

SAUDI STANDARD

DRAFT No19174 /2011

**LAMP CONTROLGEAR –
Part 2-3: Particular requirements for a.c. supplied electronic
ballasts for fluorescent lamps**

SAUDI ARABIAN STANDARDS ORGANIZATION

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FOREWORD

The Saudi Standards, Metrology and Quality Organization (SASO) has adopted the International Standard IEC 61347-2-3/2004 “LAMP CONTROLGEAR – Part 2-3: Particular requirements for a.c. supplied electronic ballasts for fluorescent lamps” issued by the International Electrotechnical Commission (IEC). It has been adopted without any technical modifications with a view to its approval as a Saudi standard.

LAMP CONTROLGEAR –**Part 2-3: Particular requirements for a.c. supplied electronic ballasts
for fluorescent lamps****1 Scope**

This part of IEC 61347 specifies particular safety requirements for electronic ballasts for use on a.c. supplies up to 1 000 V at 50 Hz or 60 Hz with operating frequencies deviating from the supply frequency, associated with fluorescent lamps as specified in IEC 60081 and IEC 60901, and other fluorescent lamps for high-frequency operation.

Particular requirements for electronic ballasts with means of protection against overheating are given in annex C.

Particular requirements for a.c./d.c. supplied electronic ballasts for maintained emergency lighting are given in annex J.

Performance requirements are the subject of IEC 60929.

2 Normative references

For the purpose of this part of IEC 61347, the normative references given in clause 2 of IEC 61347-1 which are mentioned in this standard apply, together with the following normative references.

IEC 60598-2-22, *Luminaires – Part 2-22: Particular requirements – Luminaires for emergency lighting*

IEC 61347-1, *Lamp controlgear – Part 1: General and safety requirements*

IEC 61347-2-7, *Lamp controlgear – Part 2-7: Particular requirements for d.c. supplied electronic ballasts for emergency lighting¹⁾*

3 Definitions

For the purpose of this part of IEC 61347, the definitions of clause 3 of IEC 61347-1 apply, together with the following:

3.1**a.c. supplied electronic ballast**

mains-supplied a.c. to a.c. inverter including stabilizing elements for starting and operating one or more tubular fluorescent lamps, generally at high frequency

¹⁾ To be published.

3.2**controllable ballast**

lamp power (light output) of the electronic ballast controlled between the minimum value (or off) and the maximum value by the signal on the control input of the ballast

3.3**maximum value of lamp power (of a controllable ballast)**

lamp power (light output) which complies with 8.1 of IEC 60929, unless otherwise declared by the manufacturer or responsible vendor

3.4**maximum allowed peak voltage**

highest permitted peak voltage across any insulation under open-circuit condition and any normal and abnormal operating conditions. The maximum peak voltage is related to the declared r.m.s. working voltage; see table 1

3.5**minimum value of lamp power (of a controllable ballast)**

lowest percentage of the lamp power defined in 3.3 declared by the manufacturer or responsible vendor

3.6**control terminals**

connections to the electronic ballast which are used to apply a control signal for changing the light output

NOTE The power supply terminals can also act as control terminals.

3.7**control signal**

signal which may be an a.c. or d.c. voltage, and which by analogue, digital or other means may be modulated to convey the necessary information to the ballast for the purpose of changing the light output

3.8**a.c./d.c. supplied electronic ballast for maintained emergency lighting**

mains/battery-supplied a.c./d.c to a.c. inverter including stabilizing elements for starting and operating one or more tubular fluorescent lamps, generally at high frequency for emergency lighting

3.9**cathode dummy resistor**

cathode substitution resistor as specified on the relevant lamp data sheet of IEC 60081 or IEC 60901 or as declared by the relevant lamp manufacturer or by the responsible vendor

4 General requirements

The requirements of clause 4 of IEC 61347-1 apply, together with the following additional requirement:

AC/d.c. electronic ballasts for emergency lighting shall comply with the requirements of annex J.

5 General notes on tests

The requirements of clause 5 of 61347-1 apply together with the following additional requirement:

Number of specimens

The following number of specimens shall be submitted for testing:

- one unit for the tests of clause 6 to 12 and 15 to 22;
- one unit for the test of clause 14 (additional units or components, where necessary, may be required in consultation with the manufacturer).

Tests to meet the safety requirements for a.c./d.c. supplied electronic ballasts for emergency lighting are made under the conditions specified in annex J.

6 Classification

The requirements of clause 6 of IEC 61347-1 apply.

7 Marking

Ballasts which form an integral part of the luminaire need not be marked.

7.1 Mandatory markings

In accordance with the requirements of 7.2 of IEC 61347-1, ballasts, other than integral ballasts, shall be clearly and durably marked with the following mandatory markings:

- items a), b), c), d), e), l) and k) of 7.1 of IEC 61347-1, together with
- the symbol for earthing, as applicable;
- for controllable ballasts, the control terminals shall be identified;
- a declaration of the maximum working voltage (r.m.s.) according to 12.2 between
- output terminals;
- any output terminal and earth, if applicable.

Marking for each of these two values shall be in steps of 10 V when the working voltage is equal to, or less than, 500 V, and in steps of 50 V when the working voltage is higher than 500 V. The marking of maximum working voltage is referenced in two situations, the maximum between output terminals and the maximum between any output terminal and earth. It is acceptable for only the higher of these two voltages to be marked.

Marking shall be U-OUT=...V..

7.2 Information to be provided, if applicable

In addition to the above mandatory markings, the following information, if applicable, shall be given either on the ballast, or be made available in the manufacturer's catalogue or similar:

- items h), i), and j) given in 7.1 of IEC 61347-1.

8 Protection against accidental contact with live parts

The requirements of clause 10 of IEC 61347-1 apply.

9 Terminals

The requirements of clause 8 of IEC 61347-1 apply.

10 Provisions for earthing

The requirements of clause 9 of IEC 61347-1 apply.

11 Moisture resistance and insulation

The requirements of clause 11 of IEC 61347-1 apply together with the following additional requirements:

The leakage current that may occur from contact with fluorescent lamps operated at high frequency from a.c. supplied electronic ballasts shall not exceed the values in figure 2 when measured in accordance with annex I. The values are in r.m.s. values.

The limits of leakage current values for frequencies between the values shown in figure 2 should be obtained by calculation according to the formula in the figure (under consideration).

NOTE Limits of leakage current values for frequencies above 50 Hz are under consideration.

Compliance with these requirements is checked in accordance with annex I.

12 Electric strength

The requirements of clause 12 of IEC 61347-1 apply.

13 Thermal endurance test for windings

The requirements of clause 13 of IEC 61347-1 do not apply.

14 Fault conditions

The requirements of clause 14 of IEC 61347-1 apply.

15 Protection of associated components

15.1

Under conditions of normal operation, verified with dummy cathode resistors inserted and conditions of abnormal operation, as specified in clause 16, the voltage at the output terminals shall at no time exceed the maximum permitted peak value specified in table 1.

Table 1 – Relation between r.m.s. working voltage and maximum peak voltage

Voltage at output terminals	
RMS working voltage V	Maximum permitted peak voltage V
250	2 200
500	2 900
750	3 100
1 000	3 200
NOTE Linear interpolation between the given voltage steps is allowed.	

15.2

Under normal operating conditions and abnormal operating conditions as specified in clause 15, except for the rectifying effect, and from 5 s after the switch on or beginning of the starting process, the voltage at the output terminals shall not exceed the maximum working voltage for which the ballast is declared.

15.3

In the case of a rectifying effect, i.e. abnormal operating condition according to 16 d), the r.m.s. voltage at the output terminal shall not exceed the maximum permitted value for which the ballast is designed for a period longer than 30 s after switch-on, or beginning of the starting process.

For ballasts which make more than one attempt to start a failed lamp, the combined duration of voltages above the maximum working voltage for which the ballast is declared shall not exceed 30 s.

15.4

For the tests of 15.1, 15.2 and 15.3, the output voltages measured shall be those between any output terminal and earth. Additionally, voltages that appear between output terminals shall be measured in cases where the voltage is present across insulation barriers within associated components.

15.5

For controllable electronic ballasts, the control input shall be isolated from the mains circuit by an insulation at least equal to basic insulation.

NOTE This requirement does not apply to those ballasts where control signals are injected via the supply terminals or where the control signals are completely isolated from the ballast by being transmitted remotely from infra-red or radio wave transmitters.

If SELV is to be used, then double or reinforced insulation is required.

16 Abnormal conditions

The ballast shall not impair safety when operated under abnormal conditions at any voltage between 90 % and 110 % of the rated supply voltage.

Compliance is checked by the following test.

Each of the following conditions shall be applied with the ballast operating according to the manufacturer's instructions (including a heat sink, if specified) for 1 h:

- a) the lamp or one of the lamps is not inserted;
- b) the lamp does not start because one of the cathodes is broken;
- c) the lamp does not start although the cathode circuits are intact (de-activated lamp);
- d) the lamp operates, but one of the cathodes is de-activated or broken (rectifying effect);
- e) short circuit of the starter switch, if any.

For the test simulating operation with a de-activated lamp, a resistor is connected in place of each lamp cathode. The resistor value is derived from the value of the nominal running current of the lamp prescribed in the relevant lamp data sheet of IEC 60081 and IEC 60901 and substituted in the following equation:

$$R = \frac{11,0}{2,1 \times I_n} \Omega$$

where

I_n is the rated lamp current of the lamp.

For lamps not covered by IEC 60081 and IEC 60901, the values declared by the lamp manufacturer shall be used.

When testing electronic ballasts for the rectifying effect, the circuit shown in figure 1 is used. The lamp is connected to the midpoints of the appropriate equivalent resistors. The rectifier polarity is chosen so as to give the most unfavourable conditions. If necessary, the lamp is started using a suitable starting device.

During and at the end of the tests specified under items a) to e), the ballast shall show no defect impairing safety nor shall any smoke be produced.

17 Behaviour of the ballast at end of lamp life

17.1 End of lamp life effects

At the end of lamp life the ballast shall behave in such a way that no overheating of lamp cap(s) occurs at any voltage between 90% and 110% of the rated supply voltage.

For the test simulating end of lamp life effects, three tests are described:

- a) asymmetric pulse test (described in 17.2);
- b) asymmetric power dissipation test (described in 17.3);
- c) open filament test (described in 17.4).

Any of the three tests may be used to qualify electronic ballasts. The ballast manufacturer shall determine which of the three tests will be used to test a given ballast based on the design of that particular ballast circuit. The chosen test method shall be indicated in the ballast manufacturer's literature.

NOTE Checking ballasts against their capability to cope with the partial rectifying effect is recommended by IEC 61195, Annex E, and IEC 61199, Annex H.

Lamps used in the ballast test circuits shall be new lamps seasoned for 100 h.

17.2 Asymmetric pulse test

The ballast shall have adequate protection to prevent lamp cap overheating at the end of the lamp life cycle. Compliance is checked by the following test.

The following values of maximum cathode power P_{\max} apply:

- for 13 mm (T4) lamps, $P_{\max} = 5,0$ W;
- for 16 mm (T5) lamps, $P_{\max} = 7,5$ W.

(Other diameters are under study.)

Test procedure

Refer to the schematic diagram in Figure 3.

If only one connection per electrode is available at the ballast and/or lamp, T1 shall be removed and then the ballast shall be connected to J2 and the lamp to J4. The ballast manufacturer should be asked which of the output terminals has to be connected to J4 and, in case two output terminals per electrode exist, whether they can be short-circuited or be bridged with a resistor.

- (1) Close switches S1 and S4, and set switch S2 to position A.
- (2) Turn on the ballast under test and allow lamp(s) to warm up for 5 min.
- (3) Close S3, open S1, and wait for 15 s. Open S4 and wait for 15 s.
- (4) Measure the sum of the average power dissipated in the power resistors, R1A to R1C and R2A and R2B, and the Zener diodes, D5 to D8.

NOTE The power should be measured as the average value of the product of the voltage between terminals J5 and J6 times the current flowing from J8 to J7. The voltage should be measured with a differential voltage probe, and the current should be measured with a dc current probe. A digital oscilloscope can be used for the multiplication and averaging functions. If the ballast operates in a cycling mode, the averaging interval should be set to cover an integer number of cycles. (Each cycle is typically greater than 1 s.) The sampling rate and number of samples included in the calculations should be sufficient to avoid aliasing errors.

The power dissipation shall be below P_{\max} .

If the power dissipation is greater than P_{\max} , the ballast has failed and the test is discontinued.

- (5) Close S1 and S4.
 - (6) Set S2 to position B.
 - (7) Repeat steps (2), (3) and (4).
- The ballast shall pass both position "A" and position "B" tests.

- (8) For multi-lamp ballasts, repeat steps (1) to (7) for each lamp position.

A multi-lamp ballast shall pass the tests for each lamp position.

- (9) For ballasts that operate multiple lamp types (e.g 26W, 32W, 42W), each lamp type specified shall be tested. Repeat steps (1) to (8) for each lamp type.

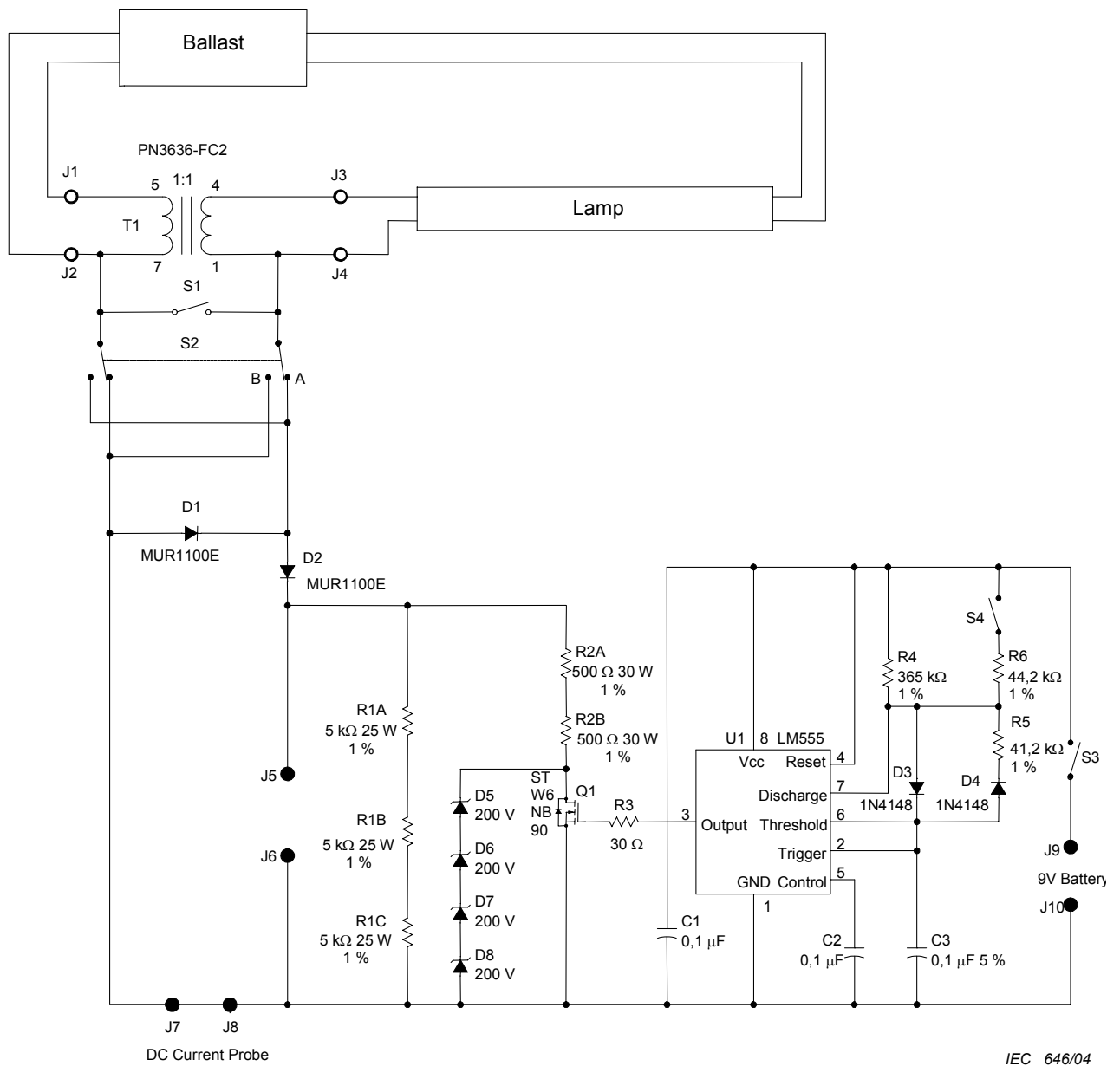


Figure 3 – Asymmetric pulse test circuit

NOTE FET Q1 should be on for 3 ms and off for 3 ms when S4 is closed, and on for 27 ms and off for 3 ms when S4 is open.

A list of material and transformer specifications is given in Annex K. Any other transformer components with the same functionality are permitted.

17.3 Asymmetric power test

The ballast shall have adequate protection to prevent lamp cap overheating at the end of the lamp life cycle. Compliance is checked by the following test.

The following values of maximum cathode power P_{\max} apply:

- for 13 mm (T4) lamps, $P_{\max} = 5,0$ W;
- for 16 mm (T5) lamps, $P_{\max} = 7,5$ W.

(Other diameters are under study.)

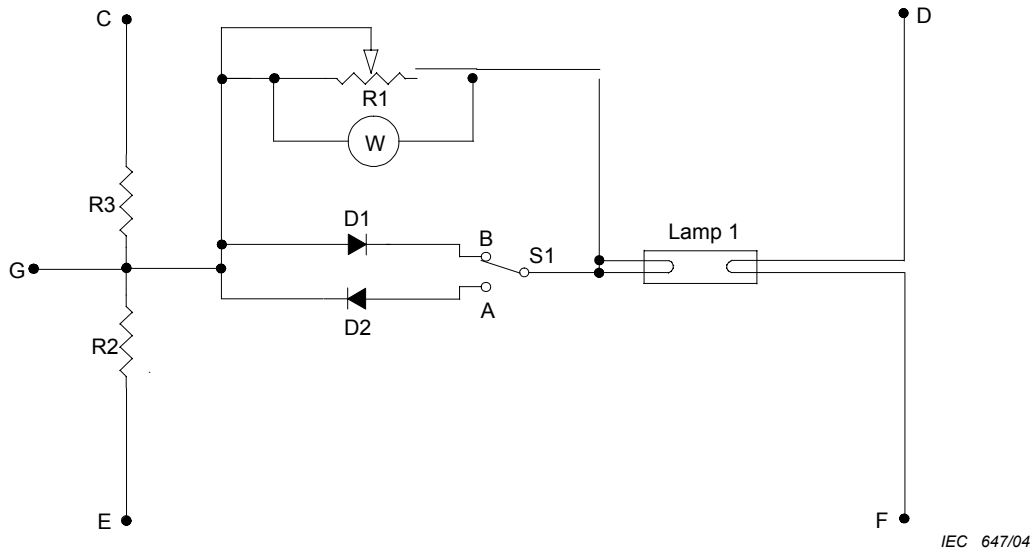
Test procedure

Refer to the schematic diagram in Figure 4.

- (1) Set switch S1 to position A.
- (2) Set resistance of resistor R1 to 0 (zero) Ω .
- (3) Start lamp(s) by turning on power to ballast under test and allow lamp(s) to warm up for 5 min.
- (4) Increase the resistance of R1 rapidly, (within 15 s) until the power dissipated by resistor R1 equals the test wattage value of 10 W for a T4 lamp or 15 W for a T5 lamp. If the ballast limits the power in R1 to a value less than the test wattage, set R1 at the value which produces the maximum wattage. If the ballast switches off before reaching the test wattage, continue with (5). If the ballast does not switch off and limits the power in R1 to a value less than the test wattage, set R1 at the value which produces the maximum wattage.
- (5) If the test wattage value was reached in step (4), wait for an additional 15 s. If the test wattage value was not reached in step (4), wait for an additional 30 s. Measure the power in R1.

The power dissipation in resistor R1 shall be below or equal to P_{\max} . If the power dissipation in resistor R1 is greater than P_{\max} , The ballast has failed and the test is discontinued.

- (6) Turn off power to ballast. Set switch S1 to position B.
- (7) Repeat test procedure steps (3) to (5) above.
The ballast shall pass both position "A" and position "B" tests.
- (8) For multi-lamp ballasts, repeat test procedure steps (1) to (7) for each lamp position.
A multi-lamp ballast shall pass the tests for each lamp position.
- (9) For ballasts that operate multiple lamp types (e.g. 26W, 32W, 42W) each lamp type specified shall be tested. Repeat steps (1) to (8) for each lamp type.



NOTE 1 $R2 = R3 = x \Omega$ (this resistance is $\frac{1}{2}$ resistance of hot cathode – refer to lamp data sheet).

NOTE 2 C, D, E and F represent cathode connections for the ballast.

NOTE 3 For instant start ballasts, connection G is connected to one and the combined D and F are connected to the other terminal.

Figure 4 – Asymmetric power detection circuit

17.4 Open filament test

17.4.1 Selection

The ballast shall have adequate protection to prevent lamp cap overheating at the end of the lamp life cycle under open filament conditions. Compliance is checked by either test procedure A or B as determined by the value of I_{max} below.

During the test the following values of maximum lamp current I_{max} apply:

- for 13 mm (T4) lamps, $I_{max} = 1$ mA;
- for 16 mm (T5) lamps, $I_{max} = 1,5$ mA.

(Other diameters are under study.)

If these current values are exceeded, test procedure B shall be applied; otherwise test procedure A shall be applied.

17.4.2 Measurements to be carried out prior to test procedure A

Determine the r.m.s. currents, $I_{LL}(1)$, $I_{LH}(1)$, $I_{LL}(2)$, $I_{LH}(2)$, at the ECG output terminals, by using a current probe and mark the terminals respectively, where:

$I_{LL}(1)$ is the lower of the r.m.s. currents through lead-in wire of electrode 1.

$I_{LH}(1)$ is the higher of the r.m.s. currents through lead-in wire of electrode 1.

$I_{LL}(2)$ is the lower of the r.m.s. currents through lead-in wire of electrode 2.

$I_{LH}(2)$ is the higher of the r.m.s. currents through lead-in wire of electrode 2.

Connect the circuit according to Figure 5a.

17.4.3 Test procedure A

Refer to schematic diagram in Figure 5a.

- (1) Set S to position 1.
- (2) Turn on the ballast under test and allow lamp(s) to warm up for 5 min.
- (3) Set S to position 2 and wait for 30 s.
- (4) Measure the r.m.s. current value of I_{lamp} with the current probe near to the lamp end. If I_{lamp} is pulsing, the r.m.s. value shall be computed over one complete pulse cycle including the off time.

The lamp discharge current I_{lamp} shall not be greater than I_{max} .

If the lamp discharge current is greater than I_{max} , the ballast has failed and the test is discontinued.

Refer to Figure 5b.

- (5) Set S to position 1.
- (6) Turn on the ballast under test and allow lamp(s) to warm up for 5 min.
- (7) Set S to position 2 and wait for 30 s.
- (8) Measure the r.m.s. current value of I_{lamp} with the current probe near to the lamp end. If I_{lamp} is pulsing, the r.m.s. value shall be computed over one complete pulse cycle including the off time.

The lamp discharge current I_{lamp} shall not be greater than I_{max} .

- (9) For multi-lamp ballasts, repeat test procedure steps 1 to 8 for each lamp position.
A multi-lamp ballast shall pass the tests for each lamp position to pass the end-of-lamp-life test.
- (10) For ballasts that operate multiple lamp types (e.g. 26W, 32W, 42W), each lamp type specified shall be tested. Repeat steps (1) to (9) for each lamp type.

17.4.4 Test procedure B

Connect the lamp as shown in Figures 5a and 5b with the measurement arrangement according to Figure 5c. If the ballast has an isolation transformer, connect the 1 M Ω resistor to the corresponding terminal defined in 17.4.2.

- (1) Set S to position 1.
- (2) Turn on the ballast under test and allow lamp(s) to warm up for 5 min.
- (3) Set S to position 2 wait for 30 s.
Measure the r.m.s. voltage value with the differential probe placed as indicated in Figure 5c. If the voltage is pulsing, the r.m.s. value shall be computed over one complete pulse cycle including the off time.
- (4) The voltage shall not be greater than 25 % of the rated lamp voltage. If the voltage is greater than 25 %, discontinue the test.

Refer to Figure 5b.

- (5) Repeat test procedure steps (1) to (4) above.
- (6) For multi-lamp ballasts, repeat test procedure steps (1) to (5) for each lamp position.
A multi-lamp ballast shall pass the test for each lamp position to pass the end-of-lamp life test.

- (7) For ballasts which operate multiple lamp types (e.g. 26W, 32W, 42W), each lamp type specified shall be tested.
- Repeat steps (1) to (6) for each lamp type. A multiple lamp ballast shall pass the test for each lamp type.

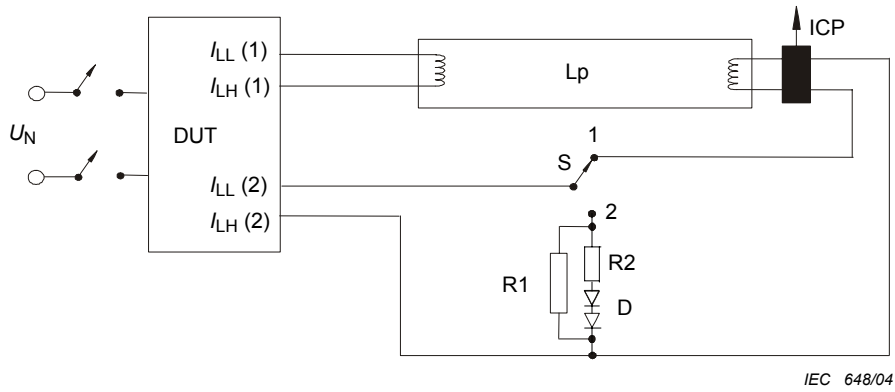


Figure 5a – Open filament test circuit; electrode (1) check

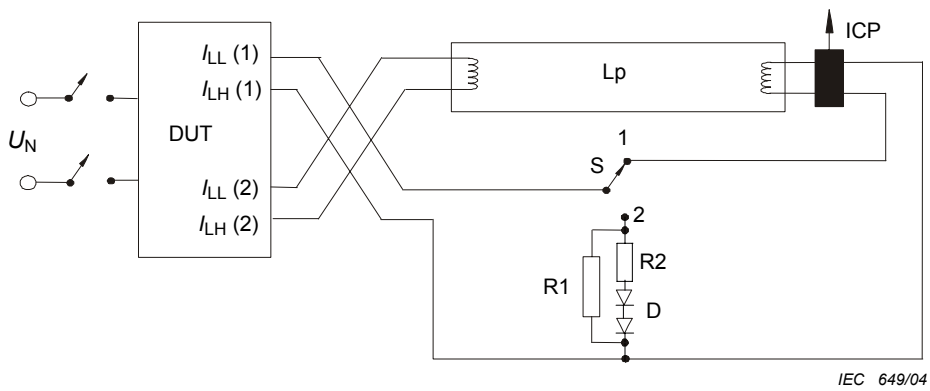
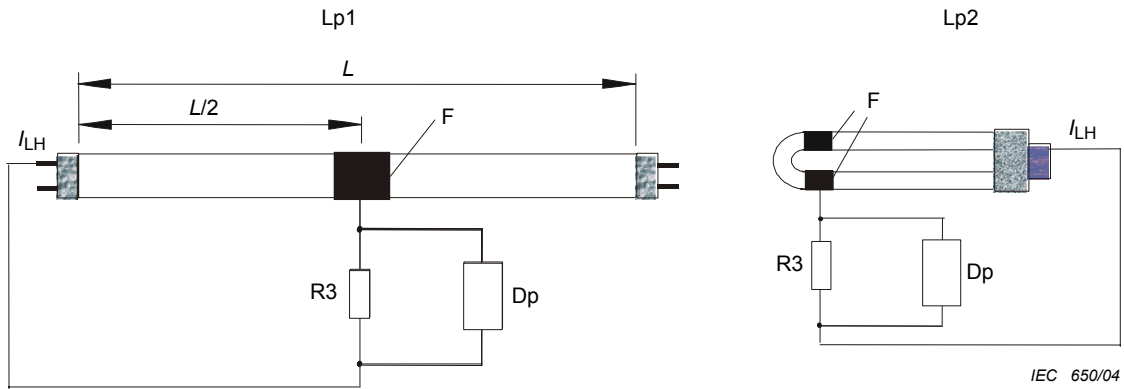


Figure 5b – Open filament test circuit; electrode (2) check



NOTE Use terminal $I_{LH}(2)$ of Figure 5a or $I_{LH}(1)$ of Figure 5b.

Figure 5c – Detection of lamp current

Key to Figures 5a, 5b and 5c

L_p = lamp

L_{p1} = straight lamp; copper foil width 4 cm

L_{p2} = bended lamp (single capped and circular); copper foil width: twice 2 cm; foils connected

U_N = supply

F = copper foil, width 4 cm and 2 cm × 2 cm

ICP = I_{amp} current probe

R_1 = 10 kΩ

R_2 = 22 Ω, 7 W

R_3 = 1 MΩ

D = fast diodes

DUT = device (ballast) under test

D_p = differential probe < 10 pF

Figure 5 – Open filament test circuits

18 Construction |

The requirements of clause 15 of IEC 61347-1 do not apply.

19 Creepage distances and clearances |

The requirements of clause 16 of IEC 61347-1 apply.

20 Screws, current-carrying parts and connections |

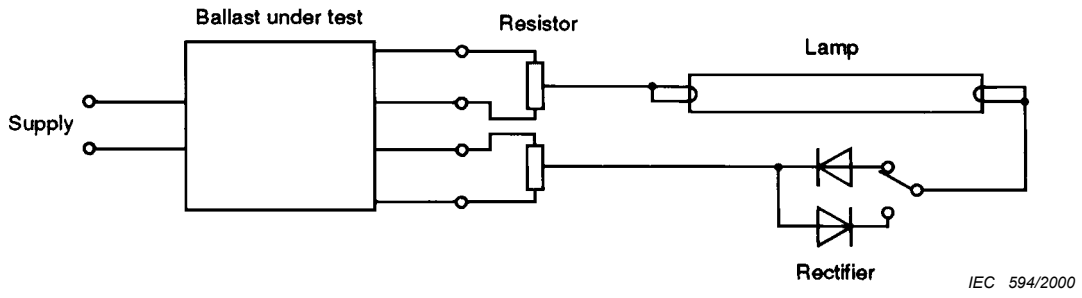
The requirements of clause 17 of IEC 61347-1 apply.

21 Resistance to heat, fire and tracking |

The requirements of clause 18 of IEC 61347-1 apply.

22 Resistance to corrosion |

The requirements of clause 19 of IEC 61347-1 apply.

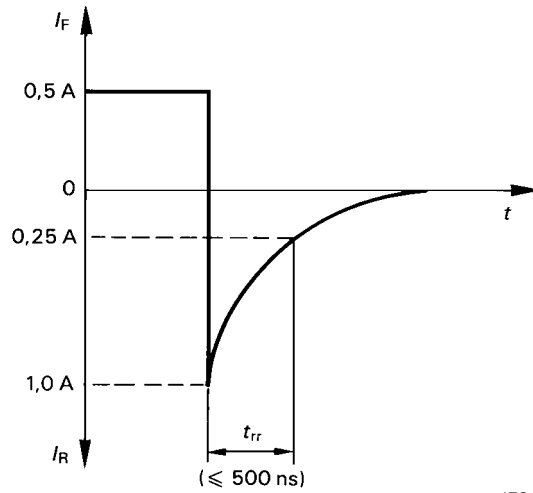


IEC 594/2000

The rectifier characteristics shall be:

Peak inverse voltage	U_{RRM}	\geq	3 000 V
Reverse leakage current	I_R	\leq	10 μ A
Forward current	I_F	\geq	three times nominal lamp running current
Reverse recovery time (maximum frequency: 150 kHz)	t_{rr}	\leq	500 ns (measured with $I_F = 0,5$ A and $I_R = 1$ A to $I_R = 0,25$ A)

Figure 1a – Circuit for testing

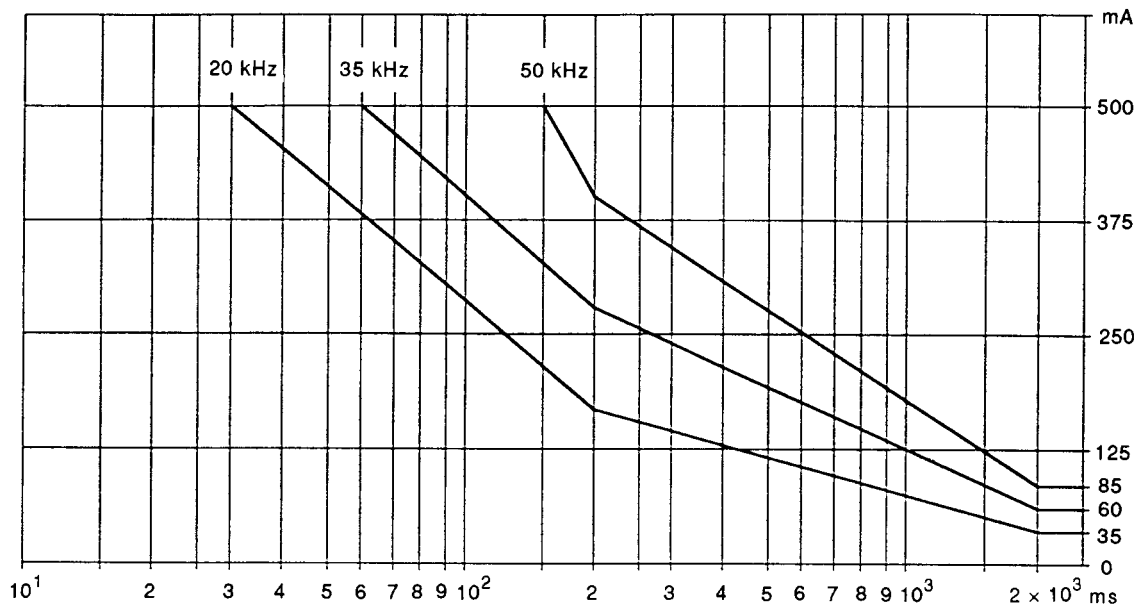


IEC 595/2000

NOTE The following types of diodes (three diodes in series) are recommended as a suitable recitifier: RGP 30 M, BYM 96 E, BYV 16.

Figure 1b – Recovery time t_{rr} of the diode

Figure 1 – Rectifying effect test



IEC 596/2000

Figure 2 – Limits for capacitive leakage current in r.m.s. of HF-operated tubular fluorescent lamps depending on duration

Annex A
(normative)

**Test to establish whether a conductive part
is a live part which may cause an electric shock**

The requirements of annex A of IEC 61347-1 apply.

Annex B
(normative)

**Particular requirements for thermally protected
lamp controlgear**

The requirements of annex B of IEC 61347-1 are not applicable.

Annex C
(normative)

**Particular requirements for electronic lamp controlgear
with means of protection against overheating**

The requirements of annex C of IEC 61347-1 apply.

Annex D
(normative)

**Requirements for carrying out the heating tests
of thermally protected lamp controlgear ballasts**

The requirements of annex D of IEC 61347-1 apply.

Annex E
(normative)

Use of constant S other than 4 500 in t_w tests

The requirements of annex E of IEC 61347-1 are not applicable.

Annex F
(normative)

Draught-proof enclosure

The requirements of annex F of IEC 61347-1 are not applicable.

Annex G
(normative)

Explanation of the derivation of the values of pulse voltages

The requirements of annex G of IEC 61347-1 are not applicable.

Annex H
(normative)

Tests

The requirements of annex H of IEC 61347-1 are not applicable.

Annex I (normative)

Measurement of high-frequency leakage current

Electronic ballasts are tested for capacitive high-frequency leakage current, as follows.

The ballast is tested in the circuit shown in figure I.1 with two normal lamps, each being connected to the circuit at only one end ("crossed pair of lamps"). This method would also provide the worst-case leakage to earth.

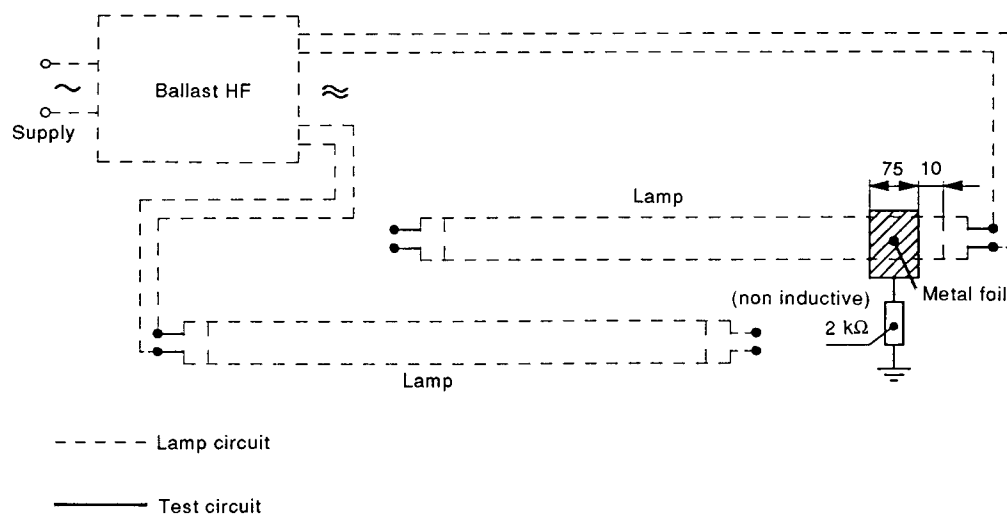
The glass tube of one of the two lamps, whichever gives the worst value, is wrapped with a 75 mm wide metal foil, together with a non-inductive 2 000 Ω resistor and a measuring device suitable for the test circuit.

The test shall be conducted with the lamps supported on two 75 mm high wooden blocks and placed on a wooden table, such that no external influence from metallic surfaces is caused.

The leakage current (i.e. the high-frequency current flowing from the metal foil through the 2 000 $\Omega \pm 50 \Omega$ resistor to earth) is measured under the following simulated operating conditions.

- Two normal lamps, each being inserted at only one end into a pair of holders, with the supply voltage switched on.
- In order to take care of the most adverse condition (that is to ensure that the highest leakage current which may occur will be measured) the procedure shall be carried out in such a way that all of the four possible holder contact/cap-pin combinations are covered.
- For ballasts with multi-lamp operation, the leakage current from each lamp position is measured separately.
- Where a range of ballasts are submitted for test, each ballast type shall be checked, not just the higher or lower power variants.
- Under each of the specified operation conditions, the capacitive leakage current measured shall not exceed the limits specified in figure 2.

NOTE Leakage currents are derived from IEC 60479.



IEC 597/2000

Figure I.1 – Test arrangement

Annex J (normative)

Particular additional safety requirements for a.c./d.c. supplied electronic ballasts for emergency lighting

J.1 Scope

This annex specifies particular safety requirements of a.c./d.c. supplied electronic ballasts for maintained emergency lighting purposes as well as specific requirements, as specified in IEC 60598-2-22.

It applies to a.c./d.c. supplied electronic ballasts for maintained emergency lighting not including batteries which are intended for connection to an emergency power supply. This can be a central battery supply system.

It does not apply to ballasts used in self-contained emergency lighting luminaires.

This annex also includes the operational requirements applicable to electronic ballasts operating on an a.c. supply in the emergency mode.

J.2 Definitions

The definitions in clause 3 apply together with the following:

J.2.1

emergency lighting

lighting provided for use when the supply to the normal lighting fails; it includes escape lighting and standby lighting

J.2.2

maintained emergency lighting

lighting provided when normal and emergency lighting is required

J.2.3

a.c./d.c. maintained emergency lighting operation ballast

ballast for operating a lamp from the normal lighting supply with normal switching and also from the emergency lighting supply when failure of the normal lighting supply occurs

J.2.4

rated battery voltage

voltage declared by the battery manufacturer

J.2.5

rated emergency power supply voltage

rated voltage of the emergency power supply claimed by the manufacturer for the information of the installer or user

J.2.6**starting aid**

device which facilitates the starting of the lamp

NOTE A conductive strip affixed to the outer surface of the lamp and a conductive plate which is spaced within an appropriate distance from a lamp are examples of starting aids.

J.2.7**ballast lumen factor**

ratio of the luminous flux of a reference lamp when the ballast under test is operated at its rated voltage and frequency compared with the luminous flux of the same lamp operated with the appropriate reference ballast supplied at its rated voltage and frequency

J.2.8**reference ballast**

special ballast designed for the purpose of providing comparison standards for use in testing ballasts, for the selection of reference lamps and for testing regular production lamps under standardized conditions; essentially characterized by the fact that at its rated frequency, it has a stable voltage/current ratio relatively uninfluenced by variations in current, temperature and magnetic surroundings as outlined in the relevant ballast standard

J.2.9**reference lamp**

discharge lamp selected for the purpose of testing ballasts and which, when associated with a reference ballast under specified conditions, has electrical values which are close to the rates specified in the relevant lamp standard or assigned by the manufacturer or responsible vendor for the particular lamp

J.2.10**calibration current of a reference ballast**

value of the current on which the calibration and control of the ballast are based

J.2.11**total circuit power**

total power dissipated by ballast and lamp in combination, at rated voltage and frequency of the ballast

J.2.12**preheat starting**

type of circuit in which the lamp electrodes are brought to emission temperature before the lamp actually ignites

J.2.13**non-preheat starting**

type of circuit which utilizes a high open-circuit voltage causing field emission from electrodes

J.2.14**pre-start time**

for ballasts according to J.2.12, period after switching on the supply voltage during which the lamp current is ≤ 10 mA

J.3 Marking

J.3.1 Mandatory markings

Ballasts shall, in addition to the requirements of 7.1, be clearly marked with the following mandatory marking:

- a) a.c./d.c. maintained emergency lighting operation ballast (symbol under consideration);
- b) rated emergency power supply voltage and voltage range.

J.3.2 Information to be provided if applicable

In addition to the above mandatory markings and the requirements of 7.2, the following information shall either be given on the ballast or be made available in the manufacturer's catalogue or similar:

- a) a clear indication regarding the type of starting, i.e. preheat or non-preheat;
- b) indication whether a starting aid is needed for the lamp(s);
- c) limits of the ambient temperature range within which an independent ballast will operate satisfactorily at the declared voltage (range);
- d) ballast lumen factor in the emergency operation mode.

J.4 General statement

The provisions of clause 6 of IEC 60929 apply at 90 % and 110 % of the rated emergency power supply voltage.

Furthermore, starting and operation of lamps shall be guaranteed across the widest rated d.c. voltage range due to the highest and lowest battery voltages.

NOTE 1 The electrical characteristics, as given on the lamp data sheets of IEC 60081 and IEC 60901, and applying to operation on a reference ballast at rated voltage with a frequency of 50 Hz or 60 Hz, may deviate when operating on a high-frequency ballast and the conditions of item c) of J.3.2 above.

NOTE 2 A starting aid is only effective when it has an adequate potential difference from one end of the lamp.

J.5 Starting conditions

The provisions of clause 7 of IEC 60929 apply. In addition, tests shall be made with rated d.c. supply voltage, and, where the highest or lowest a.c. voltage limits are given, tests shall be made with ± 10 % d.c. voltage, respectively.

J.6 Operating conditions

The provisions of clause 8 of IEC 60929 apply. In addition, tests shall be made with rated d.c. supply voltage.

J.7 Supply current

The provisions of clause 10 of IEC 60929 apply.

J.8 Maximum current in any lead to a cathode

The provisions of clause 11 of IEC 60929 apply. In addition, tests shall be made with rated d.c. supply voltage, and, where highest or lowest a.c. voltage limits are given, tests shall be made with $\pm 10\%$ d.c. voltage, respectively.

J.9 Lamp operating current waveform

The provisions of 12.2 of IEC 60929 apply. In addition, tests shall be made with rated d.c. supply voltage.

J.10 Mains transient overvoltages

The provisions of clause 15 of IEC 60929 apply.

J.11 Pulse voltage from central battery systems

NOTE This pulse voltage is under consideration.

The ballast shall withstand, without failure, any pulses caused by switching other equipment in the same circuit.

Compliance is checked by operating the ballast at the maximum voltage of the rated voltage range in association with the appropriate number of lamps and in an ambient temperature of 25 °C. The ballast shall withstand, without failure, the number of pulse voltages given in table J.1 superimposed, with the same polarity, on the supply voltage.

Table J.1 – Pulse voltages

Number of voltage pulses	Pulse voltage		Period between each pulse
	Peak value V	Pulse width at half peak ms	
3	Equal to design voltage	10	2

NOTE A suitable measuring circuit is shown in figure G.2 of IEC 61347-1.

J.12 Tests for abnormal conditions

The provisions of clause 16 of this standard and 16.1 and 16.2 of IEC 60929 apply. In addition, the tests shall be made with $\pm 20\%$ rated d.c. supply voltage.

J.13 Temperature cycling test and endurance test

The provisions of clause 25 of IEC 61347-2-7 apply. The tests shall be made with d.c. supply voltage.

Annex K (informative)

Components used in the asymmetric pulse test circuit (Figure 3)

Table K.1 – Material specification

Reference designation	Description
U1	555 timer ic
T1	1:1 transformer
D1, D2	Ultra fast recovery diode, 1 000 V, 1 A, 75 ns
D3, D4	Signal diode 75 V 200 mA
D5...D8	200 V Zener Diode
Q1	Mosfet 900 V 6 A
R1A to R1C	Resistor 5 k Ω 25 W 1 %
R2A and B	Resistor 500 Ω 30 W 1 %
S1, S3, S4	Switch
S2	Switch – double
Battery	Battery 9 V
C1, C2, C3	Capacitor 0,1 μ F 50 V 5 %
R3	Resistor 30 Ω ¼ W 5 %
R4	Resistor 365 k Ω ¼ W 1 %
R5	Resistor 41,2 k Ω ¼ W 1 %
R6	Resistor 44,2 k Ω ¼ W 1 %

Table K.2 – Transformer specification

Component	Description
Core	Two EI187 (E19/8/5), Core area 22,6 mm ² , P material or equivalent
Bobbin	8-pin, horizontal mount
Primary winding	38 Turns #26 AWG HN, 19 turns/layer. Start pin 5, finish pin 7
Inter-winding insulation	5 layers 3M #56 3/8" or equivalent
Secondary winding	38 Turns #26 AWG HN, 19 turns/layer. Start pin 4, finish pin 1
Wrapper	2 layers 3M #56 3/8" or equivalent
Inter-winding capacitance	Approximately 22 pF
HIPOT	2 500 V _{rms}