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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

FOREWORD

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

This second edition cancels and replaces the first edition, published in 2005 and constitutes a technical revision.

The main changes with respect to the previous edition are listed below.

- DVB-H has been included as a part of the main specification.
- All the performance figures have been revised as new simulation results have been made available as well as new reference receivers for DVB-H have been developed.
- DVB-H now includes all the different MPE-FEC code rates.
- New portable indoor and portable outdoor channel models have been included as well as performance figures for those.
- A new 2x TU-6 mobile SFN test channel has been included.

- A new L4 linearity pattern has been added.
- Dedicated performance figures for DVB-H for S1, S2, L1 to L4 interference patterns have been included.
- A new GSM-interference measurement method has been added.

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

CDV	Report on voting
100/1290/CDV	100/1381/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.

A list of all parts of the IEC 62002 series, under the general title *Mobile and portable DVB-T/H radio access*, can be found on the IEC website.

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- withdrawn;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.

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).

One aim is to limit the number of tests to a practical level. Nevertheless, the manufacturer is responsible of guaranteeing that the terminal fulfils all aspects of the mobile and portable DVB-T/H radio access interface specification (see IEC 62002-1).

2 Normative references

The following references 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 300 744:2007, *Digital Video Broadcasting (DVB) – Framing structure, channel coding and modulation for digital terrestrial television,* V1.5.2

ITU-R BT.1701-1, *Characteristics of radiated signals of conventional analogue television systems*

3 Abbreviations

For the purposes of part of IEC 62002, the following abbreviations apply.

λ	Lambda, wavelength (λ = 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(dBμV/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 (MHz)	Frequency in MHz
fc	Centre frequency
F	Noise factor
fd, Fd	Doppler Frequency
Fd_{3dB}	Doppler Frequency with minimum C/N requirement raised by 3 dB
FER	Frame Error Rate
G	Gain
Ga	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 x 10^{-26} J/K
K	kelvin
L1, L2, L3, L4	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
MPE-FEC	Multi Protocol Encapsulation Forward Error Correction
MPEG-2	Motion Pictures Expert Group, Video compression standard
n, m, N	Channel indexes
NF	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

PER	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	Radio Frequency
RS	Reed Solomon
Rx	Receiver
S1,S2	Selectivity Patterns
SECAM, SECAM L	Sequential á mémoire, TV-system using SECAM
SFN	Single Frequency Network
SFP	Subjective Failure Point
T	Temperature in kelvin
Tc	Corner point
Te	Total duration of the gating pulses
ti	Time of arrival for the i-th signal
TS	Transport Stream
Tg	Guard Interval duration
Tu	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
Wi	Weighting coefficient for the 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:

+15 °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 provides a summary of 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 C/N performance		Ch 45			
	Gaussian	All modulations, 2k/4k/8k			
	Portable	All modulations, 2k/4k/8k			
	PI / PO	16-QAM 2/3, 3/4, 64-QAM 2/3, GI 1/4, 8k			QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, MPE-FEC 3/4, GI 1/4, 8k
	Mobile	QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, 64-QAM 2/3 GI 1/4, 8k	-	-	QPSK 1/2, 2/3 16-QAM 1/2, 2/3, MPE-FEC 3/4, GI 1/4, 8k
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 64-QAM 2/3 additionally Ch 21, 64 (UHF), Ch 5, 12 (VHF). $N \pm 2$: Ch 45 (UHF), Ch 8 (VHF)			
		16-QAM 3/4 , 16-QAM 2/3, 16-QAM 1/2 , 64-QAM 3/4 , 64-QAM 2/3 GI 1/8			
	S2	Ch 45 (UHF), Ch 8 (VHF)			
		QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, 3/4, 64-QAM 2/3, 3/4, GI 1/8			
	L1-L3	Ch 21,45,64 (UHF) Ch 8 (VHF)			
		16-QAM 1/2, 2/3, 3/4, 64-QAM 2/3, GI 1/8, 8k	16-QAM 1/2, 2/3, 3/4, 64-QAM 2/3, GI 1/8, 8k	16-QAM 1/2, 2/3, 3/4, 64-QAM 2/3, GI 1/8, 8k	QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, GI 1/8, 8k
	L4	Ch 43			
		QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, GI 1/8, 8k	QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, GI 1/8, 8k	QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, GI 1/8, 8k	QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, GI 1/8, 8k
8 Immunity to co-channel interference from analogue TV signals		Ch 45 (UHF)			
		16-QAM 1/2, 2/3, 3/4, 64-QAM 2/3, 3/4, GI 1/8			QPSK 1/2, 2/3, 16-QAM 1/2, 2/3, MPE-FEC 3/4, GI 1/4, 8k
9 Guard interval utilization: echoes within guard interval		Ch 45 (UHF)			
		8k, 64-QAM 2/3, GI 1/8 8k, 16-QAM 1/2, GI 1/8			

Clause	Conditions	Terminal category a car terminals	Terminal category b1 portable TVs	Terminal category b2 pocketable TVs	Terminal Category c hand-held convergence terminals
10 Guard interval utilization: echoes outside the guard interval		Ch 45 (UHF)			
		8k, 64-QAM 2/3, *GI* 1/8 8k, 16-QAM 1/2, *GI* 1/8 8k, 16-QAM 2/3, *GI* 1/8			
11 Tolerance to impulse interference		Ch 45 (UHF)			
		8k, 64-QAM 2/3, *GI* 1/8, 8k 8k, 16-QAM 1/2, *GI* 1/8, 8k 8k, 16-QAM 2/3, *GI* 1/8, 8k			
12 GSM900 TX signal blocking test					8k, *GI* 1/4, QPSK 1/2CR MPE-FEC 3/4, C55
13 Mobile SFN channel test					8k, *GI* 1/4, 16-QAM 1/2 MPE-FEC 3/4, C45

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;
- MPEG-2 TS player;
- 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.

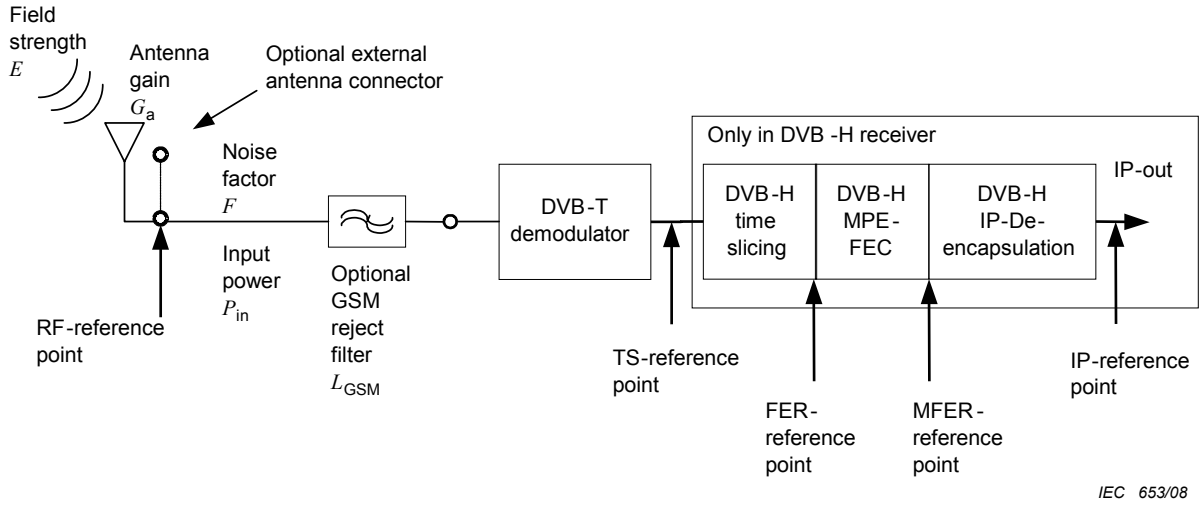


Figure 1 – Reference model

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 will be carried out in the front of the GSM rejection filter.

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 *FER (FER)* (Frame Error Rate before MPE-FEC),
- MPE-FEC *FER (MFER)* (Frame Error rate after MPE-FEC).

4.5 Degradation criteria and resynchronization

Four different degradation criteria are used. The criteria a and b are used in the non-mobile cases for DVB-T. Criterion c is for mobile reception in DVB-T and criterion d for DVB-H reception A receiver must be able to acquire a degraded signal and a resynchronization test must be done to ensure the C/N or C/I value is valid. Once the degradation criterion is achieved, all receiver input signals are removed for a period of 5 seconds and then re-applied. The same degradation criterion must be achieved within a further 5 seconds. If that is not the case, then the only degradation criterion that can be used for receiver measurement has to be based upon successful signal acquisition.

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

   This corresponds to the quasi error free (QEF) criterion in the DVB-T standard, which states: ”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 picture failure point is defined as the *C/N* or *C/I* value when picture errors become visible. This is preferred if BER measurements are unstable or unavailable. A more objective definition can be made using the ESR_5 (5 % erroneous second ratio) criterion, which allows one erroneous second within the 20 s observation period in the transport stream. Note that the reception quality is poor at picture failure point 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 dB to 2 dB carrier power increase will improve the reception quality to QEF level. A useful method to reduce the uncertainty of visual picture failure point is to use the two out of three method. Here 2 out of 3 consecutive 10 s periods must 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 picture failure point and the reference BER error criterion for various measurements. When the picture failure point 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
C/N in Gaussian channel	1,3
Minimum input level	1,3
Immunity to other channels	2,0
Immunity to co-channel	2,0
C/N 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, a subjective quality has been defined, referred to as the subjective failure point (SFP). SFP corresponds to: “on average, one visible error in the video, during an observation period of 20 s”. This corresponds to the ESR_5 (5 % erroneous second ratio, 5 % ESR) criterion, which allows one erroneous second within the 20 s observation period. Thus, the ESR_5 method can be used to measure the SFP.

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 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.

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

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.

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 5 % *FER* are very similar what would be achieved using ESR_5 criterion to the transport stream directly.

4.6 Definition of *C/N*

C/N is the ratio in dB, of the DVB-T/H signal level to the noise level present in the relevant bandwidth (5,71 MHz, 6,67 MHz or 7,61 MHz).

Example: Measured noise level in 7,61 MHz 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 the ETSI EN 300 744.

For DVB-H measurements a set of recorded TS-streams has been generated. There is a separate TS-stream for each of the pre-selected modes of DVB-H. In the streams IPV4 packets are used as payload in the burst. The IP packet length is always fixed 512 bytes. MPE-FEC number of rows is always 512. The TS streams contain several services, but only the first one should be used for physical layer measurements. The other services simulate more practical configuration with higher power saving. The burst cycle time for the measurement service is 1 s.

An example of DVB-H measurement stream is depicted in Figure 2 below.

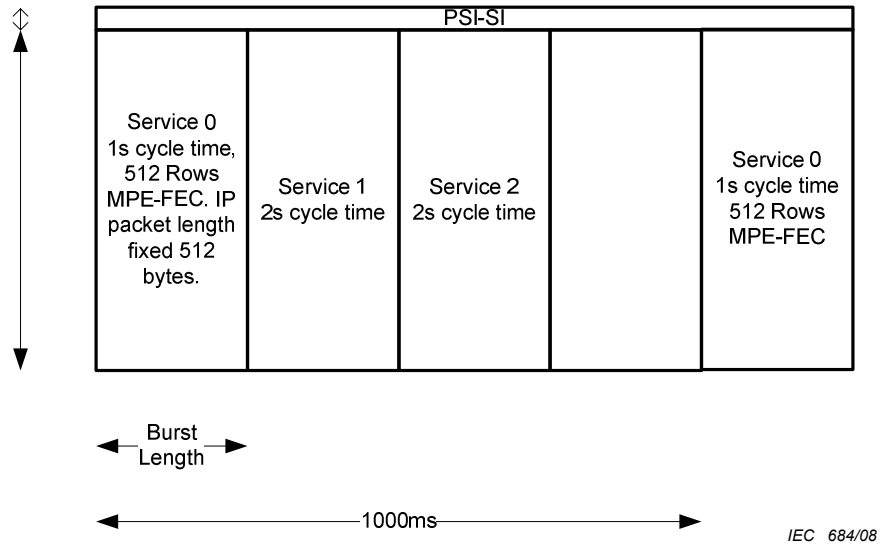


Figure 2 – DVB-H measurement stream

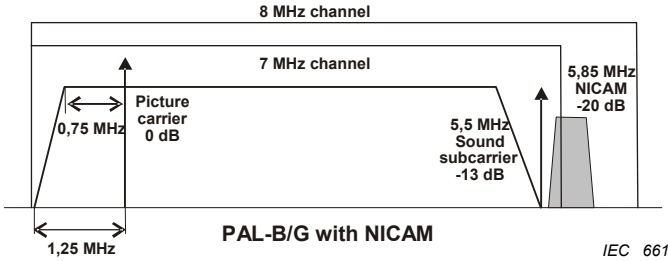
The measurement streams for the different modes are explained in the Table 3.

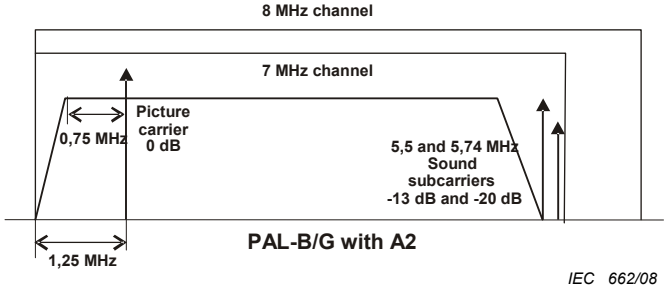
Table 3 – DVB-H measurement streams

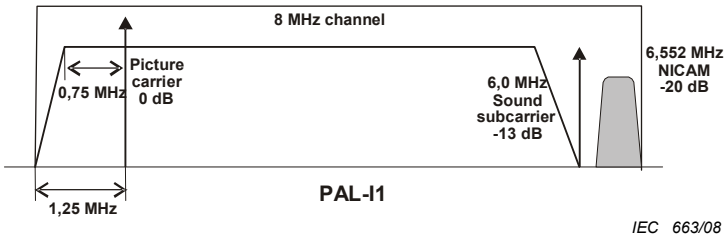
File name	FFT	GI	CodeRate Viterbi	CodeRate MPE-FEC	Burst Length [ms]	PID	Destination IP address
QPSKCR12FEC12.ts	8K	1/4	1/2	1/2	119	1001	225.6.7.8
QPSKCR12FEC23.ts	8K	1/4	1/2	2/3	179	1001	225.6.7.8
QPSKCR12FEC34.ts	8K	1/4	1/2	3/4	238	1001	225.6.7.8
QPSKCR12FEC56.ts	8K	1/4	1/2	5/6	213	1001	225.6.7.8
QPSKCR12FEC78.ts	8K	1/4	1/2	7/8	203	1001	225.6.7.8
QPSKCR23FEC23.ts	8K	1/4	2/3	2/3	133	1001	225.6.7.8
QPSKCR23FEC34.ts	8K	1/4	2/3	3/4	180	1001	225.6.7.8
QPSKCR23FEC56.ts	8K	1/4	2/3	5/6	158	1001	225.6.7.8
QPSKCR23FEC78.ts	8K	1/4	2/3	7/8	151	1001	225.6.7.8
16QAMCR12FEC23.ts	8K	1/4	1/2	2/3	88	1001	225.6.7.8
16QAMCR12FEC34.ts	8K	1/4	1/2	3/4	116	1001	225.6.7.8
16QAMCR12FEC56.ts	8K	1/4	1/2	5/6	105	1001	225.6.7.8
16QAMCR12FEC78.ts	8K	1/4	1/2	7/8	100	1001	225.6.7.8
16QAMCR23FEC23.ts	8K	1/4	2/3	2/3	65	1001	225.6.7.8
16QAMCR23FEC34.ts	8K	1/4	2/3	3/4	87	1001	225.6.7.8
16QAMCR23FEC56.ts	8K	1/4	2/3	5/6	78	1001	225.6.7.8
16QAMCR23FEC78.ts	8K	1/4	2/3	7/8	74	1001	225.6.7.8
16QAMCR34FEC34.ts	8K	1/4	3/4	3/4	73	1001	225.6.7.8
64QAMCR12FEC56.ts	8K	1/4	1/2	5/6	69	1001	225.6.7.8
64QAMCR12FEC78.ts	8K	1/4	1/2	7/8	66	1001	225.6.7.8
64QAMCR23FEC23.ts	8K	1/4	2/3	2/3	43	1001	225.6.7.8
64QAMCR23FEC34.ts	8K	1/4	2/3	3/4	58	1001	225.6.7.8
64QAMCR23FEC56.ts	8K	1/4	2/3	5/6	52	1001	225.6.7.8

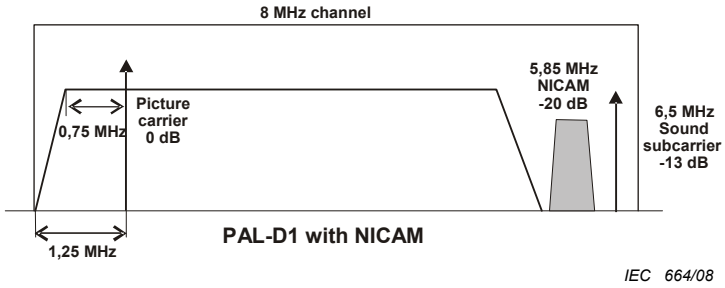
4.7.2 Interfering signal definitions

Figure 3 represents the PAL B/G/I1/D1 interfering signals, which are defined in ITU-R BT.1701. 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/D1 NICAM is 40 % and PAL I1 NICAM is 100 %. PAL D/K without the NICAM is expected to have similar performance than D1 in this standard.









Note: PAL D/K is very similar but without NICAM

Figure 3 – PAL interfering signals

Figure 4 represents the SECAM L interfering signal which is defined in ITU-R BT.1701.

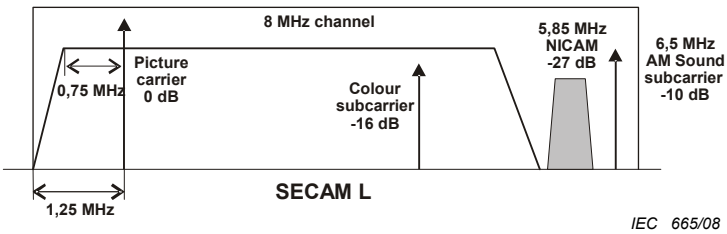


Figure 4 – SECAM L interfering signal

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

Non-controlled conditions regarding the carrier frequency position are used for the analogue signals. No precision offset is used.

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.

This test shall apply to all terminal categories specified in IEC 62002-1 document with the following exception:

For the terminal category b, the performance is measured only in Gaussian, portable channel and PI/PO channels.

5.2 Minimum requirements

5.2.1 *C/N* performance in Gaussian channel

The requirements for DVB-T using the reference *BER* criterion is shown in Table 4. For PFP the required C/N is 1,3 dB lower than reference *BER*.

Table 4 – *C/N* (dB) in Gaussian channel

Modulation	Code rate	Gaussian
QPSK	1/2	4,6
QPSK	2/3	6,4
QPSK	3/4	7,4
16-QAM	1/2	10,6
16-QAM	2/3	12,7
16-QAM	3/4	14,0
64-QAM	1/2	15,4
64-QAM	2/3	18,3
64-QAM	3/4	19,9

The requirements for DVB-H using 5 % *MFER* criterion is shown in Table 5.

Table 5 – DVB-H *C/N* (dB) for 5 % *MFER* in Gaussian channel

Modulation	Code rate	Gaussian
QPSK	1/2	3,6
QPSK	2/3	5,4
16-QAM	1/2	9,6
16-QAM	2/3	11,7
64-QAM	1/2	14,4

64-QAM	2/3	17,3

5.2.2 *C/N* performance in portable channel

The requirements for DVB-T using the reference *BER* criterion is shown in Table 6. For PFP the required C/N is 1,3 dB lower than reference *BER*.

Table 6 – *C/N* (dB) in portable channel

Modulation	Code rate	Portable
QPSK	1/2	7,5
QPSK	2/3	11,5
QPSK	3/4	15,3
16-QAM	1/2	13,8
16-QAM	2/3	17,7
16-QAM	3/4	21,5
64-QAM	1/2	18,9
64-QAM	2/3	23,4
64-QAM	3/4	27,5

The requirements for DVB-H using the 5 % *MFER* criterion is shown in Table 7.

Table 7 – *C/N* (dB) for 5 % *MFER* in portable channel

Modulation	Code rate	Rayleigh (P_1)
QPSK	1/2	6,5
QPSK	2/3	10,5
16-QAM	1/2	12,8
16-QAM	2/3	16,7
64-QAM	1/2	17,9
64-QAM	2/3	22,4

5.2.3 *C/N* performance in portable indoor (PI) and portable outdoor (PO) channels

The requirements for DVB-T using the 5 % *ESR* criterion is shown in Table 8.

Table 8 – *C/N* (dB) for 5 % *ESR* in PI & PO channel

Modulation	Code rate	PI	PO
QPSK	1/2	9,0	10,5
QPSK	2/3	12,0	13,5
QPSK	3/4	13,9	15,4
16-QAM	1/2	15,0	16,5
16-QAM	2/3	18,0	19,5
16-QAM	3/4	20,5	22,0
64-QAM	1/2	19,7	21,2

64-QAM	2/3	22,8	24,3
64-QAM	3/4	25,3	27,5

The requirements for DVB-H using the 5 % *MFER* criterion is shown in Table 9.

Table 9 – *C/N* (dB) for 5 % *MFER* in PI and PO channel

Modulation	Code rate	MPE-FEC code rate	PI	PO
QPSK	1/2	1/2	6,6	7,6
QPSK	1/2	2/3	6,8	7,8
QPSK	1/2	3/4	7,0	8,0
QPSK	1/2	5/6	7,2	8,2
QPSK	1/2	7/8	7,4	8,4
QPSK	2/3	2/3	9,8	10,8
QPSK	2/3	3/4	10,0	11,0
QPSK	2/3	5/6	10,2	11,2
QPSK	2/3	7/8	10,4	11,4
16-QAM	1/2	2/3	12,8	13,8
16-QAM	1/2	3/4	13,0	14,0
16-QAM	1/2	5/6	13,2	14,2
16-QAM	1/2	7/8	13,4	14,4
16-QAM	2/3	2/3	15,8	16,8
16-QAM	2/3	3/4	16,0	17,0
16-QAM	2/3	5/6	16,2	17,2
16-QAM	2/3	7/8	16,4	17,4
64-QAM	1/2	5/6	17,7	18,7
64-QAM	1/2	7/8	17,9	18,9
64-QAM	2/3	2/3	20,6	21,6
64-QAM	2/3	3/4	20,8	21,8
64-QAM	2/3	5/6	21	22

5.2.4 *C/N* performance in mobile channels

The performance in IEC 62002-1 is specified at 1/4 guard interval in Table 10.

Table 10 – *C/N* (dB) for 5 % *ESR* in typical urban channel

Guard interval =1/4			2k			Speed at Fd_{3dB} km/h			8k			Speed at Fd_{3dB} km/h		
Modulation	**Bit rate** Mbit/s	**Code rate**	C/N_{min} dB	Fd_{max} Hz	Fd_{3dB} Hz	**200** MHz	**500** MHz	**800** MHz	C/N_{min} dB	Fd_{max} Hz	Fd_{3dB} Hz	**200** MHz	**500** MHz	**800** MHz
QPSK	6,03	1/2	16.0	400	400	2160	864	540	16,0	100	100	540	216	135
QPSK	8,04	2/3	19,0	400	320	1728	691	432	19,0	100	80	432	173	108
16-QAM	12,06	1/2	21,0	400	300	1620	648	405	21,0	100	75	405	162	101
16-QAM	16,09	2/3	24,0	240	200	1080	432	270	24,0	60	50	270	108	68
64-QAM	18,10	1/2	26,0	220	180	972	389	243	26,0	55	45	243	97	61

64-QAM	24,13	2/3	30,0	120	100	540	216	135	30,0	30	25	135	54	34

For DVB-H these values are given in Table 11.

Table 11 – *C/N* (dB) for *MFER* 5 % for DVB-H

Guard interval = 1/4			**2k**		**Speed at Fd_{3dB}** km/h		**4k**		**Speed at Fd_{3dB}** km/h		**8k**		**Speed at Fd_{3dB}** km/h	
Modulation	**Code rate**	**MPE-FEC CR**	C/N_{min} dB	Fd_{3dB} Hz	**474** MHz	**746** MHz	C/N_{min} dB	Fd_{3dB} Hz	**474** MHz	**746** MHz	C/N_{min} dB	Fd_{3dB} Hz	**474** MHz	**746** MHz
QPSK	1/2	1/2	8,5	400	911	579	8,5	200	456	290	8,5	100	228	145
		2/3	9,0	400	911	579	9,0	200	456	290	9,0	100	228	145
		3/4	9,5	400	911	579	9,5	200	456	290	9,5	100	228	145
		5/6	10,0	400	911	579	10,0	200	456	290	10,0	100	228	145
		7/8	10,5	400	911	579	10,5	200	456	290	10,5	100	228	145
QPSK	2/3	2/3	12,0	400	911	579	12,0	200	456	290	12,0	100	228	145
		3/4	12,5	400	911	579	12,5	200	456	290	12,5	100	228	145
		5/6	13,5	400	911	579	13,5	200	456	290	13,5	100	228	145
		7/8	14,5	400	911	579	14,5	200	456	290	14,5	100	228	145
16-QAM	1/2	2/3	15,0	400	911	579	15,0	200	456	290	15,0	100	228	145
		3/4	15,5	400	911	579	15,5	200	456	290	15,5	100	228	145
		5/6	16,5	400	911	579	16,5	200	456	290	16,5	100	228	145
		7/8	17,5	400	911	579	17,5	200	456	290	17,5	100	228	145
16-QAM	2/3	2/3	18,0	380	866	550	18,0	190	433	275	18,0	95	216	138
		3/4	18,5	380	866	550	18,5	190	433	275	18,5	95	216	138
		5/6	19,5	380	866	550	19,5	190	433	275	19,5	95	216	138
		7/8	20,5	380	866	550	20,5	190	433	275	20,5	95	216	138
64-QAM	1/2	5/6	21,5	200	456	290	21,5	100	228	145	21,5	50	114	73
		7/8	22,5	200	456	290	22,5	100	228	145	22,5	50	114	73
64-QAM	2/3	2/3	25,0	120	273	174	25,0	60	137	87	25,0	30	68	43
		3/4	25,5	120	273	174	25,5	60	137	87	25,5	30	68	43
		5/6	27,0	120	273	174	27,0	60	137	87	27,0	30	68	43

5.3 Test purpose

The purpose of this test is to verify the *C/N* performance of the receiver in different channel conditions. These are specified for DVB-T in Table 4, Table 6, Table 8, Table 10 and for DVB-H in Table 5, Table 7, Table 9 and Table 11.

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 a stationary multipath channel without a direct path. The mobile channel model is used to verify the operation of the terminal while moving. For example: in a car.

5.4 Method of test

5.4.1 Initial conditions

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

Reception modes to be tested:

In Gaussian channels: all modes specified in Table 4 or Table 5. The test can be carried out with 2k or 4k or 8k modes or any combination of these. GI=1/4 is used in the test.

In portable channels: All modes specified in Table 6 or Table 7 are tested. The test can be carried out with 2k or 4k or 8k modes or any combination of these. GI = 1/4 is used in the test.

In PI/PO channels: Both PI and PO models will be used in the test. The modes for DVB-T are 16-QAM 2/3, 16-QAM 3/4 and 64-QAM 2/3 all using guard interval 1/4. The highest available FFT-size using native interleaver is selected. The modes for DVB-H receivers are QPSK 1/2, QPSK 2/3, 16-QAM 1/2 and 16-QAM 2/3, MPE-FEC code rate 3/4 is used.

In mobile channels: The modes QPSK 1/2, QPSK 2/3, 16-QAM 1/2, 16-QAM 2/3 and 64-QAM 2/3 all using guard interval 1/4. The highest available FFT-size using native interleaver is selected. With DVB-H the modes QPSK 1/2, QPSK 2/3, 16-QAM 1/2, 16-QAM 2/3 with MPE-FEC code rate 3/4 all using guard interval 1/4. Mobile test is applied only for terminal categories a and c.

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 than DVB-T.

5.4.2 Measurement setup

The measurement setup is shown in Figure 5.

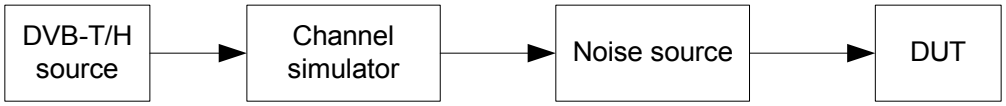


Figure 5 – Example of a possible measurement setup in *C/N* performance tests

Proceed as follows.

a) Connect DVB-T/H signal source to the channel simulator and noise source. Feed signal into the terminal reference point shown in Figure 1. If C/N of the DVB-T/H signal source can be set, it can be used in measurements instead of noise source.
b) Set the correct channel model to the channel simulator.
c) Set correct modulation and signal parameters to the DVB-T/H signal source.
d) Set the DVB-T/H signal source to channel 45 (666 MHz).
e) Set DVB-T/H signal source power level to –50 dB(mW), when measured at the terminal reference point.
f) Tune the terminal to channel 45 (666 MHz).
g) Perform the measurement as described in measurement procedure 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). Alternatively, the picture failure point (PFP) criterion (failure criterion b) may be used. For DVB-H 5 % $MFER$ criterion is used (failure criterion d). Once the reference failure criterion is reached, the 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). Alternatively picture failure point (PFP) (failure criterion b) criterion may be used. For DVB-H 5 % $MFER$ criterion is used (failure criterion d). 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 PI/PO channels

The C/N value is adjusted by changing the noise source signal level until the receiver reaches reference 5 % ESR criterion. Alternatively, the picture failure point (PFP) (failure criterion b) criterion may be used. For DVB-H 5 % $MFER$ criterion is used (failure criterion d). 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.

5.4.3.4 Mobile channel

At first the Doppler frequency in the channel simulator is set to 10 Hz and C/N value is adjusted by changing the noise source signal level until the receiver reaches the subjective failure point (SFP) (failure criterion c). For DVB-H 5 % $MFER$ criterion is used (failure criterion d). 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 specified C/N_{min}. Doppler frequency is then adjusted until the receiver reaches SFP or 5 % $MFER$ in case of DVB-H receiver. The resulting Doppler frequency is $Fd_{3\text{dB}}$. This point corresponds to the point TP3 in IEC 62002-1, Figure 4. Time slicing shall be used for DVB-H.

Next the wideband noise source is turned off and Doppler frequency is adjusted until the receiver reaches SFP. The resulting Doppler frequency is Fd_{max}. This point corresponds to the point TP1 in IEC 62002-1, Figure 4. This measurement is not performed for DVB-H receivers.

Once 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 receiver needs to meet the requirements given in Table 4, Table 6, Table 8 and Table 10 for DVB-T receivers. For terminal category b the mobile test, i.e. Table 10 may be omitted. In the case of DVB-H the receiver needs to meet requirements given in Table 5, Table 7, Table 9 and Table 11.

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. For DVB-H receivers 5 % $MFER$ criterion is used.

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 for terminal categories a, b1 and –95,1 dB(mW) in 7 MHz channel for DVB-T receivers.

The requirement is –96,6 dB(mW) for QPSK 1/2 in the 8 MHz channel for terminal category b2 and –97,1 dB(mW) in 7 MHz channel for DVB-T receivers.

For a DVB-H receiver using GSM a rejection filter, the requirement is –95,6 dB(mW) in the 8 MHz channel and –96,1 dB(mW) in the 7 MHz channel with 5 % $MFER$.

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.

Gaussian (ideal) channel will be used in the measurement.

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

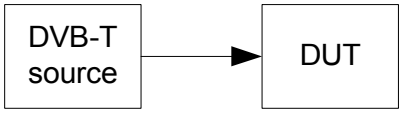
6.4.1 Initial conditions

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. MPE-FEC CR=3/4 is used for DVB-H.

6.4.2 Measurement setup

The measurement setup is shown in Figure 6.



IEC 686/08

Figure 6 – Example of a possible measurement setup in minimum and maximum receiver signal input level tests

Proceed as follows:

a) Connect DVB-T/H signal source to the terminal reference point shown in Figure 1.
b) Set DVB-T/H signal source power level to the defined power level, when measured from the terminal reference point.
c) Set correct modulation and signal parameters to the DVB-T/H signal source.
d) Set DVB-T/H signal source to correct channel frequency.
e) Set the terminal to correct channel frequency.
f) 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/H signal source power level until the receiver reaches the reference *BER* criterion 2×10^{-4} after the Viterbi decoder (failure criterion a). Alternatively, the picture failure point (PFP) criterion (failure criterion b) may be used. For DVB-H receivers 5 % *MFER* criterion is used. Measure the power level at the terminal reference point. Once the reference failure criterion is reached, the resynchronisation 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/H signal source power level to the defined maximum value. Measure the reference *BER* after the Viterbi decoder (failure criterion a). Alternatively, the picture failure point (PFP) criterion (failure criterion b) may be used. For DVB-H receivers 5 % *MFER* criterion is used. Once the reference failure criterion is reached, the resynchronisation 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 reference *BER* or *MFER* less or equal 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 as follows.

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 12 for DVB-T receivers.

Table 12 – Immunity to pattern S1

Mode	*a* [$N \pm 1$] PALG or I1	*a* [$N \pm 1$] PALB [a]	*a* [$N - 1$] SECAM L PAL D1 [b]	*a* [$N + 1$] SECAM L PAL D1 [b]	*a* [$N \pm m$] ($m \neq 1$) SECAM L	*a* [$N \pm m$] ($m \neq 1$) PAL B/G/I1
2k/8k 16-QAM CR=1/2, GI=1/8	38 dB	36 dB	30 dB	36 dB	48 dB	48 dB
2k/8k 16-QAM CR=2/3, GI=1/8	38 dB	36 dB	30 dB	36 dB	48 dB	48 dB
2k/8k 16-QAM CR=3/4, GI=1/8	37 dB	35 dB	29 dB	35 dB	48 dB	48 dB
2k/8k 64-QAM CR=2/3, GI=1/8	35 dB	33 dB	27 dB	33 dB	45 dB	46 dB
2k/8k 64-QAM CR=3/4, GI=1/8	35 dB	33 dB	27 dB	33 dB	42 dB	43 dB

[a] Note that if PAL B N-1 is with NICAM sound, the digital channel on N can not be used without offset, because of the overlapping spectrums.

[b] Note that the figures for PAL D1 are provisional. Performance for PAL D/K is similar to D1. Other analogue interfering signals may be considered in the future.

The difference shall be higher than the requirement in Table 13 for DVB-H receivers.

Table 13 – Immunity to pattern S1 for DVB-H

Mode	*a* [$N \pm 1$] PALG or I1	*a* [$N \pm 1$] PALB [a]	*a* [$N - 1$] SECAM L PAL D1 [b]	*a* [$N + 1$] SECAM L PAL D1 [b]	*a* [$N \pm m$] ($m \neq 1$) SECAM L	*a* [$N \pm m$] ($m \neq 1$) PAL B/G/I1
2k/4k/8k QPSK CR=1/2, GI=1/8	40 dB	38 dB	32 dB	38 dB	50 dB	50 dB
2k/4k/8k QPSK CR=2/3, GI=1/8	40 dB	38 dB	32 dB	38 dB	50 dB	50 dB
2k/4k/8k 16-QAM CR=1/2, GI=1/8	40 dB	38 dB	32 dB	38 dB	50 dB	50 dB
2k/4k/8k 16-QAM CR=2/3, GI=1/8	40 dB	38 dB	32 dB	38 dB	50 dB	50 dB
2k/4k/8k 16-QAM CR=3/4, GI=1/8	39 dB	37 dB	31 dB	37 dB	50 dB	50 dB
2k/4k/8k 64-QAM CR=1/2, GI=1/8	37 dB	35 dB	29 dB	35 dB	47 dB	46 dB
2k/4k/8k 64-QAM CR=2/3, GI=1/8	35 dB	33 dB	29 dB	35 dB	44 dB	43 dB

[a] Note that if PAL B $N - 1$ is with NICAM sound, the digital channel on N can not be used without offset, because of the overlapping spectrums.

[b] Note that the figures for PAL D1 are provisional. Performance for PAL D/K is similar to D1. Other analogue interfering signals may be considered in the future.

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: –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 the Table 14 for DVB-T receivers.

Table 14 – Immunity to pattern S2

Mode	a [$N \pm 1$]	a [$N \pm m$ ($m \neq 1$) except m = +9
2k/8k 16-QAM CR=1/2, GI=1/8	29 dB	40 dB
2k/8k 16-QAM CR=2/3, GI=1/8	29 dB	40 dB
2k/8k 16-QAM CR=3/4, GI=1/8	29 dB	40 dB
2k/8k 64-QAM CR=2/3, GI=1/8	27 dB	40 dB
2k/8k 64-QAM CR=3/4, GI=1/8	27 dB	40 dB

The difference shall be higher than the requirement in Table 15 for DVB-H receivers.

Table 15 – Immunity to pattern S2 for DVB-H

Mode	a [$N \pm 1$]	a [$N \pm m$ ($m \neq 1$) except m = +9
2k/4k/8k 16-QAM CR=1/2, GI=1/8	31 dB	42 dB
2k/4k/8k 16-QAM CR=2/3, GI=1/8	31 dB	42 dB
2k/4k/8k 16-QAM CR=3/4, GI=1/8	31 dB	42 dB
2k/4k/8k 64-QAM CR=1/2, GI=1/8	29 dB	42 dB

7.2.3 Immunity to pattern L1

The interferers are set to the maximum allowed level:

For terminal category a and b1, the analoque interferer is –25 dB(mW) and the digital interferer is –30 dB(mW).

For terminal categories b2 and c, the analogue interferer is –35 dB(mW) and the digital interferer –40 dB(mW).

The difference shall be higher than the requirement in Table 16.

Table 16 – Immunity to pattern L1

Mode	*a* [*N* + 2]	b [*N* + 4]
2k/8k 16-QAM *CR*=1/2, *GI*=1/8	40 dB	45 dB
2k/8k 16-QAM *CR*=2/3, *GI*=1/8	40 dB	45 dB
2k/8k 16-QAM *CR*=3/4, *GI*=1/8	36 dB	41 dB
2k/8k 64-QAM *CR*=2/3, *GI*=1/8	32 dB	37 dB

The difference shall be higher than the requirement in Table 17 for DVB-H receivers.

Table 17 – Immunity to pattern L1 for DVB-H

Mode	*a* [*N* + 2]	b [*N* + 4]
2k/4k/8k QPSK *CR*=1/2, *GI*=1/8	42 dB	47 dB
2k/4k/8k QPSK *CR*=2/3, *GI*=1/8	42 dB	47 dB
2k/4k/8k 16-QAM *CR*=1/2, *GI*=1/8	42 dB	47 dB
2k/4k/8k 16-QAM *CR*=2/3, *GI*=1/8	42 dB	47 dB

7.2.4 Immunity to pattern L2

The interferers are set to the maximum allowed level:

For terminal category a, b1: –25 dB(mW)
For terminal categories b2 and c: –35 dB(mW)

The difference shall be higher than the requirement in Table 18.

Table 18 – Immunity to pattern L2

Mode	*a* [*N* + 2 and *N* + 4]
2k/8k 16-QAM *CR*=1/2, *GI*=1/8	45 dB
2k/8k 16-QAM *CR*=2/3, *GI*=1/8	45 dB
2k/8k 16-QAM *CR*=3/4, *GI*=1/8	41 dB
2k/8k 64-QAM *CR*=2/3, *GI*=1/8	37 dB

The difference shall be higher than the requirement in Table 19 for DVB-H receivers.

Table 19 – Immunity to pattern L2 for DVB-H

Mode	*a* [*N* + 2 and *N* + 4]
2k/4k/8k QPSK *CR*=1/2, *GI*=1/8	47 dB
2k/4k/8k QPSK *CR*=2/3, *GI*=1/8	47 dB
2k/4k/8k 16-QAM *CR*=1/2, *GI*=1/8	47 dB
2k/4k/8k 16-QAM *CR*=2/3, *GI*=1/8	47 dB

7.2.5 Immunity to pattern L3

The interferers are set to the maximum allowed level:

For terminal category a, b1: –25 dB(mW)
For terminal categories b2 and c: –35 dB(mW)

The difference shall be higher than the requirement in Table 20.

Table 20 – Immunity to pattern L3

Mode	*a* [N + 2 and N + 4]
2k/8k 16-QAM CR=1/2, GI=1/8	40 dB
2k/8k 16-QAM CR=2/3, GI=1/8	40 dB
2k/8k 16-QAM CR=3/4, GI=1/8	36 dB
2k/8k 64-QAM CR=2/3, GI=1/8	32 dB

The difference shall be higher than the requirement in Table 21 for DVB-H receivers.

Table 21 – Immunity to pattern L3 for DVB-H

Mode	*a* [N + 2 and N + 4]
2k/4k/8k QPSK CR=1/2, GI=1/8	42 dB
2k/4k/8k QPSK CR=2/3, GI=1/8	42 dB
2k/4k(8k 16-QAM CR=1/2, GI=1/8	42 dB
2k/4k/8k 16-QAM CR=2/3, GI=1/8	42 dB

7.2.6 Immunity to pattern L4

The interferers are set to the levels specified in Table 22.

Table 22 – Signal levels for pattern L4

	Signal at C4 **Power level** dB(mW)	**Signal at C21** **Power level** dB(mW)
Cat a and b1	–25	–25
Cat b2 and c	–35	–35
Comment	Analogue signal	Digital signal

The difference shall be higher than the requirement in Table 23 for DVB-T receivers.

Table 23 – Immunity to pattern L4

Mode	*a*
2k/8k QPSK CR=1/2, GI=1/8	45 dB
2k/8k QPSK CR=2/3, GI=1/8	45 dB
2k/8k 16-QAM CR=1/2, GI=1/8	45 dB
2k/8k 16-QAM CR=2/3, GI=1/8	45 dB

The difference shall be higher than the requirement in Table 24 for DVB-H receivers.

Table 24 – Immunity to pattern L4 for DVB-H

Mode	*a*
2k/4k/8k QPSK CR=1/2, GI=1/8	47 dB
2k/4k/8k QPSK CR=2/3, GI=1/8	47 dB
2k/4k/8k 16-QAM CR=1/2, GI=1/8	47 dB
2k/4k/8k 16-QAM CR=2/3, GI=1/8	47 dB

7.3 Test purpose

To verify that the set reference *BER* criterion or picture failure point criterion does not exceed when strong interfering signals are neighbouring the desired channel. If the picture failure point (PFP) is used, then the requirement is increased by the delta value of 2 dB given in Table 2. For DVB-H receivers the 5 % *MFER* criterion is used.

The receivers not capable of operating when strong interfering signals are neighbouring 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 using native interleaver is used.

PAL-G with NICAM sound and 8 MHz DVB-T/H is used for the tests.

NOTE SECAM is tested according the intended market area.

7.4.1.2 Pattern S1

Pattern S1 is shown in Figure 7.

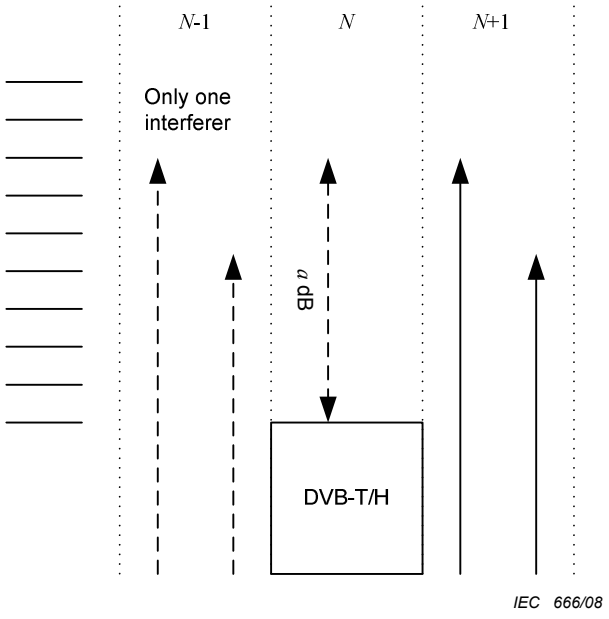


Figure 7 – Pattern S1: wanted DVB-T/H channel with *N*+1 or *N*–1 analogue interferer

Reception modes: specified in Table 12 for DVB-T and Table 13 for DVB-H.

Channel frequencies for wanted DVB-T/H signal:

For $N \pm 1$ at channel 45 (666 MHz) in UHF and at channel 8 (199 MHz) in VHF.

With the mode 64-QAM 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 only the $N + 1$ is possible to measure and with channel 12 the $N - 1$ is possible to measure.

Depending on the type of the 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 8.

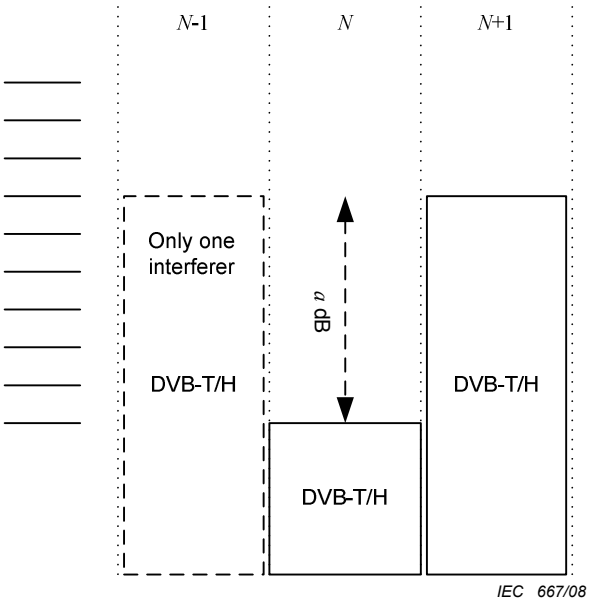


Figure 8 – Pattern S2: wanted DVB-T/H channel with N + 1 or N – 1 digital DVB-T interferer

Reception modes: specified in Table 14 for DVB-T, Table 15 for DVB-H.

Channel frequencies for wanted DVB-T/H 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 9.

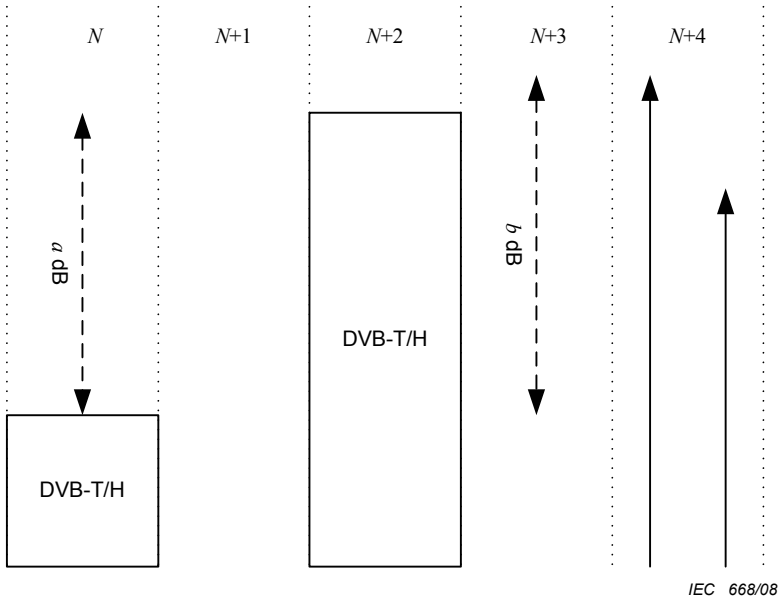


Figure 9 – Pattern L1: wanted DVB-T/H channel with one analogue signal on N + 4 channel and one digital DVB-T signal on N + 2 channel

Reception modes: specified in Table 16 for DVB-T, Table 17 for DVB-H.

Channel frequencies for wanted DVB-T/H 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 10.

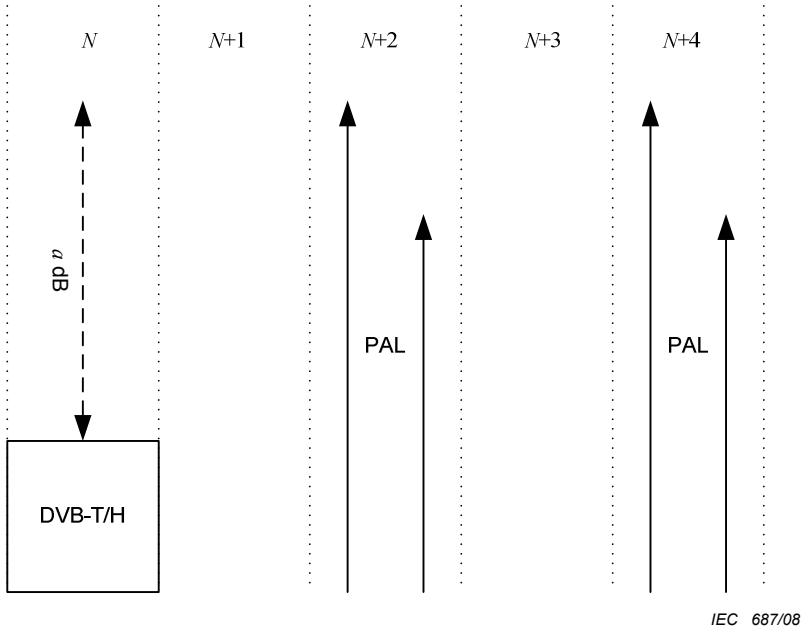


Figure 10 – Pattern L2: wanted DVB-T/H channel with one analogue signal on N + 4 channel and another analogue signal on N + 2 channel

Reception modes: specified in Table 18 for DVB-T, Table 19 for DVB-H.

Channel frequencies for wanted DVB-T/H 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.

7.4.1.6 Pattern L3

Pattern L3 is shown in Figure 11.

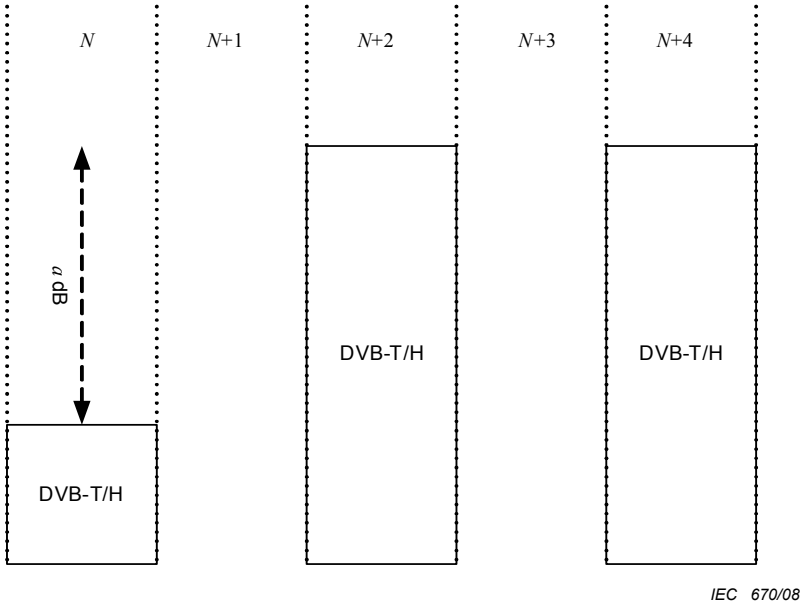


Figure 11 – Pattern L3: Wanted DVB-T/H signal with one digital DVB-T signal on N + 4 channel and another digital DVB-T signal on N + 2 channel

Reception modes: specified in Table 20 for DVB-T, Table 21 for DVB-H.

Channel frequencies for wanted DVB-T/H 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.

7.4.1.7 Pattern L4

Pattern L4 is shown in Figure 12.

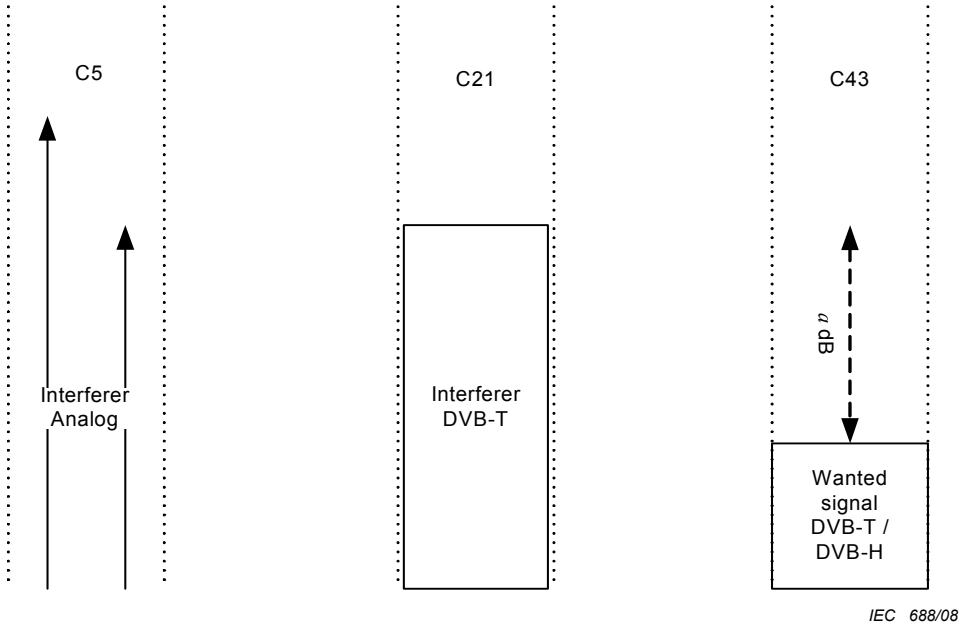


Figure 12 – Pattern L4: Wanted DVB-T/H signal with one analogue signal in C4/VHF III and one DVB-T signal in C21/UHF

Reception modes: specified in Table 23 for DVB-T, Table 24 for DVB-H.

Channel frequencies for wanted DVB-T/H signal:

The measurement is performed at channel 43 (650 MHz). The analogue interferer is at channel 5, i.e. centre frequency 177,5 MHz. The digital interferer is at channel 21, i.e. centre frequency 474 MHz.

7.4.2 Measurement setup

Measurement setup is shown in Figure 13.

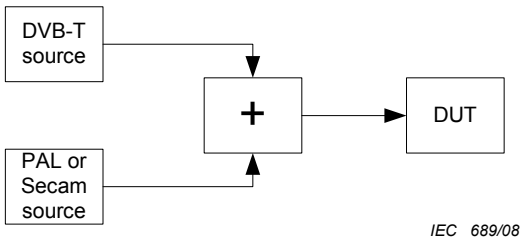


Figure 13 – Example of a possible measurement setup to test the immunity to analogue and/or to digital signals in other channels

Proceed as follows.

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

b) Set correct modulation and signal parameters to the DVB-T/H signal source.

c) Set the DVB-T/H signal source to correct channel frequency.

d) Set the DVB-T/H 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 PAL/SECAM signal source to correct frequency separation from the DVB-T/H 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/H signal source as long as the measured reference *BER* after the Viterbi decoder (failure criterion a) is above or equals the defined failure criteria. For DVB-H 5 % *MFER* criterion is used. Read the power level difference of the PAL/SECAM signal source and the DVB-T/H signal source. Once reference failure criterion is reached the resynchronisation 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 DVB-T/H 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 interference to carrier (I/C) ratio shall be higher or equal than the requirement in Table 25 for DVB-T receivers.

Table 25 – Immunity to analogue co-channel

Mode	PAL I1	PAL B/G/D1[a]	SECAM
2k/8k 16-QAM *CR*=1/2 *GI*=1/8	6 dB	6 dB	5 dB
2k/8k 16-QAM *CR*=2/3 *GI*=1/8	1 dB	–1 dB	0 dB
2k/8k 16-QAM *CR*=3/4 *GI*=1/8	0 dB	–2 dB	–3 dB
2k/8k 64-QAM *CR*=2/3 *GI*=1/8	–4 dB	–4 dB	–5 dB
2k/8k 64-QAM *CR*=3/4 *GI*=1/8	–7 dB	–7 dB	–8 dB

[a] Note that the figures for Pal D1 are provisional. Performance for PAL D/K is similar to D. Other analogue interfering signals may be considered in the future.

The interference to carrier (I/C) ratio shall be higher than the requirement in Table 26 for DVB-H receivers.

Table 26 – Immunity to co-channel interference from analogue signals for DVB-H

Mode	All analogue interferers
8k QPSK 1/2, 2/3 and 16-QAM 1/2, 2/3 modes. GI=1/8	–4 dB

8.3 Test purpose

To verify that the set reference BER criterion (failure criterion a) or picture failure point criterion (failure criterion b) does not exceed when co-channel interfering signals are present. In the case where the picture failure point (PFP) is used, then the requirement is increased by the delta value of 2 dB given in Table 2. For DVB-H the 5 % $MFER$ criterion is used.

8.4 Method of test

8.4.1 Initial conditions

Test environment: normal conditions.

Frequencies to be tested: channel 45 (666 MHz)

Tested modes for DVB-T: see modes specified in Table 25. The highest available FFT-mode using native interleaver is used. With DVB-H modes QPSK 1/2, QPSK 2/3, 16-QAM 1/2 and 16-QAM 2/3 with 8k and GI = 1/8 are tested. MPE-FEC code rate 3/4 is used for DVB-H.

NOTE SECAM is tested according the intended market area.

8.4.2 Measurement setup

The measurement setup is shown in Figure 14.

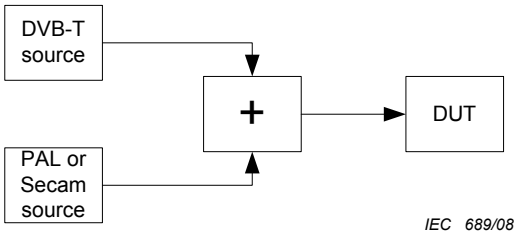


Figure 14 – Example of a possible measurement setup to test the immunity to co-channel interference from analogue TV signals

Proceed as follows.

a) Connect the DVB-T/H 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.

b) Set correct modulation and signal parameters to the DVB-T/H signal source.

c) Set the DVB-T/H signal source to the channel frequency 45 (666 MHz).

d) Set the DVB-T/H signal source power level to –50 dB(mW), when measured from the terminal reference point.

e) Set the PAL/SECAM signal source peak sync. power level to –60 dB(mW), when measured from the terminal reference point. See interfering signal definitions from 4.7.2.

f) Set the PAL/SECAM signal source to the channel frequency 45 (666 MHz).

g) Set the terminal to correct channel frequency.

h) Perform the measurement according to procedure described in 8.4.3.

8.4.3 Procedure

Decrease the power level of the DVB-T/H 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/H signal source. Once the reference failure criterion is reached, the resynchronisation needs to be achieved. For DVB-H the 5 % *MFER* criterion is used.

Repeat the measurement with all modes defined in 8.4.1.

8.5 Test requirement

The measured carrier to interference ratio of the PAL/SECAM signal and DVB-T/H signal when measured from the terminal reference point shall be higher 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

The minimum requirements are presented in Table 27.

Table 27 – Performance with echoes within the guard interval

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

9.3 Test purpose

To verify that the set reference *BER* criterion or picture failure point 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 15.

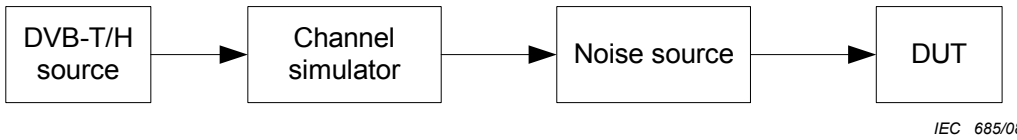


Figure 15 – Example of possible measurement setup to test echoes within the guard interval

Proceed as follows.

a) Connect DVB-T/H 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 correct modulation and signal parameters to the DVB-T/H signal source.

c) Set the DVB-T/H signal source to the channel frequency 45 (666 MHz).

d) Set the DVB-T/H signal source power level to –40 dB(mW), when measured from the terminal reference point.

e) Set the terminal to correct channel frequency.

f) Set the channel simulator to transmit paths 0 and 1 as defined in Table 28.

g) Fix C/N to values given in Table 27.

h) Add the path number 2 into the channel simulator Table 28. Care shall be taken that the C/N actually changes when the 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 as shown in Table 28.

Table 28 – Paths in echoes within guard interval measurement

Path number	**Attenuation** dB	**Delay**	**Doppler**
0	0	0	None
1	0	$Tg \times 0{,}9$	None
2	–1	$Tg \times 0{,}9$	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	$Tg \times 0{,}9$	None
2	–1	0	Pure 0,2 Hz

The measurement is repeated with delay setting $Tg \times 0{,}5$.

9.4.3 Procedure

Verify that the reception quality is better than the picture failure point (PFP) (failure criterion b), meaning no visible or TS packet errors. For DVB-H receivers this means 0 % *FER* (frame error rate before MPE-FEC).

Repeat the measurement with all modulations defined in 9.4.1.

9.5 Test requirement

The TS-*PER* for DVB-T or *FER* for DVB-H with defined echoes inside the guard interval shall be zero.

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.

10.2 Minimum requirements

The mask is defined by three points, the starting point at $0{,}9 \times Tg$, the inflection point at $1{,}0 \times Tg$ and the corner point at Tc. Timing of the point Tc is defined in Table 29. The requirement mask is shown in Figure 16.

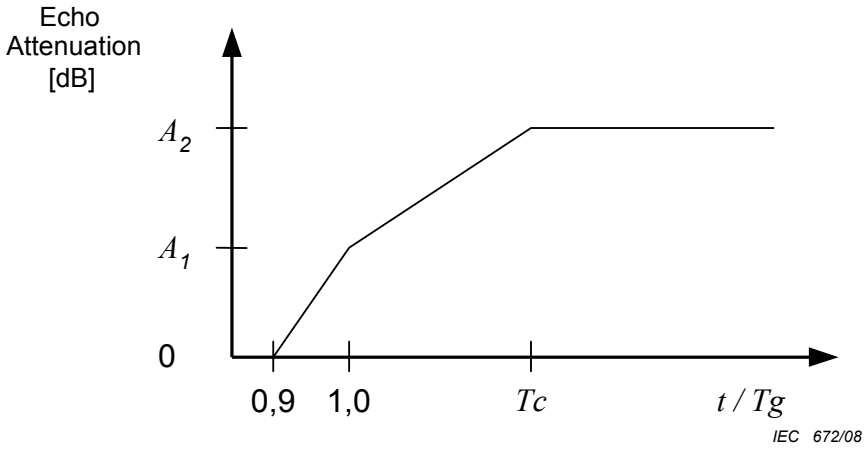


Figure 16 – Echo outside guard interval mask

Table 29 – Delay of the corner point *Tc*

Guard interval	*Tc* relative to *Tg*
1/8	1,3

Echo attenuation A_2 at the corner point Tc is dependent on the used modulation and is calculated by adding a value Δ to the C/N requirement of the mode in the Gaussian channel, as defined in Table 4. The value Δ is defined in the Table 30.

Table 30 – Definition of the value *Δ*

Modulation	*Δ* dB
16-QAM	3
64-QAM	4

Table 31 – Definition of the inflection point

Modulation	Code rate	A_1 at $t = 1{,}0 \times Tg$ dB
16-QAM	1/2	1
16-QAM	2/3	2
64-QAM	2/3	3

With above given settings, the measured BER has to be $BER < 2 \times 10^{-4}$

For DVB-H receivers 5 % FER criterion should be used.

10.3 Test purpose

To verify that the set reference BER criterion, picture failure point criterion or 5 % FER criterion does not exceed when echoes outside guard interval are present.

10.4 Method of test

10.4.1 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 and CR = 2/3.

10.4.2 Measurement setup

The measurement setup is shown in Figure 17.

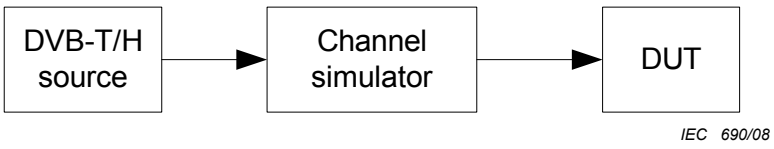


Figure 17 – Example of a possible measurement setup to test echoes outside guard interval

Proceed as follows.

a) Connect DVB-T/H signal source to channel simulator. Connect the channel simulator to the terminal reference point shown in Figure 1.

b) Set correct modulation and signal parameters to the DVB-T/H signal source.

c) Set the DVB-T/H signal source to the channel frequency 45 (666 MHz).

d) Set the DVB-T/H 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) Setup the channel simulator delay to produce the echo at inflection point.

g) Perform the measurement according to the procedure described in 10.4.3.

10.4.3 Procedure

Adjust the echo level until the QEF limit is reached. Measure the reference *BER* after the Viterbi decoder (failure criterion a). Alternatively, the picture failure point (PFP) criterion (failure criterion b) may be used. For DVB-H the 5 % *FER* criterion is used.

Once the *BER* is measured, set up the channel simulator delay to produce the echo at *Tc*. Adjust the echo level until the QEF limit is reached. Measure the reference *BER* after the Viterbi decoder (failure criterion a). Alternatively, the picture failure point (PFP) criterion (failure criterion b) may be used. For DVB-H the 5 % *FER* criterion is used.

Repeat the measurement with all the modulations defined in 10.4.1.

10.5 Test requirement

The *BER* for DVB-T and *FER* for DVB-H with the defined echo inside and outside the guard interval shall be better than the specified failure criterion.

11 Tolerance to impulse interference

11.1 Definition and applicability

This test measures the performance of the terminal in the presence of impulsive noise interference.

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

11.2 Minimum requirements

The minimum requirements for tolerance to impulse interference are presented in Table 32.

Table 32 – Measurement conditions, modes and requirements used for impulse noise

Test No.	Pulses per burst	Effective burst duration µs	Minimum pulse spacing µs	Maximum pulse spacing µs	Range of actual burst durations µs	16-QAM *CR* = 1/2 *I/C*	16-QAM *CR* = 2/3 *I/C*	64-QAM *CR* = 2/3 *I/C*
1	1	0,25	N/A	N/A	0,25	26,2		
2	2	0,50	1,5	45	1,75 – 45,25		21,1	
3	4	1,00	15	35	45,25 – 105,25		18,1	
4	12	3,00	10	15	110,25 – 165,25			7,7
5	20	5,00	1	2	19,25 – 38,25			5,5
6	40	10,00	0,5	1	19,75 – 39,25			2,5

Figure 18 illustrates the terminology used with the test patterns.

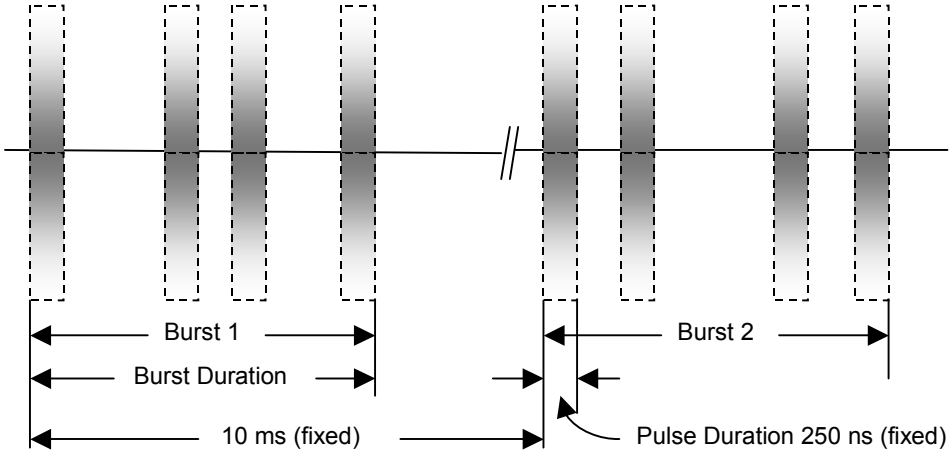


Figure 18 – Definition of the impulse interference test pattern

With the settings give in Table 32, the measured PFP (ESR) or the 5 % $MFER$ criterion shall be fulfilled.

11.3 Test purpose

To verify that the set picture failure point criterion or the 5 % $MFER$ does not exceed when different kinds of impulsive noise patterns are present.

11.4 Method of test

11.4.1 Initial conditions

Test environment: normal conditions.

Frequencies to be tested: channel 45 (666 MHz)

Reception modes:

Three different modes: 16-QAM CR = 1/2 8k, 16-QAM CR = 2/3 8k, 64-QAM CR = 2/3 8k all with guard interval GI = 1/8.

Test cases: 1 to 6 according to 11.2.

11.4.2 Measurement setup

The measurement setup is shown in Figure 19.

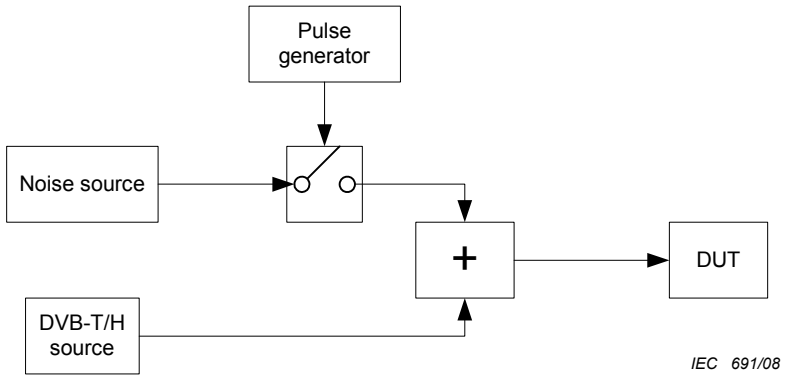


Figure 19 – Example of a measurement setup to test impulse noise interference

Proceed as follows.

a) Connect the wideband noise source to a switch. Connect the programmable pulse generator to control the switch. Connect the DVB-T/H signal source and output of the switch to the power splitter. Connect the summing branch of the power splitter to the terminal reference point as shown in Figure 1.

b) Set correct modulation and signal parameters to the DVB-T/H signal source.

c) Set the DVB-T/H signal source to the channel frequency 45 (666 MHz).

d) Set the noise source power level to –35 dB(mW), when measured at the terminal reference point using 8 MHz bandwidth. The noise should be continuous (gating switch closed) during the power measurement.

e) Set the DVB-T/H signal source power level to –30 dB(mW), when measured at the terminal reference point.

f) Set the terminal to the correct channel frequency.

g) Set the gating of the switch to the parameters matching the test number (1-6) currently under measurement.

h) Adjust the signal source power level until the PFP or 5 % $MFER$ limit is reached.

i) Perform the measurement according to procedure described in 11.4.3.

11.4.3 Procedure

Measure the power level difference of gated wideband noise and DVB-T/H signal source at the point where the PFP or 5 % $MFER$ criterion is reached. This power level difference between the signal (DVB-T/H source) and the interference (gated noise), I/C, shall be higher than the one specified in 11.2 for the test case under measurement.

Repeat the measurement with all modulations and test cases defined in 11.4.1.

11.5 Test requirement

The I/C value with the defined test cases shall be higher than the specified one when the PFP or 5 % $MFER$ criterion is reached.

12 GSM900 TX signal blocking test

12.1 Definition and applicability

To verify that the receiver sensitivity does not degrade too heavily when GSM900 TX blocking signal is present in the receiver input.

The requirements and this test apply to terminal category c.

12.2 Minimum requirements

12.2.1 Minimum input levels

The requirement is that sensitivity degradation is less than 1,5 dB caused by the blocking effect, i.e. the sensitivity is better than **–94,1 dB(mW)** in **8 MHz** channel when blocking signal is present. The GSM900 TX blocking signal level is **+18 dB(mW).** The blocking signal power level assumes worst case antenna isolation value of 15 dB, i.e. the signal level at reference point is +33 dB(mW) – 15 dB = +18 dB(mW)

12.3 Test purpose

To verify that the receiver is able to support interoperability with GSM900 transmitter from the DVB-H receiver point of view.

12.4 Method of test

12.4.1 Initial conditions

Frequencies to be tested: The measurement is performed at the last available UHF channel, i.e. channel 55 (746 MHz).

Reception modes to be tested: 8k GI = 1/4 QPSK CR = 1/2 MPE-FEC CR = 3/4.

The GSM900 TX signal is emulated with filtered and FM modulated CW signal. The CW carrier is FM modulated with ±50 kHz deviation and 1 kHz frequency. This provides worst case measurement compared to real GSM900 TX signal. The high pass filter cleans the noise from the CW signal. The noise level from the CW generator at 746 MHz should be at least 10 dB below the thermal noise floor. The CW signal level at terminal reference point is +18 dB(mW). The power level can be measured when FM modulation is OFF. The frequency of the CW generator is 880 MHz, i.e. emulating lowest available GSM900 TX channel.

12.4.2 Measurement setup

The measurement setup is shown in Figure 20.

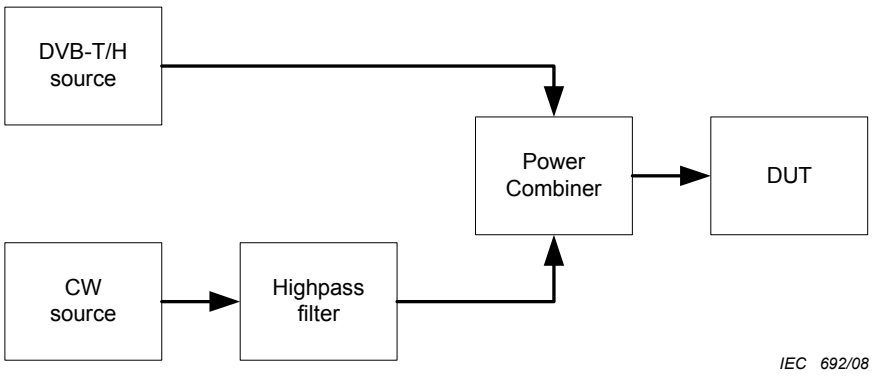


Figure 20 – Example of a measurement setup to test GSM900 TX signal blocking

Proceed as follows.

a) Connect power combiner to DUT input.

b) Connect DVB-T/H signal source to the power combiner.

c) Connect CW signal generator via high-pass filter to the power combiner.

d) Set the CW signal generator to correct frequency, modulation and power level, when measured from the terminal reference point.

e) Set DVB-T/H signal source power level to defined power level, when measured from the terminal reference point.

f) Set correct modulation and signal parameters to the DVB-T/H signal source.

g) Set DVB-T/H signal source to correct channel frequency.

h) Set the terminal to correct channel frequency.

i) Perform the measurement according to the procedure described in 12.4.3.

12.4.3 Procedure

Adjust the DVB-T/H signal source power level until the receiver reaches 5 % $MFER$ criterion. Measure the power level at the terminal reference point. Once the reference failure criterion is reached the resynchronisation needs to be achieved.

Perform the measurement in the frequency as defined in 12.4.1.

12.5 Test requirements

The measured input signal power level that causes the defined failure criterion has to be lower than the values specified in 12.2.1.

13 Mobile SFN channel test

13.1 Definition and applicability

To verify that the receiver synchronization works correctly in mobile SFN environment. Also the mobile performance should remain within the specified level.

The requirements and this test apply to DVB-H receivers.

13.2 Minimum requirements

The requirement is that the receiver has to operate correctly using time slicing mode also in mobile SFN channel profile. The reception performance should remain within the specified level, i.e. see Table 33.

Table 33 – C/N (dB) for $MFER$ 5 % for DVB-H

Guard interval = 1/4			8k		Speed at Fd_{3dB} km/h	
Modulation	**Code rate**	**MPE-FEC CR**	C/N_{min} dB	Fd_{3dB} Hz	**474** MHz	**746** MHz
16-QAM	1/2	3/4	15,5	100	228	145

The following three mobile SFN channel models (weak long echo, strong long echo, strong short echo) are used for the test.

Table 34 – Mobile SFN-channel for weak long echo

Tap number	Delay μs	Power dB	Doppler spectrum
1	0,0	–3	Rayleigh
2	0,2	0	Rayleigh
3	0,5	–2	Rayleigh
4	1,6	–6	Rayleigh
5	2,3	–8	Rayleigh
6	5,0	–10	Rayleigh
7	179,2	–13,6	Rayleigh
8	179,4	–10,6	Rayleigh
9	179,9	–12,6	Rayleigh
10	180,8	–16,6	Rayleigh
11	181,5	–18,6	Rayleigh
12	184,2	–20,6	Rayleigh

Table 35 – Mobile SFN-channel for strong long echo

Tap number	Delay μs	Power dB	Doppler spectrum
1	0,0	–3	Rayleigh
2	0,2	0	Rayleigh
3	0,5	–2	Rayleigh
4	1,6	–6	Rayleigh
5	2,3	–8	Rayleigh
6	5,0	–10	Rayleigh
7	179,2	–3	Rayleigh
8	179,4	0	Rayleigh
9	179,9	–2	Rayleigh
10	180,8	–6	Rayleigh
11	181,5	–8	Rayleigh
12	184,2	–10	Rayleigh

Table 36 – Mobile SFN-channel for strong short echo

Tap number	Delay μs	Power dB	Doppler spectrum
1	0,0	–3	Rayleigh
2	0,2	0	Rayleigh
3	0,5	–2	Rayleigh
4	1,6	–6	Rayleigh
5	2,3	–8	Rayleigh
6	5,0	–10	Rayleigh
7	6,0	–3	Rayleigh
8	6,2	0	Rayleigh
9	6,5	–2	Rayleigh
10	7,6	–6	Rayleigh
11	8,3	–8	Rayleigh
12	11,0	–10	Rayleigh

13.3 Test purpose

The purpose of this test is to guarantee the correct mobile operation of the receiver also in the SFN network. Most of the practical DVB-H networks are going to be SFN networks, therefore, the correct operation is vital.

13.4 Method of test

13.4.1 Initial conditions

Frequencies to be tested: The measurement is performed at UHF channel 45 (666 MHz).

Reception modes to be tested: 8kGI=1/4 16-QAM CR=1/2 MPE-FEC CR=3/4.

All channel models presented in 13.2 are tested.

13.4.2 Measurement setup

The measurement setup is as shown in Figure 21.

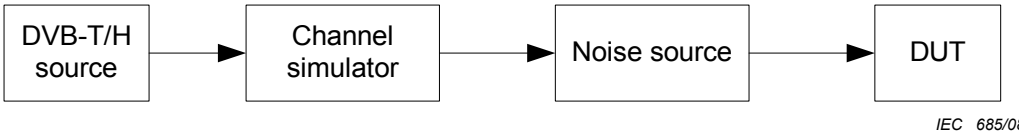


Figure 21 – Example of a measurement setup in mobile SFN test

13.4.3 Procedure

At first the Doppler frequency in the channel simulator is set to 10 Hz and C/N value is adjusted by changing the noise source signal level until the receiver reaches the 5 % $MFER$ criterion. The resulting C/N ratio is C/N_{min}.

Next the C/N ratio is increased by 3 dB from the specified C/N_{min}. Doppler frequency is then adjusted until the receiver reaches 5 % $MFER$ in case of the DVB-H receiver. The resulting Doppler frequency is $Fd_{3\text{dB}}$.

The receiver has to use time slicing during the measurement i.e. the resynchronization must happen for time slices.

13.5 Test requirements

The receiver has to meet the performance as shown in Table 33 with all the 2 × TU6 channel models presented in 13.2. The receiver synchronization must therefore also work in the mobile SFN channel.

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