

KS

KOREAN INDUSTRIAL STANDARD

Measurement methods of receiving antenna for
VHF television broadcast transmissions

KS C 6810 : 1976

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(Confirmed: In 1992)

Measurement methods of receiving antenna for VHF television broadcast transmissions

1. Scope

This standard sets out testing methods for comparing and evaluating electrical characteristics of receiving antenna for television using frequency range 54MHz up to 216MHz (*abbreviated as receiving antenna in what follows*).

2. Definition of terms

The definitions or terms used in this standard are as follows.

(1) effective gain and operated gain

(a) effective gain The ratio of the effective reception power in a specified direction of the receiving antenna in uniform electrical field and the effective reception power of half wavelength dipole under the same conditions.

(b) operated gain Effective gain less loss due to mismatching of the input impedance of the receiving antenna and the characteristic impedance of the feeder.

(2) directivity The ratio of the antenna output voltage and maximum output voltage on a specified plane.

(3) front-to-back ratio The ratio of output voltage of the receiving antenna in a specified direction (referred to as angle 0°) and maximum output in the direction with the angle $180^\circ \pm 60^\circ$ on a specified plane.

(4) half-amplitude A way of showing directivity of the receiving antenna, which means the angle giving $\frac{1}{\sqrt{2}}$ or more of the maximum output voltage

(5) voltage standing-wave ratio (VSWR) The ratio of the maximum/minimum voltage of the reflected wave, which results from a mismatch between input impedance of the antenna and characteristic impedance of feeder, and that of the standing wave, which is produced by the travelling wave on the feeder, when the receiving antenna is connected to power source with lossless wire.

(6) input impedance The impedance of the receiving antenna seen from the access terminal of the feeder.

3. General rules on testing

3.1 Measurement location

The measurement location shall be chosen with little reflection from surrounding objects. Since the earth surface acts as a reflecting surface, reflected wave should be avoided as far as possible.

3.2 Measuring frequency

Measuring frequency should comply with **Tables 1 and 2** within frequency band of the testing antenna.

Table 1 - Channel only antennas

measurement items	measuring frequency
directivity	1.5MHz below the center frequency of the channel
operated gain	Frequencies at both ends and 1.5MHz intervals in the channel
VSWR	Frequencies at both ends and 1.5MHz intervals in the channel
front-to-back ratio	Frequencies at both ends and 1.5MHz intervals in the channel
input impedance	Frequencies at both ends and 1.5MHz intervals in the channel

Table 2 - Broad-band antennas

Measurement items	measuring frequency
directivity	1.5MHz lower than central frequency of the channel
operated gain	Frequencies at center and both ends of the channel
VSWR	Frequencies at center and both ends of the channel
front-to-back ratio	Frequencies at center and both ends of the channel
input impedance	Frequencies at center and both ends of the channel

3.3 Measuring facilities

An example of measuring facilities using slot line is shown in **Figure 1**.

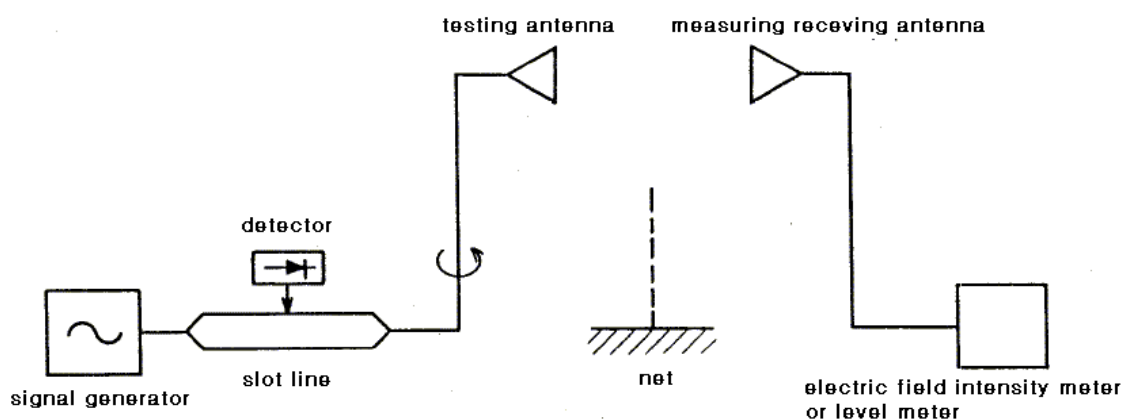


Figure 1 - An example of measurement facilities

3.4 Reference antennas for measurement

For reference antenna for measurement a folded antenna and a balun with input impedance 300

2. The structure of folded antennas is shown in **Figure 2**. The dimensions are chosen according to the frequency of each channel and the dimensions of U-type balun are chosen according to the center frequency and the frequencies at both ends. The structure of a U-type balun is shown in **Figure 3**.

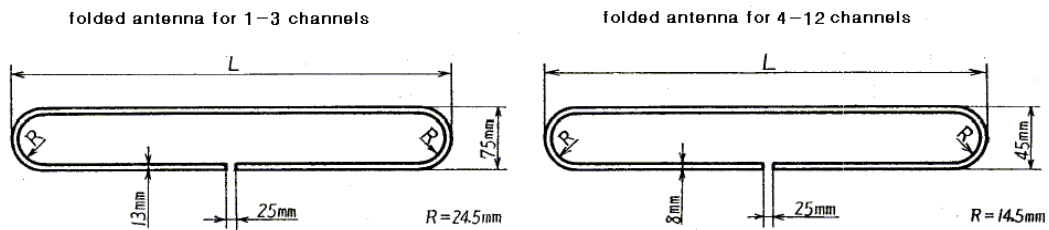
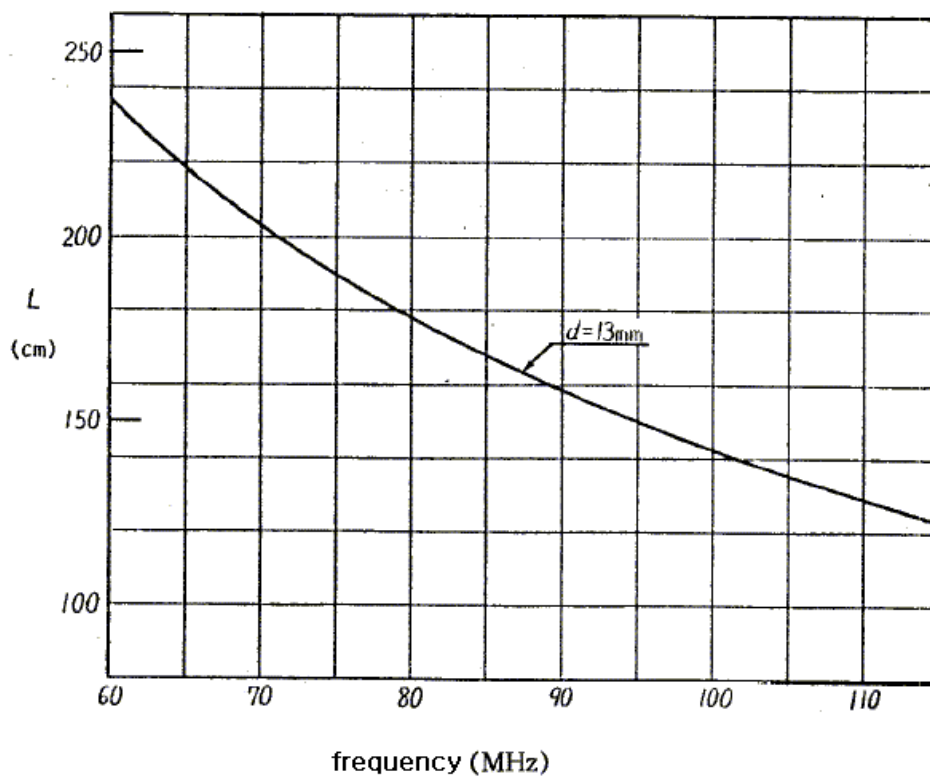
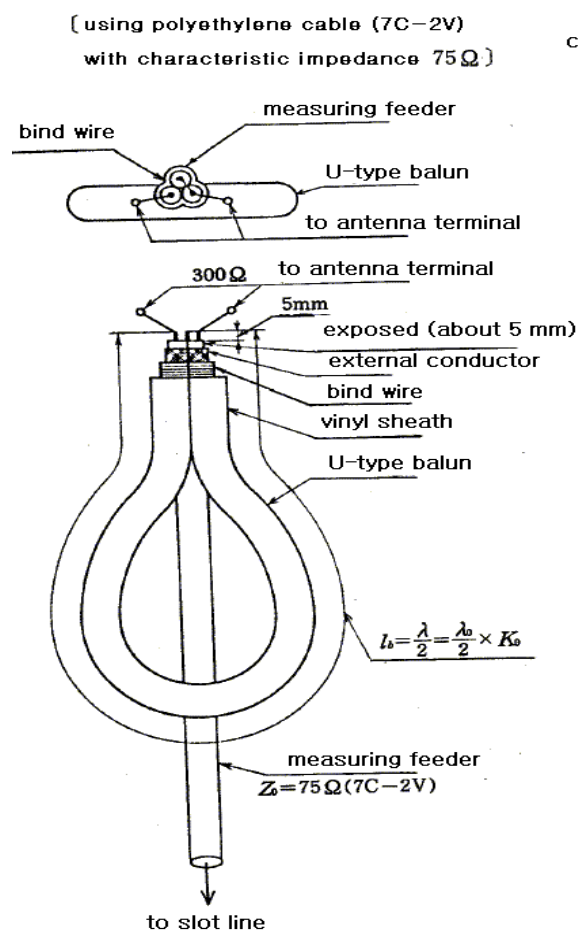
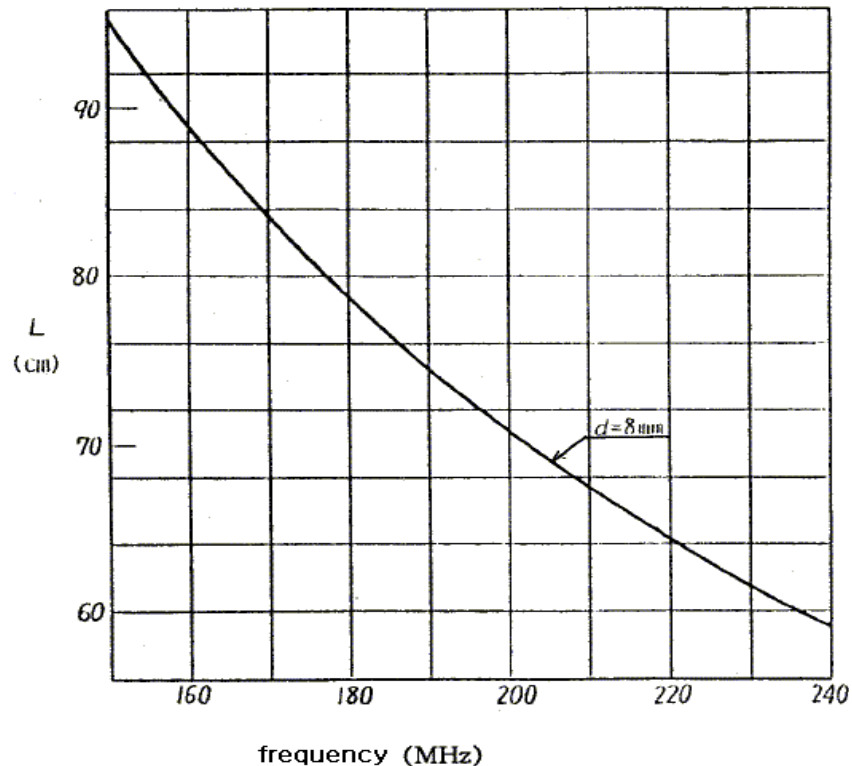


Figure 2

channel	center freq. MHz	length L cm	remarks
2	57	249	low band
3	63	225	
4	69	206	
5	79	180	
6	85	167	
7	177	80.0	high band
8	183	77.7	
9	189	75.2	
10	195	72.5	
11	201	70.5	
12	207	68.4	
13	213	66.2	





channel	measuring freq. MHz	length of U-type balun L_b (case $K_0 = 0.67$) cm
2	54	186.1
	57	176.3
	60	167.5
3	60	167.5
	63	159.5
	66	152.2
4	66	152.2
	69	145.6
	72	139.5
5	76 79 82	132.2 172.2 122.5
6	82 85 88	122.5 118.2 114.2
7	174 177 180	57.7 56.7 55.8
8	180 183 186	55.8 54.9 54.0
9	186 189 192	54.0 53.1 52.3
10	192 195 198	52.3 51.5 50.7
11	198 201 204	50.7 50.0 49.2
12	204 207 210	49.2 48.6 47.8
13	210 213 216	47.8 47.2 46.5

λ_0 : freespace wavelength

λ : wavelength in cable

K_0 : wavelength reduction rate

L_b : length of U-type balun

Figure 3 - Structure of U-type balun

3.5 Slot line and etc.

It is required that the length of the slot line used for the measurement be at least $\frac{3}{4}$ of the wavelength and the VSWR of the measuring system including slot line should be at most 1.2 in case output terminal of the balun is connected to a pure resistance of 300 Ω . The detecting probe for measuring voltage distribution shown on slot line should have as high impedance as possible to avoid disturbance by electrical field, and the detector should be calibrated beforehand. The frequency accuracy of the power source should be better than $\pm 0.5\%$ and the output fluctuation should be small. Since balun used for measurement is recommended to be 1:4 impedance-transformed, the characteristic impedance of the slot line and coaxial feeder connected to it shall be $\frac{1}{4}$ of standard impedance (usually 300 Ω).

3.6 Installation of testing antennas and measuring receiving antennas

Install testing antennas and receiving antennas as follows:

- (1) **ground height** Testing antenna should be at least 4 m high and should be horizontally installed. The ground height is meant to be the height of the lower end of the antenna measured from the earth surface or the ground level. The measuring receiving antenna should be installed in such a way that the center height coincides with that of the testing antenna.
- (2) **distance between the testing antenna and the measuring receiving antenna** The distance D between feeder terminals of the testing antenna and measuring receiving antenna shall satisfy:

$$D \geq \frac{2(W_1^2 + W_2^2)}{\lambda_0},$$

However, D should be at least the double of the wavelength.

Here, W_1 : maximum dimension of the testing antenna [m];

W_2 : maximum dimension of the measuring receiving antenna [m];

λ_0 : wavelength for the measuring frequency [m].

- (3) **ground reflected wave** The fluctuation of the gain measurement of the measuring receiving antenna according to height pattern shall be less than 1 dB.

3.7 Methods of eliminating ground reflected wave

The following methods are used to eliminate effect of ground reflection:

- (1) As shown in **Figure 4**, on two parallel buildings which do not pass wave, transmitting antenna and receiving antenna are installed in such a way that the reflected wave refracts twice. In this case, measuring receiving antenna should have half-amplitude less than or equal to 70% of directivity.

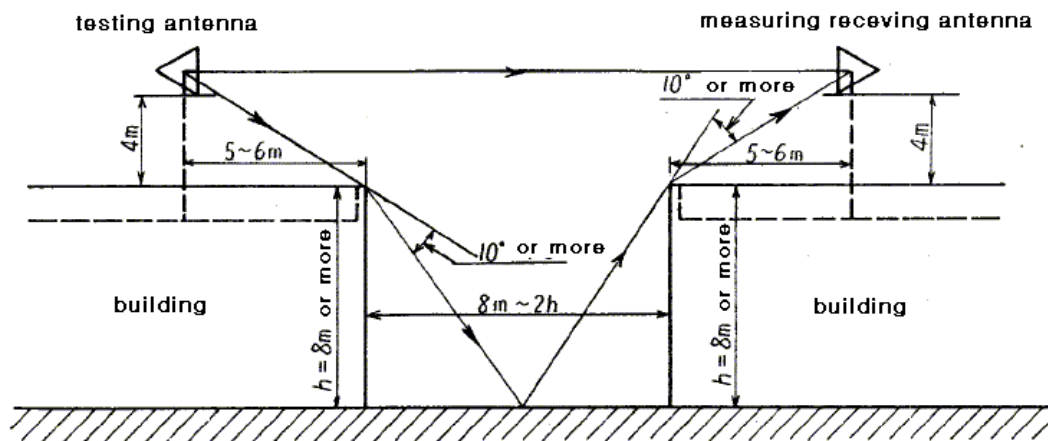


Figure 4

(2) In case the above method cannot be used, the following method may be also used.

- (a) As shown in **Figure 5**, install the antennas and by moving the receiving antenna up and down measure the maximum and minimum of the output voltage (not in dB), then at 4 m distance measure the maximum and minimum. The arithmetic mean is evaluated to be the free space output voltage.

In addition, the measuring antenna with 2-3 elements shall be used.

The topography of the earth surface shall be sufficiently small compared with wavelength.

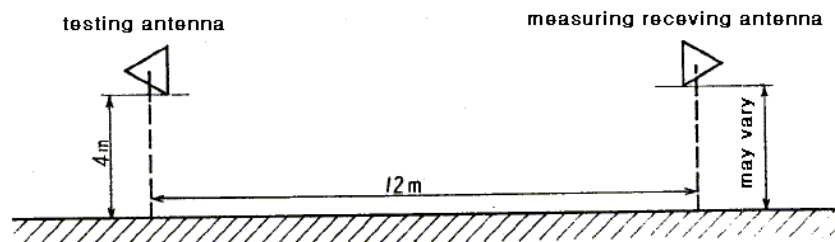


Figure 5

- (b) A method¹⁾ usually used for measuring high band receiving is as in **Figure 6**. However, for low band case also, this method can be used in case the gain is 5 dB or less. The width of the net shall be 6 m or more, a side of a mesh shall be 25 mm or less and dry earth shall be avoided. In addition, the receiving antenna with 3 elements stack antenna or better shall be used.

Note 1) Does not apply to vertically polarized wave.