THE SOCIALIST REPUBLIC OF VIETNAM

QCVN 9:2010/BTTTT

National Technical Regulation
on earthing of telecommunication stations

(This English version is for reference only)

HANOI - 2010

Content

Foreword

QCVN 9:2010/BTTTT was prepared on basis of revision and transferring of TCN 68-173:1998 "Earthing of telecommunication buildings- Technical requirements " with the enclosure of Decision No. 571/1999/QD-TCBD dated August, 23th 1999 by the Minister of the Posts, Telecommunications Ministry (now as Ministry of Information and Communications).

Technical regulations and test methods of QCVN 9:2010/BTTTT are in accordance with recommendation K. 27 of world telecom union (ITU-T) and standard 300 253 of European Telecommunication Standard Institute (ETSI)

QCVN 9:2010/BTTTT was prepared by the Posts and Telecommunications Technology Institute, submitted by Department of Science and Technology and promulgated with Circular No. 18/2010/TT-BTTTT dated July 30th, 2010 by the Minister of Information and Communications.

National technical regulation on earthing of telecommunication stations

1. GENERAL REGULATION

1.1 Scope

This national technical regulation specifies requirements on earthing of telecommunication stations which contain telecommunication equipments: switches, flow line transmission equipment, radio broadcast transmission equipment (radio and television), domestic long distance microwave devices, public land base mobile telecommunication stations (BTS).

1.2. Objectives of application

This regulation applies to the enterprises which setup telecommunication network infrastructure and the agencies, organizations and individuals with activities related to telecommunication network settings in Viet Nam.

1.3. Interpretation

1.3.1. Ground conductor

The cable from the ground to the main earthing terminal.

1.3.2 Telecommunication plant

Constructions include passive telecommunication infrastructure (home, station, columns, and tank) and installed network equipment.

1.3.3 Single point connection (SPC)

The unique location in an isolated bonding network where a connection is made to the common bonding network. It must have sufficient size to accommodate the connection of conductors

1.3.4 Soil resistivity

Resistivity of a cube soil with volume 1 m^3 when electricity flows from the side to opposite side of the soil.

1.3.5 Earthing resistance

Resistance for current spread from the earth electrode, including wiring of electrodes

1.3.6 Telecommunication system

One or more network devices placed in telecommunication buildings to provide telecommunications services, including equipments and information technology systems in the telecommunications network of enterprise.

1.3.7 Radio communication system

Information systems for transmission medium is radio wave

1.3.8 Grounding system

Include the grounding and ground conductor.

1.3.9 System block

All the equipment whose frames and associated conductive parts form a defined bonding network

1.3.10 Equipotential bonding

Electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential

1.3.11 Bonding network (BN)

A set of interconnected conductive structures that provides an electromagnetic shield for electronic systems and personnel

1.3.12 Common bonding network

It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network in a telecommunications building

1.3.13 Isolated bonding network (IBN)

A bonding network that has a single point of connection ("SPC") to either the common bonding network or another isolated bonding network. All IBNs considered here will have a connection to earth via the SPC.

1.3.14 Mesh – Isolated Bonding Network (M-IBN)

A type of IBN in which the components of the IBN are interconnected to form a mesh-like structure.

1.3.15 Star – Isolated Bonding Network (S-IBN)

A type of IBN in which the components of the IBN are interconnected to form a star-like structure

1.3.16 Mesh Bonding Network (MBN)

A bonding network in which all associated equipment frames, racks and cabinets, and usually, the d.c. power return conductor, are bonded to common bonding network (CBN) at multiple points

1.3.17 Insulation Terrestrial

Low voltage networks with neutral point isolated ground but equipment coatings are connected to earthing of independent protection.

1.3.18 Terrestrial Neutral

As the low voltage network with neutral point directly grounded

1.3.19 Terrestrial Neutral Combined

As terrestrial neutral with protection and common neutral wire (PEN). The exposed conductive parts (equipment coating) are connected to wire of protective earth network (PEN).

1.3.20 Terrestrial Neutral Separated

As terrestrial neutral with protection and separate neutral wire. The exposed conductive parts (equipment coating) are connected to the protective earth wire (PE). Protective earth wire (PE) can be metal coating of the power cables or a separate wire.

1.3.21 Terrestrial Neutral Combined and Separated

As TN network in which the top of network with protection and common neutral wire, but the back of network with protection and separate neutral wire.

1.3.22 Terrestrial

Low voltage network with neutral wire directly grounded but coating of electric equipments are connected to independent protective earth.

1.3.23 Grounding network (GN)

A grounding system or bonding multiple grounding systems.

1.3.24 Isolated d.c return (d.c-I)

A d.c. power system in which the return conductor has a single point connection to a bonding network

1.3.25 Common d.c return (d.c-C)

A d.c**.** power system in which the return conductor is connected to the surrounding BN at many locations**.**

1.3.26 Telecom building

As a house in which puts telecommunications equipment system

1.3.27 Radio wave (RW)

Electromagnetic waves travel through space specified frequency less than 3000 GHz.

1.3.28 Main earthing Terminal (MET)

A nickel-plated copper plate is drilled, installed on a bakelite and fixed on the wall for the connection of protective conductors, including equipotential bonding conductors and conductors for functional earthing

1.3.29 Telecom earth

Grounding the equipment parts in the working circuit performing the function of standard voltage of the circuit.

1.3.30 Protective earth

Grounding the parts not in working circuit to reduce hazard voltage for the protected device to allowable values. Protective earth is connected the metal parts of the electrical equipment (support, equipment coating), connected to the protective device in the building.

1.3.31 Lighting earth

Grounding the protective parts, lightning conductors ... or the metal structure of the buildings and long column.

1.3.32 Ground group

One or more earth electrodes are linked electric together and directly buried in soil or contacted soil.

1.3.33 Telecommunication station

Area consists of one or more buildings that contain telecommunications equipment, antenna mast and

other auxiliary equipments to provide telecommunications services. Telecommunication building does not include houses and subscriber equipments

1.3.34 Ring bonding – bus

Connection path with closed loop form

2. TECHNICAL REGULATION

2.1 Regulations on earthing for telecommunication equipment system

2.1.1 General requirements

a) The telecommunication equipment system, wireless communications, optical transmission equipment, fiber optic link, metal cable link and protection parts, metal structures of the building and long column must be telecom earth, protective earth and lightning earth.

b) When building a grounding system, can perform the ground groups with private functions, include:

- Telecom earth group;
- Protective earth group;
- Lightning earth group.

This ground group then must be connected an equipotential bonding.

2.1.2. Grounding for telecommunication equipment system

a) Telecom earth:

- Telecom earth for telecommunications equipment system is connected with:

+ Anode of the power supply;

+ Earthed point of the protective device in the building;

+ Metallic rack of the equipments in the building.

- Telecom earth resistance values of the telecommunication equipment systems comply with manufacture's standards.

b) Protective earth

- Protective earth for telecommunication equipment system is connected with:

+ Coating of electrical equipment;

+ Metal coating of inter-system cable;

+ Metal structure of the building,

+ Earthed point of the protective equipment outside the building.

- The value of protective earth resistance for telecommunication equipment systems not exceeding 10 Ω

c) Lightning earth:

DC resistance value of lightning earth for telecommunication equipment not more than 10 Ω

2.1.3. Grounding for radio communication system

a) Telecom earth:

- Telecom earth for radio communication system is connected to:

+ Positive pole of DC power supplies;

+ Antenna, closed circuit for radio transceiver signal;

+ Earthed point of protection equipment for coaxial cable (non-bracket cable, antenna);

+ Rack of radio equipment.

- Telecom earth resistance value of the radio communication systems comply with manufacture's standards.

b) Protective earth

- Protective earth for wireless communication system must be connected to the machine rack of electrical equipment.

- Protective earth resistance value depends on the power of electrical equipment and not more than values specified in Table 1.

Table 1- The value of protective earth resistance for radio communication system

Power of electrical equipment, kW	≥ 50	>50
Protective earth resistance value, Ω	4	10

c) Lighting earth

- Antenna mast and antenna equipment must be connected to grounding system.

- The earthed points outside the building should be connected directly to the grounding system.

- The antenna towers with metal which body of tower as lightning conductor must perform continuous projection welding on electric of the column.

- DC resistance value of lightning earth is not greater than 10Ω

2.1.4. Grounding for optical transmission equipment

a) Grounding for terminal

- Terminals are put together with switch system shared grounding system of the switch system.

- Terminals are installed independently must be equipped with a grounding system to use both two functions: telecom earth and protective earth. The grounding resistance value of this grounding system must comply with the manufacturer's standard but not more than 10 Ω

b) Grounding for mediation devices

- For mediation devices are supplied power on-site or remotely by means of wire - wire, it is necessary to equip a grounding system with both two functions: Telecom earth and protective earth with grounding resistance comply with the manufacturer's standard but not more than 10 Ω

- For mediation devices are supplied power remotely by means of wire – wire, , it is necessary to equip a grounding system with both two functions: Telecom earth and protective earth with grounding resistance comply with the manufacturer's standard but not more than 4 Ω

2.2. Regulation on earthing for telecommunication building

2.2.1. General requirements

a) Grounding network for telecommunication building must be a single grounding system, or equipotential bonding of independent grounding system with different functions.

b) The single grounding system is used when distance between the telecommunication building and the antenna mast not less than or equal to 15 m.

c) Equipotential bonding of the independent grounding systems with different functions used in the following cases:

- Distance between antenna mast and the building is greater than 15
- Lightning earth system of the building has been built (made in the building class).

d) Grounding resistance value of grounding network for telecommunication building must be less than the smallest value of telecom grounding resistance of equipment in the telecommunication building.

2.2.2. Bonding and grounding inside a telecommunication building

a) Grounding network of a telecommunication building must be done according to the configuration as follows:

- It is necessary to build a common bonding network (CBN) on the principles of continuous conduction as a Faraday cage.
- The common bonding network must be connected to the single grounding system of the telecommunications building through the main earthing terminal and bonding wire.

b) The equipment system blocks in the communication building must be grounded by bonding networks (BN). There are three types of the bonding networks:

- Mesh Bonding network (M-BN);
- Mesh – Isolated Bonding network (M-IBN);
- Star – Isolated bonding network (S-IBN);

Use of bonding networks specified as follows:

- Mesh bonding network (M-BN) can be applied to most equipment systems, as equipment without special requirements for limiting leakage currents from CBN network flowing into equipment system blocks and devices used direct current dc-C.
- Mesh – Isolated bonding network (M-IBN) is applied if having the special requirements for limiting leakage currents from CBN network flowing into equipment system blocks and devices used direct current dc-C.

- Star – Isolated bonding network (S-IBN) is applied if having the special requirements for limiting leakage currents from CBN network flowing into equipment system blocks and devices used direct current dc-C.

2.2.3 Common bonding network for new building

Form of common bonding network must ensure as a Faraday cage with continuous conductivity around the entire telecommunications buildings as Figure 1

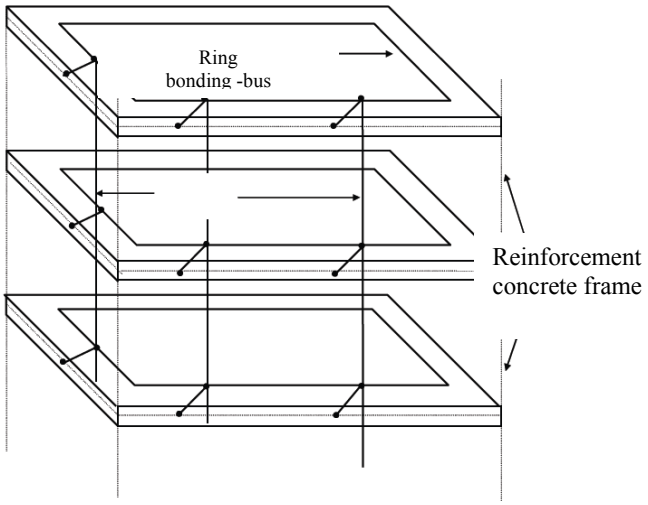


Figure 1: Common bonding network (CBN) inside a telecommunication building

a) Building connection path:

- A closed ring bonding – bus is built around floor or wall at each story of the telecommunication building build. For the 1st floor can be done under the floor at a depth of 0.5 m to 0.7 m. A ring bonding - bus is made by copper cable or copper strips or galvanized steel with a minimum cross section of 50 mm^2 ;

- To link the ring bonding - bus of each story by the vertical bonding wire, distance between the vertical wires is not greater than 5 m. Vertical bonding wire is copper bar or galvanized steel with a minimum cross section of 50 mm^2 ;

- Building the mesh on entire building's floor at the depth of 0.5 m to 0.7 m in round and galvanized steel with cross sections not less than 14 mm^2 , with mesh size of 300 mm x 300 mm or 500 mm x 500 mm (must weld all intersection points of mesh);

- Implementing projection welding of mesh panels with the ring bonding – bus around the floor or around wall.

b) Bonding a reinforcement concrete frame of building structur3

- In case of using reinforcement concrete frame for lightning conductors, it is necessary to weld entire reinforcement concrete frame of building structure at the junctions and intersections.

c) Connection path connected to metallic components of the building such as:

- All lightning conductors of the buildings;
- Entire reinforcement concrete frame of building structure;
- Rack of inter-system cable;
- Conductor pipe, metallic cable conduit.

2.2.4. Common bonding network for existing building

For existing buildings, it is necessary to perform minimum common bonding network as below regulations:

a) Building connection path:

- A closed ring bonding – bus must be built around wall at each story of the communication building. The ring bonding – bus is made by lead coated copper cable or copper strip with a minimum cross section of 50 mm^2 , or galvanized steel with minimum cross section 100 mm^2
- To link the ring bonding - bus of each story by a vertical bonding wire, distance between the vertical wires is not greater than 5 m. The vertical bonding wire is copper bar or galvanized steel with minimum cross section of 50 mm^2 ;

b) Connecting the ring bonding – bus with the metallic components of the building such as:

- All lightning conductors of the buildings;
- Each story of the reinforced concrete frame, with a number of concrete beams can be penetrated
- Rack of inter-system cable;
- Conductor pipe, metallic cable conduit.

c) Building grounding ring around the telecommunication buildings:

- At least one metallic ring buried underground around the building supplementing the grounding electrode and connecting with the telecom earth group.

2.2.5. Mesh bonding network (M-BN)

Mesh bonding network (M-BN) is built according to the following requirements:

a) Building bonding mat.

- Building a bonding mat with size is large enough to contain the equipments and cable racks are located in M-BN system block placed under equipment floor.
- The bonding mats are made of uncoated copper wire (strip) or galvanized steel wire (strip) with cross section larger than 14 mm^2 welded into the mesh.

Mesh size in the range:

20 cm x 20 cm;

30 cm x 30 cm;

40 cm x 40 cm;

50 cm x 50 cm.

b) Connecting (welding) the bonding mats with CBN network at multiple points (the more multiple points connected with CBN network, the better) with bare copper or galvanized steel with cross sections larger than 14 mm^2.

c) Connecting the conductive parts of telecommunication equipment system block with the bonding mat.

- Telecommunications equipment with electronic circuit provided a common metal coating creating standard voltage plan covering the surface of the printed circuit board. All standard voltage plans are connected together and connected to the equipment racks or with the metal coating of adjacent cable system (located in M-BN block) with the copper wire with cross section larger than 14 mm^2.
- Connecting coatings, equipment racks, metal coating of cable with the bonding mat by copper wire (strip) by the shortest route. Cross section of the connecting wire is defined in Table 5.

Table 5 - Regulations for cross section of connecting wire of cable's metallic components and equipment system with the bonding mat

Sequence Number	Name of connecting wire	Minimum cross section, mm^2
1	Connecting wire of metal coating of subscribe cable (buried)	14
2	Connecting wire of metal coating of subscribe cable (hanging)	14
3	Connecting wire of subscriber protection device on MDF filter assessor	14
4	Connecting wire of AC protection device	35
5	Connecting wire of battery	14
6	Connecting wire of metallic part of adapter rack	14
7	Connecting wire of converter rack	14
8	Connecting wire of metallic parts of exchange rack	14
9	Connecting wire of metallic parts of filter assessor	14
10	Connecting wire of cable support	14

2.2.6. Mesh – isolated bonding network (M-IBN)

Mesh – isolated bonding network (M-IBN) is built according to the following requirements:

a) Building the bonding mat insolated perfectly with the surrounding CBN. The mat size is large enough to accommodate the equipments and cabling racks in M-IBN system block.

- The bonding mat is made of copper wire (strip) or the galvanized iron wire (strip) with cross section must be greater than 14 mm^2;
- Meshes must be welded together.

- Mesh size as small as possible, within:

30 cm x 30 cm, 40 cm x 40 cm, 50 cm x 50 cm.

b) Connecting the cable rack, the equipment rack with the bonding mat.

The cable racks, the equipment racks in the M-IBN system block must be connected to the bonding mats at many points by connecting wire with size as shown in Table 5.

c) Connecting the mesh – isolated bonding network (M-IBN) with common bonding network (CBN).

- Connecting M-IBN network with CBN network must be made within single point connection (SPC);
- The single point connection (SPC) must be put in the vicinity of the M-IBN system block. The single point connection is copper wire along the edges of the bonding mat with size 2000 mm x 20 mm x 2 mm. Copper wires are soldered to the edge of bonding mat.
- Connecting the bonding path of CBN network to the SPC by copper wire with cross section is larger than 14mm^2.

2.2.7. Star – isolated bonding network (S-IBN)

Star – isolated bonding network (S-IBN) is built according to the following requirements:

a) Bonding the metallic components of the S-IBN system block

- Cable support in the S-IBN system blocks are connected together and connected to the CBN in single point connection bus bar (SPCB) using connecting wire with cross section is larger than 14 mm^2 (with sheathed multi fiber cable);
- The cabins, the equipment racks in the S-IBN system block completely isolated with CBN; they are connected together and connected to the CBN in single point connection bar using connecting wire with cross section is larger than 14 mm^2 (with sheathed multi fiber cable);

b) Connecting star – isolated bonding network (S-IBN) with common bonding network (CBN) in single point connection bus-bar (SPCB).

- The single point connection bus bar is a copper bar with size in the following range: Length not more than 2000 mm, width from 50 to 100 mm, thickness not less than 3 mm and was fastened to a proper position to length of bonding wire is the smallest.

c) When linking S-IBN network, it is necessary to check and maintain regularly to ensure the absolute isolation.

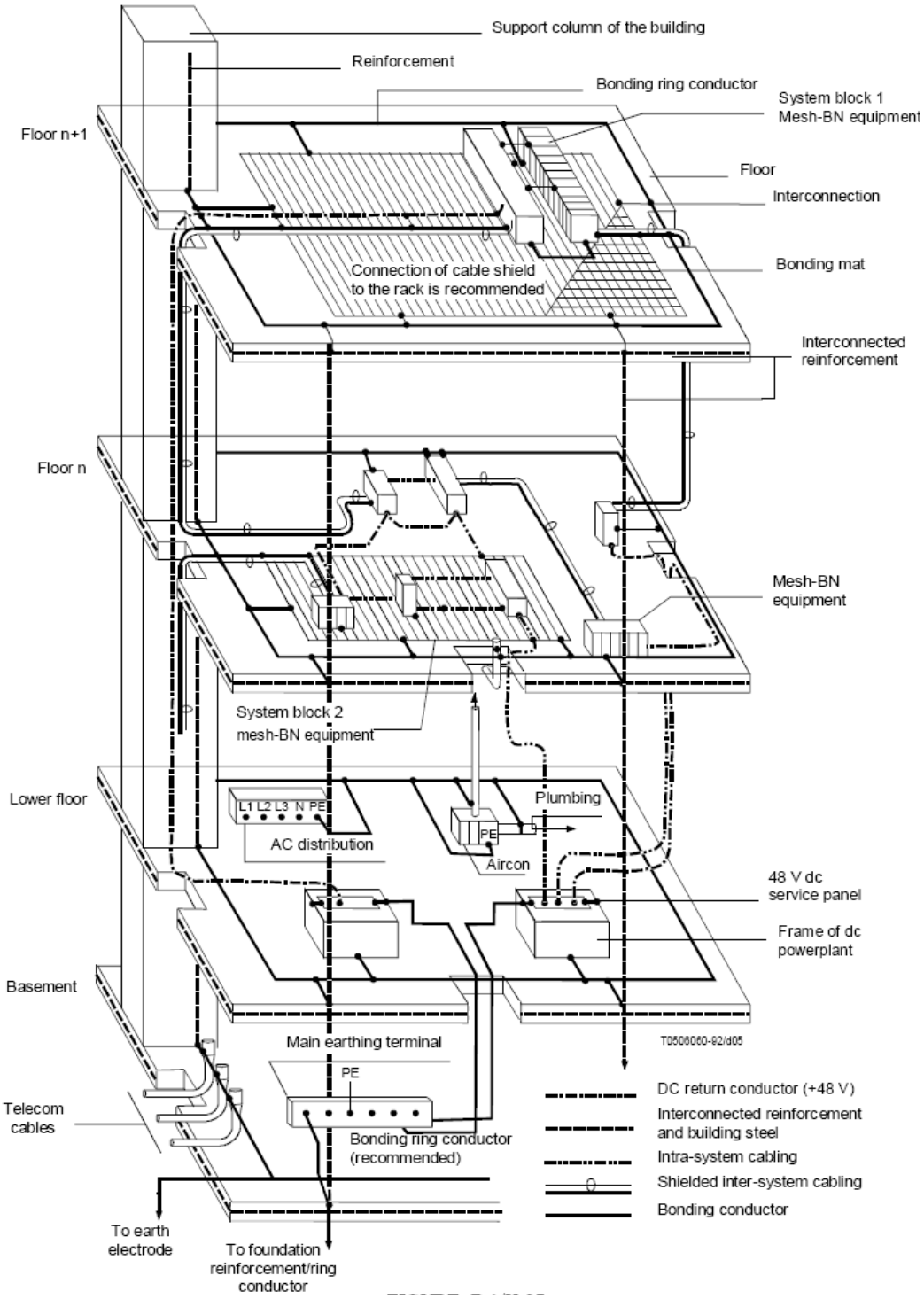


Figure 2: Mesh – bonding network (M-BN) inside a telecommunication building

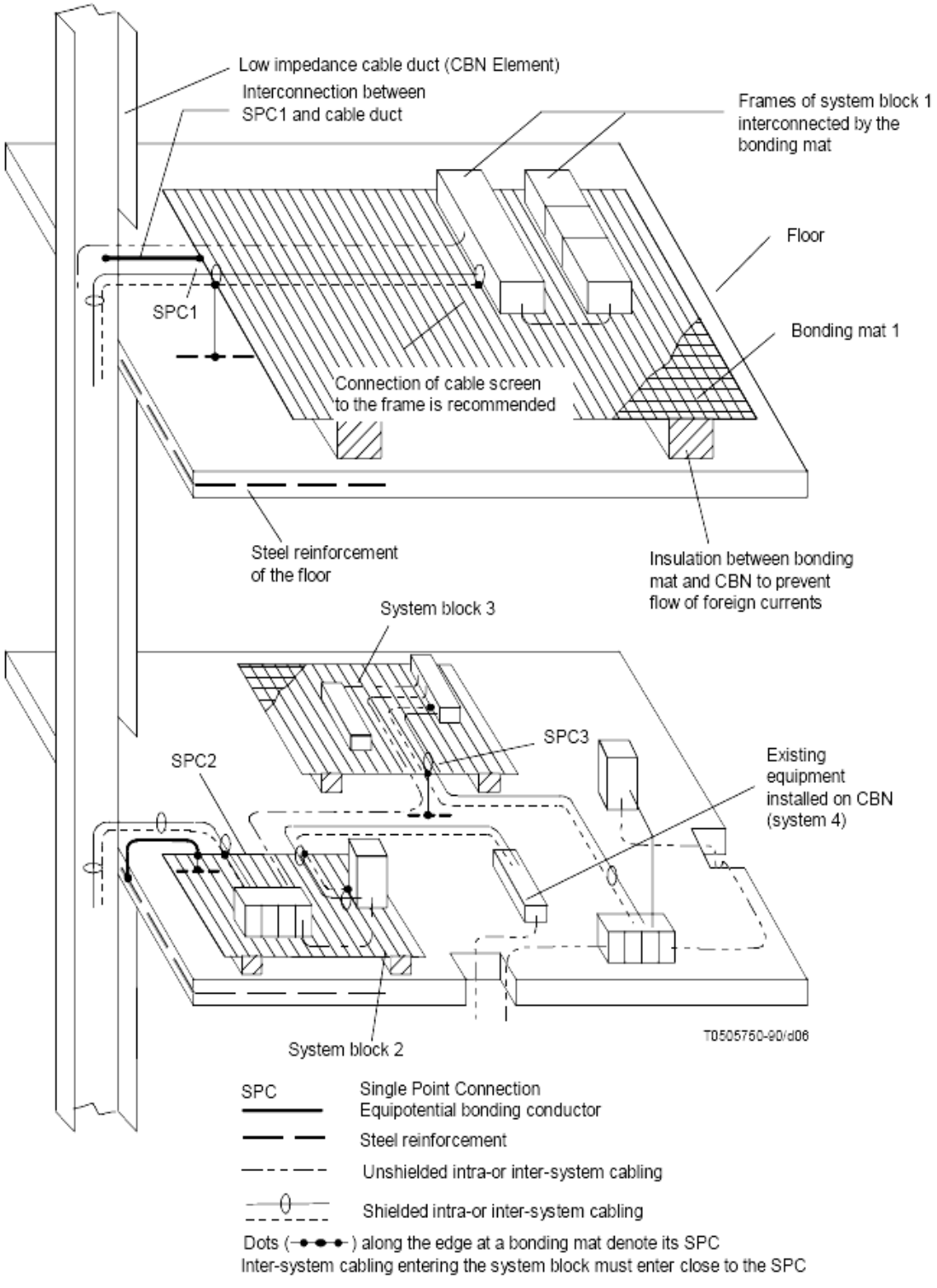


Figure 3: Mesh – Isolated bonding network (M-IBN) inside a telecommunication building

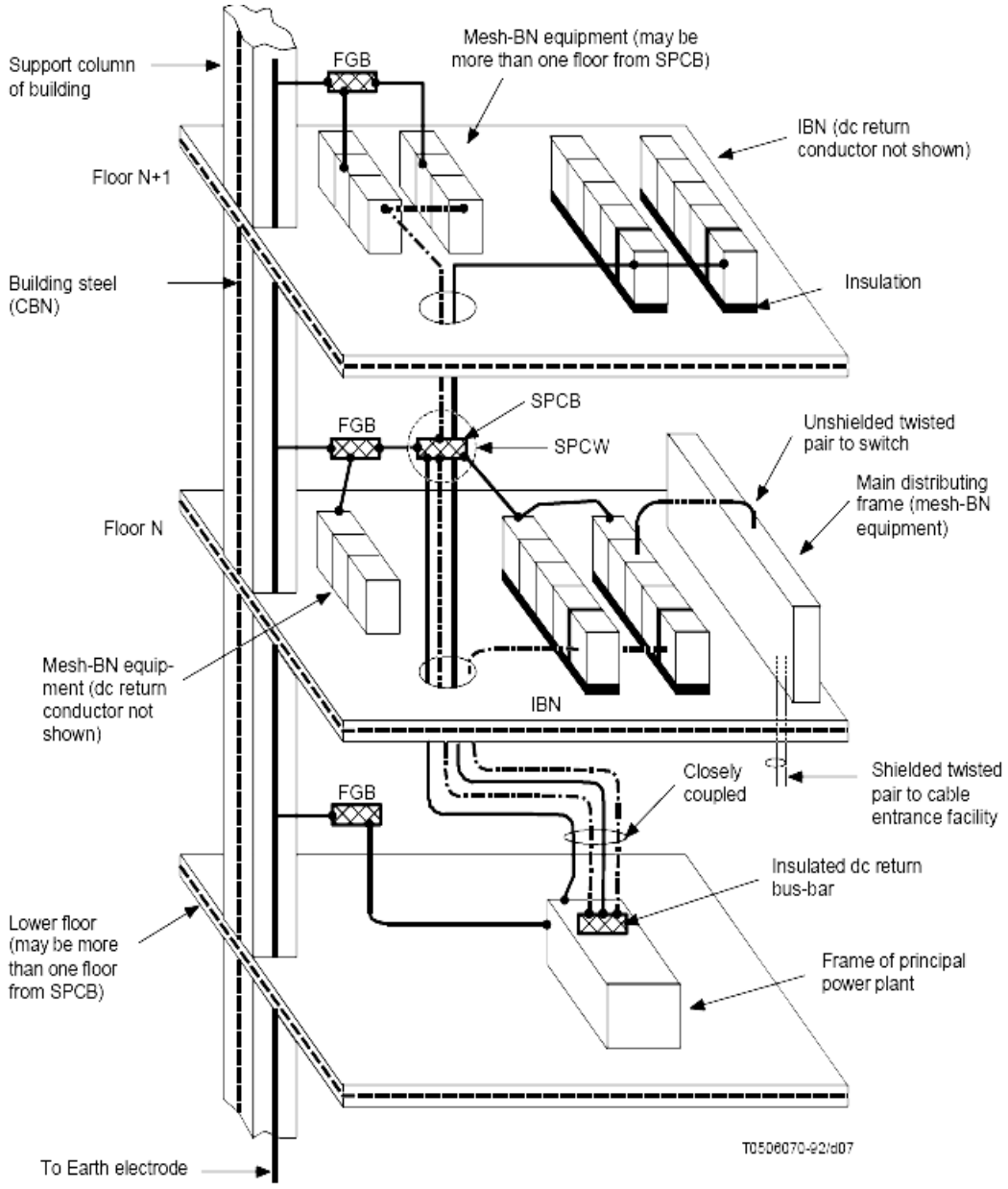


Figure 4: Star – Isolated bonding network (S-IBN) inside a telecommunication building

2.2.8. Requirements for main earthing terminal

Each telecommunication building is equipped a main earthing terminal. The main earthing terminal must satisfy the following requirements:

a) Set nearly AC source and an entrances of the telecommunication cable (the nearer the better)

b) Connecting directly to the following parts:

- Grounding group of the telecommunications building through ground conductor;
- Protection path;
- Metal coating of all inter-system cables;
- CBN network;
- Anode of DC source;
- Machines for system test.

c) Specification, size of the earthing terminal

- Main earthing terminal must be made of nickel-plated copper.
- All bolts, nuts, washers used to connect the cable must be the nickel-plated copper.

2.2.9. Technical requirements of ground conductor

Ground conductor must meet the following requirements:

- Length of ground conductor is not greater than 50m, in special cases the length of ground conductor can be increased but DC resistance of the ground conductor must be less than or equal to 0.01 Ω
- Cross section of the ground conductor depends on total of DC of the equipments in the telecommunication building and not less than 100 mm^2.

2.3. Regulations on equipotential bonding of independent grounding system

2.3.1. General requirements

a) Independent earthing system can perform the different grounding functions as follows:

+ Lightning earth use only for the antenna mast;
+ Telecom earth and protective earth for the telecommunication equipments;
+Lightning earth for the buildings.

The independent grounding system must be linked and performed a potential equilibrium in the building, between the building and the antenna mast.

b) Telecom and protective earth for telecommunication equipment

Telecom and protective earth for telecommunication equipment shall be as specified in section 2.2.

c) Lightning earth for the building

Resistance value of lighting earth for the building no larger than 10 Ω.

d) Lighting earth for antenna mast

Lightning grounding system for antenna mast must be constructed in place around plinth and its resistance value must be less than minimum earthing resistance value of the antenna mast.

2.3.2. Bonding independent grounding system

Grounding systems with independent functions should be performed potential equilibrium at parts buried underground according to one of the following methods.

a) Method 1:

Bonding the grounding systems with different functions in a telecommunications building by a voltage leveled grid. The voltage leveled grid is metallic grid that buried underground as the following order:

+ The voltage leveled grid should be constructed at the same time with grounding systems

+ Scooping on the necessary area with depth from 0.5 to 0.7 m;

+ On the ground (soil was dug), put copper wire or galvanized steel wire with diameter from 3mm to 5mm or copper or iron strips of size 15 mm x 10 mm or 10 mm x 2 mm to form a grid of size 30 cm x 30 cm or 50 cm x 50 cm;

+ All meshes are welded to form one continuous conductive grid;

+ Bonding (welded) the leveled grid to grounding systems at the appropriate positions (wires are the shortest, not more than 5 m) by bare copper wire with cross section is greater than or equal to 14 mm^2;

+ Land fin and tighten

b) Method 2:

Bonding the grounding systems in a telecommunications building by means of direct connection The grounding systems are linked together by copper cable or bare copper wire with cross section greater than or equal to 50 mm^2 buried underground deeply from 0.5 to 0.7 m.

If using stranded copper cable, diameter of a fiber is not less than 1 mm.

c) Method 3:

Bonding the grounding systems in a communication building by connecting directly the earthing terminals together or the ground conductor of the independent grounding system is connected with main earthing terminal of the building

2.4. Regulations on electricity grounding in telecommunications building

2.4.1. General requirements

- The specific step-down buildings supply for the equipments in the telecommunications building must be done neutral earthing according to technical regulations, technical regulations that obligate applying on electric power. The minimum distance between the grounding system and grounding network of the telecommunication building is 30m

- If the distance between the ground group of electric power and grounding network of telecommunication buildings of less than 30 m, it is necessary to bond the ground group of electric power with grounding network of the telecommunication building through equipotential valve.

- In the telecommunication building, AC power systems must use TN-S network. Three-phase power system must be the system of five wires (L1, L2, L3, N, PE), in which: L1, L2, L3 is phase conductor, N is the neutral conductor, PE is guard wire. PE guard wire is connected to the main grounding terminal. PE guard wire and N neutral conductor haven't common terminal.

- Specific generator of the telecommunication building must be grounded to protect cabinet frame. The resistance value of protective earth not greater than 10 Ω.

2.4.2. Requirements on supply connector for the telecommunication buildings

a) If the outdoor ac power distribution network is TN-S network then A.C power feed circuit in the building is connected as in the diagram Figure 5.a:

- Guard conductor (PE) must be connected to the main earthing terminal;

- Neutral wire (N) is not connected to the main earthing terminal.

b) If the outdoor ac power distribution network is TN-C network then A.C power feed circuit in the building is connected as in the diagram Figure 5.b:

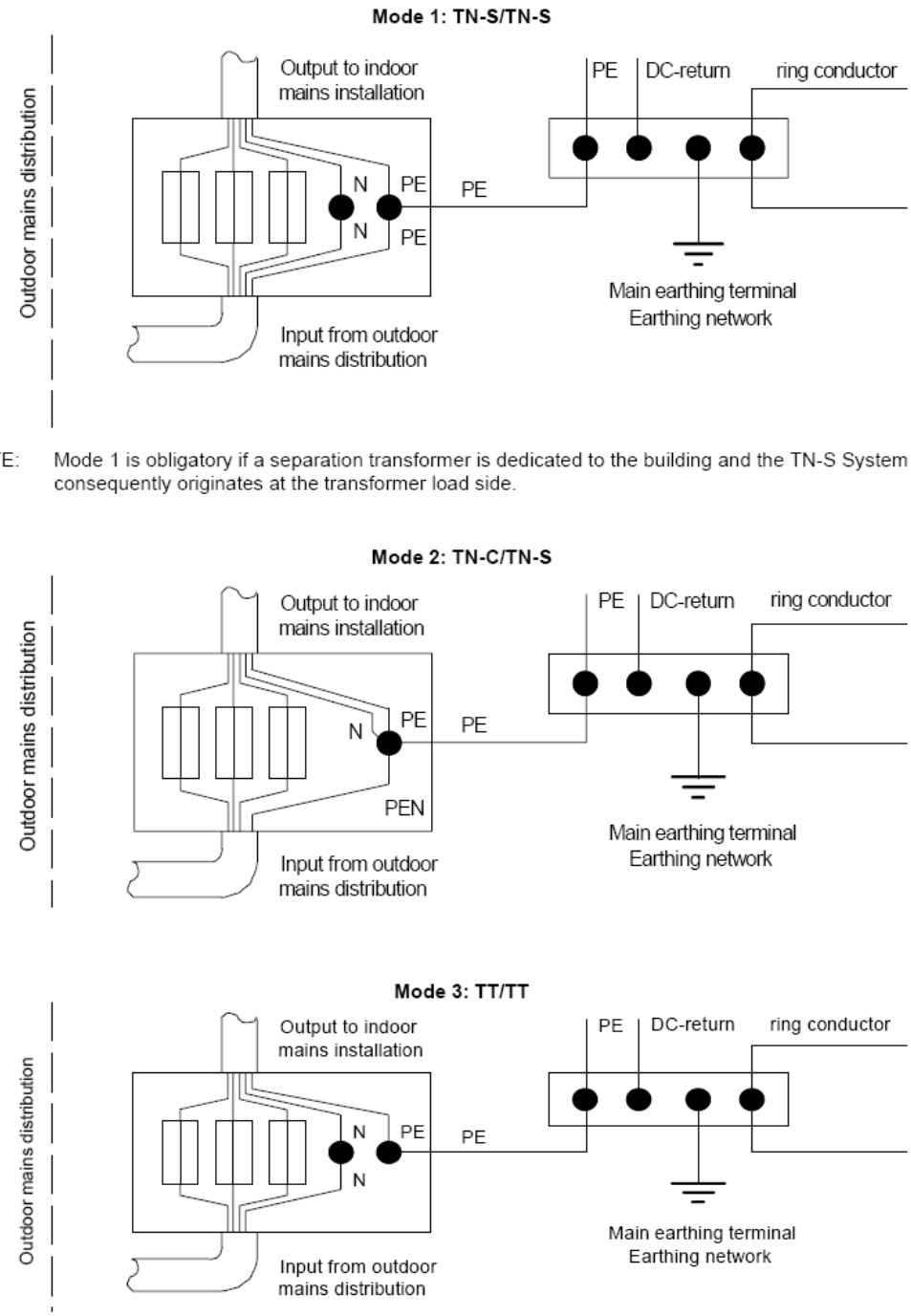
- PEN conductor is only connected to the main earthing terminal.

- From the main earthing terminal provides a PE guard conductor.

c) If the outdoor ac power distribution network is the 4 wire system (IT or TT) then A.C power feed circuit in the building is connected as in the diagram Figure 5.c:

- PE guard conductors are carried out from grounding network through the main earthing terminal

d) If the outdoor ac power distribution network is the 4-wire system (IT or TT) and use isolation transformer for the building then A.C power feed circuit in the building is connected as in the diagram Figure 5.a:



NOTE: Mode 1 is obligatory if a separation transformer is dedicated to the building and the TN-S System consequently originates at the transformer load side.

Figure 5 – Connection method of AC power supply network for a telecommunication building

3. MANAGEMENT REGULATIONS

The telecommunication building in the scope of this regulation shall comply with the requirements specified in regulation.

4. RESPONSIBILITIES OF ORGANIZATIONS, INDIVIDUALS

4.1. Businesses set up telecommunication infrastructure with the telecommunications building in the scope of this regulation shall ensure that the communication building in accordance with the regulation on design, installation, operation and maintenance.

4.2. Businesses set up telecommunication infrastructure with the telecommunications building in the scope of this regulation shall be published regulation conformity the according to the regulations and guidance of the Ministry of Information and Communications, and it is necessary to inspect regularly and irregularly by state management under the current regulations.

5. IMPLEMENTATION ORGANIZATION

5.1. Quality Management Department of Information Technology and communication and Department of Information and communication have responsibility for instruction, organization management of telecommunication buildings accordance with this Regulation

5.2. This Regulation is replaced for Standard TCN 68-141:1999 (1st revision), "Grounding for telecommunication projects - Technical Requirements".

5.3. In case there are any modifications, supplementations or replacements for regulation shown in this Regulation, the regulation in new version shall be applied.

ANNEX A

(Normative)

Method of measurement for earthing resistance

A.1 Measurement conditions for earthing resistance

It is necessary to test, check earthing resistance of a grounding system in the following cases:

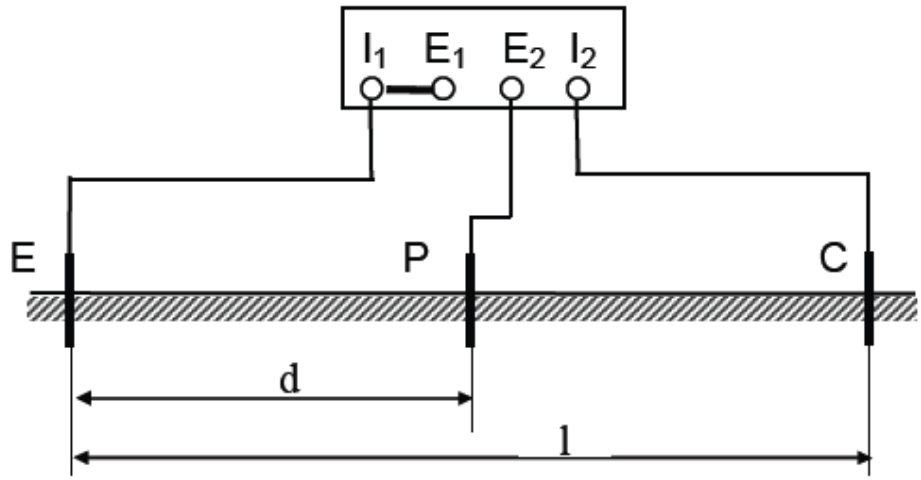
- After installing or repairing, maintaining of the grounding systems;
- Checking and testing periodically or check unexpectedly when incidents.
- There is a change, invasive grounding system components.

A.2. Methods of measurement for the earthing resistance

Check the earthing resistance of the grounding system is done by the earthing resistance meter with 3 electrodes or 4 electrodes.

Testing diagram of the earthing resistance is shown in Figure A.1.

To measure the earthing resistance exactly:



E connected to measured grounding group

P,C –Points connected to test electrode

Figure A.1 Measuring diagram of earthing resistance

- Transmission frequency of other gauges nx 50 Hz;
- It is necessary to arrange the test electrode (voltage electrodes and current electrodes) outside areas affected by the earth electrode and must ensure the distance from the measured ground to the voltage electrode by 62% the distance from measured ground to the current electrode (in case, measured electrodes arranged in a straight line).

The layout of the test electrode for grounding case is a vertical electrode is shown in Figure A.2 and grounded in a grid or multiple electrodes are shown in Figure A.3.

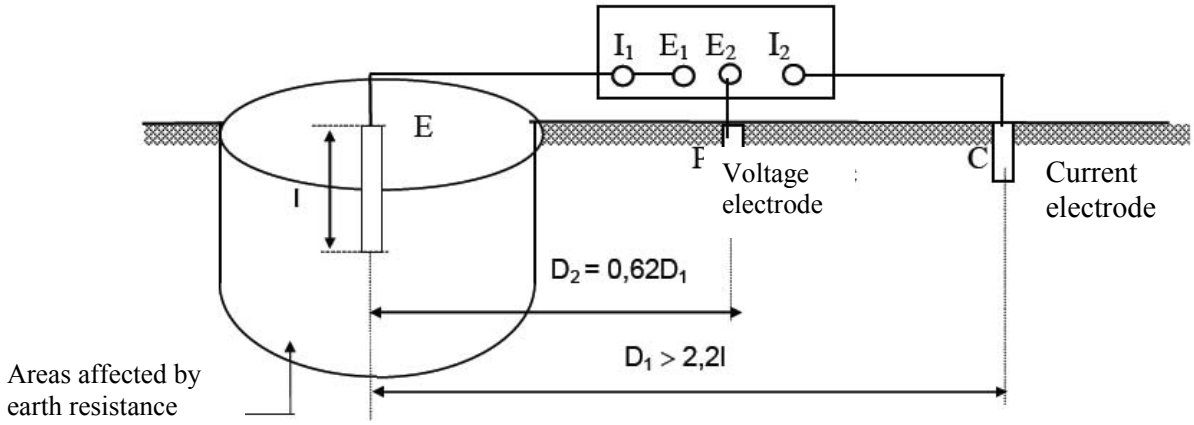


Figure A.2: Metering circuit of earthing resistance of vertical earthing electrode

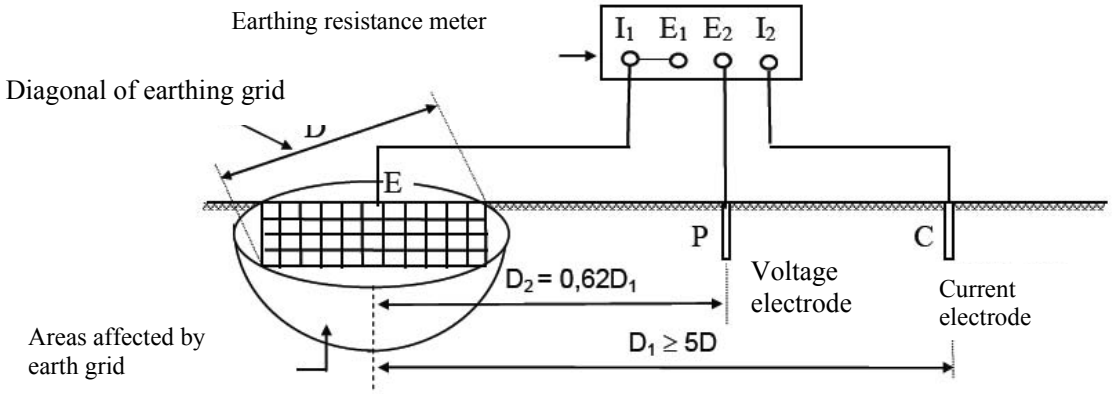


Figure A.3: Metering circuit of earthing resistance of earth grid or earth electrodes

A.3. Acceptance test of grounding system

- After finishing the construction of grounding system, it is necessary to conduct acceptance test. The earthing resistance is measured at the main grounding terminal.

- It is necessary to build and arrange the manholes where the testing earth electrodes, their positions must ensure satisfaction of the provisions as in A.1, A.2.

Manholes must be arranged at many points to use different earthing resistance meters.

A.4. Inspecting, testing and maintaining the grounding system

Inspecting, testing the earthing resistance of the grounding system regularly or irregularly also be taken as acceptance test.