

INTERNATIONAL STANDARD

IEC 62002-2

First edition
2005-10

Mobile and portable DVB-T/H radio access – Part 2: Interface conformance testing

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Mobile and portable DVB-T/H radio access – Part 2: Interface conformance testing

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MOBILE AND PORTABLE DVB-T/H RADIO ACCESS –

Part 2: Interface conformance testing

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International Standard IEC 62002-2 has been prepared by Technical Area 1: Terminals for audio, video and data services, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

CDV	Report on voting
100/921/CDV	100/1013/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 62002 consists of the following parts, under the general title *Mobile and portable DVB-T/H radio access*:

Part 1: Interface specification

Part 2: Interface conformance testing

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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MOBILE AND PORTABLE DVB-T/H RADIO ACCESS –

Part 2: Interface conformance testing

1 Scope

This part of IEC 62002 provides the conformance testing rules and guidelines for equipment built to meet the mobile and portable DVB-T/H radio access interface specification (IEC 62002-1).

The purpose of this standard is to limit the required test cases to a practical level. Nevertheless, the manufacturer is responsible for guaranteeing that the terminal fulfils the mobile and portable DVB-T/H radio access interface specification (IEC 62002-1) in all its aspects.

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.

IEC 62002-1, *Mobile and portable DVB-T/H radio access – Part 1: Interface specification*

ETSI EN 300 744, V1.5.1:2004, *Digital Video Broadcasting (DVB) – Framing structure, channel coding and modulation for digital terrestrial television*

3 Abbreviations

For the purposes of this document, the following abbreviations apply.

λ	Lambda, wavelength ($\lambda = c/f$)
A2	German analogue TV stereo system
A_A	Coupling between antennas
AGC	Automatic gain control
A_{GSM}	Stop-band attenuation of the GSM reject filter
B	Bandwidth
BER	Bit error ratio
C	Carrier power (in band carrier power including any echoes)
c	Speed of light $c = 3,0 \times 10^8$ m/s
C_i	Power contribution from the i -th signal
C_t	Total useful carrier power
C/N	Carrier-to-noise ratio
C/N_{min}	Minimum C/N
CPE	Common phase error
CR	Code rate
dB	Decibel

dBc	dB compared to carrier power C
dBd	Antenna gain in dB compared to reference dipole (0 dBd = –2,14 dBi)
dBi	Antenna gain in dB compared to isotropic antenna (0 dBi = 2,14 dBd)
dB(mW)	Power in dB compared to 1 mW
DUT	Device under test
DVB, DVB-T	Digital video broadcasting, terrestrial digital video broadcasting
DVB-H	Digital video broadcasting to hand-held terminals
DVB-RCT	DVB terrestrial return channel
E	Field strength V/m
$E(\text{dB}\mu\text{V/m})$	Field strength in dB compared to 1 μV
EDGE	Enhanced data rates for GSM/global evolution
EMC	Electromagnetic compatibility
END	Equivalent noise degradation
ENF	Equivalent noise floor
ESR	Erroneous second ratio
f	Frequency in Hz
$f(\text{MHz})$	Frequency in MHz
f_c	Centre frequency
F	Noise factor
f_d, F_d	Doppler frequency
$F_{d_{3\text{dB}}}$	Doppler frequency with minimum C/N requirement raised by 3 dB
FER	Frame error rate
G	Gain
G_a	Antenna gain
GI	Guard interval
GPRS	General packet radio service
GSM	Global system for mobile communications
I	Interfering power
ICI	Intercarrier interference
J	Joule
k	Boltzmann's constant $k = 1,38 \times 10^{-26}$ J/K
K	Kelvin
L1, L2, L3	Linearity patterns
L_{GSM}	Insertion loss of the GSM reject filter
LNA	Low noise amplifier
MER	Modulation error ratio
$MFER$	MPE-FEC frame error rate
MHz	Megahertz
MPEG-2	Motion pictures expert group, video compression standard
n, m, N	Channel indexes

<i>NF</i>	Noise figure in dB
NICAM	Additional sound carrier for analogue TV, modulated with a near instantaneous companded audio multiplex
PA	Power amplifier
PAL, PAL B, PAL G, PAL I, PAL I1	Phase alternation line, TV systems using PAL
<i>PER</i>	Packet error ratio
PFP	Picture failure point
P_{in}	Input power W
P_{in} (dB(mW))	Input power dB compared to 1 mW
P_{max}	Maximum power
ppm	Parts per million
PSI/SI	Program specific information, service information
P_{TX}	Transmission power
P_x	Excess noise power dBc
QAM16, QAM64	Quadrature amplitude modulation, 16-level and 64-level versions
QEF	Quasi error free
QoS	Quality of service
QPSK	Quaternary phase shift keying
RF	Radiofrequency
RS	Reed Solomon
Rx	Receiver
S1,S2	Selectivity patterns
SECAM, SECAM L	Sequential à mémoire, TV system using SECAM
SFN	Single frequency network
SFP	Subjective failure point
<i>T</i>	Temperature in kelvins
T_c	Corner point
T_e	Total duration of the gating pulses
t_i	Time of arrival for the <i>i</i> -th signal
TS	Transport stream
T_g	Guard interval duration
T_u	Active symbol duration
Tx	Transmitter
UHF	Ultra high frequency
UMTS	Universal mobile telecommunications system
VHF	Very high frequency
W	Watt
WCDMA	Wide-band code division multiple access
W_i	Weighting coefficient for the <i>i</i> -th component

4 Test conditions

4.1 General test conditions

4.1.1 General

The general test conditions are set out below. Manufacturers should note that the actual conditions of use could be more stringent.

4.1.2 Temperature

The terminal shall be tested in the normal laboratory conditions defined below:

+ 5 °C to +35 °C For normal conditions (with relative humidity of 25 % to 75 %)

4.1.3 Voltage

All tests are performed under nominal operating voltage as defined by the manufacturer.

4.2 Terminal categories and summarized measurement conditions

Table 1 shows which conformance measurements are performed with different terminal categories and summaries the measurement conditions.

Table 1 – Valid conformance measurements for different terminal categories

Clause	Conditions	Terminal category a car terminals	Terminal category b1 portable TVs	Terminal category b2 pocketable TVs	Terminal category c hand-held convergence terminals
5 <i>C/N</i> performance		Ch 45			
	Gaussian	All modulations, 2k/4k/8k			
	Portable	All modulations, 2k/4k/8k			
	Mobile	QPSK 1/2 , 16QAM 1/2 and 2/3 <i>GI</i> 1/4	-	-	QPSK 1/2 , 16QAM 1/2 and 2/3 <i>GI</i> 1/4
6 Receiver minimum and maximum input signal levels	Minimum and maximum input levels	Ch 21, 45, 64 (UHF), Ch 8, 12 (VHF)			
		QPSK 1/2			
7 Immunity to analogue and/or digital signals in other channels	S1	$N \pm 1$: Ch 45 (UHF), Ch 8 (VHF) with 64QAM 2/3 additionally Ch 21, 64 (UHF), Ch 5, 12 (VHF). $N \pm 2$: Ch 45 (UHF), Ch 8 (VHF)			
		16QAM 3/4 , 16QAM 2/3, 16QAM 1/2 , 64QAM 3/4 , 64QAM 2/3 <i>GI</i> 1/8			
	S2	Ch 45 (UHF), Ch 8 (VHF)			
		64QAM 2/3, <i>GI</i> 1/8			
	L1-L3	Ch 21,45,64 (UHF) Ch 8 (VHF)			
		16QAM 2/3, <i>GI</i> 1/8			
8 Immunity to co-channel interference from analogue TV signals	Ch 45 (UHF)				
	All modulations, <i>GI</i> 1/8				

Table 1 (continued)

Clause	Conditions	Terminal category a car terminals	Terminal category b1 portable TVs	Terminal category b2 pocketable TVs	Terminal category c hand-held convergence terminals
9 Guard interval utilization: echoes within guard interval		Ch 45 (UHF)			
		8k, 64QAM 2/3, GI 1/8 8k, 16QAM 1/2, GI 1/8			
10 Guard interval utilization: echoes outside the guard interval		Ch 45 (UHF)			
		8k, 64QAM 2/3, GI 1/8 8k, 16QAM 1/2, GI 1/8 8k, 16QAM 2/3, GI 1/8			
11 Tolerance to impulse interference		Ch 45 (UHF)			
		8k, 64QAM 2/3, GI 1/8 8k, 16QAM 1/2, GI 1/8 8k, 16QAM 2/3, GI 1/8			

4.3 Required equipment

The following list gives an overview of the measurement equipment required for the entire set of conformance testing. Capabilities and features of the actual equipment may vary and there could be alternative ways of performing the measurements. Therefore, no detailed instructions for various measurements are given and the list of the required equipment is an example.

- 3 DVB-T/H signal sources
- Wideband noise source
- 2 PAL/SECAM analogue TV-signal sources
- Spectrum analyser
- Channel simulator
- RF power meter
- Impulse noise source
- MPEG-2 source
- MPEG-2 decoder
- DVB-H IP encapsulator
- Step attenuators, power dividers, cables and other standard RF measurement accessories

4.4 Reference model and test point

The receiver performance is defined according to the reference model shown in Figure 1.

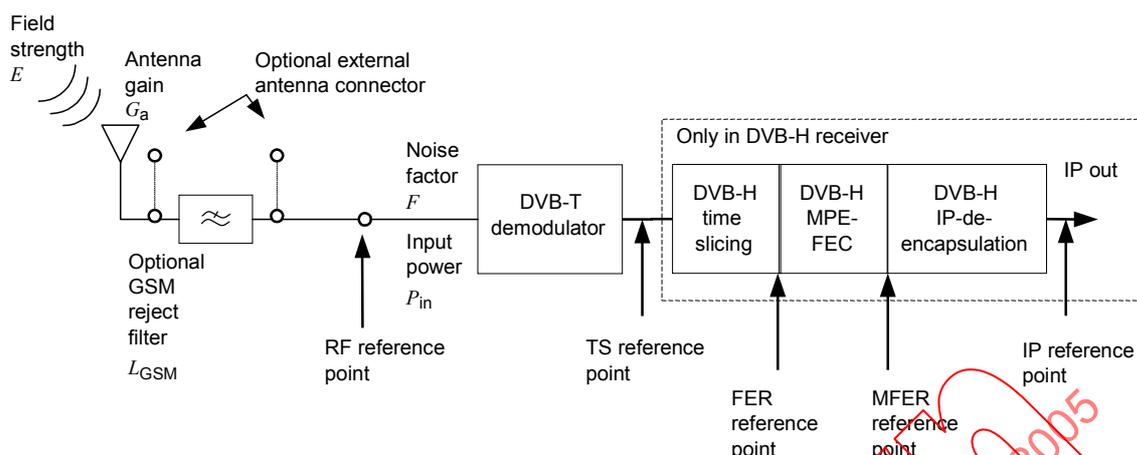


Figure 1 – Reference model

The receiver performance figures are all specified at the reference point, which is the input of the receiver. All conformance testing is performed at the same point.

In the case where the GSM rejection filter is included (terminal category c), the measurements can be carried out in the front of the GSM rejection filter and the allowed noise figure degradation is at most 1 dB. This degradation is to be included in the receiver minimum input signal level values. For all other measurements, the reference point can be moved to the front of the GSM rejection filter and all other requirements remain the same.

In the case of a DVB-H receiver, the manufacturer shall provide the specified test mode in which the following parameters can be monitored.

- TS-BER after Viterbi decoder
- TS-PER
- MPE-FEC FER

4.5 Degradation criteria

Four different degradation criteria are used. The criteria a and b are used in the non-mobile cases. Criterion c is for mobile reception and criterion d for DVB-H reception.

- a) Reference BER, defined as $BER = 2 \times 10^{-4}$ after Viterbi decoding

This criterion corresponds to the DVB-T standard defined QEF criterion, causing "less than one uncorrected error event per hour". In the stationary reception cases, QEF is equivalent to the reference BER after Viterbi decoding.

- b) Picture failure point (PFP)

The PFP is defined as the C/N or C/I value where visible picture errors start to appear on the screen. This is more convenient for some of the measurements than the normal reference BER criterion, which might be unreachable. A more objective definition can be made using the ESR_5 (erroneous second ratio 5 %) criterion, which allows one erroneous second within the 20 s observation period in the transport stream. Note that the reception quality is poor at PFP as one possible error in each 20 s interval is too much for fixed TV reception. The criterion is nevertheless suitable for measurements, and a 1-2 dB carrier power increase will improve the reception quality to QEF level. A useful method to reduce the uncertainty of visual PFP is to use the two out of three method. Here 2 out of 3 consecutive 10 s periods shall be good (no artefacts), i.e. 1 out of 3 can contain artefacts. More complex M out of N periods can lead to more accurate results but will increase the measurement time. Table 2 shows the correlation between the PFP and the reference BER

error criterion for various measurements. When the PFP is used in the measurement, the measured value can be converted to corresponding reference *BER* value by using Table 2.

Table 2 – Delta values between picture failure point and reference *BER*

Measurement	Delta dB
<i>C/N</i> in Gaussian channel	1,3
Minimum input level	1,3
Immunity to other channels	2,0
Immunity to co-channel	2,0
<i>C/N</i> in portable channels	1,3

c) Subjective failure point in mobile reception (SFP)

The reference *BER*, meaning perfect “quality of transmission”, is unfortunately not suitable in the mobile environment due to the fast channel variations. In mobile cases, the reference *BER* criterion may give unstable values, which could result in an underestimation of DVB-T mobile capabilities. Within the motivate project [5]¹, a subjective quality has been defined, referred to as the SFP. The SFP corresponds to: “on average, one visible error in the video, during an observation period of 20 s”. This corresponds to the *ESR*₅ (erroneous second ratio 5 %) criterion, which allows one erroneous second within the 20 s observation period. Thus, the *ESR*₅ method can be used to measure the SFP. The SFP corresponds also fairly well to a *PER* = 10⁻⁴ after RS decoder at the demodulator TS output. The observation period for the *PER* measurement should be at least 800 k TS packets, corresponding roughly to 2 min with 16QAM *CR* = 1/2 *GI* = 1/4 mode.

d) DVB-H error criterion

In DVB-H a suitable degradation criterion is the MPE-FEC frame error rate (*MFER*), referring to the error rate of the time-sliced burst protected with the MPE-FEC. As an erroneous frame will destroy the service reception for the whole interval between the bursts, it is appropriate to fix the degradation point to the frequency of lost frames. Obviously, the used burst and IP parameters will affect the final service quality obtained with certain fixed *MFER*, but experience has shown that the behaviour is very steep and a very small change in *C/N* will result in a large change in *MFER*.

MFER is the ratio of the number of erroneous frames (i.e. not recoverable) and total number of received frames. To provide sufficient accuracy, at least 100 frames shall be analysed.

$$MFER[\%] = \frac{\text{Number of erroneous frames} \times 100}{\text{Total number of frames}}$$

It has been agreed that 5 % *MFER* is used to mark the degradation point of the DVB-H service. Note that the service reception quality at the 5 % *MFER* degradation point may not meet the QoS requirement in all cases. The criterion is nevertheless suitable for measurements, and a small 0,5 to 1dB carrier power increase will improve the reception quality to less than 1 % *MFER*.

It is also possible to estimate the *MFER* with good accuracy without performing the actual MPE-FEC calculation by just observing row by row the number of erroneous bytes and comparing this with the error correction capability of the RS code used and marking the row erroneous or non-erroneous. If all rows are non-erroneous, the frame is non-erroneous. With this method, it is possible to decode all services (i.e. the whole transport stream) in parallel and shorten the observation time for the 100 frames needed.

¹ Figures in square brackets refer to the Bibliography.

In DVB-H receivers with no MPE-FEC, the frame error rate criterion can be used in a slightly different way. A frame is marked as erroneous if any TS packet within the frame is erroneous. This criterion is called *FER* and degradation point is set to 5 % value. Note that 5 % *FER* may lead to better actual QoS than 5 % *MFER* as in *FER* it is possible that only a few TS packets within the frame are erroneous, but in *MFER* a non-recoverable frame is probably highly corrupted. The actual performance figures with *FER* 5 % are very similar what would be achieved using *ESR_s* criterion to the transport stream directly.

4.6 Definition of *C/N*

C/N is measured from the test signals by measuring the noise level in dB(mW) present at the received channel bandwidth (5,71 MHz, 6,67 MHz or 7,61 MHz) and comparing the DVB-T/H signal level (dB(mW)) to the measured noise level.

Example: Measured noise level at 7,61 MHz channel bandwidth is –70 dB(mW). Measured DVB-T/H signal level is –50 dB(mW). Resulting *C/N* is 20 dB.

4.7 Definition of measurement signals

4.7.1 Wanted DVB-T/H signal and interfering DVB-T signal definition

The DVB-T signal is according to ETSI EN 300 744.

In the case of DVB-H, the signal used in measurements has a burst size of 2 Mbits. The DVB-H burst bit rate is always 4 Mbit/s independent of modulation. MPE-FEC parameters are 1 024 rows, *CR* 3/4. These parameters will result approximately in a duration of 0,5 s time-slicing bursts. The repetition rate of bursts can vary, and higher rates than typically used in real networks can be used to speed up the measurement. As an example, a repetition rate with a 50 % on/off period can be used.

4.7.2 Interfering signal definitions

Figure 2 shows the PAL B/G/I1 interfering signals. Modulating signals are: 75 % colour bars for the vision carrier, 1 kHz FM sound with ±50 kHz deviation and any modulation for NICAM. The level of the FM sound carrier relative to the vision carrier is –13 dB. The level of the NICAM signal relative to the vision carrier is –20 dB. Note that the filter roll-off factor for PAL B/G NICAM is 40 % and PAL I1 NICAM is 100 %.

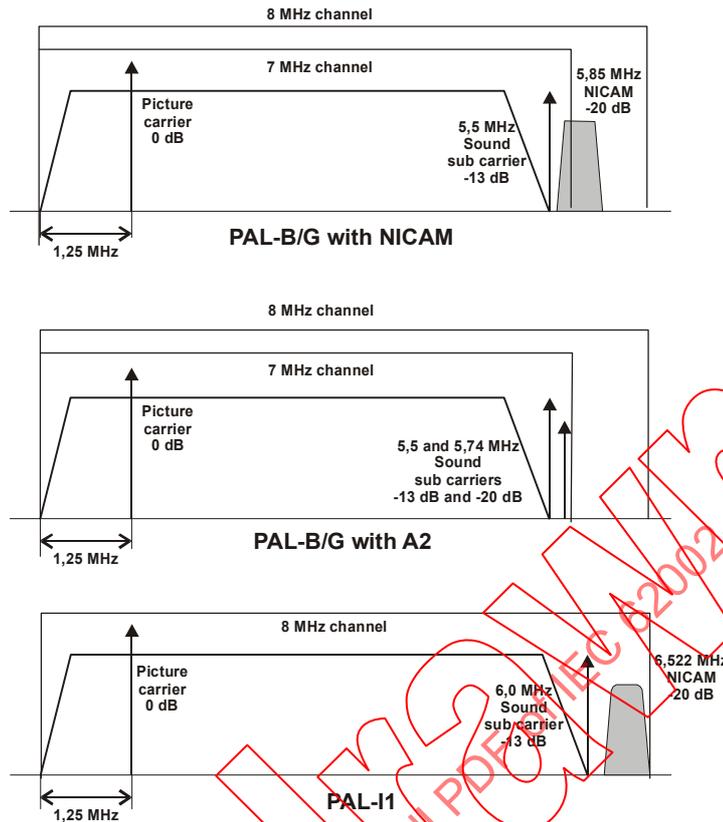


Figure 2 – PAL interfering signals

SECAM L

Figure 3 shows the standard SECAM signal with NICAM sound (1,25 MHz vestigial sideband bandwidth).

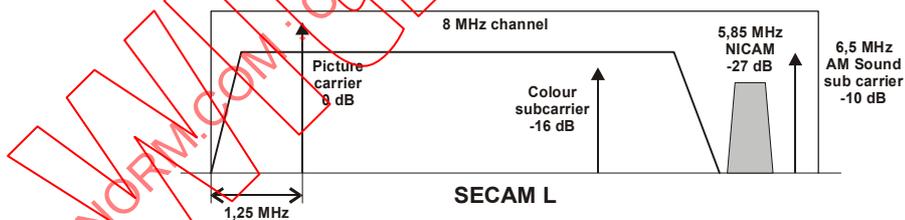


Figure 3 – SECAM L interfering signal

The level of the sound subcarrier is -10 dB relative to the vision carrier. The level of the NICAM signal relative to the analogue vision carrier is -27 dB. Note that the filter roll-off factor for SECAM L NICAM is 40 %. Modulating signals are 75 % colour bars for the vision carrier and 1 kHz with 54 % AM for the AM sound carrier.

5 C/N performance

5.1 Definition and applicability

This test measures the required carrier-to-noise ratio to reach the appropriate failure point criterion.

The requirements and this test shall apply to all terminal categories specified in IEC 62002-1 with the following exception: for terminal category b, the performance is measured only in Gaussian and portable channels.

5.2 Minimum requirements

5.2.1 C/N performance in Gaussian channel

The requirements are shown in Table 3.

Table 3 – C/N (dB) in Gaussian channel

Modulation	Code rate	C/N (dB) Ref BER	C/N (dB) PFP
QPSK	1/2	5,6	4,3
QPSK	2/3	7,4	6,1
QPSK	3/4	8,4	7,1
16-QAM	1/2	11,3	10,0
16-QAM	2/3	13,7	12,4
16-QAM	3/4	15,1	13,8
64-QAM	1/2	17,0	15,7
64-QAM	2/3	19,2	17,9
64-QAM	3/4	20,8	19,5

5.2.2 C/N performance in portable channel

The requirements are shown in Table 4.

Table 4 – C/N (dB) in portable channel

Modulation	Code rate	C/N (dB) Ref BER	C/N (dB) PFP
QPSK	1/2	7,9	6,6
QPSK	2/3	10,9	9,6
QPSK	3/4	13,2	11,9
16-QAM	2/1	13,8	12,5
16-QAM	2/3	16,8	15,5
16-QAM	3/4	19,4	18,1
64-QAM	1/2	18,7	17,4
64-QAM	2/3	22,1	20,9
64-QAM	3/4	24,8	23,5

5.2.3 C/N performance in mobile channels

The performance in IEC 62002-1 is specified at 1/32 guard interval, but the conformance measurement is carried out with the more practical guard interval of 1/4. The performance expected at the 1/4 guard interval is 85 % of that with 1/32 guard interval and the calculated figures are shown in Table 5.

Table 5 – C/N (dB) for PER = 1x10⁻⁴ in typical urban channel

Guard interval = 1/4			2k						8k					
Modulation	Bit rate (Mbit/s)	Code rate	C/N _{min} (dB)	F _d _{max} (Hz)	Speed at F _d at C/N _{min} + 3 dB (km/h)			C/N _{min} (dB)	F _d _{max} (Hz)	F _d at C/N _{min} + 3 dB	Speed at F _d at C/N _{min} + 3 dB (km/h)			
					200 MHz	500 MHz	800 MHz				200 MHz	500 MHz	800 MHz	
QPSK	4,98	1/2	13,0	270	220	1188	475	297	13,0	65	55	297	119	74
16-QAM	9,95	1/2	18,5	190	155	837	335	209	18,5	50	40	216	86	54
16-QAM	13,27	2/3	21,5	150	125	675	270	169	21,5	35	30	162	65	41

For DVB-H these values are given in Table 6.

Table 6 – C/N (dB) for MFER 5 % for DVB-H

Guard interval = 1/4			2k				4k				8k			
Modulation	Code rate	Bit rate Mbit/s)	C/N _{min} (dB)	F _d _{3dB} (Hz)	Speed at F _d _{3dB} (km/h)		C/N _{min} (dB)	F _d _{3dB} (Hz)	Speed at F _d _{3dB} (km/h)		C/N _{min} (dB)	F _d _{3dB} (Hz)	Speed at F _d _{3dB} (km/h)	
					474 MHz	698 MHz			474 MHz	698 MHz			474 MHz	698 MHz
QPSK	1/2	4,98	9,5	380	866	588	9,5	190	433	294	9,5	95	216	147
QPSK	2/3	6,64	12,5	360	820	557	12,5	180	410	279	12,5	90	205	139
16-QAM	1/2	9,95	15,5	340	775	526	15,5	170	387	263	15,5	85	194	132
16-QAM	2/3	13,27	18,5	320	729	495	18,5	160	365	248	18,5	80	182	124

NOTE These values are preliminary.

5.3 Test purpose

The purpose of this test is to verify the C/N performance of the receiver in different channel conditions specified in Table 3, 4 and 5.

The purpose of the C/N test performed in Gaussian channel conditions is to verify the operation of the terminal under ideal channel conditions. The portable channel conditions are used to test the performance of the terminal under conditions where the channel is stationary multipath channel without direct path. The mobile channel model is used to verify the operation of the terminal while moving in a car.

5.4 Method of test

5.4.1 Initial conditions

Frequencies to be tested: the measurements are performed at channel 45 (666 MHz).

Reception modes to be tested:

In Gaussian channels: all modes specified in IEC 62002-1, 10.7.1. The test can be carried out with 2 k or 4 k or 8 k modes or any combination of these.

In portable channels: all modes specified in IEC 62002-1, 10.7.2 are tested. The test can be carried out with 2 k or 4 k or 8 k modes or any combination of these.

In mobile channels: the modes QPSK 1/2, 16QAM 1/2 and 16QAM 2/3, all using guard interval 1/4. The highest available FFT-size is selected.

For DVB-H receivers with MPE-FEC when measuring with mobile channels, the failure point criterion is DVB-H error criterion (failure criterion d) using DVB-H performance target figure. DVB-H receivers without MPE-FEC are measured using *FER* criterion and the performance target figure of DVB-T. Other measurements are done with the same criteria as DVB-T.

5.4.2 Measurement setup

The measurement setup is shown in Figure 4.

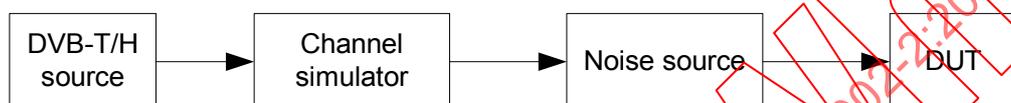


Figure 4 – Example of a possible measurement setup in C/N performance tests

- Connect the DVB-T/H signal source to the channel simulator and noise source. Feed the signal into the terminal reference point shown in Figure 1. If the *C/N* of the DVB-T/H signal source can be set, it can be used in measurements instead of noise source.
- Set the correct channel model to the channel simulator.
- Set correct modulation and signal parameters to the DVB-T/H signal source.
- Set the DVB-T/H signal source to channel 45 (666 MHz).
- Set the DVB-T/H signal source power level to -50 dB(mW), when measured from the terminal reference point.
- Tune the terminal to channel 45 (666 MHz).
- Perform the measurement as described in 5.4.3.

5.4.3 Procedure

5.4.3.1 Gaussian channel

The *C/N* value is adjusted by changing the noise source signal level until the receiver reaches reference *BER* criterion 2×10^{-4} after the Viterbi decoder (failure criterion a) (for DVB-H, see 5.4.1). Alternatively, the PFP criterion (failure criterion b) may be used. Once the reference failure criterion is reached, resynchronization needs to be achieved.

Repeat the measurement with all modes defined in 5.4.1.

5.4.3.2 Portable channel

The *C/N* value is adjusted by changing the noise source signal level until the receiver reaches reference *BER* criterion 2×10^{-4} after the Viterbi decoder (failure criterion a) (for DVB-H, see 5.4.1). Alternatively, the PFP (failure criterion b) criterion may be used. Once the reference failure criterion is reached, the resynchronization needs to be achieved.

Repeat the measurement with all the modulations defined in 5.4.1.

5.4.3.3 Mobile channel

At first the Doppler frequency in the channel simulator is set to 10 Hz and the C/N value is adjusted by changing the noise source signal level until the receiver reaches the SFP (failure criterion c) corresponding to $PER = 1 \times 10^{-4}$ as defined in 4.5 (for DVB-H, see 5.4.1). The resulting C/N ratio is the C/N_{\min} . This point corresponds to the point TP4 in IEC 62002-1, Figure 4.

Next the C/N ratio is increased by 3 dB from the measured C/N_{\min} . The Doppler frequency is then adjusted until the receiver reaches SFP. The resulting Doppler frequency is Fd_{3dB} . This point corresponds to point TP3 in IEC 62002-1, Figure 4.

Next the wideband noise source is turned off and the Doppler frequency is adjusted until the receiver reaches SFP. The resulting Doppler frequency is Fd_{\max} . This point corresponds to point TP1 in IEC 62002-1, Figure 4.

Once the reference failure criterion is reached the resynchronization needs to be achieved.

Repeat the measurement with all modulations defined in 5.4.1.

5.5 Test requirement

The C/N value measured from the terminal reference point shall not be greater than those specified in Table 3 and Table 4.

The receiver needs to meet the requirements given in Table 5 for DVB-T with the ESR 5 % criterion. In the case of DVB-H, values from Table 6 and the $MFER$ 5 % criterion are used.

C/N is measured from the test signals by measuring the noise level in dB(mW) present at the received channel bandwidth and comparing the DVB-T/H signal level (-50 dB(mW)) to the measured noise level.

6 Receiver minimum and maximum input signal levels

6.1 Definition and applicability

To verify that the set reference BER criterion or picture failure point criterion does not exceed when the input signal power level is within the defined dynamic range of the receiver.

The requirements and this test apply to all terminal categories specified in IEC 62002-1.

6.2 Minimum requirements

6.2.1 Minimum input levels

The requirement is -94,6 dB(mW) for QPSK 1/2 in the 8 MHz channel and -95,1 dB(mW) in 7 MHz channel.

In the case of the GSM rejection filter, the requirement is -93,6 dB(mW) in the 8 MHz channel and -94,1 dB(mW) in the 7 MHz channel.

6.2.2 Maximum input levels for wanted signals

For terminal category a, the measured level should be -18 dB(mW) or higher.

For terminal category b and c, the measured level should be -28 dB(mW) or higher.

6.3 Test purpose

The purpose of this test is to verify that the receiver is capable of operating with a large enough dynamic range of the input signals.

The receivers not capable of fulfilling the minimum and maximum input levels performance decrease the service coverage area. These receivers are not capable of operating in the proximity of, or far from, the transmission stations.

6.4 Method of test

6.4.1 Initial conditions

Frequencies to be tested: the measurement is performed at all available channels for the terminal category under test from the following list of channels: 21 (474 MHz), 45 (666 MHz) and 64 (818 MHz) in UHF and at channels 8 (199 MHz) and 12 (227 MHz) in VHF III.

Reception modes to be tested: QPSK 1/2. Any FFT size can be used.

6.4.2 Measurement setup

The measurement setup is shown in Figure 5.



Figure 5 – Example of a possible measurement setup in minimum and maximum receiver signal input level tests

- Connect the DVB-T signal source to the terminal reference point shown in Figure 1.
- Set the DVB-T signal source power level to the defined power level, when measured from the terminal reference point.
- Set the correct modulation and signal parameters to the DVB-T/H signal source.
- Set the DVB-T signal source to correct channel frequency.
- Set the terminal to correct channel frequency.
- Perform the measurement according to the procedure described in 6.4.3.

6.4.3 Procedure

6.4.3.1 Minimum input levels

Adjust the DVB-T signal source power level until the receiver reaches the reference *BER* criterion 2×10^{-4} after the Viterbi decoder (failure criterion a). Alternatively, the PFP criterion (failure criterion b) may be used. Measure the power level at the terminal reference point. Once the reference failure criterion is reached, resynchronization needs to be achieved.

Repeat the measurement with all frequencies defined in 6.4.1.

6.4.3.2 Maximum input level

Adjust the DVB-T signal source power level to the defined maximum value. Measure the reference *BER* after the Viterbi decoder (failure criterion a). Alternatively, the PFP criterion (failure criterion b) may be used. Once the reference failure criterion is reached, resynchronization needs to be achieved.

Repeat the measurement with all the frequencies defined in 6.4.1.

6.5 Test requirement

The measured input signal power level causing defined failure criterion has to be less than that specified in 6.2.1.

The maximum input signal level specified in 6.2.2 should result in a reference *BER* less than the specified failure criterion.

7 Immunity to analogue and/or digital signals in other channels

7.1 Definition and applicability

This test measures the performance of the terminal in presence of various types of interfering signals.

The requirements and this test apply to all terminal categories specified in IEC 62002-1.

7.2 Minimum requirements

7.2.1 Immunity to pattern S1

The interferers are set to the maximum allowed level:

for terminal category a and b1 for $N\pm 1$ measurement, this level is:	–25 dB(mW)
for terminal category b2 and c for $N\pm 1$ measurement, this level is:	–35 dB(mW)
for terminal category a and b1 for $N\pm 2$ measurement, this level is:	–18 dB(mW)
for terminal category b2 and c for $N\pm 2$ measurement, this level is:	–28 dB(mW)

The difference shall be higher than the requirement in Table 7.

Table 7 – Immunity to pattern S1

Mode	$N\pm 1$ PAL G or I1	$N\pm 1$ PAL B	$N-1$ SECAM L	$N+1$ SECAM L	$N\pm m$ ($m\neq 1$) SECAM L	$N\pm m$ ($m\neq 1$) PAL B/G/I1	<i>BER</i>
2k/8k 16QAM $CR = 1/2$ $GI = 1/8$	38 dB	36 dB	30 dB	36 dB	48 dB	48 dB	<2 x 10 ⁻⁴
2k/8k 16QAM $CR = 2/3$ $GI = 1/8$	38 dB	36 dB	30 dB	36 dB	48 dB	48 dB	
2k/8k 16QAM $CR = 3/4$ $GI = 1/8$	37 dB	35 dB	29 dB	35 dB	48 dB	48 dB	
2k/8k 64QAM $CR = 2/3$ $GI = 1/8$	35 dB	33 dB	30 dB	33 dB	45 dB	46 dB	
2k/8k 64QAM $CR = 3/4$ $GI = 1/8$	35 dB	33 dB	30 dB	33 dB	42 dB	43 dB	

7.2.2 Immunity to pattern S2

The interferers are set to the maximum allowed level:

for terminal category a and b1 for $N\pm 1$ measurement, this level is:	–35 dB(mW)
for terminal category b2 and c for $N\pm 1$ measurement, this level is:	–35 dB(mW)
for terminal category a and b1 for $N\pm 2$ measurement, this level is:	–18 dB(mW)
for terminal category b2 and c for $N\pm 2$ measurement, this level is:	–28 dB(mW)

The difference shall be higher than the requirement in the Table 8.

Table 8 – Immunity to pattern S2

Mode	$N \pm 1$	$N \pm m$ ($m \neq 1$) except $N + 9$	$N + 9$	BER
2k/8k 64QAM $CR = 2/3$ $GI = 1/8$	27 dB	40 dB	31 dB	$< 2 \times 10^{-4}$

7.2.3 Immunity to pattern L1

The interferers are set to the maximum allowed level:

- for terminal category a: –25 dB(mW)
- for terminal categories b and c: –35 dB(mW)

The difference shall be higher than the requirement in Table 9.

Table 9 – Immunity to pattern L1

Mode	$a [N + 2]$	$b [N + 4]$	BER
2k/8k 16QAM $CR = 2/3$ $GI = 1/8$	40 dB	45 dB	$< 2 \times 10^{-4}$

7.2.4 Immunity to pattern L2

The interferers are set to the maximum allowed level:

- for terminal category a: –25 dB(mW)
- for terminal categories b and c: –35 dB(mW)

The difference shall be higher than the requirement in Table 10.

Table 10 – Immunity to pattern L2

Mode	$a [N + 2 \text{ and } N + 4]$	BER
2k/8k 16QAM $CR = 2/3$ $GI = 1/8$	45 dB	$< 2 \times 10^{-4}$

7.2.5 Immunity to pattern L3

The interferers are set to the maximum allowed level:

- for terminal category a: –25 dB(mW)
- for terminal categories b and c: –35 dB(mW)

The difference shall be higher than the requirement in Table 11.

Table 11 – Immunity to pattern L3

Mode	a [$N + 2$ and $N + 4$]	BER
2k/8k 16QAM $CR = 2/3$ $GI = 1/8$	40 dB	$< 2 \times 10^{-4}$

7.3 Test purpose

To verify that the set reference BER criterion or PFP criterion does not exceed when strong interfering signals are near the desired channel. In the case where the PFP is used, then the requirement is increased by the delta value of 2 dB given in Table 2.

The receivers not capable of operating when strong interfering signals are near the desired channel decrease the service coverage area.

7.4 Method of test

7.4.1 Initial conditions

7.4.1.1 General

The highest available FFT mode is used.

NOTE SECAM is tested according to the intended market area.

7.4.1.2 Pattern S1

Pattern S1 is shown in Figure 6.

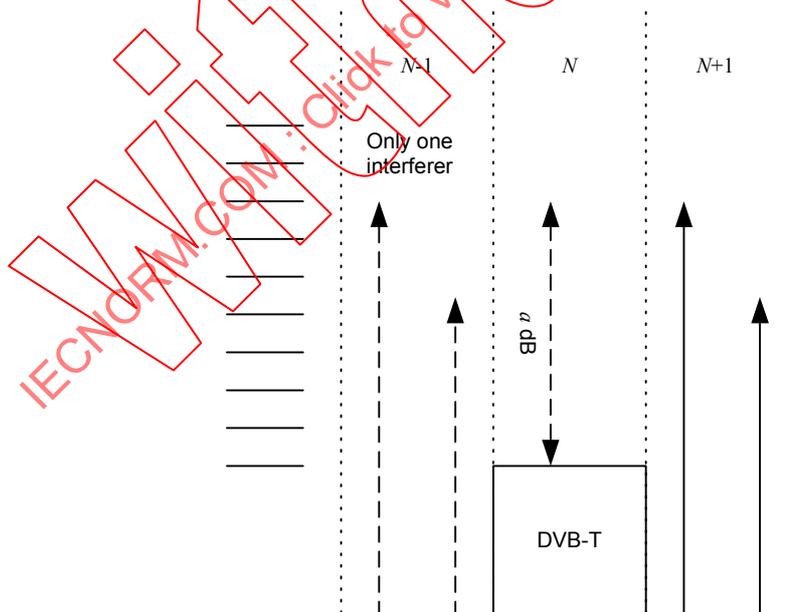


Figure 6 – Pattern S1: wanted DVB-T channel with $N + 1$ or $N-1$ analogue interferer

Reception modes: specified in Table 8.

Channel frequencies for wanted DVB-T signal: for $N \pm 1$ at channel 45 (666 MHz) in UHF and at channel 8 (199 MHz) in VHF.

With the mode 64QAM 2/3, additionally channels 21 (474 MHz) and 64 (818 MHz) in UHF and channels 5 (178 MHz) and 12 (227 MHz) in VHF are tested. With channels 21 and 5, it is only possible to measure $N + 1$ and, with channel 12, it is possible to measure $N - 1$.

Depending on the type of analogue interfering signal, a frequency offset may be applied. For PAL B and SECAM, 0,5 MHz offset is used the in case of $N - 1$ measurement.

The $N \pm m$ measurement is performed with $m = 2$ at channel 45 (666 MHz) in UHF and at channel 8 (199 MHz) in VHF.

7.4.1.3 Pattern S2

Pattern S2 is shown in Figure 7.

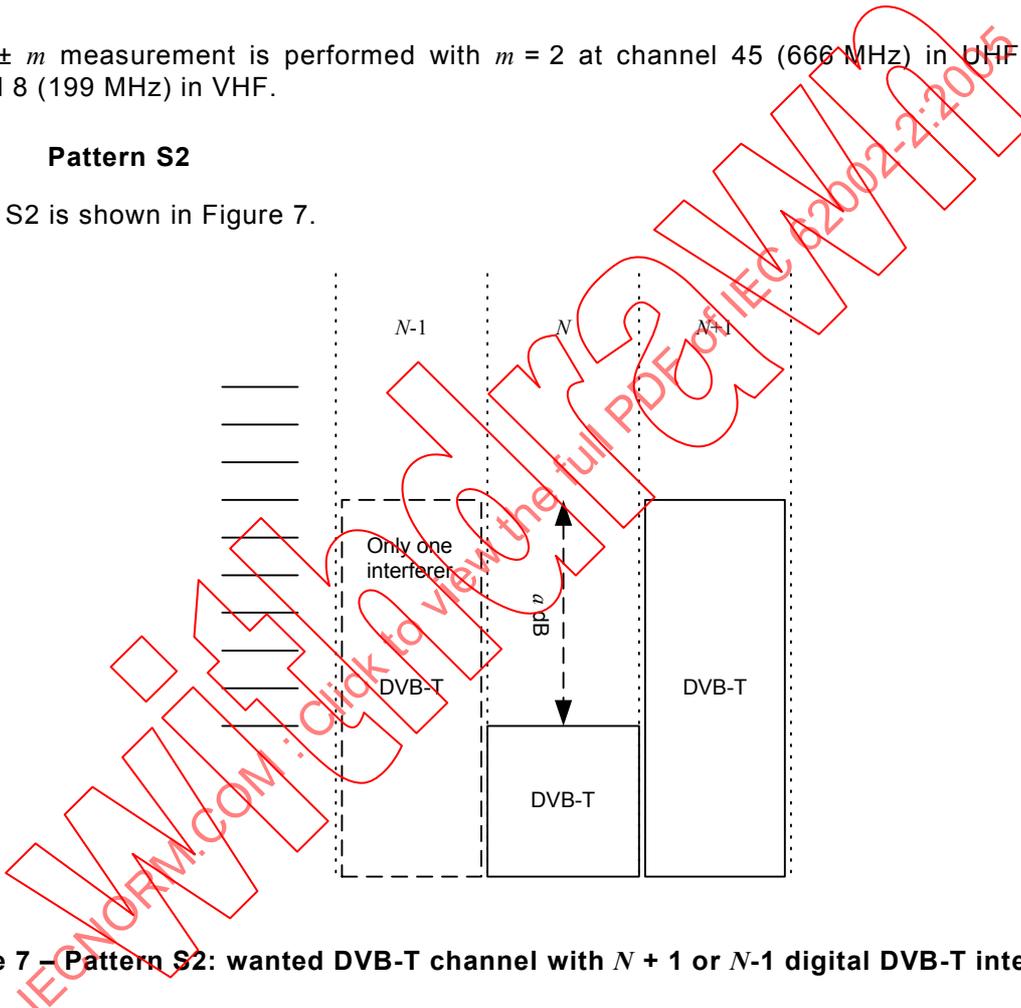


Figure 7 – Pattern S2: wanted DVB-T channel with $N + 1$ or $N - 1$ digital DVB-T interferer

Reception modes: specified in Table 8.

Channel frequencies for wanted DVB-T signal: the $N \pm 1$ measurement is performed at channel 45 (666 MHz) in UHF and at channel 8 (199 MHz) in VHF.

The $N \pm m$ measurement is performed with $m = 2$ at channel 45 (666 MHz) in UHF and at channel 8 (199 MHz) in VHF.

7.4.1.4 Pattern L1

Pattern L1 is shown in Figure 8.

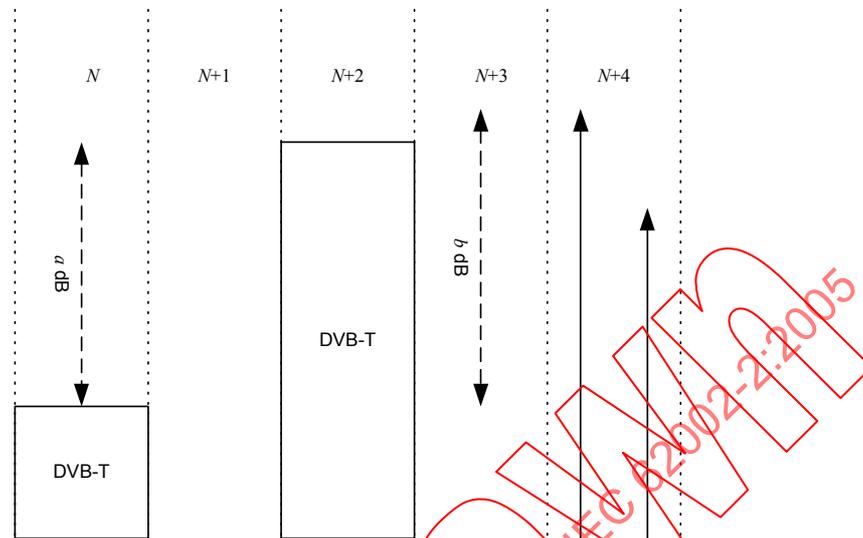


Figure 8 – Pattern L1: wanted DVB-T channel with one analogue signal on $N + 4$ channel and one digital DVB-T signal on $N + 2$ channel

Reception modes: specified in Table 9

Channel frequencies for wanted DVB-T signal: the measurement is performed at channels 21 (474 MHz), 45 (666 MHz) and 64 (818 MHz) in UHF and at channel 8 (199 MHz) in VHF.

7.4.1.5 Pattern L2

Pattern L2 is shown in Figure 9.

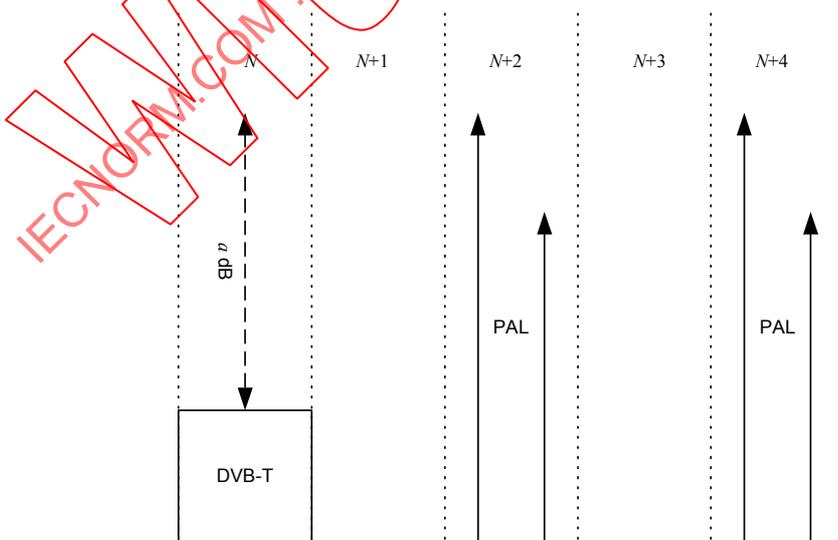


Figure 9 – Pattern L2: wanted DVB-T channel with one analogue signal on $N + 4$ channel and another analogue signal on $N + 2$ channel

Reception modes: specified in Table 10.

Channel frequencies for wanted DVB-T signal: the measurement is performed at channels 21 (474 MHz), 45 (666 MHz) and 64 (618 MHz) in UHF and at channel 8 (199 MHz) in VHF.

7.4.1.6 Pattern L3

Pattern L3 is shown in Figure 10.

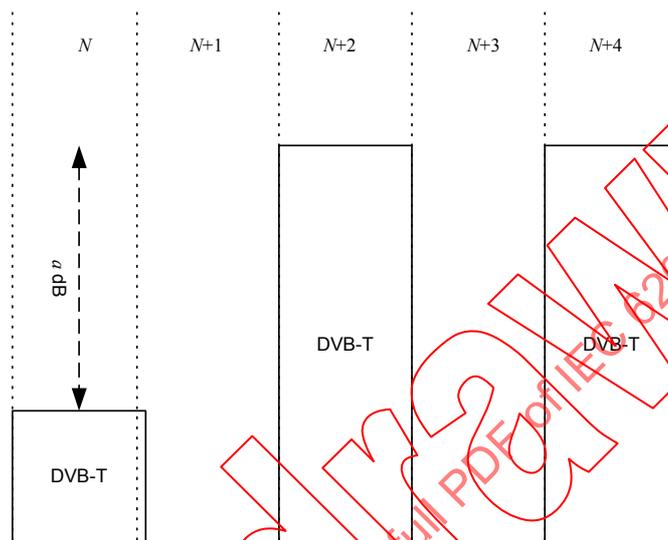


Figure 10 – Pattern L3: Wanted DVB-T signal with one digital DVB-T signal on $N + 4$ channel and another digital DVB-T signal on $N + 2$ channel

Reception modes: specified in Table 11.

Channel frequencies for wanted DVB-T signal: the measurement is performed at channels 21 (474 MHz), 45 (666 MHz) and 64 (618 MHz) in UHF and at channel 8 (199 MHz) in VHF.

7.4.2 Measurement setup

The measurement setup is shown in Figure 11.

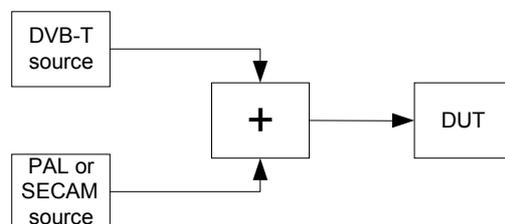


Figure 11 – Example of a possible measurement setup in immunity to analogue and/or digital signals in other channels test.

- a) Connect the DVB-T signal source to the power splitter. Connect the PAL/SECAM signal source to the same power splitter. Connect summing branch of the power splitter to the terminal reference point shown in Figure 1.
- b) Set the correct modulation and signal parameters to the DVB-T/H signal source.

- c) Set the DVB-T signal source to the correct channel frequency.
- d) Set the DVB-T signal source power level to -40 dB(mW), when measured from the terminal reference point.
- e) Set the PAL/SECAM signal source power level to defined peak sync. power level, when measured from the terminal reference point. See interfering signal definitions from IEC 62002-1, 10.9.2.
- f) Set the PAL/SECAM signal source to correct frequency separation from the DVB-T signal frequency.
- g) Set the terminal to the correct channel frequency.
- h) Perform the measurement according to the procedure described in 7.4.3.

7.4.3 Procedure

Decrease the power level of the DVB-T signal source as long as the measured reference *BER* after the Viterbi decoder (failure criterion a) is above, or equals, the defined failure criteria. Read the power level difference of the PAL/SECAM signal source and the DVB-T signal source. Once reference failure criterion is reached, resynchronization needs to be achieved.

Repeat the measurement with all modes and frequencies defined in 7.4.1.

7.5 Test requirement

The measured power level difference of the PAL/SECAM signal and the DVB-T signal when measured from the terminal reference point shall be greater than specified in 7.2.

8 Immunity to co-channel interference from analogue TV signals

8.1 Definition and applicability

This test measures the performance of the terminal in presence of co-channel analogue interfering signals.

The requirements and this test apply to all terminal categories specified in IEC 62002-1.

8.2 Minimum requirements

The difference shall be lower than the requirement in Table 12.

Table 12 – Immunity to analogue co-channel

Mode	PAL I1	PAL B/G	SECAM	<i>BER</i>
2k/8k 16QAM $CR = 1/2$ $GI = 1/8$	-6 dB	-6 dB	-5 dB	$< 2 \times 10^{-4}$
2k/8k 16QAM $CR = 2/3$ $GI = 1/8$	-1 dB	-1 dB	0 dB	
2k/8k 16QAM $CR = 3/4$ $GI = 1/8$	0 dB	2 dB	3 dB	
2k/8k 64QAM $CR = 2/3$ $GI = 1/8$	4 dB	4 dB	5 dB	
2k/8k 64QAM $CR = 3/4$ $GI = 1/8$	7 dB	7 dB	8 dB	

8.3 Test purpose

To verify that the set reference *BER* criterion (failure criterion a) or PFP criterion (failure criterion b) does not exceed when co-channel interfering signals are present. In the case where the FP is used, then the requirement is increased by the delta value of 2 dB given in Table 2.

8.4 Method of test

8.4.1 Initial conditions

Test environment: normal conditions.

Frequencies to be tested: channel 45 (666 MHz)

Reception modes: all modes specified in 10.10 of IEC 62002-1, with $G/1 = 1/8$. The highest available FFT mode is used.

NOTE SECAM is tested according to the intended market area.

8.4.2 Measurement setup

The measurement setup is shown in Figure 12.

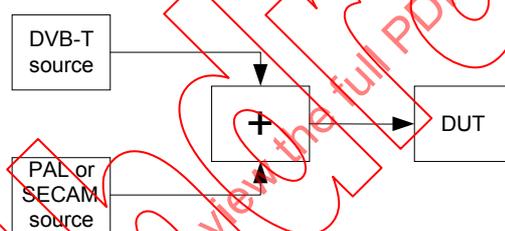


Figure 12 – Example of a possible measurement setup in the immunity to co-channel interference from analogue TV signals test

- Connect the DVB-T signal source to the power splitter. Connect the PAL/SECAM signal source to the same power splitter. Connect the summing branch of the power splitter to the terminal reference point shown in Figure 1.
- Set correct modulation and signal parameters to the DVB-T/H signal source.
- Set the DVB-T signal source to the channel frequency 45 (666 MHz).
- Set the DVB-T signal source power level to -40 dB(mW), when measured from the terminal reference point.
- Set the PAL/SECAM signal source peak sync. power level to -40 dB(mW), when measured from the terminal reference point. See interfering signal definitions from IEC 62002-1, 10.9.2.
- Set the PAL/SECAM signal source to the channel frequency 45 (666 MHz).
- Set the terminal to the correct channel frequency.
- Perform the measurement according to the procedure described in 8.4.3.

8.4.3 Procedure

Decrease the power level of the DVB-T signal source as long as the measured reference *BER* after the Viterbi decoder (failure criterion a) is above, or equals, the defined failure criteria. Read the power level difference of the PAL/SECAM signal source and the DVB-T signal source. Once the reference failure criterion is reached, resynchronization needs to be achieved.

Repeat the measurement with all modes defined in 8.4.1.

8.5 Test requirement

The measured power level difference of the PAL/SECAM signal and DVB-T signal when measured from the terminal reference point shall be greater than specified in 8.2.

9 Guard interval utilization: echoes within guard interval

9.1 Definition and applicability

This test measures the performance of the terminal in presence of echoes.

The requirements and this test apply to all terminal categories specified in IEC 62002-1.

9.2 Minimum requirements

Table 13 – Performance with echoes within the guard interval

Mode	<i>C/N</i> (dB)	<i>BER</i>
8k, 16-QAM, <i>CR</i> = 1/2, <i>GI</i> = 1/8	16,3	$< 2 \times 10^{-4}$
8k, 64-QAM, <i>CR</i> = 2/3, <i>GI</i> = 1/8	26,2	

9.3 Test purpose

To verify that the set reference *BER* criterion or PFP criterion does not exceed when echoes inside the guard interval are present.

9.4 Method of test

9.4.1 Initial conditions

Test environment: normal conditions.

Frequencies to be tested: channel 45 (666 MHz).

Reception modes: guard interval *GI* = 1/8 is tested with 8k mode with modulations 64-QAM with *CR* = 2/3 and 16-QAM with *CR* = 1/2.

9.4.2 Measurement setup

The measurement setup is shown in Figure 13.

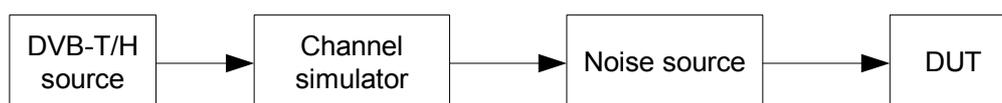


Figure 13 – Example of a possible measurement setup in echoes within the guard interval test

- a) Connect the DVB-T signal source to the channel simulator. Connect the channel simulator to the noise generator. Connect the noise generator to the terminal reference point shown in Figure 1.
- b) Set the correct modulation and signal parameters to the DVB-T/H signal source.
- c) Set the DVB-T signal source to channel frequency 45 (666 MHz).
- d) Set the DVB-T signal source power level to -40 dB(mW), when measured from the terminal reference point.
- e) Set the terminal to the correct channel frequency.
- f) Set the channel simulator to transmit paths 0 and 1 as defined in Table 14.
- g) Fix C/N to the values given in Table 13.
- h) Add path number 2 into the channel simulator Table 14. Care shall be taken that the C/N actually changes when path number 2 is added.
- i) Perform the measurement according to the procedure described in 9.4.3.

A channel simulator is used to set up the echo pattern (post echo) shown in Table 14.

Table 14 – Paths in echoes within guard interval measurement

Path number	Attenuation (dB)	Delay	Doppler
0	0	0	None
1	0	$T_g \times 0,9$	None
2	-1	$T_g \times 0,9$	Pure 0,2 Hz
The test is repeated by setting the following echo pattern (pre echo).			
Path number	Attenuation (dB)	Delay	Doppler
0	0	0	None
1	0	$T_g \times 0,9$	None
2	-1	0	Pure 0,2 Hz

The measurement is repeated with delay setting $T_g \times 0,5$.

9.4.3 Procedure

Verify that the reception quality is better than the PFP (failure criterion b), meaning no visible or TS packet errors.

Repeat the measurement with all modulations defined in 9.4.1.

9.5 Test requirement

The BER with defined echoes inside and outside the guard interval shall be better than the specified failure criterion.

10 Guard interval utilization: echoes outside the guard interval

10.1 Definition and applicability

This test measures the performance of the terminal in presence of echoes.

The requirements and this test apply to all terminal categories specified in IEC 62002-1.