

Australian/New Zealand Standard™

**Coaxial cable and optical fibre systems
for the RF distribution of digital
television, radio and in-house analog
television signals in single and multiple
dwelling installations**



AS/NZS 1367:2016

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee CT-002, Broadcasting and Related Services. It was approved on behalf of the Council of Standards Australia on 7 April 2016 and by the Standards New Zealand Approval Board on 20 April 2016.
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Australian Digital and Telecommunications Industry Association
Australian Industry Group
Australian Information Industry Association
Australian Subscription Television and Radio Association
CHOICE
Commercial Radio Australia
Community Broadcasting Association of Australia
Consumer Electronics Suppliers Association
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Free TV Australia
Media Access Australia
Ministry of Business, Innovation and Employment, New Zealand
Telecommunications Users Association of New Zealand

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Australian/New Zealand Standard™

Coaxial cable and optical fibre systems for the RF distribution of digital television, radio and in-house analog television signals in single and multiple dwelling installations

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee CT-002, Broadcasting and Related Services, to supersede AS/NZS 1367:2007, *Coaxial cable and optical fibre systems for the RF distribution of analog and digital television and sound signals in single and multiple dwelling installations*.

The objective of this Standard is to provide specifications and requirements for the cabling of range of premises and buildings generally referred to in this Standard as dwellings, for distribution of analog and digital services such as free-to-air TV and radio, subscription or pay TV, or in-house video systems via radio frequency (RF) distribution. Such distributed services may include an interactive path.

A further objective of this Standard is to provide building owners, managers, architects, consultants, designers, manufacturers, installers, maintainers, service providers and users with requirements to meet user and service provider expectations, including performance criteria, for existing and foreseeable future services.

This Standard specifies the required equipment and system performance to meet safety, electromagnetic compatibility (EMC) and quality of service requirements of the end user or consumer.

This revision of AS/NZS 1367:2007 (including the renaming of the Standard) reflects the changes in free-to-air (FTA) terrestrial television broadcasts in Australia, including the cessation of analog PAL and transmission frequency reorganization (restack) to allow the implementation of mobile broadband services using the 'digital dividend'. Other advances in DVB-S, DVB-S2 and DVB-C equipment and systems are also included. The main additions and revisions are as follows:

- (a) Transmission medium and major equipment type additions:
 - (i) DVB-S2.
 - (ii) DVB-T2 (NZ).
- (b) Specification and text revisions:
 - (i) Removal of off-air reception above ch51 (694 MHz).
 - (ii) Filter requirements for LTE (mobile broadband) interference.
 - (iii) T-DAB advance to DAB+ (available in mainland capital city digital radio services).
 - (iv) Renaming of High-grade to Grade 1 and Basic-grade to Grade 2.
 - (v) Safety requirements revisions.
 - (vi) Revision of diagrams, drawings and schematics.
 - (vii) Revision of Appendix C—F-type connector advisory modifications and recommendations.
 - (viii) Glossary revision.
 - (ix) Revision of symbols.

Statements expressed in mandatory terms in notes to figures and tables are deemed to be requirements of this Standard.

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard**Coaxial cable and optical fibre systems for the RF distribution of digital television, radio and in-house analog television signals in single and multiple dwelling installations**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements and gives guidelines for the design, installation, electrical safety aspects, working performance and final commissioning and ongoing maintenance of a range of radio frequency (RF) distribution systems using passive and active components that will enable the high quality distribution of off-air and in-house television and radio signals in single and multiple unit dwellings (and where required, in other premises such as electrical goods retail stores, offices, etc.).

The end result of compliant systems and components is to make available RF-based broadcast and, if required, in-house signals carried by coaxial cable or by a combination of coaxial cable and fibre optic cable, to one or several outlets in a user's dwelling(s) and then onto a user's receiver where a tuner may reliably select and decode the desired signal with an adequate robustness by maintaining minimum distortion and interference of the received or input signals.

NOTE: As an important part of this Standard, the recommended signal levels and signal quality at the system outlets (e.g. wallplates) are given in Tables 9.2 (levels), 9.3 (level ratios) and 9.4 (C/N, MER and BER).

This Standard is relevant to systems capable of accommodating the distribution of RF signals depending on service requirements that may include interactive return path, over a frequency range that may cover from 5 MHz to 2150 MHz, including any required d.c. or low frequency power or signalling paths.

This Standard covers distribution systems that typically carry, as a minimum, the local digital television free-to-air (FTA) terrestrially broadcast services (see Note below), through to extensive systems that combine terrestrial and satellite IF (single or multiple) or satellite derived distribution. There may also be separately distributed subscription television services.

NOTE: For example, 'FreeView' provides free-to-air digital television and radio in New Zealand.

This Standard provides specifications for a range of passive and active devices including coaxial cable and connectors. The specification compliance of individual components performance and the interaction between them is seen as an essential primary requirement to allow a system design that has a predictable level and quality outcomes.

This Standard provides examples of system topology and although applying limitations, this Standard is not intended to restrict other potentially compliant system topologies.

In addition to a television receiver's RF input, the separate requirement of an interactive-capable connection for a receiver via a separate IP ethernet connection is not covered in this Standard. This Standard does not cover the interfacing and distribution of telephony, IP or other data services within communication systems.

NOTE: The scope is illustrated in Figure 1.1.

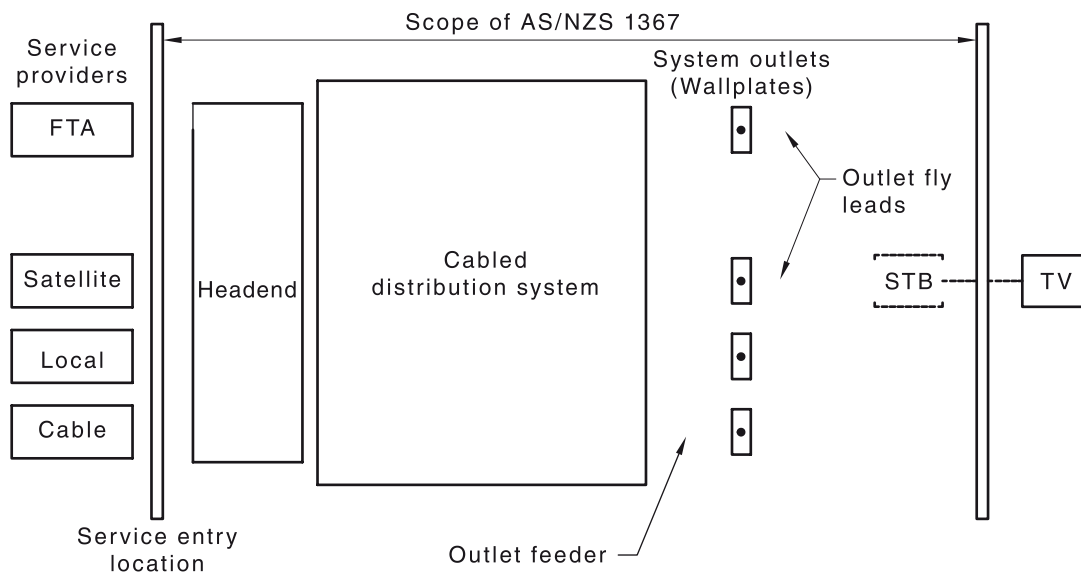


FIGURE 1.1 ILLUSTRATION OF THE SCOPE OF THIS STANDARD

1.2 OBJECTIVE

The intended result of the application of the requirements in this Standard is a distribution system that delivers a desired range of RF-based broadcast and if required, in-house signals, to the end-users' tuners/receivers at a sufficient but not excessive level to ensure that noise, intermodulation, cross-modulation or other interference will not impair reception quality. A compliant specified design and construction of the distribution system is also intended to minimize other effects such as reflections, and signal ingress to or egress from the system that could be caused, for example, by component and coaxial cable mismatch or shielding deficiency.

The level and quality parameters applicable to the final system are provided for both design guidance and system commissioning.

A further objective of this Standard is to ensure the provision of reasonable documentation of the system that remains accessible to the owners or managers to be used for maintenance and possible later modifications or additions (refer to Appendix D).

1.3 APPLICATION

This Standard is equally applicable to new installations or upgrades to existing installations and is intended to be applied to the design, installation and commissioning of all multi-channel coaxial cable distribution systems including fibre optic distribution systems.

This Standard is applicable to a range of coaxial cable and hybrid coaxial/optical fibre distribution systems in single or multiple residential and commercial buildings designed to carry multi-channel television and radio signals originating from a choice of terrestrial/satellite/cable FTA digital television, FTA radio, VAST and Freeview (New Zealand) satellite television, subscription satellite or cable television (pay TV), or in-house video systems.

The digital platforms supported in this Standard include DVB-T, DVB-T2, DVB-S, DVB-S2, DVB-C and DAB+.

DVB-C consideration is generally limited to 64QAM to 256QAM modulation intended for services transmodulated from satellite sourced services. The service provider needs to be contacted to supplement the specifications and requirements in this Standard for the support of DVB-C, which of course requires users to have a specialized DVB-C tuner/receiver.

Situations are covered where, in addition to the reticulation of FTA terrestrial services, a separate distribution system may be required to reticulate signals of other services, such as cable or satellite. Because of spectrum overlaps and other factors, systems carrying services from multiple providers may require systems each with their own outlets to feed specific receivers.

Special cases include the multiple signal reticulation needed for (subscription) satellite TV where separate feeds of the two transmission polarizations of one or multiple satellites may be required to allow simultaneous independent access by multiple tuners in receivers typically used in a satellite personal video recorder (PVR). These systems require multiple backbone or trunk cables with multiswitches that feed multiple system outlets or wallplates.

This Standard also specifies minimum requirements for outlet flyleads from wallplates to the user receiver (see Clause 5.6).

1.4 EQUIPMENT QUALITY GRADE—GRADE 1 AND GRADE 2

To cater for the requirements of different modulation schemes, and also for various degrees of design complexities and the size of a system, the system may be constructed of equipment complying with Grade 1 and/or Grade 2 performance specifications given in this Standard.

Equipment shall comply as a minimum with the Grade 2 specification, but equipment meeting Grade 1 specifications is essential for higher order modulation schemes.

NOTE: Refer to Clause 1.12.8.

1.5 AREAS COVERED IN THIS STANDARD

This Standard includes coverage of the following subjects in the indicated Sections. The areas listed below contain requirements:

- (a) Safety requirements—Section 2.
- (b) Electromagnetic compatibility (EMC) requirements—Section 3.
- (c) Active distribution equipment—Section 4.
- (d) Passive equipment—Section 5.
- (e) Headend equipment—Section 6.
- (f) Optical equipment—Section 7.
- (g) Satellite systems and equipment—Section 8.
- (h) System performance—Section 9.
- (i) Australian and New Zealand television bands and channel frequencies—Appendix A.
- (j) Documentation and labelling—Appendix D.

The areas listed below contain information and guidance:

- (A) IEC 61169-2 (Belling Lee) connector advisory modifications—Appendix B.
- (B) F-Type connector advisory modifications and recommendations—Appendix C.
- (C) Glossary of terms—Appendix E.
- (D) Drafting symbols—Appendix F.
- (E) System design—Sample—Appendix G.
- (F) Recommended cabling installation practices—Appendix H.

1.6 DOCUMENTATION PROVIDED WITH THE SYSTEM

In this Standard, wherever the term ‘shall be specified’ is used, the information shall be included in the documentation provided with the system and that documentation or a copy shall remain with the system after commissioning. While such information may also be necessary at the planning, design, installation and commissioning stages, there is also much value for later maintenance or system upgrade if the equipment details are available, even though that product is discontinued and/or the original manufacturer no longer exists.

NOTES:

- 1 Appendix D provides requirements on documentation as recommended to be provided by the installer and/or system contractor.
- 2 Appendix D also details minimum equipment labelling and specifications.
- 3 Appendix F provides recommended symbols to be used in diagrams and plans.

1.7 EXCLUSIONS

This Standard does not specify requirements for information technology (IT) connectivity, including asymmetric digital subscribers line (ADSL) over twisted pair, Broadband over NBN, Broadband over Powerlines (BPL), Local Area Networks (LANs) and in-home digital multimedia networks and baseband systems.

NOTE: While it is recognized that there is an expectation that new generation ‘connected’ television receivers and other electronic media devices may need access to IP and Internet connections, the distribution and arrangement of IP connectivity is not within the scope of this Standard.

This Standard does not cover distribution of AM radio.

1.8 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

- | | |
|--------|---|
| 1417 | Receiving antennas for radio and television in the VHF and UHF broadcast bands—Design, manufacture and performance of outdoor terrestrial television antennas |
| 4599 | Digital television—Terrestrial broadcasting |
| 4599.1 | Part 1: Characteristics of digital terrestrial television transmissions |
| 4933 | Digital television—Requirements for receivers for VHF/UHF DVB-T television broadcasts including ancillary services |
| 60529 | Degrees of protection provided by enclosures (IP Code) |

AS/NZS

- | | |
|-------|---|
| 1768 | Lightning protection |
| 3000 | Electrical installations (known as the Australian/New Zealand Wiring Rules) |
| 60065 | Audio, video and similar electronic apparatus—Safety requirements (IEC 60065, Ed.7.2 (2011), MOD) |

IEC

- | | |
|----------|---|
| 61169 | Radio-frequency connectors |
| 61169-1 | Part 1: Generic specification—General requirements and measuring methods |
| 61169-2 | Part 2: Sectional specification—Radio frequency coaxial connectors of type 9,52 |
| 61169-24 | Part 24: Sectional specification—Radio-frequency coaxial connectors with screw coupling, typically for use in 75 Ω cable networks (type F) |

IEC

- 60728 Cable networks for television signals, sound signals and interactive services
- 60728-1 Part 1: System performance of forward paths
- 60728-2 Part 2: Electromagnetic compatibility for equipment
- 60728-3 Part 3: Active wideband equipment for coaxial cable networks
- 60728-6 Part 6: Optical equipment
- 60966 Radio frequency and coaxial cable assemblies
- 60966-1 Part 1: Generic specification—General requirements and test methods

EN

- 50083 Cable networks for television signals, sound signals and interactive services

ETSI EN

- 300 401 Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers
- 300 421 Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services
- 300 429 Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems
- 300 473 Digital Video Broadcasting (DVB); Satellite Master Antenna Television (SMATV) distribution systems
- 300 744 Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television

NZS

- 6610 Digital Television Transmission for Satellite, Cable and Terrestrial Broadcasting

AS/CA

- S009 Communications Alliance
Installation requirements for customer cabling (Wiring rules)

ACMA

- Broadcast stations' locations and operating frequencies
- Broadcasting Planning Manual—Technical Planning Guidelines
- Digital Terrestrial Television Broadcasting Planning Handbook
- Radio and Television Broadcasting Stations Book
- Technical Planning Guidelines: see Broadcasting Planning Manual

ANSI/SCTE

- 01 Specification for 'F' Port, Femail, Outdoor
- 74 Specification for Braided 75 Ω Flexible RF Coaxial Drop Cable
- TR 101 290 Digital Video Broadcasting (DVB); Measurement guidelines for DVB systems

Free TV Australia

Operational Practices—Engineering Guides

- OP 40 Allocation of DVB Service Information Codes for Australia
- OP 41 Logical Channel Descriptor and Allocation of Logical Channel Numbers
- OP 45 Application of Time Related Tables in Australian DVB-T Systems
- OP 71 Recommended Settings of DVB-T Transmitter/Modulator's Operating Parameters and Transport Stream SI for Use in Temporary Events or in TV Distribution Systems

SBCA

Connector Recommended Practices

‘F’ Male DBS Connector Dimensional and Performance Specification

1.9 DEFINITIONS

NOTE: A glossary of terms is provided in Appendix E.

1.10 SERVICES**1.10.1 General**

This Standard covers the distribution of television and radio signals, which comprise the services defined below.

1.10.2 DVB-T and DVB-T2 (NZ) TV (DTV)

DVB-T services utilizing multi-carrier COFDM modulation as referenced by ETSI EN 300 744 and in Australia using 7 MHz channels, as detailed in the *Digital Terrestrial Television Broadcasting Planning Handbook* available from the ACMA, and in AS 4599 (transmission) and AS 4933 (receivers). In New Zealand, 8 MHz channels are used in UHF Bands IV and V. For DVB-T2, refer to NZS 6610 (Freeview DTT Transmission rules).

1.10.3 DVB-S and DVB-S2 TV

Satellite digital television services utilizing single-carrier QPSK or 8PSK modulation as detailed for DVB-S in ETSI EN 300 421 and for DVB-S2 in ETSI EN 302 307. In New Zealand, refer to NZS 6610 (Freeview DTH Transmission rules).

1.10.4 DVB-C TV

Cable digital television service utilizing single-carrier QAM modulation is as detailed in the ETSI EN 300 429. Consideration in this Standard includes 64QAM to 256QAM. In New Zealand, refer to NZS 6610.

1.10.5 FM radio

Frequency modulated (FM) radio services are located in the frequency range 87.5 MHz to 108 MHz that is commonly referred to as Band II. The characteristics of terrestrial transmissions in Australia are defined in *Broadcasting Services (Technical Planning) Guidelines 2007*, available from the ACMA.

1.10.6 DAB+ (T-DAB) radio

Digital radio services for Australian terrestrial transmissions utilize multi-carrier COFDM modulation with AAC+ audio as detailed in the ETSI EN 300 401 and TS 102 563 and operate in VHF Band III between 174 MHz to 230 MHz. Four nominally 1.5 MHz wide carriers (Mode 1) fit into a 7 MHz TV channel and in Australia are mainly planned to operate in a sub-band in TV RF Channels 9 and 9A catering for commercial, national (public) and community broadcast services.

1.10.7 Analog TV (ATV)

Analog TV while a legacy system continues to be used within MATV distribution systems for the support of in-house systems operating to PAL analog receivers. It can only provide Standard Definition (SDTV) pictures.

1.11 LOCATIONS

1.11.1 Dwelling categories

Single and multiple dwellings are defined in terms of ability to isolate a.c. mains and accommodation, plus whether there is exclusive or shared use of an antenna.

For the purpose of this Standard a single commercial premise such as a retail showroom is considered as a single dwelling.

A single dwelling has—

- (a) only one mains power feed that may be isolated; and
- (b) accommodation that may be isolated by the locking of doors without interfering with other dwellings.

Examples of a single dwelling are an individual house, a townhouse or flat/unit/apartment within a complex.

A multiple dwelling has—

- (i) a shared mains power feed on a property that feeds all the dwellings on the property;
- (ii) multiple lockable individual accommodation; and
- (iii) shared use of an antenna between dwellings on a property.

Examples of multiple dwellings are a block of flats, apartments, home units, a motel, a hotel, a retirement village, a resort, etc.

Recommended cabling installation practices are summarized in Appendix G.

1.11.2 Service entry locations

The nominal location for the service entry (SE) location [previously referred to as the premises cabling interface (PCI)] for each type of network operator is shown in Table 1.1.

TABLE 1.1
NOMINAL SERVICE ENTRY LOCATIONS

Service carriage medium	SE—Single dwellings	SE—Multiple dwellings
Terrestrial free-to-air TV (FTA) (DVB-T and DVB-T2 (NZ)) Terrestrial FM radio Digital radio (DAB +)	At output of FTA antenna	At output of FTA antenna
Satellite TV (DVB-S/S2)	Output of LNB or down converter	Output of LNB or down converter
Cable TV (DVB-C)	Refer to particular carrier network operator for definition of entry location or network boundary. Potential defined entry may be either— (a) customer side of the network isolator located in the network termination box, typically at the building entry point; or (b) wall outlet	Refer to particular carrier network operator for definition of entry location or network boundary. Potential defined entry may be either— (a) located at the input to the local headend; or (b) wall outlet

1.12 SYSTEMS

1.12.1 Types of systems

Figures 1.2–1.8 illustrate examples of system configurations that may be employed to distribute a variety of services in single and multiple-dwelling units. The considered system designs extend from a basic FTA distribution system to designs catering for satellite and cable services. The topography of the design may change to suit a particular building type.

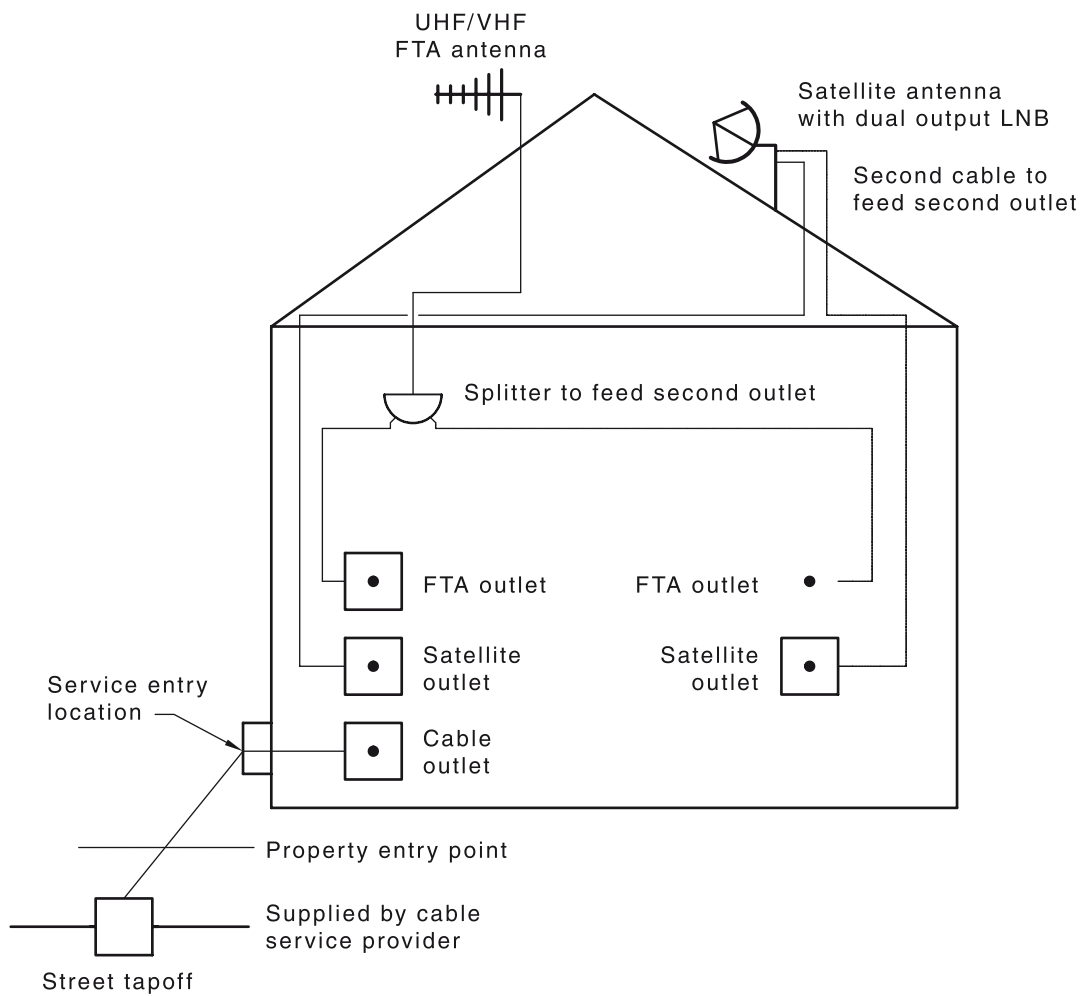


FIGURE 1.2 CONCEPT EXAMPLE OF A SINGLE DWELLING SYSTEM WITH MULTIPLE SERVICES

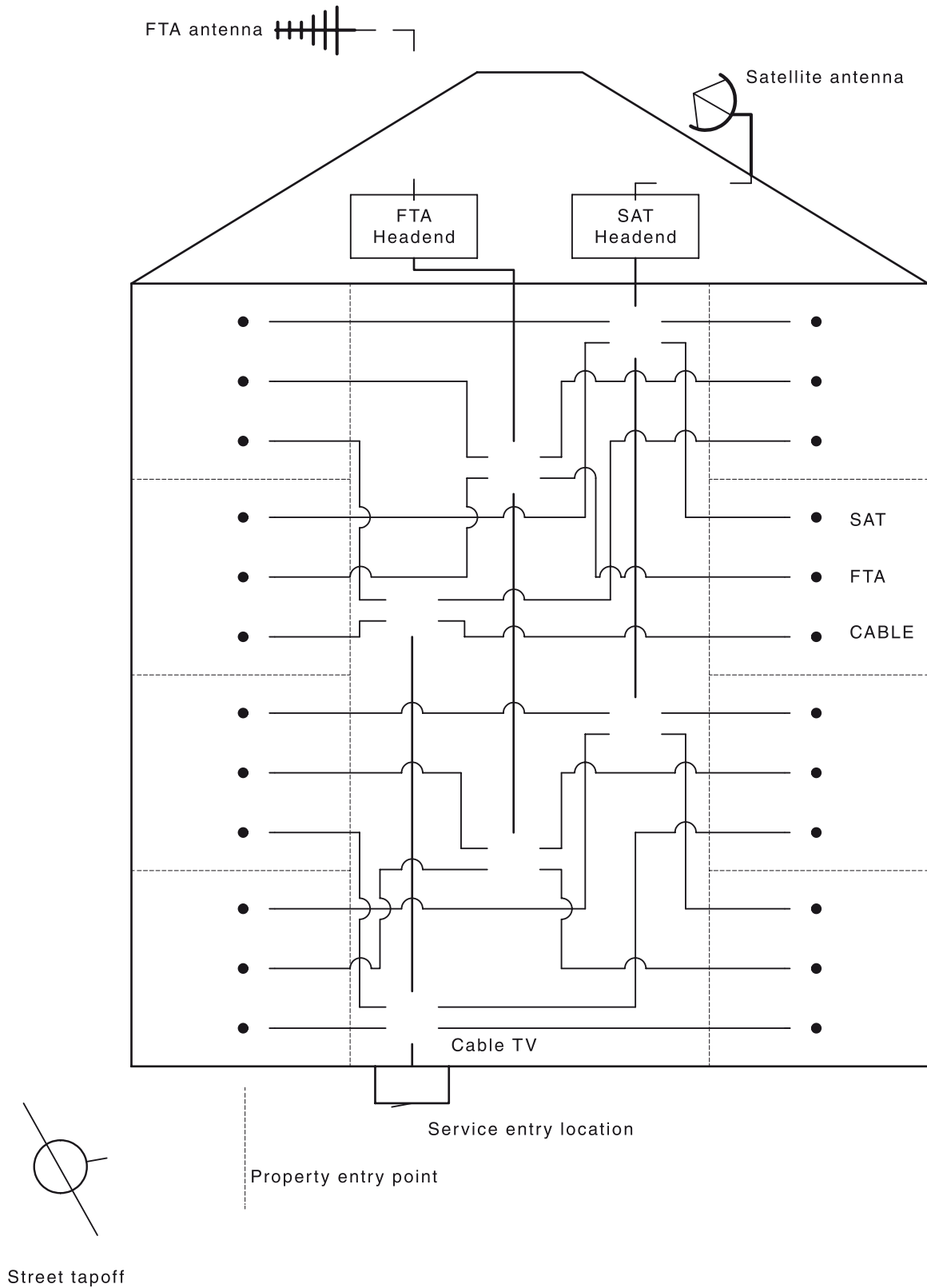
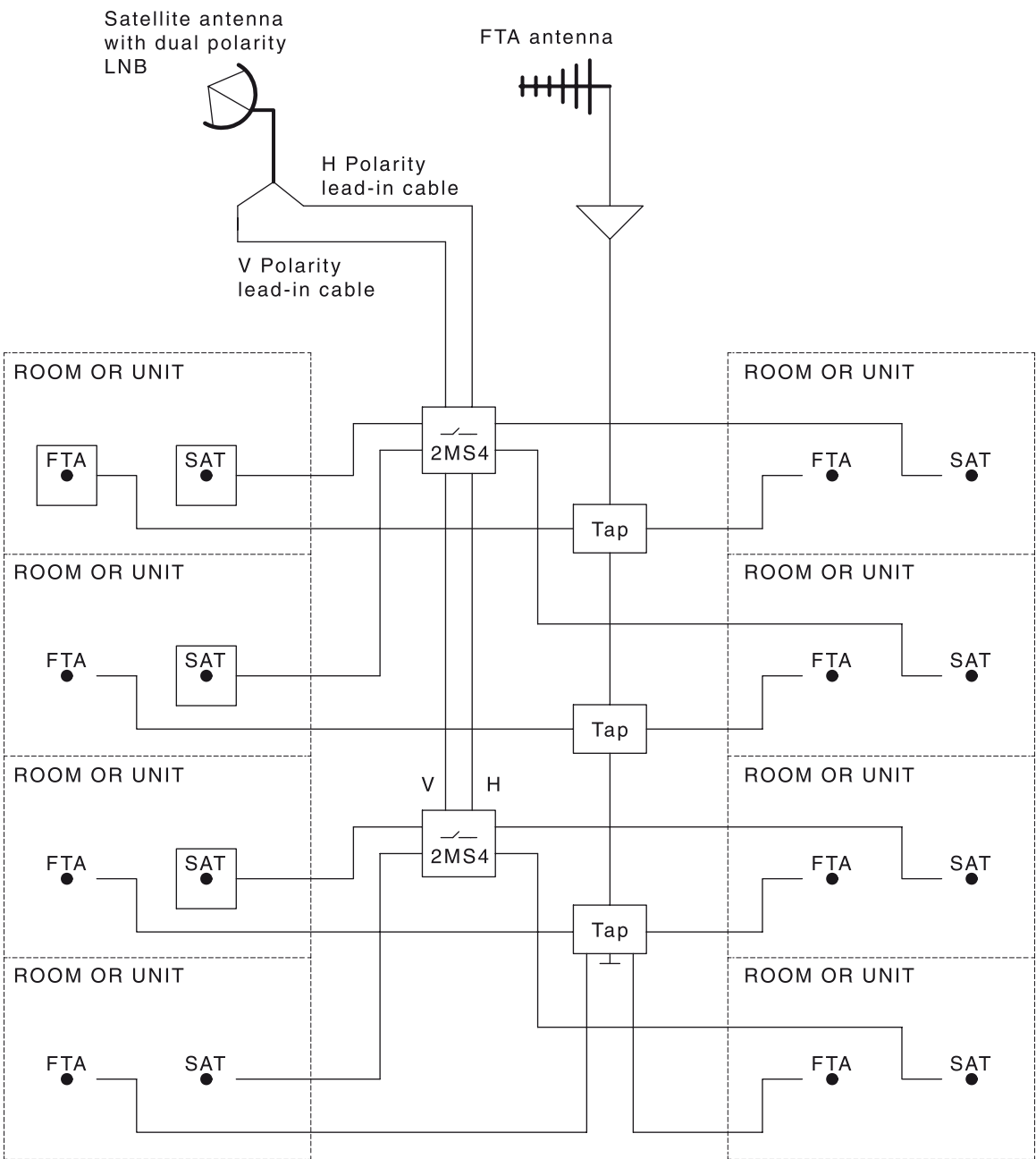
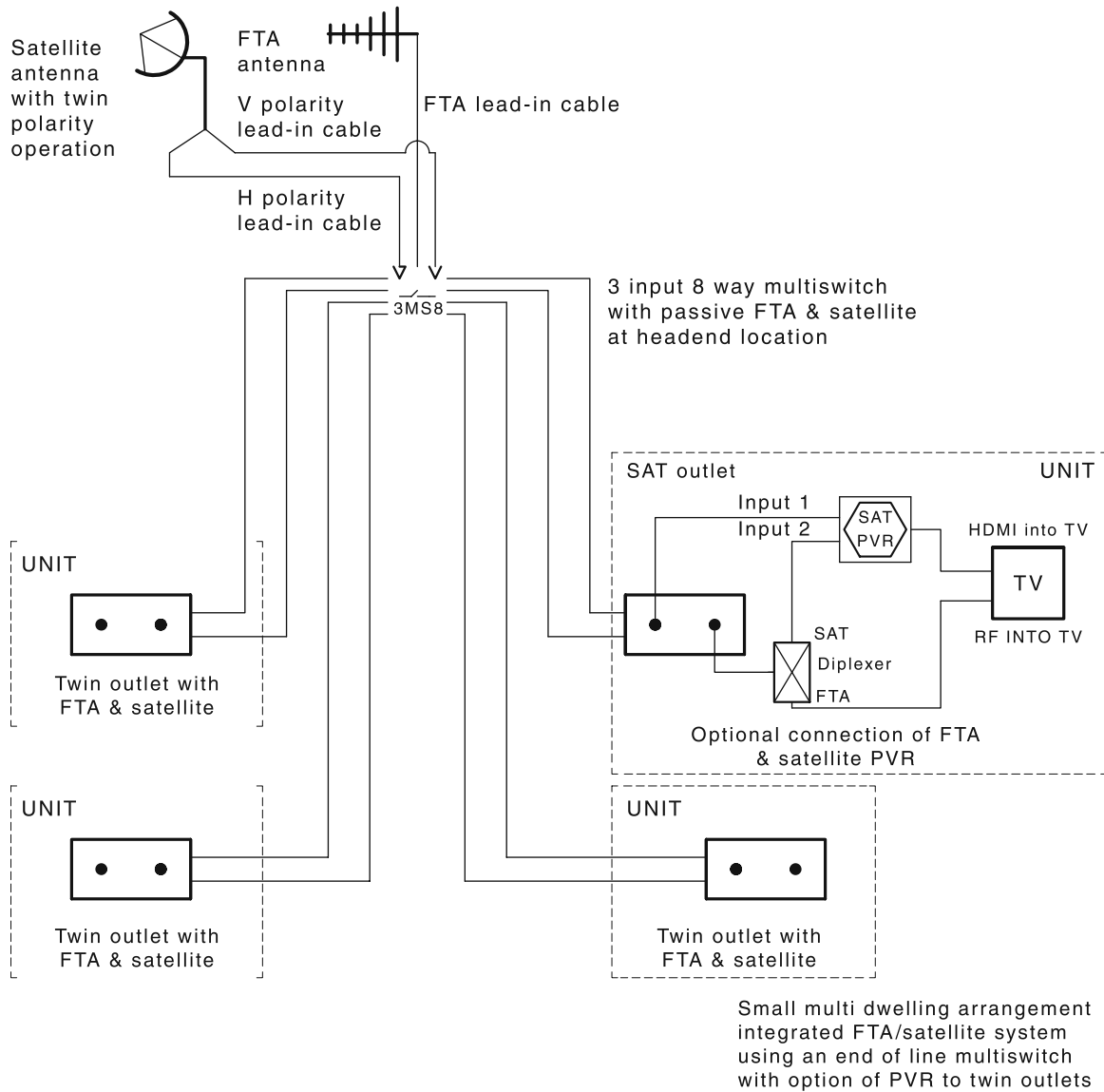


FIGURE 1.3 CONCEPT EXAMPLE OF A MULTIPLE DWELLING SYSTEM WITH THREE SEPARATE SERVICES



NOTE: ‘2MS4’ is a two input (V and H polarity) multiswitch to feed four outlets.

FIGURE 1.4 INSTALLATION EXAMPLE OF SEPARATE SATELLITE IF AND FTA SYSTEMS FOR SINGLE OR MULTIPLE DWELLINGS



NOTE: The multiswitch needs to have high pass filtering to reduce noise below 950 MHz from LNB sources.

FIGURE 1.5 INSTALLATION EXAMPLE OF INTEGRATED SATELLITE IF AND FTA SYSTEM FOR SINGLE OR MULTIPLE DWELLINGS

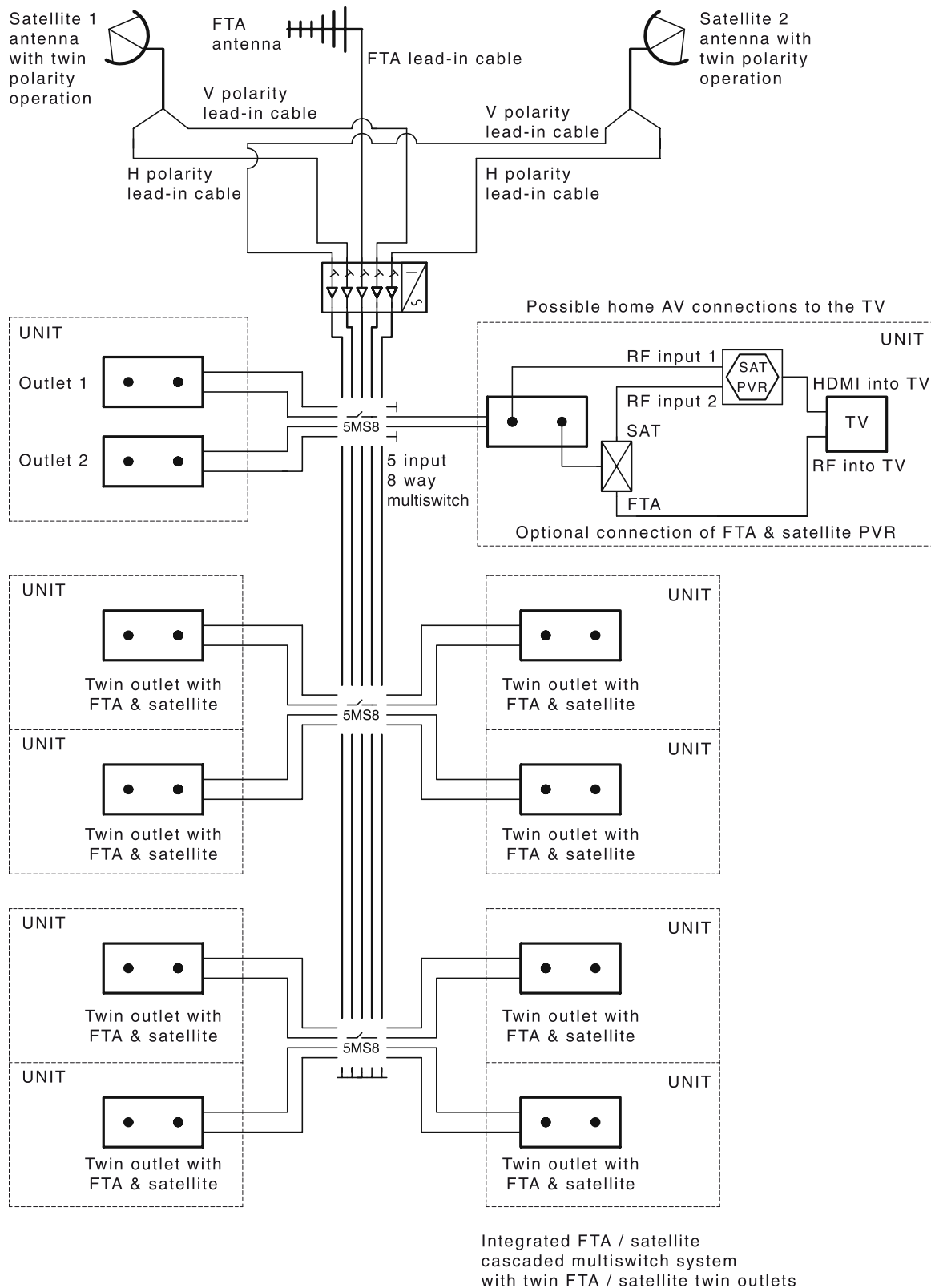


FIGURE 1.6 INSTALLATION EXAMPLE OF INTEGRATED SATELLITE IF AND FTA SYSTEM WITH BACKBONE FOR MULTIPLE DWELLINGS

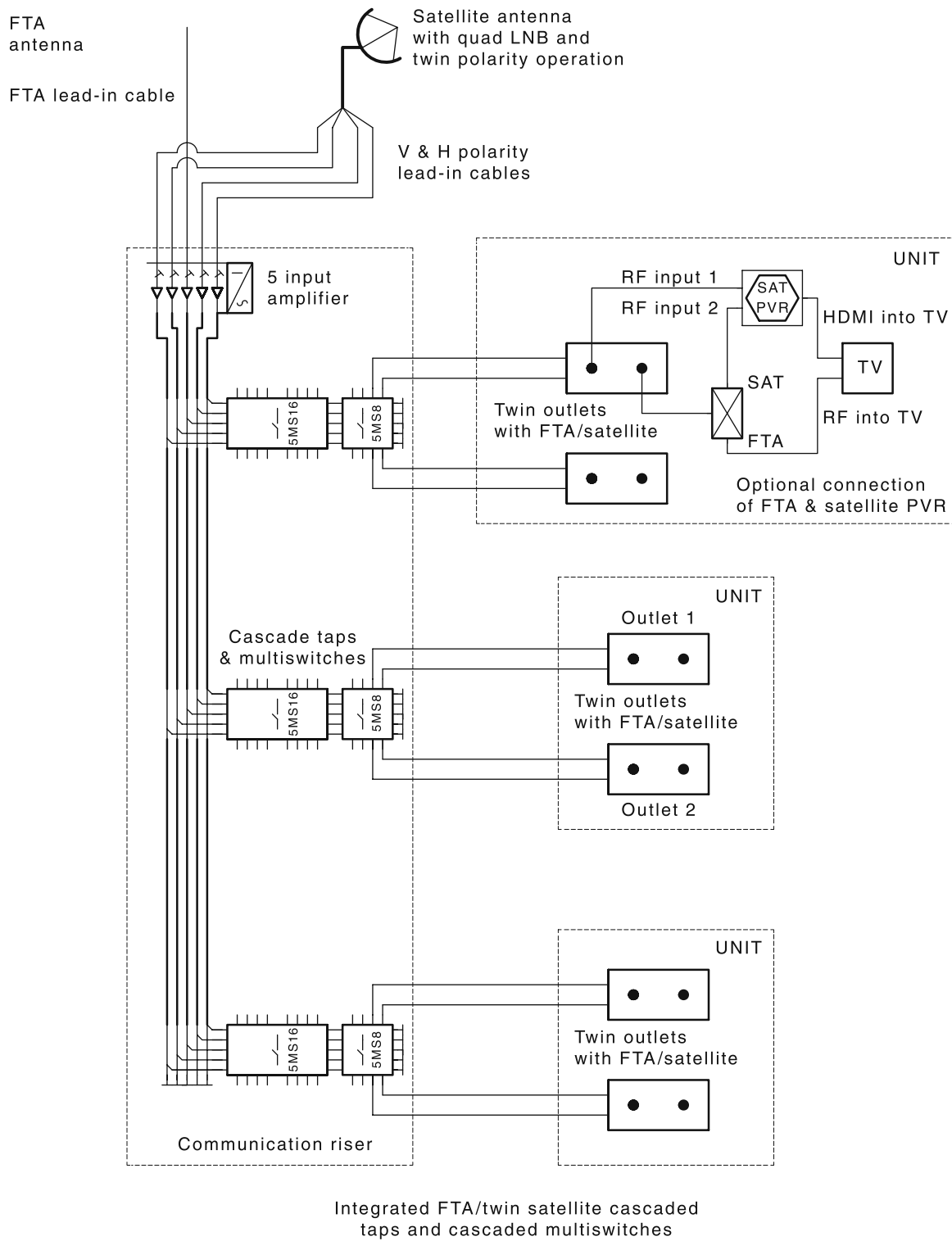
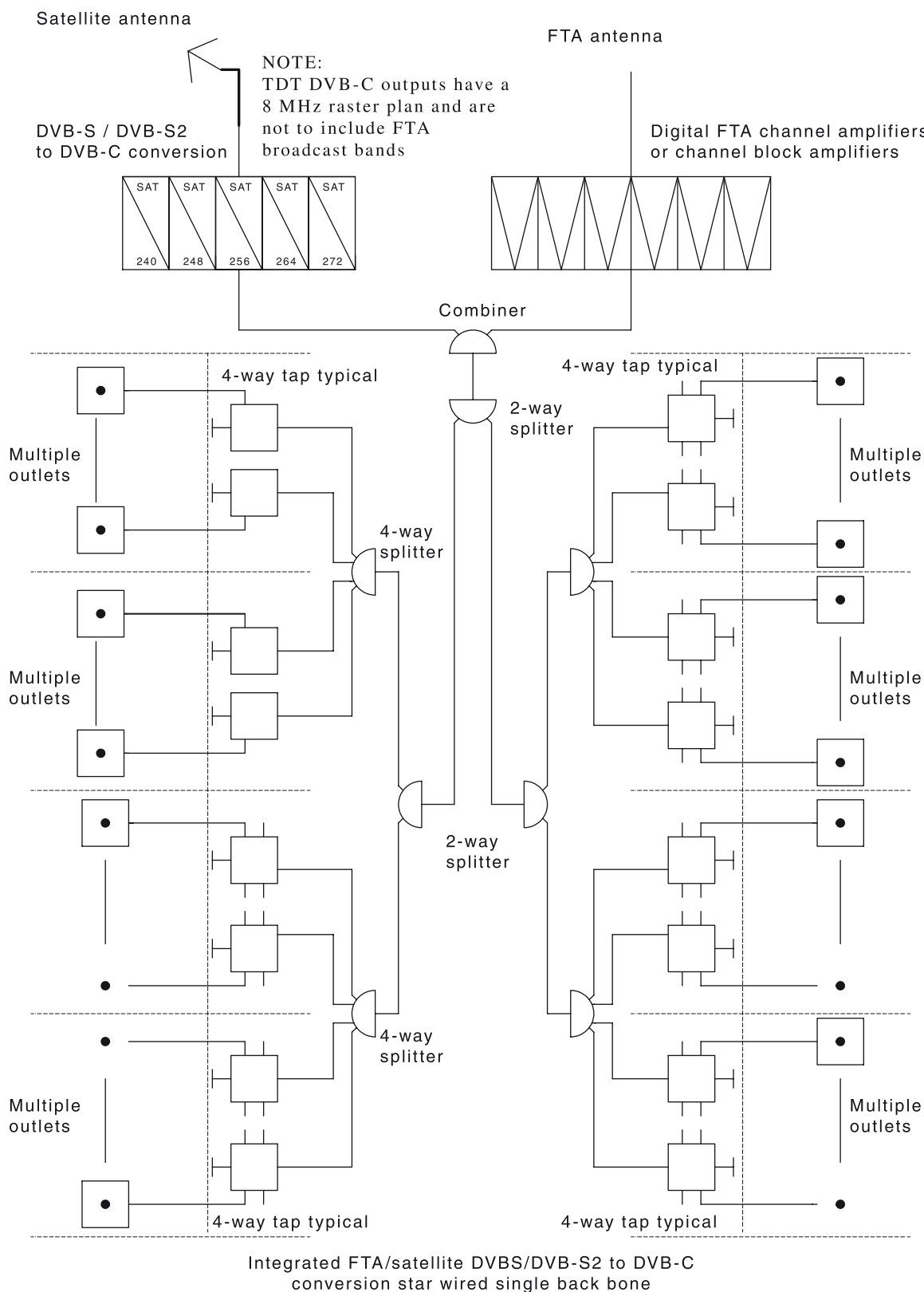


FIGURE 1.7 INSTALLATION EXAMPLE OF A READILY EXTENDABLE SYSTEM WITH BACKBONE FOR MULTIPLE DWELLINGS



LEGEND:
TDT = Transparent digital transmodulator

FIGURE 1.8 INSTALLATION EXAMPLE OF A CHANNEL PROCESSING SYSTEM FOR MULTIPLE DWELLINGS

1.12.2 Excluded configurations

Any system using loop-through system outlets on wallplates within and between dwellings does not comply with this Standard (see Figure 1.9). This connection method results in the signal level and quality being dependent upon the termination conditions on other outlet(s). The lack of isolation between outlets may allow cumulative leakage, leading to higher touch currents that may have a startle effect on the user or installer.

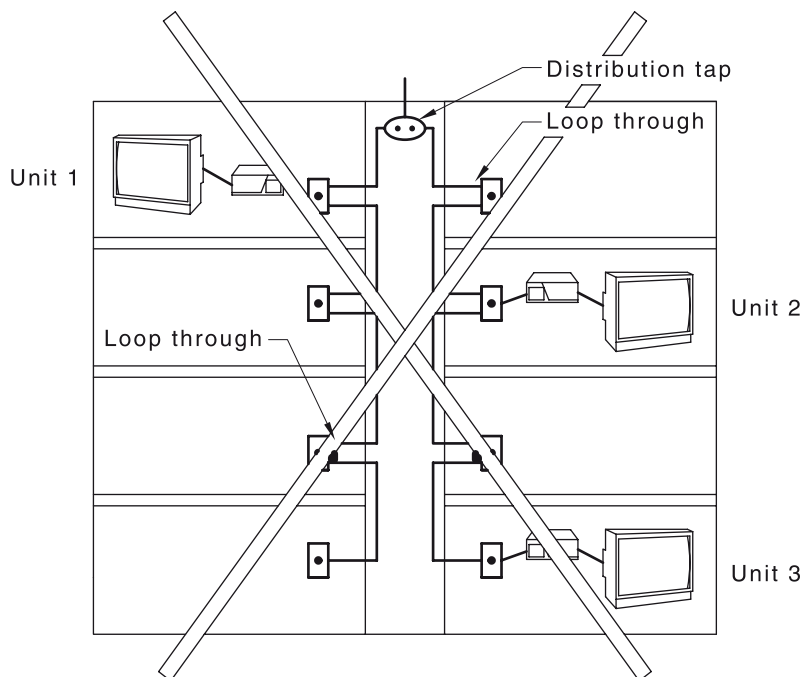


FIGURE 1.9 ILLUSTRATION OF A NON-COMPLIANT LOOP-THROUGH SYSTEM

1.12.3 Frequency usage on the distribution system

The frequency range of 5 MHz to 2150 MHz may be nominally divided into three frequency sub-bands 45 MHz to 862 MHz; 950 MHz to 2150 MHz and 5 MHz to 30 MHz, as follows:

- (a) The first sub-band, 45 MHz to 862 MHz is commonly used for the distribution of signals originating from free-to-air (FTA) digital TV terrestrial transmissions (DTV), in-house services and a portion of this band for DVB-C type services in Australia. In New Zealand the first sub-band is 44 MHz to 806 MHz.

NOTES:

- 1 See Appendix A for the nominal channel allocations for Australia and New Zealand within this band.
- 2 In almost all Australian cities and towns both the main transmitters and translator repeater sites have the FTA transmissions within a Block of 6 adjacent channels.

In Australia, FTA DTV occupy 174 MHz to 230 MHz (Channels 6–12 also known as VHF Band III or Block A channels) and 519 MHz to 694 MHz (Channels 27–51 also known as UHF Bands IV and V—in six channel Blocks B, C, D, and E).

Australian FTA DAB+ radio co-exists with TV in Band III normally in TV channels 9 and 9A.

New Zealand FTA (Freeview) 8 MHz digital TV terrestrial transmissions occupy 510–694 MHz (Channels 26–48 also known as UHF Bands IV and V).

FM radio services occupy 87.5 MHz to 108 MHz known as Band II.

The availability of FTA DTV, DAB+ and FM radio services at the wallplate outlet means that any readily available open-market consumer receiver will be able to operate.

In systems where additional services are provided, the frequencies chosen for the additional services should not be on channels used by FTA DTV and DAB+ radio services in that area.

In-house DTV and ATV modulation systems, as well as transmodulated DVB-S to DVB-C (QPSK to QAM) systems and DVB-C systems require special non-domestic receiver tuner capability usually sourced by the system owner or the service operator, (e.g. a subscription TV supplier). These may be able to use non-broadcast 'S-band or Hyper-band' channels that cover 111 MHz to 174 MHz and 230 MHz to 519 MHz and former broadcast channels from 52–69 (in New Zealand 230 MHz to 510 MHz and former broadcast channels from 49–69).

- (b) The second sub-band (usually referred to as 'L-Band'), 950 MHz to 2150 MHz, is used for the distribution of satellite intermediate frequencies (IF).
- (c) The third sub-band, 5 MHz to 30 MHz, is sometimes used for signals travelling in the reverse direction to that of the services delivered to the consumer in the first and second sub-bands. This path may be called the *Reverse path* or *Return path*.

Cable TV network operators may utilize a 65/85 MHz band split, where the reverse path occupies the 5 MHz to 65 MHz band and the forward path occupies the 85 MHz to 750 MHz frequency band.

Specific forward sub-band and reverse sub-band frequencies and component selection will vary according to the requirements of the system design. A third-party system design shall comply with the frequency band and/or sub-band allocations and maximum number of channels for which the system is designed.

1.12.4 Variations in equipment specifications

In order to meet system performance objectives at commissioning, the specifications of equipment used should be superior to or equal to those specified in this Standard. In cases of retrofit, regardless of the scale of retrofit, variation of the equipment from the original specification should be permitted only if the system requirements can be maintained or surpassed.

1.12.5 System modifications or additions

Any connection subsequent to an existing cabled distribution system that has previously met the requirements of this specification shall not degrade the existing system and/or the service provider's system. Typically, additional connections may include another network operator's system, an external signal source sub-system, such as a VHF/UHF MATV system, an in-house video system or any locally originated signal source.

1.12.6 Provision of free-to-air digital services

1.12.6.1 Free-to-air services definition

Where the term 'free-to-air (FTA)' is used in this Standard, it refers to the digital TV and digital radio services from commercial, national (public) and community broadcasters locally received from an antenna. In the case of digital TV it does not include individual service extracts from FTA TV services that are redistributed on Pay TV networks.

1.12.6.2 *Provision for FTA Digital TV services*

The most usual requirement is to deliver the off-air received FTA digital TV signals to the system outlets. These FTA signals shall be delivered intact with all the services and other features included in the signal by the broadcaster, such as programs in high definition, widescreen, multichannel with interactive services and service information (SI). Such a requirement does not preclude, for example, processing for level control (AGC) or channel frequency translation, although this may be less necessary with the channels now broadcast in contiguous blocks.

NOTE: SI carries mandatory parental guidance rating information in the program guide (EIT) (see AS 4599.1).

1.12.6.3 *FTA antenna selection, location and impulsive noise consideration*

See Clause 6.5.4 in this Standard for detailed information on antenna selection and installation. Clause 2.2 gives some details of safety aspects. The following is a basic starting guide for FTA reception:

- (a) Information on the broadcast transmissions available in the area may be obtained from the ACMA and the broadcasters. This will include details of the distance and direction or bearing to the optimum transmit site, be it a main or local retransmitter. Also required are the RF channels (in Australia usually an 8 or 6 channel block for FTA DTV), and antenna polarization.
- (b) In Australia, since the introduction of digital TV and the switch off of all analog PAL broadcasts the TV coverage of many Australian cities and towns has been enhanced by the addition of extra 'gap-filler' retransmit sites. Reception from one of these sites may be a better alternative. Several of these sites on Australia's east coast currently have a total of 8 UHF channels (1 ½) blocks to include both metropolitan and regional broadcasters transmissions.
- (c) Antenna type selection criteria and guidance is provided by AS 1417.
- (d) Antenna location and height should be selected so that there is no local obstructions such as buildings, trees etc.
- (e) Avoiding antenna locations near power lines, particularly high voltage lines that have a potential to generate impulsive noise from arcing.
- (f) Antennas with baluns should preferably be of the transformer type (offered by ferrite type baluns) to achieve good rejection of impulsive noise.
- (g) Providing good shielding in the system to reduce the possible ingress of impulsive noise, by compliance to this Standard in particular to the use of quad shielded cable and F-type compression connectors from the antenna output to the system outlet.
- (h) A separate antenna for the FM radio and/or DAB+ may be used.

Further information and guidance on impulsive noise is provided in AS 1417 and Clause 6.5.4.4 in this Standard.

NOTES:

- 1 Replacement of legacy antennas with an antenna designed for the specific VHF 8 channel Block A and UHF 6 channel blocks (B, C, D and E) being broadcast is important to ensure equal reception level across the band and no loss of performance at the band edge (e.g. RF channels 6 and 12 in VHF Block A). A VHF Block A antenna that has minimal pickup below RF channel 6 may minimize pickup of impulsive noise. UHF antennas that have suitable response up to RF channel 51 (694 MHz), but little response above, may minimize other interference from mobile broadband devices.
- 2 Care may need to be exercised in combining multiple antennas, for example, the use of a diplexer between the bands.

1.12.6.4 *System outlet signal quality*

The recommended signal levels, level difference between services and signal quality at a dwelling's wallplate outlet are given in Tables 9.2, 9.3 and 9.4 respectively.

Note that the DVB-T level requirements are applicable to all COFDM signals operating at 64QAM and $\frac{3}{4}$ error correction Code Rate (FEC), except any signal operating in QPSK or 16QAM mode, such as transmitted by a 'community' DTV station, where a lower received level and outlet level may typically be up to 10 dB less for the same reception quality and MER.

1.12.6.5 *Legacy system structures*

In some distribution systems, one or more of the channels now used by FTA digital TV and DAB+ radio transmissions have been used for various other purposes, resulting in blocked access to these digital TV and radio signals. There is a strong preference that the FTA digital TV channels are not blocked by the in-house services. The digital radio channels shall not be translated from their transmitted RF channel.

NOTES:

- 1 Digital TV RF channels contain several programs and features that will not be accessible if the broadcaster's complete digital signal is not available to the receiver.
- 2 Some legacy systems intercept digital TV signals in the headend where 'fixed-tuned' digital receivers are used to select one or more services as provide in standard definition (SD) to an analog PAL modulator to be distributed to drive in-house analog TV receivers. These systems compromise the display of digital widescreen 16:9 pictures on PAL analog 4:3 picture aspect ratio receivers. However, it is to be emphasized, such systems may have a limited life and may create problems for end user viewers as the format of FTA digital broadcasts can change from time to time.

1.12.6.6 *Subscription Pay TV and FTA TV services*

The provision of a distribution system for subscription Pay TV services does not preclude the need to provide a separate or integrated distribution system for access to off-air FTA TV services. These FTA TV services are normally available via reception from terrestrial transmissions although in some cases in remote or poor reception areas FTA TV services may be obtained from the encrypted satellite service (VAST) after placing an application to receive the service.

Where FTA and satellite IF systems share the same cabled distribution system, Clause 8.6 describes the requirements to protect FTA signals from noise or interference from the satellite IF system.

1.12.6.7 *Selecting free channel space*

System designs that require other services as well as FTA TV and radio distribution, such as in-house channels and/or DVB-C services (via satellite to cable TDT for conversion of DVB-S or DVB-S2 to DVB-C for this example) should have the following selection priorities for the RF channel allocations to ensure current and future integrity of FTA TV and radio services:

(a) For in-house services:

- (i) Use of channels above 694 MHz (however, there is potential of local interference from mobile broadband transmissions).
- (ii) Use of unused channels in terrestrial transmissions; refer to the ACMA for local area channel frequency allocations.

NOTES:

- 1 See Australian Communications and Media Authority at <http://www.acma.gov.au/>.
- 2 As future FTA services may be scheduled to use currently unused channels in that area, caution needs to be exercised.

- (iii) Use of Band I channels 0–2 for in-house analog TV to analog PAL receivers.
- (b) For TDT derived services:
 - (i) Use of S-band and Hyper-band for cable DVB-C distribution.
 - (ii) Use of channels above 694 MHz (however, there is potential of local interference from mobile broadband transmissions).

1.12.7 Compliance and specific requirements

For a cabled distribution system to meet this Standard, the system performance and installation quality shall comply with relevant conditions and specifications for FTA, satellite and cable service delivery called up in this Standard.

Since the specific requirements of satellite and cable service providers vary, the targeted service provider should be identified, and this provider's interface parameters made known, prior to system design.

1.12.8 Specification grades

The specification grades used throughout this Standard have the following general relevance to system type:

- (a) *Grade 1*—Systems with more than 24 outlets.
 - (i) Medium (24–48 outlets) to large systems (higher than 48 outlets):
 - (A) DVB-T and DVB-T2.
 - (B) DVB-S and DVB-S2.
 - (ii) All systems using DVB-C with 128QAM and 256QAM.
- (b) *Grade 2*—Single dwelling and systems with up to 24 outlets:
 - (i) DVB-T and DVB-T2.
 - (ii) DVB-S2 VAST systems (and legacy DVB-S).

1.12.9 Component quality and aging

Consideration should be given to the quality of components, cables and electronic systems in regard to aging. As components and systems age, their characteristics may vary, which may cause degradation of signal levels and/or quality. In poorly selected components and systems, the aging may be accelerated leading to more frequent maintenance. Typical aging problems may be frequency drifting and increased phase noise in transmodulators, loss of system gain, increase in noise and/or hum in amplifiers, loss of shielding due to lost or degraded connectors and increased attenuation plus poor return loss in cables due to damage or exposure to the environment. Consideration should also be given to shelter from the weather, humidity, extreme temperatures and dust in order to prevent premature degradation of the system components and connectors.

1.12.10 Documentation and labelling

Refer to Appendix D for details on the documentation, system and equipment labelling that shall be provided with and in a system.

SECTION 2 SAFETY REQUIREMENTS

2.1 APPLICATION AND GENERAL REQUIREMENTS

2.1.1 Application

This Section specifies requirements and gives guidelines for the safety of the system, the authorized service personnel working on it, the occupant, and the occupant's equipment. It deals with safety aspects only. It is not intended to protect the equipment used in the system and does not constitute a lightning protection system (LPS).

2.1.2 General requirements

The cabled distribution system within single or multiple dwellings shall be so designed, constructed and installed as to prevent hazards, either in normal use or under any single fault condition, to the occupants connected to the system, or to any other person who may come in contact with normally accessible components of the system.

In particular, a system shall provide—

- (a) personal protection against electric shock;
- (b) personal protection against physical injury including eye damage in the case of optical systems; and
- (c) protection against fire.

WARNING: AUTHORIZED SERVICE PERSONNEL, WHEN WORKING ON THE EQUIPMENT IN AN APPROVED MANNER, MAY BE EXPOSED TO LIVE PARTS OF THE EQUIPMENT BY THE REMOVAL OF EQUIPMENT PROTECTIVE COVERS.

2.2 ANTENNAS

2.2.1 General

This Clause (2.2) is intended to give guidance for personal safety and to minimize effects of static atmospheric overvoltages and lightning discharges that may be encountered with antenna systems, including satellite antennas.

If the building is equipped with an LPS, any connection between the LPS and the antenna system shall be referred to the LPS designers.

NOTE: The LPS should conform to AS/NZS 1768.

2.2.2 Antenna earthing

In systems feeding multiple dwellings, a safety earth cable of 2.5 mm² should run from the antenna metal support. This earth wire should be run with the signal feed cable back to the earthing point at the headend or initial distribution point, known as a communications earthing terminal (CET). To reduce the possibility of discharges coming down the cable feed, an inductive loop (typically three turns of approximately 200 mm diameter) in each cable feed(s) from the antenna(s) may reduce the possibility of equipment damage.

In a single house installation, earthing an antenna mast should be approached with caution as there is the possibility of minor electric shock (touch current effect) when plugging in or removing the antenna lead from a receiver. This may be caused by mains current leakage that in many cases may be made greater by the receiver's interconnection with other 'double-insulated' non-earthed consumer equipment such as amplifiers, DVD players etc.

An exclusion is made for antenna systems including satellite dishes external to the building that are located more than 2 m below the apex of the roof and less than 1.5 m from the building.

2.3 POWERING OF CABLED DISTRIBUTION SYSTEM

2.3.1 Line powered

In systems where line powering is used on the coaxial cable between the service entry (SE) and the distribution tap, the following conditions shall be met:

- (a) Line powering shall be confined to feeder only and shall not extend to the outlet cable.
- (b) Line powering voltage shall be completely inaccessible to unauthorized personnel.
- (c) Line powering voltage shall be accessible to authorized personnel only after removal of equipment protective covers by means of a tool.

In systems with a coaxial cable powered to operate active equipment, voltages of up to 90 V a.c. r.m.s. may exist between the inner and outer conductors.

2.3.2 Remote powering and control signals via the outlet

Where 'back powering and control signals' to a network or to outdoor equipment are employed, such as amplifiers, low noise block converters, polarizers in antenna installations and multiswitches, the system shall comply with the following:

- (a) The maximum voltage applied between the inner and outer conductor of the outlet shall not exceed the safety extra low voltage (SELV) limit, as defined in AS/NZS 60065, i.e. 42.4 V a.c. r.m.s. or 60 V d.c.
- (b) The equipment shall be so designed and constructed such that no hazardous voltages can be touched under normal operating or single fault conditions.

NOTE: Equipment may need to comply with appropriate Australian regulatory requirements. Refer to Electrical Regulatory Authorities Council (ERAC) information available on the ACMA website.

2.3.3 Mains connected devices

The devices used in a cabled distribution system shall meet the requirements of AS/NZS 60065 for electrical safety.

2.4 ENVIRONMENTAL PROTECTION

Devices installed outdoors and either operated from the mains supply or line powered shall provide, as a minimum, a degree of protection afforded by an IPX4 rating, in accordance with AS 60529. Alternatively, they shall be installed in an appropriate splash-proof or watertight enclosure so as to provide the appropriate degree of protection for both atmospheric conditions and safety, preventing access by fingers.

2.5 TRANSIENT AND FAULT PROTECTION

2.5.1 General

When a coaxial cable distribution system is installed in a building, there are a number of aspects to be considered including the following:

- (a) The power-related currents that may flow in the coaxial cable.
- (b) The potential the coaxial cable can assume with respect to other earth zones, e.g. the power earth.
- (c) The ability to bleed induced voltages and currents resulting from static discharge and the accumulation of leakage currents.

The system shall employ equipotential bonding and/or a.c. mains isolation as summarized in Table 2.1.

2.5.2 Protection method choice

In cases where control signals and back powering are used, e.g. satellite multiswitches and LNBs, a.c. mains isolation at outlets shall not be used. Equipotential bonding should be employed in this system structure.

2.5.3 Equipotential bonding

2.5.3.1 General

Equipotential bonding to earth can be used to ensure that no hazardous voltages are present on the outer conductors of any cable or accessible metalwork of any equipment, including passive items.

Bonding can bleed induced voltages and currents resulting from static discharge pickup on outer conductors of cabling thus possibly reducing the chance of damage to system components and connected equipment.

2.5.3.2 Equipotential bonding technique

Equipotential bonding shall be achieved by connecting each active and passive device together and terminating to the CET location.

The CET is connected to the earth point for the area where the cabled distribution system is located.

If the cabled distribution system covers a number of earth zones then the use of isolators may be necessary (refer to Clause 2.5.4).

2.5.3.3 Installation of communications earth terminal (CET)

The CET is a terminal block that allows the bonding conductors to be individually disconnected.

The CET shall be installed in a convenient and readily accessible location near but external to the electrical switch or distribution board.

The CET shall be marked 'Communications earth terminal'.

The CET shall be connected to protective earth using a bonding conductor. The bonding conductor shall be labelled (communications earth system) at the protective earth end.

The connection to protective earth may be made either within the switchboard (Option 1) or external to the switchboard (Option 2) and shall comply with AS/NZS 3000 with respect to earthing arrangements and earthing conductors (see Figures 2.1 and 2.2).

NOTE: Only a licensed electrical worker may make connections within the switchboard (see AS/NZS 3000).

The protective earth connection can be made to the earthing conductor external to the switchboard if the earthing conductor(s) is not cut or rearranged or has the electrical integrity impaired during the installation of the bonding conductor terminations. Finally, any insulation removed shall be reinstated.

For the case of an external connection in multistorey dwellings, the bonding conductor can only be connected to the earthing conductor on its vertical rise between the floor and the tee-off for the switchboard or distribution board.

The bonding conductor from a distribution component shall be connected via the CET and not direct to the earth electrode except in an individual house.

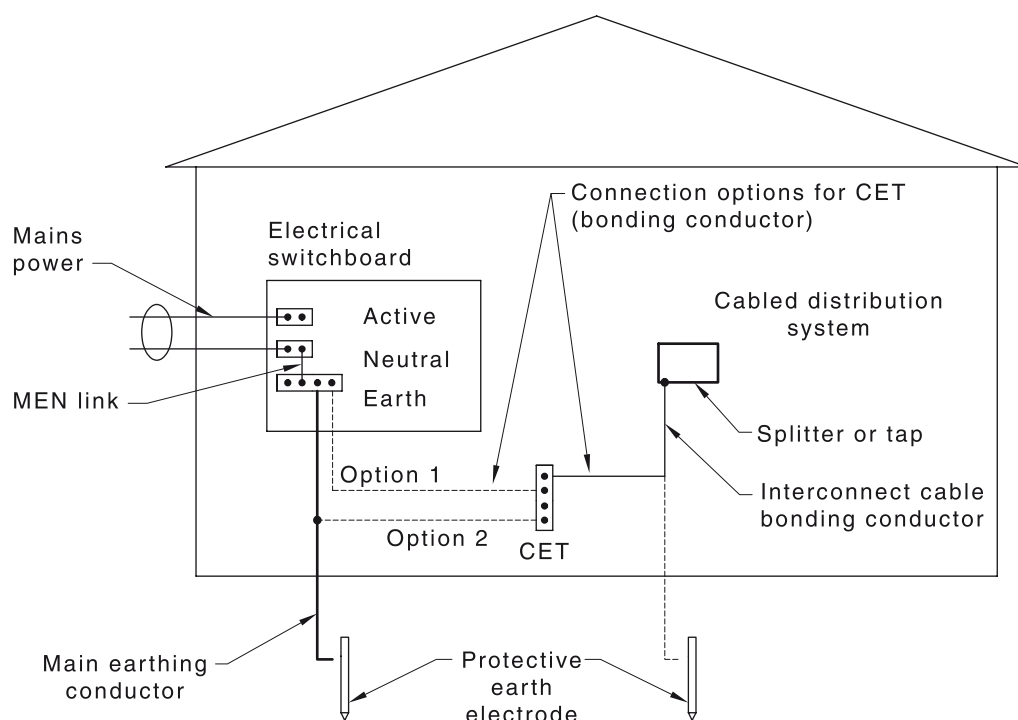


FIGURE 2.1 OPTIONS FOR EARTHED EQUIPOTENTIAL BONDING IN A SINGLE DWELLING INSTALLATION

2.5.3.4 Bonding conductors

The conductors used for equipotential bonding shall be green/yellow PVC insulated multi-stranded copper conductors having a cross-section of at least 6 mm^2 and shall be as short as practicable. Every connection of an earthing or bonding lead shall be soundly made by the use of clamps, connectors, crimp connectors, or soldering and shall be accessible for inspection.

2.5.3.5 Component earthing cable

Cables for earthing of components shall be a minimum of 2.5 mm^2 .

2.5.3.6 Fault current capacity

When equipotential bonding is employed, all coaxial cable sheaths, sheath series fittings, and series components with an impedance of less than 1Ω shall be capable of carrying a current of 30 A r.m.s. for a period of 5 s. Such components shall be accessible for inspection, even if only with the aid of a tool. The outer system between any connecting device, such as a socket forming part of a system outlet point and the next bonding point shall be capable of carrying a current of 30 A r.m.s. for a period of 5 s. Provision shall be made to maintain bonding while units are changed or removed.

NOTE: This requirement prevents equipment reaching dangerous voltages under fault conditions.

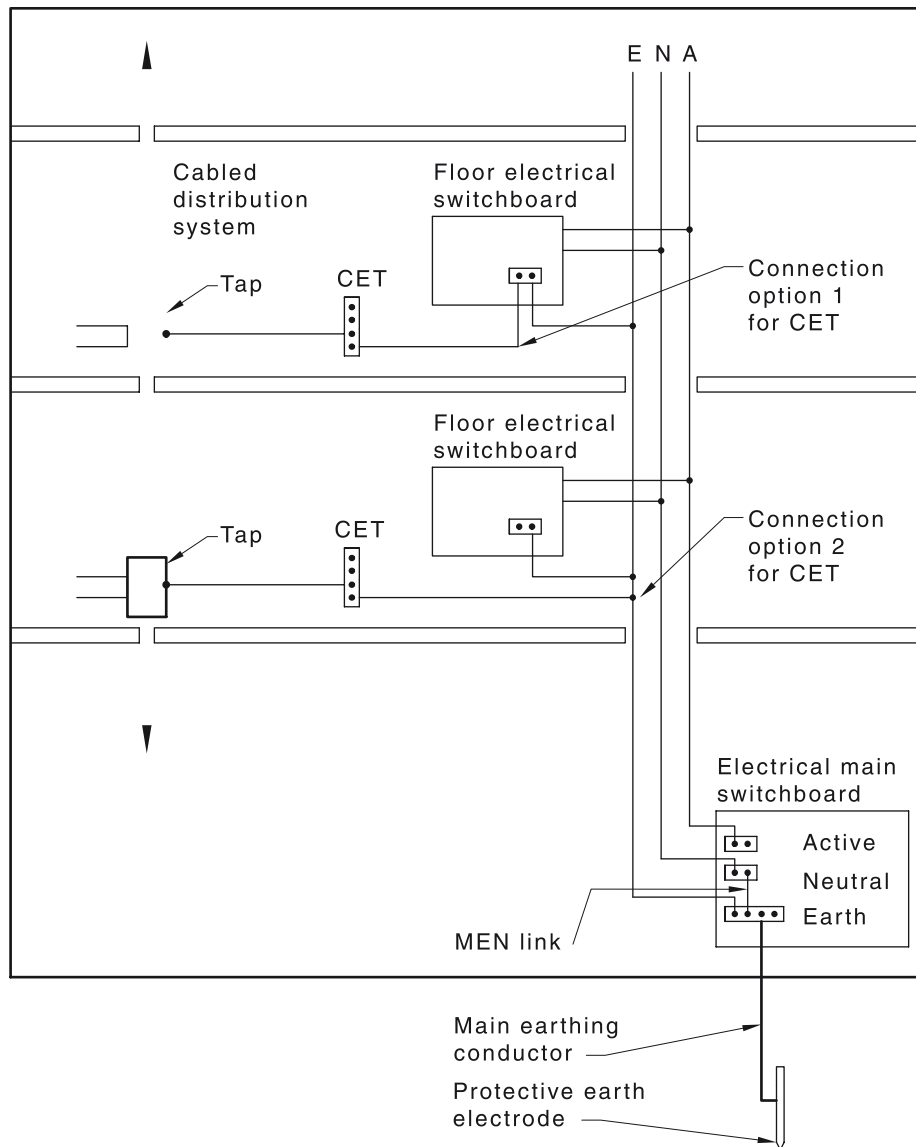


FIGURE 2.2 OPTIONS FOR EQUIPOTENTIAL BONDING IN A MULTIPLE DWELLING INSTALLATION

2.5.3.7 Earth loops

Employing equipotential bonding may produce 'earth loops' from multiple earths. This is due to different parts of a system being connected to separate earthing electrodes, allowing earth currents to flow. This can result in hum and other disturbances in the system. An isolator inserted in the main distribution path between different 'earthed' sections of a system will prevent such currents from arising.

2.5.4 Mains isolation

2.5.4.1 General

Where isolation is to be used, e.g. between premises or different earth zones, it shall be provided by a galvanic isolator where at mains frequency both the centre and outer conductors of the coaxial cable are isolated across the device. This prevents mains currents from flowing in the coaxial cable. The complete device shall be capable of withstanding 3.5 kV without breakdown.

NOTES:

- 1 If the cabled distribution system is connected to a cable operator, check with the cable operator for isolation requirements.
- 2 As a device providing a.c. mains isolation may cause the radiation or pick-up of RF energy usually at lower frequencies, special attention should be given to ensuring the device's screening effectiveness is adequate, especially if a return path is utilized.
- 3 For mains isolator/galvanic isolator RF performance specifications, refer to Clause 5.10.

2.5.4.2 Outlets

The following outlet types apply:

(a) *Non-isolated system outlet*

This type of outlet doesn't have any isolation components and is widely used in Australia. These non-isolated outlets allow remote powering and/or controlling of devices such as mast-head amplifiers and LNBs or selecting source in a multiswitch. Provision shall be made in the distribution system to prevent the power reaching other outlets. When a non-isolated outlet is used, an equipotential bonding system is required for safety reasons.

NOTE: For systems with integrated satellite and FTA on the same cable, a diplexer provides the required d.c. isolation.

(b) *Fully isolated system outlet*

This type of outlet incorporates d.c. isolating components in series with both the inner and the outer conductors of the coaxial connections as in Clause 2.5.4.1. The isolating components may be either high-voltage capacitors or double-wound transformers. This type of outlet inhibits remote powering and/or control of remote devices and is generally not used in Australia.

2.5.4.3 *Single dwellings*

In an installation within a single dwelling installation, an a.c. mains isolating device (RF pass) shall be provided if—

- (a) there is a feed from an external network, in which case the device shall be installed externally, prior to any splitting at the dwelling cabling interface (refer to Figure 2.3); or
- (b) the number of outlets exceeds six and does not have equipotential bonding.

This is to prevent the cumulative leakage currents from double insulated equipment from becoming excessive and tripping the core-balance residual current device (RCD) safety switch protecting the dwelling. Such leakage currents give rise to touch currents that can become excessive and result in unpleasant sensations when any part of the installation is contacted. One or more isolating devices can be used to divide the outlets into groups of approximately equal numbers such that the total in each group does not exceed six.

A consumer mains power board (power strip) with a loop-through RF port with the outer connected to the protective earth (preferably via a 0.02 μf high voltage capacitor) may be used to offer equipotential bonding.

NOTE: For descriptions of single and multiple dwelling categories, see Clause 1.11.1.

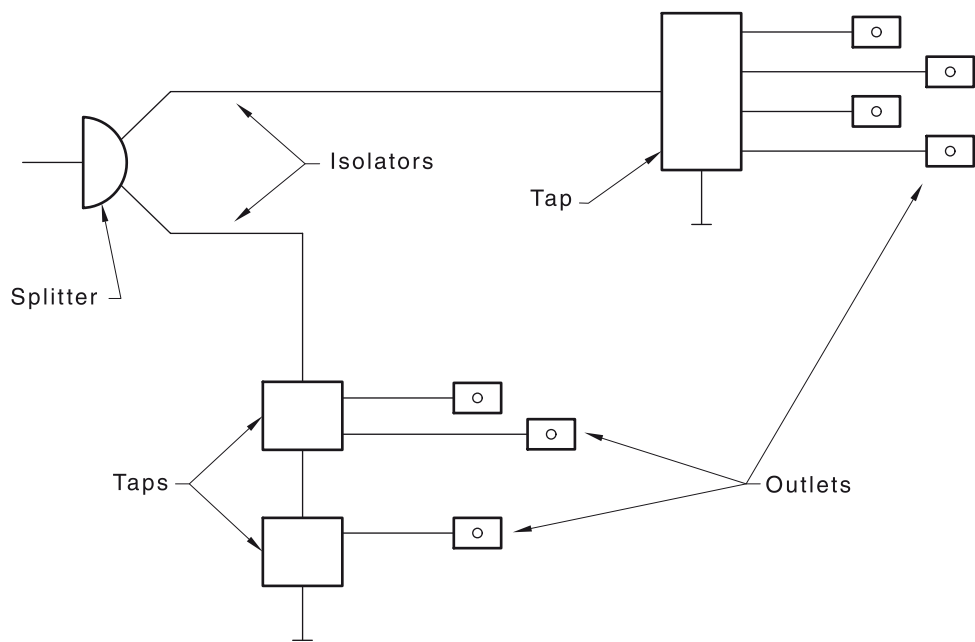


FIGURE 2.3 EXAMPLE OF AN INSTALLATION OF ISOLATORS IN A SINGLE DWELLING WHERE THE NUMBER OF OUTLETS EXCEEDS SIX

2.5.4.4 Multiple dwellings

In multiple dwelling installations, an a.c. mains isolating device shall be installed in each dwelling’s coaxial cable, that is, between each output port of the distribution tap and the corresponding dwelling’s coaxial cable, unless the installation uses the equipotential bonding technique, which shall be used in the case of control signals and back powering (see Clause 2.5.2).

NOTE: The mains isolating device may be an integral part of the wallplate.

In addition, any external network shall be isolated prior to the local headend or distribution equipment.

TABLE 2.1
SUMMARY OF EQUIPOTENTIAL BONDING AND ISOLATING REQUIREMENTS

	Single dwelling	Multiple dwelling	
		Free standing or with feed from external cable network	With back powering and/or control signals
Antenna support earthing	Optional for a single house	Required as per Clause 2.2.2	Required as per Clause 2.2.2
Distribution system earthing	Required as per Clause 2.5.3	Required as per Clause 2.5.2	Required as per Clause 2.5.2
Outlet group/dwelling isolation	Required. If the number in a group of outlets exceeds 6 as per Clause 2.5.4.3(b)	Required as per Clause 2.5.4.4 for outlets for cable network isolation	N/A as per Clause 2.5.2
External cable network isolation	Required as per Clause 2.5.4.3(a) for system isolation	Required as per Clause 2.5.4.4 for cable network isolation	N/A

2.6 PROXIMITY TO AND SEGREGATION FROM OTHER SYSTEMS

2.6.1 General

The cabled distribution system shall be adequately protected against inadvertent contact with or hazardous (fault condition) induction from power distribution, lightning or high voltage systems.

NOTE: Some guidelines are set out in Appendix G.

2.6.2 Segregation

In Australia, segregation of system cables from other wiring shall comply with the relevant parts of AS/NZS 3000 and AS/CA S009.

Segregation from lightning down conductors shall be ensured.

System cables installed in concealed locations and not enclosed in conduits or ducts shall be separated, for their entire length, from mains wiring by at least 50 mm unless there is an interposing, substantial, durable insulating barrier between them. This 50 mm distance may be reduced to 6 mm at crossings of cable systems provided that a durable insulating material, overlapping the crossing point by at least 25 mm in all directions, separates the cable systems.

When system cables are installed in fire hydrant enclosures or risers they shall be installed in metal conduit.

Cables shall not be installed in fire hydrant enclosures or risers without the express permission of the respective authorities.

When system cables are installed in fire escapes they shall be installed in metal conduit.

NOTE: There should be the equivalent of at least double insulation for the highest voltage present between the system distribution cables and other cables in the enclosure, possibly by using a separate duct or by using a fixed continuous barrier within the duct.

Segregation of system cabling from non-electrical hazards such as pipes carrying corrosive or flammable fluids, liquid or gas, and pipe temperatures exceeding 60°C, shall be ensured.

Cables run in lift shafts or lift motor rooms shall comply with AS/NZS 3000.

System outlet points shall not be installed in wet areas, as defined by the conditions in AS/NZS 3000.

2.7 OPTICAL SYSTEMS—SAFETY PRECAUTIONS

Appropriate warning signs shall be prominently displayed wherever there are active optical transmitters or optical cable ends carrying power levels in excess of 0 dBm (1 mW). The safety precautions shall be in accordance with IEC 60728-6.

SECTION 3 ELECTROMAGNETIC COMPATIBILITY (EMC) REQUIREMENTS

3.1 GENERAL

3.1.1 Introduction

To minimize the risk both of interference to other radio-frequency services external to the cabled distribution system and of the possible penetration of unwanted external emissions into the cabled distribution system, it is necessary not only to use equipment which satisfies the emission and immunity requirements, that is the EMC requirements, but also to ensure the integrity of the total installation and in particular of all coaxial cable connections to each item of active or passive equipment.

3.1.2 Application

This Section is applicable to electromagnetic emission and immunity characteristics of complete cabled distribution systems for the reception and distribution of television and radio signals. Test methods for conformance testing are described, and system requirements are specified in terms of maximum allowed emission (signal egress from the system), and minimum immunity levels (signal ingress into the system) for both normal and fault conditions. Both environment and conduction limits are also provided.

3.1.3 Electromagnetic compatibility regulation

The individual devices within the cabled distribution system need to comply with the relevant EMC regulations and standards.

NOTE: The relevant EMC regulations and standards are mandated by Australian and New Zealand regulators, the Australian Communications and Media Authority (ACMA) and the Ministry of Economic Development, Radio Spectrum Management Group (RSM), respectively. Compliant devices are required to have a C-Tick or regulatory compliance mark (RCM). The RCM replace the C-Tick mark after 1 March 2016. The compliance requirements of the individual devices within the cabled distribution system for both Australia and New Zealand can be obtained from the ACMA website (www.acma.gov.au).

3.1.4 Specification

The EMC of active and passive equipment is detailed in the screening effectiveness clauses in Sections 4, 5, 6, 7 and 8 of this Standard.

3.1.5 Theoretical basis

3.1.5.1 General

The EMC performance of a system (emission and immunity) is dependent on the quality of installation practices, the level of signals distributed on the network and individual component EMC performance, in terms of balancing and screening effectiveness, i.e. the ability of a device to attenuate the influence of electromagnetic fields from outside the device or to suppress the emission of electromagnetic fields from inside the device.

NOTE: See Figure 3.1.

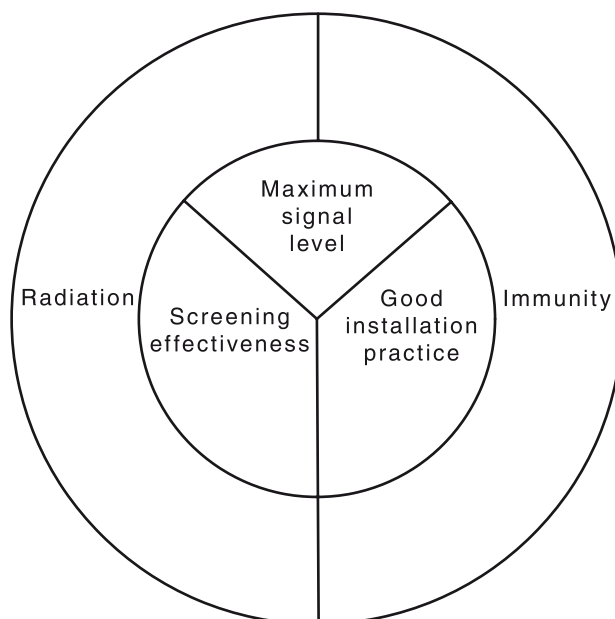


FIGURE 3.1 FACTORS GOVERNING SYSTEM EMC PERFORMANCE

3.1.5.2 Sources of unwanted interference

Unwanted interference to and from a cabled distribution system may arise from the following:

- (a) Improper selection of system components, i.e.—
 - (i) poor screening of active and passive equipment (splitters, amplifiers, etc.); or
 - (ii) poor screening of the distribution cables against induced voltages and currents.
- (b) Excessive impedance in the ground connection of the input terminals of active equipment.
- (c) Poor connections in the outer conductor of the coaxial cables, usually where the coaxial cable is jointed to system equipment or, occasionally, from a damaged section of coaxial cable.
- (d) Poor balancing of antenna elements that include the use of either no or a poor performing balun (balanced to unbalanced transformer).

NOTE: Problems such as poor balancing of antenna elements force unwanted signals or impulse noise on the outer of the antenna drop coaxial cable into the inner of the coaxial cable with the result of injection of unwanted signal or impulse noise into the system and therefore to the end user. This results in decreased margins in digital systems.

3.2 EMISSION FROM A SYSTEM (ENVIRONMENT)

3.2.1 General

The field strength of leakage emission at any point is a resultant of contributions from several leakage points that have random phase and amplitude, although close to major faults only one source can be locally dominant. A fault in a cabled distribution system which causes undue emission will result in a similar overall effect at all frequencies but the field strength in one location may vary with frequency.

3.2.2 Measurement method

3.2.2.1 General

The method of measurement for emission from cabled distribution systems or parts thereof requires—

- (a) the inclusion of an identifiable test or carrier signal on the system, in order that the measurement is not confused by off-air signals; and
- (b) means to detect, calibrate and measure the threshold levels of the whole measurement system, namely—
 - (i) a calibrated half wave dipole antenna or an appropriate measurement antenna; and
 - (ii) a selective tuneable receiver (field strength meter) or appropriate single-frequency receiver, spectrum analyser etc.

3.2.2.2 Configuration

The necessary measuring arrangement is shown in Figure 3.2. The test set-up shall be well matched. Matching attenuators, measurement cables and connectors to suit the test equipment and system under test shall be used.

3.2.2.3 Test signal

The test signal should be applied to the system at the system input at a level equal to or proportioned to the potential maximum channel power (for digitally modulated services) or carrier level (for analog TV and radio). The test signal should have the following:

- (a) A carrier level not exceeding 120 dB μ V (+11.25 dBm).
NOTE: The maximum level in the MATV system is the sum of the channel powers of carried signals which might include DVB-terrestrial, cable, satellite, analog TV and radio. A potential maximum level may be catered for by testing with a lower level and applying a correction for the difference between the lower test level and the potential maximum level.
- (b) A level not resulting in unacceptable interference by overload and intermodulation to the other system signals.
- (c) A frequency not interfering with normal system operation.
- (d) Suitable modulation to allow for explicit identification.

For maintenance testing on an operational system, some service providers provide either pilot tones or ‘channel tagging’ on specific carriers, to clearly identify whether an emission source emanates from their channels. This will negate the need to inject a signal into the system. An adjustment shall then be applied to the measured results to compensate for the difference between the pilot tone level and the maximum potential level of individual services in the cabled distribution system.

3.2.2.4 Measurement

The measurement is made at a distance (d) from the point to be measured (assumed source of radiation). Standardized measuring distances, 3 m or 10 m, are recommended. The measurement shall be made in the direction, from the point to be measured, which is as free of obstacles as possible. An effort shall be made to maximize the indication of the measuring receiver by turning the reception antenna and moving it in different directions. Special attention should be given to emissions in the aeronautical radio navigation and radio communication frequencies that fall in the range 118 MHz to 140 MHz.

3.2.2.5 Calibration

The antenna shall be calibrated, and the selective or tuneable receiver, suitable for the frequency band used and having a signal level output with adequate dynamic range, can be used for the measurements. The total sensitivity and accuracy of the measuring system shall not cause more than ± 3 dB error in RF threshold levels, taking into account the temperature and operating voltage conditions that occur in practical use.

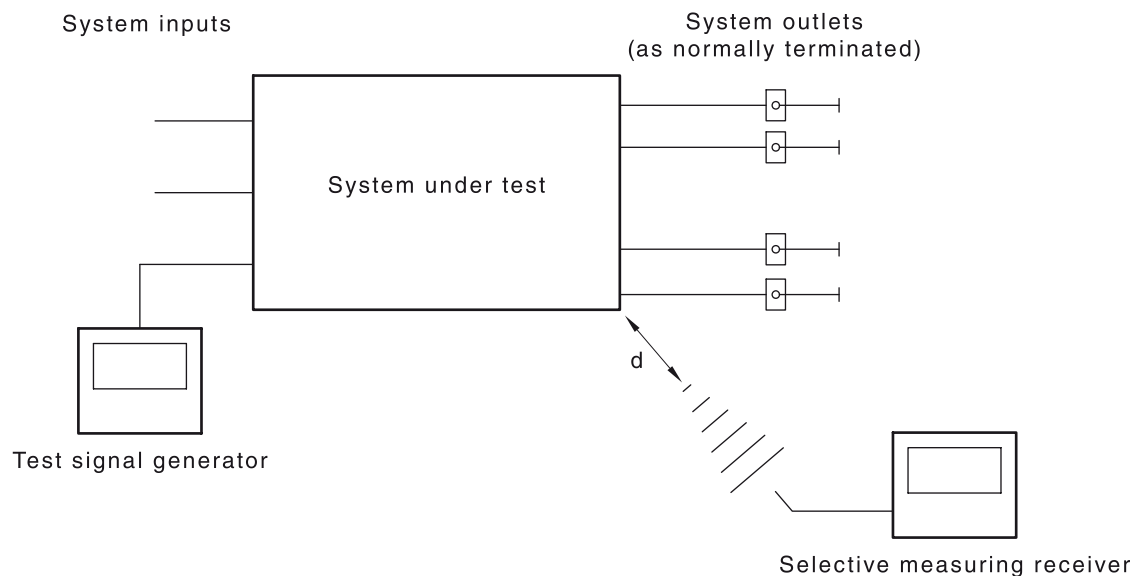


FIGURE 3.2 SYSTEM EMISSION MEASUREMENT SETUP

3.2.3 Emission field strength limits

The maximum emission field strength limits are shown in Table 3.1.

TABLE 3.1
EMISSION FIELD STRENGTH LIMITS

Frequency range MHz	Maximum isotropic power of a service generated external to MATV system dBpW	Maximum field strength (F/S) at 3 m	
		$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$
5 to 45	5	3	10
45 to 1000	5 to 20	3 to 18	10 to 25
1000 to 2500	20 to 43	18 to 258	25 to 48
2500 to 25000	43 to 57	258 to 1293	48 to 62

NOTE:

- 1 The increase from lowest to highest limit is related to a linear change of F/S in $\mu\text{V/m}$ over stated frequency range, for example, at 45 MHz: 5 dBpW; 3 $\mu\text{V/m}$; 10 $\text{dB}\mu\text{V/m}$ applies and at 500 MHz: 15 dBpW; 10 $\mu\text{V/m}$; 20 $\text{dB}\mu\text{V/m}$ applies and at 1000 MHz: 20 dBpW; 18 $\mu\text{V/m}$; 25 $\text{dB}\mu\text{V/m}$ applies.
- 2 Emissions above 2150 MHz are not anticipated. The limits above 2150 MHz are provided as a control on parasitic spurious emissions and are included for design purposes only.

3.3 EMISSION FROM A SYSTEM (CONDUCTION)

Conducted emission voltages from equipment on the mains supply cable shall comply with the maximum levels in Table 3.2.

TABLE 3.2
CONDUCTED EMISSION VOLTAGES

Frequency range MHz	Maximum level dB μ V	
	Quasi peak-to-peak	Average value
0.15 to 0.5	66 to 56 (see Note)	56 to 46 (see Note)
0.5 to 5	56	46
5 to 30	60	50

NOTE: Decreasing to the equation $20 \times \log$ arithm of the frequency ratio.

3.4 IMMUNITY OF A SYSTEM (ENVIRONMENT)

3.4.1 General

The method described in this Clause (3.4) applies to the measurement of the ‘figure of merit’ relating to the external immunity of a cabled distribution system to ambient environment electromagnetic fields, i.e. in the test methodology no test signals are generated in the system.

The ‘figure of merit’ is defined, for synchronous working, as the ratio of the working signal level at an outlet to the maximum level of the ‘picked-up’ signal at the same outlet with all system inputs terminated. For asynchronous working, it is the ratio of the level of the nearest working signal to the maximum level of the pick-up signal.

3.4.2 System immunity limits from other transmitted services

The immunity of the system shall be such that, at any system outlet on any distributed channel, the ratio of the wanted carrier to the interfering signal (caused by an external field) is not less than the limits given for single-frequency interference shown in Table 3.3.

TABLE 3.3
SYSTEM IMMUNITY LIMITS

Frequency range, MHz	Figure of merit, dB
5 to 45	See Note 1
45 to 862	Greater than 60 dB
862 to 950	Not specified (see Note 2)
950 to 2150	Greater than 35 dB

NOTE:

- 1 If the frequency range of 5 MHz to 45 MHz is used, the level will be determined by the requirements of the application. For example, as a return channel, an analog carrier may require a ratio greater than 60 dB.
- 2 This band is not used for cable TV services, therefore no protection is required. It is allocated to mobile telecommunication.

3.4.3 Maximum unwanted interfering field strength

It is assumed that the just perceptible disturbance corresponds to an external unwanted field strength (F/S) defined in Table 3.4.

TABLE 3.4
MAXIMUM UNWANTED INTERFERING FIELD STRENGTH

Frequency range MHz	Field strength dB μ V/m
0.15 to 1000	125
1000 to 2150	100

NOTE: If an LTE source radiates the allowable maximum EIRP of +47 dBm/30 kHz spectral density, (spread, for example, over an 8 MHz bandwidth of a DVB-C service), then even at 350 m distance, the resultant field strength would still be in the order of 125 dB μ V/m. This emphasizes the need to ensure such signals are not easily able to ingress the cable system.

3.4.4 System immunity from impulsive noise

Wanted digital services shall also be protected from impulsive noise interference. Such impulsive noise may be generated by mains power distribution systems (power lines), industrial/commercial facilities and from domestic electrical and electronic devices in close proximity to the antenna and antenna distribution systems. DVB-T and DVB-C systems have a sensitivity to impulsive noise and, dependent on the particular receiver's ability to reject such interference, it may cause some receivers to produce audible and/or visible program corruption.

To minimize the effects of impulsive noise interference it is important that the antenna location be properly chosen and the system shielding and matching integrity comply with this Standard as defined for headend, passives and actives sections, including the final fly-lead to the consumer's receivers and decoders.

3.4.5 Method of measurement of the external immunity of a system

3.4.5.1 General

The following requirements apply to external immunity measurements:

- (a) The test set-up shall be well matched.
- (b) An accurate signal level meter suitable for measuring r.m.s. on peak sync of television signals, r.m.s. of carrier wave (CW) signals and the channel power of digitally modulated signals shall be used. The level meter shall cover the operating frequency of the system to be measured and be capable of measuring down to 0 dB μ V. The immunity of the signal level meter itself shall be adequate for the measurement to be made.
- (c) Well screened load(s) of 75 Ω impedance and with a return loss greater than 18 dB over the frequency range to be measured shall be used.
- (d) Matching attenuators, measurement cables and connectors to suit the test equipment and system under test shall be used.

NOTE: Equipment layout and connections are shown in Figure 3.3.

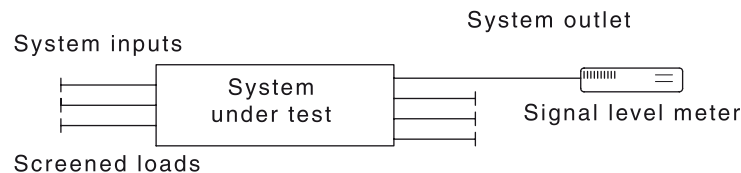


FIGURE 3.3 SYSTEM IMMUNITY MEASUREMENT SETUP

3.4.5.2 Operating conditions

Measurement shall be made after the system has been set to its nominal levels.

3.4.5.3 Immunity measurement procedure

In determining the immunity to unwanted signal ingress, the following test sequence is recommended:

- (a) *Remove all inputs and known signal sources* At the headend, disconnect the system input(s) and terminate with well-screened load(s). Modulator(s) and any other systems that generated carriers should be disabled. Also, any AGC functions should be disabled.
- (b) *Identify unwanted ingress signals* Measure the level of all signals appearing at the furthest system outlet(s). Record the frequencies. Measurements should be made at sufficient outlets on each branch to ensure adequate representation of the immunity throughout the system.
NOTE: Setting up near a suitable antenna and observing if any of these signals are receivable may assist confirmation of measured ingress frequencies.
- (c) *Measure wanted and unwanted signals* Reconnect the system input(s), restore normal operation of the system including AGC and measure the levels of the signals at all distribution frequencies (wanted signals), and at any other frequencies (unwanted signals), as recorded, when the system inputs were terminated. Record these results.

The results should fall within the system immunity limits specified in Table 3.3 and as determined in Clause 3.4.2.

NOTE: This procedure assists in determining the ‘integrity’ of the system including any problematic connectors. Some local knowledge of nearby potential sources of interference is useful, especially if those potential sources operate intermittently.

3.4.5.4 Interpretation of results

The figure of merit at any system outlet may be calculated from the results recorded during the measurement procedure, as follows:

$$\text{Figure of merit (dB)} = \text{Wanted (dB}\mu\text{V)} - \text{unwanted (dB}\mu\text{V)}$$

The figure of merit for the system outlet is derived from the individual figures obtained at the different measurement frequencies as calculated above, and is the worst (lowest) of these figures.

The figure of merit representing the external immunity of the complete system is derived from the results obtained above for each of the different system outlets tested. It is the worst (lowest) of these figures.

3.5 IMMUNITY OF A SYSTEM (CONDUCTION)

3.5.1 General

All equipment covered in this Standard shall to be immune to conducted signals up to maximum levels defined in the limits below.

3.5.2 Limits

3.5.2.1 Mains lead conduction

Mains lead conducted immunity limits are specified in Table 3.5.

TABLE 3.5
MAINS LEAD CONDUCTED IMMUNITY LIMITS

Frequency range MHz	Minimum level dB μ V
0.15 to 45	125
45 to 100	120
100 to 230	120 to 80 (see Note)

NOTE: Decreasing to the equation $112 \times \log_{10}$ of the frequency ratio (relative 100 MHz).

3.5.2.2 Non-mains lead conduction

External immunity to signals conducted via connected cables (non-mains lead) shall comply with the limits in Table 3.6.

TABLE 3.6
NON-MAINS LEADS CONDUCTED IMMUNITY LIMITS

Frequency range MHz	Minimum level dB μ V
1.5 to 230	126
230 to 862	120

SECTION 4 ACTIVE DISTRIBUTION EQUIPMENT

4.1 GENERAL

This Section is applicable to all limited bandwidth and broadband equipment used in coaxial cable distribution systems in the frequency range 5 MHz to 2150 MHz.

For other specifications relating to active distribution equipment, refer to the following:

- (a) Section 6 for headend equipment.
- (b) Section 7 for optical specific equipment.
- (c) Section 8 for satellite specific equipment.

In order to comply with this Section of the Standard, details of the performance specifications from manufacturers or suppliers of all active distribution equipment used in a system shall be specified as detailed in Appendix D. Installation and operating instructions for active distribution equipment should be available from the equipment supplier.

4.2 ENVIRONMENT

The acceptable operating temperature range for equipment should be specified. The operating range shall be suitable for the environment in which the equipment is to be operated. The equipment shall withstand an ambient temperature range of -10°C to $+55^{\circ}\text{C}$. The equipment shall remain within specification over a temperature range of 5°C to $+50^{\circ}\text{C}$ with up to 95% non-condensing humidity.

4.3 ELECTROMAGNETIC COMPATIBILITY

4.3.1 Emission from equipment

Performance requirements are detailed by relevant limits in Clauses 3.2 and 3.3.

4.3.2 Immunity of equipment

Performance requirements are detailed by relevant limits in Clauses 3.4 and 3.5.

4.4 EQUIPMENT EARTHING

All active devices shall have conveniently available an earth terminal capable of accepting a 2.5 mm^2 earthing conductor as required by equipotential bonding in Clause 2.5.3.4.

4.5 FREQUENCY RANGE

The frequency range, or ranges, over which the equipment is specified, shall be published and displayed on the equipment label or associated data sheet.

4.6 NOMINAL IMPEDANCE

4.6.1 General

The nominal impedance of input and output ports and test points shall be $75\ \Omega$. All measurements shall be referred to this impedance.

4.6.2 Return loss

The return loss specification of all input and output ports and test points of an active device shall be achieved under all specified conditions of automatic and manual gain and slope controls, and with any combination of fitted plug-in equalizers and attenuators or polarization selection, as specified by the manufacturer for use with the device.

The return loss of input and output ports of any broadband or limited bandwidth active device shall be measured over the operating frequency range as follows:

- (a) For Grade 2 RL: ≥ 10 dB in 5 MHz to 862 MHz, and ≥ 10 dB in 950 MHz to 2150 MHz.
- (b) For Grade 1 RL: ≥ 16 dB in 5 MHz to 862 MHz, and ≥ 14 dB in 950 MHz to 2150 MHz.

4.7 GAIN

4.7.1 Gain and gain range

The guaranteed gain, or maximum gain with gain range, whichever is applicable, of the active equipment at the minimum and maximum specified operating frequency shall be published and marked in decibels (dB) on the equipment label or associated data sheet.

4.7.2 Frequency dependant gain (slope)

Where applicable, fixed or variable slope characteristics shall be specified and marked on the equipment label or associated data sheet. Such a rating may be combined with the gain description.

4.8 AMPLITUDE FLATNESS

4.8.1 General

The term 'flatness' refers to the deviation from a linear amplitude response through the bandwidth being assessed. The flatness specification or measurement shall not include any specified or intended amplitude slope in the linear amplitude response.

NOTE: The term 'linearity' is sometimes used in the description of gain variation with frequency. As this term can be confused with non-linear (i.e. distortion producing) performance terms such as video luminance linearity, the use of the term 'linearity' as related to amplitude response should be discouraged and is not used in this Standard in this context. The term 'slope' is the alternative description of a change in gain or loss of the amplitude response with frequency and is used in this Standard.

4.8.2 Specification

4.8.2.1 Wideband flatness

Wideband flatness is applicable to active devices covering an operating band or bands, for example, terrestrial amplifiers, satellite IF amplifiers and broadband amplifiers.

The amplitude versus frequency response flatness from the input to output of the active device over the operating frequency range or individual band shall be as follows:

- (a) For Grade 1: within ± 1 dB.
- (b) For Grade 2: within ± 2 dB.

The wideband flatness shall be measured with reference to the centre of the operating frequency range or as follows:

- (i) 200 MHz for VHF terrestrial.
- (ii) 600 MHz for UHF terrestrial.
- (iii) 1500 MHz for satellite IF.
- (iv) 1000 MHz for covering all bands.

These tolerances can be relative to any specified or intended positive amplitude slope.

4.8.2.2 *Narrowband flatness*

Narrowband flatness is applicable to any active device, for example, broadband amplifiers and channel amplifiers.

The peak-to-peak narrowband flatness from input to output of the active device shall be as follows:

- (a) In the terrestrial band: within ± 0.2 dB for any 0.5 MHz segment
within ± 0.3 dB for any 7 MHz segment.
- (b) In the satellite IF band: within ± 0.3 dB for any 2 MHz segment
within ± 0.5 dB for any 36 MHz segment.

NOTE: These tolerances can be relative to any specified or intended positive amplitude slope.

4.8.3 **Conditions**

The flatness specification shall be achieved under all specified conditions of automatic and manual gain and slope control, polarization selection as applicable or specified for use with the device.

The RL of the test equipment used in this measurement may play a major role in the flatness measurement result as a consequence of the mismatching or reflections creating ripples in the amplitude response. To avoid this potential variation in the test results the test equipment RL should be at least 18 dB otherwise the type of test equipment should be indicated with the test results.

4.9 **TEST POINTS**

Test monitoring points shall be 75 Ω . The RL should correspond to that specified in Clause 4.6.1 with the grade being at least consistent with the rating of the other ports.

The test point loss should be stated on the equipment's label and its loss relative to the equipment's output should be constant across the operating frequency range.

4.10 **GROUP DELAY—DVB-T, DVB-S, DVB-C, DAB+ AND FM RADIO**

Group delay refers to the variation in arrival time of a band of signals over a given frequency range at the outlet measuring point. It was more important in analog modulation systems such as wide band FM over a 36 MHz range or analog PAL TV over a nominal 5 MHz to 7 MHz range.

Group delay can be caused by rapid amplitude roll off (loss) in filters and may be reduced by compensating 'phase-correcting' networks added to the filter design.

While the variation in delay caused measurable distortion effects to the demodulated analog signal, the effects on digital signals is less severe. It is expected that any group delay that MATV systems can provide will not result in distortion DVB-T and DAB+ services.

For DVB-S, DVB-C and FM radio, the group delay variation across the centre 80% of the particular RF nominal bandwidth should not exceed 80 ns.

For in-house analog TV the group delay variation from 1 MHz below the vision carrier to 4.5 MHz above the vision carrier should not exceed 80 ns (see also Clause 9.14.4).

4.11 **NOISE FIGURE**

The maximum noise figure over the specified frequency range shall be published to allow the system designer to determine the overall system carrier to noise ratio.

4.12 RADIO FREQUENCY ISOLATION

4.12.1 Equipment with multiple outputs

The RF mutual isolation between output ports of the equipment such as an amplifier shall be ≥ 18 dB within the band 5 MHz to 862 MHz and ≥ 15 dB within the band 950 MHz to 2150 MHz.

4.12.2 Equipment catering for multiple trunks

Where multiple active equipment such as amplifiers are combined within the same unit, the RF isolation between each trunk path shall be ≥ 40 dB within the band 5 MHz to 862 MHz and ≥ 30 dB within the band 950 MHz to 2150 MHz.

4.13 MAXIMUM OUTPUT LEVEL CAPABILITY

4.13.1 General

The maximum level of individual services that a distribution system is able to accommodate is influenced by the following:

- (a) The total number of services (or channel loading).
- (b) The intermodulation distortion performance of EACH active device.
- (c) The arrangement of the active devices within a system design, (e.g., the number in cascade).
- (d) The recommended maximum system outlet levels as given in Table 9.2.

When designing a system, each active device's maximum level capability needs to be considered in the design to ensure that each service's signal will not exceed a maximum allowable overload level. Such overload causes excessive intermodulation (IM) spurious products that seriously degrade the required service quality as specified in Clause 9.11 and Table 9.4.

4.13.2 Methods of rating output level capability

A device's maximum output level capability can be derived based upon the choice of following methods:

- (a) Maximum output level (MOL) rating:
NOTE: This is a standardized method used to specify a MOL for an individual active device in the system—see Clause 4.13.4.1 for the choice of a Standard that may be used to provide a MOL for a device.
- (b) The digital service rating (DSR) that may be determined by:
 - (i) Conversion of MOL rating to DSR by applying de-rating factors for channel/transponder loading (see Clause 4.13.4).
 - (ii) DSR direct measurement by using a single digital service (see Clause 4.13.5).
 - (iii) DSR direct measurement by 1 dB compression point (see Clause 4.13.6).
 - (iv) DSR direct measurement by wideband noise and frequency notch (see Clause 4.13.6).

4.13.3 Rating definitions

The following definitions are applicable in this Standard:

- (a) MOL only indicates the maximum output level capability of a device as derived from the CW carrier-based test methods given in the Standards indicated in Clause 4.13.4. MOL on its own does not provide the maximum output level capability that will be available for any digital service in a channel or transponder loaded spectrum from the device. MOL is required to have de-rating factors applied to obtain a DSR.
- (b) DSR is the maximum output level capability of a device for a digital service with a purpose defined channel/transponder loading.

4.13.4 MOL rating methods

4.13.4.1 General

The MOL of an individual active device shall be provided via the following criteria and determined by CW test methods of the second and/or third order IM distortion rating with various defined CW carrier structures.

The methods of measurement shall be chosen from, and in accordance with, the following:

- (a) Terrestrial (5 MHz to 862 MHz):
 - (i) DIN 45004B (3 carriers IM_3 @ -60 dB)—*Broadband amplifiers*.
 - (ii) EN 50083-3 or EN 60728-3 (2 carriers IM_2 and 3 carriers IM_3 @ -60 dB)—*active wideband equipment for coaxial cable networks* for distribution and cascaded amplifiers.
 - (iii) EN 50083-5 or IEC 60728-5 (2 carriers IM_2 and 3 carriers IM_3 @ -60 dB)—*Headend equipment*.
- (b) Satellite (950 MHz to 2150 MHz):
 - (i) EN 50083-3 or IEC 60728-3 (2 carriers IM_2 and 3 carriers IM_3 @ -35 dB)—*active wideband equipment for coaxial cable networks* for distribution and cascaded amplifiers.
 - (ii) EN 50083-5 or IEC 60728-5 (2 carriers IM_2 and 2 carriers IM_3 @ -35 dB)—*Headend equipment*.

Both IM_2 and IM_3 as determined in Clauses 4.13.4.2 and 4.13.4.3 shall be measured. Both or the lowest maximum level for equivalent two-channel operation shall be recorded on the label of the device along with the Standard used for the measurement method.

In the case where EN 50083-3 IM_3 is used for terrestrial, the number of carriers shall be indicated, for example, whether 3 carriers or 42 carriers.

4.13.4.2 Second order distortion (IM_2)

The maximum output level is determined with the worst case adjustment or configuration of the equipment under test that produces—

- (a) -60 dB IM_2 for terrestrial bands; or
- (b) -35 dB IM_2 for satellite IF bands.

4.13.4.3 Third order distortion (IM_3)

The maximum output level is determined with the worst case adjustment or configuration of the equipment under test that produces—

- (a) -60 dB IM_3 for terrestrial bands; or
- (b) -35 dB IM_3 for satellite IF bands.

4.13.5 Conversion of MOL to DSR

4.13.5.1 General

In the absence of information provided by the manufacturer for channel loading and cascading of an active device de-rating factors, the de-rating of the MOL to obtain a DSR is provided in Clauses 4.13.4.1 and 4.13.4.2 and is summarized in Tables 4.1 and 4.2.

4.13.5.2 De-rating of MOL rating by channel loading

The DSR of an individual active device can be determined by the use of the lowest value determined for MOL and applying:

- (a) A de-rating factor (R1) to allow for the number of channels.

Channel loading de-rating (R1)

$$R1(\text{dB}) = 7.5 \times \text{Log}_{10}(N - 1)$$

where

N = the number of digital channels

NOTE: R1 is given in Table 4.1 for some examples of a number of channels.

- (b) A method type adjustment factor (S) for the method within a Standard used for measurement of MOL.

Method type adjustment (S):

There are nominal differences between the various techniques used. After determining the de-rating factor (R1) a correction factor as given below should be applied to obtain DSR.

For tests based upon a Standard with:

2-carrier IM₂ S = 0 dB (i.e. no adjustment is required)

2-carrier IM₃ S = -1 dB

3-carrier IM₃ S = -3 dB

42-carrier IM₃ S = -12 dB

The difference between the measurement methods (S) is very dependent upon the active device design for example whether the output stage uses MOSFET or bipolar technology devices and whether it is a balanced or unbalanced design that consequently will produce either third or second order IMs at different levels. Therefore, the figures given for S are intended as a guide and are to indicate there is a difference between amplifier types and measurement methods. Guidance from the product manufacturer should be obtained if available. The difference between IM₂ and IM₃-based MOL can typically vary from 0 dB to 8 dB between amplifier types. Therefore:

$$\text{DSR of a device} = \text{MOL} - R1 - S$$

NOTES:

- 1 When determining the channel loading, an in-house analog TV service vision carrier level nominally 6 dB higher than a digital TV service channel power counts as one service as does the DTV service.
- 2 Table 4.1 is to be used only as a guide, as the actual result will not only vary with the actual level difference between services but also with the design and technology utilized in the active devices.
- 3 A further de-rating is applicable when active devices are cascaded in a system as in Clause 4.13.