

# Military Test System

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# Brief Overview of Phenomena

Testing of service systems and vehicles is aimed at ensuring that equipment used on active service performs as intended no matter how hostile or electromagnetically polluted the environment.

With the introduction of more sophisticated systems and an increasing reliance on computer and microchip technology coupled with a need for interoperability between land, sea and air forces, testing requirements are becoming tougher and more extensive.

There are two main sources of transients. Internally generated switching transients can be generated as a result of bouncing relay contacts. These transients could initiate resonances in platform cabling. Such transients can appear in both power supply and data cables.

External events such as incidence of lightning or EMP can result in damped oscillatory transients being transmitted throughout a platform wiring.

Apart from switching transients, lightning or EMP, the most significant EMC events for military vehicles are electrostatic discharge (ESD). Military vehicles in particular can become charged as a result of precipitation, moving through dust laden atmospheres, fuel flow or launch vehicles. An aircraft, for example, has the potential for a discharge equivalent to several 100 Kilovolts, which is a potential threat to operators and servicing personnel. Under dry and cool conditions, personnel can also become charged, that is a potential danger to electronic components and munitions or explosive devices such as foil initiators in ejector seats etc.

EMC PARTNER military generators can replicate the following phenomena:



- **Bulk Cable Injection, Impulse Excitation (CS115)**

Used to simulate bouncing relay contacts that could initiate resonances in platform cabling.

Applied to all cables both power supplies and data using an injection clamp. This simulates the platform structure being used as the power return path.

The sharp (2ns) rise and fall times and the pulse duration approximate the energy content of such transients.

A high repetition rate is used to ensure equipment resistability.



- **Damped Sinusoidal Transients (CS116)**

A selection of damped sinusoidal transients are used to simulate oscillations arising from excitation of the platform wiring due to incidence of lightning, EMP or platform switching. Typical frequencies are in the range from 10's of kHz to 100's of MHz.



- **ESD**

ESD can result from charging of personnel or equipment. Resultant waveforms and test levels are dependant on location. ESD impulses are used to ensure equipment is not damaged during maintenance procedures.



- **Voltage Spike**

Voltage spikes on the AC or DC power supply interfaces are due to platform power supply switching transients. These are transmitted by interconnecting cables and appear at equipment interfaces throughout a platform on the power supply pins. Disturbances on AC power lines may appear synchronised to particular switching angles of a 400Hz supply.

# Applicable Standards

## Department of Defence

MIL-STD-461F (2007): Requirements for the control of Electromagnetic Interference characteristics of subsystems and equipment.

MIL-STD-883E (1999): Test method standard Microcircuits.

MIL-STD-331B (1989): Fuse and Fuse components.

MIL-STD-750D (1995): Test Method Standard Semiconductor devices.

MIL-STD-464 (1997): Electromagnetic Environmental Effects requirements for systems.

MIL-STD-1541 (1987): Electromagnetic Compatibility Requirements for space systems.

MIL-STD-1275B (2004): Characteristics of 28V DC electrical systems in military vehicles.

MIL-DTL-23659D: Exploding Foil Initiator (EFI) Qualification.



## Airbus

ABD0100.1.2 and ABD0100.1.8.1: Variable frequency (115V) and dc power supply tests.



## North Atlantic Treaty Organisation

Test Requirement CS-EFA-4 (Imported Transients) of Eurofighter SPE-J-00-E-1000 (1991).

# Test System Overview

## Test System Features

- Modular construction allows for future expansion
- Clean reproducible waveforms
- Simple operation
- Parameter change during operation (+/-)
- Internal program memory
- Electronic polarity change
- Compact designs
- Fulfills ALL transient requirements
- Remote control and software upgrade through standard interface
- Full range of accessories
- 2 year warranty

## User Benefits

The technical excellence and many unique features of EMC PARTNER military generators translate directly into benefits for the user:

- Cost effective solutions to meet many test requirements
- Simple extension to meet future test needs
- Increase quality of test object
- Real time parameter change, ideal development tool
- Save operator time with the automated test routines and test report facility
- Unparalleled reliability and system up-time

## Generators

The EMC PARTNER family of military test generators simulate transient and EMC events that have been observed in military vehicles and systems due to external lightning and EMP events or internal platform generated transients. EMC PARTNER military generators are available in a number of versions which can be upgraded to give enhanced test capability at a later date.



MIG2000-6



MIG1212EMP with DN-MIG12-16

### - MIG2000-6

MIG2000-6 is a modular system using plug-in technology to simulate a wide range of specialist impulses. These include the MIL-STD-461F CS115, CS116 and CS106 waveforms. Modules for the Euro fighter CS-EFA-4 (NATO Fast & Slow) requirement are available as well as for voltage spikes on power supplies.

The unique modular architecture of MIG2000-6 enables integration of additional waveforms to meet specialist requirements.

### - MIG1212EMP

This generator simulates the incidence of electromagnetic pulse induced into power supply cables in military or civil defence installations. This system delivers impulses of 0.5/50 $\mu$ s and 0.5/250 $\mu$ s. Together with the DN-MIG12-16 decoupling unit, it can be moved between locations to test installations in-situ.

### - ESD3000

ESD3000 is a light weight, hand-held battery operated tester. A range of changeable Discharge Modules (DMs) and Discharge Networks (DNs) have been developed specially for military applications. A broad range of accessories enable testing to many applications for contact discharge, air discharge and indirect discharge up to 30kV. ESD3000 architecture allows customer specific requirements to be realised.

Remote control of EMC PARTNER military test systems is possible using either the EMC PARTNER TEMA or GENECS-MIG software packages.

A wide range of accessories are available to facilitate testing. Coupling transformers for cable serial injection and test probes for parallel injection complete the system.

## System Flowcharts

The following flowcharts illustrate EMC PARTNER equipment configurations necessary to perform transient tests in accordance with military and avionic standards.

### MIG2000-6

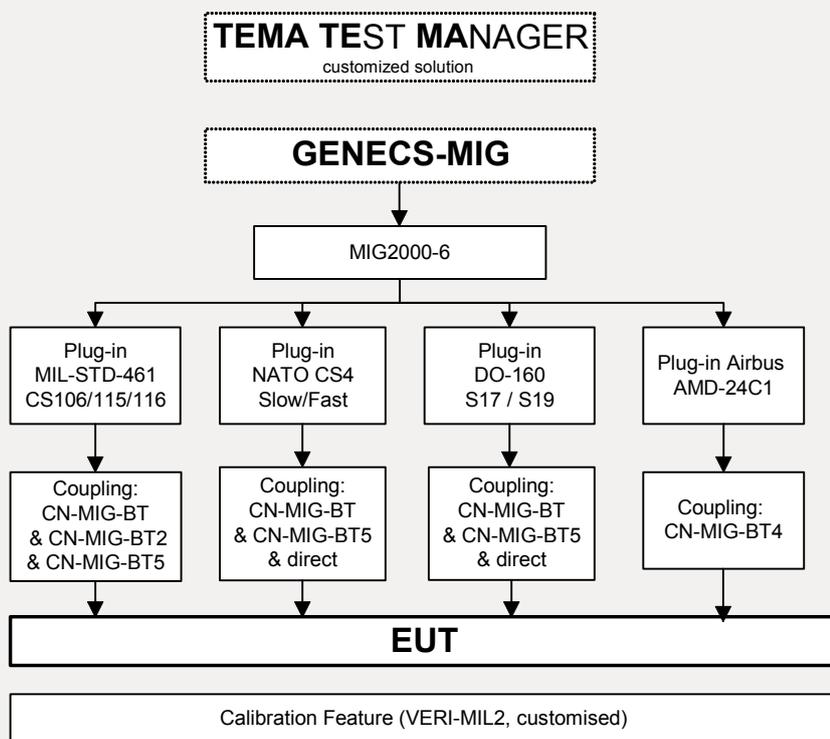
#### - Serial Coupling

The CN-MIG-BT and CN-MIG-BT2 couplers are used to inject the CS115 transient, the CS116 damped sinusoidal wave and CS106 voltage spikes by the cable induction method.

Waveforms are induced through the coupling transformer(s) into interconnecting cables and power leads.

#### - Parallel Coupling

The waveforms are applied directly from the generator output, using special test probes, to designated connector pins or connections on an EUT.



As part of the test process, each transient must be verified. A calibration feature is substituted for the EUT to verify the test set-up including couplers and cables.



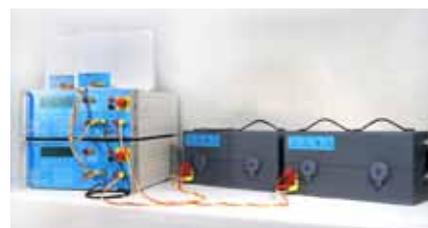
ESD3000



Serial Coupling with CN-MIG-BT

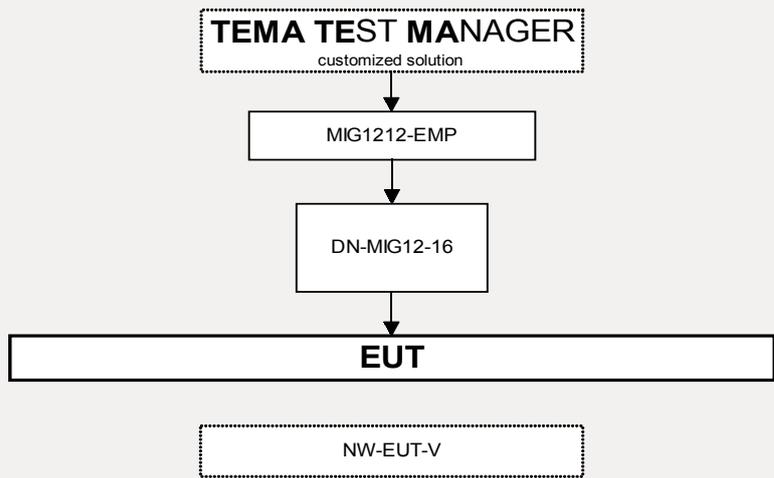


Parallel coupling "direct"

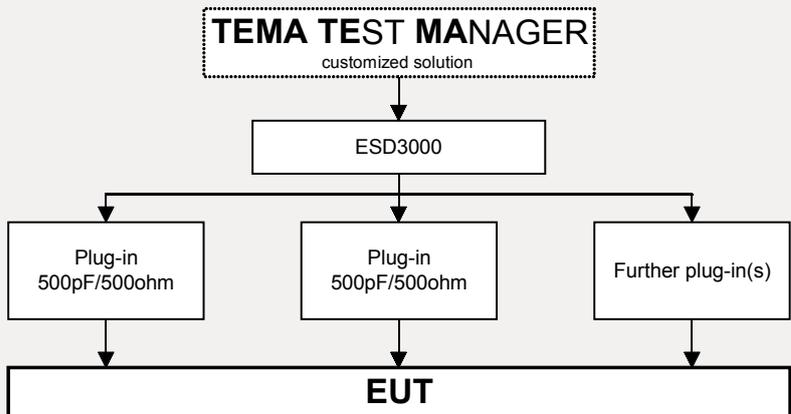


Test System for ABD0100.1.8

**MIG1212EMP**



**ESD3000**



# Generator Specifications

## MIG2000-6 (MIL-STD-461 Modules)

### FX-CS106

Voltage range	100V up to 500V
Rise time	1.5µs
Fall time	3.5µs
Duration	5µs
Repetition rate	10Hz (max)

### CS115REC

Current range into 100ohm	1A up to 10A
Rise time	< 2ns
Fall time	< 2ns
Duration	30ns
Repetition rate	30Hz (max)

### CS116-10K10M - 10kHz

Current range into 100ohm	0.02A up to 0.2A
Frequency	10kHz
Damping	4th peak 40 to 50%
Repetition rate	2Hz (max)

### CS116-10K10M - 100kHz

Current range into 100ohm	0.2A up to 2A
Frequency	100kHz
Damping	4th peak 40 to 50%
Repetition rate	2Hz (max)

### CS116-10K10M - 1MHz

Current range into 100ohm	1A up to 15A
Frequency	1MHz
Damping	4th peak 40 to 50%
Repetition rate	2Hz (max)

### CS116-10K10M - 10MHz

Current range into 100ohm	2A up to 12A
Frequency	10MHz
Damping	4th peak 40 to 50%
Repetition rate	2Hz (max)

### CS116-30M100M - 30MHz

Current range into 100ohm	2A up to 12A
Frequency	30MHz
Damping	4th peak 40 to 50%
Repetition rate	2Hz

### CS116-30M100M - 100MHz

Current range into 100ohm	1A up to 6A
Frequency	100MHz
Damping	4th peak 40 to 50%
Repetition rate	2Hz

### Fx-AMD24C1

Open circuit voltage	50V up to 1200V (Wave shape dependent)
Impulse duration	10µs / 50µs / 100µs / 200µs / 400µs
Rise time	< 2µs
Source impedance	5 Ohm and 50 Ohm
Repetition	up to 2 Hz (Wave shape dependent)
Coupler	CN-MIG-BT4

## MIG1212EMP

### 0.5/250µs

Voltage Range Common mode	1 up to 12kV
Risetime	500ns
Duration	ca. 250µs
Current Range Common mode	100 up to 1.2kA
Risetime	500ns
Duration	ca. 155µs

### 0.5/50µs

Voltage Range Differential mode	1 up to 12kV
Risetime	500ns
Duration	ca. 50µs
Current Range Differential mode	100 up to 1.2kA
Risetime	500ns
Duration	ca. 155µs



Fx-AMD24C1 with Capacitor Box NW-AMD24C1

## ESD3000

Please refer to ESD Test System brochure for further information.

# Accessories and Options

## MIG2000-6

	MIL-STD-461 CS106	MIL-STD-461 CS115	MIL-STD-461 CS116 10kHz	MIL-S TD-461 CS116 100kHz	MIL-STD-461 CS116 1MHz	MIL-STD-461 CS116 10MHz	MIL-STD-461 CS116 30MHz	MIL-STD-461 CS116 100MHz	MIL-STD-1275	Euro Fighter CS-EFA-4	Airbus ABD0100.1.8.1	DO160 section 17	DO160 section 19
<b>Plug-ins</b>													
<b>FX-CS106</b>	X												
<b>CS115REC</b>		X											
<b>CS116-10K10M</b>			X	X	X	X							
<b>CS116-30M100M</b>							X	X					
<b>NATO-SLOW-10u</b>										X			
<b>NATO-FAST-150n</b>										X			
<b>Fx-DO-160-S17</b>												X	
<b>Fx-DO-160-S19</b>													X
<b>Fx-MIL1275B</b>									X				
<b>Fx-AMD24C1</b>											X		
<b>Accessories</b>													
<b>CN-MIG-BT</b>	X		X	X	X	X				X		X	
<b>CN-MIG-BT2</b>		X					X	X					
<b>CN-MIG-BT4</b>											X		
<b>SYNC-ADAPTER</b>										X	X	X	
<b>VERI-MIL2</b>		X	X	X	X	X	X	X					
<b>VERI50</b>		X	X	X	X	X	X	X		X		X	
<b>VERI5</b>	X									X	X		
<b>DC-S17CL</b>	X									X	X	X	
<b>CN-MIG-BT5</b>	X		X	X	X	X				X		X	

## Plug-ins

Enhance MIG2000-6's capability by including additional waveforms. New plug-ins are automatically recognised and controlled by the MIG2000-6 firmware.



Example of a plug-in

## CN-MIG-BT

Coupling transformer for cable bundles up to 3 x 6cm.



CN-MIG-BT

## CN-MIG-BT2

Coupling transformer for cable bundles up to 2.5 diameter. Includes 0.1ohm calibration shunt.



CN-MIG-BT2

## CN-MIG-BT4

Coupling transformer for cable bundles up to 3.5 x 6cm.



CN-MIG-BT4

## VERI5

Coaxial high voltage termination and integrated divider with 5ohm.



VERI5

## VERI50

Coaxial high voltage termination and integrated divider with 50ohm.



VERI50

## SYNC-ADAPTER

Power line synchronisation box for superimposing transients on 50Hz, 60Hz and 400Hz supplies.



SYNC-ADAPTER

## VERI-MIL2

Coaxial calibration jig. Needs two 50ohm terminations with dividers.



VERI-MIL2

## DC-S17CL

Set of 4 boxes for Voltage Spikes Testing according to DO-160-S17 and MIL-STD-461E CS106, consisting of:

- two decoupling boxes "PARALLEL INJECTION". Can be used separately for 230V, 50/60Hz, 10A or connected in parallel for max. 115V, 400Hz, max. 10A
- two decoupling boxes "SERIAL INJECTION" with 2x 10µF for use max. 230V, 50Hz or 115V, 60Hz, 400Hz.



DC-S17CL

## CN-MIG-BT5

**For cable bundles up to 8cm diameter. CN-MIG-BT5 is a larger version of our popular CN-MIG-BT coupler. Avionics applications for CN-MIG-BT5 include DO-160WF2 and WF31MHz and 10MHz plus the voltage spike test in Section 17. CS116 and CS106 tests from MIL-STD-461 can also be performed with this new coupler.**



CN-MIG-BT5



# MIG1212EMP

MIG1212EMP with DN-MIG12-16



NW-EUT-V



## DN-MIG12-16

De-coupling network. Single phase up to 230V/3kVA and three phase 440V/10kVA.  
Application: Superimposing NEMP impulses onto power supply lines.

## NW-EUT-V

Reference load used to verify MIG1212EMP voltage impulse. 6nF capacitor from each phase to PE.

# Software

For remote control of EMC PARTNER military generators, 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 several generator types to be included in the same test sequence. Generates an enhanced level of test report.

Predefined test routines for MIL

**Test-Manager - <milcs116.seq>**

File Edit Action Protocol Options Help

Sequence Log Rep 1 Rep 2 Rep 3 Rep 4

**MIL-STD-461F, CS116 10kHz to 100MHz**

12:12 13.05.2008 EMC-PARTNER AG, 4242 Laufen, Switzerland

Operator : J. Bloggs Unit : Black Box  
Remarks Serial Nbr.: 001  
Test Equipment MIG2000-6

1 CS116 10kHz test 0.1A  
Load Setup: CS11610k  
Generator : MIG2000-6 3.54  
Result : Test not run

2 CS116 100kHz test 1.0A  
Load Setup: CS116100k

3 CS116 10kHz test 0.1A  
Load Setup: CS11610k  
Generator : MIG2000-6 3.54  
Result : Test not run

4 CS116 100kHz test 1.0A  
Load Setup: CS116100k

5 CS116 10kHz test 0.1A  
Load Setup: CS11610k  
Generator : MIG2000-6 3.54  
Result : Test not run

**MIG2000-6**

Abort Block Abort Sequence Show Protocol

EMC-PARTNER MODULAR IMPULSE GENERATOR

Running MIL-461E 10kHz100%

Ipeak + .10A

Time: 225s Rep.: 1.00s

Status: o.k. Fail Mark

F1 F2 F3 F4 F5 F6

Operator Action before Continuing with Test

# 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 CS108, 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  
avionics 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](http://www.emc-partner.com)**

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### **Your local representative**

