BIDD05N60T Insulated Gate Bipolar Transistor (IGBT)

Features
- 600V, 5A, Low VCE(sat)
- Novel field stop technology
- Optimized for conduction
- Robust
- RoHS compliant*

Applications
- Switch-Mode Power Supplies (SMPS)
- Uninterruptible Power Sources (UPS)
- Power Factor Correction (PFC)

General Information
The Bourns® Model BIDD05N60T IGBT device combines technology from a MOS gate and a bipolar transistor, resulting in an optimum component for high voltage and high current applications. This device uses Trench-Gate Field-Stop technology providing greater control of dynamic characteristics while resulting in a lower Collector-Emitter Saturation Voltage (VCE(sat)) and fewer switching losses. In addition, this structure increases the robustness of the device.

Maximum Electrical Ratings (T_C = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector-Emitter Voltage</td>
<td>V_CES</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Collector Current (T_C = 25 °C), limited by Tj_{max}</td>
<td>I_C</td>
<td>10</td>
<td>A</td>
</tr>
<tr>
<td>Continuous Collector Current (T_C = 100 °C), limited by Tj_{max}</td>
<td>I_C</td>
<td>5</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Collector Current, I_p limited by Tj_{max}</td>
<td>I_CP</td>
<td>15</td>
<td>A</td>
</tr>
<tr>
<td>Gate-Emitter Voltage</td>
<td>V_GE</td>
<td>±30</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Forward Current (T_C = 25 °C), limited by Tj_{max}</td>
<td>I_F</td>
<td>10</td>
<td>A</td>
</tr>
<tr>
<td>Short-circuit Withstand Time (V_C = 300 V, V_G = 15 V)</td>
<td>T_SC</td>
<td>10</td>
<td>μs</td>
</tr>
<tr>
<td>Total Power Dissipation</td>
<td>P_{total}</td>
<td>82</td>
<td>W</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_STG</td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Junction Temperature</td>
<td>T_J</td>
<td>-55 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Thermal Resistance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>IGBT Thermal Resistance Junction - Case</td>
<td>R_{th(j-c)}_{IGBT}</td>
<td>1.51</td>
<td>°C/W</td>
</tr>
<tr>
<td>Diode Thermal Resistance Junction - Case</td>
<td>R_{th(j-c)}_{Diode}</td>
<td>2.14</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Typical Part Marking

Internal Circuit

WARNING Cancer and Reproductive Harm
www.P65Warnings.ca.gov

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### BIDD05N60T Insulated Gate Bipolar Transistor (IGBT)

#### Static Electrical Characteristics (T<sub>C</sub> = 25 °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>Collector-Emitter Breakdown Voltage</td>
<td>BV&lt;sub&gt;CES&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GE&lt;/sub&gt; = 0 V, I&lt;sub&gt;C&lt;/sub&gt; = 250 μA</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>Collector-Emitter Saturation Voltage</td>
<td>V&lt;sub&gt;CE(sat)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GE&lt;/sub&gt; = 15 V, I&lt;sub&gt;C&lt;/sub&gt; = 5 A, T&lt;sub&gt;C&lt;/sub&gt; = 25 °C</td>
<td>1.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V&lt;sub&gt;GE&lt;/sub&gt; = 15 V, I&lt;sub&gt;C&lt;/sub&gt; = 5 A, T&lt;sub&gt;C&lt;/sub&gt; = 125 °C</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Diode Forward On-Voltage</td>
<td>V&lt;sub&gt;F&lt;/sub&gt;</td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 5 A, T&lt;sub&gt;C&lt;/sub&gt; = 25 °C</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I&lt;sub&gt;F&lt;/sub&gt; = 5 A, T&lt;sub&gt;C&lt;/sub&gt; = 125 °C</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>V&lt;sub&gt;GE(th)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = V&lt;sub&gt;GE&lt;/sub&gt;, I&lt;sub&gt;C&lt;/sub&gt; = 250 μA</td>
<td>3.5</td>
<td>V</td>
</tr>
<tr>
<td>Collector Cut-off Current</td>
<td>I&lt;sub&gt;CES&lt;/sub&gt;</td>
<td>V&lt;sub&gt;GE&lt;/sub&gt; = 0 V, V&lt;sub&gt;CE&lt;/sub&gt; = 600 V</td>
<td>—</td>
<td>μA</td>
</tr>
<tr>
<td>Gate-Emitter Leakage Current</td>
<td>I&lt;sub&gt;GES&lt;/sub&gt;</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 0 V, V&lt;sub&gt;GE&lt;/sub&gt; = ± 20 V</td>
<td>—</td>
<td>nA</td>
</tr>
</tbody>
</table>

#### Dynamic Electrical Characteristics (T<sub>C</sub> = 25 °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>Input Capacitance</td>
<td>C&lt;sub&gt;ies&lt;/sub&gt;</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 30 V, V&lt;sub&gt;GE&lt;/sub&gt; = 0 V, f = 1 MHz</td>
<td>—</td>
<td>pF</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>C&lt;sub&gt;oes&lt;/sub&gt;</td>
<td></td>
<td>340</td>
<td></td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>C&lt;sub&gt;res&lt;/sub&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>Q&lt;sub&gt;G&lt;/sub&gt;</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 400 V, V&lt;sub&gt;GE&lt;/sub&gt; = 15 V, I&lt;sub&gt;C&lt;/sub&gt; = 5.0 A</td>
<td>—</td>
<td>nC</td>
</tr>
<tr>
<td>Gate-Emitter Charge</td>
<td>Q&lt;sub&gt;GE&lt;/sub&gt;</td>
<td></td>
<td>5.1</td>
<td></td>
</tr>
<tr>
<td>Gate-Collector Charge</td>
<td>Q&lt;sub&gt;GC&lt;/sub&gt;</td>
<td></td>
<td>8.6</td>
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</tr>
</tbody>
</table>

#### IGBT Switching Characteristics (Inductive Load, T<sub>C</sub> = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter (T&lt;sub&gt;C&lt;/sub&gt; = 25 °C)</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turn-on Delay Time</td>
<td>t&lt;sub&gt;d(on)&lt;/sub&gt;</td>
<td>V&lt;sub&gt;CE&lt;/sub&gt; = 400 V, V&lt;sub&gt;GE&lt;/sub&gt; = 15 V, I&lt;sub&gt;C&lt;/sub&gt; = 5.0 A, R&lt;sub&gt;G&lt;/sub&gt; = 10 Ω</td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Current Rise Time</td>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Turn-off Delay Time</td>
<td>t&lt;sub&gt;d(off)&lt;/sub&gt;</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Current Fall Time</td>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td></td>
<td>—</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on Switching Energy</td>
<td>E&lt;sub&gt;on&lt;/sub&gt;</td>
<td></td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Turn-off Switching Energy</td>
<td>E&lt;sub&gt;off&lt;/sub&gt;</td>
<td></td>
<td>145</td>
<td></td>
</tr>
<tr>
<td>Total Switching Energy</td>
<td>E&lt;sub&gt;ts&lt;/sub&gt;</td>
<td></td>
<td>0.2</td>
<td>mJ</td>
</tr>
</tbody>
</table>

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Diode Switching Characteristics (T_C = 25 °C, unless otherwise specified)

<table>
<thead>
<tr>
<th>Parameter (T_C = 25 °C)</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Recovery Time</td>
<td>t_{rr}</td>
<td>\text{d}i_p/\text{d}t = 200 A/\mu s \quad i_p = 5.0 A</td>
<td>Min. - Max.</td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>Q_{rr}</td>
<td></td>
<td>40 - 80 ns</td>
</tr>
</tbody>
</table>

Electrical Characteristic Performance

Typical Output Characteristics

- Collector Current – IC (A) vs. Collector-emitter Voltage – V_{CE} (V)

- Collector-emitter Voltage – V_{CE} (V) vs. Collector Current – IC (A)

Forward Bias Safe Operating Area

- Collector Current – IC (A) vs. Collector-emitter Voltage – V_{CE} (V) at different times (Note: TC = 25 °C)

Typical Saturation Voltage Characteristics

- Collector Current – IC (A) vs. Collector-emitter Voltage – V_{CE} (V)

- Collector-emitter Voltage – V_{CE} (V) vs. Collector Current – IC (A)

Typical Transfer Characteristics

- Collector Current – IC (A) vs. Gate-emitter Voltage – V_{GE} (V)

- Collector-emitter Voltage – V_{CE} (V) vs. Collector Current – IC (A) at different T_C values

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BIDD05N60T Insulated Gate Bipolar Transistor (IGBT)

Electrical Characteristic Performance (continued)

Typical $V_{CE(sat)}$ vs $V_{GE}$ @ $T_C = 25 \, ^\circ C$

- Collector-emitter Voltage – $V_{CE(sat)}$ (V)
- Gate-emitter Voltage – $V_{GE}$ (V)
- Common Emitter
- $T_C = 25 \, ^\circ C$
- $I_C = 2.5 \, A$
- $I_C = 5 \, A$
- $I_C = 10 \, A$

Typical $V_{CE(sat)}$ vs $V_{GE}$ @ $T_C = 125 \, ^\circ C$

- Collector-emitter Voltage – $V_{CE(sat)}$ (V)
- Gate-emitter Voltage – $V_{GE}$ (V)
- Common Emitter
- $T_C = 125 \, ^\circ C$
- $I_C = 2.5 \, A$
- $I_C = 5 \, A$
- $I_C = 10 \, A$

Typical $V_{CE(sat)}$ vs Case Temperature

- Collector-emitter Voltage – $V_{CE(sat)}$ (V)
- Case Temperature – $T_C$ ($^\circ C$)
- Common Emitter
- $V_{GE} = 15 \, V$
- $I_C = 2.5 \, A$
- $I_C = 5 \, A$
- $I_C = 10 \, A$

Typical Capacitance Characteristics

- Collector-emitter Voltage – $V_{CE}$ (V)
- Capacitance (pF)
- Common Emitter
- $V_{GE} = 0 \, V, f = 1 \, MHz$
- $T_C = 25 \, ^\circ C$

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Electrical Characteristic Performance (continued)

Typical Gate Charge Characteristic

![Graph of Typical Gate Charge Characteristic]

- Gate-emitter Voltage – VGE (V)
- Gate Charge – Qg (nC)
- Common Emitter
- VCC = 100 V
- VCC = 200 V
- VCC = 300 V

Typical Switching Time Characteristics vs IC

![Graph of Typical Switching Time Characteristics vs IC]

- Collector Current – IC (A)
- Switching Time (ns)
- Common Emitter
- VCC = 400 V, VGE = 15 V
- IC = 5 A, TC = 25 °C

Typical Switching Time Characteristics vs RG

![Graph of Typical Switching Time Characteristics vs RG]

- Gate Resistance – RG (Ω)
- Switching Time (ns)
- Common Emitter
- VCC = 400 V, VGE = 15 V
- IC = 5 A, TC = 25 °C

Typical Switching Loss vs RG

![Graph of Typical Switching Loss vs RG]

- Gate Resistance – RG (Ω)
- Switching Loss (µJ)
- Common Emitter
- VCC = 400 V, VGE = 15 V
- IC = 5 A, TC = 25 °C

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Typical Switching Loss Characteristics vs $I_C$

- Common Emitter
- $V_{CC} = 400$ V, $V_{GE} = 15$ V
- $R_G = 10$ Ω, $T_C = 25$ °C

Typical Diode $I_F$ vs $V_F$

- $T_C = 125$ °C
- $T_C = 25$ °C

Typical Reverse Recovery Time vs $I_F$

- $di/dt = 100$ A/µs
- $di/dt = 200$ A/µs

Typical Reverse Recovery Charge vs $I_F$

- $di/dt = 200$ A/µs
- $di/dt = 100$ A/µs
BIDD05N60T Insulated Gate Bipolar Transistor (IGBT)

Electrical Characteristic Performance (continued)

IGBT Transient Thermal Impedance vs $t_{p(on)}$ Duration ($D=t_{p}/T$)

Diode Transient Thermal Impedance vs $t_{p(on)}$ Duration ($D=t_{p}/T$)

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BIDD05N60T Insulated Gate Bipolar Transistor (IGBT)

Inductive Load Test Circuit

L = 11.2 mH, $V_{CE} = 400$ V, $V_{GE} = 15$ V, $I_C = 5$ A, $R_G = 10$ Ω

How to Order

B I D D 05 N 60 T

$B = Bourns^\text{®}$

$i = IGBT$

Type

D = Discrete

Packaging Code

D = TO-252 (DPAK)

Current Rating

$05 = 5$ A

Device Type

N = N-channel

Nominal Voltage (divided by 10)

$60 = 600$ V

Optimization

T = Medium Speed

Environmental Characteristics

Moisture Sensitivity Level .................................................. 3
ESD Class (HBM) ............................................................... 1B

Product Dimensions

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Min.</th>
<th>Nom.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2.10 [.083]</td>
<td>2.30 [.091]</td>
<td>2.50 [.098]</td>
</tr>
<tr>
<td>A1</td>
<td>0 —</td>
<td>0.127 [.005]</td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>0.66 [.026]</td>
<td>0.76 [.030]</td>
<td>0.89 [.035]</td>
</tr>
<tr>
<td>b1</td>
<td>5.10 [.201]</td>
<td>5.33 [.210]</td>
<td>5.46 [.215]</td>
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<tr>
<td>c</td>
<td>0.45 [.018]</td>
<td>—</td>
<td>0.65 [.026]</td>
</tr>
<tr>
<td>c1</td>
<td>0.45 [.018]</td>
<td>—</td>
<td>0.65 [.026]</td>
</tr>
<tr>
<td>D</td>
<td>5.80 [.228]</td>
<td>6.10 [.240]</td>
<td>6.40 [.252]</td>
</tr>
<tr>
<td>E</td>
<td>6.30 [.248]</td>
<td>6.60 [.260]</td>
<td>6.90 [.272]</td>
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<tr>
<td>e</td>
<td>2.30 [.091]</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>H</td>
<td>9.60 [.378]</td>
<td>10.10 [.398]</td>
<td>10.60 [.417]</td>
</tr>
<tr>
<td>L</td>
<td>1.40 [.055]</td>
<td>1.50 [.059]</td>
<td>1.70 [.067]</td>
</tr>
<tr>
<td>L1</td>
<td>2.90 [.114]</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>L2</td>
<td>0.60 [.024]</td>
<td>0.80 [.031]</td>
<td>1.00 [.039]</td>
</tr>
</tbody>
</table>

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BIDD05N60T Insulated Gate Bipolar Transistor (IGBT)

Packaging Specifications

DIMENSIONS: MM (INCHES)  USER DIRECTION OF FEED
QTY: 2500 PCS PER REEL

Asia-Pacific: Tel: +886-2 2562-4117 • Email: asiacus@bourns.com
EMEA: Tel: +36 88 885 877 • Email: eurocus@bourns.com
The Americas: Tel: +1-951 781-5500 • Email: americus@bourns.com
www.bourns.com

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