

Field Stop IGBT

600 V, 20 A

AFGB20N60SFD-BW

General Description

Using novel field-stop IGBT technology, **onsemi**'s new series of field-stop IGBTs offers the optimum performance for automotive chargers, inverters, and other applications where low conduction and switching losses are essential.

Features

- High Current Capability
- Low Saturation Voltage: $V_{CE(sat)} = 2.2 \text{ V @ } I_C = 20 \text{ A}$
- High Input Impedance
- Fast Switching
- AEC-Q101 Qualified to Automotive Requirements
- These Devices are Pb-Free and are RoHS Compliant

Typical Applications

- Inverters, SMPS, PFC, UPS
- Automotive Chargers, Converters, High Voltage Auxiliaries

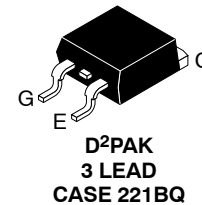
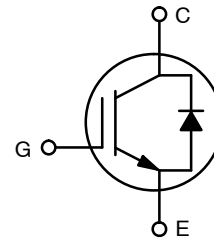
ABSOLUTE MAXIMUM RATINGS ($T_C = 25^\circ\text{C}$ unless otherwise stated)

Parameter	Symbol	Value	Unit
Collector-to-Emitter Voltage	V_{CES}	600	V
Gate-to-Emitter Voltage	V_{GES}	± 20	V
Collector Current ($T_C = 25^\circ\text{C}$)	I_C	40	A
Collector Current ($T_C = 100^\circ\text{C}$)		20	A
Pulsed Collector Current (Note 1)	I_{CM}	60	A
Diode Forward Current ($T_C = 25^\circ\text{C}$)	I_F	20	A
Diode Forward Current ($T_C = 100^\circ\text{C}$)		10	A
Pulsed Diode Maximum Forward Current (Note 1)	I_{FM}	60	A
Maximum Power Dissipation ($T_C = 25^\circ\text{C}$)	P_D	208	W
Maximum Power Dissipation ($T_C = 100^\circ\text{C}$)		83	W
Operating Junction and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ\text{C}$
Maximum Lead Temp. For Soldering Purposes, 1/8" from case for 5 seconds	T_L	300	$^\circ\text{C}$

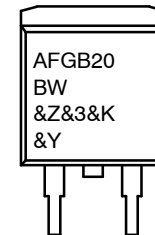
Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Repetitive rating: pulse width limited by max. junction temperature

BV_{CES}	$V_{CE(sat)}$ TYP	I_C MAX
600 V	2.2 V	60 A



MARKING DIAGRAM



AFGB20BW = Specific Device Code
 &Z = Assembly Plant Code
 &3 = 3-Digit Date Code
 &K = 2-Dig Lot Traceability Code
 &Y = **onsemi** Logo

ORDERING INFORMATION

Device	Package	Shipping†
AFGB20N60SFD-BW	D2PAK (TO-263)	800 Units / Tape & Reel
AFGB20N60SFD-BW7		

†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.

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Table 1. THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Thermal Resistance Junction-to-Case, for IGBT	$R_{\theta JC}$	0.6	°C/W
Thermal Resistance Junction-to-Case, for Diode	$R_{\theta JC}$	2.6	
Thermal Resistance Junction-to-Ambient (PCB Mount) (Note 2)	$R_{\theta JA}$	75	

2. $R_{\theta JC}$ for D2-PAK: according to Mil standard 883–1012 test method.

$R_{\theta JA}$ for D2-PAK: according to JESD51–2, test method environmental condition and JESD51–3, low effective thermal conductivity test board for leaded surface mount package. thermal measurements. JESD51–2: Integrated Circuits Thermal Test Method Environmental Conditions – Natural Convection (Still Air).

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector-to-Emitter Breakdown Voltage	BV_{CES}	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	600	–	–	V
Temperature Coefficient of Breakdown Voltage	$\Delta BV_{CES} / \Delta T_J$	$V_{GE} = 0\text{ V}, I_C = 250\text{ }\mu\text{A}$	–	0.79	–	V/°C
Collector Cut-Off Current	I_{CES}	$V_{CE} = V_{CES}, V_{GE} = 0\text{ V}$	–	–	250	μA
		ICES at 80% *BV _{CES} , 150°C	–	–	250	
G–E Leakage Current	I_{GES}	$V_{GE} = V_{GES}, V_{CE} = 0\text{ V}$	–	–	±400	nA

ON CHARACTERISTICS

G–E Threshold Voltage	$V_{GE(th)}$	$V_{GE} = V_{CE}, I_C = 250\text{ }\mu\text{A}$	4.0	4.8	6.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	$I_C = 20\text{ A}, V_{GE} = 15\text{ V}, T_C = 25^\circ\text{C}$	–	2.2	2.85	V
		$I_C = 20\text{ A}, V_{GE} = 15\text{ V}, T_C = 125^\circ\text{C}$	–	2.4	–	V

DYNAMIC CHARACTERISTICS

Input Capacitance	C_{ies}	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	940	1250	pF
Output Capacitance	C_{oes}		–	110	146	
Reverse Transfer Capacitance	C_{res}		–	40	53	

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 20\text{ A}, R_G = 10\text{ }\Omega,$ $V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	–	10	13	ns
Rise Time	t_r		–	16	21	ns
Turn-Off Delay Time	$t_{d(off)}$		–	90	120	ns
Fall Time	t_f		–	24	36	ns
Turn-On Switching Loss	E_{on}		–	0.31	0.41	mJ
Turn-Off Switching Loss	E_{off}		–	0.13	0.21	mJ
Total Switching Loss	E_{ts}		–	0.44	0.59	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{ V}, I_C = 20\text{ A}, R_G = 10\text{ }\Omega,$ $V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 125^\circ\text{C}$	–	12	16	ns
Rise Time	t_r		–	16	21	ns
Turn-Off Delay Time	$t_{d(off)}$		–	95	126	ns
Fall Time	t_f		–	28	43	ns
Turn-On Switching Loss	E_{on}		–	0.45	0.60	mJ
Turn-Off Switching Loss	E_{off}		–	0.21	0.38	mJ
Total Switching Loss	E_{ts}		–	0.66	0.88	mJ
Total Gate Charge	Q_g	$V_{CE} = 400\text{ V}, I_C = 20\text{ A},$ $V_{GE} = 15\text{ V}$	–	63	95	nC
Gate-to-Emitter Charge	Q_{ge}		–	7	11	nC
Gate-to-Collector Charge	Q_{gc}		–	32	48	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
DIODE CHARACTERISTICS						
Diode Forward Voltage	V_{FM}	$I_F = 10\text{ A}, T_C = 25^\circ\text{C}$	–	1.9	2.5	V
		$I_F = 10\text{ A}, T_C = 125^\circ\text{C}$	–	1.7	–	
Diode Reverse Recovery Time	t_{rr}	$I_{ES} = 10\text{ A}$ $dI_{ES}/dt = 200\text{ A}/\mu\text{s}, T_C = 25^\circ\text{C}$	–	111	–	ns
Diode Reverse Recovery Charge	Q_{rr}		–	174	244	nC
Diode Reverse Recovery Time	t_{rr}	$I_{ES} = 10\text{ A}$ $dI_{ES}/dt = 200\text{ A}/\mu\text{s}, T_C = 125^\circ\text{C}$	–	204	–	ns
Diode Reverse Recovery Charge	Q_{rr}		–	463	–	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 PERFORMANCE CHARACTERISTICS

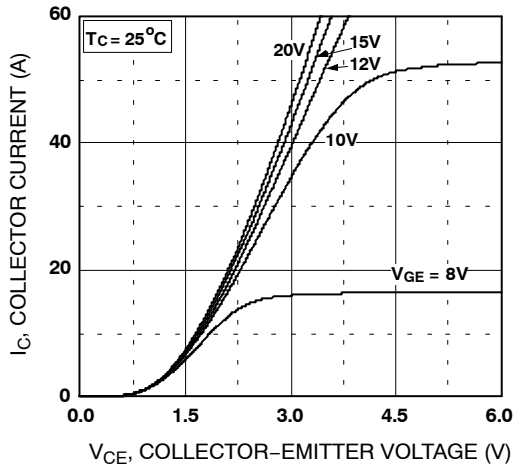


Figure 1. Typical Output Characteristics (25°C)

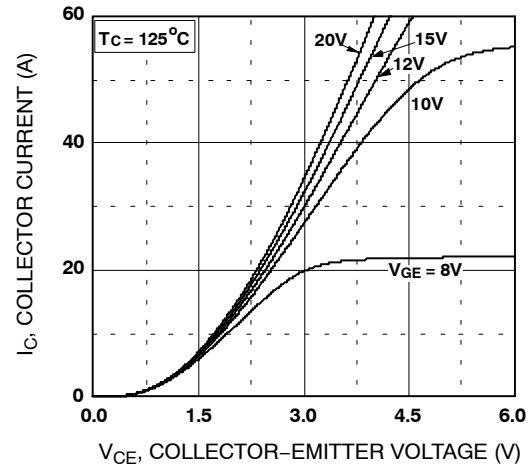


Figure 2. Typical Output Characteristics (125°C)

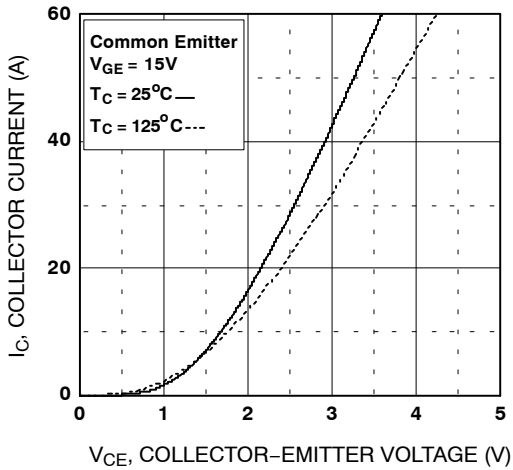


Figure 3. Typical Saturation Voltage Characteristics

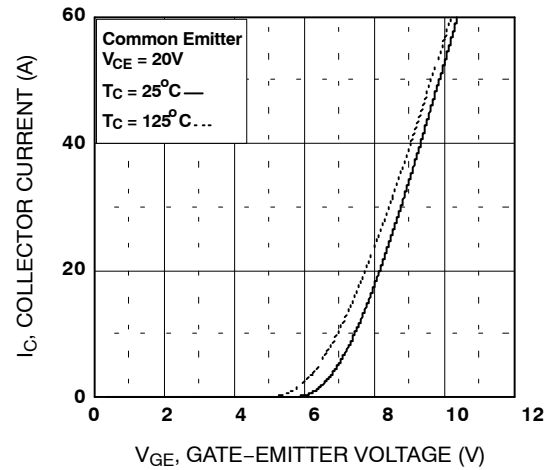


Figure 4. Transfer Characteristics

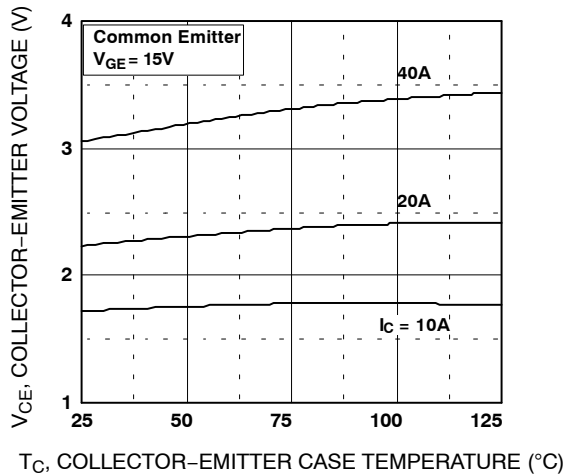


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

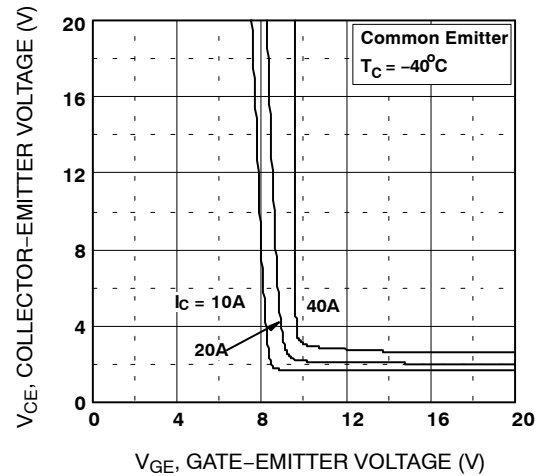


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS

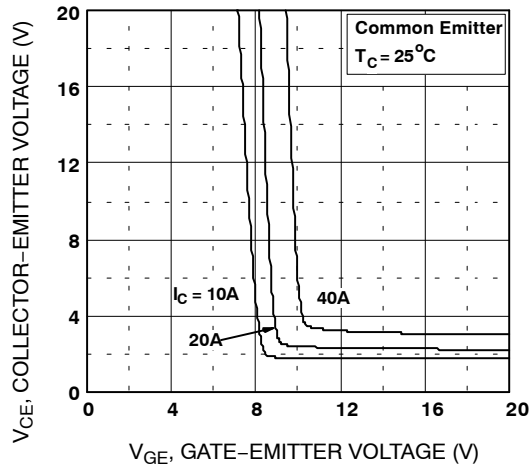


Figure 7. Saturation Voltage vs. V_{GE}

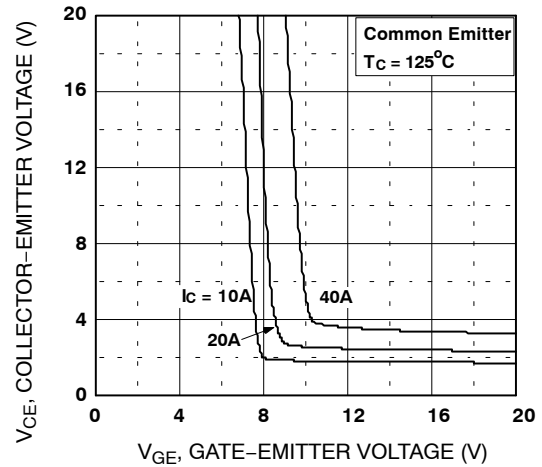


Figure 8. Saturation Voltage vs. V_{GE}

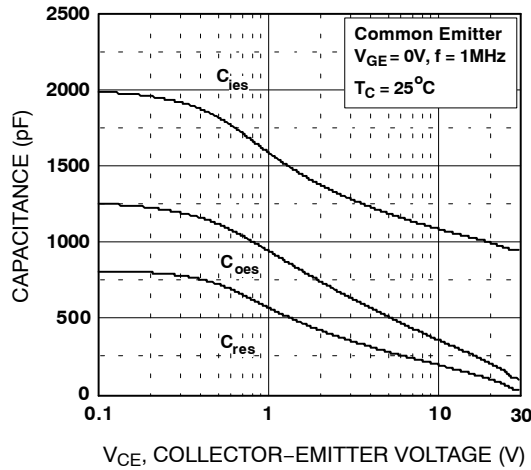


Figure 9. Capacitance Characteristics

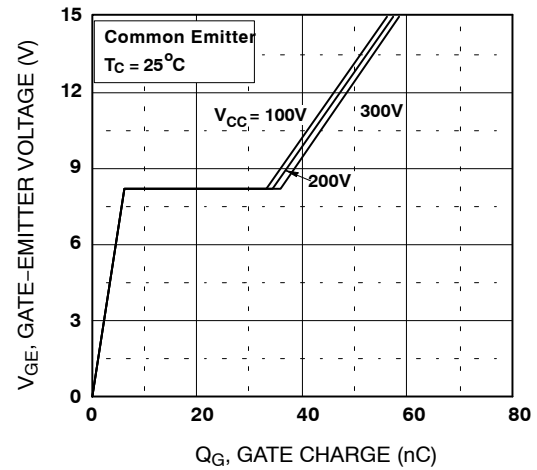


Figure 10. Gate Charge Characteristics

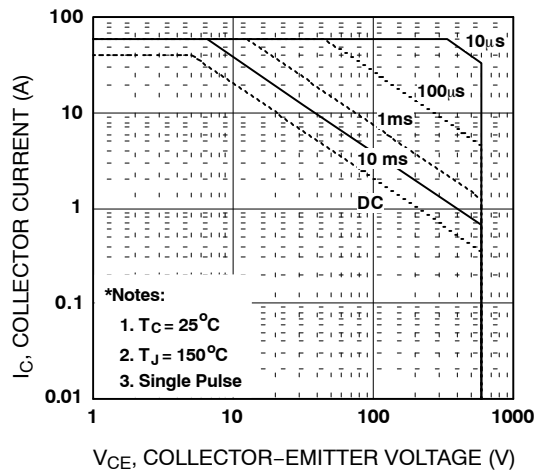


Figure 11. SOA Characteristics

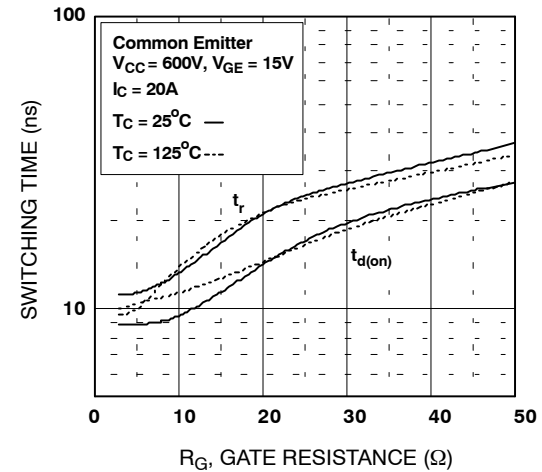


Figure 12. Turn-on Characteristics vs. Gate Resistance

TYPICAL PERFORMANCE CHARACTERISTICS

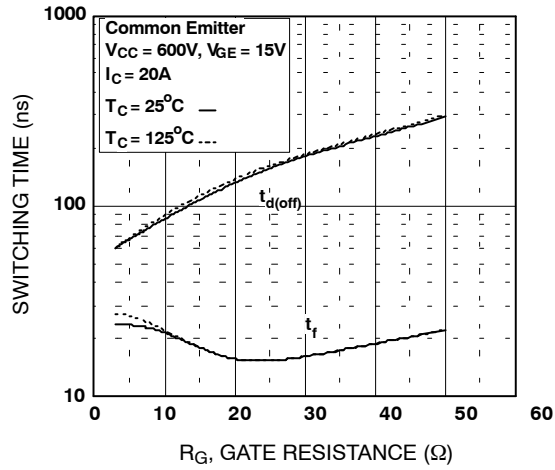


Figure 13. Turn-off Characteristics vs. Gate Resistance

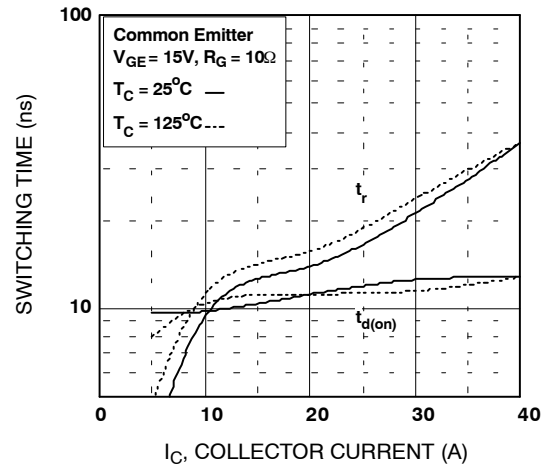


Figure 14. Turn-on Characteristics vs. Collector Current

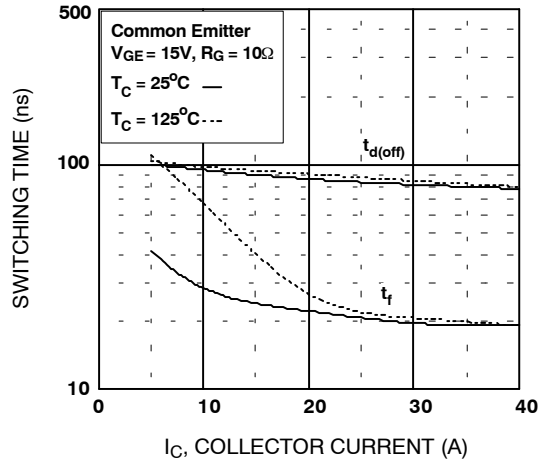


Figure 15. Turn-off Characteristics vs. Collector Current

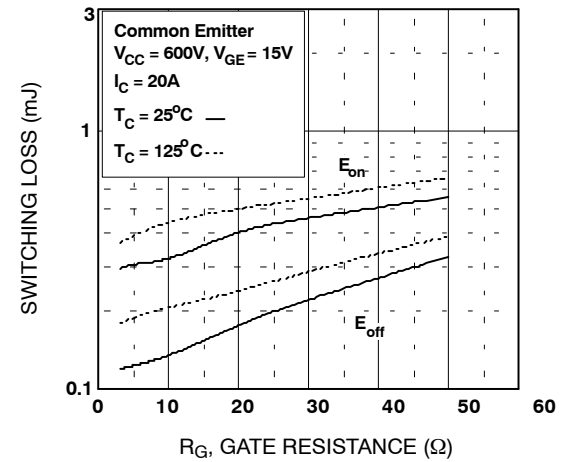


Figure 16. Switching Loss vs. Gate Resistance

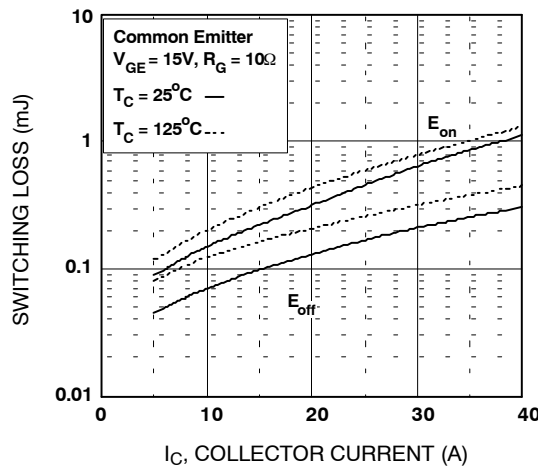


Figure 17. Switching Loss vs. Collector Current

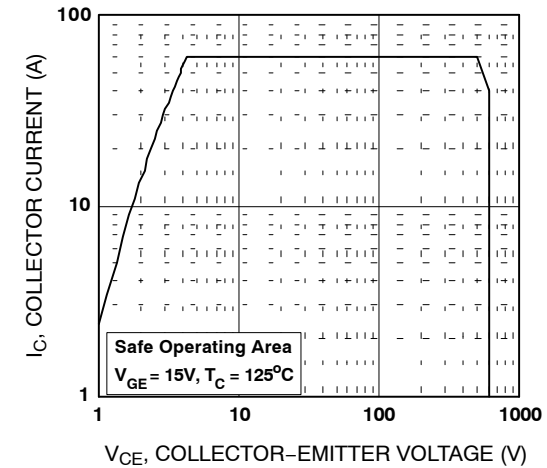


Figure 18. Turn off Switching SOA Characteristics

TYPICAL PERFORMANCE CHARACTERISTICS

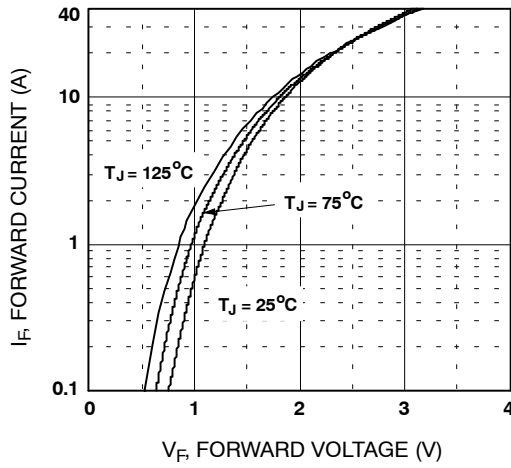


Figure 19. Forward Characteristics

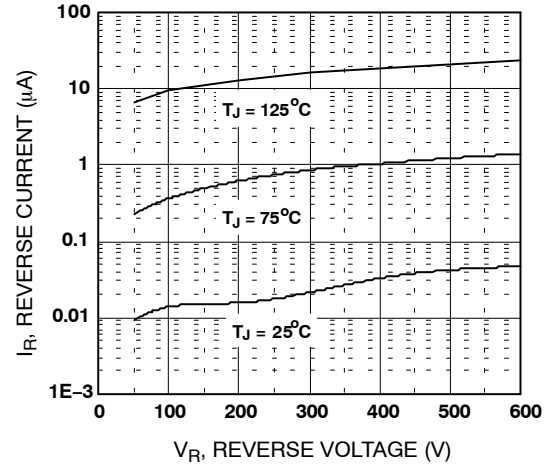


Figure 20. Typical Reverse Current vs. Reverse Voltage

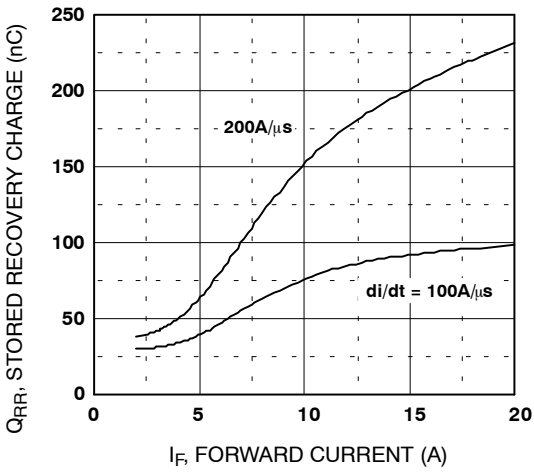


Figure 21. Stored Charge

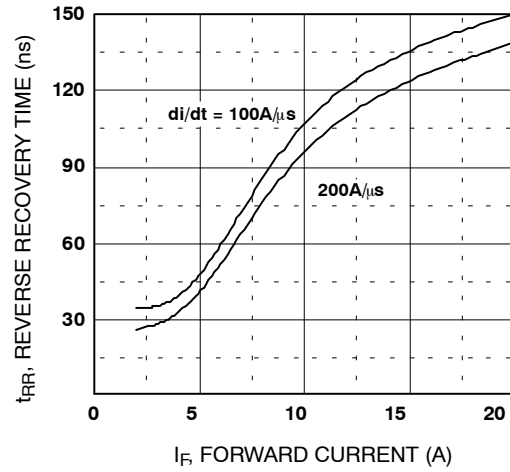


Figure 22. Reverse Recovery Time

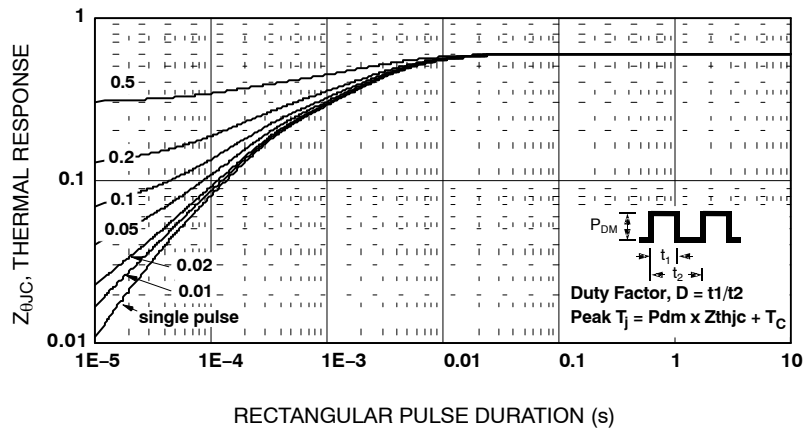


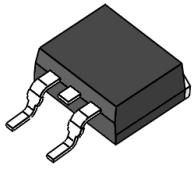
Figure 23. Transient Thermal Impedance of IGBT

AFGB20N60SFD-BW

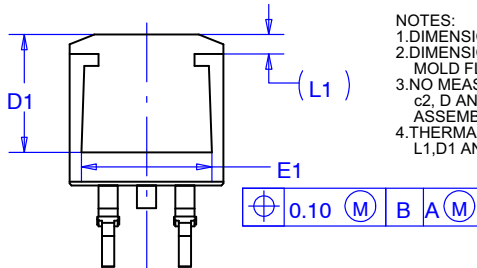
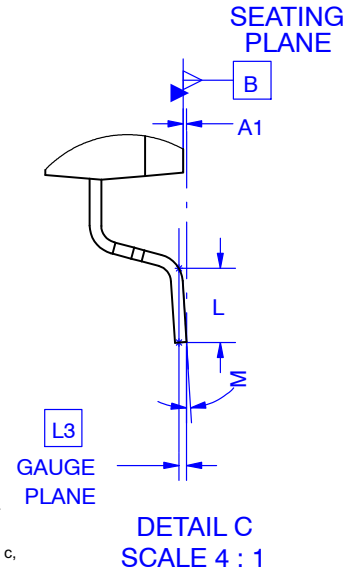
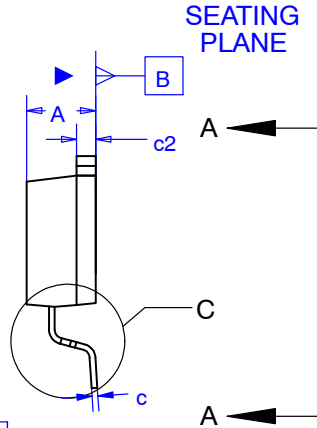
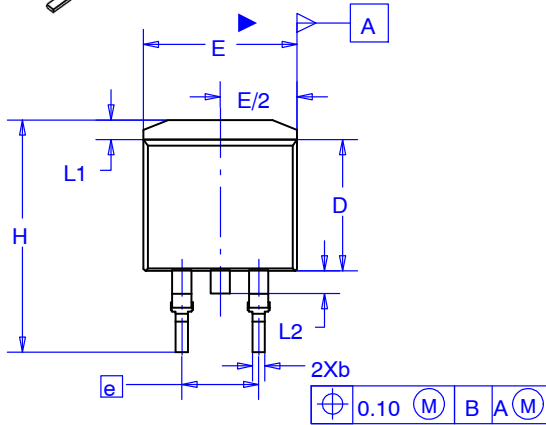
PACKAGE DIMENSIONS

D2PAK3 (TO-263-3LD)
CASE 221BQ
ISSUE O

DATE 09 SEP 2020

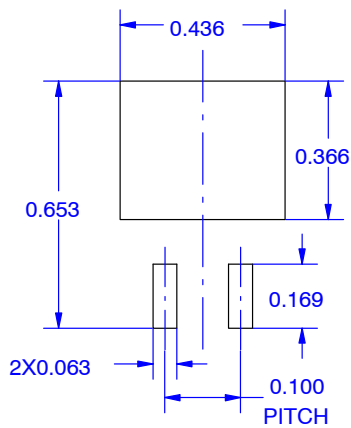


SCALE 1:1



- 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



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.

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.

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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