

JIS

JAPANESE INDUSTRIAL STANDARD

**Measuring Methods of
Receivers for
Television Broadcast Transmissions**

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

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JAPANESE INDUSTRIAL STANDARD

J I S

Measuring Methods of Receivers for Television
Broadcast Transmissions

C 6101-1988

1. Scope

This Japanese Industrial Standard specifies standard test methods for comparing and evaluating the performances of receivers for television broadcast transmissions and that of multiplex sound system (hereinafter referred to as "receivers"). The test items may be chosen as needed at the time of test.

2. Definitions

For the purpose of this Standard the following principal definitions apply:

- (1) values of voltage and current Various voltages and currents for testing purpose shall be expressed in r.m.s. values, unless otherwise specified. However, television signal voltages and currents shall be expressed by the r.m.s. value of video carrier, video signal voltages and currents shall be expressed in peak-to-peak values (the amplitude from positive peak value to negative peak value of a.c. voltage or current) V_{P-P} and I_{P-P} .
- (2) television signal A television signal is composed of a radio frequency negative amplitude modulated by video signal and a radio frequency frequency-modulated by an audio signal and complying with the specification of standard television system.

Remark: The standard television system means the standard transmission systems of television broadcast and of multiplex sound television broadcast.

- (3) picture carrier modulation factor The percentage of the difference between the amplitude of carrier at no modulation and the minimum amplitude of carrier modulated by the video signal to the amplitude of non-modulate carrier.

Applicable Standards, Corresponding International Standards and
Reference Standards: See page 123.

- (4) modulation index of sound carrier and sound subcarrier The percentage of the maximum frequency deviation which occurs when sound carrier or sound subcarrier is frequency-modulated by the audio signal to the specified frequency deviation. The frequency deviations at modulation indexes 100 % and 30 % shall be as given in Table 2.1

Table 2.1. Maximum Frequency Deviation at Sound Multiplex Modulation

Unit: kHz

Classification of modulation signal	Maximum frequency deviation of main carrier due to main-audio-channel signal	Frequency deviation of main carrier due to sub-audio-channel signal	Maximum frequency deviation of sub-carrier	Frequency deviation of main-carrier due to control channel signal	Description
Dual sound	25 (7.5)	15 (15)	10 (3)	2 (2)	
Stereo (L = R)	25 (7.5)	20 (20)	0 (0)	2 (2)	Simultaneous modulation of left sound and right sound at the same level in the same phase
Stereo (L or R)	12.5 (3.75)	20 (20)	5 (1.5)	2 (2)	Modulation of left (or right) sound only
Stereo (L = -R)	0 (0)	20 (20)	10 (3)	2 (2)	Simultaneous modulation of left sound and right sound at the same level in the opposite phase

- Remarks 1. The numerals in the upper rows indicate the frequency deviation at modulation index 100 % and the numerals in parentheses in the lower row indicate the frequency deviation at modulation index 30 %.
2. The modulation index 30 % on one side only in the stereo modulation means such state that the modulation is done on both of left and right sides at the same level in the same phase and then the signal on other side is cut off, and the modulation index is 15 % on each of the main and sub audio channels.

3. In the test item in which the test is carried out by changing the modulation frequency while the modulation index is maintained constant, the pre-emphasis shall be cut off.

- (5) test channel number This is the channel number of television signal to be used for testing of receivers. For video and sound carriers, the numbers shall be as given in Table 2.2.

Table 2.2

Unit: MHz

Test channel number	Video carrier frequency	Sound carrier frequency	Test channel number	Video carrier frequency	Sound carrier frequency
1	91.25	95.75	32	585.25	589.75
2	97.25	101.75	33	591.25	595.75
3	103.25	107.75	34	597.25	601.75
4	171.25	175.75	35	603.25	607.75
5	177.25	181.75	36	609.25	613.75
6	183.25	187.75	37	615.25	619.75
7	189.25	193.75	38	621.25	625.75
8	193.25	197.75	39	627.25	631.75
9	199.25	203.75	40	633.25	637.75
10	205.25	209.75	41	639.25	643.75
11	211.25	215.75	42	645.25	649.75
12	217.25	221.75	43	651.25	655.75
13	471.25	475.75	44	657.25	661.75
14	477.25	481.75	45	663.25	667.75
15	483.25	487.75	46	669.25	673.75
16	489.25	493.75	47	675.25	679.75
17	495.25	499.75	48	681.25	685.75
18	501.25	505.75	49	687.25	691.75
19	507.25	511.75	50	693.25	697.75
20	513.25	517.75	51	699.25	703.75
21	519.25	523.75	52	705.25	709.75
22	525.25	529.75	53	711.25	715.75
23	531.25	535.75	54	717.25	721.75
24	537.25	541.75	55	723.25	727.75
25	543.25	547.75	56	729.25	733.75
26	549.25	553.75	57	735.25	739.75
27	555.25	559.75	58	741.25	745.75
28	561.25	565.75	59	747.25	751.75
29	567.25	571.75	60	753.25	757.75
30	573.25	577.75	61	759.25	763.75
31	579.25	583.75	62	765.25	769.75

It is not necessary to use all the numbers in Table 2.2 in all the test. The group specified from among the test channel number groups given in Table 2.3 shall be used.

In the test for which no test channel number is specified, an optional test channel number in table 2.2 shall be used.

Table 2.3

Test channel number group	Test channel number
A	2, 8, 25, 50
B	1, 3, 4, 8, 12, 13, 25, 38, 50, 62
C	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 62
D	All the test channel numbers having frequencies close to the fundamental and harmonics which is possible to occur in the receiver and to cause impairment.

- (6) test input signal This is the television signal to be applied to the receiver for tests. The test input level shall, as a rule, be expressed by the available power of the signal generator output circuit including the matching circuit and other additional circuits. Decibel [dB (mW)] based on 1 mW = 0 dB is used as the unit. In the television signal, the power ratio of video carrier to sound carrier shall always be maintained 1 to 0.25, and the signal level shall be expressed by the video carrier level.

Remarks 1. The available power means the maximum power capable of being taken out from the above-mentioned output circuit, mW is used as the unit, and it is obtained from the following formula:

$$P = \frac{E_g^2}{4R_g} \times 10^3$$

where, P : available power (mW)

E_g : open-circuit terminal voltage of above output circuit (V)

R_g : output resistance of above output circuit (Ω)

2. The output resistance of the signal generator means the pure resistance equivalent to the specified input impedance of the receiver.

When the test input signal is expressed in voltage, it shall be expressed by the open-circuit terminal voltage of the signal generator output circuit including the matching and other additional circuits, and the specified input impedance of the receiver shall be clearly stated in this case.

The open-circuit terminal voltage for this test is obtained from the following formula:

$$E = 2\sqrt{PR \times 10^{-3}}$$

where, E : open-circuit terminal voltage (V)

P : available power (mW)

R : specified input impedance of receiver (Ω)

The relation between the electrical quantities mentioned above are as given in Table 2.4.

Table 2.4

Available power mW	Input signal level dB (mW)	Open-circuit terminal voltage ($R=300\Omega$)		Open-circuit terminal voltage ($R=75\Omega$)	
		dB(μ V)	μ V	dB(μ V)	μ V
10^{-11}	-110	11	3.5	5	1.75
10^{-10}	-100	21	1.1×10	15	5.5
10^{-9}	-90	31	3.5×10	25	1.75×10
10^{-8}	-80	41	1.1×10^2	35	5.5×10
10^{-7}	-70	51	3.5×10^2	45	1.75×10^2
10^{-6}	-60	61	1.1×10^3	55	5.5×10^2
10^{-5}	-50	71	3.5×10^3	65	1.75×10^3
10^{-4}	-40	81	1.1×10^4	75	5.5×10^3
10^{-3}	-30	91	3.5×10^4	85	1.75×10^4
10^{-2}	-20	101	1.1×10^5	95	5.5×10^4
10^{-1}	-10	111	3.5×10^5	105	1.75×10^5
1	0	121	1.1×10^6	115	5.5×10^5
10	10	131	3.5×10^6	125	1.75×10^6

- (7) standard test input signal level The standard test input signal level means such a state that the input signal level is -50 dB (mW). Unless otherwise specified, each test shall be carried out at this standard input signal level.

- (8) test video signal This means the video signal which modulates the video carrier of the television signal to be used for tests, and the signals are shown in Figs. 2.1 to 2.26.

The left drawing is the waveform drawing, mark H on abscissa indicates horizontal period and mark V indicates vertical period. The right figure shows the pictorial image corresponding to the left waveform drawing. The numerals indicated on the waveform drawing mean the following parameters:

Numerals at left side of ordinate (%) These represent the carrier levels when modulated by the video signal, and 100 % means no modulation.

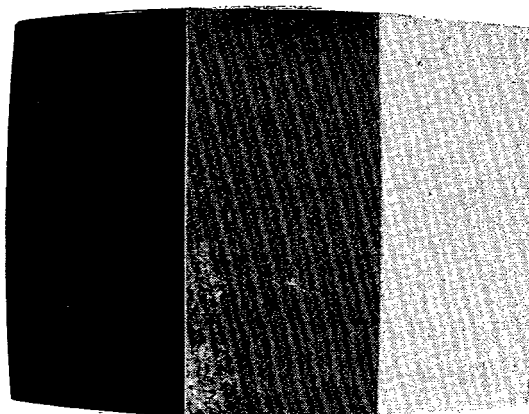
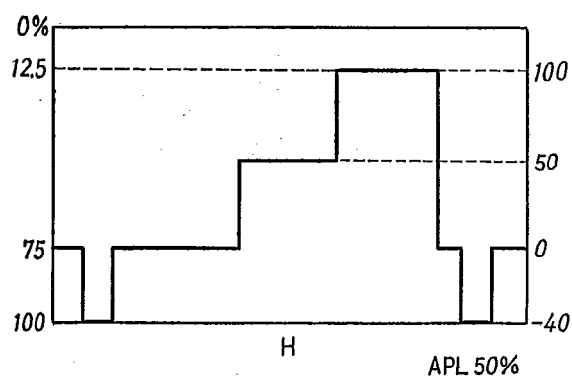
Numerals at right side of ordinate or in drawing (IRE unit) These represent the amplitude levels of video signal corresponding to the carrier level. When the pedestal level is 0 IRE, the reference white level is 100 IRE and the synchronous end level is -40 IRE, then the following equation holds:

$$\text{IRE unit} = 120 - 1.6 \times (\text{carrier level})$$

APL (average picture level) % This represents the average level of video signal excluding the blanking intervals when the pedestal level of the video signal is 0 % and the reference white level of the said signal is 100 %.

(c) three-staircase signal

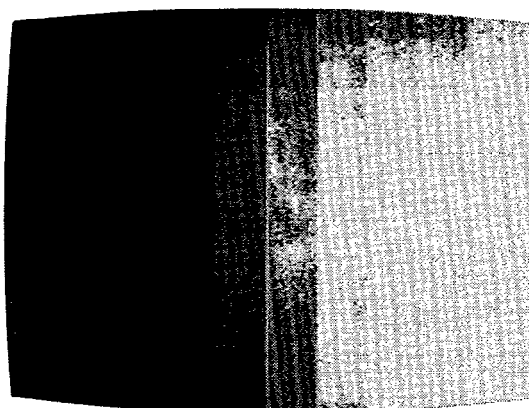
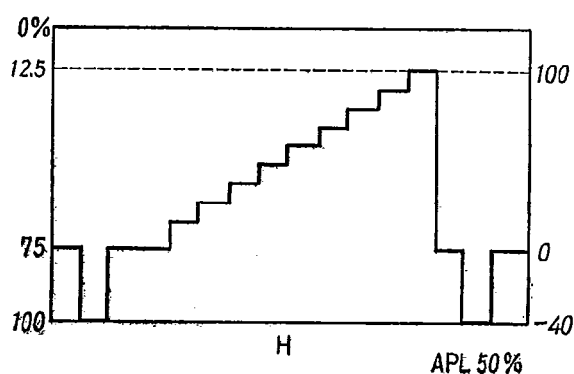
Fig. 2.3



Remark: This is used for test of sub-clause 6.2.2.

(d) ten-staircase signal

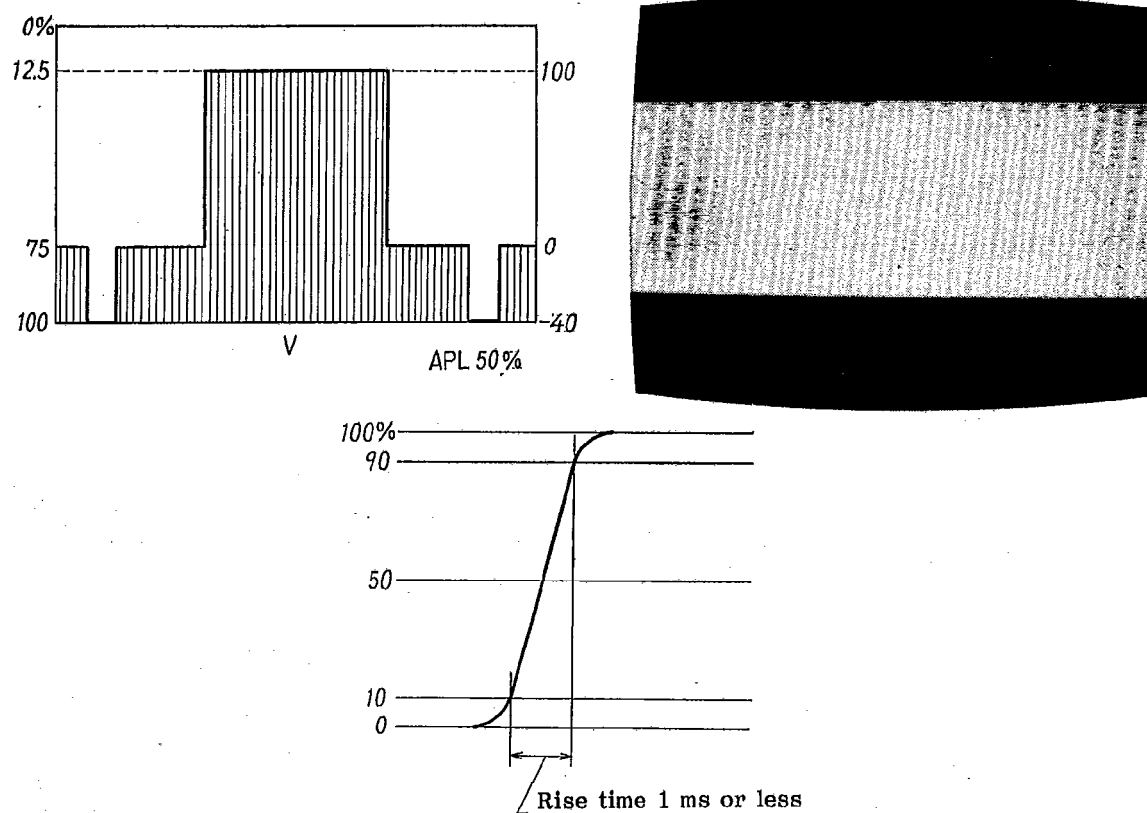
Fig. 2.4



Remark: This is used for tests of sub-clauses 6.2.5, 6.2.6 and 7.1.4 (1).

(e) one-horizontal-stripe signal

Fig. 2.5

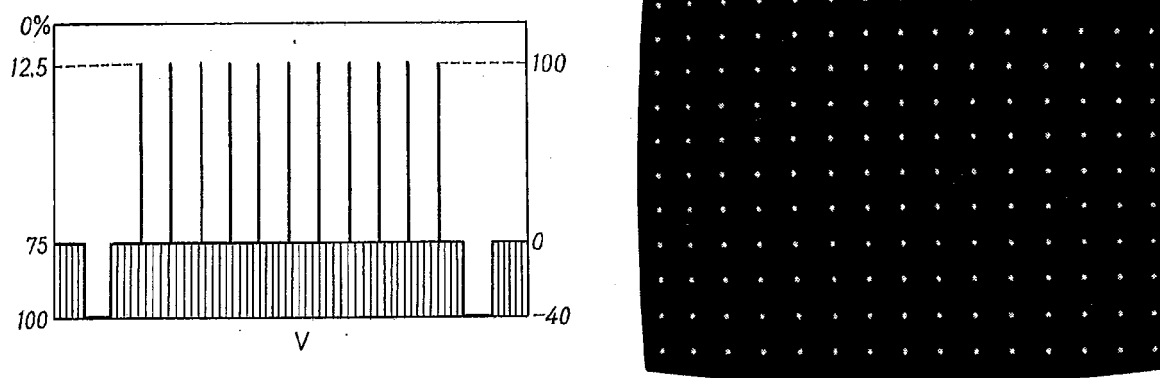


Remarks 1. The rise characteristic of rectangular wave shall satisfy the above requirement.

2. This is used for test of sub-clause 6.4.5.

(f) dot pattern signal

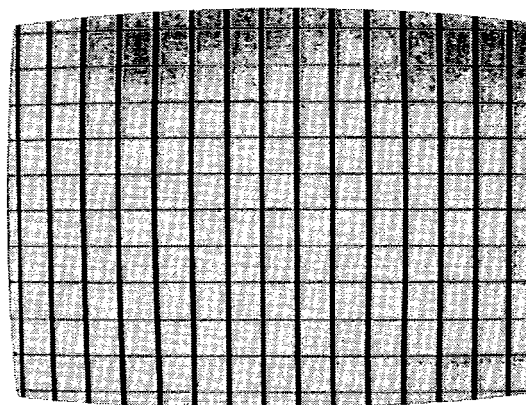
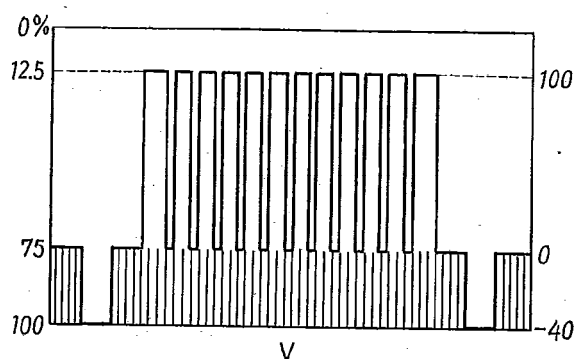
Fig. 2.6



Remark: This is used for test of sub-clause 7.1.3.

(g) black grating signal

Fig. 2.7

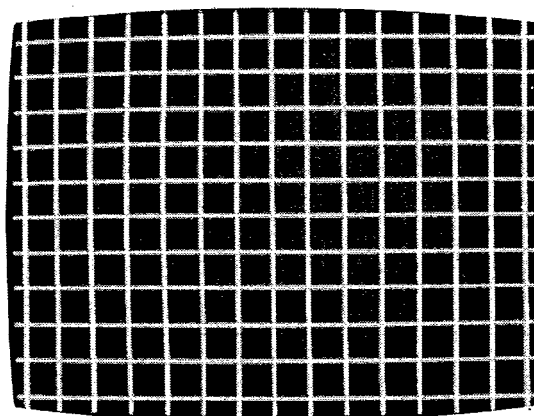
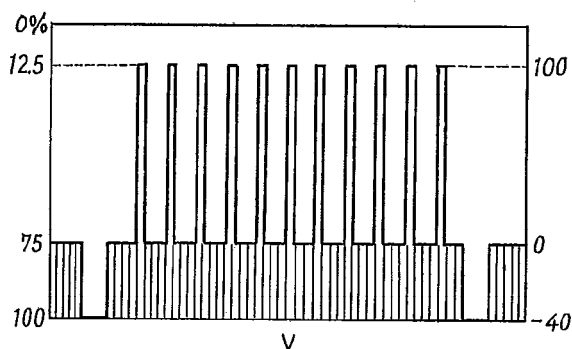


Remarks 1. As for the number of gratings, 12 in vertical and 16 in horizontal are the standard.

2. This is used for test of sub-clause 7.1.1.

(h) white grating signal

Fig. 2.8

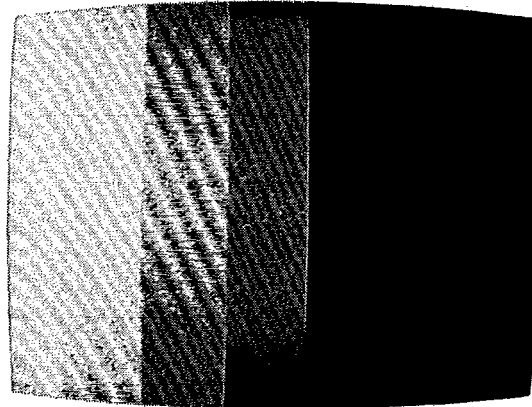
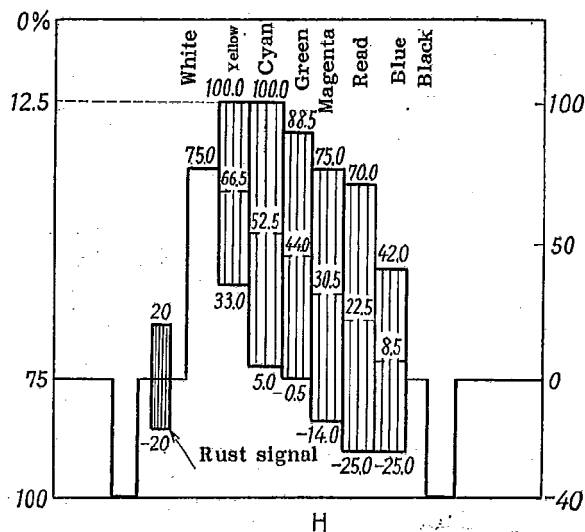


Remark: This is used for tests of sub-clauses 6.1.1 and 6.1.6.

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(i) color-bar signal

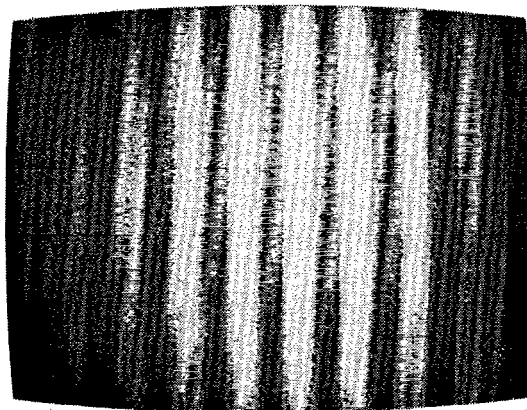
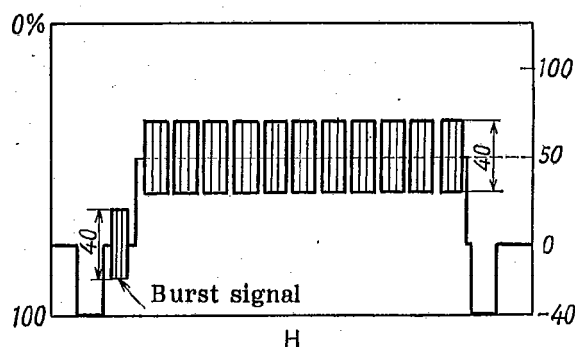
Fig. 2.9



Remark: This is used for tests of sub-clauses 6.2.8, 6.3.7 (1), 7.1.4 (2), 7.2.1 (1), 7.2.2, 7.3, 7.4.5, 7.4.6, 7.4.7, 7.5.1 (2) and 7.5.2.

(j) offset-carrier color-bar signal

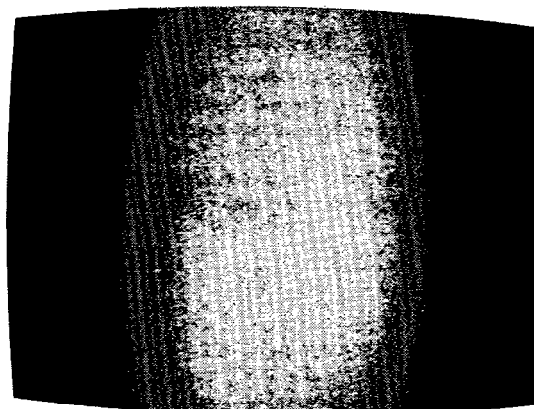
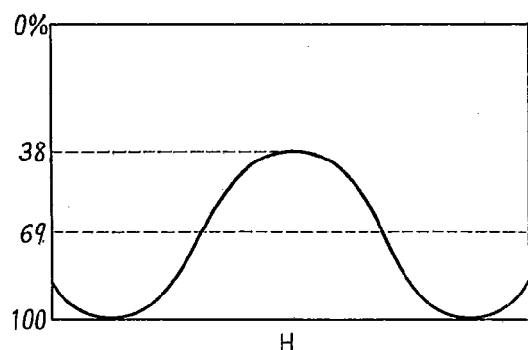
Fig. 2.10



Remark: This is used for tests of sub-clauses 7.4.3 (2), 7.4.4 (2) and 7.5.4.

(k) sine wave signal

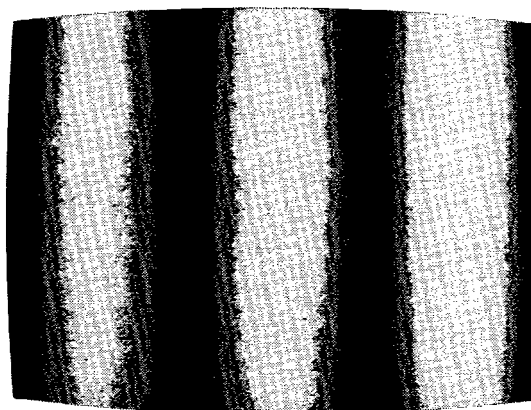
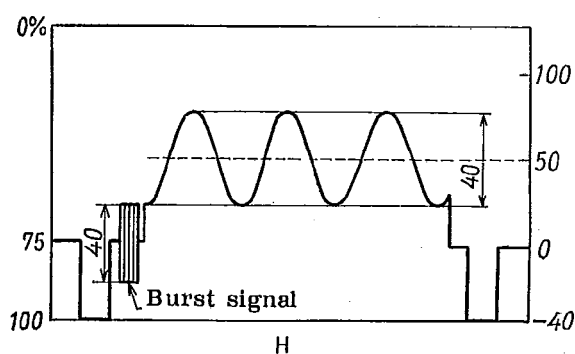
Fig. 2.11



- Remarks 1. The sine wave signal means the carrier which is amplitude modulated by a sine wave, and Fig. 2.11 shows the signal modulated by a sine wave of 15.75 kHz.
2. This signal is equal to a 45 % sine-wave modulated wave, but care should be taken that the carrier level is different by about 3 dB.
3. This is used for tests of sub-clauses 6.3.1 (1), 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.6 and 6.3.7 (2).

(l) composite sine wave signal

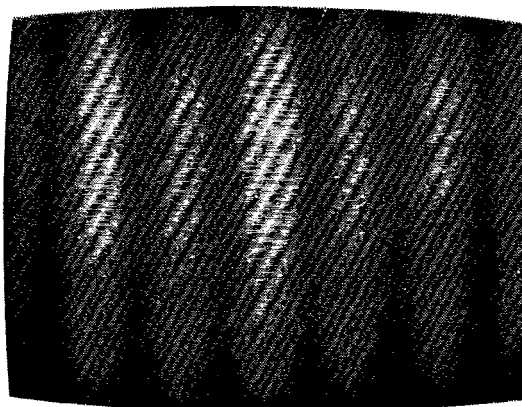
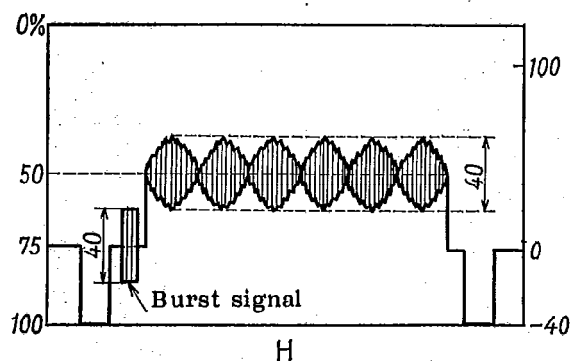
Fig. 2.12



Remark: This is used for tests of sub-clauses 6.4.1, 7.4.1 and 7.6.1.

(m) sine-wave modulated color signal

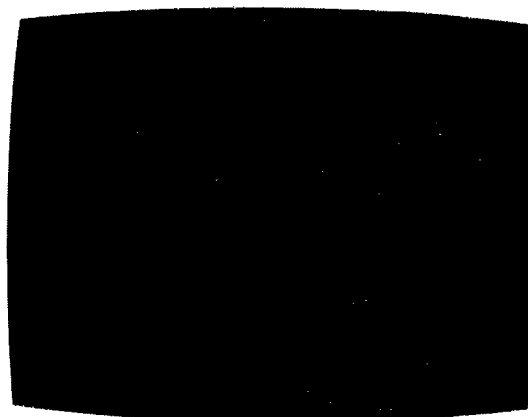
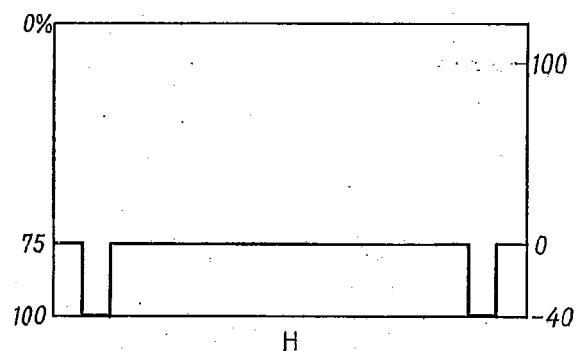
Fig. 2.13



Remark: This is used for test of sub-clause 7.4.2.

(n) all black signal

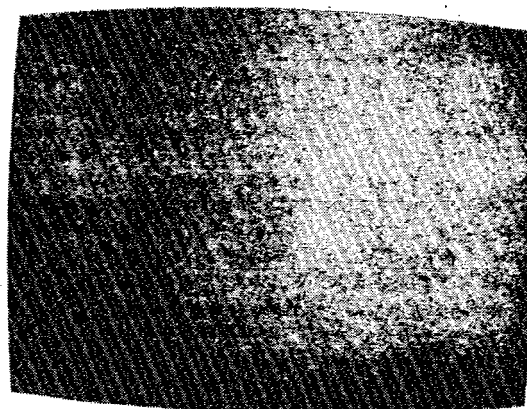
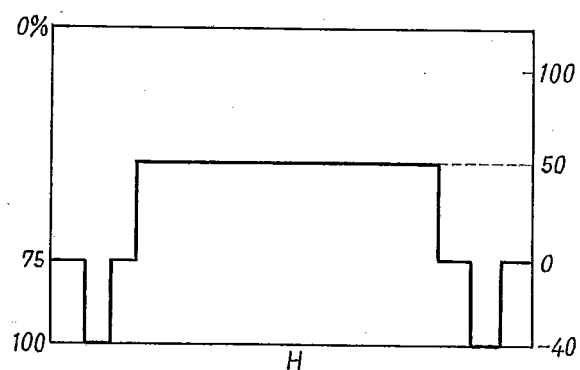
Fig. 2.14



Remark: This is used for tests of sub-clauses 6.5.1, 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 9.1 to 9.8 (excl. 9.3).

(o) gray signal

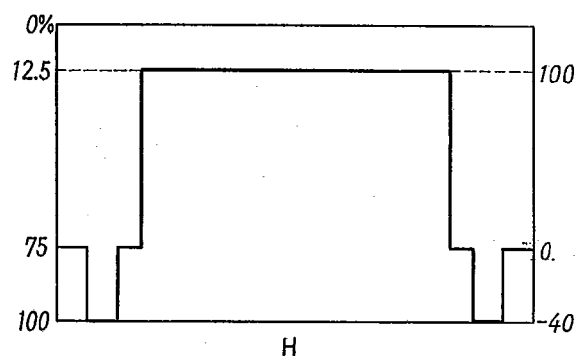
Fig. 2.15



Remark: This is used for test of sub-clause 6.2.2 (2).

(p) all white signal

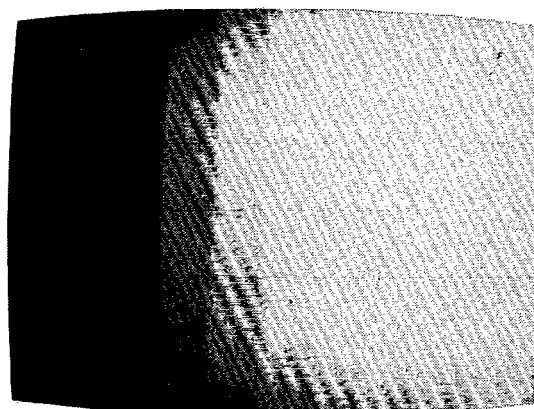
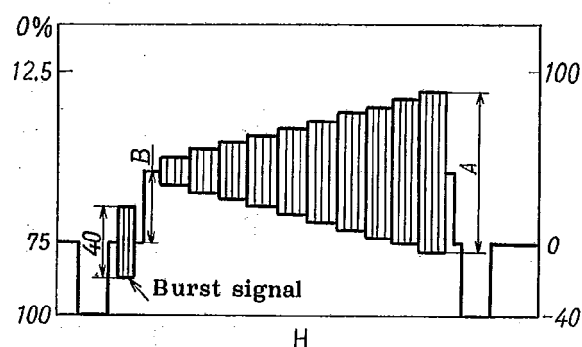
Fig. 2.16



Remark: This is used for test of sub-clause 7.1.2.

(q) color staircase signal

Fig. 2.17

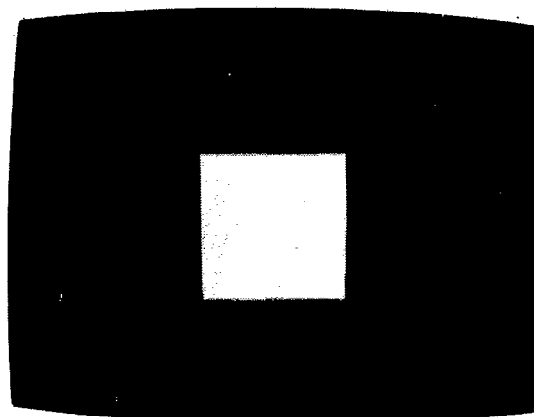
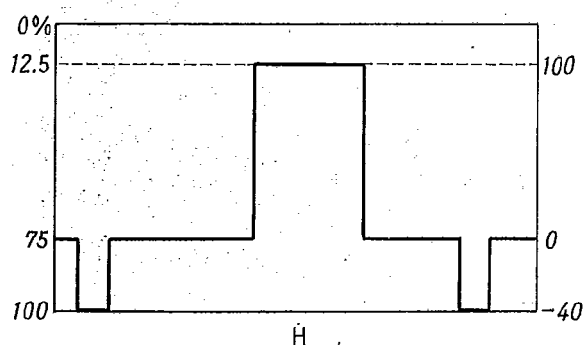


Remarks 1. The maximum amplitude A and luminance level B at each color shall be made equal to those of color-bar signal.

2. This is used for test of sub-clause 7.4.11.

(r) white window signal

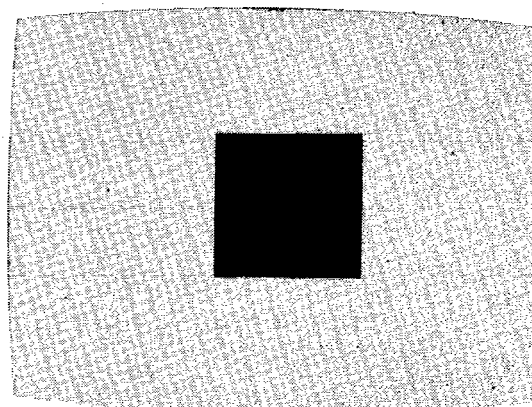
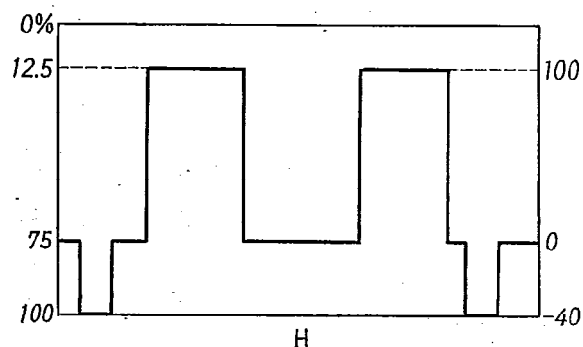
Fig. 2.18



Remark: This is used for tests of sub-clauses 6.1.4 (1), (2), (4) and 6.1.6.

(s) black window signal

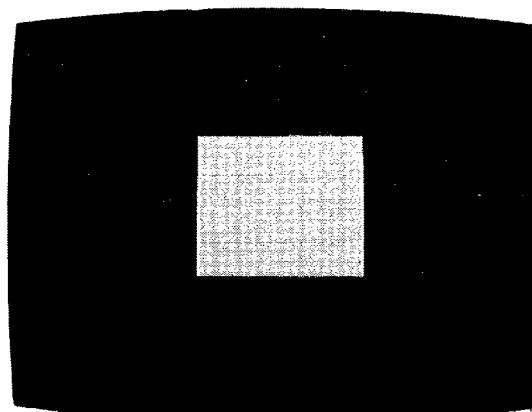
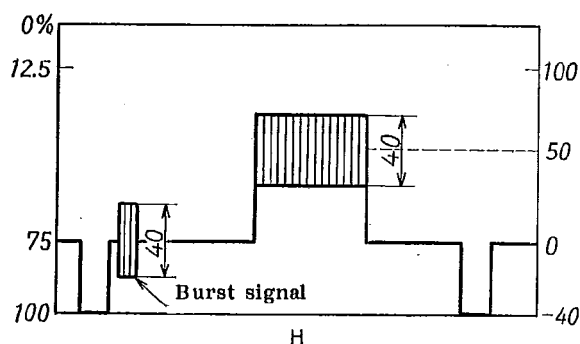
Fig. 2.19



Remark: This is used for test of sub-clause 6.1.4 (3).

(t) color window signal

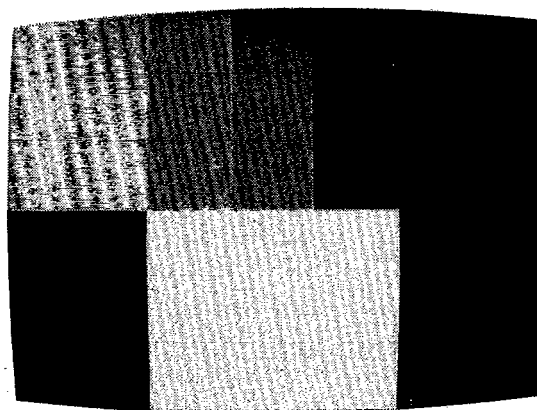
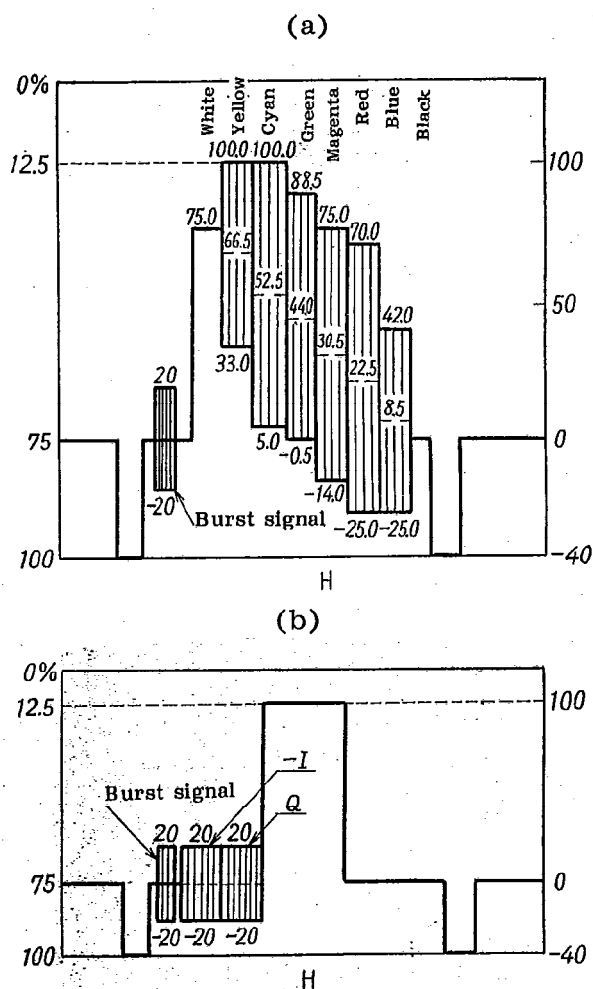
Fig. 2.20



Remark: This is used for tests of sub-clauses 7.2.1 (2), 7.4.3 (1) and 7.4.4 (1).

(u) Composite color-bar signal

Fig. 2.21

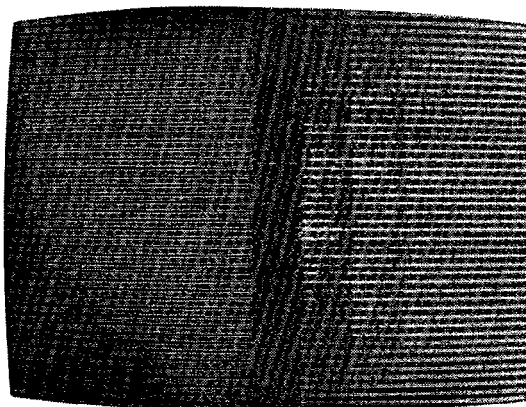
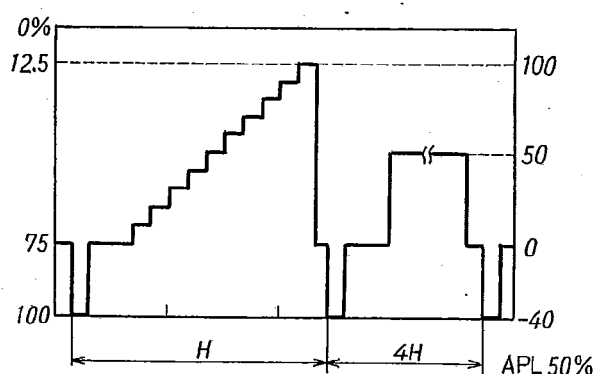


Remarks 1. The composite color bars shall be composed of (a) in the upper part of the picture and of (b) in the lower part.

2. This is used for tests of sub-clauses 8.1.3, 9.2, 9.3 and 9.

(v) variable APL ten-staircase signal

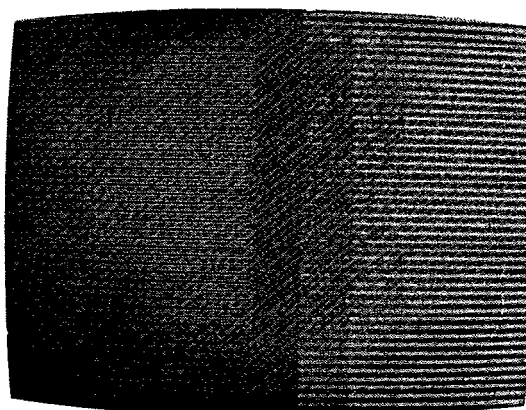
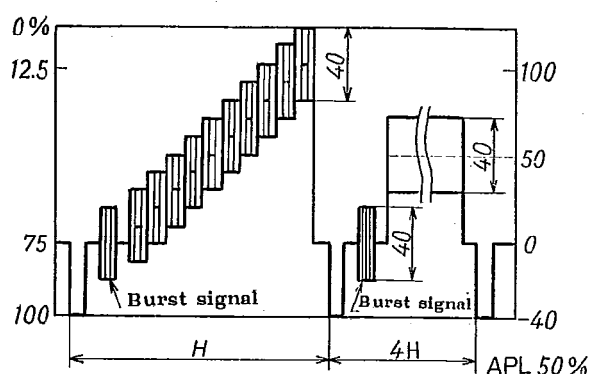
Fig. 2.22



- Remarks 1. This drawing shows the case of APL 50 %, and the APL becomes 10 % and 90 % when the gray signal of 4 H is 0 IRE and 100 IRE respectively.
2. This is used for tests of sub-clauses 8.4.2 and 6.4.3..

(w) modulated variable APL ten-staircase signal

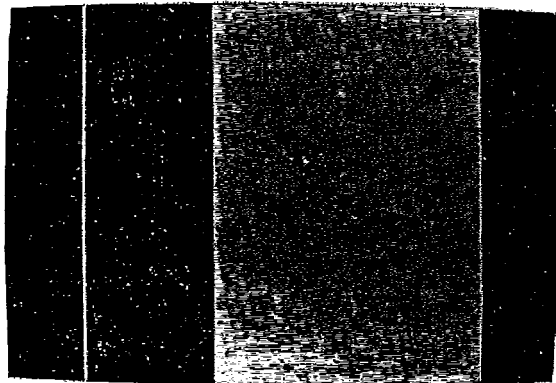
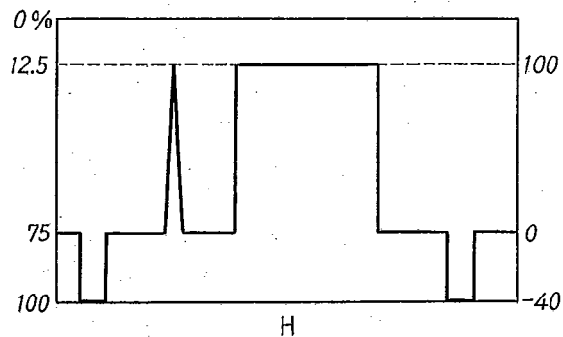
Fig. 2.23



- Remarks 1. This drawing shows the case of APL 50 %, and the APL becomes 10 % and 90 % when the gray signal of 4 H is 0 IRE and 100 IRE respectively.
2. This is used for test of sub-clause 7.4.9.

(x) sine squared 2 T pulse and 2 T bar signal

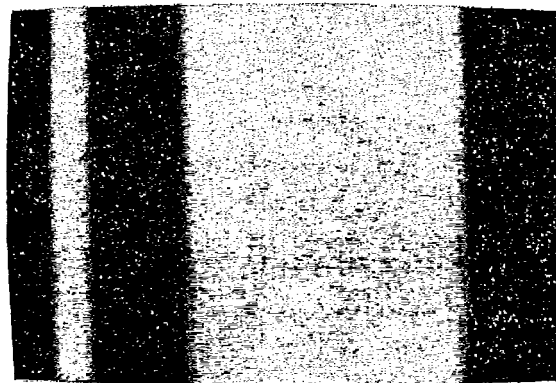
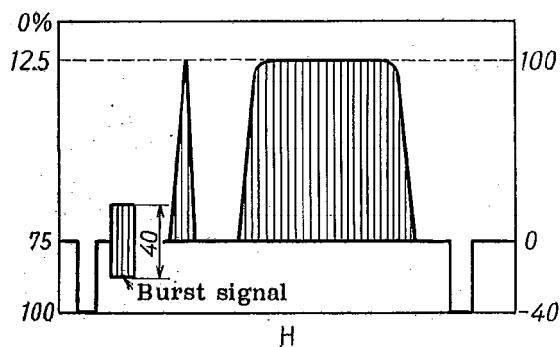
Fig. 2.24



Remark: This is used for test of sub-clause 6.4.4.

(y) modulated 20 T pulse and 20 T bar signal

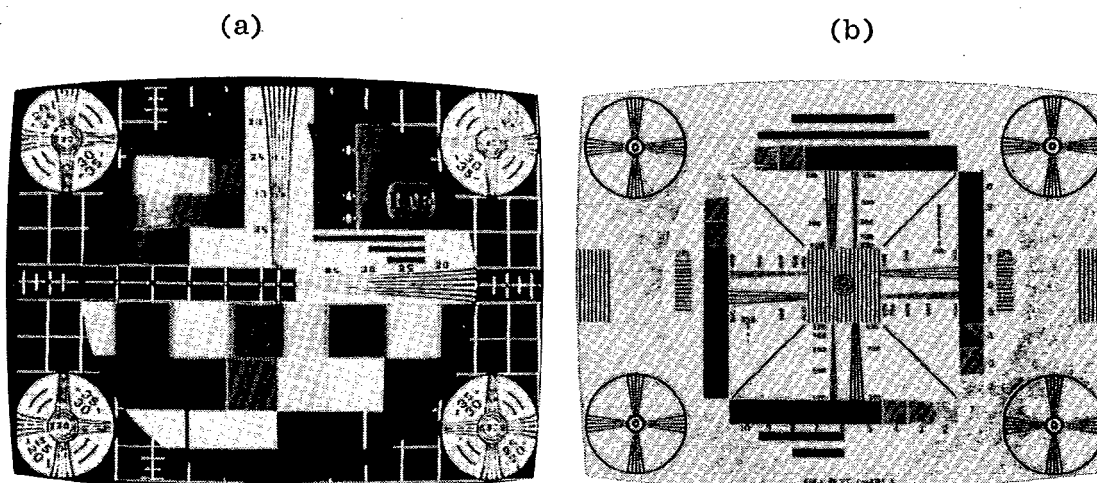
Fig. 2.25



Remark: This is used for tests of sub-clauses 7.4.8 and 7.4.10.

(z) test pattern signal

Fig. 2.26



Remark: Test pattern signal (a) is the pattern signal to be used for testing characteristics of video parts and color parts and has the following features:

- (i) The tests for horizontal resolution and vertical resolution are possible in the center and four corners of the picture (resolution wedge).
- (ii) The test for linearity is possible in any part of picture (circle and vertical and horizontal lines at equal intervals).
- (iii) The test for tone characteristic is possible (white and black tone).
- (iv) The tests for transient characteristics and reflection are possible (vertical and horizontal bars).
- (v) The tests for good synchronization, influence of retrace line and flare are possible (checker pattern).
- (vi) The degree of interlace scan can be checked (interlace checker).
- (vii) The test for waveform distortion of luminance signal is possible (sine squared 2 T pulse).
- (viii) The judgement of DG and DP can be done on the picture.
- (ix) The test for frequency band of color signal is possible (numerals x 100 kHz band).
- (x) The flesh color can be checked.
- (xi) The test for waveform distortion of color signal is possible (modulated 20 T pulse).
- (xii) The time lay between color signal and luminance signal can be checked (color discrepancy checker).

(xiii) The average brightness is about 1/2 of the brightness of the most bright part.

(xiv) There is a scale by which the aspect ratio and over scanning can be calculated.

Test pattern signal (b) is the pattern signal for testing the video parts only, it has no color subcarrier and has the features of (i), (iii), (iv) and (xiii) given above.

(9) test audio signal This means the audio signal which modulates the sound carrier (sound main- and sub- carriers for sound multiplex system) of the television signal to be used for tests. Unless otherwise specified, the test audio signal shall have a frequency of 1 kHz and its sound carrier shall be frequency modulated by 30 %.

(10) standard test output

(a) standard video test output This means the peak-to-peak value of video signal input voltage of the picture tube corresponding to the brightness of each case that the brightness of bright part of picture is adjusted to 80 cd/m² (nt) and the brightness of dark part to 2 cd/m² (nt) under such a state that no illumination is made around the receiver. The measurement shall be carried out at an adequate voltage for the kind of receiver, and the value of voltage shall be additionally recorded.

(b) standard audio test output this is expressed by the input to a loudspeaker and means the power consumed by a resistance equal to the impedance at 1 kHz of the loudspeaker. The standard audio test output shall be 50 mW. If there is special reason 500 mW or 5 mW may be used instead of 50 mW. In such a case the output used and the reason of use shall be clearly stated.

(11) receiver

(a) receiver of a.c. system a receiver which receives the power from a.c. distribution lines.

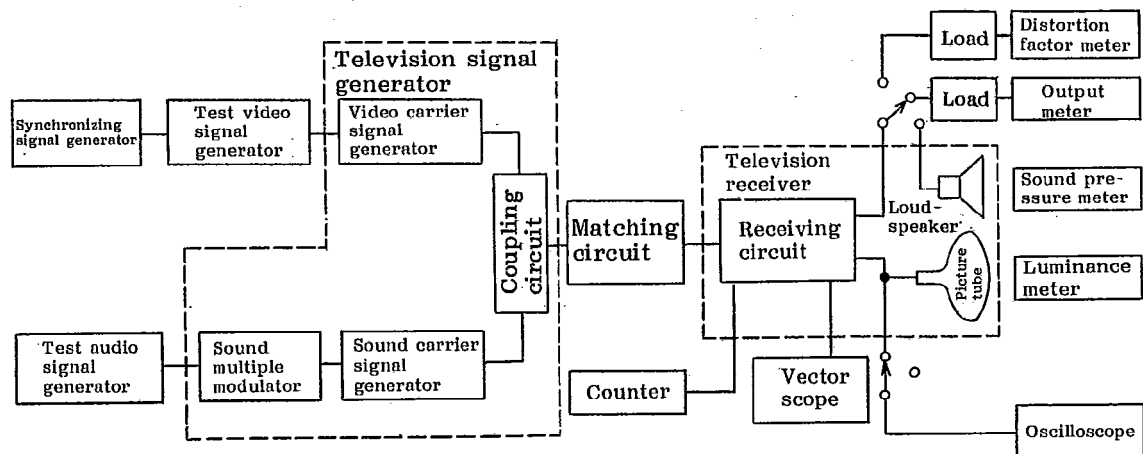
(b) receiver of battery system A receiver which employs primary battery, secondary battery or both of them as the power supply.

(c) receiver of d.c./a.c. system A receiver which employs one or both of primary battery and secondary battery and a.c. distribution line as the power supply.

3. Configuration of Test Apparatus

The tests of receivers shall be carried out by connecting the test apparatus as illustrated in Fig. 3.1.

Fig. 3.1. Connection Diagram of Test Apparatus



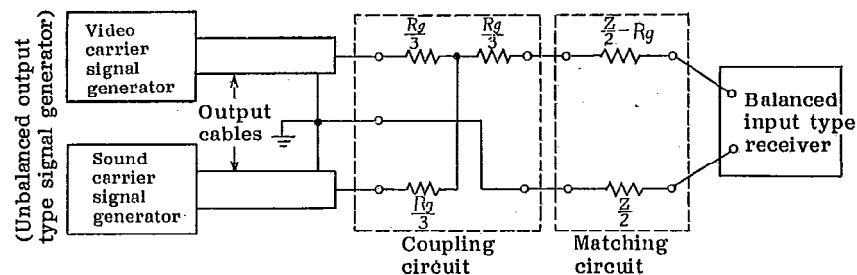
Remark: The luminance meter in Fig. 3.1 includes colorimeter.

To couple the outputs from two signal generators, the coupling circuit shown in Fig. 3.2 as an example is used. In this case each input level of these two signals becomes $1/2$ of the indicated value on the coupled signal generator.

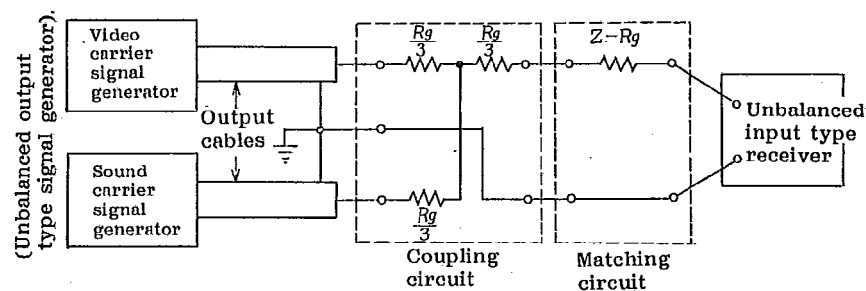
Each element of the coupling circuit shall consist of pure resistances. The output cables coupling circuit, matching circuit and receiver shall be connected short conductors as far as possible.

Fig. 3.2

- (a) Connection from Unbalanced Output Type Signal Generator to Balanced Input Type Receiver



- (b) Connection from Unbalanced Output Type Signal Generator to Unbalanced Input Type Receiver



R_g : output impedance of signal generator

Z : specified input impedance of receiver

4. Standard Test Conditions

4.1 Ambient Conditions The receivers shall be tested in a place where the receiver does not interfered by external undesired radio waves. Therefore it is desirable to carry out the tests in a shielded room where external electric field is sufficiently shielded.

The ambient light shall be such that the incident luminance vertical to the tube surface is 75 lux, the observing distance shall be six times the effective hight of picture and the background noise shall be not more than 35 dB (A).

Further the effect of external magnetic field shall be taken into consideration if necessary.

Remark: As for the observing distance and background noise, IEC 569 (Informative guide for subjective tests on television receivers) is referred.

4.2 Reference Temperature and Reference Humidity In this Standard the reference temperature shall be 20°C and the reference humidity shall be 65 % (see JIS Z 8703). Unless otherwise specified, all the tests shall be carried out under the ordinary temperature and ordinary humidity (temperature 5 to 35°C, humidity 45 to 85 %). However, if doubt arises on the decision or reproducibility is required, the tests shall be carried out under the referee condition I, temperature grade 2 and relative humidity grade 2 (temperature $20 \pm 2^\circ\text{C}$ and relative humidity 60 to 70 %) specified in JIS C 0010.

4.3 Power Supply The power supply suitable for the receiver to be tested shall be used. Unless especially specified, the power supply shall be as follows:

- (1) Power Supply for Receivers of A.C. System A power supply with a voltage and frequency equal to the rated voltage and rated frequency of the receiver shall be used. If the specimen has more than one kind of rated voltage or rated frequency an optional rated voltage or frequency shall be chosen for use.

The voltage regulation and frequency regulation of the power supply shall be not more than $\pm 2\%$, and the harmonic content of the power supply shall not exceed 5 %.

- (2) Power Supply for Receivers of Battery System An appropriate d.c. power supply of a voltage equal to the rated voltage of the receiver shall be used. If a primary battery is used, a battery having the same type, voltage and internal resistance as those of the battery to be used for the receiver shall be used.

- (3) Power Supply for Receivers of A.C./D.C. System In general, the power supply shall be as explained in (1).

4.4 Adjustment of Receiver

4.4.1 Input Signal The input signal to be used for adjusting of receivers shall be as follows:

- (1) The test input signal level shall be -50 dB (mW) (standard test input signal).

(2) The test video signal shall be test pattern signal (a).

(3) The test sound carrier shall be 1 kHz and 30 % frequency modulation depth.

4.4.2 Tuning In general the tuning shall be so adjusted that the picture is in best conditions and the distortion of audio output and the noise are minimized. If the said two conditions can not be attained at one tuning point, the point at which the picture is best shall be selected.

In the tuning adjustment employing the test input signal modulated by a sine wave signal, the frequency shall be correctly matched to the value corresponding to the frequency to receive the local oscillation frequency.

4.4.3 Contrast and Brightness Unless otherwise specified in the test method, the adjustment of contrast shall be made to attain the best condition within the range where no distortion is caused on the resolution, linearity and others in the picture.

The brightness shall be set within a beam current by which no blooming is caused on each electron gun.

4.4.4 Automatic Gain Control It is difficult to determine the adjustment condition of automatic gain control circuit indiscriminately, since the operating characteristics of the circuit vary according to the system and the effect of the circuit conditions differs according to the test item. Therefore, the operating conditions shall be specified individually for a test item which is affected by the automatic gain control action.

4.4.5 Volume Control Unless otherwise specified in the test method, the volume control shall be set to the position corresponding to the standard audio test output.

4.4.6 Tone Control Unless otherwise specified in the test method, the tone control, if provided, shall be set to the mechanical center or the position where most flat frequency characteristic is obtained electrically.

4.4.7 Balance Control Unless otherwise specified in the test method, the balance control shall be set to the position where the audio outputs of left side and right side become equal when examined by means of the stereo audio signal.

4.4.8 Picture Quality Control Unless otherwise specified in the test method, the picture quality control, if provided, shall be set to the mechanical center.

4.4.9 Color Saturation Control Unless otherwise specified in the test method, the color saturation shall be set to the best conditions.

4.4.10 Hue Control Unless otherwise specified in the test method, the hue shall be adjusted to the best conditions.

4.4.11 Synchronization Control Unless otherwise specified in the test method, the synchronization control shall be set to the center of the range of pulling into synchronization.

4.4.12 Others Unless otherwise specified in the test method, other controls shall be set to the best conditions.

Further, if necessary the internal controls for white balance, chromatic purity, convergence, etc. shall be set to the best conditions.

4.5 Time Point of Initiation of Measurement Unless otherwise specified in the test methods, tests shall be carried out after the receiver reaches sufficiency stable conditions.

5. Inspection of General Operation Conditions

5.1 Inspection in General Inspect a receiver, before it is subjected to various performance test specified in 6. Test Methods of Picture Part and following clauses, on the items given below, to observe whether its operating conditions are enough to endure the various tests or not. Express the measured results as given in Table 5.1.

In this inspection if a receiver is decided not enough in its operation, readjust or repair the receiver and then carry out various tests.

Table 5.1. Inspection of General Operating Conditions

Inspection item			Inspection result
Mechanical construction			No abnormality
Receiving frequency band			Receiving of all the test channel numbers is possible
Power consumption			95 W (a.c. 100 V)
Insulation	Insulation resistance		100 M Ω min.
	Di-electric strength	Between power supply terminals and external metal parts	No abnormality
		Between high tension terminals and external metal parts	No abnormality
Temperature rise			23.5°C (135 min) (room temperature 31°C)
Continuous operation			No abnormality

5.2 Mechanical Construction Operate the receiver under the standard test conditions, tune it to an optional television signal, operate each control and examine the operating state and existence or non-existence of any abnormality.

5.3 Receiving Frequency Band Operate the receiver under the standard test conditions, and examine the range of frequency of television signal which can be received by operating the channel tuning mechanism.

5.4 Working Voltage of Each Part and Power Consumption Operate the receiver under the standard test conditions, and measure the voltages of principal parts with suitable voltmeters.

Also measure the power consumption.

5.5 Insulation Operate the receiver under the standard test conditions for 1 h and then carry out the following tests:

- (1) Insulation Resistance Test Measure the insulation resistance between the power supply terminals and dead metal parts exposed outside the cabinet with a 500 V insulation resistance tester.
- (2) Dielectric Strength Test Carry out dielectric strength test as follows:
 - (a) Apply an a.c. voltage of 1 kV between the power supply terminals and the dead metal parts liable to be earthed continuously for 1 min and examine existence or non-existence of any abnormality.
 - (b) Apply or generate a d.c. voltage equal to the test voltage calculated from the following formula continuously for 1 min, between the live parts in the high voltage rectified circuit and the dead metal part exposed outside the cabinet, and examine existence or non-existence of any abnormality.

$$E' = 1.25E + 1750$$

where, E' : test voltage (V)

E : maximum voltage measured between anode or cathode of high voltage rectifier and chassis (V)

Carry out the measurement with the charging preventive high resistance removed. Carry out no measurement on the earth terminal and earphone terminal.

5.6 Temperature Rise Operate the receiver under the standard test conditions, place a thermometer inside the cabinet above the center of chassis, and measure the temperature rise when the temperature is almost stabilized.

5.7 Continuous Operation Operate the receiver under the standard test conditions continuously for 6 h and examine existence or non-existence of any abnormality.

6. Test Method of Video Part

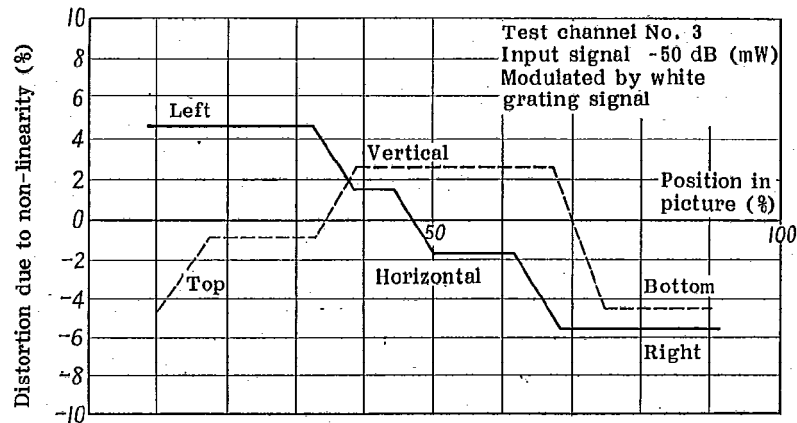
6.1 Quality of Picture

6.1.1 Geometrical Distortion of Picture In the test for geometrical distortion, carry out the tests for the distortion due to non-linearity of scanning and for the distortion due to deviation of raster from a square.

- (1) Non-linear Distortion Use the test input signal modulated by the white grating signal and adjust the receiver so that it reproduces the best grating. Measure the spacings between horizontal lines and vertical lines which pass near the center of picture area and form a grating, obtain the differences between this measured spacings and the average spacings, and take the percent ratio of this difference to the relevant average spacing as the distortion due to non-linearity of scanning.

Express the measured result on a graph by plotting the horizontal and vertical positions in the picture on the abscissa and the deviation due to non-linearity on the ordinate. One example of measured results is shown in Fig. 6.1.

Fig. 6.1. Geometrical Distortion of Picture (Non-linearity)



- (2) Raster Distortion Use the test input signal modulated by the white grating signal and adjust the receiver so that it reproduces the best grating.

Measure the raster distortion on the outermost contour of the grating pattern in the picture area. As illustrated in Fig. 6.2 assume the corner points A, B, C and D , and make the quadrilateral $ABCD$. Assume the centers of the sides of quadrilateral $ABCD, E, F, H$ and K , draw auxiliary lines EH and KF , and assume the intersection G . Draw GE' from G vertical to the straight line KF . Assume the angle made by straight line HE and straight line GE' θ .

As shown in Fig. 6.2, assume the maximum deviation of the contour lying inside straight line AB a_1 , and the maximum deviation of contour lying outside the said line a_2 . Similarly assume such deviations on other sides b_1, b_2, c_1, c_2, d_1 and d_2 as shown in Fig. 6.2.

Calculate the raster distortion from the following formula:

$$\text{Horizontal trapezium distortion \%} = \frac{AD - BC}{AD + BC} \times 100$$

$$\text{Vertical trapezium distortion \%} = \frac{AB - DC}{AB + DC} \times 100$$

$$\text{Upper barrel distortion \%} = 4 \frac{a_2}{AD + BC} \times 100$$

$$\text{Lower barrel distortion \%} = 4 \frac{b_2}{AD + BC} \times 100$$

$$\text{Left barrel distortion \%} = 4 \frac{c_2}{AB + DC} \times 100$$

$$\text{Right barrel distortion \%} = 4 \frac{d_2}{AB+DC} \times 100$$

$$\text{Upper pincushion distortion \%} = 4 \frac{a_1}{AD+BC} \times 100$$

$$\text{Lower pincushion distortion \%} = 4 \frac{b_1}{AD+BC} \times 100$$

$$\text{Left pincushion distortion \%} = 4 \frac{c_1}{AB+DC} \times 100$$

$$\text{right pincushion distortion} = 4 \frac{d_1}{AB+DC} \times 100$$

Parallelogram distortion θ (counterclockwise direction is positive)

Express the measured results as given in Table 6.1.

Carry out the above measurements on the photograph of the picture taken from a point sufficiently distant from the picture, or on the image projected on a plane on the optical axis of the picture area and perpendicular to the axis.

Fig. 6.2. Geometrical Distortion of Picture (Raster Distortion)

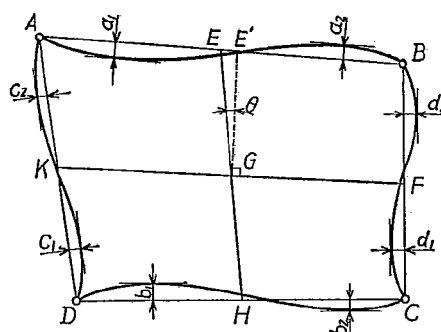


Table 6.1. Geometrical Distortion of Picture (Raster Distortion)

Trapezium distortion %		Barrel distortion %		Pincushion distortion %		Parallelogram distortion
Horizontal	+0.7	Left	1.0	Left	0.6	$\theta = 0^\circ$
		Right	0	Right	1.2	
Vertical	-0.57	Upper	0	Upper	0.9	
		Lower	1.5	Lower	0.2	

6.1.2 Over-scanning Set up the receiver under the standard test conditions, and apply the test input signal modulated by test pattern signal (a) to the receiver. Obtain the display factor a (%) of the picture, the center of picture area being the reference, according to Fig. 6.3 and then calculate the over-scanning from the following formula:

$$\text{Over-scanning (\%)} = 100 - a$$

Express the measured results in percentage for left and right in horizontal direction, top and bottom in vertical direction separately as listed in Table 6.2.

Remark: The overall over-scanning means the half of the sum of left and right deviations in horizontal direction and that of top and bottom deviations in vertical direction.

Fig. 6.3. Display Factor of Picture a

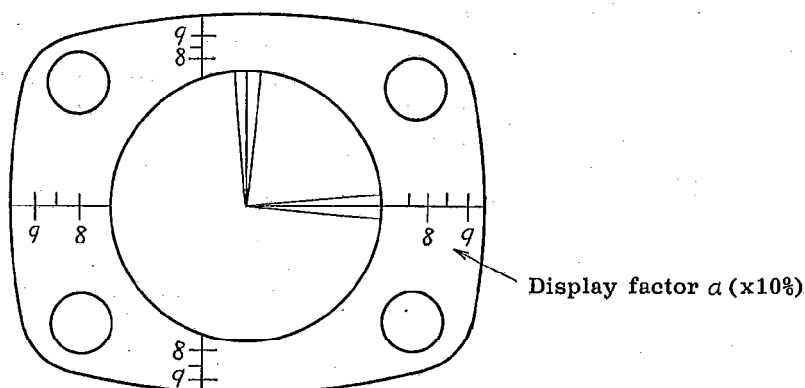


Table 6.2. Over-scanning

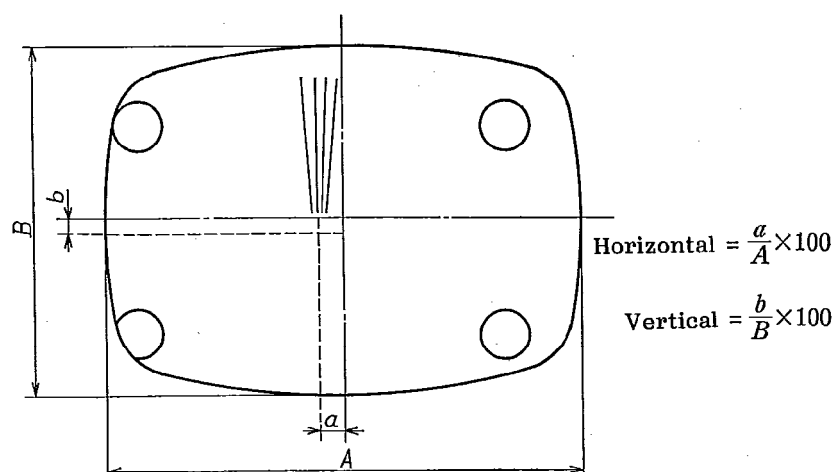
Unit: %				
Horizontal	Left	9.8	Overall	9.5
	Right	9.2		
Vertical	Top	8.5	Overall	9.0
	Bottom	9.5		

6.1.3 Centering Deviation Set up the receiver under the standard test conditions, and apply the test input signal modulated by test pattern signal (a) to the receiver. Measure the deviation of the center of the test pattern from the center of picture area obtained by a suitable method. Express the degree of centering deviation by the respective ratios of the horizontal and vertical deviations to the maximum horizontal and vertical dimensions. Express the measured results in percentage for horizontal and vertical directions separately as given in Table 6.3.

Table 6.3 Centering Deviation

Unit: %		
Horizontal	Left	2.5
Vertical	Bottom	1.8

Fig. 6.4. Centering Deviation



6.1.4 Brightness Carry out this test under such conditions that the picture tube is accommodated in an enclosure and no light is introduced from the surroundings.

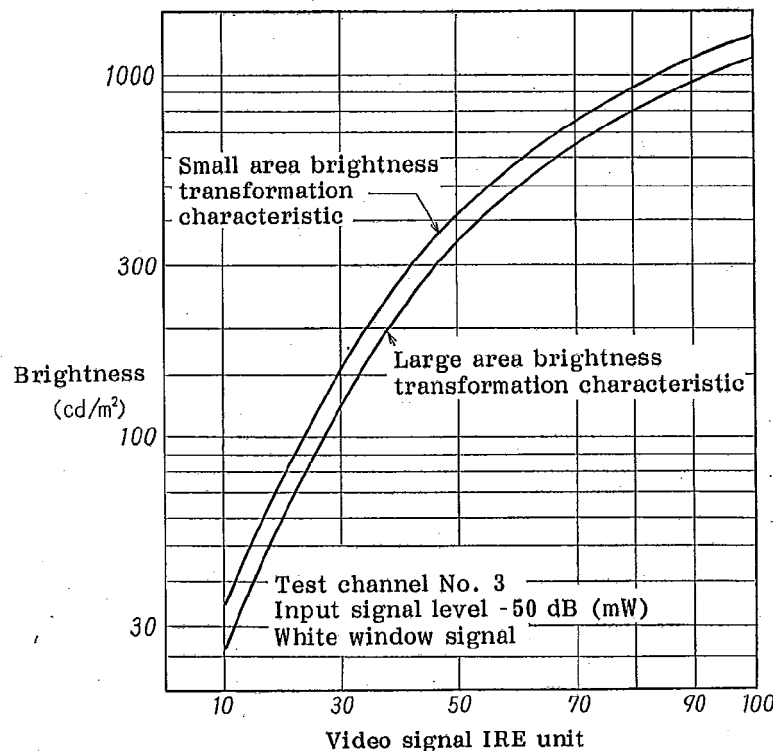
- (1) **Brightness Transformation Characteristics** Set up the receiver under the standard test conditions, apply the test input signal modulated by the white window signal and adjust one side of the white window to 40 % of W . Change the video signal up to 100 IRE at intervals of 10 IRE, and measure the brightness of the center of window in a circle with a diameter equal to 4 % of W in each step. Consider the characteristic so obtained as large area brightness transformation characteristic. The W means the width of picture and the window shall be a square on the picture area.

Next, carry out the similar measurements while one side of the white window is made 5 % of W . Take the results as small area brightness transformation characteristic.

Express the measured results on a graph by plotting the video signal on the abscissa and the brightness on the ordinate of logarithmic scale.

An example of measured results is shown in Fig. 6.5.

Fig. 6.5. Brightness Transformation Characteristic



- (2) Maximum Brightness Consider the brightness at video signal of 100 IRE in the brightness characteristics as the large area maximum brightness and small area maximum brightness.

Express the measured results as given in Table 6.4.

Table 6.4. Maximum Brightness

Unit: cd/m ²	
Large area maximum brightness	1050
Small area maximum brightness	1340

- (3) Contrast Set up the receiver under the standard test conditions, apply the test input signal modulated by the black window signal to the receiver, and adjust one side of the black window to 40 % of W . Measure the brightness at positions L_b , L_{W1} to L_{W4} in a circle with a diameter equal to 4 % of W as shown in Fig. 6.6. Calculate large area contrast a_a from the following formula:

$$a_a = \frac{L_{W1} + L_{W2} + L_{W3} + L_{W4}}{4 L_b}$$

Next, carry out the similar measurements while one side of the black window is made 5 % of W .

Calculate small area contrast a_b from the following formula:

$$a_b = \frac{L_{W1} + L_{W2} + L_{W3} + L_{W4}}{4 L_b}$$

Express the measurement results as given in Table 6.5.

Fig. 6.6

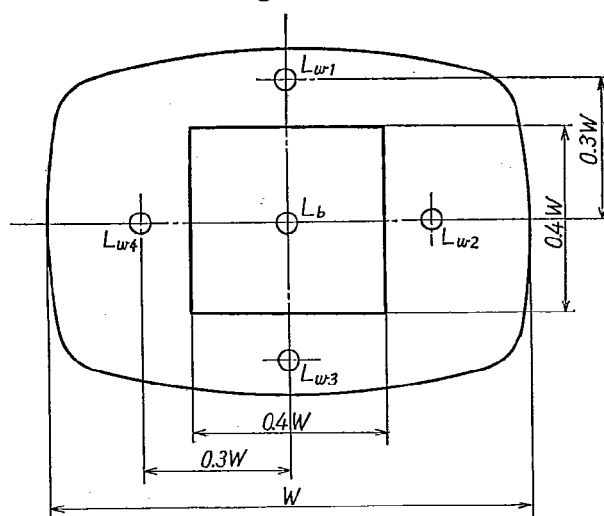


Table 6.5. Contrast

Large area contrast	76
Small area contrast	18

- (4) **Black Level Deviation** Set up the receiver under the standard test conditions, apply the test input signal modulated by the white window signal to the receiver and adjust one side of the white window to 60 % of W . Assume the brightness at the center of window when the video signal is 100 IRE L_w , and the brightness of black part L_b .

Next, measure the brightness of black level L_{bs} when the test video signal is made all black signal. Calculate the black level deviation from the following formula:

$$\text{Black level deviation (\%)} = \frac{L_{bs} - L_b}{L_w - L_b} \times 100$$

One example of measurement results is shown in Table 6.6. When the deviated black level falls below the cut-off point of the picture tube at a certain value of used black level, record such fact on the report.

Table 6.6. Black Level Deviation

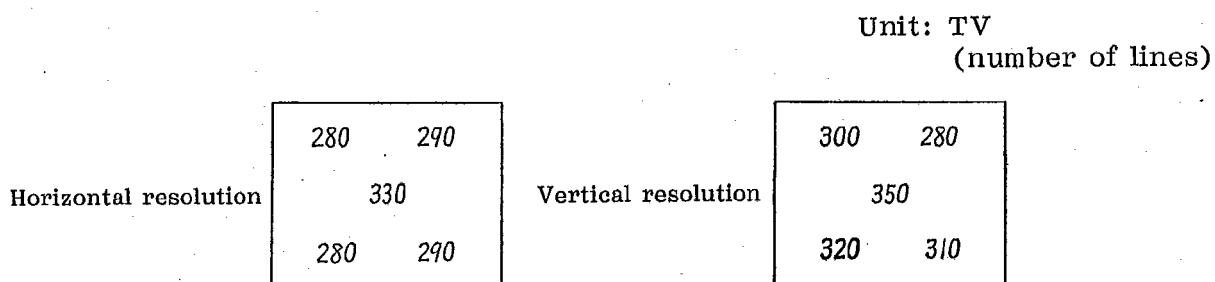
Unit: %	
Black level deviation	2

6.1.5 Resolution Set up the receiver under the standard test conditions, and apply the test input signal modulated by test pattern signal (a) to the receiver. Read the number of distinguishable lines in the resolution wedge located in the center and four corners of the pattern under the above stated conditions.

Express the vertical resolution and horizontal resolution at each position of the picture in the number of lines as shown in Fig. 6.7 to report the measurement results. Use the channel number group A given in Table 2.3 for this test.

If the resolution differs due to existence or non-existence of burst signal, record both measurement results side by side.

Fig. 6.7. Resolution



6.1.6 Characteristic due to Non-synchronization with Supply Obtain the effect due to non-synchronization of vertical scanning frequency with the power supply frequency by the measurements of change of picture brightness, weave of picture and change of geometrical distortion.

Measure the amplitude of brightness change at the center of picture under the test conditions of 6.1.4 (2) Maximum Brightness, and express the measured value in percentage of the maximum brightness as the brightness change. It is desirable, in general, to use a luminance meter and an oscilloscope for the measurement of the changed amount. Carry out the test under the test conditions of 6.1.1 Geometrical Distortion of Picture on the receiver the picture area of which is divided into four sections. Measure the displacement of the measurement point at the center of each divided picture area and near by the intersection points of the separating lines and contour. Express the horizontal and vertical displacements in percentage of width and height of picture respectively, as the weave of picture and change of geometrical distortion.

Express the measurement results as given in Table 6.7.

Table 6.7. Characteristic due to Non-synchronization with Supply

Change of brightness	Measurement is impossible due to very small change
Weave of picture	Not observed at each point.
Weave of raster	0.5 % at the horizontal right end, no weave is observed at other parts.

6.1.7 Other Characteristics Related to Quality of Picture Determine the following characteristics related to quality of picture by observation using the test input signal modulated by the test pattern signal.

Observe the picture by means of the interlace checker of the test pattern signal (a), and examine the positional symmetricalness of scanning lines and existence or non-existence of weave to evaluate the interlace scanning.

Use the test pattern signal (b), and examine the disturbance due to symmetry of black and white or other special conditions, existence or non-existence of vertical and/or horizontal weave and deviation, aliasing error and other abnormal phenomena to evaluate the synchronization.

Express the measurement results as given in Table 6.8.

If it is possible to display checkered pattern on the screen by using the test pattern signal (a) and decreasing the amplitude of the receiver, evaluate the synchronization by means of the said signal in the same way as mentioned above.

Table 6.8. Other Characteristics Referring to Quality of Picture

Interlace scanning	It is not perfect, but such state is repeated that the position almost in the middle (spacing 6:4) and two lines are tangential.
Others	Flicker is somewhat conspicuous.

6.2 Receiving Characteristics

6.2.1 Maximum Sensitivity Set up the receiver under the standard test conditions, use the test input signal modulated by the three-vertical-stripe signal and adjust each control so that the degree of amplification is the maximum.

Regulate the input signal level so that the received picture corresponds to the standard video test output, and obtain the value of level.

Use the test channel number group B given Table 2.3 for this test. Express the measurement results as given in Table 6.9.

6.2.2 Noise-limited Sensitivity The noise-limited sensitivity means the minimum value of the receiver input by which the standard video test output with a SN ratio of 30 dB is obtained. The SN ratio shall be the ratio of the peak-to-peak value of the signal voltage (not including synchronizing signal) to the r.m.s. value of the noise voltage.

- (1) Set up the receiver under the standard test conditions, use the test input signal modulated by the three-step waveform signal, and regulate the receiver so that the amplification is the maximum.

Increase the input signal level from that at the maximum sensitivity step by step, and adjust the amplification of the receiver so that the standard video test output is obtained at each level. Obtain the ratio of the peak-to-peak value of the video output voltage to the noise output voltage (r.m.s. value) appearing in the gray part, at each input signal level. Measure the noise output voltage (r.m.s. value) by comparing it with a noise voltage the r.m.s. value of which is already known using an oscilloscope.

For receivers equipped with the picture quality control, carry out the measurement at both ends of the picture quality control, in addition to the measurement under the standard test conditions, and additionally record the results.

In the case of a receiver whose band characteristics of picture changes due to the color signal, carry out the measurements after causing the change same as the change of circuit when a burst signal is received.

Use the test channel number group B given in Table 2.3 for this test. Express the measurement results as given in Table 6.9.

- Remarks 1. The known noise signal shall be a noise signal having a band almost equal to the band width of the receiver.
2. If the noise voltage the r.m.s. value of which is known is not available, measure the peak-to-peak voltage of the noise voltage. Assume the ratio of the noise output voltage (r.m.s. value) to the peak-to-peak value measured about 1:5.

- (2) The SN ratio may be obtained by the following method as an alternative method:

Set up the receiver under the standard test conditions, and connect the apparatus as shown in Fig. 6.8. Apply the test input signal modulated by the three-staircase signal, and control the receiver so that the standard video test output is obtained.

Change the three-step waveform signal to the gray signal and measure the noise output voltage appearing at the gray part of the video output with a video noise meter. Obtain the SN ratio as the ratio of the standard video test voltage V_1 (peak-to-peak value) to the noise output voltage V_2 (r.m.s. value). Increase the test input level step by step from that at the maximum sensitivity, and repeat the above measurement at each input level.

Fig. 6.8. Noise-limited Sensitivity Measurement System Diagram

