# fastPACK E2 SiC

<table>
<thead>
<tr>
<th>Features</th>
<th>1200 V / 16 mΩ</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Compact and low inductive design</td>
<td></td>
</tr>
<tr>
<td>• High frequency SiC MOSFET</td>
<td></td>
</tr>
<tr>
<td>• Integrated NTC</td>
<td></td>
</tr>
</tbody>
</table>

## Target applications

- Charging Stations
- Power Supply
- Welding & Cutting

## Types

- 10-EY124PA016ME-LP49F18T

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**Schematic**

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### Maximum Ratings

$T_j = 25 \, ^\circ C$, unless otherwise specified

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H-Bridge Switch - Lo side</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain-source voltage</td>
<td>$V_{DSS}$</td>
<td></td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Drain current</td>
<td>$I_D$</td>
<td>$T_j = T_{j\text{max}}$, $T_i = 80 , ^\circ C$</td>
<td>71</td>
<td>A</td>
</tr>
<tr>
<td>Peak drain current</td>
<td>$I_{D\text{int}}$</td>
<td>$I_t$ limited by $T_{j\text{max}}$</td>
<td>240</td>
<td>A</td>
</tr>
<tr>
<td>Total power dissipation</td>
<td>$P_{tot}$</td>
<td>$T_j = T_{j\text{max}}$, $T_i = 80 , ^\circ C$</td>
<td>126</td>
<td>W</td>
</tr>
<tr>
<td>Gate-source voltage</td>
<td>$V_{GSS}$</td>
<td></td>
<td>-4 / 15</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j\text{max}}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td><strong>H-Bridge Switch - Hi side</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drain-source voltage</td>
<td>$V_{DSS}$</td>
<td></td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>Drain current</td>
<td>$I_D$</td>
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<td>$T_j = T_{j\text{max}}$, $T_i = 80 , ^\circ C$</td>
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</tr>
<tr>
<td>Gate-source voltage</td>
<td>$V_{GSS}$</td>
<td></td>
<td>-4 / 15</td>
<td>V</td>
</tr>
<tr>
<td>Maximum Junction Temperature</td>
<td>$T_{j\text{max}}$</td>
<td></td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Module Properties**

**Thermal Properties**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage temperature</td>
<td>$T_{stg}$</td>
<td></td>
<td>-40...+125</td>
<td>°C</td>
</tr>
<tr>
<td>Operation temperature under switching condition</td>
<td>$T_{op}$</td>
<td></td>
<td>-40...$(T_{j\text{max}} - 25)$</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Isolation Properties**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation voltage</td>
<td>$V_{isol}$</td>
<td>DC Test Voltage*, $t_i = 2 , s$</td>
<td>6000</td>
<td>V</td>
</tr>
<tr>
<td>Isolation voltage</td>
<td>$V_{isol}$</td>
<td>AC Voltage, $t_i = 1 , \text{min}$</td>
<td>2500</td>
<td>V</td>
</tr>
<tr>
<td>Creepage distance</td>
<td></td>
<td></td>
<td>min. 12,7</td>
<td>mm</td>
</tr>
<tr>
<td>Clearance</td>
<td></td>
<td></td>
<td>9,14</td>
<td>mm</td>
</tr>
<tr>
<td>Comparative Tracking Index</td>
<td>CTI</td>
<td></td>
<td>≥ 600</td>
<td></td>
</tr>
</tbody>
</table>

*100 % tested in production
# Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drain-source on-state resistance</td>
<td>$r_{DS(on)}$</td>
<td>15</td>
<td>80</td>
<td>25, 125, 150</td>
</tr>
<tr>
<td>Gate-source threshold voltage</td>
<td>$V_{GS(th)}$</td>
<td>0</td>
<td>0,02</td>
<td>25</td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>$I_{GSS}$</td>
<td>15</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>$I_{DSS}$</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>$r_{g}$</td>
<td>0</td>
<td>85</td>
<td>Ω</td>
</tr>
<tr>
<td>Gate charge</td>
<td>$Q_{g}$</td>
<td>-4/15</td>
<td>800</td>
<td>80</td>
</tr>
<tr>
<td>Short-circuit input capacitance</td>
<td>$C_{iss}$</td>
<td>0</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>Short-circuit output capacitance</td>
<td>$C_{oss}$</td>
<td>$f = 100$ kHz</td>
<td>150</td>
<td>258</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>$C_{rss}$</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diode forward voltage</td>
<td>$V_{F}$</td>
<td>0</td>
<td>40</td>
<td>25</td>
</tr>
</tbody>
</table>

## Thermal

**Thermal resistance junction to sink**<sup>*</sup>  $R_{th(j-s)}$ ≤ 3,4 W/mK (PSX)  0,75  K/W

<sup>*</sup>Only valid with pre-applied Vincotech thermal interface material.

## Dynamic

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn-on delay time</td>
<td>$t_{d(on)}$</td>
<td>25</td>
<td>125, 150</td>
<td>19,84, 18,88, 18,56</td>
</tr>
<tr>
<td>Rise time</td>
<td>$t_{r}$</td>
<td>$R_{on} = 2$ Ω, $R_{off} = 2$ Ω</td>
<td>25</td>
<td>125, 150</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>$t_{d(off)}$</td>
<td>$R_{on} = 2$ Ω, $R_{off} = 2$ Ω</td>
<td>25</td>
<td>125, 150</td>
</tr>
<tr>
<td>Fall time</td>
<td>$t_{f}$</td>
<td>-4/15</td>
<td>600</td>
<td>64</td>
</tr>
<tr>
<td>Turn-on energy (per pulse)</td>
<td>$E_{on}$</td>
<td>$\Delta FWD=0,776$ µC</td>
<td>25</td>
<td>125, 150</td>
</tr>
<tr>
<td>Turn-off energy (per pulse)</td>
<td>$E_{off}$</td>
<td>$\Delta FWD=1,06$ µC</td>
<td>25</td>
<td>125, 150</td>
</tr>
</tbody>
</table>
# Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainsource on-state resistance</td>
<td>( r_{DS(on)} )</td>
<td>15</td>
<td>80</td>
<td>25</td>
</tr>
<tr>
<td>Gate-source threshold voltage</td>
<td>( V_{GS(th)} )</td>
<td>0</td>
<td>0,02</td>
<td>25</td>
</tr>
<tr>
<td>Gate to Source Leakage Current</td>
<td>( I_{oss} )</td>
<td>15</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Zero Gate Voltage Drain Current</td>
<td>( I_{GSS} )</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Internal gate resistance</td>
<td>( r_g )</td>
<td>-4/15</td>
<td>800</td>
<td>80</td>
</tr>
<tr>
<td>Short-circuit input capacitance</td>
<td>( C_{iss} )</td>
<td>0</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>Short-circuit output capacitance</td>
<td>( C_{oss} )</td>
<td>0</td>
<td>150</td>
<td>0</td>
</tr>
<tr>
<td>Reverse transfer capacitance</td>
<td>( C_{rss} )</td>
<td>16</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Diode forward voltage</td>
<td>( V_{SD} )</td>
<td>0</td>
<td>40</td>
<td>25</td>
</tr>
</tbody>
</table>

## Static

**Thermal**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal resistance junction to sink*</td>
<td>( R_{th(j-s)} )</td>
<td>λ = 3,4 W/mK (PSX)</td>
<td>0,75</td>
<td>K/W</td>
</tr>
</tbody>
</table>

*Only valid with pre-applied Vincotech thermal interface material.

## Dynamic

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn-on delay time</td>
<td>( t_{on} )</td>
<td>-4/15</td>
<td>600</td>
<td>64</td>
</tr>
<tr>
<td>Rise time</td>
<td>( t_r )</td>
<td>( R_{on} = 2 \Omega ) ( R_{off} = 2 \Omega )</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>( t_{off} )</td>
<td>-4/15</td>
<td>600</td>
<td>64</td>
</tr>
<tr>
<td>Fall time</td>
<td>( t_f )</td>
<td>( R_{on} = 2 \Omega ) ( R_{off} = 2 \Omega )</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-on energy (per pulse)</td>
<td>( E_{on} )</td>
<td>( ΔP_{on} = 0,776 \mu C ) ( ΔP_{on} = 1,06 \mu C ) ( ΔP_{on} = 1,17 \mu C )</td>
<td>25</td>
<td>125</td>
</tr>
<tr>
<td>Turn-off energy (per pulse)</td>
<td>( E_{off} )</td>
<td>( ΔP_{off} )</td>
<td>25</td>
<td>125</td>
</tr>
</tbody>
</table>
## Characteristic Values

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{GE}$</td>
<td>$V$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{GS}$</td>
<td>$V$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{CE}$</td>
<td>$V$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{DS}$</td>
<td>$V$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$V_{F}$</td>
<td>$V$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{C}$</td>
<td>$A$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{D}$</td>
<td>$A$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$I_{F}$</td>
<td>$A$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T_{j}$</td>
<td>$[°C]$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Thermistor

#### Static

<table>
<thead>
<tr>
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<th>Symbol</th>
<th>Conditions</th>
<th>Values</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated resistance</td>
<td>$R$</td>
<td></td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Deviation of $R_{Th}$</td>
<td>$\Delta R$</td>
<td>$R_{Th} = 493 \Omega$</td>
<td>100</td>
<td>-5</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>$P$</td>
<td></td>
<td>245</td>
<td>mW</td>
</tr>
<tr>
<td>Power dissipation constant</td>
<td>$d$</td>
<td></td>
<td>25</td>
<td>1.4</td>
</tr>
<tr>
<td>B-value</td>
<td>$B_{25/50}$</td>
<td>Tol. ±2 %</td>
<td>3375</td>
<td>K</td>
</tr>
<tr>
<td>B-value</td>
<td>$B_{25/100}$</td>
<td>Tol. ±2 %</td>
<td>3437</td>
<td>K</td>
</tr>
</tbody>
</table>

Vincotech Thermistor Reference: K
H-Bridge Switch - Lo side Characteristics

**Figure 1.**
Typical output characteristics

\[ I_D = f(V_{DS}) \]

- \( t_p = 250 \mu s \)
- \( I_T = 14 \) V
- \( T_j \): 25 °C, 125 °C, 150 °C

**Figure 2.**
Typical output characteristics

\[ I_D = f(V_{DS}) \]

- \( t_p = 250 \mu s \)
- \( V_GS \): from -20 V to 20 V in steps of 2 V
- \( V_{DS} \):
  - -20 V
  - -18 V
  - -16 V
  - -14 V
  - -12 V
  - -10 V
  - -8 V
  - -6 V
  - -4 V
  - -2 V
  - 0 V
  - 2 V
  - 4 V
  - 6 V
  - 8 V
  - 10 V
  - 12 V
  - 14 V
  - 16 V
  - 18 V
  - 20 V

**Figure 3.**
Typical transfer characteristics

\[ I_D = f(V_{GS}) \]

- \( t_p = 250 \mu s \)
- \( V_{DS} = 10 \) V
- \( T_j \): 25 °C, 125 °C, 150 °C

**Figure 4.**
Transient thermal impedance as a function of pulse width

\[ Z_{th}(s) = f(t_p) \]

- \( D = \frac{t_p}{T} \)
- \( R_{th} = 0.752 \) K/W

IGBT thermal model values

\[ R (K/W) \quad t (s) \]

- 5.19E-02 2.61E+00
- 9.26E-02 5.45E-01
- 3.53E-01 9.51E-02
- 1.55E-01 2.37E-02
- 6.57E-02 3.84E-03
- 3.38E-02 5.95E-04
H-Bridge Switch - Lo side Characteristics

Figure 5. MOSFET Safe operating area

\[ I_C = f(V_{CE}) \]

\( D = \) single pulse

\( T_s = 80 \, ^\circ C \)

\( V_{GE} = 14 \, V \)

\( T_j = T_{j_{max}} \)
H-Bridge Switch - Hi side Characteristics

Figure 6. MOSFET
Typical output characteristics

\[ I_D = f(V_{DS}) \]
\[ t_{p} = 250 \, \mu s \]
\[ V_{GS} = 14 \, V \]

Figure 7. MOSFET
Typical output characteristics

\[ I_D = f(V_{DS}) \]
\[ t_{p} = 250 \, \mu s \]
\[ V_{GS} = 14 \, V \]
\[ T_j = 150 \, ^\circ C \]

VGS from -20 V to 20 V in steps of 2 V

Figure 8. MOSFET
Typical transfer characteristics

\[ I_D = f(V_{GS}) \]
\[ t_{p} = 250 \, \mu s \]
\[ V_{DS} = 10 \, V \]

Figure 9. MOSFET
Transient thermal impedance as a function of pulse width

\[ Z_{th(j-s)} = f(t_{p}) \]
\[ D = \frac{t_{p}}{T} \]
\[ R_{th(j-s)} = 0.752 \, K/W \]

IGBT thermal model values

\[ R \, (K/W) \quad \tau \, (s) \]
5.19E-02 2.61E-01
9.26E-02 5.45E-01
3.53E-01 9.51E-02
1.55E-01 2.37E-02
6.57E-02 3.84E-03
3.38E-02 5.95E-04
H-Bridge Switch - Hi side Characteristics

Figure 10. MOSFET Safe operating area

\[ I_C = f(V_{CE}) \]

\[ D = \text{single pulse} \]

\[ T_s = 80 \degree C \]

\[ V_{GE} = 14 \text{ V} \]

\[ T_j = T_{j\text{max}} \]
H-Bridge Switching Characteristics - Lo side

**Figure 11.**
MOSFET
Typical switching energy losses as a function of drain current

$$E = f(I_D)$$

With an inductive load at:
- $V_{DS} = 600 \text{ V}$
- $V_{GS} = -\frac{4}{15} \text{ V}$
- $R_{gon} = 2 \text{ Ω}$
- $R_{goff} = 2 \text{ Ω}$
- $T_j$: 25 °C, 125 °C, 150 °C

**Figure 12.**
MOSFET
Typical switching energy losses as a function of gate resistor

$$E = f(R_g)$$

With an inductive load at:
- $V_{DS} = 600 \text{ V}$
- $V_{GS} = -\frac{4}{15} \text{ V}$
- $I_D = 64 \text{ A}$
- $T_j$: 25 °C, 125 °C, 150 °C

**Figure 13.**
MOSFET
Typical reverse recovery energy loss as a function of drain current

$$E_{rec} = f(I_D)$$

With an inductive load at:
- $V_{DS} = 600 \text{ V}$
- $V_{GS} = -\frac{4}{15} \text{ V}$
- $R_{gon} = 2 \text{ Ω}$
- $T_j$: 25 °C, 125 °C, 150 °C

**Figure 14.**
MOSFET
Typical reverse recovery energy loss as a function of gate resistor

$$E_{rec} = f(R_g)$$

With an inductive load at:
- $V_{DS} = 600 \text{ V}$
- $V_{GS} = -\frac{4}{15} \text{ V}$
- $I_D = 64 \text{ A}$
- $T_j$: 25 °C, 125 °C, 150 °C
H-Bridge Switching Characteristics - Lo side

**Figure 15.** MOSFET
Typical switching times as a function of drain current

$t = f(I_D)$

With an inductive load at

- $V_{DS} = 600 \, \text{V}$
- $V_{GS} = -4/15 \, \text{V}$
- $R_{gon} = 2 \, \Omega$
- $R_{goff} = 2 \, \Omega$
- $T_j = 150 \, ^\circ\text{C}$

**Figure 16.** MOSFET
Typical switching times as a function of gate resistor

$t = f(R_g)$

With an inductive load at

- $V_{DS} = 600 \, \text{V}$
- $V_{GS} = -4/15 \, \text{V}$
- $I_D = 64 \, \text{A}$
- $T_j = 150 \, ^\circ\text{C}$

**Figure 17.** MOSFET
Typical reverse recovery time as a function of drain current

$t_{rr} = f(I_D)$

At

- $V_{DS} = 600 \, \text{V}$
- $V_{GS} = -4/15 \, \text{V}$
- $R_{gon} = 2 \, \Omega$

- $T_j = 25 \, ^\circ\text{C}$
- $T_j = 125 \, ^\circ\text{C}$
- $T_j = 150 \, ^\circ\text{C}$

**Figure 18.** MOSFET
Typical reverse recovery time as a function of turn on gate resistor

$t_{rr} = f(R_{gon})$

At

- $V_{DS} = 600 \, \text{V}$
- $V_{GS} = -4/15 \, \text{V}$
- $I_D = 64 \, \text{A}$

- $T_j = 25 \, ^\circ\text{C}$
- $T_j = 125 \, ^\circ\text{C}$
- $T_j = 150 \, ^\circ\text{C}$
H-Bridge Switching Characteristics - Lo side

Figure 19. MOSFET
Typical recovered charge as a function of drain current
\( Q_r = f(I_D) \)

Figure 20. MOSFET
Typical recovered charge as a function of turn on gate resistor
\( Q_r = f(R_{gon}) \)

Figure 21. MOSFET
Typical peak reverse recovery current as a function of drain current
\( I_{RM} = f(I_D) \)

Figure 22. MOSFET
Typical peak reverse recovery current as a function of turn on gate resistor
\( I_{RM} = f(R_{gon}) \)
H-Bridge Switching Characteristics - Lo side

Figure 23. MOSFET
Typical rate of fall of forward and reverse recovery current as a function of drain current
\( \frac{di}{dt}, \frac{di_{rr}}{dt} = f(I_D) \)

\[
\begin{align*}
\text{At } & V_{GS} = 600 \text{ V} \\
& V_{DS} = -4/15 \text{ V} \\
& R_{xon} = 2 \Omega \\
& R_{xoff} = 2 \Omega \\
& T_j: 25 \text{ °C}, 125 \text{ °C}, 150 \text{ °C}
\end{align*}
\]

Figure 24. MOSFET
Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor
\( \frac{di}{dt}, \frac{di_{rr}}{dt} = f(R_{gon}) \)

\[
\begin{align*}
\text{At } & V_{GS} = 600 \text{ V} \\
& V_{DS} = -4/15 \text{ V} \\
& I_D = 64 \text{ A} \\
& T_j: 25 \text{ °C}, 125 \text{ °C}, 150 \text{ °C}
\end{align*}
\]

Figure 25. MOSFET
Reverse bias safe operating area
\( I_D = f(V_{ds}) \)

\[
\begin{align*}
\text{At } & T_j = 150 \text{ °C} \\
& R_{xoff} = 2 \Omega \\
& R_{xon} = 2 \Omega
\end{align*}
\]
H-Bridge Switching Characteristics - Hi side

Figure 26. MOSFET
Typical switching energy losses as a function of drain current

\[ E = f(I_D) \]

With an inductive load at

- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( R_{gon} = 2 \) Ω
- \( R_{goff} = 2 \) Ω
- \( T_j: 25 \) °C, 125 °C, 150 °C

Figure 27. MOSFET
Typical switching energy losses as a function of gate resistor

\[ E = f(R_g) \]

With an inductive load at

- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( I_D = 64 \) A
- \( T_j: 25 \) °C, 125 °C, 150 °C

Figure 28. MOSFET
Typical reverse recovered energy loss as a function of drain current

\[ E_{rec} = f(I_D) \]

With an inductive load at

- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( R_{gon} = 2 \) Ω

Figure 29. MOSFET
Typical reverse recovered energy loss as a function of gate resistor

\[ E_{rec} = f(R_g) \]

With an inductive load at

- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( I_D = 64 \) A
- \( T_j: 25 \) °C, 125 °C, 150 °C
H-Bridge Switching Characteristics - Hi side

Figure 30. MOSFET
Typical switching times as a function of drain current

$t = f(I_D)$

With an inductive load at
- $V_{DS} = 600$ V
- $V_{GS} = -4/15$ V
- $R_{gon} = 2$ Ω
- $R_{goff} = 2$ Ω
- $T_j = 150$ °C

Figure 31. MOSFET
Typical switching times as a function of gate resistor

$t = f(R_g)$

With an inductive load at
- $V_{DS} = 600$ V
- $V_{GS} = -4/15$ V
- $I_D = 64$ A
- $T_j = 150$ °C

Figure 32. MOSFET
Typical reverse recovery time as a function of drain current

$\tau_{rr} = f(I_D)$

At $V_{DS} = 600$ V
- $V_{GS} = -4/15$ V
- $R_{gon} = 2$ Ω

Figure 33. MOSFET
Typical reverse recovery time as a function of turn on gate resistor

$\tau_{rr} = f(R_{gon})$

At $V_{DS} = 600$ V
- $V_{GS} = -4/15$ V
- $I_D = 64$ A

Copyright Vincotech
**H-Bridge Switching Characteristics - Hi side**

**Figure 34. MOSFET**
Typical recovered charge as a function of drain current

\[ Q_r = f(I_D) \]

<table>
<thead>
<tr>
<th>( Q_r (\mu C) )</th>
<th>0</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>100</th>
<th>125</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_D (A) )</td>
<td>0</td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>125</td>
</tr>
</tbody>
</table>

Conditions:
- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( R_{gon} = 2 \) Ω

**Figure 35. MOSFET**
Typical recovered charge as a function of turn on gate resistor

\[ Q_r = f(R_{gon}) \]

<table>
<thead>
<tr>
<th>( Q_r (\mu C) )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{gon} (\Omega) )</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Conditions:
- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( I_D = 64 \) A

**Figure 36. MOSFET**
Typical peak reverse recovery current as a function of drain current

\[ I_{RM} = f(I_D) \]

<table>
<thead>
<tr>
<th>( I_{RM} (A) )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_D (A) )</td>
<td>0</td>
<td>25</td>
<td>50</td>
<td>75</td>
<td>100</td>
<td>125</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Conditions:
- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( R_{gon} = 2 \) Ω

**Figure 37. MOSFET**
Typical peak reverse recovery current as a function of turn on gate resistor

\[ I_{RM} = f(R_{gon}) \]

<table>
<thead>
<tr>
<th>( I_{RM} (A) )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{gon} (\Omega) )</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

Conditions:
- \( V_{DS} = 600 \) V
- \( V_{GS} = -4/15 \) V
- \( I_D = 64 \) A
H-Bridge Switching Characteristics - Hi side

**Figure 38.** MOSFET
Typical rate of fall of forward and reverse recovery current as a function of drain current
\(\frac{di}{dt}, \frac{d_{irr}}{dt} = f(I_D)\)

<table>
<thead>
<tr>
<th>di/dt (A/μs)</th>
<th>ID (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>125</td>
</tr>
</tbody>
</table>

At
- \(V_{DS} = 600\) V
- \(V_G = -4/15\) V
- \(T_j = 25\) °C
- \(T_j = 125\) °C
- \(T_j = 150\) °C

**Figure 39.** MOSFET
Typical rate of fall of forward and reverse recovery current as a function of turn on gate resistor
\(\frac{di}{dt}, \frac{d_{irr}}{dt} = f(R_{gon})\)

<table>
<thead>
<tr>
<th>di/dt (A/μs)</th>
<th>R_{gon} (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
</tr>
</tbody>
</table>

At
- \(V_{DS} = 600\) V
- \(V_G = -4/15\) V
- \(I_D = 64\) A
- \(T_j = 25\) °C
- \(T_j = 125\) °C
- \(T_j = 150\) °C

**Figure 40.** MOSFET
Reverse bias safe operating area
\(I_D = f(V_{DS})\)

<table>
<thead>
<tr>
<th>ID (A)</th>
<th>V_{DS} (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>100</td>
<td>125</td>
</tr>
<tr>
<td>125</td>
<td>150</td>
</tr>
</tbody>
</table>

At
- \(T_j = 150\) °C
- \(R_{gon} = 2\) Ω
- \(R_{goff} = 2\) Ω
Switching Definitions

**Figure 41.** MOSFET
Turn-off Switching Waveforms & definition of $t_{doff}$, $t_{Eoff}$ ($t_{Eoff} = \text{integrating time for } E_{off}$)

**Figure 42.** MOSFET
Turn-on Switching Waveforms & definition of $t_{don}$, $t_{Eon}$ ($t_{Eon} = \text{integrating time for } E_{on}$)

**Figure 43.** MOSFET
Turn-off Switching Waveforms & definition of $t_f$

**Figure 44.** MOSFET
Turn-on Switching Waveforms & definition of $t_r$
Switching Definitions

Figure 45. Turn-off Switching Waveforms & definition of $t_{rr}$

Figure 46. Turn-on Switching Waveforms & definition of $t_{Qrr} \quad (t_{Qrr} = \text{integrating time for } Q_{rr})$

Figure 47. Turn-on Switching Waveforms & definition of $t_{Erec} \quad (t_{Erec} = \text{integrating time for } E_{rec})$
### Pinout

![Pinout Diagram]

### Identification

<table>
<thead>
<tr>
<th>ID</th>
<th>Component</th>
<th>Voltage</th>
<th>Current</th>
<th>Function</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>T2, T4</td>
<td>MOSFET</td>
<td>1200 V</td>
<td>15 mΩ</td>
<td>H-Bridge Switch - Lo side</td>
<td></td>
</tr>
<tr>
<td>T1, T3</td>
<td>MOSFET</td>
<td>1200 V</td>
<td>16 mΩ</td>
<td>H-Bridge Switch - Hi side</td>
<td></td>
</tr>
<tr>
<td>Rt</td>
<td>Thermistor</td>
<td></td>
<td></td>
<td>Thermistor</td>
<td></td>
</tr>
</tbody>
</table>
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