INTERNATIONAL STANDARD

IEC 62054-11

First edition
2004-05

Electricity metering (a.c.) – Tariff and load control –

Part 11: Particular requirements for electronic ripple control receivers

Reference number
IEC 62054-11:2004(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

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International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE T

For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICITY METERING (AC) – TARIFF AND LOAD CONTROL –

Part 11: Particular requirements for electronic ripple control receivers

FOREWORD

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International Standard IEC 62054-11 has been prepared by IEC technical committee 13: Equipment for electrical energy measurement and load control. This standard, in conjunction with IEC 62052-21, cancels and replaces IEC 61037:1990, *Electricity metering – Tariff and load control – Particular requirements for electronic ripple control receivers.*

This standard is to be used in conjunction with IEC 62052-21 and the relevant parts of the IEC 62059 series.

The text of this standard is based on the following documents:

FDIS	Report on voting
13/1306/FDIS	13/1315/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2013. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This standard distinguishes between protective class I and protective class II equipment

The test levels are regarded as minimum values to guarantee the proper functioning of the equipment under normal working conditions. For special applications, other test levels might be necessary and should be agreed on between the user and the manufacturer.

Ripple control receivers are components of a system of remote control permitting the simultaneous operation of a large number of receivers from a central point. The signal generally used for this purpose is an audio-frequency voltage superimposed on the mains frequency and coded in the form of pulses, which can provide a multiplicity of control functions. Other types of signals, such as frequency modulation, deformation of the mains frequency, etc. may also be used. These signals are propagated through the electricity supply network, from the injection point to the receiver sites.

Some characteristics of such systems, for example, the value of the frequency or the method of coding, are not standardized here.

To facilitate the application of this standard the following principles should be applied.

1) The requirements of this standard are not limiting. If it is absolutely unavoidable, a user can add additional technical requirements in his specification.

   The technical requirements and tests relate to the general functioning of the receiver. The method of operation of the functional elements is not specified. These requirements and tests may, however, be the subject of additional technical agreements.

2) Ripple control systems are auxiliary equipment for network operation. Their design is determined by the network characteristics and other factors. At the present time rapid development of power electronic equipment is leading to a parallel increase in the amount of harmonic distortion in the supply voltage. The harmonic levels indicated in this standard take account of this development. They are not to be considered as values that could be regarded as permissible on the network but as recommended values for designing and testing receivers. These recommended levels could be adapted to particular characteristics of networks under consideration.

   Receivers designed for use with transmitters already in operation and having a control frequency equal, or very close, to a harmonic, need not conform to the whole of the requirements of this standard.

For information, the relevant parts of IEC 62052, IEC 62054 and IEC 62059 are listed below.

IEC 62052-21 Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 21: Tariff and load control equipment

(*Replaces the general requirements of IEC 61037 and IEC 61038.)*

IEC 62054-11 Electricity metering – Tariff and load control – Part 11: Particular requirements for electronic ripple control receivers

(*Replaces the particular requirements of IEC 61037.)*

IEC 62054-21 Electricity metering – Tariff and load control – Part 21: Particular requirements for time switches

(*Replaces the particular requirements of IEC 61038.)*

IEC 62059-11 Electricity metering equipment – Dependability – Part 11: General concepts

IEC 62059-21 Electricity metering equipment – Dependability – Part 21: Collection of meter dependability data from the field

IEC 62059-41 Electricity metering equipment – Dependability – Part 41: Reliability prediction[1]

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[1] To be published.

ELECTRICITY METERING (AC) – TARIFF AND LOAD CONTROL –

Part 11: Particular requirements for electronic ripple control receivers

1 Scope

This part of IEC 62054 specifies particular requirements for the type test of newly manufactured indoor electronic ripple control receivers for the reception and interpretation of pulses of a single audio frequency superimposed on the voltage of the electricity distribution network and for the execution of the corresponding switching operations. In this system the mains frequency is generally used to synchronize the transmitter and receivers. Neither the control frequency nor the encoding are standardized in this standard.

This standard gives no requirements for constructional details internal to the receiver.

In the case where ripple control functionality is integrated in multifunction electricity metering equipment, the relevant parts of this standard apply.

This standard does not cover the acceptance tests and the conformity tests. Nevertheless, an example of what could be an acceptance test is given in Annex D.

The dependability aspect is covered by the documents of the IEC 62059 series.

When using this standard in conjunction with IEC 62052-21, the requirements of this standard take precedence over those of IEC 62052-21 with regard to any item already covered in it.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62052-21, *Electricity metering equipment (a.c.) – General requirements, tests and test conditions – Part 21: Tariff and load control equipment* [2]

3 Terms and definitions

For the purposes of this document, the definitions of IEC 62052-21 apply.

4 Standard electrical values

The values given in IEC 62052-21 apply.

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[2] To be published

5 Mechanical requirements and tests

The requirements and tests specified in IEC 62052-21 and the following apply.

5.1 Operation status indicator

The receiver shall have an operation status indicator to indicate the quiescent state, the message reception or the command execution.

6 Climatic conditions, requirements and tests

The conditions, requirements and tests specified in IEC 62052-21 apply.

7 Electrical requirements and tests

The requirements and tests specified in IEC 62052-21 and the following apply.

7.1 Supply voltage

7.1.1 Supply voltage range

The values specified in IEC 62052-21 apply.

7.1.2 Supply frequency range

IEC 62052-21 applies.

7.1.3 Power consumption

IEC 62052-21 applies.

7.1.4 Voltage dips and short interruptions

See 7.6.8.

7.1.5 Long interruptions of supply voltage

7.1.5.1 Requirements

If the position of the output elements is controlled only by the information received from the decoding element – the ripple control messages – the output elements shall not change their position at an interruption of the supply voltage, the length of which is to be agreed on between user and supplier, or shall take up the pre-determined position within 5 s after the restoration of the nominal supply voltage.

If the position of the output elements is also affected by the timers of the ripple control receiver, then the output elements shall take up their position according to the timer programme.

7.1.5.2 Test of effect of a long interruption of the supply voltage

The test consists of verifying that, after interrupting the supply voltage for an agreed length of time and when the supply is restored to the receiver, the output elements retain or return to the position that they had before the interruption or that they take up the predetermined position agreed between the user and the supplier.

This test shall be carried out for all possible positions of the output switches.

The restoration of voltage shall be made with switching devices free from bounce.

7.1.6 Operation reserve

7.1.6.1 Requirements

If the ripple control receiver is equipped with a back-up power supply, IEC 62052-21 applies.

7.1.6.2 Tests

The test consists of verifying that, after interrupting the supply for a time period of 36 h, the internal timers of the ripple control receiver maintain their value and when the supply is restored to the receiver, the output elements take up the position according to the timer programme.

7.1.7 Life of back-up power supply

If the ripple control receiver is equipped with a back-up power supply, IEC 62052-21 applies.

7.1.8 Back up power supply replacement

If the ripple control receiver is equipped with a back-up power supply, IEC 62052-21 applies.

7.2 Heating

IEC 62052-21 applies.

7.3 Insulation

IEC 62052-21 applies.

7.4 Output elements

IEC 62052-21 applies.

7.5 Functional requirements and tests – Control performance

7.5.1 General test conditions

Place the ripple control receiver under test in its normal operating position and, if necessary, in a climatic chamber and supply it from an apparatus free of short interruptions and voltage dips. Unless otherwise indicated, the reference conditions shown in Annex B of IEC 62052-21 shall be maintained.

The sources providing the neighbouring harmonics shall conform to the requirements of 7.6.12.2.1.

7.5.2 Operate voltage

7.5.2.1 Requirements

The operate voltage shall be agreed upon case by case taking into account the characteristics of the ripple control system, the supply network, the manufacturing tolerances and the variations of the influence quantities:

– supply voltage;

– supply frequency;

– temperature;
– harmonics/interharmonics;
– control frequency.

7.5.2.2 Test of operation

The correct operation of the receiver shall be tested successively for all the combinations of parameters, which are shown in Table C.1 in accordance with the requirements of 7.6.11, the control frequency varying within limits agreed between the user and the supplier.

For all these combinations, the receiver tested shall operate faultlessly and carry out the commands corresponding to messages transmitted according to their codes, both at the operate voltage U_f and at the maximum control voltage U_{max}.

NOTE It is assumed that if the ripple control receiver passes the test both at U_f and U_{max}, it will work correctly between these limits.

7.5.3 Non-operate voltage

7.5.3.1 Requirements

The non-operate voltage shall be agreed upon case by case taking into account the characteristics of the ripple control system, the supply network, the manufacturing tolerances and the variations of the influence quantities:

– supply voltage;
– supply frequency;
– temperature;
– harmonics/interharmonics;
– control frequency.

7.5.3.2 Test of non-operation

For this test, apply all the combinations of parameters given in Annex C in accordance with the requirements of 7.6.11, the control frequency varying within the limits agreed between the user and the supplier.

For all these combinations, the receiver tested shall not switch in response to a correctly coded message at the non-operate voltage U_{nf}.

7.5.4 Maximum control voltage

For control frequencies below 250 Hz, the maximum voltage shall be at least 8 times and, for frequencies above 750 Hz, at least 15 times greater than the operate voltage. For intermediate frequencies, a linear interpolation shall be made according to the following formula:

$$U_{max} = U_f \left(8 + \frac{(f_s - 250) \times 7}{500} \right)$$

where f_s is expressed in hertz.

7.5.5 Tolerance on the message

7.5.5.1 Requirements

The receiver shall operate correctly up to the specific timing tolerance limits of the code. The tolerances and the test shall be agreed between the user and the supplier.

7.5.5.2 Test

This test shall be adapted and agreed between the user and the supplier.

7.6 Electromagnetic compatibility (EMC)

The requirements and values defined in IEC 62052-21 and the following apply.

7.6.1 Immunity to electromagnetic disturbances

IEC 62052-21 applies.

7.6.2 General test conditions

IEC 62052-21 applies.

7.6.3 Test of immunity to electrostatic discharges

In addition to IEC 62052-21, the following applies.

The application of the electrostatic discharge shall not affect the receiver:

– in a quiescent state, the receiver shall not start;
– during a transmission cycle, the output elements shall operate correctly, according to the commands of the message.

7.6.4 Test of immunity to electromagnetic r.f. fields

In addition to IEC 62052-21, the following applies.

- Field strength of the unmodulated signal: 10 V/m: the application of the electromagnetic r.f. fields shall not affect the receiver
  - in a quiescent state, the receiver shall not start and the timers must not be disturbed;
  - during a transmission cycle, the output elements shall operate correctly according to the commands of the message, and the internal timers, if any.
- Field strength of the unmodulated signal: 30 V/m: during the test, a temporary degradation or loss of function or performance is acceptable.

If the r.f. field is applied while the receiver is in a quiescent state, it shall be verified that the receiver does not start as an effect of the r.f. field. For this purpose, 3 s after removing the r.f. field, a message is transmitted with operate voltage U_f. The output elements shall operate correctly according to the commands of the message.

If the r.f. field is applied during a transmission cycle, it is accepted that no operation is carried out.

The application of the r.f. field shall not affect the internal timers. It shall be verified that, after the test, the operations carried out on the basis of such internal timers are correctly executed.

7.6.5 Fast transient burst test

In addition to IEC 62052-21, the following applies.

The receiver shall be tested in a quiescent state and during transmission cycles, each time for 1 min and each time for both positive and negative polarities.

If the bursts are applied while the receiver is in a quiescent state, it shall be verified that the receiver does not start as an effect of the bursts. For this purpose, 3 s after the bursts have been applied a message is transmitted with operate voltage U_f. The output elements shall operate correctly according to the commands of the message.

If the bursts are applied in such a way that bursts occur during a transmission cycle, it shall be verified that bursts did not impede the operation capability of the receiver. For this purpose, the receiver is started by a message with the operate voltage U_f. It shall be verified that, despite the application of the bursts, no wrong operation occurs. In cases where the disturbance coincides with the start bit or an information pulse related to this command, or is adjacent to it, it is accepted that no operation is carried out. In all other cases, the command must be carried out.

However, in non-operation or even with some kinds of codes, a malfunction may be accepted if the transient coincides with a pulse position or is adjacent to it.

The application of the bursts shall not affect the internal timers. It shall be verified that after the test, operations carried out based on such internal timers are correctly executed.

7.6.6 Test of immunity to conducted disturbances, induced by r.f. fields

In addition to IEC 62052-21, the following applies.

The receiver shall be tested in a quiescent state and during transmission cycles.

If the conducted r.f. disturbances are applied while the receiver is in a quiescent state, it shall be verified that the receiver does not start as an effect of the conducted r.f. disturbances. For this purpose, 3 s after removing the conducted r.f. disturbances, a message is transmitted with operate voltage U_f. The output elements shall operate correctly according to the commands of the message.

If the conducted r.f. disturbances are applied during a transmission cycle, it shall be verified that the conducted r.f. disturbances did not impede the operation capability of the receiver. For this purpose, the receiver is started by a message with the operate voltage U_f. It shall be verified that, despite the application of the conducted r.f. disturbances, no wrong operation occurs.

The application of the conducted r.f. disturbances shall not affect the internal timers. It shall be verified that operations carried out on the basis of such internal timers are correctly executed.

7.6.7 Surge immunity test

In addition to IEC 62052-21, the following applies.

The receiver shall be tested in a quiescent state and during transmission cycles, each time for both positive and negative polarities.

If the surges are applied while the receiver is in a quiescent state, it shall be verified that the receiver does not start as an effect of the surges. For this purpose, 3 s after the surges have been applied a message is transmitted with operate voltage U_f. The output elements shall operate correctly according to the commands of the message.

If the surges are applied in such a way that surges occur during a transmission cycle, it shall be verified that the surges did not impede the operation capability of the receiver. For this purpose, the receiver is started by a message with the operate voltage U_f. It shall be verified that, despite the application of the surges, no wrong operation occurs. In cases where the disturbance coincides with the start bit or an information pulse related to this command, or is adjacent to it, it is accepted that no operation is carried out. In all other cases, the command must be carried out.

However, in non-operation or even with some kinds of codes, a malfunction may be accepted if the transient coincides with a pulse position or is adjacent to it.

The application of the surges shall not affect the internal timers. It shall be verified that after the test, the operations carried out based on such internal timers are correctly executed.

7.6.8 Test of immunity to voltage dips and short interruptions

7.6.8.1 Requirements

When the receiver is in quiescent state, voltage dips or short interruptions lower than 500 ms shall not affect, or initiate the starting of the receiver. For short interruptions longer than 500 ms, the receiver and its internal timers may stop and are re-initialized.

When the receiver is receiving a transmission cycle, voltage dips or short interruptions lower than 500 ms must not impede the operation capability of the receiver. For short interruptions longer than 500 ms, it is accepted that the receiver and its timers stop and are re-initialized.

If the receiver is equipped with a back-up power supply, voltage dips and short interruptions shall not affect the timers.

7.6.8.2 Test of effect of short interruptions of supply and voltage dips in operation

The aim of the test is to check that the operation of the receiver is not unduly disturbed by a voltage interruption of maximum 0,5 s ± 20 ms and that nothing other than the reset of the receiver occurs when the voltage interruption is longer than 0,5 s. Two situations have to be considered:

– the interruption takes place while the receiver is connected to the network in a quiescent state;

– the interruption takes place during a transmission cycle.

a) The 0,5 s interruption takes place while the receiver is in a quiescent state. It shall be verified that the receiver does not start as an effect of the voltage interruption and that internal timers are not affected. For this purpose, 3 s after the voltage interruption, a message is transmitted with the operate voltage U_f. The output elements should operate correctly according to the commands of the message.

b) The 0,5 s interruption takes place during a transmission cycle. It shall be verified that the interruption does not impede the operation capability of the receiver. For this purpose, the receiver is started by a message with the operate voltage U_f, the other influence quantities having their reference values. At a certain point of the cycle, the supply voltage is interrupted for 0,5 s, whereby this point can be placed at different positions in subsequent cycles (for instance, at the position of the start pulse, of an information pulse or of a pulse interval). The message is to be composed in such a manner that a command to change the state of the output element(s) is placed after the interruption.

   It shall be verified that no wrong operation occurs. In the case where the disturbance coincides with the start bit or an information pulse related to this command, or is adjacent to it, it is accepted that no operation is carried out. In all other cases, the command must be carried out.

7.6.9 Test of immunity to d.c. magnetic fields

In addition to IEC 62052-21, the following applies.

During the test, the receiver must retain its operational capacities (test of operation with U_f, test of non-operation with U_{nf}, the control voltage being correctly coded, the other influence quantities having reference values as given in Annex B of IEC 62052-21).

7.6.10 Test of immunity to a.c. magnetic fields

In addition to IEC 62052-21, the following applies.

During the test, the receiver must retain its operational capacities (test of operation with U_f, test of non-operation with U_{nf}, the control voltage being correctly coded, the other influence quantities having reference values as given in Annex B of IEC 62052-21).

7.6.11 Test of influence of harmonics

The receivers shall be designed in such a way that their operation is not disturbed by the presence of voltage harmonics on the distribution network. The levels of harmonics, which shall not disturb the function of the receivers, are shown in Table A.1.

In the case of receivers intended for use on existing ripple control installations having control frequencies very close to a harmonic, the harmonics to be considered and their levels are to be the subject of agreement between the user and the supplier.

The receivers shall not be disturbed in their operation when a correctly coded operate control voltage is applied and shall not be disturbed with regard to their non-operation when a correctly coded non-operate control voltage is applied over the temperature range specified in Clause 6, over the supply voltage range specified in 7.1.1 and when they are subjected to the following harmonics.

a) Singly, the harmonic H_a of the network voltage immediately below the control frequency, having the amplitude indicated in Table C.1 (or being the subject of agreement).

b) Singly, the harmonic H_b of the network voltage immediately above the control frequency, having the amplitude indicated in Annex C (or being the subject of agreement).

c) Singly, the harmonic H_c of the network voltage immediately below H_a or immediately above H_b with the amplitude shown in Annex A. The choice of this harmonic and, where appropriate its amplitude, shall be the subject of agreement between the user and the supplier (see Figure B.1).

d) The combination of the harmonics H_a, H_b, H_c. Their amplitudes, whether taken from Annex F or obtained by agreement between the user and the supplier, shall be multiplied by a factor k = 0,6.

7.6.12 Test of immunity to interharmonics (quasi-steady voltages of non harmonic frequencies)

7.6.12.1 Requirements

These voltages are produced by certain high-power industrial equipment (for example, cyclo-converters or induction furnaces) or by overspill from neighbouring transmitters.

The ability of the receiver to resist these voltages is represented by a curve called the "disturbance-limit curve". It represents the maximum value of these voltages as a function of frequency which the receiver can withstand in the presence of the combination of neighbouring harmonics given in 7.6.11d) and

– still function correctly under a coded control voltage equal to αU_f (α = parameter >1) (disturbance-limit curve relative to operation);

– certainly not operate under a coded control voltage equal to βU_{nf} (β = parameter <1) (disturbance-limit curve relative to non-operation);

where U_f and U_{nf} are coded according to the message of the command to which the receiver is set. The behaviour of the receiver at the frequencies $f = f_s \pm n f_n$ where n = 1 and 2 shall also be verified.

The limit values of the disturbance voltage limit curves shall be agreed between the user and the supplier.

7.6.12.2 Test of influence of interharmonics (quasi-steady disturbing voltages of non harmonic frequencies)

7.6.12.2.1 Disturbance-limit curve relative to operation

In order to determine the limits of disturbing voltages which still allow the receiver to operate faultlessly, the disturbance-limit curve shall be plotted under the following conditions (see Annex F for an example of test configuration).

a) Submit the receiver under test to a control voltage $U_s = \alpha\ U_f$, α being equal to 1,5. The control voltage shall be coded according to the message for which the receiver is set.

b) Apply simultaneously three harmonics near to the control frequency as indicated in 7.6.11 d). One of these harmonics may be suppressed if the effect on the test results of its removal is negligible due to its distance from the control frequency.

   The phases of these harmonics in the supply system are normally not fixed. This effect may be reproduced by taking harmonic frequencies slightly different from their exact values without, however, the difference not exceeding ± 0,2 %. The phases of the harmonics are also not fixed between themselves, and, to simulate this effect, the frequency differences are adjusted in relation to each other by a displacement of approximately ±0,1 % to ±0,3 % (see Annex B).

c) The other quantities shall have their reference values (see Annex B of IEC 62052-21).

d) In the range of frequencies between the harmonics, apply a voltage U_v of variable frequency and amplitude. For each frequency, the limit of U_v for which the receiver functions correctly shall be determined. U_v shall not exceed U_{max}.

e) The performance of the receiver shall also be tested at the frequencies $f = f_s \pm n f_n$ where n = 1 and 2. In this case also U_v will be limited to U_{max}.

NOTE 1 Beating, which is not synchronous with the code, occurs between the control voltage, the harmonic voltages and the variable non-harmonic voltage U_v. The limit is the value of U_v for which no more than one mal-operation occurs during 10 messages.

NOTE 2 Among a number of receivers the threshold of operation varies over a certain range as a result of manufacturing tolerances. It follows that the disturbance limit curves of a group of receivers will vary over a certain band even with homogeneous manufacture.

The supplier should provide an envelope curve that takes account of manufacturing tolerances.

7.6.12.2.2 Disturbance-limit curve relative to non-operation

The limit of disturbance voltages, which affect the non-operation of the receiver is determined by the same method of measurement and under the same conditions as in 7.6.12.2.1, taking account of the following differences.

a) The receiver under test is submitted to a control voltage $\beta.U_{nf}$, β being equal to 0,67. The control voltage shall be coded according to the message for which the receiver is set.

b) As in 7.6.12.2.1b).

c) As in 7.6.12.2.1c).

d) In the range of frequencies between harmonics apply a voltage U_v of variable frequency and amplitude. For each frequency, the limit of U_v for which the receiver just does not carry out the operation is determined. U_v shall not exceed U_{max}.

e) As in 7.6.12.2.1e).

NOTE The same remarks as in 7.6.12.2.1 apply.

7.6.13 Test of immunity to disturbing pulses

7.6.13.1 Requirements

The operation of the receivers in the presence of such pulses shall be represented by two curves called "sensitivity curves". One relates to the starting of a receiver and the other to the behaviour of a receiver that has started. These curves represent the maximum amplitude (as a function of the duration) of a pulse at the rated control frequency, which causes the same operation as a normal starting pulse or control pulse.

NOTE These curves are determined by the characteristics of the input element and the decoding element. In considering the overall sensitivity of the receivers to disturbing pulses, it should be noted that additional protection may be given by the particular properties of the code and that non-execution of an order is considered less important than a mal-operation.

7.6.13.2 Test of effect of disturbing pulses on operation

a) Plotting of the sensitivity curve relative to the starting of the receiver

Submit the receivers under test, being in a quiescent state, to a pulse at the rated control frequency of which the amplitude and length are variable. This pulse is followed after a time approximately equal to half a cycle by a message comprising only the number of pulses of level U_f necessary to carry out the command for which the receiver is adjusted.

The other influencing quantities shall have their reference values (see Annex B of IEC 62052-21).

For each chosen length of the disturbing pulse, the amplitude shall be found for which the command is just not carried out. This limiting amplitude shall be shown on a diagram as a function of the length of the pulse.

b) Plotting the sensitivity curve relative to the operation of the receiver after starting.

The receivers, initially quiescent, shall be submitted to a message, which lacks one of the pulses needed to execute the order for which they are adjusted. This missing pulse shall be replaced by a disturbing pulse similar to that described under a), the pulse being in the most favourable position to operate the output element. For each chosen length of the disturbing pulse, the amplitude shall be found for which the output element just carries out an operation.

This amplitude shall also be shown on a diagram as a function of pulse length.

7.7 Radio interference suppression

IEC 62052-21 applies.

8 Test conditions and type test

IEC 62052-21 applies.

Annex A
(normative)

Harmonic levels for testing ripple control receivers

Table A.1 – Recommended values for 50 Hz networks*

Harmonic order N	Frequency Hz	Level % of U_n
2	100	2
3	150	7
4	200	1,5
5	250	8
6	300	1
7	350	7
8	400	0,8
9	450	1,2
10	500	0,7
11	550	5
13	650	5
15	750	0,5
17	850	2
19	950	2
23	1 150	1,5
25	1 250	1,5
29	1 450	0,8
31	1 550	0,8
35	1 750	0,7
37	1 850	0,7

The level of each harmonic between 600 Hz and 2 000 Hz not listed above is 0,3 % of U_n.

* For 60 Hz networks, multiply by 1,2 the figures stated for frequency.

Annex B
(normative)

Selection of frequency for tests with harmonics

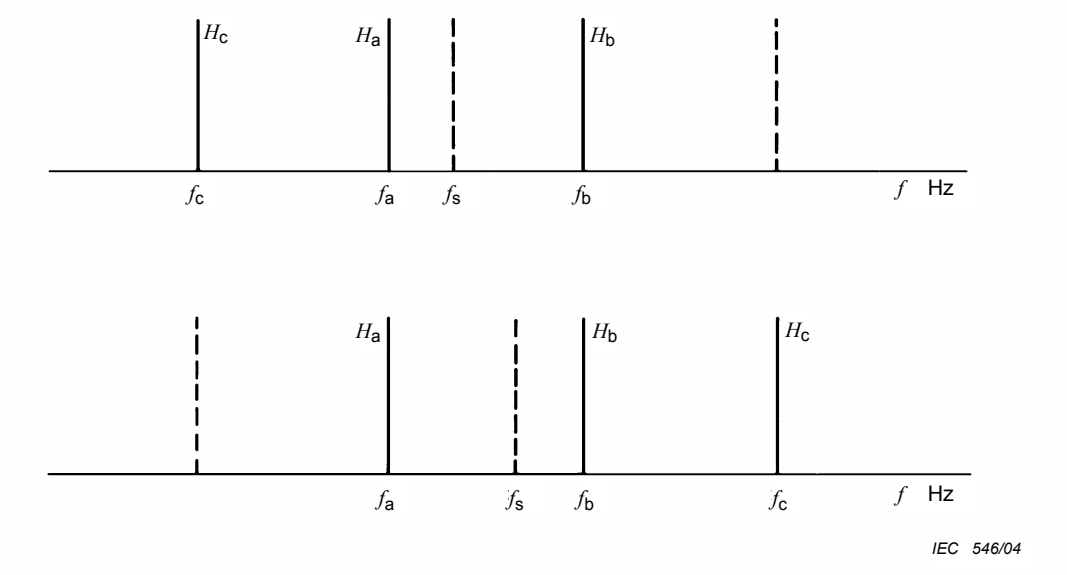
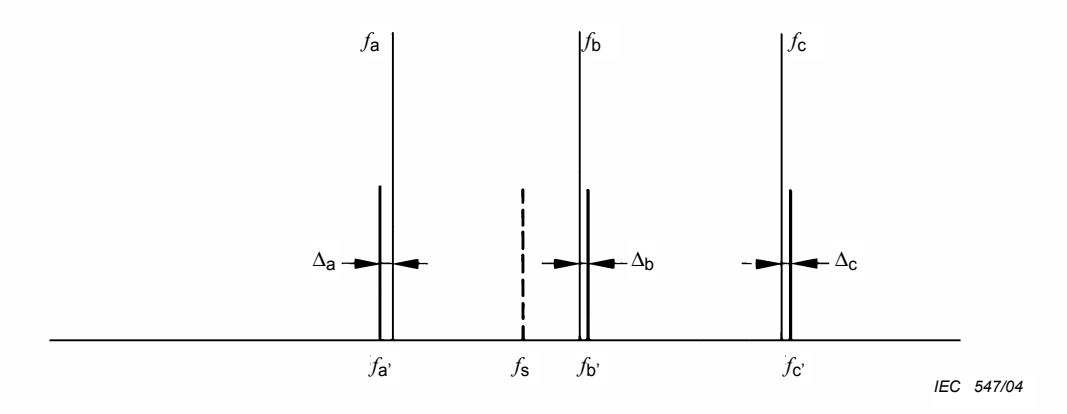


Figure B.1 – Examples for selection of the frequency H_c



$0 < \Delta_a \neq \Delta_b \neq \Delta_c < \pm$ 0,2 % of f_h

$|\Delta_a - \Delta_b|$, $|\Delta_b - \Delta_c|$, $|\Delta_c - \Delta_a| \simeq$ 0,1 % ... 0,3 % of f_h

where f_h is the frequency of the considered harmonic.

Figure B.2 – Frequency deviations for measurement of the disturbance-limit curves

Annex C
(normative)

Combination of parameters for operation and non-operation tests

Table C.1 – Combination of parameters

		Testing for operation				Testing for non-operation		
Control voltage		U_f			U_{max}	U_{nf}		
Supply voltage		180 V	230 V	255 V	230 V	180V	230 V	255 V
Temperature / Harmonic level								
0	-25 °C	o	+	o	o	o	+	o
	+23 °C	+	+	+	+	+	+	+
	+55 °C	o	+	o	o	o	+	o
H_a	-25 °C	o	+	o	o	o	+	o
	+23 °C	o	+	o	o	o	+	o
	+55 °C	o	+	o	o	o	+	o
H_b	-25 °C	o	+	o	o	o	+	o
	+23 °C	o	+	o	o	o	+	o
	+55 °C	o	+	o	o	o	+	o
H_c	-25 °C	o	+	o	o	o	+	o
	+23 °C	o	+	o	o	o	+	o
	+55 °C	o	+	o	o	o	+	o
$0{,}6*(H_a+H_b+H_c)$	-25 °C	o	+	o	o	o	+	o
	+23 °C	+	+	+	o	+	+	+
	+55 °C	o	+	o	o	o	+	o

+ = Combinations of parameters to be applied.

o = Combinations of parameters that are not applicable.

NOTE 1 The values of the supply indicated are valid for U_n = 230 V. For other values of the reference voltage, the values have to be calculated accordingly.

NOTE 2 In case of extended temperature range, the supplier and the manufacturer may agree to perform the tests at the limits of the extended range.

Annex D
(informative)

Acceptance tests

The procedure described in IEC 62052-21 and the following apply.

Acceptance tests shall comprise

a) an operating test
   - at operate voltage U_f;
   - for each of the supply voltages 180 V, 230 V and 255 V (the test at 230 V may be omitted);
   - at the reference values of the other influence quantities as given in Annex B of IEC 62052-21;

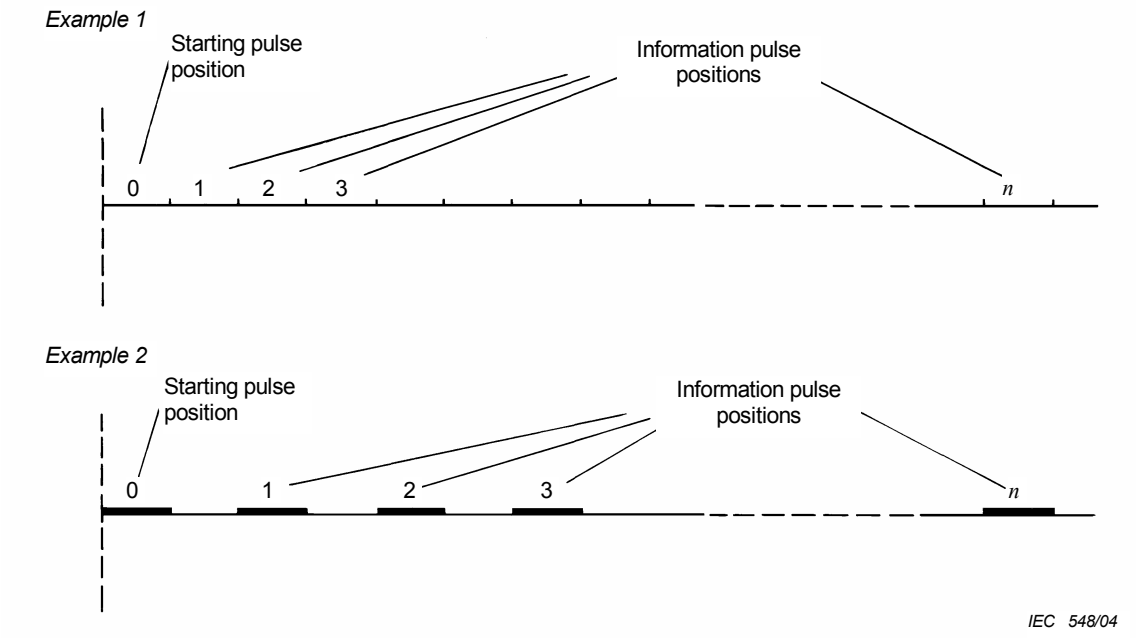
b) a test of non-operation
   - at the non-operate voltage U_{nf};
   - for each of the supply voltages 180 V, 230 V and 255 V (the test at 230 V may be omitted);
   - at the reference values of the other influence quantities as given in Annex B of IEC 62052-21.

NOTE The values of the supply indicated are valid for U_n = 230 V. For other values of the reference voltage, the values have to be calculated accordingly.

Annex E
(informative)

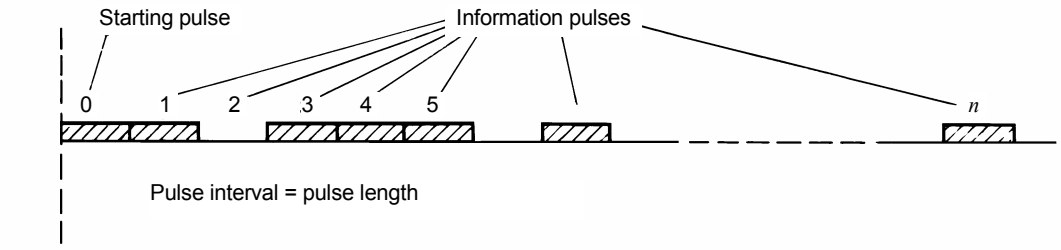
Code terms

E.1 Ripple control code

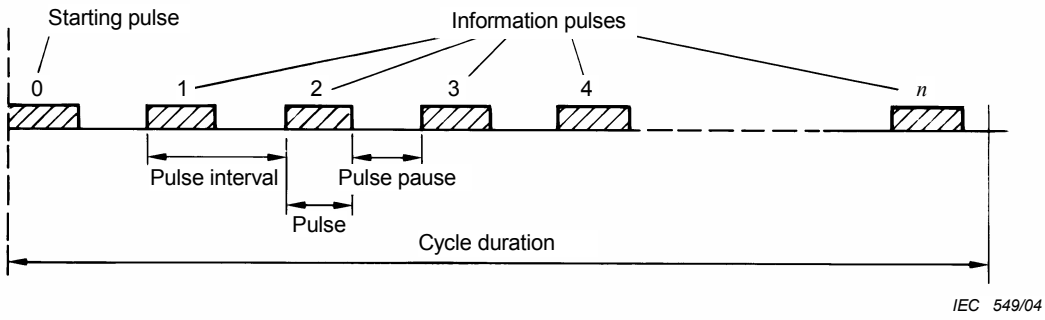


E.2 Message

Example 1 (without interval between the pulses)



Example 1 (with a pause between the pulses)



Annex F
(informative)

Example of a test configuration for operation and non-operation tests and for measurement of disturbance-limit curves

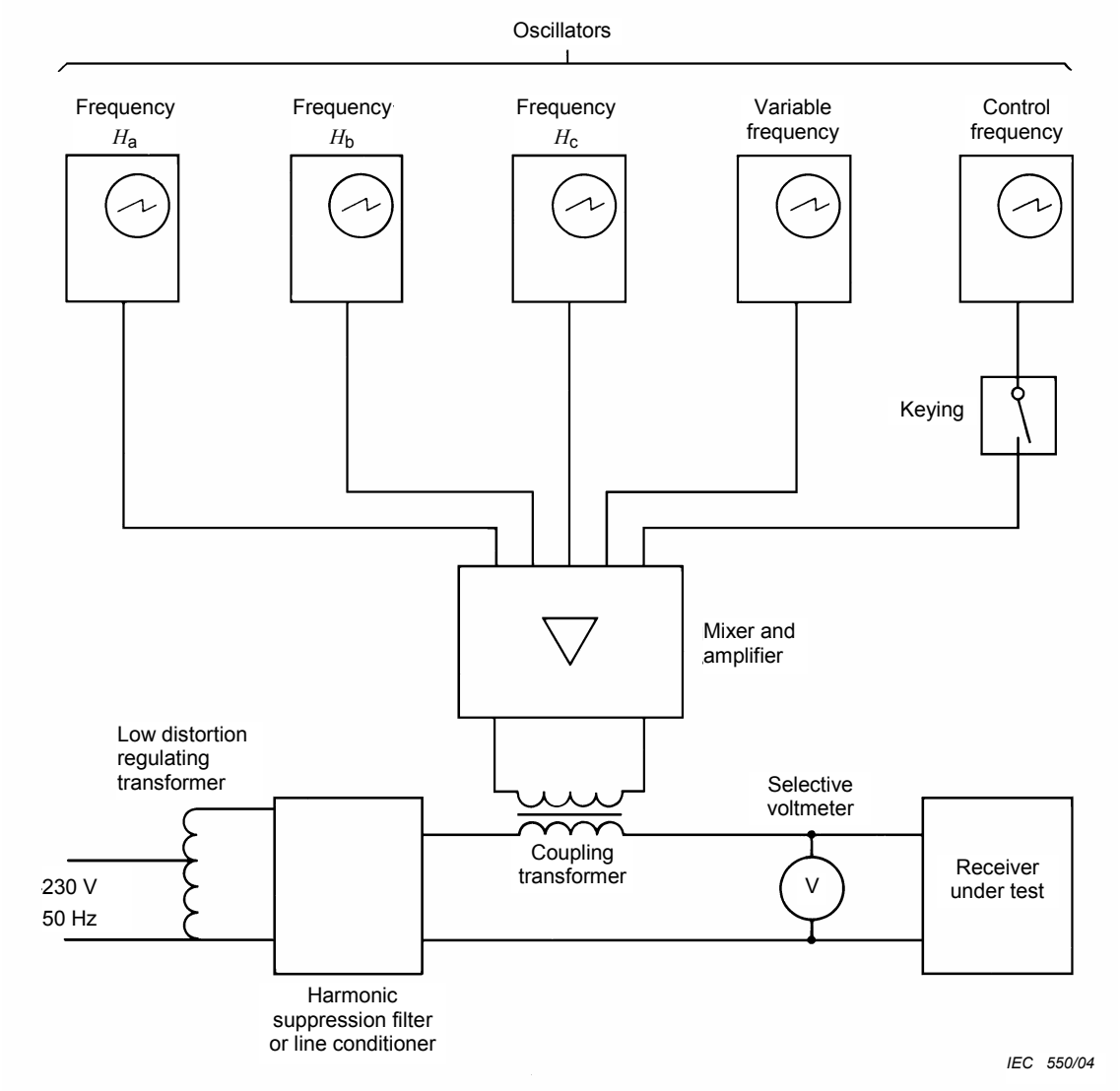


Figure F.1 – Test configuration

For zero harmonic level, a residual level of 10 % of the value of 0,1 % of U_n given in Annex A is permissible, whichever value is the larger.

Annex G
(informative)

Values of the influence quantities for the different tests

Sub-clause	Influence quantity test	Supply voltage V	Control voltage U_s	Control frequency, f_s	Harmonic level	Message	Temperature °C	Humidity %	Notes
IEC 62054-11									
7.5.1	General test conditions	*N*	U_f	*N*	0	*N*	15-25	45-75	
7.5.2.2	Test of operation	180/230/255	U_f	N ± Δf	0/max.	*N*	–25/+23/+55	*N*	See Annex C
7.5.2.2	Test of operation	230	U_{max}	*N*	0	*N*	+23	*N*	See Annex C
7.5.3.2	Test of non-operation	180/230/255	U_{nf}	*N* ± Δf	0/max.	*N*	–25/+23/+55	*N*	See Annex C
7.6.12.2.1	Disturbance-limit curve relative to operation	*N*	$\alpha\ U_f$	*N*	Max. (3 harm.)	*N*	*N*	*N*	
7.6.12.2.2	Disturbance-limit curve relative to non-operation	*N*	$\beta\ U_{nf}$	*N*	Max. (3 harm.)	*N*	*N*	*N*	
7.6.13.2	Effect of disturbing pulses on operation	*N*	Variable	*N*	0	Variable	*N*	*N*	
7.6.13.2	Effect of disturbing pulses on operation	*N*	U_f	*N*	0	N	*N*	*N*	
7.1.5.2	Effect of a long interruption of the supply voltage	*N*	–	–	–	–	*N*	*N*	
IEC 62052-21									
7.4.3	Number of operations of the output elements	1,15 U_c	–	–	–	–	*N*	*N*	
7.4.4.2	Short-circuit performance of the a.c. switches >2A	–	–	–	–	–	*N*	*N*	
7.1.3.2	Power consumption	*N*	–	–	–	–	*N*	*N*	
7.3.2	Insulation properties	–	–	–	–	–	*N*	*N*	Atmos. Pressure: *N*
5.9.2.a)	Protection against penetration of dust	–	–	–	–	–	*N*	*N*	
5.9.2 b)	Protection against penetration of water	–	–	–	–	–	*N*	*N*	
6.3.1	Dry heat test	–	–	–	–	–	Variable	Variable	
6.3.2	Cold test	–	–	–	–	–	Variable	Variable	
6.3.3	Damp heat cyclic test	*N*	–	–	–	–	Variable	Variable	
6.3.3	Damp heat cyclic test	*N*	U_f	*N*	0	*N*	*N*	*N*	
7.2.2	Influence of heating	1,15 U_n	U_f	*N*	0	*N*	+40	*N*	Contacts: I_{rot}
5.2.2.1	Spring hammer test	–	–	–	–	–	*N*	*N*	
5.2.2.2	Shock test	*N*	U_f/U_{nf}	–	–	–	*N*	*N*	
5.2.2.3	Vibration test	*N*	U_f/U_{nf}	–	–	–	*N*	*N*	
IEC 62054-11									
7.6.3	Immunity to electrostatic discharges	*N*	U_f	*N*	0	*N*	*N*	*N*	
7.6.4	Immunity to electromagnetic r.f. fields	*N*	U_f	*N*	0	*N*	*N*	*N*	
7.6.5	Fast transient burst test	*N*	U_f	*N*	0	*N*	*N*	*N*	
7.6.6	Immunity to conducted disturbances induced by r.f. fields	*N*	U_f	*N*	0	*N*	*N*	*N*	

Sub-clause	Influence quantity test	Supply voltage V	Control voltage U_s	Control frequency, f_s	Harmonic level	Message	Temperature °C	Humidity %	Notes
7.6.7	Surge immunity test	*N*	U_f	*N*	0	*N*	*N*	*N*	
7.6.8.2	Immunity to voltage dips and short interruptions	*N*	U_f	*N*	0	Variable	*N*	*N*	
7.6.9	Immunity to d.c. magnetic fields	*N*	U_f/U_{nf}	*N*	0	*N*	*N*	*N*	
7.6.10	Immunity to a.c. magnetic fields	*N*	U_f/U_{nf}	*N*	0	*N*	*N*	*N*	
7.6.11	Influence of harmonics	230	U_f/U_{nf}	*N*	H_a, H_b, H_c,	*N*	-25/+23/ +55	*N*	
7.6.11	Influence of harmonics	180/230 /255	U_f/U_{nf}	*N*	0,6*(H_a+H_b+ H_c)	*N*	-25/+23/ +55	*N*	
7.7	Radio interference suppression	*N*	U_f	*N*	0	*N*	*N*	*N*	

NOTE 1 *N* is the reference value as in Annex B of IEC 62052-21

NOTE 2 – is irrelevant for the test

NOTE 3 $\pm\Delta f$ is the tolerance to be observed

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ISBN 2-8318-7514-5

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Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND