

Flickermeter — Functional and design specifications

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British Standard

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National foreword

This British Standard has been prepared under the direction of the General Electrotechnical Standards Policy Committee and is the English language version of EN 60868:1993, *Flickermeter — Functional and design specifications*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 868:1986 + A1:1990 published by the International Electrotechnical Commission (IEC).

This British Standard supersedes BS 6796:1986 which is withdrawn.

BS EN 60868-0:1993 is complementary to this standard as it covers statistical evaluation of flicker severity.

NOTE The reference in note 3 to Table IV should refer to Appendix D of IEC 255-8:1978. This appendix was deleted in the 1990 revision of IEC 255-8 and it has therefore been reproduced in National annex NA.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 22, an inside back cover 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.

Descriptors: Measuring instrument, flickermeter, design, performance, specification, test

English version

Flickermeter — Functional and design specifications

(IEC 868:1986 + A1:1990)

Flickermètre — Spécifications fonctionnelles et
de conception
(CEI 868:1986 + A1:1990)

Flickermeter — Funktionsbeschreibung und
Auslegungsspezifikation
(IEC 868:1986 + A1:1990)

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CENELEC

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

At the request of 72 Technical Board,
HD 498 S2:1992 (IEC 868:1986 + A1:1990) was
submitted to the CENELEC voting procedure for
conversion into a European Standard.
The text of the International Standard was
approved by CENELEC as EN 60868
on 9 March 1993.
The following dates were fixed:
— latest date of publication of
an identical national
standard (dop) 1994-03-01
— latest date of withdrawal
of conflicting national
standards (dow) —
Annexes designated “normative” are part of the
body of the standard. In this standard, Annex ZA is
normative.

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INTRODUCTION

This report gives a functional and design specification for flicker measuring apparatus intended to indicate the correct flicker perception level for all practical voltage fluctuation waveforms. Sufficient information is presented to enable such an instrument to be constructed.

The method of flicker severity assessment from flickermeter output data will form the subject of other publications.

In its present form, this report is not intended to be an appendix to IEC Publications 555-3: Disturbances in Supply Systems Caused by Household Appliances and Similar Electrical Equipment, Part 3: Voltage Fluctuations.

This report is based on specifications prepared by the Disturbances Study Committee of the International Union for Electroheat (UIE).

1 Scope and object

The purpose of this report is to provide basic information for the design and the implementation of an analogue or digital flicker measuring apparatus.

It does not specify the method of calculating a flicker severity value, or give tolerable limit values.

2 Description of the instrument

The description given below is based on an analogue implementation. A partly or completely digital meter is equally acceptable provided that it offers the same functional characteristics.

The flickermeter architecture is described by the block diagram of Figure 1, page 12, and can be divided into two parts, each performing one of the following tasks:

- simulation of the response of the lamp-eye-brain chain;
- on-line statistical analysis of the flicker signal and presentation of the results.

The first task is performed by blocks 2, 3 and 4 of Figure 1, whilst the second task is accomplished by block 5. Although this last block is not mandatory, as flicker signal analysis can be performed off-line using a suitable recording medium, its inclusion is recommended because it will allow a more complete and efficient use of the instrument.

2.1 Block 1 — Input voltage adaptor and calibration checking circuit

This block contains a signal generator to check the calibration of the flickermeter on site and a voltage adapting circuit that scales the mean r.m.s. value of the input mains frequency voltage down to an internal reference level. In this way flicker measurements can be made independently from the actual input carrier voltage level and expressed as a percent ratio. Taps on the input transformer establish suitable input voltage ranges to keep the input signal to the voltage adaptor within its permissible range.

2.2 Block 2 — Square law demodulator

The purpose of this block is to recover the voltage fluctuation by squaring the input voltage scaled to the reference level, thus simulating the behaviour of the lamp.

2.3 Blocks 3 and 4 — Weighting filters, squaring and smoothing

Block 3 is composed of a cascade of two filters and a measuring range selector, which can precede or follow the selective filter circuit.

The first filter eliminates the d.c. and double mains frequency ripple components of the demodulator output.

The second does the shaping of the flickermeter frequency response to the modulating fluctuation, as follows: the weighting filter block simulates the frequency response to sinusoidal voltage fluctuations of a coiled coil filament gas filled lamp (60 W – 230 V) combined with the human visual system. The response function is based on the perceptibility threshold found for each frequency on 50 % of the persons tested¹⁾.

¹⁾ A reference filament lamp for 100–130 V systems would have a different frequency response and would require a corresponding adjustment of the weighting filter. The characteristics of discharge lamps are totally different, and wider modifications of this report would be necessary to take them into account.

Block 4 is composed of a squaring multiplier and a first order low-pass filter. The human flicker sensation via lamp, eye and brain is simulated by the combined non-linear response of blocks 2, 3 and 4.

Block 3 alone is based on the borderline perceptibility curve for sinusoidal voltage fluctuations; the correct weighting of non-sinusoidal and stochastic fluctuations is achieved by an appropriate choice of the complex transfer function for blocks 3 and 4. Accordingly the correct performance of the model has also been checked with periodic rectangular signals as well as with transient signals.

The output of block 4 represents the instantaneous flicker sensation.

2.4 Block 5 — On-line statistical analysis

Block 5 incorporates a microprocessor that performs an on-line analysis of the flicker level, thus allowing direct calculation of significant evaluation parameters.

A suitable interface allows data presentation and recording. The use of this block is related to methods of deriving measures of flicker severity by statistical analysis.

The statistical analysis, whether performed on-line by block 5 or off-line on a recording of the output of block 4, shall be made by subdividing the amplitude of the flicker level signal into a suitable number of classes.

The flicker level signal is sampled at a constant rate.

Every time that the appropriate value occurs, the counter of the corresponding class is incremented by one. In this way, the frequency distribution function of the input values is obtained. By choosing a scanning frequency sufficiently higher than the maximum flicker frequency, the final result at the end of the measuring interval represents the distribution of flicker level duration in each class. Adding the content of the counters of all classes and expressing the count of each class relative to the total gives the probability density function of the flicker levels.

From this, one obtains the cumulative probability function used in the time-at-level statistical method.

Figure 2, page 13, schematically represents the statistical analysis method, limited for simplicity of presentation to 10 classes.

From the cumulative probability function, significant statistical values can be obtained such as mean, standard deviation, flicker level being exceeded for a given percentage of time or, alternatively, the percentage of time an assigned flicker level has been exceeded.

The observation period is defined by two adjustable time intervals: T_{short} and T_{long} .

The long interval defines the total observation time and is always a multiple of the short interval:

$$(T_{\text{long}} = n \cdot T_{\text{short}}).$$

For on-line processing, immediately after conclusion of each short time interval, the statistical analysis of the next interval is started and the results for the expired interval are made available for output.

In this way, n short time analyses will be available for a given observation period T_{long} , together with the results for the total interval. Cumulative probability function plots should preferably be made by using a Gaussian normal distribution scale.

2.5 Outputs

The flickermeter diagram in Figure 1, page 12, shows a number of outputs between blocks 1 and 5. The outputs marked with an asterisk are not essential, but may allow a full exploitation of the instrument potential for the investigation of voltage fluctuations. Further optional outputs may be considered.

2.5.1 The aim of optional output 1 and associated r.m.s. meter is to display the voltage fluctuation waveform in terms of changes in r.m.s. value of the input voltage. This can be achieved by squaring, integrating between zero crossings on each half-cycle and square rooting the signal.

In order to observe small voltage changes with good resolution, an adjustable d.c. offset and rectification should be provided.

2.5.2 Output 2 is mainly intended for checking the response of block 3 and making adjustments.

2.5.3 Output 3 gives an instantaneous linear indication of the relative voltage change $\frac{\Delta V}{V}$ expressed as per cent equivalent of an 8.8 Hz sinusoidal wave modulation. This output is useful to select the proper measuring range.

2.5.4 Output 4 gives the 1 min integral of the instantaneous flicker sensation.

2.5.5 Output 5 represents the instantaneous flicker sensation and can be recorded on a strip-chart recorder for a quick on-site evaluation, or on magnetic tape for long duration measurements and for later processing.

2.5.6 Output 6 in block 5 is connected to a serial digital interface suitable for a printer and a magnetic tape recorder. Using another digital to analogue converting interface, analogue plots of the cumulative probability function can be obtained directly from this block.

3 Specification

3.1 Analogue response

The overall analogue response from the instrument input to the output of block 4 is given in Table I and Table II for sinusoidal and rectangular voltage fluctuations as defined in IEC Publication 555-3. One unit output from block 4 corresponds to the reference human flicker perceptibility threshold. The response is centred at 8.8 Hz for sinusoidal modulation.

The prescribed accuracy is achieved if the input values for sine and square-wave modulations are within $\pm 5\%$ of the tabulated values, for an output of one unit of perceptibility.

Table I — Normalized flickermeter response for sinusoidal voltage fluctuations

Input relative voltage fluctuation $\frac{\Delta V}{V}$ for one unit of perceptibility at output

Hz	Voltage fluctuation (%)	Hz	Voltage fluctuation (%)
0.5	2.340	9.5	0.254
1.0	1.432	10.0	0.260
1.5	1.080	10.5	0.270
2.0	0.882	11.0	0.282
2.5	0.754	11.5	0.296
3.0	0.654	12.0	0.312
3.5	0.568	13.0	0.348
4.0	0.500	14.0	0.388
4.5	0.446	15.0	0.432
5.0	0.398	16.0	0.480
5.5	0.360	17.0	0.530
6.0	0.328	18.0	0.584
6.5	0.300	19.0	0.640
7.0	0.280	20.0	0.700
7.5	0.266	21.0	0.760
8.0	0.256	22.0	0.824
8.8	0.250	23.0	0.890
		24.0	0.962
		25.0	1.042