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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*.



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# Introduction

For aircrafts electrical power systems, there is a trend toward higher voltage and higher current systems. There are several advantages in 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 or shutting down 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 this purpose, this document specifies requirements such as physical, environmental and individual items 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:

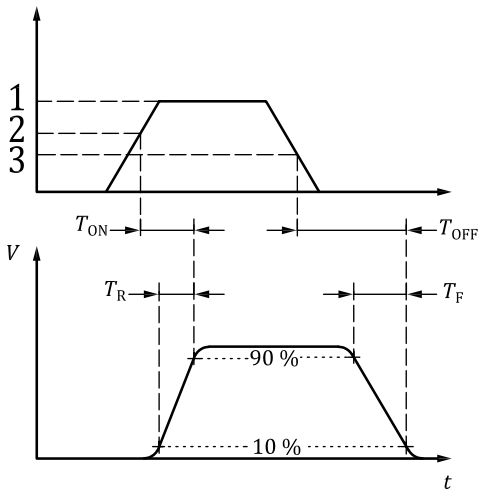
— ISO Online browsing platform: available at https://www.iso.org/obp

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

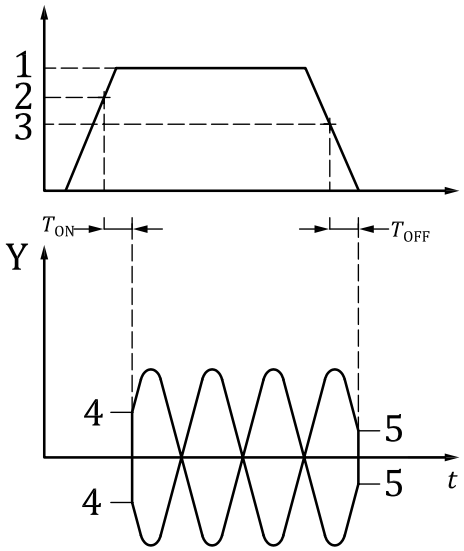


**3.1**
**turn-on time**
<DC device and non-zero-crossing turn-on AC device> time interval between the initiation of the *turn-on signal* (3.5) or the latest frame of the turn-on command data packet via the control signal bus and the time when the output reaches 90 % of its steady-state on value

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




**a) DC HPSSPC**




**b) AC HPSSPC**

**Key**

| | |
|---|---|
| Y | load voltage |
| $V$ | voltage |
| $t$ | time |
| $T_{ON}$ | turn-on time |
| $T_{OFF}$ | turn-off time |
| $T_R$ | rise time |
| $T_F$ | fall time |
| 1 | rated control signal (which can optionally 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 reaches 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 moved from the term to Note 1 to entry; 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 versus 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 in 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 in which, with the turn-off signal applied, the device prevents power from being passed to the load

[SOURCE: ISO 27027:2014, 3.5]

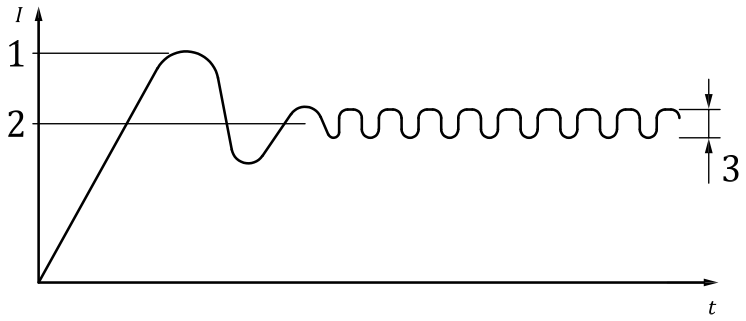
**3.22**
**short circuit**
circuit with the impedance of less than 1 mΩ applied between the output terminal and ground

[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]