<Level>	Test level
<Frequency>	Test frequency
<Dimension>	Dimension of the radiating loop
<Unit>	Unit of the test level
<Coil>	Name of the radiating loop
<Coil_path>	Path to the radiating loop cal-file

Printout of magnetic field short term generation	
Variable	*Explanation*
<Id-no>	Identity number
<Device>	Name of the device
<Company>	Name of the company
<Test_engineer>	Name of the test engineer
<Operating_mode>	Operating mode of the EUT
<Time>	System time at test
<Date>	System date at test
<Unit>	Unit of the test level
<Coil>	Name of the radiating loop
<Coil_path>	Path to the radiating loop cal-file
<Field>	Maximum field strength during the test

Printout of DO-160 Section 19 tests	
Variable	**Explanation**
<Id-no>	Identity number
<Device>	Name of the device
<Company>	Name of the company

Printout of DO-160 Section 19 tests	
<Test_engineer>	Name of the test engineer
<Operating_mode>	Operating mode of the EUT
<Time>	System time at test
<Date>	System date at test
<Standard>	Name of the standard file
<Standard_path>	Path of the standard file
<Start_freq.>	Start frequency
<Stop_freq.>	Stop frequency
<Steps>	Steps
<Dwell_time>	Dwell time
<Coupling_length>	Coupling length

6.0 Specifications

Voltage input (Analyzer)	
Frequency range	DC - 250 kHz
Input impedance	1MΩ / 50 Ω (changeable by user)
Connector	XLR, unbalanced (1 ground, 2 +, 3-)
Max. input voltage	100V continuous 10 V bei 50 Ω
Gain	-20/0/20/40 dB pre-amplifier 0/20 dB ADC amplifier Self-calibration with ultra-stable onboard reference
Current input	
Frequency range	DC - 250 kHz
Shunts	10mΩ / 10Ω
Max. input current	20A continuous (overload protection) 1 Ω and 100 Ω shunt is protected by additional 1,5A fuse
Connector	4mm safety jack (+, -) measurement via insulation amplifier
Measurement range	20A, 10A, 1A, 100mA, 10mA, 1mA automatic offset and gain Self-calibration with ultra-stable onboard reference
AD converter	
Resolution	16 Bit
Sampling rate	1 MSPS
Aliasing filter	0.01dB Tschebyscheff filter, fg=260kHz; filter may be switched off
Generator	
Frequency range	DC - 250 kHz
Connector	BNC, unbalanced
Signal types	Sine wave / rectangle / triangle / DC
Amplitude	0 – 10V AC, -10V - +10V DC
Resolution	12 Bit (2.5 mV) -20 dB output attenuator available Self-calibration with ultra-stable onboard reference
Amplifier	
Frequency range	DC - 1MHz

Connector	4mm safety jacks (output) BNC, unbalanced (input)
Current	16 Arms
Voltage	50 Vrms
Distortion (DC – 100 kHz, load ≥ 4 Ω)	0.10%

General Data	
EUT monitor / serial port	9-pin Sub-D; RS232
Connection to PC	USB
Operating temperature	0° - 40° C
Warm-up time	15 min
Housing	19'' sub-rack
Width / height / depth	449 mm / 177 mm / 580 mm
Weight	Approx. 34 kg

Factory Calibration

To ensure accuracy the MGA 1033 shall be factory calibrated every year.

Appendix

DLL Measurement

The DLL measurement allows a user to use its own measuring within the program. In order to establish data transfer from the measurement device to the MGA 1033 a DLL needs to created. It has to be a Microsoft Windows DLL with only one function which is used by the program:

double measure(**void**)

This function is called by the program and the return value should be the current value seen at the measurement device. Due to its simple structure this function is called ever y time a frequency step has taken place.