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Remarks:

**PLEASE NOTE:**

- The technical committee, SABS TC 74, responsible for the preparation of this standard has reached consensus that the attached document should become a South African standard. It is now made available by way of public enquiry to all interested and affected parties for public comment, and to the technical committee members for record purposes. Any comments should be sent by the indicated closing date, either by mail, or by fax, or by e-mail to

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Edition 1

## **SOUTH AFRICAN NATIONAL STANDARD**

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

Draft SA Standard

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# SANS 862:2009

Edition 1

## Table of changes

Change No.	Date	Scope

## 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 SANS document was published in xxxxx 2009.

At various places in the standard 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). Contacts for these licensees are –

South African Broadcasting Corporation  
Head of Regulatory  
Auckland Park  
Johannesburg

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## Introduction

Digital terrestrial television (DTT) broadcasting is introduced in South Africa from 1 November 2008. Initially the service will be available in parallel with the existing analogue network, but it is anticipated that the analogue network will be switched off from November 2011.

The DTT transmissions in South Africa utilize the MPEG-4 coding standard. The transmission standard will be DVB-T in accordance with SANS 300744. The transmissions are in the VHF and UHF bands.

The objective of this standard is to ensure an STB decoder which in conjunction with an analogue television receiver will provide good quality images for the viewer.

All the requirements of this standard are mandatory.

Where the standard is silent on a feature it is regarded as being optional. The inclusion of optional features can be seen as being part of the marketing strategy of the manufacturer.

This standard sets requirements for a free-to-air set-top box decoder for DTT that will result in a low cost, low maintenance unit providing basic functionality, i.e. decoding DTT broadcasts to provide baseband and UHF modulated outputs, and an electronic program guide (EPG) providing details of the available services. However, the STB decoder should also be capable of providing interactive services and control means that will allow decoders to be disabled and to prevent them from being utilized outside South Africa.

**Introduction** *(concluded)*

The MHEG-5 standard application environment in accordance with ISO/IEC 13522-5 has been selected for easy integration. The South African profile of MHEG-5 does not allow a return path, but the MHEG 5 roadmap will provide return path capability. .

For the South African DTT networks, cached applications and data are used to avoid the high bandwidth needs of carousels. The STB decoder is not required to accommodate high definition services.

Although this standard is applicable 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 services and applications are displayed fully, without any alteration or hindrance.

Control means are required to prevent subsidised STB decoders from being used outside South Africa and to allow stolen decoders to be disabled.

The main functional elements specified for security are:

- a secure over-the-air software and bootstrap loader;
- a unique serial number (SA DTT Identification number);
- a mechanism to prevent STB decoders from functioning in non-RSA DTT networks; and
- a mechanism, using the unique SA DTT identification, allowing stolen STB decoders to be disabled.

The detailed security requirements are not specified in this standard. 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 information 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 set-top box decoder for free-to-air, standard definition, digital terrestrial television in South Africa.

The standard concerns:

- broadcasters
- broadcasting signal distributors, and
- decoder manufacturers.

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

### **2 Normative references**

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. All standards are subject to revision and, since any reference to a standard is deemed to be a reference to the latest edition of that standard, parties to agreements based on this standard are encouraged to take steps to ensure the use of the most recent editions of the standards indicated below. Information on currently valid national and international standards can be obtained from Standards South Africa.

ETR 154, *Digital Video Broadcasting (DVB); Implementation guidelines for the use of MPEG-2 systems, video and audio in satellite cable and terrestrial broadcasting applications.*

ETR 211, *Digital broadcasting systems for television, sound and data services; Guidelines on the implementation and usage of DVB service information (SI).*

ETSI ES 202 184, *MHEG-5 Broadcast Profile*

ETSI ETS 300 743, *Digital Video Broadcasting (DVB); DVB subtitling systems.*

ETSI TS 102 006, *DVB System Software Update (SSU).*

IEC 60169-2, *Radio-frequency connectors – Part 2: Coaxial unmatched connectors.*

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



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ISO/IEC 13522-5, *Information technology – Coding of multimedia and hypermedia information – Part 5: Support for base-level interactive applications.*

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*

SANS 164-1, *Plugs and socket-outlets 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, *Code for the representation of names of languages - Part 2: Alpha-3 code:*

SANS 894, *Test methods 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 13818-3/ISO/IEC 13818-3, *Information technology - Generic coding of moving pictures and associated audio information Part 3: Audio*

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 – 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 for harmonic current emissions (equipment input current  $\leq$  16 A per phase).*

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/ETS 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.*

### **3 Definitions and abbreviations**

#### **3.1 Definitions**

For the purpose of this document, the following definitions apply:

**audio description**

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

**digital terrestrial television**

**DTT**

the terrestrial delivery of digital transmissions in the UHF/VHF frequency bands using the DVB-T standard as set out in SANS 300744

**Multiplex**

**Mux**

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

**private data stream**

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

**set-top box decoder**

**STB decoder**

**decoder**

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

#### **3.2 Abbreviations and symbols**

For the purpose of this standard, the following abbreviations and symbols apply:

AD	audio description
AFC	automatic frequency control
AFD	active format descriptor
BAT	bouquet association table
BER	bit error rate
Bw	bandwidth

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C/N	carrier to noise ratio
C/(N+I)	ratio of carrier to noise plus interference
CA	conditional access
COFDM	coded orthogonal frequency division multiplexing
CPU	central processing unit
CRC	cyclic redundancy check
CVBS	composite video baseband signal
DMO	Digital Migration Office – “Digital Dzonga”
DTT	digital terrestrial television
DVB	digital video broadcasting
DVB-T	DVB-Terrestrial
EEPROM	electrically erasable programmable read-only memory
EIT	event information table
EPG	electronic programme guide
EPT	effective protection target
FEC	forward error correction
FFT	fast Fourier transform
FTA	free to air
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
LCN	logical channel number
MFN	multi-frequency network
MHEG	multimedia and hypermedia information coding experts group
MPEG	moving picture experts group
NEC	Nippon Electric Company
NF	noise figure
NICAM	near instantaneous companded amplitude modulation
NIT	network information table

NVRAM	non-volatile random access memory
PAL	phase alternating line
PCM	pulse code modulation
PIN	personal identification number
PSI	program specific information
QAM	quadrature amplitude modulation
QEF	quasi error free
QPSK	quaternary phase shift keying
R	code rate
RCU	remote control unit
RF	radio frequency
RGB	red/green/blue
r.m.s.	root mean square
RST	running status table
SANS	South African national standard
SDT	service description table
SFN	single frequency network
SI	service information
SSU	system software update
STB	set-top box
TDT	time and date table
TOT	time offset table
TPS	transmission parameter signalling
$T_u$	useful symbol time.
TV	television
UHF	ultra-high frequency
VCR	video cassette recorder
VHF	very-high frequency

YUV a signal defined as colour space, luminance (Y) and colour difference (U/V)

Draft SA Standard

## 4 Performance requirements

### 4.1 Spectrum and DTT modulation and coding

#### 4.1.1 Spectrum

The STB decoder shall operate within the VHF and UHF television broadcasting bands using 8 MHz channel spacing. In South Africa, the UHF band ranges between 470 MHz to 854 MHz. The VHF band is 174 MHz to 238 MHz and 246 MHz to 254 MHz.

#### 4.1.2 DTT modulation and coding

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

## 4.2 Radio frequency

### 4.2.1 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. It shall be capable of receiving transmissions broadcast with any allowable combination of modulation and transmission parameters, as follows:

Modulation constellation: QPSK, 16-QAM, 64-QAM

Outer Coding (FEC) Rc: 1/2, 2/3, 3/4, 5/6, 7/8

Guard Interval  $\Delta/T_u$ : 1/4, 1/8, 1/16, 1/32

Transmission mode: 8K

### 4.2.2 Tuning

#### 4.2.2.1 Automatic tuning

The STB decoder shall be capable of performing automatic tuning over the following frequency ranges: VHF (174 MHz to 238 MHz and 246 MHz to 254 MHz) and UHF (470 MHz to 854 MHz), to find all the multiplexes and services received in the complete frequency range. It shall also be able to interpret and respond to tuning parameters found in the SI/PSI (e.g. within the network information table (NIT)).

The decoder shall display a given service only once in the service list (so avoiding duplicates of the same service), even if this service (i.e. same path comprising original network identifier, transport stream identifier and service identifier) is received from more than one transmitter. In such an example, 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.

The complete decoder automatic tuning function shall take no more than five minutes. During the scanning procedure the priority in table 1 shall be observed in order to minimise the tuning time (MFN environment).

Table 1 — Priority order for parameters used for each channel

1	2	3
Priority order	FFT mode	Guard interval
1	8K	1/8
2	8K	1/4
3	8K	1/16
4	8K	1/32

Note that frequency planning may move to a single frequency network (SFN) basis for local repeaters, and in this case the recommended priority for scanning by guard interval should be changed to 1/8, 1/4, 1/32, 1/16 respectively for the 8K mode.

#### 4.2.2.2 Manual tuning

In addition to automatic tuning, the STB decoder shall be capable of performing manual tuning where the channel number and/or frequency is entered by the viewer. The decoder shall tune to this channel, search all available DTT modes and 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 (so avoiding duplicates of the same service), even if this service (i.e. same path comprising 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.

#### 4.2.3 Tuner performance

##### 4.2.3.1 Noise

The maximum noise level of the decoder tuner shall not exceed 7 dB across the operational frequency range.

##### 4.2.3.2 Return loss

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

##### 4.2.3.3 Centre frequencies and signal bandwidth

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

###### a) VHF tuning

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

where K is an integer from 4 to 13.

###### b) UHF tuning

$$f_c = 306 \text{ MHz} + K * 8 \text{ MHz}$$

where K is an integer from 21 to 68.

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

**4.2.3.4 Maximum frequency offset**

The STB decoder shall be able to receive signals with an offset of up to 125 kHz from the nominal centre frequency.

**4.2.3.5 Carrier to noise ratio**

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

NOTE This requirement is given as quasi error free (QEF) in SANS 300744, and corresponds to BER = 10 to 11 at the input of the MPEG demultiplexer.

The carrier-to-noise (C/N) ratio values in table 2 are specified for two profiles:

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.

Profile 2: The wanted carrier I 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 1.95µs to 0.95 times the guard interval length and has 0 degree phase at the channel center.

**Table 2 — Required C/N for QEF reception (with 1/4 guard interval and FFT size 8K)**

1 Modulation	2 Code rate	3 C/N ratio (dB) minimum		4
		Profile 1: Gaussian		
		Profile 1: Gaussian	Profile 2: 0 dB echo	
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	–	

**4.2.3.6 Minimum decoder input signal levels**

The STB decoder shall provide QEF reception in both the VHF and the UHF bands, for the minimum signal levels (P<sub>min</sub>) derived as follows:

$$P_{min}(dBm) = -105,2 \text{ dBm} + NF (7 \text{ dBm}) + C/N (dBm)$$



where

NF equals noise figure and

C/N is specified in table 2.

The required minimum signal levels are summarized in table 3:

**Table 3 — Minimum signal input levels ( $P_{min}$ ) for QEF reception (with 1/4 guard interval and FFT size 8K)**

1 Modulation	2 Code rate	3 Minimum input level		4
		P <sub>min</sub> (dBm)		
		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	-	

**4.2.3.7 Maximum STB decoder input signal levels**

The decoder shall provide QEF reception for DVB-T signals up to an input level of -35 dBm maximum, in the presence of an analogue TV signal input level of -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 signal input level is valid for the following combination of modes:

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

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

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

where

R is code rate, and

$T_u$  is useful symbol time.

#### 4.2.3.8 STB decoder immunity to analogue signals in other channels

The 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 4.2.3.7.

#### 4.2.3.9 STB decoder immunity to digital signals in other channels

In table 4, the lowest values are given 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 4.2.3.7.

**Table 4 — Minimum required I/C for QEF reception with interfering DVB-T signals**

1	2	3	4	5	6
Band	Signal bw	Channel frequency raster	Minimum I/C (dB)		
	(MHz)	(MHz)	Adjacent Chs	Other Chs	Image Chs
VHF	8	8	28	38	-
UHF	8	8	28	38	28

#### 4.2.3.10 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 table 5 below when an 8 MHz DVB-T signal is exposed to interference from a co-channel PAL-I signal including video with teletext, an FM sound carrier and a NICAM sub-carrier as specified in 4.2.3.8 above.

**Table 5 — C/I (dB) for QEF, in presence of 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

#### 4.2.3.11 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).

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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:

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

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

### 4.2.3.12 Synchronisation for varying echo power levels in single frequency networks

For these modes:

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

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

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

the reception shall be QEF at the C/N ratio specified in table 6 below (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 6 — C/N ratio for QEF reception with dynamically varying echo power levels**

1	2	3
Modulation	Code Rate	C/N performance (dB)
64-QAM	R2/3	26,2
64-QAM	R3/4	30,6

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

If there are more than one FFT window positions for the time-synchronisation 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 equalise the signal for echoes up to  $7T_u/24$  (the interval of correct equalization – for an 8 MHz DVB-T signal, up to 260  $\mu$ s).

For these modes:

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

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

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

the C/N ratio for Profile 2 (specified in 4.2.3.5) for QEF reception shall be obtained when the channel contains two static paths with relative delay from 1,95  $\mu\text{s}$  up to 0,95 times guard interval length, independently of the relative amplitudes and phases of the two paths.

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

For echoes outside the guard interval, for 8 MHz DVB-T signal, QEF reception shall be possible with echo levels up to the values defined in table 7.

**Table 7 — Echo attenuation**

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

#### 4.2.4 Response to changes in modulation

The STB decoder shall recover automatically from any change in the modulation parameters as defined in table 8, continuing to provide an error-free transport stream after recovery.

Recovery shall take a maximum of one second for any one change. In order to minimise this time the decoder shall be able to detect a change of modulation parameter signalled in the TPS data of the transmitted signal.

**Table 8 — Modulation parameters for DVB-T**

1	2	3
Forward error correction (FEC)	Guard interval	Modulation
1/2	1/4	QPSK
2/3	1/8	16QAM
3/4	1/16	64QAM
5/6	1/32	–
7/8	–	–

#### 4.2.5 Bypass support

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

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The RF bypass gain shall be in the range  $-1\text{ dB}$  to  $+3\text{ dB}$  over the frequency range 174 MHz to 254 MHz and 470 MHz to 854 MHz.

### **4.2.6 UHF re-modulator**

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 rec. 624-4, except that dual side bands shall be allowed;
- b) have a peak signal level of 3 mV nominal across 75 ohm ( $-39\text{ dBm}$ );
- c) have a return loss at the output 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 a male output connector in accordance with IEC 60169-2;
- h) have an audio FM deviation of 40 kHz  $\pm 5\text{ kHz}$  at  $-12\text{ dB}$  full-scale transmitter output setting (equivalent to  $+6\text{ dBm}$  studio sound level);
- i) have a vision to sound carrier ratio of 16  $\pm 4\text{ dB}$ ;
- j) produce spurious output levels no greater than:
  - o in band (174 MHz–254 MHz and 470 MHz–854 MHz): 12 dB $\mu$ V max
  - o out of band (30 MHz–1 GHz, excluding in-band above): 43 dB $\mu$ V max;
- k) with the 'RF out' terminated in 75 ohm, exhibit an output voltage leakage to the 'RF in' terminal of 36 dB $\mu$ V maximum.

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

## **4.3 Demultiplexing and decoding**

### **4.3.1 Support of MPEG-4**

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

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 standard definition video resolution shall be 720 x 576.

### **4.3.2 Service acquisition time**

The STB decoder shall implement all reasonable measures to reduce the time taken for changing channels. Where services are not encrypted the time to acquire a service shall be:

typically 500 ms, but shall not exceed 750 ms, where the required service is carried in the same transport stream as the current service, and

typically 750 ms, but shall not exceed 1000 ms, where the required service is in a different transport stream.

### **4.3.3 Video**

#### **4.3.3.1 Support for active format descriptor**

The STB decoder shall handle 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 ETR 154.

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:

- \* Display the material as a 16:9 letterbox within a 4:3 frame, or
- \* Perform a 4:3 centre cut-out on the originating material and present this full-frame within the 4:3 display;

or

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.

#### **4.3.3.2 Support of still pictures**

The STB decoder shall be able to decode and display still pictures (frame), i.e. a video sequence containing a single intra-coded picture. Such a video bit stream will cause the buffer to under-flow. 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.

#### **4.3.3.3 Outputs**

A PAL-I modulated video and audio signal shall be presented on a female connector in accordance with IEC 60169-2.

The decoder shall also provide a composite (CVBS) video output from an RCA connector.

### **4.3.4 Audio**

#### **4.3.4.1 Standards**

The STB decoder shall support MPEG-1 Layer 1&2 (Musicam with 32, 44.1 and 44 kHz sampling), in accordance with SANS 13818-3.

The decoder shall also comply with HE-AAC v2 encoding in accordance with ISO/IEC 14496-3 and ISO/IEC 13818-7.

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At the minimum manual attenuation setting, the decoder shall provide an audio output level of 1,5 V r.m.s. +/-3 dB across 10 k ohm at 0 dB full scale for each of the left and right channels.

### **4.3.4.2 Multiple audio channels**

Alternative language audio components may be available for some services. The decoder shall identify the presence of such alternatives when a service is acquired. The default selection shall be driven by the language selected by the user during initial configuration of the decoder. However, if available, the decoder shall signal the presence of alternative languages within the Now and Next Banner.

### **4.3.4.3 Audio description**

The audio description operation shall be configured within the On-Screen Menu system. The presence of audio description for a particular event shall be indicated in the Now and Next Banner. The audio description channel will be selectable via the On-Screen Menu and will be a PCM mixed feed in the decoder once the audio description option has been selected. There shall be volume control for the main audio. There shall be separate volume control for the audio description channel within the settings menu.

The audio description shall be presented on the right channel when selected by the user. The main audio output shall be presented on the left channel in mono only.

### **4.3.4.4 Mono audio**

There shall be a configurable option in the On-screen Menu to replace Stereo Left with a Mono feed.

## **4.4 Subtitling**

The decoder shall be capable of displaying subtitles in accordance with the DVB subtitling specification SANS 300743 for the hearing impaired. The decoder shall be capable of overlaying the subtitle text on the picture. The hearing impaired subtitles may differ from the normal subtitles by the number of text displayed per second, which is controlled by the broadcasted content.

The decoder shall be capable of displaying subtitles of 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 as given below, in accordance with SANS 528-2/ISO 639-2, *Code for the representation of names of languages - Part 2: Alpha-3 code*:

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

The decoder shall provide the option of Enabling or Disabling the displaying 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, 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.

## 4.5 Teletext

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

## 4.6 Service information (SI) and programme specific information (PSI)

### 4.6.1 SI tables

The general implementation of SI and PSI shall be in accordance with SANS 300 744 and SANS 300468). Table 9 summarises the SI table structure and mandatory/optional descriptors as defined in SANS 300468):

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 (See Note 1)	Optional (See Note 1)
TDT	Mandatory	N/A
TOT	Optional	N/A
RST	Optional	N/A
NOTE 1 EIT schedule will not be required, assuming use of an MHEG-based full-function EPG as described in Section 6.2.		

The STB decoder shall be able to process the PSI/SI tables, both for the 'Actual' and for 'Other' transport streams including Mandatory and Optional PSI/SI tables

### 4.6.2 Networks and bouquets

It is anticipated 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 Bouquet Association Table and the Logical Channel Numbering



functionality to construct accurate 'Now and Next' information for the region identified in the appropriate Menu screen.

### 4.6.3 Service configuration

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

The STB decoder shall automatically detect configuration changes such as service information (table 9), modulation (table 8) and frequency (4.1), as well as the adding and/or the deleting of services, and shall amend its operation accordingly without user intervention or disruption to services.

### 4.6.4 EIT present/following, EIT other and EIT schedule

EIT tables will only contain Now and Next information, including extended event Information, for services carried in all DTT transport streams, i.e. EIT present/following including genre tables, parental control and series descriptor. EIT schedule will not be broadcast. Schedule information for a full function EPG will be carried in a compressed format within Private Data streams.

### 4.6.5 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 an MHEG-based notification screen (the "Placeholder") which will typically provide the service name and its hours of operation. If no MHEG application is available a standard message shall be displayed: "This service is not currently available". The location and parameters of the Placeholder screens will be signalled as part of the SI system.

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. When a service is signalled as inactive the decoder shall not present any component (video, audio, subtitling, interactive applications) associated with that service.

## 4.7 Memory

The STB decoder shall have a memory capacity of:

256 Mbytes Flash memory  
64 Mbytes RAM.

Settings and parameters, e.g. security-related data, shall be stored in non-volatile memory.

There shall be 200 Mbytes of free Flash memory in the STB decoder dedicated for broadcasters' use.

NOTE Manufacturers may emulate EEPROM in Flash in which case some parts of this data must be enciphered in the NVRAM.

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 meet the requirements of this specification.

## 4.8 Graphics capabilities

### 4.8.1 Resolution

Colour resolution shall be 16 bits and the STB decoder shall include a look-up table capable of storing a minimum of 256 x 24-bit RGB colour/transparency entries.

### 4.8.2 Multiple display planes

The STB decoder shall have four display planes with the capability of blending these with active video. A minimum of 16 individual transparency levels shall be supported.

- **Graphics plane ('front' plane).** Supporting full screen MHEG-5 graphics and On Screen Display information. The sizing of the graphics display plane shall be 4:3 aspect ratio regardless of the video aspect ratio.
- **Video plane.** Supporting a full screen MPEG video stream or still image
- **Image plane.** Supporting a single full-screen MPEG still image, GIFs, JPEGs and PNGs
- **Background plane ('back' plane).** A single-colour (24-bit RGB) background with a default setting of black.

## 4.9 Standby operation

### 4.9.1 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. Passive standby shall have an acquisition time from standby of not more than 10 seconds as specified in 4.9.4.

### 4.9.2 Active standby operation

In case it is not possible to provide a true low power passive standby, the STB decoder shall provide an active standby state. After selecting standby the decoder shall remain in active standby for 5 minutes before switching to passive standby.

This mode shall support the downloading of data (including STB decoder control information if this capability is installed) to the STB decoder Flash memory (if this capability is installed).

### 4.9.3 Processor wake-up timer

The STB decoder shall include a wake-up timer. It shall enter active standby during the wake-up period which should last for 1 hour or until any download that is in progress is complete. Whilst in active standby the decoder shall tune to the multiplex carrying the Engineering Service so that updates can be identified and downloaded if applicable.

It shall not be possible to disable the timer, but the wakeup time shall be adjustable.

NOTE The wake-up timer is a means to reduce broadcast bandwidth. EPG data, software downloads and download of interactive applications shall take place during this time. (See also support for cached applications.)

### 4.9.4 Power-up times

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

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The following time limits will apply to transitions in and out of standby operation:

- a) STB decoder Off to Service display    maximum 20 s
- b) Active Standby to Service display    maximum 5 s
- c) Passive Standby to Service display    maximum 10 s

### **4.9.5 Power consumption**

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

Normal Operation	10 W
Standby (Active)	6 W
Standby (Passive)	3 W

NOTE These values will be reviewed to reduce energy consumption when technology permits.

### **4.10 Power supply**

The STB decoder shall be capable of operating over 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. Both protection against over/under-voltage and reversed polarity shall be incorporated

In addition, the decoder may have the optional capability of operating on a 230 V a.c. +/- 10% mains supply. The mains supply power unit may, at the discretion of the manufacturer, be incorporated within the decoder or be external.

### **4.11 Interfaces**

#### **4.11.1 LED indications**

The STB decoder shall have a minimum of two bi-colour LED's (LED #1 and LED #2) on the front panel.

The two LED's 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.

LED #1 shall be defined as the Power LED on the left hand side.

LED #2 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.

#### **The Power LED – Red/Green**

Standby = Red

Operate = Green

Reception of RCU command = flashing single burst

#### **The Status LED – Red/Green**

System boot/program search = flashing Green

Normal operation = continuous Green

Fault/no signal found = continuous Red

Software download in progress = flashing Red

#### **4.11.2 Controls**

The following controls shall be provided on the front panel:

Programme selector P+ and P-

Volume selector V+ and V-

Standby/On

#### **4.11.3 Connectors**

The following connectors shall be used:

- a) RF input type IEC female in accordance with IEC 60169-2
- b) RF output connector, type IEC male in accordance with IEC 60169-2
- c) Colour-coded RCA sockets for composite (CVBS) video and stereo audio
- d) 2,5 mm d.c. power jack, minimum rating of 1,5 A, the centre pin as +12 V and the outer contact as earth
- e) USB 2.0 port via a USB type A jack (for future use)
- f) (Optional) A C8 a.c. power inlet in accordance with SANS 60320-1 if the power supply is built into the STB decoder.

#### **4.11.4 Identification**

The decoder shall have a label with the following information:

Manufacturer's/Supplier's identification

Decoder model number

Decoder serial number

### **5. STB decoder control**

#### **5.1 Control requirements**

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The minimum hardware and software requirements for STB Control shall be implemented according to the specification titled *STB control for free-to-air DTT decoders in South Africa*. Manufacturers can obtain the STB control specification from the free-to-air broadcasting service licensees in South Africa or their appointed third party (see foreword).

## 5.2 Menu operation

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

- (a) System name – maximum 10 characters
- (b) Software Version Number – maximum 8 characters

## 5.3 SA DTT Identification Number

Each STB decoder shall have a unique SA 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 will be a maximum 14 digits. Only 10 of the digits will comprise the unique address. Numbering shall be from the most significant digit first and shall be numbered as follows:

South African DTT Identification Number													
Manufacturer's ID		Manufacturer Model Number		Transmission Type	Unique Serial Number								
1 <sup>st</sup> digit	2 <sup>nd</sup> digit	3 <sup>rd</sup> digit	4 <sup>th</sup> digit	5 <sup>th</sup> digit	6 <sup>th</sup> digit	7 <sup>th</sup> digit	8 <sup>th</sup> digit	9 <sup>th</sup> digit	10 <sup>th</sup> digit	11 <sup>th</sup> digit	12 <sup>th</sup> digit	Check digit	Check digit

### Digit Meaning

- 1-2 Manufacturer Code (Allocated by free-to-air broadcasting service licensees)
- 3-4 Manufacturer model number (Selected by manufacturer)
- 5 Transmission Type e.g. 1 = DTT (Selected by manufacturer)
- 6-12 Consecutive numbers
- 13-14 Two check digits using an approved cyclic redundancy check digit scheme

The format of the number shall be ASCII.”

## 6 Applications

### 6.1 MHEG-5 application environment

The STB decoder shall operate in accordance with MHEG-5 (ISO/IEC 13522-5:1997) in accordance with the broadcast profile ETSI ES 202 184.

## **6.2 Electronic programme guide and cached applications**

For the South African DTT networks all cached applications and Electronic Programme Guide (EPG) data shall be downloaded in a file, carouselled as a private data service. The STB decoder shall download this file while in passive standby if the broadcast file has a later version number or date than the stored file. In the standard running mode this file shall be decompressed into RAM for the EPG data together with a directory of stored applications. Applications shall only be decompressed when they are called.

The EPG shall use an MHEG-based application to provide the EPG function. The MHEG-based application will be provided to manufacturers by the free-to-air broadcasting service licensees in South Africa.

The STB decoder shall implement an EPG using compressed schedule data carried as private data in the transport stream, together with an MHEG-based application to decompress and store the data, and to display it on screen. The EPG function shall be launched via a single press of a key on the RCU.

The schedule shall describe all services carried on the DTT FTA platform for that region for the following 7 days.

In order to provide a timely response when the EPG function is selected, the decoder shall cache both the MHEG EPG application and the schedule data whenever it is not in standby mode. The free-to-air broadcasting service licensees will provide the application for managing the caching process.

## **6.3 Secure downloads and updates**

### **6.3.1 Support for downloads**

The STB decoder control function shall not prevent over-the-air downloads of authorised software.

### **6.3.2 Secure download function**

The STB decoder operating system shall include a download function supporting the partial or total updating of any code stored in Flash (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.

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 STB decoder shall be approved by the free-to-air broadcasting service licensees or the appointed trusted third party. The decoder shall check for the presence of an applicable code update whenever power is applied or whenever the decoder comes out of standby.

The decoder shall check for updates at least every 7 days if a check has not been triggered by the above.

An applicable code update is one which is labelled as:

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

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:

- \* Update now
- \* Update later
- \* Do not update

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

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 minutes from initiation. Unique error messages shall be displayed for either:

- failure to complete the download of the new data;
- failure of the CRC check;
- failure to complete the update within the time-out period.

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 defined above.

If an STB decoder is not placed in standby within 24 hours of an applicable code update being detected, the decoder shall initiate the update process at the following local time of 03h00, as determined from the appropriate SI tables.

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

Over-air updates shall use the DVB System Software Update mechanism (DVB-SSU) specified in ETSI TS 102 006. The STB decoder shall ensure the security of downloaded data by use of a digital signature mechanism specified by the free-to-air broadcasting service licensees. The update operation shall not interfere with the normal operation of the STB decoder.

Each software release shall have a unique model/version reference which shall be used by the decoder to establish whether it is to be downloaded. The decoder shall only respond to updates containing 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 lab and field trial tests of new software without affecting the in-field population of STB decoders.

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

## **7 User interface**

**Note** The user interface specification will be provided by the free-to-air broadcasting service licensees or their appointed agents (see foreword).

## **7.1 Now and Next Banner**

### **7.1.1 Operation**

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. If the required information is not present in SI the decoder shall leave the relevant field blank. The banner shall include:

- a) Name and logical channel number for the current service
- b) Name of the current event
- c) Start and end time of the current event
- d) Parental control rating for the current event
- e) Name and start time of the following event
- f) Service options

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

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 not require access to the Menu screens.

### **7.1.2 Banner triggering**

The Now and Next Banner 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 screen for a configurable display time. The banner display time shall be controlled via a parameter field in the STB decoder configuration menu screen. The minimum display time shall be 1 s and the maximum display time shall be 10 s in increments of 500 ms.

## **7.2 On-screen Menu**

### **7.2.1 Operation**

#### **7.2.1.1 General**

The Main Menu shall provide access to all functional features of the STB decoder, via a structured and explicit organisation of these features. Shortcuts might be provided to access any of the features with a direct access from the remote control, in addition to the regular access from the menu.

#### **7.2.1.2 Ability to modify menu contents**



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It shall be possible to modify the contents, structure and operation of the menu structure via the over-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.

### **7.2.1.3 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 defined in 7.5.

### **7.2.2 Main Menu screen**

The Main Menu shall contain the following options:

- a) Channels
- b) Languages
- c) Interactivity
- d) Guide
- e) Settings (including installation)

Each of these options shall link to a set of supplementary screens of information configuration options as defined below.

### **7.2.3 Channels screen**

The channels option shall provide access to:

- \* The channels list (TV and radio)
- \* The Now and Next Banner

#### **7.2.3.1 Channels list**

The STB decoder shall be able to store 999 individual channels. Following any frequency scan, channels shall be stored in the order of their logical channel number.

The user shall be able to scroll through the list of channels and tune to the highlighted channel with a single key press on <OK>.

The user shall be able to access the now and next event information for the highlighted channel.

#### **7.2.3.2 Now and Next Banner**

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 of a minimum of

300 characters for each event, to set a reminder on any following event, and to tune to the highlighted channel.

#### **7.2.4 Languages**

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 either audio, subtitle, or audio description. The list always includes a minimum of 2 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.

#### **7.2.5 Interactivity**

The interactivity option shall access the interactive services. The list or portal presented from this option shall include the interactive applications transversal to the platform (games, magazines, MHEG portal, etc., as well as the service-bound application for the current channel if one is available). The screen triggered from this option is the same as the one displayed when pressing the interactivity key on the RCU.

The navigation in the interactive applications shall be defined by the application's editor, and be made possible with specified keys as given in the user manual. Menu shall always include an option to exit the application.

#### **7.2.6 Electronic Programme Guide (EPG)**

This option shall access a channel guide with a list of programmes organised by channel number, based on the extended EPG data for the whole depth of the EPG. Optionally, the guide can include additional patterns of organisation of the extended EPG data, for example by time-slots, genre, etc.

The channel guide shall be made available for all channels, whether TV or radio. The programmes shall be organised by start / end time by default. The channel guide shall show a minimum of 5 programmes. The guide shall present navigation shortcuts to the next page (or further point in the list if not organized by pages) and to the next day.

If the current programme (video and sound) is allowed to continue after the launch of the guide, the decoder shall allow the channel to be changed by using the <+> and <-> keys of the RCU, and possibly the numeric keys.

Programme information includes: title, service on which it is broadcast, start and end time, genre, available languages, service options, ratings, synopsis (short description). All of this information shall be made available from any event presented in the guide, although not necessarily from the programme list.

## **7.2.7 Settings**

### **7.2.7.1 General**

The settings option accesses a settings menu providing 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 options are presented:

- \* Technical parameters (or installation)
- \* Favourite channels
- \* Languages
- \* Display
- \* Parental control

### **7.2.7.2 Installation menu**

This menu includes all parameters that affect the proper functioning of the STB decoder.

#### **7.2.7.2.1 Country and regional set-up**

The user shall be required to select from a number of options to show where the STB decoder is located, and the preferred language options.

##### **\* Country selection**

A single entry showing "South Africa".

##### **\* Regional selection**

A pull-down menu of specified regional names. This entry shall be used to derive the appropriate channel listings for use by the EPG. It shall be possible to amend the regional setting should the decoder be transferred to another region.

##### **\* Language selection**

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

- Menu - controlling the language used in the menu screens
- Audio - configuring the preferred audio component
- Subtitles - configuring the preferred subtitling component

In each case the default language shall be English. It shall be possible to override the selected preferences by selections made from the event-based Now and Next Banner.

### **7.2.7.2.2 Channel scanning**

Channel scanning shall cover the complete range of frequencies between 174 MHz and 854 MHz.

Three options shall be available:

- \* A rescan of the required frequency range to locate and add new or changed services.
- \* The deletion of all stored settings and subsequent scan storage of new ones.
- \* 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 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.

Where more than one multiplex is found to contain the same services, the decoder shall prioritise the one having 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 minutes to complete a full scan of the frequency range between 174 MHz and 854 MHz.

### **7.2.7.2.3 TV settings**

#### **\* Aspect ratio**

- Letterbox: 4:3
- Widescreen: 16:9

#### **\* Video output**

Control of whether YUV or RGB is provided on the (optional) component outputs.

#### **\* RF modulator**

It shall be possible to switch off the RF modulator unit.

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

### **7.2.7.3 Service updates**

The service update screen shall contain details of the current software and firmware 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.

#### **7.2.7.4 System information and diagnostics**

A Diagnostics screen shall provide the following information:

- Hardware and Software version numbers
- Middleware and other resident application version numbers
- A list of the received multiplexes along with indications of both signal strength and error rates
- The unique serial number and state of the STB decoder.

The signal strength and error rate indications shall be shown as a bar on screen.

It shall be colour coded Green, Yellow, Red to indicate in-tolerance, marginal and out-of-tolerance conditions. The display shall be supported by a text description -

- Signal strength OK
- Signal strength marginal
- Signal strength too low

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

- a) Channel number and transmitter
- b) Signal strength and average error rate
- c) Network ID and COFDM mode
- d) List of Services carried in the transport stream, by logical channel number
- e) Indications of Service availability (CA protected, parental control setting etc.)

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

#### **7.2.7.5 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 instance 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.

#### **7.2.7.6 Favourite channels**

It shall be possible for the user to select preferences for particular channels but not to delete, reorder or rename channels. The channel screen shall provide a list of all services currently stored within the STB decoder memory. It shall also allow the user to select and unselect any of the available services as a preferred channel. This selection of channels will constitute a user defined channel line-up that can be navigated with the <+> and <-> keys of the RCU when the favourite mode is activated. The favourite channels screen also allows the user to activate and deactivate the favourite mode.

#### **7.2.7.7 Language selection**

Menus shall be available for each of the following:

- Menu - controlling the language used in the menu screens
- Audio - configuring the preferred audio component
- Subtitles - configuring the preferred subtitling component

In each case the default language shall be English. 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.

#### **7.2.7.8 Now/Next Banner display time**

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 500 ms.

#### **7.2.7.9 Parental control**

Parental control parameters support the operation of parental control as described in 7.5, including 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.

### **7.3 Operation at first-time switch-on**

The STB decoder when shipped by the manufacturer shall not have any preset information stored in the NVRAM. When the decoder is switched on for the first time and it detects that the NVRAM is clear, a banner shall be displayed indicating that no preset information is present.

The following sequence of configuration screens shall be displayed:

- a) **Language** – the user shall be able to select the language. The language menu shall remain until a language has been selected. This language selection shall define the language of all subsequent menus.
- b) **Region selection** - the user shall be able to select the region (if provided).
- c) **Aspect ratio (4:3 or 16:9)** - the user shall be able to select the aspect ratio
- d) **Signal acquisition mode** - the user shall be able to select automatic scan or manual channel selection.
  - (i) **Automatic scan** – if the user selects this option the full UHF and VHF band as defined in this specification is scanned. The output of the decoder re-modulator shall be preset to an agreed frequency, selected to avoid co-channel interference in the majority of cases. The sound channel shall be muted until such time as a valid program is presented.

At completion of the scanning, the following shall be displayed:

**“Signal found”**

plus the network information table (NIT) that shall include:

- the types and number of services available
- the current software version
- an indication of signal quality/strength.

Subsequently the available program with the lowest program number shall be selected.

The Now/Next Banner shall be displayed for 3 seconds.

- (ii) **Manual channel selection** - an entry field shall be presented where the user can enter a specific channel number.

If at the completion of a full channel scan the signal is too weak or not found the screen shall display the error messages -

**“Signal not found”** and **“Press [OK] on the remote control unit for help”**.

The status LED shall display continuous red.

If the [OK] key is pressed, the scan process shall be interrupted and a help screen presented displaying the following text information:

“Signal too weak or not found”

“Check that the antenna is correctly installed and connected to the STB decoder”

“Refer to your quick guide for further information or contact the following help lines for more support”

“Help line telephone numbers”

“Software version number”

“Press [OK] on the remote control unit to exit this page and resume signal search” .

The above configuration screens shall remain displayed until a selection has been made, or the Exit/Back key is pressed.

These screens shall not be presented at any subsequent switch on if the NVRAM contains preset information.

## **7.4 Time and date information**

The STB decoder shall use the time and date information carried in the relevant SI tables, to provide an On-screen display in the following screens:

- Menu Page
- Now and Next Banner

## **7.5 Parental control**

### **7.5.1 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.

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, e.g. at switch on, coming out of standby, at channel change and at event boundaries.

Parental control pin shall be reset by performing a reset to factory settings.

The factory default setting shall be parental control disabled.

### **7.5.2 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 4-digit parental control PIN before allowing access to the event.



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

After 5 incorrect attempts the decoder shall advise the user that no further attempts can be made for a period of 10 minutes.

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

### 7.5.3 Configuration

The Menu structure shall include provision for 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 allow viewing of content with a lower rating. 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 10 defines the ratings that will be used initially, but the STB decoder shall support alternative ratings as defined in ETR 211, i.e. minimum age = rating + 3 years.

**Table 10 — Parental control ratings for South Africa**

1	2
Rating	Minimum Age
0x09	13
0x0D	16
0x0F	18

## 7.6 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 for TV channels. Optionally, if details event information is available, the banner shall not time out and shall remain on screen unless alternative content is signalled within SI, in which case the banner should time out as for a television service. The banner shall move over the screen after 1 minute of acquiring the service as a screen saver.

## 8 Remote control unit

### 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 the standardised RCU protocol given below.

In the interest of interoperability, it is recommended that manufacturers 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**

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

- a) enter the programme channel number via numeric keys
- b) access and navigate the menu structure
- c) access the electronic programme guide (now and next banner and event) and programme information
- d) confirm an option selection
- 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
- h) increase or decrease the audio level
- i) adjust the audio level to zero (mute) and restore back to previous setting
- j) display and suppress subtitles
- k) toggle between normal and standby operation
- l) toggle between television and radio services
- m) provide a shortcut to interactive services and overlay text.

The RCU shall have four application keys (to be defined).

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 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 will be assigned a three-digit logical channel number (LCN). The RCU shall be configured for three-digit LCN operation.

#### **8.1.4.3 End 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**

It is recommended that manufacturers make available alternative RCUs for those with impaired vision or impaired manual dexterity (e.g. over-sized keys and character fonts, shaped keys).

## **8.3 Reliability**

### **8.3.1 Robustness**

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The RCU shall be designed to withstand frequent usage, with a robust case that is resistant to damage from being dropped onto hard surfaces or sat upon.

### 8.3.2 Environmental

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

### 8.3.3 Key life

The design of the key mechanism shall be such as to provide a minimum of 5 years operation under normal expected usage.

## 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 are to 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)

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

Emissions: SANS 213  
Immunity: SANS 2200

The following test methods shall be used:

SANS 61000-3-2  
SANS 61000-3-3  
SANS 61000-4-2      Test Level (4 kV contact/ 8 kV air)  
SANS 61000-4-3      Test Level (10 V/m)  
SANS 61000-4-4      Test Level 3  
SANS 61000-4-5      Test Level 4  
SANS 61000-4-11

### 9.3 Performance

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

## 10 Accessories

The STB decoder shall be supplied with the following accessories:

- a) **A 230 V a.c. to 12 V d.c. converter** (in the case of an external power supply).
- b) **A mains cord set** of at least 1,5 m complying with SANS 60799 and incorporating a plug complying with SANS 164-1 and an appliance connector C7 complying with SANS 60320-1 (in the case of an internal power supply).

- c) **An RF flexible coaxial 75 ohm cable** of at least 1,5 m (RG6 or equivalent double screened), fitted with TV aerial IEC connectors (IEC 60169-2), one male and one female, at either end.
- d) **A composite (CVBS) video/stereo audio cable** of at least 1,5 m terminated with RCA connectors.
- e) **A remote control unit (RCU)** complying with clause 8, together with 'AA' or 'AAA' sized batteries.
- f) **A user manual**
- g) **A quick guide** (in English and at least one other official language) which contains a basic wiring diagram showing alternative connections for installations with and without a VCR, and with and without baseband (video and audio) input to the television display.

## 11 Packaging

The STB decoder shall be securely packaged to protect it against possible damage during transit. The packaging shall contain all the accessories in clause 10, and the following information shall be visible on the outside of the packaging.

- Manufacturer's identification
- Decoder model number
- Decoder serial number