

International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

Series K
Supplement 7
(05/2017)

SERIES K: PROTECTION AGAINST INTERFERENCE

ITU-T K.44 – AC supply configurations

ITU-T K-series Recommendations – Supplement 7

ITU-T



Supplement 7 to ITU-T K-series Recommendations

ITU-T K.44 – AC supply configurations

Summary

Supplement 7 to the ITU-T K-series Recommendations gives an overview of typical alternating current (AC) mains supply configurations known as: IT, TT, TN-C, TN-C-S and TN-S together with wiring practices.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T K Suppl. 7	2017-05-24	5	11.1002/1000/13271

Keywords

AC, IT, mains supply, MEN, PE, PEN, PME, TN-C, TN-C-S, TN-S, TT.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/1830-en>.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this publication, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this publication is voluntary. However, the publication may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the publication is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the publication is required of any party.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this publication may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the publication development process.

As of the date of approval of this publication, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this publication. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

© ITU 2017

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, without the prior written permission of ITU.

Table of Contents

	Page
1 Scope.....	1
2 References.....	1
3 Definitions	1
3.1 Electrical supply system letter classification terms defined in this Supplement.....	1
3.2 AC power distribution wiring terms defined in this Supplement.....	1
4 Abbreviations and acronyms	2
5 Conventions	2
6 Example AC distribution systems	2

Supplement 7 to ITU-T K-series Recommendations

ITU-T K.44 – AC supply configurations

1 Scope

This Supplement defines the AC supply configurations known as: IT, TT, TN-C, TN-C-S and TN-S. Distribution wiring practices used for these AC supply configurations are specified. Circuit examples of six AC distribution systems and their wiring practices are given.

2 References

None.

3 Definitions

3.1 Electrical supply system letter classification terms defined in this Supplement

This Supplement defines the following thermal terms:

3.1.1 IT: Unearthed (isolated) electrical supply system with or without a distributed neutral and the electrical equipment protective earthing is local to the equipment.

3.1.2 multiple earthed neutral (MEN): Neutral wire is earthed multiple times.

3.1.3 protective multiple earthing (PME): PEN wire is earthed multiple times.

3.1.4 protective earthing (PE): Conductor for equipment protective earthing.

3.1.5 protective earthing and neutral (PEN): Conductor that is both the earthed neutral conductor and the protective earthing conductor.

3.1.5 TT: Neutral earthed electrical supply system where the neutral is earthed at the source and the electrical equipment protective earthing is local to the equipment.

3.1.6 TN-C: Neutral earthed electrical supply system where the neutral conductor is combined with the protective earthing conductor.

3.1.7 TN-C-S: Neutral earthed electrical supply system where, in part of the installation, the neutral conductor is also the protective earthing conductor, and in other parts there are separate neutral and protective earthing conductors.

3.1.8 TN-S: Neutral earthed electrical supply system with separate neutral and protective earthing conductors.

3.2 AC power distribution wiring terms defined in this Supplement

This Supplement defines the following conductor terms:

3.2.1 two-wire single-phase AC system: Single-phase AC system comprising two conductors only, between which the load is connected.

NOTE 1 – The two conductors are typically referenced as L (Live) and N (Neutral).

NOTE 2 – Other non-power delivery function wires may be present or combined such as a protective earthing (PE) conductor.

3.2.2 three-wire single-phase AC system: Single-phase AC system comprising two conductors and a neutral wire, the supply being taken from the two outer conductors or from the neutral wire and either outer conductor, the neutral wire carrying only the difference-current.

NOTE 1 – The three conductors are typically referenced as L1 (Live 1), L2 (Live 2) and N (Neutral).

NOTE 2 – Other non-power delivery function wires may be present or combined such as a protective earthing (PE) conductor.

3.2.3 three-wire three-phase AC system: Three-phase AC system comprising three conductors connected to a three-phase supply.

NOTE 1 – The three conductors are typically referenced as L1 (Live 1), L2 (Live 2) and L3 (Live 3).

NOTE 2 – Other non-power delivery function wires may be present such as a protective earthing (PE) conductor.

3.2.4 four-wire three-phase AC system: Three-phase AC system comprising four conductors of which three are connected to a three-phase supply and the fourth to a neutral point in the source of supply.

NOTE 1 – The four conductors are typically referenced as L1 (Live 1), L2 (Live 2), L3 (Live 3) and N (Neutral).

NOTE 2 – Other non-power delivery function wires may be present or combined such as a protective earthing (PE) conductor.

4 Abbreviations and acronyms

This Supplement uses the following abbreviations and acronyms:

AC	Alternating Current
MEN	Multiple Earthed Neutral
PME	Protective Multiple Earthing
PE	Protective Earthing
PEN	Protective Earthing & Neutral

NOTE – IT, TT, TN-C, TN-C-S and TN-S have been defined in clause 3.1 of this Supplement.

5 Conventions

Electrical distribution systems are classification by the combination of two letters.

The first letter indicates the relationship of the power system to earth:

- **T** = direct connection to earth of one point, usually the neutral, in AC systems,
- **I** = all live parts isolated from earth or one point, usually the neutral, connected to earth through an impedance.

The second letter indicates the relationship of the exposed-conductive-parts of the installation to earth:

- **T** = direct electrical connection of exposed-conductive-parts to earth,
- **N** = electrical connection of the exposed-conductive-parts to an earthed point of the power system.

Subsequent letters, if any, indicates the arrangement of neutral and protective conductors:

- **S** = protective earthing and neutral functions provided by separate conductors,
- **C** = protective earthing and neutral functions combined in a single conductor (PEN conductor)

6 Example AC distribution systems

Figures 1 to 6 graphically show the electrical supply system letter classifications and distribution wiring terms.

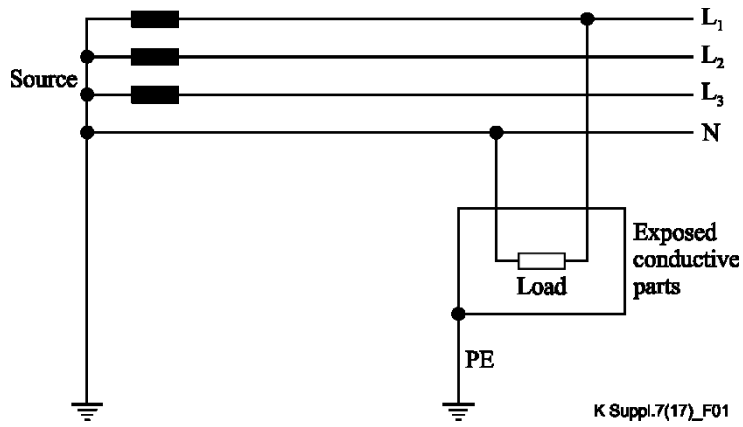


Figure 1 – TT electrical distribution

(Four-wire three-phase AC system at source and two-wire single-phase at load)

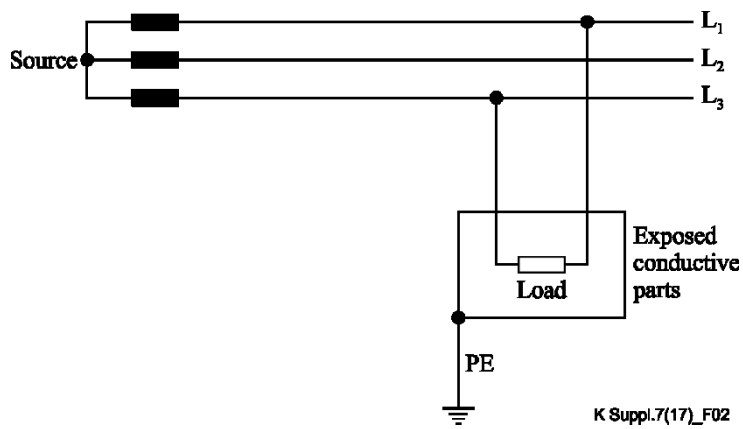


Figure 2 – IT electrical distribution

(Three-wire three-phase AC system at source and two-wire single-phase at load)

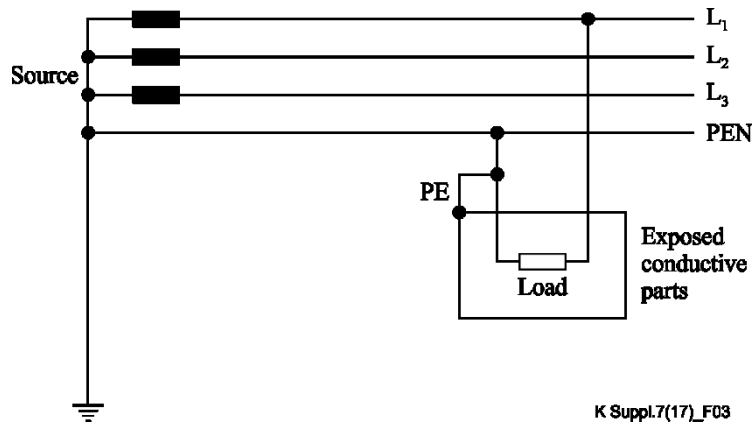


Figure 3 – TN-C electrical distribution

(Four-wire three-phase AC system at source and two-wire single-phase at load with PEN split into PE and N)

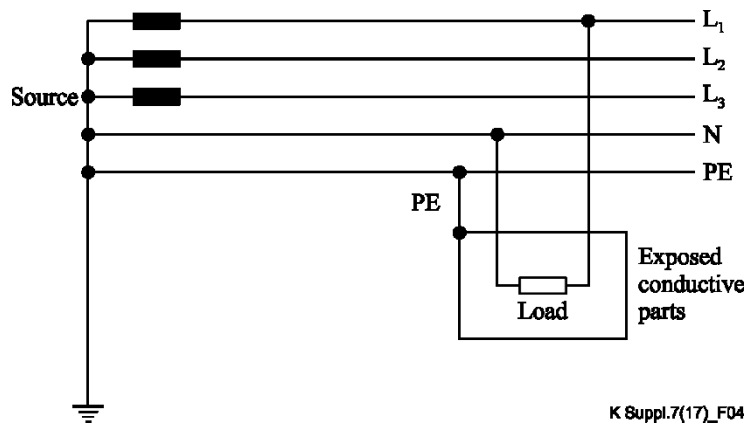


Figure 4 – TN-S electrical distribution

(Four-wire three-phase AC system at source and two-wire single-phase at load with separate PE wire)

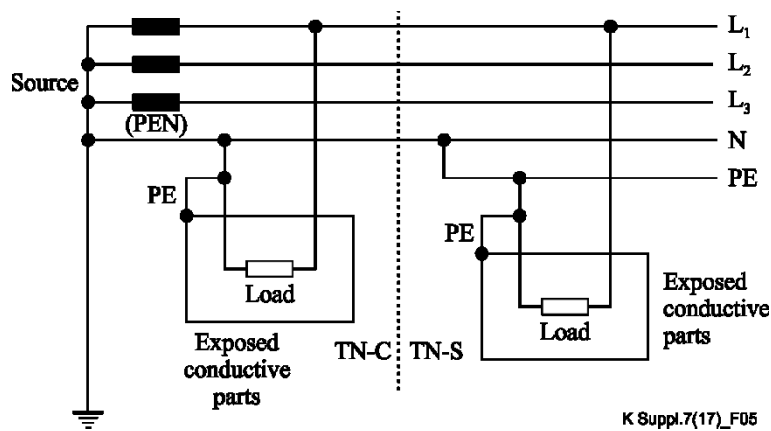


Figure 5 – TN-C-S electrical distribution

(Four-wire three-phase AC system and at source and two-wire single-phase at load with source PEN split into PE and N)

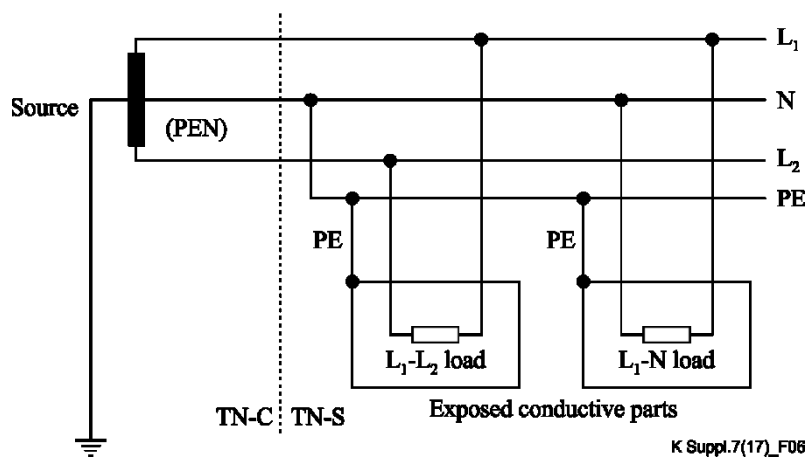


Figure 6 – TN-C-S electrical distribution

(Three-wire single-phase AC system and two-wire single-phase at load with separate PE wire)

Examples of country specific earthing

- United Kingdom – TN-C-S with protective multiple earthing (PME)
- Australia / New Zealand – TN-C-S with multiple earth neutral (MEN)
- USA / Canada – TN-C-S with three-wire single-phase
- Denmark / France / Japan – TT

SERIES OF ITU-T RECOMMENDATIONS

- Series A Organization of the work of ITU-T
- Series D Tariff and accounting principles and international telecommunication/ICT economic and policy issues
- Series E Overall network operation, telephone service, service operation and human factors
- Series F Non-telephone telecommunication services
- Series G Transmission systems and media, digital systems and networks
- Series H Audiovisual and multimedia systems
- Series I Integrated services digital network
- Series J Cable networks and transmission of television, sound programme and other multimedia signals
- Series K Protection against interference**
- Series L Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
- Series M Telecommunication management, including TMN and network maintenance
- Series N Maintenance: international sound programme and television transmission circuits
- Series O Specifications of measuring equipment
- Series P Telephone transmission quality, telephone installations, local line networks
- Series Q Switching and signalling, and associated measurements and tests
- Series R Telegraph transmission
- Series S Telegraph services terminal equipment
- Series T Terminals for telematic services
- Series U Telegraph switching
- Series V Data communication over the telephone network
- Series X Data networks, open system communications and security
- Series Y Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities
- Series Z Languages and general software aspects for telecommunication systems