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Technical requirements of Digital Terrestrial Transmission System (DVB-T/T2) Receivers

المتطلبات الفنية لأجهزة الاستقبال البث الأرضي الرقمي DVB-T /T2

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FOREWORD

The Saudi Standards, Metrology and Quality Organization (SASO) have prepared this draft Standard “Technical requirements of Digital Terrestrial Transmission System (DVB-T/T2) Receivers” based on relevant regional, International and National foreign Standards and references.

Technical requirements of Digital Terrestrial Transmission System (DVB-T/T2) Receivers

1- Scope

This standard specifies technical characteristics and methods of measurements for digital terrestrial television broadcast receivers fitted with an external antenna input (tuner port) capable of receiving DVB-T and/or DVB-T2 signals.

Receivers without external antenna connectors, receivers with diversity, and receivers intended for mobile or automotive reception are not covered by the present document.

The present document includes considerations of interference from LTE transmissions in the 700 MHz and 800 MHz bands and DTT transmissions in UHF band IV (according to the Saudi National Frequency Plan). The requirements of the installation system (antenna, feeder cable, amplifiers, etc.) are not addressed.

Table 1: Broadcast frequency bands

Broadcast frequency bands	Frequency range
UHF IV and V	470-692 MHz

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.

- ETSI EN 303 340 V1.2.1
- SASO-CITC-RI121

3- Terms, Symbols, and Abbreviations:

3.1 Terms

For the purposes of the present document, the following terms apply:

3.1.1 Adjacent Channel Leakage Power Ratio (ACLR): ratio of the on-channel transmit power to the power measured in one of the adjacent channels with no active channel in the adjacent channel.

NOTE: In the present document this definition also applies to an unwanted signal at a specified frequency offset in a non-adjacent channel.

3.1.2 Adjacent Channel Selectivity (ACS): a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

NOTE 1: In the present document adjacent channel selectivity is determined by the onset of picture degradation.

NOTE 2: The interference power I is equal to the licensed power of the interferer. This definition does not have the same meaning as the term "Adjacent Channel Selectivity" (ACS) used in other organizations such as ITU, CEPT, and in co-existence studies. The adjacent channel selectivity in the present document is equivalent to the measured I/C ratio.

3.1.3 blocking or desensitization: a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal at any frequency other than those of the spurious responses or of the adjacent channels.

NOTE 1: In the present document receiver blocking is determined by the onset of picture degradation.

NOTE 2: The wanted signal level in the blocking tests of the present document is set at the specified receiver sensitivity level plus 6 dB.

3.1.4 Broadcast receiver: digital terrestrial television broadcast receiver comprising of at least a tuner and demodulator **broadcast receiver.**

3.1.5 Tuner port: DTT receiver tuner RF input connector licensed power: highest RMS power of the active portions of the signal measured over a specific time period.

NOTE: In the case of interference power measurements, this is the reference power used for I/C calculations in the present document. Typically for cases of LTE interference, this power is measured with a spectrum analyser in zero spans with a gated power measurement function and RMS detector over a period equal to an LTE symbol time. Alternatively, it can be calculated by measuring the long-term RMS power and adding the appropriate LAPR from table 4.

3.1.6 Long-term RMS power: RMS power of the signal measured over a period long enough to smooth out any fluctuations in the signal power over time such as those due to transmission bursts.

NOTE: This can be measured on an average power meter with an input filter time constant set high enough to average out fluctuations in the measured signal power or alternatively using a spectrum analyser with settings.

3.1.7 Onset of picture degradation: minimum time between successive errors in the displayed video is 15 seconds.

3.1.8 Radio equipment: product or relevant component thereof capable of communication by means of the emission and/or reception of radio waves utilizing the spectrum allocated to terrestrial/space radio communication.

NOTE: For the purposes of the present document the radio equipment is a digital terrestrial television broadcast receiver comprising of at least a tuner and demodulator.

3.1.9 receiver overloading: interfering signal level expressed in dBm, above which the receiver begins to lose its ability to discriminate against interfering signals at frequencies differing from that of the wanted signal due to the onset of strong non-linear behaviour.

NOTE 1: In the present document the overload level is determined by the onset of picture degradation.

NOTE 2: Above the overloading level the receiver will behave in a non-linear way but does not necessarily fail immediately depending on the receiver and interference characteristics.

3.1.10 Sensitivity: maximum usable sensitivity is defined as the minimum receiver Radio Frequency (RF) input signal level or field strength able to produce a specified analogue SINAD ratio or Bit Error Ratio (BER), or other specified output performance which depends on this input signal level.

NOTE: In the present document receiver sensitivity is determined by the onset of picture degradation.

3.2 Symbols, Abbreviations

Symbols	Definition
C	Wanted signal
G_C	Coupling Gain
I	Interferer signal
I_{lic}	Licensed power
I_{rms}	Long term RMS power
P_{RX_UE}	Received UE interference power
P_{UE}	UE transmitted power

Abbreviations	Definition
256-QAM	256-ary Quadrature Amplitude Modulation
64-QAM	64-ary Quadrature Amplitude Modulation
ACE	Active Constellation Extension
ACLR	Adjacent Channel Leakage Power Ratio
ACS	Adjacent Channel Selectivity
AGC	Automatic Gain Control

AWGN	Additive White Gaussian Noise
BER	Bit Error Ratio
BS	Base Station for mobile communications
CEPT	European Conference of Postal and Telecommunications administrations
DTG	UK Digital TV Group
DTT	Digital Terrestrial Television
DVB-T	Digital Video Broadcast Terrestrial - first generation
NOTE:	See ETSI EN 300 744 [i.4].
DVB-T2	Digital Video Broadcast Terrestrial - second generation
NOTE:	See ETSI EN 302 755 [i.5].
EFTA	European Free Trade Association
FEC	Forward Error Correction
FEF	Future Extension Frame
FFT	Fast Fourier Transform
HEM	High Efficiency Mode
ISSY	Input Stream SYnchronizer
LAPR	Licensed to Average Power Ratio
NOTE:	This is the ratio of the licensed power (described above) to the long term RMS power (described above) of the signal.
LDPC	Low Density Parity Check (codes)
LTE	Long Term Evolution
PAPR	Peak to Average Power Ratio
PLP	Physical Layer Pipe
QAM	Quadrature Amplitude Modulation

RF	Radio Frequency
SINAD	(Signal + Noise + Distortion)/(Noise + Distortion) ratio
SISO	Single Input Single Output
NOTE:	Meaning one transmitting and one receiving antenna.
TFS	Time-Frequency Slicing
UE	User Equipment for mobile communications
NOTE:	Example handsets, dongles, etc.
UHF	Ultra-High Frequency
VHF	Very High Frequency

4- DVB-T/T2 Technical Requirements

Representative DVB-T and DVB-T2 configurations used for conformance and testing are shown in Tables 1 and 2. These are used in the NorDig test plan.

4.1 Table 1: DVB-T configuration

Parameter	Value for "8 MHz" UHF tests
Bandwidth	7,61 MHz
FFT size	8K
Modulation	64-QAM
Hierarchy	Non-Hierarchical
Guard interval	1/4
Code rate	2/3
Channel Bandwidth	8 MHz

4.2 Table 2: DVB-T2 configuration

Parameter	Value for "8 MHz" UHF tests
Bandwidth	7,77 MHz
FFT	32K
Carrier mode	Extended
SISO/MISO	SISO
Guard Interval	1/16
Version	1.2.1
Number of symbols/frame (L_f)	62
Pilot pattern	PP4
TFS	No
FEF	Not used
Auxiliary streams	Not used
Subslices/T2 frame	1
Frames/Superframe	2
L1 post FEC type	16k LDPC (see note 1)
L1 repetition	0
L1 post extension	No
L1 post modulation	64-QAM

L1 post scrambling	None
L1_ACE_MAX	0 (see note 2)
L1 bias balancing cells	No
PAPR	L1-ACE & TR (see note 3)
PAPR: V_{clip}	3,1 V (see note 1)
PAPR: Number of iterations	10 (see note 1)
TS bit rate (Mbit/s)	36,552
Parameter	**Value for "8 MHz" UHF tests**
Input mode	Mode A (single PLP mode)
Number of PLPs	1
PLP type	Data type 1
Constellation rotation	Yes
PLP FEC type	64k LDPC
FEC Frame length	64 800 (see note 4)
Baseband Mode	High Efficiency Mode (HEM)
ISSY	None
In band signalling	Disabled
Null packet deletion	Disabled
Time interleaver length	3

Frame interval	1
Time interleaver type	0
T2 frames/Interleaver frame	1 (see note 5)
FEC Blocks/Interleaving Frame	200
Code rate	2/3
Modulation	256-QAM
NOTE 1: This parameter is present on some modulators. NOTE 2: This value disables L1 ACE operation. NOTE 3: This parameter is referred to as "TR" on some modulators. NOTE 4: This parameter is referred to as "Normal" on some modulators. NOTE 5: Derived value shown for information only. Forced to 1 when time interleaver type = 0.	

4.3 Table 3: Receiver Sensitivity

Test number	**Test description**	**C** **wanted signal centre frequency (MHz)**	**Required sensitivity limit for DTT configurations in tables 1 and 2 (dBm)**	
			DVB-T	**DVB-T2**
1	Sensitivity UHF	666	-77	-75

4.4 Adjacent Channel Selectivity

4.4.1 Definition

In the present document, adjacent channel selectivity (I/C) is defined as the measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended. In the present document, adjacent channel selectivity is determined by the onset of picture degradation.

NOTE 1: The interference power I is equal to the licensed power of the interferer. This definition does not have the same meaning as the term "Adjacent Channel Selectivity" (ACS) used in other organizations such as ITU, CEPT, and in co-existence studies. The adjacent channel selectivity in the present document is equivalent to the measured I/C ratio.

NOTE 2: In the present document this definition also applies to an unwanted signal at a specified frequency offset in a non-adjacent channel.

4.4.2 Table 4: Adjacent Channel Selectivity Requirements

Test	Interferer (I) type	I interference test signal waveform name	C Wanted signal centre frequency (MHz)	I interferer centre frequency (MHz)	I_{lic} (licensed) (dBm)	I_{rms} (rms) (dBm)	I LAPR (dB)	Minimum required I/C limit (where I = I_{lic}) for DTT configurations in tables 1 and 2 (dB)		Equivalent wanted level C_{rms} for DTT configurations in tables 1 and 2 (dBm)	
								DVB-T	DVB-T2	DVB-T	DVB-T2
1 (see notes 1 and 2)	10 MHz LTE 800 BS light load (near idle)	LTE_BS-idle_synth	786	796	-15	-23,3	8,3	35	36	-50	-51
2 (see note 2)	10 MHz LTE 700 BS light load (near idle)	LTE_BS-idle_synth	690	763 (see note 3)	-15	-23,3	8,3	43	43	-58	-58
3 (see note 2)	10 MHz LTE 700 UE Video-Stream	Short_UE VideoStream	690	708	-25	-42,7	17,7	33	38	-58	-63
4 (see note2)	N-1 UHF	8 MHz DVB-T	482	474	-30	-30	0	25	25	-55	-55

5 (see note 2)	N+1 UHF	8 MHz DVB-T	482	490	-30	-30	0	25	25	-55	-55

NOTE 1: For broadcast receivers that do not receive DVB-T/T2 signals above 698 MHz, test 1 is not applicable.

NOTE 2: It is acceptable to use an alternative lower interference frequency such as 761 MHz This may be necessary due to test equipment limitation

4.5 DVB-S/S2 LNB Indicator Test Requirements

LNB indicator is the core component of DVB-S/S2.

Parameters		Specification			
		Min	Typical	Max	Unit
Voltage to LNB (Vdc）	Vertical Polarization	12.5	13	14	V
	Horizontal Polarization	17	18	19	V
DiSEqC Control Signal	Frequency (Fctrl)	20	22	24	kHz
	Duty Cycle (DCctrl）	40	50	60	%
	Peak To Peak Voltage (Vpp)	0.4	0.6	0.8	V
	Transition Time (TTS TTD)	5	10	15	US

Annex A (normative): Requirements for the interfering signal minimum ACLR

The required minimum ACLR level depends on the magnitude of I/C values to be measured. Minimum ACLR values to just pass the tests in the present document are provided in table F.1. These values assume a 3 dB ACLR degradation contributing to on the measured performance.

Table A.1: Required interference signal ACLR

Test description	Assumed AWGN C/N	I/C requirement	Recommended minimum ACLR (dB)
Adjacent channel selectivity test 1	DVB-T C/N = 18.7 dB	35	53
Adjacent channel selectivity test 2		43	61
Adjacent channel selectivity test 3		33	51
Adjacent channel selectivity tests 4 & 5		25	43
Blocking test 1		N/A	64
Overloading test 1		N/A	49
Adjacent channel selectivity test 1	DVB-T2 C/N = 19.3 dB	36	58
Adjacent channel selectivity test 2		43	65
Adjacent channel selectivity test 3		38	60
Adjacent channel selectivity tests 4 & 5		25	47
Blocking test 2		N/A	66
Overloading test 1		N/A	53

Annex B (informative): Justification of omitted receiver parameters

B.1 Receiver parameters omitted

B.1.1 Co-channel rejection

Receiver co-channel rejection is a measure of the capability of a receiver to receive a wanted signal, without exceeding a given degradation, due to the presence of an unwanted signal, both signals being at the nominal frequency of the receiver.

A specific test for co-channel rejection is not included because, in the TV bands, co-channel interference is other DTT signals, possibly from neighbouring countries or distant MFN transmitters (at a low level). Since DTT signals are Gaussian in nature, the co-channel performance is strongly correlated to AWGN performance. See measured data in table G.1. Therefore, weaknesses in receiver co-channel rejection will result in degraded sensitivity test results (table 4 of the present document).

Table B.1: Example measurements of the correlation between AWGN and co-channel C/I

Test setup	**Two signal generators with a power combiner**			
DVB-T	**Signal: 482 MHz, -55 dBm, 8k GI 1/4 64-QAM CR 2/3 8 MHz**			
	Desired signal	**Criteria**	**C/N or D/U (dB)**	**Test item**
	Undesired Case1	No uncorrected errors	18.66	AWGN C/N
	Undesired Case2	No uncorrected errors	18.4	DVB-T Co-channel
DVB-T2	**Signal: 482 MHz, -55 dBm, 32k_ext GI 1/16 256-QAM rot PP4 CR 2_3 PAPR TR 8 MHz**			
	Desired signal	**Criteria**	**C/N or D/U (dB)**	**Test item**
	Undesired Case1	No uncorrected errors	18.92	AWGN C/N
	Undesired Case2	No uncorrected errors	18.8	DVB-T2 Co-channel