Capacitor Test System

Brief Overview of Phenomena ........................................... 2
Applicable Standards ...................................................... 2
Test System Overview .................................................... 3
Generator Specifications .................................................. 6
Accessories and Options .................................................. 8
Software ........................................................................ 10
EMC PARTNER’s Product Range ........................................ 11
Long wires to sensors or power supplies are very often connected to the inputs or outputs of industrial electronic equipment. 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. AC capacitors are designed to be used primarily in power frequency applications (50/60Hz) for suppression of switching transients and Radio Frequency Interference (R.F.I). Two types of capacitor can be differentiated for these applications. X capacitors, where a breakdown of the capacitor due to lightning or switching transients would not lead to an electric shock hazard and Y capacitors, used in applications where capacitor breakdown could cause a dangerous situation.

EMC PARTNER capacitor test systems are used to simulate transient (impulse) and active flammability tests on both X and Y capacitor types over a wide range of values.

- **Impulse Voltage Tests**
  
  This impulse voltage test is used to check the breakdown insulation of capacitors. A normalised voltage impulse of 1,2/50μs as defined in the standard IEC 60060-1 is used as an industry standard for voltage insulation tests. For X and Y capacitors the generator, waveform and test levels are specified in IEC 60384-14: X class capacitors are tested from 0,8 up to 4kV and Y class from 2,5 up to 8kV. All X and Y capacitor types must be subjected to impulse tests with the exception of types X3 and Y3.

- **Active flammability Tests — Surge**
  
  In the standards 60384-14 a passive flammability test is defined. In Amendment 1 of 60384-14 an active flammability test is also defined. The active flammability test must be carried out on X and Y capacitors (except type Y1).
  
  Each capacitor sample shall be subjected to 20 discharges up to 5kV (depending on capacitor class) from a 3μF tank capacitor. This surge voltage is superimposed onto the AC power supply. Each capacitor is wrapped in cheesecloth which should not ignite when the test voltage is applied. The test usually results in destruction of the capacitor.

  Capacitor testing is performed on batches of 24 samples with all values being recorded. Capacitor test systems from EMC PARTNER can easily be extended to include automatic switching between samples and registration of test values.

### Applicable Standards

**International Electrotechnical Committee (IEC)**

**Test System Overview**

**Test System Features**
The Capacitor Test System has many unique and outstanding features:

- Up to 8kV impulse voltage levels
- Up to 825V RMS for active flammability tests
- AC voltage adjustment in 1V steps
- Impulse circuits changed to match capacitor load
- All parameters on one screen
- Parameter ramp feature
- Internal program memory
- Backlit LCD display
- Electronic polarity change
- Semiconductor switches
- Compact design
- Fulfils ALL standard requirements
- Remote control and software upgrade through standard interface
- Wide range of accessories
- 2 year warranty

**User Benefits**
The technical excellence and many unique features of the Capacitor Test System translate directly into benefits for the user:

- Cost effective solution for batch testing
- Increase quality of test object
- Easily transportable
- Save operator time with the automated test routines and test report facility
- Easy integration into a full test suite
- Unparalleled reliability and system up-time

**Generators**
The Capacitor Test System is available as three separate units (MIG0603CAP, MIG1212CAP and MIG1803CAP).

Each of the generators is a stand alone instrument that requires only a test cabinet (TC-MIG24 or TC-MIG24F).

To fully comply with IEC60384-14, the serial resistors Rs, the impulse capacitance $C_I$ and the load capacitance $C_P$ are automatically switched when different capacitance ranges are selected.

Verification of the testers are defined with load capacitors: $C_x = 0.01\mu F$ and $C_x = 0.1\mu F$.

The generators have single high voltage outputs, used to test individual capacitor samples. To speed up batch testing, an eight position multiplexer can be added. This fits inside the test cabinet and is linked to the individual generator’s safety circuit.

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.
- **MIG0603CAP**
Generates the impulse voltage 1.2/50μs up to 6kV for testing capacitors up to 10μF. Three categories are defined for X capacitors: X1 (2.5 to 4kV), X2 (up to 2.5kV) and X3 (up to 1.2kV). MIG0603CAP is optimized to meet these requirements. The single high voltage output can be extended with a multiplexer to automatically test 8 capacitor samples without the need of operator intervention.

- **MIG1212CAP**
Generates a 1.2/50μs voltage impulse up to 12kV for testing capacitors up to 10μF. Four categories are defined for Y capacitors, although only three categories require an impulse test (Y3 is exempt): Y4 (2.5kV), Y2 (5kV) and Y1 (8kV). MIG1212CAP is optimized to meet these requirements. The single high voltage output can be extended with a multiplexer to automatically test 8 capacitor samples without the need of operator intervention.

- **MIG1803CAP**
Active flammability testing determines the ability of a capacitor to burn with a flame as a result of electrical loading. An impulse voltage is applied to the sample which is simultaneously connected to an AC supply. The AC supply is manually adjustable up to 860V. An isolation transformer is included in the generator to block secondary voltages. Because the nature of this test means that capacitors could set fire to a cheese cloth wrapping, the complete assembly must be fire proof.

MiG0603CAP and MIG1212CAP can be extended to test SMD capacitors using special adapter sets.

Each of the instruments can be integrated into a complete test package which includes software control of the impulse generators and a measurement oscilloscope. Results are automatically collected and recorded for further analysis. The EMC PARTNER TEMA software is complimented with an additional test module to fulfil these functions (MIG OPTION IEC60384-14).

### System Flowcharts

**Impulse Voltage Tests - X Class with MIG0603CAP**

![System Flowchart](image)
Impulse Voltage Tests - Y Class with MIG1212CAP

Active Flammability Tests with MIG1803CAP
## Generator Specifications

<table>
<thead>
<tr>
<th>MIG0603CAP</th>
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<tr>
<td><strong>CT = 250nF</strong></td>
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<tr>
<td>Voltage range</td>
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<tr>
<td>Voltage increment</td>
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<tr>
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<tr>
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<td>Pulse front time 0 to 120nF</td>
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</tr>
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</tr>
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</tr>
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### Component Tests: Capacitor Test System

**CT = 20μF**

- **Voltage range**: 0.5 up to 12kV
- **Voltage increment**: 1V steps
- **Impulse capacitor**: 20μF
- **Energy at 6kV**: 1440J
- **Pulse front time 0 to 27nF**: 1.2μs
- **Pulse duration 0 to 27nF**: 50μs
- **Overswing**: < 10%
- **Pulse repetition**: up to 6 per minute
- **Polarity**: positive, negative, alternating
- **Programmable parameter ramps**: voltage, synchronisation, polarity

**Combination Wave (Inductance Tests)**

- **Voltage range**: 0.5 up to 12kV
- **Voltage increment**: 1V steps
- **Impulse capacitor**: 20μF
- **Energy at 12kV**: 1,440J
- **Source impedance**: 4ohm
- **Pulse front time**: 1.2μs
- **Pulse duration**: 50μs (variable with load inductance)
- **Overswing**: < 5%
- **Pulse repetition**: up to 6 per minute
- **Polarity**: positive, negative, alternating
- **Programmable parameter ramps**: voltage, synchronisation, polarity

**MIG1803CAP**

**Impulse Tester (Active Flammability)**

- **Voltage range**: 0.75 up to 18kV
- **Vmin at 4 to 10μF load**: 4kV
- **Vmax at 4μF load**: 6kV
- **Impulse capacitor**: 3μF
- **Energy at 18kV**: 486J
- **Pulse repetition Cx < 4μF**: up to 12 per minute
- **Pulse repetition Cx 4 to 10μF**: up to 6 per minute
- **Polarity**: positive, negative, alternating
- **Load capacitor Cx > 1μF**: serial resistor 5ohm
- **Load capacitor 0.22μF < Cx < 1μF**: serial resistor 10ohm
- **Load capacitor 0.068μF < Cx > 0.22μF**: serial resistor 40ohm
- **Load capacitor Cx < 0.068μF**: serial resistor 100ohm
- **Programmable parameter ramps**: voltage, synchronisation, polarity

**Voltage Control (Coupling / de-coupling)**

- **Voltage range**: 50 to 800V
- **AC power ranges**: 0 to 275V, 275 to 550V, 550 to 825V
- **EUT current**: 16A
**Accessories and Options**

**TC-MIG24**
A test cabinet for EUT with maximum dimensions 12 x 15 x 28cm. Can be used together with MIG0603CAP and MIG1212CAP. MIG OPTION DUT MUX can be fitted inside the test cabinet.

TC-MIG24 is linked to the MIG0603CAP and MIG1212CAP safety circuit. Opening the test cabinet disables test voltages. Safety circuit status is indicated by red and green lamps in the test cabinet.

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**TC-MIG24F**
A test cabinet for EUT with maximum dimensions 12 x 15 x 28cm. Can be used together with MIG OPTION EUT SET and MIG1803CAP. The test cabinet includes a glass cover to contain flames, should the capacitors start to burn.

TC-MIG24F is linked to the MIG1803CAP safety circuit. Opening the test cabinet, disables test voltages. Safety circuit status is indicated by red and green lamps in the test cabinet.

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**MIG-CAP DUT-MUX**
An eight channel multiplexer that can be used together with the MIG0603CAP and MIG1212CAP. The multiplexer connects directly to the MIG generator for high voltage and also control signals. Requires TC-MIG24 for personnel protection.

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**MIG EUT-SET**
An eight channel multiplexer that can be used together with the MIG1803CAP. Special construction ensures the MIG OPTION EUT SET does not burn during active flammability tests. The multiplexer connects directly with the MIG generator for high voltage and also control signals. Requires TC-MIG24F for personnel protection.
**CN-MIG-SMD**

Adapter with PCB panel to fit Surface Mount Device (SMD) capacitors of different sizes. Can be used with MIG0603CAP, MIG1212CAP and MIG1803CAP.

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**SOFTW IEC60384-14**

This is a complete package to fully automate X and Y capacitor testing. It includes a PC with TEMA and the module “Insulation test on X and Y capacitors” pre-loaded, a two channel Digital Storage Oscilloscope (DSO) and all connections necessary to perform measurement and testing.
Software

For remote control of Capacitor Test systems, an 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.

- **SOFTW IEC60384-14**: This is a special module for the TEMA software specially written for automatic testing of X and Y capacitors using the MIG-CAP DUT-MUX or the MIG EUT-SET.
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 fulfills IEC and EN 61000-4-2, -4, -5, -8, -9, -11, -12, -16, -18, -20.

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.

Component Tests
Modular impulse generators (MIG) for transient component testing on: varistors, gas discharge tubes (GDT), surge protective devices (SPD), X Y 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).

Component Tests: 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 techniques 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.

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 18.7Hz to 400Hz. Frequency variation tests can be made using the PS3-SOFT-EXT. Complies with IEC / EN 81000-4-28.
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:

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