BIDW50N65T Insulated Gate Bipolar Transistor (IGBT)

General Information

The Bourns® Model BIDW50N65T 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 ($V_{CE(sat)}$) and fewer switching losses. In addition, this structure provides a lower thermal resistance $R_{th}$.

Maximum Electrical Ratings ($T_C = 25 \degree C$, 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>650</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Collector Current ($T_C = 25 \degree C$, limited by $T_{j_{max}}$)</td>
<td>$I_{C}$</td>
<td>100</td>
<td>A</td>
</tr>
<tr>
<td>Continuous Collector Current ($T_C = 100 \degree C$, limited by $T_{j_{max}}$)</td>
<td>$I_{C}$</td>
<td>50</td>
<td>A</td>
</tr>
<tr>
<td>Pulsed Collector Current, $I_{p}$ limited by $T_{j_{max}}$</td>
<td>$I_{CP}$</td>
<td>150</td>
<td>A</td>
</tr>
<tr>
<td>Gate-Emitter Voltage</td>
<td>$V_{GE}$</td>
<td>±20</td>
<td>V</td>
</tr>
<tr>
<td>Continuous Forward Current ($T_C = 100 \degree C$, limited by $T_{j_{max}}$)</td>
<td>$I_{F}$</td>
<td>50</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>$P_{total}$</td>
<td>416</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>0.3</td>
<td>°C/W</td>
</tr>
<tr>
<td>Diode Thermal Resistance Junction - Case</td>
<td>$R_{th(j-c)Diode}$</td>
<td>0.65</td>
<td>°C/W</td>
</tr>
</tbody>
</table>

Typical Part Marking

Warning: Cancer and Reproductive Harm

www.P65Warnings.ca.gov

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**BIDW50N65T 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>B_VCES</td>
<td>V_{GE} = 0 V, I_C = 250 µA</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Collector-Emitter Saturation Voltage</td>
<td>V_{CE(sat)}</td>
<td>V_{GE} = 15 V, I_C = 50 A, T_C = 25 °C</td>
<td>1.65, 2.2</td>
<td>V</td>
</tr>
<tr>
<td>Diode Forward On-Voltage</td>
<td>V_F</td>
<td>I_F = 50 A, T_C = 25 °C</td>
<td>1.7, 2.5</td>
<td>V</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, 5.0, 7.0</td>
<td>V</td>
</tr>
<tr>
<td>Collector Cut-off Current</td>
<td>I_CES</td>
<td>V_{GE} = 0 V, V_CE = 650 V</td>
<td>200</td>
<td>µA</td>
</tr>
<tr>
<td>Gate-Emitter Leakage Current</td>
<td>I_{GES}</td>
<td>V_{CE} = 0 V, V_{GE} = ± 20 V</td>
<td>±400</td>
<td>nA</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_{ies}</td>
<td>V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz</td>
<td>2723</td>
<td>pF</td>
</tr>
<tr>
<td>Output Capacitance</td>
<td>C_{oes}</td>
<td>V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz</td>
<td>230</td>
<td>pF</td>
</tr>
<tr>
<td>Reverse Transfer Capacitance</td>
<td>C_{res}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>123</td>
<td>nC</td>
</tr>
<tr>
<td>Total Gate Charge</td>
<td>Q_g</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>31</td>
<td>nC</td>
</tr>
<tr>
<td>Gate-Emitter Charge</td>
<td>Q_{ge}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>48</td>
<td>nC</td>
</tr>
<tr>
<td>Gate-Collector Charge</td>
<td>Q_{gc}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td></td>
<td>nC</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_{d(on)}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>37</td>
<td>ns</td>
</tr>
<tr>
<td>Current Rise Time</td>
<td>t_r</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>133</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-off Delay Time</td>
<td>t_{d(off)}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>125</td>
<td>ns</td>
</tr>
<tr>
<td>Current Fall Time</td>
<td>t_f</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>121</td>
<td>ns</td>
</tr>
<tr>
<td>Turn-on Switching Energy</td>
<td>E_{on}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A, R_{G} = 10 Ω</td>
<td>3.0</td>
<td>mJ</td>
</tr>
<tr>
<td>Turn-off Switching Energy</td>
<td>E_{off}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>1.1</td>
<td>mJ</td>
</tr>
<tr>
<td>Total Switching Energy</td>
<td>E_{ts}</td>
<td>V_{CE} = 400 V, V_{GE} = 15 V I_C = 50.0 A</td>
<td>4.1</td>
<td>mJ</td>
</tr>
</tbody>
</table>

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Diode Switching Characteristics (\(T_C = 25 \, ^\circ\text{C}\), 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>(\frac{dl_F}{dt} = 200 , \text{A/\mu s}) (I_F = 50.0 , \text{A})</td>
<td>---</td>
<td>37.5</td>
</tr>
<tr>
<td>Reverse Recovery Charge</td>
<td>(Q_{rr})</td>
<td></td>
<td>---</td>
<td>78</td>
</tr>
</tbody>
</table>

Electrical Characteristic Performance

**Typical Output Characteristics**

- Collector-emitter Voltage – \(V_{CE}\) (V)
  - \(V_{GE} = 9 \, \text{V}\)
  - \(V_{GE} = 11 \, \text{V}\)
  - \(V_{GE} = 13 \, \text{V}\)
  - \(V_{GE} = 15 \, \text{V}\)
  - \(V_{GE} = 17 \, \text{V}\)

**Typical Saturation Voltage Characteristics**

- Collector Current – \(I_C\) (A)
  - \(V_{GE} = 15 \, \text{V}\)

**Typical Transfer Characteristics**

- Collector Current – \(I_C\) (A)
  - Gate-emitter Voltage – \(V_{GE}\) (V)
  - \(T_C = 125 \, ^\circ\text{C}\)
  - \(T_C = 25 \, ^\circ\text{C}\)
Electrical Characteristic Performance (continued)

**Typical V_{CE(sat)} vs V_{GE} @ T_{C} = 25 °C**

![Graph showing typical V_{CE(sat)} vs V_{GE} @ T_{C} = 25 °C](image)

**Typical V_{CE(sat)} vs V_{GE} @ T_{C} = 125 °C**

![Graph showing typical V_{CE(sat)} vs V_{GE} @ T_{C} = 125 °C](image)

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

![Graph showing typical V_{CE(sat)} vs Case Temperature](image)

**Typical Capacitance Characteristics**

![Graph showing typical Capacitance Characteristics](image)

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### Typical Gate Charge Characteristics

**Common Emitter**

- $V_{CC} = 100$ V
- $V_{CC} = 200$ V
- $V_{CC} = 300$ V

**Collector Current**

- $IC = 50$ A
- $TC = 25$ °C

### Typical Switching Time Characteristics vs $RG$

- $V_{CC} = 400$ V, $V_{GE} = 15$ V
- $IC = 50$ A, $TC = 25$ °C

### Typical Switching Loss vs $RG$

- $V_{CC} = 400$ V, $V_{GE} = 15$ V
- $IC = 50$ A, $TC = 25$ °C

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Electrical Characteristic Performance (continued)

**Typical Switching Loss Characteristics vs IC**

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

**Typical Diode $I_F$ vs $V_F$**

- $T_C = 125\,\text{°C}$
- $T_C = 25\,\text{°C}$

**Typical Reverse Recovery Time vs $I_F$**

- $E(on)$
- $E(off)$
- $di/dt = 200\,\text{A}/\mu\text{s}$
- $di/dt = 100\,\text{A}/\mu\text{s}$

**Typical Reverse Recovery Charge vs $I_F$**

- $di/dt = 200\,\text{A}/\mu\text{s}$
- $di/dt = 100\,\text{A}/\mu\text{s}$

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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 ($D=t_p/T$)
BIDW50N65T Insulated Gate Bipolar Transistor (IGBT)

Electrical Characteristic Performance (continued)

Forward Bias Safe Operating Area

<table>
<thead>
<tr>
<th>Collector Current – I_C (A)</th>
<th>Collector-emitter Voltage – V_CE (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10^-1</td>
<td>10^0</td>
</tr>
<tr>
<td>10^-2</td>
<td>10^1</td>
</tr>
<tr>
<td>10^-3</td>
<td>10^2</td>
</tr>
<tr>
<td>10^-4</td>
<td>10^3</td>
</tr>
</tbody>
</table>

Note:
1. Max. junction temperature: 150 °C
2. Max. reference temperature: 25 °C

Inductive Load Test Circuit

L = 1.12 mH, V_CE = 400 V, V_GE = 15 V, I_C = 50 A, R_G = 10 Ω

How to Order

B I D W 50 N 65 T

B = Bourns®
I = IGBT
D = Discrete
W = TO-247-3L
Type
Current Rating
50 = 50 A
Device Type
N = N-channel
Nominal Voltage (divided by 10)
65 = 650 V
Optimization
T = Medium Speed

Environmental Characteristics

ESD Class (HBM)……………………………………………………..2
BIDW50N65T Insulated Gate Bipolar Transistor (IGBT)

Product Dimensions

Packaging Specifications

BIDW50N65T .................................................30 pieces per tube

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

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