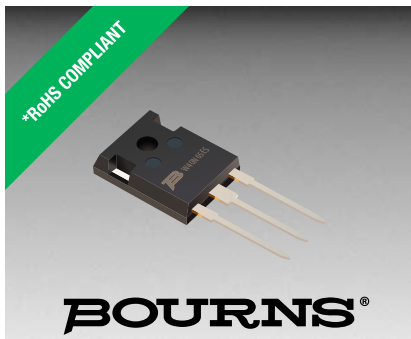




Features

- 650 V, 40 A, Low Collector-Emitter Saturation Voltage ($V_{CE(sat)}$)
- Novel trench-gate field-stop technology
- Optimized for conduction
- Medium-speed switching
- Maximum operating $T_j = 175\text{ }^{\circ}\text{C}$
- RoHS compliant*

Applications

- Switched-Mode Power Supplies (SMPS)
- Uninterruptible Power Sources (UPS)
- Power Factor Correction (PFC)
- Inverters
- Welding converters
- Photovoltaic

BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

General Information

The Bourns® Model BIDW40N65ES5 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.

Additional Information

Click these links for more information:



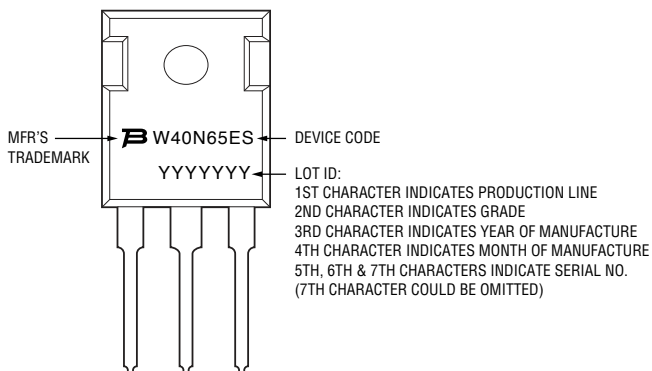
Maximum Electrical Ratings ($T_C = 25\text{ }^{\circ}\text{C}$, unless otherwise specified)

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	80	A
Continuous Collector Current ($T_C = 100\text{ }^{\circ}\text{C}$), limited by T_{jmax}	I_C	40	A
Pulsed Collector Current, t_p limited by T_{jmax}	I_{CP}	160	A
Gate-Emitter Voltage	V_{GE}	± 20	V
Gate-Emitter Voltage ($t_p \leq 10\text{ }\mu\text{s}$, $D < 1\%$)	V_{GE}	± 30	V
Continuous Forward Current ($T_C = 100\text{ }^{\circ}\text{C}$), limited by T_{jmax}	I_F	40	A
Total Power Dissipation	P_{total}	230	W
Storage Temperature	T_{STG}	$-55\text{ to }+150$	$^{\circ}\text{C}$
Operating Junction Temperature	T_j	$-40\text{ to }+175$	$^{\circ}\text{C}$

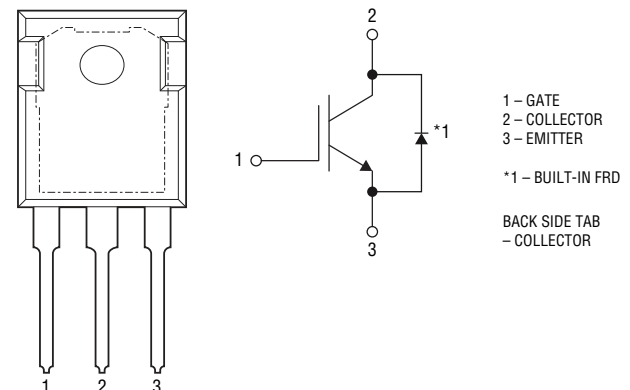
Thermal Resistance

Parameter	Symbol	Max	Unit
IGBT Thermal Resistance Junction - Case	$R_{th(j-c)}_{IGBT}$	0.65	$^{\circ}\text{C/W}$
Diode Thermal Resistance Junction - Case	$R_{th(j-c)}_{Diode}$	0.6	$^{\circ}\text{C/W}$

Typical Part Marking



Internal Circuit



*RoHS Directive 2015/863, Mar 31, 2015 and Annex.

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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

BOURNS®

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	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_C = 25\text{ }^\circ\text{C}$	—	1.35	1.7	V
		$V_{GE} = 15\text{ V}$, $I_C = 40\text{ A}$, $T_C = 150\text{ }^\circ\text{C}$	—	1.5	—	
Diode Forward On-Voltage	V_F	$I_F = 40\text{ A}$, $T_C = 25\text{ }^\circ\text{C}$	—	1.45	1.9	V
		$I_F = 40\text{ A}$, $T_C = 150\text{ }^\circ\text{C}$	—	1.32	—	V
Gate Threshold Voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	3.2	4.5	5.8	V
Collector Cut-off Current	I_{CES}	$V_{GE} = 0\text{ V}$, $V_{CE} = 650\text{ V}$	—	—	100	μA
Gate-Emitter Leakage Current	I_{GES}	$V_{CE} = 0\text{ V}$, $V_{GE} = \pm 20\text{ V}$	—	—	± 100	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}	$V_{CE} = 30\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1\text{ MHz}$	—	2856	—	pF
Output Capacitance	C_{oes}		—	82	—	
Reverse Transfer Capacitance	C_{res}		—	12	—	
Total Gate Charge	Q_g	$V_{CE} = 520\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 40.0\text{ A}$	—	107	—	nC
Gate-Emitter Charge	Q_{ge}		—	24	—	
Gate-Collector Charge	Q_{gc}		—	31	—	

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	$t_{d(on)}$	$V_{CE} = 400\text{ V}$, $V_{GE} = 15\text{ V}$, $I_C = 40.0\text{ A}$, $R_G = 10\text{ }\Omega$	—	28	—	ns
Current Rise Time	t_r		—	26	—	ns
Turn-off Delay Time	$t_{d(off)}$		—	150	—	ns
Current Fall Time	t_f		—	36	—	ns
Turn-on Switching Energy	E_{on}		—	0.58	—	mJ
Turn-off Switching Energy	E_{off}		—	0.63	—	mJ
Total Switching Energy	E_{ts}		—	1.21	—	mJ

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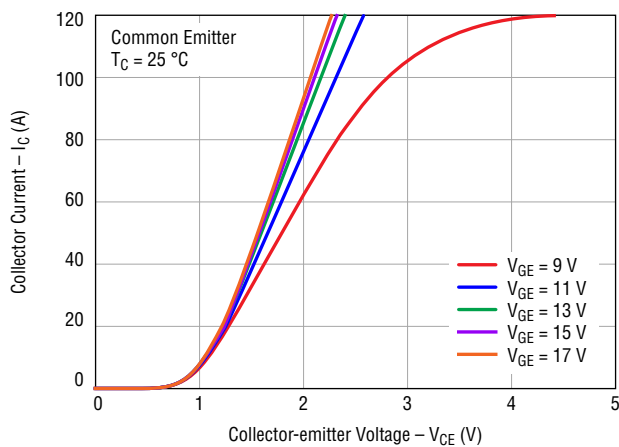
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Diode Switching Characteristics ($T_C = 25^\circ\text{C}$, unless otherwise specified)

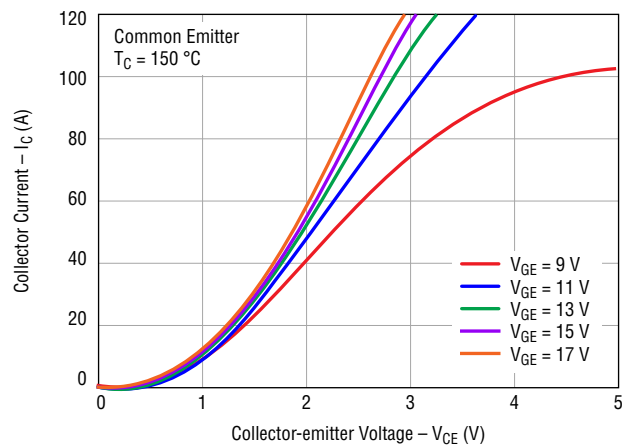
Parameter	Symbol	Conditions	Value			Unit
			Min.	Typ.	Max.	
Reverse Recovery Time	t_{rr}	$di_F/dt = 200 \text{ A}/\mu\text{s}$, $I_F = 40 \text{ A}$	—	106	—	ns
Reverse Recovery Charge	Q_{rr}		—	258	—	nC

Electrical Characteristic Performance

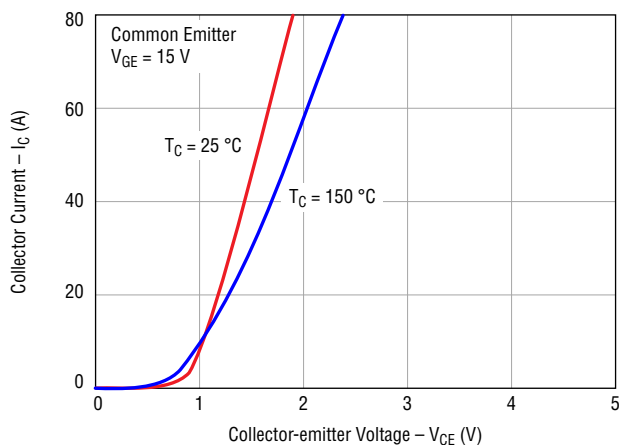
Typical Output Characteristics



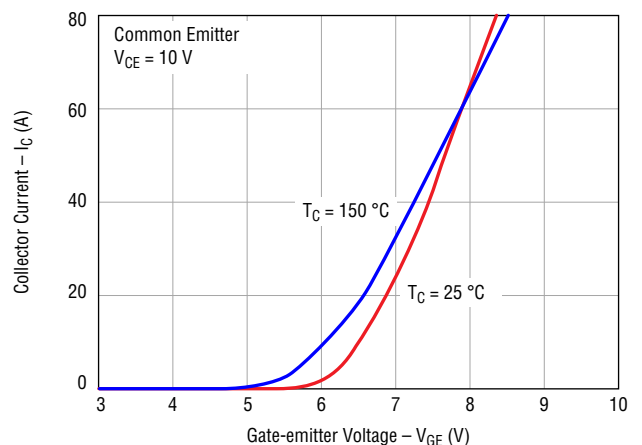
Typical Output Characteristics



Typical Saturation Voltage Characteristics



Typical Transfer Characteristics



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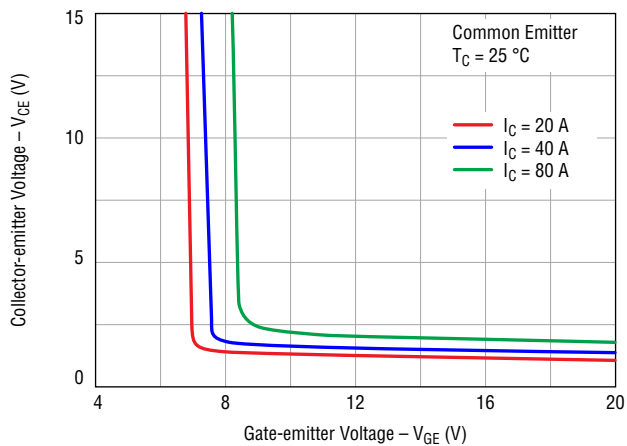
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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

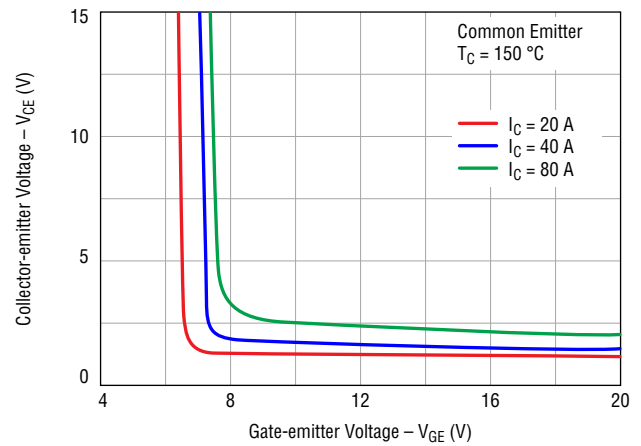
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Electrical Characteristic Performance (continued)

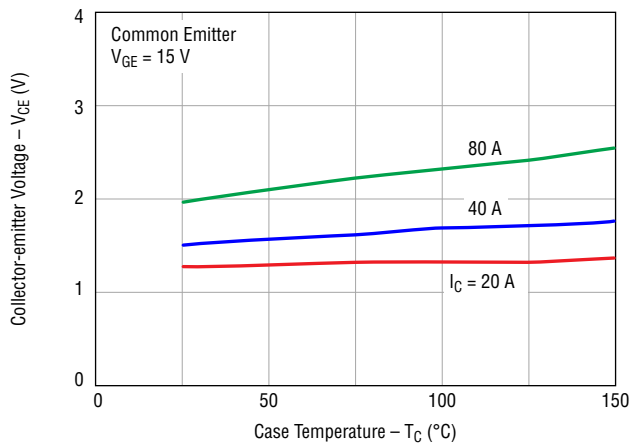
Typical Saturation Voltage Drop vs V_{GE} @ $T_C = 25^\circ\text{C}$



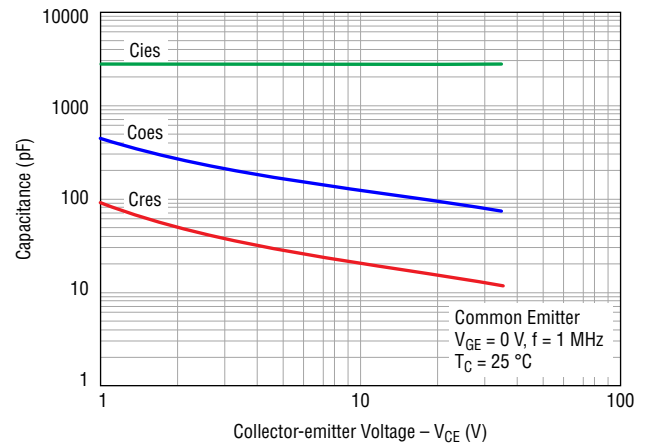
Typical Saturation Voltage Drop vs V_{GE} @ $T_C = 150^\circ\text{C}$



Typical Saturation Voltage Drop vs Temperature



Typical Capacitance Characteristics



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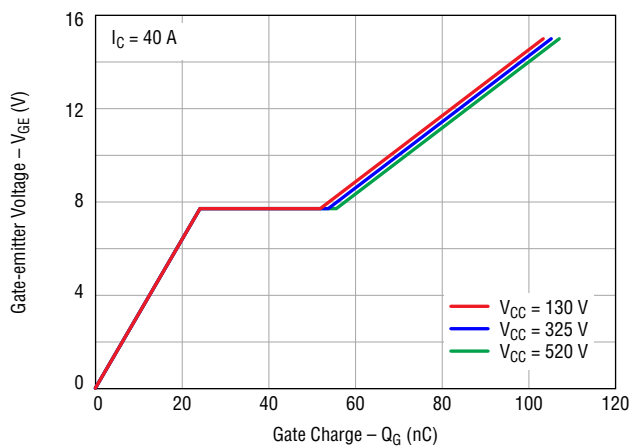
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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

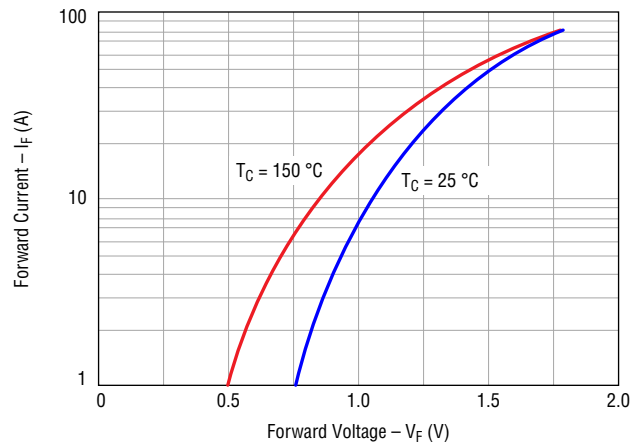
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Electrical Characteristic Performance (continued)

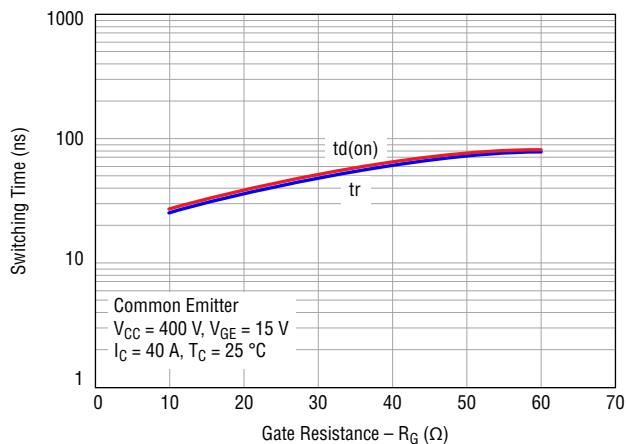
Typical Gate Charge Characteristics



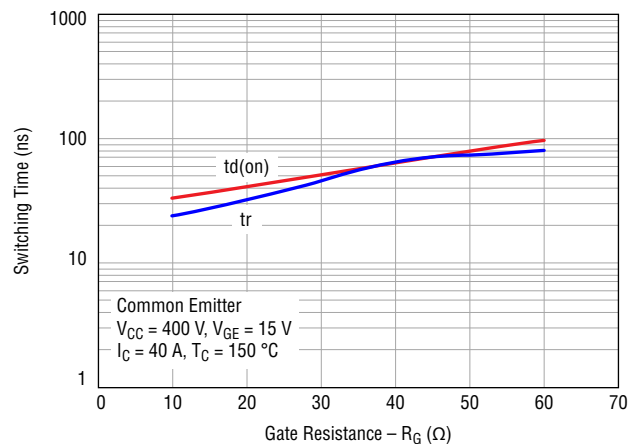
Typical Forward Characteristics



Typical Turn-on Characteristics vs Gate Resistance @ $T_C = 25$ °C



Typical Turn-on Characteristics vs Gate Resistance @ $T_C = 150$ °C



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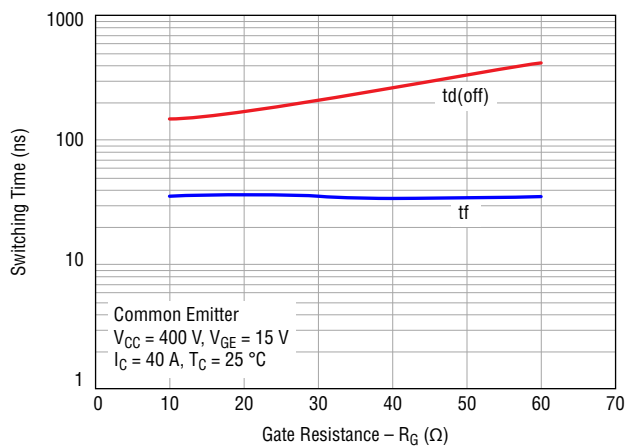
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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

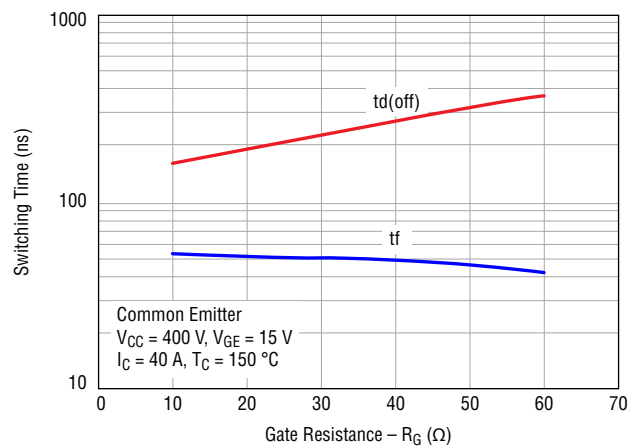
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Electrical Characteristic Performance (continued)

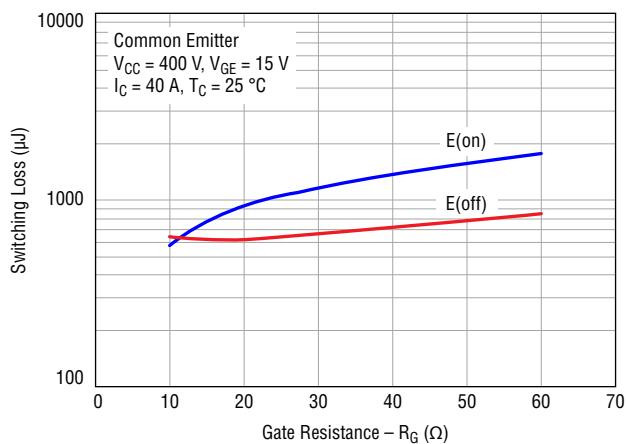
Typical Turn-off Characteristics vs Gate Resistance @ $T_C = 25^\circ\text{C}$



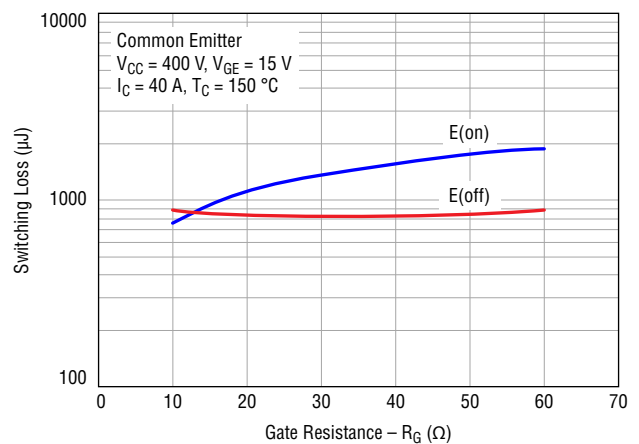
Typical Turn-off Characteristics vs Gate Resistance @ $T_C = 150^\circ\text{C}$



Typical Switching Loss vs Gate Resistance @ $T_C = 25^\circ\text{C}$



Typical Switching Loss vs Gate Resistance @ $T_C = 150^\circ\text{C}$



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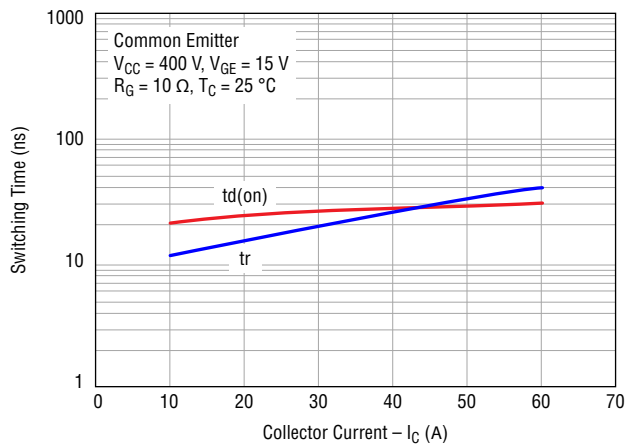
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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

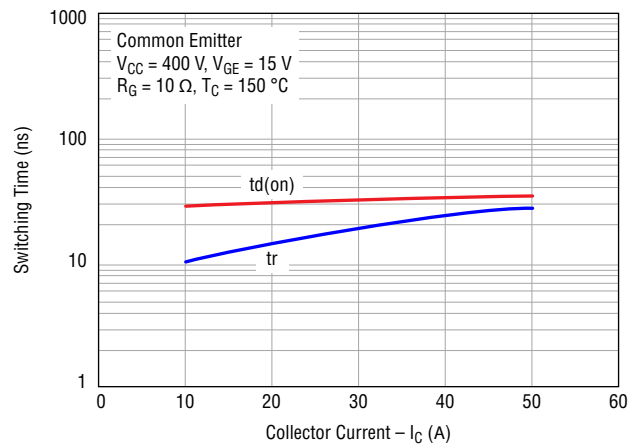
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Electrical Characteristic Performance (continued)

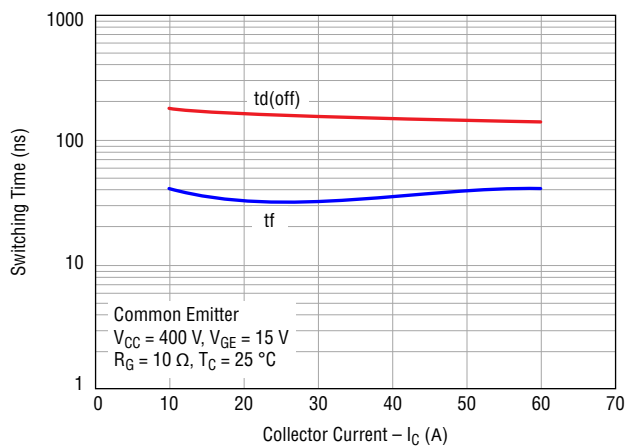
Typical Turn-on Characteristics vs Collector Current @ $T_C = 25^\circ\text{C}$



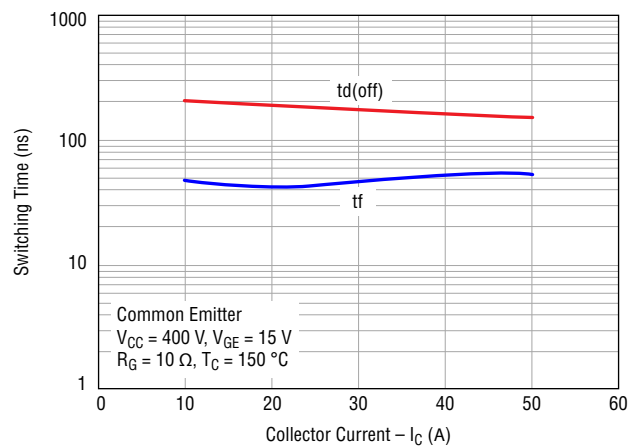
Typical Turn-on Characteristics vs Collector Current @ $T_C = 150^\circ\text{C}$



Typical Turn-off Characteristics vs Collector Current @ $T_C = 25^\circ\text{C}$



Typical Turn-off Characteristics vs Collector Current @ $T_C = 150^\circ\text{C}$



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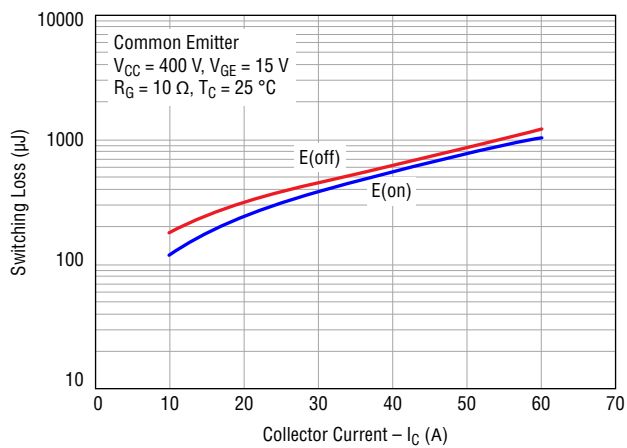
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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

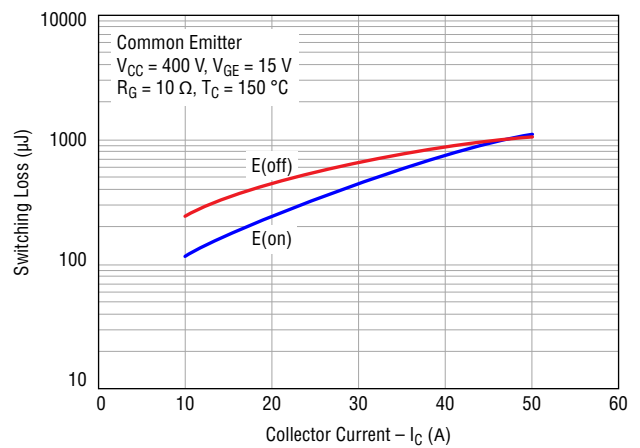
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Electrical Characteristic Performance (continued)

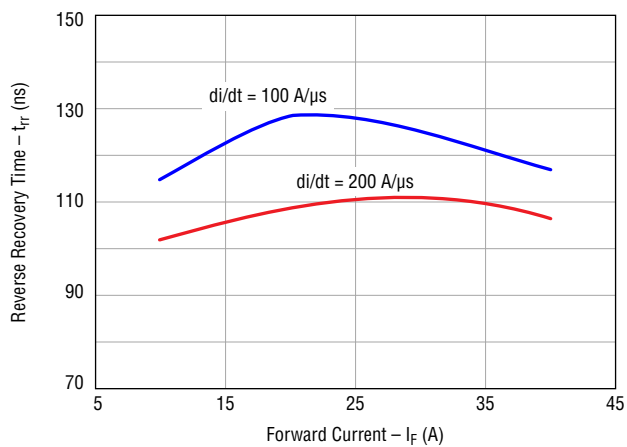
Typical Switching Loss vs Collector Current @ $T_C = 25^\circ\text{C}$



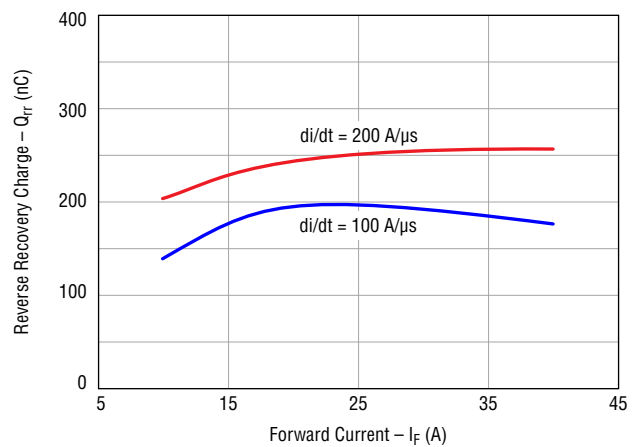
Typical Switching Loss vs Collector Current @ $T_C = 150^\circ\text{C}$



Typical Reverse Recovery Time vs Forward Current



Typical Reverse Recovery Charge vs Forward Current



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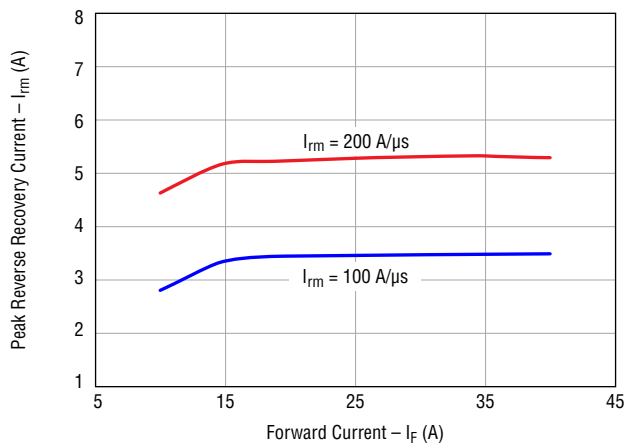
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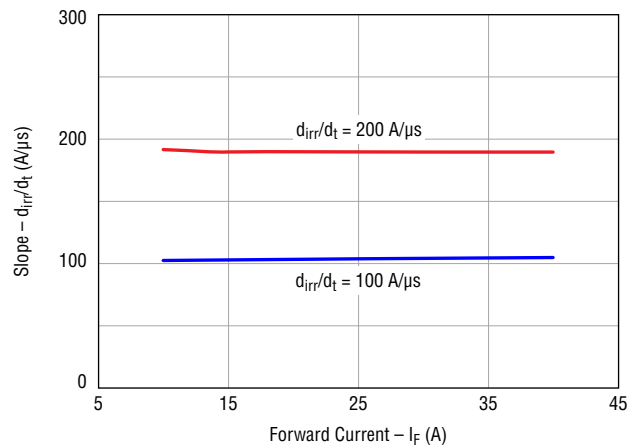
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Electrical Characteristic Performance (continued)

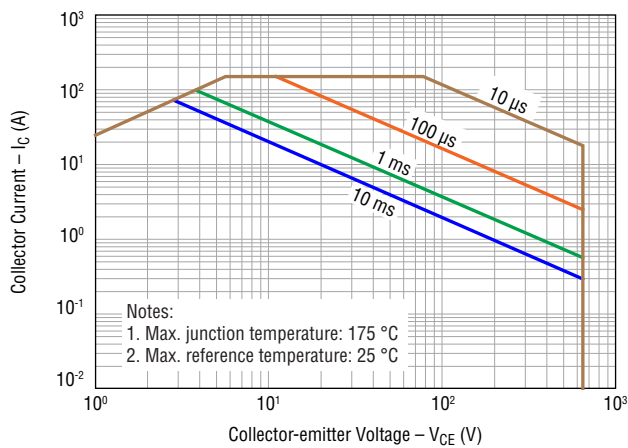
Typical Peak Reverse Recovery Current vs Forward Current



Typical Slope vs Forward Current



Maximum Safe Operating Area



Specifications are subject to change without notice.

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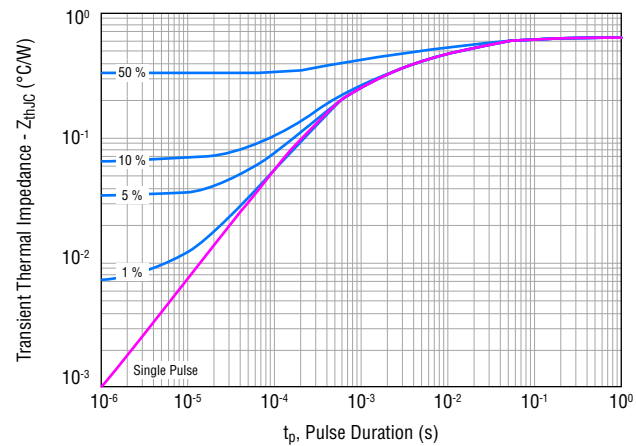
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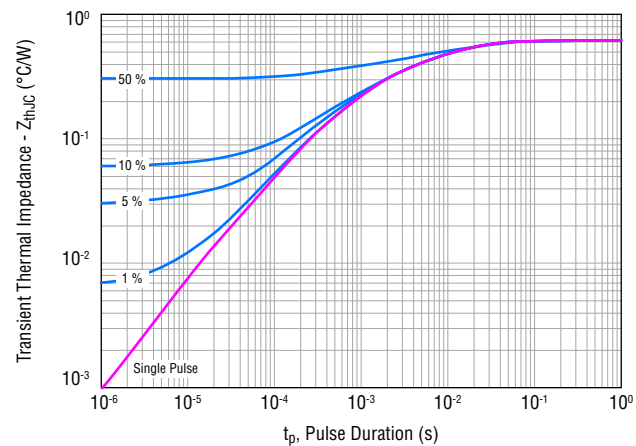
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Electrical Characteristic Performance (continued)

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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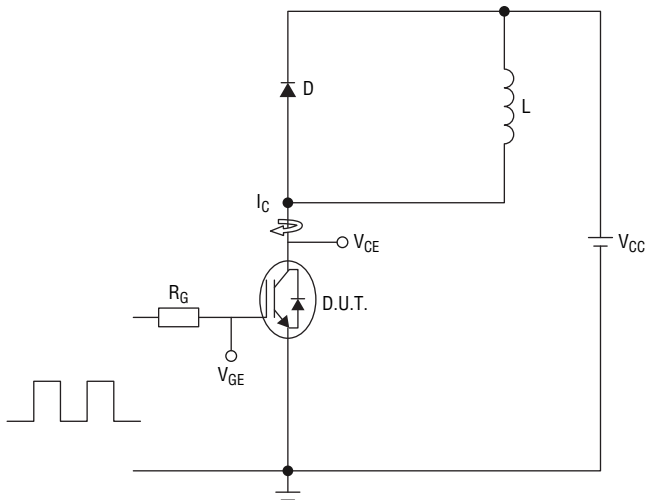
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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

BOURNS®

Inductive Load Test Circuit



$L = 200 \mu\text{H}$, $V_{CE} = 400 \text{ V}$, $V_{GE} = 15 \text{ V}$, $I_C = 40 \text{ A}$, $R_G = 10 \Omega$

How to Order

B I D W 40 N 65 ES5

B = Bourns®
 I = IGBT
 Type _____
 D = Discrete
 Package Code _____
 W = TO-247-3L
 Current Rating _____
 40 = 40 A
 Device Type _____
 N = N-channel
 Nominal Voltage (divided by 10) _____
 65 = 650 V
 Optimization _____
 ES = Efficient Medium Speed
 Version Number _____
 5 = Revision Control

Environmental Characteristics

ESD Class (HBM)2

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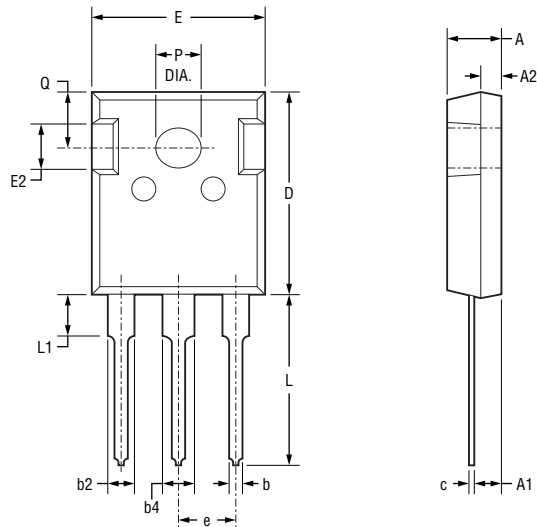
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BIDW40N65ES5 Insulated Gate Bipolar Transistor (IGBT)

BOURNS®

Product Dimensions



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

Packaging Specifications

BIDW40N65ES5..... 30 pieces per tube

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	$\frac{5.60}{(.220)}$	$\frac{5.80}{(.228)}$	$\frac{6.00}{(.236)}$

BOURNS®

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REV. 11/23

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The characteristics and parameters of a Bourns® product set forth in its data sheet are based on laboratory conditions, and statements regarding the suitability of products for certain types of applications are based on Bourns' knowledge of typical requirements in generic applications. The characteristics and parameters of a Bourns® product in a user application may vary from the data sheet characteristics and parameters due to (i) the combination of the Bourns® product with other components in the user's application, or (ii) the environment of the user application itself. The characteristics and parameters of a Bourns® product also can and do vary in different applications and actual performance may vary over time. Users should always verify the actual performance of the Bourns® product in their specific devices and applications, and make their own independent judgments regarding the amount of additional test margin to design into their device or application to compensate for differences between laboratory and real world conditions.

Unless Bourns has explicitly designated an individual Bourns® product as meeting the requirements of a particular industry standard (e.g., ISO/TS 16949) or a particular qualification (e.g., UL listed or recognized), Bourns is not responsible for any failure of an individual Bourns® product to meet the requirements of such industry standard or particular qualification. Users of Bourns® products are responsible for ensuring compliance with safety-related requirements and standards applicable to their devices or applications.

Bourns® products are not recommended, authorized or intended for use in nuclear, lifesaving, life-critical or life-sustaining applications, nor in any other applications where failure or malfunction may result in personal injury, death, or severe property or environmental damage. Unless expressly and specifically approved in writing by two authorized Bourns representatives on a case-by-case basis, use of any Bourns® products in such unauthorized applications might not be safe and thus is at the user's sole risk. Life-critical applications include devices identified by the U.S. Food and Drug Administration as Class III devices and generally equivalent classifications outside of the United States.

Bourns expressly identifies those Bourns® standard products that are suitable for use in automotive applications on such products' data sheets in the section entitled "Applications." Unless expressly and specifically approved in writing by two authorized Bourns representatives on a case-by-case basis, use of any other Bourns® standard products in an automotive application might not be safe and thus is not recommended, authorized or intended and is at the user's sole risk. If Bourns expressly identifies a sub-category of automotive application in the data sheet for its standard products (such as infotainment or lighting), such identification means that Bourns has reviewed its standard product and has determined that if such Bourns® standard product is considered for potential use in automotive applications, it should only be used in such sub-category of automotive applications. Any reference to Bourns® standard product in the data sheet as compliant with the AEC-Q standard or "automotive grade" does not by itself mean that Bourns has approved such product for use in an automotive application.

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