MACE

MAINS SUPPLY INTERFERENCE SIMULATOR

OPERATING INSTRUCTIONS

204A910

Bracken Hill, South West Industrial Estate
Peterlee, Co. Durham, England, SR8 2JJ
Telephone +44 (0)191 586 3511
Fax +44 (0)191 586 0227

SAFETY

READ INSTRUCTIONS BEFORE USE !

Due to the potential hazards associated with any electrical circuit it is important that the user is familiar with the instructions covering the capabilities and operation of this instrument. The user should ensure that all reasonable safety precautions are followed and if any doubt exists should seek advice before proceeding.

The MACE performs electrical tests which involve high voltages. Never touch the appliance being tested while the testing procedure is being followed.
This product is designed for use by suitably trained competent personnel in a controlled working area.

This instrument can generate high local RF fields during ESD & Transient tests, and should not be used in the presence of people with a Heart Pacemaker or similar medical apparatus.

Contents

Introduction to MACE

This document provides a preliminary guide to the use of the SEAWARD MACE. It outlines the functions available on the instrument and any restrictions which apply to the settings.

MACE is a microprocessor controlled mains interference simulator. Designed in general with prEN50 093 (IEC 1000-4-11), IEC 801-4 and IEC 801-2. MACE is capable of applying Voltage Dip, Fast Transient and Electrostatic Discharge (ESD).

The MACE is a cost-effective pre-compliance test unit. An alpha numeric dot matrix LCD and membrane keypad allows tests to be programmed. An ESD probe is included with MACE. MACE is available for all international single phase voltages.

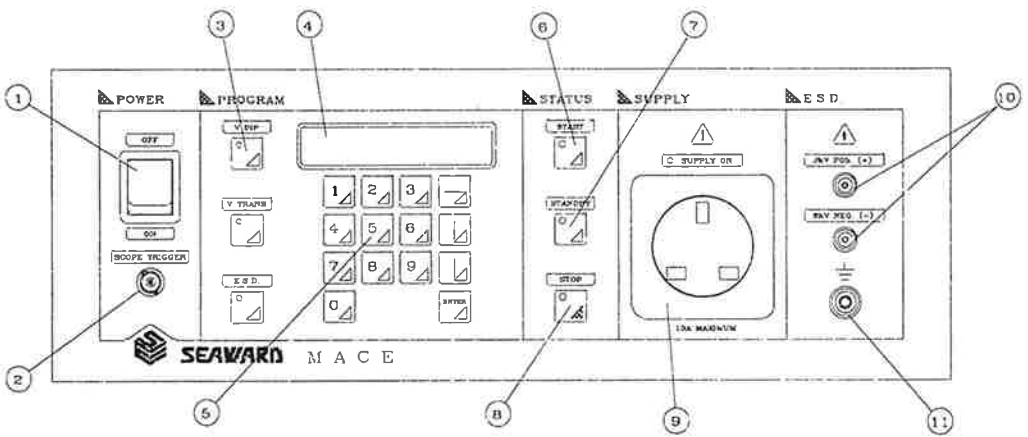
Mounting requirements

MACE is designed to be used on a laboratory bench or other similar environment. Mace should be operated with sufficient space for free air circulation to both sides, and to the rear. Before operation, due regard should be made to the potential EMC interference which may be generated by the tests.

WARNING

Mace **MUST** be used with an earthed mains supply using the integral mains lead supplied. Test results will be invalid, and damage may result to the unit if MACE is not correctly earthed.

FRONT PANEL LAYOUT



DESCRIPTION

1.	MAINS SWITCH	Switches MACE ON and OFF
2.	SCOPE TRIGGER	Allows an oscilloscope to be triggered for viewing Fast Transient Bursts
3.	TEST KEYS	Used to select required test mode
4.	LCD	Displays test conditions
5.	KEYPAD	Used to enter data
6.	START	Used to initiate ESD Tests
7.	STANDBY KEY	Used to connect mains to equipment under test
8.	STOP KEY	Used to ABORT tests and allow user to select another test **NOTE:** ESD test cannot be aborted after the test has been started
9.	MAINS SOCKET	Equipment under test is connected here
10.	ESD SOCKETS	ESD Probe is plugged in one of these sockets depending on required polarity
11.	4MM EARTH TERMINAL	This is the Earth return for the copper ground plate used on ESD Tests (REF IEC 801-2)

Symbols used on the MACE:

Refer to operator manual

Earth (ground) Terminal - functional earth only, Not a Protective Earth connection

Caution risk of electric shock

APPLICATIONS

Tests using MACE should be conducted in accord with the EMC standards relevant to the Equipment Under Test (EUT). The user should consult these to ascertain test layouts and methods.....

pr EN50 093 (IEC 1000-4-11) - Voltage Dip

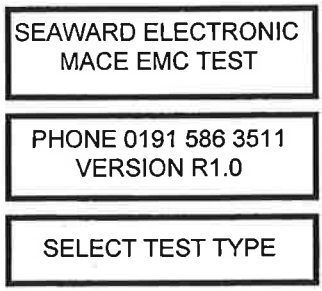
IEC 801-4 - Voltage transient

IEC 801-2 - Electrostatic Discharge

Alternatively, information is included in Seaward's EXPERT CONSULTANT EMC guidance software (Part No 224A910) which is available for purchase from Seaward. For more information please contact Seaward Customer Service (0191) 586 3511.

Ensure the Equipment Under Test is fully operational and has been tested for electrical safety.

Switch on the MACE. The LCD will show the following messages:



At this prompt one of the following three keys can be pressed

- **V Dip** Applies a voltage dip to the EUT (pr EN 50 093)
- **V tran** Applies a burst of transients to the EUT (IEC 801-4)
- **ESD** Applies an Electrostatic Discharge via the ESD probe (IEC 801-2)

Select the test type required using one of the three keys on the left of the front panel (V DIP, V TRANS, E.S.D). The instructions on the LCD will then guide you through the appropriate tests as detailed in the following pages.

With exception of the E.S.D test, the user can abort the programming or testing procedure by pressing **STOP.**

The user may then select a different test (V.Dip, V.Trans or E.S.D) and the relevant LED will illuminate. The user should then follow the method for the desired test, outlined in this manual.

During each immunity test, the EUT must be monitored to assess any degradation in performance relative to the manufacturers specific requirements or those of any relevant EMC standards.

Voltage Dip Test - Introduction

Testing of immunity to voltage dips and interruptions simulates the effect of disturbances to the mains power supply.

Voltage dips and short interruptions may be caused by faults on the distribution network or by the switching of large loads. They are abrupt changes in voltage level and are generally specified to last for between one half and 50 cycles. Three test levels are specified, each with a range of test durations. Equipment will usually be tested to each level with one duration, it being considered that if the equipment passes for one duration it will pass for shorter durations at that level.

Method

Voltage dips and short interruptions are tested by applying each relevant combination of the voltage variation with a sequence of three dips/interruption at intervals of 10 seconds. Each operating mode of the EUT must be tested in this way.

Further information is available in prEN 50 093 - see section on EMC standards - Immunity at the rear of this manual.
Alternatively, information is included in Seaward's EXPERT CONSULTANT EMC guidance software (Part No 224A910) which is available for purchase from Seaward. For more information please contact Seaward Customer Service (0191) 586 3511

Voltage Dip Test - Using MACE

Plug the equipment to be tested into the socket on the MACE front panel. At the prompt "**Select Test Type**", press the key marked **V Dip.** The LED on the **V Dip** key will then illuminate. The display will show the following message:

PRESS STANDBY TO CONNECT SUPPLY

At any time during the Voltage Dip Test the user can abort the programming or testing procedure by pressing **STOP**

The user may then select a different test (V.Tran or E.S.D) and the relevant LED will illuminate. The user should then follow the method for the desired test, outlined elsewhere in this manual.

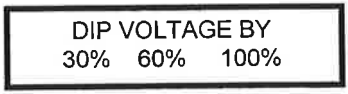
IMPORTANT

Ensure the EUT is in a safe, secure position as the following steps will apply power to the EUT.

Press **STANDBY** to connect the supply to the EUT, The 'Standby' and 'Supply on" LED's will illuminate. The LCD will display the test type chosen

VOLTAGE DIP TEST

and then requests you to select the voltage dip required.



Voltage Dips can be selected by using the → key to move the cursor to the desired level. Pressing the **ENTER** key will confirm the dip selection.

The LCD then shows choices of Voltage Dip time in units of mains cycles.

Duration times can be selected by using the → key to move the cursor to the desired time. Pressing the **ENTER** key will confirm the duration selection.

The LCD will then display a summary of the selections made and prompt the user to proceed with the Voltage Dip Test by pressing the **ENTER** key. Pressing any other key will restart selection of DIP Parameters.

There will be three voltage dips of the duration programmed at intervals of 10 seconds. The LCD counts the Dips as they occur and counts down the time interval between the Dips.

VOLTAGE DIP NO 1 TIME 8 SECONDS

After the third Voltage Dip there is a 10 second delay before the display returns to the following message

START TO REPEAT 0 TO RE-PROGRAM

Pressing the **0** key returns the user to the **SELECT DIP VOLTAGE** screen, and the test can be re-programmed using the steps outlined above.

Pressing the **START** key repeats the last programmed test sequence.

The test can be aborted at any time by pressing the **STOP** key. If the **STOP** key is pressed, the test is halted and the supply is disconnected from the EUT. Pressing the **STANDBY** key will return the MACE to the Voltage Dip programming mode and re-apply power to the EUT.

At the end of the Voltage Dip Test the user can disconnect the EUT if testing is complete, or leave the EUT connected to conduct the Voltage Transient test.

To conduct other tests consult the relevant manual sections on Voltage Transient and Electrostatic Discharge tests.

Voltage Transient Test - Introduction

The aim of this test is to simulate interference which may be induced in cables connected to a unit. The source of the interference may be some distance away from the unit, but fast transient interference is a familiar problem in large industrial environments where ducting may contain electrical supplies for a great variety of purposes.

IEC 801-4 details the fast transient interference tests. By coupling fast transient signals into the mains cable of the unit, and onto any other cables which leave the unit, the level of immunity may be determined.

The fast transient interference consists of a series of pulses of 15mS burst duration, with a total burst period of 300mS.

The transient pulses each have a nominal rise time of 5 ns and a nominal duration of 50 ns. This pulse is commonly known as a 5/50 ns waveform. The repetition rate of the pulses is either 5 or 2.5 kHz, depending upon the peak value of the output voltage.

The test severity level is defined according to the environment in which the equipment is to be placed. The generic immunity standards (EN 50-082-1 and prEN 50 082-2) define peak voltages, and IEC 801-4 defines the criteria for each classification of environment.

Bursts of fast transients should be applied to each conductor in turn, starting at the lowest severity level and increasing until the required test level is

reached. Tests should then be repeated with the opposite pulse polarity. The duration of the test is negotiable, but should be a minimum of one minute.

The test voltage should be applied between each of the mains conductors and the protective earth. In addition to the mains cable, IEC 801-4 requires that any other cables such as input, output, or communications lines should also be subject to the test. Since these cables do not carry mains voltages, the same process of direct coupling to the EUT cannot be used. Instead, a capacitive coupling clamp, (not supplied with MACE) is used which ensures that there is no galvanic connection to the cables. The Capacitive Coupling Clamp (Part No 245A910) is available for purchase from Seaward. For more information please contact Seaward Customer Service (0191) 586 3511.

It should be borne in mind that the application of fast transients can be destructive if the EUT does not have adequate immunity.

Further information is available in EN 50-082-1, prEN 50082-2 and IEC 801-4 - See Section on EMC Standards - Immunity at the rear of this manual.

Alternatively, information is included in Seaward's EXPERT CONSULTANT EMC guidance software (Part No 224A910) which is available for purchase from Seaward. For more information please contact Seaward Customer Service (0191) 586 3511.

Voltage Transient Test - Using MACE

Plug the equipment to be tested into the socket on the MACE front panel.

At the prompt "**Select Test Type**" press the key marked **V Trans.** The LED on the **V Trans** key will then illuminate. The display will show the following message:

PRESS STANDBY TO CONNECT SUPPLY

At any time during the Voltage transient test the user can abort the programming or testing procedure by pressing **STOP**

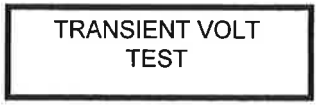
The user may then select a different test (V Dip, or E.S.D) and the LED will illuminate. The user should then follow the method for the desired test, outlined elsewhere in this manual.

IMPORTANT

Ensure the EUT is in a safe, secure position as the following steps will supply power to the EUT.

Press the **STANDBY** key to apply power to the EUT. The **STANDBY** and **SUPPLY ON** LED's will illuminate.

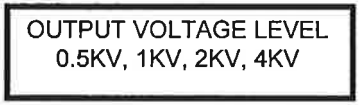
The LCD will show the test type chosen and then request the user to select



POSITIVE or **NEGATIVE** transients.

The Transient polarity can be selected by using the → key to move the cursor to the desired option. Pressing the **ENTER** key will initiate actual polarity selection.

The LCD will display Output Voltage Level and then requests the user to select the desired level.



Transient output voltage can be selected by using the → key to move the cursor to the desired option. Pressing the **ENTER** key will initiate actual output voltage level selection.

The LCD will then ask the user whether pulse output is required at the rear socket only.

By selecting **YES** the output is sent only to the rear co-axial socket. This option should be selected if the user wishes, to view the transient burst

waveform in conjunction with a suitable oscilloscope, or to attach a capacitive coupling clamp.

By selecting **NO** the user will proceed with a full test by specifying the supply conductors of the EUT to which the transient burst will be applied.

YES or **NO** can be selected by using the → key to move the cursor to the desired option and pressing the **ENTER** key

IF YES IS SELECTED the user will be prompted to select the test duration. (See page 18)

IF NO IS SELECTED the LCD will then show for a few seconds

ENSURE REAR SOCKET COVER CLOSED

This is a reminder to close the access door to the transient output socket fitted to the rear of the MACE. If it is left open the transient injection onto the EUT Mains supply lines will be disabled.

The user can proceed with a full test by specifying the EUT supply conductors which a transient burst will be applied to .....

The LCD will then show

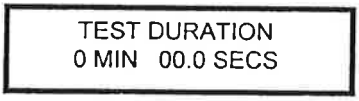
SELECT CONNECTION L N E

The voltage transient can be applied to one of three supply lines - **LIVE, NEUTRAL or EARTH**- or any combination of the above.

Connections can be selected by using the → key to move the cursor to the desired option and using the 1 key to select and the 0 key to de-select.
Eg If the user selects LIVE the display will show.

Once the desired selection is complete the ENTER key can be pressed.

The LCD will display the time duration of the test in minutes, seconds and tenths of seconds.



The → key is used to move the cursor to the relevant section of the display. Values can then be entered by pressing the relevant number of the keypad. When a number has been entered the cursor moves to the next number.

If an incorrect value is entered, simply use the → key to move the cursor and use the numbered keys to enter the correct value. (The cursor moves left to right and once the last digit is highlighted and entered the cursor will return to the first digit). The new value will then 'overwrite' the old value.
NOTE: The maximum time duration is 5 minutes 59.9 seconds.
Once the correct value has been entered the ENTER key should then be pressed

A summary will then be shown on the LCD eg

POS 0.5KV L 5:00.0 ENTER IF CORRECT

The **ENTER** should then be pressed to initiate the Transient Volt Test.

The above example shows Positive transients of 0.5 KV will be applied to the LIVE conductor in bursts of 15mS every 300mS for a duration of 5 minutes in line with IEC 801-4.
The display will then show a countdown as the test is carried out.
At the end of the test the display will then show

START TO REPEAT 0 TO RE-PROGRAM

Pressing the **0** key will return the user to the **TRANSIENT POLARITY** screen and the test can be re-programmed using the steps outlined above. Pressing the **START** key repeats the last programmed test sequence.

If the **STOP** key is pressed the test is halted and the supply is disconnected from the EUT. Pressing the **STANDBY** key will return MACE to the transient volt test programming mode

At the end of the voltage transient test the user can disconnect the EUT to finish testing or leave the EUT connected to conduct other tests such as Voltage Dip or Electrostatic Discharge.
To conduct other tests consult the relevant manual sections on Voltage Transient & Electrostatic Discharge tests.

Electrostatic Discharge (ESD) Testing - Introduction

The electrostatic environment in which some equipment is now operated has become increasingly harsh over the past few years. In the domestic environment, an increasing number of homes have central heating which results in lower humidity. This, combined with the widespread use of synthetic based floor coverings, can enable a person to become highly charged. The maximum values to which a person may become electrostatically charged varies as a function of clothing material type and as a function of relative humidity.

Two methods of discharge are used in ESD testing and are termed direct and indirect discharge. In addition there are two methods of applying direct discharges to the equipment under test. These are contact and non-contact discharge.

The MACE may be used for ESD testing. It supplies an air (non-contact) discharge.

Air discharge is designed to simulate the effect of a charged finger approaching a piece of equipment. The static discharge occurs before contact is made between the finger and the equipment.

Further information is available in IEC 801-2. See section on EMC standards - Immunity at the rear of this manual.

Alternatively, information is included in Seaward's EXPERT CONSULTANT EMC guidance software (Part No 224A910) which is available for purchase from Seaward. For more information please contact Seaward Customer Service (0191) 586 3511.

Electrostatic Discharge (ESD) Testing - Using MACE

Connect the EUT to a **SEPARATE** power supply ie **NOT** the MACE.

This ensures that the earth return path for the discharge is not impeded by the MACE, and that testing can be carried out in accordance with IEC 801-2.

Check that the Earth from the green terminal on the MACE is connected to the same metal ground plane as the EUT. **Take every precaution to ensure personnel safety during this test.**

Switch on MACE unit, at the prompt **"SELECT TEST TYPE"**, press the key marked **E.S.D.** The LCD will show the following message:

and then prompt the user to select the POLARITY.

The user has the choice of positive or negative voltages. Insert the ESD probe into the required socket on the MACE front panel and touch the probe tip to the metal ground plane to remove any residual change. When changing polarity of the ESD probe the user should again touch the probe

tip to the metal ground plane to remove any residual charge before proceeding to reprogram

Note : Do not connect any ESD probe or gun other than the SEAWARD ESD probe supplied with the MACE. The MACE ESD Probe is designed for use with the MACE only, do not use with any other instrument.

WARNING

Do not attempt to charge the ESD circuit without the probe being connected, as there will be no means of discharging without connecting the probe.

Once the ESD probe is connected press the **ENTER** key.

The LCD will then ask the user to select the desired voltage level.

OUTPUT VOLTAGE (KV)
0.5 1 2 4 8

Voltage levels can be selected by using the → key. When the desired voltage is shown press the **ENTER** key. The LCD will now prompt the user to press **START** to charge the probe.

PRESS START TO CHARGE THE PROBE

WARNING

Ensure that the ESD probe is held securely, using the handgrip at the rear of the probe and that no contact, with the human body, or equipment other than the EUT, is made by the metal tip of the probe.

Upon pressing **START** the buzzer sounds and the LCD will prompt the user

THE PROBE IS CHARGING

When the required voltage level is reached the display will show

THE PROBE IS READY WARNING HV!!!!

The user then has 3 seconds to discharge by applying its tip to the EUT, as required in IEC801-2, during which time the buzzer will sound an intermittent note.

To prevent any **danger of discharge to the user**, ensure that the ESD probe is only handled by the textured grip at the cable end of the probe during the charge and discharge cycle. **To ensure user safety**, the ESD probe tip should be fully discharged by holding the probe on the metal ground plane following an ESD discharge to remove any residual charge. The probe should not be discharged to the MACE or any point other than the unit under test.

At the end of the ESD test ensure the probe is fully discharged by touching the ground-plane with its tip.

The **STOP** key **CANNOT** be used to interrupt this test, and once the probe has been charged it **must be discharged fully** as described above.
The LCD will then show

START TO REPEAT 0 TO RE-PROGRAM

Pressing the **0** key returns the user to the **CONNECT SEAWARD PROBE** and the test can be re-programmed using the steps outlined above. Pressing the **START** key re-initiates the test sequence.

To conduct other tests consult the relevant manual sections on Voltage Transient Tests and Voltage Dip Tests

Specification

Voltage dip - pr EN50 093 (IEC 1000-4-11)

- Voltage dips 30%, 60% and 100%
- Dip Duration times 0.5, 5, 10, 25, 50 cycles
- 3 voltage dips are initiated at 10 second intervals

Fast transients - IEC801-4

- Output Voltages 0.5KV, 1KV, 2KV, 4KV
- Positive and negative transients
- Repetition rate 2.5KHz or 5.0KHz
- Connection to any combination of Live, Neutral and Earth
- Test times between 0 and 6 minutes in 0.1 second steps

Electrostatic discharge (ESD) - IEC801-2

- Utilising Air Discharge ESD probe
- Output Voltages 0.5KV, 1KV, 2KV, 4KV, 8KV
- Positive and negative polarities

MACE Part numbers

• MACE - 230V, UK	part number 204A910
• MACE - 100V, Japan	part number 204A913
• MACE - 240V, Australia	part number 204A914
• MACE - 110V, USA	part number 204A915
• MACE - 230V, Europe & Schucko	part number 204A916
• ESD Probe - spare	part number 204A912

GENERAL

MAINS SUPPLY

230v +10%, -6%, 50Hz

(Units are calibrated at 230v)

30VA (no load)

3KVA (full load) (see below)

MAINS FUSES

16A (where fitted)

DUTY CYCLE

Operation (i.e. STANDBY on) above 2KVA or near full load for extended periods (>10mins) should be avoided.

ENVIRONMENTAL

Operating Temperature	0°C to 40°C
Storage Temperature	-10°C to 70°C
Relative Humidity	Maximum 80% up to 31°C decreasing to 50% at 40°C
For indoor use	Altitude up to 2000M
Installation Category II	Pollution degree 2

SIZE 450 x 360 x 150 mm (approx)

WEIGHT 16 Kg

Maintenance

1. There are no user replaceable parts in the MACE

2. Always check the MACE for signs of damage before use

3. Keep the MACE clean and dry

4. No attempt should be made to gain access to the MACE whilst conducting tests

5. The Mace enclosure can be cleaned with a damp (not wet), lint-free cloth. Ensure no dampness enters the rear transient socket or either of the front ESD sockets.

6. The fan filter should be periodically inspected, and can be cleaned by unscrewing the filter cover, removing the filter, and brushing off accumulated dust. Replace the filter, and screw back the cover.

For repair or calibration return the instrument to:

SEAWARD Electronic LTD
Bracken Hill
South West Industrial Estate
Peterlee
Co. Durham
SR8 2JJ
Tel : +44 (0)191 - 586 3511
Fax: +44 (0)191 - 587 0157

Other EMC products

SEAWARD's EMC low cost in-house testing package consists of

- MACE - Mains interference simulator
- SCEPTRE - Spectrum analyser with in-built LISN
- EXPERT CONSULTANT - EMC guidance software

SCEPTRE - SPECTRUM ANALYSER

SCEPTRE is a microprocessor PC controlled spectrum analyser, designed to measure radiated and conducted emissions. All controls are set via the PC screen using a proprietary software package operating in a Microsoft Windows environment.

The SCEPTRE software also displays results, graphical information and an integral control panel allows further analysis and interpretation. Complimentary with other Windows based packages it provides the ability to transfer results to final report documents, such as Technical Construction Files.

Specification SCEPTRE

- Input Frequency Range 150KHz - 450MHz
- 1MHz, 3db bandwidths 9KHz & 120KHz CISPR 16 bandwidths
- Spans of 1MHz, 3MHz, 10MHz, 100MHz, 300MHz
- Gains +20dB, 0dB, -20dB
- 8 Amp LISN standard, other sizes optional

- Quasi Peak Detection
- Averaging Facility
- Peak Hold Facility
- Limit Line Indication
- Cursor Markers

Part numbers SCEPTRE

- SCEPTRE - 230V, UK part number 219A910
- SCEPTRE - 100V, Japan part number 219A912
- SCEPTRE - 240V, Australia part number 204A914
- SCEPTRE - 110V, USA part number 219A915
- SCEPTRE - 230V, Europe + Schuko part number 219A916

EXPERT CONSULTANT

SEAWARD's EXPERT CONSULTANT is a Microsoft Windows based software package which not only identifies the relevant standard for any product for both emissions and susceptibility, but also guides the user to choose the most appropriate route towards compliance.

Containing summaries of all the relevant standards and utilising the knowledge of the country's leading experts and the technology of major UK Universities, SEAWARD have developed a package that provides a professional EMC knowledge base for those involved in electrical or electronic product design, manufacturer or sale.

Features include

Level 1: identification

- Identifies the route to achieve compliance with EMC directive
- Identifies and explains the appropriate standards
- Defines actions required to compile Technical Construction File

Level 2: diagnostics

- Describes the EMC tests and measurement methods defined by the standards
- Provides interpretation of the results obtained from using EMC assessment instrumentation
- Provides diagnostics to enable effective EMC countermeasures to be incorporated within a design

System requirements (EXPERT CONSULTANT)

- IBM compatible PC, 386sx 25MHz minimum
- IBM VGA or other graphics card compatible with Microsoft Windows 3.1 or higher with 800 x 600 pixel capability
- Microsoft MS-DOS 5.0 and Microsoft Windows 3.1 or higher
- Hard disk drive with 10M byte free space (15 M byte needed for installation)

Part number EXPERT CONSULTANT

- EXPERT CONSULTANT part number 224A910

EMC Directive - an overview

From 1 January 1996 The EMC Directive becomes fully effective throughout the European Community and will apply to all products having an electrical/electronic content.

What's in, what's out?

Following the European Commission's explanatory document of 1991 and the UK EMC Regulations of October 1992, we can now see whether or not a product is within the scope of the EMC Directive and know when it applies.

If equipment can be described as being benign from an EMC viewpoint, then it is exempt from the EMC Directive. That is to say, it does not emit unwanted electromagnetic (EM) disturbances and its performance is unaffected by external EM disturbances.

Non-commercial amateur radio equipment is also exempt. Further exemptions are second-hand equipment and equipment for export outside the European Community (EC).

Product specific directives having EMC provisions take precedence over the EMC Directive. Some product specific directives have partial EMC provisions.

The EMC Directive applies to equipment when it is first placed on the market or is taken into service. It covers all equipment that enters the distribution chain after 1 January 1996 and therefore applies to those products being manufactured now that will still be marketed after this date, as well as to

new products. If products comply with the EMC Directive **now**, manufacturers or their agents can mark their products with the **CE mark** and have full access to the Single Market.

The period up to 1996 is called the 'transition period', during which time a manufacturer whose product does not comply may still market it in any member state under the existing national regulations.

However, from January 1996, there will be no option but to comply.

Compliance

Having determined that a product comes under the EMC Directive, it is necessary to demonstrate compliance with its requirements: **equipment should not interfere with the intended function of other electrical or electronics equipment or broadcast services, and it should have intrinsic immunity to external EM disturbances.**

If products can be claimed to conform with standards published in the Official Journal of the European Communities (OJ), then compliance with the EMC Directive has also been demonstrated.

If a product is not covered by a product-specific standard, then it may be possible to apply the generic standards. These apply to a broad range of products that can be used in defined environments.

Conformance with standards really means testing products in accordance with the test methods described in the standards. Such testing is the

responsibility of the manufacturer (or European 'appointed representative' if appropriate) and may be performed in-house or by a third party. So how else may compliance be demonstrated?

A manufacturer may also demonstrate compliance using a technical construction file (TCF). This is prepared by the manufacturer in consultation with a Competent Body and includes a technical description of the product or range of products, along with any necessary drawings, a description of the EMC provisions, and results of any testing or theoretical prediction that has been carried out.

This report is submitted to the Competent Body, which will issue a technical report or certificate if it believes the product(s) to be compliant with the 'protection requirements'.

There is a third route to compliance, which applies to radio transmission or transceiver equipment. This type of equipment must be submitted to a Notified Body for EC type examination.

When compliance has been demonstrated then a manufacturer is in a position to make a Declaration of Conformity. The declaration should identify the product, the standards with which it conforms, or its TCF, or its EC type examination certificate and the signatory binding the manufacturer. The CE (Communaute Europeene) mark can then be affixed to the product or its packaging, allowing the product to be marketed freely throughout the EC (but note that the CE mark can only be affixed if the product complies with

all the new approach directives that apply to it, e.g. an electronic toy must comply with both the EMC and the Toy Safety directives).

Penalties

The penalties included in the UK legislation allow for a £5000 fine and, for certain offences, up to a 3 month prison sentence. However the most serious deterrent is the possibility of non-compliant products being excluded from the market, and hence the commercial threat to a company's existence.

References

- 89/336/EEC Council Directive 'on the approximation of laws of Member States relating to electromagnetic compatibility', Official Journal of the European Communities, 25 May 1989, 139, pp.19-26
- DTI: 'The Electromagnetic Compatibility Regulations', HMSO, October 1992
- MARSHMAN, C A:'The Guide to the EMC Directive 89/336/EEC' (EPA Press, 1992)

EMC Standards - Immunity

Tests using MACE should be conducted in accordance with the EMC standards relevant to the Equipment Under Test (EUT).

The following is a summary of EMC Immunity standards. It is intended to provide general information and should be used as a guide only.

prEN 50 065-2	Mains signalling equipment
prEN 50 093	Voltage dips
EN 55 020	Broadcast receivers and associated equipment
IEC 801	Industrial process, measurement and control
EN 50 082-1	Generic class; residential, commercial and light industry
prEN 50 082-2	Generic class: Industrial
EN 60 601	Medical electrical equipment

prEN 50 065-2: Signalling on low-voltage electrical installations in the frequency range 3 kHz to 148.5 kHz.
Part 2: Immunity from interference

This standard applies to electrical equipment using signals in the frequency range 3 kHz to 148.5 kHz to transmit information on low voltage electrical systems, either on the public supply system or within a customers premises.

It specifies immunity requirements for Mains Communication Equipment/Systems (MCES) on low-voltage installations from EMI in general and more specifically EMI coming from other MCES.
It does not specify immunity for MCES operating in the same band.

It specifies information on the following topics:

1. Type of application and environment
2. Performance criteria
3. Test circuit
4. Immunity Specifications
5. Documentation

prEN 50 093: 1991 Basic Immunity Standard for Voltage Dips, Short Interruptions and Voltage Variations.

This standard defines the test methods and levels of immunity of equipment to voltage variations, dips and short interruptions fed by low voltage power supply networks.

This standard applies to equipment having an input current not exceeding 16 A per phase. It does not apply to equipment for connection to DC networks or 400 Hz AC networks.

Voltage variations are caused by continuously varying loads connected to the network. Voltage dips and short interruptions are caused by faults in the network or by a sudden large change of load. In practice voltage dips and short interruptions are not always abrupt and some equipment is more sensitive to gradual variations than to abrupt changes. Different types of test are specified to simulate the effects of both phenomena.

prEN 50 093 also provides information on:
Voltage Variations, Dips and interruptions

Test Levels

Test Equipment

Test Set-up

Test Procedure

Analysis of Results

EN 55 020 - Immunity from radio interference of broadcast receivers and associated equipment

EN 55 020 provides information on the following topics:

1. It defines Broadcast receivers and associated equipment
2. Limits of Immunity
3. Test criteria
4. Methods of Measurement
5. Application of Results to Series Production

IEC 801-2: 1984, IEC 801-2: 1991 (BS EN 60 801-2: 1993)
Electrostatic Discharge (ESD)

IEC 801-2 defines the immunity requirements and test methods for equipment which must withstand electrostatic discharges directly from operators or adjacent objects. IEC 801-2 provides the user with the following information:

1. ESD
2. Test severity levels

3 Test equipment

4. Test methods

5. Evaluation of test results

IEC 801-4: Fast Transient Burst

IEC 801-4 relates to the immunity of industrial process measurement and control instrumentation to repetitive electrical fast transients.

IEC 801-4 provides information on the following topics:

Severity Levels
Test Equipment
Test Set-up
Test Procedures
Evaluation Of Results

EN 50 082-1: 1992 Electromagnetic compatibility - Generic immunity standard
Part 1. Residential, commercial and light industry

This generic standard will cover a large proportion of the products falling within the scope of the EMC directive. The generally recognised break-point between 'residential' or 'light industrial' and 'industrial' is whether or not a device can be served by a 13A socket outlet.

EN 50 082-1 provides the following information:

1. it defines the generic environment-residential, commerical and light industry
2. it defines the generic equipment ports
3. it defines the performance criteria
4. it specifies immunity limits and the reference standards
5. it provides further applicability guidance
6. it includes an informative annex
7. it specifies test conditions and documentation that should be provided with the product.

prEN 50 082-2 'Electromagnetic Compatibility - Generic Immunity Standard Generic Class: Industrial

CENELEC Technical Committee 110 has drafted a generic immunity standard for the 'industrial' environment, prEN 50 082 Part 2.

This generic standard will cover a large proportion of the falling within the scope of the EMC Directive and follows a similar format to the 'residential, commercial and light industry' standard. The generally recognised break-point between 'residential' or 'light industrial' and 'industrial' is whether or not a device can be served by a 13A socket outlet.

Reference is made to published standards, principally IEC 801. An informative annex is also included, however its use is optional.

prEN 50 082-2 provides the following information:

1. it defines the generic industrial environment

2. it defines the generic equipment ports
3. it specifies industrial immunity limits and the reference standards
4. it defines the performance criteria
5. it provides further applicability guidance
6. it includes an informative annex
7. it specifies test conditions and documentation that should be provided with the product.
8. it states the configuration of the EUT and load conditions for immunity.

EN 60 601-1-2 Medical electrical equipment part 1 general requirements for safety

part 2. collateral standard: electromagnetic compatibility - requirements and tests

Euro-Norm 60 601 is the harmonised standard defining the permitted emission limits of radiated and conducted interference and levels of immunity to externally generated radiated and conducted interference. It applies to Medical Electrical equipment, Medical Electrical systems, Information Technology equipment used in medical electrical applications and all other equipment forming part of Medical Electrical systems. This standard specifies general requirements and tests for EMC of equipment and/or systems and makes reference to other product specific standards for test methods.

The UK equivalent is BS EN 60 601-1-2 which is based on IEC 601-1-2. EN 55 022 provides the manufacturer with the following information:

1. it defines the scope as described above;
2. for emissions, it states the limits for
   radiated emissions and for conducted emissions and defines the measurement methods;
3. for immunity it states the levels of protection for:
   ESD, radiated immunity and conducted transients, both bursts and surges.