montena

Test Setup for MIL-STD-461 D, E&F CS116

System description

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1. Montena

Montena started in 1903 with as capacitor manufacturing company.

In 1978, montena emc was created to address the arising emc problems. Since then montena has earned a worldwide reputation for its leading-edge skills in the fields of high voltage, high frequency and electromagnetic fields.

Montena has the number one EMC test lab in Switzerland. With two large anechoic chambers, an open area test site and multiple shielded rooms, montena can test and validate all kinds of equipment.

Figure 1 : Montena emc headquarters - helicopter in an anechoic chamber

Montena can count on highly specialized know-how in the field of electromagnetic compatibility. These skills are put to good use in the development and construction of various kinds of equipment, especially emc test equipment and fast electrical pulse generator.

1.1 Products

Montena designs, builds and markets equipment and accessories for EMC tests. The range of products includes antennas, TEM cells, striplines, field sensors, all kind of pulse generators, test benches, etc.

Montena's high voltage pulse generators are mainly used for EMC tests, ultra-rapid imaging and pulsed light decontamination. Montena also builds pulse generators according the custom specific needs.

Figure 2 : some of montena emc products

1.2 Turn key MIL STD 461 test installations

Montena has developed and sold worldwide turnkey test setups for MIL-STD 461 test as RS 101, CS 101, CS 114, CS 115, CS 116 and RS 105.

Figure 3 : example of test setup from montena

2. Test setup description

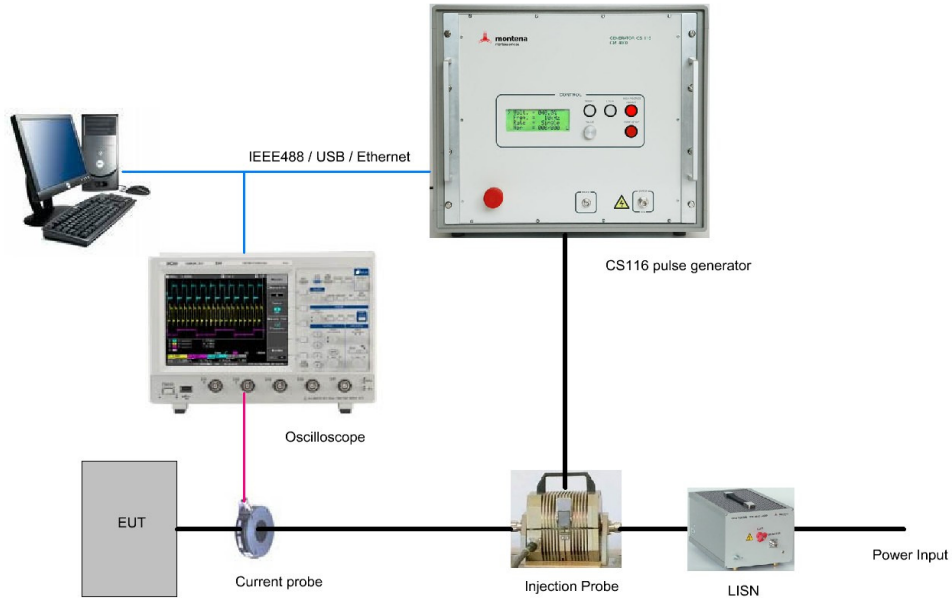MIL-STD 461, CS 116 test setup typically comprises following elements:

Figure 4 : schematic of a typical CS 116 test setup installation

The damped sinusoidal generator delivers the high voltage pulse to the injection probe to test the conducted susceptibility of the EUT. An oscilloscope connected to current probe checks the level of the injected perturbation. LISN are to be used to control the impedance on the power input.

A PC with a control software allows fully automatic calibration and test sequences, as well as the automatic generation of test reports.

Pulse shapes

Montena's CS 116 test installation delivers a damped sinusoidal pulse according to MIL-STD 461 D, E and F versions.
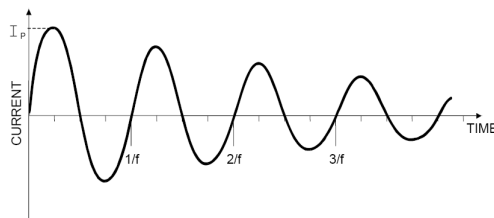
NOTES: 1. Normalized waveform: $e^{-(\pi f\, t)/Q}\sin(2\pi ft)$

Where:
f = Frequency (Hz)
t = Time (sec)
Q = Damping factor, 15 ± 5

2. Damping factor (Q) shall be determined as follows:

$$Q = \frac{\pi(N - 1)}{\ln(I_P/I_N)}$$

Where:
Q = Damping factor
N = Cycle number (i.e. N = 2, 3, 4, 5,…)
I_P = Peak current at 1st cycle
I_N = Peak current at cycle closest to 50% decay
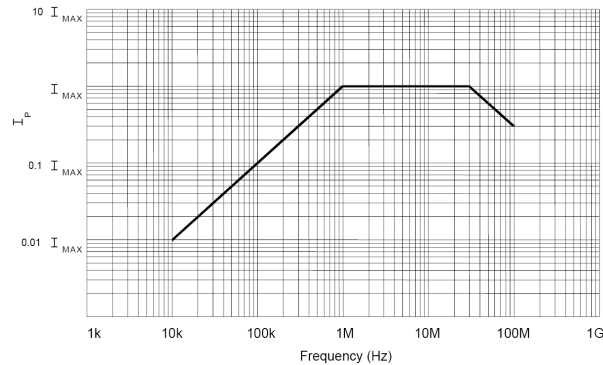ln = Natural log

3. I_P as specified in Figure CS116-2

Figure 5 : MIL-STD-461 D, E&F CS116 pulse shape

Current injection level

The damped sinusoidal pulse level can be manually tuned to obtain the required current injection level.

Note: in the MIL-STD 461 D&E versions, two levels are defined with

1. For Army and Navy procurements, I_{MAX} = 10 amperes

2. For Air Force procurements, I_{MAX} = 5 amperes

Figure 6 : MIL-STD-461 D, E&F CS116 pulse current level

In the automatic mode (software controlled) the current injection level can be defined for each available discrete frequency and the system calibration will automatically determine the required generator's output level to obtain the specified current injection level.

3. Damped sinusoidal pulse generator

The damped sinusoidal generator POG_116 xF can be supplied with 6 to 17 discrete frequencies.

Figure 7: Montena pulse generator for CS 116

Menu driven control panel

The menu driven control panel allows the user to select the desired discrete frequency, the pulse voltage level, the repetition rate and the number of pulse to be generated.

`> Volt. = 070.0%`	Voltage in % of maximum level
`  Freq. =    1MHz`	Frequency
`  Rate  =  0.5Hz`	Repetition rate
`  Nbr   = 019/600 L`	Number of pulses (current count/fixed number)

One single signal output

The generator has one signal output for all available discrete frequencies. By having one single output, the whole calibration or the measurement phase can be performed without any need to change the cabling, considerably reducing the calibration and measurement time.

Figure 8: single signal output

From 6 to 17 frequencies

The MIL STD 461 D, E & F CS116 requires testing the susceptibility at 6 discrete frequencies between 10 kHz and 100 MHz.

Montena's CS116 generator provides additional frequencies too:

Oscillation frequency	Maximal current [1]	PDG116 - 6F	PDG116 - 9F	PDG116 - 17F
10 kHz	**0.1 A**	X	X	X
18 kHz[2]	0.2 A			X
30 kHz[2]	0.3 A		X	X
56 kHz[2]	0.6 A			X
100 kHz	**1 A**	X	X	X
180 kHz[2]	2 A			X
300 kHz[2]	3 A		X	X
560 kHz[2]	6 A			X
1 MHz	**10 A**	X	X	X
1.8 MHz[2]	10 A			X
3 MHz[2]	10 A		X	X
5.6 MHz[2]	10 A			X
10 MHz	**10 A**	X	X	X
18 MHz[2]	10 A			X
30 MHz	**10 A**	X	X	X
56 MHz[2]	5.5 A			X
100 MHz	**3 A**	X	X	X

[1]	At 100 % voltage setting and with a 2 m 50 Ω coaxial cable, with the dedicated injection probe (e.g. Prâna IP-DR250) and calibration jig, on the 100 ohm calibration load.

[2]	These frequencies are not required by the MIL STD 461 but we recommend them to have a better coverage of the frequency range.
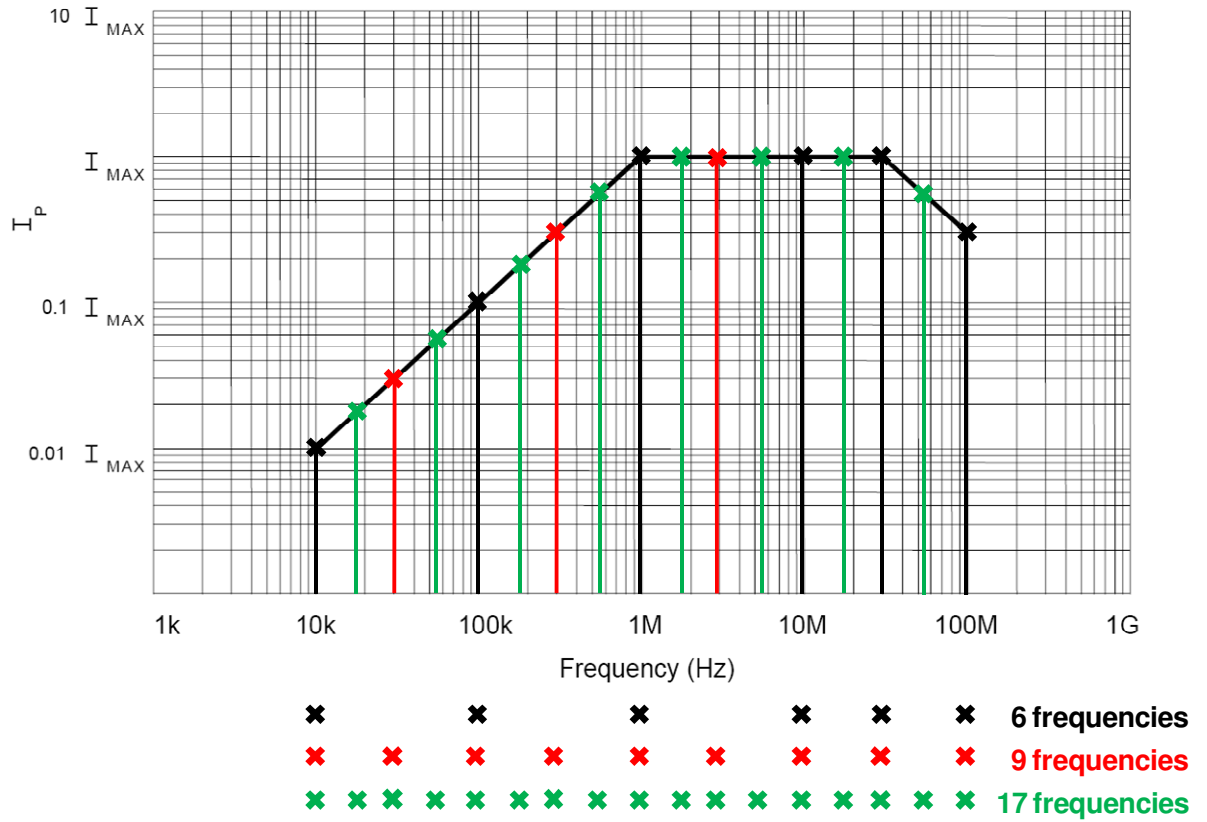
Figure 9: Available CS116 test frequencies

4. Control interface for fully automated system

The remote control can be carried out through RS 232 or USB. An ASCII based command protocol allows a total control of the generator.

The CS 116 test setup from montena is supplied with a dedicated based control software with graphical user interface as shown below.
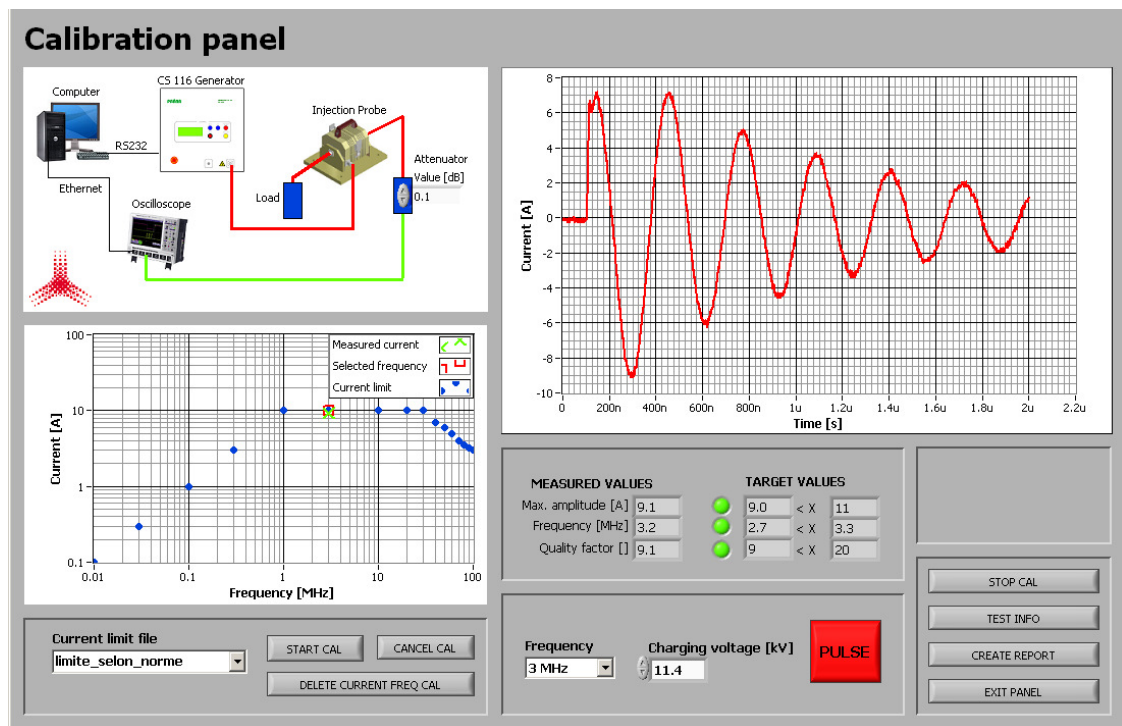

Figure 10 : CS116 control software

This control software comprises:

- A **calibration** panel allowing a fully automated calibration of the system (generator and injection probe) to define the required generator output pulse voltage to inject the defined perturbation current at each available discrete frequency.

- A **measurement** panel allowing a fully automated measurement phase with sequential injection of the defined current level at each available discrete frequency.

- A **report generation** to keep track of measurements as well as of calibrations.
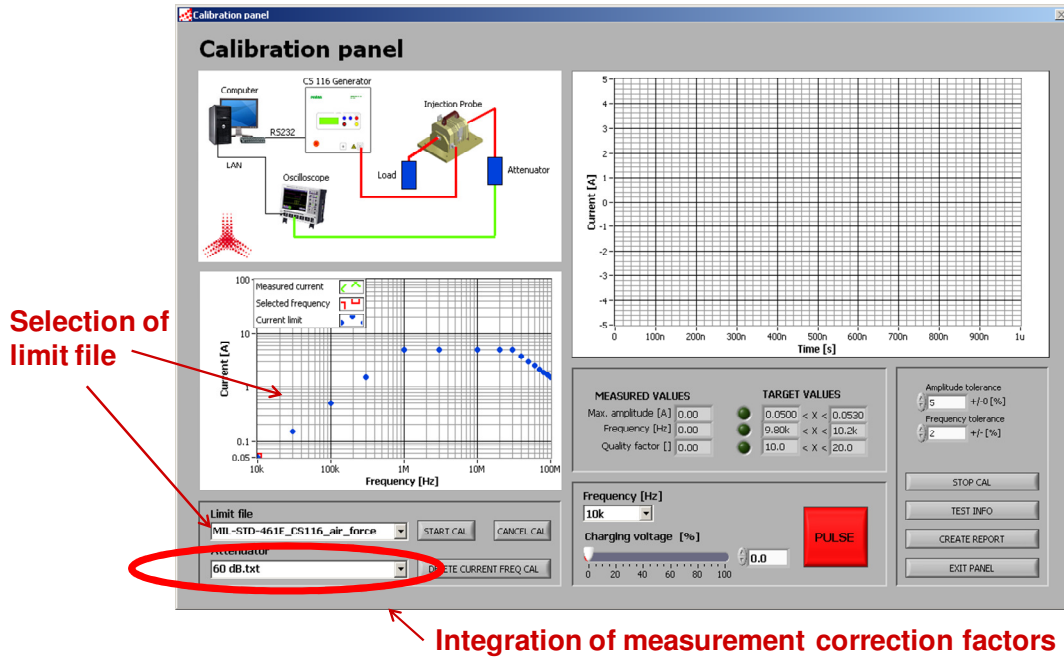
Calibration panel main features

Figure 11 : Calibration panel main features

In order to ease the system calibration procedure, the control software provides:

- A selection of the standard to apply (limit files)

- An integration of the measurement correction factors (attenuators)

- An automatic calibration procedure (jump to next frequency -> slowly increase the generator loading voltage until the desired injected current level is obtained -> record generator setting -> jump to next frequency -> ….)

- Automatic edition of a system calibration report
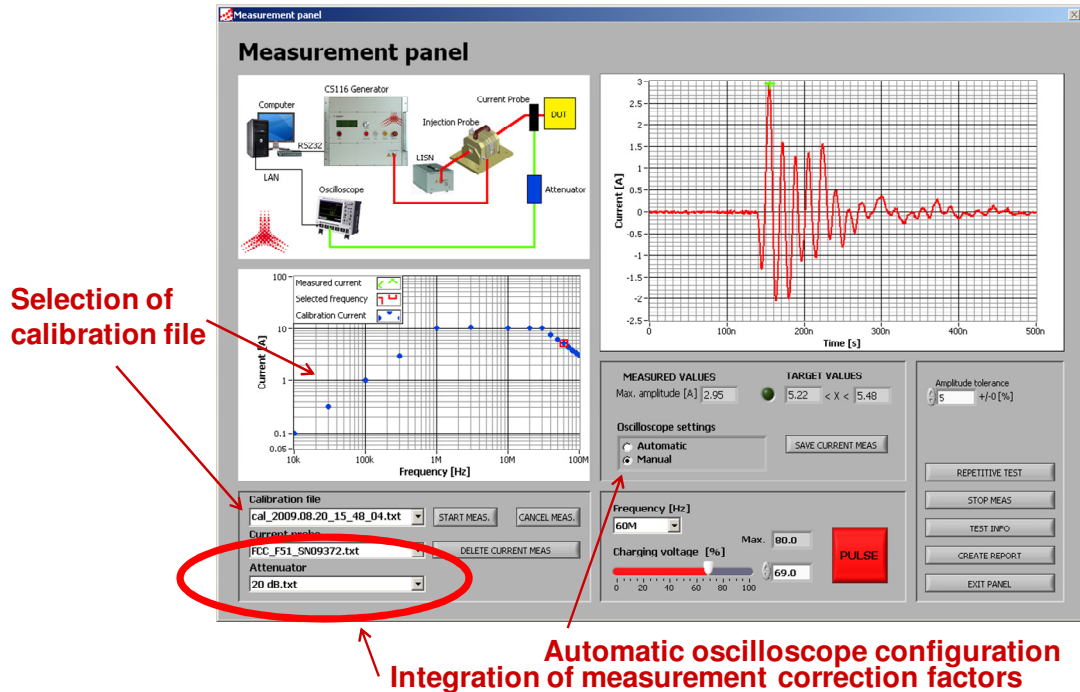
Measurement panel main features

Figure 12 : Measurement panel main features

In order to ease the test measurement procedure, the control software provides:

- A selection of the values to be applied (a calibration file)

- An integration of the measurement correction factors (attenuators and current sensors)

- An automatic measurement procedure (jump to next frequency -> slowly increase the generator loading voltage until the desired injected current level is obtained -> record generator setting -> jump to next frequency -> ….), this with the possibility to setup a overall maximal injected current level.

- Automatic configuration of the oscilloscope to get the optimal measurement & display parameters

- Display or the injected pulses

- A test report generation.

TEST PROCEDURE SUMMARY

With montena test setup with automation software, the user only has to :

1. Build the calibration setup as displayed in the schematic displayed on the calibration panel
2. Select the standard to apply (i.e. MIL STD 461F, CS116)
3. Select the probes and attenuators factors (i.e. FCC_F51_SNxxxxx.txt)
4. Automatically calibrate all test frequencies
   Press once "Start Calibration"
5. Generate the calibration report
6. Build the test setup as displayed in the software schematic displayed on the measurement panel
7. Select the standard to apply (i.e. Cal_CS116_01_Jan_2010.txt)
8. Select the probes and attenuators factors (i.e. FCC_F51_SNxxxxx.txt)
9. Apply all test frequencies automatically
   Press once "Start Measurement"
10. Generate the test report

✓ **NO need to exchange injection probe for the different frequencies**

✓ **NO need to reconnect generator output cable for each test frequency or each test setup**

✓ **NO need to exchange frequency modules for each test frequency**

✓ **Automatic calibration at all frequencies**

✓ **Application of all test frequencies automatically, level can be selected or automatic**

✓ **NO need to configure the oscilloscope**

✓ **NO need to manually integrate the transfer function of the current probes and attenuators**

✓ **Generation of test reports, NO need to record all values read from the oscilloscope**

✓ **Generation of calibration reports, NO need to record all calibration setting parameters**

5. Other measurement systems & accessories

5.1 Injection probe with calibration jig

The injection probe is required for both measurement and for the calibration phases.

For the system calibration phase, the current injection probe is calibrated with help of a calibration jig, an attenuator and a 50 ohm termination load.
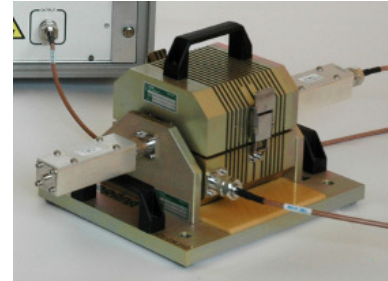
5.2 LISN

The LISN (Line Impedance Stabilisation Network) are used to provide standardised impedance in common mode to the lines connected to the EUT. This allows a better reproducibility of the tests.

The LISN50-25 fulfils the MIL-STD 461 D,E and F requirements

- 50 Ω // 50 µH
- 1 x 25 A
- 230 Vac (50/60 Hz) - 115 Vac (400 Hz)

6. Services

6.1 Onsite installation and training

Montena provides onsite installation and training performed by either an engineer from montena or by a local authorized representative support engineer with help of skilled and unskilled workmen provided by the customer.

A training session is usually given directly after installation. This training includes both the test system operation and maintenance.

6.2 Maintenance

No periodical maintenance is required other than a calibration of the measurement equipment.

On customer request montena can offer this calibration service with support of montena's authorized local representative.

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7. Technical specifications of the CS116 pulse generator

Type	POG-CS116-6	POG-CS116-9	POG-CS116-17
Frequencies	10, 100 kHz 1, 10, 30, 100 MHz	10, 30, 100, 300 kHz 1, 3, 10, 30, 100 MHz	10, 18, 30, 56, 100, 180, 300, 560 kHz 1, 1.8, 3, 5.6, 10, 18, 30, 56, 100 MHz
Standard	MIL-STD 461 D / E / F CS116		
Output current	10 A on 100 ohm (depends on the frequency)		
Output impedance	< 100 ohm		
Damping factor	15 +/- 5		
Repetition rates	single, 0.5 Hz, 1 Hz		
Power rating	210 - 250 V_{ac} / 50 - 60 Hz / 35 W / 75 VA		
Generator weight	21 - 23 kg		
Dimensions	53 x 53 x 45 cm (L x W x H)		