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Aerospace — High power solid state power controller — General performance requirements

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Contents

Page

Foreword

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This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 1, *Aerospace electrical requirements*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

For aircrafts electrical power systems, there is a trend toward higher voltage and higher current systems. There are several advantages by using a solid-state power controller (SSPC) for the distribution system. A standard of the SSPC for lower electrical power supply has been established (ISO 27027); but the standard for the SSPC for higher electrical power supply, which is intended for application in the primary power distribution of aircrafts, has not been established. Therefore, it is necessary to develop a standard for the high-power solid-state power controller (HPSSPC).

The purpose of this document is to standardize the requirements for HPSSPCs that are physically and environmentally diversified;

The HPSSPC:

a) consists of a solid-state switching device and its driver circuit;

b) turns on or off the power output by receiving the control signal;

c) detects the over current in the load which results in limiting this current or shutting down for this current, and/or optionally detects the arc fault in the circuit which results in shutting down the fault;

d) has the built-in test function which can detect the health status of itself;

e) indicates the on or off status of the power output.

In order to satisfy the purpose of this document, requirements such as physical, environmental and individual items are specified in accordance with the detail requirements that are issued individually.

Aerospace — High power solid state power controller — General performance requirements

1 Scope

This document specifies the general performance requirements and test methods to determine the performance of the high-power solid-state power controller (HPSSPC) for use in the primary power distribution of aircrafts.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 1540, *Aerospace — Characteristics of aircraft electrical systems*

ISO 7137:1995, *Aircraft — Environmental conditions and test procedures for airborne equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

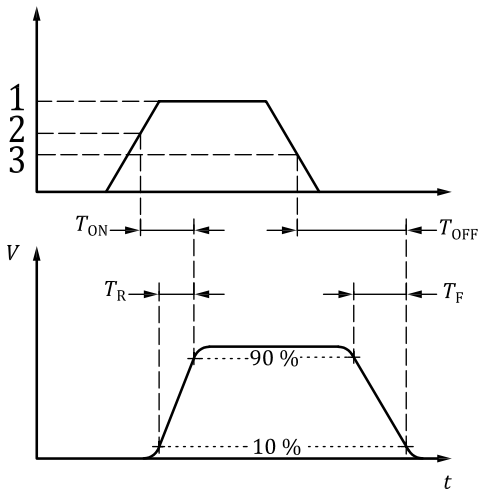
ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

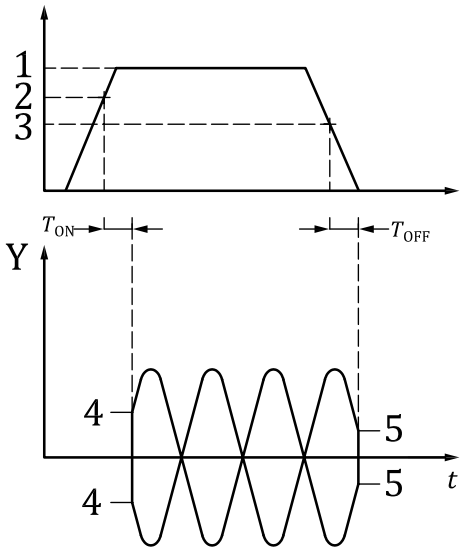
— IEC Electropedia: available at https://www.electropedia.org/

3.1
turn-on time
<DC device and non-zero crossing turn-on AC device> time interval between the initiation of the *turn-on signal* (3.5) or the latest frame of the turn-on command data packet via the control signal bus and the time when the output reach 90 % of its steady-state on value

Note 1 to entry: Shown in Figure 1 a).



a) DC HPSSPC



b) AC HPSSPC

Key

Y	load voltage
t	time
T_{ON}	turn-on time
T_{OFF}	turn-off time
T_R	rise time
T_F	fall time
ZVTO	zero voltage turn-on
ZCVO	zero current turn-off
1	rated control signal (which may optionally be consist of control bus)
2	turn on (min)
3	turn off (max)
4	zero voltage turn-on
5	zero current turn-off

Figure 1 — Illustration of timing characteristics

3.2
turn-on time
<AC device with zero-crossing turn-on> time interval between the initiation of the *turn-on signal* (3.5) or the latest frame of the turn-on command data packet via the control signal bus and the time when the output switch is on at zero crossing

Note 1 to entry: Shown in Figure 1 b).

3.3
turn-off time
<DC device and non-zero crossing turn-on AC device> time interval between the initiation of the turn-off signal or the latest frame of the turn-off command data packet via the control signal bus and the time when the output reach 10 % of its steady-state on value

Note 1 to entry: Shown in Figure 1 a).

3.4
turn-off time
<AC device with zero-crossing turn-on> time interval between the initiation of the turn-off signal or the latest frame of the turn-off command data packet via the control signal bus and the time when the output switch is off at zero crossing

Note 1 to entry: Shown in Figure 1 b).

3.5
turn-on signal
control signal level or turn-on command data packet via the control signal bus at which the power controller is turned on

3.6
turn-off signal
control signal level or turn-off command data packet via the control signal bus at which the power controller is turned off

3.7
load voltage rise and fall time
time interval between 10 % and 90 % of the steady state *load voltage* (3.10) value

Note 1 to entry: This definition applies to DC devices and non-zero crossing turn-off AC devices.

Note 2 to entry: The load voltage rise and fall time for DC devices is shown in Figure 1 a).

[SOURCE: ISO 27027:2014, 3.4, modified — "(DC devices and non-zero crossing turn-off AC devices)" has been removed from the term; note 1 to entry has been added instead; the reference to Figure 1 a) has been moved from the end of the definition to note 2 to entry.]

3.8
soft on/off
function for the power output current to increase linearly with the *turn-on signal* (3.5) or the turn-on command data packet via the control signal bus and to decrease linearly with the turn-off signal or the turn-off command data packet via the control signal bus

3.9
supply voltage
voltage applied between the power input terminal of the *HPSSPC* (3.13) and the power ground

3.10
load voltage
voltage between the power output terminal of the *HPSSPC* (3.13) and the power ground

3.11
voltage drop
voltage across load and line terminals of the *HPSSPC* (3.13) in the *on state* (3.20) at the specified load

3.12
rated current
supplied maximum current that the *HPSSPC* (3.13) continuously outputs from the output terminal without tripping

3.13
HPSSPC
high-power solid-state power controller
solid-state power controller (SSPC) which is applied on primary power distribution

3.14
power dissipation
power loss which includes all power dissipated in the power switching circuit, due to internal leakage currents and power supplies

Note 1 to entry: When the *HPSSPC* (3.13) is off, the power dissipation includes only dissipation due to leakage currents and internal power supplies.

3.15
HPSSPC trip
automatic reversion to the *off state* (3.21) of the *HPSSPC* (3.13) output caused by an overcurrent or a *short circuit* (3.22) condition or detection of an *arc fault* (3.28)

3.16
HPSSPC trip free
feature which prevents subsequent re-closing unless preceded by a *reset* (3.19) signal, when the *HPSSPC* (3.13) has tripped due to an overcurrent or a *short circuit* (3.22) condition or detection of an *arc fault* (3.28)

3.17
trip time
time interval between the application of an overcurrent or a *short circuit* (3.22) condition or detection of an *arc fault* (3.28) and the 10 % value of rated output current

Note 1 to entry: In general, the higher the over current condition, the shorter the trip time.

3.18
trip curve
curve which sets the minimum and maximum trip points of the *HPSSPC* (3.13) and is plotted as current verses time

3.19
reset
restoration of the tripped *HPSSPC* (3.13) to a state from which it can be turned on

3.20
on state
condition which, with the *turn-on signal* (3.5) applied, the device allows power to be passed to the load

[SOURCE: ISO 27027:2014, 3.6]

3.21
off state
condition which, with the turn-off signal applied, the device prevents power from being passed to the load

[SOURCE: ISO 27027:2014, 3.5]

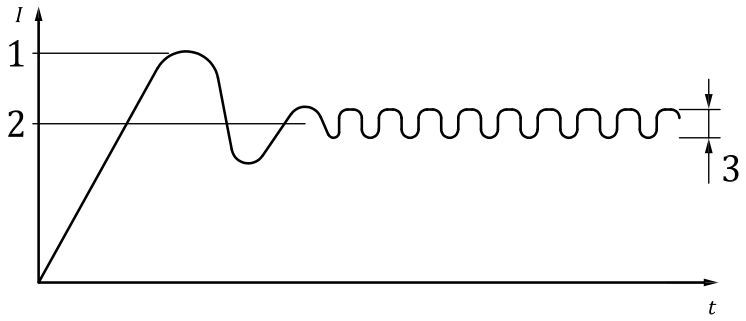
3.22
short circuit
circuit with the impedance of less than 1 mΩ applied between the output terminal and ground

[SOURCE: ISO 27027:2014, 3.13]

3.23
current limiting
function to limit the power output current to the required level within required time from overload or *short circuit* (3.22) conditions

Note 1 to entry: Shown in Figure 2.

[SOURCE: ISO 27027:2014, 3.2, modified — The reference to Figure 2 has been moved from the end of the definition to note 1 to entry.]



Key

I load current
t time
1 peak let through current
2 specified current limit
3 ripple

Figure 2 — Overload let through current

3.24
peak let-through current
peak value of the current at the maximum system voltage that the *HPSSPC* (3.13) conducts for a specified time interval without damage

3.25
zero voltage turn-on
characteristic that requires the *HPSSPC* (3.13) to turn on only at the half-cycle zero-crossing point, regardless of when the control signal is applied

Note 1 to entry: This characteristic applies only to AC devices.

3.26
zero current turn-off
characteristic that requires the *HPSSPC* (3.13) to turn off only at the half-cycle zero-crossing point, regardless of when the control signal is removed

Note 1 to entry: This characteristic applies only to AC devices.

3.27
reverse current
current into the load terminal of the *HPSSPC* (3.13) from the load energy source

3.28
arc fault
sustained luminous discharge of electricity across a gap in a circuit or between conductors

Note 1 to entry: Arc impedance can reduce low voltage fault current magnitudes appreciably.

[SOURCE: ISO 27027:2014, 3.1]

3.29
parallel arc fault
arc fault (3.28) condition in which arcing occurs in a circuit from line-to-line or line-to-ground and not through any load(s)

Note 1 to entry: Only the arc impedance and the system current impedance limit the magnitude of the arc fault current.

[SOURCE: ISO 27027:2014, 3.7]

3.30
series arc fault
arc fault (3.28) condition in which the current passes through the arc and each circuit load

Note 1 to entry: The load equipment limits the magnitude of the arc fault current.

[SOURCE: ISO 27027:2014, 3.12]

3.31
unwanted trip
nuisance trip
tripping function in response to a condition that is not an arc fault but a condition that occurs as part of the normal or anticipated operation of circuit components

[SOURCE: ISO 27027:2014, 3.26, modified — Note 1 to entry has been removed; "nuisance trip" has been added as an admitted term.]

4 Requirements

4.1 Detail requirements

The individual item requirements shall be specified in accordance with the detail requirements that are issued individually. ISO 7137 should be used for the specification of environmental conditions and test procedures for the SSPCs installed in the airborne equipment.

4.2 Electrical characteristics

When tested as specified in 5.1, the HPSSPC shall operate with supply voltage variations in accordance with ISO 1540 or the detail requirements; and the HPSSPC shall be capable of controlling all type of loads as required by the detail requirements.

4.3 Performance

4.3.1 Control signals

When tested as specified in 5.1.2, the control signals shall be as specified in the detail requirements.

4.3.2 Turn-on and turn-off time

When tested as specified in 5.1.3, the turn-on and turn-off time shall be as specified in the detail requirements.

4.3.3 Load voltage rise and fall time (soft on/off function)

When tested as specified in 5.1.4, the rise and fall time as the soft on/off function shall be as specified in the detail requirements.

