1. General description

Silicon Carbide MOSFET in a TO247-4L plastic package, designed for high frequency, high efficiency systems.

2. Features and benefits

- Separate driver source pin
- Low on-resistance
- Fast switching speed
- 0V turn-off gate voltage for simple gate drive
- 100% UIS Tested
- Easy to parallel
- Controllable dV/dt for optimized EMI
- Reduced cooling requirements
- RoHS compliant

3. Applications

- Switch Mode Power Supplies
- UPS
- Solar string inverter and solar optimizer
- EV Charger
- Motor Drives

4. Quick reference data

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Absolute maximum rating</td>
<td></td>
<td></td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>$V_{DS}$</td>
<td>drain-source voltage</td>
<td>$25 , ^\circ C \leq T_j \leq 175 , ^\circ C$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_D$</td>
<td>drain current</td>
<td>$V_{GS} = 18 , V; T_{mb} = 25 , ^\circ C$</td>
<td>106.4</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>$P_{tot}$</td>
<td>total power dissipation</td>
<td>$T_{mb} = 25 , ^\circ C; T_j = 175 , ^\circ C$</td>
<td>652</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>$T_j$</td>
<td>junction temperature</td>
<td></td>
<td></td>
<td>-55 to 175</td>
<td>°C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{DSS(on)}$</td>
<td>drain-source on-state resistance</td>
<td>$V_{GS} = 15 , V; I_D = 40 , A; T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>30</td>
<td>mΩ</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_{G(tot)}$</td>
<td>total gate charge</td>
<td>$I_D = 40 , A; V_{DS} = 800 , V; V_{DS} = -4 , V/18 , V; T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>151</td>
<td>nC</td>
</tr>
<tr>
<td>$Q_{GD}$</td>
<td>gate-drain charge</td>
<td></td>
<td>-</td>
<td>21</td>
<td>nC</td>
</tr>
<tr>
<td>$Q_r$</td>
<td>recovered charge</td>
<td>$I_{SD} = 40 , A; \text{di/dt} = 500 , A/\mu s; V_{DS} = 400 , V; T_j = 25 , ^\circ C$</td>
<td>-</td>
<td>129</td>
<td>nC</td>
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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>D</td>
<td>drain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>S</td>
<td>source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SS</td>
<td>source sense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>G</td>
<td>gate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mb</td>
<td>D</td>
<td>mounting base; connected to drain</td>
<td></td>
<td></td>
</tr>
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6. Ordering information

Table 3. Ordering information

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<thead>
<tr>
<th>Type number</th>
<th>Package Name</th>
<th>Orderable part number</th>
<th>Packing method</th>
<th>Small packing quantity</th>
<th>Package version</th>
<th>Package issue date</th>
</tr>
</thead>
<tbody>
<tr>
<td>WNSC2M30120R</td>
<td>TO247-4L</td>
<td>WNSC2M30120R6Q</td>
<td>Tube</td>
<td>30</td>
<td>TO247N-4L</td>
<td>17-Dec-2021</td>
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7. Marking

Table 4. Marking codes

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<tr>
<td>WNSC2M30120R</td>
<td>WNSC2M 30120R</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>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{DS}</td>
<td>drain-source voltage</td>
<td>25 °C ≤ T_j ≤ 175 °C</td>
<td></td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>V_{GS,max}</td>
<td>gate-source voltage</td>
<td></td>
<td>-12 to 24</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V_{GS,op}</td>
<td>gate-source voltage</td>
<td></td>
<td>-4 to 18</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>P_{tot}</td>
<td>total power dissipation</td>
<td>T_{mb} = 25 °C, T_j = 175 °C</td>
<td></td>
<td>652</td>
<td>W</td>
</tr>
<tr>
<td>I_D</td>
<td>drain current</td>
<td>V_{DS} = 18 V; T_{mb} = 25 °C</td>
<td></td>
<td>106.4</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{DS} = 18 V; T_{mb} = 100 °C</td>
<td></td>
<td>75.2</td>
<td>A</td>
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<tr>
<td>I_{DM}</td>
<td>peak drain current</td>
<td>pulse width t_p limited by T_{jmax}</td>
<td></td>
<td>200</td>
<td>A</td>
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<tr>
<td>I_S</td>
<td>continuous diode current</td>
<td>V_{DS} = -4 V; T_{mb} = 25 °C</td>
<td></td>
<td>84.4</td>
<td>A</td>
</tr>
<tr>
<td>I_{SM}</td>
<td>pulse diode current</td>
<td>V_{DS} = -4 V; pulse width t_p limited by T_{jmax}</td>
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<tr>
<td>E_{as}</td>
<td>single pulse drain-to-source avalanche</td>
<td>I_{as} = 20 A; L = 1 mH; V_{DS} = 100 V; T_j = 25 °C</td>
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<td>200</td>
<td>mJ</td>
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<tr>
<td>T_{stg}</td>
<td>storage temperature</td>
<td></td>
<td>-55 to 175 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T_j</td>
<td>junction temperature</td>
<td></td>
<td>-55 to 175 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T_{sld(M)}</td>
<td>peak soldering temperature</td>
<td></td>
<td>260</td>
<td>°C</td>
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Fig. 1. Total power dissipation as a function of mounting base temperature; maximum values

Fig. 2. Continuous Drain Current as a function of mounting base temperature
9. Thermal & Mechanical characteristics

Table 6. Thermal & Mechanical characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>R_{th(j-mb)}</td>
<td>thermal resistance from junction to mounting base</td>
<td></td>
<td></td>
<td>-</td>
<td>0.23</td>
<td>-</td>
<td>KW</td>
</tr>
<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>40</td>
<td>-</td>
<td>KW</td>
</tr>
<tr>
<td>M_d</td>
<td>Mounting torque</td>
<td>M3 or 6 - 32 screw</td>
<td></td>
<td>-</td>
<td>-</td>
<td>0.6</td>
<td>Nm</td>
</tr>
</tbody>
</table>

Note: It is recommended that a metal washer is inserted between screw head and mounting tab.
Do not use self-tapping screws.
Device is ESD sensitive. Handling precautions are recommended.

Fig. 3. Transient thermal impedance from junction to mounting base as a function of pulse duration
### 10. Characteristics

#### Table 7. Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Notes</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{BRDSS}$</td>
<td>drain-source breakdown voltage</td>
<td>$I_0 = 100 \mu A; V_{GS} = 0 V; T_j = 25 ^\circ C$</td>
<td></td>
<td>1200</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>$V_{GS(th)}$</td>
<td>gate-source threshold voltage</td>
<td>$I_0 = 12 mA; V_{DS} = 10 V; T_j = 25 ^\circ C$</td>
<td>1.9</td>
<td>2.6</td>
<td>3.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>$I_{DSS}$</td>
<td>drain leakage current</td>
<td>$V_{DS} = 1200 V; V_{GS} = 0 V; T_j = 25 ^\circ C$</td>
<td></td>
<td>0.2</td>
<td>100</td>
<td>-</td>
<td>μA</td>
</tr>
<tr>
<td>$I_{GSS}$</td>
<td>gate leakage current</td>
<td>$V_{GS} = 24 V; V_{DS} = 0 V; T_j = 25 ^\circ C$</td>
<td></td>
<td>10</td>
<td>100</td>
<td>-</td>
<td>nA</td>
</tr>
<tr>
<td>$R_{DS(on)}$</td>
<td>drain-source on-state resistance</td>
<td>$V_{GS} = 15 V; I_0 = 40 A; T_j = 25 ^\circ C$</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>mΩ</td>
<td></td>
</tr>
<tr>
<td>$R_{G}$</td>
<td>gate resistance</td>
<td>$f = 1 MHz; T_j = 25 ^\circ C$</td>
<td>-</td>
<td>0.8</td>
<td>-</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>$g_{ds}$</td>
<td>transconductance</td>
<td>$V_{DS} = 20 V; I_0 = 40 A; T_j = 25 ^\circ C$</td>
<td>-</td>
<td>27</td>
<td>-</td>
<td>S</td>
<td></td>
</tr>
</tbody>
</table>

#### Static characteristics

- **Symbol**: $V_{BRDSS}$
- **Parameter**: Drain-source breakdown voltage
- **Conditions**: $I_0 = 100 \mu A; V_{GS} = 0 V; T_j = 25 ^\circ C$
- **Notes**: Min: 1200, Typ: - , Max: - , Unit: V

- **Symbol**: $V_{GS(th)}$
- **Parameter**: Gate-source threshold voltage
- **Conditions**: $I_0 = 12 mA; V_{DS} = 10 V; T_j = 25 ^\circ C$
- **Notes**: Min: 1.9, Typ: 2.6, Max: 3.5, Unit: V

- **Symbol**: $I_{DSS}$
- **Parameter**: Drain leakage current
- **Conditions**: $V_{DS} = 1200 V; V_{GS} = 0 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 0.2, Max: 100, Unit: μA

- **Symbol**: $I_{GSS}$
- **Parameter**: Gate leakage current
- **Conditions**: $V_{GS} = 24 V; V_{DS} = 0 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 10, Max: 100, Unit: nA

- **Symbol**: $R_{DS(on)}$
- **Parameter**: Drain-source on-state resistance
- **Conditions**: $V_{GS} = 15 V; I_0 = 40 A; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 30, Max: - , Unit: mΩ

#### Dynamic characteristics

- **Symbol**: $Q_{G(total)}$
- **Parameter**: Total gate charge
- **Conditions**: $I_0 = 40 A; V_{DS} = 800 V; V_{GS} = -4 V/18 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 151, Max: - , Unit: nC

- **Symbol**: $Q_{GS}$
- **Parameter**: Gate-source charge
- **Conditions**: $I_0 = 40 A; V_{DS} = 800 V; V_{GS} = -4 V/18 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 63, Max: - , Unit: nC

- **Symbol**: $Q_{GD}$
- **Parameter**: Gate-drain charge
- **Conditions**: $I_0 = 40 A; V_{DS} = 800 V; V_{GS} = -4 V/18 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 21, Max: - , Unit: nC

- **Symbol**: $C_{iss}$
- **Parameter**: Input capacitance
- **Conditions**: $V_{GS} = 1000 V; V_{DS} = 0 V; f = 1 MHz; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 3305, Max: - , Unit: pF

- **Symbol**: $C_{oss}$
- **Parameter**: Output capacitance
- **Conditions**: $V_{GS} = -12 V; V_{DS} = 0 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 139, Max: - , Unit: pF

- **Symbol**: $E_{oss}$
- **Parameter**: Coss stored energy
- **Conditions**: $V_{GS} = 800 V; V_{DS} = -4 V/18 V; V_{GS(th)} = 2.4 \Omega; I_0 = 40 A; L = 100 \mu H; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 69.5, Max: - , Unit: μJ

- **Symbol**: $t_{on}$
- **Parameter**: Turn-on delay time
- **Conditions**: $V_{GS} = 800 V; V_{DS} = -4 V/18 V; V_{GS(th)} = 2.4 \Omega; I_0 = 40 A; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 7, Max: - , Unit: ns

- **Symbol**: $E_{on}$
- **Parameter**: Turn-on energy (SiC Diode FWD)
- **Conditions**: $V_{GS} = 800 V; V_{DS} = -4 V/18 V; V_{GS(th)} = 2.4 \Omega; I_0 = 40 A; L = 100 \mu H; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 248, Max: - , Unit: μJ

- **Symbol**: $E_{off}$
- **Parameter**: Turn-off energy (SiC Diode FWD)
- **Conditions**: $V_{GS} = 800 V; V_{DS} = -4 V/18 V; V_{GS(th)} = 2.4 \Omega; I_0 = 40 A; L = 100 \mu H; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 172, Max: - , Unit: μJ

- **Symbol**: $E_{on}$
- **Parameter**: Turn-on energy (Body Diode FWD)
- **Conditions**: $V_{GS} = 800 V; V_{DS} = -4 V/18 V; V_{GS(th)} = 2.4 \Omega; I_0 = 40 A; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 303, Max: - , Unit: μJ

- **Symbol**: $E_{off}$
- **Parameter**: Turn-off energy (Body Diode FWD)
- **Conditions**: $V_{GS} = 800 V; V_{DS} = -4 V/18 V; V_{GS(th)} = 2.4 \Omega; I_0 = 40 A; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 219, Max: - , Unit: μJ

#### Source-drain diode

- **Symbol**: $V_{SD}$
- **Parameter**: Source-drain voltage
- **Conditions**: $V_{DS} = 0 V; I_{SD} = 20 A; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 3.1, Max: - , Unit: V

- **Symbol**: $t_{rr}$
- **Parameter**: Reverse recovery time
- **Conditions**: $I_{SD} = 40 A; di/dt = 500 A/μs; V_{DS} = 400 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 33.4, Max: - , Unit: ns

- **Symbol**: $Q_r$
- **Parameter**: Recovered charge
- **Conditions**: $I_{SD} = 40 A; di/dt = 500 A/μs; V_{DS} = 400 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 129, Max: - , Unit: nC

- **Symbol**: $I_{rrm}$
- **Parameter**: Reverse recovery current
- **Conditions**: $I_{SD} = 40 A; di/dt = 500 A/μs; V_{DS} = 400 V; T_j = 25 ^\circ C$
- **Notes**: Min: - , Typ: 6.9, Max: - , Unit: A
Fig. 4. Output characteristics; drain current as a function of drain-source voltage; typical values

Fig. 5. Output characteristics; drain current as a function of drain-source voltage; typical values

Fig. 6. Output characteristics; drain current as a function of drain-source voltage; typical values

Fig. 7. Drain-source on-state resistance as a function of drain current; typical values
Fig. 8. Drain-source on-state resistance as a function of junction temperature

\[ I_{DS} = 40 \, \text{A}; \quad t_p < 200 \, \mu\text{s} \]

Fig. 9. Transfer characteristics; drain current as a function of gate-source voltage; typical values

\( V_{DS} = 20 \, \text{V}; \quad t_p < 200 \, \mu\text{s} \)

1. \( T_j = 175 \, ^\circ\text{C} \)
2. \( T_j = 25 \, ^\circ\text{C} \)
3. \( T_j = -55 \, ^\circ\text{C} \)

Fig. 10. Body diode forward characteristics; typical values

\( T_j = -55 \, ^\circ\text{C}; \quad t_p < 200 \, \mu\text{s} \)

Fig. 11. Body diode forward characteristics; typical values

\( T_j = 25 \, ^\circ\text{C}; \quad t_p < 200 \, \mu\text{s} \)
Fig. 12. Body diode forward characteristics; typical values

\[ T_j = 175 \, ^\circ\text{C}; \, t_{pd} < 200 \, \mu\text{s} \]

Fig. 13. Threshold voltage as a function of junction temperature

\[ V_{DS} = 10 \, \text{V}; \, I_{DS} = 12 \, \text{mA} \]

Fig. 14. Gate-source voltage as a function of gate charge; typical values

\[ I_{DS} = 40 \, \text{A}; \, I_{GS} = 0.1 \, \text{mA}; \, V_{DS} = 800 \, \text{V}; \, T_j = 25 \, ^\circ\text{C} \]

Fig. 15. Output capacitor stored energy as a function of drain-source voltage

\[ E_{C\text{ES}} = 80 \, \mu\text{J}; \, V_{DS} = 1000 \, \text{V} \]
$V_{DS} = 0 \text{ to } 1000 \text{ V}$

$T_J = 25 \degree C; V_{AC} = 25 \text{ mV}; f = 1 \text{ MHz}$

**Fig. 16.** Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values

$T_J = 25 \degree C; D = 0$

**Fig. 17.** Forward bias safe operating area

$T_J = 25 \degree C; V_{DD} = 800 \text{ V}; R_{G(ext)} = 2.4 \text{ } \Omega$

$V_{GS} = -4 \text{ V/18 V}; L = 100 \text{ } \mu\text{H}$

**Fig. 18.** Clamped Inductive Switching Energy as a function of drain current

$T_J = 25 \degree C; V_{DD} = 600 \text{ V}; R_{G(ext)} = 2.4 \text{ } \Omega$

$V_{GS} = -4 \text{ V/18 V}; L = 100 \text{ } \mu\text{H}$

**Fig. 19.** Clamped Inductive Switching Energy as a function of drain current
Fig. 20. Clamped Inductive Switching Energy as a function of junction temperature

\[ T_j = 25 \, ^\circ\text{C}; \, V_{DD} = 800 \, \text{V}; \, I_{DS} = 40 \, \text{A}; \, V_{GS} = -4 \, \text{V}/18 \, \text{V} \]

\[ \text{FWD} = \text{WNSC2M30120R}; \, L = 100 \, \mu\text{H} \]

Fig. 21. Clamped Inductive Switching Energy as a function of external gate resistance

\[ T_j = 25 \, ^\circ\text{C}; \, V_{DD} = 800 \, \text{V}; \, I_{DS} = 40 \, \text{A}; \, V_{GS} = -4 \, \text{V}/18 \, \text{V} \]

\[ \text{FWD} = \text{WNSC2M30120R}; \, L = 100 \, \mu\text{H} \]

Fig. 22. Switching time as a function of external gate resistance

\[ T_j = 25 \, ^\circ\text{C}; \, V_{DD} = 800 \, \text{V}; \, I_{DS} = 40 \, \text{A}; \, V_{GS} = -4 \, \text{V}/18 \, \text{V} \]

\[ \text{FWD} = \text{WNSC2M30120R}; \, L = 100 \, \mu\text{H} \]

Fig. 23. Switching time definition
11. Package outline

Plastic single-ended through-hole package; heatsink mounted; 1 mounting hole; 4 leads TO-247

Note:
1. Metal exposed with Sn plating.
2. All dimensions do not include mold flash & gate remain.

| UNIT | A | A1 | A2 | b | b1 | c | D | D1 | D2 | D3 | E | E1 | e | e1 | ØP | P1 | L | S |
|------|---|----|----|---|----|---|---|----|----|----|---|----|---|----|-----|----|----|---|---|
| MAX  | 5.10 | 2.51 | 2.10 | 1.30 | 1.80 | 0.70 | 21.10 | 16.85 | 1.35 | 25.27 | 15.90 | 13.50 | 2.64 | 2.54 | 5.18 | 5.08 | 20.10 | 3.70 | (7.40) | (6.15) |
| NOM  | 4.90 | 2.31 | 1.90 | 1.10 | 1.10 | 0.50 | 20.90 | 16.25 | 1.05 | 24.97 | 15.70 | 13.10 | 2.64 | 2.54 | 5.08 | 4.98 | 19.80 | 3.50 | - | |

Note:
1. Metal exposed with Sn plating.
2. All dimensions do not include mold flash & gate remain.
12. Legal information

Data sheet status

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<th>Document status</th>
<th>Product status</th>
<th>Definition</th>
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<td>Development</td>
<td>This document contains data from the objective specification for product development.</td>
</tr>
<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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13. 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. Ordering information .................................................... 2
8. Limiting values ............................................................ 3
9. Thermal & Mechanical characteristics ......................... 4
10. Characteristics ............................................................ 5
11. Package outline .......................................................... 11
12. Legal information ........................................................ 12
13. Contents .................................................................... 14

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For sales office addresses, please send an email to: salesaddresses@ween-semi.com
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