

# IGBT for Automotive Applications

650 V, 30 A, D<sup>2</sup>PAK

## AFGB30T65SQDN-BW

### Features

- Maximum Junction Temperature:  $T_J = 175^{\circ}\text{C}$
- High Speed Switching Series
- $V_{CE(sat)} = 1.6\text{ V (typ.) @ } I_C = 30\text{ A}$
- Low VF Soft Recovery Co-packaged Diode
- AEC-Q101 Qualified
- 100% of the Parts are Dynamically Tested (Note 1)

### Typical Applications

- Automotive On Board Charger
- Automotive DC/DC Converter for HEV

### MAXIMUM RATINGS ( $T_C = 25^{\circ}\text{C}$ unless otherwise stated)

Parameter	Symbol	Value	Unit
Collector-to-Emitter Voltage	$V_{CES}$	650	V
Gate-to-Emitter Voltage	$V_{GES}$	$\pm 20$	V
Transient Gate-to-Emitter Voltage	$V_{GES}$	$\pm 30$	V
Collector Current ( $T_C = 25^{\circ}\text{C}$ )	$I_C$	60	A
Collector Current ( $T_C = 100^{\circ}\text{C}$ )		30	A
Pulsed Collector Current (Note 2)	$I_{CM}$	120	A
Diode Forward Current ( $T_C = 25^{\circ}\text{C}$ )	$I_F$	40	A
Diode Forward Current ( $T_C = 100^{\circ}\text{C}$ )		20	A
Pulsed Diode Maximum Forward Current (Note 2)	$I_{FM}$	120	A
Maximum Power Dissipation ( $T_C = 25^{\circ}\text{C}$ )	$P_D$	220	W
Maximum Power Dissipation ( $T_C = 100^{\circ}\text{C}$ )		110	W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	$-55$ to $+175$	$^{\circ}\text{C}$

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

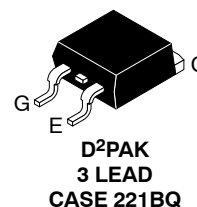
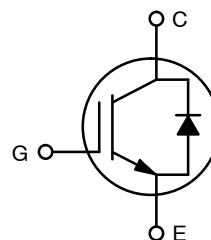
1.  $V_{CC} = 400\text{ V}$ ,  $V_{GE} = 15\text{ V}$ ,  $I_C = 90\text{ A}$ ,  $R_G = 100\ \Omega$ , Inductive Load
2. Repetitive rating: pulse width limited by max. Junction temperature
3. Surface-mounted on FR4 board using 1 in<sup>2</sup> pad size, 1 oz Cu pad.
4. The entire application environment impacts the thermal resistance values shown, they are not constants and are only valid for the particular conditions noted.



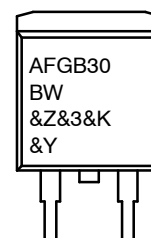
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$BV_{CES}$	$V_{CE(sat)}$ TYP	$I_C$ MAX
650 V	1.6 V	120 A



### MARKING DIAGRAM



AFGB30BW	= Specific Device Code
&Z	= Assembly Plant Code
&3	= 3-Digit Date Code
&K	= 2-Dig Lot Traceability Code
&Y	= ON Semiconductor Logo

### ORDERING INFORMATION

Device	Package	Shipping†
AFGB30T65SQDN-BW	D2PAK (TO-263)	800 Units / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# AFGB30T65SQDN-BW

**Table 1. THERMAL RESISTANCE RATINGS**

Parameter	Symbol	Max	Unit
Thermal Resistance Junction-to-Case, for IGBT	$R_{\theta JC}$	0.68	°C/W
Thermal Resistance Junction-to-Case, for Diode	$R_{\theta JC}$	1.55	
Thermal Resistance Junction-to-Ambient	$R_{\theta JA}$	40	

**Table 2. ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector-to-Emitter Breakdown Voltage	$BV_{CES}$	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	650	–	–	V
Temperature Coefficient of Breakdown Voltage	$\Delta V_{CES}/\Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 1\text{ mA}$	–	0.6	–	V/°C
Collector Cut-Off Current	$I_{CES}$	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	–	–	250	μA
G-E Leakage Current	$I_{GES}$	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	–	–	±400	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 30\text{ mA}$	3.0	4.5	6.0	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 30\text{ A}, V_{GE} = 15\text{ V}, T_C = 25^\circ\text{C}$	–	1.6	2.1	V
		$I_C = 30\text{ A}, V_{GE} = 15\text{ V}, T_C = 175^\circ\text{C}$	–	1.92	–	V
DYNAMIC CHARACTERISTICS						
Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	1871	–	pF
Output Capacitance	$C_{oes}$		–	44	–	
Reverse Transfer Capacitance	$C_{res}$		–	7	–	
SWITCHING CHARACTERISTICS						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 30\text{ A}, R_G = 6\ \Omega,$ $V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	–	14.5	–	ns
Rise Time	$t_r$		–	16	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	63.2	–	ns
Fall Time	$t_f$		–	8.3	–	ns
Turn-On Switching Loss	$E_{on}$		–	0.783	–	mJ
Turn-Off Switching Loss	$E_{off}$		–	0.160	–	mJ
Total Switching Loss	$E_{ts}$		–	0.943	–	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 30\text{ A}, R_G = 6\ \Omega,$ $V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 175^\circ\text{C}$	–	12.8	–	ns
Rise Time	$t_r$		–	20.8	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	67.2	–	ns
Fall Time	$t_f$		–	11.5	–	ns
Turn-On Switching Loss	$E_{on}$		–	1.01	–	mJ
Turn-Off Switching Loss	$E_{off}$		–	0.369	–	mJ
Total Switching Loss	$E_{ts}$		–	1.379	–	mJ
Total Gate Charge	$Q_g$	$V_{CE} = 400\text{ V}, I_C = 30\text{ A},$ $V_{GE} = 15\text{ V}$	–	56	–	nC
Gate-to-Emitter Charge	$Q_{ge}$		–	11	–	nC
Gate-to-Collector Charge	$Q_{gc}$		–	14	–	nC

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**Table 2. ELECTRICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$  unless otherwise stated)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
<b>DIODE CHARACTERISTICS</b>						
Diode Forward Voltage	$V_{FM}$	$I_F = 20\text{ A}$	–	1.5	2.1	V
Reverse Recovery Energy	$E_{rec}$	$I_F = 20\text{ A}$ $dI_F/dt = 200\text{ A}/\mu\text{s}$ , $T_C = 25^\circ\text{C}$	–	22	–	$\mu\text{J}$
Diode Reverse Recovery Time	$t_{rr}$		–	131	–	ns
Diode Reverse Recovery Charge	$Q_{rr}$		–	348	–	nC
Reverse Recovery Energy	$E_{rec}$	$I_F = 20\text{ A}$ $dI_F/dt = 200\text{ A}/\mu\text{s}$ , $T_C = 175^\circ\text{C}$	–	100	–	$\mu\text{J}$
Diode Reverse Recovery Time	$t_{rr}$		–	245	–	ns
Diode Reverse Recovery Charge	$Q_{rr}$		–	961	–	nC

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS

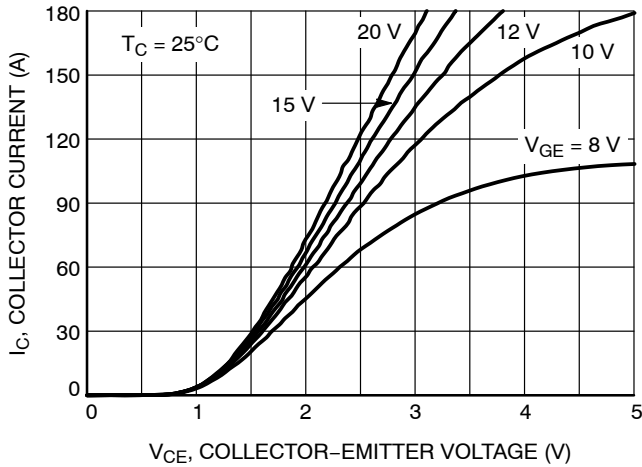


Figure 1. Typical Output Characteristics (25°C)

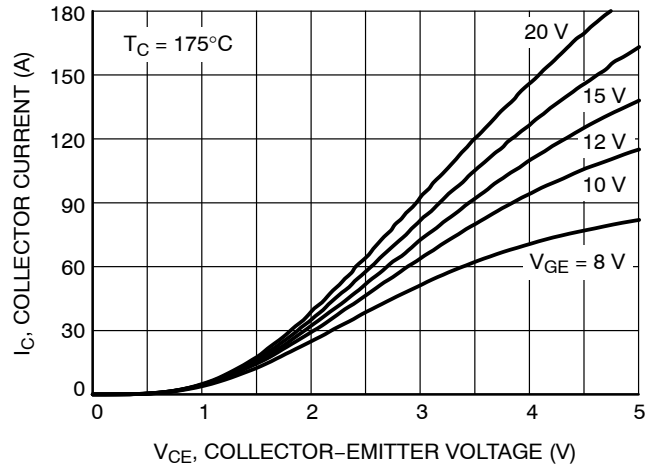


Figure 2. Typical Output Characteristics (175°C)

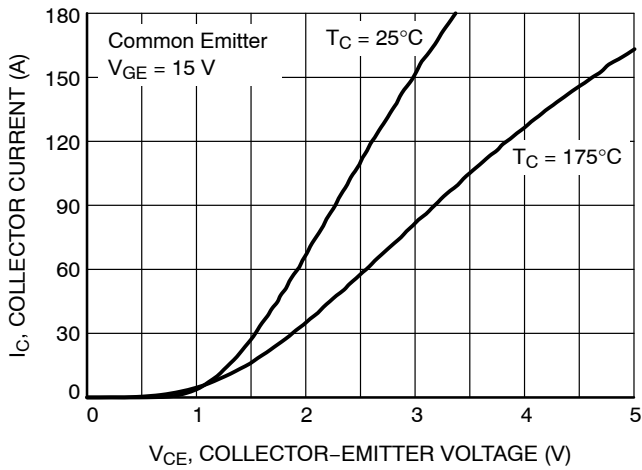


Figure 3. Typical Saturation Voltage Characteristics

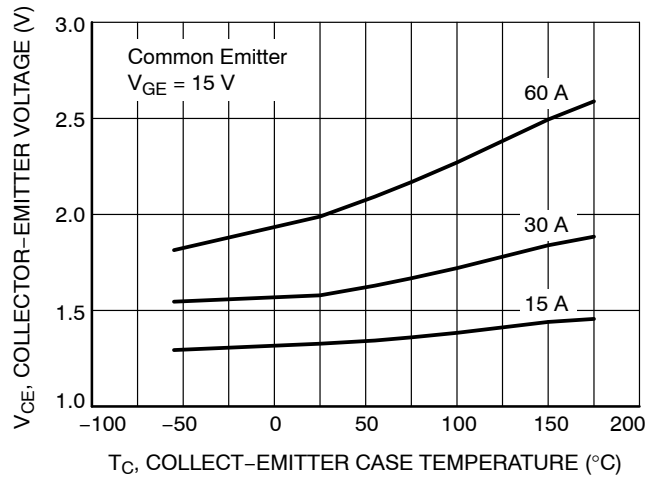


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

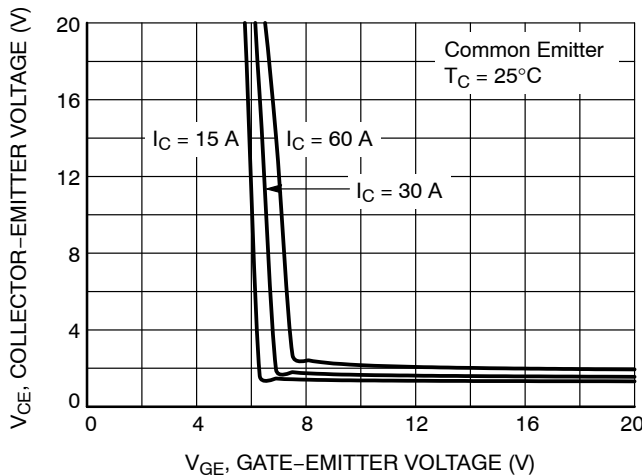


Figure 5. Saturation Voltage vs.  $V_{GE}$  (25°C)

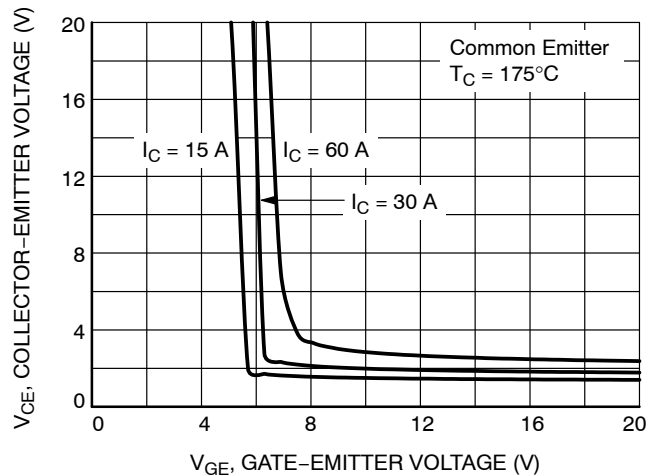


Figure 6. Saturation Voltage vs.  $V_{GE}$  (175°C)

TYPICAL CHARACTERISTICS

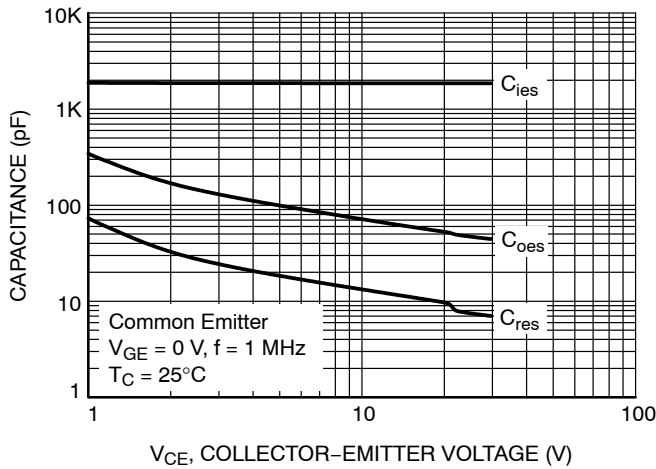


Figure 7. Capacitance Characteristics

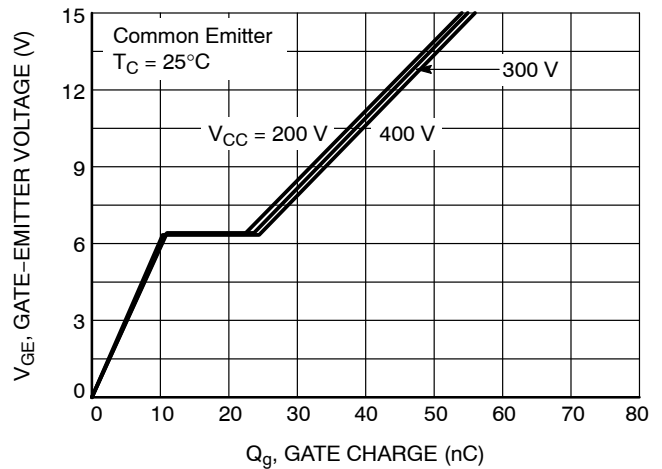


Figure 8. Gate Charge Characteristics

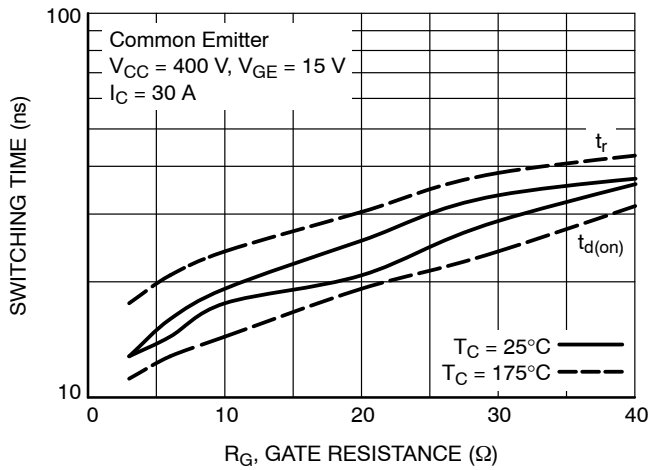


Figure 9. Turn-on Characteristics vs. Gate Resistance

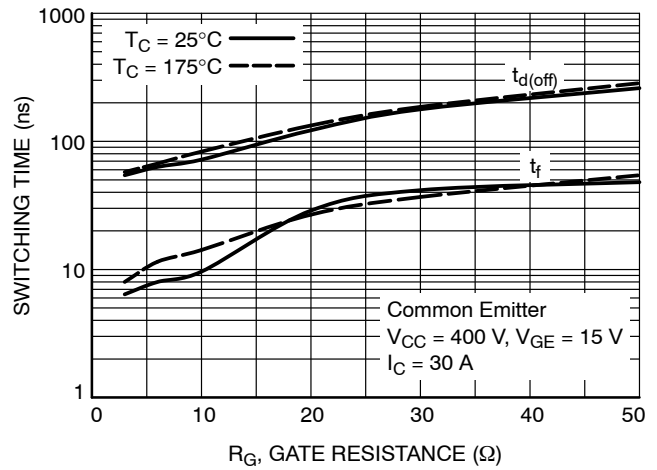


Figure 10. Turn-off Characteristics vs. Gate Resistance

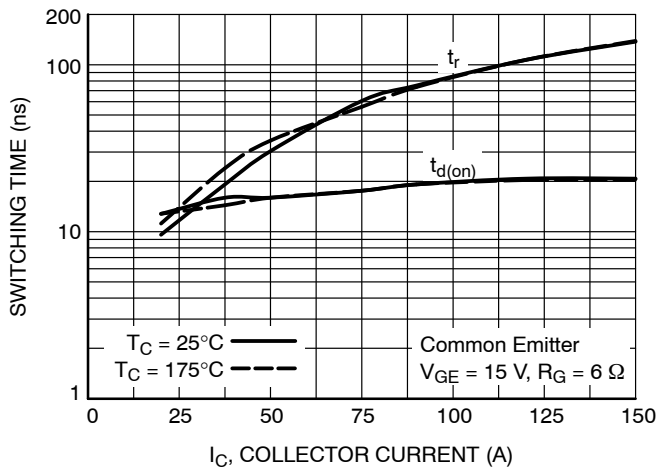


Figure 11. Turn-on Characteristics vs. Collector Current

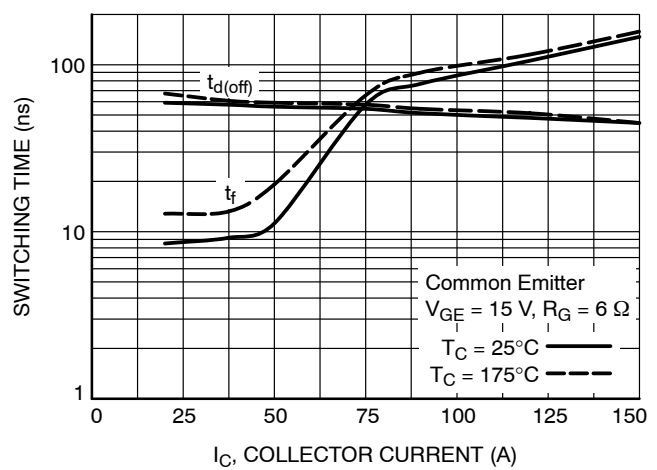


Figure 12. Turn-off Characteristics vs. Collector Current

# AFGB30T65SQDN-BW

## TYPICAL CHARACTERISTICS

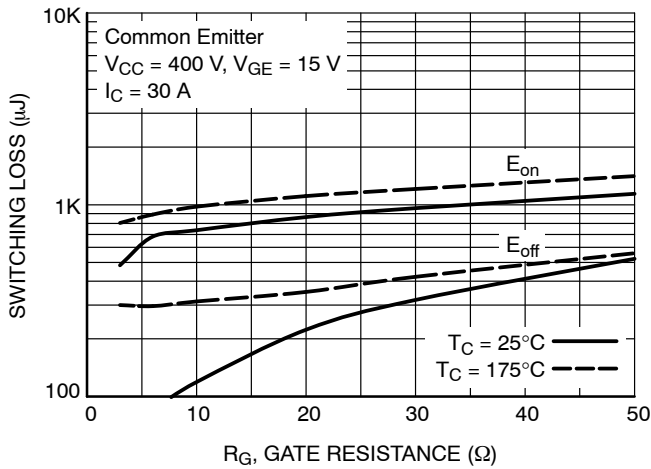


Figure 13. Switching Loss vs. Gate Resistance

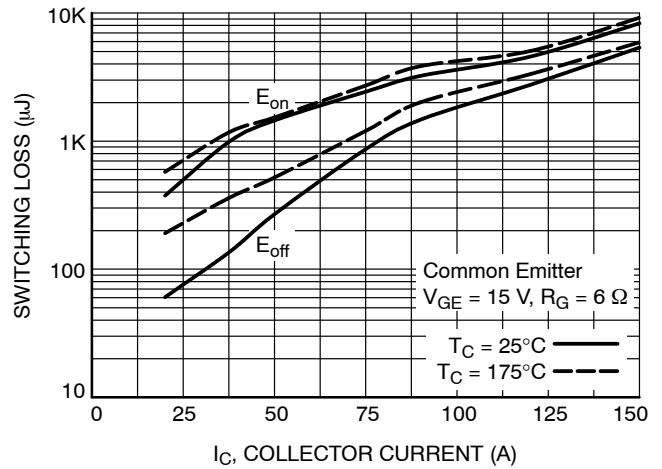


Figure 14. Switching Loss vs. Collector Current

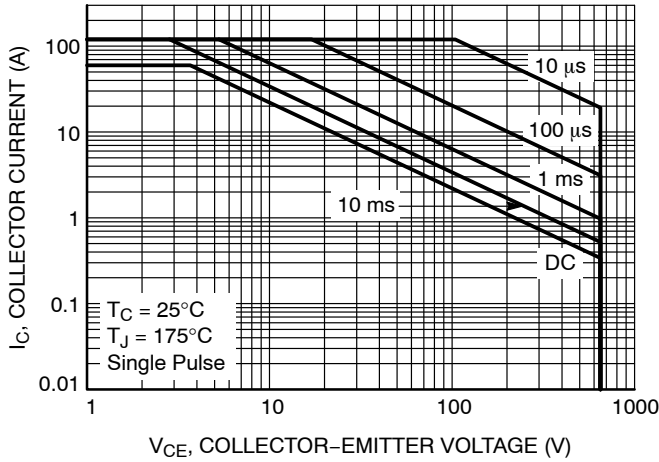


Figure 15. SOA Characteristics

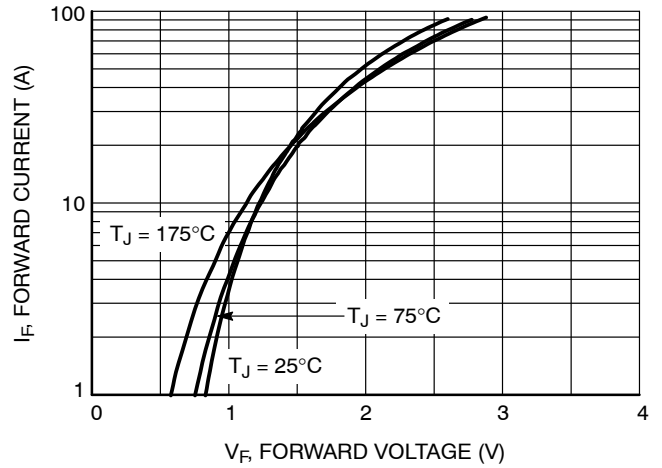


Figure 16. Forward Characteristics

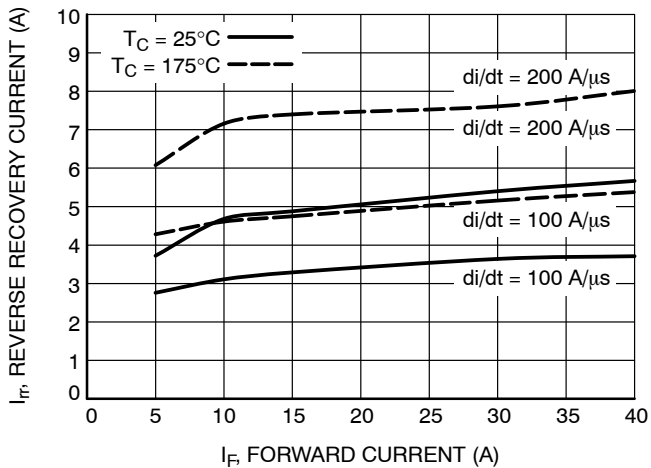


Figure 17. Reverse Recovery Current

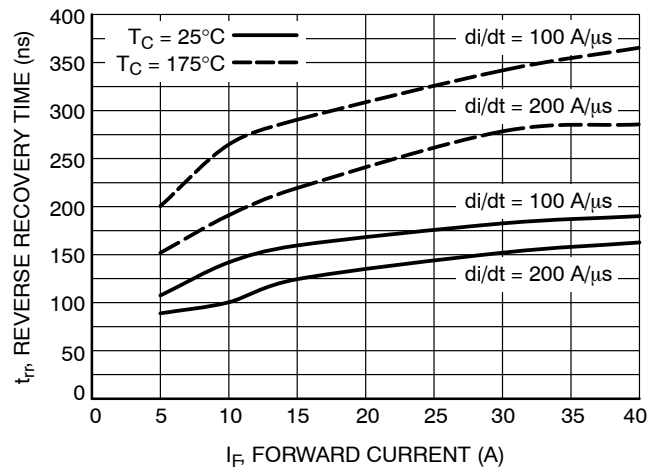


Figure 18. Reverse Recovery Time

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## TYPICAL CHARACTERISTICS

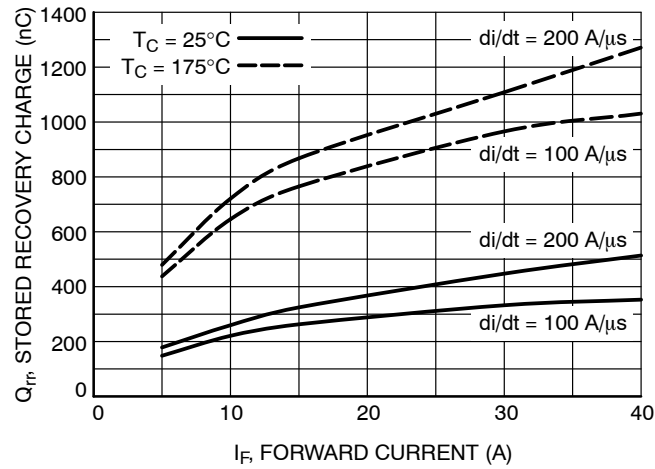


Figure 19. Stored Charge

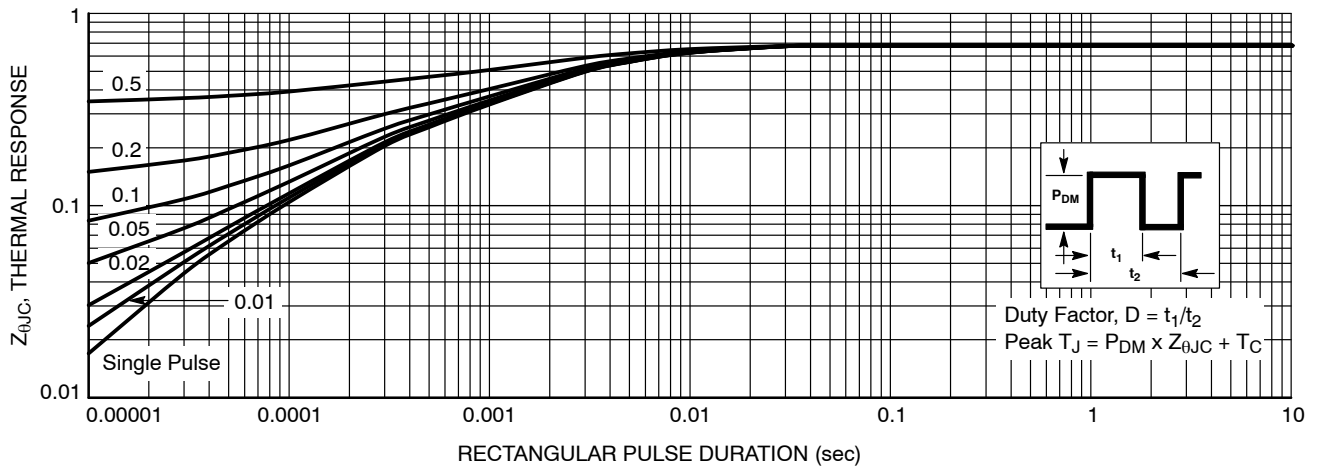


Figure 20. Transient Thermal Impedance of IGBT

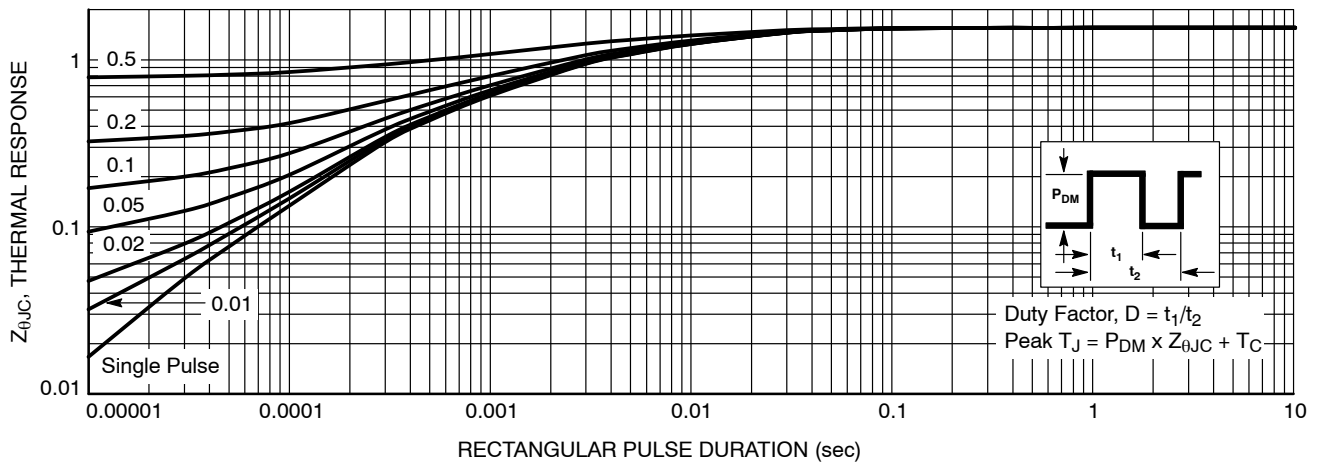


Figure 21. Transient Thermal Impedance of Diode

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

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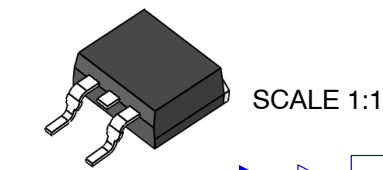
ON

### D2PAK3 (TO-263-3LD)

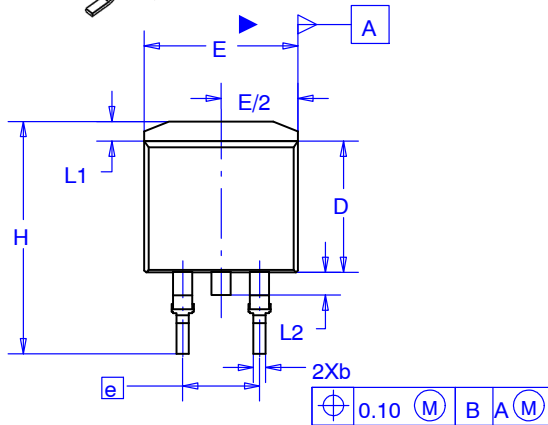
#### CASE 221BQ

#### ISSUE O

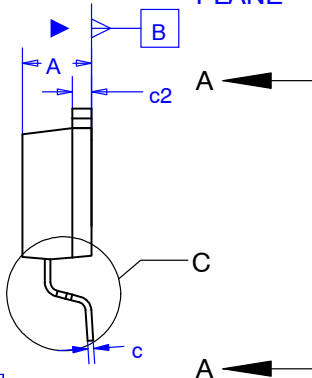
DATE 09 SEP 2020



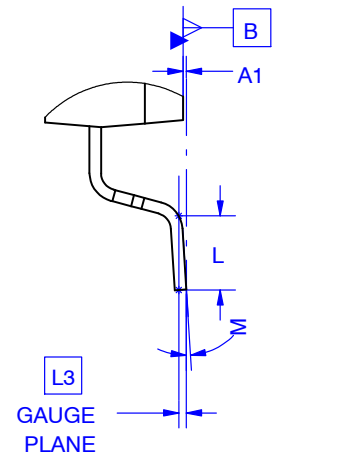
SCALE 1:1



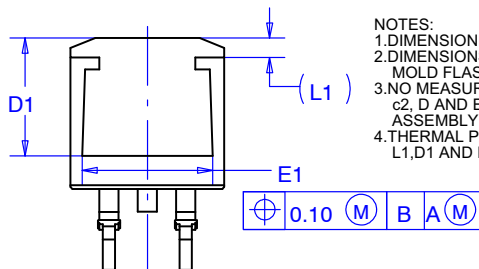
SEATING  
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SEATING  
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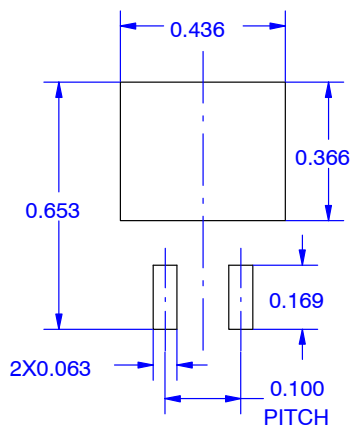


DETAIL C  
SCALE 4 : 1



- NOTES:
- 1.DIMENSIONING AND TOLERANCING PER ASME Y14.5M.2009.
  - 2.DIMENSIONS c, c2 AND D, E DO NOT INCLUDE BURR AND MOLD FLASH.
  - 3.NO MEASUREMENT AND OUTGOING VISION CAPABILITY ON c, c2, D AND E. FLASH AND BURR ARE UNAVOIDABLE IN ASSEMBLY PROCESS.
  - 4.THERMAL PAD CONTOUR IS OPTIONAL WITH DIMENSIONS E, L1, D1 AND E1.

VIEW A-A



### GENERIC MARKING DIAGRAM\*



XXXX = Specific Device Code  
A = Assembly Location  
Y = Year  
WW = Work Week  
ZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.


### RECOMMENDED MOUNTING FOOTPRINT

FOR additional information on our Pb-Free strategy and soldering, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.160	0.190	4.060	4.830
A1	0.000	0.010	0.000	0.250
b	0.020	0.039	0.510	0.990
c	0.013	0.019	0.327	0.487
c2	0.047	0.054	1.200	1.360
D	0.334	0.350	8.490	8.890
D1	0.260	---	6.600	---
E	0.380	0.420	9.650	10.670
E1	0.245	---	6.220	---
e	0.200 BSC		5.080 BSC	
H	0.575	0.625	14.600	15.880
L	0.070	0.110	1.780	2.790
L1	---	0.066	---	1.680
L2	---	0.070	---	1.780
L3	0.010 BSC		0.250 BSC	
M	-8°	8°	-8°	8°

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DESCRIPTION:	D2PAK3 (TO-263-3LD)	PAGE 1 OF 1

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