BIDW20N60T Insulated Gate Bipolar Transistor (IGBT)

Features
- 600 V, 20 A, Low Collector-Emitter Saturation Voltage ($V_{CE(sat)}$)
- Novel trench-gate field-stop technology
- Optimized for conduction
- Low switching loss
- RoHS compliant*

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

General Information
The Bourns® Model BIDW20N60T 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 advanced Trench-Gate Field-Stop technology providing greater control of dynamic characteristics while resulting in a lower conduction loss and fewer switching losses. In addition, this structure provides a positive temperature coefficient.

Maximum Electrical Ratings ($T_C = 25 \, ^\circ C$, 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 ($T_C = 25 , ^\circ C$), limited by $T_{j\text{max}}$</td>
<td>$I_C$</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>Continuous Collector Current ($T_C = 100 , ^\circ C$), limited by $T_{j\text{max}}$</td>
<td>$I_C$</td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Collector Current, $t_p$ limited by $T_{j\text{max}}$</td>
<td>$I_{CP}$</td>
<td>60</td>
<td>A</td>
</tr>
<tr>
<td>Gate-Emmitter Voltage</td>
<td>$V_{GE}$</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Forward Current ($T_C = 25 , ^\circ C$), limited by $T_{j\text{max}}$</td>
<td>$I_F$</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>Continuous Forward Current ($T_C = 100 , ^\circ C$), limited by $T_{j\text{max}}$</td>
<td>$I_F$</td>
<td>20</td>
<td>A</td>
</tr>
<tr>
<td>Short-circuit Withstand Time ($V_{CE} = 300 , V$, $V_{GE} = 15 , V$)</td>
<td>$T_{SC}$</td>
<td>10</td>
<td>µs</td>
</tr>
<tr>
<td>Total Power Dissipation</td>
<td>$P_{\text{total}}$</td>
<td>192</td>
<td>W</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>$T_{STG}$</td>
<td>-55 to +150</td>
<td>^\circ C</td>
</tr>
<tr>
<td>Operating Junction Temperature</td>
<td>$T_j$</td>
<td>-55 to +150</td>
<td>^\circ 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>$R_{h(j-c),\text{IGBT}}$</td>
<td>0.65</td>
<td>^\circ C/W</td>
</tr>
<tr>
<td>Diode Thermal Resistance Junction - Case</td>
<td>$R_{h(j-c),\text{Diode}}$</td>
<td>1.19</td>
<td>^\circ C/W</td>
</tr>
</tbody>
</table>

Typical Part Marking

Internal Circuit

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# BIDW20N60T Insulated Gate Bipolar Transistor (IGBT)

### Static Electrical Characteristics (T_C = 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_CES</td>
<td>V_{GE} = 0 V, I_C = 250 µA</td>
<td>600</td>
<td>V</td>
</tr>
<tr>
<td>Collector-Emitter Saturation Voltage</td>
<td>V_CES(sat)</td>
<td>V_{GE} = 15 V, I_C = 20 A T_{C} = 25 °C</td>
<td>1.7</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V_{GE} = 15 V, I_C = 20 A T_{C} = 125 °C</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Diode Forward On-Voltage</td>
<td>V_F</td>
<td>I_F = 20 A, T_C = 25 °C</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I_F = 20 A, T_C = 125 °C</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Gate Threshold Voltage</td>
<td>V_{GE(th)}</td>
<td>V_{CE} = V_{GE}, I_C = 250 µA</td>
<td>4.0</td>
<td>6.5</td>
</tr>
<tr>
<td>Collector Cut-off Current</td>
<td>I_CES</td>
<td>V_{GE} = 0 V, V_{CE} = 600 V</td>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Gate-Emitter Leakage Current</td>
<td>I_GES</td>
<td>V_{CE} = 0 V, V_{GE} = ±20 V</td>
<td></td>
<td>±400</td>
</tr>
</tbody>
</table>

### Dynamic Electrical Characteristics (T_C = 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_{res}</td>
<td>V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz</td>
<td>1100</td>
<td>pF</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>C_{oess}</td>
<td></td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>C_{res}</td>
<td></td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>Q_g</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 20.0 A</td>
<td>52</td>
<td>nC</td>
</tr>
<tr>
<td>Gate-Emitter Charge</td>
<td>Q_{ge}</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Gate-Collector Charge</td>
<td>Q_{gc}</td>
<td></td>
<td>22</td>
<td></td>
</tr>
</tbody>
</table>

### IGBT Switching Characteristics (Inductive Load, T_C = 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>Turn-on Delay Time</td>
<td>t_{on(on)}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 20.0 A, R_{G} = 10 Ω</td>
<td>19</td>
<td>ns</td>
</tr>
<tr>
<td>Current Rise Time</td>
<td>t_r</td>
<td></td>
<td>55</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-off Delay Time</td>
<td>t_{off}</td>
<td></td>
<td>48</td>
<td>ns</td>
</tr>
<tr>
<td>Current Fall Time</td>
<td>t_f</td>
<td></td>
<td>115</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on Switching Energy</td>
<td>E_{on}</td>
<td></td>
<td>1</td>
<td>mJ</td>
</tr>
<tr>
<td>Turn-off Switching Energy</td>
<td>E_{off}</td>
<td></td>
<td>0.3</td>
<td>mJ</td>
</tr>
<tr>
<td>Total Switching Energy</td>
<td>E_{ts}</td>
<td></td>
<td>1.3</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</th>
<th>Symbol</th>
<th>Conditions</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse Recovery Time</td>
<td>t_{rr}</td>
<td>dl/dt = 200 A/μs</td>
<td>—</td>
<td>33.7</td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>Q_{rr}</td>
<td>I_F = 20.0 A</td>
<td>—</td>
<td>73.3</td>
</tr>
</tbody>
</table>

### Electrical Characteristic Performance

#### Typical Output Characteristics

- **Common Emitter**
  - T_C = 25 °C
  - V_{GE} = 9 V
  - V_{GE} = 11 V
  - V_{GE} = 13 V
  - V_{GE} = 15 V
  - V_{GE} = 17 V

- **Common Emitter**
  - T_C = 125 °C
  - V_{GE} = 9 V
  - V_{GE} = 11 V
  - V_{GE} = 13 V
  - V_{GE} = 15 V
  - V_{GE} = 17 V

#### Typical Saturation Voltage Characteristics

- **Common Emitter**
  - V_{GE} = 15 V
  - T_C = 25 °C
  - T_C = 125 °C

#### Typical Transfer Characteristics

- **Common Emitter**
  - V_{GE} = 10 V
  - T_C = 25 °C
  - T_C = 125 °C
Electrical Characteristic Performance (continued)

**Typical V\text{CE(sat)} vs V\text{GE} @ T\text{C} = 25 °C**

![Graph showing typical V\text{CE(sat)} vs V\text{GE} at T\text{C} = 25 °C]

**Typical V\text{CE(sat)} vs V\text{GE} @ T\text{C} = 125 °C**

![Graph showing typical V\text{CE(sat)} vs V\text{GE} at T\text{C} = 125 °C]

**Typical V\text{CE(sat)} vs Case Temperature**

![Graph showing typical V\text{CE(sat)} vs Case Temperature]

**Typical Capacitance Characteristics**

![Graph showing typical Capacitance Characteristics]

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Typical Gate Charge Characteristics

![Gate Charge Characteristics](image1)

- Gate-emitter Voltage – $V_{GE}$ (V)
- Common Emitter
- $T_C = 25 \, ^\circ C$
- $V_{CC} = 100 \, V$
- $V_{CC} = 200 \, V$
- $V_{CC} = 300 \, V$

Typical Switching Time Characteristics vs $R_G$

![Switching Time Characteristics](image2)

- Switching Time (ns)
- $V_{CC} = 400 \, V$, $V_{GE} = 15 \, V$
- $I_C = 20 \, A$, $T_C = 25 \, ^\circ C$

Typical Switching Time Characteristics vs $I_C$

![Switching Time Characteristics vs $I_C$](image3)

- Switching Time (ns)
- Common Emitter
- $V_{CC} = 400 \, V$, $V_{GE} = 15 \, V$
- $R_G = 10 \, \Omega$, $T_C = 25 \, ^\circ C$

Typical Switching Loss vs $R_G$

![Switching Loss vs $R_G$](image4)

- Switching Loss (µJ)
- Common Emitter
- $V_{CC} = 400 \, V$, $V_{GE} = 15 \, V$
- $I_C = 20 \, A$, $T_C = 25 \, ^\circ C$

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Electrical Characteristic Performance (continued)

**Typical Switching Loss Characteristics vs \(I_C\)**

- Common Emitter
- \(V_{CC} = 400\, \text{V}, V_{IF} = 15\, \text{V}\)
- \(R_{d} = 10\, \Omega, T_C = 25\, ^\circ\text{C}\)

**Typical Diode \(I_F\) vs \(V_F\)**

- \(T_C = 125\, ^\circ\text{C}\)
- \(T_C = 25\, ^\circ\text{C}\)

**Typical Reverse Recovery Time vs \(I_F\)**

- \(di/dt = 100\, \text{A/µs}\)
- \(di/dt = 200\, \text{A/µs}\)

**Typical Reverse Recovery Charge vs \(I_F\)**

- \(di/dt = 200\, \text{A/µs}\)
- \(di/dt = 100\, \text{A/µs}\)

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Electrical Characteristic Performance (continued)

Forward Bias Safe Operating Area

![Graph showing forward bias safe operating area]

Inductive Load Test Circuit

![Diagram of inductive load test circuit]

L = 2.8 mH, $V_{CE} = 400$ V, $V_{GE} = 15$ V, $I_C = 20$ A, $R_G = 10 \Omega$

Environmental Characteristics

ESD Class (HBM) .............................................................................. 1C

How to Order

B I D W 20 N 60 T

B = Bourns®
I = IGBT
Type
D = Discrete
Package Code
W = TO-247
Current Rating
20 = 20 A
Device Type
N = N-channel
Nominal Voltage (divided by 10)
60 = 600 V
Optimization
T = Medium Speed

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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>4.80 (.189)</td>
<td>5.00 (.197)</td>
<td>5.20 (.205)</td>
</tr>
<tr>
<td>A1</td>
<td>2.21 (.087)</td>
<td>2.41 (.095)</td>
<td>2.59 (.102)</td>
</tr>
<tr>
<td>A2</td>
<td>1.85 (.073)</td>
<td>2.00 (.079)</td>
<td>2.15 (.085)</td>
</tr>
<tr>
<td>b</td>
<td>1.11 (.044)</td>
<td>—</td>
<td>1.36 (.054)</td>
</tr>
<tr>
<td>b2</td>
<td>1.91 (.075)</td>
<td>—</td>
<td>2.25 (.089)</td>
</tr>
<tr>
<td>b4</td>
<td>2.91 (.115)</td>
<td>—</td>
<td>3.25 (.128)</td>
</tr>
<tr>
<td>c</td>
<td>0.51 (.020)</td>
<td>—</td>
<td>0.75 (.030)</td>
</tr>
<tr>
<td>D</td>
<td>20.80 (.819)</td>
<td>21.00 (.827)</td>
<td>21.30 (.839)</td>
</tr>
<tr>
<td>E</td>
<td>15.50 (.610)</td>
<td>15.80 (.622)</td>
<td>16.10 (.634)</td>
</tr>
<tr>
<td>E2</td>
<td>4.40 (.173)</td>
<td>5.00 (.197)</td>
<td>5.20 (.205)</td>
</tr>
<tr>
<td>e</td>
<td>5.44 (.214) BSC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>19.72 (.776)</td>
<td>19.92 (.784)</td>
<td>20.22 (.796)</td>
</tr>
<tr>
<td>L1</td>
<td>—</td>
<td>—</td>
<td>4.30 (.169)</td>
</tr>
<tr>
<td>P</td>
<td>3.40 (.134)</td>
<td>—</td>
<td>3.80 (.150)</td>
</tr>
<tr>
<td>Q</td>
<td>5.60 (.220)</td>
<td>5.80 (.228)</td>
<td>6.00 (.236)</td>
</tr>
</tbody>
</table>

Packaging Specifications

BIDW20N60T ................................................. 30 pieces per tube

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