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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical installations for lighting and beaconing of aerodromes – Constant current regulators

Installations électriques pour l'éclairage et le balisage des aérodromes – Régulateurs de courant constant

IEC 61822:2009

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Electrical installations for lighting and beaconing of aerodromes – Constant current regulators

Installations électriques pour l'éclairage et le balisage des aérodromes – Régulateurs de courant constant

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International Standard IEC 61822 has been prepared by IEC Technical Committee 97: Electrical installations for lighting and beaconing of aerodromes.

This second edition cancels and replaces the first edition published in 2002. It is a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) revision and update of terms and definitions;
b) addition of new paragraphs, such as "Nominal output current range and tolerances";
c) modification of some paragraphs, such as those related to "Local control" and "Remote control";
d) deletion of some paragraphs, in particular "Power transformers" and "Output current indicator".

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

FDIS	Report on voting
97/135/FDIS	97/139/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 the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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ELECTRICAL INSTALLATIONS FOR LIGHTING AND BEACONING OF AERODROMES – CONSTANT CURRENT REGULATORS

1 Scope

This International Standard specifies the requirements for a Constant Current Regulator (CCR) having a nominal output of 6,6 A for use in an aeronautical ground lighting constant current series circuit. However, CCRs may be manufactured which have a different power rating (kVA) and current steps than those specified in this standard in order to be used on existing circuits. This standard should be applied where appropriate for these CCRs.

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 60038, *IEC standard voltages*

IEC 60439-1:1999, *Low-voltage switchgear and control gear assemblies – Part 1: Type-tested and partially type-tested assemblies*

IEC 60529*, Degrees of protection provided by enclosures (IP Code)*

IEC 61000-6-2*, Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC/TS 61000-6-5, *Electromagnetic compatibility (EMC) – Part 6-5: Generic standards – Immunity for power station and substation environments*

IEC 61024-1, *Protection of structures against lightning – Part 1: General principles*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61439-1:2009, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 62305-1, *Protection against lightning – Part 1: General principles*

IEC 62305-3, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

CISPR 11, *Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics – Limits and methods of measurement*

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

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3 Terms and definitions

For the purposes of this document, the following terms and definitions developed to be included in international standards relating to airport/aerodrome visual aids apply

3.1
aeronautical ground lighting (AGL) constant current series circuit
apparatus configured as an electrical circuit designed to produce and operate with a constant current, independent of variations in the load, in order to provide a specified light output for aeronautical purposes

3.2
constant current regulator (CCR)
apparatus which produces a current output at a constant r.m.s. value independent of variations in the constant current series circuit load, input voltage and service conditions as specified

3.3
open circuit
AGL constant current series circuit with an unplanned interruption at any location of the primary current line that produces a hazardous high voltage between the interrupted circuit sections

3.4
forced ventilation
cooling system in which the air is moved by external power

3.5
live
electrically connected to a source of electricity or having acquired a charge by other means

4 Classification

4.1 Output current

The CCR shall produce a maximum rated r.m.s. current output of 6,6 A and a minimum rated r.m.s. current output of 1,8 A.

4.2 Current steps

CCRs shall be classified according to the number of output current steps available, as follows:

- style 1 : 3 current steps;
- style 2 : 5 current steps.

Each step shall have a single adjustment over the full range specified in 4.1.

NOTE An additional low current step(s) for non-illumination purposes may be offered as an option (see 5.7.6). Each style CCR can be configured to operate with a reduced number of current steps.

4.3 Ratings

CCRs shall be manufactured in the following output power ratings:

1 kVA; 2,5 kVA; 5 kVA; 7,5 kVA; 10 kVA; 15 kVA; 20 kVA; 25 kVA; and 30 kVA.

NOTE 1 There may be situations where greater power rating is required than that specified in this International Standard to meet existing circuit requirements. In this case, the CCR should meet the applicable performance, qualification and safety requirements contained in this International Standard.

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The nominal input voltage to the CCR (see 5.3.6) shall be a single-phase or multiple phase value in accordance with IEC 60038.

The operating frequency shall be 50 Hz ± 7,5 % or 60 Hz ± 7,5 %.

NOTE 2 The CCR may be designed to operate from a d.c. power source.

5 Requirements

5.1 General

The following requirements are grouped into six categories: environmental, performance, EMC, design, protection against electric shock and optional accessories.

5.2 Environmental requirements

The equipment shall be designed for continuous indoor operation without derating, under the following conditions:

– temperature range from 0 °C to +50 °C;
– relative humidity from 10 % to 95 % without dewing;
– altitude from sea-level to 1 000 m;
– electromagnetic compatibility – as per IEC 61000-6-2.

5.3 Performance requirements

5.3.1 Nominal output current range and tolerances

The nominal output current range is:

- Style 1: 4,8 A to 6,6 A;
- Style 2: 2,8 A to 6,6 A.

Table 1 gives the standard pre settings of the CCR. These settings may be varied according to the requirements of an airport.

Table 1 – Standard CCR output current step pre-settings

Style	Current step	Nominal output current A (r.m.s.)
1	3	6,60
	2	5,50
	1	4,80
2	5	6,60
	4	5,20
	3	4,10
	2	3,40
	1	2,80

Tolerance of ± 0,1 A for each current step setting within the nominal output current range.

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5.3.2 Regulation – resistive loading

While powering any resistive load between no load (short circuit) and full load, the CCR shall provide an output current within the specified tolerance for each current step setting within the nominal output current range.

CCRs shall provide regulation over the full range of environmental conditions specified in 5.2 and within the input voltage range of 90 % to 110 %.

5.3.3 Regulation – reactive loading

The CCR shall maintain the current within the specified tolerance for each current step setting within the nominal output current range when the load has an inductive power factor of 0,60.

5.3.4 Efficiency

At all current steps, the average efficiency of the CCR, operating at rated input voltage into a full nominal resistive load shall not be less than 80 %.

5.3.5 Power factor

The power factor of the CCR, operating at rated input voltage into a full nominal resistive load shall not be less than 0,90.

5.3.6 Input voltage

Input voltage shall be as stated in 4.3. The CCR shall operate as required in 5.3.1 when the input voltage is anywhere between 90 % and 110 % of the nominal input.

The CCR shall be designed to withstand momentary increases of voltage up to 120 % and momentary decreases of voltage down to 80 % of the nominal input voltage without being de-energized or damaged by such voltages. The CCR shall withstand such voltage excursions for up to 50 ms within a period of 1 min. The CCR shall automatically resume normal operation (Table 1) when the input voltage returns to 90 % to 110 % of the nominal value.

5.3.7 Load matching

CCRs shall match connected loads from 50 % to 100 % of the rated load.

For resistive loads in the range of 50 % to 100 % of the rated load, at the rated input voltage, and with an output current at 100 %, the efficiency and power factor shall not be less than the values specified in 5.3.4 and 5.3.5. If required, additional output load taps may be provided to allow a more precise adjustment or lower load matching.

5.3.8 Operation

The CCR shall stabilize the output current at any selected current step within 500 ms, and shall hold the output current stable within the specified tolerance of the nominal output current. There shall not be any interruption of output current to the series circuit when switching from one current step to another.

5.3.9 Control/Monitoring System

5.3.9.1 Functions

The CCR shall be capable of being controlled locally and from a remote location. Information on the selected current step and remote/local status shall be provided at the CCR regardless of whether the CCR is in local or remote control.

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The local control system shall be integral to the CCR and shall not be supplied from a source located outside the CCR package. The CCR shall be capable of being controlled remotely for any current level by parallel wiring or serial interface. The design of the remote control interface shall provide, at least, the inputs and outputs described in Table 2.

Table 2 – CCR remote control/monitoring functions

Remote control			Remote monitoring			
	Standard	Option	Standard		Option	
a	On/Off selection		a	CCR on		
			b	Local/Remote		
b	Current step selection		c	Step 1 selected	c1	Step 1 obtained
			d	Step 2 selected	d1	Step 2 obtained
			e	Step 3 selected	e1	Step 3 obtained
			f	Step 4 selected	f1	Step 4 obtained
			g	Step 5 selected	g1	Step 5 obtained
					h	CCR out of range
			I	Open circuit trip		
			J	Over current trip		
c		CCR Non-illumination step			k	CCR non-illumination step
d		Circuit Selector Switch			l	Circuit selector fault
					m	Lamp fault warning
					n	Lamp fault alarm
					o	Earth fault warning
					p	Earth fault alarm
NOTE For the monitoring section, if (c1) to (g1) is implemented, (c) to (g) can be omitted						

5.3.9.2 Control interface

The standard source voltage for controlling and monitoring the CCR shall be +24 V d.c, +48 V d.c., or +60 V d.c. nominal, with the negative pole being common. Remote control power shall be provided from a source either external or internal to the CCR. If internal, a dedicated power supply shall be for remote control only.

Relays or other isolating devices shall be provided for switching on and setting the current steps of the CCR.

Monitoring of the CCR data output shall be provided by relay contacts or another isolating device rated at minimum 60 V d.c. and 50 mA. Where a common pole is used, it shall be negative.

Terminal blocks or connectors having a minimum voltage rating of 300 V shall be installed in the control cabinet for connection of external wiring associated with monitoring and remote control. Terminal blocks or connectors shall accommodate 0,250 mm^2 to 2,500 mm^2 cable with a minimum insulation rating of 300 V. Space for spare positions shall be provided to accommodate optional devices.

5.3.9.3 Monitoring terminals

One terminal for each of the functions listed in 5.3.9.1 shall be provided.

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5.3.10 Output current surge limitation

The CCR shall be designed with a controlled feature, so that switching the CCR on and off, changing current steps, or shorting the load, shall not damage the CCR, trip a protective device, nor produce output current surges (transients) that will damage series circuit equipment. Changes of intensity due to switching of current steps in local or remote control shall occur without over-shoots exceeding 6,7 A r.m.s.

5.3.11 Dynamic response

For sudden load variations exceeding 10 % of the load, the duration of the possible over current condition shall be limited to one half-cycle. If the peak current reaches twice the maximum peak current while in normal operation, (i.e. peak current in short circuit at maximum current and maximum input voltage) or the current reaches 125 % of the maximum r.m.s. value, the current shall be limited under 2,0 A r.m.s. after the half sine wave in progress. The suppression shall remain for one to four cycles and then the current limits of Table 1 shall be achieved in 500 ms or less.

5.3.12 Output voltage limitation

With the open circuit protection disabled, the peak output voltage of an open-circuited CCR shall not exceed twice the rated r.m.s. output kVA divided by the rated r.m.s. output current.

5.3.13 Protective devices

5.3.13.1 Open circuit protection

The CCR shall include an open-circuit protective device to de-energize the CCR output within 1 s after an open circuit condition occurs in the primary series circuit. The protective device shall be reset manually from the local position only. The CCR shall not trip out due to the switching of load circuits or other transients.

5.3.13.2 Overcurrent protection

The CCR shall include an overcurrent protective device to de-energize the CCR output between 3 s and 5 s when the output current exceeds 6,75 A r.m.s. The CCR shall de-energize the output within 300 ms when the output current exceeds 8,30 A r.m.s. The protective device shall be reset manually from the local position only.

5.3.13.3 Primary switching

The CCR shall have an electro-mechanical isolating device that interrupts the input power before it reaches the main power transformer and shall not interrupt internal control power.

5.3.13.4 Input power loss

In the event of an input power loss for up to 1 min, the CCR shall resume operation on the selected current setting within 500 ms after the restoration of input power.

NOTE It is not required to fulfil the 500 ms run up time for a power loss period longer than 1 min.

5.3.13.5 Output series circuit switching

When the CCR is used with a circuit selector, the CCR shall not lock-out or produce surges that would damage the connected series circuits.

Means shall be provided for interlocking the CCR and circuit selector switch. A breaking switch in the circuit selector switch shall force the CCR output current to zero while the circuit selector switch is operating.

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5.4 Electromagnetic compatibility (EMC)

5.4.1 Limits for emission

CCRs shall comply with IEC 61000-6-4, the EMC generic emission standard for industrial environments. Radiated emission limits shall be in accordance with CISPR 11, class B.

5.4.2 Output current waveform

The CCR shall provide an output current waveform with a crest factor of less than 3,2 at all current steps at the nominal input voltage and with 10 % resistive load.

5.4.3 Limits for immunity

CCRs shall comply with the generic immunity standards for industrial environments IEC 61000-6-2, supplemented by applicable parts of IEC/TS 61000-6-5 containing EMC immunity requirements for power station and substation environments (locations where apparatus for electricity utilities are installed). CCRs shall comply with requirements for apparatus installed in type G locations (power stations and medium voltage substations) as defined in IEC/TS 61000-6-5.

5.5 Design requirements

5.5.1 Local control

The CCR shall be capable of being locally controlled to provide the following functions:

– on/off;
– local/remote control;
– current steps.

5.5.2 Local indication

The CCR shall provide on the front of the unit an indication for the following:

– an open-circuit trip-out has occurred;
– an over current trip-out has occurred;
– input voltage is present;
– CCR is set to local or remote control;
– selected current step;
– output current is present (if no ammeter is installed according to 5.7.8).

5.5.3 Wiring diagram

A wiring diagram showing all customer connection points shall be permanently readable, and located in a visible place in the CCR.

5.5.4 Mechanical design

The CCR shall be constructed only of materials capable of withstanding the mechanical, electrical, and thermal stresses as well as the effects of humidity, which are likely to be encountered in normal service.

Protection against corrosion shall be ensured by the use of suitable materials or by the application of equivalent protective coatings to the exposed surface, taking account of the intended conditions of use and maintenance.

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All enclosures and partitions shall be of a mechanical strength sufficient to withstand the stresses to which they may be subjected in normal service.

The CCR cabinet shall be designed for ease of installation movement of the unit (e.g. rollers, lifting rings, etc.).

If a CCR is designed as a distributed system where parts of the CCR are not in the same housing, the cabling used for interconnection between the separated parts has to be defined by the manufacturer.

The apparatus and circuits in the CCR shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

The CCR shall be designed and arranged in such a way that certain operations, according to agreement between manufacturer and user, can be performed when the CCR is connected to the mains.

Such operations may be:

a) visual inspection of
   - switching devices and other apparatus,
   - settings and indicators,
   - conductor connections and markings;

b) adjusting and resetting of relays, releases and electronic devices;

c) certain fault location operations.

Necessary measures shall be taken to enable maintenance of the CCR, with adjacent functional units or groups energized. Such measures may be:

– sufficient space between subassemblies;
– use of barrier protected sub-sections for each subassembly;
– use of compartments for each subassembly;
– insertion of additional protective means provided or specified by the manufacturer.

5.5.5 Electrical design

All components used in the design of the CCR shall be suitable for their function and shall not operate in excess of 80 % of the component manufacturer's recommended rating. In order to maximize reliability, it is recommended that no forced ventilation be utilized. If either is used, it shall be monitored with an alarm given upon failure. Upon failure of the cooling or heating element, the CCR shall continue to operate normally for a period of time specified by the manufacturer.

All cabling and small wiring shall be securely placed in systematic runs and coded where terminated. Power cabling shall be terminated with lugs or eyes and terminals shall be clearly and appropriately coded. Wiring identification shall be in agreement with the indicators on wiring diagrams and drawings. Bushings, glands, or grommets shall protect cabling and wiring passing through metal work.

The protective earth conductor shall be readily distinguishable by twin coloured green and yellow markings. When the protective conductor is an insulated single core cable, this colour identification shall be used throughout the entire length.

Insulated conductors shall be rated for at least the maximum voltage of the circuit concerned.

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Cables between two connecting devices shall have no intermediate splices or soldered joints. Connections shall be made at fixed terminals. The connection of two or more conductors to one terminal is permissible only in those cases where the terminals are designed for this purpose.

5.5.6 Nameplate

A permanently readable nameplate (Figure 1) with the information listed below shall be securely attached to a visible location on the exterior of the CCR enclosure. If the nameplate is attached to a readily removable surface, such as a cover, the serial number shall be duplicated in a permanent conspicuous place elsewhere on the CCR.

Constant current regulator
Manufacturer's name and part number: _____
Number of current steps:__
Input: V Hz
Remote control voltage: _____ V d.c. or serial physical layer:
Output: kVA at 6,6 A. Maximum output voltage: _____ V
Serial number: ___
Year of manufacture:_____

Figure 1 – Nameplate *IEC 1609/02*

5.5.7 Instruction manual

The manufacturer shall specify in its instruction manuals the conditions for the installation, operation and maintenance of the CCR and the equipment contained herein.

The instructions for the transport, installation and operation of the CCR shall indicate the measures that are of particular importance for the proper and correct installation, commissioning and operation of the CCR.

The instruction manual shall include the following:

– theory of operation;
– wiring and control diagrams;
– general operation;
– installation instructions;
– preventive maintenance;
– spare parts list;
– troubleshooting;
– revision information including firmware (if applicable);
– options.

5.6 Protection against electric shock

CCRs shall be provided with protection against electric shock in accordance with the fundamental rules outlined in IEC 61140.

For provision of equipotential bonding and connection of protective conductors, refer to IEC 61439-1.

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The degree of protection provided by the cabinet containing a CCR assembly against contact with live parts or ingress of solid bodies and liquid shall be indicated by the IP designation, according to IEC 60529.

For CCR assemblies for indoor use where there is no requirement for protection against ingress of water, the degree of protection shall be at least IP2X after installation in accordance with the manufacturer's instructions.

For CCR assemblies for outdoor use having no supplementary protection, the second numeral shall be at least 3.

High voltage equipment (1 000 V or greater), including the power transformer, shall be isolated from the low voltage equipment either by construction when they are in the same assembly, or by inclusion in a separate switchgear assembly.

The internal access plates shall be fitted with the appropriate IEC warning label.

5.7 Optional accessories

5.7.1 Earth fault monitor

An earth fault indicator may be built into the CCR for monitoring its own output circuit and shall be designed in one of the following ways.

– When the CCR is in a brightness step, it shall be designed to apply a d.c. voltage of 500 V maximum on the output series circuit relative to ground or earth potential.
– When the CCR is disconnected, it shall be designed to apply a d.c. voltage of 1 000 V maximum on the output series circuit relative to ground or earth potential.

The earth fault indicator shall be able to detect an insulation resistance with a minimum range of 10 kΩ to 50 MΩ.

The insulation resistance reading shall be independent of the current step setting, and of the location of the fault. The fault shall be measured permanently as soon as the local switch is on "remote control" position or on a current step setting. If operated at voltages exceeding 70 V d.c., when the CCR is in local-off, this control device shall be automatically switched off.

At least two thresholds (warning and alarm), determined in relation to the local operational requirement of the airport, shall be offered with information available locally and remotely.

5.7.2 Load indicator

A load indicator may be installed in the CCR in order to indicate the amount of load on the CCR.

5.7.3 Lamp fault indicator

A lamp fault detector may be installed in the CCR to detect a pre-determined number of burnt out lamps on the series circuit.

Table 3 – Lamp failure indicator

Range of burnt out lamps in % of total installed lamps	Required accuracy of the lamp failure indicator in % of total installed lamps
≤ 10 %	1 %
>10 % to ≤30 %	2 %

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