



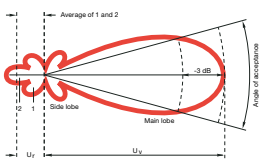
TRIAX

connecting the future



TRIAX[®] technical appendix

Basic requirements, Planning and installation, TV standards, Frequency, Channels, etc.





TRIAX



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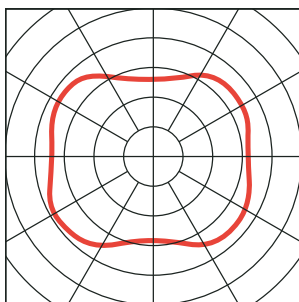


Terrestrial aerials

Introduction

Television antennas for DVB-T

DVB-T reception is possible with any antenna that is suitable for the related frequency band and polarization. In the catalogue all antennas suitable for the reception of DVB-T signals in VHF III and UHF IV/V bands are marked with the DVB logo.



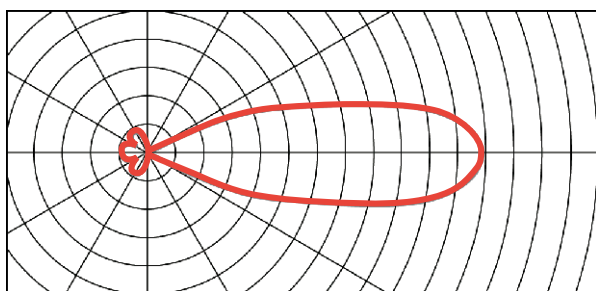
Antennas are suitable for the reception of digital terrestrial signals (DVB-T)

Omnidirectional reception

The omnidirectional radio antenna has approximately the same sensitivity for all directions and can only be recommended for well supplied reception areas.

Directional reception

The directional antenna receives signals from one main direction better than omnidirectional antennas, but has poorer reception of signals from other directions. A directional antenna is absolutely necessary for areas where signals are weak, or in areas where a particular weak transmitter is to be received.

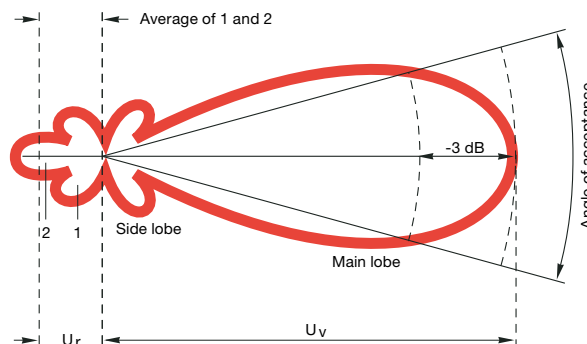


Antennas

Stereo signals can be received using any FM antenna.

Because, however, a higher signal level and greater freedom from reflection are needed for clear stereo reception than for mono reception, it is usually necessary to use a directional antenna.

Radiation pattern – The most important terms



Gain

Ratio of an antenna's reception power in its main receiving direction to receive power of a 1/2 dipole at the same installation site (logarithmic measure expressed in dB).

Angle of acceptance

Angular aperture of the major lobe between the points where the gain is lower by 3 dB than its maximum value.

Major lobe

Section of the radiation pattern in the direction of the maximum gain.

Side lobe

Lateral and rearward lobe-shaped sections of the radiation pattern that have a lower gain than in the main receiving direction.

Front to back ratio*

Ratio of the voltage U_v in the main receiving direction to an average U_r generated on the basis of the voltages of the side lobe 2 in the back direction (180°) and of the larger side lobe 1 in the rear sector (90° - 270°) (logarithmic measure expressed in dB).

* Corresponding to a definition by the Technical Commission of the "Receiving Antennas" association in ZVEI

Mast calculation

designed for superior TV reception

The sum of the moments resulting from the intrinsic moment of the mast and the bending moments caused by the mounted antennas must not exceed the maximum permitted bending moments of the mast itself.

The bending moment caused by an antenna is calculated by the following formula:

$$\text{Wind load (N)} \times \text{distance (m)} = \text{bending moment (Nm)}$$

The distance and bending moment refer to the top clamping point. Bending moments in excess of 1650 Nm require proof of structural stability.

$$\text{Wind load} \times \text{distance} = \text{bending moment}$$

$$1) 16 \text{ N} \times 3,6 \text{ m} = 57,6 \text{ Nm}$$

$$2) 56 \text{ N} \times 2,8 \text{ m} = 156,8 \text{ Nm}$$

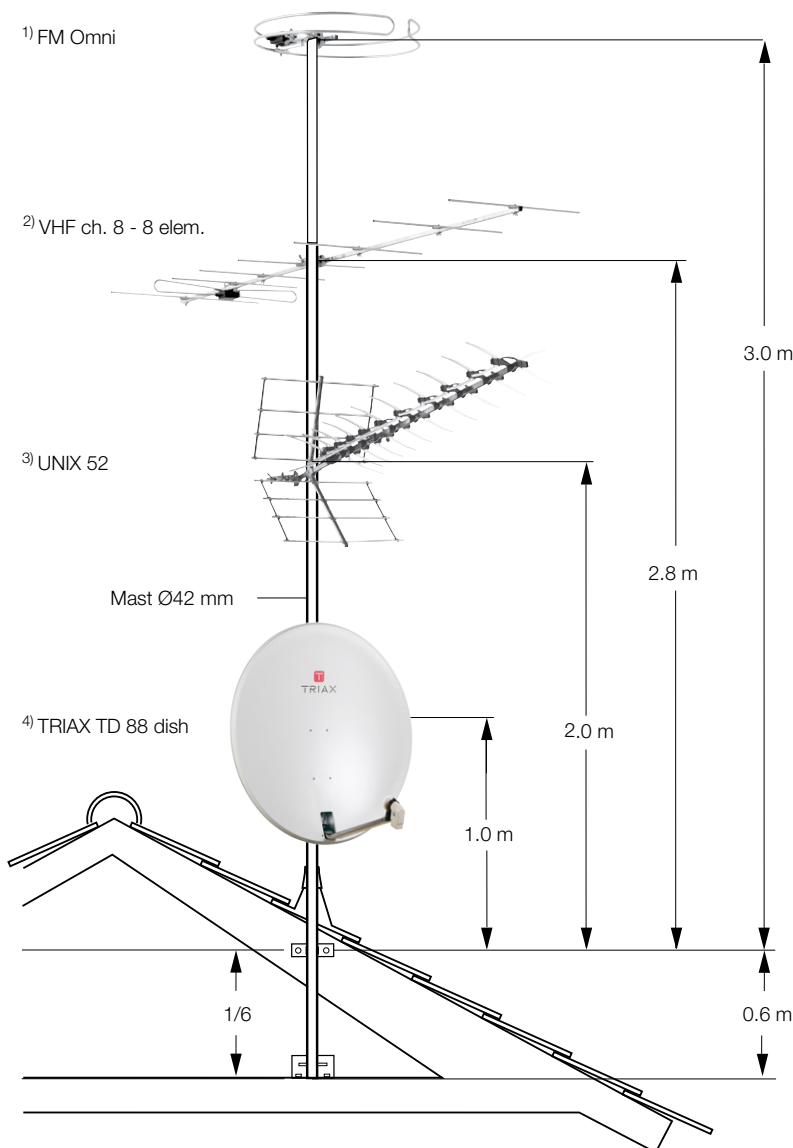
$$3) 96 \text{ N} \times 2,0 \text{ m} = 192,0 \text{ Nm}$$

$$4) 619 \text{ N} \times 1 \text{ m} = 619,0 \text{ Nm}$$

$$\text{Total bending moment of the antennas } 1025,4 \text{ Nm}$$

The total bending moment for the antenna at 1025.4 Nm is less than the usable bending moment for the antenna to be mounted of 1250 Nm.

Therefore the intended configuration is permitted!



In accordance with DIN EN 50083-1 the clamped length of the mast must be at least 1/6 of the mast length

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1. Basic technical requirements

All equipment and components in this catalogue meet, unless otherwise stated, the European standards for "Cable networks for television signals, sound signals and interactive services" from the standardisation organisation CENELEC, which have been adopted in national versions.

EN 50083-1	Safety requirements
EN 50083-1/A1	
EN 50083-1/A2	
EN 50083-2	Electromagnetic compatibility (EMC) of equipment

The equipment conforms to the uniform European "EMC directive" in accordance with legal requirements. For the majority of the product groups in this catalogue, EN 50083-2 is relevant. In relation to the "Low voltage directive". EN 60065 is the basis to which reference is made in EN 50083-1 "Safety requirements". The CE marking for products in relation to EMC and the low voltage directive is based on these standards.

In addition, CENELEC committee TC 209 has ratified European standards for equipment and system requirements for "Cable networks for television signals, sound signals and interactive services".

EN 50083-3	Active broadband equipment for coaxial cable networks
EN 50083-4	Passive broadband equipment for coaxial cable networks
EN 50083-5	Headend equipment
EN 50083-6	Optical equipment
EN 50083-7	System requirements
EN 50083-8	Electromagnetic compatibility of cable networks
EN 50083-9	Interfaces for CATV/SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams
EN 50083-10	System performance for return paths

The system and equipment requirements are matched to each other in such a way that the minimum requirements for signal quality at the subscriber's outlet can be met with a minimum of technical effort. In addition, requirements that result from use of both analogue and digital signal transmission have also been taken into account. The EN 50083 standards provide the network operator, planner and installer with concrete guidelines for network design and selection of appropriate network components. TRIAX network components are developed to these standards and are marked in the catalogue by the relevant EN standard. The equipment standards (EN 50083 Parts 3...6) include fulfillment of the safety and EMC requirements (EN 50083 Parts 1 + 2).

The legally required CE marking for antenna and telecommunication products refers to adherence to electromagnetic compatibility (EMC) limits and, from 1 Jan 1997, to adherence to the low voltage directive.

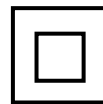
The CE marking does not therefore imply fulfilment of the product and system requirements according to EN 50083-3...-10. For this reason Triax indicates compliance with these basic requirements on equipment (EN 50083-3...6) by explicitly noting the corresponding EN standard in the catalogue and in the operating instructions.

1.1 Marking of components for TV cable networks

With the CE marking Triax confirms the compliance of its products with the applicable EU directives (currently EMC and low voltage directives) as well as with the standards EN 50083-1, EN 50083-2 and EN 60065. For receivers the standards EN 55013, EN 55020 and EN 61000 are applied. The CE marking is placed on the product, on the packaging and/or included in the operating instructions.

To prevent interference between TV cable networks and radio services, it is necessary to use components with sufficient shielding. Due to the varying conditions in European countries, the shielding rate was defined in the European standard EN 50083-2 in two stages, the high quality class A and class B with reduced shielding rate values.

For compliance with the legal EMC requirements for TV cable networks, we expressly recommend the use of class A components, including connecting cables so marked for terminal equipment.



Protection class 2 according to IEC 60417-5172 for components with power connection 230 V ~.

2. Technical data in the catalogue

2.1. Characteristic impedance

Unless otherwise expressly mentioned, all technical data in the catalogue refer to a 75Ω impedance for RF connections.

2.2. Operating temperature

All passive units in the catalogue can be used within an operating temperature range of -20 °C to $+60\text{ °C}$.

The mains-operated units meet the requirements of the EN 60065 standard within the temperature range from -20 °C to $+50\text{ °C}$.

Operability of these units is nevertheless also maintained fully in the temperature range from -20 °C to $+60\text{ °C}$.

Individual units that deviate with regard to the above operating temperature range are specifically mentioned.

2.3. Mains voltage

All mains-operated units in the catalogue already meet the requirements of the IEC 60038 standard, with a rated voltage of $230\text{ V} \sim +6\% / -10\%$.

2.4. Wind load

For antenna locations, safety regulations according to EN 50083-1 differentiate between two heights above ground (up to 20 m and above 20 m).

They specify different dynamic pressure values for each height. $q = 800\text{ N/m}^2$ and $q = 1100\text{ N/m}^2$ respectively.

The wind load values (horizontal and vertical) specified in this catalogue were determined using a dynamic pressure of $q = 800\text{ N/m}^2$. If a value for $q = 1100\text{ N/m}^2$ is needed, the value in the catalogue has to be multiplied by 1.37.

2.5. Permissible output level for active electronic equipment

Specification of the permissible output level is made according to EN 50083-3 "Active broadband equipment for coaxial cable networks" for a signal-to-noise ratio of:

- IMD = 60 dB for amplifiers for AM, QAM and FM signals (in SMATV/MATV, broadband cable, CATV installations)
- IMD = 35 dB for amplifiers for FM signals only (satellite IF transmission)

Now that this measurement method is standard throughout Europe, this important parameter has become transparent and comparable. With the aid of this information, the network planner and installer are able to determine the optimum amplifier gain (refer also to the planning instructions) to maintain the required minimum signal-to-noise ratios for a given number of channels.

This procedure provides considerable advantages wherever new networks with a minimum number of amplifiers (cost advantage) are planned or where overriding regulations apply to certain parts of the network.

For example the permissible output level for a house connection amplifier to a house connection point is explicitly specified at $\text{CTB/CSO} \geq 66\text{ dB}$.

This means that the required signal quality ($\text{CTB/CSO} \geq 57\text{ dB}$ according to EN 50083-7) can be maintained up to the subscriber's connection. Other permissible output levels are also given on the one hand for the CENELEC spacing (EN 50083-3) and on the other hand for full adjacent channel load of TV bands.

Maintaining the latter control limits allows for any channel load with analogue and digital TV signals (worst case: complete channel load with analogue and digital TV channels). Assigning only digital TV channels in the frequency range $< 606\text{ MHz}$ makes it possible to raise the output level of the house connection amplifier by up to 2 dB.

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3. Planning and installation instructions

3.1. Permissible output level for house connection amplifiers, multiple band amplifiers, and postamplifiers

It is always recommended to carry out these calculations on a Windows PC using:

- AND by CDS Germany (www.cdsgmbh.de)
- CACAO by PTE-software (www.ptesoftware.dk)

The following explanations can be an additional help for solving problems and for understanding the underlying relationships.

The permissible output level is dependent on:

- The required signal-to-noise ratio CTB, CSO
- The number of TV channels to be transmitted
- The frequency distribution of the channels

The signals of the FM radio band can be treated as a single TV channel if their levels are 6-8 dB below the level of the TV channels. The first selection criterion is the number of TV channels to be transmitted.

3.1.1 Maximum number of TV channels: 10 (MATV systems)

- Determine the permissible output level from the technical data: for IMD2 (60dB 2nd order intermodulation products according to EN 50083-5), for IMR3 (60dB 3rd order intermodulation products according to EN 50083-5)
- Reduce the IMR3 value according to the number of channels

The smaller of the two output levels (with respect to IMD2, IMR3) is the permissible output level (dB(μV)) for a signal-to-interference ratio of IMD=60 dB.

Number of channel loads	Correction to the catalog value in dB	
2	0	<i>Table1: Level reduction as a function of the number of channels loaded</i>
3	- 2	
4	- 3	
5	- 4	
6	- 5	
7	- 5.5	
8	- 6	
10	- 7	

3.1.2 More than 10 TV channels (broadband cable, MATV, CATV)

In order to obtain optimal gain from amplifiers with many channels loaded, it is necessary to use the permissible output levels specifically defined for each such case (for a CSO and CTB ratio of 60 dB) and a channel raster as close as possible to a defined one.

3.1.3 Approximate calculation for the permissible output level:

- a) Permissible output level dependent on required CSO and CTB values that are different from catalogue values:

CSO

Question: "How high is the permissible output level for a CSO value D a dB above the catalogue value (CSO = 60 dB)?"

n_{a1} = output level in dB(μV) for CSO = 60 dB (catalogue value)
 n_{a2} = output level in dB(μV) for CSO = (60 + D) dB

$$n_{a2} = n_{a1} - \Delta a$$

i. e. on an increase in the CSO requirement by Δ a dB, the permissible output level is reduced by Δ a dB.

CTB

Question: "How high is the permissible output level for a CTB value D a dB above the catalogue value (CTB = 60 dB)?"

n_{a3} = output level in dB(μV) for CTB = 60 dB (catalogue value)
 n_{a4} = output level in dB(μV) for CTB = (60 + Δ) dB

$$n_{a4} = n_{a3} - \Delta a/2$$

i. e. on an increase in the CTB requirement by Δ a dB, the permissible output level is reduced by Δ a/2 dB.

- b) Permissible output level for channel loads deviating from catalogue specifications

The individual Triax operating instructions list the maximum permissible output level for a signal-to-interference ratio of 60 dB for three different channel spacings:

- up to 450 MHz: 36 TV + 24 FM channels.
 - up to 606 MHz: 29 TV channels ("CENELEC raster")
 - up to 862 MHz: 42 TV channels ("CENELEC raster")
- Refer to "Channel spacing" table

These conditions are critical with respect to the development of non-linear distortion (CTB, CSO). For small deviations of the actual channel spacing from the standard ones, it is not necessary to reduce the output level shown in the operating instructions. For larger deviations, the following rules of thumb can help to obtain a rough approximation for the adjustment:

1. Select the catalogue values corresponding to the highest channel frequency.
2. For a channel pattern with twice the number of channels specified in the catalogue, reduce the output level by **about 3 dB**.

3. Planning and installation instructions

- continued from last page

If the frequency band contains only one half of the number of channels (with constant channel spacing), it is possible to raise the output level by 3 dB. If the configuration lies somewhere in between these extremes, it is possible to make a rough interpolation.

- c) Maximum output level for frequency pre-compensation (line equaliser)

A frequency pre-compensation value for example of 10 dB using a line equaliser permits driving the amplifier approximately 2 dB higher. This value can also be treated as output reserve. It should be noted, however, that the signal-to-interference ratio at low frequencies will deteriorate by the amount of compensation attenuation. For extreme cases, optimisation by a planning specialist is therefore required.

- d) Permissible output level when cascading amplifiers

For cascades, reduce the output level by 3 dB each time you double the number of cascaded amplifiers.

3.2. Radiated interference power and max. operating level

The radiated interference power of an antenna system according to EN 50083-2 may not exceed:

- 20 dB(pW) = 39 dB(μV) at 75W in the frequency range 30-950 MHz
- 43 dB(pW) = 62 dB(μV) at 75W in the frequency range 950-2500 MHz

Thus, in conjunction with the shielding rate specified for the equipment, the maximum operating level is as follows:
Maximum operating level =

- Shielding rate + 39 dB(μV)
(in the 30-950 MHz frequency range)
- Shielding rate + 62 dB(μV)
(in the 950-2500 MHz frequency range)

3.3. Shielding rate

The passive TRIAX components in this catalogue meet as a minimum the shielding rates required by EN 50083-2. class B:

- 5-470 MHz 75 dB min
- 470-950 MHz 65 dB min
- 950-3000 MHz 50 dB min

Class A components meet the increased requirements of EN 50083-2

- 5-300 MHz 85 dB min
- 300-470 MHz 80 dB min
- 470-950 MHz 75 dB min
- 950-3000 MHz 55 dB min



For active units, the class A marking also documents compliance with EN 50083-2.

3.4. Signal-to-noise ratio, noise factor

The signal-to-noise ratio is the ratio of the used signal power to the noise power expressed in decibels. The noise factor defines by how much the signal-to noise ratio at the output of an active unit (e. g. amplifier) is less than the signal-to-noise ratio at the input.

The thermal noise level on a 75 W resistor amounts
- for a bandwidth of 5 MHz (TV channel) and
- for a temperature of 293 K to approximately 2 dB(μV).

The signal-to-noise ratio of the received signal is the decisive factor for the video quality of a TV set (see below). The signal-to-noise ratio at the output of an individual amplifier (for ideal. i.e. noise-free input signal) can be determined as follows:

Operating level at the output

- gain
- noise factor
- noise level

Example:

An amplifier with the following output parameters:
94 dB(μV) operating level, 21 dB gain, and 7 dB noise factor.

The signal-to-noise ratio at the output of an individual amplifier would then be:

$$\begin{array}{rcl}
 94 & \text{dB}\mu\text{V} & \text{operating level} \\
 - 21 & \text{dB} & \text{set gain} \\
 - 7 & \text{dB} & \text{noise figure} \\
 \hline
 = 64 & \text{dB}\mu\text{V} & \text{noise level} \\
 = 64 & \text{dB} & \text{s/n out}
 \end{array}$$

3.5. Signal-to-noise ratio / noise / picture quality

Signal-to-noise ratio	Noise	Picture quality
> 46 dB	invisible	very good
37 dB	visible, but not interfering	good
30 dB	clearly visible, interfering	unsatisfactory
< 26 dB	dominant compared to required signal	unusable

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4. Earthing and equipotential bonding cables

EN 50083-1 specifies the following earthing and equipotential bonding cables for antenna systems:

Earthing cables:

Material	Cross-section	Ø	Condition	Example
Copper	> 16 mm ²	> 4.6 mm	bare or insulated	Koka
Aluminium	> 25 mm ²	> 5.7 mm	bare (indoors only) or insulated	
Aluminium	> 50 mm ²	> 8.0 mm	(wrought) alloy	
Steel wire	-	8.0 mm	galvanised	-
Steel strip	2.5 x 20 mm	-	galvanised	-

Cable types: single conductor or multi-conductor, but no fine wires

Equipotential bonding cables:

Material	Cross-section	Ø	Condition	Example
Copper	4 mm ²	2.3 mm	bare or insulated	Koka

Frequency ranges of radio waves

Frequency range	Int. abb.	Abb.	Modulation Picture/ sound	Channel width	Channels	Frequency	Wave- length	Polarisation
Long wave	LF	L	AM	9 kHz	2-4	150 - 285 kHz	2000 - 1050 m	V
Medium wave	MF	M	AM	9 kHz		510 - 1605 kHz	590 - 187 m	V
Short wave	HF	K	AM	9 kHz		3.95 - 26.1 MHz	76 - 11.5 m	V
Band I	VHF	F I	AM FM	7 MHz	2-4	47 - 68 MHz	6.35 - 4.4 m	H/V
Band II (radio)	VHF	UKW	FM	300 kHz	2-70	87.5 - 108 MHz	3.4 - 2.8 m	H
S-channels	VHF	USB	AM FM	7 MHz	S2 - S10	111 - 174 MHz	2.7 - 1.7 m	- ¹⁾
Band III	VHF	F III	AM FM	7 MHz	5-12	174 - 230 MHz	1.7 - 1.3 m	H/V
S-channels	VHF	OSB	AM FM	7 MHz	S11 - S20	230 - 300 MHz	1.3 - 1.0 m	- ¹⁾
S-channels	UHF	ESB	AM FM	8 MHz	S21 - S38	302 - 446 MHz	99 - 68 cm	- ¹⁾
Band IV	UHF	F IV	AM FM	8 MHz	21-39	470 - 622 MHz	64 - 68 cm	H/V
Band V	UHF	F V	AM FM	8 MHz	40-60	622 - 790 MHz	48 - 38 cm	H/V

-1) in wideband installation

5. TV standards

Standard	No. of lines	Channel width (MHz)	Video bandwidth (MHz)	Video/audio separation (MHz)	Vestigial sideband (MHz)	Video modulation	Audio modulation
B (CCIR)	625	7	5	+ 5.5 (+5.742)	0.75	negative	FM, FM ¹⁾
D (OIRT)	625	8	6	+ 6.5	0.75	negative	FM
G (CCIR)	625	8	5	+ 5.5 (+5.742)	0.75	negative	FM, FM ¹⁾
H (B)	625	8	5	+ 5.5	1.25	negative	FM
I (GB)	625	8	5.5	+ 6.0	1.25	negative	FM
K (OIRT)	625	8	6	+ 6.5	0.75	negative	FM
K1 (CCIR)	625	8	6	+ 6.5	1.25	negative	FM
L (F)	625	8	6	+ 6.5	1.25	positive	AM
M (FCC)	525	6	4.2	+ 4.5	0.75	negative	FM
N (South America)	625	6	4.2	+ 4.5	0.75	negative	FM

¹⁾ Second audio carrier for dual or stereo operation

6. Frequency ranges and channel allocation

Unit	Channel number	Frequency range MHz	Channel centre MHz	Picture carrier MHz	1st sound
Return/data communication		4 - 30			
Return/data communication		5 - 65			
Return-TV	R 1	14.75-21.75			
	R 2	21.75-28.75			
Band I	2	47 - 54	50.50	48.25	53.75
	3	54 - 61	57.50	55.25	60.75
	4	61 - 68	64.50	62.25	67.75
Data channel		70 - 75			
Band II / FM	2 - 70	87.5 - 108			
Digital-sound	S 2	111 - 118			
1st channel	S 3	118 - 125			
Lower	S 4	125 - 132	128.50	126.25	131.75
S-channels	S 5	132 - 139	135.50	133.25	138.75
	S 6	139 - 146	142.50	140.25	145.75
USB	S 7	146 - 153	149.50	147.25	152.75
	S 8	153 - 160	156.50	154.25	159.75
	S 9	160 - 167	163.50	161.25	166.75
	S 10	167 - 174	170.50	168.25	173.75
Band III	5	174 - 181	177.50	175.25	180.75
TV/DAB	6	181 - 188	184.50	182.25	187.75
	7	188 - 195	191.50	189.25	194.75
	8	195 - 202	198.50	196.25	201.75
	9	202 - 209	205.50	203.25	208.75
	10	209 - 216	212.50	210.25	213.75
	11	216 - 223	219.50	217.25	222.75
	12	223 - 230	226.50	224.25	229.75
Upper	S 11	230 - 237	233.50	231.25	236.75
S-channels	S 12	237 - 244	240.50	238.25	243.75
	S 13	244 - 251	247.50	245.25	250.75
	S 14	251 - 258	254.50	252.25	257.75
	S 15	258 - 265	261.50	259.25	264.75
	S 16	265 - 272	268.50	266.25	271.75
	S 17	272 - 279	275.50	273.25	278.75
	S 18	279 - 286	282.50		
	S 19	286 - 293	289.50	287.25	
	S 20	293 - 300	296.50	294.25	299.75
S-channels	S 21	302 - 310	306.00	303.25	308.75
	S 22	310 - 318	314.00	311.25	316.75
	S 23	318 - 326	322.00	319.25	324.75
	S 24	326 - 334	330.00	327.25	332.75
	S 25	334 - 342	338.00	335.25	340.75
	S 26	342 - 350	346.00	343.25	348.75
	S 27	350 - 358	354.00	351.25	356.75
	S 28	358 - 366	362.00	359.25	364.75
	S 29	366 - 374	370.00	367.25	372.75
	S 30	374 - 382	378.00	375.25	380.75
	S 31	382 - 390	386.00	383.25	388.75
	S 32	390 - 398	394.00	391.25	396.75
	S 33	398 - 406	402.00	399.25	404.75
	S 34	406 - 414	410.00	407.25	412.75
	S 35	414 - 422	418.00	415.25	420.75
	S 36	422 - 430	426.00	423.25	428.75
	S 37	430 - 438	434.00	431.25	436.75
	S 38	438 - 446	442.00	439.25	444.75

Unit	Channel number	Frequency range MHz	Channel centre MHz	Picture carrier MHz	1st sound
Band IV	21	470 - 478	474.00	471.25	476.75
	22	478 - 486	482.00	476.25	484.75
	23	486 - 494	490.00	487.25	492.75
	24	494 - 502	498.00	495.25	500.75
	25	502 - 510	506.00	503.25	508.75
	26	510 - 518	514.00	511.25	516.75
	27	518 - 526	522.00	519.25	524.75
	28	526 - 534	530.00	527.25	532.75
	29	534 - 542	538.00	535.25	540.75
	30	542 - 550	546.00	543.25	548.75
	31	550 - 558	554.00	551.25	556.75
	32	558 - 566	562.00	559.25	564.75
	33	566 - 574	570.00	567.25	572.75
	34	574 - 582	578.00	575.25	580.75
	35	582 - 590	586.00	583.25	588.75
	36	590 - 598	594.00	591.25	596.75
	37	598 - 606	602.00	599.25	604.75
	38	606 - 614	610.00	607.25	612.75
	39	614 - 622	618.00	615.25	618.75
Band V	40	622 - 630	626.00	623.25	626.75
	41	630 - 638	634.00	631.25	636.75
	42	638 - 646	642.00	639.25	644.75
	43	646 - 654	650.00	647.25	652.75
	44	654 - 662	658.00	655.25	660.75
	45	662 - 670	666.00	663.25	668.75
	46	670 - 678	674.00	671.25	676.75
	47	678 - 686	682.00	679.25	684.75
	48	686 - 694	690.00	687.25	692.75
	49	694 - 702	698.00	695.25	700.25
ECN/LTE 700	50	702 - 710	706.00	703.25	708.75
Band V	51	710 - 718	714.00	711.25	716.75
	52	718 - 726	722.00	719.25	724.75
	53	726 - 734	730.00	727.25	732.75
	54	734 - 742	738.00	735.25	740.75
	55	742 - 750	746.00	743.25	748.75
	56	750 - 758	754.00	751.25	756.75
	57	758 - 766	762.00	759.25	764.75
	58	766 - 774	770.00	767.25	772.75
	59	774 - 782	778.00	775.25	780.75
	60	782 - 790	786.00	783.25	788.75
ECN/LTE 800	61	790 - 798	794.00	791.25	796.75
Band V	62	798 - 806	802.00	799.25	804.75
	63	806 - 814	810.00	807.25	812.75
	64	814 - 822	818.00	815.25	820.75
	65	822 - 830	826.00	823.25	828.75
	66	830 - 838	834.00	831.25	836.75
	67	838 - 846	842.00	839.25	844.75
	68	846 - 854	850.00	847.25	852.75
	69	854 - 862	858.00	855.25	860.75

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6. Channels and frequencies

Channel	Channel limits (MHz)	Video carrier (MHz)	Audio carrier (MHz)
Standard B. Italy			
VHF I A	52.5-59.5	53.75	59.25
B	61-68	62.25	67.75
VHF II C	81-88	82.25	87.75
VHF III D	174-181	175.25	180.75
E	182.5- 189.5	183.75	189.25
F	191-198	192.25	197.75
G	200-207	201.25	206.75
H	209-216	210.25	215.75
H 1	216-223	217.25	222.75
H 2	223-230	224.25	229.75
Standard D. OIRT			
VHF I R I	48.5-56.5	49.75	56.25
R II	58-66	59.25	65.75
R III	76-84	77.25	83.75
(VHF II) R IV	84-92	85.25	91.75
R V	92-100	93.25	99.75
s1	110-118	111.25	117.75
s2	118-126	119.23	125.75
s3	126-134	127.25	133.75
s4	134-142	135.25	141.75
s5	142-150	143.25	149.75
s6	150-158	151.25	157.75
s7	158-166	159.25	165.75
s8	166-174	167.25	173.75
(VHF III) R VI	174-182	175.25	181.75
R VII	182-190	183.25	189.75
R VIII	190-198	191.25	197.75
R IX	198-206	199.25	205.75
R X	206-214	207.25	213.75
R XI	214-222	215.25	221.75
R XII	222-230	223.25	229.75
s9	230-238	231.25	237.75
s10	238-246	239.25	245.75
s11	246-254	247.25	253.75
s12	254-262	255.25	261.75
s13	262-270	263.25	269.75
s14	270-278	271.25	277.75
s15	278-286	279.25	285.75
s16	286-294	287.25	293.75
s17	294-302	295.25	301.75
s18	302-310	303.25	309.75
s19	310-318	311.25	317.75
s20	318-326	319.25	325.75
s21	326-334	327.25	333.75
s22	334-342	335.25	341.75
s23	342-350	343.25	349.75
..
s38	462-470	463.25	469.75

Spec. channel

Spec. channel

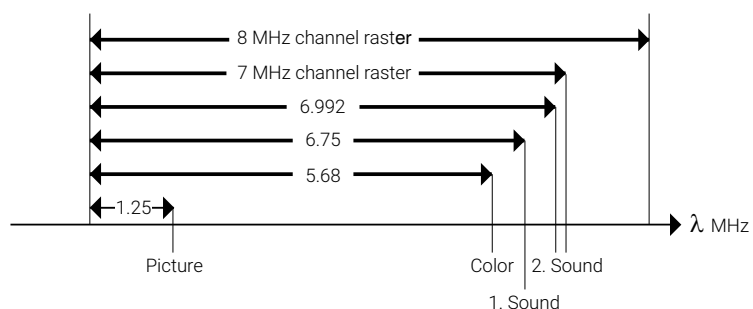
Channel	Channel limits (MHz)	Video carrier (MHz)	Audio carrier (MHz)
Standard D. China			
VHF I 1	48.5-56.5	49.75	56.25
2	56.5-64.5	57.75	64.25
3	64.5-72.5	65.75	72.25
4	76.0-84.0	77.25	83.75
5	84.0-92.0	85.25	91.75
VHF III 6	167-175	168.25	174.75
7	175-183	176.25	182.75
8	183-191	184.25	190.75
9	191-199	192.25	198.75
10	199-207	200.25	206.75
11	207-215	208.25	214.75
12	215-223	216.25	222.75
Standard I. Ireland			
VHF I IA	44.5-52.5	45.75	51.75
IB	52.5-60.5	53.75	59.75
IC	60.5-68.5	61.75	67.75
VHF III ID	174-182	175.25	181.25
IE	182-190	183.25	189.25
IF	190-198	191.25	197.25
IG	198-206	199.25	205.25
IH	206-214	207.25	213.25
IJ	214-222	215.25	221.25
Standard L. France			
VHF I A	41.00-49.00	47.75	41.25
B	49.00-57.00	55.75	49.25
C	57.00-65.00	63.75	57.25
C 1	53.75-61.75	60.50	54.00
VHF III 5	174.75-182.75	176.00	182.50
6	182.75-190.75	184.00	190.50
7	190.75-198.75	192.00	198.50
8	198.75-206.75	200.00	206.50
9	206.75-214.75	208.00	214.50
10	214.75-222.75	216.00	222.50
Standard K1. (France)			
VHF III 4	174-182	175.25	181.75
5	182-190	183.25	189.75
6	190-198	191.25	197.75
7	198-206	199.25	205.75
8	206-214	207.25	213.75
9	214-222	215.25	221.75

7. Carrier frequencies for radio and TV channels

Frequencies of a TV-signal
(Norm B. G/Pal)

7 MHz raster:
FI. USB. F III. OSB

8 MHz raster:
ESB. F IV. F V



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8. Analogue colour and broadcasting systems by country

Country	TV	Colour system	Stereo	Subtitles
Albania	B/G	PAL		
Argentina	N	PAL-N		
Australia	B/G	PAL	FM-FM	Teletext
Austria	B/G	PAL	FM-FM	Teletext
Azores (Portugal)	B	PAL		
Bahamas	M	NTSC		
Bahrain	B	PAL		
Barbados	M	NTSC		
Belgium	B/G	PAL	Nicam	Teletext
Bermuda	M	NTSC		
Brazil	M	PAL-M	MTS	
Bulgaria	D	SECAM		
Canada	M	NTSC	MTS	CC
Canary Is	B	PAL		
China	D	PAL		
Colombia	M	NTSC		
Cyprus	B	PAL		
Czechoslovakia	D/K	SECAM/PAL		
Denmark	B	PAL	Nicam	Teletext
Egypt	B	SECAM		
Faroe Islands (DK)	B	PAL		
Finland	B/G	PAL	Nicam	Teletext
France	E/L	SECAM		Teletext
Gambia	I	PAL		
Germany	B/G	PAL	FM-FM	Teletext
Germany (old East)	B/G	SECAM/PAL		
Gibraltar	B	PAL		
Greece	B/G	PAL		
Hong Kong	I	PAL	Nicam	
Hungary	B/G & D/K	PAL	Nicam (Budapest)	
Iceland	B	PAL		
India	B	PAL		
Indonesia	B	PAL		
Iran	H	SECAM		
Ireland	I	PAL	Nicam	Teletext
Israel	B/G	PAL	Nicam	Teletext
Italy	B/G	PAL	FM/FM	Teletext
Jamaica	N	SECAM		
Japan	M	NTSC	Matrix	
Jordan	B	PAL		
Kenya	B	PAL		
Korea	M	NTSC		
Luxembourg	B/G	PAL	NICAM	Teletext
Madeira	B	PAL		
Madagascar	B	SECAM		
Malaysia	B	PAL		
Malta	B/G	PAL		
Mauritius	B	SECAM		
Mexico	M	NTSC	MTS	CC
Monaco	L/G	SECAM/PAL		
Morocco	B	SECAM		

Country	TV	Colour system	Stereo	Subtitles
Netherlands	B/G	PAL	FM-FM	Teletext
New Zealand	B/G	PAL	Nicam	Teletext
North Korea	D/K	SECAM		
Norway	B/G	PAL	Nicam	
Pakistan	B	PAL		
Paraguay	N	PAL		
Peru	M	NTSC		
Philippines	M	NTSC		
Poland	D/K	PAL		Teletext
Portugal	B/G	PAL	Nicam	Teletext
Romania	G	PAL		
Russia	D/K	SECAM		
Saudi Arabia	B	SECAM		
Seychelles	I	PAL		
Singapore	B	PAL		
South Africa	I	PAL		
South Korea	M	NTSC		
Spain	B/G	PAL	Nicam	Teletext
Sri Lanka	B/G	PAL		
Sweden	B/G	PAL	Nicam	Teletext
Switzerland	B/G	PAL	FM-FM	Teletext
Tahiti	KI	SECAM		
Taiwan	M	NTSC		
Thailand	B	PAL		
Trinidad	M	NTSC		
Tunisia	B	SECAM		
Turkey	B	PAL	-	Teletext
United Arab Emirates	B/G	PAL		
United Kingdom	I	PAL	Nicam	Teletext
Uruguay	N	PAL	MTS	
USA	M	NTSC	MTS	CC
Venezuela	M	NTSC		
Yugoslavia	B/H	PAL		
Zimbabwe	B	PAL		

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9. Signal level - mV to dB μ V

Signal level - mV to dB μ V				Voltage ratio in dB			
mV v/75 W dB μ V		mV v/75 W dB μ V		*) Factor -dB		*) Factor +dB	
0.100	40	20.0	86	1.0	0.0	1.0	
0.112	41	22.5	87	0.95	0.5	1.06	
0.125	42	25.0	88	0.89	1.0	1.12	
0.140	43	28.0	89	0.84	1.5	1.19	
0.160	44	31.5	90	0.8	2.0	1.25	
0.180	45	35.5	91	0.75	2.5	1.33	
0.200	46	40.0	92	0.71	3.0	1.41	
0.225	47	45.0	93	0.67	3.5	1.5	
0.250	48	50.0	94	0.63	4.0	1.6	
0.280	49	56.0	95	0.60	4.5	1.67	
0.315	50	63.0	96	0.56	5.0	1.78	
0.355	51	70.0	97	0.53	5.5	1.88	
0.400	52	80.0	98	0.50	6.0	2.0	
0.450	53	90.0	99	0.47	6.5	2.12	
0.500	54	100	100	0.45	7.0	2.24	
0.560	55	112	101	0.42	7.5	2.37	
0.630	56	125	102	0.4	8.0	2.5	
0.700	57	140	103	0.38	8.5	2.66	
0.800	58	160	104	0.35	9.0	2.82	
0.900	59	180	105	0.33	9.5	3.00	
1.00	60	200	106	0.32	10	3.16	
1.12	61	225	107	0.28	11	3.55	
1.25	62	250	108	0.25	12	4.00	
1.40	63	280	109	0.22	13	4.5	
1.60	64	315	110	0.2	14	5.00	
1.80	65	355	111	0.18	15	5.62	
2.00	66	400	112	0.16	16	6.3	
2.25	67	450	113	0.14	17	7.1	
2.50	68	500	114	0.125	18	8.0	
2.80	69	560	115	0.11	19	8.9	
3.15	70	630	116	0.10	20	10.0	
3.55	71	700	117	0.089	21	10.0	
4.00	72	800	118	0.08	22	12.5	
4.50	73	900	119	0.071	23	14.1	
5.00	74	1000	120	0.063	24	16.0	
5.60	75	1120	121	0.056	25	17.8	
6.30	76	1250	122	0.050	26	20.0	
7.00	77	1400	123	0.045	27	22.4	
8.00	78	1600	124	0.04	28	25.0	
9.00	79	1800	125	0.035	29	28.2	
10.0	80	2000	126	0.032	30	31.6	
11.2	81	2250	127	0.028	31	35.5	
12.5	82	2500	128	0.025	32	40	
14.0	83	2800	129	0.022	33	45	
16.0	84			0.020	34	50	
18.0	85			0.018	35	56	
				0.016	36	63	
				0.014	37	71	
				0.0125	38	80	
				0.011	39	89	
				0.01	40	100	
				0.0056	45	178	
				0.0032	50	316	
				0.0018	55	562	
				0.001	60	1000	

*) The numbers are dB value calculated to times.

Signal level is often stated in dB μ V which is to be understood as the number of dB the signal exceeds 1 μ V.

10. Power level dBm to mV to dBm

dBm		mW		dBm		mW	
-20	0,01	-20,00	0,01	-20,00	0,01	-20,00	0,01
-19	0,01	-16,99	0,02	-16,99	0,02	-16,99	0,02
-18	0,02	-15,23	0,03	-15,23	0,03	-15,23	0,03
-17	0,02	-13,98	0,04	-13,98	0,04	-13,98	0,04
-16	0,03	-12,30	0,05	-12,30	0,05	-12,30	0,05
-15	0,03	-12,22	0,06	-12,22	0,06	-12,22	0,06
-14	0,04	-11,55	0,07	-11,55	0,07	-11,55	0,07
-13	0,05	-10,97	0,08	-10,97	0,08	-10,97	0,08
-12	0,06	-10,46	0,09	-10,46	0,09	-10,46	0,09
-11	0,08	-10,00	0,1	-10,00	0,1	-10,00	0,1
-10	0,10	-6,99	0,2	-6,99	0,2	-6,99	0,2
-9	0,13	-5,23	0,3	-5,23	0,3	-5,23	0,3
-8	0,16	-3,98	0,4	-3,98	0,4	-3,98	0,4
-7	0,20	-3,01	0,5	-3,01	0,5	-3,01	0,5
-6	0,25	-2,22	0,6	-2,22	0,6	-2,22	0,6
-5	0,32	-1,55	0,7	-1,55	0,7	-1,55	0,7
-4	0,40	-0,97	0,8	-0,97	0,8	-0,97	0,8
-3	0,50	-0,46	0,9	-0,46	0,9	-0,46	0,9
-2	0,63	-0,00	1	-0,00	1	-0,00	1
-1	0,79	3,01	2	3,01	2	3,01	2
0	1,00	4,77	3	4,77	3	4,77	3
1	1,26	6,02	4	6,02	4	6,02	4
2	1,58	6,99	5	6,99	5	6,99	5
3	2,00	7,78	6	7,78	6	7,78	6
4	2,51	8,45	7	8,45	7	8,45	7
5	3,16	9,03	8	9,03	8	9,03	8
6	3,98	9,54	9	9,54	9	9,54	9
7	5,01	10,00	10	10,00	10	10,00	10
8	6,31	10,41	11	10,41	11	10,41	11
9	7,94	10,79	12	10,79	12	10,79	12
10	10,00	11,14	13	11,14	13	11,14	13
11	12,59	11,46	14	11,46	14	11,46	14
12	15,85	11,76	15	11,76	15	11,76	15
13	19,95	12,04	16	12,04	16	12,04	16
14	25,12	12,30	17	12,30	17	12,30	17
15	31,62	12,55	18	12,55	18	12,55	18
16	39,81	12,79	19	12,79	19	12,79	19
17	50,12	13,01	20	13,01	20	13,01	20
18	63,10	13,22	21	13,22	21	13,22	21
19	79,43	13,42	22	13,42	22	13,42	22
20	100,00	13,62	23	13,62	23	13,62	23
21	125,89	13,80	24	13,80	24	13,80	24
22	158,49	13,98	25	13,98	25	13,98	25
23	199,53	14,15	26	14,15	26	14,15	26
24	251,19	14,31	27	14,31	27	14,31	27
25	316,23	14,47	28	14,47	28	14,47	28
26	398,11	14,62	29	14,62	29	14,62	29
27	501,19	14,77	30	14,77	30	14,77	30



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