

# Methods of measurement on receivers for television broadcast transmissions —

## Part 1: General considerations — Measurements on displays at radio and video frequencies

The European Standard EN 60107-1:1997 has the status of a  
British Standard

ICS 33.160.20

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

**BSI**  
Documents

AVA

Document Sharing Hub

# National foreword

This British Standard is the English language version of EN 60107-1:1997. It is identical with IEC 60107-1:1997. It supersedes BS 3549-1:1979 which will be withdrawn on 1997-12-01.

The UK participation in its preparation was entrusted by Technical Committee ELP/100, Audio, video and multimedia systems and equipment, to Subcommittee EPL/100/1, Receiving equipment, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

### Cross-references

Attention is drawn to the fact that Annex ZA lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or using the “Find” facility of the BSI Standards Electronic Catalogue.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 126 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

### Amendments issued since publication

| Amd. No. | Date | Comments |
|----------|------|----------|
|          |      |          |
|          |      |          |
|          |      |          |
|          |      |          |
|          |      |          |

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 July 1997

© BSI 07-1999

ISBN 0 580 27734 8

# Contents

|                    | Page               |
|--------------------|--------------------|
| National foreword  | Inside front cover |
| Foreword           | 2                  |
| Text of EN 60107-1 | 7                  |



---

ICS 33.160.20

Descriptors: Television receivers, electric measurements, display devices, radio frequencies, tests, electrical properties, sensitivity, luminance, chrominance, images, synchronisation, quality

English version

Methods of measurement on receivers for television  
broadcast transmissions  
Part 1: General considerations Measurements at radio and  
video frequencies

(IEC 60107-1:1997)

Méthodes de mesures applicables  
aux récepteurs de télévision  
Partie 1: Considérations générales  
Mesures aux domaines radiofréquences  
et vidéofréquences  
(CEI 60107-1:1997)

Meßverfahren für Empfänger von  
Fernseh-Rundfunksendungen  
Teil 1: Allgemeine Vorschriften,  
Messungen bei Radio- und  
Videofrequenzen  
(IEC 60107-1:1997)

This European Standard was approved by CENELEC on 1997-03-11. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

## CENELEC

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

---

© 1997 CENELEC — All rights of exploitation in any form and by any means reserved worldwide for CENELEC members.

## Foreword

The text of document 100A/5 + 5A/FDIS, future edition 3 of IEC 60107-1, prepared by SC 100A, Multimedia end-user equipment, of IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60107-1 on 1997-03-11.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-12-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1997-12-01

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex A, Annex B and Annex ZA are normative and Annex C is informative. Annex ZA has been added by CENELEC.

## Endorsement notice

The text of the International Standard IEC 60107-1:1997 was approved by CENELEC as a European Standard without any modification.

In the official version, for Annex C, Bibliography, the following notes have to be added for the standards indicated:

IEC 61079-1 NOTE Harmonized as EN 61079-1:1993 (not modified)

IEC 61079-2 NOTE Harmonized as EN 61079-2:1993 (not modified)

IEC 61079-3 NOTE Harmonized as EN 61079-3:1993 (not modified)

IEC 61079-5 NOTE Harmonized as EN 61079-5:1993 (not modified)

## Contents

|                                                 | Page |
|-------------------------------------------------|------|
| 1 General                                       | 7    |
| 1.1 Scope                                       | 7    |
| 1.2 Normative references                        | 7    |
| 2 General explanation of terms                  | 8    |
| 2.1 Definitions                                 | 8    |
| 2.2 Types of receivers                          | 8    |
| 2.3 Peripheral connectors                       | 8    |
| 3 General notes on measurement                  | 9    |
| 3.1 General conditions                          | 9    |
| 3.1.1 Operation conditions                      | 9    |
| 3.1.2 Test room                                 | 9    |
| 3.1.3 Presentation of results                   | 9    |
| 3.1.4 Environmental conditions                  | 9    |
| 3.1.5 Precautions during measurement            | 9    |
| 3.1.6 Power supply                              | 9    |
| 3.1.7 Stabilization period                      | 10   |
| 3.2 Test signals                                | 10   |
| 3.2.1 Video test signals                        | 10   |
| 3.2.2 Audio test signals                        | 14   |
| 3.2.3 Teletext test signals                     | 14   |
| 3.3 Radiofrequency (r.f.) television signal     | 31   |
| 3.3.1 Carrier levels                            | 31   |
| 3.3.2 Reference modulation                      | 31   |
| 3.3.3 Test channels                             | 32   |
| 3.4 Radiofrequency input signals                | 33   |
| 3.4.1 Radiofrequency input signal level         | 33   |
| 3.4.2 Radiofrequency input arrangements         | 33   |
| 3.4.3 Radiofrequency input to built-in antennas | 33   |
| 3.5 Measuring system and test instruments       | 35   |
| 3.5.1 Measuring system                          | 35   |
| 3.5.2 Baseband test signal generators           | 35   |
| 3.5.3 Television test modulator                 | 36   |
| 3.5.4 RF signal generator                       | 36   |
| 3.5.5 Spectrum analyzer                         | 36   |
| 3.5.6 Video noise meter                         | 36   |
| 3.5.7 Oscilloscope                              | 36   |
| 3.5.8 Vectorscope                               | 36   |
| 3.5.9 Audio level/distortion meter              | 36   |
| 3.5.10 Passive devices                          | 36   |
| 3.5.11 Luminance meter and colorimeter          | 36   |
| 3.5.12 Other optical measuring instruments      | 37   |
| 3.6 Standard measuring conditions               | 37   |

|                                                                 | Page |                                                                                                              | Page |
|-----------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------|------|
| 3.6.1 Standard input signal levels                              | 37   | 5.3.8 IF beat interference ratio                                                                             | 59   |
| 3.6.2 Standard output signal levels                             | 37   | 5.3.9 Spurious frequency interference ratio                                                                  | 59   |
| 3.6.3 Standard receiver settings                                | 39   | 5.3.10 Internally generated interference                                                                     | 60   |
| 3.6.4 Standard viewing conditions                               | 39   | 6 Characteristics of luminance and chrominance channels                                                      | 62   |
| 3.6.5 General conditions                                        | 40   | 6.1 Characteristics of the luminance channel                                                                 | 62   |
| 4 Initial tests under general operating conditions              | 40   | 6.1.1 General measuring conditions                                                                           | 62   |
| 4.1 Electrical and mechanical performance                       | 40   | 6.1.2 Amplitude response to video frequency                                                                  | 62   |
| 4.2 Power consumption                                           | 41   | 6.1.3 Group delay characteristics to video frequency                                                         | 63   |
| 5 Characteristics of radiofrequency channel                     | 42   | 6.1.4 Linear waveform response                                                                               | 63   |
| 5.1 Tuning characteristics                                      | 42   | 6.1.5 Line-time non-linearity                                                                                | 65   |
| 5.1.1 Operating frequency and its stability                     | 42   | 6.1.6 Chrominance to luminance intermodulation                                                               | 65   |
| 5.1.2 Fine tuning frequency range                               | 42   | 6.1.7 Black level and its stability                                                                          | 65   |
| 5.1.3 Automatic frequency control (AFC)                         | 42   | 6.1.8 Cross luminance (SECAM system)                                                                         | 66   |
| 5.1.4 Tuning sensitivity                                        | 43   | 6.2 Characteristics of chrominance channels                                                                  | 68   |
| 5.1.5 Mechanical properties of tuning system                    | 43   | 6.2.1 General measuring conditions                                                                           | 68   |
| 5.1.6 Performance characteristics of presettable tuning systems | 44   | 6.2.2 Chrominance automatic gain control characteristics                                                     | 69   |
| 5.1.7 Tuning steps                                              | 44   | 6.2.3 Differential gain and differential phase                                                               | 69   |
| 5.2 Sensitivity                                                 | 47   | 6.2.4 Amplitude response to modulation frequency                                                             | 70   |
| 5.2.1 General measuring conditions                              | 47   | 6.2.5 Linear waveform response in chrominance channel                                                        | 70   |
| 5.2.2 Gain-limited sensitivity                                  | 47   | 6.2.6 Luminance/chrominance delay inequality                                                                 | 72   |
| 5.2.3 Noise-limited sensitivity                                 | 48   | 6.2.7 Line-time non-linearity of chrominance signals                                                         | 73   |
| 5.2.4 Synchronizing sensitivity                                 | 48   | 6.2.8 Colour signal reproduction characteristics                                                             | 73   |
| 5.2.5 Colour sensitivity                                        | 48   | 6.2.9 Stability of colour synchronization                                                                    | 74   |
| 5.2.6 Coefficient of reflection at the antenna input            | 49   | 6.2.10 Phase stability of subcarrier oscillator                                                              | 74   |
| 5.2.7 Automatic gain control (AGC) static characteristics       | 49   | 6.2.11 Cross-colour distortion                                                                               | 75   |
| 5.2.8 Automatic gain control (AGC) dynamic characteristics      | 50   | 6.2.12 Group delay characteristics at subcarrier frequency                                                   | 77   |
| 5.2.9 Colour killing                                            | 50   | 6.2.13 Chrominance amplifier and limiter in SECAM receivers                                                  | 77   |
| 5.2.10 Maximum usable single r.f. input signal level            | 50   | 6.3 Demodulation characteristics of chrominance signals inherent in each colour system (NTSC, PAL and SECAM) | 85   |
| 5.2.11 Maximum usable multiple r.f. input signal level          | 51   | 6.3.1 Errors of chrominance signal demodulation angle — NTSC system                                          | 85   |
| 5.3 Selectivity and response to undesired signals               | 52   | 6.3.2 Errors of chrominance signal demodulation angle — PAL system                                           | 87   |
| 5.3.1 General                                                   | 52   |                                                                                                              |      |
| 5.3.2 Two-signal selectivity                                    | 53   |                                                                                                              |      |
| 5.3.3 Intermediate frequency interference ratio                 | 54   |                                                                                                              |      |
| 5.3.4 Adjacent channel interference ratio                       | 55   |                                                                                                              |      |
| 5.3.5 Image interference ratio                                  | 56   |                                                                                                              |      |
| 5.3.6 Intermodulation interference ratio                        | 57   |                                                                                                              |      |
| 5.3.7 Cross-modulation interference ratio                       | 58   |                                                                                                              |      |

|                                                                                                     | Page |                                                                                                                                 | Page |
|-----------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------|------|
| 6.3.3 Effects of phase distortion on incoming signal for small picture areas — PAL system           | 88   | 7.4.5 Dependence of chromaticity on viewing angle                                                                               | 115  |
| 6.3.4 Direct and delayed signal amplitude matching — SECAM system                                   | 88   | 7.4.6 Screen gain and luminous flux index of a projector                                                                        | 115  |
| 6.3.5 Colour flaming on luminance transients — SECAM system                                         | 89   | 7.4.7 Blanking                                                                                                                  | 117  |
| 6.3.6 Influence of the reference frequency deviation of the FM demodulator in SECAM colour decoders | 89   | 7.5 Characteristics inherent in LCD displays                                                                                    | 118  |
| 6.3.7 Deviation of the r.f. de-emphasis frequency adjustment in SECAM colour decoders               | 90   | 7.5.1 General                                                                                                                   | 118  |
| 6.3.8 Colour crosstalk (SECAM system)                                                               | 91   | 7.5.2 Luminance uniformity                                                                                                      | 119  |
| 7 Characteristics of displayed pictures                                                             | 95   | 7.5.3 Variation of luminance with time                                                                                          | 119  |
| 7.1 General properties of the picture                                                               | 95   | 7.5.4 Uniformity of chromaticity                                                                                                | 119  |
| 7.1.1 General measuring conditions                                                                  | 95   | 7.5.5 Viewing angle and dependence of luminance uniformity on the angle                                                         | 119  |
| 7.1.2 Geometric distortion                                                                          | 95   | 7.5.6 Dependence of chromaticity on viewing angle                                                                               | 119  |
| 7.1.3 Over- and under-scanning and centring                                                         | 98   | 7.6 Characteristics inherent in widescreen displays                                                                             | 119  |
| 7.1.4 Luminance and contrast                                                                        | 99   | 7.6.1 General                                                                                                                   | 119  |
| 7.1.5 Colour purity of colour CRT                                                                   | 100  | 7.6.2 Display mode                                                                                                              | 119  |
| 7.1.6 White uniformity of colour CRT                                                                | 100  | 7.6.3 Methods of measurement                                                                                                    | 119  |
| 7.1.7 Convergence and registration errors                                                           | 101  | 8 Characteristics inherent in the receivers using double-rate scan displays                                                     | 120  |
| 7.1.8 White balance                                                                                 | 101  | 8.1 General                                                                                                                     | 120  |
| 7.1.9 Resolution                                                                                    | 101  | 9 Disturbance on the picture due to signals inserted into the field blanking interval                                           | 120  |
| 7.1.10 Interference due to asynchronicity of mains frequency with field scanning frequency          | 102  | 9.1 Introduction                                                                                                                | 120  |
| 7.1.11 Sound to picture interference                                                                | 103  | 9.2 Method of measurement                                                                                                       | 120  |
| 7.1.12 Other characteristics of the picture                                                         | 103  | 9.3 Presentation of results                                                                                                     | 121  |
| 7.2 Synchronizing quality                                                                           | 109  | 10 Characteristics inherent in teletext signals                                                                                 | 121  |
| 7.2.1 Synchronizing range                                                                           | 109  | 10.1 General                                                                                                                    | 121  |
| 7.2.2 Pulling on whites                                                                             | 110  | 10.2 General measuring conditions                                                                                               | 121  |
| 7.2.3 Pulling on field synchronization pulses                                                       | 110  | 10.3 Characteristics of teletext signal                                                                                         | 121  |
| 7.2.4 Quality of interlace                                                                          | 110  | Annex A (normative) Analytical description of the offset-carrier colour bar signal                                              | 122  |
| 7.3 Picture size stability versus changes of CRT beam current                                       | 112  | Annex B (normative) Calculation of the relative amplitude and the group delay by the response of a modulated sine-squared pulse | 123  |
| 7.3.1 Picture breathing (static loading influences on picture geometry)                             | 112  | Annex C (informative) Bibliography                                                                                              | 124  |
| 7.3.2 Local picture distortion (dynamic loading influences on picture geometry)                     | 112  | Annex ZA (normative) Normative references to international publications with their corresponding European publications          | 125  |
| 7.4 Characteristics inherent in projection type displays                                            | 113  | Figure 1 — Primary colour bar signals                                                                                           | 15   |
| 7.4.1 General                                                                                       | 113  | Figure 2 — NTSC split-field colour bar                                                                                          | 15   |
| 7.4.2 Luminance uniformity                                                                          | 113  | Figure 3 — NTSC colour bar signal (75/0/75/0)                                                                                   | 16   |
| 7.4.3 Uniformity of chromaticity                                                                    | 114  |                                                                                                                                 |      |
| 7.4.4 Viewing angle and dependence of luminance uniformity on the angle                             | 114  |                                                                                                                                 |      |

|                                                              | Page |                                                                                                                                          | Page |
|--------------------------------------------------------------|------|------------------------------------------------------------------------------------------------------------------------------------------|------|
| Figure 4 — NTSC colour bar signal<br>(77/7,5/77/7,5)         |      | Figure 37 — Measuring set-up for TEM<br>device method                                                                                    | 35   |
| Figure 5 — PAL and SECAM full-field<br>colour bar            | 16   | Figure 38 — Functional block diagram of<br>measuring system                                                                              | 38   |
| Figure 6 — PAL colour bar signal<br>(100/0/75/0)             | 16   | Figure 39 — Arrangement of equipment for<br>measuring local oscillator frequencies                                                       | 45   |
| Figure 7 — SECAM colour bar signal<br>(100/0/75/0)           | 17   | Figure 40 — Example of operating frequency<br>stability                                                                                  | 46   |
| Figure 8 — SECAM colour bar signal<br>(30/0/30/0)            | 17   | Figure 41 — AFC curve for variation of vision<br>carrier frequency (conceptual diagram)                                                  | 47   |
| Figure 9 — Three vertical bar signal                         | 18   | Figure 42 — AFC curve for variation of local<br>oscillator frequency (conceptual diagram)                                                | 47   |
| Figure 10 — Cross-hatch signals                              | 18   | Figure 43 — Arrangement of equipment for<br>return loss measurement                                                                      | 52   |
| Figure 11 — Flat level signal                                | 19   | Figure 44 — Example of AGC static<br>characteristics                                                                                     | 52   |
| Figure 12 — White window signal                              | 19   | Figure 45 — Arrangement of test equipment<br>for two-signal method                                                                       | 61   |
| Figure 13 — Black and white window<br>signal                 | 20   | Figure 46 — Arrangement of test equipment<br>for three-signal method                                                                     | 62   |
| Figure 14 — Line and window signal                           | 20   | Figure 47 — $2T$ bar response                                                                                                            | 67   |
| Figure 15 — Two step signal                                  | 21   | Figure 48 — $2T$ pulse response                                                                                                          | 67   |
| Figure 16 — Colour reference signal                          | 21   | Figure 49 — Field rate square-wave<br>response                                                                                           | 68   |
| Figure 17 — Composite sine-wave<br>signal                    | 21   | Figure 50 — Line-time non-linearity                                                                                                      | 68   |
| Figure 18 — Multiburst signal                                | 22   | Figure 51 — Waveform of B primary colour<br>signal                                                                                       | 78   |
| Figure 19 — Multipulse signal                                | 22   | Figure 52 — Example of chrominance<br>automatic gain control characteristics                                                             | 79   |
| Figure 20 — $2T$ pulse and bar signal                        | 22   | Figure 53 — Example of chrominance output<br>signal amplitude response to modulation<br>frequency                                        | 79   |
| Figure 21 — Horizontal bar signal                            | 23   | Figure 54 — Modulated $20T$ bar response                                                                                                 | 80   |
| Figure 22 — Staircase signal                                 | 23   | Figure 55 — Modulated $20T$ pulse<br>response                                                                                            | 80   |
| Figure 23 — PLUGE signal                                     | 24   | Figure 56 — Luminance-chrominance<br>delay                                                                                               | 80   |
| Figure 24 — White PLUGE signal                               | 25   | Figure 57 — Waveform of output signals                                                                                                   | 81   |
| Figure 25 — Colour staircase signal                          | 26   | Figure 58 — Example of non-linearity of<br>chrominance signal                                                                            | 81   |
| Figure 26 — Sine-wave modulated<br>chrominance signal        | 26   | Figure 59 — In phase (a) and quadrature (b)<br>output terminal of the “B” drive port                                                     | 82   |
| Figure 27 — Modulated $20T$ pulse and bar<br>signals         | 27   | Figure 60 — “B” output terminal: in phase<br>output (a) and two quadrature outputs (b) with<br>difference (c) due to frequency deviation | 82   |
| Figure 28 — Y/C timing test signal                           | 28   | Figure 61 — Arrangement of test equipment<br>for cross-colour measurement                                                                | 82   |
| Figure 29 — Staircase-modulated<br>chrominance signal        | 29   | Figure 62 — Frequencies and levels of video<br>test signals and output signals in cross-colour<br>distortion measurement                 | 83   |
| Figure 30 — Modulated pedestal<br>signal                     | 29   |                                                                                                                                          |      |
| Figure 31 — Single colour bar signal                         | 29   |                                                                                                                                          |      |
| Figure 32 — Offset-carrier colour bar<br>signal              | 29   |                                                                                                                                          |      |
| Figure 33 — Four-line colour difference<br>signal            | 30   |                                                                                                                                          |      |
| Figure 34 — Checkered pattern signal                         | 31   |                                                                                                                                          |      |
| Figure 35 — Modulated radiofrequency<br>signals              | 32   |                                                                                                                                          |      |
| Figure 36 — Measuring set-up for radiating<br>antenna method | 35   |                                                                                                                                          |      |

|                                                                                                                                                                                                   | Page |                                                                                                                                         | Page |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------------------------|------|
| Figure 63 — Example of cross-colour distortion measured                                                                                                                                           | 83   | Figure 86 — Pulling on field synchronizing pulses                                                                                       | 111  |
| Figure 64 — Modulated sine-squared pulse response                                                                                                                                                 | 84   | Figure 87 — Quality of interlace                                                                                                        | 111  |
| Figure 65 — Modulated $20T$ nomograph for M/NTSC system ( $T = 0,125 \mu\text{s}$ ) (from IEEE Trans. BC-18, No.1, March 1972, page 15)                                                           | 84   | Figure 88 — Interlace check pattern                                                                                                     | 112  |
| Figure 66 — Modulated $20T$ nomograph for B,G/PAL systems ( $T = 0,100 \mu\text{s}$ ) (from IEEE Trans. BC-18, No.1, March 1972, page 17)                                                         | 84   | Figure 89 — Measurement of local picture distortion                                                                                     | 113  |
| Figure 67 — Vector diagram of offset-carrier colour bar signal                                                                                                                                    | 85   | Figure 90 — Standard viewing position                                                                                                   | 117  |
| Figure 68 — Waveforms of colour output signals in line sweep                                                                                                                                      | 92   | Figure 91 — Measurement of viewing angles                                                                                               | 118  |
| Figure 69 — X-Y (vector) representation of demodulated four-line colour difference signal                                                                                                         | 92   | Figure A.1 — Phase angle of R-Y colour difference signal                                                                                | 122  |
| Figure 70 — Distortion of small picture areas; p-p value of venetian blinds                                                                                                                       | 93   | Figure A.2 — Phase angle of G-Y colour difference signal                                                                                | 123  |
| Figure 71 — R-Y/B-Y colour difference display a, b, and c; R/B primary display d, e, and f (without frequency deviation error: a and d; with frequency error: b and e; zero saturation; c and f.) | 93   | Table 1 — Recommended values for terminal voltage                                                                                       | 34   |
| Figure 72 — Beat interference due to colour crosstalk in SECAM R and B signals                                                                                                                    | 94   | Table 2 — Example of luminance/chrominance inequality measurement (expressed in $\mu\text{s}$ )                                         | 73   |
| Figure 73 — Typical outline distortions                                                                                                                                                           | 95   | Table 3 — Example of colour signal reproduction characteristics (expressed in per cent and measured with (75/0/75/0) colour bar signal) | 74   |
| Figure 74 — Example of non-linearity graph                                                                                                                                                        | 104  | Table 4 — Example of outline distortion                                                                                                 | 98   |
| Figure 75 — Points for measuring outline distortion values                                                                                                                                        | 104  | Table 5 — Example of viewing angles measured (unit: degree)                                                                             | 117  |
| Figure 76 — Inner distortion                                                                                                                                                                      | 105  |                                                                                                                                         |      |
| Figure 77 — Over-scanning                                                                                                                                                                         | 105  |                                                                                                                                         |      |
| Figure 78 — Under-scanning                                                                                                                                                                        | 106  |                                                                                                                                         |      |
| Figure 79 — Centring                                                                                                                                                                              | 106  |                                                                                                                                         |      |
| Figure 80 — Measuring points for contrast                                                                                                                                                         | 107  |                                                                                                                                         |      |
| Figure 81 — Example of electro-optical transfer characteristics measured                                                                                                                          | 107  |                                                                                                                                         |      |
| Figure 82 — Measuring points for convergence and registration errors                                                                                                                              | 108  |                                                                                                                                         |      |
| Figure 83 — Measurement of convergence or registration errors at an intersection                                                                                                                  | 108  |                                                                                                                                         |      |
| Figure 84 — Example of light output of a screen operated by asynchronous power supply                                                                                                             | 109  |                                                                                                                                         |      |
| Figure 85 — Pulling on whites                                                                                                                                                                     | 109  |                                                                                                                                         |      |

## 1 General

### 1.1 Scope

This part of IEC 60107 deals with the standard conditions and methods of measurement on television receivers that conform to the terrestrial broadcast television standards specified by the ITU-R<sup>1)</sup>. Such receivers may be used for direct off-air, reception, reception via cabled networks or as a monitor for prerecorded video, home movies and games among other applications. This part does not include the measurements specific to the sound channels which are dealt with by other parts: IEC 60107-2, IEC 60107-3, IEC 60107-4, and IEC 60107-5. Measurements for the non-broadcast signals are dealt with by IEC 60107-6.

This part of IEC 60107 deals with the determination of performance and permits the comparison of equipment by listing the characteristics which are useful for specifications and by laying down uniform methods of measurement for these characteristics. Performance requirements are not specified.

This part of IEC 60107 does not deal with general safety matters, for which reference is required to IEC 60065, or other appropriate IEC safety standards, nor with radiation and immunity, for which reference is required to CISPR 13 and CISPR 20.

### 1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60107. At the time of publication, the editions indicated were valid. All normative documents are subject to revision and the parties to agreements based on this part of IEC 60107 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60065:1985, *Safety requirements for mains operated electronic and related apparatus for household and similar general use.*

Amendment 2 (1989) which incorporates amendment 1

Amendment 3 (1992)

IEC 60068-1:1988, *Environmental testing — Part 1: General and guidance.*

IEC 60107-2:1997, *Methods of measurement on receivers for television broadcast transmissions — Part 2: Audio channels — General methods and methods for monophonic channels.*

IEC 60107-3:1988, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 3: Electrical measurements on multichannel sound television receivers using subcarrier systems.*

IEC 60107-4:1988, *Recommended methods of measurements on receivers for television broadcast transmissions — Part 4: Electrical measurements on multichannel sound television receivers using the two-carrier FM system.*

IEC 60107-5:1992, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 5: Electrical measurements on multichannel sound television receivers using the NICAM two-channel digital sound system.*

IEC 60107-6:1989, *Recommended methods of measurement on receivers for television broadcast transmissions — Part 6: Measurements under conditions different from broadcast signal standards.*

IEC 60569:1977, *Informative guide for subjective tests on television receivers.*

IEC 60933-1:1988, *Audio, video and audiovisual systems — Interconnections and matching values — Part 1: 21-pin connector for video systems — Application No. 1.*

Amendment 1 (1992)

IEC 60933-2:1991, *Audio, video and audiovisual systems — Interconnections and matching values — Part 2: 21-pin connector for video systems — Application No. 2.*

IEC 60933-5:1992, *Audio, video and audiovisual systems — Interconnections and matching values — Part 5: Y/C connector for video systems — Electrical matching values and description of the connector.*

CISPR 13:1990, *Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.*

Amendment 3 (1995) which incorporates amendments 1 and 2

CISPR 20:1996, *Limits and methods of measurement of immunity characteristics of sound and television broadcast receivers and associated equipment.*

ITU-R BT.471-1:1994, *Nomenclature and description of colour bar signals.*

ITU-T J.63:1990, *Insertion of test signals in the field-blanking interval of monochrome and colour television signals.*

ITU-R BT.470-4:1995, *Television systems.*

<sup>1)</sup> Former CCIR.

ITU-R BT.814-1:1994, *Specifications and alignment procedures for setting of brightness and contrast of displays*.

CIE 15.2:1986, *Colorimetry*.

CIE 46:1979, *A review of publications on properties and reflection values of material reflection standards*.

C.W. Rhodes, *The 12.5T modulated sine-squared pulse for NTSC*, *IEEE Transactions on Broadcasting*, vol. BC-18, No. 1, March 1972.

C.A. Siocos, *Chrominance-to-luminance ratio and timing measurements in color television*, *IEEE Transactions on broadcasting*, Vol. BC-14, No. 1, March 1968.

## 2 General explanation of terms

### 2.1 Definitions

For the purpose of this part of IEC 60107-1, the following general definitions apply:

#### 2.1.1

##### signal strength

the signal strength is considered to be equal to the r.m.s. value of unmodulated radiofrequency signal having the same peak envelope amplitude as that of the modulated television signal at peak amplitude

#### 2.1.2

##### picture modulation percentage

the picture modulation percentage is expressed on a linear scale to indicate the picture signal level at any instant where:

- 0 % picture modulation corresponds to black level;
- 100 % picture modulation corresponds to white level.

NOTE The peak colour signal modulation can exceed these values.

#### 2.1.3

##### audio modulation percentage

the audio modulation percentage is expressed on a linear scale. The modulation percentages to be used during measurements are described in 3.3.2

NOTE Audio modulation is needed when making some of the video measurements.

#### 2.1.4

##### envelope level

the envelope level is expressed on a linear scale to indicate the level of the vision radiofrequency signal at any given instant

#### 2.1.5

##### luminance

luminance (L) in a given direction is the luminous intensity per unit of projected area of any surface, as viewed for that direction

the luminance value is expressed in candela per square metre ( $\text{cd/m}^2$ )

#### 2.1.6

##### chromaticity

property of colour stimulus defined by chromaticity coordinates (x, y) of the CIE 1931 standard colorimetric system or chromaticity coordinates ( $u'$ ,  $v'$ ) of the CIE 1976 uniform chromaticity system (see IEC 845-03-34)

#### 2.1.7

##### composite video signal

a composite video signal is a signal comprising the luminance, chrominance and the complete synchronizing information. It can also include digital data

## 2.2 Types of receivers

Television receivers are usually designed to be capable of receiving broadcast and similar signals in a variety of ways. Examples are direct off-air reception or via a cabled network in the VHF/UHF bands, and from satellite broadcasts in conjunction with an outdoor unit and a DBS tuner. The signal may also include digital information, such as teletext.

For non-broadcast signals, the receiver may be used as a monitor to display prerecorded video or home movies. The equipment providing such information may modulate the signals on an r.f. carrier for connection to the antenna terminal, or provide baseband signals or both.

General purpose television receivers are usually designed for all the above external signals. They may also include a DBS tuner/decoder and decoders for data information signals. Or, the receiver may be provided with outlets to permit use as a tuner.

The methods of measurement described in this standard take account of the various options.

## 2.3 Peripheral connectors

Most receivers are provided with connectors for the interface with audio and video signals other than those at radiofrequencies. Examples are the 21-pin connector (see IEC 60933-1 and IEC 60933-2) and Y/C connector (see IEC 60933-5).

### 3 General notes on measurement

#### 3.1 General conditions

Measurements shall be made in accordance with the following conditions to ensure repeatable results.

##### 3.1.1 Operation conditions

Unless otherwise specified in the relevant clauses, the receiver under test shall be brought under the standard measuring conditions, as specified in 3.6.

##### 3.1.2 Test room

Measurements shall be carried out in a room which is not subject to external interference from radiofrequency and low-frequency electromagnetic fields. If interference may affect the results, the measurements shall be carried out in a screened room.

##### 3.1.3 Presentation of results

The results of measurement shall be listed in a table or presented graphically. However, the relationship between two or more quantities is often more clearly represented in a graph than in a table.

When the results of a point-by-point measurement for an individual sample are presented as a continuous curve in a graph, the measured points shall be clearly indicated. Extrapolated, theoretical or other information presented, but not based on direct measurements, shall be clearly distinguished from measured curves, for example by another style of drawing. Linear or logarithmic scales are recommended for graphical presentation. Linear decibel scales are equivalent to logarithmic scales. If deviations from the recommended method are adopted, these shall be clearly stated with the results. When known, the accuracy of measuring instruments shall also be given.

##### 3.1.4 Environmental conditions

Measurements and mechanical checks may be carried out at any combination of temperature, humidity, and pressure, within the following limits:

- ambient temperature: 15 °C to 35 °C, preferably 20 °C;
- relative humidity: 25 % to 75 %;
- air pressure: 86 kPa to 106 kPa.

For equipment designed for use in vehicles, the ambient temperature limits are provisionally 5 °C to 45 °C (final values are under consideration).

If the manufacturer finds it necessary to specify climatic conditions differing from the above, these should be chosen from IEC 60068-1 and the measurements shall be made under the specified conditions.

The conditions mentioned above represent those under which the equipment is required to meet its specifications. Over a wider range the equipment may operate but not meet all of its specifications and it may be permissible to store the equipment under much more extreme conditions. For more complete discussion of these concepts refer to IEC 60068.

##### 3.1.5 Precautions during measurement

When carrying out measurements, all test conditions or operations which may lead to damage of the receiver shall be avoided. This applies particularly to sensitive solid-state devices and similar constructions.

If a protective cover is removed and parts that are directly connected to the mains become accessible, the equipment shall be connected to the a.c. mains via a safety transformer whose secondary winding is insulated in accordance with the principle of double insulation.

It shall be ascertained that the use of a safety transformer does not influence the receiver properties to be measured. In particular, the internal impedance of the safety transformer shall be sufficiently low for the behaviour of the receiver to be the same as when directly connected to the mains supply.

##### 3.1.6 Power supply

The following types of power supply are considered:

- mains: any centralized a.c. or d.c. power sources;
- batteries: accumulators, primary batteries or similar sources such as solar batteries, thermo-electric cells etc;
- a.c. adapters: alternatives to normally lower d.c. voltage power sources and appropriately specified for the receiver.

The type, voltage and internal resistance of the power sources used during the measurements shall be either the power source specified for the receiver or closely simulate it. Any substitute arrangement used shall be stated with the results.

Receivers intended for use with more than one type of power supply should be measured with each type of power supply.

NOTE In this respect, a.c. and d.c. mains are considered different types of power supply.

Measurements of the receiver characteristics shall be carried out at the rated voltage of the power supply. The fluctuation of the power supply voltage during the tests shall not exceed  $\pm 2\%$ . When a.c. mains are used, the frequency fluctuation and the harmonic components of the power supply shall not exceed  $\pm 2\%$  and  $5\%$  respectively.

To determine the influence of variations in the supply voltages on the receiver characteristics, supplementary measurements may be needed at overvoltages and undervoltages, these being chosen appropriately with due regard to the manufacturer's specifications.

### 3.1.7 Stabilization period

In order to ensure that when measurements begin, the receiver characteristics are not changing significantly with time, the receiver shall be operated under standard measuring conditions for a sufficient period to permit the characteristics to stabilize.

## 3.2 Test signals

### 3.2.1 Video test signals

Video test signals shall be electronically generated. Waveforms of test signals and test patterns shown in this subclause are examples, other signals with similar characteristics may be used.

The amplitude of a picture component is measured from the blanking level and expressed as a percentage to the amplitude of the reference white level. Synchronizing tips correspond to – 40 % for NTSC system and – 43 % for PAL and SECAM systems. No set-up is given in the figures of the signal waveforms except for one of the NTSC colour bar signals, so that the black level coincides with the blanking level. If the system for the receiver under test requires a set-up, the black level corresponds to the blanking level plus the set-up level.

All the composite signals which are used to judge colour or background colour shall be provided with the colour burst for the relevant system. For the SECAM system, these signals shall be superimposed by the subcarrier applicable to the relevant colour and with the standard amplitude.

The white reference level can be obtained from composite test patterns, (100/0/75/0) colour bar, split-field colour bar, three vertical bar and staircase signals, which are defined in this subclause.

Test signals for measuring general properties of pictures include patterns for testing wide screen displays with 16 : 9 aspect ratio.

NOTE 1 The insertion test (ITS) signals defined by the Recommendation ITU-R BT.473-5 can be applied for testing the luminance and chrominance channels.

NOTE 2 In order to avoid excessive overshoots of the signal waveform which may occur in the television test modulator and the receiver under test, high-frequency components of the signal beyond 6 MHz should be attenuated by a suitable low-pass filter.

NOTE 3 Figures of waveforms with subcarrier and/or burst refer mainly to NTSC and PAL; for measurements on composite signals or luminance signals, they can be used in SECAM receivers as well.

Specific SECAM waveforms with subcarrier are indicated as such.

NOTE 4 In the case of SECAM measurements, the waveforms intended for black and white measurements will be superimposed with SECAM subcarrier at the frequency and amplitude corresponding to black and white.

#### 3.2.1.1 Composite test pattern signal

A composite test pattern signal comprises a combination of monochrome and colour signal components that offer as much information as possible on the performance of the television system. Such a pattern should include at least the following items:

- circles, and equidistant horizontal and vertical lines for linearity and colour convergence checks;
- a marking to check the aspect ratio;
- a known brightness scale of brightness steps from five to ten for gradation checks;
- vertical and horizontal definition wedges in the centre and in the four corners of the picture area;
- vertical bars of different widths or a wedge and horizontal blocks giving black-white and white-black transitions for checking overshoot, reflections, and low-frequency response;
- areas at the reference white level and black level to check the maximum and minimum brightness of the picture;
- coloured areas to check decoding operation, colour transitions and luminance/chrominance time equalization.

An average picture level (APL) of the pattern signal should be approximately 50 %.

#### 3.2.1.2 Colour bar signal

A colour bar signal consists of vertical bands of colours in order of descending luminance, left to right, which are defined by the ITU-R Recommendation BT.471-1. The colour bar signal for PAL and SECAM receivers shall be a full-field type colour bar signal consisting of (100/0/75/0) bars. For the SECAM receivers, (30/0/30/0) bars are also required.

The colour bar signal for NTSC receivers shall be a split-field type colour bar signal consisting of (75/0/75/0) bars or (77/7,5/77/7,5) bars, a 100 % white window and other colour windows.

The primary colour signals of the bars are shown in Figure 1.

NOTE For the nomenclature of bars, see ITU-R Recommendation BT.471-1.

The same bar arrangements can be used for wide aspect ratio pictures.

The composite colour signal of the bars shall comply with the television standard used. Waveforms of the composite colour signals for NTSC, PAL and SECAM systems are shown in Figure 2 to Figure 8.

### 3.2.1.3 *Three vertical bar signal*

The three vertical bar signal produces three equidistant vertical white bars on a black background. The width of each bar is  $1/6$  times the nominal horizontal width ( $W$ ) of the picture. A line-time waveform of the signal is shown in Figure 9. This signal has an APL of 50 % and includes the reference white level. It is suitable for setting the output signal level and the luminance level of white.

For the SECAM measurements, the subcarrier with the frequency and amplitude corresponding to black and white is superimposed on the signal.

The same bar width can be applied for the wide aspect ratio picture.

### 3.2.1.4 *White and black cross-hatch pattern signals*

The white cross-hatch pattern signal produces a white cross-hatch on a black background and the black cross-hatch pattern signal produces a black cross-hatch on a white background.

The white cross-hatch pattern is used to measure convergence errors or registration errors of displays and the black cross-hatch pattern is used as a scale for locating a point on the screen and other purposes.

The cross-hatch pattern consists of equidistant horizontal and vertical lines which form rectangular windows. Numbers of the lines are 13 and 17 for the standard aspect ratio of 4 : 3, and 13 and 21 for the wide aspect ratio of 16 : 9, as shown in Figure 10.

For colour-frame testing on luminance transients in the SECAM system, a white cross-hatch pattern signal with the subcarrier representing neutral colour is also required. The subcarrier is superimposed on the pattern at the standard amplitude.

### 3.2.1.5 *Flat level, full white, full grey and full black signals*

The flat level signal is a full-field flat amplitude signal, as shown in Figure 11. The picture amplitude is continuously variable from 0 % to 100 %.

The full white, full grey and full black signal are flat level signals whose amplitudes are set at 100 %, 50 % and 0 % respectively.

For the SECAM measurements, the subcarrier with the frequency and amplitude corresponding to black and white is superimposed on the signal.

These signals are used to measure luminance and other characteristics of displays.

### 3.2.1.6 *White window signal and wide white window signal*

The white window signal produces a white rectangular window on the black background, as shown in Figure 12. The width of the window is  $1/6$  times the active picture height ( $H$ ). The signal amplitude of the window is variable from 10 % to 100 %.

This signal is used to measure luminance of displays.

The wide white window signal produces a white rectangular window with a width of  $1/2$  times the nominal picture height and its amplitude is variable from 10 % to 100 %. This signal is not required, if the PLUGE signal is available.

For the SECAM measurements, the subcarrier with the frequency and amplitude corresponding to black and white is superimposed on the signal.

The same windows can be applied for the test of wide screen displays, although the aspect ratio of the background has to be changed.

### 3.2.1.7 *Black and white window signal*

The black and white window signal produces a white rectangular window and four black rectangular windows on the 40 % grey background, as shown in Figure 13.

The size of the windows is the same as that of the white window signal.

For the SECAM measurements, the subcarrier with the frequency and amplitude corresponding to black and white is superimposed on the signal.

This signal is used to measure contrast of displays.

The same windows can be applied for the test of wide screen displays, although the aspect ratio of the background has to be changed.

### 3.2.1.8 *Line and window signal*

The line and window signal consists of three vertical white lines placed at the centre and both sides of the picture and a window placed at the upper central part, as shown in Figure 14. The background is set at the black level.

For the SECAM measurements, the subcarrier with the frequency and amplitude corresponding to black and white is superimposed on the signal.

This signal is used to measure local picture distortion due to variation of the CRT beam current.

This pattern can be applied for the test of wide screen displays, although the aspect ratio of the pattern has to be changed.

### 3.2.1.9 Two-step signal

A line-time waveform of the signal is shown in Figure 15.

For the SECAM measurements, the subcarrier with the frequency and amplitude corresponding to black and white is superimposed on the signal.

This signal is used to measure gain- and noise-limited sensitivity.

### 3.2.1.10 Colour reference signal (VIR signal) (NTSC system only)

A line-time waveform of the signal is shown in Figure 16.

The phase of the colour subcarrier is set to that of the colour burst.

This signal is used to assess interference with a picture caused by undesired signals.

### 3.2.1.11 Composite sine-wave signal

The composite sine-wave signal consists of a variable-frequency sine-wave component superimposed on a grey signal with a peak-to-peak amplitude of 40 %, as shown in Figure 17. The frequency of the sine-wave is variable from 100 kHz to 6 MHz and locked to the harmonics of the line frequency.

This signal is mainly used to measure amplitude-frequency response of the luminance channel and cross-colour measurements. In the measurements of the luminance channel at a frequency range of colour subcarrier, the colour burst shall be switched off.

The amplitude of the sine-wave component is changed to 100 % for the measurement of horizontal resolution.

### 3.2.1.12 Multiburst signal

The multiburst signal comprises six bursts of discrete frequencies from 500 kHz to the limit of the system for which the receiver is intended. The signal starts with a four step reference with the values 0 %, 25 %, 50 % and 75 %. The frequency bursts having a peak-to-peak value of 50 % are superimposed on a 50 % luminance level. The colour bursts are not present. The signal waveform is shown in Figure 18.

This signal is used to measure amplitude-frequency response of the luminance channel.

NOTE Duration of the burst should be sufficiently long to contain at least four cycles.

### 3.2.1.13 Multipulse signal

The multipulse signal is built up of modulated  $20T$  sine-squared pulses with high-frequency components at various frequencies in the pass band of the television system for which the receiver is designed, where  $T$  is the same definition as that for the  $2T$  pulse and bar signal. The colour bursts are not present.

The accuracy of the measurement at the lowest frequency can be improved, if a  $40T$  pulse is used instead of the  $20T$  pulse. The same nomograph, as shown in Figure 65 and Figure 66 can be applied. However, the values stated in the nomograph must be multiplied by a factor 2.

The signal waveform is shown in Figure 19.

This signal is used to measure group delay response of the luminance channel.

### 3.2.1.14 $2T$ pulse and bar signal

The pulse and bar signal is composed of a sine-squared pulse and a sine-squared bar. The pulse width at the half amplitude and the rise time of the bar are equal to  $2T$ .

( $T = 0,125 \mu\text{s}$  for the 525-line systems and system N, and  $T = 0,100 \mu\text{s}$  for the 625-line systems excluding system N.)

Duration of the bar is  $36/128 H$  for the 525-line system and  $5/32 H$  for the 625-line system measured at its half amplitude ( $H$ : duration of a line).

A line-time waveform of the signal is shown in Figure 20.

This signal is used to measure linear waveform response of the luminance channel.

NOTE Bar and  $2T$  pulse included in line 17 of ITU-R ITS signals can be used as an alternative.

### 3.2.1.15 Horizontal bar signal

The horizontal bar signal produces a horizontal white bar, whose width is equal to one-half of the nominal picture height on the black background, as shown in Figure 21.

This signal is used to measure low-frequency square-wave response of the luminance channel.

### 3.2.1.16 Staircase signal and APL-variable staircase signal

Generally a staircase with five-riser is used as the test signal.

A line-time waveform of the five-riser signal is shown in Figure 22a.

The APL-variable staircase signal is composed of the staircase signal of one line and flat level signals of four lines. The average picture level of the total signal can be adjusted in a range of 10 % to 90 % by varying the amplitude of the flat level signals from 0 % to 100 %. A waveform of the signal is shown in Figure 22b.

This signal is used to measure line-time non-linearity of the luminance channel.

NOTE For the 625-line systems, the five-riser staircase included in line 17 of the ITU-R ITS signal can be used.

### 3.2.1.17 *PLUGE signal*

The signal arranges three narrow black vertical stripes on the left-hand side and a four-riser grey scale bar on the right-hand side on the black background, as shown in Figure 23. The levels of the left and right stripes are set at 2 % below and 2 % above the background level respectively. The level of the centre stripe is equal to the background level.

This signal is used to measure black level stability of the luminance channel and of the display.

NOTE This signal is adopted by ITU-R as Recommendation BT.814-1. Detailed parameters of the signal are described in the Recommendation. The acronym, PLUGE, was derived from Picture Line Up Generating Equipment.

### 3.2.1.18 *White PLUGE signal*

The left-hand side of the picture is the same as the PLUGE signal, the right-hand side consists of 100 % peak white, as shown in Figure 24.

The APL of the total picture is about 50 %.

This signal is used to measure black level stability of the luminance channel and of the display.

### 3.2.1.19 *Colour staircase signal and APL-variable colour staircase signal*

The colour staircase signal is a staircase signal on which the colour subcarrier is superimposed at an amplitude equal to that of the colour burst, as shown in Figure 25.

The APL-variable colour staircase signal is a colour staircase signal with APL variable function.

This signal is used to measure differential gain (DG) and differential phase (DP) of the composite signal at the baseband output terminal.

NOTE The five-riser colour staircase included in line 17 (line 330) of the ITU-R ITS signal can be used as an alternative.

### 3.2.1.20 *Sine-wave modulated chrominance signal*

The sine-wave modulated chrominance signal is a sine-wave modulated subcarrier superimposed on a grey level, as shown in Figure 26. The frequency of the sine-wave is variable from 20 kHz to 2 MHz.

For the NTSC and PAL systems, the colour is changeable to R-Y, B-Y and G-Y. For the SECAM system, the colour is set to magenta and the values of R-Y and B-Y are set to 0,3 so as to prevent clipping after low-frequency pre-emphasis in the encoder.

This signal is used to measure amplitude-frequency response of the chrominance channel.

### 3.2.1.21 *Modulated 20T pulse and bar signals*

The modulated 20T pulse and bar signal type A is a chrominance signal modulated with a 20T pulse and a 20T bar superimposed on a black background and the modulated 20T pulse and bar signal type B consists of a 20T pulse, a 20T bar and a 50 % Y signal, where  $T$  has the same definition as that for the 2T pulse and bar signal. The width of the bar is the same as that defined for the 2T pulse and bar signal. To avoid overranging in the decoder, the subcarrier in the signal B shall represent the green or magenta.

Line-time waveforms of the signals are shown in Figure 27a and Figure 27b.

Signal A is used to measure group delay of a composite signal at the subcarrier frequency while signal B is used to measure linear waveform response of the chrominance channel.

NOTE The modulated 20T pulse in line 17 of 625-line systems in the ITU-R ITS signal can be used for 20T pulse measurements instead of signal A.

### 3.2.1.22 *Y/C timing test signal*

This signal consists of three equal height horizontal bars, as shown in Figure 28a).

The upper and lower bars of the pattern consist of colour difference signals corresponding to green and magenta on 50 % constant luminance level. The width of the coloured bars is equal to those of the colour bar signal.

The centre bar consists of seven 2T pulses on a black background level, as shown in Figure 28b. The middle pulse coincides with the centre colour transient (0 ns). The first and the last pulses coincide respectively with - 300 ns and + 300 ns, the second and the sixth ones with - 200 ns and + 200 ns, and the third and the fifth ones with - 100 ns and + 100 ns.

The amplitude of the colour difference signals is equal to a value of  $\pm 40$  % for PAL and NTSC systems. For SECAM system, the amplitude should not exceed  $\pm 19$  % so as to prevent clipping after low-frequency pre-emphasis in the encoder.

This signal is used to measure luminance/chrominance delay inequality of decoded colour signals.

### 3.2.1.23 Staircase-modulated chrominance signal

The staircase-modulated chrominance signal is a staircase-modulated subcarrier superimposed on a flat level signal. The staircase has five-riser and the colour is changeable to each colour of the colour bars. The amplitude of the flat level signal and the maximum amplitude of the subcarrier are equal to the luminance and chrominance components of the colour bar at 75 % saturation. A line-time waveform of the signal is shown in Figure 29.

This signal is used to measure line-time non-linearity of the chrominance channel for NTSC and PAL receivers.

### 3.2.1.24 Modulated pedestal signal

This signal consists of three modulated chrominance packets of different amplitude on a luminance level of 50 %, as shown in Figure 30. The peak-to-peak value of the packets are 20 %, 40 % and 80 % of the peak white value. To avoid overload of R, G or B values in the colour encoder or decoder, the phase shall be in accordance with the magenta (60,68°).

This signal is used to test chrominance to luminance intermodulation of NTSC and PAL receivers.

### 3.2.1.25 Single colour bar signal

The single colour bar signal produces a single vertical colour bar on the grey background. The width of the bar is set to about one-half of the active line scan period. The colour is set to B-Y or B.

The phase and amplitude of the colour burst is variable and the subcarrier frequency is also variable within  $\pm 1\,000$  Hz of the nominal subcarrier frequency.

A line-time waveform of the signal is shown in Figure 31.

This signal is used to measure errors of demodulation angles of the chrominance signal and stability of colour synchronization in the NTSC and PAL decoders.

### 3.2.1.26 Offset-carrier colour bar signal (NTSC system only)

The offset-carrier colour bar signal consists of 11 subcarrier bursts superimposed on the grey level, as shown in Figure 32. The subcarrier phase is continuously varied clockwise from  $0^\circ$  to  $360^\circ$  relative to the reference colour burst during the active line period and each burst is arranged to the position at which the phase at its centre corresponds to a multiple of  $30^\circ$ .

This signal is used to measure errors of demodulation angles of the chrominance signal for the NTSC system.

### 3.2.1.27 Four-line colour difference signal (PAL system only)

The four-line colour difference signal comprises colour difference signals of four lines superimposed on the 50 % grey level. The picture is divided into clusters of 16 lines consisting of four colour difference, and 12 non-colour lines, as shown in Figure 33.

This signal is used to measure errors of the demodulation angles of chrominance signals for the PAL system.

### 3.2.1.28 Checkered pattern signal

The checkered pattern comprises checkered patterns on the left and right sides and a vertical line in the middle, as shown in Figure 34. The background of the pattern is set at a 25 % grey level. The checker consists of black and white square blocks with a width of one-ninth the picture height. This pattern is used to test the pulling on whites.

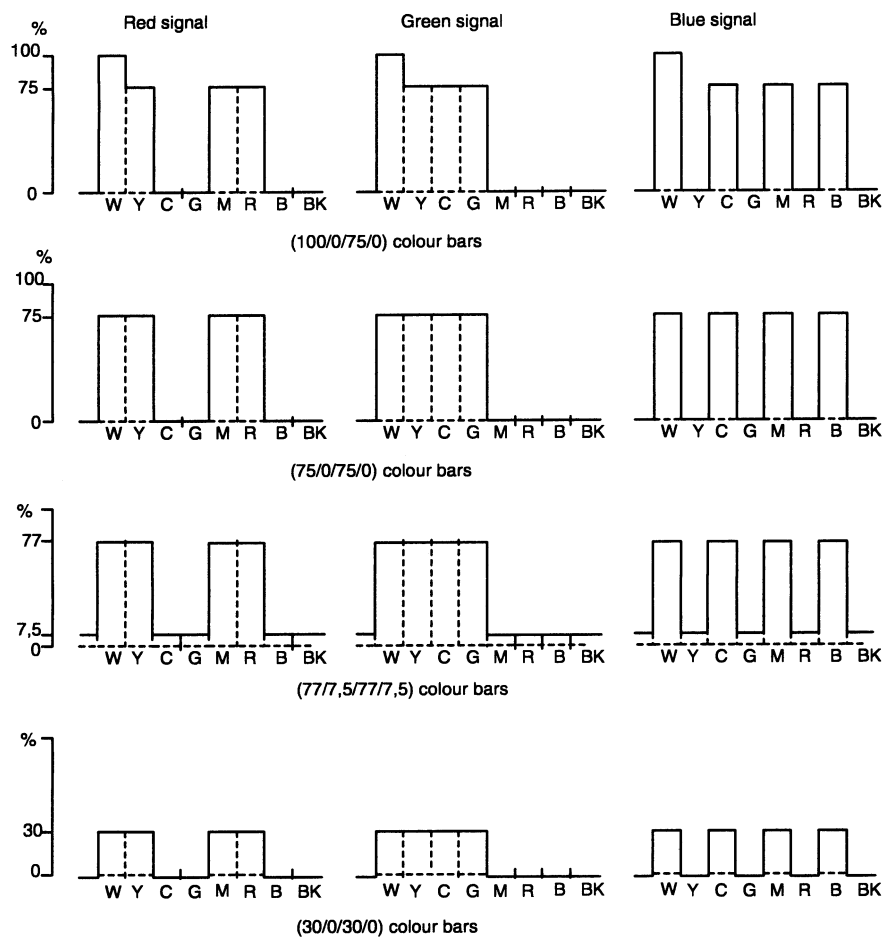
### 3.2.2 Audio test signals

- a) 1 kHz sine-wave signal
- b) Frequency variable sine-wave signal

Sine-wave signal in a frequency range of 50 Hz to 15 kHz

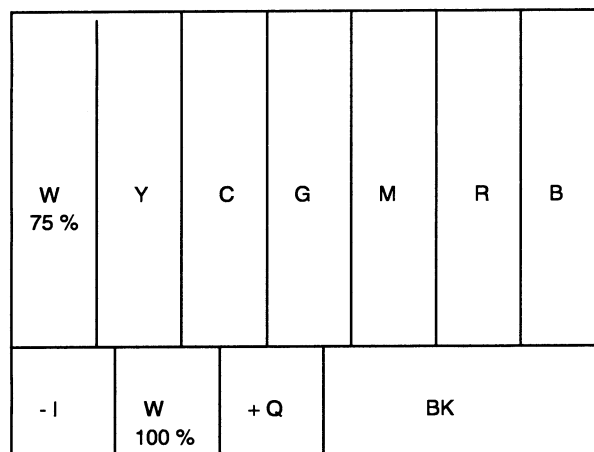
### 3.2.3 Teletext test signals

Under consideration.



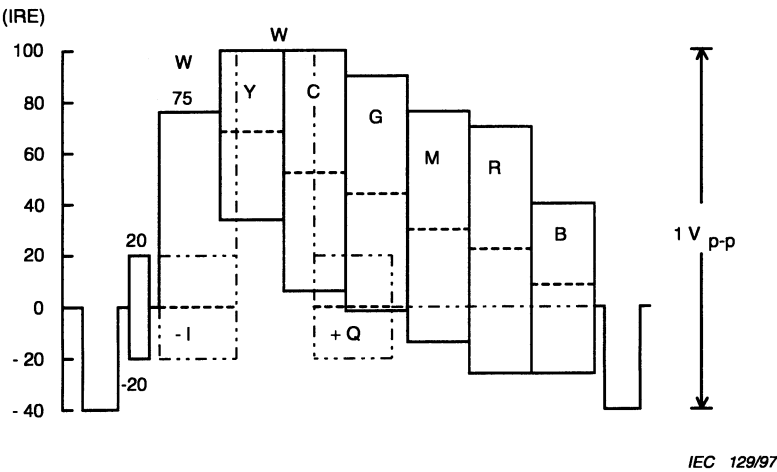
IEC 127/87

Figure 1 — Primary colour bar signals (3.2.1.2)



IEC 128/97

Figure 2 — NTSC split-field colour bar (3.2.1.2)



NOTE IRE is a unit used for the NTSC system.  
**Figure 3 — NTSC colour bar signal (75/0/75/0) (3.2.1.2)**

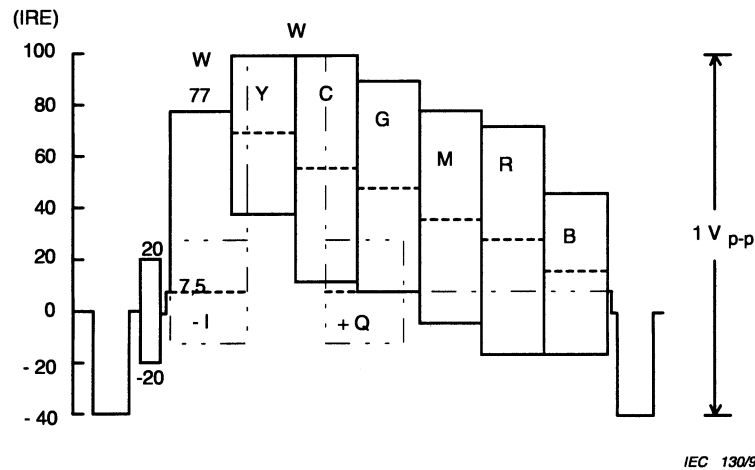


**Figure 4 — NTSC colour bar signal (77/7,5/77/7,5) (3.2.1.2)**

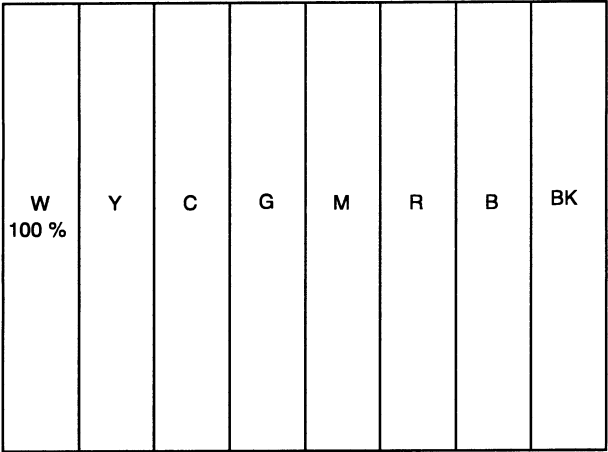


**Figure 5 — PAL and SECAM full-field colour bar (3.2.1.2)**

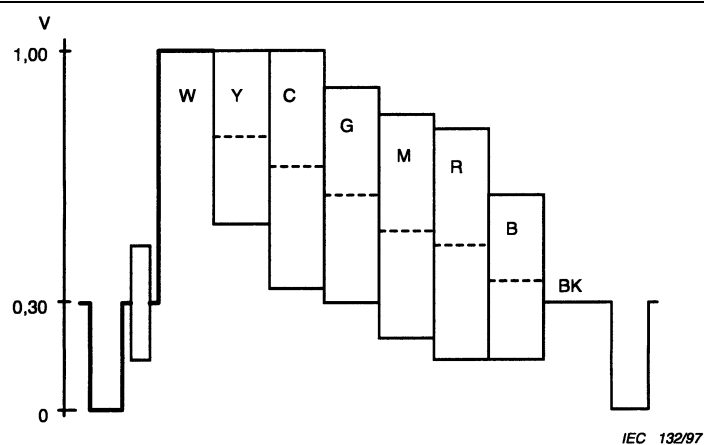


Figure 6 — PAL colour bar signal (100/0/75/0) (3.2.1.2)

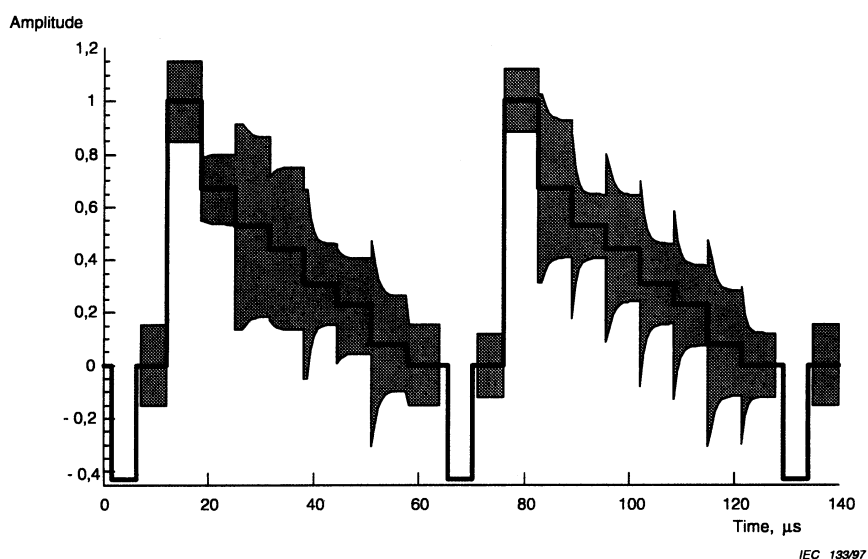


Figure 7 — SECAM colour bar signal (100/0/75/0) (3.2.1.2)

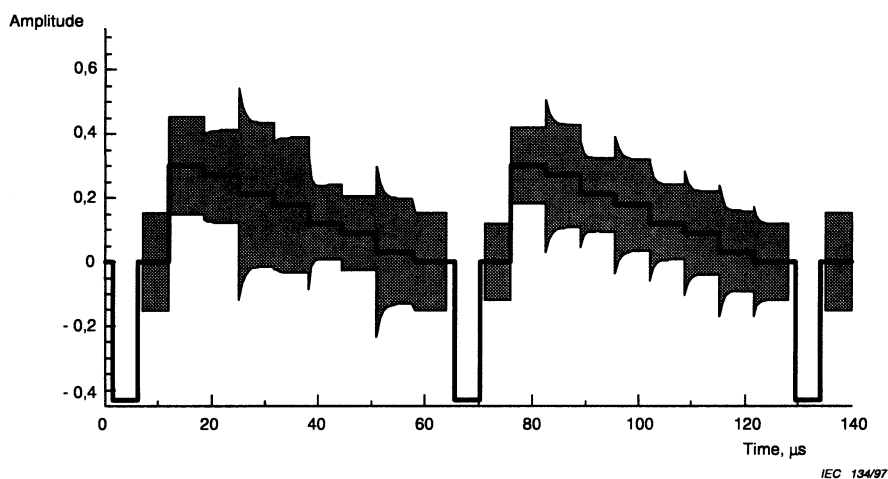


Figure 8 — SECAM colour bar signal (30/0/30/0) (3.2.1.2)

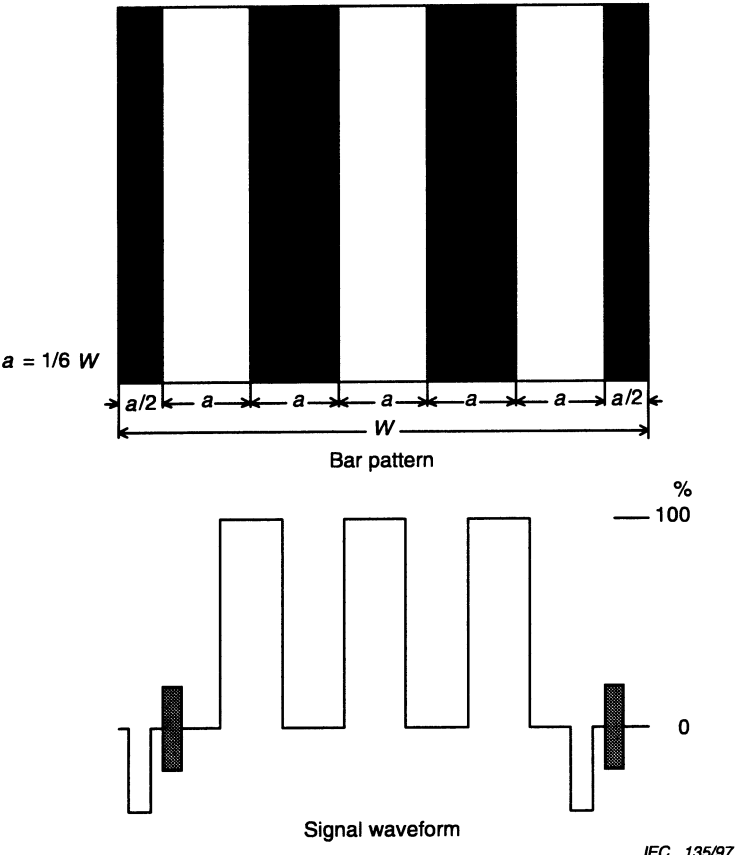
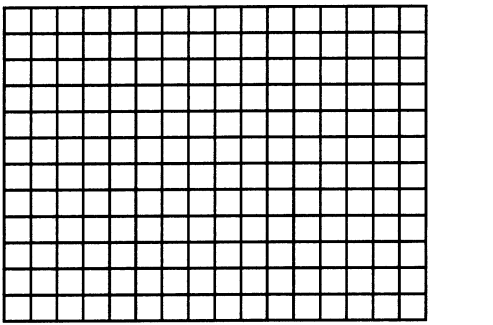
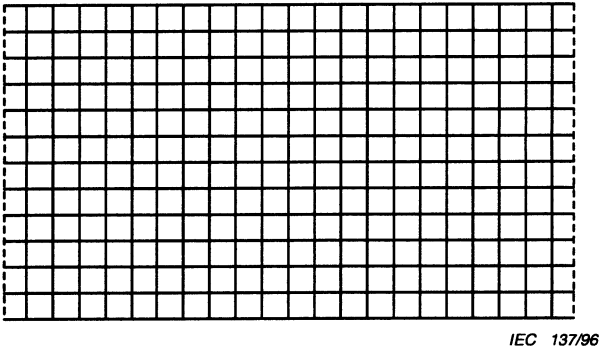


Figure 9 — Three vertical bar signal (3.2.1.3)

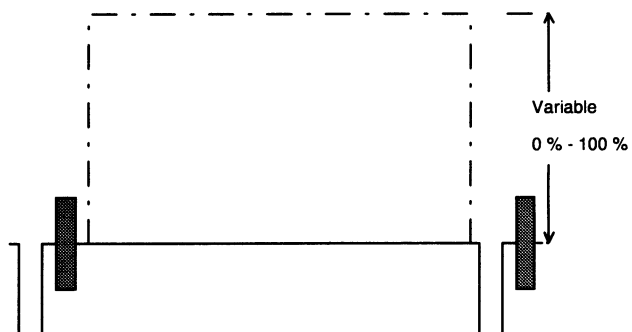


10a – Pattern for 4:3 aspect ratio



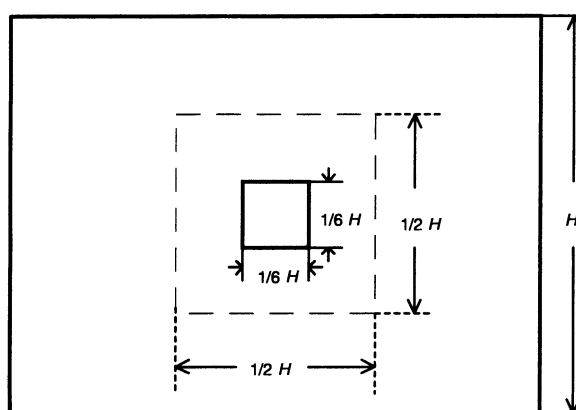
10b – Pattern for 16:9 aspect ratio

Figure 10 — Cross-hatch signals (3.2.1.4)

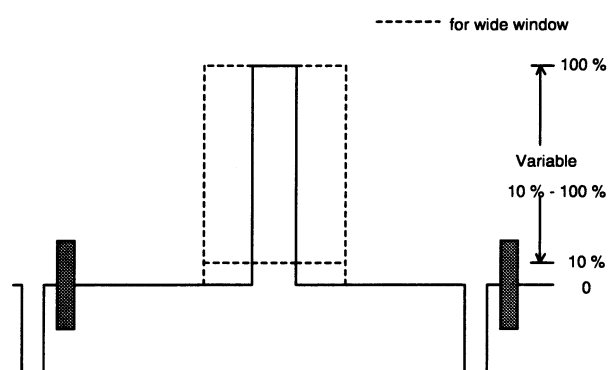


IEC 138/97

Figure 11 — Flat level signal (3.2.1.5)



Window pattern



Signal waveform

IEC 138/97

Figure 12 — White window signal (3.2.1.6)

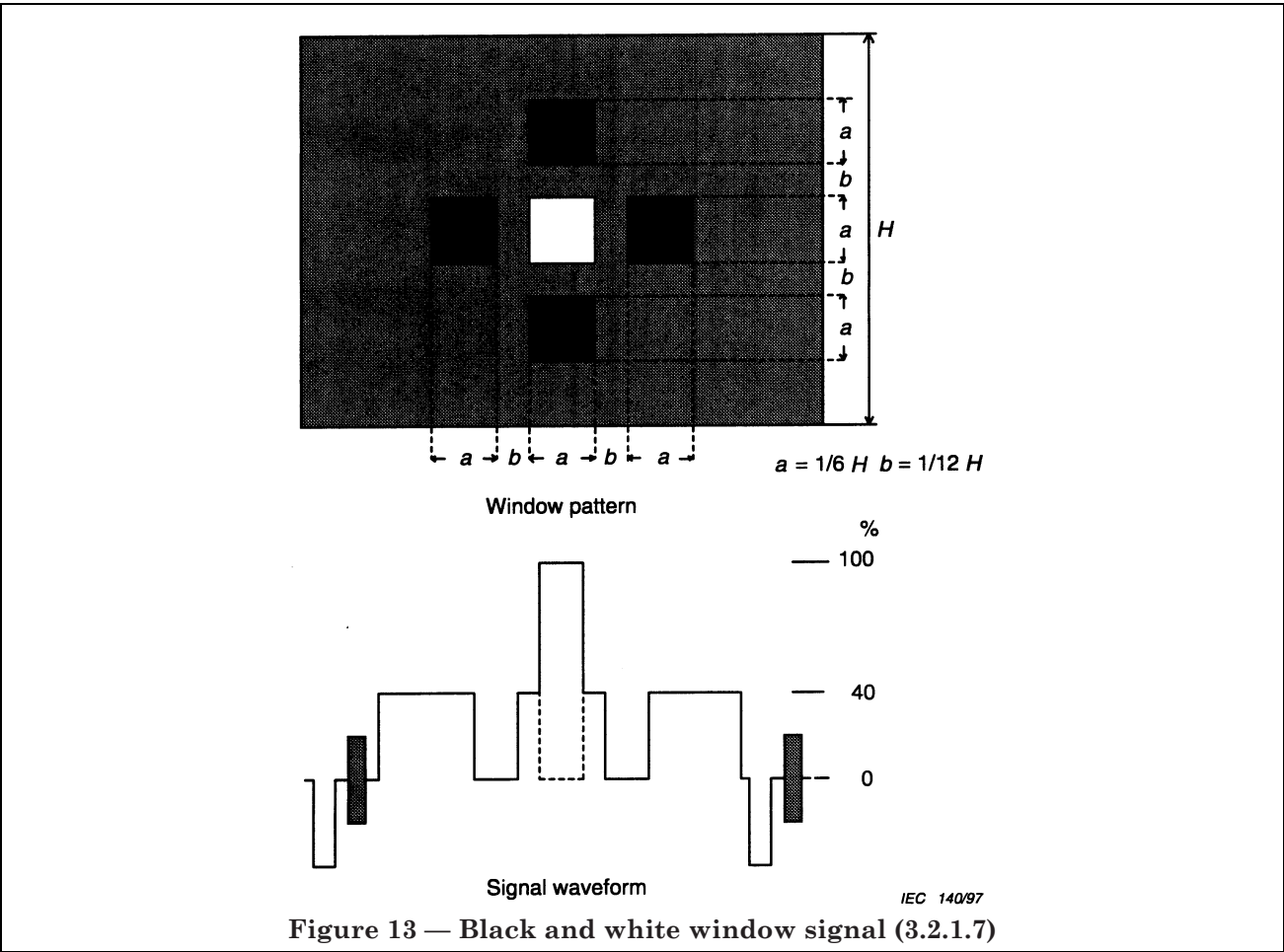


Figure 13 — Black and white window signal (3.2.1.7)

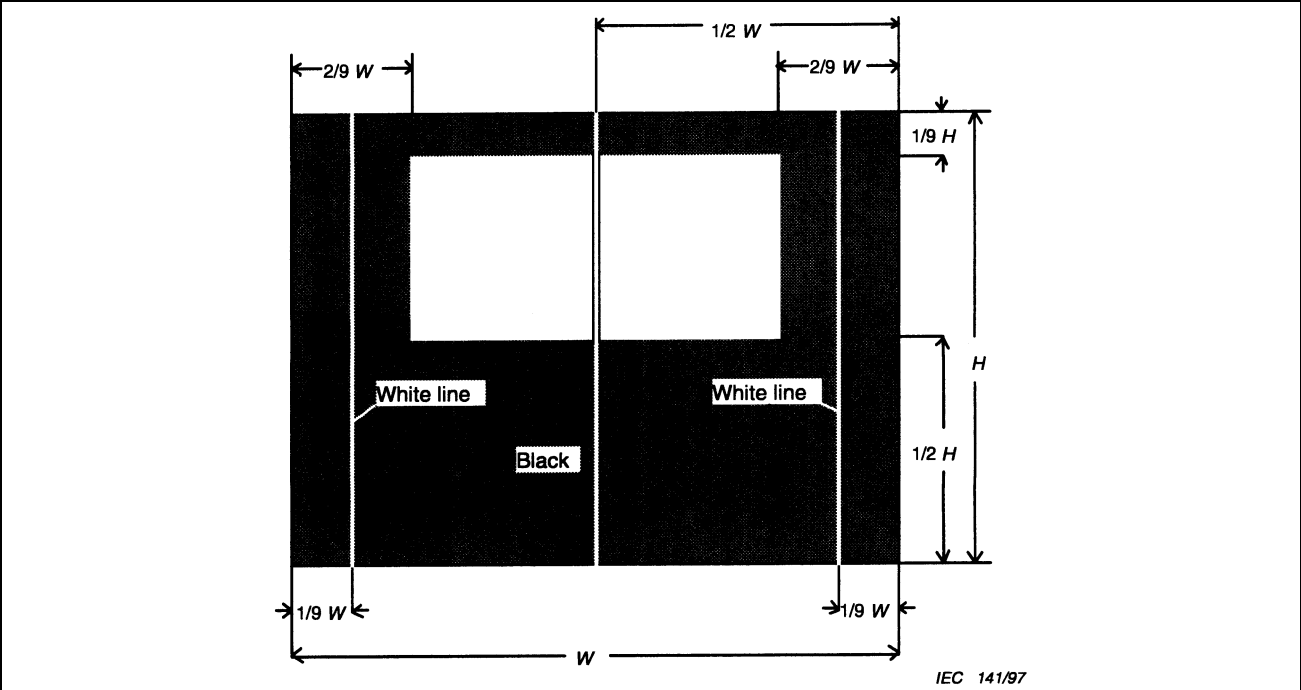


Figure 14 — Line and window signal (3.2.1.8)

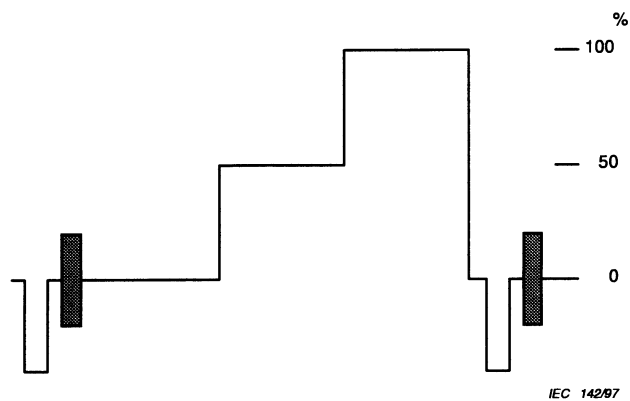


Figure 15 — Two step signal (3.2.1.9)

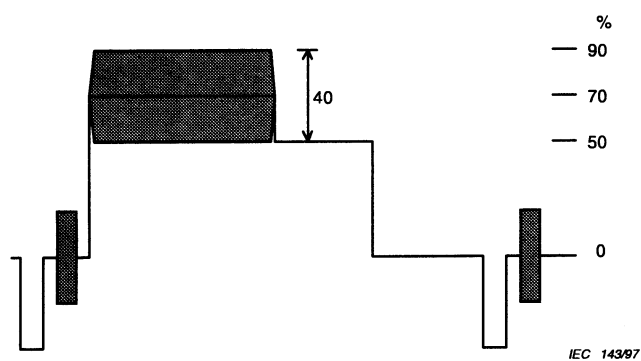


Figure 16 — Colour reference signal (3.2.1.10)

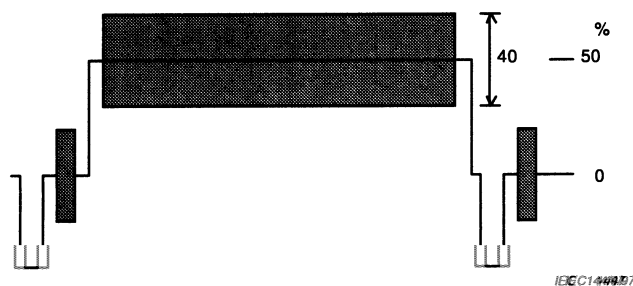
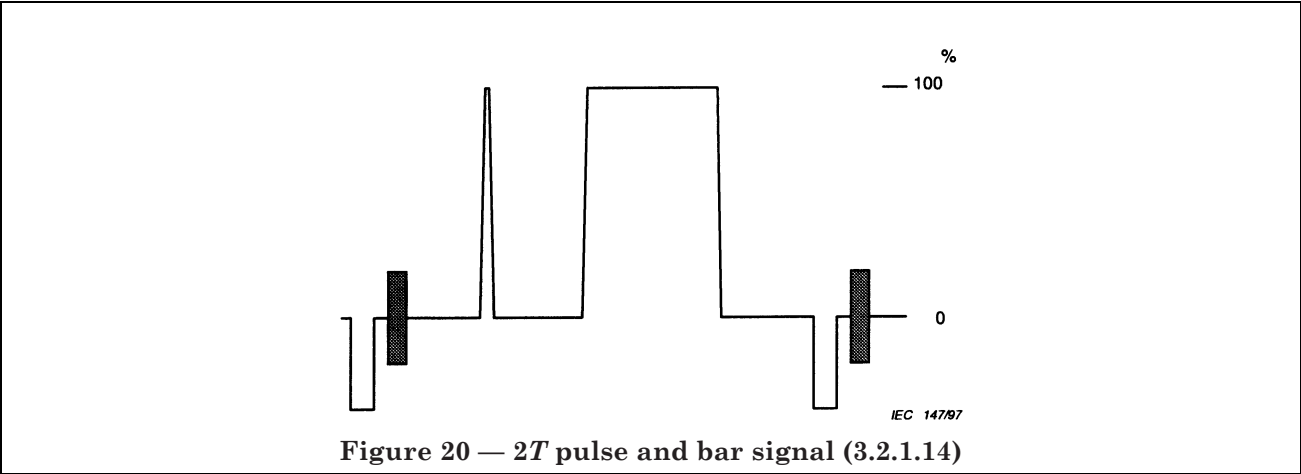
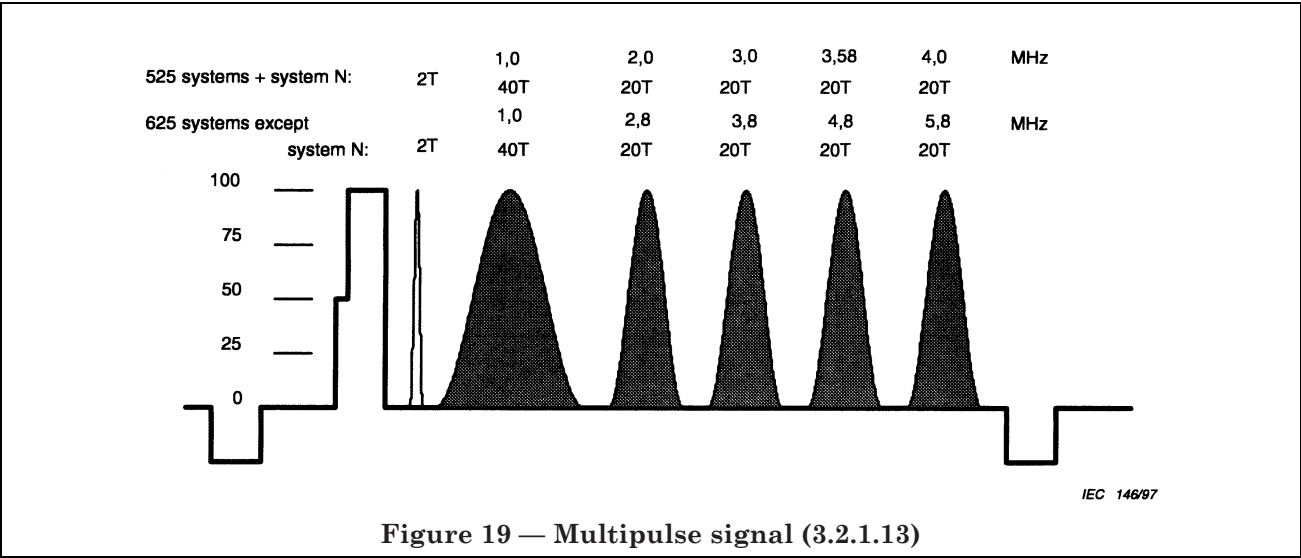
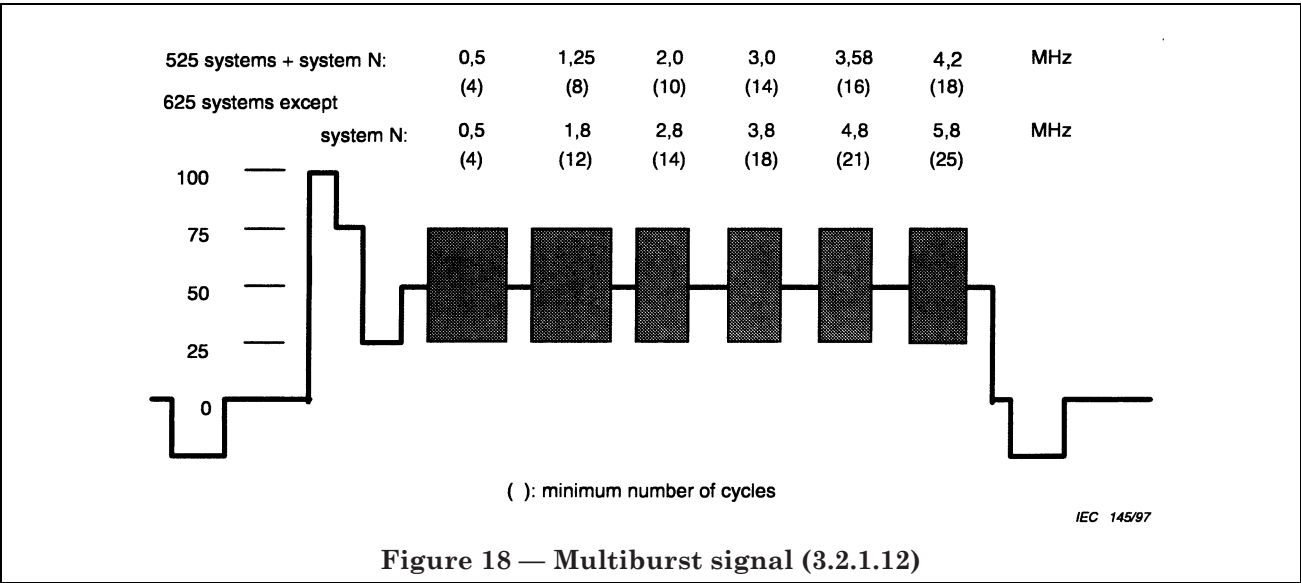
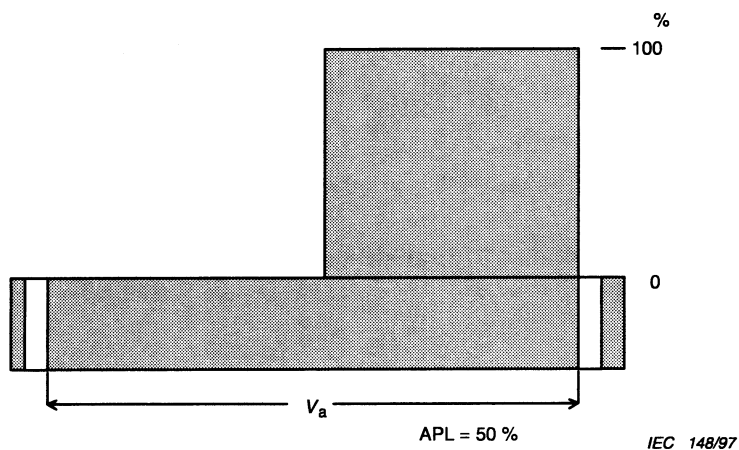


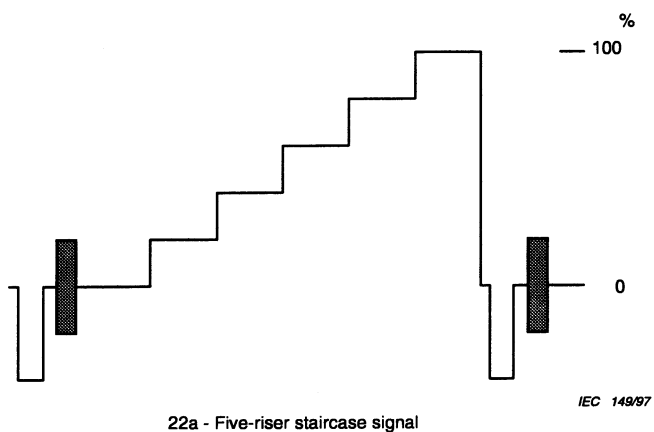
Figure 17 — Composite sine-wave signal (3.2.1.11)



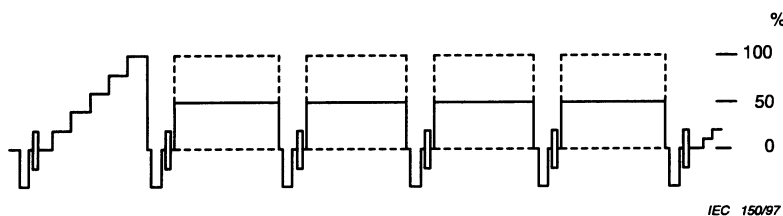


$V_a$ : active field period

Figure 21 — Horizontal bar signal (3.2.1.15)

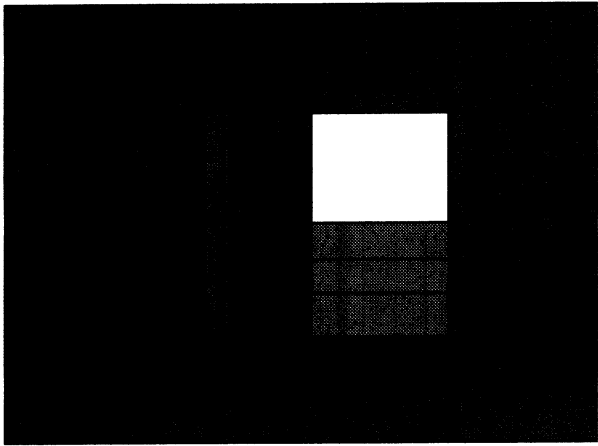


22a - Five-riser staircase signal

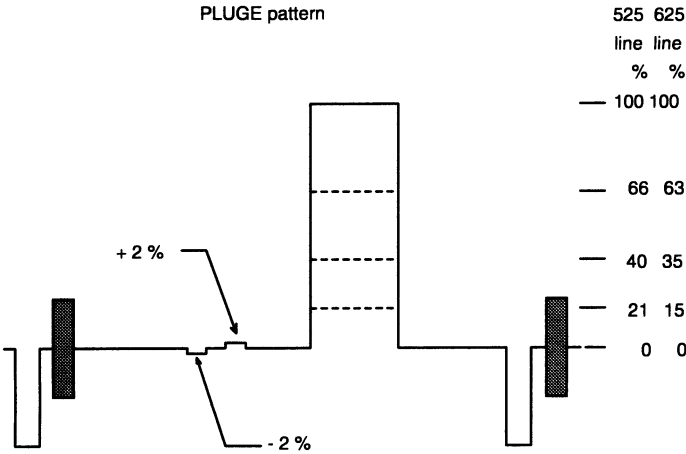


22b - APL-variable staircase signal

Figure 22 — Staircase signal (3.2.1.16)



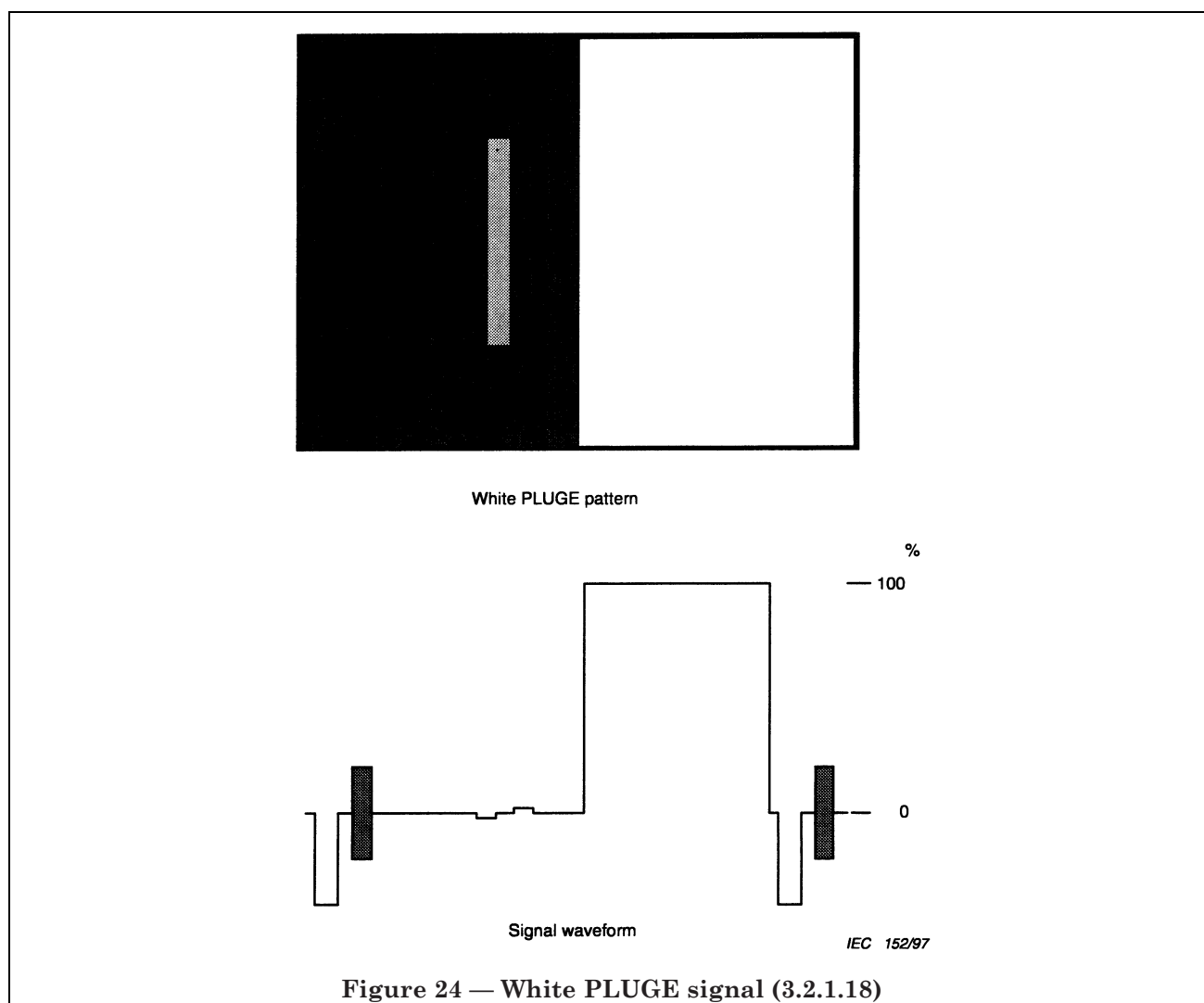
PLUGE pattern



Signal waveform

IEC 151/97

Figure 23 — PLUGE signal (3.2.1.17)



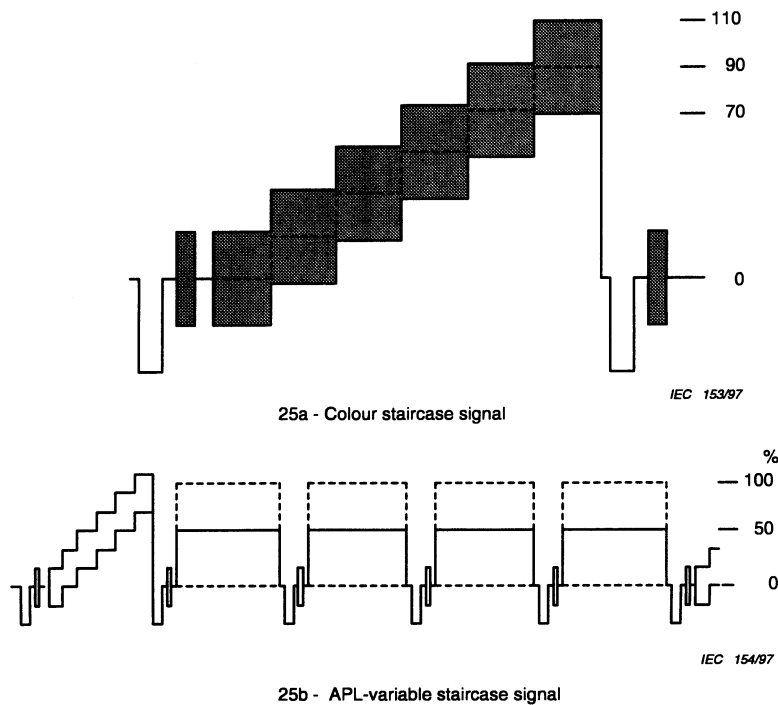


Figure 25 — Colour staircase signal (3.2.1.19)

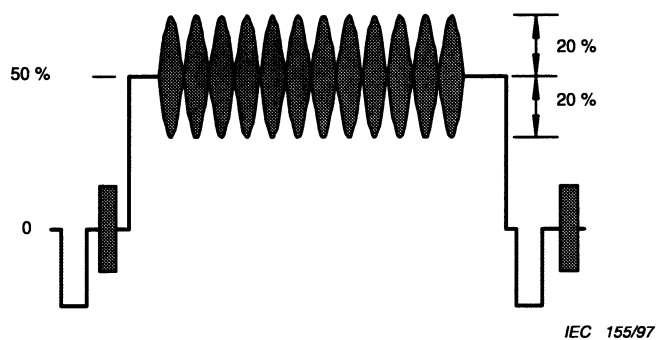


Figure 26 — Sine-wave modulated chrominance signal (3.2.1.20)

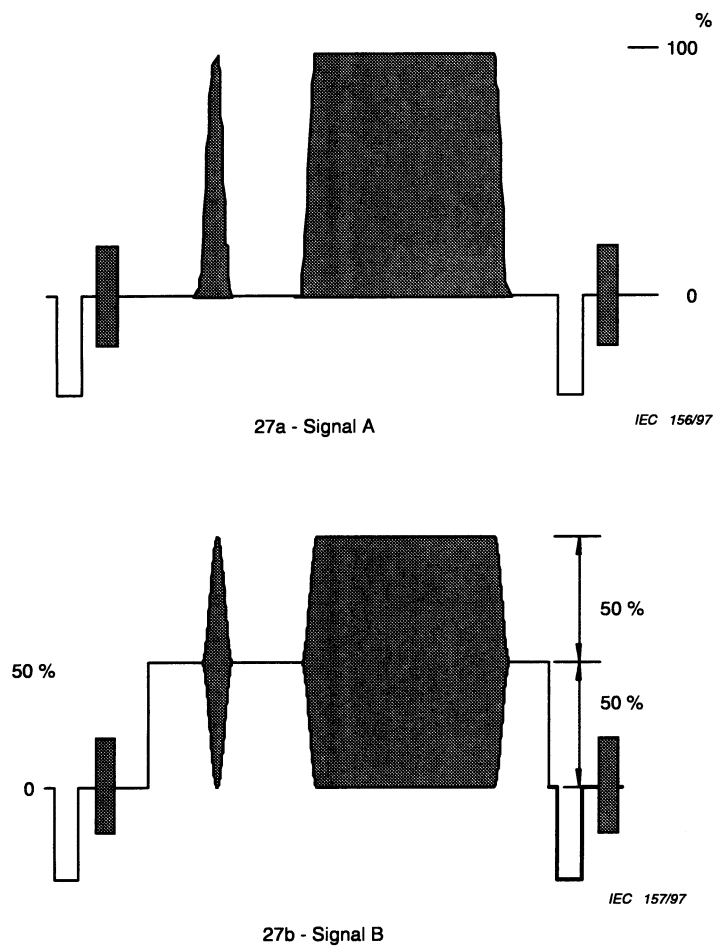


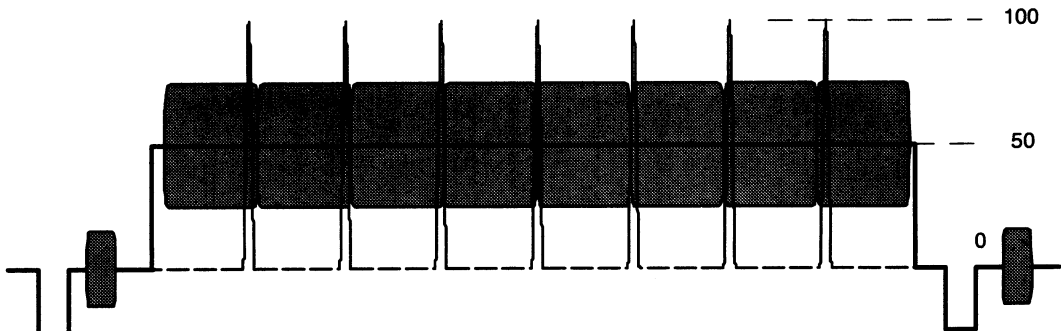
Figure 27 — Modulated 20T pulse and bar signals (3.2.1.21)

CT (colour transients)

|                                                                  |                       |         |         |         |         |         |         |
|------------------------------------------------------------------|-----------------------|---------|---------|---------|---------|---------|---------|
| Y level = 50 %<br>Colour difference level = 0.4 (0.19 for SECAM) |                       |         |         |         |         |         |         |
| Magenta                                                          | Green                 | Magenta | Green   | Magenta | Green   | Magenta | Green   |
| Black-bar with 2T pulses or 200 ns square pulse                  | 2T pulse at CT-300 ns | -200 ns | -100 ns | 0 ns    | +100 ns | +200 ns | +300 ns |
| Green                                                            | Magenta               | Green   | Magenta | Green   | Magenta | Green   | Magenta |

IEC 158/97

28a – Y/C timing test pattern



IEC 159/97

28b – Signal waveform

Figure 28 — Y/C timing test signal (3.2.1.22)

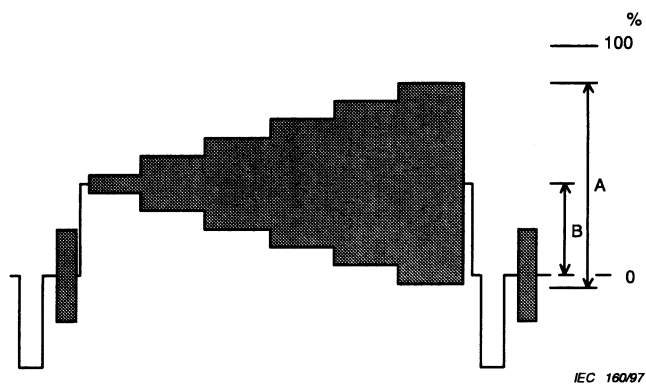


Figure 29 — Staircase-modulated chrominance signal (3.2.1.23)

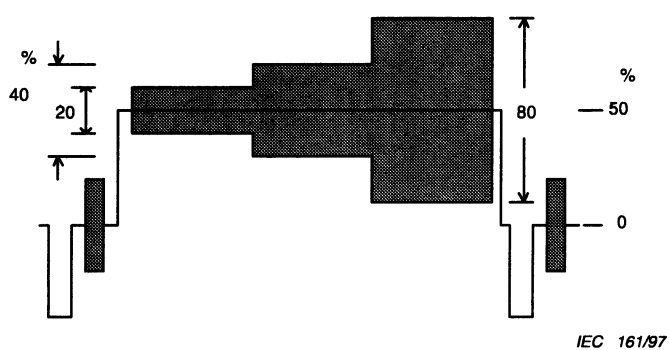


Figure 30 — Modulated pedestal signal (3.2.1.24)

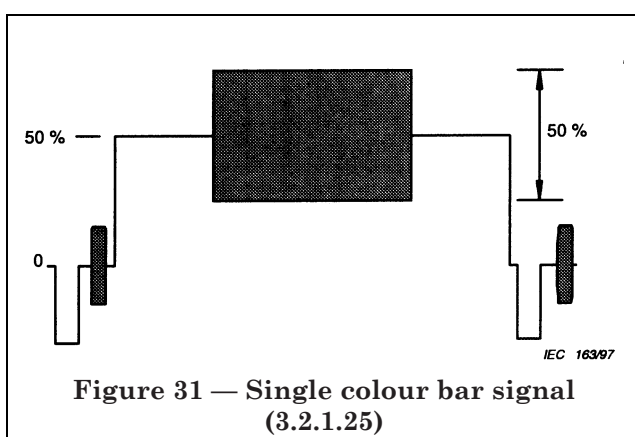


Figure 31 — Single colour bar signal (3.2.1.25)

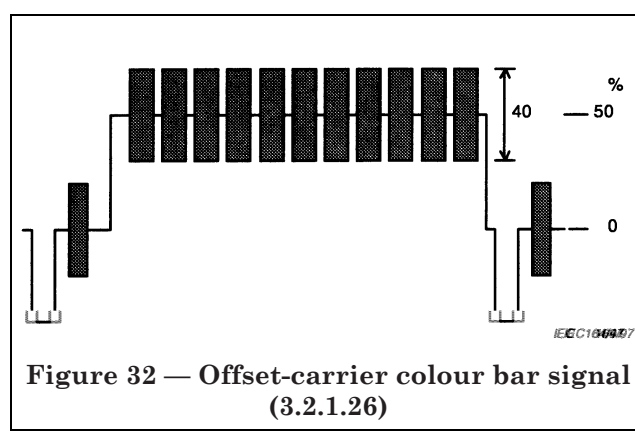
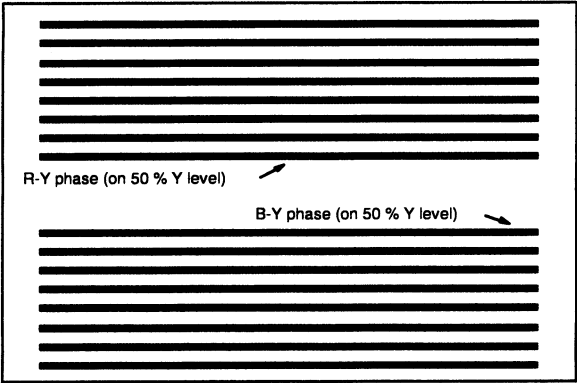
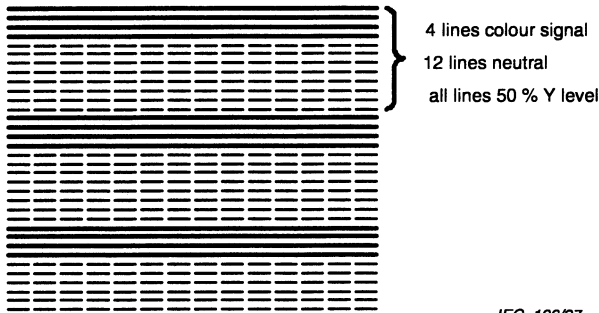


Figure 32 — Offset-carrier colour bar signal (3.2.1.26)



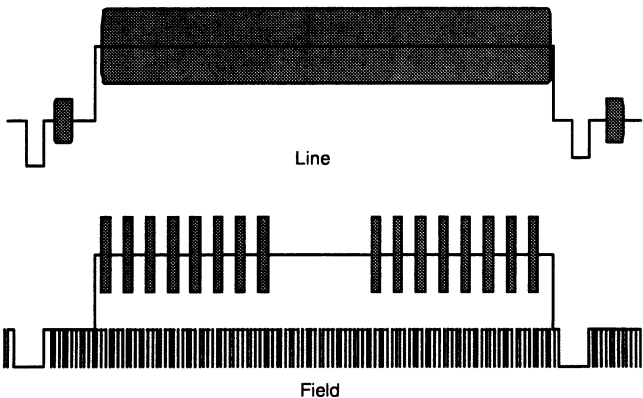
IEC 165/97

33a – Pattern



IEC 166/97

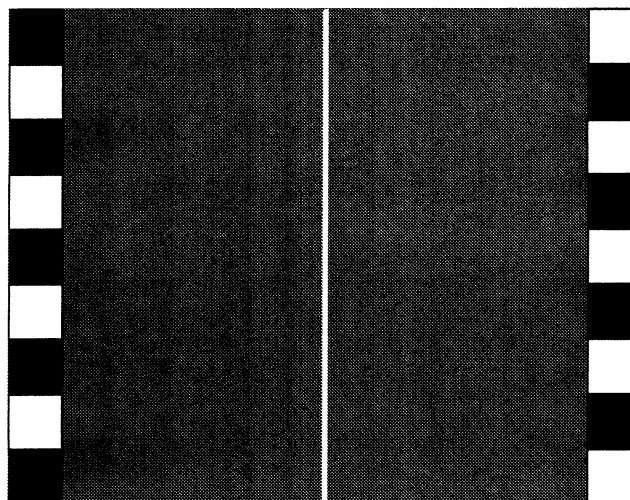
33b – Detail of pattern



IEC 167/97

33c – Signal waveform

Figure 33 — Four-line colour difference signal (3.2.1.27)



IEC 168/97

Figure 34 — Checkered pattern signal (3.2.1.28)

### 3.3 Radiofrequency (r.f.) television signal

A television channel transmits a vision carrier and one or two sound carriers. In this standard, this group of the carriers is designated as radiofrequency (r.f.) television signal.

#### 3.3.1 Carrier levels

The level of a radiofrequency television signal shall be expressed by the level of the modulated vision carrier in the signal.

The level of a vision carrier shall be expressed as the r.m.s. value for the peak amplitude during the synchronization pulses for negative modulation, and the r.m.s. value at the peak of a white reference signal for positive modulation.

Some of the measurements described in this standard require presence of modulated or unmodulated sound carrier(s) together with a vision carrier. In such cases, the sound carrier(s) shall be present at the power ratio(s) of the sound carrier(s) to the vision carrier defined by the television standard for which the receiver under test is designed. The level of a sound carrier shall be expressed as the r.m.s. value when modulation is not present.

#### 3.3.2 Reference modulation

Definition of modulation percentage of a vision carrier shall be in accordance with the television standard for which the receiver under test is designed.

Reference modulation percentage of a vision carrier shall be 100 % when modulated with a white reference signal, as shown in Figure 35.

If the television system provides multi-channel sound, the modulation shall be present in all the channels.

The following modulation levels shall be used as a reference for sound carrier(s):

##### 3.3.2.1 Monophonic channel

- Amplitude-modulated sound carrier: 54 % at 1 kHz.
- FM modulated sound carrier: 54 % at 1 kHz.

##### 3.3.2.2 Stereophonic channel

Both the left and right channels are modulated with a single sine-wave signal with the same polarity at the same level.

- Subcarrier systems: 30 % at 1 kHz.
- Two-carrier FM system: 54 % at 1 kHz.
- NICAM system: Full-scale minus 20 dB at 1 kHz.

##### 3.3.2.3 Additional channel

- Subcarrier systems: 30 % at 1 kHz.

### 3.3.3 Test channels

Unless otherwise specified, tests shall be made on representative channels selected according to the following criteria:

- band I (VHF): two channels, one at each edge of the band;
- band III (VHF): two channels, one at each edge of the band;
- band IV (UHF): two channels, one at the lower edge and one in the middle;
- band V (UHF): three channels, two at the edges and one in the middle;
- each band for cable television systems (VHF and UHF): two channels at the edges of each band and one in the middle.

For items whose characteristics are not affected by the frequency band, any one channel selected from the VHF and UHF bands can be used as typical channel.

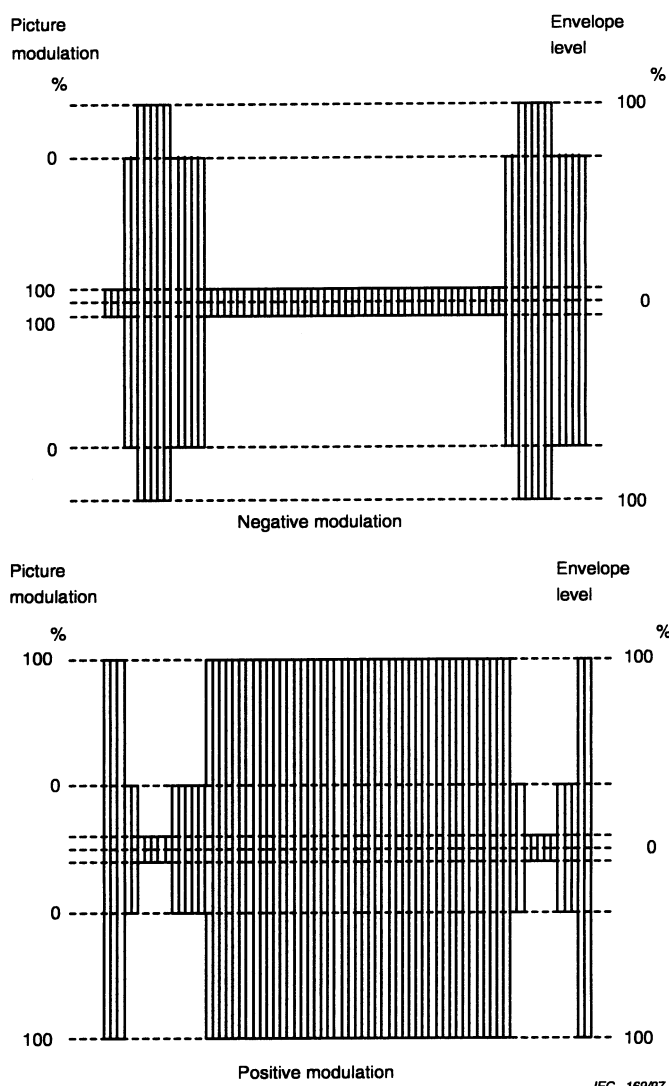


Figure 35 — Modulated radiofrequency signals (3.3.1)

### 3.4 Radiofrequency input signals

#### 3.4.1 Radiofrequency input signal level

The radiofrequency input level of the receiver shall be expressed as a terminal voltage. The terminal voltage is the voltage across the terminal of a generator when terminated with its specified terminal impedance.

In this standard, it is assumed that the input impedance of receivers is  $75\ \Omega$ . If matching, balancing or combining networks are used, the terminal voltage is the voltage across the  $75\ \Omega$  termination resistor of these networks.

For the receivers with input circuits for specified source impedance of  $75\ \Omega$ , the input signal level shall be expressed in dB( $\mu$ V) over  $75\ \Omega$ . In the case of an r.f. television signal, the level shall be represented by the level of the vision carrier as defined in 3.3.

To facilitate the direct comparison of receivers for which different source impedances are specified, it is useful to compare the input signal levels in terms of the power-equivalent terminal voltage at the output terminals of the generator including the corresponding matching, balancing or combining networks.

For receivers with input circuits specified for source impedance other than  $75\ \Omega$ , the power-equivalent terminal voltage  $E'$  is the input voltage to the receiver delivering the same available power to the specified termination resistor as  $E$  in the case of  $75\ \Omega$ .

$E'$  for  $R\ \Omega$  can be calculated using the following formula:

$$E' = E + 10 \log_{10} \frac{R}{75}$$

where

$E'$  is the signal level across the resistance  $R\ \Omega$  in dB( $\mu$ V);

$E$  is the signal level across  $75\ \Omega$  in dB( $\mu$ V);

$R$  is the impedance in ohms.

Table 1 gives recommended values for the terminal voltage.

For the receivers with built-in antennas, the input signal shall be expressed in terms of field strength in dB( $\mu$ V/m).

For tests requiring the application of very low input signal levels, care shall be taken that interfering signals entering the receiver, in any spurious way, do not influence the results of the measurements.

#### 3.4.2 Radiofrequency input arrangements

##### 3.4.2.1 Matching network

The specified source impedance  $R_r$  for which the receiver is designed, is not to be confused with actual input impedance of the receiver, as measurable at the antenna input terminals.

A receiver with an unbalanced or a balanced input circuit for a specified source impedance shall be measured with a signal source having respectively an unbalanced or a balanced output, whose internal impedance  $R_i$  is matched to the specified source impedance  $R_r$ .

If the specified source impedance  $R_r$  and the internal impedance of the signal source  $R_i$  are unequal, a suitable matching network shall be inserted between the signal source and the receiver.

Care shall be taken that connecting cables in the relevant parts of the circuit have characteristic impedance  $R_r$  or  $R_i$ , as appropriate.

If a balanced signal source is not available when needed, a suitable balancing network shall be used. Its influence on the signal shall be taken into account by calibrating the circuit fitted with the appropriate termination resistance before measurements.

##### 3.4.2.2 Combining networks

For the application of two or multi-signal measuring methods, suitable combining networks (combiners) shall be applied when coupling various signal sources.

A combining network may be followed by a balancing and/or a matching network according to its application.

The influence of the total network on the signal shall be taken into account by calibrating the circuit fitted with the appropriate terminal resistances.

#### 3.4.3 Radiofrequency input to built-in antennas

If the receiver under test has a built-in antenna but no antenna terminal, one of the methods described in 3.4.3.1 to 3.4.3.3 shall be used.

##### 3.4.3.1 Radiating antenna method

The radiating antenna method defined in CISPR 13 shall be used except for the setting of the receiving antenna.

This method should preferably be used in an electromagnetic anechoic chamber in order to avoid interference due to ambient fields. Arrangement of the test equipment is shown in Figure 36.

The height of the radiating antenna and direction of the built-in antenna shall be adjusted to obtain the best picture and the sound without noise and distortion. If both conditions cannot be met, the condition for the best picture shall be adopted.

It is preferable to operate the receiver by a battery, if it is designed for battery operation.

If this method cannot be used, the following subclauses provide means to apply r.f. input signal to the receiver under test in a less defined way or a limited frequency range.

#### 3.4.3.2 TEM (strip line) device method

The TEM device defined in CISPR 20 shall be used. Arrangement of the equipment is shown in Figure 37.

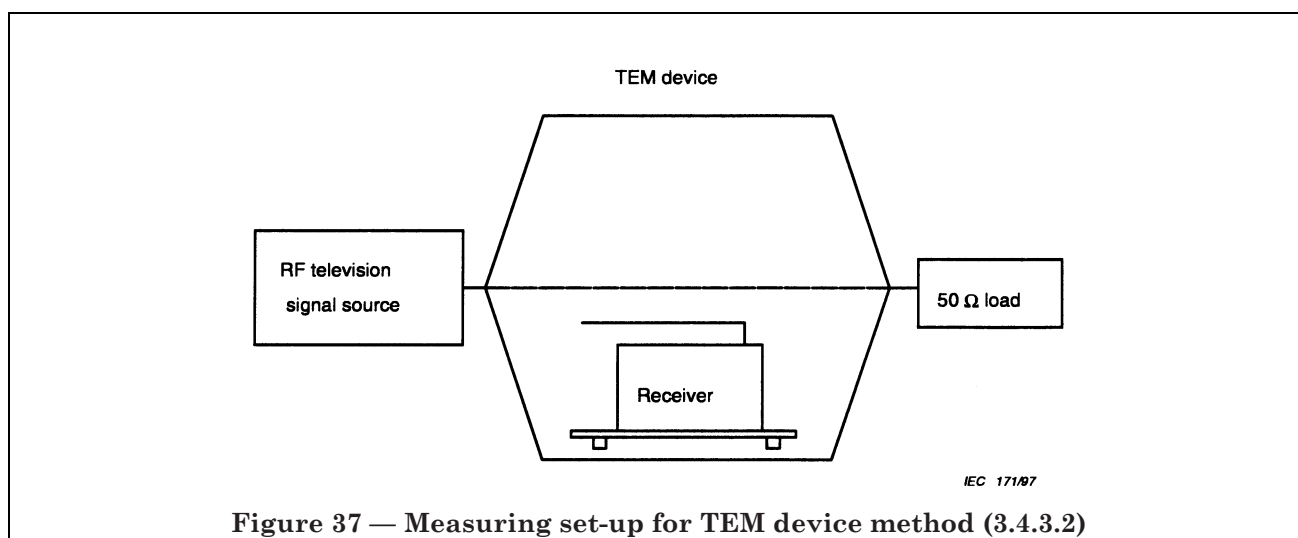
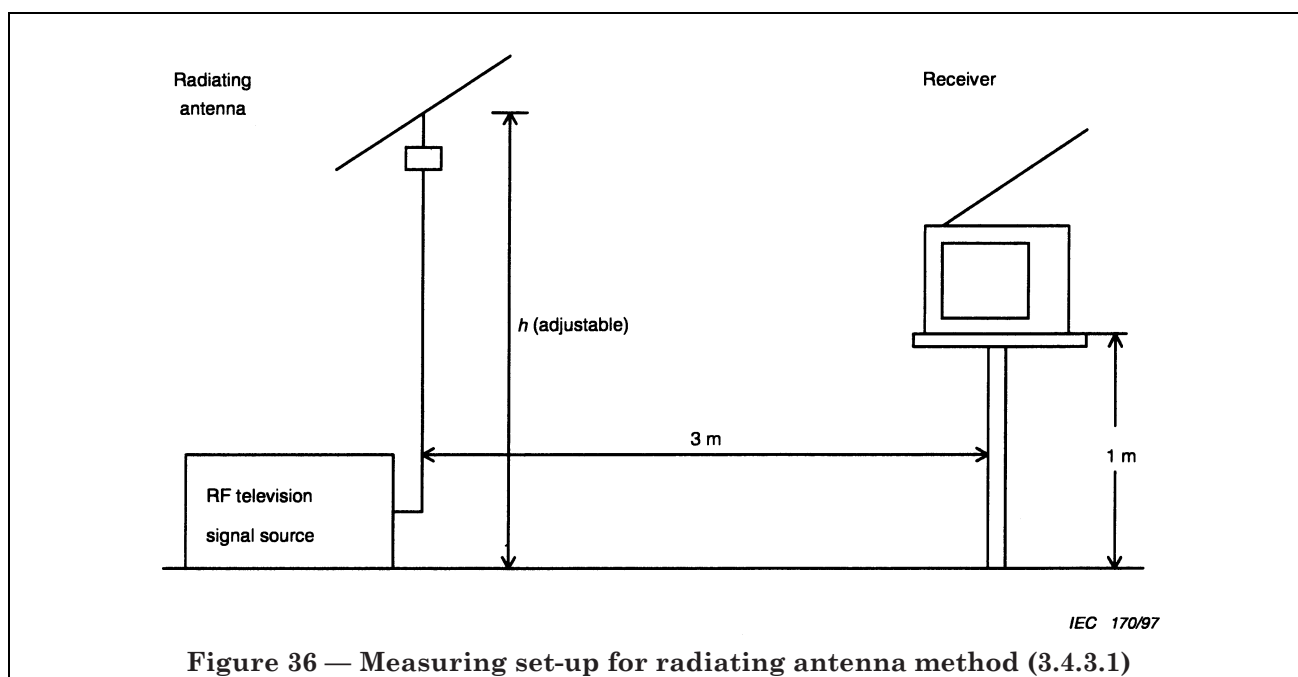
#### 3.4.3.3 Coaxial cable method

If accurate input signal levels or precise video-frequency characteristics are not required, an r.f. signal can be fed by a coaxial cable, connected directly to the bottom part of a monopole antenna, and through a balun for a dipole antenna.

In this method, the receiver shall be placed on a metallic plate larger than the area of the bottom of the receiver, and the inner conductor of the cable shall be connected to the antenna at the shortest length and the outer sheath of the cable shall also be connected to the plate.

**Table 1 — Recommended values for terminal voltage**

| Input signal level in terms of terminal voltage across 75 $\Omega$ |                                     | Input signal level in terms of terminal voltage across 300 $\Omega$ |
|--------------------------------------------------------------------|-------------------------------------|---------------------------------------------------------------------|
| Recommended values                                                 |                                     |                                                                     |
| Preferred values<br>dB( $\mu$ V)                                   | Intermediate values<br>dB( $\mu$ V) | Power equivalent terminal voltage<br>dB( $\mu$ V)                   |
| 20                                                                 | 15                                  | 21                                                                  |
|                                                                    |                                     | 26                                                                  |
| 30                                                                 | 25                                  | 31                                                                  |
|                                                                    |                                     | 36                                                                  |
| 40                                                                 | 35                                  | 41                                                                  |
|                                                                    |                                     | 46                                                                  |
| 50                                                                 | 45                                  | 51                                                                  |
|                                                                    |                                     | 56                                                                  |
| 60                                                                 | 55                                  | 61                                                                  |
|                                                                    |                                     | 66                                                                  |
| 70                                                                 | 65                                  | 71                                                                  |
|                                                                    |                                     | 76                                                                  |
| 80                                                                 | 75                                  | 81                                                                  |
|                                                                    |                                     | 86                                                                  |
| 90                                                                 | 85                                  | 91                                                                  |
|                                                                    |                                     | 96                                                                  |
| 100                                                                | 95                                  | 101                                                                 |
|                                                                    |                                     | 106                                                                 |
| 110                                                                | 105                                 | 111                                                                 |
|                                                                    |                                     | 116                                                                 |
| 120                                                                | 115                                 | 121                                                                 |
|                                                                    |                                     | 126                                                                 |



### 3.5 Measuring system and test instruments

#### 3.5.1 Measuring system

A notional block diagram for the measuring system is shown in Figure 38.

The r.f. interfering signal source is only required for measuring the maximum usable multiple r.f. input signal level and selectivity and immunity to undesired signals.

#### 3.5.2 Baseband test signal generators

##### 3.5.2.1 Video test signal generator

The video test signal generator shall be capable of generating the test signals specified in 3.2.1 in the form of composite video signals of the system for which the receiver under test is designed. An output level of 1 V<sub>p-p</sub> across 75 Ω is required. In some measurements, the Y/C component signals or the R, G, B signals may also be required.

A video test signal generator with variable synchronizing frequency function is required for measuring synchronizing frequency ranges of receivers.

### 3.5.2.2 Audio test signal generator

The audio test signal generator shall be capable of generating the test signals specified in 3.2.2. An output level of 0,5 V r.m.s across 47 k $\Omega$  is required. For testing the receivers with multichannel sound, two or more signal outputs are required.

### 3.5.2.3 Teletext test signal generator

The teletext test signal generator shall be capable of generating the test signals, and inserting them into the field blanking intervals of a video test signal at the level and intervals specified in the teletext standard for which the receiver under test is designed.

### 3.5.3 Television test modulator

The television test modulator shall be capable of modulating vision and sound carriers, and shall be capable of generating r.f. television signals specified in 3.3 at an output level of more than 110 dB( $\mu$ V). For the multichannel sound system, the sound encoder is required for modulation of the sound carrier(s). The output channels required are specified in 3.3.3.

Additional video test signal generator(s) and modulator(s) are required for testing the maximum usable multiple r.f. input signal level and the immunity to undesired signals.

Special care shall be taken for the sideband filtering characteristics of the modulated vision carrier and spurious frequency components outside the channel when testing the selectivity and immunity to undesired signals. In addition to this, the group delay characteristics shall be precorrected for the receiver group delay characteristic.

Since most of the tests require the absence of the sound carrier(s), these shall be easily switched off. For measuring the AFC characteristics of the local oscillator, a test signal generator with variable vision carrier frequency is required, although it does not need modulation characteristics as tight as those for other measurements. The carrier frequency should be variable within  $\pm 200$  kHz of the nominal vision carrier frequencies.

### 3.5.4 RF signal generator

For testing the selectivity and response to undesired signals, one or two conventional AM signal generators, with a frequency range of 26 MHz to 1 GHz and with the maximum output level of more than 110 dB( $\mu$ V), are required. They are also used as c.w. signal generators.

### 3.5.5 Spectrum analyzer

The spectrum analyzer is used to measure the spectrum and levels of r.f. signals and video frequency components. If a digital frequency counting function is provided, it is also used for measuring the local oscillator frequencies. If not, a tuned r.f. amplifier and a frequency counter are required for measuring the local oscillator frequencies.

### 3.5.6 Video noise meter

The video noise meter shall be capable of measuring the r.m.s. level of random noise on the video signal. It shall have an unblanked video signal output in which the synchronizing signal components are eliminated.

It is necessary to use a low capacitance probe when measuring the signal and noise at the CRT electrodes.

### 3.5.7 Oscilloscope

A conventional oscilloscope covering the video frequency range can be used. It is, however, necessary to prepare a low capacitance probe when measuring the characteristics of the luminance and chrominance channels at the CRT electrodes.

The oscilloscope is also used as an X-Y oscilloscope with d.c. coupling.

### 3.5.8 Vectorscope

The vectorscope is used for testing the characteristics of the chrominance channel and also for measuring differential gain (DG) and differential phase (DP) of composite signals at the baseband output.

### 3.5.9 Audio level/distortion meter

A conventional audio measuring equipment can be used.

### 3.5.10 Passive devices

Combining networks of two and three r.f. signals, a directional coupler and a VSWR bridge are required for testing the r.f. channel.

### 3.5.11 Luminance meter and colorimeter

The luminance meter (photometer) shall be capable of measuring the luminance of a small area on the screen within a range of 0,2 cd/m<sup>2</sup> to about 1 000 cd/m<sup>2</sup>.

The colorimeter is capable of measuring the chromaticity of a small area on the screen as chromaticity coordinates ( $x, y$ ) or ( $u', v'$ ) at a luminance level lower than 2 cd/m<sup>2</sup>.

The area should be a circle with a diameter less than 4 % of the screen width.