

ECMA

EUROPEAN COMPUTER MANUFACTURERS ASSOCIATION

LOCAL AREA NETWORKS SAFETY REQUIREMENTS

TR/19

March 1984

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BRIEF HISTORY

ECMA TC24 started work on Local Area Networks at the beginning of 1981, in cooperation with IEEE 802. It was soon realized that, although the equipment to be connected via Local Area Networks could be designed according to Standard ECMA-57, Safety Requirements for DPE, the special requirements of the cables interconnecting the equipment were not fully considered in Standard ECMA-57.

ECMA TC24 then asked ECMA TC12 to prepare a document, to be used in conjunction with ECMA-57, describing specific requirements of LAN.

This field is rather new and further experience is needed. For this reason, this document is published as a Technical Report. A future revision of this document could be published as an ECMA Standard or incorporated in a future revision of Standard ECMA-57.

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1. INTRODUCTION

For interconnected equipment designed with conventional interface circuitry and installed in a limited area, Standard ECMA-57 fully covers the safety requirements. With the introduction of networks extending into unspecified and uncontrolled environments, other parameters not covered by ECMA-57, such as high-voltage fault consequences, earth-differential potentials, lightning, etc have to be considered.

When considering the safety of Local Area Networks, various parameters, which also relate to experience from existing telecommunications installations, have been taken into account, such as:

- Different Local Area Network systems, e.g. CSMA/CD, Token Bus, Token Ring, etc.
- Different power systems, e.g. high-voltage distribution, TN-C, TN-S, TT and IT systems.
- Power distribution in high-rise buildings.
- Local Area Networks between buildings.
- Single vs multiple earthing, equipotential bonding.
- Design of DTE interface circuits.
- Environmental restrictions, e.g. flame spread, flammability, smoke and fumes, electrochemical potentials, etc.
- Protective measures against lightning and other transient effects.
- Installation and maintenance requirements.

NOTE 1

Some of the above considerations are still under study.

2. SCOPE

This Technical Report ECMA TR/19 applies to Local Area Networks (LAN) which consist of trunk cables, medium access units (MAU), medium interface connectors (MIC) and all cabling between the data terminal equipment (DTE) and network components. MAU may be incorporated into DTE. A typical configuration of the above units is given in Appendix B.

Examples of LAN are described in the ECMA Standards referenced below.

3. REFERENCES

ECMA-57:	Safety Requirements for DPE
ECMA-80:	LAN - CSMA/CD Coaxial Cable System
ECMA-81:	LAN - CSMA/CD Physical Layer
ECMA-89:	LAN - Token Ring Technique
ECMA-90:	LAN - Token Bus Technique
IEC Publ. 60:	High Voltage Test Methods
IEC Publ. 384:	Capacitors for Radio Interference Suppression
IEC Publ. 364:	Electrical Installations of Buildings

4. DEFINITIONS

The definitions for the following terms are contained in the referenced ECMA Standards, where the full text of the definition will be found at the referenced paragraph.

4.1 Equipment, Class I

See ECMA-57, definition 1.2.10.

4.2 Power System, TN

See ECMA-57, definition 1.2.32.

4.3 Power System, TT

See ECMA-57, definition 1.2.33.

4.4 Power System, IT

See ECMA-57, definition 1.2.34.

4.5 Safety Extra Low Voltage (SELV) Circuit

See ECMA-57, definition 1.2.41.

4.6 Medium Access Unit (MAU)

A junction unit by which a DTE may obtain access to the trunk cable medium.

4.7 Trunk Coupling Unit (TCU)

See ECMA-89, definition 1.3.26. In this Technical Report TCU and MAU are considered to be equivalent for safety considerations and are referred to as MAU.

4.8 Medium Interface Connector (MIC)

See ECMA-89, definition 1.3.7.

4.9 Data Terminal Equipment (DTE)

See ECMA-89, definition 1.3.2.

5. DESIGN

The design and installation requirements for the DTE, MAU, cables and other network components shall conform with the requirements stated in Section 6 as appropriate to the installation situation, and with ECMA-57.

6. REQUIREMENTS

Requirements are classified according to two different mains supply situations A and B, with additional requirements where cables leave buildings.

6.1 Situation A

This situation implies a single low-voltage incoming mains supply to the area served by the LAN.

6.1.1 Installation in Situation A

All Class I equipment and all extraneous metalwork shall be bonded to the principal protective earthing point associated with the incoming mains supply. The electrical installation of the building shall be in accordance with IEC Publication 364, and hence earth

differential voltages are limited in accordance with Section 413 of that IEC Publication.

6.1.2 Design Requirements for LAN in Situation A

- In the DTE and any other equipment similarly connected, the MAU interface circuits shall be SELV circuits. This requirement applies whether the MAU is free-standing or is integrated with the DTE or with another function.
- There is no safety requirement to earth the screen, (if any) of the trunk cable. However, where it is earthed for EMC or other reasons it shall be connected to the protective earth of the area served by the LAN. One or more connections may be used. A single connection should be made as close as possible to the main earthing point for the area, to minimize differential voltages.

NOTE 2

Care should be taken in the installation that there is separation or insulation to IEC 364-4-41 Section 413 between mains terminals and the screen of the trunk cable, especially where the screen is not connected to earth.

- There is no safety requirement for isolation in the MAU between the DTE interface circuits, including the earth circuit, if any, and the trunk cable. However, where such isolation is provided for functional purposes or where a capacitor, which may have any value, is provided for EMC or other purposes, it should withstand an electric strength test at 500 V rms for 1 minute, in case earth differential voltages described in 6.1.1 occur.
- Isolation shall be provided between a LAN segment which is in Situation A and any other LAN, unless both segments use the same incoming mains supply. Such isolation shall withstand the electric strength test in 6.2.2.
- A LAN segment which is in Situation A may be connected to an inter-building section of the trunk cable provided that the protection specified in 6.3 is used.

6.2 Situation B

This situation implies more than one incoming mains supply to the area served by the LAN.

6.2.1 Installation in Situation B

In situation B hazardous earth differential voltages can occur between the protective earth systems associated with the different incoming mains supplies. These earth differential voltages are likely to arise from interruption of the PEN conductor in TN-C power systems, from earth faults on the supply authority's high-voltage distribution network or from lightning. Where it can be demonstrated that the earth

differential voltages within a single building are limited to the voltage/time characteristics specified in IEC Publication 364 Section 413, the requirements in 6.1.2 apply. This may be achieved by equipotential bonding, provided either in the building wiring or together with the LAN installation, or by other means. Otherwise, the requirements of 6.2.2 apply.

6.2.2 Design Requirements for LAN in Situation B

- In the DTE and any other equipment similarly connected, the MAU interface circuits shall be SELV circuits. This requirement applies whether the MAU is free-standing or is integrated with the DTE or with another function.
- There is no safety requirement to connect the screen (if any) of the trunk cable to earth. However, where this is required for EMC or other reasons it shall be connected to the protective earth of the building by one of the following methods:
 - . directly, at any single point on any one LAN segment; or
 - . directly, at each MAU and at appropriate intervals for EMC on untapped trunk cable; or
 - . indirectly, by voltage limiting devices which limit the voltage to 1500 V or less, at any one or more points on the LAN.

NOTE 3

In order to comply with the requirements for high-integrity earths one earth conductor of a multiple earth connected LAN has to be permanent and comply with Publication IEC 364-4-47, Section 471.

- Circuit separation shall be provided in the MAU between the DTE interface circuits and the trunk cable connectors, and between the drop cable screen and the trunk cable screen (if any).
- It shall not be possible to touch any metalwork connected to the trunk cable screen or signal conductors with the test finger (ECMA-57, Fig. 1).
- Capacitors connected across safety separation for EMC or other purposes shall be limited in value to 0,01 uF per MAU and shall comply with the requirements of IEC Publication 384 for Class Y capacitors.

Insulation provided to comply with the requirements of 6.2.2 (other than capacitors) shall withstand one of the following electric strength tests:

- 2000 V rms at 50 Hz to 60 Hz for 1 minute (see test procedure in ECMA-57, 5.3.3)
- 3000 V dc for 1 minute (see test procedure in ECMA-57, 5.3.3)
- 3200 V impulse test in accordance with Appendix A.

6.3 Additional Requirements

These requirements apply to LAN with sections of trunk cable between buildings.

Unless the inter-building section of a trunk cable uses fiber optics or other non-conducting technology, the design shall comply with the following requirements. At each point where the inter-building section of the trunk cable enters a building, lightning arrestors shall be connected between signal conductors, and from each signal conductor and the cable screen (if any) to protective earth. Such lightning arrestors shall be so designed and installed that they limit the voltage in the indoor section of the trunk cable to:

- 400 V peak for a segment which is in situation A, and
- 1500 V peak for a segment which is in situation B.

NOTE 4

A clipped lightning pulse with an amplitude of 400 V is considered in Publication IEC 364, Section 413 as non-hazardous.

Where the screen of the trunk cable is directly earthed, in accordance with 6.2.2, at a building entry point, no lightning arrestor is required between the screen and earth at that point.

NOTE 5

Some lightning arrestors may introduce unacceptable series impedance into the signal circuit.

Where a LAN segment which includes an inter-building section has only one direct earth connection, in accordance with 6.2.2 this should be at one of the building entry points, lightning arrestors being used at other building entry points.

Where the buildings connected by an inter-building section of trunk cable are served by different incoming mains supplies, the lightning arrestors shall be protected from transients due to mains supply faults by fusible links in the trunk cable.

In addition:

- inter-building sections of trunk cable should be installed underground;
- earth connections should have as low an inductance as possible.

7. INSTALLATION

Installation instructions shall be supplied with the trunk cable system and shall call attention to the following points:

- correct choice of hardware for situations A and B;
- rules for joining cable segments, with lightning protection where necessary;
- correct earthing of cable screens (6.2.2);
- it is recommended that the cable and power installation procedures be in compliance with IEC Publication 364 or equivalent local installation regulations;
- care shall be taken when installing the trunk cable to avoid damage to the jacket, and situations such as sharp bends and corners which could cause subsequent damage to the jacket, resulting in short-circuits between the screen and local metalwork such as ducting, plumbing and structural metalwork;
- during installation, exposed parts conductively connected to the trunk cable screen shall be insulated to prevent accidental contact with local metalwork;
- it is important to keep accurate and up-to-date records of the network configuration and earthing arrangements so that the requirements can be assured when re-configuration is undertaken;
- where possible, trunk cable runs should not coincide with the paths of lightning conductors;
- trunk cables should preferably be separated from the outside surfaces of buildings, especially roofs;
- earth conductors used as the reference for protection shall be as short as possible and of low inductance (i.e. wide);
- the inductance of the trunk cable entering a building may be increased by coiling (with spaced turns) to obtain further reduction of pulse current, or other filtering methods employed, such as ferrite rings.

8. MAINTENANCE AND NETWORK MODIFICATION

Unless the network is specifically designed for user installation, maintenance instructions and, where relevant, user instructions, shall call attention to the following points. These are concerned with minimizing any risk to maintenance personnel arising from unusual voltages which may occasionally exist on the trunk cable screen when it is earthed at a remote point.

When work (e.g. addition of an MAU, or cable re-routing) is necessary on a trunk cable which has been installed and earthed in accordance with this Technical Report:

- the work should be carried out by qualified electricians or other suitably trained personnel;
- no work should be undertaken while there is a likelihood of an inter-building section of the cable being struck by lightning;
- prior to work on the cable, a check should be made on the voltage existing between the cable screen and the earth.

- If it exceeds 30 V rms this indicates an electrical fault which should first be investigated;
- either the screen of the trunk cable should be temporarily earthed locally in two places, one each side of the intended cut or disconnection, or these two places should be joined by a temporary strap, the temporary connection in either case having a current-carrying capacity at least equal to that of the cable screen and being removed after normal continuity is restored;
 - personnel should not contact the trunk cable screen and any locally earthed part simultaneously unless the screen has been earthed locally.

It should be noted that normal operation of the network is liable to be disturbed by these operations.

APPENDIX A

IMPULSE TEST

Electric strength test using 10 impulses having the peak voltage specified, applied at intervals of not less than 1 s, the polarity being reversed after each impulse. The waveform shall be 1,2/50 us (see IEC Publication 60). After application of the impulses, the part under test shall have a resistance of at least 2 MOhm, measured at 500 V dc.

NOTE

The following equivalence between impulse tests and tests using dc or 50/60 rms ac test voltages applied for 1 minute, is from document IEC 28 A (Sec) 18 and is therefore provisional.

<u>Impulse</u>	<u>AC</u>	<u>DC</u>
3200 V	2000 V	3000 V

APPENDIX B

TYPICAL CONFIGURATION



