1. (normative)
Source control drawing for bare solar cell (SCD‑BSC) ‑ DRD
	1. DRD identification
		1. Requirement identification and source document

This DRD is called from ECSS-E-ST-20-08, requirement 7.1.1.2b.

* + 1. Purpose and objective

The source control drawing for bare solar cell (SCD-BSC) contains the specific project dependent requirements, and together with this Standard, which contains the general requirements, constitutes the whole set of requirements for the qualification and acceptance of bare solar cells.

The SCD-BSC can be produced as a standalone document or as part of a system-level specification document.

The information on traceability to high level requirements can be included in the SCD-BSC itself or in the requirements traceability in the design justification file (DJF, see ECSS-E-ST-10). In either case a cross-reference is made.

The SCD-BSC is a major input to the qualification plan.

* 1. Expected response
		1. Scope and content

Introduction

The SCD-BSC shall contain a description of the purpose, objective, content and the reason prompting its preparation.

Applicable and reference documents

The SCD-BSC shall list the applicable and reference documents to support the generation of the document.

Terms and definitions, abbreviated terms and symbols

The SCD-BSC shall include any additional definition, abbreviation or symbol used.

Deviations from ECSS-E-ST-20-08

In conformance with requirement 7.1.1.2c, the SCD-BSC shall include the justification for any deviation in the in-process, acceptance and qualification tests.

Materials

The SCD-BSC shall include:

Reference to the procurement specification of the supplier.

For silicon solar cells, the following characteristics of the cells:

growth technique;

doping element;

orientation;

main breakage direction;

base resistivity;

thickness;

for ARC: materials;

for metal contact materials and thickness.

For single and multi-junction III-V solar cells, the following characteristics of the cells:

substrate material, orientation and thickness;

doping element of the substrate;

substrate resistivity;

for each sub-cell: materials,

for ARC: materials;

for metal contact materials and thickness.

Acceptance tests

Visual inspection.

In conformance with clause 7.5.1.5.4, the SCD-BSC shall list the maximum visible semiconductor length at the corners, in mm.

Dimensions and weight

In conformance with clause 7.5.2, the SCD-BSC shall include:

The dimensions shown in Figure C-1 to Figure C-3 including tolerances.

The measurement method used to perform the test.

The interval of the thickness of the silicon layer, in μm, for silicon solar cells.

The interval of the thickness of the substrate with epi-layers, in m, for III-IV cells.

The maximum weight, in mg, of the average shipment lot.

: BSC front side

: BSC rear side

: BSC contact

Contact uniformity

In conformance with clause 7.5.10, the SCD-BSC shall include:

The equipment to measure the contact thickness;

The maximum and minimum values of the contact thickness in μm.

Surface finish

In conformance with clause 7.5.11, the SCD-BSC shall include the maximum value of the surface finish (Rz) in μm.

Electrical performance

In conformance with clause 7.3.2.2.2, the SCD-BSC shall include the following test conditions:

the Vtest, in mV;

the temperature, in C;

the cells used as reference and their traceability to primary standards.

In conformance with clause 7.3.2.2.3 for the pass-fail criteria, the following requirements shall be included:

the minimum value for Itest, in mA;

the average value for Itest, in mA;

In conformance with clause 7.3.2.2.4 the SCD-BSC shall include the intervals in mA for electrical grading

Hemispherical reflectance

In conformance with clause 7.5.6.2, the SCD-BSC shall include the interval of reflectance for silicon BSR cells, at 1,5 μm, as a percentage (%).

Humidity and temperature

In conformance with clause 7.5.7.2.2, the SCD-BSC shall include the chemical contents, type and % in the mist, to be added to the humid environment when there are specific requirements on the contents of the environment and the voltage bias condition to be applied to the BSC.

Pull

In conformance with clause 7.5.12, the SCD-BSC shall include:

the interconnection technique parameter;

the material and dimension of the interconnectors;

the value of the pull speed in mm/min;

the value of the ultimate pull strength in N;

the pull direction (0°, 45° or 90°).

Integral diode performance

In conformance with clause 9.4.5.2, the SCD-BSC shall include for cells with protection diode electrically isolated from the cell:

For the test specified in requirement 9.4.5.2.2b:

the temperature,

the forward current,

the reverse voltage.

The pass-fail criteria for the test specified in clause 9.4.5.2.3:

the maximum absolute value of the forward voltage in V;

the reverse current in mA.

The physical limits in terms of maximum forward current and reverse voltage.

Cell coverglass gain-loss

In conformance with clause 7.5.6.3, the SCD-BSC shall include:

the agent used to simulate the properties of the adhesive;

the coverglass used for the test;

for the test conditions, the temperature, in C;

for the pass-fail criteria, the maximum ISC, in %.

Qualification

Visual inspection

The SCD-BSC shall include the same provisions as in the visual inspection for the acceptance tests (in conformance with clause C.2.1<6.1>).

Dimensions and weight

The SCD-BSC shall include the same provisions as in the dimensions and weight for the acceptance tests (in conformance with clause C.2.1<6.2>).

Electrical performance

In conformance with clause 7.5.3.2, the SCD-BSC shall include the pass-fail values shown in Table C-1, for

the individual solar cells, and

the minimum average.

: Electrical performance pass-fail criteria

|  |  |  |
| --- | --- | --- |
| Parameter | BOL | Remaining Factors (at 25 C) |
| EOL([Insert value]) (particles/cm2)a) | EOL([Insert value]) (particles/cm2)a) | EOL([Insert value]) (particles/cm2)a) |
| Ratio | Ratio | Ratio |
| VOC [mV] | [Insert value] | [Insert value] | [Insert value] | [Insert value] |
| Isc [mA/cm2] | [Insert value] | [Insert value] | [Insert value] | [Insert value] |
| Vmax [mV] | [Insert value] | [Insert value] | [Insert value] | [Insert value] |
| Imax [mA/cm2] | [Insert value] | [Insert value] | [Insert value] | [Insert value] |
| Pmax [mW/cm2] | [Insert value] | [Insert value] | [Insert value] | [Insert value] |
| I(Vt) [mA] | [Insert value] | [Insert value] | [Insert value] | [Insert value] |
| a) particles are electrons or protons after photon irradiation and temperature annealing |

Spectral response

If the method using narrow band interference filters the SCD-BSC shall include (in conformance with requirement 7.5.5.2b.1(c) for multi-junction GaAs solar cells the number of narrow band interference filters and their wavelength.

Optical properties

Hemispherical reflectance

The SCD-BSC shall include the same provisions as in the hemispherical reflectance for acceptance tests (in conformance with clause C.2.1<6.6>).

Coverglass gain-loss

The SCD-BSC shall include the same provisions as in the coverglass gain-loss for acceptance tests (in conformance with clause C.2.1<6.10>).

Humidity and temperature

The SCD-BSC shall include the same provisions as in the humidity and temperature for acceptance tests (in conformance with clause C.2.1<6.7>.).

Contact uniformity

In conformance with clause 7.5.9, the SCD-BSC shall include

the equipment to measure the contact thickness;

the requirements of the interconnection process to uniformity of the contact.

1. Example: maximum and minimum values of the contact thickness in μm.

Surface finish

The SCD-BSC shall include the same provisions as in the surface finish for acceptance tests (in conformance with clause C.2.1<6.4>).

Pull

The SCD-BSC shall include the same provisions as in the pull test for acceptance tests (in conformance with clause C.2.1<6.8>).

Electron irradiation

In conformance with clause 7.5.13.2, the SCD-BSC shall include:

The five fluences at 1 MeV and five fluences at 3MeV, in e- cm-2.

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Proton irradiation

In conformance with clause 7.5.14.2, the SCD-BSC shall include:

The five fluences at 1 MeV and the five fluences at 3 MeV, in p+cm‑2 ;

For each of the two energies defined in C.2.1<7.11> a.1, the nominal flux in p+cm‑2 s-2.

Solar cell reverse bias

In conformance with clause 7.5.16.2, the SCD-BSC shall include

the parameters of reverse IV characteristics measurement, such as test temperature in °C, hold time in s, current limitation in mA and maximum reverse bias in V

the pass/fail criteria

1. Example: maximum allowed difference in Iop before and after test.

Integral diode

In conformance with clause 9.6, the SCD-BSC shall include for cells with integral protection diode electrically isolated from the cell:

for burn in (in conformance with clause 9.6.5): the junction temperature of the diode at which burn in is to be performed

for diode characterization the same provisions as in the diode characterization for the acceptance tests (in conformance with clause C.2.1<6.9>)

for ESD (in conformance with clause 9.6.16.3): the pass fail criteria

for switching test (in conformance with requirement 9.6.17.2f): the test conditions and pass fail criteria for level 1 and 2

for Long Duration - Life Test (in conformance with requirement 9.6.18.2e): the total number of reverse bias and forward bias test steps, and the IREV, IFW and VFW.

Thermal cycling

In conformance with clause 7.5.17, the SCD-BSC shall include the number of thermal cycles to be performed before pull test on subgroup A and after humidity and temperature test in subgroup O, and their extreme temperatures.

Active-passive interface evaluation

In conformance with clause 7.5.18, the SCD-BSC shall include:

The deviation of total energy in the spectral region of 0,8 μm to 1,1 μm as a percentage, using a non-infrared rich solar simulator.

The maximum delta in Voc of the cell under both solar simulator conditions (1 S.C. (AM0) and non-infrared rich).

Flatness

In conformance with clause 7.5.19, the SCD-BSC shall include:

The measurement method used to determine the flatness.

The minimum flatness, as the maximum value of deflection, in mm.

* + 1. Special remarks

None.