



Digital television—Requirements for receivers for VHF/UHF DVB-T television broadcasts including ancillary services



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- Australian Broadcasting Corporation
 - Australian Communications and Media Authority
 - 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
 - Department of Communications (Australian Government)
 - Free TV Australia
 - Media Access Australia
 - Special Broadcasting Service
-

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Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Australian Standard[®]

Digital television—Requirements for receivers for VHF/UHF DVB-T television broadcasts including ancillary services

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PREFACE

This Standard was prepared by the Australian members of the Joint Standards Australia/Standards New Zealand Committee CT-002, Broadcasting and Related Services, to supersede AS 4933.1—2010, *Digital television—Requirements for receivers, Part 1: VHF/UHF DVB-T television broadcasts*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand Standard.

The objective of this Standard is to provide television receiver manufacturers with the technical specifications and requirements relating to digital television receivers intended to be used in Australia to receive and decode free-to-air DVB-T transmissions that comply with the Australian Digital Terrestrial Television Broadcasting (DTTB) transmission Standard AS 4599.1, *Digital television—Terrestrial broadcasting, Part 1: Characteristics of digital terrestrial television transmissions*. This Standard does not cover DVB-T2.

When this Standard was originally conceived, the intention was to develop a digital television receiver Standard in several parts. The first part, AS 4933.1, provided technical specifications and requirements for open market receivers suitable for free-to-air broadcasters' transmissions in Australia. Additional parts were intended to cover cable and satellite delivered subscription television services. However, the subscription television operators have chosen to keep their receiver requirements private, consequently removing the need for separate parts and the need for this Standard to be designated Part 1.

This Standard has been revised to provide manufacturers with additional essential requirements, including the need to decode MPEG-4 video and HE AAC audio. This revision also indicates future requirements such as HEVC. Also included are requirements for ancillary features such as IPTV and HbbTV services.

Current requirements and specifications relating to antenna input connections and other interconnect features, both digital and analog, are included in this Standard. These are significant improvements, changes and additions to the interconnection requirements and extend beyond AS 4542.1 *Consumer television interfaces, Part 1: PAL RF*, which mainly dealt with analog PAL requirements.

This Standard does not specify the final presentation characteristics of picture (display) and sound or associated services, or requirements for Stereoscopic 3D or 4K UHD TV.

Interoperability issues for DVB-S, DVB-C and datacasting are not addressed in this Standard.

The terms 'normative' and 'informative' are 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. Advisory information is also included in the main body of this Standard.

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FOREWORD

Digital Terrestrial Television Broadcasting (DTTB) officially began in Australia on 1 January 2001 and replaced the previous PAL-B analog transmissions by the end of December 2013. The transmissions are based on the DVB-T system, however, it should be noted that the international DVB Standards and related ETSI, IEC, ISO and ITU-R documents provide for a range of operational systems.

Many other digital television systems around the world are based on pay satellite and cable systems. In such cases the compatibility of the transmission and reception equipment within each system is generally under the control of a single system operator. These are known as ‘vertical’ markets.

In Australia, in contrast, the digital terrestrial television broadcasting system is not under the control of a single operator. Rather, there are multiple free-to-air services, and domestic digital television receiver/decoders produced by many different manufacturers are available through a wide range of retail outlets. This is known as a ‘retail’ or ‘horizontal’ market.

Consumers in Australia expect to have access to a wide choice of receiving equipment, ranging from fully integrated receivers with inbuilt displays to modular set-top box receivers designed to be connected to a separate display and sound reproduction system. In addition, the various broadcasters in Australia use different brands of encoding and transmission equipment. Manufacturers who are supplying the Australian market are obliged, therefore, to ensure that their equipment will operate satisfactorily under the relevant Australian conditions.

This Standard aims to assist manufacturers by providing the information necessary for them to ensure that any digital terrestrial television receiving equipment made for the Australian system will operate satisfactorily to receive Australian digital terrestrial television broadcast transmissions.

A separate Australian Standard, AS 4599.1, *Digital television—Terrestrial broadcasting, Part 1: Characteristics of digital terrestrial television transmissions*, provides information specific to the transmission aspects of the Australian adaptation of the relevant ETSI/DVB-T Standards.

Some receiver features are defined in this document as essential—that is, their inclusion is mandatory. Without them the equipment will not comply with this Standard. Whether features nominated as recommended are included will be a marketing decision by the manufacturer, but some optional features, if provided, are subject to certain requirements. These requirements are specified in this Standard.

Section 2 provides a summary of the minimum requirements for DTTB receivers intended for use in the Australian environment.

NOTE: Manufacturers should note that, because DTTB is a rapidly evolving technological environment, this Standard may require revisions and additions from time to time.

STANDARDS AUSTRALIA

Australian Standard

Digital television—Requirements for receivers for VHF/UHF DVB-T television broadcasts including ancillary services

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies the requirements for equipment to be used in Australia for the reception of free-to-air (FTA) terrestrial VHF/UHF DVB-T broadcast television and allow access to all program services offered. In addition, this Standard covers a number of optional features that manufacturers may provide. These optional features include PVR capabilities and other extended functionality such as HbbTV.

The requirements for digital television receivers set out in this Standard are consistent with the relevant Australian broadcast regulatory requirements. The international DVB Standards and related ETSI, ISO/IEC and ITU-R documents provide for various implementation systems. This Standard specifies the choices available in Australia and references Australian adaptations of these international Standards where appropriate.

Section 2 sets out the minimum requirements for receivers if they are to operate satisfactorily in the Australian environment to receive Australian FTA terrestrial VHF/UHF DVB-T broadcasts.

Section 3 provides a comprehensive list of receiver specifications and features, indicating whether they are essential or optional, and if optional, whether they are recommended or subject to certain requirements, or both. The optional features referred to in this Standard include interactive middleware and audio decoding choices, such as surround and multilingual sound, as well as interfaces for ancillary equipment.

This Standard does not specify the final presentation characteristics of picture (display) and sound, or associated services or requirements for Stereoscopic 3D or 4K UHD TV.

This Standard does not cover the requirements for subscription television receivers.

Attention is drawn to the following Appendices:

- (a) Appendix B (normative) specifies requirements and measurement methods for the RF performance of the receiver's tuner.
- (b) Appendix G (informative) provides further guidance on decoding and display of Closed Captions (CCs).
- (c) Appendix K (normative) provides requirements and further guidance on extended functionality services such as HbbTV.

1.2 GENERAL

The primary purpose of this Standard is to identify the minimum essential requirements for equipment intended to receive, demodulate and decode television broadcasts that comply with the Australian implementation of DVB-T, and referenced ISO/IEC and ETSI Standards. However, because there is a range of optional features that receiver manufacturers may provide, additional information and recommendations are provided to clarify the preferred or required (as applicable) operation or facility in such cases.

As indicated in the minimum requirements, equipment shall be capable of simultaneously decoding from the Transport Stream (TS) a video stream, an associated audio stream and associated teletext CCs. The decoded information shall be presented in a time-synchronized manner suitable for a display device and sound reproduction system subject to the mandatory implementation of the parental lock function.

If necessary, the video might be required to be spatially format-converted ('scaled'), as the received format may be different from the display format. For example, if a set-top box receiver is connected to a legacy 4:3 PAL television display, downscaling will be required to display a received HD 16:9 program. Correspondingly, the received audio channels might need to be processed or downmixed to suit the available sound reproduction equipment.

This Standard specifies video picture formats in Clause 3.8 but does not cover the resolution of displays or requirements for Stereoscopic 3D or 4K UHD TV. For further information on video picture formats and timings refer to Appendix H.

1.3 REFERENCED DOCUMENTS

The documents referred to in this Standard are listed in Appendix A.

1.4 DEFINITIONS

For the purpose of this Standard, the definitions below apply. For further definitions, see the abbreviations and glossary in Appendix J.

1.4.1 May

Indicates the existence of an option.

1.4.2 Shall

Indicates that a statement is mandatory.

1.4.3 Should

Indicates a recommendation.

SECTION 2 MINIMUM REQUIREMENTS FOR RECEIVERS

2.1 INTRODUCTION

This Section sets out the minimum functions and operating parameters that a digital TV receiver shall have in order to operate satisfactorily in the Australian FTA digital television environment.

2.2 ESSENTIAL RECEIVER REQUIREMENTS

Table 2.2 sets out the minimum requirements for digital TV receivers intended to be used in Australia to receive Australian FTA terrestrial television broadcasts. These requirements are essential for satisfactory operation and are derived from the comprehensive details given in Section 3.

TABLE 2.2
ESSENTIAL RECEIVER REQUIREMENTS

Item	Description
1	Channel frequencies and bandwidth
	The receiver shall tune and operate in 7 MHz VHF and UHF digital channel allocations (refer to Table D1) within the frequency range of 174 MHz to 230 MHz and 519 MHz to 820 MHz, to accommodate over the air broadcast services up to 694 MHz and services provided by cabled distribution systems up to 820 MHz. The centre frequency of some transmissions may be offset by plus or minus 125 kHz (refer to Clause 3.5.2.5). Higher-powered adjacent channels may be present (refer to Appendix B).
2	Demodulation
	The receiver shall be capable of correctly demodulating all modes specified in EN 300 744 (DVB-T COFDM), except hierarchical modulation.
3	Tuning and scanning
	Receivers shall be able to scan the required spectrum to detect valid DVB-T transmissions and shall ignore non-compatible transmissions and continue scanning. Receivers shall have a user accessible full auto-tune function that completely erases the tuning and related databases including 'favourites', prior to the rescan. The factory reset function is not a substitute for this requirement.
4	Adapt to changes in transmission DVB-T COFDM parameters
	Receivers shall automatically be able to continue reception of a transmission if the transmission's RF COFDM parameters are changed. A receiver shall demodulate and decode the Transmission Parameter Signalling (TPS) data to determine the transmission's COFDM parameters, such as guard interval and Code Rate. If a previously receivable Transport Stream (TS) and its service(s) are lost, a receiver shall re-access the TPS to determine if there has been a change—if so, it shall reset to the new operating parameters in order to restore reception of the TS.
5	Operate in the presence of multipath signals and SFNs
	Receivers shall be able to operate in SFN and multipath environments, and do so with either pre-echoes or post-echoes within the nominal guard interval range (refer to Appendix B).

(continued)

TABLE 2.2 (continued)

6	PSI and SI changes
	In the currently selected TS the PMTs shall be monitored at least every second and on selection of a different service. A change shall be implemented within 1 s of reception of the change. For the purposes of discovery of added or changed services, receivers shall detect and respond to changes in the PSI and SI in the TS by checking for service changes at intervals not exceeding 24 hours. This monitoring shall include the PAT, SDT and NIT set of tables and may be while the receiver is in active or standby modes (refer to Clause 3.4.4.7 and Table 3.4.4.7).
7	PID numbering
	Receivers shall be so configured that no sequenced or ordered numbering of the PID values of various components of a service is assumed.
8	Use LCNs for services
	Receivers shall use the broadcast Logical Channel Number (LCN) of services for channel selection. The LCNs are found in the NIT second loop with tag of 0x83 (refer to Clause 3.4.4.1). Information on Australian use of LCNs may be found in Appendix I and Free TV OP-41.
9	Access SD and HD program streams
	Receivers shall separate services from within a TS. Receivers shall be able to decode program service streams with video in defined 25/50 Hz based formats in MPEG-2 and MPEG-4, Part 10 AVC (ITU-T H.264) over a range of bit rates (as detailed in Clause 3.8.2—refer also to Appendix H) together with accompanying audio and Closed Caption streams.
10	Audio formats MPEG-1 Layer II, AC-3 and HE-AAC v2
	Receivers shall be capable of decoding audio streams in MPEG-1 Layer II, AC-3 and HE-AAC v2 formats at the respective bit rates given in Clause 3.9. If a program service has more than one associated audio stream, the receiver shall provide a method for the user to be able to select which audio stream is presented.
11	Audiovisual synchronization
	Receivers shall maintain the alignment of the sound and vision to within ± 20 ms with reference to the transmitted sound and vision alignment (as signalled in the PTS).
12	Access audio only (radio) program streams
	Receivers shall decode audio only (radio) services in any of the standard audio formats specified (refer to Clause 3.9).
13	Closed Captions (CCs) using Teletext
	Receivers shall be able to decode a program service's CCs carried in a TS in accordance with ETSI EN 300 472 within teletext magazine 8 (0), page 01. When selected by the user, the decoded text shall be correctly displayed over the picture using the received character code and the control characters including colour, size and boxed background. The characters shall be located as indicated by row number and position in the row's 40 character packet. This location is within a teletext defined 40 character by 24 row grid positioned over the on-screen picture (refer to Clause 3.11 and Appendix G).
14	Decoding unsupported formats
	If a receiver does not recognize a program service type, it shall not include it in the service list.
15	Time zone region selection
	The receiver shall provide a menu setup for a user to choose their Australian time zone region by a state and territory list, in accordance with the time zones listed in Clause 3.7.4 and Table 3.7.4.1. The receiver shall then access the information for that time zone in the transmitted TOT for any time display or related functions in the receiver. NOTE: This is essential for correct times (including daylight saving) in EPG displays.

(continued)

TABLE 2.2 (continued)

16	Parental guidance codes
	Receivers shall utilize parental guidance information for a program (where provided), and shall display this information in the format indicated in the Australian-specific Look-Up Tables (refer to Clause 3.13.2 and Appendix F). Parental guidance information is transmitted in the EIT.
17	Parental lock
	The receiver shall conform to the ACMA <i>Broadcasting and Datacasting Services (Parental Lock) Technical Standard 2010</i> . NOTE: Parental lockout information can be obtained from EITp/f (actual) (refer to Clauses 3.4.6 and 3.13).
18	Mains operated receivers
	Mains operated receivers shall be designed to operate at a nominal mains input of 230 V a.c., 50 Hz (refer to Clause 3.2.4.2 for range of voltages).

NOTE: Receivers also need to comply with Australian regulatory requirements including (but not limited to) safety, EMC, MEPS and energy rating labelling Standards.

SECTION 3 RECEIVER FEATURES

3.1 GENERAL

The provisions in this Section relating to the operation of Digital Terrestrial Television Broadcasting (DTTB) reception equipment are based on the Australian adaptation of the DVB-T Standards for digital television terrestrial transmissions, and are for manufacturers and suppliers of Australian DTTB consumer equipment. The provisions are set out in table form for ease of reference.

In this Section, the *Applicability* column indicates whether a feature is essential, recommended or optional (see below), and the category of receiver to which the clause applies. This column also includes a clarifying comment or further explanation where necessary.

Applicability	Intent
Essential	Indicates that this function or feature shall be present to conform to this Standard.
Highly recommended	Indicates that this function or feature is highly desirable (and, indeed, virtually expected to be present).
Recommended	Indicates that this function or feature should be present.
Optional	Indicates that this function or feature may be present.
Informative	The information is given for clarification.

NOTE: Semantic elements of the PSI and SI syntax code, such as descriptors, are printed in a san serif font (e.g. 'linkage_descriptor = 0x05').

3.2 REQUIREMENTS/RECOMMENDATIONS AND APPLICABILITY

Requirement/recommendation	References	Applicability
3.2.1 Summary of conformance requirements and recommendations for terrestrial reception Clauses 3.2.1 to 3.16 list the conformance requirements for DVB-T receivers capable of receiving Australian DTTB transmissions, and also any requirements that apply to optional (non-essential) features of such receivers. These clauses are based on ETSI/DVB-T Standards as amended to allow for reception of FTA transmissions, in accordance with the Australian terrestrial transmission Standard AS 4599.1. The receiver shall be able to receive, decode and present an FTA television service from a correctly constituted Australian DVB-T Transport Stream (TS) irrespective of other services (that might be encrypted) in that TS.		Essential

Requirement/recommendation	References	Applicability
In situations where there is a mixture of FTA services and encrypted services in a TS, the receiver shall be able to decode the FTA services without the need for any decryption mechanism. 3.2.2 Decoding service format types Receivers shall be capable of decoding services from the TS. The decoded picture, sound and other information shall be presented (scaled appropriately) in a time-synchronized manner. The TS comprises the following: (a) Video formats at a 25/50 Hz frame/field rates, including— (i) any SD video stream of up to $720 \times 576 \times 25\text{p}/50\text{i}$ using MP@ ML MPEG-2 video or MPEG-4 Part 10 at level 3; and (ii) any HD video stream of up to $1920 \times 1080 \times 25\text{p}/50\text{i}$ MP@HL MPEG-2 video and MPEG-4 Part 10 at level 4. (b) Audio formats of types— (i) MPEG-1 Layer II; (ii) AC 3; and (iii) MPEG-4 HE-AAC up to and including v2. (c) Closed Captions (CCs) in teletext format. 3.2.3 Capability of receiving analog PAL-B transmissions This capability is optional, as all Australian terrestrial PAL-B analog transmissions ceased in December 2013. NOTE: Cabled TV distribution systems may continue to use analog PAL-B modulated signals for some time. 3.2.4 Advisory: Australian regulatory and safety requirements 3.2.4.1 General In Australia, electrical safety Standards are adopted by relevant state and territory legislation. Receivers need to meet these safety requirements, and other Australian regulatory requirements, including EMC, MEPS and energy rating conditions.	Appendix G ITU-R BT.1700	Essential Optional Informative

Requirement/recommendation	References	Applicability
3.2.4.2 Electrical safety Mains powered equipment is required to comply with an electrical safety Standard. Depending on the relevant state/territory and federal regulatory regimes that apply, testing in accordance with AS/NZS 60065 or AS/NZS 60950.1 might be required. Mains voltage: Australian electrical mains supply is nominally 230 V a.c., 50 Hz. The voltage may vary over a nominal range of 230 V, -6% to +10% NOTE: It has been reported that in some locations due to system peak loads causing voltage drops or power feeds to the grid from photovoltaic (PV) array installations, this voltage range may extend from 205 V to 264 V. Touch current: In the interest of minimizing the effects of cumulative touch currents in the typical domestic situation, where multiple electronic, multimedia and IT devices are connected together, manufacturers need to minimize an individual receiver's touch current as far as is practicable. Ensuring that touch currents are less than 0.35 mA peak or earthing the equipment frame could minimize such effects. AS/NZS 60065 and AS/NZS 60950.1 deal extensively with the issue of touch currents. Note 4 to Clause 9.1.1.1 of AS/NZS 60065:2012 states the following: 'To avoid unnecessarily high TOUCH CURRENTS when several apparatus are interconnected, it is recommended that the individual TOUCH CURRENT values are not higher than needed for functional reasons'. 3.2.4.3 Electromagnetic Compatibility (EMC) and other ACMA regulations The Australian Communications and Media Authority (ACMA) has a number of regulatory arrangements that impose labelling and record keeping requirements on importers and manufacturers of digital television receivers. Digital receiver equipment supplied in Australia needs to meet certain requirements under the EMC regulatory arrangement.		Informative Informative Informative Informative Informative

Requirement/recommendation	References	Applicability
The EMC regulatory arrangement places limits on the incidental radio emissions from digital receivers to reduce their potential for causing interference to radiocommunications devices. The ACMA recognizes that there is a number of industry Standards that manufacturers may use to demonstrate compliance with the EMC regulatory arrangements. Where digital receiver equipment supplied in Australia has a radiocommunications transmitter, it might need to meet mandatory requirements under the ACMA's radiocommunications devices regulatory arrangement and the RF human exposure regulatory arrangement. Radiocommunications transmitters include devices that connect to wireless local area networks (LANs) or similar technologies. Where digital receiver equipment supplied in Australia has a telecommunications interface incorporated into the equipment, it might need to meet mandatory requirements under the ACMA's telecommunications customer equipment regulatory arrangement. Mandatory requirements might apply to the device and to any included accessory cable. Further details on the ACMA's regulatory arrangements are available on the ACMA website (http://www.acma.gov.au/). 3.2.4.4 Minimum Energy Performance Standards (MEPS) Receivers may need to comply with relevant Australian Minimum Energy Performance Standards. Refer to the Equipment Energy Efficiency (E3) website (http://www.energyrating.gov.au/).	AS/NZS 62087.1 AS/NZS 62087.2.1 AS/NZS 62087.2.2	Informative Informative

3.3 POWER ON OPERATIONS

Requirement/recommendation	References	Applicability
3.3.1 First-time operation initialization In summary, if required, the on-screen setup menu should allow the user to— (a) set the OSD language (default-English); (b) set the preferred picture format and aspect ratio (for output to another device); (c) set the Australian region for time offset (e.g. NSW, SA); and (d) start a frequency scan for available services or enter tuning details (refer to Clause 3.4.3).		Recommended

Requirement/recommendation	References	Applicability
3.3.2 Subsequent switch on When switched on subsequently, a receiver should always return to the previous setup (last selected service).		Recommended

3.4 USER OPERATION

Requirement/recommendation	References	Applicability
3.4.1 Operating system The underlying basic operating system is the manufacturer's choice (refer to Clause 3.10).		Informative
3.4.2 Receiver diagnostics and reset The receiver (via menu selection) should be able to show the current firmware and software versions, and initiate a full reset to the manufacturer's default start up settings if required.		Recommended
3.4.3 Tuner functionality		
3.4.3.1 Scanning to find services All receivers shall have a user-initiated scanning capability to identify all receivable services.		Essential
If the digital receiver is also capable of analog TV reception, a menu item to select either or both of the individual DVB-T and analog scanning should be provided.		Highly recommended
A full rescan function shall be provided that completely erases the existing tuning and related databases, including 'favourites', prior to the rescan. NOTE: This is to ensure that changed services are not given multiple listings which may confuse viewers. Reception of duplicate services on different frequencies needs to be sorted as detailed in Clause 3.4.4.		Essential
This scanning capability shall scan all channel frequencies listed in Table D1.		Essential
The scanning of channels listed in Appendix E is optional.		Optional
A full scan of the DTTB broadcast bands should start with VHF Band III channels and proceed through the UHF band channels.		Recommended
The receiver should display the RF channel number as the scan proceeds.		Recommended

Requirement/recommendation	References	Applicability
3.4.3.2 Use TPS for transmission discovery During a scan, it is highly recommended that the tuner access the DVB-T Transmission Parameter Signalling (TPS) carriers to determine a transmission's COFDM parameters. NOTE: The TPS are differential bi-phase shift keyed (DBPSK) carriers making its reception more robust.		Highly recommended
3.4.3.3 Manual entry of tuning details There shall also be a single channel frequency entry capability for the user to manually add channels that may have been missed in a full scan.		Essential
3.4.3.4 Automatic detection of new or changed services If a receiver does a background scan for new RF transmissions (e.g. in standby), the viewer should be advised of any new transmissions or services found when they next switch on the receiver with the option to include the changes. Receivers should be able to discover service changes within an existing (TS) and advise viewers of these changes.		Recommended
3.4.4 Assigning numbers to services and navigation		Recommended
3.4.4.1 Logical Channel Numbering (LCN) A receiver shall provide, as a minimum, a menu listing using LCNs of available services. Each service's LCN (as included by the broadcaster in the transmitted NIT) shall be used for service menu listings and service selection via direct number entry of the LCN on the receiver's remote control. During scanning, the receiver should examine the TS SI NITs and SDTs and identify the LCN data from the Logical Channel Descriptor (tag value 0x83) that is included in the cyclic second loop of the NIT.	AS 4599.1 Appendix I	Essential
Informative notes: DVB TRIPLE: each service in a TS is uniquely identified to a receiver by the <code>original_network_id</code>, <code>transport_stream_id</code> and <code>service_id</code>, and to the viewer by its LCN, found in the NIT. For NIT and SDT syntax, refer to ETSI EN 300 468.		Recommended
		Informative

Requirement/recommendation	References	Applicability
Multiple NITs in Transport Stream Because of distribution requirements, some Australian networks' TSs contain several NITs. When accessing the LCN assignments from the NIT, the receiver software needs to check that the <code>transport_stream_id</code> in the NIT corresponds to the actual <code>transport_stream_id</code> given in the PAT. Australian use of <code>original_network_id</code>: The LCN system is similar to that specified in IEC 62216. However, LCNs are applied somewhat differently in Australia than in Europe, particularly in relation to the associated use of <code>original_network_id</code>. In Australia, each broadcast network has been allocated its own individual <code>original_network_id</code> by DVB. For LCN syntax, refer to Appendix I. This Appendix gives the updated version adopted by Australia, where the first of the 'reserved' bits is now used as a 'visible_service_flag', Possible LCNs range between 1 and 999. Australian broadcasters have agreed to use a convention that assigns LCNs corresponding to each broadcaster's 'brand' number. 3.4.4.2 Services without LCNs Services found without LCNs should be allocated numbers starting at 350 up to 399. This number range should also be used when duplicate service LCNs are found (refer to Clause 3.4.4.3). 3.4.4.3 Duplicated LCNs The service with best signal quality should be assigned the broadcaster's LCN number and the other(s) either discarded or changed to a number in the range 350–399. Alternatively, duplicate LCNs may be listed so that the viewer may edit the list for the best signal. 3.4.4.4 Finding duplicate LCNs When transmissions overlap, a receiver may encounter duplicated services when frequency scanning, e.g. reception from a parent and from a translator. This creates the situation where there might be identical services with the same LCN but on different RF transmissions.	Appendix I2.1 Free TV OP-41 Free TV OP-41 Free TV OP-41 Appendix I	Informative Informative Informative Recommended Recommended Optional Informative

Requirement/recommendation	References	Applicability																								
3.4.4.5 Follow broadcaster service changes The receiver should regularly update its listing of and access to available services. NOTE: Broadcasters may change the LCN values in the NIT for existing services or when adding or removing services. These will also be listed in the SDT, PAT.	AS 4599.1	Highly recommended																								
3.4.4.6 Linkage descriptor Receivers should read and use the Linkage Descriptor within the SDT to navigate away from 'not_running' services. Notes on Linkage Descriptors: NOTE: Australian broadcasters may use the DVB Linkage Descriptor, particularly the linkage_type=0x05, which indicates that a 'service_replacement' service exists. The broadcasters' operational use of this descriptor may be found in Free TV OP-43. Receivers without this feature require the viewer to manually navigate away from services that have switched to a 'not running' status. The linkage_type=0x09 and 0x0A are also used with over-the-air data download System Software Update (OASSU).	ETSI EN 300 468 ETSI TR 101 211	Recommended																								
3.4.4.7 Response to service changes—PSI and SI updates The receiver shall regularly check PSI and SI information repetitively. The recommended refresh period values are given in Table 3.4.4.7, which is based on the update times for a DVB transmission given in ETSI TR 101 290.	ETSI TS 102 006	Essential																								
TABLE 3.4.4.7 RECEIVER PSI/SI UPDATE TIMES <table border="1"> <thead> <tr> <th>Table in received Transport Stream</th><th>ETSI TR 101 290 (for transmission)</th><th>Recommended receiver PS and SI refresh period</th></tr> </thead> <tbody> <tr> <td>PAT</td><td>0.5 s</td><td>≤1 s</td></tr> <tr> <td>PMT</td><td>0.5 s</td><td>≤1 s</td></tr> <tr> <td>NIT</td><td>10 s</td><td>≤20 s</td></tr> <tr> <td>SDT</td><td>2 s</td><td>≤4 s</td></tr> <tr> <td>EITp/f actual</td><td>2 s</td><td>≤4 s</td></tr> <tr> <td>TDT</td><td>30 s</td><td>≤60 s</td></tr> <tr> <td>TOT</td><td>30 s</td><td>≤60 s</td></tr> </tbody> </table>	Table in received Transport Stream	ETSI TR 101 290 (for transmission)	Recommended receiver PS and SI refresh period	PAT	0.5 s	≤1 s	PMT	0.5 s	≤1 s	NIT	10 s	≤20 s	SDT	2 s	≤4 s	EITp/f actual	2 s	≤4 s	TDT	30 s	≤60 s	TOT	30 s	≤60 s	ETSI EN 300 468 ETSI TR 101 290	Recommended
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TOT	30 s	≤60 s																								

Requirement/recommendation	References	Applicability
NOTE: Refer to Appendix K for information on and provisions for AIT and additional tables that may be required to be checked on a more regular basis to successfully receive extended functionality services.		Informative
When a user selects another program service, the receiver should use the previously stored tuning information in order to give a fast channel change. After changing the frequency, it is recommended that the TPS is checked to ensure the transmission parameters have not changed.		Recommended
If the receiver cannot find the required service (because the broadcaster has changed its operation or the service list), the receiver should check the PAT (and the relevant PMT), the NIT and the SDT.		Recommended
The receiver should respond to changes to services as identified in the NIT and SDT by altering the channel lists presented to the viewer in a timely fashion.		Highly recommended
3.4.5 Electronic Program Guide (EPG)		
3.4.5.1 General		
Receivers shall be able to use information from EITs, but shall not be adversely affected by the absence of EITs in a transmission.		Essential
3.4.5.2 Use of EITschedule-program information		
Receivers should be able to capture, store and display EITschedule-program information as required.	ETSI EN 300 468 Free TV OP-58	Recommended
NOTE: Broadcasters provide up to 8 days information of EITschedule-actual (i.e. current day plus 7 days).		Informative
3.4.6 I-plate (information banner), OSD and navigation using EITp/f actual		
3.4.6.1 General		
The receiver shall be able to use the parental guidance information in the transmitted EIT p/f actual for the purposes of operating the parental lock feature.	ETSI EN 300 468 Free TV OP-44	Recommended
EITp/f information should be presented for a short period when a service is selected or when an 'information' key is pressed.		Recommended
The display should include the LCN and service name, current time, program event name, program event start time and end time, or duration/progress and parental guidance rating.		Highly recommended
In addition, other information can include the genre, the EIT short event program description, and the EIT extended event program description information.		Recommended

Requirement/recommendation	References	Applicability
Information banner OSD detail: The recommended minimum character positions capable of being displayed include the following: Service number (LCN from NIT) 3 digits Service name (from SDT service descriptor) 20 characters From the EIT for each event: EIT short_event_descriptor: Program (event) title 40 characters Description/synopsis 200 characters EIT extended_event_descriptor information Optional display Also from the EIT for each event: Parental guidance rating 6 characters Now/next event start time/duration 13 characters Australian broadcasters use event descriptors as follows: (a) The short_event_descriptor provides details of the program name or episode and a short description of the event in text form. (b) The extended_event_descriptor, when used, provides an extended synopsis and other details of the program. For information on the use of EITschedule, refer to Free TV Operational Practice OP-58. 3.4.6.2 Character set The character set used within both EIT p/f and EITschedule should conform to ETSI EN 300 468 (v 1.13.1) Annex A, Figure A.1, to allow the inclusion of special characters such as the copyright symbol (©). 3.4.6.3 Icons for special features Manufacturers may also choose to display information or icons to indicate other features of a program that the receiver supports, such as the available audio mode, teletext CCs, other languages (if present), signal quality and program progress. 3.4.6.4 Parental guidance Rating in the I-Plate Also refer to Clause 3.13 and Appendix F. This coding is carried within the parental_rating_descriptor syntax in the EIT.	ETSI TR 101 211 Free TV OP-44 Free TV OP-58	Recommended Recommended Optional Informative

Requirement/recommendation	References	Applicability
Receivers should refresh the EITp/f (actual) no less than every 4 s.		Recommended
3.4.7 Signal strength and quality indicator An easily accessed display should be provided that shows both signal strength and signal quality for any tuned, receivable DVB-T transmission and their RF channel numbers. The signal strength display should warn the user if the signal level is too low or too high. One way of doing this would be for the colour of the indication to change to red. The signal quality display should be derived from the pre-Viterbi bit error ratio (BER) and should preferably incorporate a coloured numerical scale. NOTE: A signal strength display is very useful for users during the setup scanning procedure to differentiate between duplicate services/LCNs that may be received from a main transmitter and translator, or to identify other reception problems such as antenna problems. It is also useful as feedback to a customer service centre in order to help diagnose problems. Appendix C gives further details and examples of displays.	Appendix C	Recommended
3.4.8 Selection of radio services Receivers shall be able to select and decode audio-only (radio) services presented in any of the audio formats listed as essential in this Standard. Radio services are identified by an LCN. Radio services are identified in the SDT by service_type 0x02 in the service_descriptor (tag 0x48) syntax.		Informative
3.4.9 Service unavailable—On-screen service 3.4.9.1 Poor or no RF signal When the signal level is below the decoding threshold, this should be indicated to the viewer by a display such as 'No signal'.		Essential
3.4.9.2 Service selected that has no content or is 'not running' If a broadcaster includes a 'linkage_descriptor', the receiver should then go to the linked service—no message is necessary. If there is no 'linkage_descriptor' or the service is flagged 'not running', then a suitable message should be displayed.		Recommended

Requirement/recommendation	References	Applicability
3.4.9.3 Incompatible service selected If a service outside the receiver's decode capability is selected, then a suitable message should be displayed.		Recommended
3.4.10 Remote control		Recommended
3.4.10.1 Basic navigation As a minimum, the remote control would be expected to provide the requirements for basic navigation in the digital TV environment.		Recommended
3.4.10.2 Display of Closed Captions (CCs) It is highly recommended that a separate button is provided to activate display of CCs and should remain active until deactivated by the user.		Highly recommended
3.4.10.3 Selection of audio description services A separate button may be provided for activation of an audio description service.		Optional
3.4.10.4 Aspect ratio control button Refer to Clause 3.8.7.4—Picture shape change button on remote control.		Informative

3.5 RF, PERFORMANCE, COFDM DEMODULATION AND CHANNEL DECODING

Requirement/recommendation	References	Applicability
3.5.1 General The following clauses are a summary of the detailed requirements for a receiver's RF performance and the methods for measurement given in the normative Appendix B. For information and specifications on RF input and output connectors, refer to Clause 3.15.1.		
3.5.2 RF performance		
3.5.2.1 7 MHz transmission channel bandwidth The Australian transmission channel bandwidth is 7 MHz. Receivers shall be able to operate on 7 MHz channel spacing at both VHF and UHF. Receivers with tuners designed to operate with either 7 MHz or 8 MHz channel assignments at UHF should be preset to 7 MHz before sale, or have an easy-to-find menu function identified as Australia that contains 7 MHz channel assignments on the broadcast band, as detailed in Table D1.	AS 4599.1	Essential Highly recommended

Requirement/recommendation	References	Applicability
3.5.2.2 RF input channel loading allowance Digital receivers shall be able to operate with scenarios of RF inputs identified in Appendix B. In addition to the TV VHF and UHF channel loading, RF signals including FM and DAB radio, and VHF and UHF land mobile, should be design considerations when assessing channel loading.	Appendix B	Essential Recommended
3.5.2.3 Receiver sensitivity Receiver sensitivity requirements are set out in Appendix B. Receiver sensitivity is a function of tuner noise figure and carrier-to-noise threshold as detailed in Appendix B.	Appendix B	Essential
3.5.2.4 Digital terrestrial receiver tuner's frequency range The digital receiver tuner's frequency range shall cover VHF Band III (174 MHz to 230 MHz), UHF Band IV (519 MHz to 582 MHz) and UHF Band V (582 MHz to 820 MHz), in accordance with the Australian channel tuning Table D1 for terrestrial transmissions up to CH51 and from CH52 to CH69 for cabled distribution systems. Bands I and II are not used in Australia for digital terrestrial transmissions. Manufacturers may optionally provide a tuner that also covers the extended frequency bands for cabled distribution systems. Such equipment would enable access to channel shift in cabled distribution systems, e.g. in commercial premises such as multi-unit dwellings including hotels, resorts and retirement villages (refer to Appendix E).	Appendix D, Table D1	Essential Optional
3.5.2.5 Channel offsets Receivers shall be able to tune into and demodulate DVB-T transmissions that are offset from the nominal channel centre frequencies listed in Table D1 by ± 125 kHz. The tuner's AFC pull-in range shall be more than adequate to lock to transmissions with this offset.	Appendix B	Essential
3.5.2.6 Operation in Single Frequency Network (SFN) environment Receivers shall be able to operate in SFN environments with either pre-echo or post-echo signals within the guard interval. The measurement of SFN performance of receivers is addressed in Appendix B.	Appendix B	Essential

Requirement/recommendation	References	Applicability
3.5.2.7 Interference immunity—Impulse noise rejection The receiver's RF tuner system should include impulse noise suppression technology as impulse noise is usually more severe in the VHF bands and VHF Band III is widely used in Australia. The receiver shall comply with the tests for impulse noise rejection specified in Appendix B11.	Appendix B	Highly recommended
3.5.3 DVB-T COFDM transmission parameters 3.5.3.1 General The receiver shall— (a) use Transmission Parameter Signalling (TPS); (b) be able to receive 2K and 8K carrier modes; (c) accept QPSK, 16QAM or 64QAM; (d) accept any valid DVB-T guard intervals; and (e) accept any valid DVB-T code rates. The receiver shall automatically detect which COFDM transmission parameters are being used in the selected 7 MHz channel that are identified in the TPS carriers.	ETSI EN 300 744 AS 4599.1	Essential
3.5.3.2 Change in COFDM transmission parameters—acquisition time The acquisition lock time should be— (a) within 2 s when a viewer changes to a service that is on a different RF channel; or (b) within 5 s when a broadcaster changes the COFDM transmission parameters of a transmitter as identified by TPS.	AS 4599.1	Recommended
3.5.3.3 Reception of DVB-T Hierarchical Modulation (HM) transmissions NOTE: HM transmission methods are not used in Australia for digital terrestrial transmissions.		Informative

3.6 MULTIPLEX AND TRANSPORT STREAM

Requirement/recommendation	References	Applicability
Packet Identifier (PID) filters Receivers should be able to manage 32 PIDs simultaneously as a minimum. NOTE: Receivers with interactive features may require the ability to manage a greater number of PIDs.		Recommended

3.7 PROCESSING PROGRAM-SPECIFIC INFORMATION (PSI) AND SERVICE INFORMATION (SI)

Requirement/recommendation	References	Applicability
3.7.1 Interpretations of SI variations for Australia DTTB transmissions in Australia differ in some respects from those in Europe. Clauses relating to Australian practice that directly concern receiver manufacturers include the following: In the EIT: Parental guidance (refer to Clause 3.12 and Appendix F). Program classification/genre (refer to Clause 3.7.5). In the TDT and TOT: Time offset zones (refer to Clause 3.7.4 and Appendix I). In the NIT: Logical Channel Numbers (refer to Clause 3.4.4.1). In the SDT: linkage_descriptor (refer to Clauses 3.4.4.6). These aspects of receiver performance are directly referenced in Australian DVB-T documents, including this Standard and AS 4599.1. Other information on broadcaster codes for DVB-T that is not necessary for receiver design but may be of interest to receiver manufacturers, such as 'network_id', is available in Free TV OP-40. 3.7.2 Interpretation of MPEG, DVB mandatory and DVB optional tables 3.7.2.1 General Australian broadcasters regularly change their program service arrangements for a variety of reasons. In the currently selected TS the PMTs shall be monitored, at least every second and on selection of a different service. A change shall be implemented within 1 s of reception of the change. For the purposes of discovery of added or changed services, receivers shall detect and respond to changes in the PSI and SI in the TS by checking for service changes at intervals not exceeding 24 h. This monitoring shall include the PAT, SDT and NIT set of tables and may be while the receiver is in active or standby modes (refer to Clause 3.4.4.7). NOTE: Australia has registration in DVB of	AS 4599.1 Appendix I Free TV OP-40 AS 4599.1 ETSI EN 300 468 ETSI TR 101 211	Informative Essential

 **Documents**
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Requirement/recommendation	References	Applicability																										
3.7.4 Interpretation of Time and Date Table and Time-Offset Tables (Australian time zone regions) 3.7.4.1 General Receivers shall display the current local time on the STB front panel or in OSD program guides, or both. This information is available from the TOT. The time displayed shall correspond to the local time of the region the user has identified. TABLE 3.7.4.1 country_region_id FOR AUSTRALIAN STATES (TIME ZONES) <table> <tr> <th></th><th>Transmitted code</th><th>Receiver's setup menu display</th></tr> <tr> <td rowspan="11">country_region_id =</td><td>00 0000</td><td>Not used</td></tr> <tr> <td>00 0001</td><td>Reserved</td></tr> <tr> <td>00 0010</td><td>NSW/ACT</td></tr> <tr> <td>00 0011</td><td>Vic.</td></tr> <tr> <td>00 0100</td><td>QLD</td></tr> <tr> <td>00 0101</td><td>SA</td></tr> <tr> <td>00 0110</td><td>WA</td></tr> <tr> <td>00 0111</td><td>Tas.</td></tr> <tr> <td>00 1000</td><td>NT</td></tr> <tr> <td>00 1001</td><td>Reserved</td></tr> <tr> <td>11 1111</td><td>Reserved</td></tr> </table> Receivers shall provide a setup menu that allows users to select their region, as shown in Table 3.7.4.1. The receiver will typically need to recognize and respond to the following in the TDT and TOT: country_code = AUS In binary: '0100 0001 0101 0101 0101 0011' local_time_offset_polarity = '0' (advanced to UTC, east of Greenwich) and a range of: local_time_offset = '0001 0001 0000 0000' (summer: Australian Eastern Daylight Saving Time + 11 h UTC) to: '0000 1000 0000 0000' (Australian Western Standard Time + 8 h UTC)		Transmitted code	Receiver's setup menu display	country_region_id =	00 0000	Not used	00 0001	Reserved	00 0010	NSW/ACT	00 0011	Vic.	00 0100	QLD	00 0101	SA	00 0110	WA	00 0111	Tas.	00 1000	NT	00 1001	Reserved	11 1111	Reserved	AS 4599.1 ETSI TR 101 211, Appendix I	Essential Essential Essential
	Transmitted code	Receiver's setup menu display																										
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	00 0111	Tas.																										
	00 1000	NT																										
	00 1001	Reserved																										
	11 1111	Reserved																										

Requirement/recommendation	References	Applicability
3.7.4.2 Informative notes on Time-Offset Tables Receivers are able to find time information in DVB Time and Date Table (TDT) but, more importantly, TOTs in a transmission. These tables are transmitted with the same unique PID of 0x0014, but separately identified by the table_ids of 0x70 and 0x73 respectively. The TOT will contain the time in Universal Coordinated Time (UTC) and the date in Modified Julian Date (MJD), followed by a local_time_offset_descriptor loop (tag value 0x58). A secondary loop contains country_code, country_region_id, local_time_offset_polarity and local_time_offset, etc. This second loop allows offsets for each time zone to be given if needed. The country_code at the beginning of this second loop will be Australia's three character code—'AUS'. The receiver will need to know the country_region_id code value to correctly interpret the local_time_offset descriptor information found in the TOT. The receiver will need to have a setup menu entry that allows users to select their region and also the capacity to store the users' selection. Some broadcasters transmit TOTs with a single loop containing the region code and time offset for the area covered by that transmission. Other broadcasters use TOTs with multiple loops, each loop for a separate Australian time zone with the offset for that zone. Further information is available in Free TV Australia Operational Practice OP-45 <i>Application of Time Related Tables in Australian DVB-T Systems</i>. 3.7.5 Content descriptors (Australian variation from international DVB Standards) Receivers may display, as required, a program's classification/genre as identified by the content_descriptor (tag value = 0x54) that may be found in the EIT. Only the content_nibble_level_1 is currently defined.		Informative Informative Informative Optional

Requirement/recommendation		References	Applicability
It is as follows:			
content_nibble_level_1 code	Description		
0x0	Undefined content		
0x1	Movie		
0x2	News		
0x3	Entertainment		
0x4	Sport		
0x5	Children's		
0x6	Music		
0x7	Arts/culture		
0x8	Current affairs		
0x9	Education/information		
0xA	Infotainment		
0xB	Special		
0xC	Comedy		
0xD	Drama		
0xE	Documentary		
0xF	Reserved—not defined		
NOTE: content_nibble_level_2 and user_nibbles are currently not defined. 3.7.6 Radio services All receivers shall be able to receive radio services carried in a TS. Radio services may be identified in the SDT by service_type 0x02 in the service_descriptor (tag 0x48) syntax. Radio services currently use the MPEG-1 Layer II format but may use any audio coding format specified as essential in this Standard.		ETSI EN 300 468	Essential Informative Informative

3.8 VIDEO DECODE AND DISPLAY

Requirement/recommendation	References	Applicability
3.8.1 General Provisions, choices and format details for interfaces and connections to a display are given in Appendix H and Clause 3.16. 3.8.2 MPEG-2 and -4 Part 10 video decoding 3.8.2.1 Decode SD MP @ ML video formats The receiver shall decode all valid MPEG-2 (MP@ML) 25 frames/s progressive and 50 fields/s interlace video formats. These include the following: Pixels × lines: 720 × 576; 544 × 576; and 480 × 576; 352 × 576 They also include the following: 720 pixels × 576 lines at 25 frames/s progressive scan ('film mode' or 50 fields/s interlaced). A display may operate at other rates. 3.8.2.2 Decode HD MP@HL video formats HD streams are able to be identified by information in the MPEG video ES header and in the PMT. The receiver shall decode all valid MP@HL 25/50 Hz formats as follows: (a) 1080 active line formats at: 25 frame/s progressive scan (film mode) or 50 field/s interlace: 1920 or 1440 or 1280 × 1080 line (b) Progressive formats at 50 frame/s: 1280 × 720 active line '720 p50' and 25p (film mode) 3.8.2.3 Decoding of MPEG-4 Part 10 AVC Decoding capability shall be provided for MPEG-4, Part 10 AVC (ITU-T H.264) video in SD and HD 25 Hz/50 Hz formats up to level 4 and decoding of accompanying audio formats. The receiver shall be able to decode the following video formats: SD: 720 × 576 50 field/s interlace or 25 frame/s film mode HD: 1280 × 720 25/50p or 1920/1440 × 1080 50i or film mode	ETSI EN 300 468 ETSI TS 101-154, ISO/IEC 13818-2 ETSI EN 300 468, AS 4599.1 ETSI TS 101 154 ISO/IEC 14496-10 AS 4599.1 ETSI TS 101 154	Essential Essential for all receivers Essential Essential