User manual

CCM

Contact Current Meter

Updated to Firmware Version:
CCM V.1.09

SAFETY NOTES

Read carefully before using the product

MPB works to provide its customers with the best safety conditions available, complying with the current safety standards. The instrumentation described in this manual has been produced and tested in conditions that fully comply with the European standards. To maintain it in safe conditions, ensure the correct use of the product and prevent any danger, these general instructions must be fully understood and applied before any use.

This product is intended for industrial environments and laboratories and should be used by authorized personnel only. The CCM was designed and developed to be used according to the norms and regulations of the country where the worker is operating in.

Please use the device only after checking the presence and validity of the safety devices (e.g. breakers, differential switches and the conformity of the grounding).

MPB disclaims any responsibility for a different use of the device.

For safety reasons, the GROUND PLANE mode measurement (whose explanation will be detailed in the following chapters) MUST always be done before the HAND mode measurement. The GROUND PLANE mode measurement shall not exceed the limits defined by the 2013/35/EU regulation (CCM-A version) or 2004/40/EC (for the CCM version) and must be performed ONLY with the cover provided with the instrument. Please also note that even when in GROUND PLANE mode, total safety is not guaranteed if the use of the instrument is not made according to the instructions explained in this manual. All these procedures will be better underlined below.

Declaration of conformity

CE

(according to EMC 89/336/EEC directive and low voltage 73/23/EEC)

This is to certify that the product: CCM
(Contact Current Meter)

complies with the following European Standards:
Safety: CEI EN 61010-1 (undated reference, applies to all editions)
EMC: EN 61326-1 (undated reference, applies to all editions)

This product complies with the essential requirements of the Low Voltage Directive
2014/35/EU, EMC directive 2014/30/EU and with the RoHs Directive 2011/65/EU.

MPB S.r.l.

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1. General information

1.1. Introduction

CCM was designed to measure in a fast and accurate way the contact current that may be generated when touching electrical/electronic equipment inside a radio frequency field.

1.2. Description

CCM (Figure 1-1. CCM) is a portable measuring device with two measurement modes. It can measure by means of the GROUND PLANE (with related cover to wrap the instrument and resistance for closing the circuit on the ground), and it can work without a cable, making use of the impedance level of the user through the conductive area on the handle. In the next chapters we will go more deeply into this subject.

Figure 1-1. CCM

1.3. Composition

1.3.1. Standard configuration

- Rigid Case
- CCM
- 1,5 V Batteries (2 pcs.)
- RG316 Cable (length 3 m) sma(M) sma(M)
- Body Simulation Impedance (Z-2251)
- Ground Plane plate (dimensions 360 X 239 mm)
- Ground Plane Cover
- USB Cable for PC Connection
- USB Key with:
- User Manual

- Data Sheet
- Calibration Certificate

1.3.2. Optional kit

CCM-JIG Kit, including:
- Calibration JIG
- Standard resistance (R45)
- Cable (length 1 m) N(M) sma(M)

1.3.3. Optional Item

- IEC-60990 Body Simulation Impedance

1.4. Front

In Figure 1-2 is shown the CCM front panel:
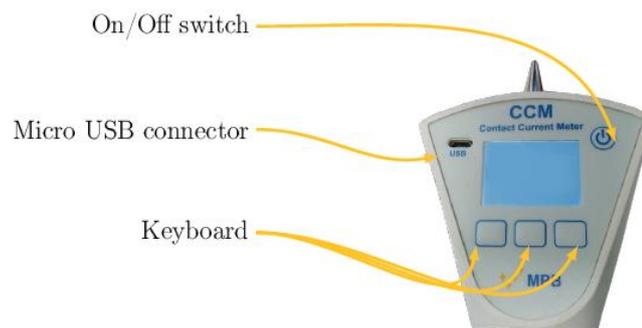
Figure 1-2. CCM front

1.5. Rear

In Figure 1-3 is shown the CCM rear panel:

Figure 1-3. CCM rear

1.6. Technical specification

Frequency Range	
Low band	40 Hz to 2.5kHz
Medium band	2.5 kHz to 100 kHz
High band	100 kHz to 110 MHz (CCM);
	100 khz to 10 MHz (CCM-A)
Frequency Response	
Low band @ 1 mA	< ± 1.5 dB
Medium band @ 100%	< ± 1.5 dB
High band @ 20 mA	< ± 1.5 dB
Measurement range	
Low band	
Level range	0.01…3 mA (ICNIRP limit 1mA)
Damage level	100 mA
Resolution	1 nA
Dynamic range @ 500 hz	50 dB
Linearity error @ 500 Hz; 0.3…3 mA	< ± 1 dB
Medium band	
Level range	1…300%
	(ICNIRP limit 1…40mA)(Ty)
Damage level	500%
Resolution	1 nA
Dynamic range @ 25 kHz	50 dB
Linearity error @ 25 kHz; 10…200%	< ± 1 dB
High band (CCM:100kHz…110MHz;CCM-A:100 kHz…10MHz)	
Level range	0.4..120mA (ICNIRP limit 40mA)
Damage level	300 mA
Resolution	10 nA
Dynamic range @ 10 MHz	50 dB
Linearity error @ 10MHz; 12…120 mA	< ± 1 dB
Input signal attenuation	20 MHz -> 7 dB
	30 MHz -> 18 dB
	40 MHz -> 31 dB
	100 MHz… 3 GHz -> 45 dB
Input signal attenuation (CCM-A)	20 MHz -> 7 dB
	30 MHz -> 18 dB
	40 MHz -> 31 dB
	100 MHz… 3 GHz -> 45 dB
Measurement mode	Hand and Ground Plane
Alarm sound	Programmable level
Display	Graphic LCD with led backlight
Detectors	RMS
Contact tip	Interchangeable
USB Interface	Micro USB connector
Standards	Directive 2004/40/EC (CCM);
	Directive 2013/35/EU (CCM-A)
Operating Temperature	+10 °C to +40 °C
Power supply	
Battery	2pcs AA Alkaline
Operation	48 hours
Dimension	205 x 90 x 45 [mm]
Weight	200 g
Recommended calibration interval	24 months
Built-in self-test	Safety front-end functionality test

2. Principle of operation

2.1. Logic schema

The schema shown in Figure 2.1 describes the CCM work flow:
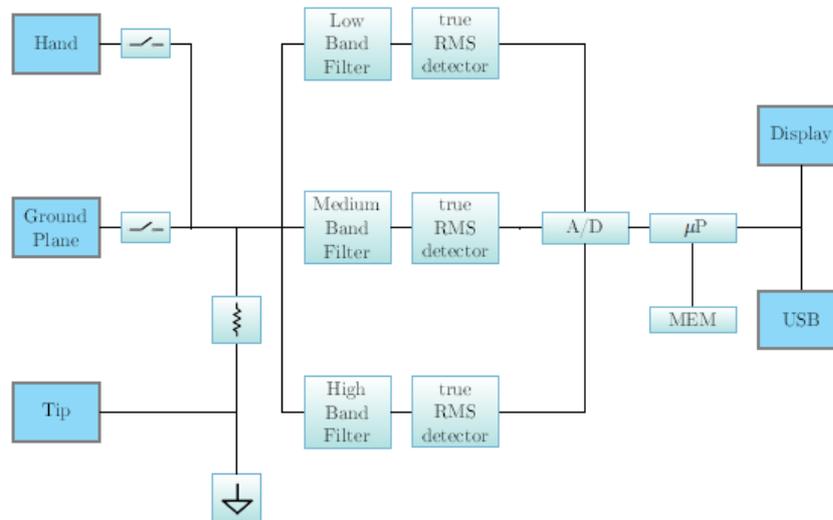

Figure 2-1. CCM block diagram

2.2. Measurements

The CCM digital nature allows it to measure contact currents through the true RMS (Root Mean Square) value for all analog signals from 40Hz. The RMS value of a waveform signal is equal to a DC current which provides the same power to the load. The signal measured by the TIP passes through the most suitable filter (Low, Medium and High), then arrives to the true RMS detector, that makes a conversion of the measured current to RMS. The equation is the following:

$$e_{rms} = \sqrt{\frac{1}{T}\int_0^T [V(t)]^2 dt}$$

The actual regulations defines the minimum requirements for the safety of workers in areas of risk, and the limit values for the exposure to contact current.

2.3. Contact current

The contact current flows when a person or an object serve as electrical conductors when reaching another metallic object immersed in an electromagnetic field: the contact current is expressed in Amperes. The moment right after the contact can imply a discharge of associated currents (First attachment of 2013/35/EU). In the workplace, as well as in the world we live in, the electric and magnetic fields are always present and can have natural or artificial origin. The natural electric fields are, for example, those produced by the accumulation of electric charges during a

lightning, while the natural magnetic fields are those that are found in nature, such as the terrestrial one that orients the compass needle North-South.

The electric and magnetic artificial fields are produced by artificial devices and systems, such as electrical equipment or systems for the distribution of electricity. The electromagnetic field can be defined as a physical phenomenon resulting from the simultaneous presence of an electric field and a magnetic field. Moving from the source of the electromagnetic field, the waves decrease in intensity, it is therefore clear that the intensity is maximum if there is a contact with the object or with the system which is generating the electromagnetic field. A device with metallic shell, if immersed in an electromagnetic field, can become a RF voltage carrier and can accumulate electrical charges. If you come into contact with the device without adequate protection, you can risk that the RF voltage discharges to ground flowing through the limbs and the body. In this case, the electrical charges on the device, immersed in the electric field through the operator's body, have generated a contact current. An electrical equipment not properly shielded can emit electromagnetic waves. When coming into contact with that machinery without adequate protection, even in this case there is a risk that the electromagnetic waves, flowing through the limbs and the operator's body, can generate a contact current.

2.4. Safety

The GP measurement mode has only been developed for safety reasons, since it does not guarantee reliable measurements. For the operator's safety and security it is absolutely mandatory to make sure that, when performing GP measurements, the cover provided with the instruments wraps it like in the picture below, the plate is set in the same position as the operator's and the impedance is connected to the plate connector and not to the CCM. For more details please scroll down to 4.4.

Figure 2-2. GP cover

3. Option

Starting from FW version 1.09, new options are available.

3.1. Display all the values in the three bands

By activating this functionality, the measure in MF band can be shown.

Figure 3-1. Display of measurement

For enabling this functionality, the Option **CCM-SHOW MF** is required (contact your *MBP* representative for enabling it).

3.2. Auto measure and store

By activating this functionality, the user is enabled to:

- program the CCM for automatic read
- program CCM for starting the measure at specific time and for synchronizing measure between multiple CCMs (if necessary)
- program CCM for storing the average of measures

For this functionality, the Option **CCM-AUTO MEASURE** is required (contact your *MBP* representative for enabling it).

3.3. Enable the option

The steps for options enabling are listed below:

1. copy and paste the *passkey.txt* file received by mail into CCM
2. disconnect CCM from USB
3. switch off the CCM
4. after turning back on, the instrument will have read and applied the changes and deleted the previously entered passkey.txt file

4. CCM usage

4.1. Turn on

When the CCM is on, it displays the MPB logo and the firmware version (Figure 4-1). After a few seconds a warning message will appear (as in Figure 4-2), and users have to declare to have read this manual and to be aware of the risks involved during the current measurement. In case of negative answer (by pressing "DENY"), the device will automatically turn off.

Release n°

Figure 4-1. Turned ON CCM
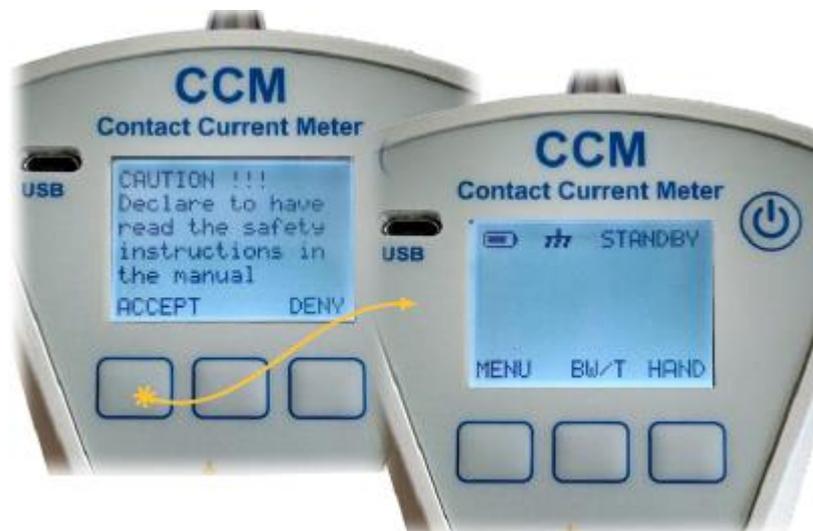
Figure 4-2. CCM Menu

4.2. First use

If the CCM has just been switched on (or if it's been more than one minute since the last measurement) it is in STANDBY mode. At the first use, the user will have to set date & time (please refer to Chapter 4.7.5), contrast (please refer Chapter 4.7.6), and clear eventual data (please refer Chapter 4.7.7). Once all the data have been set, or immediately if not in case of a first use, a message will appear: "GP MODE MUST

use the cover". The use of the cover is mandatory in Ground Plane mode, which is the default mode: by pressing the trigger you will confirm to have noticed the instruction: by pressing the trigger again, the device will select the relay and active the WAIT mode, which indicates that the device is loading. In the end, the message READY is displayed. Before pressing the trigger again, the operator will have to wait for the appearance of the READY message on the screen (Figure 4-4). From this moment on, the device is ready to perform the test in real-time.

So, in order to perform measurements, please follow the instructions below:

- *Press the trigger to switch the instrument mode from STANDBY to READY. Only when the READY key appears (please do not press the trigger again) reach the equipment under test with the tip and, only after making contact, press the trigger to start the measurement. You can make single or consequential measurements.*
- *With each new measurement, the operator will be warned by an acoustic signal (if enabled) and, simultaneously, by a brighter display illumination. All measures are automatically stored by the CCM.*
- *In both modes the measuring tip of the CCM must never be removed from the equipment under test.*

Figure 4-3. GP cover message

Figure 4-4. Ready for measurement

4.3. Standby screen

In Figure 3.5 is shown the standby screen. On the top part, you will find:
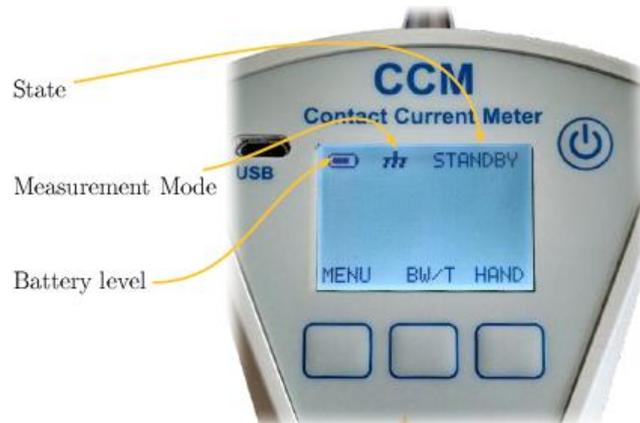
Figure 4-5. First use

- *Battery indicator.*
- *The Measurement Mode icon shows which kind of circuit is selected in that specific measurement session, and (we'll see that more accurately in next paragraph) there are two different measurement modes:*
    - *HAND for measurements that use the body impedance of the operator as a reference.*
    - *GP (or GROUND PLANE) for measurements that concern the supplied metal plate with a standardized impedance as a reference.*
- *The State indicates to the user whether the device is ready to make a measurement or not.*

4.4. Hand or GP

Please remember that the GP measurement mode does not guarantee reliable measurements but it must be in any case performed before the Hand measurement mode due to safety reasons, and with the cover provided in the case wrapping the instrument. Please scroll back to 2.4 for more details. In the main screen, the key on the right (in this specific case it can be GP or HAND) allows the user to choose which circuit to use for the measurement (Figure 4-6). It is mandatory to measure with the Ground Plane before doing the HAND measurement (so that, in extreme cases, a high current will simply discharge on the ground). In the Hand measurement mode the CCM will instead consider the real impedance value of the human body.
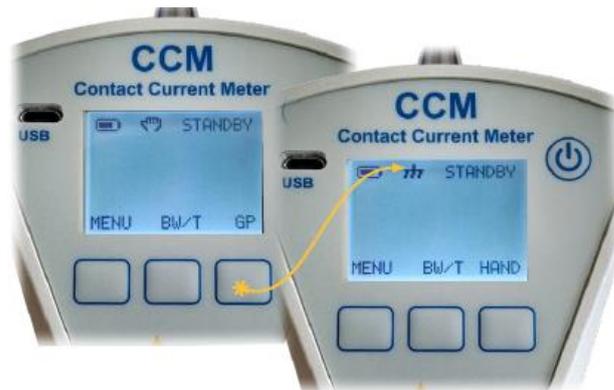
Figure 4-6. Hand or GP mode

4.5. Bandwith / Total

The central key, BW/T, allows the user to choose the visualization mode:
- **BANDWITH**: Display of the measurement divided by bands (or selective measurement), with the final result expressed in mA.
- **TOTAL**: Overall view of the measured value, in percentage, compared to the ICNIRP limit.

$$TOTAL = MAX\ (\%LF; \%MF; \%HF)$$
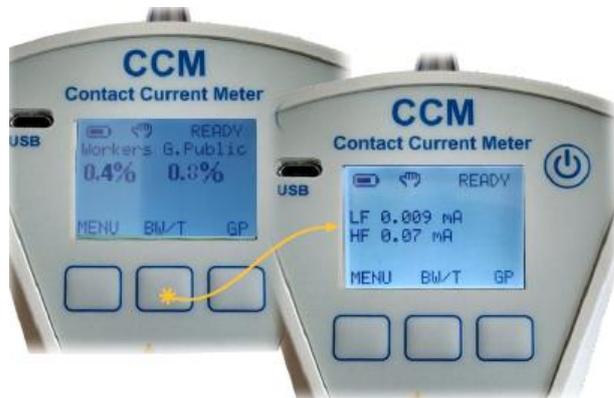
Figure 4-7. BW/T

You can find below the formulas for LF, MF and HF.

$$\%LF(t) = \frac{valLF_{[mA]}(t)}{1_{mA}} \times 100$$

$$\%MF(t) = \frac{valMF_{[mA]}(t)}{0.4_{[mA/_{kHz}]} \times f_{kHz}} \times 100$$

$$\%HF(t) = \frac{valHF_{[mA]}(t)}{40_{mA}} \times 100$$

You can find an example of what happens in Figure 4-7. The Low band Filter starts at 40 Hz to 2.5 kHz (IC bound = 1 mA), while the High band Filter starts at 0.1 MHz to 110 MHz (10 MHz for the CCM-A version) (IC bound = 40 mA).

The value of the contact current in the range of frequencies ranging from 2.5 kHz to 100 kHz is displayed when the values of LF and HF are low. For this reason it is suggested to make the measurement while "displaying" TOTAL and then check in BANDWIDTH at what frequency the limit has been exceeded. Please consider that by the "TOTAL" wording it is not meant that a total summation is made over all three bands but the Max value from the three bands is taken.

4.6. Built-in self-test

Before any first Ground Plane measurement, before switching from Ground Plane to Hand mode and vice versa, back from Hand mode to Ground Plane mode, the CCM will perform a test to verify the front-end functionality of the instrument.

In case the test is not passed a "Contact Service" fault message will appear.

WARNING: in case of such message the instrument cannot be used and it will be mandatory to send it back to MPB for a full check. In case the test is passed, a GP mode measurement (always through the cover provided) will be allowed. Performed the measurement and stored the data, it will be allowed to switch to Hand mode, after showing the message "warning HAND mode, remove the cover".

Please make sure not to connect to a signal generator the equipment under test turned off, and then turn it on at a later time: please instead connect it only after the "Ready" wording appears.
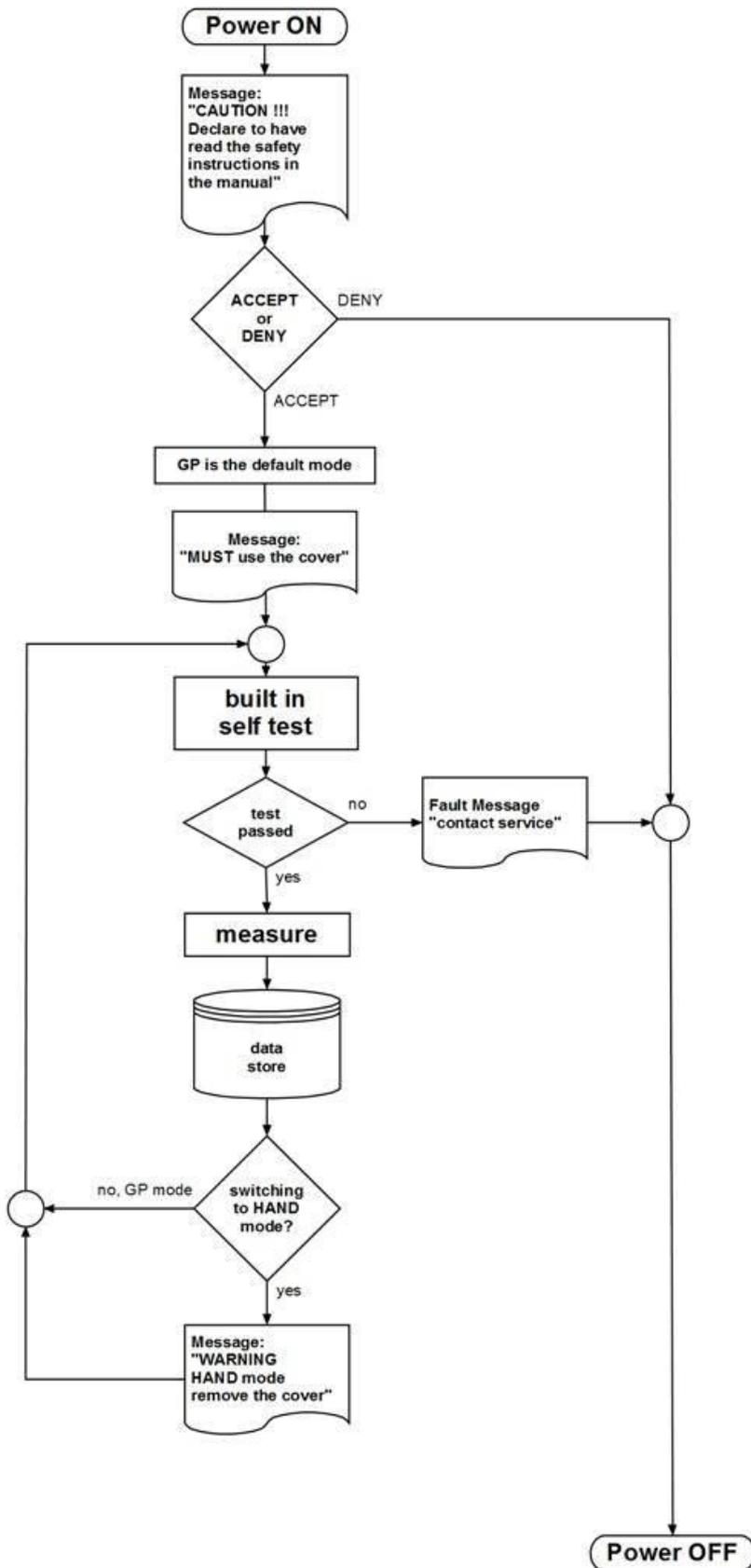
Figure 4-8. Flow Chart

Figure 4-9. Built-in Self-test

Figure 4-10. GP-Hand switching

4.7. CCM menu

The next part of the manual sequentially shows the possible configurations of the device.

4.7.1. Regulation limits

From the standby screen, by pressing the MENU key, you will reach the screen shown in Figure 4-11.
This screen is intended as a reminder for the user, since it displays the limit values for which the CCM is designed.
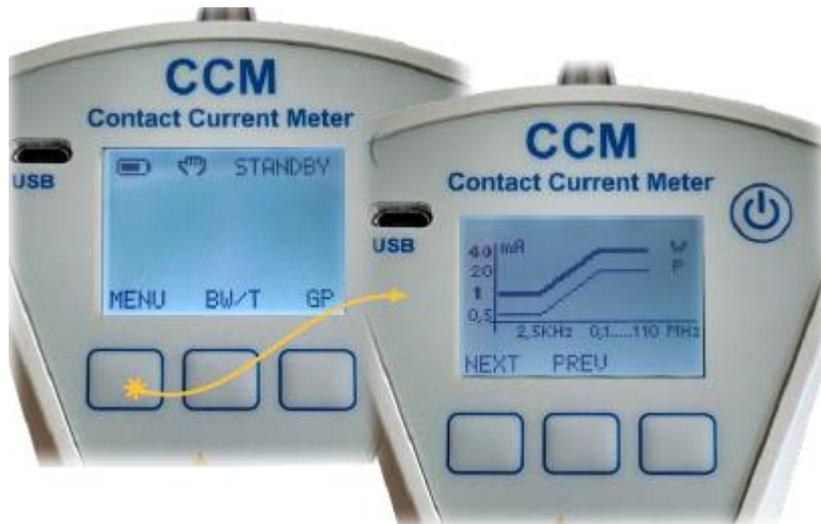
Figure 4-11. Limits

4.7.2. Beep on press

The second page of the menu allows you to enable or disable the beep every time you press the corresponding key. To change this setting enter the page by pressing the key SET, as in Figura 4-12.

Figura 4-12. Beep on press

4.7.3. Alarm

Scrolling back the menu (always using the NEXT key) the third page displayed is the alarm page. This happens when the SET key is pressed (as shown in Figure 4-13). By default the alarm is disabled, while, when pressing the UP key, the value is incremented by 5% until it reaches the maximum warning threshold of 300%.

Please do not forget that the percentage value is parametric compared to the frequency of the input signal (see the graph shown on the first page of the menu - Chapter 4.7.1).
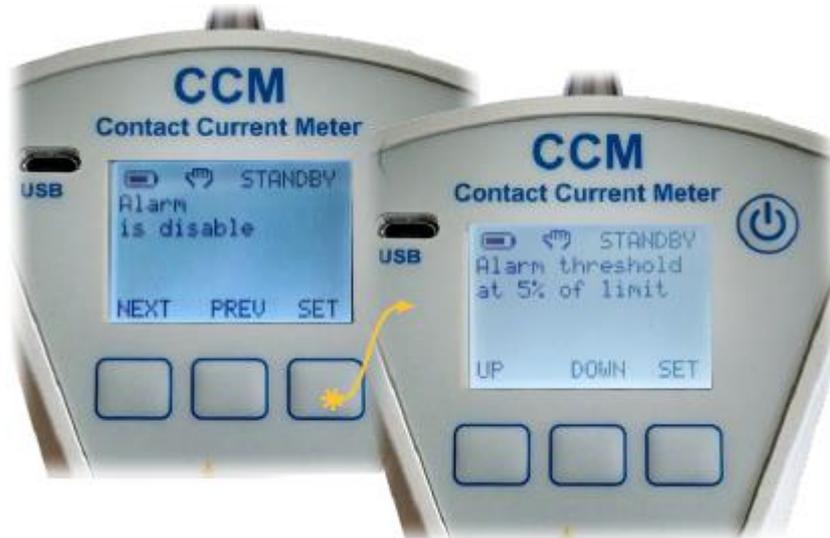
Figure 4-13. Alarm

4.7.4. Auto off

Through this setting the user can decide how long after inaction it will take before the device will automatically shut down. This is the fourth page of the menu, and in Figure 4-14 you can see how, also on this page, the left and center key change usage. Ranges for this setting vary from 10 minutes to 60 minutes (with a 10 minutes span). You cannot disable this option for battery saving.

Figure 4-14. Auto off

4.7.5. Data & Time

The fifth menu item allows you to change the date and time of the device (Figure 4-15). It is important that this information is correct, because the results of the measurements in the downloaded data (csv file generated by the device) are associated with the day and time of the measurements.
The changes of the fields are carried out using the keys UP and DOWN, and will follow the sequential order of day, month, year, hours, minutes and seconds.

Figure 4-15. Date & Time

4.7.6. Contrast

The sixth page of the menu (Figure 4-16) allows you to change the contrast of the LCD display by using the same keys, UP and DOWN. By default an intermediate value is already set.

Figure 4-16. Contrast

4.7.7. Clear data

In this menu, the operator has the possibility to delete all the data stored in the internal memory. If measurements from the previous session have remained, it is possible to clean the memory without a PC. The Figure 4-17shows how this functionality works.

Figure 4-17. Clear Data

4.8. Auto read

Enable this functionality as per Chapter 3.3 Enable the option at page - 12 -.
The operative instructions are listed below:

A. measure the value in repetition mode
- generate a text file named *setting.txt*
- input in the file:
  - repetition time <number in second>
 - number measure <number of measure>

Example:
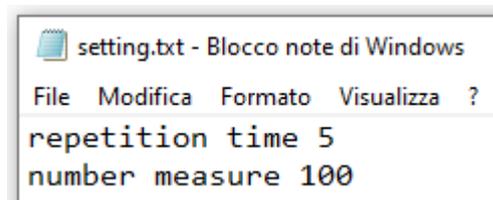
Figure 4-18. Example A

In this mode, clicking the orange trigger, the CCM reads every 5 seconds and stores the measurements up to 100 values.

B. measure the value in repetition mode and start at a specific time (used to synchronize measurements):
- generate a text file named *setting.txt*

- input in the file :
  - repetition time <number in second>
  - number measure <number of measure>
 - time to start <hh:mm:ss>

Example:
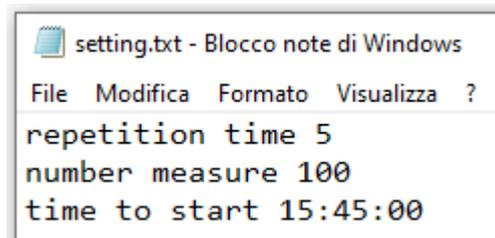
Figure 4-19. Example B

IMPORTANT: use " **:** " (two points) to separate hours: minutes: seconds

By setting desired time into CCM, the instrument starts automatically the measurements, repeats every 5 second and stores the measurements up to count 100 measures.

C. **store average of measure:**
- generate a text file named *setting.txt*
- input in the file :
  - repetition time <number in second>
  - number measure <number of measure>
  - time to start <hh:mm:ss>
  - average <minute>

Example:
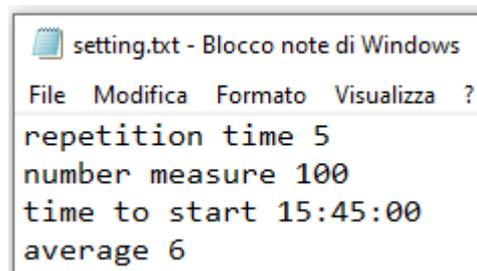
Figure 4-20. Example C

IMPORTANT: use " **:** " (two points) to separate hours: minutes: seconds

By setting correct time into CCM, the instrument starts automatically the measurements, repeats every 5 second, stores the average of measures in a time interval of 6 minutes and stops the selection when it counts 100 measurements taken.

The user can realize a customized setting combining different values of different parameters.

The allowable values for parameters are:

repetition time = from 0 to 3600 seconds
number measure = from 0 to 500
time to start = from 00:00:00 to 23:59:59
average = from 0 to 60 minutes

In order to apply the programming, the user has to follow these steps:
1. create the file named *setting.txt* with notepad.exe in windows or similar text editor
2. copy this file into CCM
3. disconnect the CCM from the PC
4. reboot CCM by switch OFF and switch ON
5. after confirming the security message, the display shows:
    a. Auto Read detected = if have setup only time to start
    b. Auto Repetition = if have setup number measure
    c. ... store average = if have setup average

5. Data Download

5.1. Connect to PC

The data downloading operation has been designed to improve the speed and simplicity of use. The data generated by the CCM are stored in csv (comma separated value), which is a text file with value separators. This allows the user to read, edit and process the downloaded data via various software including MS Excel.

When connecting your device, it must be already turned on. At the first connection, through the USB-Micro USB cable supplied with the instrument, the CCM will be recognized by the PC as a mass storage device (Figure 5-1). For this reason there is no need for special drivers, because drivers self-installed by Windows OS will be ready to use.


Figure 5-1. Installation of driver

If your PC has enabled the autoPlay, the next window appearing will be the one to access to the new peripheral (Figure 5-2), otherwise it can be accessed by opening "My Computer" and selecting the **MPB (CCM)** marked device.
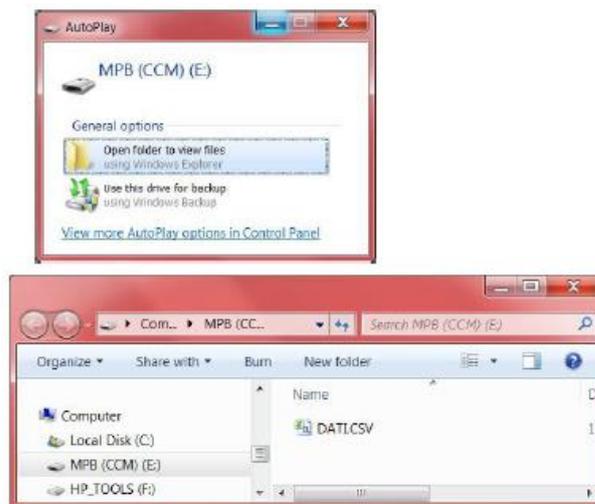
Figure 5-2. Access Data

5.2. Data Format

Measurement by measurement, the device forwards, to the only data.csv file generated, all the information about a measurement. More specifically, the stored data are ordered as follows:

- Date & Time
- Total value Measurement (expressed in %) For workers.
- Total value Measurement (expressed in %) For general public
- Value in mA from the Low Filter.
- Value in mA from the High Filter.
- Measurement made through HAND or GP.

To correctly display the date and time, the format to enter is dd:mm:yyyy:hh:mm:ss.

To correctly display the acquired values: the decimal separator is the "." (point), and the digit grouping symbol is a "," (comma)

In case of visualization issues, please change the "Language and region" setting in the control panel.

This file, opened with *MS Excel* will appear as in Figure 5-3

MPB CCM FW 1.04					
date time	Workers	G.Public	LF	HF	Input
GG/MM/AAAA hh:	%	%	mA	mA	from
01/01/2015 10:02	1.5	3.1	0.013	0.06	gnd
01/01/2015 10:02	50	100.1	0.013	20.03	gnd
01/01/2015 10:03	50	100.1	0.014	20.03	gnd
01/01/2015 10:04	50	100.1	0.012	20.03	gnd
01/01/2015 10:05	50	100.1	0.013	20.03	gnd
01/01/2015 10:05	49.9	99.9	0.013	19.99	gnd
01/01/2015 10:06	49.9	99.9	0.013	19.99	hand
01/01/2015 10:07	50.4	100.8	0.013	20.17	hand
01/01/2015 10:08	103.2	206.5	1.032	0.06	hand
01/01/2015 10:08	103.5	207	1.035	0.06	hand
01/01/2015 10:09	103.4	206.8	1.034	0.06	hand

Figure 5-3. Data dump

6. JIG – General information

6.1. Introduction

The JIG was designed to standardize the CCM calibration procedure, and give the final user the possibility to perform calibration whenever he needs to.

Figure 6-1. CCM and JIG

6.2. Description

The JIG is built on an iron base, with a connector to be plugged to the CCM's Jig room, an iron locking stirrup designed for the HAND plate, and adaptive connectors designed for the contact current meter. This guarantees a stable support during the test procedure. During that, the user will have to subject the device to RF signals, using the special connectors on the JIG or on the CCM itself.

6.3. Composition

The CCM with the JIG option comes with:
- Rigid Case
- CCM
- 1,5 V batteries (2 pcs)
- RG316 Cable (length 3 m) sma(M) sma(M)
- Body Simulation Impedance (Z-2251)
- Ground Plane Plate (dimensions 360 x 239 mm)
- Ground Plane cover
- USB Key with:
  - User Manual
  - Data Sheet
- Calibration Certificate
- Calibration JIG
- Standard resistance (R45)
- Cable (length 1 m) N(M)-sma (M)

6.4. Kit case

In Figure 6-2 is shown the complete Kit for the CCM:

GP Compartment

CCM

JIG lock

JIG

R45 and Z-2251

Batteries
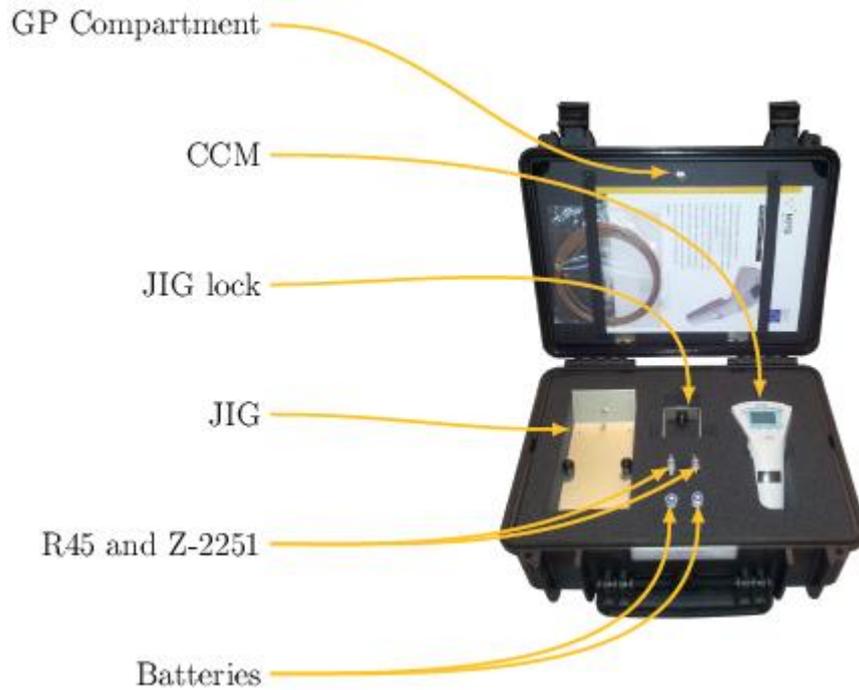
Figure 6-2. Case

In Figure 6-3 is shown the inner compartment of the case:

Ground Plane

Thickness
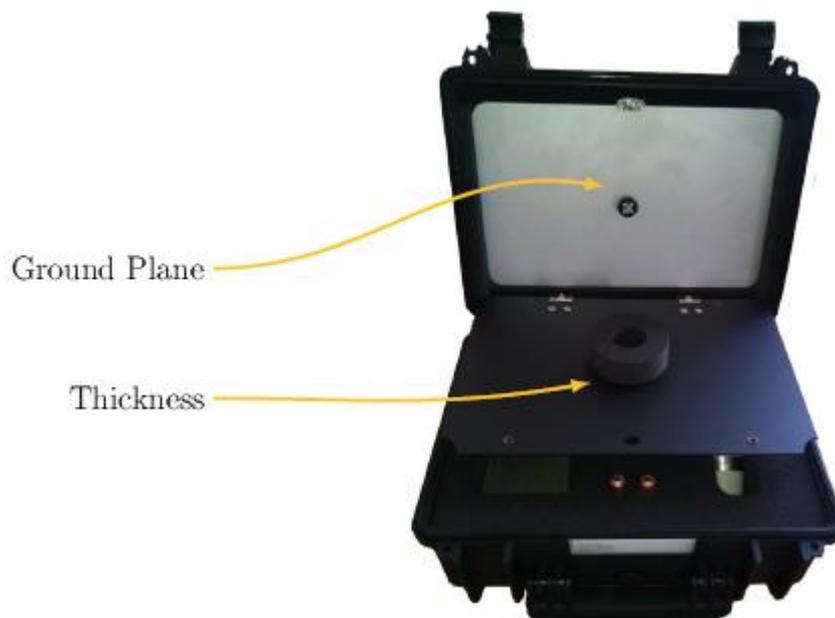
Figure 6-3. Case compartment

7. Jig – Functioning

7.1. Equipment

To use the JIG is necessary to have a signal generator, able to generate sinusoidal signals from 40 Hz to 110 MHz. All the other tools needed for the calibration are supplied with the JIG kit. For the specific connection with the signal generator, a N-sma cable (as in Figure 7-1) and a R45 resistance will be used;


Figure 7-1. Cable and resistance

The CCM has an inner resistance of 5 Ohm and, since almost all the signal generators are adapted for 50 Ohm, 45 Ohm must be added to the load. Assembling the resistance included on the sma attack of the cable. The connector must be plugged to the generator. In the next paragraphs, we will see different ways of plugging the CCM through this confguration.

7.2. Install the CCM on the JIG

To install the CCM on the JIG in order to be able to make a calibration, first of all we need to remove the TIP from the CCM, simply by sliding it out, as shown in Figure 7-2.

(a) CCM TIP   (b) unplug the TIP

(c) CCM TIP unplugged
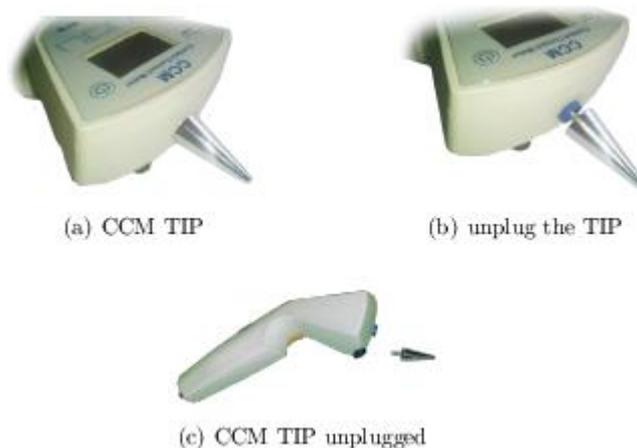
Figure 7-2. Remove the TIP

Now the device is ready to be installed on the JIG.

Set the JIG base near your signal generator, and plug the CCM on the JIG through the TIP connector as in Figure 7-3.

Figure 7-3. Set Up the JIG

The next step is to lock down the CCM with the special JIG lock using the knobs, so that the HAND plate will be connected to the lock sma connector (the result is shown in Figure 7-4).

Figure 7-4. Set Up JIG

It's important to tighten the knobs on the basis, just to ensure a good conductivity between the metal JIG and its lock plate.

7.3. "Ground Plane" test

WARNING: Please do not shift from Hand mode to GP mode (and vice versa) on the equipment under test, when the equipment is connected to a signal generator.

As already described on the CCM manual, the GROUND PLANE measure has to be done **before** the HAND measure. To properly connect the device plane connector to the generator we will use our N-sma cable and the R45 resistance as in Figure 7-5.
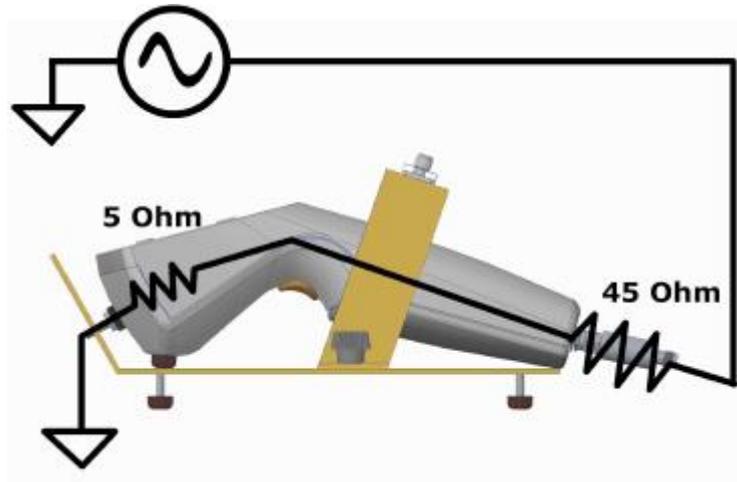

Figure 7-5. Ground Plane Plug

We can now turn on the device and set up the "Ground Plane" mode. Once the signal generator is configured and operating, you can pull the trigger and perform the measurement.

1. turn on the device under test and wait for the READY wording
2. plug the R45 adapter to the "SMA" connector in the "GP" input
3. plug the "SMA-N" cable to the adapter and to the signal generator
4. set the generator on the appropriate level
5. switch to the "GP mode" (see Chapter 4.4)
6. press the "GET" button to perform the measurement

For instructions on how to set the generator please see the examples in 7.5.1, 7.5.2 and 7.5.3.

7.4. "Hand" test

For the "HAND" measurement you have to plug the R45 resistance to the sma connector on the JIG lock, then the N-sma cable from the impedance to the generator, as shown in Figure 7-6.
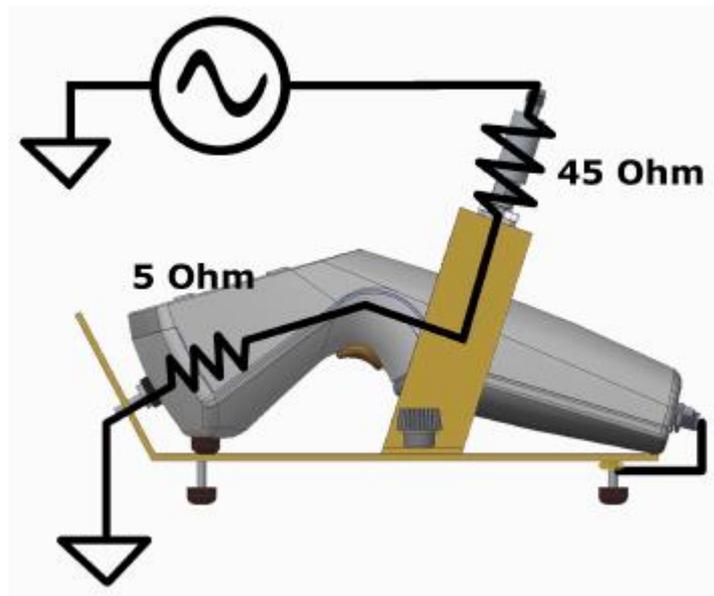
Figure 7-6. Hand Plug

With the device turned on, switch the reading mode to "HAND". Now you can start to generate the desired signal. When ready please pull the trigger to perform the measure.

1. turn on the device under test and wait for the READY wording
2. plug the R45 adapter to the "SMA" connector in the "JIG" input
3. plug the "SMA-N" cable to the adapter and to the signal generator
4. set the generator on the appropriate level
5. switch to the "HAND" modality (see Chapter 4.4)
6. press the "GET" button to perform the measurement

For instructions on how to set the generator please see the examples in 7.5.1, 7.5.2 and 7.5.3.

7.5. Certificate measurements

To test the correct functioning of the CCM, make sure your generator is working properly and the grounding is in compliance with the law. Please remember that, as every other device, the CCM is subject to a minimum eventual error. To know the ideal outcome of the device, please apply the following formula:

$$P_{GEN[dBm]} = 10 \times \log_{10} \left(\frac{50_{[\Omega]} \times I^2_{IN[A]}}{1 \times 10^{-3}_{[W]}} \right)$$

7.5.1. Low band

In this band (from 40 Hz to 2,5 kHz) the limit for workers is 1 mA, so the 100% is equal to 1 mA. To test the correct functioning of the CCM at low frequencies, please set the frequency of the generator at 1 kHz and the power at -13.01 dBm.

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You will obtain an outcome with accuracy of around 100%, corresponding to 1 mA. Within this range we suggest to set the "Bandwidth" visualization mode in order to read the result in mA as well (and not only in percentage compared to the limit).

7.5.2.Medium band

In this band (from 2,5 kHz to 100 kHz) the limit for workers depends on the frequency with the following rule: mA= 0,4 f where f is expressed in kHz. Within this frequency range the limit varies in function of the frequency of the emitted signal. We will provide three sample frequencies:

- setting the frequency at 10 kHz and the power at -0.97 dBm, you will obtain an outcome with accuracy of around 100%, corresponding to 4 mA.
- setting the frequency at 20 kHz and the power at +5.05 dBm, you will obtain an outcome with accuracy of around 100%, corresponding to a 8 mA.
- setting the frequency at 50 kHz and the power at +13.01 dBm, you will obtain an outcome with accuracy of around 100%, corresponding to a 20 mA.

7.5.3.High band

In this band (from 100 kHz to 110 MHz - to 10 MHz for the CCM-A version) the limit for workers is 40 mA, so the 100% is equal to 40 mA. Within the high frequencies range, setting the frequency at 10 MHz and the power at +19.03 dBm, you will obtain an outcome with accuracy of around 100%, corresponding to a 40 mA. Within this range we suggest to set the "Bandwidth" visualization mode in order to read the result in mA as well (and not only in percentage compared to the limit).

8. Software update

7.6. Instruction for Firmware upgrade

Installation of new versions of CCM firmware requires to follow these steps:
1. Go to MPB web site on download section
   (http://www.gruppompb.uk.com/download.asp#mpb)
2. Download the new release of firmware (file **CCM_ver1_xx.txt**)
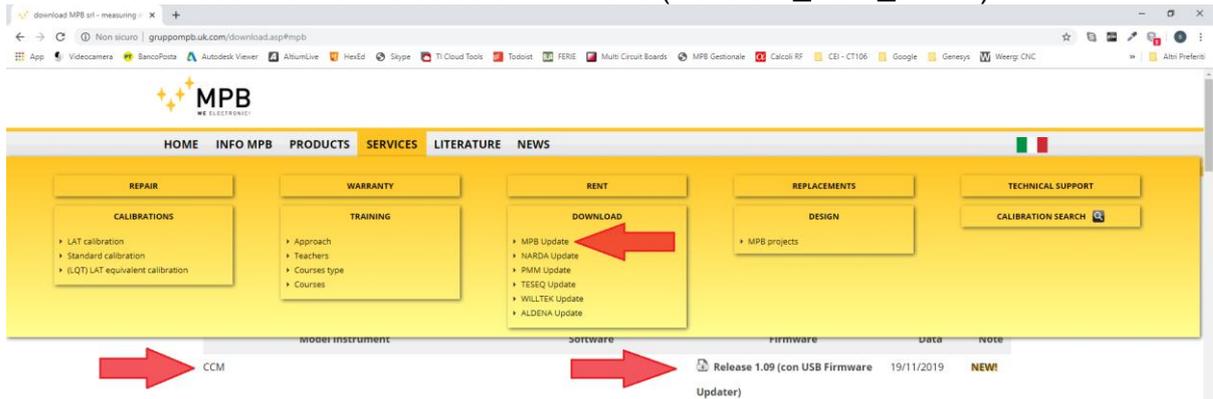
Figure 8-1

3. Download and install **USB_UPDATER.exe**

Figure 8-2

After MPB *USB Firmware Updater* installation:

4. **Switch off** the device and connect it to PC by Micro-USB cable
5. Run **MPB USB Firmware Updater** and click on "Next"
6. The display of CCM is turned on automatically
7. Click on "Browse" and select file **CCM_ver1_xx.txt**
8. Click on "Upgrade Firmware"
9. Wait for completion of upgrading, disconnect and turn the device
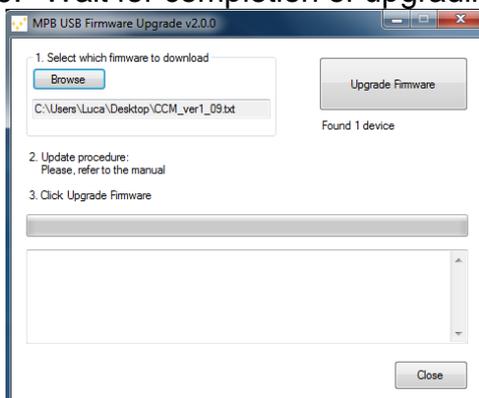
Figure 8-3. Firmware upgrading (a)
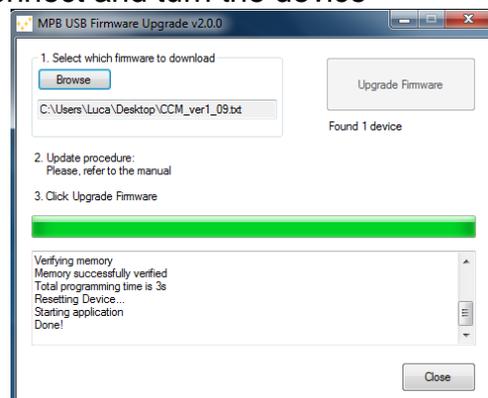
Figure 8-4. Firmware upgrading (b)