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**SANS 862:2012**

Edition 2

## **SOUTH AFRICAN NATIONAL STANDARD**

### **Set-top box decoder for free-to-air digital terrestrial television**

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**Table of changes**

| Change No. | Date | Scope |
|------------|------|-------|
|            |      |       |

**Acknowledgement**

The SABS Standards Division wishes to acknowledge the valuable assistance derived from the publication *NorDig unified requirements for integrated receiver decoders for use in cable, satellite, terrestrial and IP-based networks (ver 2.2.1)*.

**Foreword**

This South African standard was approved by National Committee SABS TC 74, *Communication technology*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in June 2012.

This document supersedes SANS 862:2009 (edition 1).

At various places in this document, reference is made to broadcasting service licensees. In South Africa, this means the free-to-air individual broadcasting service licensees or their appointed agents (trusted third parties). Contact details for these broadcasting service licensees are available from the Independent Communication Authority of South Africa (ICASA):

Independent Communication Authority of South Africa  
Blocks A, B, C and D, Pinmill Farm  
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2146



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## Introduction

Digital terrestrial television (DTT) broadcasting has been trialled in South Africa since 1 November 2008 using the Digital Video Broadcasting Terrestrial System (DVB-T). In January 2011 the Second Generation Digital Video Broadcasting Terrestrial System (DVB-T2) was confirmed as the transmission standard to be used in South Africa. Therefore, this revision of SANS 862 incorporates the requirements for DVB-T2.

Initially, the DTT service will be available in parallel with the existing analogue network, but it is anticipated that the analogue network will be switched off from December 2013.

The objective of this document is to provide requirements for a set-top box decoder (STB decoder) which, in conjunction with an analogue television receiver, will provide good quality video and sound for the viewer, and to ensure the lowest possible cost for the free-to-air set-top box decoder.

Where the document is silent on a specific feature, that feature is regarded as being optional. The inclusion of optional features can be seen as part of the marketing strategy of the manufacturer.

For the South African DTT networks, cached MHEG applications and data will be used to avoid the high bandwidth needs of carousels.

The MHEG-5 application environment, in accordance with ISO/IEC 13522-5, ETSI ES 202 184 and the *MHEG-5 Profile for South Africa*, has been selected for easy integration. The South African MHEG-5 profile supports a return path, but this is optional in this document.

The STB decoder should also be capable of providing interactive services, and control means are required to prevent subsidized STB decoders from being used outside South Africa.

The main functional elements specified for security are:

- a) a secure over-the-air software and bootstrap loader;
- b) a mechanism to prevent STB decoders from functioning in non-RSA DTT networks;
- c) STB control system that will enable mass messaging.

Detailed security requirements are not specified in this document. The STB decoder manufacturer is responsible for the implementation of the security requirements specified by the free-to-air individual broadcasting service licensees in South Africa and for the proper configuration of the chipsets.

Manufacturers can obtain the security requirements from the free-to-air individual broadcasting service licensees in South Africa or from their appointed agents (trusted third parties) (see foreword).



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## Set-top box decoder for free-to-air digital terrestrial television

### 1 Scope

**1.1** This standard sets out the minimum technical requirements for a standard-definition and high-definition set-top box decoder for free-to-air digital terrestrial television in South Africa.

NOTE 1 This will result in a low cost, low maintenance unit that provides basic functionality, i.e. decoding the DTT broadcasts to provide baseband and UHF modulated outputs, and an Electronic Programme Guide (EPG) that provides details of the available services.

NOTE 2 Although this standard applies only to free-to-air DTT set-top box decoders, any other set-top box decoder which is capable of receiving the free-to-air DTT services should ensure that the audio and video services and over-the-air applications are displayed fully, without any alteration or hindrance.

**1.2** This standard applies to

- a) broadcasters,
- b) broadcasting signal distributors,
- c) decoder manufacturers, and
- d) the public.

**1.3** This standard does not cover integrated digital television (IDTV).

### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

ETSI EN 300 743, *Digital Video Broadcasting (DVB); Subtitling systems.*

ETSI TR 101 211, *Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI).*

ETSI TS 101 154, *Digital Video Broadcasting (DVB); Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream.*

ETSI TS 102 006, *Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems.*

ETSI TS 102 366, *Digital Audio Compression (AC-3, Enhanced AC-3) Standard.*



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IEC 60728-5, *Cable networks for television signals, sound signals and interactive services – Part 5: Headend equipment.*

IEC 61169-2, *Radio-frequency connectors – Part 2: Sectional specification – Radio frequency coaxial connectors of type 9,52.*

IEC 61938, *Audio, video and audiovisual systems – Interconnections and matching values – Preferred matching values of analogue signals.*

ISO 639-4, *Codes for the representation of names of languages – Part 4: General principles of coding of the representation of names of languages and related entities, and application guidelines.*

ISO/IEC 13818-7, *Information technology – Generic coding of moving pictures and associated audio information – Part 7: Advanced Audio Coding (AAC).*

ISO/IEC 14496-3, *Information technology – Coding of audio-visual objects – Part 3: Audio.*

ISO/IEC 14496-10, *Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding.*

ITU-R BT.624-4, *Characteristics of television systems.*

ITU-R BT.709-5, *Parameter values for the HDTV standards for production and international programme exchange.*

ITU-R BT.1700, *Characteristics of composite video signals for conventional analogue television systems.*

*MHEG-5 Profile for South Africa.*

SANS 164-1, *Plug and socket-outlet systems for household and similar purposes for use in South Africa – Part 1: Conventional system, 16 A 250 V a.c.*

SANS 213/CISPR 13, *Sound and television broadcast receivers and associated equipment – Radio disturbance characteristics – Limits and methods of measurement.*

SANS 528-2/ISO 639-2, *Codes for the representation of names of languages – Part 2: Alpha-3 code.*

SANS 894, *Test Specifications for SD and HD Level Integrated Receiver Decoders.*

SANS 2200/CISPR 20, *Sound and television broadcast receivers and associated equipment – Immunity characteristics – Limits and methods of measurement.*

SANS 13818-1/ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: Systems.*

SANS 60065/IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements.*

SANS 60320-1/IEC 60320-1, *Appliance couplers for household and similar general purposes – Part 1: General requirements.*

SANS 60799/IEC 60799, *Electrical accessories – Cord sets and interconnection cord sets.*

SANS 61000-3-2/IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3-2: Limits – Limits of harmonic current emissions (equipment input current  $\leq$  16 A per phase).*

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SANS 61000-3-3/IEC 61000-3-3, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current  $\leq 16$  A per phase and not subject to conditional connection.*

SANS 61000-4-2/IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test.*

SANS 61000-4-3/IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test.*

SANS 61000-4-4/IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test.*

SANS 61000-4-5/IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test.*

SANS 61000-4-11/IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests.*

SANS 300468/ETSI EN 300468, *Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems.*

SANS 300744/ETSI EN 300744, *Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television.*

SANS 302755/ETSI EN 302755, *Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2).*

SMPTE ST 274, *Television – 1920 × 1080 image sample structure, digital representation and digital timing reference sequences for multiple picture rates.*

SMPTE ST 296, *1280 × 720 progressive image 4:2:2 and 4:4:4 sample structure – Analog and digital representation and analog interface.*

### 3 Definitions, abbreviations and symbols

For the purposes of this document, the following definitions, abbreviations and symbols apply.

#### 3.1 Definitions

##### 3.1.1

##### **audio description**

ancillary service, primarily provided for the visually impaired, that provides a spoken description of the video component of a service

##### 3.1.2

##### **digital terrestrial television**

##### **DTT**

terrestrial delivery of digital transmissions in the UHF/VHF frequency bands using the DVB-T2 standard as set out in SANS 302755

##### 3.1.3

##### **free-to-air**

service which is broadcast and capable of being received without payment of subscription fees

##### 3.1.4

##### **multiplex**

##### **mux**

group of digital terrestrial television (DTT) channels that are combined together into one output signal for broadcast



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**3.1.5**

**private data stream**

DVB data stream designed for a specific application which is ignored by other DVB decoders that are not designed to use the data

**3.1.6**

**set-top box decoder**

**STB decoder**

**decoder**

stand-alone device that converts a DVB-T signal into analogue video and audio signals for presentation on a television receiver or another suitable display device

**3.2 Abbreviations and symbols**

|         |  |
|---------|--|
| a/v     | Audio/Visual   |
| AC-3    | Audio Coding 3 (Dolby Digital used for 5.1 multichannel digital audio) |
| ACE     | Active Constellation Extension   |
| AD      | Audio Description  |
| AFC     | Automatic Frequency Control  |
| AFD     | Active Format Descriptor   |
| API     | Application Programming Interface                                      |
| ASCII   | American Standard Code for Information Interchange                     |
| AVC     | Advanced Video Coding  |
| BAT     | Bouquet Association Table  |
| BCH     | Bose Chaudhuri Hocquenghem Code  |
| BER     | Bit Error Rate   |
| bw      | Bandwidth  |
| C/(N+I) | Ratio of Carrier to Noise plus Interference                            |
| C/I     | Carrier-to-Interference Ratio  |
| C/N     | Carrier-to-Noise Ratio   |
| CPU     | Central Processing Unit  |
| CRC     | Cyclic Redundancy Check  |
| CVBS    | Composite Video Baseband Signal  |
| DTT     | Digital Terrestrial Television   |
| DVB     | Digital Video Broadcasting   |
| DVB-H   | Digital Video Broadcasting – Handheld                                  |
| DVB-T   | Digital Video Broadcasting – Terrestrial                               |
| DVB-T2  | Second Generation Digital Video Broadcasting Terrestrial System        |
| E-AC-3  | Enhanced Audio Coding 3  |
| EDID    | Extended Display Identification Data                                   |
| E-EDID  | Enhanced Extended Display Identification Data                          |
| EEPROM  | Electrically Erasable Programmable Read-Only Memory                    |
| EIT     | Event Information Table  |
| EPG     | Electronic Programme Guide   |
| EPT     | Effective Protection Target  |



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|           |  |
|-----------|--|
| $f_c$     | Centre Frequency   |
| FEC       | Forward Error Correction                                   |
| FEF       | Future Extension Frame                                     |
| FFT       | Fast Fourier Transform                                     |
| FM        | Frequency Modulation                                       |
| FTA       | Free To Air  |
| HD        | High Definition  |
| HDCP      | High-Bandwidth Digital Content Protection                  |
| HDMI      | High-Definition Multimedia Interface                       |
| HDTV      | High-Definition Television                                 |
| HE-AAC V2 | High Efficiency Advanced Audio Coding                      |
| HEM       | High Efficiency Mode                                       |
| HL        | High Level   |
| HP        | High Profile   |
| I         | Wanted Carrier   |
| I/C       | Interference-to-Wanted Signal Level Ratio                  |
| ID        | Identification   |
| IDTV      | Integrated Digital Television                              |
| IRD       | Integrated Receiver Decoder                                |
| L         | Level  |
| LCN       | Logical Channel Number                                     |
| LED       | Light-Emitting Diode                                       |
| MFN       | Multi-Frequency Network                                    |
| MHEG      | Multimedia and Hypermedia Information Coding Experts Group |
| MISO      | Multiple Input Single Output                               |
| ML        | Main Level   |
| MP        | Main Profile   |
| MPEG      | Moving Picture Experts Group                               |
| N         | Gaussian Noise   |
| NEC       | Nippon Electric Company                                    |
| NF        | Noise Figure   |
| NICAM     | Near Instantaneous Companded Audio Multiplex               |
| NIT       | Network Information Table                                  |
| NM        | Normal Mode  |
| NVRAM     | Non-Volatile Random Access Memory                          |
| OFDM      | Orthogonal Frequency Division Multiplexing                 |
| P         | Profile  |
| PAL       | Phase Alternating Line                                     |
| PAPR      | Peak-to-Average-Power Ratio                                |
| PCM       | Pulse Code Modulation                                      |
| PER       | Packet Error Ratio   |
| PES       | Packetized Elementary Stream                               |



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|        |  |
|--------|--|
| PID    | Packet Identifier                                  |
| PIN    | Personal Identification Number                     |
| PLP    | Physical Layer Pipe                                |
| Pmin.  | Minimum Input Signal Level                         |
| PP     | Pilot Pattern                                      |
| PSI    | Programme-Specific Information                     |
| PTS    | Presentation Time Stamp                            |
| QAM    | Quadrature Amplitude Modulation                    |
| QEF    | Quasi Error Free                                   |
| QPSK   | Quaternary Phase Shift Keying                      |
| R      | Code Rate  |
| RCA    | Radio Corporation of America                       |
| RCU    | Remote Control Unit                                |
| RF     | Radio Frequency                                    |
| RGB    | Red/Green/Blue                                     |
| r.m.s. | Root Mean Square                                   |
| RST    | Running Status Table                               |
| Rx     | Transmission Receiver                              |
| SD     | Standard Definition                                |
| SDT    | Service Description Table                          |
| SDTV   | Standard-Definition Television                     |
| SFN    | Single Frequency Network                           |
| SI     | Service Information                                |
| SISO   | Single Input Single Output                         |
| SMPTE  | Society of Motion Picture and Television Engineers |
| S/PDIF | Sony/Phillips digital interface                    |
| SQI    | Signal Quality Indicator                           |
| SSI    | Signal Strength indicator                          |
| SSU    | System Software Update                             |
| STB    | Set-Top Box  |
| TDT    | Time and Date Table                                |
| TFS    | Time Frequency Slicing                             |
| TOT    | Time Offset Table                                  |
| TPS    | Transmission Parameter Signalling                  |
| TR     | Tone Reservation                                   |
| TS     | Transport Stream                                   |
| $T_u$  | Useful symbol time                                 |
| TV     | Television   |
| UHF    | Ultra-High Frequency                               |
| USB    | Universal Serial Bus                               |
| VCR    | Video Cassette Recorder                            |
| VHF    | Very High Frequency                                |

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## 4 Performance requirements

### 4.1 General

The DTT transmissions in South Africa utilize MPEG-4 coding. Transmission shall be DVB-T2 in accordance with SANS 302755, and shall be in the VHF and UHF bands.

Table 1 indicates some of the major hardware and firmware functions in the STB decoder. Detailed requirements are specified in the appropriate performance requirements.

**Table 1 — Main hardware/firmware functions for the various IRD configurations**

| 1  | 2     | 3      |
|--|-------|--------|
| Functions  | DVB-T | DVB-T2 |
| <b>Video decoding/processing</b>                 |       |        |
| MPEG-2 MP@ML SDTV video                          | M     | -      |
| MPEG-4 AVC HL@L4 SDTV + HDTV video               | M     | M      |
| <b>Audio decoding/processing</b>                 |       |        |
| E-AC-3, including down-mix to stereo             | -     | M      |
| E-AC-3 (E-AC-3 converted to AC-3) digital output | -     | M      |
| HE-AAC V2 (Mono or stereo audio pairs)           | M     | M      |
| <b>Subtitling</b>                                |       |        |
| DVB (SDTV) subtitling                            | M     | M      |
| DVB (HDTV) subtitling                            | -     | M      |
| <b>Teletext and API</b>                          |       |        |
| DVB MHEG-5                                       | M     | M      |
| <b>STB Control</b>                               |       |        |
| Embedded STB Control                             | -     | M      |
| <b>Interfaces</b>                                |       |        |
| DVB-T front end                                  | M     | -      |
| DVB-T2 front end                                 | -     | M      |
| UHF re-modulator                                 | M     | M      |
| RF female input connector                        | M     | M      |
| RF male output connector                         | M     | M      |
| Analogue SD video output                         | M     | M      |
| HDMI output                                      | -     | M      |
| HDCP   | -     | M      |
| Analogue audio left output                       | M     | M      |
| Analogue audio right output                      | M     | M      |
| 12 V DC input                                    | M     | M      |
| M = Mandatory                                    |       |        |



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## 4.2 Spectrum and DTT modulation and coding

### 4.2.1 Spectrum

The STB decoder shall operate within the VHF and UHF television broadcasting bands as shown in table 2 using 8 MHz channel spacing.

**Table 2 — Mandatory frequency bands**

| 1    | 2       | 3                      |
|------|---------|------------------------|
| Band |         | Frequency range<br>MHz |
| VHF  | VHF III | 174 to 238             |
|      | VHF III | 246 to 254             |
| UHF  | UHF IV  | 470 to 606             |
|      | UHF V   | 606 to 862             |

### 4.2.2 DTT modulation and coding

The STB decoder shall support the 8 K mode of operation in accordance with SANS 300744 (the DVB-T standard). The decoder shall be capable of achieving full specified performance with any of the combinations of modulation (QPSK/16-QAM/64-QAM), FEC coding and guard interval as specified in SANS 300744.

The STB decoder shall support the 16 K and 32 K modes, as well as the normal and extended carrier modes, as defined in SANS 302755.

The decoder shall be capable of achieving full specified performance with any of the modes of operation defined for DVB-T2 in SANS 302755.

## 4.3 Radio frequency

### 4.3.1 DTT tuner/demodulator

The STB decoder shall be provided with a single DTT tuner/demodulator for the reception of signals from terrestrial transmitters broadcasting in accordance with SANS 300744 (for DVB-T) and SANS 302755 (for DVB-T2). It shall be capable of receiving transmissions broadcast with any allowable combination of modulation and transmission parameters in accordance with tables 3 and 4.



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Table 3 — Modulation and transmission parameters

| 1                           | 2                                       | 3   |
|-----------------------------|---|---|
| Modulation and transmission | Parameters                              |   |
|                             | DVB-T                                   | DVB-T2  |
| Constellation               | QPSK, 16-QAM, 64-QAM                    | QPSK, 16-QAM, 64-QAM, 256-QAM (rotated and non-rotated)   |
| Code rate                   | 1/2, 2/3, 3/4, 5/6, 7/8                 | 1/2, 3/5, 2/3, 3/4, 4/5, 5/6  |
| Guard interval              | $T_U/32$ , $T_U/16$ , $T_U/8$ , $T_U/4$ | $T_U/128$ , $T_U/32$ , $T_U/16$ , $T_U/19/256$ , $T_U/8$ , $T_U/19/128$ , $T_U/4$   |
| Transmission mode           | 8 K                                     | 1 K, 2 K, 4 K, 8 K, 16 K, 32 K normal and extended  |
| Pilot pattern               | N/A                                     | PP1, PP2, PP3, PP4, PP5, PP6, PP7, PP8  |
| SISO/ MISO                  | N/A                                     | Both modes to be supported  |
| PAPR                        | N/A                                     | No PAPR used, ACE-PAPR only used, TR PAPR only used, ACE and TR PAPR used;  |
| FEC frame length            | N/A                                     | 64 800, 16 200  |
| Input mode                  | N/A                                     | Mode A (single PLP) or Input Mode B (Multiple PLPs – Common PLP, Type 1 and 2 up to the maximum allowed figure 255). The STB Decoder shall automatically detect which mode is being used.           |
| Single RF frequency or TFS  | N/A                                     | Both modes to be supported  |
| NM or HEM                   | N/A                                     | Both modes to be supported  |
| FEF and auxiliary streams   | N/A                                     | STB decoder not required to demodulate or decode content of FEF parts and auxiliary streams but the existence of FEF or auxiliary streams (or both) shall not cause the STB decoder to malfunction. |



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## 4.3.2 Tuning

### 4.3.2.1 General

The decoder shall ignore all services originating from any non-DTT sources, such as DVB-H services, to avoid confusing the consumer.

### 4.3.2.2 Automatic tuning

The STB decoder shall be capable of performing automatic tuning over the frequency ranges indicated in table 2, to find all the multiplexes and services received in the complete frequency range. The STB decoder shall automatically detect which mode is being used (see table 3). It shall also be able to interpret and respond to tuning parameters found in the SI/PSI (e.g. within the NIT).

When receiving a DVB-T2 signal with multiple PLPs (i.e. Mode B), the decoder shall analyse and interrogate the SI information per PLP.

The decoder shall display a given service only once in the service list (thereby avoiding duplication of the same service), even if this service (i.e. the same path comprising an original network identifier, transport stream identifier and service identifier) is received from more than one transmitter. In such a case, the service emanating from the transmission with the highest quality (as defined by signal strength and signal quality) shall be the one chosen to be entered into the service list.

### 4.3.2.3 Manual tuning

In addition to automatic tuning, the STB decoder shall be capable of performing manual tuning where the channel number or frequency (or both) is entered by the viewer. The decoder shall tune to the channel entered by the viewer, search all available DTT modes, add any new services and replace existing services in the service list.

The decoder shall display a given service only once in the service list (thereby avoiding duplication of the same service), even if this service (i.e. the same path comprising an original network identifier, transport stream identifier and service identifier) is received from more than one transmitter. In such a case, the service emanating from the transmission with the highest quality (as defined by signal strength and signal quality) shall be the one chosen to be entered into the service list.

## 4.3.3 Tuner performance

### 4.3.3.1 Noise

The maximum noise figure (NF) of the decoder tuner shall not exceed 6 dB across the operational frequency range in accordance with table 5.

Table 5 — Maximum noise figures for set-top box decoders

| 1       | 2                          | 3                           |
|---------|----------------------------|-----------------------------|
| Band    | Noise figure (NF)<br>DVB-T | Noise figure (NF)<br>DVB-T2 |
| VHF III | 7 dB                       | 6 dB                        |
| UHF IV  | 7 dB                       | 6 dB                        |
| UHF V   | 7 dB                       | 6 dB                        |



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**4.3.3.2 Return loss**

Input return loss measured at the antenna input shall be equal to or less than -6 dB (75 Ω) across the operational frequency range.

**4.3.3.3 Centre frequencies and signal bandwidth**

The decoder tuner shall be capable of tuning to the centre frequency,  $f_c$ , of the incoming DVB-T and DVB-T2 signal, as follows:

a) in the case of VHF tuning

$$f_c = 178 \text{ MHz} + (K - 4) \times 8 \text{ MHz}$$

where

$f_c$  is the centre frequency of the incoming DVB-T signal, in megahertz,

$K$  is an integer from 4 to 13.

b) in the case of UHF tuning

$$f_c = 306 + K \times 8$$

where

$f_c$  is the centre frequency of the incoming DVB-T signal, in megahertz;

$K$  is an integer from 21 to 68.

NOTE 1 For a DVB-T signal, an 8 MHz channel corresponds to a signal bandwidth of 7,61.

NOTE 2 For a DVB-T2 signal, an 8 MHz channel corresponds to a signal bandwidth of 7,61 MHz in the normal carrier mode, and 7,71 MHz for FFT size 8 K and 7,77 MHz for FFT size 16 K and 32 K in the extended carrier mode.

**4.3.3.4 Maximum frequency offset**

The STB decoder shall be able to receive signals with an offset of up to 50 kHz from the nominal centre frequency.

**4.3.3.5 Carrier-to-noise ratio**

**4.3.3.5.1** The C/N shall be less than one uncorrected error event per hour over the entire frequency range.

NOTE This requirement is given as QEF in SANS 300744, where QEF means less than one uncorrected error event per hour and corresponds to BER =  $10^{-11}$  at the input of the MPEG de-multiplexer.

SANS 302755 defines QEF for DVB-T2 as "less than one uncorrected error event per transmission hour at the level of a 5 Mbit/s single TV service decoder", approximately corresponding to a TS PER <  $10^{-7}$  before the de-multiplexer.

**4.3.3.5.2** The C/N values in tables 6 and 7 are specified for two profiles:

a) Profile 1: Gaussian noise (N) is applied together with the wanted carrier (I) in a signal bandwidth of a DVB-T signal. No echo is applied.

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b) Profile 2: the wanted carrier (l) includes the direct path signal and an echo. The echo has the same power (0 dB echo) as the direct path signal and is delayed from 1,95  $\mu$ s to 0,95 times the guard interval length, and has a 0 degree phase at the channel centre.

4.3.3.5.3 The C/N as given in table 7 applies generally for all Input Mode A (single PLP) and Input Mode B (multiple PLPs) including TFS (using 2-6 frequencies). For TFS, the levels of all RF channels involved are identical. For TFS the 0 dB echo profile is also identical on all RF channels.

**Table 6 — Minimum required C/N for QEF reception of DVB-T (with 1/4 guard interval and FFT size 8 K) for profiles 1 and 2**

| Modulation | Code rate | Minimum C/N<br>dB   |                      |
|------------|-----------|---------------------|----------------------|
|            |           | Profile 1: Gaussian | Profile 2: 0 dB echo |
|            |           | 1                   | 2                    |
| QPSK       | 1/2       | 5,1                 | 8,8                  |
| QPSK       | 2/3       | 6,9                 | 13,7                 |
| QPSK       | 3/4       | 7,9                 | 17,4                 |
| QPSK       | 5/6       | 8,9                 | –                    |
| QPSK       | 7/8       | 9,7                 | –                    |
| 16-QAM     | 1/2       | 10,8                | 13,3                 |
| 16-QAM     | 2/3       | 13,1                | 17,9                 |
| 16-QAM     | 3/4       | 14,6                | 22,1                 |
| 16-QAM     | 5/6       | 15,6                | –                    |
| 16-QAM     | 7/8       | 16,0                | –                    |
| 64-QAM     | 1/2       | 16,5                | 19,0                 |
| 64-QAM     | 2/3       | 18,7                | 23,2                 |
| 64-QAM     | 3/4       | 20,2                | 27,6                 |
| 64-QAM     | 5/6       | 21,6                | –                    |
| 64-QAM     | 7/8       | 22,5                | –                    |



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**Table 7 — Maximum required C/N for QEF reception of DVB-T2 at TS output (with 1/8 guard interval, PP2 and FFT size 32 K) for profiles 1 and 2**

| 1<br>Modulation | 2<br>Code rate | 3<br>Minimum C/N         |                      | 4 |
|-----------------|----------------|--------------------------|----------------------|---|
|                 |                | dB                       |                      |   |
|                 |                | Profile 1: Gaussian      | Profile 2: 0 dB echo |   |
| QPSK            | 1/2            | 3,5                      | 5,2                  |   |
| QPSK            | 3/5            | 4,7                      | 6,8                  |   |
| QPSK            | 2/3            | 5,6                      | 8,4                  |   |
| QPSK            | 3/4            | 6,6                      | 9,8                  |   |
| QPSK            | 4/5            | 7,2 (7,5) <sup>a</sup>   | —                    |   |
| QPSK            | 5/6            | 7,7 (8,0) <sup>a</sup>   | —                    |   |
| 16-QAM          | 1/2            | 8,7                      | 10,9                 |   |
| 16-QAM          | 3/5            | 10,1                     | 12,7                 |   |
| 16-QAM          | 2/3            | 11,4                     | 14,3                 |   |
| 16-QAM          | 3/4            | 12,5                     | 16,3                 |   |
| 16-QAM          | 4/5            | 13,3 (13,6) <sup>a</sup> | —                    |   |
| 16-QAM          | 5/6            | 13,8 (14,1) <sup>a</sup> | —                    |   |
| 64-QAM          | 1/2            | 13,0                     | 16,0                 |   |
| 64-QAM          | 3/5            | 14,8                     | 18,0                 |   |
| 64-QAM          | 2/3            | 16,2                     | 19,7                 |   |
| 64-QAM          | 3/4            | 17,7                     | 22,0                 |   |
| 64-QAM          | 4/5            | 18,7 (19,0) <sup>a</sup> | —                    |   |
| 64-QAM          | 5/6            | 19,4 (19,7) <sup>a</sup> | —                    |   |
| 256-QAM         | 1/2            | 17,0                     | 20,6                 |   |
| 256-QAM         | 3/5            | 19,4                     | 23,1                 |   |
| 256-QAM         | 2/3            | 20,8                     | 25,1                 |   |
| 256-QAM         | 3/4            | 22,9                     | 28,0                 |   |
| 256-QAM         | 4/5            | 24,3 (24,6) <sup>a</sup> | —                    |   |
| 256-QAM         | 5/6            | 25,1 (25,4) <sup>a</sup> | —                    |   |

<sup>a</sup> These values are temporarily relaxed; the values in parentheses applied before 2012.



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**4.3.3.6 Minimum decoder input signal levels**

The STB decoder shall provide QEF reception in both the VHF and the UHF bands for the minimum input signal levels ( $P_{min.}$ ), which can be derived as follows:

$$P_{min.} = -105,2 + NF + C/N$$

where

$P_{min.}$  is the minimum input signal level, in decibels (dBm);

NF is the noise figure, in decibels (dBm);

C/N is as specified in tables 6 and 7, in decibels (dBm).

The required  $P_{min.}$  are summarized in tables 8 and 9.

**Table 8 — Minimum input signal levels ( $P_{min.}$ ) for QEF reception of DVB-T (with 1/4 guard interval and FFT size 8 K) for profiles 1 and 2**

| 1<br>Modulation | 2<br>Code rate | 3<br>Minimum input signal level ( $P_{min.}$ )<br>dB |                      | 4 |
|-----------------|----------------|--|----------------------|---|
|                 |                |  |                      |   |
|                 |                | Profile 1: Gaussian                                  | Profile 2: 0 dB echo |   |
| QPSK            | 1/2            | -93,1  | -89,4                |   |
| QPSK            | 2/3            | -91,3  | -84,5                |   |
| QPSK            | 3/4            | -90,3  | -80,8                |   |
| QPSK            | 5/6            | -89,3  | -                    |   |
| QPSK            | 7/8            | -88,5  | -                    |   |
| 16-QAM          | 1/2            | -87,4  | -84,9                |   |
| 16-QAM          | 2/3            | -85,1  | -80,3                |   |
| 16-QAM          | 3/4            | -83,6  | -76,1                |   |
| 16-QAM          | 5/6            | -82,6  | -                    |   |
| 16-QAM          | 7/8            | -82,2  | -                    |   |
| 64-QAM          | 1/2            | -81,7  | -79,2                |   |
| 64-QAM          | 2/3            | -79,5  | -75,0                |   |
| 64-QAM          | 3/4            | -78,0  | -70,6                |   |
| 64-QAM          | 5/6            | -76,6  | -                    |   |
| 64-QAM          | 7/8            | -75,7  | -                    |   |



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**Table 9 — Minimum input signal levels (P<sub>min.</sub>) for QEF reception of DVB-T2 (with 1/8 guard interval, PP2 and FFT size 32 K extended bandwidth for profiles 1 and 2)**

| Modulation | Code rate | Minimum input signal level (P <sub>min.</sub> )<br>dB |                      |
|------------|-----------|---|----------------------|
|            |           | Profile 1: Gaussian                                   | Profile 2: 0 dB echo |
|            |           | 1   | 2                    |
| QPSK       | 1/2       | -95,6   | -93,9                |
| QPSK       | 3/5       | -94,4   | -92,3                |
| QPSK       | 2/3       | -93,5   | -90,7                |
| QPSK       | 3/4       | -92,5   | -89,3                |
| QPSK       | 4/5       | -91,9   | -88,2                |
| QPSK       | 5/6       | -91,4   | -87,0                |
| 16-QAM     | 1/2       | -90,4   | -88,2                |
| 16-QAM     | 3/5       | -89,0   | -86,4                |
| 16-QAM     | 2/3       | -87,7   | -84,8                |
| 16-QAM     | 3/4       | -86,6   | -82,8                |
| 16-QAM     | 4/5       | -85,8   | -81,3                |
| 16-QAM     | 5/6       | -85,3   | -80,2                |
| 64-QAM     | 1/2       | -86,1   | -83,1                |
| 64-QAM     | 3/5       | -84,3   | -81,1                |
| 64-QAM     | 2/3       | -82,9   | -79,4                |
| 64-QAM     | 3/4       | -81,4   | -77,1                |
| 64-QAM     | 4/5       | -80,4   | -75,1                |
| 64-QAM     | 5/6       | -79,7   | -73,6                |
| 256-QAM    | 1/2       | -82,1   | -78,5                |
| 256-QAM    | 3/5       | -79,7   | -76,0                |
| 256-QAM    | 2/3       | -78,3   | -74,0                |
| 256-QAM    | 3/4       | -76,2   | -71,1                |
| 256-QAM    | 4/5       | -74,8   | -68,3                |
| 256-QAM    | 5/6       | -74,0   | -65,5                |

#### 4.3.3.7 Maximum STB decoder input signal levels

The STB decoder shall provide QEF reception for DVB-T and DVB-T2 signals up to an input level of -35 dBm. The analogue TV input signal level is restricted to -20 dBm maximum (where the analogue TV signal is defined as the r.m.s. value of the vision carrier at peaks of the modulated envelope).

This maximum DVB-T input signal level is valid for the following combination of modes:

8 K, 64-QAM, R = 2/3,  $\Delta/T_u = 1/8$ ;

8 K, 64-QAM, R = 2/3,  $\Delta/T_u = 1/4$ ;

8 K, 64-QAM, R = 3/4,  $\Delta/T_u = 1/4$ .

The DVB-T2 signal input is valid for the modes shown in table 10.

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**4.3.3.8 STB decoder immunity to analogue signals in other channels**

The STB decoder shall maintain QEF reception with adjacent-channel PAL-I carriers of up to 33 dB higher power levels.

NOTE In South Africa, the PAL FM sound carrier level relative to the vision carrier is -13 dB, and the level of the NICAM signal relative to the vision carrier is -20 dB.

On channels other than adjacent channels, QEF reception shall be maintained with analogue PAL carriers up to 44 dB higher than the wanted DVB-T signal. This applies to DVB-T transmissions with the combination of modes given in 4.3.3.7.

For DVB-T2, the requirements in this subclause refer to signals in the UHF and VHF bands for the modes defined in table 4.

**4.3.3.9 STB decoder immunity to digital signals in other channels**

Table 10 gives the lowest values of the interference-to-wanted signal level ratio (I/C) at which the decoder shall maintain QEF performance in the presence of an interfering DVB-T signal. This requirement applies to DVB-T transmissions with the combination of modes given in 4.3.3.7, and for DVB-T2 with the modes given in table 4.

**Table 10 — Minimum required I/C for QEF reception with interfering DVB-T/DVB-T2 signals**

| 1<br>Band | 2<br>Signal bw<br>MHz | 3<br>Channel<br>frequency raster<br>MHz | 4<br>Minimum I/C<br>dB |                   |                   |
|-----------|-----------------------|---|------------------------|-------------------|-------------------|
|           |                       |   | Adjacent<br>channels   | Other<br>channels | Image<br>channels |
| VHF       | 8                     | 8                                       | 28                     | 38                | ~                 |
| UHF       | 8                     | 8                                       | 28                     | 38                | 28                |

**4.3.3.10 Immunity to co-channel interference from analogue TV signals**

The sensitivity for interference from analogue TV is specified as the minimum carrier-to-interference ratio (C/I) required for QEF reception.

The STB decoder shall operate at QEF at values specified in tables 11 and 12 when an 8 MHz DVB-T or DVB-T2 signal is exposed to interference from a co-channel PAL-I signal including video with teletext, and an FM sound carrier (see 4.3.3.8).

**Table 11 — C/I for QEF in the presence of a co-channel analogue TV carrier**

| 1              | 2      | 3    |
|----------------|--------|------|
| Constellation  | 64-QAM |      |
| Code rate      | 2/3    | 3/4  |
| Guard interval | 1/8    | 1/4  |
| C/I            | 3 dB   | 7 dB |



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Table 12 — C/I for QEF of DVB-T2 in the presence of a co-channel analogue TV carrier

| 1             | 2       | 3    | 4    |
|---------------|---------|------|------|
| Constellation | 256-QAM |      |      |
| Code rate     | 3/5     | 2/3  | 3/4  |
| C/I           | 3 dB    | 5 dB | 7 dB |

## 4.3.3.11 Performance in time-varying channels

The STB decoder shall be able to operate with all signal-time variations that naturally exist in connection with fixed roof-top reception (e.g. swaying mast, moving antenna) and in-house portable reception (e.g. people in the vicinity of the receiving antenna).

The increase in required C/N for QEF reception shall be less than 3 dB for a 0 dB echo with frequency separation equal to 20 Hz and a delay of 20  $\mu$ s (corresponding to a Doppler shift of  $\pm 10$  Hz (after AFC)), compared to a 0 dB echo with frequency separation equal to 1 Hz and a delay of 20  $\mu$ s (corresponding to a Doppler shift of  $\pm 0,5$  Hz (after AFC)), for the following modes:

8 K, 64-QAM, R = 2/3,  $\Delta/T_u = 1/8$ ;

8 K, 64-QAM, R = 2/3,  $\Delta/T_u = 1/4$ .

The increase in required C/N for QEF reception shall be less than 3 dB for a 0 dB echo with frequency separation equal to 10 Hz and a delay of 20  $\mu$ s (corresponding to a Doppler shift of  $\pm 5$  Hz (after AFC)), compared to a 0 dB echo with frequency separation equal to 1 Hz and a delay of 20  $\mu$ s (corresponding to a Doppler shift of  $\pm 0,5$  Hz (after AFC)), for mode 8 K, 64-QAM, R = 3/4,  $\Delta/T_u = 1/4$  and for DVB-T2 for the modes given in table 4.

## 4.3.3.12 Synchronization for varying echo power levels in single frequency networks

For modes

8 K, 64-QAM, R = 2/3,  $\Delta/T_u = 1/8$ ,

8 K, 64-QAM, R = 2/3,  $\Delta/T_u = 1/4$ ,

8 K, 64-QAM, R = 3/4,  $\Delta/T_u = 1/4$ ,

the reception shall be QEF at the C/N specified in table 13 (defined at 0 dB level crossing) when the channel contains two paths with relative delay from 1,95  $\mu$ s up to 0,95 times guard interval length and the relative power levels of the two paths are dynamically varying, including 0 dB echo level crossing.

Table 13 — C/N for QEF reception of DVB-T with dynamically varying echo power levels

| 1          | 2         | 3                     |
|------------|-----------|-----------------------|
| Modulation | Code rate | C/N performance<br>dB |
| 64-QAM     | 2/3       | 26,2                  |
| 64-QAM     | 3/4       | 30,6                  |



For the DVB-T2 modes given in table 4, the required C/N value, specified in table 14, for QEF reception shall be obtained when the channel contains two paths with relative delay from 1,95  $\mu$ s up to 0,95 times guard interval length and the relative power levels of the two paths are dynamically varying, including 0 dB echo level crossing. The C/N value is defined at 0 dB level crossing.

**Table 14 — C/N for QEF reception of DVB-T2 with dynamically varying echo power levels**

| 1          | 2         | 3                     |
|------------|-----------|-----------------------|
| Modulation | Code rate | C/N performance<br>dB |
| 256-QAM    | 3/5       | 26,1                  |
| 256-QAM    | 2/3       | 28,1                  |
| 256-QAM    | 3/4       | 31,0                  |

#### 4.3.3.13 C/(N+I) performance in single frequency networks

**4.3.3.13.1** If there are more than one FFT window positions for the time synchronization that will give an aggregate available C/(N+I) larger than or equal to the required EPT, the STB decoder shall be able to find one of these positions, independently of echo profile. The decoder shall also be able to correctly equalize the signal for echoes up to

- a)  $7 T_J/24$  (the interval of correct equalization – for an 8 MHz DVB-T signal, up to 260  $\mu$ s), and
- b) 57/64 (= 89,1 %) of the Nyquist time for the scattered pilots (after time interpolation) for a particular FFT size, pilot pattern and RF bandwidth for DVB-T2.

#### 4.3.3.13.2 For modes

8 K, 64-QAM, R = 2/3,  $\Delta/T_U = 1/8$ ,

8 K, 64-QAM, R = 2/3,  $\Delta/T_U = 1/4$ ,

8 K, 64-QAM, R = 3/4,  $\Delta/T_U = 1/4$ ,

the C/N for profile 2 (specified in 4.3.3.5) for QEF reception shall be obtained when the channel contains two static paths with relative delay from 1,95  $\mu$ s up to 0,95 times guard interval length, independently of the relative amplitudes and phases of the two paths.

For the DVB-T2 modes shown in table 4, the required C/N value for profile 2 (specified in table 7) for QEF reception shall be obtained when the channel contains two static paths with relative delay from 1,95  $\mu$ s up to 0,95 times guard interval length, independently of the relative amplitudes and phases of the two paths.

**4.3.3.13.3** In the case of specific echo attenuation, the C/N shall have approximately the same value, independent of the actual delay length. The deviation in C/N from the median value shall be less than 1 dB for any echo length from 1,95  $\mu$ s up to 0,95 times guard interval length.

In the case of echoes outside the guard interval, for

- a) an 8 MHz DVB-T signal: QEF reception shall be possible with echo levels up to the values defined in table 15;
- b) an 8 MHz DVB-T2 signal: QEF reception shall be possible with echo levels up to the values defined in table 16.



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Table 15 — QEF reception for echoes outside the guard interval for 8 MHz DVB-T

| 1  | 2  | 3    | 4    | 5    | 6    | 7   | 8   | 9   | 10  | 11  |
|--|--|------|------|------|------|-----|-----|-----|-----|-----|
| Mode                                     | Echo attenuation in dB relative to reference |      |      |      |      |     |     |     |     |     |
|  | Delay<br>$\mu\text{s}$                       |      |      |      |      |     |     |     |     |     |
|  | -260   | -230 | -200 | -150 | -120 | 120 | 150 | 200 | 230 | 260 |
| 8 K, 64-QAM, R = 2/3, $\Delta/T_u = 1/8$ | 15   | –    | 13   | 10   | 5    | 5   | 10  | 13  | –   | 15  |
| 8 K, 64-QAM, R = 2/3, $\Delta/T_u = 1/4$ | 10   | 5    | N/A  | N/A  | N/A  | N/A | N/A | N/A | 5   | 10  |
| 8 K, 64-QAM, R = 3/4, $\Delta/T_u = 1/4$ | 12   | 6    | N/A  | N/A  | N/A  | N/A | N/A | N/A | 6   | 12  |

Table 16 — QEF reception for echoes outside the guard interval for 8 MHz DVB-T2

| 1   | 2  | 3    | 4    | 5    | 6    | 7   | 8   | 9   | 10  | 11                   |
|---|--|------|------|------|------|-----|-----|-----|-----|----------------------|
| Mode  | Echo attenuation in dB relative to reference |      |      |      |      |     |     |     |     |                      |
|   | Delay<br>$\mu\text{s}$                       |      |      |      |      |     |     |     |     |                      |
|   | -260   | -230 | -200 | -150 | -120 | 120 | 150 | 200 | 230 | 260                  |
| 32 K, 256-QAM, PP4,<br>R = 3/5, $\Delta/T_u = 1/16$ , | 4 (20) <sup>a</sup>                          | 2    | N/A  | N/A  | N/A  | N/A | N/A | N/A | 2   | 4 (20) <sup>a</sup>  |
| 32 K, 256-QAM, PP4,<br>R = 2/3, $\Delta/T_u = 1/16$ , | 6 (22) <sup>a</sup>                          | 3    | N/A  | N/A  | N/A  | N/A | N/A | N/A | 3   | 6 (22) <sup>a</sup>  |
| 32 K, 256-QAM, PP4,<br>R = 3/4, $\Delta/T_u = 1/16$   | 8 (24) <sup>a</sup>                          | 4    | N/A  | N/A  | N/A  | N/A | N/A | N/A | 4   | 8 (24) <sup>a</sup>  |
| 32 K, 256-QAM, PP4,<br>R = 3/5, $\Delta/T_u = 1/32$   | 10 (20) <sup>a</sup>                         | 9    | 7    | 4    | 2    | 2   | 4   | 7   | 9   | 10 (20) <sup>a</sup> |
| 32 K, 256-QAM, PP4,<br>R = 2/3, $\Delta/T_u = 1/32$   | 12 (22) <sup>a</sup>                         | 11   | 10   | 6    | 3    | 3   | 6   | 10  | 11  | 12 (22) <sup>a</sup> |
| 32 K, 256-QAM, PP4,<br>R = 3/4, $\Delta/T_u = 1/32$   | 14 (24) <sup>a</sup>                         | 13   | 12   | 8    | 4    | 4   | 8   | 12  | 13  | 14 (24) <sup>a</sup> |

<sup>a</sup> These values are temporarily relaxed; the values in parentheses applied before 2012.

#### 4.3.4 Response to changes in modulation

The STB decoder shall recover from changes in modulation parameters and output error-free TS. This should take less than 1 s for any change. The STB decoder shall be able to detect a change of modulation parameters signalled in the TPS data of the DVB-T signal, in order to reduce the recovery time.

The STB decoder tuned to a DVB-T2 transmission shall automatically recover from changes in P1, L1 pre-signalling data and L1 post signalling. An error-free TS shall be available within 5 s for any P1 or L1 (or both) pre-signalling change. An error-free TS shall be output within 5 s for any L1 post signalling FEF change and within 2 s for any other L1 post-signalling change.



#### 4.3.5 Bypass support

The path from RF input to RF output shall allow RF bypass independently of the operational or standby status of the decoder, so that connected equipment (e.g. a TV set) can continue to operate.

The RF bypass gain shall be in the range  $-1$  dB to  $+3$  dB over the frequency ranges in table 2.

#### 4.3.6 UHF re-modulator

4.3.6.1 The STB decoder shall provide a UHF re-modulated output for use with a PAL TV receiver which shall

- a) modulate the decoded baseband signal onto PAL-I in accordance with ITU-R BT.624-4, except that dual side bands shall be allowed;
- b) have a peak signal level of 3 mV nominal across  $75 \Omega$  ( $-39$  dBm);
- c) have a return loss at the output of less than 6 dB;
- d) be tunable from 470 MHz to 854 MHz;
- e) be preset at the factory to channel 63;
- f) support PAL mono-audio output, with a volume control;
- g) have an audio FM deviation of  $40 \text{ kHz} \pm 5 \text{ kHz}$  at  $-12$  dB full-scale transmitter output setting (equivalent to  $+6$  dBm studio sound level);
- h) have a vision-to-sound carrier ratio of  $16 \text{ dB} \pm 4 \text{ dB}$ ;
- i) produce spurious output levels that do not exceed
  - 1) in band (as in table 2):  $12 \text{ dB}\mu\text{V}$  max.,
  - 2) out of band (30 MHz to 1 GHz, excluding in band above):  $43 \text{ dB}\mu\text{V}$  max.; and
- j) with the "RF out" terminated in  $75 \Omega$ , exhibit an output voltage leakage to the "RF in" terminal of  $36 \text{ dB}\mu\text{V}$  max.

4.3.6.2 The RF output shall be combined with an RF bypass facility that provides feeds for analogue TVs and VCRs. The second-order intermodulation at the RF output, measured in accordance with IEC 60728-5 with  $85 \text{ dB}\mu\text{V}$  input, shall be equal to or lower than  $-60$  dBc.

#### 4.3.7 Time interleaving

The STB decoder shall, at least, include time-interleaving capability that corresponds to the maximum time interleaving in accordance with SANS 302755, i.e.  $2^{19} + 2^{15}$  OFDM cells for a data PLP and its common PLP together.

### 4.4 De-multiplexing and decoding

#### 4.4.1 Support of MPEG-4

The decoder shall support MPEG-4 AVC/H.264 level 3 decoding for standard definition display only.



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The transport stream shall comply with SANS 13818-1, and the video profile level shall be main profile level 3 in accordance with ISO/IEC 14496-10.

The STB decoder shall support standard-definition video resolution of 720 × 576. The decoder shall support MPEG-4 AVC/H.264 video decoding for both high-definition and standard-definition display. The STB decoder shall support the minimum set of resolutions and frame rates given in table 17.

**Table 17 — Video decoder — Resolutions and frame rates**

| 1           | 2                      | 3           | 4            | 5         |
|-------------|------------------------|-------------|--------------|-----------|
| Resolution  | Frame rate<br>frames/s | Scanning    | Aspect ratio | Profile   |
| 720 × 576   | 25                     | Interlaced  | 4:3 or 16:9  | AVC HP@L3 |
| 1280 × 720  | 50                     | Progressive | 16:9         | AVC HP@L4 |
| 1440 × 1080 | 25                     | Interlaced  | 16:9         | AVC HP@L4 |
| 1920 × 1080 | 25                     | Interlaced  | 16:9         | AVC HP@L4 |
| 1920 × 1080 | 25                     | Progressive | 16:9         | AVC HP@L4 |

#### 4.4.2 Video

##### 4.4.2.1 General

Video decoding shall be in accordance with 4.4.2.2 to 4.4.2.5. The set-top box decoder shall provide an HD output and a down-converted SD output.

##### 4.4.2.2 Down-conversion of HD video for SD output

For RF-PAL and CVBS outputs, the decoded HD video shall be down-converted by the SD format converter to SD resolution for output via these outputs. Down-conversion of pictures shall be implemented from any of the incoming encoded HD full screen luminance resolution values (1920 × 1080, 1440 × 1080, and 1280 × 720) to SD resolution (720 × 576).

When down-converting any 1:1 pixel aspect ratio format (i.e. 1280 × 720 or 1920 × 1080) in the decoder composition output to 720 × 576 resolution, the target shall be 720 × 576 pixels centred in the 720 × 576 grid with nine black pixels inserted at the start of the 720 pixel active line and nine pixels inserted at the end of the 720 pixel active line. The down-converted HD video shall be displayed as 16:9 letterbox on 4:3 displays. Centre cut shall not be allowed as a display option, since it would limit the safe area to 4:3 for HD production.

The SD format converter shall apply appropriate re-interlacing (field mode integration re-interlacing). It shall process and output 720 × 576i25 in a 4:3 frame aspect ratio or 16:9 frame aspect ratio video with colours in accordance with the standards listed in table 18.



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Table 18 — Video decoder — Colour frame aspect ratio

| 1   | 2   | 3  |
|---|---|--|
| Active composition resolution in the decoder composition output (horizontal × vertical) | Standards for appropriate colour processing | Comments   |
| 720 × 576   | ITU-R BT.1700                               | Note that 576 lines in both interlaced scan (576i) and progressive scan (576p) shall be processed and output with equal colour parameters. |
| 1280 × 720  | ITU-R BT.709-5 (SMPTE ST 296)               | The colour parameters in SMPTE ST 296 are the same as in ITU-R BT.709-5.   |
| 1920 × 1080   | ITU-R BT.709-5 (SMPTE ST 274)               | The colour parameters in SMPTE ST 274 are the same as in ITU-R BT.709-5.   |

#### 4.4.2.3 Aspect ratio

The STB decoder shall support both 16:9 (widescreen) and 4:3 picture format changes, including support for the correct aspect ratio and use of the active format descriptor (AFD) as defined in ETSI TS 101 154.

For the HD output, the STB decoder shall be able to use the EDID information provided by the display to automatically determine the STB decoder output.

The STB decoder shall provide an "Original Format" option, i.e. to output the same format as received if supported by the display, as indicated by the EDID information. If the received format is not supported, the STB decoder shall select the display mode that provides the best possible video quality. This is to prevent the STB decoder output from going black, if there is a mismatch between received format and display capabilities.

It shall also be possible to manually set the default output format from the STB decoder to a fixed format.

For the down-converted SD format, the decoder shall support manual selection of the required aspect ratio.

For SD video and down-converted HD video, the combination of coded frame aspect ratio information plus the use of the AFD, embedded by the MPEG encoder into the video sequence header, shall provide the viewer with the following options:

- a) 16:9 material on 4:3 displays: the decoder shall provide the following viewer options:
- 1) display the material as a 16:9 letterbox within a 4:3 frame; or
  - 2) perform a 4:3 centre cut-out on the originating material and present this full frame within the 4:3 display. In this case the decoder shall support a 'pan and scan' operation;



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- b) 4:3 material on 16:9 displays: the decoder shall allow "pillarboxing" of 4:3 material into a 16:9 frame, in order to maintain the correct aspect ratio of the originating material.

**4.4.2.4 Support of still pictures**

The STB decoder shall be able to decode and display still pictures (frame), i.e. a video sequence that contains a single intra-coded picture. Such a video bitstream will cause the buffer to underflow. In this situation, while the decoding process shall continue to examine the buffer, the display process associated with the decoder shall repeat the previously decoded picture until the normal operation of the buffer can resume.

**4.4.2.5 Outputs**

A PAL-I modulated SD video and audio signal shall be presented as specified in 4.3.6.1 on a connector as defined in 4.12.3.

The decoder shall also provide a composite (CVBS) video output on an RCA socket as defined in 4.12.3. The composite video signal levels shall be in accordance with IEC 61938. For HD content, the decoder shall derive a down-converted version for output via this interface as described in 4.4.3. The decoder shall provide a single HDMI output for HD content.

**4.4.3 Audio**

**4.4.3.1 General**

The STB decoder shall support the possibility of adjusting the audio-delay on the S/PDIF output (if available) up to 250 ms. It should be adjustable in 10 ms steps, as the STB decoder might have several different user set-ups, resulting in different a/v delays, e.g. the STB decoder might be connected to several types of external audio-amplifiers and the STB decoder might be connected to several types of external screens.

Receivers shall support decoding of E-AC-3 elementary streams. Receivers shall also support the conversion of E-AC-3 elementary streams to an AC-3 bitstream for output via HDMI and SPDIF. The decoding and conversion of an E-AC-3 elementary stream shall comply with the requirements in ETSI TS 102 366. Support for decoding MPEG-1 Layer II (Musicam) is not required. The decoder shall use the language descriptors in ISO 639-4 to determine the languages of audio service elements, handle dynamic changes, and present audio service information.

The decoder shall also comply with the HE-AAC V2 encoding in accordance with ISO/IEC 14496-3 and ISO/IEC 13818-7. The use of HE-AAC V2 shall primarily be for mono or stereo video services or radio services (or both).

**4.4.3.2 Audio mode**

Receivers shall be capable of decoding the first independent substream of an E-AC-3 elementary stream (independent substream 0) containing up to 5.1 channels of audio. Receivers shall implement E-AC-3 decoding functionality that is capable of outputting at least two channels of decoded PCM. Receivers shall support downmixing of E-AC-3 streams that contain more than two channels of audio.

**4.4.3.3 Bit rate**

Receivers shall support decoding of E-AC-3 elementary streams encoded at bit rates of up to 3 024 kbit/s.



**4.4.3.4 Sampling frequency**

Receivers shall support decoding of E-AC-3 elementary streams encoded at a sample rate of 48 kHz.

**4.4.3.5 Substream support**

Receivers shall be able to accept E-AC-3 elementary streams that contain more than one substream. Receivers shall be capable of decoding independent substream 0. Support for decoding of additional dependent substreams is optional.

**4.4.3.6 Audio description****4.4.3.6.1 General**

Receivers shall be capable of simultaneously decoding two different programme elements (main audio and audio description) carried either in two separate E-AC-3 elementary streams, or in separate independent substreams within a single E-AC-3 elementary stream, and then combining the programme elements into a complete programme. Receivers shall, in addition to the decoding requirements specified in sections 4.4.3.2 to 4.4.3.5, implement audio description decoding with the capabilities given in 4.4.3.6.2 to 4.4.3.6.6.

**4.4.3.6.2 Audio mode**

The audio description (AD) decoder shall be capable of decoding a single independent substream from an E-AC-3 elementary stream containing up to 5.1 channels of audio. The AD decoder shall be capable of outputting at least two channels of decoded PCM. The AD decoder shall support downmixing of E-AC-3 streams that contain more than two channels of audio.

**4.4.3.6.3 Sampling frequency**

The AD decoder shall support decoding of E-AC-3 substreams and elementary streams encoded at a sample rate of 48 kHz. If the sample rate of the AD service does not match the sample rate of the main audio service, the receiver shall decode only the main audio service.

**4.4.3.6.4 Substream support**

The AD decoder shall support decoding of a single independent substream. Substream ID values of 0, 1, 2 and 3 shall be supported. Receivers shall be able to select a single independent substream from an E-AC-3 elementary stream that contains multiple independent substreams and route this single substream to the AD decoder. Receivers shall support AD services delivered within the same E-AC-3 bitstream as the main audio service, and delivered using a separate E-AC-3 elementary stream carried in a separate PID within the broadcast transport stream.

**4.4.3.6.5 Mixing metadata**

The AD decoder shall support extraction of mixing metadata from the E-AC-3 bitstream and delivery of this mixing metadata to an audio mixing component within the receiver. The AD\_Descriptor, if present, shall be ignored.

**4.4.3.6.6 AD synchronization requirements.**

If audio access units from two audio services, which are to be simultaneously decoded, have identical values of PTS indicated in their corresponding PES headers, then the corresponding audio access units shall be presented to the audio decoder for simultaneous synchronous decoding.



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Synchronous decoding means that for corresponding audio frames (access units), corresponding audio samples are presented at the identical time.

If the PTS values do not match (indicating that the audio encoding was not frame synchronous), then the audio frames (access units) of the main audio service may be presented to the audio decoder for decoding and presentation at the time indicated by the PTS. An AD service, which is being simultaneously decoded, may have its audio frames, which are in closest time alignment (as indicated by the PTS) to those of the main service being decoded, presented to the audio decoder for simultaneous decoding. In this case, the associated service may be reproduced out of sync by as much as 1/2 of a video frame.

#### 4.4.3.7 Mono-audio

##### 4.4.3.7.1 General

There shall be a configurable option in the on-screen menu to replace the analogue Stereo Left signal output via one of the RCA sockets with a derived analogue monofeed.

##### 4.4.3.7.2 HDMI outputs

Receivers shall include an HDMI output, as described in 4.12.3, and the following audio-specific requirements shall be implemented:

- a) Receivers shall determine the audio decoding capability of a connected HDMI sink device by reading the E-EDID structure of the sink device.
- b) If the HDMI sink device indicates support for E-AC-3 decoding, the receiver shall output the E-AC-3 elementary stream directly to the HDMI sink device.
- c) If the HDMI sink device does not indicate support for E-AC-3 decoding, but supports AC-3 decoding, the receiver shall convert the E-AC-3 elementary stream to an AC-3 bitstream before HDMI output.
- d) If the sink device does not indicate support for either AC-3 or E-AC-3 decoding, or the user has selected "stereo" output via the on-screen menu, the receiver shall decode the elementary stream to stereo PCM before HDMI output.

##### 4.4.3.7.3 S/PDIF audio outputs

Receivers shall include an S/PDIF output, as described in 4.12.3, and the following requirements shall be implemented:

- a) The receiver shall convert the E-AC-3 elementary stream to AC-3 before S/PDIF output.
- b) If the user has selected "stereo" output via the on-screen menu, the receiver shall decode the elementary stream to stereo PCM before S/PDIF output.

##### 4.4.3.7.4 Analogue audio outputs

Receivers shall include an analogue audio output, as described in 4.12.3, and decode the audio elementary stream before analogue audio output.

## 4.5 Subtitling

The STB decoder shall be capable of displaying subtitles for the hearing impaired in accordance with ETSI EN 300 743. The decoder shall be capable of overlaying the subtitle text on the picture.



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The subtitles for the hearing impaired may differ from the normal subtitles by the amount of text displayed per second, which is controlled by the broadcasted content.

The decoder shall be capable of displaying subtitles in the eleven official languages when transmitted. The order of the transmitted subtitle services will be determined by the broadcaster.

The language codes of the transmitted subtitle descriptors shall be in accordance with SANS 528-2, and as given below:

|                 |              |     |
|-----------------|--------------|-----|
| Afrikaans       | (Afrikaans)  | afr |
| English         | (English)    | eng |
| Ndebele         | (IsiNdebele) | nbl |
| Sotho, Northern | (Sepedi)     | nso |
| Sotho, Southern | (Sesotho)    | sot |
| Swati           | (SiSwati)    | ssw |
| Tsonga          | (Xitsonga)   | tso |
| Tswana          | (Setswana)   | tsn |
| Venda           | (Tshivenda)  | ven |
| Xhosa           | (IsiXhosa)   | xho |
| Zulu            | (IsiZulu)    | zul |

The decoder shall provide the option of enabling or disabling the display of subtitles. When enabled, subtitles will automatically be displayed. When disabled, the decoder shall allow manual selection from the available list of broadcasted subtitle services. The decoder shall allow the user to configure the preferred first and second language subtitle services, which will be automatically displayed, when available. Should neither be available, the first available subtitle language shall be presented. The decoder shall provide the option of disabling the language presented, or of selecting another available language.

The presence of subtitle services shall be indicated by a subtitle icon on the Now and Next Banner. When the languages button is selected on the remote control unit, the list of available subtitle languages shall be displayed and the user can select his preference.

The decoder shall be capable of displaying subtitling and interactive graphics simultaneously, where available.

#### 4.6 Teletext

MHEG-5 shall be used to provide all interactive services, including teletext-like services.

#### 4.7 Service information (SI) and programme-specific information (PSI)

##### 4.7.1 SI tables

The general implementation of SI and PSI shall be in accordance with SANS 300744 and SANS 300468. Table 19 summarizes the SI table structure and the mandatory and optional descriptors as defined in SANS 300468.

The STB decoder shall be able to process the PSI/SI tables, including the mandatory and optional PSI/SI tables, both for the "Actual" and for "Other" transport streams.



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#### 4.7.2 Networks and bouquets

It is anticipated that bouquets will be allocated on a regional basis. Services will be broadcast on both a national and regional basis with the SI tables containing information on all events. The STB decoder shall use the descriptors in the BAT and the LCN functionality to construct accurate Now and Next information for the region identified on the appropriate menu screen.

**Table 19 — SI table structure**

| 1                     | 2                       | 3                      |
|-----------------------|-------------------------|------------------------|
| SI table              | Actual transport stream | Other transport stream |
| NIT                   | Mandatory               | Optional               |
| BAT                   | Mandatory               | N/A                    |
| SDT                   | Mandatory               | Optional               |
| EIT present/following | Mandatory               | Optional               |
| EIT schedule          | Optional <sup>a</sup>   | Optional <sup>a</sup>  |
| TDT                   | Mandatory               | N/A                    |
| TOT                   | Optional                | N/A                    |
| RST                   | Optional                | N/A                    |

<sup>a</sup> Assuming the use of an MHEG-based full-function EPG as described in 6.2, the EIT schedule will not be required.

#### 4.7.3 Service configuration

The STB decoder shall automatically detect configuration changes, such as service information (see table 19), modulation (see 4.2) and frequency (see 4.2), as well as the adding or the deleting of services, and shall amend its operation accordingly without user intervention or disruption to services.

NOTE It is anticipated that the DTT service will include a dynamic element in terms of the use of available bandwidth.

#### 4.7.4 EIT present/following, actual/other and EIT schedule

Only EIT present/following (Now and Next) information shall be broadcast, including extended event information, for services carried in all DTT transport streams, i.e. EIT present/following including genre tables, parental control and series descriptors. Schedule information for a full function EPG will be carried in a compressed format within private data streams and displayed using an MHEG application.

#### 4.7.5 Time-exclusive services

The STB decoder shall support the use of time-exclusive services, i.e. where part of the multiplex capacity is used to support different services depending upon the time of the day. The services shall be shown within the relevant channel listings and users shall be able to select them as for normal services. During the time period when a service is not using the multiplex capacity (i.e. the service is inactive), the decoder shall display the notification screen (the Placeholder) provided by an MHEG application which will typically provide the service name and its hours of operation. The location and parameters of the Placeholder screens will be defined by the MHEG application.

The decoder shall provide seamless transitions between active and inactive states so that the user experiences the replacement of the Placeholder screen with the active service, and vice versa.



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## 4.8 Memory

4.8.1 The STB decoder shall have a memory capacity of

- a) 64 Mbytes flash memory, and
- b) 256 Mbytes RAM.

4.8.2 Settings and parameters, for example security-related data, shall be stored in non-volatile memory.

4.8.3 There shall be at least 32 Mbytes of free flash memory in the STB decoder dedicated for MHEG file system acceleration cache and 512 kB dedicated for the MHEG non-volatile memory persistent store.

4.8.4 Manufacturers may emulate EEPROM in flash memory, in which case some parts of this data shall be enciphered in the NVRAM.

4.8.5 The memory specification has been chosen to allow for the lowest component price assuming the use of NAND Flash, but manufacturers are free to propose alternative technologies, such as a hybrid solution making use of NOR and NAND Flash, where these comply with the requirements of this standard.

## 4.9 Graphics capabilities

### 4.9.1 Resolution

The colour resolution shall be at least 16 bits (4:4:4) and the STB decoder shall include a look-up table capable of storing a minimum of 256 × 24-bit RGB colour/transparency entries.

### 4.9.2 Multiple display planes

The STB decoder shall have three display planes:

- a) Graphics plane ("front" plane), that supports full screen MHEG-5 graphics and on-screen display information. The sizing of the graphics display plane shall be a 4:3 aspect ratio, regardless of the video aspect ratio.
- b) Video plane, that supports a full screen MPEG video stream or still image.
- c) Background plane ("back" plane), that comprises a single-colour (24-bit RGB) background with a default setting of black.

Each display plane shall have the capability of blending with active video. A minimum of 16 individual transparency levels shall be supported.

## 4.10 Standby operation

### 4.10.1 Passive standby operation

Passive standby shall be provided and shall be the main standby mode, with the main CPU disabled but the RCU Rx function active and the re-modulator bypass active.



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**4.10.2 Active standby operation**

Where it is not possible to provide a passive standby with the power requirements given in 4.10.4(c), the STB decoder shall provide an active standby state. After selecting standby, the decoder shall remain in active standby for 5 min before switching to passive standby.

This mode shall support the downloading of data using DVB-SSU (including STB decoder control information, if this capability is installed) to the STB decoder flash memory.

**4.10.3 Power-up times**

The STB decoder shall generate an on-screen message within 10 s of the start of a reboot operation confirming that the decoder is powering up.

The following time limits shall apply to transitions in and out of standby operations:

- a) STB decoder off to service display: a maximum of 20 s;
- b) active standby to service display: a maximum of 5 s;
- c) passive standby to service display: a maximum of 10 s.

**4.10.4 Power consumption**

The decoder, together with its power supply, shall have the following maximum power consumption:

- a) normal operation: 10 W;
- b) standby (active): 6 W;
- c) standby (passive): 3 W.

NOTE These values will be reviewed to reduce energy consumption when technologically possible.

**4.11 Power supply**

The STB decoder shall be capable of operating in a voltage range of 10,8 V to 14,4 V d.c. with a socket for connection to a 12 V d.c. source. Protection against overvoltage or undervoltage and reversed polarity shall be incorporated.

In addition, the decoder may have the optional capability of operating on a 230 V a.c.  $\pm 10\%$  mains supply. The mains supply power unit may, at the discretion of the manufacturer, be incorporated in the decoder.

A d.c. power supply of +5 V capable of supplying a maximum current of 100 mA suitable for powering an external antenna amplifier shall be available on the input RF connector. The d.c. power supply should not degrade the performance of the RF input. The d.c. power supply shall be protected against short circuits. It shall be possible to switch the d.c. power supply on or off via a selection in the menu structure. The default at first-time initialization and resetting to factory default shall be the d.c. supply switched off.



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## 4.12 Interfaces

### 4.12.1 LED Indications

#### 4.12.1.1 Bi-colour LEDs

The STB decoder shall have a minimum of two bi-colour LEDs (LED1 and LED2) on the front panel.

The two LEDs shall be clearly distinguishable from each other either by their physical position (separation, left side LED and right side LED), or by means of a label.

LED1 shall be defined as the power LED on the left-hand side.

LED2 shall be defined as the status LED on the right-hand side.

The colours of the power LED shall be red/green.

The colours of the status LED shall be red/green.

#### 4.12.1.2 Power LED — Red/green

The power LED indications shall be as follows:

- a) standby: red;
- b) operate: green; and
- c) reception of RCU command: flashing single burst (either red or green).

#### 4.12.1.3 Status LED — Red/green

The status LED indications shall be as follows:

- a) system boot/programme search: flashing green;
- b) normal operation: continuous green;
- c) fault/no signal found: continuous red;
- d) software download in progress: flashing red.

### 4.12.2 Controls

The following controls shall be provided on the front panel:

- a) programme selector P+ and P-;
- b) volume selector V+ and V-;
- c) standby/on.

### 4.12.3 Connectors

The following connectors shall be used:

- a) An RF input female connector that complies with IEC 61169-2.



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- b) An RF output male connector that complies with IEC 61169-2.
- c) Colour-coded RCA sockets for composite (CVBS) video and stereo audio.
- d) A d.c. power jack of length 9,5 mm, outside diameter (OD) of 5,5 mm, centre pin of 2,5 mm, and with the centre pin as +12 V and the outer contact as earth.
- e) A USB 2,0 port via a USB type A jack (for future use).
- f) HDMI – type A.
- g) S/PDIF (electrical).

The use of a C8 a.c. power inlet in accordance with SANS 60320-1, if the power supply is built into the STB decoder, is optional.

#### 4.12.4 Identification

The decoder shall have an external label with the following information:

- a) identification of the manufacturer or the supplier (or both);
- b) model number of the decoder, and
- c) serial number of the decoder.

## 5 STB decoder control

### 5.1 Control requirements

The minimum hardware and software requirements for STB decoder control shall be implemented in accordance with the STB decoder control specification for free-to-air DTT in South Africa. Manufacturers can obtain the STB decoder control specification from the incumbent terrestrial free-to-air broadcasting service licensees in South Africa or their appointed agents (trusted third parties) (see foreword).

### 5.2 Menu operation

The menu structure shall include a dedicated page for STB decoder control support, accessed from the Main Menu page. The dedicated page shall contain the unique South African DTT identification number, plus headings for the following minimum information:

- a) the system name: a maximum of 10 characters; and
- b) the software version number: a maximum of 8 characters.

### 5.3 South African DTT identification number

Each STB decoder shall have a unique South African DTT identification number stored securely in fully write-protected, non-volatile memory. This number shall be the same as the serial number of the STB decoder. The decoder serial number shall be a maximum of 14 digits. The unique address comprises only 10 of the digits. Numbering shall be from the most significant digit first and subsequently as shown in table 20.



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Table 20 — South African DTT identification number

| 1   | 2          | 3  | 4          | 5                                    | 6                                       | 7          | 8          | 9          | 10          | 11          | 12          | 13                       | 14                       |
|---|------------|--|------------|--------------------------------------|---|------------|------------|------------|-------------|-------------|-------------|--------------------------|--------------------------|
| <b>South African DTT identification number</b>  |            |  |            |                                      |   |            |            |            |             |             |             |                          |                          |
| <b>Manufacturer's identification number<sup>a</sup></b>   |            | <b>Manufacturer's model number<sup>b</sup></b> |            | <b>Transmission type<sup>c</sup></b> | <b>Unique serial number<sup>d</sup></b> |            |            |            |             |             |             |                          |                          |
| <b>1st</b>  | <b>2nd</b> | <b>3rd</b>                                     | <b>4th</b> | <b>5th</b>                           | <b>6th</b>                              | <b>7th</b> | <b>8th</b> | <b>9th</b> | <b>10th</b> | <b>11th</b> | <b>12th</b> | <b>Check<sup>e</sup></b> | <b>Check<sup>e</sup></b> |
| digit   | digit      | digit  | digit      | digit                                | digit                                   | digit      | digit      | digit      | digit       | digit       | digit       | digit                    | digit                    |
| The format of the numbers shall be ASCII.   |            |  |            |                                      |   |            |            |            |             |             |             |                          |                          |
| <sup>a</sup> The manufacturer's code is allocated by free-to-air broadcasting service licensees (see foreword).<br><sup>b</sup> The manufacturer's model number is selected by the manufacturer.<br><sup>c</sup> The transmission type, e.g. 1 = DTT is selected by the manufacturer.<br><sup>d</sup> The serial number is made up of consecutive numbers.<br><sup>e</sup> Two check digits using an approved cyclic redundancy check digit scheme. |            |  |            |                                      |   |            |            |            |             |             |             |                          |                          |

## 6 Applications

### 6.1 MHEG-5 interactive application environment

The STB decoder shall implement all the mandatory requirements of the *MHEG-5 Profile for South Africa*.

### 6.2 Electronic programme guide (EPG) and cached applications

The EPG shall be provided by an MHEG application and shall include the Now and Next Banner. The application shall be delivered over broadcast object carousel by the FTA broadcasting service licensees in South Africa or their appointed agents (trusted third parties) (see foreword).

The EPG function shall be launched by a single press of a key on the RCU. The EPG schedule data shall describe all the services carried on the DTT FTA platform for that region for the current day plus the following 7 d.

In order to provide a timely response, when a service carrying the appropriate signalling is selected, the decoder shall cache both the MHEG EPG application and the EPG schedule data. In addition, when the STB decoder is in active standby, it may download and cache the EPG application and schedule data as described in 4.10.2 and 4.10.3.

### 6.3 Secure downloads and updates

#### 6.3.1 Support for downloads

The STB decoder control function shall support the over-the-air downloads of authorized software.

#### 6.3.2 Secure download function

6.3.2.1 The STB decoder operating system shall include the DVB-SSU simple profile download function that supports the partial or total updating of any code stored in flash memory (a code update). All downloads shall be subject to authentication by a double signature process, with downloads signed by both the manufacturer and the body responsible for the engineering channel on the DTT frequency network.



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To support reliable downloads, the loader shall be capable of starting from any segment in the download, and of receiving subsequent segments in any order. Where a downloaded segment is found to contain an error, the loader shall repeat the download for that segment alone, rather than restart the whole process.

The download function employed in the decoder shall be approved by the free-to-air broadcasting service licensees or their appointed agents (trusted third parties) (see foreword). The decoder shall check for the presence of an applicable code update whenever power is applied or whenever the decoder comes out of passive standby.

The decoder shall check for updates at least every 7 d if a check has not been triggered.

**6.3.2.2** An applicable code update is one that is labelled as

- a) intended for the specific hardware build of the STB decoder, and
- b) being a version with a later version number than that of the code currently stored in the flash memory.

**6.3.2.3** On detecting the presence of an applicable code update, the STB decoder shall present an advisory message to the user and prompt one of three responses:

- a) update now;
- b) update later; or
- c) do not update.

**6.3.2.4** Where the user requests an immediate update, the decoder shall commence the update process whilst displaying a dynamic indication of its progress.

**6.3.2.5** Should the update process fail to complete, the decoder shall abort the process once an error is detected or after a time-out period of 10 min from initiation. Unique error messages shall be displayed for

- a) failure to complete the download of the new data;
- b) failure of the CRC check; and
- c) failure to complete the update within the time-out period.

**6.3.2.6** Where an update is requested for later, the decoder shall take no action until next placed in standby, when it will first complete the update process. Advisory messages and indications shall be provided to the user as in 6.3.2.3. (See also 4.10.3.)

**6.3.2.7** If an STB decoder is not placed in standby within 24 h of an applicable code update being detected, the decoder shall initiate the update process at the following local time of 03:00, as determined from the appropriate SI tables.

### **6.3.3 Over-the-air updates**

Over-the-air updates shall use the DVB system software update mechanism (DVB-SSU simple profile) specified in ETSI TS 102 006. The STB decoder shall ensure the security of downloaded data by the use of a digital signature mechanism specified by the free-to-air broadcasting service licensees (see foreword).



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Each software release has a unique model or version reference which shall be used by the decoder to establish whether it is to be downloaded. The decoder shall only respond to updates that contain this unique identifier. In particular, the decoder shall not respond to updates targeted at other decoder models produced by the same manufacturer.

The system shall allow for separate test keys to enable laboratory and field trial tests of new software without affecting the in-field population of decoders.

Decoders shall be supplied with the download mode enabled, such that any updates issued after the production date will immediately be recognized and processed as part of the initial setting up operation.

## 7 User interface

### 7.1 General

The EPG shall be provided as an MHEG application by the free-to-air broadcasting service licensees or their appointed agents (trusted third parties) (see foreword).

NOTE This clause deals with the decoder menu and the Now and Next banner and the operations thereof.

### 7.2 Now and Next Banner

#### 7.2.1 Operation

7.2.1.1 The STB decoder shall be capable of displaying a banner message containing key information for the service and event currently accessed.

The banner shall contain the following minimum information where this is signalled in the SI:

- a) the name and logical channel number of the current service;
- b) the name of the current event;
- c) the start and end times of the current event;
- d) the parental control rating for the current event;
- e) the name and start time of the following event;
- f) the service options.

If the required information is not present in the SI, the decoder shall leave the relevant field blank.

7.2.1.2 The STB decoder shall be able to present the user with information on the present and following event on any channel. The Now and Next Banner shall present this information, allowing the user to navigate the present and following event information for each channel, to access the event description (that consists of a minimum of 300 characters for each event), to set a reminder on any following event, and to tune to the highlighted channel.

7.2.1.3 It shall also be possible to access extended event information by a single press of a key on the RCU whilst the Now and Next Banner is displayed.

7.2.1.4 "Service options" refers to an indication of the presence of additional languages, subtitling, interactive services, audio description and other options associated with the current event. These options shall be selectable from the RCU and shall not require access to the menu screens.



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### 7.2.2 Banner triggering

The banner shall not be displayed if any MHEG application is signalled on the tuned service. If MHEG is not signalled, the Now and Next Banner display shall be triggered by a single press of a key on the RCU or the completion of a channel change operation. The banner shall not be triggered at event boundaries.

The banner shall be generated within less than 1 s of the trigger action and remain on the screen for a configurable display time. The banner display time shall be controlled through a parameter field in the decoder configuration menu screen.

NOTE This setting is not applicable to the MHEG EPG application Now/Next banner.

## 7.3 On-screen menu

### 7.3.1 Operation

#### 7.3.1.1 General

The main menu shall provide access to functional features of the STB decoder, through a structured and explicit organization of these features. Short cuts might be provided to access any of the features with a direct access from the RCU, in addition to the regular access from the menu.

#### 7.3.1.2 Ability to modify menu contents

It shall be possible to modify the contents, structure and operation of the menu structure through the over-the-air update mechanism.

This shall include the addition of further options within existing pages and also the addition of further pages to the menu structure.

#### 7.3.1.3 PIN access option

The STB decoder shall provide the option of requiring the entry of a menu access PIN before displaying the parental control menu and allowing access to its option screens.

The operation of this function is specified in 7.7.

### 7.3.2 Main menu screen

The main menu provides access to all configuration screens, including user preferences and installation. Installation screens are intended for infrequent access by the user, primarily at initial installation and where manual updates are required.

The following menu options are presented:

- a) languages;
- b) installation;
- c) display;
- d) parental control.

Each of these options shall link to a set of supplementary screens of information configuration options as specified in 7.4, 7.5, 7.6 and 7.7.

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## 7.4 Languages

### 7.4.1 General

The languages option shall access a list of languages available for the programme currently running, including, in a single list, audio options, subtitles options, and audio description.

Each language shall be accompanied by an icon defining the option as audio, subtitle, or audio description. The list shall include a minimum of two items: the default audio of the programme, and "no subtitle". Pressing <OK> on any of the options shall activate it and close the list.

If available, the same list can be accessed with the language key on the RCU.

### 7.4.2 Language selection

Pull-down menus exist for each of the following, each containing specified language options:

- a) menu for controlling the language used in the menu screens;
- b) audio for configuring the preferred audio component;
- c) subtitles for configuring the preferred subtitling component.

In each case, the default language shall be English original. It shall be possible to override the selected preferences for audio and subtitles by selections made from the languages list, for which information is extracted from the SI/EIT.

## 7.5 Installation

### 7.5.1 Country selection

The STB decoder shall display a single entry that shows "South Africa".

### 7.5.2 Channel scanning

Channel scanning shall cover the complete range of frequencies as given in table 2.

The following three options shall be available:

- a) a rescan of the required frequency range to locate and add new or changed services;
- b) the deletion of all stored settings and subsequent scan and storage of new ones; and
- c) the scan of a single multiplex (manual search; entry of the channel number to be searched).

When the rescan option is selected, the default operation shall be to scan all applicable channels, however, there shall also be a manual option allowing the user to limit the scan to a specific channel.

Where the deletion option is selected, an on-screen warning shall be provided to warn the user that this action will delete the currently saved channels.

During all scanning operations, the STB decoder shall provide an indication of progress by displaying the number of the channel currently being scanned and the number of services located. Where a multiplex is encountered, the decoder shall display details of its name and network identification, together with the signal strength and quality.



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Where more than one multiplex is found to contain the same services, the decoder shall prioritize the one that has the best signal strength and quality. The decoder shall ensure that there is no duplication of entries in the channel list.

The decoder shall take not more than 5 min to complete a full scan of the complete range of frequencies as given in table 2.

### 7.5.3 TV settings

The following TV settings shall be available:

a) Aspect ratio:

- 1) 4:3, or
- 2) 16:9;

b) Audio descriptor and audio settings:

- 1) audio descriptor on/off;
- 2) audio descriptor volume offset, or
- 3) audio multichannel/stereo/mono;

c) RF modulator:

It shall be possible to select the output UHF channel number of the RF modulator.

### 7.5.4 Service updates

The service update screen shall contain details of the current software and hardware versions stored in the STB decoder.

In addition, an indication of whether updates are available shall also be provided.

A scan update option shall allow the user to check for updates.

Where updates are available, an initiate update option shall allow the user to start the update process manually rather than wait for the normal update during standby operation.

### 7.5.5 System information and diagnostics

#### 7.5.5.1 Diagnostics screen

A diagnostics screen shall provide the following information:

- a) hardware and software version numbers;
- b) middleware and other resident application version numbers;
- c) the received multiplex with indications of signal strength and bit error rates based on the received PLP;
- d) the unique serial number and state of the STB decoder (error code).



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**7.5.5.2 Signal strength and quality indicators****7.5.5.2.1 General**

A signal strength indicator and a signal quality indicator shall be provided for the on-the-screen display.

The on-the-screen display or bar shall be colour coded to indicate in-tolerance, marginal and out-of-tolerance conditions.

The display shall be supported by a text description that indicates

- a) signal OK,
- b) signal marginal, or
- c) signal poor/too low.

**7.5.5.2.2 Signal strength indicator**

The STB decoder shall be provided with a signal strength indicator (SSI). The value for the SSI shall be referred to the RF signal input.

The absolute accuracy shall be  $\pm 5$  dB at RF signal input levels  $-80$  dBm to  $-60$  dBm and  $\pm 7$  dB for RF signal input levels higher than  $-60$  dBm. The relative accuracy should be  $\pm 3$  dB between centre frequencies within one frequency band, e.g. VHF Band III or UHF Band IV/V, supported by the receiver.

The SSI shall have a relative value within a range of 0 % to 100 % and with a resolution of 1 %.

The SSI shall be updated once per second.

**7.5.5.2.3 Signal quality indicator**

The STB decoder shall be provided with a signal quality indicator (SQI). The value for the SQI shall be referred to the RF signal input for DVB-T signals and for DVB-T2 the value for the SQI should be referred to a PLP in the received signal at the RF signal input.

The absolute accuracy of the C/N value reported for DVB-T shall be  $\pm 1$  dB for C/N values of 17 dB to 27 dB at the RF signal input.

For DVB-T2, the SQI should refer to a PLP in the received signal and its combination of C/N and BER before BCH where the signal quality is weighted by the received C/N, e.g. PLP without bit error before BCH should be weighted with C/N.

The SQI shall have a relative value within a range of 0 % to 100 % and with a resolution of 1 %.

The SQI shall be updated once per second.

**7.5.5.3 Multiplex entry selection**

When a multiplex entry is selected, a further screen containing the following details shall be displayed:

- a) channel number and transmitter;



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- b) signal strength and average error rate in accordance with 7.5.5.2.3;
- c) DVB-T/DVB-T2 mode;
- d) transport stream ID;
- e) original network ID;
- f) network ID;
- g) service ID;
- h) T2 system ID;
- i) PLP ID;
- j) list of services carried in the transport stream, by logical channel number; and
- k) indications of service availability (parental control setting, etc.).

An additional text message shall indicate when parameters are out of tolerance, for example: "Low signal level" or "Poor quality signal".

#### 7.5.6 Factory reset

The STB decoder shall include the provision for restoring the factory default settings in response to a user instruction.

This shall return the decoder to the state in which it left the factory, with all locally stored data (for example, user preferences, PINs, channel lists, etc.) removed.

The factory reset function shall also be triggered by a defined sequence of key presses of the front panel buttons, i.e. without the need for an RCU.

If parental control is applied, the factory default setting shall be parental control disabled.

#### 7.6 Display

There shall be a setting to control the duration that the Now and Next Banner is displayed. Values for the display time options can be defined between 1 s and 10 s in increments of 1 s.

This setting will not apply to the MHEG EPG application Now/Next banner.

#### 7.7 Parental control

##### 7.7.1 General

Parental control parameters support the operation of parental control as described in 7.7.2 to 7.7.4. This includes the setting and resetting of PINs for both content access and access to the parental control settings, the activation of the parental control mode, and the setting of the age threshold.



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### 7.7.2 Operation

It shall be possible to apply parental control on individual events and complete channels. Parental control for individual channels shall be implemented as part of the channel store and preferences function.

The parental control function for an event or channel shall be controlled by the parental rating contained in the EPG (SI, EIT information). The STB decoder shall suppress both video and audio if the parental rating is above the configuration threshold for the event. Unblocking of a parentally blocked event shall be done through the entering of a parental PIN. Once the event has been unblocked, it shall remain unblocked for the duration of the event. A change away from the channel and back again shall not require PIN re-entry within the timescale of that event.

When a higher rating is applied to an unblocked event, the unblocked event shall be blocked and the user will be required to re-enter the parental PIN.

Checking of parental control status and subsequent content suppression, if appropriate, shall apply across all state transitions, for example, at switch-on, at coming out of standby, and at channel changes and event boundaries.

The parental control PIN shall be reset by performing a reset to factory settings.

The factory default setting shall be parental control disabled.

### 7.7.3 On-screen messages

If the user has enabled parental control and the rating of the current event is above the trigger level, the STB decoder shall request the entry of a four-digit parental control PIN before allowing access to the event.

If an incorrect PIN is entered, the decoder shall generate an error message and request re-entry.

After five incorrect attempts, the decoder shall advise the user that no further attempts can be made for a period of 10 min.

During this period, it shall be possible to select other services, put the decoder into standby, etc. However, these actions shall not reset the timer, and the error message shall be displayed whenever the user returns to that event.

### 7.7.4 Configuration

The menu structure shall include provision for the user configuration of parental control settings, including the resetting of the PIN sequence, changing the PIN sequence, and setting the minimum-age trigger level.

Events higher than the parental rating selected by the user shall be blocked for viewing and only viewing of content with a lower rating shall be allowed. In the absence of a parental rating for an event, all content shall be parentally blocked.

The factory default setting shall be parental control disabled.

Table 21 shows the ratings that will be used initially, but the STB decoder shall support alternative ratings as specified in ETSI TR 101 211, i.e. minimum age = rating + 3 years.



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Table 21 — Parental control ratings for South Africa

| 1                                 | 2   |
|-----------------------------------|---|
| DVB Parental Value carried in EIT | Parental Rating on Viewer's Decoder Display |
| 0                                 | ALL   |
| 2                                 | PG-10                                       |
| 3                                 | 10  |
| 6                                 | PG-13                                       |
| 7                                 | 13  |
| 10                                | 16  |
| 13                                | 18  |
| 15                                | R-18  |

## 7.8 Operation with radio services

If a radio service is selected, the STB decoder shall display the relevant Now and Next Banner once the service is acquired. The banner has the same functionalities and navigation opportunities as in the case of TV channels. Optionally, if detailed event information is available, the banner shall not time out and shall remain on the screen unless alternative content is signalled within the SI, in which case the banner shall time out as for a television service. The banner shall move over the screen, after 1 min of acquiring the service, as a screen saver.

## 8 Remote control unit (RCU)

### 8.1 Minimum functionality

#### 8.1.1 Protocol

Each STB decoder shall be supplied with an RCU with which the full functionality of the decoder shall be operated.

The decoder shall use a standardized RCU protocol.

For interoperability, the manufacturers should use the NEC protocol for the RCU.

#### 8.1.2 Infrared receiver frequency

The infrared carrier frequency for the RCU shall be 38 kHz.

#### 8.1.3 Keys and layout

8.1.3.1 It shall be possible to perform the following functions by means of the RCU:

- a) enter the programme channel number by numeric keys;
- b) access and navigate the menu structure;
- c) access the EPG (Now and Next Banner and event) and programme information;
- d) confirm an option selection;

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- e) control the on-screen cursor (up, down, left, right);
- f) exit from the menu and information structure,
- g) select the next service up or down (P+ and P-);
- h) increase or decrease the audio level;
- i) adjust the audio level to zero (mute) and restore to previous setting;
- j) display and suppress subtitles;
- k) toggle between normal and standby operation;
- l) toggle between television and radio services; and
- m) provide a short cut to interactive services and overlay text.

**8.1.3.2** The RCU shall implement all the keys in accordance with the SA-MHEG profile.

**8.1.3.3** The design requirements for the RCU will be provided by the free-to-air broadcasters.

#### **8.1.4 Operation**

##### **8.1.4.1 Response time**

The design of the STB decoder and the RCU operating system shall ensure a maximum time of 100 ms between the release of the key and the commencement of the specified response.

##### **8.1.4.2 Channel entry**

All television, radio and interactive services shall be assigned a three-digit LCN. The RCU shall be configured for three-digit LCN operation.

##### **8.1.4.3 N-key rollover**

The design of the keypad and the RCU operating system shall prevent unintended repeated entries. This shall include a delay of 100 ms between the completion of a key press and the recognition of the next entry.

#### **8.2 Alternative RCU design**

Manufacturers should make available alternative RCUs for those with impaired vision or impaired manual dexterity (e.g. over-sized keys and character fonts, and shaped keys).

#### **8.3 Reliability**

##### **8.3.1 Robustness**

The RCU shall be designed to withstand frequent usage. It shall have a robust case which is resistant to damage when dropped onto hard surfaces.

##### **8.3.2 Environmental**

The RCU shall be designed to work in the same environmental conditions (i.e. ambient temperature and humidity) as the STB decoder.



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### 8.4 Packaging

The RCU shall be included in the same shipping carton as the STB decoder. The internal packaging shall be sufficient to prevent any damage or scuffing to the RCU during transit. Batteries shall be provided separately and packaged to prevent accidental short-circuiting during transit.

## 9 Compliance

### 9.1 Health and safety

The STB decoder and all accessories shall comply with SANS 60065.

### 9.2 Electromagnetic compatibility (EMC)

9.2.1 The STB decoder and all accessories shall comply with the following standards:

- a) Emissions: SANS 213;
- b) Immunity: SANS 2200.

9.2.2 The following test methods shall be used:

- a) SANS 61000-3-2;
- b) SANS 61000-3-3;
- c) SANS 61000-4-2: test level (4 kV contact/8 kV air);
- d) SANS 61000-4-3: test level (10 V/m);
- e) SANS 61000-4-4: test level 3;
- f) SANS 61000-4-5: test level 4;
- g) SANS 61000-4-11.

### 9.3 Performance

Compliance of the STB decoder and the RCU with the performance requirements shall be determined using the relevant test methods given in SANS 894.

## 10 Accessories

The STB decoder shall be supplied with the following accessories:

- a) 230 V a.c. to 12 V d.c. converter (in the case of an external power supply).
- b) Mains cord set, of length at least 1,5 m, that complies with SANS 60799 and that incorporates a plug that complies with SANS 164-1, and an appliance connector C7 that complies with SANS 60320-1 (in the case of an internal power supply).
- c) RF flexible coaxial 75  $\Omega$  cable, of length at least 1,5 m (RG6 or equivalent double-screened), fitted with TV aerial connectors (one male and one female) at either end.



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- d) Composite (CVBS) video/stereo audio cable, of length at least 1,5 m, terminated with RCA connectors.
- e) Remote control unit (RCU), that complies with the requirements in clause 8, together with "AA" or "AAA" sized batteries.
- f) User manual.
- g) Quick guide (in English and at least one other official language) that contains a basic wiring diagram, which shows alternative connections for installations with and without a VCR, and with and without baseband (video and audio) input to the television display.

**11 Packaging**

**11.1** The STB decoder shall be securely packaged to protect it against possible damage during transit.

**11.2** The packaging shall contain all the accessories set out in clause 10, and the following information which shall be visible on the outside of the packaging:

- a) the identification of the manufacturer;
- b) the model number of the decoder;
- c) the serial number of the decoder.

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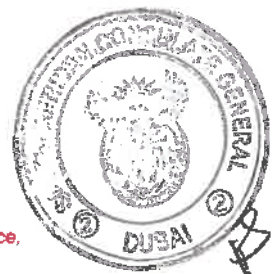
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