Field Stop Trench IGBT, 20 A, 650 V

FGAF20S65AQ

Using novel field stop IGBT technology, ON Semiconductor's new series of field stop 4th generation of RC IGBTs offer the optimum performance for PFC applications and welder where low conduction and switching losses are essential.

Features

- Maximum Junction Temperature: T_J = 175°C
- Positive Temperature Co−efficient for Easy Parallel Operating
- High Current Capability
- Low Saturation Voltage: $V_{CE(Sat)}$ = 1.4 V (Typ.) @ I_C = 20 A
- 100% of the Parts Tested for I_{LM} (Note 1)
- High Input Impedance
- Fast Switching
- Tighten Parameter Distribution
- IGBT with Monolithic Reverse Conducting Diode
- This Device is Pb−Free and is RoHS Compliant

Typical Applications

- PFC, Welder

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector to Emitter Voltage	V_{CES}	650	V
Gate to Emitter Voltage Transient Gate to Emitter Voltage	V_{GES}	±20 ±30	V
Collector Current @T_C = 25°C @T_C = 100°C	I_C	40 20	A
Pulsed Collector Current (Note 1)	I_{LM}	60	A
Pulsed Collector Current (Note 2)	I_{CM}	60	A
Diode Forward Current @T_C = 25°C @ T_C = 100°C	I_F	20 10	A
Pulsed Diode Maximum Forward Current	I_{FM}	60	A
Maximum Power Dissipation@T_C = 25°C @ T_C = 100°C	P_D	75 37	W
Operating Junction / Storage Temperature Range	T_J, T_{STG}	−55 to +175	°C
Maximum Lead Temp. for Soldering Purposes, 1/8″ from case for 5 seconds	T_L	260	°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 V, V_{GE} = 15 V, I_C = 60 A, R_G = 23 Ω, Inductive Load, 100% Tested
2. Repetitive rating: pulse width limited by max. Junction temperature

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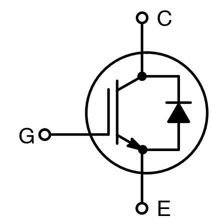
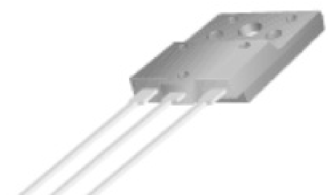
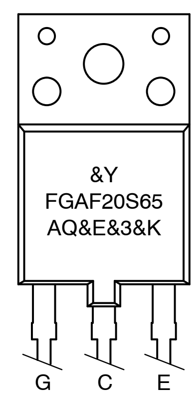
20 A, 650 V
$V_{CE(sat)}$ = 1.4 V (Typ.)





TO−3PF
CASE 340AH

MARKING DIAGRAM



&Y = ON Semiconductor Logo
&E = Designate space on marking
&3 = 3−Digit Data Code
&K = 2−Digit Lot Traceability Code
FGAF20S65AQ = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
FGAF20S65AQ	TO−3PF−3L	30 Units / Rail

Table 1. THERMAL CHARACTERISTICS

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction−to−Case, for IGBT	$R_{\theta JC}$	2	°C/W
Thermal Resistance, Junction−to−Case, for Diode	$R_{\theta JC}$	3.6	°C/W
Thermal Resistance, Junction−to−Ambient	$R_{\theta JA}$	40	°C/W

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTIC						
Collector−emitter breakdown voltage, gate−emitter short−circuited	V_{GE} = 0 V, I_C = 1 mA	BV_{CES}	650	–	–	V
Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 1 mA	ΔBV_{CES} / ΔT_J	–	0.5	–	V/°C
Collector−emitter cut−off current, gate−emitter short−circuited	V_{GE} = 0 V, V_{CE} = 650 V	I_{CES}	–	–	250	μA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	–	–	±400	nA
ON CHARACTERISTIC						
Gate−emitter threshold voltage	V_{GE} = V_{CE}, I_C = 20 mA	$V_{GE(th)}$	2.6	5.3	6.6	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 20 A V_{GE} = 15 V, I_C = 20 A, T_J = 175°C	$V_{CE(sat)}$	– –	1.4 1.7	2.1 –	V
DYNAMIC CHARACTERISTIC						
Input capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	1319	–	pF
Output capacitance		C_{oes}	–	21	–	
Reverse transfer capacitance		C_{res}	–	6	–	
Gate charge total	V_{CE} = 400 V, I_C = 20 A, V_{GE} = 15 V	Q_g	–	38	–	nC
Gate to emitter charge		Q_{ge}	–	9	–	
Gate to collector charge		Q_{gc}	–	11	–	
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn−on delay time	T_J = 25°C V_{CC} = 400 V, I_C = 5 A R_g = 23 Ω V_{GE} = 15 V Inductive Load	$t_{d(on)}$	–	16	–	ns
Rise time		t_r	–	6.4	–	
Turn−off delay time		$t_{d(off)}$	–	109	–	
Fall time		t_f	–	27	–	
Turn−on switching loss		E_{on}	–	200	–	μJ
Turn−off switching loss		E_{off}	–	56	–	
Total switching loss		E_{ts}	–	256	–	
Turn−on delay time	T_J = 25°C V_{CC} = 400 V, I_C = 10 A R_g = 23 Ω V_{GE} = 15 V Inductive Load	$t_{d(on)}$	–	18	–	ns
Rise time		t_r	–	11	–	
Turn−off delay time		$t_{d(off)}$	–	102	–	
Fall time		t_f	–	21	–	
Turn−on switching loss		E_{on}	–	345	–	μJ
Turn−off switching loss		E_{off}	–	95	–	
Total switching loss		E_{ts}	–	440	–	

Table 2. ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn−on delay time	T_J = 175°C V_{CC} = 400 V, I_C = 5 A R_g = 23 Ω V_{GE} = 15 V Inductive Load	$t_{d(on)}$	–	14.4	–	ns
Rise time		t_r	–	6.4	–	
Turn−off delay time		$t_{d(off)}$	–	118	–	
Fall time		t_f	–	51	–	
Turn−on switching loss		E_{on}	–	301	–	μJ
Turn−off switching loss		E_{off}	–	94	–	
Total switching loss		E_{ts}	–	395	–	
Turn−on delay time	T_J = 175°C V_{CC} = 400 V, I_C = 10 A R_g = 23 Ω V_{GE} = 15 V Inductive Load	$t_{d(on)}$	–	16	–	ns
Rise time		t_r	–	12	–	
Turn−off delay time		$t_{d(off)}$	–	114	–	
Fall time		t_f	–	46	–	
Turn−on switching loss		E_{on}	–	466	–	μJ
Turn−off switching loss		E_{off}	–	177	–	
Total switching loss		E_{ts}	–	643	–	
DIODE CHARACTERISTIC						
Forward Voltage	I_F = 10 A I_F = 10 A, T_J = 175°C	V_F	– –	1.3 1.3	1.6 –	V
Reverse Recovery Energy	I_F = 10 A, dI_F/dt = 200 A/μs	E_{rec}	–	179	–	μJ
Diode Reverse Recovery Time	I_F = 10 A, dI_F/dt = 200 A/μs I_F =10 A, dI_F/dt = 200 A/μs, T_J = 175°C	T_{rr}	–	235 302	–	nS
Diode Reverse Recovery Charge	I_F = 10 A, dI_F/dt = 200 A/μs I_F = 10 A, dI_F/dt = 200 A/μs, T_J = 175°C	Q_{rr}	–	802 1286	–	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

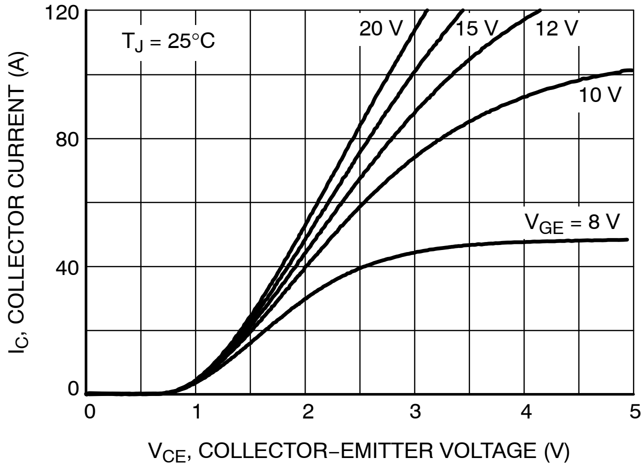


Figure 1. Typical Output Characteristics

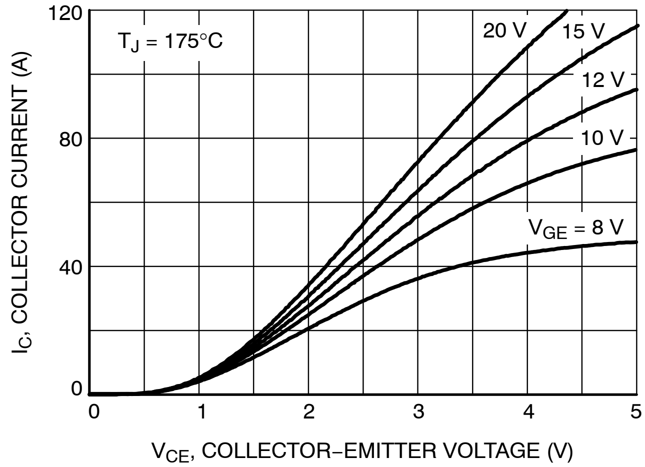


Figure 2. Typical Output Characteristics

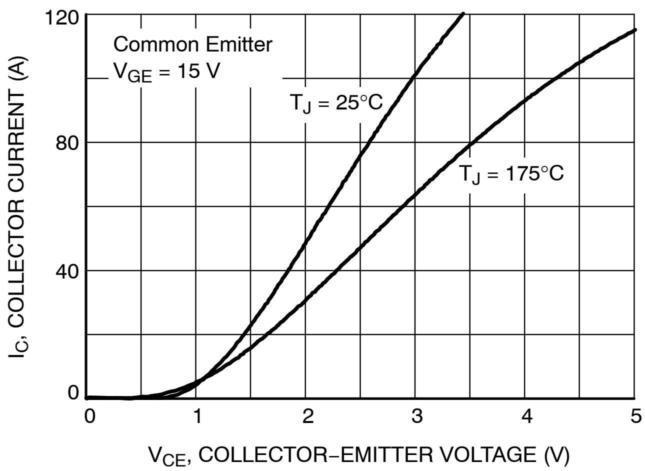


Figure 3. Typical Saturation Voltage Characteristics

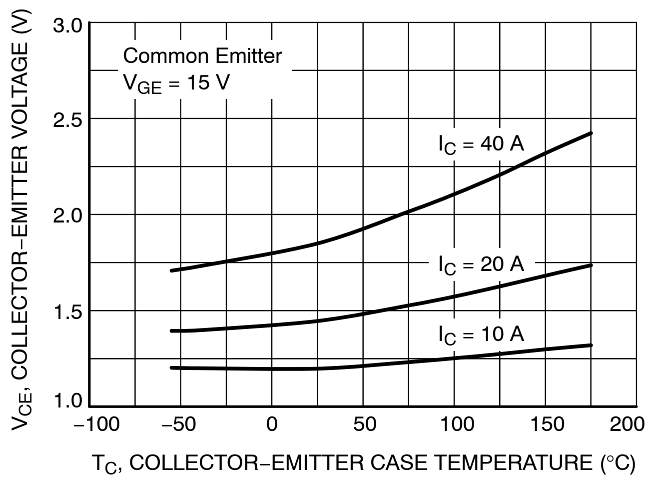


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

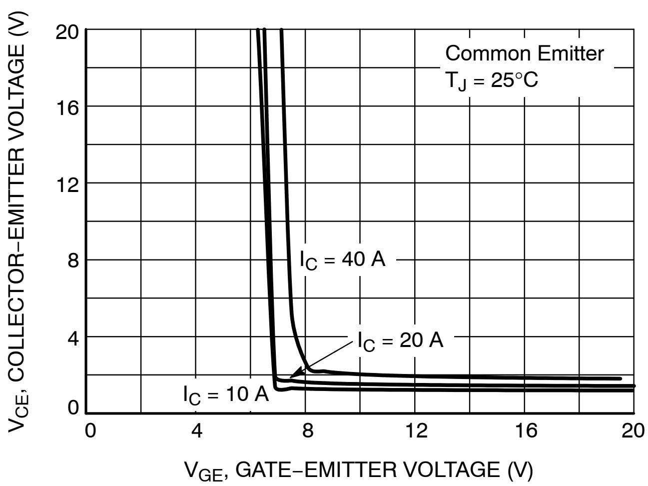


Figure 5. Saturation Voltage vs. V_{GE}

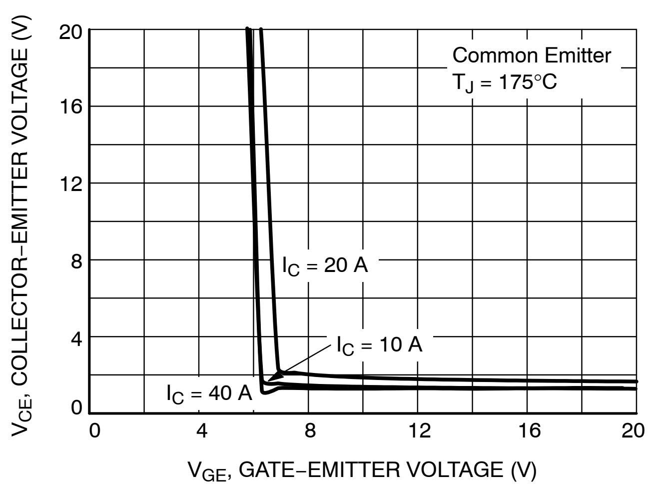


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL CHARACTERISTICS

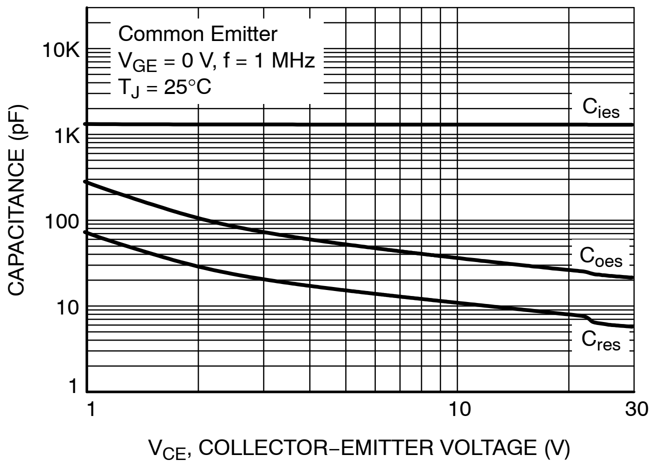


Figure 7. Capacitance Characteristics

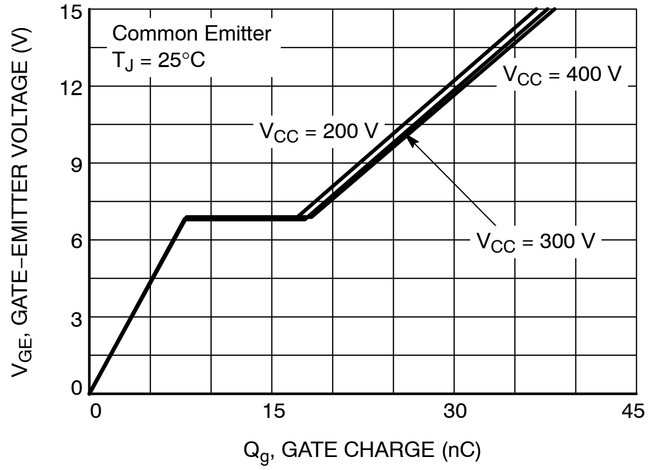


Figure 8. Gate Charge

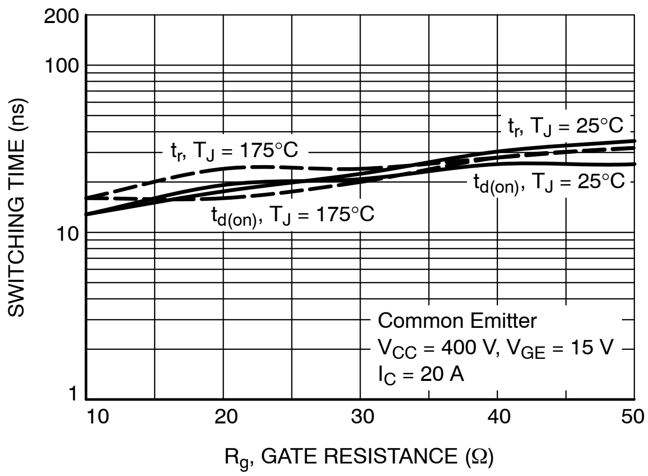


Figure 9. Turn−On Characteristics vs. Gate Resistance

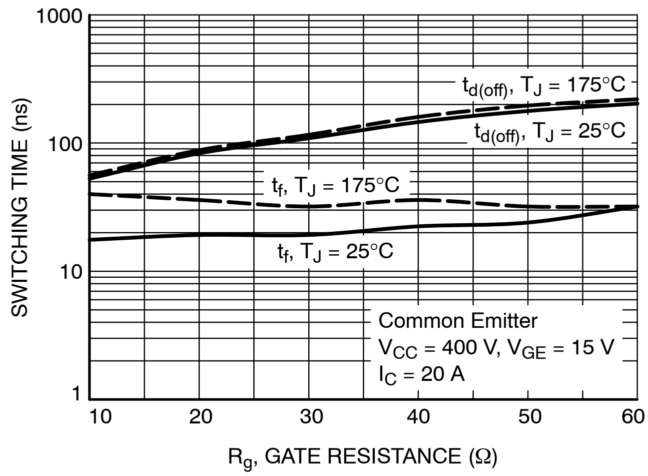


Figure 10. Turn−Off Characteristics vs. Gate Resistance

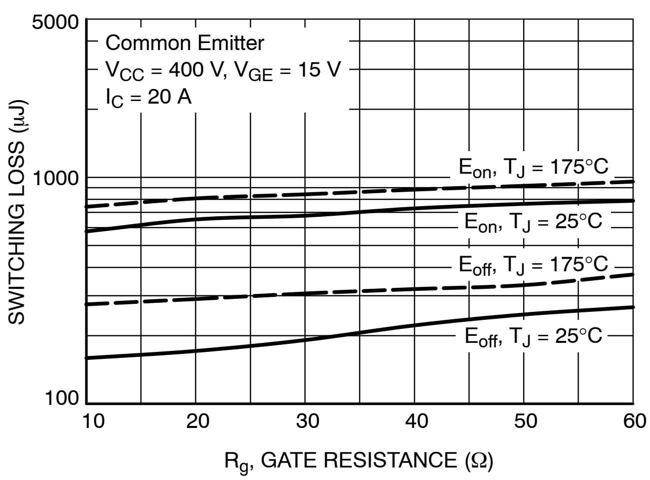


Figure 11. Switching Loss vs. Gate Resistance

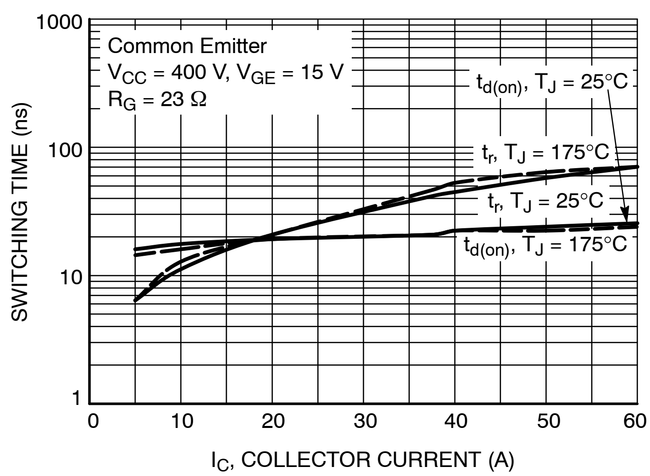


Figure 12. Turn−On Characteristics vs. Collector Current

TYPICAL CHARACTERISTICS

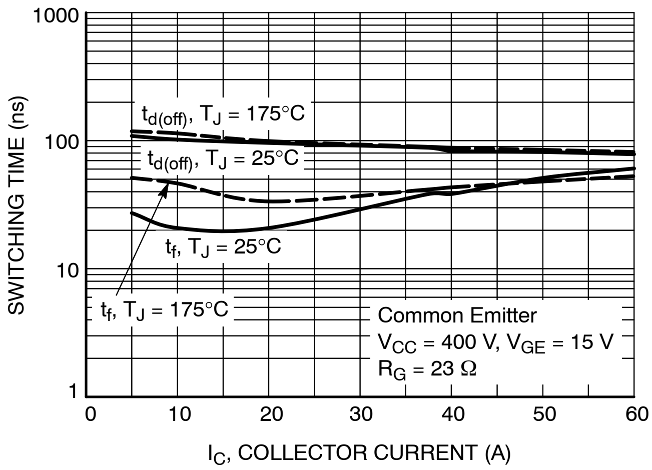


Figure 13. Turn−Off Characteristics vs. Collector Current

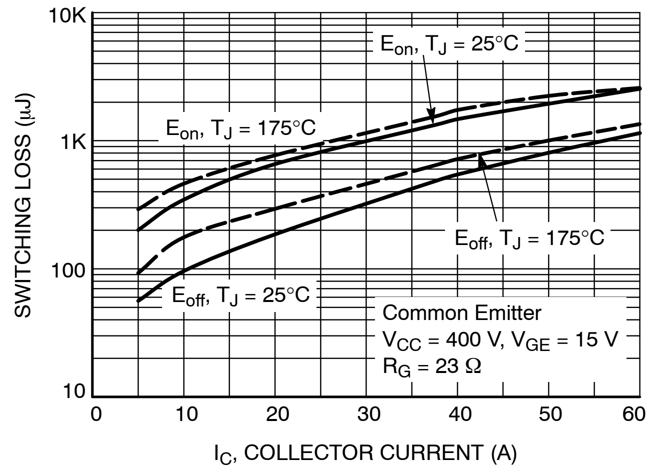


Figure 14. Switching Loss vs. Collector Current

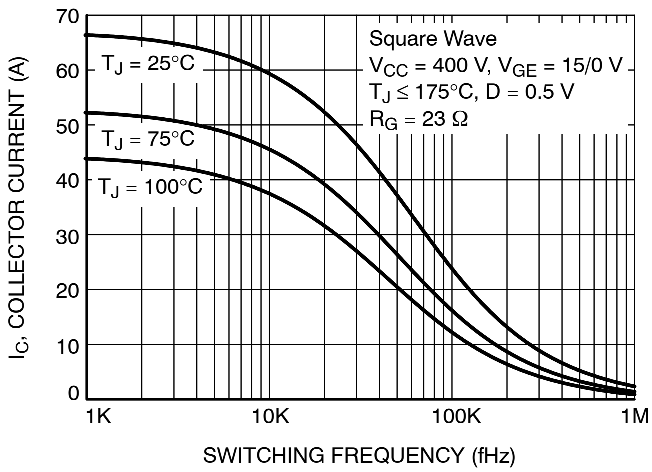


Figure 15. Load Current vs. Frequency

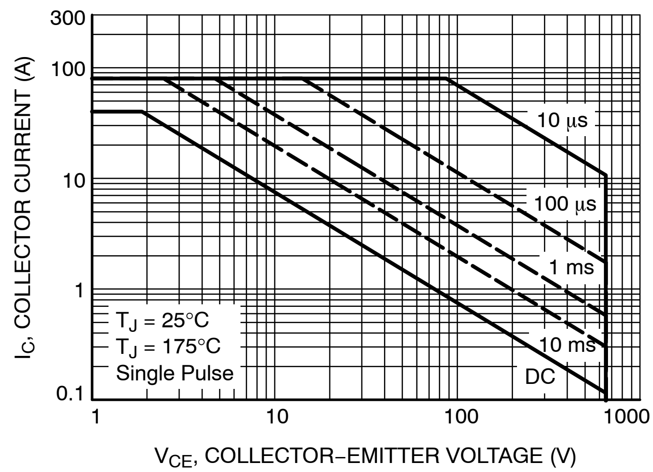


Figure 16. SOA Characteristics (FBSOA)

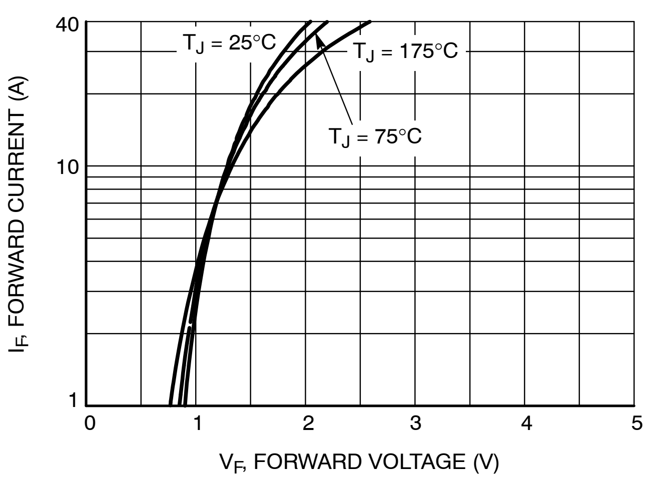


Figure 17. Forward Characteristics

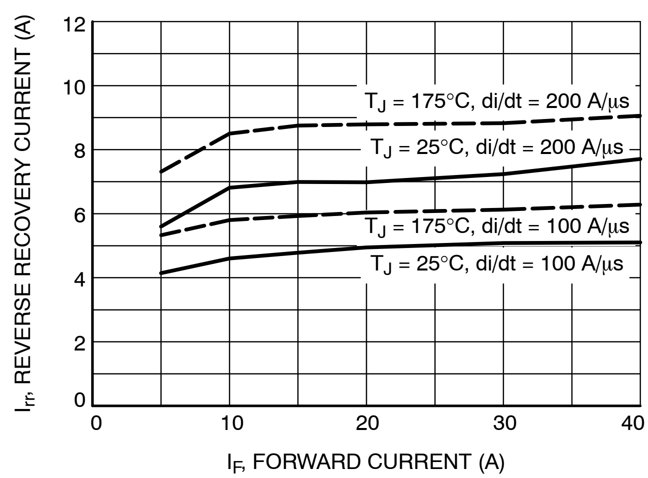


Figure 18. Reverse Recovery Current

TYPICAL CHARACTERISTICS

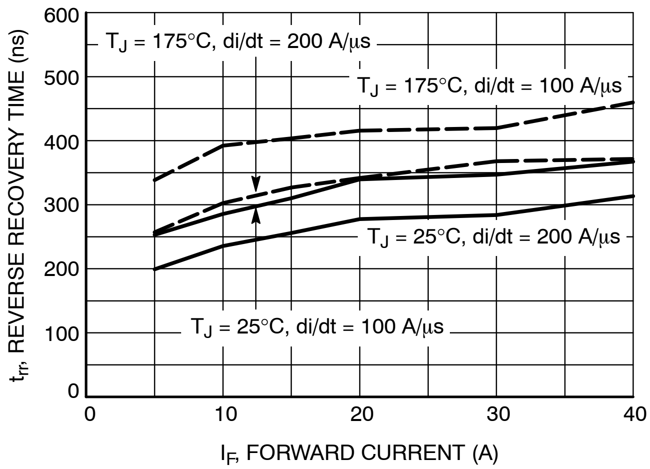


Figure 19. Reverse Recovery Time

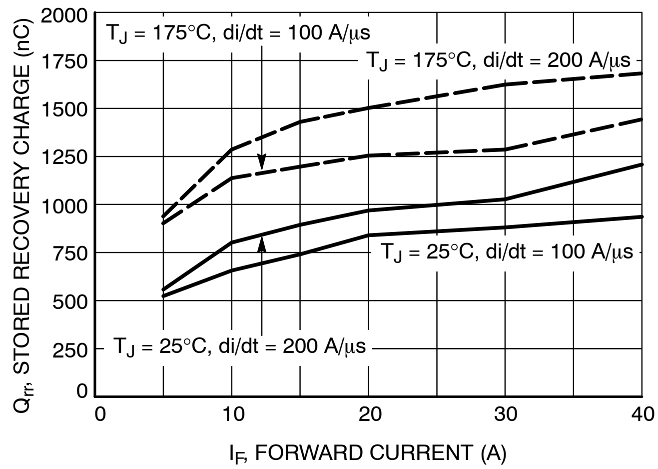


Figure 20. Stored Charge

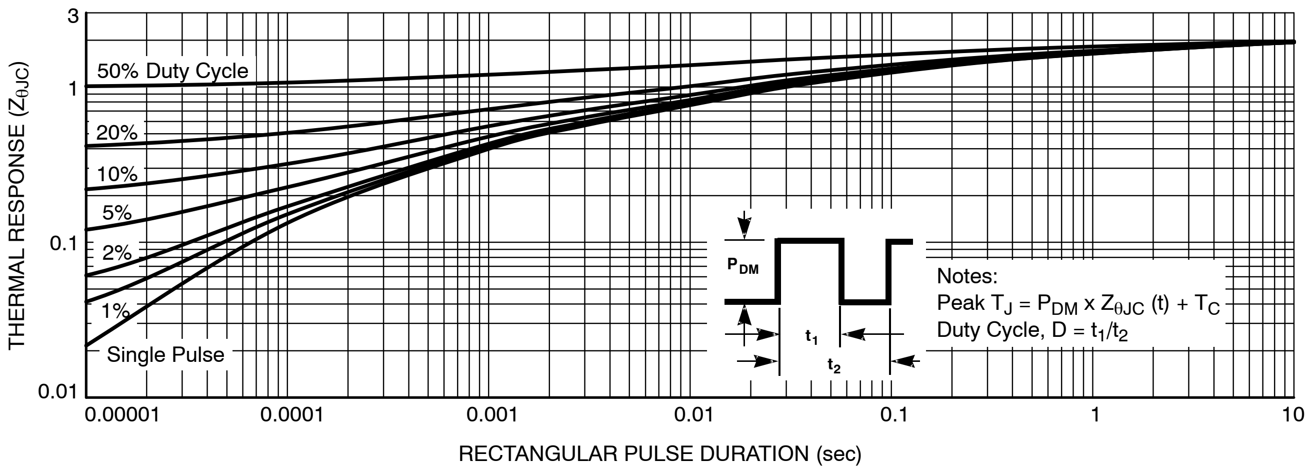


Figure 21. Transient Thermal Impedance of IGBT

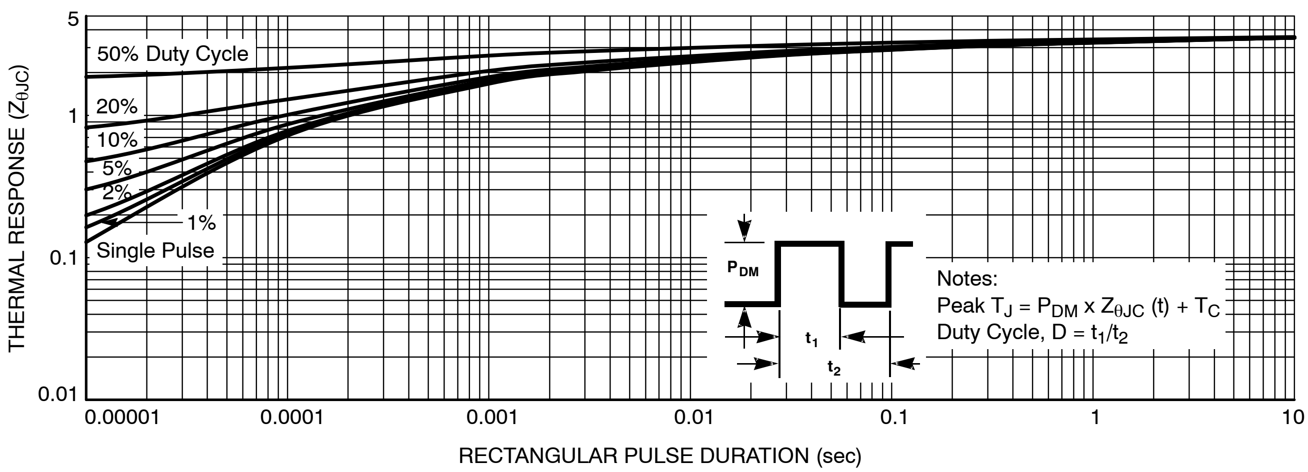
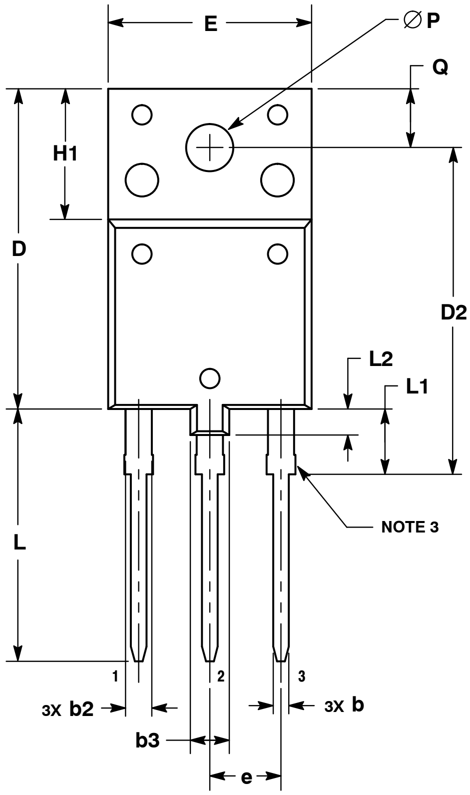
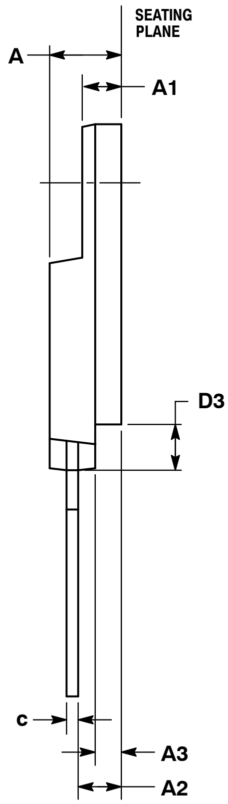


Figure 22. Transient Thermal Impedance of Diode

TO−3PF−3L
CASE 340AH
ISSUE A

DATE 09 JAN 2015





NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. CONTOUR UNCONTROLLED IN THIS AREA (6 PLACES).
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE TO BE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. DIMENSION b2 DOES NOT INCLUDE DAMBAR PROTRUSION. LEAD WIDTH INCLUDING PROTRUSION SHALL NOT EXCEED 2.20.

	MILLIMETERS	
DIM	MIN	MAX
A	5.30	5.70
A1	2.80	3.20
A2	3.10	3.50
A3	1.80	2.20
b	0.65	0.95
b2	1.90	2.15
b3	3.80	4.20
c	0.80	1.10
D	24.30	24.70
D2	24.70	25.30
D3	3.30	3.70
E	15.30	15.70
e	5.35	5.55
H1	9.80	10.20
L	19.10	19.50
L1	4.80	5.20
L2	1.90	2.20
P	3.40	3.80
Q	4.30	4.70

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DESCRIPTION:	TO−3PF−3L	PAGE 1 OF 1

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