

SEMI E33-94

SPECIFICATION FOR SEMICONDUCTOR MANUFACTURING FACILITY ELECTROMAGNETIC COMPATIBILITY

This Standard was technically approved by the Metrics Global Technical Committee.

1 Purpose

1.1 The purpose of this Specification is to assure that semiconductor manufacturing facilities and the equipment used for manufacturing semiconductor devices will operate together reliably without failures caused by electromagnetic interference or electrostatic discharge. This goal is generally known as 'electromagnetic compatibility' or EMC.

2 Scope

2.1 This Specification applies to facilities and equipment constructed for the purpose of manufacturing semiconductor devices including all facilities alarm, safety, communications and control systems, processing equipment, metrology equipment, automation equipment, and information technology equipment.

3 Limitations

3.1 This Specification does not apply to the equipment and facilities used for the assembly and functional testing of integrated circuits. This Specification does not apply to process-specific charging that may occur to semiconductors under manufacture.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

4 Referenced Standards and Documents

- 4.1 ANSI C63.4-1991¹ — American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- 4.2 CISPR Publication 22, 1985² — Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment
- 4.3 CENELEC EN 55 022, 1987² — Modifications to CISPR 22
- 4.4 Draft British Standard EN 50 082-2³ — Electromagnetic Compatibility — Generic Immunity Standard: Industrial (CLC/TC 110 (Sec) 44)
- 4.5 Emerald Book¹ — IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment, IEEE, 1992
- 4.6 EOS/ESD Association Advisory for Electrostatic Discharge Terminology⁴ — Glossary, 1992
- 4.7 FIPS (Federal Information Processing Standards) Publication 94, 21 September 1983⁵ — Guideline on Electrical Power for ADP Installations
- 4.8 IEC 801-2, Second Edition, 1991-04² — Electrostatic Discharge Requirements
- 4.9 IEC 801-3, First Edition, 1984² — Radiated Electromagnetic Field Requirements
- 4.10 IEC 801-4, First Edition, 1988² — Electrical Fast Transient/Burst Requirements

¹ Institute of Electrical and Electronics Engineers, 3 Park Avenue, 17th Floor, New York, NY 10016-5997, USA; Telephone: +1.212.419.7900, Fax: +1.212.752.4929, <http://www.ieee.org>.

² American National Standards Institute, 25 West 43rd Street, New York, NY 10036, USA; Telephone: +1.212.642.4900, Fax: +1.212.398.0023, <http://www.ansi.org>.

³ Sales Administration (Drafts), BSI, Linford Wood, Milton Keynes MK 14 6LE, United Kingdom.

⁴ EOS/ESD Association, 218 W. Court St., Rome, NY 13440-2069, USA; Telephone: +1.315.339.6937, <http://www.esda.org>.

⁵ National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

4.11 IEC TC 65 (Sec.) 137 (801-5) Committee Draft, July 1992² — Surge Immunity Requirements

4.12 IEC TC 65 (Sec.) 144 (801-6) Committee Draft, February 1992² — Immunity to Conducted Disturbances Induced by Radio Frequency Fields above 9 kHz

5 Terminology

5.1 *earth port* — European term for an equipment ground. This term is used extensively in the basic standards.

5.2 *electromagnetic compatibility (EMC)* — the ability of electronic equipment to function properly with respect to environmental EMI and ESD.

5.3 *electromagnetic interference (EMI)* — any electrical signal in the non-ionizing (sub-optical) portion of the electromagnetic spectrum with the potential to cause an undesired response in electronic equipment.

5.4 *electrostatic discharge (ESD)* — the transfer of electrostatic charge between bodies at different electrostatic potentials.

5.5 *ELF* — extremely low frequency (about 1 Hz to 1 kHz) magnetic fields generated by current flow (most commonly 60 Hz in the U.S. and 50 Hz in Europe) within equipment and facilities.

5.6 *ELF sensitive equipment* — any equipment whose performance is adversely affected by ELF, such as a scanning electron microscope (SEM).

5.7 *EUT* — equipment under test.

5.8 *port* — a particular interface of the specified equipment with the external electromagnetic environment (see Figure 1).

5.9 *enclosure port* — the physical boundary of the apparatus through which electromagnetic fields may radiate or impinge.

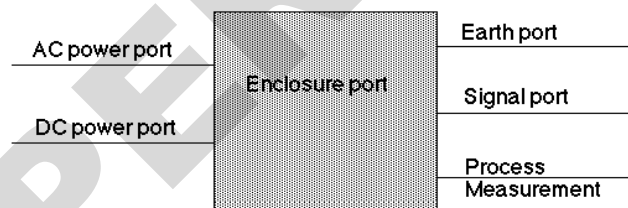


Figure 1

6 Requirements

6.1 *Performance Criteria* — The following are generic failure criteria for the various classes of equipment and electronic systems used in semiconductor manufacturing. However, any kind of failure or aberration during EMC testing shall be noted in the test report.

6.1.1 *Performance Criteria A* — The equipment operates as intended during and after the test. In the case of process equipment, all process results are within specifications. No safety hazards nor false alarms are present. In some cases, the performance level may be replaced by a documented permissible loss of performance if such loss is minor and agreeable to the concerned parties.

6.1.2 *Performance Criteria B* — The equipment operates as intended after the test, but experiences a loss of function or degradation of performance during the test to a level specified by the manufacturer. No change of operating state or loss of stored data is allowed. Restoration of performance or function does not require human intervention.

6.1.3 *Performance Criteria C* — Temporary loss of function is allowed, provided the loss of function is recoverable, either automatically or through operation of the controls. Any failure of control or alarm systems is in a fail-safe mode, such as a false alarm or equipment shutdown.

6.1.4 *Safety Criteria* — Equipment will automatically fail if testing results in an unsafe or potentially unsafe condition, such as threat to life or property. Examples would be failure of an emergency machine off (EMO) button to operate or faulty opening of a toxic gas valve.

6.1.5 *Conditions During Testing* — All EMC testing is to be done with the equipment installed and operational. As much as possible, the test installation should be identical to the final production installation. Substitutes may be used for hazardous gases and chemicals, and other modifications may be made as deemed reasonable to ensure testing can be performed in a completely safe and environmentally acceptable manner. Special EMC facilities are not required by this standard.

7 Test Methods

7.1 The tables below are organized by ports to which the tests apply, as defined above. The basic standards provide the test setup and procedures to be followed, except as noted. In all events, EMC testing is intended to prevent EMC problems when the equipment is installed and operating in a semiconductor manufacturing facility. Any modification or interpretation of the test setup and procedure should be judged by this overriding goal.

7.2 Immunity Tests

Table 1 Enclosure Ports

	<i>Test Type</i>	<i>Specification</i>	<i>Basic Standard</i>	<i>Remarks</i>	<i>Performance Criteria</i>
1.1	ESD immunity	4 kV Contact 8 kV Air discharge	IEC 801-2 (1991)	See Appendices A and B	A
1.2	Radiated immunity Amplitude modulated	10 V/m 450-520 MHz 800-950 mHz 80% AM (1 kHz)	IEC 801-3	See facilities requirements (See § 5.1.1)	A
1.3	ELF immunity	Level A–E as required	ELF testing (See § 5.1.2)	Required only of ELF-sensitive equipment	A
1.4	Radiated immunity Pulse modulated	3 V/m 1.89 GHz 50% Duty cycle 100 Hz rep freq.	TC 65 (Sec.) 136 Draft	Europe only Cellular phone band	A

7.2.1 *Facilities Requirements* — Due to the size and complexity of much semiconductor factory equipment, testing in a shielded enclosure, anechoic chamber, or other special facility is not required. If such facilities can be used, the results will be more reproducible and accurate.

7.2.1.1 Note that radiated immunity testing is required only at frequencies used for mobile communications. As shown in Table 1, Row 1.2. Testing should be conducted in conformance with national and local emission requirements at the frequencies specified (see Appendix D).

7.2.2 *ELF Testing* — The following sensitivity levels are defined:

- *Level A* — ELF of less than 0.25 milliGauss rms
- *Level B* — ELF of less than 0.50 milliGauss rms
- *Level C* — ELF of less than 1.00 milliGauss rms
- *Level D* — ELF of less than 2.00 milliGauss rms
- *Level E* — ELF of 2.00 milliGauss rms and greater