Manual

for Operation

Continuous Wave Simulator

CWS 500N2
CWS 500N2.1

Compact RF simulator for BCI, Stripline and TEM cell applications. 9kHz – 400MHz (1000MHz)

The CWS500N2 is the state of the art solution in a compact one-box design to test immunity to conducted disturbances induced by radio frequency fields. The CWS500N2 includes signal generator, RF amplifier directional coupler, 3 channel power meter, software and GPIB interface.
The integrated amplifier can also be controlled using external signal generators. The icd.control software supports the test routines and controls external measuring devices.

- ISO 11452 part 4
- ISO 11452 part 5
- RTCA DO 160D
- Mil 461 CS 114
- EN/IEC 61000-4-6
- various automotive manufacturer's specifications

the benchmark for emc

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Contents

1. Safety Aspects

Before using the CWS 500 N2 read the following manuals carefully :

- Safety requirements manual
- Manual for operation CWS 500N2

2. Setup the CWS 500N2

2.1. Connections CWS 500N2

Below are all possible connections to the CWS 500N2

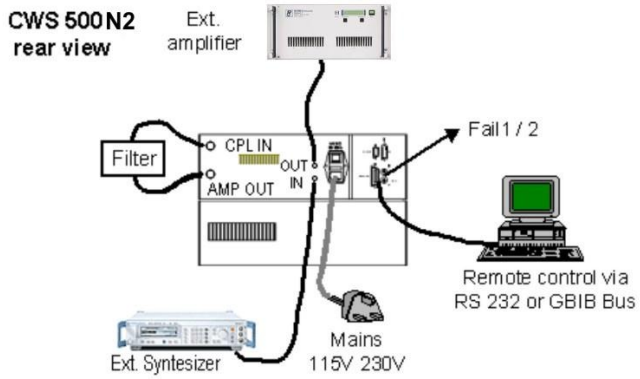


Fig 2.2 : CWS 500N2 (1 GHz) connection rear view

2.2. Test Setup CWS 500N2

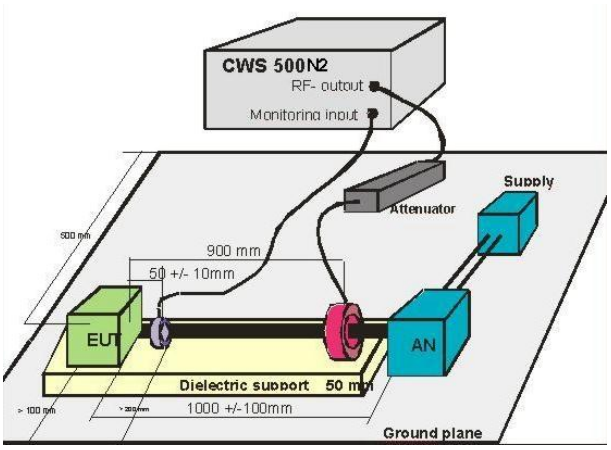


Figure 2.3a / 2.3b : Typical test setup with required parts for BCI application with CWS 500N2

2.3. Part Identifications and Functions

Continuous Wave Simulator CWS 500N2 1GHz

Fig 2.4

2.3.1. Clamp Applications for Automotive standards

Fig 2.5

Bulk Current Injection Clamp BCI type (selection of clamps)

F-130-A1	10kHz – 400MHz
F-120- 6A	10kHz – 400MHz
FCC-BCICF-1	Calibration Fixture for BCI clamp (jig)
F-140A	100kHz - 1000 MHz
FCC-BCICF-2	Calibration Fixture for BCI clamp (jig)

Fig 2.6

Current Monitor Probe

F-33-2	1kHz – 250MHz
F- 55	10kHz – 500MHz
F- 65	100kHz - 1GHz

Fig 2.7

Attenuator 3dB optional

Type ATT3/100

3dB 100W

Fig 2.8

Attenuator 20dB (for DO and MIL application)

Type ATT20/100

20dB 100W

Fig 2.9

Attenuator 20dB

20dB 15W

Fig 2.10

Terminating resistor 50 Ohm optional

50 Ω 6W

2.3.2. CDN Applications as per IEC 61000-4-6

Fig 2.11

Bulk Current Injection Clamp BCI type

F-120-9A 10kHz – 230MHz

FCC-BCICF-4 Calibration Fixture for BCI clamp (jig)

Fig 2.12

Attenuator 6 dB / 75W

Fig 2.13

Coupling / Decoupling Network

Types:

CDN-M 1; M 2; M 3; M4; M 5;
CDN-S1-50/75Ω; S 2; S 4; S 9; S 15; S 25; S68
CDN-T 2; T 4; T 2-RJ11; T8-RJ45;
CDN-AF 2; AF 3; AF 4; AF 8

Fig 2.14

EM Clamp

Type EM 101

Fig 2.15

Calibration

CWS-Cal Basic Calibration Kit
Transport Case
150Ω to 50Ω Adapter
BNC cable 0.5m

Cal adapter according to CDN ,

Fig 2.16

Adapter

R100N 150Ω to 50Ω Adapter

R100A 150Ω to 50Ω Adapter for Current Clamp CAL Fixture

3. Operating Functions

3.1. Front View

Fig 3.1

1. Display
2. Function keys "F1..F7"
3. "Test On"
4. Knob (Inc / Dec)
5. Cursor keys "←" and "→"
6. Exit
7. Escape
8. RF Output
9. LED RF Output Monitor
10. Current Probe Input (Monitor)
11 LED Current Probe Input

1 Display
All functions and parameters are displayed (8 lines with max. 40 characters).

2 Function Keys "F1 .. F7"
Parameters and functions displayed in the lowest line and functions displayed with ” F “, can be selected with the related function key.

3 Test On
By pressing the key "TEST ON", the RF signal will be released and the test procedure can be started.

4 Knob (Inc / Dec)
This knob increments or decrements parameters with a numeric value or selects parameters from a list.

5 Cursor Key
Parameters and functions can be changed during the test. The selection of these parameters is done with the cursor, moving it to the left or to the right.

6 EXIT
The EXIT button resets the firmware to the main menu. This is only possible, if no test routine is running.

7 ESC
The ESC button returns back to the previous level in the menu.

8 RF-Output
At this output the RF power is available. The 3dB-attenuator is connected, if available, via coaxial cable. For conducted tests together with CDN’s, EM clamps or current injection clamps, it may be suggested to load the simulator with a matched 50 ohm load. In case the above mentioned coupling device may not represent such matched load, then it is recommended to add a 3dB attenuator in between.

9 LED RF Output Monitor
When the RF output is active this LED on the front panel is illuminated to indicate that a test signal is generated.

10 Current Probe Input
For tests with a current injection clamp where the EUT current has to be measured and/or monitored, the current probe can be connected to this input.
ATTENTION: Do not connect the RF output directly to this input otherwise it will be damaged.

11 LED Current Probe Input
When current monitoring is active this LED on the front panel is illuminated.

3.2. Rear view CWS 500N2

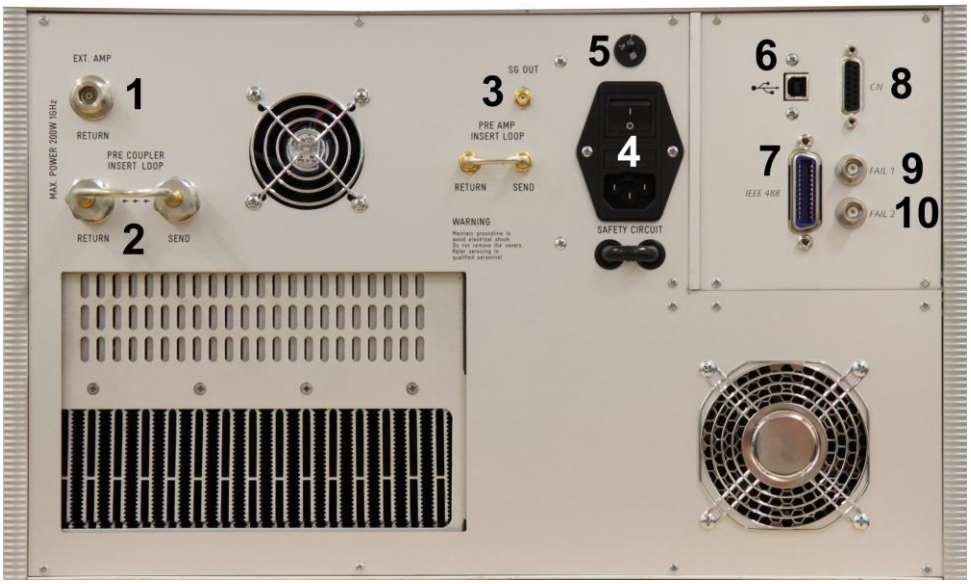


Fig 3.3

1 Connection Ext. Amplifier RETURN
2 Pre coupler insert loop
3 SG out
4 Power On Switch
5 Power selector 115V – 230V
6 USB Interface
7 IEEE Interface
8 Remote Control Connector
9 Fail 1 Detection "Stop"
10 Fail 2 Detection "Pause"
11 Pre Amp Insert Loop

1 Connector External Amplifier (EXT AMP Return)
Input signal from an external amplifier. (max. power 200W)

2 Pre Coupler insert loop
Output and return connection for the external device like a filter or TEM cell

3 SG Out
Output to an external amplifier for control an amplifier >100W .

4 Power On Switch
The switch and the main fuses are part of this box. (230V / 3.15AT or 115V / 6.3AT)

5 Power selector
Input power selector for input voltage 115V – 230V.

6 USB interface
USB interface “USB B” connector. For datatransfer a USB interface is available. The internal RS 232 interface is converted to USB standard. Therefore the user must set the same Baudrate in the device and control software.
Using the USB interface the user can have emc problems during burst tests Our experiences says, that usually the computer USB port is disturbed by interference’s. Therefore a high quality USB cable (USB 2.0 standard) must be used.

7 Parallel Interface IEEE
IEEE 488 interface with IEEE connector.

8 Remote Control Connector
not used.

9 Fail Detection FAIL 1 (TEST STOP)
The BNC input FAIL 1 can be used for failure detection on the EUT. If the input is set to ground (chassis), the CWS 500N2 generator will be stopped and finish the test routine. It is not possible to continue the test. A complete restart of the routine will be necessary. The message "FAIL 1" is indicated in the icd.control software.

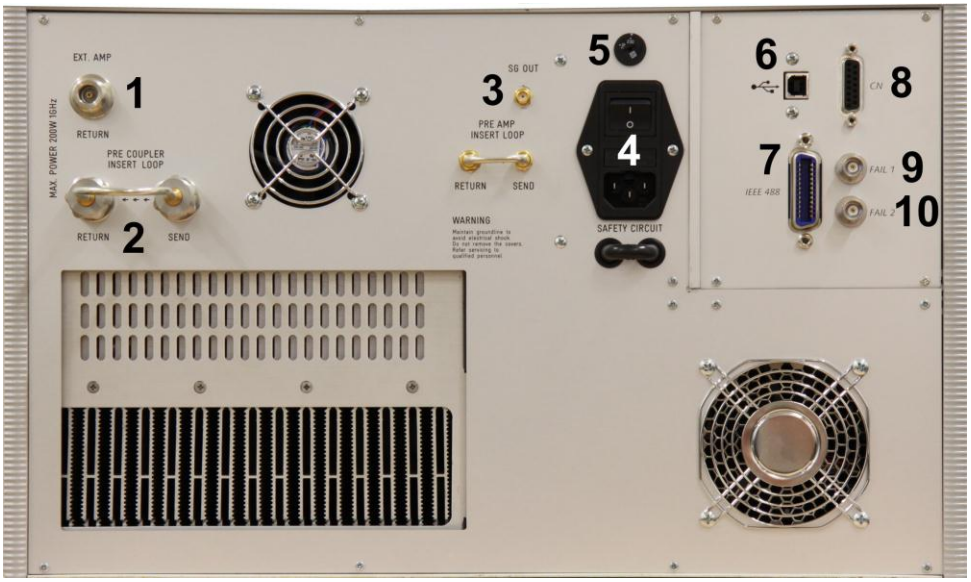


Fig 3.3

1 Connection Ext. Amplifier RETURN
2 Pre coupler insert loop
3 SG out
4 Power On Switch
5 Power selector 115V – 230V
6 USB Interface
7 IEEE Interface
8 Remote Control Connector
9 Fail 1 Detection "Stop"
10 Fail 2 Detection "Pause"
11 Pre Amp Insert Loop

10 Fail Detection FAIL 2

The BNC input FAIL 2 can be used for failure detection on the EUT. If the input is set to ground (chassis), the failure will be detected and the test continues normally. After a FAIL 2 events the test routine will stop and the message ”FAIL 2“ will appear in the host screen (icd.control software).

11 Pre Amp Insert Loop

Output and return connection for the external device like an external Amplifier.

4. Front Panel Operation

4.1. Basic Operations

The simulator **CWS 500 N2** is operated by an easy menu control system. Seven function keys are available to select parameters and functions. All functions are indicated on the display; max. 8 lines and 40 characters.

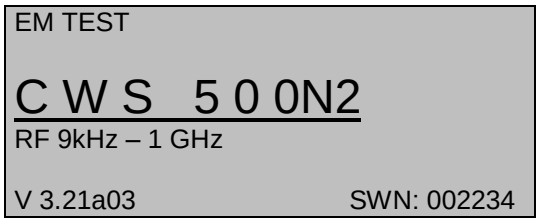
The selected parameter is blinking and can be changed by turning the knob (incr./decr.).

←→ : The digit to be changed can be selected with the cursor (**←→**).
- Setted values are direct indicated on the screen.
- Status on the bottom lines shows thedesired status after pressing the function key.

ESC : ESC will take you back to the previous level in the menu and set the displayed values. The latest settings are stored automatically and will be recalled when the menu is selected again.

EXIT : The firmware will reset to the main screen.

Start-up display



← Generator Model
← Frequency Range

The version number and the software number SWN are used for tracing purposes. These numbers are listed in the test reports and calibration certificates. These numbers are also listed within the test reports generated by the software report generator.

Page 1 (Main Menu)

F1 F2 F3 F4 F5 F6 F7

F1 Quickstart
Manual operation by entering the attenuation, frequency and modulation

F7 Service
Setup can be selected and displayed

4.2. Quickstart

Easy and very fast operation for functions check and verification of the CWS 500N2.

Page 2 (Show Parameters)

```
Quickstart
Att    =  63,0 dB          f    =    109.500 MHz
Mod    =  AM  1kHz 80%



START  CHANGE
```

F1 F2 F3 F4 F5 F6 F7

Page 3 (Change)

```
Quickstart

Att :    0.0 dB -          63.5 dB
f :      0.009 MHz -       400.0 MHz
Mod :    OFF, AM 80%, AM 90%, Pulse

Att      f         Mod
57.0     109.5     ON
```

F1 F2 F3 F4 F5 F6 F7

Press **START** to begin testing.
Press **CHANGE** and the actual parameters can be changed. Selecting a parameter to change will display the range.

The test begins by pressing **START**. The blinking parameter can be changed with the knob inc./dec.
Use the cursor keys (🡐🡒) to select other parameters. By pressing **STOP** the test will be stopped and on the last line of the display it will be indicated that the test has been stopped.

Page 3 (Operating)

```
Quickstart
Att    =  33,0 dB          f    =    109.500 MHz
Mod    =  AM  1kHz 80%

FPow = -   9.7  dBm        Mon  =  -56.9 dBm
Rpow = -  16.5 dBm

STOP
```

F1 F2 F3 F4 F5 F6 F7

Error messages:

```
Quickstart
Att    =  40,0 dB          f    =    109.500 MHz
Mod    =  off

FPow = +    6.6  dBm       Mon  =  -57.3 dBm
Rpow = +    6.8  dBm

Fpow to low!
```

Message : **Fpow to low !**

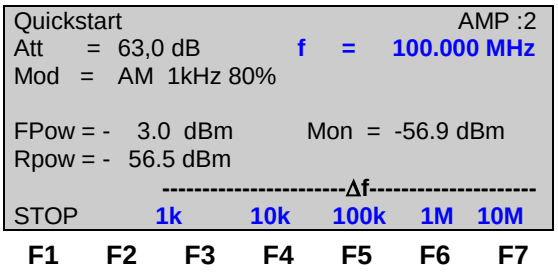
What happens : The amplifier does not supply the expected gain. The firmware checks the ratio between the signal generator output and the Forward power. The reason can be an amplifier defect or an internal error in the CWS 500N2. This message appears only when using internal amplifier.

4.2.1. Quickstart during instrument calibration

This function needs Firmware 2.11 or higher.

In case of a calibration of the measuring instrument it is necessary to use external signal generators. The CWS instrument has frequency matched calibration curves for each instrument channel. When using the internal signal generator CWS 500 knows the actual frequency and select automatically the correct reference. When using an external signal Generator, the instrument does not know the actual frequency. Therefore it is very important to adjust the frequency in the display to the actual applied frequency. otherwise the displayed measuring value can be wrong.

Page 3 (Operating)

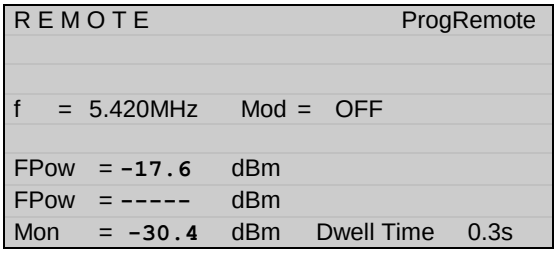


Adjust the frequency when using an external signal generator during instrument calibration

4.3. Display during Remote control

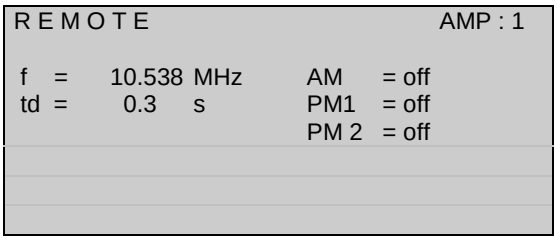
The CWS 500 can only work with remote control from the icd.control software Version 3.00 or higher. During the operation the following information appears on the display:

Remote control

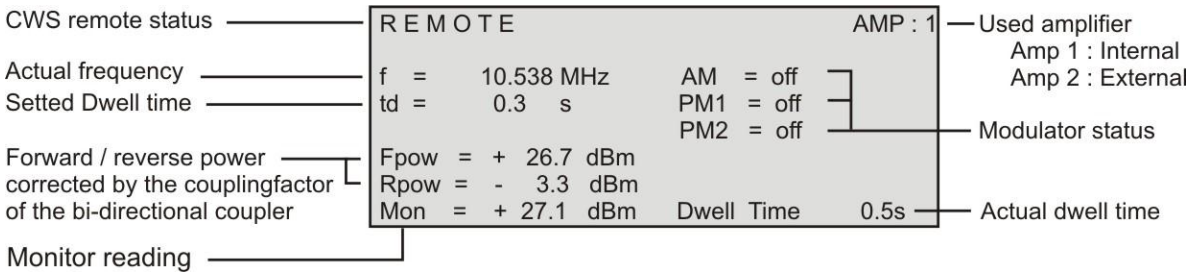


During Remote operation the display shows different screens depend the actual software procedure

Waiting



Display during a test



4.3.1. Modulation

Modulation as per IEC

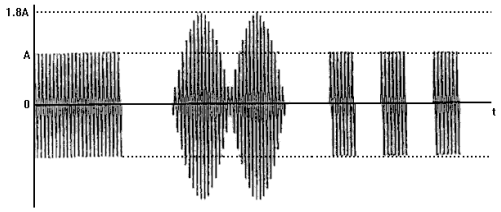
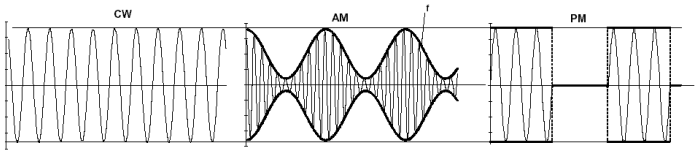


Figure 4.3 shows the modulation for IEC application.

Fig 4.3 : Unmodulated 80% AM Pulse modulation

Modulation as per ISO



Modulation signal as per ISO, peak conservation (pulse) standard. These standards recommends the modulation signal with the same amplitude as the non modulated signal.

Fig 4.4 : AM modulation with peak conservation

4.4. Service

All service functions are indicated in the display.

Page 2 (Overview service)

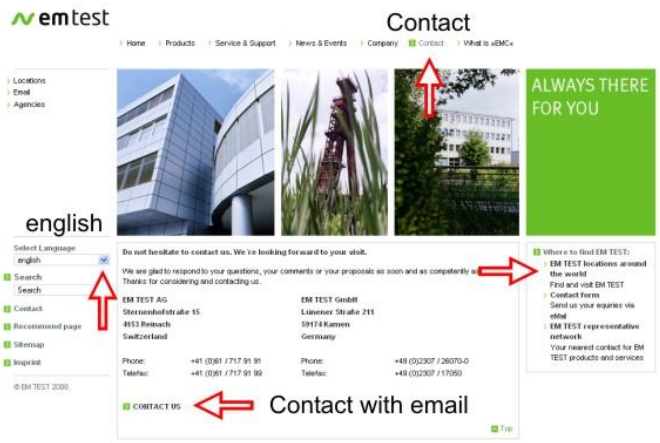
SERVICE
F1 : Addresses

F3 : Setup
F4 : Amplifier Switch
F5 : Function check powermeter
F6 : Function check amplifier switch

F1 F2 F3 F4 F5 F6 F7

F1 Addresses
The addresses of the EM TEST AG and the EM TEST GmbH are shown. The addresses of all EM TEST sales agencies are listed on the web site of EM Test under :

www.emtest.com



F3 Setup
The software will clearly explain the setup procedure.

F4 Amplifier Switch
Set the amplifier to internal / external.
Default setting after power on or go to local setting : internal

F5 Function check Powermeter
Function check routine for the built in powermeter (PM). With this check function the correct working of the PM can be verified.

F6 Function check amplifier switch
Check function for verification of the correct working of the built in amplifier switch, and the built in Amplifier (gain >50dB).

4.4.1. Setup

This menu helps the user to define the configuration of the CWS 500N2.

Page 3 (Setup Overview)

Setup
F1 : Change language / Sprache ändern
F2 : LCD Back Lighting
F3 : Interfaces
F4 : Keyboard Beeper
F5 : Timer

F1 F2 F3 F4 F5 F6 F7

F1 Change language / Sprache ändern
The user can choose between two languages, German and English.

F2 LCD Back Lighting
With the use of F2 the back lighting can be switched ON or OFF. The Auto-Off Function can be programmed to switch the back lighting off after a predetermined time following the last manual operation (1 - 30 minutes).
Due to the limited lifetime of the LCD back lighting (approx. 10,000 hours), this function should always be activated.
The Auto ON/OFF function does not switch on during remote operating

F3 Interfaces
With this menu the user can define the status of the integrated serial and parallel interfaces, e.g. the baud rate of the RS232- or the address of the IEEE-interface.

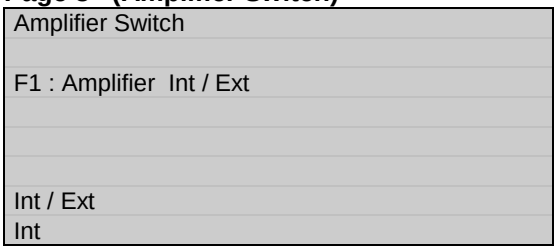
F4 Keyboard Beeper
F4 selects the beeper ON/OFF mode.

F5 Timer
By pressing F5 will display the total operating time of the CWS 500N2 will be displayed.

4.4.2. Amplifier Switch

Change of the used amplifier internal or external

Page 3 (Amplifier Switch)



The CWS display shows the actual setting for the used amplifier

Int : Internal = Amp 1
Ext : External = Amp 2

After **power on** the default amplifier is set to **internal**

5. Starting Operation

5.1. Safety Aspects

Tests performed with RF-disturbances, induced by radio-frequency fields, are immunity tests on electronic equipment. Therefore it is the responsibility of the user to avoid critical failures and risks to the environment and the operators.

Long power supply lines to the EUT may radiate energy. It is the responsibility of the user to determine whether it is allowed to conduct immunity tests in a given location.

The RF voltages on the center pin of the RF output connector can be hazardous. The RF output connector must be connected to a load before AC power is applied to the CWS 500N2. Do not touch the center pin of the RF output connector or accessories which are connected to it. Switch the equipment to the “Test OFF” position before disconnecting or connecting the load to the RF output connector.

During this test RF interference is generated at a power of 100W or more. Therefore, the test should be performed in a shielded room to prevent interference with other equipment in the vicinity. Also see the information included in the declaration of conformity for the CE mark.

For the test setup, national and international safety regulations must be observed.

Persons beings with pacemakers must not be allowed to perform such tests.

Special Information For Operating the CWS 500N2:

1. The intake and outlet for the cooling system must not be covered. Free air circulation of is required for proper function of the CWS 500N2. Blockage of the cooling air system may result in damage to the RF amplifier or intermittent shut down of the equipment.

2. All panels must be installed. They are important components of the cooling system. Never perform tests with a partially or completely open generator.

3. Before a test or a calibration may be performed, the CWS 500N2 must be operating for at least 15 minutes warm up time. After this time the CWS 500N2 output becomes stable

4. High voltage components will only be exposed when the 3 cover panels are removed (unscrewed). To service the inside the generator, the power supply must be turned off and the power cord must be removed before opening the equipment.

5. CDN’s are coupling/decoupling networks as specified in IEC 61000-4-6. Due to this specification, higher ground current exists as a result of increased value of the Y-capacitors. Therefore, the general use of fault current protection relays is not possible. The use of isolating transformers for the power supply may be required.

6. Some CDN’s are designed for higher and hazardous voltages. It is necessary to remove the power cord from the input connection of the CDN’s before opening the housing.

7. Only trained and qualified service technicians are allowed to perform service and repair the instruments. Please contact an EM TEST service center or your local sales partner for repairing or servicing the units.

8. The calibration of the test setup has to be done on the output of the CDN’s. To connect the 150-to-50Ω matching resistor, special adapters are required (e.g. power supply connector to single pole plugs).

9. Make sure to read carefully and completely all the manuals.

5.2. Generator Function Check

As with all testing equipment, the continuous wave simulator type CWS 500N2 should be checked for performance and accuracy from time to time. The check should be completed as listed below.

- Connect the RF-output of the CWS 500N2 to the 40dB-attenuator or an adequate attenuator.
- Switch on the power supply.
- Select the in Quickstart with the following parameters:
  Attenuation : 30dB
  Frequency : 23MHz
  Modulation : OFF, 2Hz, 400Hz or 1kHz
- Connect the output of the 40dB-attenuator with the 50Ω input channel of the oscilloscope. Take care to the rated power of the used attenuators!

ATTENTION	Take attention to the **maximum input power capability** and the bandwidth of the test input and power of the **used attenuators**. Using two 20dB attenuators with 15W each Generator ATT setting range: **10 dB to 63.5 dB** will not destroy the attenuators

- Push "TEST ON" and start the test.

ATTENTION	DO NOT connect the output of the attenuator nor the output of the CWS 500N2 to the monitor input without sufficient attenuation, otherwise the monitor input will be destroyed.

Using an oscilloscope or powermeter for checking the operation of the generator very easy. Fig 5.1.

Take notice that this procedure is only a functional check of the generator. Differences in the test level may be caused by a limited bandwidth or mismatching within the testing system.

Exact and accurate measurements can only be guaranteed with the specified test setup according to standard.

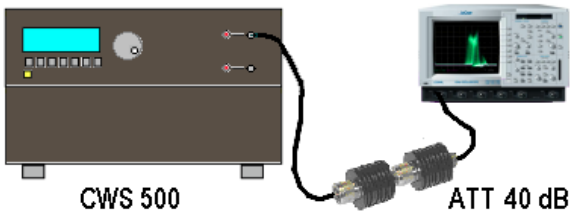


Fig 5.1

Expected values ≈23 dBm (-30dB + 53dB = 23dBm ± 4dB)

Remark:
- 30dB : Setted attenuation
+ 53dB : Gain of the amplifier
+ 23dB : Measuring result

Take attention to the used attenuator (40dB) for calculate the correct measuring result.

5.3. Function Check internal Powermeter

This function is for checking the built in 3-channel powermeter e.g. Forward Power and Rev Power and current monitor. Within this measuring procedure the measured values are compared with some nominal values, this in order to verify the correct function of the three measuring inputs. In addition also the accuracy of the measuring is checked in a larger range. In order to avoid any damage, it may be self explaying that only a low voltage signal may be released by the amplifier and occur at these inputs.

The MONITOR input is tested with the following signals:
- Measuring with a 50Ω terminal connection at the input.
- Measuring with the maximum attenuation (-60dB) to the RF output via a 3dB attenuator.
- Measuring with a reduced attenuation (-45dB) to the RF output via a 3dB attenuator.

The function check has the following procedure:

Page 3 (Service)

Function check Powermeter	step 1/ 2
- Press TEST ON - Disconnect the HF OUT - Connect a 50 Ohm matching resistor to the MONITOR input	
continue	break

F1 F2 F3 F4 F5 F6 F7

Fig 5.2 50 Ω matching resistor connected at the monitor input.

Page 3 (Service)

Function check Powermeter	step 2/ 2
- Connect the MONITOR input to the HF OUT via a ATT 3 dB attenuator	
continue	break

F1 F2 F3 F4 F5 F6 F7

Fig 5.3

Page 3 (Service)

Function check Powermeter	result
	Pass / Fail
end	

F1 F2 F3 F4 F5 F6 F7

Finally the result of the check appears in the display. With the measured results the user is able to check the correct function of the measuring inputs.

5.4. **Function Check amplifier switch** (1GHz model only)

This function is for checking the correct operation of the built in amplifier switch. During this test the output connector at the frontside should be left open.

The function check has the following procedure:

Page 3 (Service)

Function check amplifier switch

- Press TEST ON
- Disconnect the HF OUT
- Connect the SG OUT directly to the CPL IN (on the backside)

continue break

F1 F2 F3 F4 F5 F6 F7

Fig 5.4

Page 3 (Service)

Function check amplifier switch
result

Pass / Fail

end

F1 F2 F3 F4 F5 F6 F7

5.5. Calibration

5.5.1. Calibration Setup for Bulk Current Injection Clamp (BCI) as per ISO / DO / MIL

Fig 5.5 : Calibration setup with BCI

ATTENTION

During calibration of the test setup on a ground reference plane at very low levels (very low currents) is important. The test results may be influenced by the cable layout on the ground plane. High grade coaxial cables are essential.

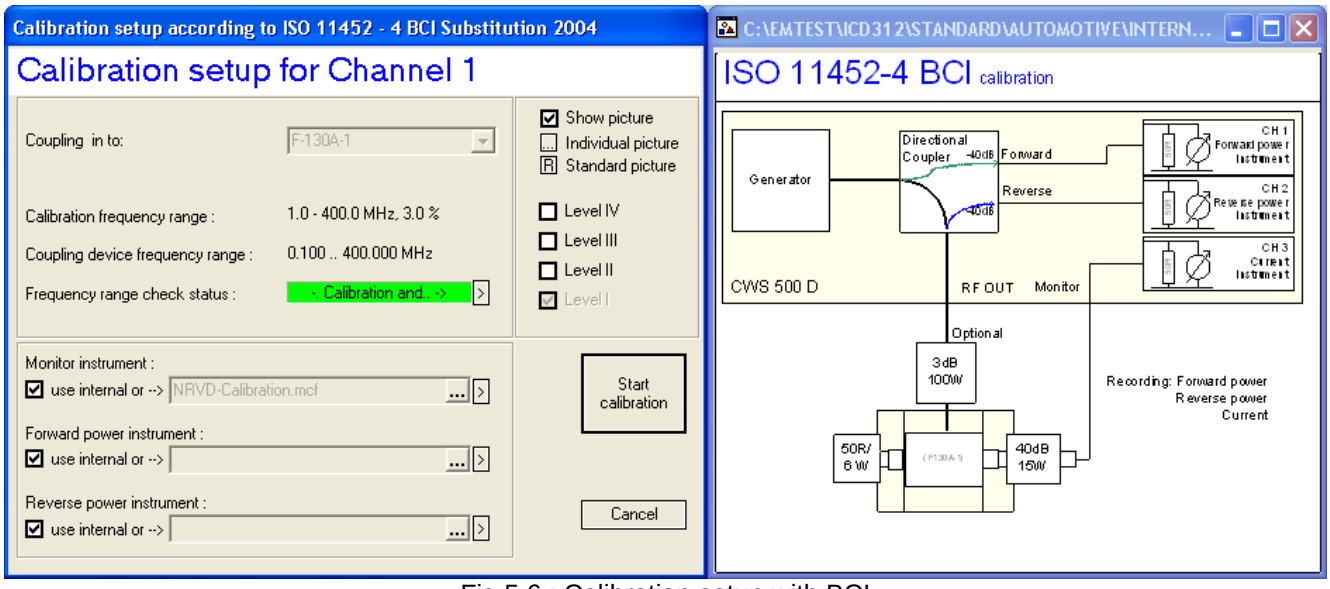


Fig 5.6 : Calibration setup with BCI

5.5.2. Calibration Setup EM TEST and IEC 61000-4-6

The setup for calibration according to IEC 61000-4-6 is shown in the figure 5.7. below. EM Test has carefully tested the calibration setup and propose to eliminate the 150Ω terminating resistor on the AE port for CDN calibration. (Fig 5.8)

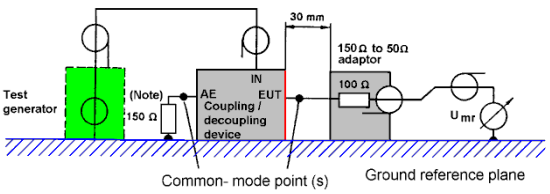


Fig 5.7 : Calibration Setup per IEC 61000-4-6

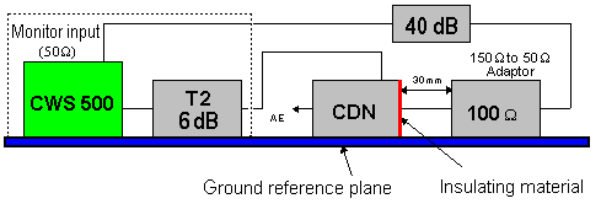
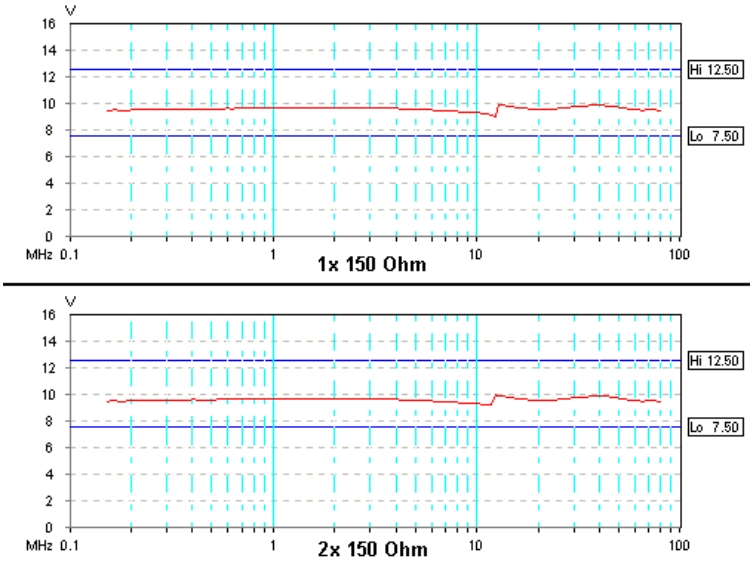


Fig 5.8 : Calibration Setup EM Test method

Reason for the EM Test calibration test setup:

- The AE port must only be applied to unshielded cables (shielded cables have their shielding connected to the ground reference plane of the AE port).
- The uncoupling inductance according to the standard is >280µH. The EM Test CDN has a higher inductance (CDN M3 typical >500µH). Therefore, the calibration error at 150kHz is max 10% and will be reduced by increasing the frequency. (Error at 400kHz approx.5%).
- The tolerance of the applied signal according to IEC 61000-4-6 is ± 25%. The figure below shows two CDN M3 10V measurements with different calibration methods. The results are within the ± 25% limit and the result is very similar.
- The influence of the internal synthesizer attenuator is responsible for the non-linear result of the calibration test.



EM Test Calibration Setup

EUT port : 1x 150Ω:
R100 (100Ω)
power meter (50Ω)

AE port : open circuit

IEC 61000-4-6 Setup

EUT port : 1x 150Ω:
R100 (100Ω)
power meter (50Ω)

AE port : 1x 150Ω:
R100 (100Ω)
terminating (50Ω)

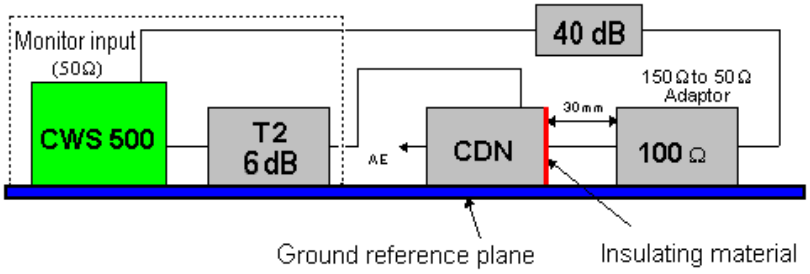
Fig 5.9 : Difference between the calibration methods

However, for a calibration according to the standard it is necessary to add the additional calibration acessories for the AE port termination :

150Ω to 100Ω adapter : R-100
50Ω termination resistor : T-50

5.5.3. Calibration Setup with CDN

Maximum Voltage on the Monitor INPUT U_{max} = 13 dBm



Make sure CDN and the 150Ω to 50Ω adapter are well connected to the ground reference plane (i.e. by using copper tape).

Fig 5.10 : Calibration set-up

Fig 5.11 :Example Calibration Setup with CDN

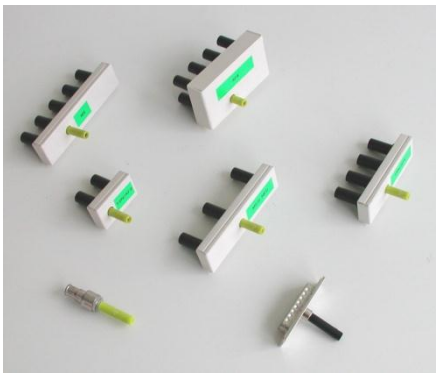


Fig 5.12 :Example of cal adapters

For calibration procedures with PM 403 or external receivers, power meters or analyzers, the icd.control software must be used. Additional, test instruments with IEEE488 (GPIB) interfaces may be incorporated.

Fig 5.13 :Example Calibration Setup with BCI

5.5.4. Calibration Setup with EM Clamp

The calibration with an EM Clamp is similar to the CDN calibration.

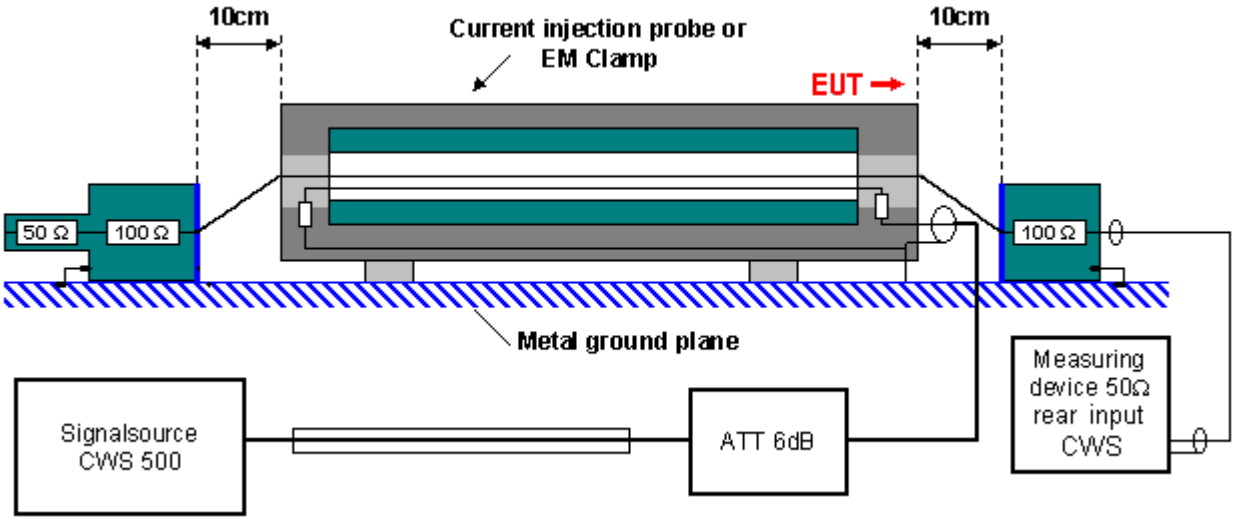


Fig 5.14 : Calibration setup with EM Clamp

Make sure to connect the EM clamp correctly in the test and calibration setup. The **EUT port** must be on the measuring device side, or calibration in the higher frequency range will be wrong.

Correct setup : Red line with correct EM Clamp direction
Wrong setup : Green line (reduced signal at high frequency)

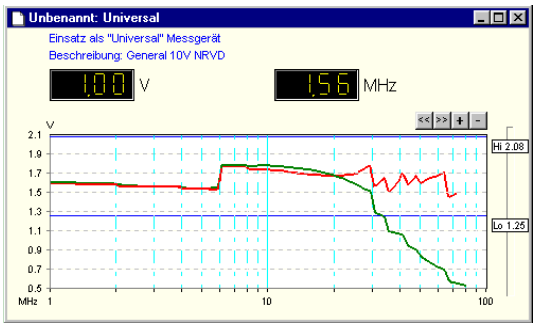


Fig 5.15 : Measuring result with correct and wrong EM Clamp direction

5.6. Failure Input

Fail 1: A short circuit at the Fail 1 input will stop the test procedure. It is not possible to continue this test.

Fail 2: A short circuit at the Fail 2 input will store the actual test data. The test procedure will continue normally after Fail 2 is released. The display indicates the number of Fail 2 events.

After the first Fail 2, the following events on the same test level are ignored (for the actual selected dwell time).

After 10 Fail 2 events, the test procedure will stop automatically.

6. Test Equipment CWS 500N2

The CWS 500N2 continuous wave simulator is divided into three main parts. The control unit is completely separated and uncoupled from the RF power section.

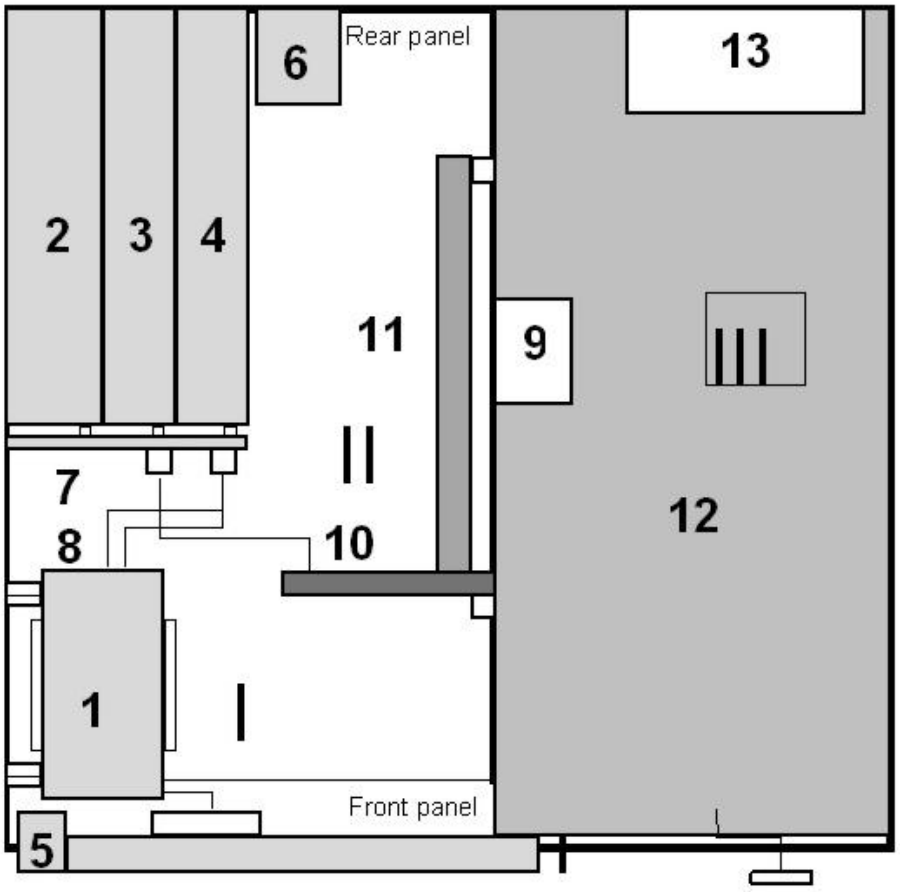


Fig 6.1

I Control unit

1 Transformer
2 Power Supply
3 Interface Board
4 Processor Board
5 Keyboard / LC Display
6 Power Supply Filter
7 Connection Board
8 Flat Band Cables to Front Panel
9 Calibration Measuring Device or PM Powermeter

II Generator Unit

10 Signal Generator Connection Board
11 Signal Generator

III RF Power Unit

12 Amplifier
13 Bi- directional coupler

6.1. Control Unit

The control section includes the processing unit and the driver electronics for the high frequency section. All signals coming from and going to the processing unit are uncoupled.

6.2. Generator Unit

The signal generator provides all RF signals required for the operation of the amplifier. The signal generator is controlled by serial communication from the control unit.

Modulators

The signal generator is realized with 3 built in modulators for generate the different signals. There are one amplitude modulator (AM) and two pulse modulators (PM)

AM : For amplitude modulated signals
PM1 : Pulse modulator
PM2 : Superimposed pulse modulator

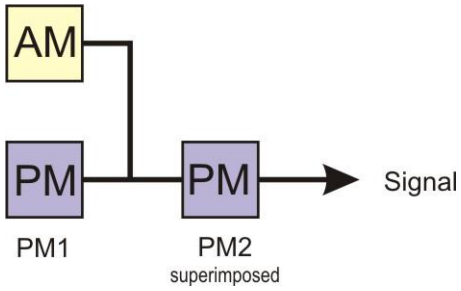


Figure 6.2

6.3. High frequency Power Unit

Amplifier

This part is a class A amplifier with a nominal power of 100 watts and forced air cooling.

Bi directional coupler

The built in 200W dual directional coupler is used for measuring the **Forward power** and **Reverse power** . The coupling factor of –40dB is corrected by the display of the internal powermeter PM 1000

Figure 6.3

6.4. 3dB Attenuator

The 3dB attenuator is a helpful optional device to match the output of CWS 500N2 to a 50Ω system and render there with the built in amplifier more efficient. Especially by using coupling devices not from EM Test, it may represent an non-usable arrangement.
By using EM Test recommended coupling devices, it is not necessary to connect the attenuator. How ever in case of use, the 3dB attenuator is connected directly to the RF output of the CWS 500N2

INPUT = ENTREE
OUTPUT = SORTIE

Fig 6.4 : ATT 3/100

The attenuator is required in some standards. However, the included amplifier will work correctly with any load. Although the CWS 500N2 can also be used correctly without the attenuator for **high current** application the 3dB cannot be used!

6.5. 6dB Attenuator

The 6dB attenuator is connected directly to the RF-output of the CWS 500N1. The attenuator has to be used together with the CWS 500N1 and matches the output to a 50Ω system. The attenuator must be connected as close as possible to the coupling/uncoupling network (CDN, EM clamp or current injection clamp), using a 50cm (20 inch) coaxial cable.

Fig 8.5 : ATT 6/75

The attenuator is symmetrical designed. It doesn't matter where is the input/output.

The attenuator is required in the actual standard. However, the included amplifier will work correctly with any load. Although the CWS 500N1 can also be used correctly without the 6dB-attenuator, all functions of the CWS 500N1 and the ICD.control software is designed to be used with the 6dB-attenuator.

6.6. CDN Coupling/ Decoupling Network

The CDN's are connected externally to the output of the simulator or the 6dB-attenuator. The coupling network is used to couple the disturbance signal to the lines of the equipment under test. The coupling is accomplished with capacitors or resistors having a sufficient bandwidth according to IEC 61000-4-6.

The components, such as the common mode impedance and the coupling factor are specified within the standard.

Fig 6.5 : CDN M5

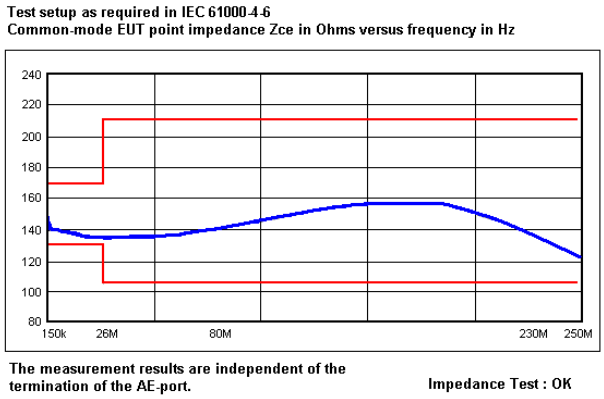


Fig 6.6 : Typical Impedance Zce of a CDN

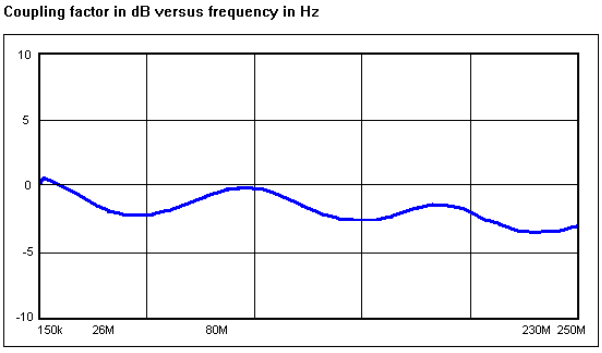


Fig 6.7 : Typical Coupling factor of a CDN

Examples of a single shielded line (S1) and a 3-line power supply (M3) are shown below.

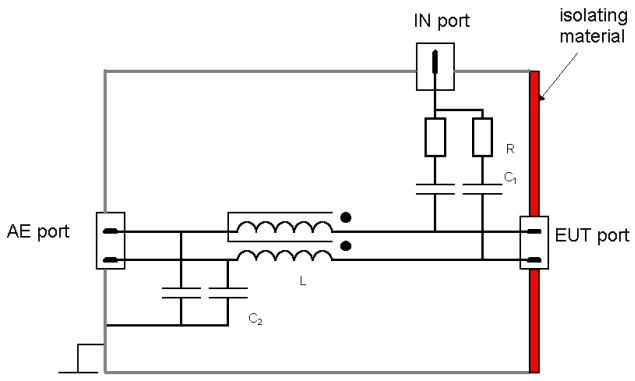


Fig 6.8 : CDN S1

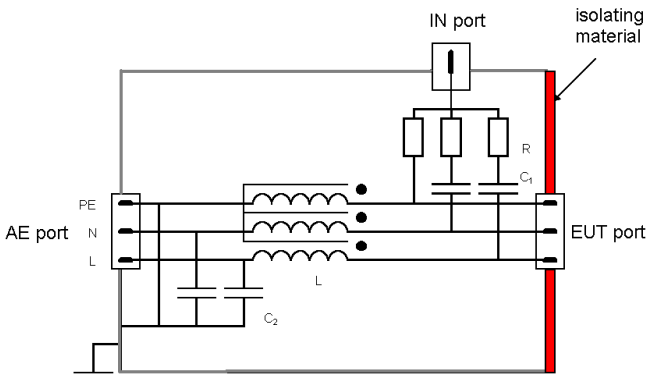


Fig 6.9 : CDN M3

6.7. Test Setup with CDN's

The following information is important for a correct test setup as per. IEC:

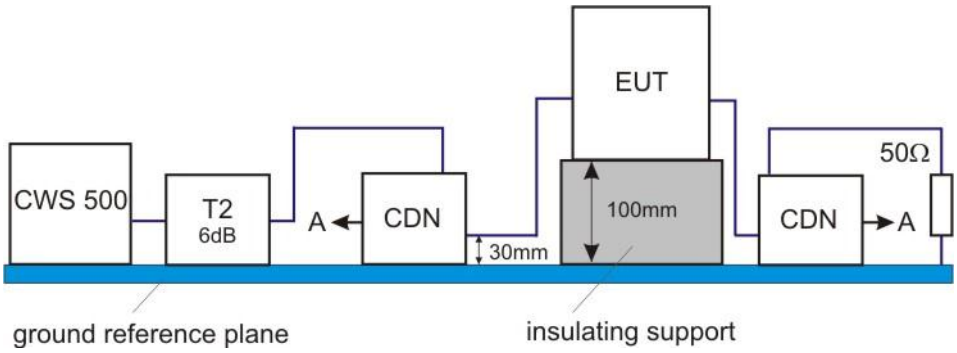


Fig 6.10 :Test setup with CDN

1. All lines not being tested must be decoupled:
   - with CDN's where the RF input ports are terminated by a 50Ω load resistor
   - with an EM Clamp
   - with ferrites components on the cables
2. The CDN's must be connected securely to the ground reference plane.
3. The lines of the EUT must be separated by 30mm (1.2 inches) from the ground reference plane (whenever possible). This also applies for lines not being tested.
4. The EUT must be separated by 100mm (4 inches) from the ground reference plane.
5. The coaxial cables must be as short as possible. It is recommended to use the cables provided by CWS 500N2.
6. The 50Ω matching resistor must be an adequate RF type.

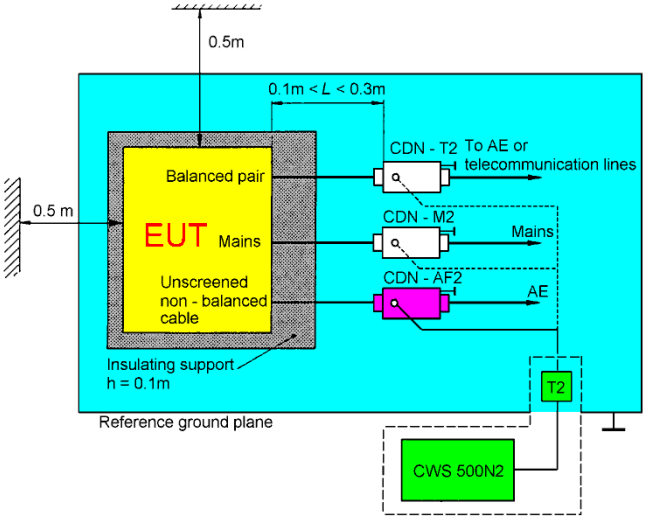


Fig 6.11 :Test Setup using CDN's

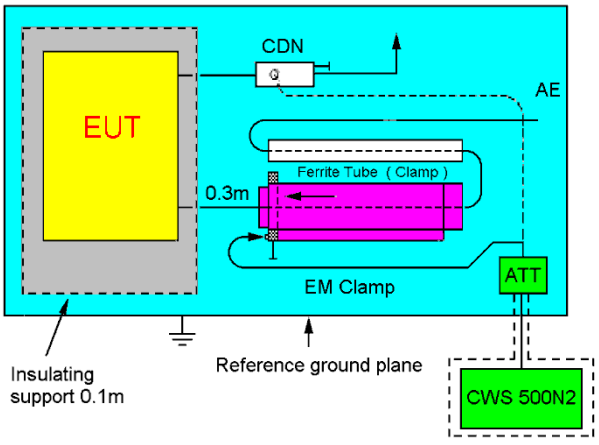


Fig 6.12 :Test Setup using an EM clamp

6.8. Test Setup with the Current Monitor

Maximum Voltage on the MONITOR INPUT V_{max} = 13dBm

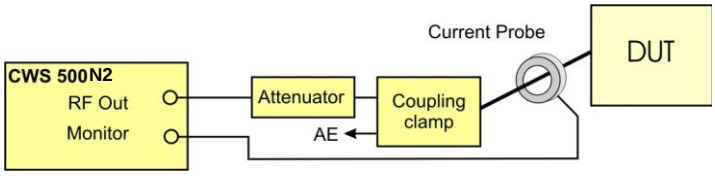


Fig 6.13: Test Setup current monitoring probe

With the CWS500N2 and the built-in Powermeter PM tests with current clamp (BCI) or with EM clamps are easily made whatever with or without DUT current monitoring.

In case of DUT current monitoring, connect the 50Ω output of the current probe to the monitor input of the CWS500N2. The setup above is applicable for both clamps (current injection clamp or EM clamp). In addition go to the standard library of the icd.control software.

In such routine the DUT current is controlled and after DUT current is controlled and after each parameter increment / decrement (routine-step) the measured DUT current is compared to Imax. In case of higher value the output voltage is reduced until Imax is underbid.

$I_{max} = U_0 / 150\Omega$ as per EN61000-4-6

6.9. Test Level and Modulation

Test Level as per ISO 11452-4

Suggested test severity levels and frequency bands

Frequency Range 1MHz to 400MHz	
Level	Value mA
I	25mA
II	50mA
III	75mA
IV	100mA
V	Specific value agreed between the users of this part of ISO 11452, if necessary

Test Level as per IEC 61000-4-6

Testing is normally carried out at individual frequencies in the ranges from 150kHz to 80MHz.

Frequency Range 150 kHz to 80MHz		
Level	Voltage level (e.m.f)	
	U_o [dBμV]	U_o [V]
1	120	1
2	130	3
3	140	10
X	special	special

Frequency Sweep

When using an individual frequency sweep, the step size shall not exceed 1% of the start and thereafter 1% of the preceding frequency in the specified frequency range from 150kHz to 80 MHz thus it will result in 232 steps in a decade or a total of 632 frequencies.

7. Technical Data

7.1. CWS500N2

Test Level:

Output power	100W (nominal)	
Output impedance	50 Ohm, VSWR 2.0 : 1 nominal	
Level approx.	-13dBm ... 50dBm	
Amplifier	Class A, Gain > 52dB	
Current 4MHz ... 400MHz	max. 700mA (100W amplifier, without attenuator, F-130A clamp)	

Test frequencies (synthesizer)

Sinusoidal (CW)	9kHz - 1000MHz	
Frequency bands	9kHz - 1000MHz	step: 1kHz (icd.control and Quickstart online)
Quickstart setting	9kHz - 9,999MHz	step: 1kHz
	10MHz - 99,99MHz	step: 9kHz
	100MHz - 1000MHz	step: 100kHz

Modulation

AM	Frequency :	1Hz ... 3000Hz
	Index :	0%...95%
PM	Frequency :	1Hz ... 3000Hz
	Duty cycle :	10%...80%

Attenuator

Range	0 dB - -63.5dB
Step level	0.5dB

Timing:

Dwell time	general	td = 0,3s - 9999.9s
	pulse modulation	td = 3s - 9999.9s
Rest time	tr = 0 / 0,3s - 9999.9s	

Output

Direct	N type connector

EUT control

BNC input FAIL 1	Fail 1; test will be stopped immediately
BNC input FAIL 2	Fail 2; failure is detected, test continues

Routines (integrated)

Service	Service, Setup
Test routines	All test only in remote control with icd.control software version >3.00

Interfaces

Serial Interface	USB
Parallel IEEE 488 GPIB interface	Addresses 1 - 30 selectable
	All interfaces are included as standard features.

Powermeter PM 1000

Frequency range	9kHz – 1000 MHz	
Input range	Monitor	-45 dBm ... +13 dBm
	FWD power	-50 dBm ... +13 dBm
	REV power	-50 dBm ... +13 dBm
Max. Input MONITOR	13dBm	approx. 1.3 Vrms
Accuracy	< ± 0.5 dB	(0.1MHz...400MHz)
	< ± 1.0 dB	(0.009MHz...1000MHz)

Bi directional coupler

Frequency range	9 kHz .. 1000MHz
Power (maximum)	200Watt
Coupling factor	40 dB
Directivity	25 dB typical
Insertion loss	approx. 1 dB (including relays)
VSWR	1.25 maximum

RF Amplifier 100W (built in)

Frequency range	9 kHz .. 400 MHz	
Output power nominal	20kHz...300MHz	50dBm
Output power minimum	9kHz...400MHz	47dBm
Gain	approx. > 51dB	
Compression at nominal output power	1dB (typical)	
Harmonic distortion	> 20dBc at max. power	

General data CWS500N2

Dimensions (HxWxD)	19"/6HE (286 x 450 x 500) mm
Weight	approx. 31.5kg
Power supply	110-230V/ 50/60Hz
Input power	max. 780W
Power factor	cosϕ=0,98 at max output power acc. to IEC 555
Fuse	2x6,3AT (115V / 230V)
Cooling	active cooling, air ventilation
Environment conditions	10°C - 40°C
Humidity	Max. rel. humidity 80% up to 31°C Decreasing linearly to 50% at 40°C

7.2. CWS500N2.1

Summary:

Output power	150W (nominal)
Output impedance	50 Ohm, VSWR 2.0: 1 nominal
Level approx.	-13dBm ... 51.7dBm
Current 4MHz ... 400MHz	max. 950mA (150W amplifier, without attenuator, F-130A clamp)

Test frequencies (synthesizer)

Sinusoidal (CW)	9kHz - 1000MHz	
Frequency bands	9kHz - 1000MHz	step: 1kHz (icd.control and Quickstart online)
Quickstart setting	9kHz - 9,999MHz	step: 1kHz
	10MHz - 99,99MHz	step: 9kHz
	100MHz - 1000MHz	step: 100kHz

Modulation

AM	Frequency:	1Hz ... 3000Hz
	Index:	0%...95%
PM	Frequency:	1Hz ... 3000Hz
	Duty cycle:	10%...80%

Attenuator

Range	0 dB - -63.5dB
Step level	0.5dB

Timing:

Dwell time	general	td = 0,3s - 9999.9s
	pulse modulation	td = 3s - 9999.9s
Rest time	tr = 0 / 0,3s - 9999.9s	

Output

Direct	N type connector

EUT control

BNC input FAIL 1	Fail 1; test will be stopped immediately
BNC input FAIL 2	Fail 2; failure is detected, test continues

Routines (integrated)

Service	Service, Setup
Test routines	All test only in remote control with icd.control software version >3.00

Interfaces

Serial Interface	USB
Parallel IEEE 488 GPIB interface	Addresses 1 - 30 selectable
	All interfaces are included as standard features.

Powermeter PM 1000

Frequency range	9kHz – 1000 MHz	
Input range	Monitor	-45 dBm ... +13 dBm
	FWD power	-50 dBm ... +13 dBm
	REV power	-50 dBm ... +13 dBm
Max. Input MONITOR	13dBm	approx. 1.3 Vrms
Accuracy	< ± 0.5 dB	(0.1MHz...400MHz)
	< ± 1.0 dB	(0.009MHz...1000MHz)

Bi directional coupler

Frequency range	9 kHz .. 1000MHz
Power (maximum)	200Watt
Coupling factor	40 dB
Directivity	25 dB typical
Insertion loss	approx. 1 dB (including relays)
VSWR	1.25 maximum

RF Amplifier 150W

Frequency range	9 kHz .. 400 MHz	
Output power nominal	20kHz...300MHz	52dBm
Output power minimum	9kHz...400MHz	51dBm
Gain	approx. > 51.7dB	
Compression at nominal output power	1dB (typical)	
Harmonic distortion	> 20dBc at max. power	
Input Maximum	0 dBm (1mW)	
Input VSWR	<2:1 typ.	

General data CWS500N2.1

Dimensions (HxWxD)	19"/12HE (600 x 550 x 800) mm
Weight	approx. 84.0kg
Power supply	110-230V/ 50/60Hz
Input power	max. 1430W
Power factor	cosϕ=0,98 at max output power acc. to IEC 555
Fuse	2x6,3AT (115V / 230V)
Cooling	active cooling, air ventilation
Environment conditions	10°C - 40°C

Humidity Max. rel. humidity 80% up to 31°C Decreasing linearly to 50% at 40°C

=>> Non compulsory specification, may be subject to change <<=

8. Maintenance

8.1. General

The generator is absolutely maintenance-free by using solid state semiconductors. The generator uses forced air cooling. Take care to not cover the cooling slots

8.2. Calibration and Verification

8.2.1. Factory calibration

Every EM TEST generator is entirely checked and calibrated as per international standard regulations before delivery. A calibration certificate is issued and delivered along with a list of the equipment used for the calibration proving the traceability of the measuring equipment. All auxiliary equipment and accessories are checked to our internal manufacturer guidelines.

The calibration certificate and the certificate of compliance (if available) show the date of calibration.

The EM Test equipment are calibrated in the factory and marked with a calibration mark. The used measuring instruments are traceable to the Swiss Federal Office of Metrology.
The calibration date is marked. The validity of the calibration is to the responsibility of the user's quality system. Neither the certificate of calibration nor the corresponding label mark any due date for re-calibration.

Example: Calibration mark

8.2.2. Guideline to determine the calibration period of EM Test instrumentation

Our International Service Departments and our QA Manager are frequently asked about the calibration interval of EM TEST equipment.

EM TEST doesn't know each customer's Quality Assurance Policy nor do we know how often the equipment is used and what kind of tests are performed during the life cycle of a test equipment. Only the customer knows all the details and therefore the customer needs to specify the calibration interval for his test equipment.

In reply to all these questions we like to approach this issue as follows :
EM TEST make use of a solid state semiconductor switch technique to generate high voltage transients. A precious advantage of this technique is the absolute lack of periodical maintenance effort. In consequence thereof a useful calibration period has to be defined based on two criteria :

- The first one is the customer's Quality Assurance Policy. Any existent internal regulation has to be applied at highest priority. In the absence of such internal regulation the utilization rate of the test equipment has to be taken into consideration.

- Based on the experience and observation collected over the years **EM TEST recommend a calibration interval of 1 year** for frequently used equipment. A 2-years calibration interval is considered sufficient for rarely used test generators in order to assure proper performance and compliance to the standard specifications.

8.2.3. Calibration of Accessories made by passive components only

Passive components do not change their technical specification during storage. Consequently the measured values and the plots stay valid throughout the storage time. The date of shipment shall be considered as the date of calibration.

8.2.4. Periodically In-house verification

Please refer to the corresponding standard before carrying out a calibration or verification. The standard describes the procedure, the tolerances and the the necessary auxiliary means. Suitable calibration adapters are needed. To compare the verification results, EM Test suggests to refer to the waveshape and values of the original calibration certificate.

All calibrations and verifications are always done without mains supply voltage connected to the coupling network input.


Danger

Before starting the calibration or verification

remove the EUT Mains Supply

from the generator and from the coupling network

9. Delivery Groups

9.1. Basic equipment

- Continuous wave simulator type CWS 500N2
- Mains cable
- Manual CWS 500N2 on delivered CD
- Calibration certificate
- icd.control software available on CD
- Cable with N type connectors

Identical accessory parts are delivered only once if several devices are orderes. The delivered packing list is in each case valid for the delivery.

9.2. Options and Accessories

	Accessories
C-IEEE	IEEE cable for CWS computer interconnection
Set C-BNC	BNC cable for current monitor probe
AD-N-BNC	N to BNC adapter for ATT20/15
	Options
ATT3/100	Attenuator for BCI, 3dB /100W
ATT20/15	2 x 20dB/15W attenuator for current monitor path
T-50 A	50 Ohm / 6 W matching resistor
	BCI set of clamp, fixture and monitor probe for MIL461E DO160
F-120-6A	Clamp-on injection probe, 10kHz - 400MHz, 40mm
FCC-BCICF1	Injection probe calibration fixture (jig) for F-120/F130 probe types
F-55	Clamp-on monitor probe, 10kHz - 500MHz, 32mm diameter
ATT 6/75	Attenuator 6dB / 75 W
R-100	150 to 50 Ohm Adaptor
R-100A	150 to 50 Ohm Adaptor with N-type-connector for current clamp calibration
T-50	50 Ohm Termination
	Accessories for IEC 61000-4-6 test application
KIT-IEC-6	Cable and adapater kit consisting of 2 BNC cables 25cm each, 1 BNC cable 50cm, 2 adapters N-BNC and 1 adapter BNC-N
Coupling networks (CDN)	as per IEC 61000-4-6 Wide range of different CDN's
Coupling clamps	EM clamp as per IEC 61000-4-6 for coupling of the RF signal to multiple cables.Current injection clamp acc. To IEC 61000-4-6
Current Probe	acc. IEC 61000-4-6
Cal adapters	For all types of CDN's and clamps (manufactured and delivered by EM Test)
ATT 6/75	Attenuator 6dB / 75 W
R-100N	150 to 50 Ohm Adaptor
R-100A	150 to 50 Ohm Adaptor with N-type-connector for current clamp calibration
T-50	50 Ohm Termination

Software for PC control

User software "icd.control"	Control, protocol, Cal measurements for different Coupling devices Generation of analysis and documentation under windows (see separate documentation)

10. Appendix

10.1. Blockdiagram

Blockdiagram CWS 500 N2

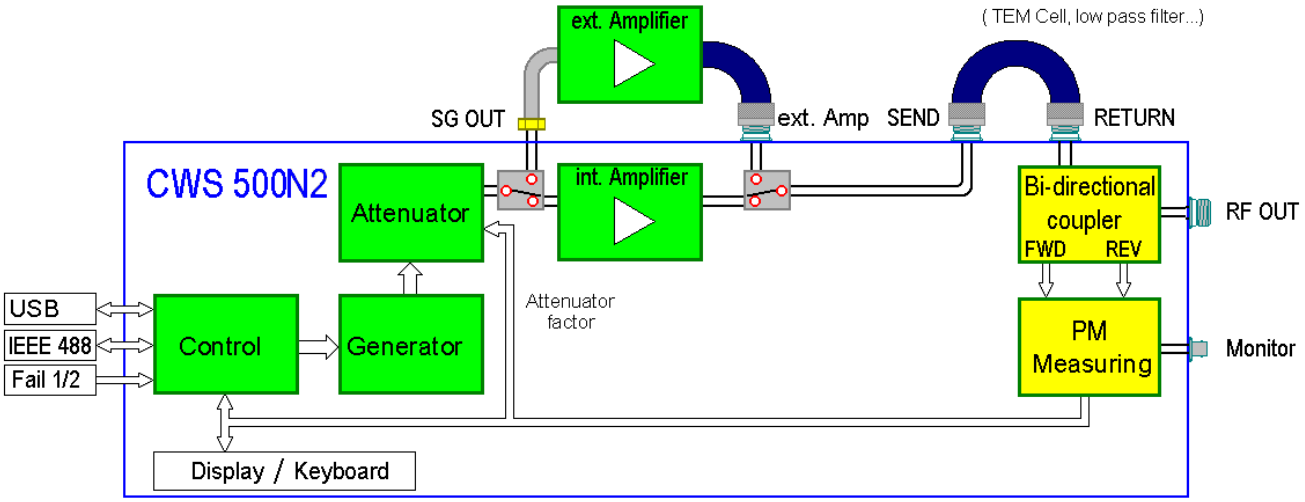


Fig 10.1

Blockdiagram CWS 500 N2.1

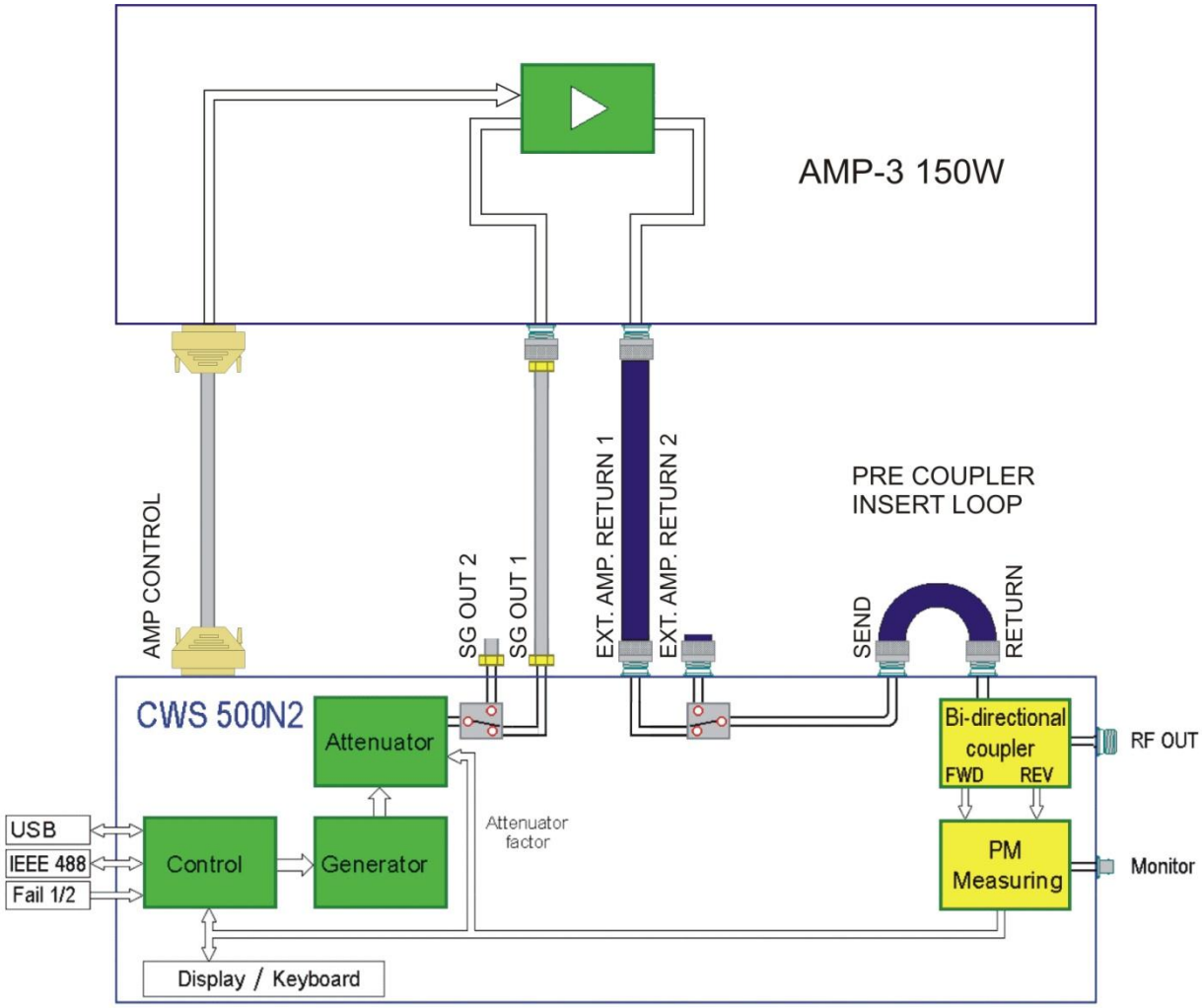


Fig 10.2

10.2. Declaration CE- Conformity

DECLARATION OF CONFORMITY

Manufacturer :	**EM TEST Switzerland GmbH**
Address:	Sternenhofstr. 15 CH 4153 Reinach Switzerland

declares, that under is sole responsibility, the product's listed below, including all their options, are conformity with the applicable CE directives listed below using the relevant section of the following EC standards and other normative documents.

Product's name:	Continuous Wave Simulator
Model Number(s)	CWS 500 N2, CWS500N2.1

Low Voltage Directive 2006/95/EC

Standard to which conformity is declared:

EN 61010-1 : 2006	Safety requirements for electrical equipment for measurement, control, and laboratory use.

EMC Directive 2004/108/EG

Standard(s) to which conformity is declared:

EN 61326-1 : 2006	Electrical equipment for measurement, control and laboratory use Class A
EN 61000-3-2 : 2007	Limits for harmonic current emissions
EN 61000-3-3 : 2005	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

	European representative	Manufacturer
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By	U. Flor General manager	A. Burger Design and Research
Place	Kamen, Germany	Reinach BL , Switzerland
Date	07.December 2011	07.December 2011