

Combination Wave Test System

- Brief Overview of Phenomena.** 2
- Applicable Standards** 3
- Test System Overview.** 4
- Generator Specifications.** 8
- Accessories and Options.** 12
- Software** 14
- EMC PARTNER's Product Range** 15

Brief Overview of Phenomena

The most frequent cause of damage in industrial electronic systems is overvoltages, caused either by switching actions in the equipment itself or by atmospheric discharges such as lightning. If the interference source is in the same circuit as the electronic equipment, the transfer impedance is low and the impulse takes a current form. If the interference is from some external source, the transfer impedance will be higher and a voltage impulse results. To simulate both these conditions, a Combination Wave Generator (CWG) is designed to deliver a voltage impulse into an open circuit and a current impulse into a short circuit. This is also known as a "Hybrid" generator. Combination Wave Generators have a virtual impedance (open circuit voltage / short circuit current) of 2 ohms.

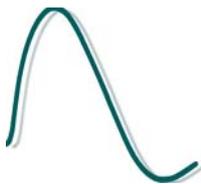
Power network transients can be modified by the cable properties so that in a well protected domestic or commercial environment, the impulse energy has an oscillatory form. This is known as a "Ring wave".

EMC Partner Combination Wave and Ring wave Generators are used to simulate transient (impulses) in the public power supply network.



- Impulse Voltage Waves (1.2/50)

An external interference source such as lightning discharge has a relatively high transfer impedance resulting in a voltage impulse. The voltage impulse is defined in the standards IEC 60060-1 and ANSI C62.41 as having rise/fall times of 1,2/50 μ s. This is an industry standard definition for impulses in the open circuit condition. Dependant on the application and equipment location, impulse amplitudes can range from a few hundred volts to tens of thousands of volts.



- Impulse Current (8/20)

An interference source within the same physical circuit as electronic equipment, has a low transfer impedance so disturbance impulses tend to have a current form. Dependant on the application and equipment location, impulse amplitudes can range from a few hundred amps to several thousand amps. ANSI C62.41 requires impulse currents up to 10kA.s.



- Ring wave (100kHz)

Transients on power networks are modified by the cable properties so that in a well protected domestic or commercial environment, the impulse energy has an oscillatory form. This is known as a "Ring wave". IEC61000-4-12 and ANSI C62.41 define the oscillation to have 100kHz. Ring waves are single bipolar oscillatory events. Both the voltage and current waveshapes are similar. Peak current is limited by the equipment location. Ringwave generators have a virtual impedance of 12 or 30 ohms for power network applications.

Combination wave and Ring wave testing is performed on power or communication networks, which require Coupling and Decoupling Networks (CDNs) to superimpose the impulses and provide protection for auxiliary equipment that is not part of the test setup. Synchronization of the impulse with power frequencies is also required

Applicable Standards

International Electrotechnical Committee (IEC)

IEC 61000-4-5 Ed 2: Electromagnetic compatibility (EMC) - Testing and measurement techniques - Surge immunity test.

IEC61000-4-12 Ed 2: Electromagnetic compatibility (EMC) - Testing and measurement techniques - Ring wave immunity test.



International Telecommunications Union (ITU)

K.44 (2008): Resistibility tests for telecommunications equipment exposed to overvoltages and overcurrents - Basic recommendation

K.20 (2008): Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents

K.21 (2008): Resistibility of telecommunication equipment installed in customer premises to overvoltages and overcurrents.



American National Standards Institute (ANSI)

ANSI C62.41 (1991): IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits..



Test System Overview

Test System Feature

- Up to 24000V impulse voltage
- Up to 12000A impulse current
- Combined Surge and Ring wave generator combinations
- Power CDNs up to 100A per phase
- Automatic coupling path selection
- Accurate and stable phase angle synchronisation
- Telecom and dataline CDNs
- Impulse parameters defined at CDN output
- Parameter ramp feature
- Electronic polarity change
- Semiconductor switches
- Generators use patented EMC PARTNER impulse modules
- Integrated emergency stop switch
- Safety circuit design to protect operators
- Compact designs
- High degree of automation without software
- 2 year warranty

User Benefits

The technical excellence and many unique features of combination and ring wave generators translate directly into benefits for the user:

- Impulse repeatability pulse to pulse
- Reproducible test results between locations
- Automation reduces operator error
- Combined coupler for all EMC power tests
- Operator safety ensured
- Reduced test time
- ANSI coupling path compatible
- Save operator time with the automated test routines and test report facility
- Unparalleled reliability and system up-time

Generators

Two distinct generator types are available. Models up to 6kV with built-in automatic single phase CDNs intended for immunity testing (MIG0603INx), and generators with impulse amplitudes over 12kV (MIG1206, MIG1809, MIG2412, MIG1206-1P & 3P).

Many of the generators include more than one impulse type, making them ideal for laboratory applications.

All MIG0603INx versions include automatic peak synchronisation, which at the press of a button ensures the impulse is superimposed on the positive (90°) and negative (270°) peaks of the EUT power.

In all cases, the most significant test parameters can all be programmed as fixed values on the instrument front panel, or using the ramp function to change parameters during a test. Impulse voltage level, synchronisation angle and polarity can all be programmed using this feature.



MIG0603IN

- MIG0603IN S

The "classic" combination wave generator for IEC, EN and ANSI applications up to 6kV/3kA. The integrated single phase CDN operates with EUT power up to 280V/16Aac and 110V/16Adc. Three applications can be programmed with the MIG0603IN; CWG 1.2/50us 2 ohm, CWG 1.2/50us 2+10 ohm and CWG 1.2/50us IEC. There is a direct output for data line testing as well as the CDN output.

- MIG0603IN1 S-R

A combination wave generator with Ringwave for IEC, EN and ANSI applications up to 6kV. The integrated single phase CDN operates with EUT power up to 280V/16Aac and 110V/16Adc. Six applications can be programmed with the MIG0603IN1; CWG 1.2/50us 2 ohm, CWG 1.2/50us 2+10 ohm, CWG 1.2/50us IEC, ringwave 12 ohms, ringwave 30 ohms and ringwave 200 ohms. There is a direct output for data line testing as well as the CDN output.

- MIG0603IN3 S-R-T

A compact generator with three distinct waveforms for IEC, EN, ANSI and ITU telecom applications up to 6kV. A combination wave, ringwave and 10/700us impulse can be applied through the integrated single phase CDN or for telecom applications using the direct output to the external CDN-UTP. The integrated single phase CDN operates with EUT power up to 280V/16Aac and 110V/16Adc. The addition of a 10/700us impulse makes this unit ideal for basic level telecom applications.

- MIG0603IN4 R

A pure ringwave generator with three outputs at 12, 30 and 200 ohms. This generator is appropriate for IEC, EN and ANSI applications. The integrated single phase CDN operates with EUT power up to 280V/16Aac and 110V/16Adc.

- MIG0603-3P100 S

The "flag ship" Combination Wave generator with fully automatic 100A three phase CDN and optional EFT/Burst. Specially designed for higher current EUTs. The fully automatic CDN outputs are placed at the correct height for floor standing EUTs to fulfill both the IEC61000-4-5 and IEC61000-4-4 requirements. A high degree of automation, enables this generator to be programmed for a complete test suite including voltage ramping, phase angle ramping and coupling path selection. -

- MIG1206-1P

A 12kV Combination wave generator with integrated and automatic single phase CDN. EUT current is 32Aac and 25Adc.

- MIG1206-3P

Similar to the MIG1206-1P except that a fully automatic three phase CDN is integrated with the combination wave generator. EUT current through the CDN is rated at 32A per phase.

- MIG1206

A pure combination wave generator, MIG1206 can be applied for component testing using the TC-MIG24 test cabinet accessory. The high voltage outputs are conveniently located on the generator top. For applications requiring connection to AC or DC power, the CDN-MIG12-32 can be used. Coupling path selection is manual on the front panel using safety high voltage connectors.

- MIG1809

Like the MIG1206, MIG1809 is a combination wave generator conceived for direct connection to components. The high voltage outputs on top of the instrument are protected by the TC-MIG24 test cabinet which is integrated into the generator safety circuit.

- MIG2412

This, is the highest level stand alone combination wave generator from EMC PARTNER. It is also designed for component testing with the high voltage outputs on top and the TC-MIG24 test cabinet.



MIG0603IN3



MIG0603IN4



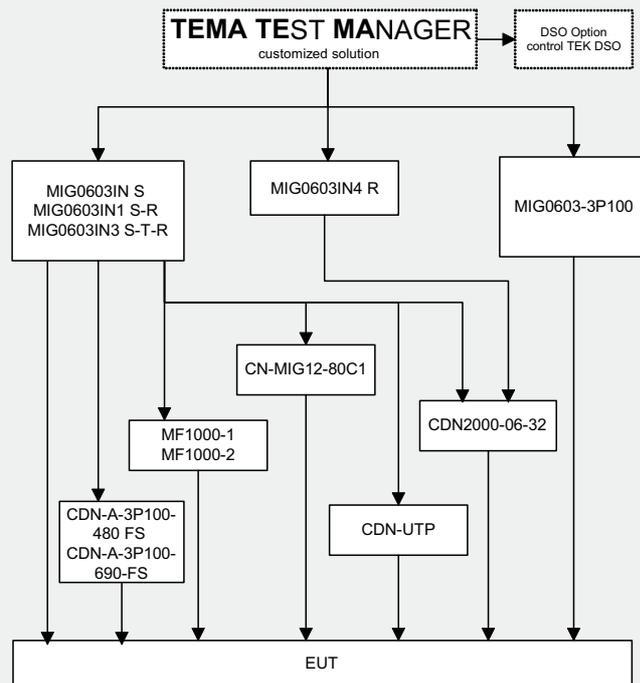
MIG0603-3P100 S



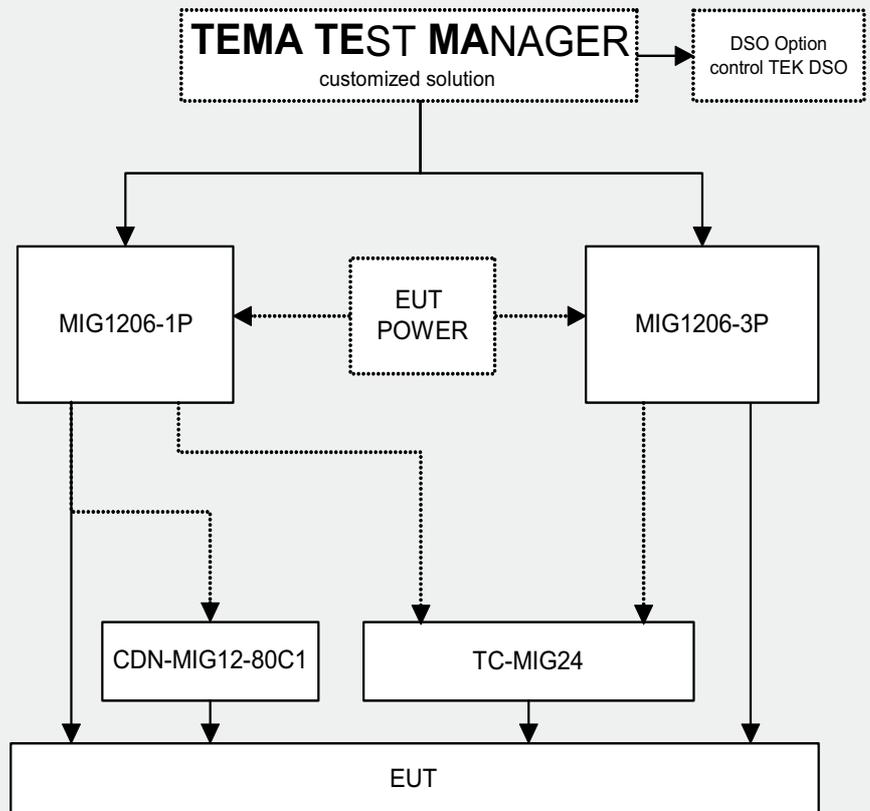
MIG1206-1P

Flowcharts

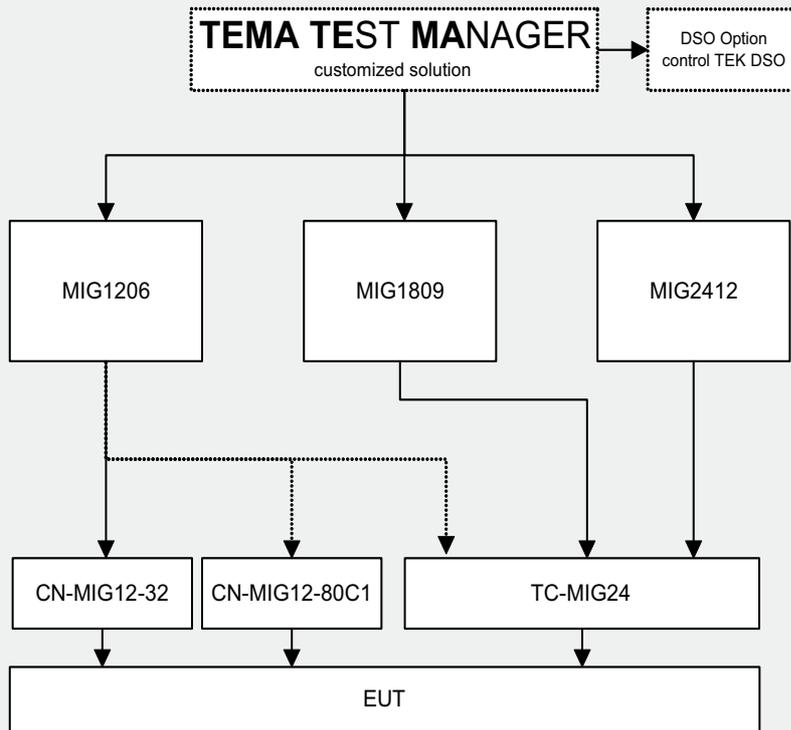
Combination wave up to 6kV



Combination wave up to 12kV



Combination wave > 12kV



Generator Specifications

6kV Impulse with built in CDN

MIG0603IN S

Voltage range	0.25 up to 6kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.125 up to 3kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Coupling path selection	automatic
Coupling paths	L - N (18uF), L - PE (9uF) & N - PE (9uF)
Maximum voltage on CDN	280Vac 50/60Hz
Maximum current	16A

MIG0603IN1 S-R

Combination Wave 1.2/50 μ s (8/20 μ s)

Voltage range	0.25 up to 6kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.125 up to 3kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Coupling path selection	automatic
Coupling paths	L - N (18uF), L - PE (9uF) & N - PE (9uF)
Maximum voltage on CDN	280Vac 50/60Hz
Maximum current	16A

Ring wave 100kHz

Voltage range	0.25 up to 6kV
Risetime	0.5 μ s
Oscillation frequency	100kHz
Source impedance	12ohms (500A)
	30ohm (200A)
	200ohm (30A)

MIG0603IN3 S-R-T

Combination Wave 1.2/50 μ s (8/20 μ s)

Voltage range	0.25 up to 6kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.125 up to 3kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Coupling path selection	automatic
Coupling paths	L - N (18uF), L - PE (9uF) & N - PE (9uF)
Maximum voltage on CDN	280Vac 50/60Hz
Maximum current	16A

Ring Wave

Voltage range	0.25 up to 6kV
Risetime	0.5 μ s
Oscillation frequency	100kHz
Source impedance	12ohms (500A)
	30ohm (200A)
	200ohm (30A)

10/700us Telecom wave

Voltage range	0.25 up to 6kV
Risetime	10 μ s
Duration	700 μ s
Source impedance	15ohms
Damping resistor	25ohms
Current range	12.5 up to 150A

MIG0603IN4 R

Voltage range	0.25 up to 6kV
Risetime	0.5 μ s
Oscillation frequency	100kHz
Source impedance	12ohms (500A)
	30ohm (200A)
	200ohm (30A)
Coupling path selection	automatic
Coupling paths	L - N (18uF), L - PE (9uF) & N - PE (9uF)
Maximum voltage on CDN	280Vac 50/60Hz
Maximum current	16A

MIG0603-3P100 S

Combination Wave 1.2/50 μ s (8/20 μ s)

Voltage range	0.25 up to 6kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.125 up to 3kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Coupling path selection	automatic
Coupling paths	L1 - PE (9uF), L2 - PE (9uF), N - PE (9uF)
	L1 - L2, L2 -L3, L1 - L3, L1 - N, L2 - N, L3 - N (18uF), L1 + L2 & L1 + L3 to any path
Maximum ac voltage on CDN	690Vac 50/60Hz phase - phase
	398Vac 50/60Hz phase - neutral / PE
Maximum ac current	100Aac per phase
Maximum dc voltage on CDN	110V
Maximum dc current	63A

EFT/Burst Option (refer to Transient Test System Brochure)

Coupling path selection	automatic
Coupling paths	L1 - GND, L2 - GND, L3 - GND, N - GND, PE - GND
	L1 + L2 + L3 + N + PE to GND
Maximum ac voltage on CDN	690Vac 50/60Hz phase - phase
	398Vac phase - neutral / PE
Maximum ac current	100Aac per phase
Maximum dc voltage on CDN	110V
Maximum dc current	63A

12kV Impulse with built in CDN**MIG1206-1P**

Voltage range	0.5 up to 12kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.25 up to 6kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Polarity	Positive, Negative, Alternating
Coupling path selection	automatic
Coupling paths	L - N (18uF), L - PE (9uF) & N - PE (9uF)
Maximum AC voltage	280V 50/60Hz
Maximum AC current	32A per phase
Maximum DC voltage	110V
Maximum DC current	25A

MIG1206-3P

Voltage range	0.5 up to 12kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.25 up to 6kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Polarity	Positive, Negative, Alternating
Coupling path selection	automatic
Coupling paths	L1 - PE (9uF), L2 - PE (9uF), N - PE (9uF)
	L1 - L2, L2 -L3, L1 - L3, L1 - N, L2 - N, L3 - N (18uF), L1 + L2 & L1 + L3 to any path
Maximum AC voltage on CDN	480V 50/60Hz Phase to Phase
	280V Phase to PE
Maximum AC current	32A per phase
Maximum DC voltage	110V
Maximum DC current	25A

> 12kV Impulse

MIG1206

Voltage range	0.5 up to 12kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.25 up to 6kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Polarity	Positive, Negative, Alternating
Peak Impulse measurement	voltage & current
Peak measurement	on display & BNC outputs
Energy at maximum charging voltage	750J

MIG1809

Voltage range	0.75 up to 18kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.375 up to 9kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Polarity	Positive, Negative, Alternating
Peak Impulse measurement	voltage & current
Peak measurement	on display & BNC outputs
Energy at maximum charging voltage	1650J

MIG2412

Voltage range	1 up to 24kV
Pulse front time	1.2 μ s
Pulse duration	50 μ s
Current range	0.5 up to 12kA
Pulse front time	8 μ s
Pulse duration	20 μ s
Source impedance	2ohm
Polarity	Positive, Negative, Alternating
Peak Impulse measurement	voltage & current
Peak measurement	on display & BNC outputs
Energy at maximum charging voltage	3000J

Accessories and Options



CDN2000-06-25



CDN2000A-06-32



CDN-MIG12-32



CDN-A-3P100-480 F-S



CDN-MIG12-80C1

External Three Phase Couplers up to 6kV

Combination and Ring wave testers can be extended with automatic or manual three-phase coupling networks. The CDN2000-06-25 and CDN2000A-06-32 can also be used for EFT/Burst. Coupling path selection is either from the MIG firmware, from GENECS and TEMA software or manually on the CDN front panel (manual version only). The coupling networks fulfill the requirements laid down in the IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-12 (ring wave) and ANSI C62.41 standards.

Note: CDN2000-06-25 can be used for Combination Wave, Ring wave and EFT testing. With an EMC PARTNER oscillatory wave tester power and up to four data lines using the 100kHz and 1MHz oscillatory waves can be tested according to IEC61000-4-18.

External Three Phase Couplers up to 12kV

Combination waves up to 12kV testers can also be extended with automatic or manual three-phase coupling networks. The CDN-A-3P100-480 F-S and CDN-A-3P100-690 F-S can also be used for EFT/Burst. Coupling path selection is either from the MIG firmware, from GENECS and TEMA software or manually on the CDN front panel (manual version only). The coupling networks fulfill the requirements laid down in the IEC 61000-4-4 and IEC 61000-4-5 standards.

CDN2000A-06-32 & CDN-MIG12-32 OPTION 690V

Extends three phase CDN for line voltages L to N = 280V and L to L = 690V. Applicable for combination waves. EFT/burst and ring wave impulses can be used with CDN2000A-06-32.

CDN-MIG12-80C1

This DC CDN can carry up to 80A EUT current at a maximum voltage of 75V. Coupling path selection of EFT and Surge is manual from the unit front panel. Impulses can be coupled into either the positive or negative supply. Maximum impulse voltage is 12kV.

Magnetic Field Testing

Applicable standard is IEC 61000-4-9 (IMPULSE).

Combination wave generators can be extended by the MF1000 coil antennas.

MF1000 antennas are used to generate magnetic fields when connected to the MIG generator high voltage outputs. The following levels can be reached:

	Coil dimensions	Impulse magnetic fields (8/20 μ s)
MF1000-1	1m x 1m	0.1 up to 1.5kA/m
MF1000-2	1m x 2.6m	0.1 up to 1.1kA/m
MF1000-3	1m x 1m	n/a



MF1000-1
MF1000-2
MF1000-3

CDN-UTP

The CDN-UTP is a sophisticated coupling and de-coupling network for superimposing surge impulses on balanced communication lines in accordance with IEC 61000-4-5 (Figure 12: unshielded symmetrical interconnection lines), ITU-K20, K21 and FCC part 68.

It is designed for 1.2/50 μ s and 10/700 μ s pulses up to 6.6kV.

CDN-UTP is also available with 4 pairs (8 lines) as the CDN-UTP8 version.



CDN-UTP

TC-MIG24

A test cabinet for EUT with maximum dimensions 12 x 15 x 28cm. Can be used together with all Protection Device Testers except the MIG1248 which has its own built-in test cabinet.

TC-MIG24 is linked to the MIG tester safety circuit. Opening the test cabinet disables test voltages. Safety circuit status is indicated by red and green lamps in the test cabinet.



TC-MIG24

For remote control of combination wave generators, the OPTICAL LINK and one of the following software packages is needed:

- GENECS-MIG: This is a relatively simple program that reproduces generator front panel functions on a PC. In addition to remote programming and control of the generators, test report information is available to word processing or other evaluation programs such as EXCEL.
- TEMA Software: Comfortable control of EMC PARTNER generators from a PC. Enables up to four generator types to be included in the same test sequence. Generates an enhanced test report.

Predefined test routines

Combination Wave Test according to IEC61000-4-5

12:46 22.04.09 EMC-PARTNER AG

Notes

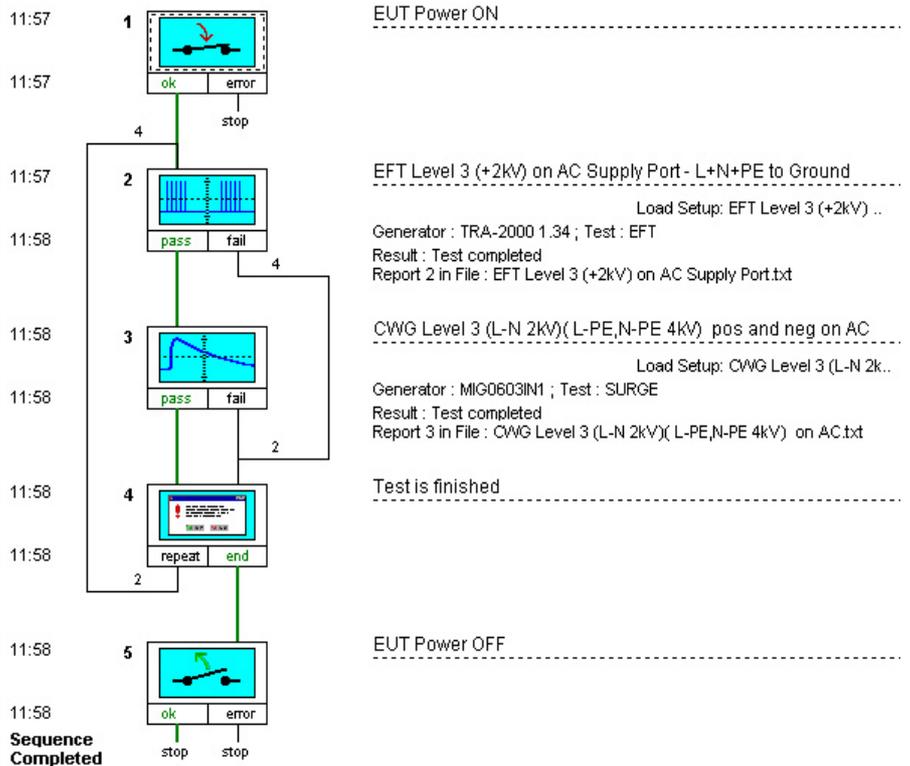
Operator :

Unit :

Remarks

Serial Nbr.:

11:57 20.07.01 This example shows a simple test sequence with Power on / off



EMC PARTNER's Product Range

The Largest Range of Impulse Test Equipment up to 100kA and 100kV.

Immunity Tests

Transient Test System can be used to perform all EMC tests on electronic equipment. ESD, EFT, surge, AC dips, AC magnetic field, surge magnetic field, common mode, damped oscillatory and DC dips tests are available as stand-alone or combined test instruments. A large range of accessories for different applications is available: three phase couplers up to 690V/100A, telecom and data line couplers, verification sets, magnetic field coils. Immunity test systems fulfill IEC and EN 61000-4-2, -4, -5, -8, -9, -11, -12, -16, -18, -29.

TRA3000 and ESD3000 ideal for CE testing
Easily extended to meet other applications



Lightning Tests

A range of test equipment and accessories for aircraft, military and telecom applications. Complete solutions including all hardware and software to meet the requirements of RTCA / EUROCAE DO160 / ED14 for indirect lightning on aircraft systems, MIL-STD-461 tests CS106, CS115, CS116, for military vehicles, ITU-T .K44 basic and enhanced tests for impulse, power contact and power induction, FCC part 68 for telecom equipment testing.

MIG2000-6 – a flexible solution for military and avionic applications



Component Tests

Modular impulse generators (MIG) for transient component testing on: varistors, gas discharge tubes (GDT), surge protective devices (SPD), XY capacitors, circuit breakers, watt-hour meters, protection relays, insulation material, suppressor diodes, connectors, chokes, fuses, resistors, emc-gaskets, cables, etc. Manual or fully automated solutions are available up to 100kA (8/20us) and 144kV (1.2/50us).

MIG1212CAP – an automatic
8 bank capacitor test system



Emission Measurements

One unit performs all measurements on the power supplies of electronic equipment and products for the CE-Mark. HAR1000 uses a novel technique to deliver clean power source for the EUT in a compact and lightweight form. The system includes all hardware and software including line impedance networks, control and evaluation software. A basic 1-phase system can be easily extended to 3-phase by adding 2 further phases. HARCS Immunity software further expands the system by adding interharmonic tests, voltage variation and ripple on DC tests. Complies with IEC / EN 61000-3-2, -3 IEC / EN 61000-4-13, -14,

HAR1000-3P and HARCS software
a complete test system



System Automation

As addition to the basic generators, a range of accessories are available to enhance capability. Test cabinets, test pistols, adapters and software, simplify interfacing with the EUT.

PS3 programmable source is an EMC hardened supply for frequencies from 16.7Hz to 400Hz. Frequency variation tests can be made using the PS3-SOFT-EXT. Complies with IEC / EN 61000-4-28

PS3 - programmable source
ideal for EMC applications



For further information please do not hesitate to contact EMC PARTNER's representative in your region. You will find a complete list of our representatives and a lot of other useful information on our website:

www.emc-partner.com

The Headquarters in Switzerland

EMC PARTNER AG
Baselstrasse 160
CH - 4242 Laufen
Switzerland

Phone: +41 61 775 20 30
Fax: +41 61 775 20 59
Email: sales@emc-partner.ch
Web-Site: www.emc-partner.com

Your local representative

