PBSS5230PAP
30 V, 2 A PNP/PNP low VCEsat (BISS) transistor
11 January 2013 Product data sheet

1. General description

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

NPN/PNP complement: PBSS4230PANP. NPN/NPN complement: PBSS4230PAN.

2. Features and benefits

- Very low collector-emitter saturation voltage VCEsat
- High collector current capability IC and ICM
- High collector current gain hFE at high IC
- 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>
</table>
| Per transistor
| VCEO   | collector-emitter voltage         | open base               | -   | -   | -30 | V    |
| IC     | collector current                 |                         | -   | -   | -2  | A    |
| ICM    | peak collector current            | single pulse; tp ≤ 1 ms | -   | -   | -3  | A    |
| RCEsat | collector-emitter saturation resistance | IC = -1 A; IB = -0.1 A; pulsed; tp ≤ 300 µs; δ ≤ 0.02 ; Tamb = 25 °C | -   | -   | 195 | mΩ   |
5. Pinning information

Table 2. 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>6 5 4</td>
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<tr>
<td>2</td>
<td>B1</td>
<td>base TR1</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>C2</td>
<td>collector TR2</td>
<td>1 2 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>E2</td>
<td>emitter TR2</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>B2</td>
<td>base TR2</td>
<td></td>
<td></td>
</tr>
<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

Table 3. Ordering information

<table>
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<th>Type number</th>
<th>Package</th>
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<td>PBSS5230PAP</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

Table 4. Marking codes

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<td>PBSS5230PAP</td>
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8. Limiting values

Table 5. Limiting values

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

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<thead>
<tr>
<th>Symbol</th>
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<th>Conditions</th>
<th>Min</th>
<th>Max</th>
<th>Unit</th>
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<tr>
<td>V_{CBO}</td>
<td>collector-base voltage</td>
<td>open emitter</td>
<td>-</td>
<td>-30</td>
<td>V</td>
</tr>
<tr>
<td>V_{CEO}</td>
<td>collector-emitter voltage</td>
<td>open base</td>
<td>-</td>
<td>-30</td>
<td>V</td>
</tr>
<tr>
<td>V_{EBO}</td>
<td>emitter-base voltage</td>
<td>open collector</td>
<td>-</td>
<td>-7</td>
<td>V</td>
</tr>
<tr>
<td>I_{C}</td>
<td>collector current</td>
<td></td>
<td>-</td>
<td>-2</td>
<td>A</td>
</tr>
<tr>
<td>I_{CM}</td>
<td>peak collector current</td>
<td>single pulse; t_{p} ≤ 1 ms</td>
<td>-</td>
<td>-3</td>
<td>A</td>
</tr>
<tr>
<td>I_{B}</td>
<td>base current</td>
<td></td>
<td>-</td>
<td>-0.3</td>
<td>A</td>
</tr>
</tbody>
</table>
### Symbol | Parameter | Conditions | Min | Max | Unit
--- | --- | --- | --- | --- | ---
$I_{BM}$ | peak base current | single pulse; $t_p \leq 1$ ms | - | -1 | A

### $P_{tot}$ | total power dissipation | $T_{amb} \leq 25 \, ^\circ C$ | [1] | - | 370 mW
[2] | - | 570 mW
[3] | - | 530 mW
[4] | - | 700 mW
[5] | - | 450 mW
[6] | - | 760 mW
[7] | - | 700 mW
[8] | - | 1450 mW

### Per device

| $P_{tot}$ | total power dissipation | $T_{amb} \leq 25 \, ^\circ C$ | [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 | - | - | 150 $^\circ C$
| $T_{amb}$ | ambient temperature | -55 | 150 | $^\circ C$
| $T_{stg}$ | storage temperature | -65 | 150 | $^\circ C$

[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.
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>Per transistor</td>
<td>R\textsubscript{th(j-a)}</td>
<td>thermal resistance from junction to ambient in free air</td>
<td>[1]</td>
<td>-</td>
<td>338</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[3]</td>
<td>-</td>
<td>236</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[5]</td>
<td>-</td>
<td>278</td>
<td>K/W</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>[6]</td>
<td>-</td>
<td>164</td>
<td>K/W</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>[7]</td>
<td>-</td>
<td>179</td>
<td>K/W</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>[8]</td>
<td>-</td>
<td>86</td>
<td>K/W</td>
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<tr>
<td>Per transistor</td>
<td>R\textsubscript{th(j-sp)}</td>
<td>thermal resistance from junction to solder point</td>
<td>-</td>
<td>-</td>
<td>30</td>
<td>K/W</td>
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</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

<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>[-]</td>
<td>[-]</td>
<td>245</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[-]</td>
<td>[-]</td>
<td>160</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[-]</td>
<td>[-]</td>
<td>171</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>[-]</td>
<td>[-]</td>
<td>130</td>
<td>K/W</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[-]</td>
<td>[-]</td>
<td>202</td>
<td>K/W</td>
</tr>
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<td>[-]</td>
<td>[-]</td>
<td>120</td>
<td>K/W</td>
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<td></td>
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<td>[-]</td>
<td>[-]</td>
<td>63</td>
<td>K/W</td>
</tr>
</tbody>
</table>

[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.

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

Fig. 5. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values

FR4 PCB 70 µm, standard footprint

Fig. 6. Per transistor: transient thermal impedance from junction to ambient as a function of pulse duration; typical values
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
### 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><strong>Per transistor</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I_\text{CBO}</td>
<td>collector-base cut-off current</td>
<td>( V_{\text{CB}} = -24 \text{ V}; I_E = 0 \text{ A}; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>-</td>
<td>-</td>
<td>-100</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{\text{CB}} = -24 \text{ V}; I_E = 0 \text{ A}; T_j = 150 \text{ °C} )</td>
<td>-</td>
<td>-</td>
<td>-50</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{\text{EB}} = -5 \text{ V}; I_C = 0 \text{ A}; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>-</td>
<td>-</td>
<td>-100</td>
<td>nA</td>
</tr>
<tr>
<td>I_\text{EBO}</td>
<td>emitter-base cut-off current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h_\text{FE}</td>
<td>DC current gain</td>
<td>( V_{\text{CE}} = -2 \text{ V}; I_C = -100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ µs}; \delta \leq 0.02 ; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>260</td>
<td>370</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_{\text{CE}} = -2 \text{ V}; I_C = -500 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ µs}; \delta \leq 0.02 ; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>210</td>
<td>290</td>
<td>-</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>( V_{\text{CE}} = -2 \text{ V}; I_C = -1 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ µs}; \delta \leq 0.02 ; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>160</td>
<td>230</td>
<td>-</td>
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<tr>
<td></td>
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<td>( V_{\text{CE}} = -2 \text{ V}; I_C = -2 \text{ A}; \text{pulsed}; t_p \leq 300 \text{ µs}; \delta \leq 0.02 ; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>100</td>
<td>145</td>
<td>-</td>
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<td>V_{\text{CEsat}}</td>
<td>collector-emitter saturation voltage</td>
<td>( I_C = -500 \text{ mA}; I_B = -50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ µs}; \delta \leq 0.02 ; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>-</td>
<td>-75</td>
<td>-110</td>
<td>mV</td>
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<td>( I_C = -1 \text{ A}; I_B = -50 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ µs}; \delta \leq 0.02 ; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>-</td>
<td>-155</td>
<td>-220</td>
<td>mV</td>
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<td>( I_C = -2 \text{ A}; I_B = -100 \text{ mA}; \text{pulsed}; t_p \leq 300 \text{ µs}; \delta \leq 0.02 ; T_{\text{amb}} = 25 \text{ °C} )</td>
<td>-</td>
<td>-295</td>
<td>-420</td>
<td>mV</td>
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</tbody>
</table>

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

4-layer PCB 70 µm, mounting pad for collector 1 cm²
### Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
--- | --- | --- | --- | --- | --- | --- |
$R_{CEsat}$ | collector-emitter saturation resistance | $I_C = -2 A; I_B = -200 mA; pulsed; t_p \leq 300 \mu s; \delta \leq 0.02 ; T_{amb} = 25 ^\circ C$ | - | -275 | -390 | mV |
$R_{CEsat}$ | | $I_C = -1 A; I_B = -0.1 A; pulsed; t_p \leq 300 \mu s; \delta \leq 0.02 ; T_{amb} = 25 ^\circ C$ | - | - | 195 | mΩ |
$V_{BEsat}$ | base-emitter saturation voltage | $I_C = -500 mA; I_B = -50 mA; pulsed; t_p \leq 300 \mu s; \delta \leq 0.02 ; T_{amb} = 25 ^\circ C$ | - | - | -1 | V |
$V_{BEsat}$ | | $I_C = -1 A; I_B = -50 mA; pulsed; t_p \leq 300 \mu s; \delta \leq 0.02 ; T_{amb} = 25 ^\circ C$ | - | - | -1 | V |
$V_{BEsat}$ | | $I_C = -2 A; I_B = -100 mA; pulsed; t_p \leq 300 \mu s; \delta \leq 0.02 ; T_{amb} = 25 ^\circ C$ | - | - | -1.1 | V |
$V_{BEsat}$ | | $I_C = -2 A; I_B = -200 mA; pulsed; t_p \leq 300 \mu s; \delta \leq 0.02 ; T_{amb} = 25 ^\circ C$ | - | - | -1.2 | V |
$V_{BEon}$ | base-emitter turn-on voltage | $V_{CE} = -2 V; I_C = -0.5 A; pulsed; t_p \leq 300 \mu s; \delta \leq 0.02 ; T_{amb} = 25 ^\circ C$ | - | - | -0.9 | V |
$t_d$ | delay time | $V_{CC} = -12.5 V; I_C = -1 A; I_{Bon} = -50 mA; I_{Boff} = 50 mA; T_{amb} = 25 ^\circ C$ | - | 10 | - | ns |
$t_r$ | rise time | | - | 50 | - | ns |
$t_{on}$ | turn-on time | | - | 60 | - | ns |
$t_s$ | storage time | | - | 200 | - | ns |
$t_f$ | fall time | | - | 45 | - | ns |
$t_{off}$ | turn-off time | | - | 245 | - | ns |
$f_T$ | transition frequency | $V_{CE} = -10 V; I_C = -50 mA; f = 100 MHz; T_{amb} = 25 ^\circ C$ | 50 | 95 | - | MHz |
$C_c$ | collector capacitance | $V_{CB} = -10 V; I_C = 0 A; I_B = 0 A; f = 1 MHz; T_{amb} = 25 ^\circ C$ | - | 22 | 29 | pF |
**Fig. 10.** DC current gain as a function of collector current; typical values

- $V_{CE} = -2\, V$
- $T_{amb} = 100\, ^\circ C$
- $T_{amb} = 25\, ^\circ C$
- $T_{amb} = -55\, ^\circ C$

**Fig. 11.** Collector current as a function of collector-emitter voltage; typical values

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

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

- $V_{CE} = -2\, V$
- $T_{amb} = -55\, ^\circ C$
- $T_{amb} = 25\, ^\circ C$
- $T_{amb} = 100\, ^\circ C$

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

- $I_{C}/I_{B} = 20$
- $T_{amb} = -55\, ^\circ C$
- $T_{amb} = 25\, ^\circ C$
- $T_{amb} = 100\, ^\circ C$
**Fig. 14. Collector-emitter saturation voltage 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. 15. Collector-emitter saturation voltage 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) $I_C/I_B = 10$

**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

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

13. Soldering

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

14. Revision history

Table 8. Revision history

<table>
<thead>
<tr>
<th>Data sheet ID</th>
<th>Release date</th>
<th>Data sheet status</th>
<th>Change notice</th>
<th>Supersedes</th>
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<tbody>
<tr>
<td>PBSS5230PAP v.1</td>
<td>20130111</td>
<td>Product data sheet</td>
<td>-</td>
<td>-</td>
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15. Legal information

15.1 Data sheet status

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<td>Objective (short) data sheet</td>
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<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>
</tr>
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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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nexperia.com.

15.2 Definitions

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16. Contents

1 General description ........................................ 1
2 Features and benefits ...................................... 1
3 Applications .................................................. 1
4 Quick reference data ........................................ 1
5 Pinning information .......................................... 2
6 Ordering information ......................................... 2
7 Marking .......................................................... 2
8 Limiting values ............................................... 2
9 Thermal characteristics ..................................... 4
10 Characteristics ............................................... 9
11 Test information .............................................. 13
11.1 Quality information ....................................... 13
12 Package outline .............................................. 14
13 Soldering ....................................................... 14
14 Revision history .............................................. 14
15 Legal information ........................................... 15
15.1 Data sheet status .......................................... 15
15.2 Definitions .................................................. 15
15.3 Disclaimers .................................................. 15
15.4 Trademarks .................................................. 16

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Date of release: 11 January 2013