

## Features

- 650 V, 50 A, Low Collector-Emitter Saturation Voltage ( $V_{CE(sat)}$ )
- Novel trench-gate field-stop technology
- Optimized for conduction
- RoHS compliant\*

## Applications

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

# 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  $R_{(th)}$ .

### Additional Information

Click these links for more information:



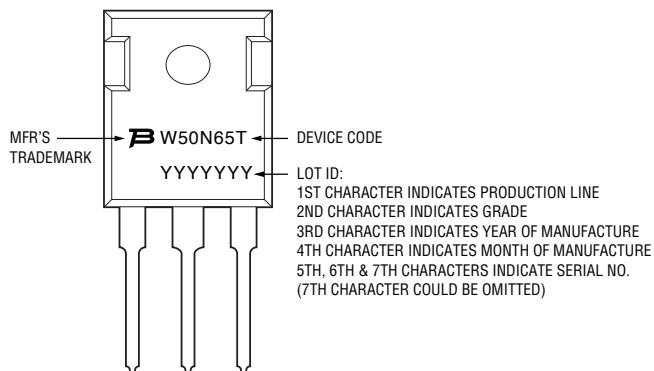
### Maximum Electrical Ratings ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

Parameter	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CES}$	650	V
Continuous Collector Current ( $T_C = 25\text{ }^\circ\text{C}$ ), limited by $T_{jmax}$	$I_C$	100	A
Continuous Collector Current ( $T_C = 100\text{ }^\circ\text{C}$ ), limited by $T_{jmax}$	$I_C$	50	A
Pulsed Collector Current, $t_p$ limited by $T_{jmax}$	$I_{CP}$	150	A
Gate-Emitter Voltage	$V_{GE}$	$\pm 20$	V
Continuous Forward Current ( $T_C = 100\text{ }^\circ\text{C}$ ), limited by $T_{jmax}$	$I_F$	50	A
Short-circuit Withstand Time ( $V_{CE} = 300\text{ V}$ , $V_{GE} = 15\text{ V}$ )	$T_{SC}$	10	$\mu\text{s}$
Total Power Dissipation	$P_{total}$	416	W
Storage Temperature	$T_{STG}$	-55 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_j$	-55 to +150	$^\circ\text{C}$

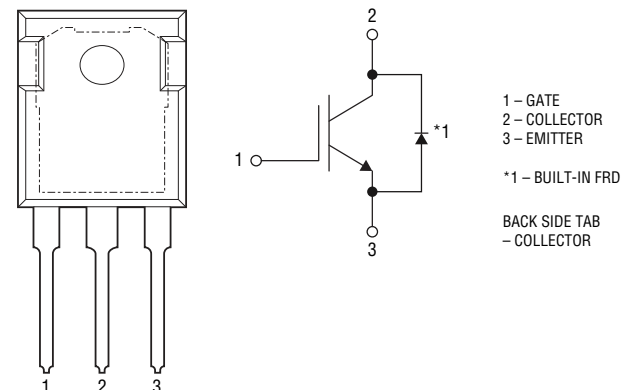
### Thermal Resistance

Parameter	Symbol	Max	Unit
IGBT Thermal Resistance Junction - Case	$R_{th(j-c)}_{IGBT}$	0.3	$^\circ\text{C/W}$
Diode Thermal Resistance Junction - Case	$R_{th(j-c)}_{Diode}$	0.65	$^\circ\text{C/W}$

### Typical Part Marking



### Internal Circuit



\*RoHS Directive 2015/863, Mar 31, 2015 and Annex.  
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# BIDW50N65T Insulated Gate Bipolar Transistor (IGBT)

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## Static Electrical Characteristics ( $T_C = 25\text{ }^\circ\text{C}$ , Unless Otherwise Specified)

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Collector-Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	650	—	—	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $T_C = 25\text{ }^\circ\text{C}$	—	1.65	2.2	V
		$V_{GE} = 15\text{ V}, I_C = 50\text{ A}$ $T_C = 125\text{ }^\circ\text{C}$	—	1.9	—	
Diode Forward On-Voltage	$V_F$	$I_F = 50\text{ A}, T_C = 25\text{ }^\circ\text{C}$	—	1.7	2.5	V
		$I_F = 50\text{ A}, T_C = 125\text{ }^\circ\text{C}$	—	1.3	—	V
Gate Threshold Voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$	4.0	5.0	7.0	V
Collector Cut-off Current	$I_{CES}$	$V_{GE} = 0\text{ V}, V_{CE} = 650\text{ V}$	—	—	200	$\mu\text{A}$
Gate-Emitter Leakage Current	$I_{GES}$	$V_{CE} = 0\text{ V}, V_{GE} = \pm 20\text{ V}$	—	—	$\pm 400$	nA

## Dynamic Electrical Characteristics ( $T_C = 25\text{ }^\circ\text{C}$ , Unless Otherwise Specified)

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V},$ $f = 1\text{ MHz}$	—	2723	—	pF
Output Capacitance	$C_{oes}$		—	230	—	
Reverse Transfer Capacitance	$C_{res}$		—	55	—	
Total Gate Charge	$Q_g$	$V_{CE} = 400\text{ V}, V_{GE} = 15\text{ V}$ $I_C = 50.0\text{ A}$	—	123	—	nC
Gate-Emitter Charge	$Q_{ge}$		—	31	—	
Gate-Collector Charge	$Q_{gc}$		—	48	—	

## IGBT Switching Characteristics (Inductive Load, $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Turn-on Delay Time	$t_{d(on)}$	$V_{CE} = 400\text{ V}, V_{GE} = 15\text{ V}$ $I_C = 50.0\text{ A}, R_G = 10\text{ }\Omega$	—	37	—	ns
Current Rise Time	$t_r$		—	133	—	ns
Turn-off Delay Time	$t_{d(off)}$		—	125	—	ns
Current Fall Time	$t_f$		—	121	—	ns
Turn-on Switching Energy	$E_{on}$		—	3.0	—	mJ
Turn-off Switching Energy	$E_{off}$		—	1.1	—	mJ
Total Switching Energy	$E_{ts}$		—	4.1	—	mJ

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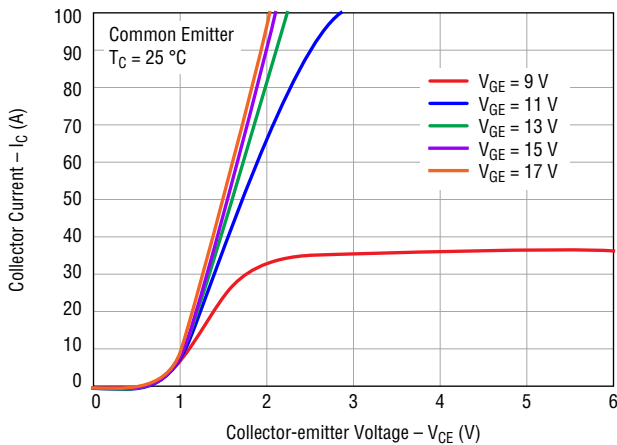


## Diode Switching Characteristics ( $T_C = 25\text{ }^\circ\text{C}$ , unless otherwise specified)

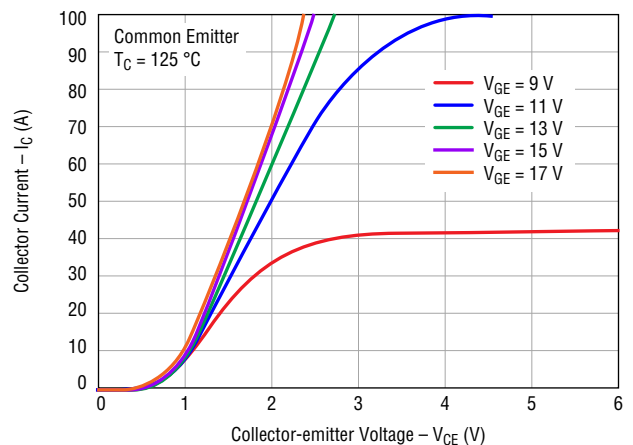
Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Reverse Recovery Time	$t_{rr}$	$di_F/dt = 200\text{ A}/\mu\text{s}$ $I_F = 50.0\text{ A}$	—	37.5	—	ns
Reverse Recovery Charge	$Q_{rr}$		—	78	—	nC

## Electrical Characteristic Performance

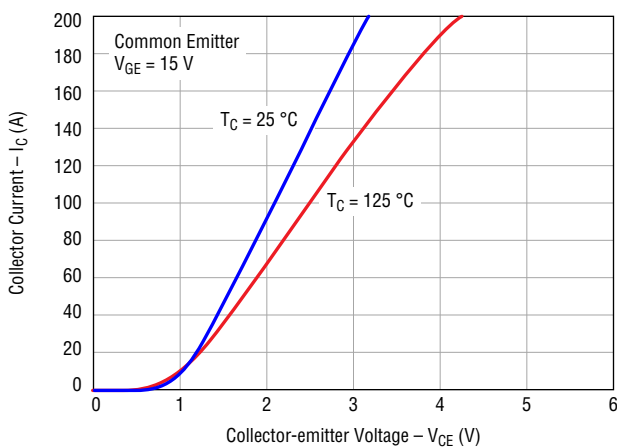
### Typical Output Characteristics



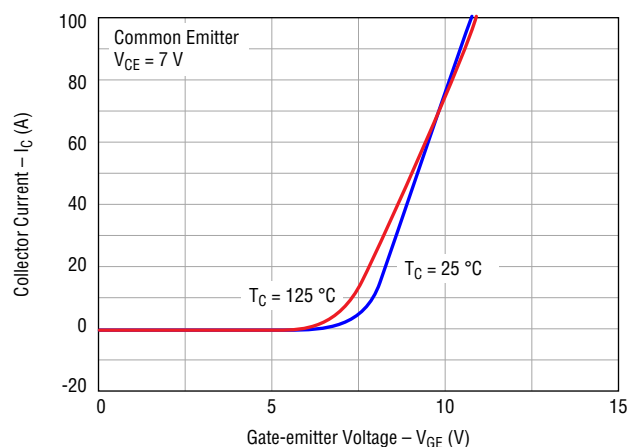
### Typical Output Characteristics



### Typical Saturation Voltage Characteristics



### Typical Transfer Characteristics



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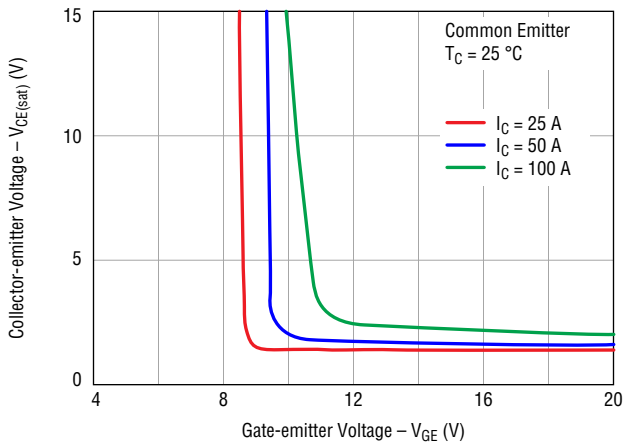
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# BIDW50N65T Insulated Gate Bipolar Transistor (IGBT)

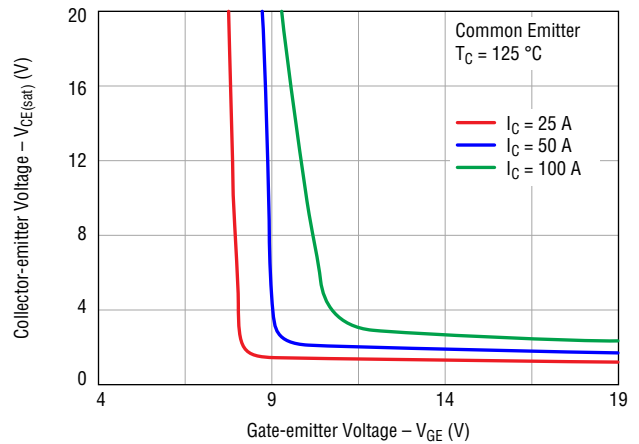
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## Electrical Characteristic Performance (continued)

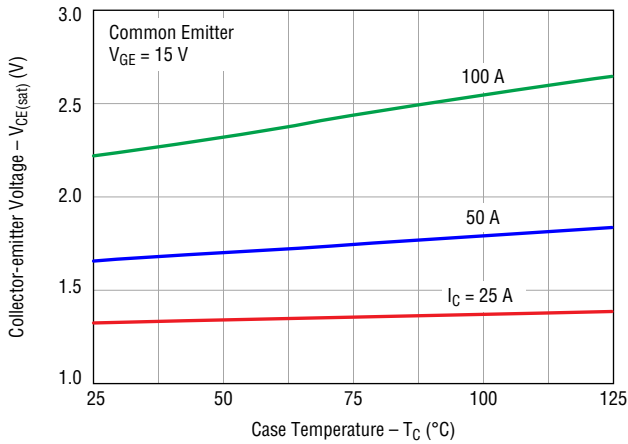
### Typical $V_{CE(sat)}$ vs $V_{GE}$ @ $T_C = 25^\circ\text{C}$



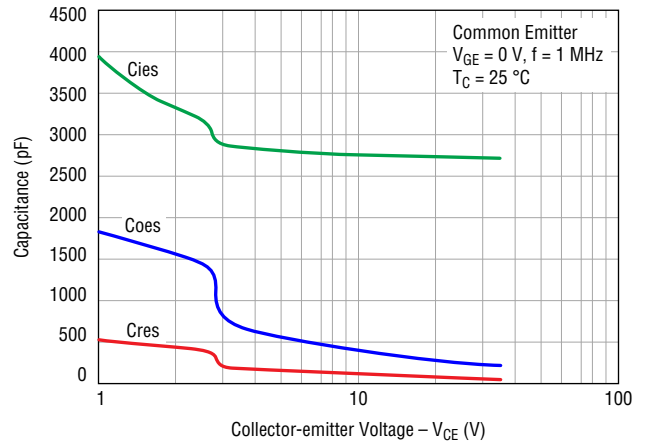
### Typical $V_{CE(sat)}$ vs $V_{GE}$ @ $T_C = 125^\circ\text{C}$



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



### Typical Capacitance Characteristics



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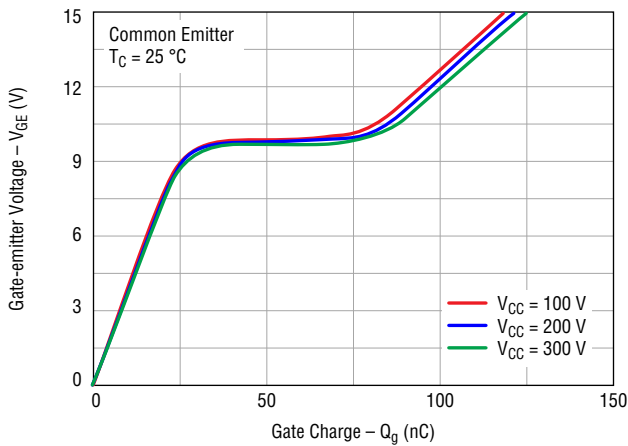
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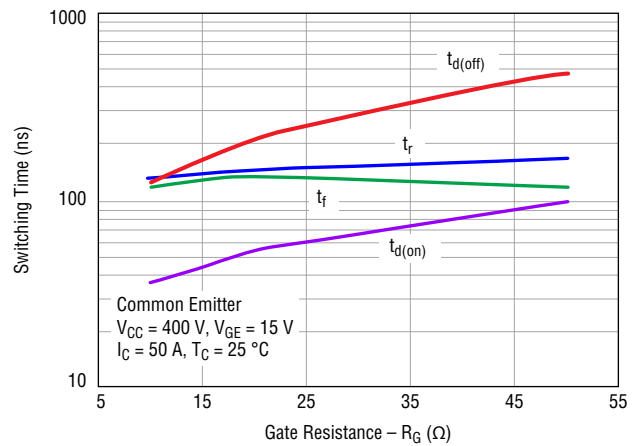


## Electrical Characteristic Performance (continued)

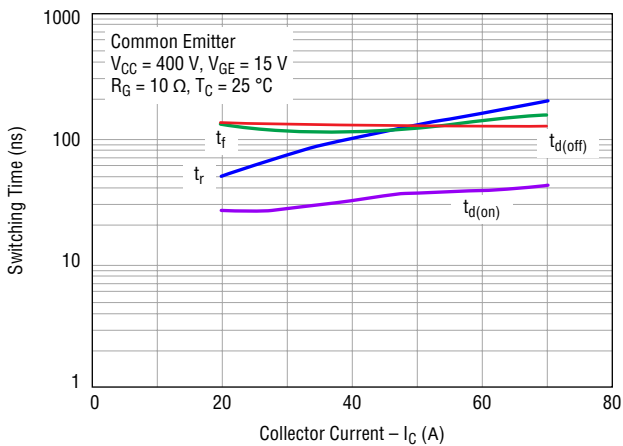
### Typical Gate Charge Characteristics



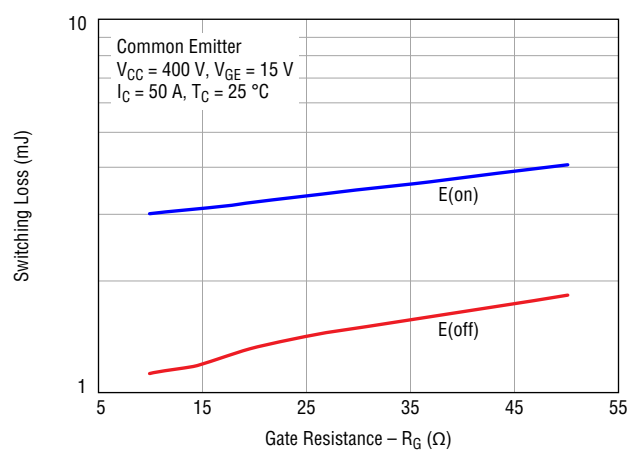
### Typical Switching Time Characteristics vs $R_G$



### Typical Switching Time Characteristics vs $I_C$



### Typical Switching Loss vs $R_G$



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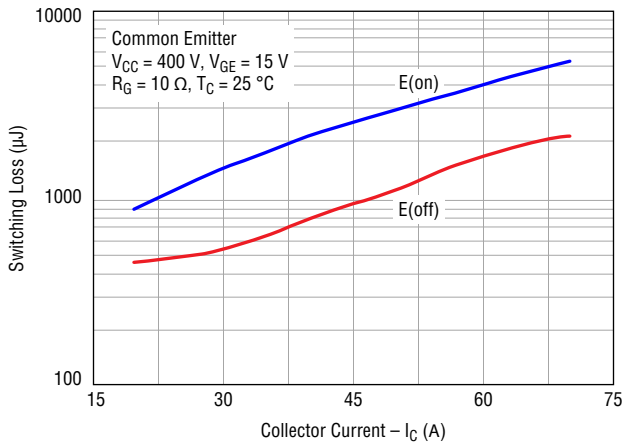
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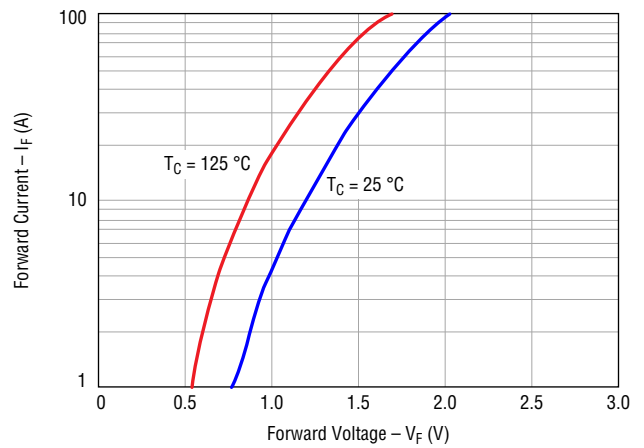


## Electrical Characteristic Performance (continued)

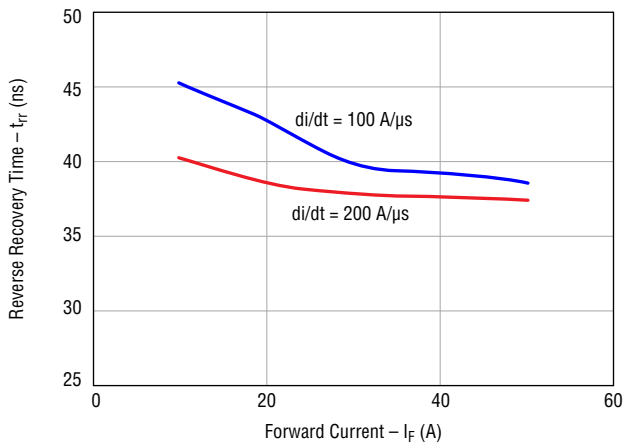
### Typical Switching Loss Characteristics vs $I_C$



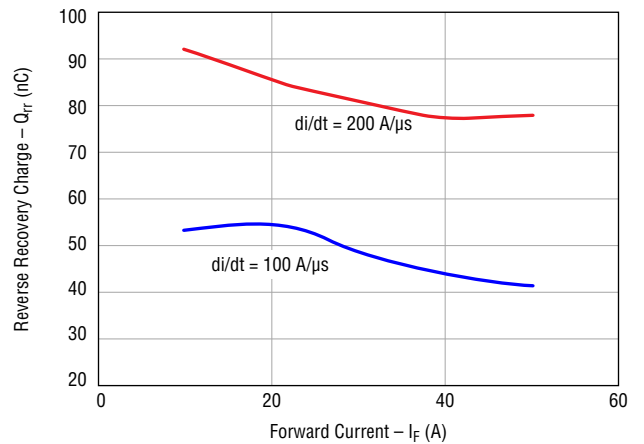
### Typical Diode $I_F$ vs $V_F$



### Typical Reverse Recovery Time vs $I_F$



### Typical Reverse Recovery Charge vs $I_F$



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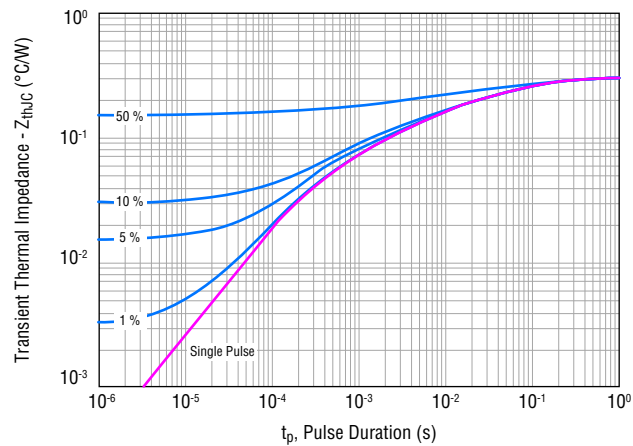
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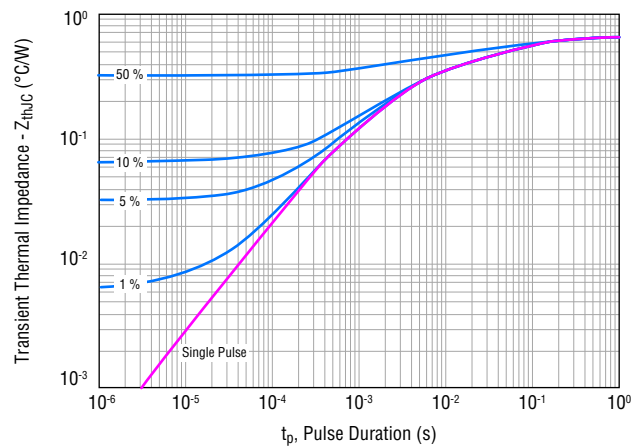
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## Electrical Characteristic Performance (continued)

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



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



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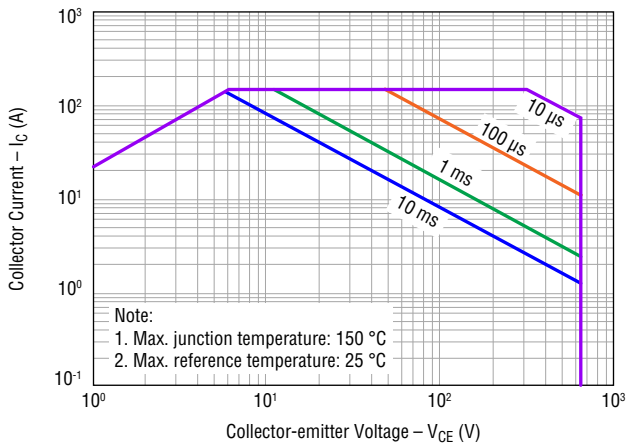
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# BIDW50N65T Insulated Gate Bipolar Transistor (IGBT)



## Electrical Characteristic Performance (continued)

### Forward Bias Safe Operating Area

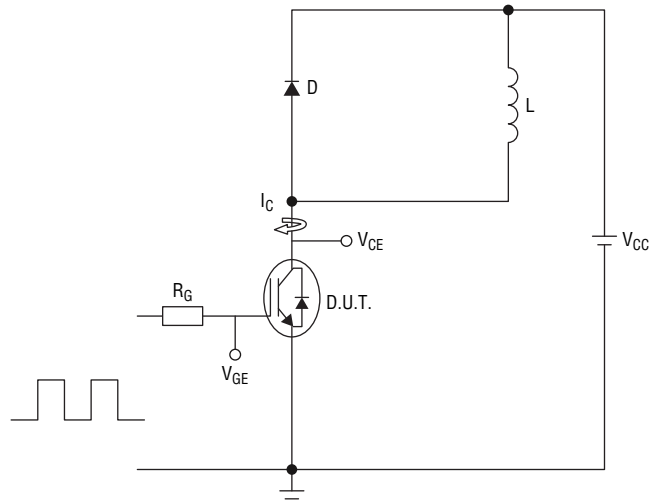


### How to Order

**B I D W 50 N 65 T**

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

## Inductive Load Test Circuit



$L = 1.12 \text{ mH}$ ,  $V_{CE} = 400 \text{ V}$ ,  $V_{GE} = 15 \text{ V}$ ,  $I_C = 50 \text{ A}$ ,  $R_G = 10 \Omega$

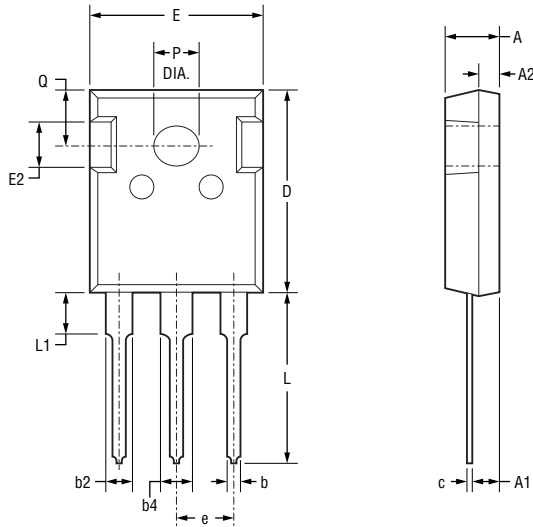
## Environmental Characteristics

ESD Class (HBM) .....2

# BIDW50N65T Insulated Gate Bipolar Transistor (IGBT)

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## Product Dimensions



DIMENSIONS:  $\frac{\text{MM}}{\text{(INCHES)}}$

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

## Packaging Specifications

BIDW50N65T ..... 30 pieces per tube

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