1. General description

PNP/PNP low $V_{CEsat}$ Breakthrough In Small Signal (BISS) transistor in a leadless medium power DFN2020-6 (SOT1118) Surface-Mounted Device (SMD) plastic package.

NPN/PNP complement: PBSS4130PANP. NPN/NPN complement: PBSS4130PAN.

2. Features and benefits

- Very low collector-emitter saturation voltage $V_{CEsat}$
- High collector current capability $I_C$ and $I_{CM}$
- High collector current gain $h_{FE}$ at high $I_C$
- Reduced Printed-Circuit Board (PCB) requirements
- High energy efficiency due to less heat generation
- AEC-Q101 qualified

3. Applications

- Load switch
- Battery-driven devices
- Power management
- Charging circuits
- Power switches (e.g. motors, fans)

4. Quick reference data

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{CEO}$</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-</td>
<td>-30</td>
<td>V</td>
</tr>
<tr>
<td>$I_C$</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-1</td>
<td>A</td>
</tr>
<tr>
<td>$I_{CM}$</td>
<td>peak collector current</td>
<td>single pulse; $t_p \leq 1$ ms</td>
<td>-</td>
<td>-</td>
<td>-2</td>
<td>A</td>
</tr>
<tr>
<td>$R_{CESat}$</td>
<td>collector-emitter saturation resistance</td>
<td>$I_C = -1$ A; $I_B = -0.1$ A; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>250</td>
<td>mΩ</td>
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5. Pinning information

<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Description</th>
<th>Simplified outline</th>
<th>Graphic symbol</th>
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<tr>
<td>1</td>
<td>E1</td>
<td>emitter TR1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>B1</td>
<td>base TR1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C2</td>
<td>collector TR2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>E2</td>
<td>emitter TR2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>B2</td>
<td>base TR2</td>
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<td></td>
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<tr>
<td>6</td>
<td>C1</td>
<td>collector TR1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>C1</td>
<td>collector TR1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>C2</td>
<td>collector TR2</td>
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6. Ordering information

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<thead>
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<td>PBSS5130PAP</td>
<td>DFN2020-6</td>
<td>plastic thermal enhanced ultra thin small outline package; no leads; 6 terminals; body 2 x 2 x 0.65 mm</td>
<td>SOT1118</td>
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7. Marking

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8. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

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<th>Max</th>
<th>Unit</th>
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</thead>
<tbody>
<tr>
<td>$V_{CEO}$</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-60</td>
<td>-60</td>
<td>V</td>
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<tr>
<td>$V_{EBO}$</td>
<td>emitter-base voltage</td>
<td>open collector</td>
<td>7</td>
<td>7</td>
<td>V</td>
</tr>
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<td>$I_C$</td>
<td>collector current</td>
<td>-1 A</td>
<td>-1</td>
<td>-1</td>
<td>A</td>
</tr>
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<td>$I_{CM}$</td>
<td>peak collector current</td>
<td>single pulse; $t_p \leq 1 \text{ ms}$</td>
<td>-2</td>
<td>-2</td>
<td>A</td>
</tr>
<tr>
<td>$I_B$</td>
<td>base current</td>
<td>-0.3 A</td>
<td>-0.3</td>
<td>-0.3</td>
<td>A</td>
</tr>
<tr>
<td>Symbol</td>
<td>Parameter</td>
<td>Conditions</td>
<td>Min</td>
<td>Max</td>
<td>Unit</td>
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<td>----------------------------</td>
<td>-------------------------------------</td>
<td>-------</td>
<td>-------</td>
<td>------</td>
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<tr>
<td>( I_{\text{BM}} )</td>
<td>peak base current</td>
<td>single pulse; ( t_p \leq 1 \text{ ms} )</td>
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<td>-1</td>
<td>A</td>
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<tr>
<td>( P_{\text{tot}} )</td>
<td>total power dissipation</td>
<td>( T_{\text{amb}} \leq 25 \degree \text{C} )</td>
<td>[1]</td>
<td>370</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[2]</td>
<td>570</td>
<td>mW</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>[3]</td>
<td>530</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[4]</td>
<td>700</td>
<td>mW</td>
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<td></td>
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<td>[5]</td>
<td>450</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>[6]</td>
<td>760</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[7]</td>
<td>700</td>
<td>mW</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[8]</td>
<td>1450</td>
<td>mW</td>
</tr>
</tbody>
</table>

### Per device

| \( P_{\text{tot}} \) | total power dissipation | \( T_{\text{amb}} \leq 25 \degree \text{C} \) | [1]   | 510   | mW   |
|                      |                        |                                     | [2]   | 780   | mW   |
|                      |                        |                                     | [3]   | 730   | mW   |
|                      |                        |                                     | [4]   | 960   | mW   |
|                      |                        |                                     | [5]   | 620   | mW   |
|                      |                        |                                     | [6]   | 1040  | mW   |
|                      |                        |                                     | [7]   | 960   | mW   |
|                      |                        |                                     | [8]   | 2000  | mW   |

\( T_j \) junction temperature

\( T_{\text{amb}} \) ambient temperature

\( T_{\text{stg}} \) storage temperature

---

[1] Device mounted on an FR4 PCB, single-sided 35 \( \mu \)m copper strip line, tin-plated and standard footprint.
[2] Device mounted on an FR4 PCB, single-sided 35 \( \mu \)m copper strip line, tin-plated, mounting pad for collector 1 cm\(^2\).
[3] Device mounted on 4-layer PCB 35 \( \mu \)m copper strip line, tin-plated and standard footprint.
[4] Device mounted on 4-layer PCB 35 \( \mu \)m copper strip line, tin-plated, mounting pad for collector 1 cm\(^2\).
[5] Device mounted on an FR4 PCB, single-sided 70 \( \mu \)m copper strip line, tin-plated and standard footprint.
[6] Device mounted on an FR4 PCB, single-sided 70 \( \mu \)m copper strip line, tin-plated, mounting pad for collector 1 cm\(^2\).
[7] Device mounted on 4-layer PCB 70 \( \mu \)m copper strip line, tin-plated and standard footprint.
[8] Device mounted on 4-layer PCB 70 \( \mu \)m copper strip line, tin-plated, mounting pad for collector 1 cm\(^2\).
9. Thermal characteristics

Table 6. Thermal characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{th(j-a)}$</td>
<td>thermal resistance from junction to ambient</td>
<td>in free air</td>
<td>$[1]$</td>
<td>-</td>
<td>-</td>
<td>338 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$[2]$</td>
<td>-</td>
<td>-</td>
<td>219 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$[3]$</td>
<td>-</td>
<td>-</td>
<td>236 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$[4]$</td>
<td>-</td>
<td>-</td>
<td>179 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$[5]$</td>
<td>-</td>
<td>-</td>
<td>278 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$[6]$</td>
<td>-</td>
<td>-</td>
<td>164 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$[7]$</td>
<td>-</td>
<td>-</td>
<td>179 K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$[8]$</td>
<td>-</td>
<td>-</td>
<td>86 K/W</td>
</tr>
<tr>
<td>$R_{th(j-sp)}$</td>
<td>thermal resistance from junction to solder point</td>
<td>-</td>
<td>-</td>
<td>30 K/W</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) 4-layer PCB 70 µm, mounting pad for collector 1 cm²
(2) FR4 PCB 70 µm, mounting pad for collector 1 cm²
(3) 4-layer PCB 70 µm, standard footprint
(4) 4-layer PCB 35 µm, mounting pad for collector 1 cm²
(5) FR4 PCB 35 µm, mounting pad for collector 1 cm²
(6) 4-layer PCB 35 µm, standard footprint
(7) FR4 PCB 70 µm, standard footprint
(8) FR4 PCB 35 µm, standard footprint

Fig. 1. Per transistor: power derating curves
### Symbol | Parameter | Conditions | Min | Typ | Max | Unit
---|---|---|---|---|---|---

[2] Device mounted on an FR4 PCB, single-sided 35 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
[3] Device mounted on 4-layer PCB 35 µm copper strip line, tin-plated and standard footprint.
[4] Device mounted on 4-layer PCB 35 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
[6] Device mounted on an FR4 PCB, single-sided 70 µm copper strip line, tin-plated, mounting pad for collector 1 cm².
[7] Device mounted on 4-layer PCB 70 µm copper strip line, tin-plated and standard footprint.
[8] Device mounted on 4-layer PCB 70 µm copper strip line, tin-plated, mounting pad for collector 1 cm².

**Fig. 2.** Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values
Fig. 3. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB 35 µm, mounting pad for collector 1 cm²

Fig. 4. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

4-layer PCB 35 µm, standard footprint
Fig. 5. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

4-layer PCB 35 µm, mounting pad for collector 1 cm²

Fig. 6. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB 70 µm, standard footprint
**Fig. 7.** Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB 70 µm, mounting pad for collector 1 cm²

**Fig. 8.** Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

4-layer PCB 70 µm, standard footprint
4-layer PCB 70 µm, mounting pad for collector 1 cm²

Fig. 9. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

10. Characteristics

Table 7. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per transistor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{CBO}$</td>
<td>collector-base cut-off current</td>
<td>$V_{CB} = -24$ V; $I_E = 0$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>-100</td>
<td>nA</td>
</tr>
<tr>
<td>$I_{EBO}$</td>
<td>emitter-base cut-off current</td>
<td>$V_{CB} = -24$ V; $I_E = 0$ A; $T_j = 150$ °C</td>
<td>-</td>
<td>-</td>
<td>-50</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{EB} = -5$ V; $I_C = 0$ A; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>-100</td>
<td>nA</td>
</tr>
<tr>
<td>$h_{FE}$</td>
<td>DC current gain</td>
<td>$V_{CE} = -2$ V; $I_C = -100$ mA; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>250</td>
<td>350</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$V_{CE} = -2$ V; $I_C = -500$ mA; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>170</td>
<td>250</td>
<td>-</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>$V_{CE} = -2$ V; $I_C = -1$ A; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>120</td>
<td>175</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>$V_{CESat}$</td>
<td>collector-emitter saturation voltage</td>
<td>$I_C = -500$ mA; $I_B = -50$ mA; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-85</td>
<td>-140</td>
<td>mV</td>
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<td></td>
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<td>$I_C = -1$ A; $I_B = -50$ mA; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-175</td>
<td>-280</td>
<td>mV</td>
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<td>$I_C = -1$ A; $I_B = -100$ mA; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
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<td>-160</td>
<td>-250</td>
<td>mV</td>
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<tr>
<td>$R_{CESat}$</td>
<td>collector-emitter saturation resistance</td>
<td>$I_C = -1$ A; $I_B = -0.1$ A; pulsed; $t_p \leq 300$ µs; $\delta \leq 0.02$; $T_{amb} = 25$ °C</td>
<td>-</td>
<td>-</td>
<td>250</td>
<td>mΩ</td>
</tr>
</tbody>
</table>
## Symbol | Parameter | Conditions | Min | Typ | Max | Unit
--- | --- | --- | --- | --- | --- | ---
$V_{\text{BEsat}}$ | base-emitter saturation voltage | $I_C = -500 \, \text{mA}; I_B = -50 \, \text{mA}$; pulsed; $t_p \leq 300 \, \mu s$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \, ^\circ \text{C}$ | - | - | -1 | V
| | | $I_C = -1 \, \text{A}; I_B = -50 \, \text{mA}$; $T_{\text{amb}} = 25 \, ^\circ \text{C}$ | - | - | -1 | V
| | | $I_C = -1 \, \text{A}; I_B = -100 \, \text{mA}$; pulsed; $t_p \leq 300 \, \mu s$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \, ^\circ \text{C}$ | - | - | -1.1 | V

$V_{\text{BEon}}$ | base-emitter turn-on voltage | $V_{CE} = -2 \, \text{V}; I_C = -0.5 \, \text{A}$; pulsed; $t_p \leq 300 \, \mu s$; $\delta \leq 0.02$; $T_{\text{amb}} = 25 \, ^\circ \text{C}$ | - | - | -0.9 | V

$t_d$ | delay time | $V_{CC} = -10 \, \text{V}; I_C = -0.5 \, \text{A}$; $I_{\text{Bon}} = -25 \, \text{mA}$; $I_{\text{Boff}} = 25 \, \text{mA}$; $T_{\text{amb}} = 25 \, ^\circ \text{C}$ | - | 15 | - | ns

$t_r$ | rise time | - | 35 | - | ns

$t_{\text{on}}$ | turn-on time | - | 50 | - | ns

$t_s$ | storage time | - | 105 | - | ns

$t_f$ | fall time | - | 35 | - | ns

$t_{\text{off}}$ | turn-off time | - | 140 | - | ns

$f_T$ | transition frequency | $V_{CE} = -10 \, \text{V}; I_C = -50 \, \text{mA}$; $f = 100 \, \text{MHz}; T_{\text{amb}} = 25 \, ^\circ \text{C}$ | 65 | 125 | - | MHz

$C_C$ | collector capacitance | $V_{CB} = -10 \, \text{V}; I_C = 0 \, \text{A}; I_E = 0 \, \text{A}$; $f = 1 \, \text{MHz}; T_{\text{amb}} = 25 \, ^\circ \text{C}$ | - | 13 | 17 | pF

---

![Fig. 10. DC current gain as a function of collector current; typical values](image1)

$V_{CE} = -2 \, \text{V}$

(1) $T_{\text{amb}} = 100 \, ^\circ \text{C}$

(2) $T_{\text{amb}} = 25 \, ^\circ \text{C}$

(3) $T_{\text{amb}} = -55 \, ^\circ \text{C}$

![Fig. 11. Collector current as a function of collector-emitter voltage; typical values](image2)

$T_{\text{amb}} = 25 \, ^\circ \text{C}$
PBSS5130PAP

30 V, 1 A PNP/PNP low VCEsat (BISS) transistor

Fig. 12. Base-emitter voltage as a function of collector current; typical values

\[ V_{CE} = -2 \text{ V} \]
(1) \( T_{\text{amb}} = -55 \, ^\circ \text{C} \)
(2) \( T_{\text{amb}} = 25 \, ^\circ \text{C} \)
(3) \( T_{\text{amb}} = 100 \, ^\circ \text{C} \)

Fig. 13. Base-emitter saturation voltage as a function of collector current; typical values

\[ I_{C}/I_{B} = 20 \]
(1) \( T_{\text{amb}} = -55 \, ^\circ \text{C} \)
(2) \( T_{\text{amb}} = 25 \, ^\circ \text{C} \)
(3) \( T_{\text{amb}} = 100 \, ^\circ \text{C} \)

Fig. 14. Collector-emitter saturation voltage as a function of collector current; typical values

\[ I_{C}/I_{B} = 20 \]
(1) \( T_{\text{amb}} = 100 \, ^\circ \text{C} \)
(2) \( T_{\text{amb}} = 25 \, ^\circ \text{C} \)
(3) \( T_{\text{amb}} = -55 \, ^\circ \text{C} \)

Fig. 15. Collector-emitter saturation voltage as a function of collector current; typical values

\[ T_{\text{amb}} = 25 \, ^\circ \text{C} \]
(1) \( I_{C}/I_{B} = 100 \)
(2) \( I_{C}/I_{B} = 50 \)
(3) \( I_{C}/I_{B} = 10 \)
PBSS5130PAP

30 V, 1 A PNP/PNP low VCEsat (BISS) transistor

**Fig. 16.** Collector-emitter saturation resistance as a function of collector current; typical values

- **I\(_C\)/I\(_B\) = 20**
- (1) \(T_{amb} = 100^\circ C\)
- (2) \(T_{amb} = 25^\circ C\)
- (3) \(T_{amb} = -55^\circ C\)

**Fig. 17.** Collector-emitter saturation resistance as a function of collector current; typical values

- **T\(_{amb}\) = 25 \(^\circ C\)**
- (1) \(I_C/I_B = 100\)
- (2) \(I_C/I_B = 50\)
- (3) \(I_C/I_B = 10\)
11. Test information

Fig. 18. BISS transistor switching time definition

Fig. 19. Test circuit for switching times

11.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard Q101 - Stress test qualification for discrete semiconductors, and is suitable for use in automotive applications.
12. Package outline

![Package outline DFN2020-6 (SOT1118)](image)

Fig. 20. Package outline DFN2020-6 (SOT1118)

13. Soldering

![Reflow soldering footprint for DFN2020-6 (SOT1118)](image)

Fig. 21. Reflow soldering footprint for DFN2020-6 (SOT1118)

14. Revision history

<table>
<thead>
<tr>
<th>Table 8. Revision history</th>
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<td>PBSS5130PAP v.1</td>
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15. Legal information

15.1 Data sheet status

<table>
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<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
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<tr>
<td>Objective [short] data sheet</td>
<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
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<tr>
<td>Preliminary [short] data sheet</td>
<td>Qualification</td>
<td>This document contains data from the preliminary specification.</td>
</tr>
<tr>
<td>Product [short] data sheet</td>
<td>Production</td>
<td>This document contains the product specification.</td>
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</table>

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term “short data sheet” is explained in section “Definitions”.

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