Dual INT-A-PAK Low Profile “Half Bridge” (Standard Speed IGBT), 400 A

Dual INT-A-PAK Low Profile

PRIMARY CHARACTERISTICS	
V_{CES}	600 V
I_C DC at T_C = 25 °C	750 A
$V_{CE(on)}$ (typical) at 400 A, 25 °C	1.24 V
Speed	DC to 1 kHz
Package	Dual INT-A-PAK low profile
Circuit configuration	Half bridge

FEATURES

- Gen 4 IGBT technology
- Standard: optimized for hard switching speed
- Low $V_{CE(on)}$
- Square RBSOA
- HEXFRED® antiparallel diode with ultrasoft reverse recovery characteristics
- Industry standard package
- Al_2O_3 DBC
- UL approved file E78996
- Designed for industrial level
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

BENEFITS

- Increased operating efficiency
- Performance optimized as output inverter stage for TIG welding machines
- Direct mounting on heatsink
- Very low junction to case thermal resistance

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	TEST CONDITIONS	MAX.	UNITS
Collector to emitter voltage	V_{CES}		600	V
Continuous collector current	I_C (1)	T_C = 25 °C	750	A
		T_C = 80 °C	525	
Pulsed collector current	I_{CM}		1000	
Clamped inductive load current	I_{LM}		1000	
Diode continuous forward current	I_F	T_C = 25 °C	219	
		T_C = 80 °C	145	
Gate to emitter voltage	V_{GE}		± 20	V
Maximum power dissipation (IGBT)	P_D	T_C = 25 °C	1563	W
		T_C = 80 °C	875	
RMS isolation voltage	V_{ISOL}	Any terminal to case (V_{RMS} t = 1 s, T_J = 25 °C)	3500	V

Note

(1) Maximum continuous collector current must be limited to 500 A to do not exceed the maximum temperature of terminals

<table>
<tr><th colspan="7">ELECTRICAL SPECIFICATIONS (T_J = 25 °C unless otherwise specified)</th></tr>
<tr><th>PARAMETER</th><th>SYMBOL</th><th>TEST CONDITIONS</th><th>MIN.</th><th>TYP.</th><th>MAX.</th><th>UNITS</th></tr>
<tr><td>Collector to emitter breakdown voltage</td><td>$V_{BR(CES)}$</td><td>V_{GE} = 0 V, I_C = 500 μA</td><td>600</td><td>-</td><td>-</td><td rowspan="6">V</td></tr>
<tr><td rowspan="4">Collector to emitter voltage</td><td rowspan="4">$V_{CE(on)}$</td><td>V_{GE} = 15 V, I_C = 300 A</td><td>-</td><td>1.14</td><td>1.35</td></tr>
<tr><td>V_{GE} = 15 V, I_C = 400 A</td><td>-</td><td>1.24</td><td>1.52</td></tr>
<tr><td>V_{GE} = 15 V, I_C = 300 A, T_J = 125 °C</td><td>-</td><td>1.08</td><td>1.29</td></tr>
<tr><td>V_{GE} = 15 V, I_C = 400 A, T_J = 125 °C</td><td>-</td><td>1.21</td><td>1.5</td></tr>
<tr><td>Gate threshold voltage</td><td>$V_{GE(th)}$</td><td>V_{CE} = V_{GE}, I_C = 250 μA</td><td>3.0</td><td>4.6</td><td>6.3</td></tr>
<tr><td rowspan="2">Collector to emitter leakage current</td><td rowspan="2">I_{CES}</td><td>V_{GE} = 0 V, V_{CE} = 600 V</td><td>-</td><td>0.075</td><td>1</td><td rowspan="2">mA</td></tr>
<tr><td>V_{GE} = 0 V, V_{CE} = 600 V, T_J = 125 °C</td><td>-</td><td>1.8</td><td>10</td></tr>
<tr><td rowspan="4">Diode forward voltage drop</td><td rowspan="4">V_{FM}</td><td>I_{FM} = 300 A</td><td>-</td><td>1.48</td><td>1.75</td><td rowspan="4">V</td></tr>
<tr><td>I_{FM} = 400 A</td><td>-</td><td>1.63</td><td>1.98</td></tr>
<tr><td>I_{FM} = 300 A, T_J = 125 °C</td><td>-</td><td>1.50</td><td>1.77</td></tr>
<tr><td>I_{FM} = 400 A, T_J = 125 °C</td><td>-</td><td>1.70</td><td>2.04</td></tr>
<tr><td>Gate to emitter leakage current</td><td>I_{GES}</td><td>V_{GE} = ± 20 V</td><td>-</td><td>-</td><td>± 200</td><td>nA</td></tr>
</table>

<table>
<tr><th colspan="7">SWITCHING CHARACTERISTICS (T_J = 25 °C unless otherwise specified)</th></tr>
<tr><th>PARAMETER</th><th>SYMBOL</th><th>TEST CONDITIONS</th><th>MIN.</th><th>TYP.</th><th>MAX.</th><th>UNITS</th></tr>
<tr><td>Turn-on switching loss</td><td>E_{on}</td><td rowspan="3">I_C = 400 A, V_{CC} = 360 V, V_{GE} = 15 V,
R_g = 1.5 Ω, L = 500 μH, T_J = 25 °C</td><td>-</td><td>8.5</td><td>-</td><td rowspan="6">mJ</td></tr>
<tr><td>Turn-off switching loss</td><td>E_{off}</td><td>-</td><td>113</td><td>-</td></tr>
<tr><td>Total switching loss</td><td>E_{tot}</td><td>-</td><td>121.5</td><td>-</td></tr>
<tr><td>Turn-on switching loss</td><td>E_{on}</td><td rowspan="7">I_C = 400 A, V_{CC} = 360 V, V_{GE} = 15 V,
R_g = 1.5 Ω, L = 500 μH, T_J = 125 °C</td><td>-</td><td>21</td><td>-</td></tr>
<tr><td>Turn-off switching loss</td><td>E_{off}</td><td>-</td><td>163</td><td>-</td></tr>
<tr><td>Total switching loss</td><td>E_{tot}</td><td>-</td><td>184</td><td>-</td></tr>
<tr><td>Turn-on delay time</td><td>$t_{d(on)}$</td><td>-</td><td>532</td><td>-</td><td rowspan="4">ns</td></tr>
<tr><td>Rise time</td><td>t_r</td><td>-</td><td>377</td><td>-</td></tr>
<tr><td>Turn-off delay time</td><td>$t_{d(off)}$</td><td>-</td><td>496</td><td>-</td></tr>
<tr><td>Fall time</td><td>t_f</td><td>-</td><td>1303</td><td>-</td></tr>
<tr><td>Reverse bias safe operating area</td><td>RBSOA</td><td>T_J = 150 °C, I_C = 1000 A, V_{CC} = 400 V,
V_P = 600 V, R_g = 22 Ω, V_{GE} = 15 V to 0 V,
L = 500 μH</td><td colspan="3">Fullsquare</td><td></td></tr>
<tr><td>Diode reverse recovery time</td><td>t_{rr}</td><td rowspan="3">I_F = 300 A, dI_F/dt = 500 A/μs,
V_{CC} = 400 V, T_J = 25 °C</td><td>-</td><td>150</td><td>179</td><td>ns</td></tr>
<tr><td>Diode peak reverse current</td><td>I_{rr}</td><td>-</td><td>43</td><td>59</td><td>A</td></tr>
<tr><td>Diode recovery charge</td><td>Q_{rr}</td><td>-</td><td>3.9</td><td>6.3</td><td>μC</td></tr>
<tr><td>Diode reverse recovery time</td><td>t_{rr}</td><td rowspan="3">I_F = 300 A, dI_F/dt = 500 A/μs,
V_{CC} = 400 V, T_J = 125 °C</td><td>-</td><td>236</td><td>265</td><td>ns</td></tr>
<tr><td>Diode peak reverse current</td><td>I_{rr}</td><td>-</td><td>64</td><td>80</td><td>A</td></tr>
<tr><td>Diode recovery charge</td><td>Q_{rr}</td><td>-</td><td>8.6</td><td>11.1</td><td>μC</td></tr>
</table>

<table>
<tr><th colspan="7">THERMAL AND MECHANICAL SPECIFICATIONS</th></tr>
<tr><th colspan="2">PARAMETER</th><th>SYMBOL</th><th>MIN.</th><th>TYP.</th><th>MAX.</th><th>UNITS</th></tr>
<tr><td colspan="2">Operating junction and storage temperature range</td><td>T_J, T_{Stg}</td><td>-40</td><td>-</td><td>150</td><td>°C</td></tr>
<tr><td rowspan="2">Junction to case per leg</td><td>IGBT</td><td rowspan="2">R_{thJC}</td><td>-</td><td>-</td><td>0.08</td><td rowspan="3">°C/W</td></tr>
<tr><td>Diode</td><td>-</td><td>-</td><td>0.4</td></tr>
<tr><td colspan="2">Case to sink per module</td><td>R_{thCS}</td><td>-</td><td>0.05</td><td>-</td></tr>
<tr><td rowspan="2">Mounting torque</td><td>case to heatsink: M6 screw</td><td></td><td>4</td><td>-</td><td>6</td><td rowspan="2">Nm</td></tr>
<tr><td>case to terminal 1, 2, 3: M5 screw</td><td></td><td>2</td><td>-</td><td>5</td></tr>
<tr><td colspan="2">Weight</td><td></td><td>-</td><td>270</td><td>-</td><td>g</td></tr>
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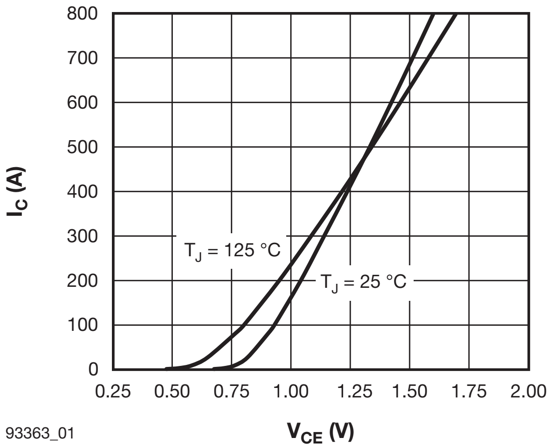


Fig. 1 - Typical Output Characteristics, T_J = 25 °C, V_{GE} = 15 V

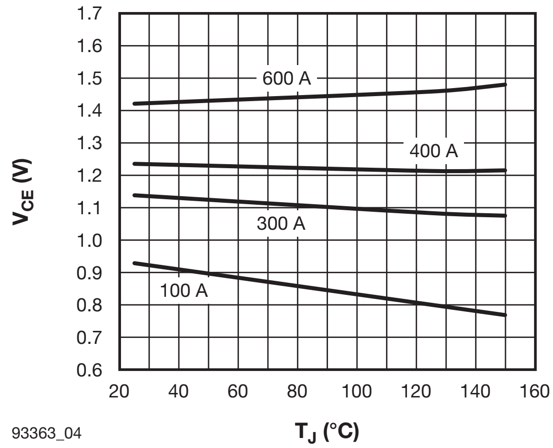


Fig. 4 - Typical IGBT Collector to Emitter Voltage vs. Junction Temperature, V_{GE} = 15 V

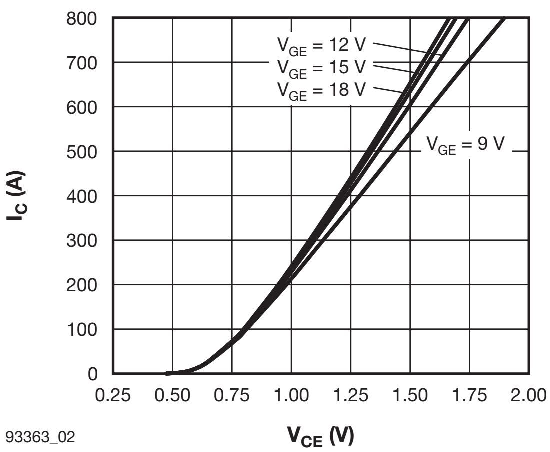


Fig. 2 - Typical Output Characteristics, T_J = 125 °C

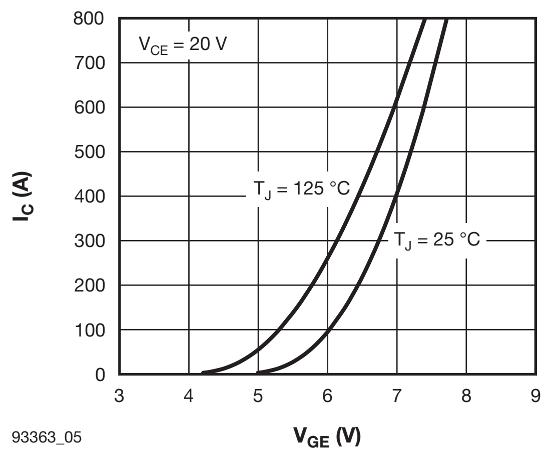


Fig. 5 - Typical IGBT Transfer Characteristics

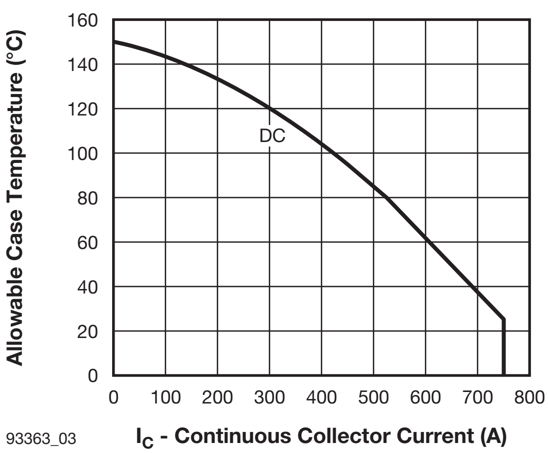


Fig. 3 - Maximum DC IGBT Collector Current vs. Case Temperature

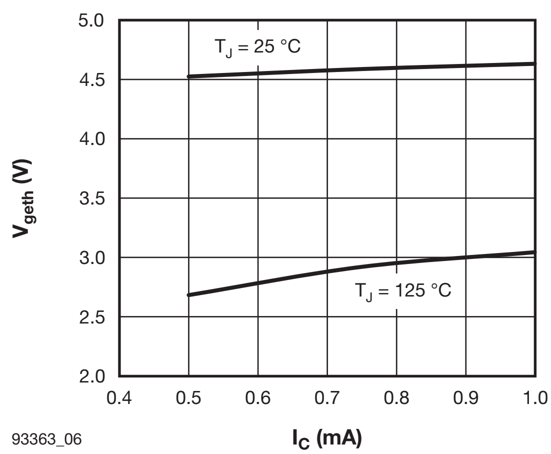


Fig. 6 - Typical IGBT Gate Threshold Voltage

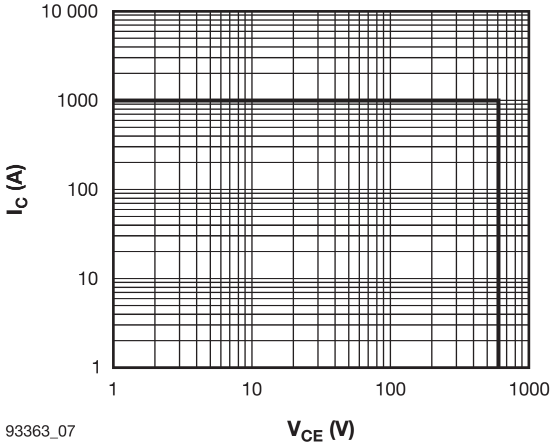


Fig. 7 - IGBT Reverse Bias SOA,
T_J = 150 °C, V_{GE} = 15 V, R_g = 22 Ω

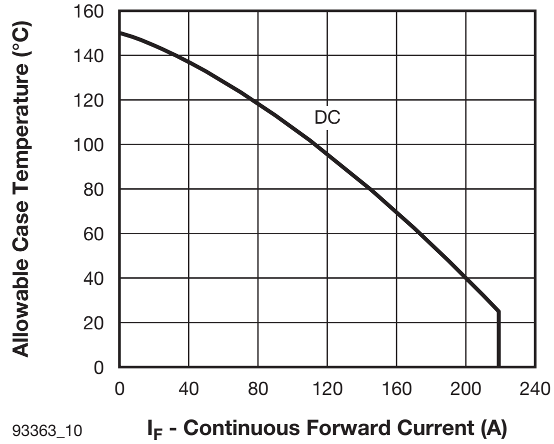


Fig. 10 - Maximum DC Forward Current vs. Case Temperature

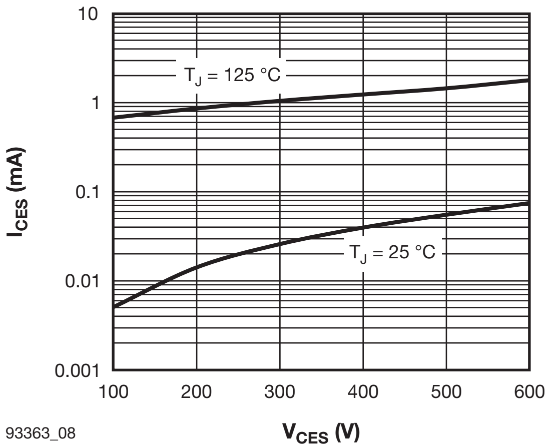


Fig. 8 - Typical IGBT Zero Gate Voltage Collector Current

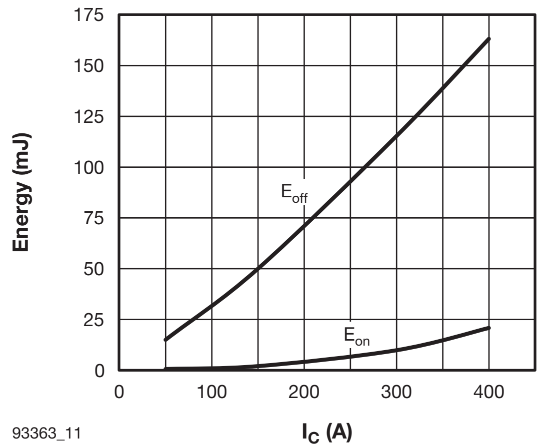


Fig. 11 - Typical IGBT Energy Loss vs. I_C,
T_J = 125 °C, V_{CC} = 360 V, R_g = 1.5 Ω,
V_{GE} = 15 V, L = 500 µH

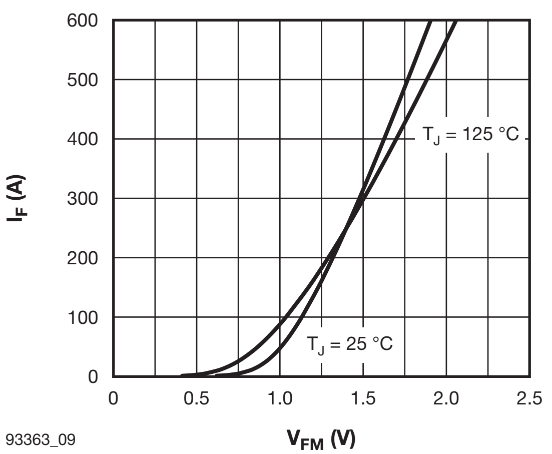


Fig. 9 - Typical Diode Forward Characteristics

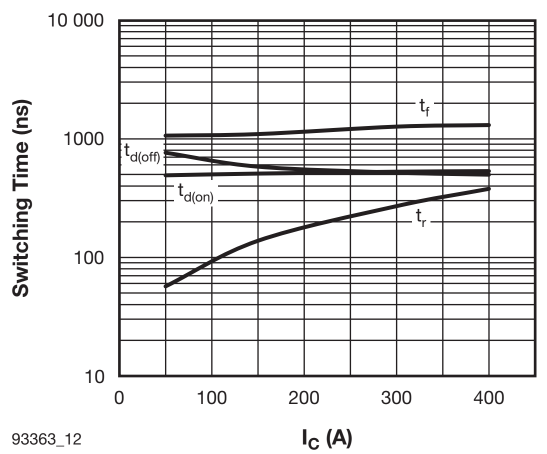


Fig. 12 - Typical IGBT Switching Time vs. I_C,
T_J = 125 °C, V_{CC} = 360 V, R_g = 1.5 Ω,
V_{GE} = 15 V, L = 500 µH

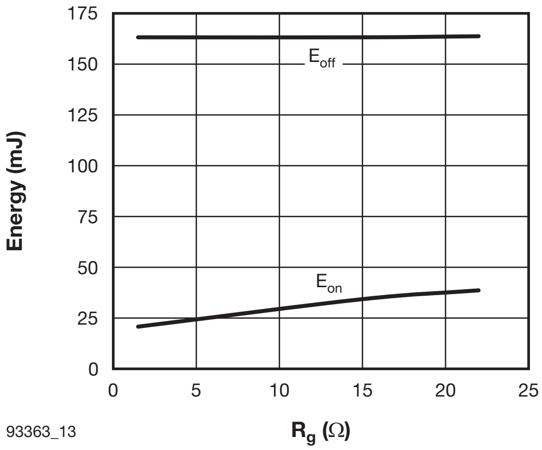


Fig. 13 - Typical IGBT Energy Loss vs. R_g, T_J = 125 °C, I_C = 400 A, V_{CC} = 360 V, V_{GE} = 15 V, L = 500 µH

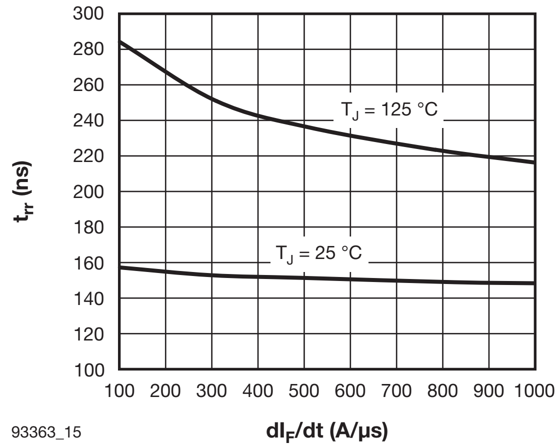


Fig. 15 - Typical Reverse Recovery Time vs. dI_F/dt, V_{CC} = 400 V, I_F = 300 A

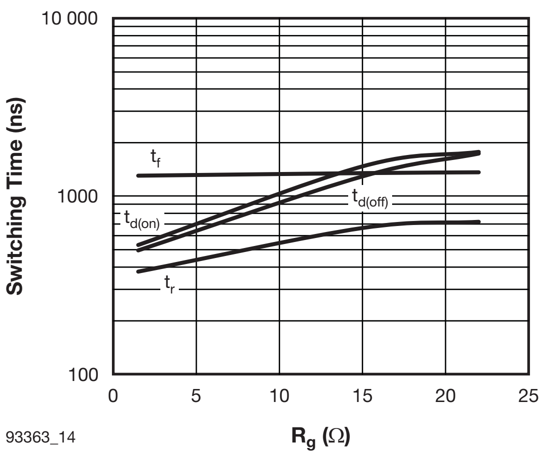


Fig. 14 - Typical IGBT Switching Time vs. R_g, T_J = 125 °C, I_C = 400 A, V_{CC} = 360 V, V_{GE} = 15 V, L = 500 µH

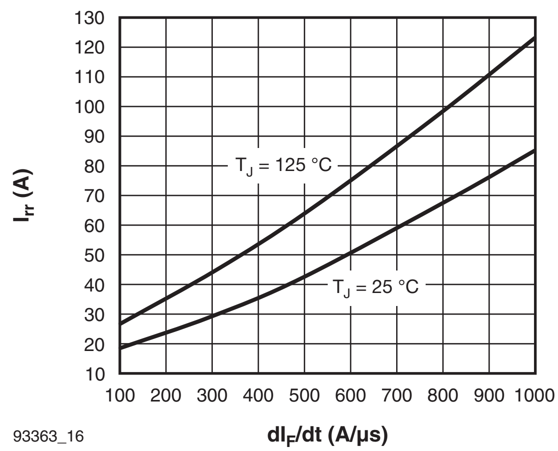


Fig. 16 - Typical Reverse Recovery Current vs. dI_F/dt, V_{CC} = 400 V, I_F = 300 A

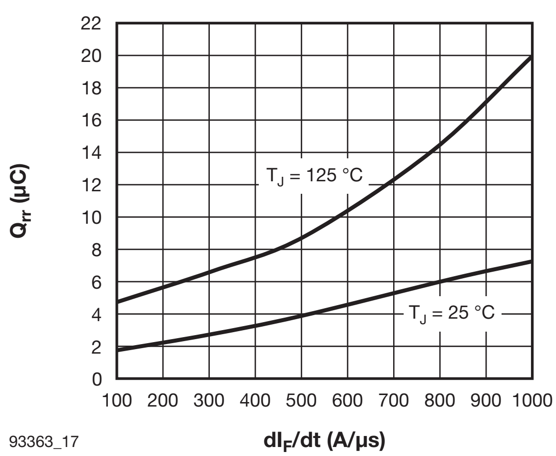


Fig. 17 - Typical Reverse Recovery Charge vs. dI_F/dt, V_{CC} = 400 V, I_F = 300 A

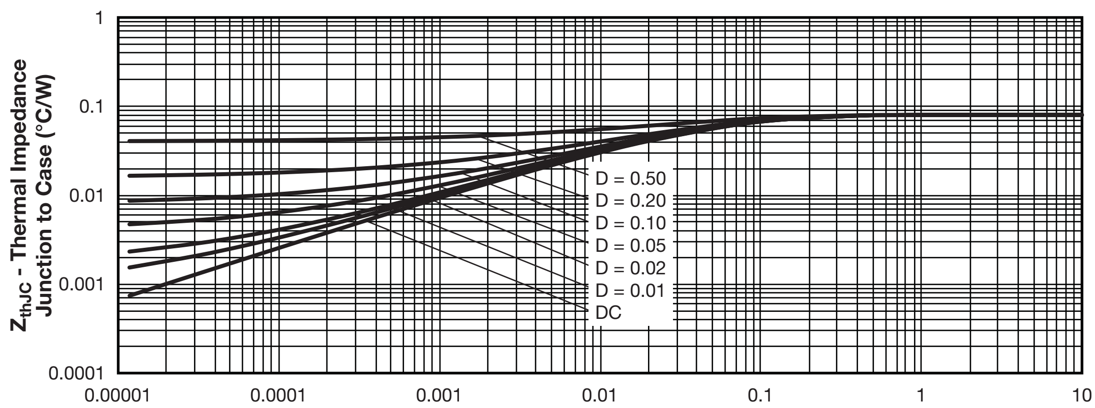


Fig. 18 - Maximum Thermal Impedance Z_{thJC} Characteristics (IGBT)

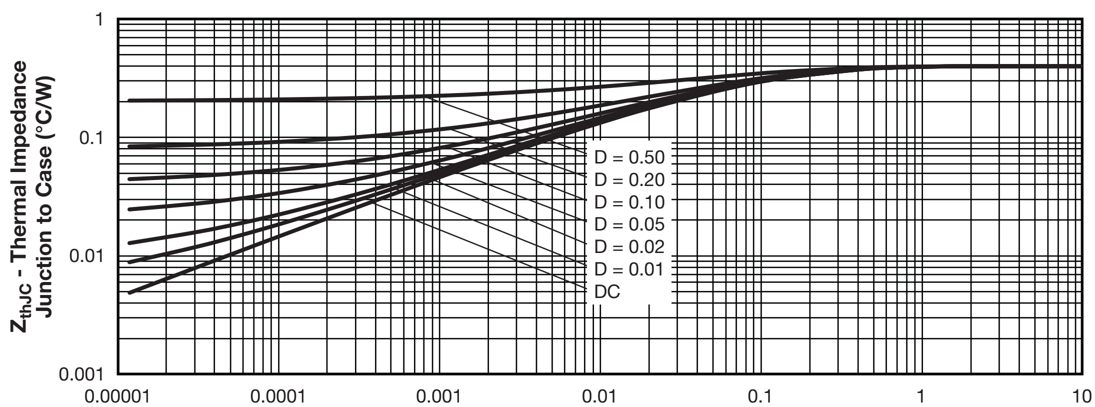


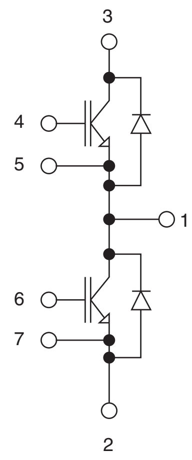
Fig. 19 - Maximum Thermal Impedance Z_{thJC} Characteristics (Diode)

ORDERING INFORMATION TABLE

Device code	G	A	400	T	D	60	S
	1	2	3	4	5	6	7

- **1** - Insulated gate bipolar transistor (IGBT)
- **2** - A = Gen 4 IGBT
- **3** - Current rating (400 = 400 A)
- **4** - Circuit configuration (T = half-bridge)
- **5** - Package indicator (D = dual INT-A-PAK low profile)
- **6** - Voltage rating (60 = 600 V)
- **7** - Speed / type (S = standard speed IGBT)

CIRCUIT CONFIGURATION



LINKS TO RELATED DOCUMENTS	
Dimensions	www.vishay.com/doc?95435

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