Microsemi®

650V, 95A, $V_{CE\,(on)}$ = 1.9V Typical

Ultra Fast NPT - IGBT® with Ultra Soft Recovery Diode

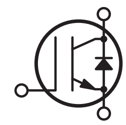
The Ultra Fast 650V NPT-IGBT® family of products is the newest generation of IGBTs optimized for outstanding ruggedness and best trade-off between conduction and switching losses.

ISOTOP®
Combi (IGBT and Diode)

Features

- **Low Saturation Voltage**
- **Low Tail Current**
- **RoHS Compliant**
- **Smooth Reverse Recovery**
- **Short Circuit Withstand Rated**
- **High Frequency Switching**
- **Ultra Low Leakage Current**
- **Snap-free Switching**

Unless stated otherwise, Microsemi discrete IGBTs contain a single IGBT die. This device is recommended for applications such as induction heating (IH), motor control, general purpose inverters and uninterruptible power supplies (UPS).



MAXIMUM RATINGS

All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Parameter	Ratings	Unit
V_{CES}	Collector Emitter Voltage	650	V
V_{GE}	Gate-Emitter Voltage	±30	
I_{C1}	Continuous Collector Current @ T_C = 25°C	135	A
I_{C2}	Continuous Collector Current @ T_C = 76°C	95	
I_{CM}	Pulsed Collector Current ①	380	
SCWT	Short Circuit Withstand Time: V_{CE} = 325V, V_{GE} = 15V, T_C=125°C	10	μs
P_D	Total Power Dissipation @ T_C = 25°C	446	W
T_J,T_{STG}	Operating and Storage Junction Temperature Range	-55 to 150	°C
T_L	Max. Lead Temp. for Soldering: 0.063" from Case for 10 Sec.	300	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Min	Typ	Max	Unit
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage (V_{GE} = 0V, I_C = 350mA)	650			Volts
$V_{GE(TH)}$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 2.5mA, T_j = 25°C)	3.5	5.0	6.5	
$V_{CE(on)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 95A, T_j = 25°C)		1.9	2.4	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 95A, T_j = 125°C)		2.4		
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 190A, T_j = 25°C)		2.6		
I_{CES}	Collector Cut-off Current (V_{CE} = 650V, V_{GE} = 0V, T_j = 25°C) ②		20	350	μA
	Collector Cut-off Current (V_{CE} = 650V, V_{GE} = 0V, T_j = 125°C) ②		200		
I_{GES}	Gate-Emitter Leakage Current (V_{GE} = ±20V)			± 250	nA

CAUTION: These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

DYNAMIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
C_{ies}	Input Capacitance	Capacitance		5910		pF
C_{oes}	Output Capacitance	V_{GE} = 0V, V_{CE} = 25V		1151		
C_{res}	Reverse Transfer Capacitance	f = 1MHz		565		
V_{GEP}	Gate to Emitter Plateau Voltage	Gate Charge		7.5		V
Q_g (3)	Total Gate Charge	V_{GE} = 15V		312	420	nC
Q_{ge}	Gate-Emitter Charge	V_{CE}= 325V		42	55	
Q_{gc}	Gate- Collector Charge	I_C = 95A		154	210	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C)		29		ns
t_r	Current Rise Time	V_{CC} = 433V		76		
$t_{d(off)}$	Turn-Off Delay Time	V_{GE} = 15V		226		
t_f	Current Fall Time	I_C = 95A		84		
E_{on2} (5)	Turn-On Switching Energy	R_G = 4.3 Ω (4)		3150	4730	μJ
E_{off} (6)	Turn-Off Switching Energy	T_J = +25°C		2550	2830	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C)		29		ns
t_r	Current Rise Time	V_{CC} = 433V		76		
$t_{d(off)}$	Turn-Off Delay Time	V_{GE} = 15V		246		
t_f	Current Fall Time	I_C = 95A		90		
E_{on2} (5)	Turn-On Switching Energy	R_G = 4.3 Ω (4)		4450	6675	μJ
E_{off} (6)	Turn-Off Switching Energy	T_J = +125°C		2745	4120	

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance (IGBT)			0.28	°C/W
	Junction to Case Thermal Resistance (Diode)			0.63	
$V_{isolation}$	RMS Voltage (50-60Hz Sinusoidal Waveform From Terminals to Mounting Base for 1 Min.)	2500			
W_T	Package Weight		1.03		oz
			29.2		g
Torque	Maximum Mounting Torque			10	lb•in
				1.1	N•m

1 Repetitive Rating: Pulse width and case temperature limited by maximum junction temperature.
2 Pulse test: Pulse Width < 380μs, duty cycle < 2%.
3 See Mil-Std-750 Method 3471.
4 R_G is external gate resistance, not including internal gate resistance or gate driver impedance. (MIC4452)
5 E_{on2} is the energy loss at turn-on and includes the charge stored in the freewheeling diode.
6 E_{off} is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1.
Microsemi reserves the right to change, without notice, the specifications and information contained herein.

TYPICAL PERFORMANCE CURVES

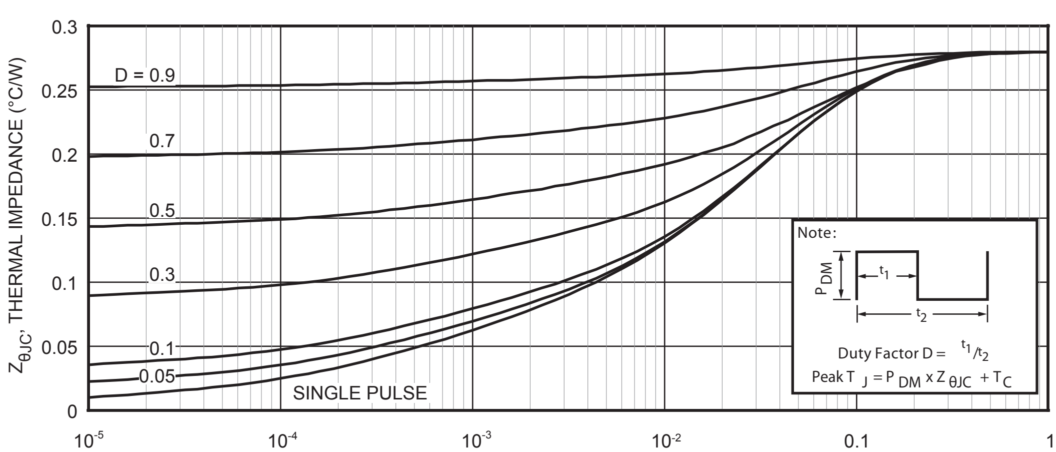


FIGURE 1, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

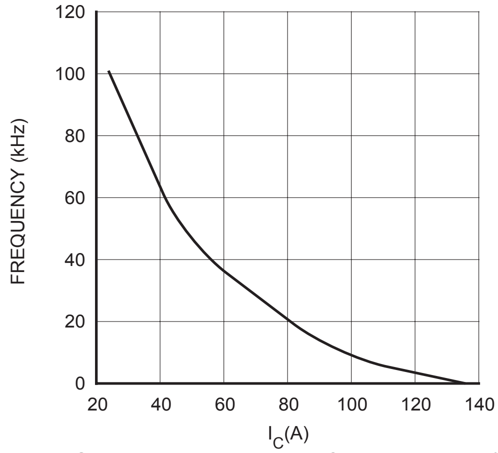


FIGURE 2, Max Frequency vs Current (T_{case} = 75°C)

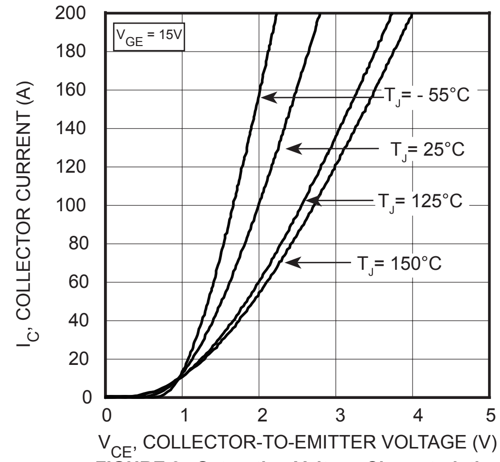


FIGURE 3, Saturation Voltage Characteristics

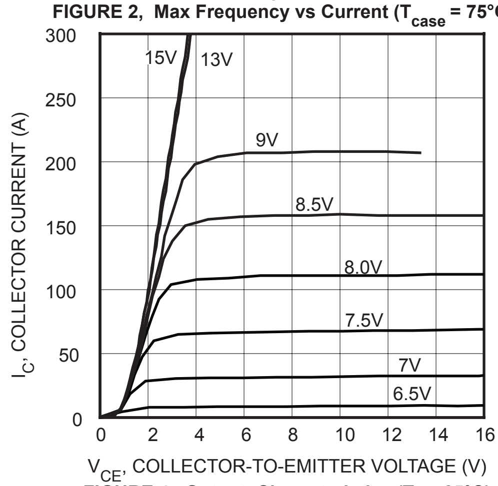


FIGURE 4, Output Characteristics (T_J = 25°C)

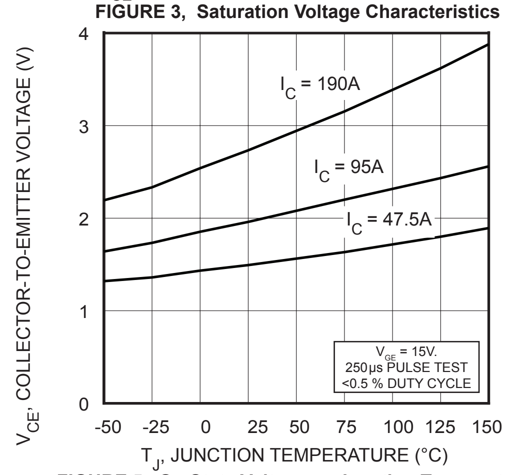


FIGURE 5, On State Voltage vs Junction Temperature

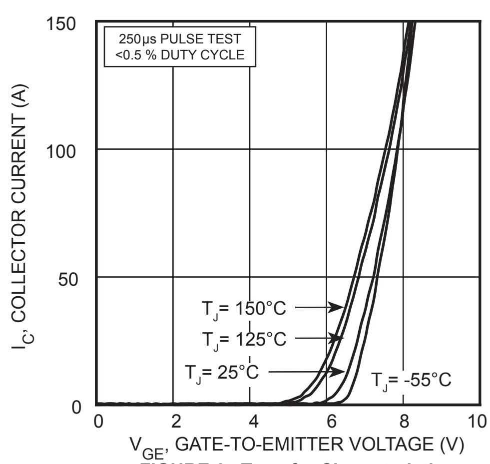


FIGURE 6, Transfer Characteristics

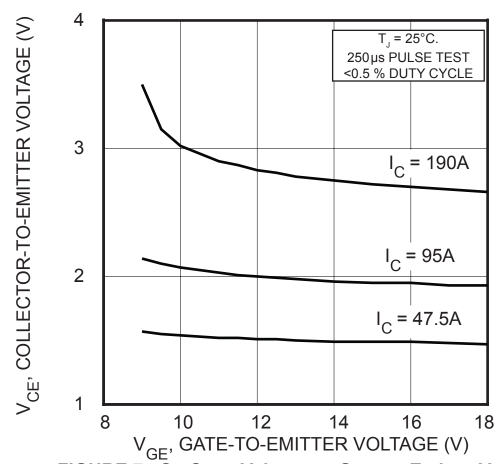


FIGURE 7, On State Voltage vs Gate-to-Emitter Voltage

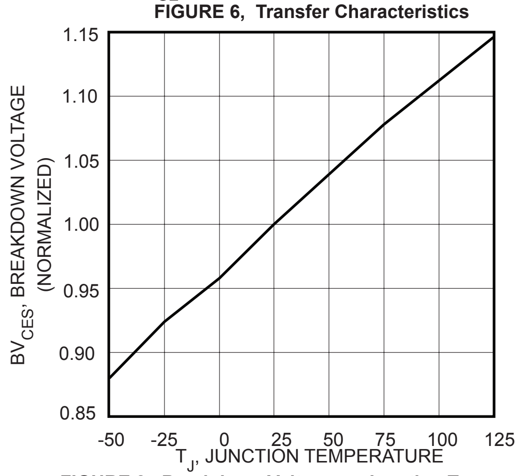


FIGURE 8, Breakdown Voltage vs Junction Temperature

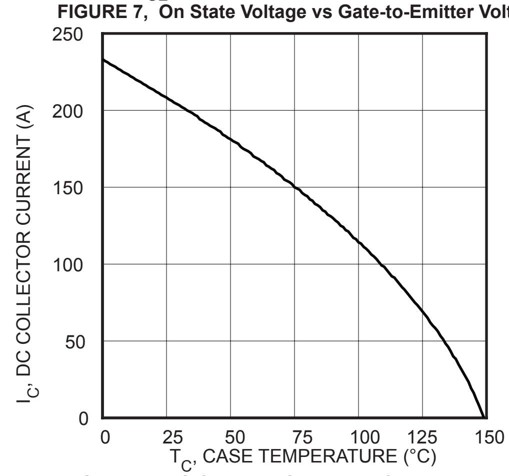


FIGURE 9, DC Collector Current vs Case Temperature

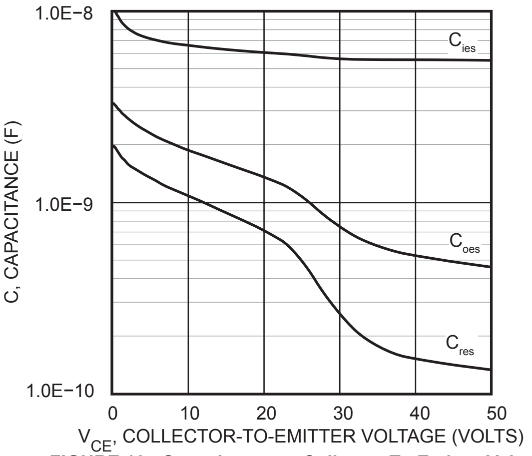


FIGURE 10, Capacitance vs Collector-To-Emitter Voltage

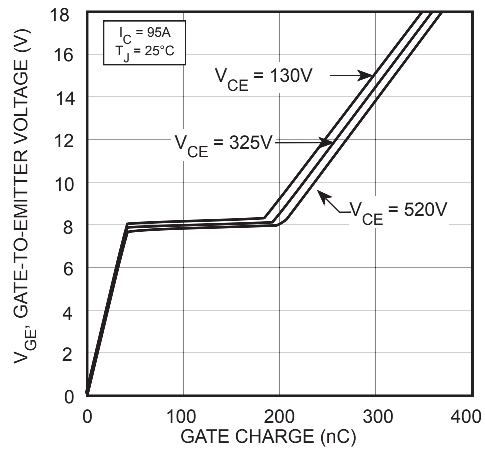


FIGURE 11, Gate charge

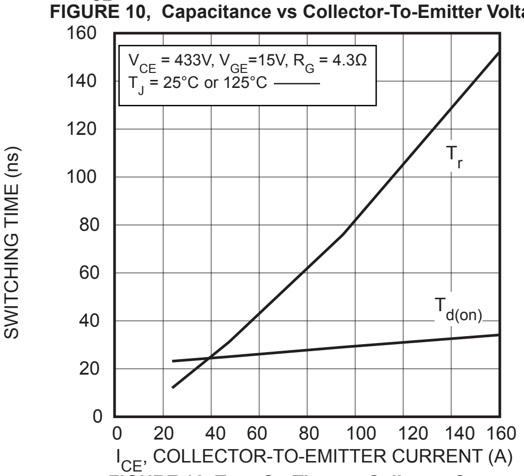


FIGURE 12, Turn-On Time vs Collector Current

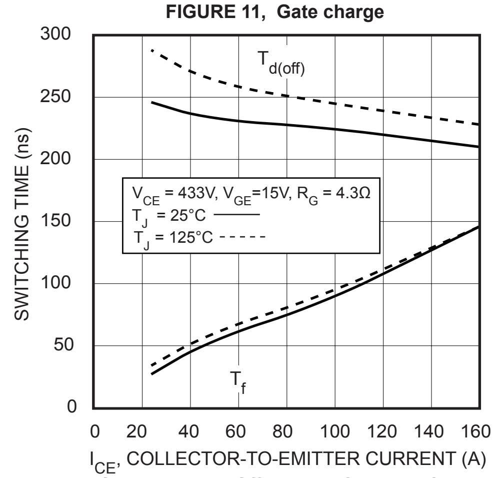


FIGURE 13, Turn-Off Time vs Collector Current

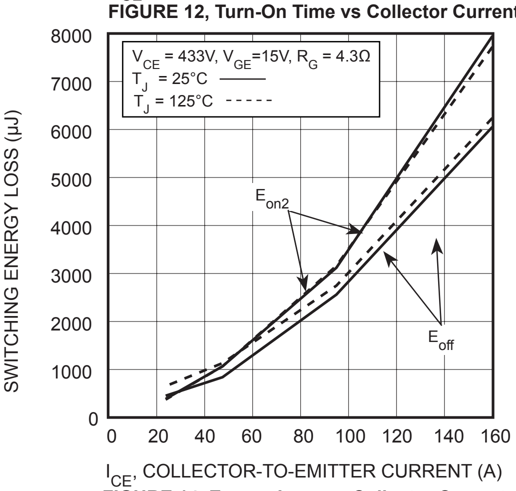


FIGURE 14, Energy Loss vs Collector Current

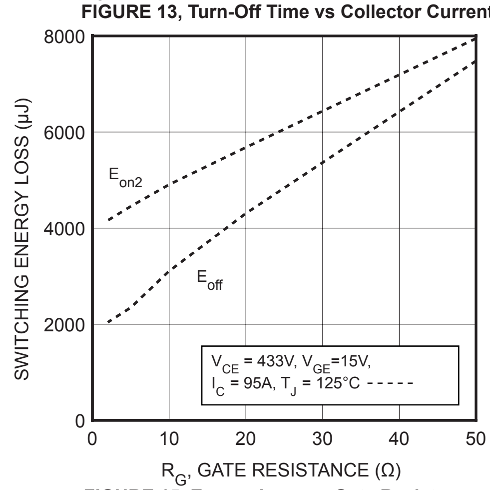


FIGURE 15, Energy Loss vs Gate Resistance

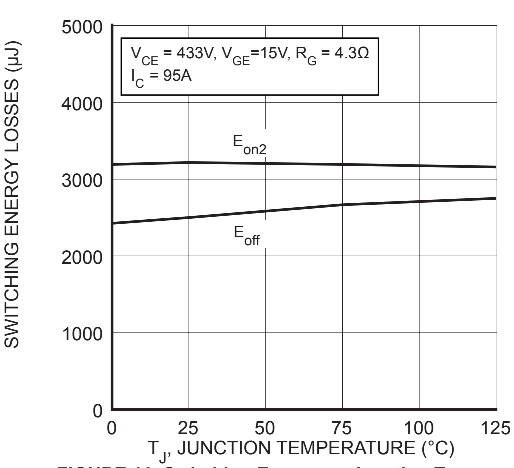


FIGURE 16, Switching Energy vs Junction Temperature

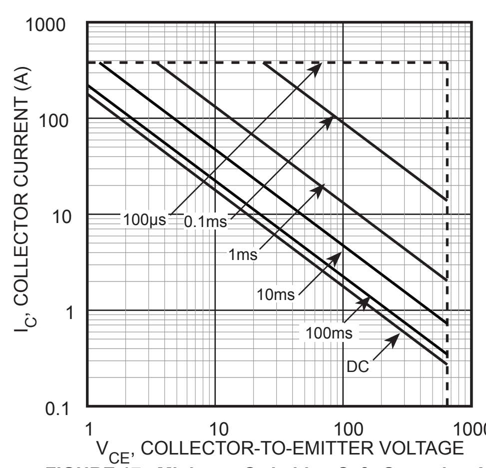


FIGURE 17, Minimum Switching Safe Operating Area

ULTRA SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

All Ratings: T_C = 25°C unless otherwise specified.

Symbol	Characteristic / Test Conditions	APT95GR65JDU60	Unit
$I_{F(AV)}$	Maximum Average Forward Current (T_C = 75°C, Duty Cycle = 0.5)	40	Amps
$I_{F(RMS)}$	RMS Forward Current (Square wave, 50% duty)	73	
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 45°C, 8.3ms)	TBD	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions		Min	Typ	Max	Unit
V_F	Forward Voltage	I_F = 60A		3.0		Volts
		I_F = 120A		4.0		
		I_F = 60A, T_J = 125°C		2.5		

DYNAMIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
t_{rr}	Reverse Recovery Time	I_F = 1.0A, dif/dt= -100 A/µs, V_R = 30V, T_j = 25°C		28		ns
t_{rr}	Reverse Recovery Time	I_F = 60 Amps dif/dt= -200 A/µs V_R = 433 Volts T_j = 25°C		93		ns
Q_{rr}	Reverse Recovery Charge			149		nC
I_{rrm}	Maximum Reverse Recovery Current			4		Amps
E_{rr}	Reverse Recovery Energy			2		µJ
t_{rr}	Reverse Recovery	I_F = 60 Amps dif/dt= -200 A/µs V_R = 433 Volts T_j = 125°C		404		ns
Q_{rr}	Reverse Recovery Charge			1496		nC
I_{rrm}	Maximum Reverse Recovery Current			9		Amps
E_{rr}	Reverse Recovery Energy			100		µJ
t_{rr}	Reverse Recovery	I_F = 60 Amps dif/dt= -1000 A/µs V_R= 433 Volts T_j = 125°C		198		ns
Q_{rr}	Reverse Recovery Charge			2844		nC
I_{rrm}	Maximum Reverse Recovery Current			32		Amps
E_{rr}	Reverse Recovery Energy			479		µJ
S	Softness Factor (tb/ta)	I_F = 30A, dif/dt= -1000 A/µs, V_R= 433V, T_j = 125°C		3		

TYPICAL PERFORMANCE CURVES

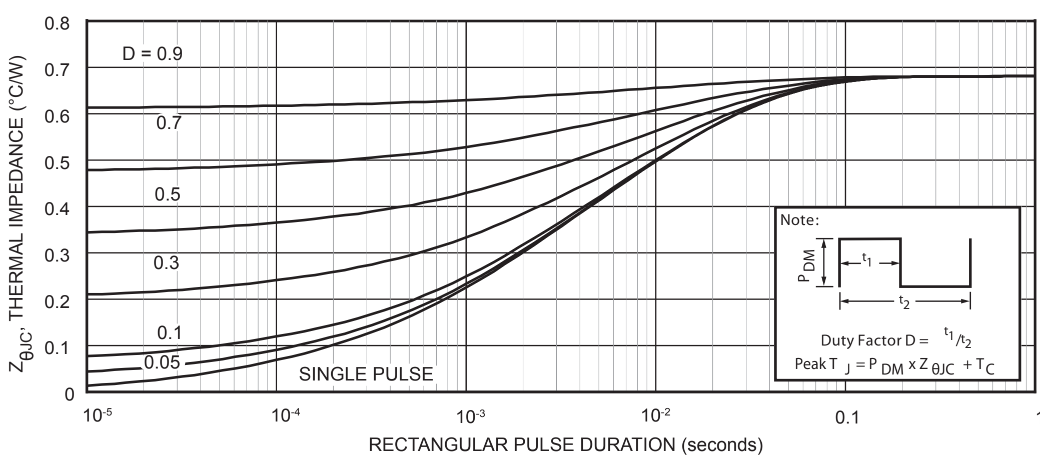


FIGURE 18. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

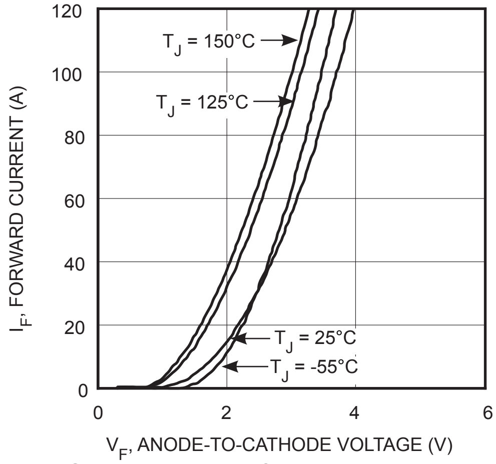


FIGURE 19, F Forward Current vs. Forward Voltage

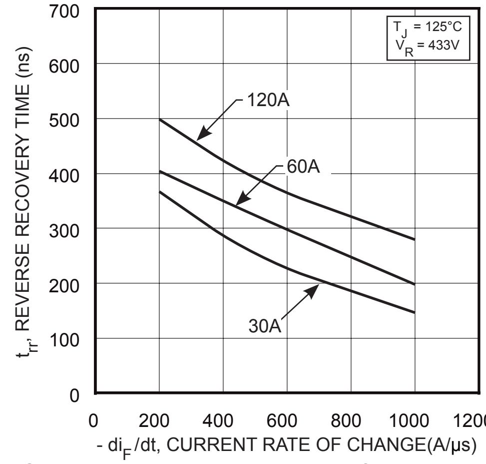


FIGURE 20, Reverse Recovery Time vs. Current Rate of Change

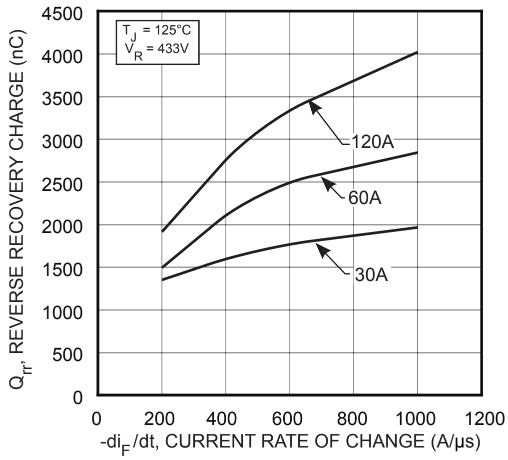


FIGURE 21, Reverse Recovery Charge vs. Current Rate of Change

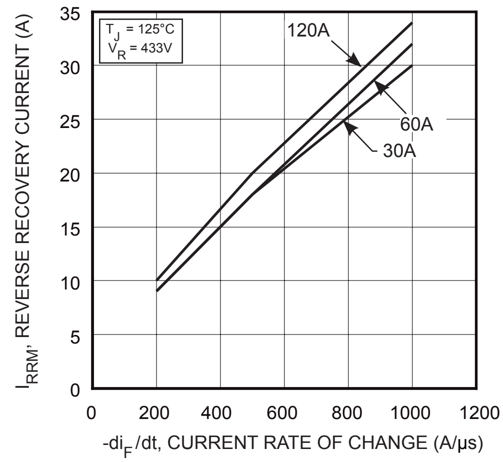


FIGURE 22, Reverse Recovery Current vs. Current Rate of Change

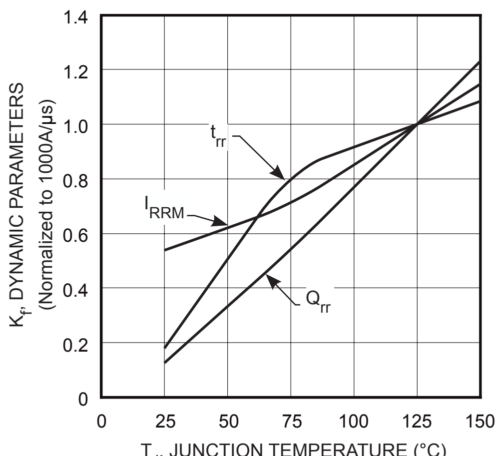


FIGURE 23, Dynamic Parameters vs. Junction Temperature

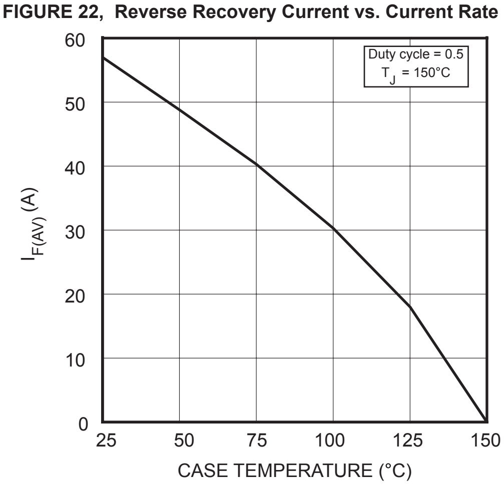


FIGURE 24, Max Average Forward Current vs. CaseTemperature

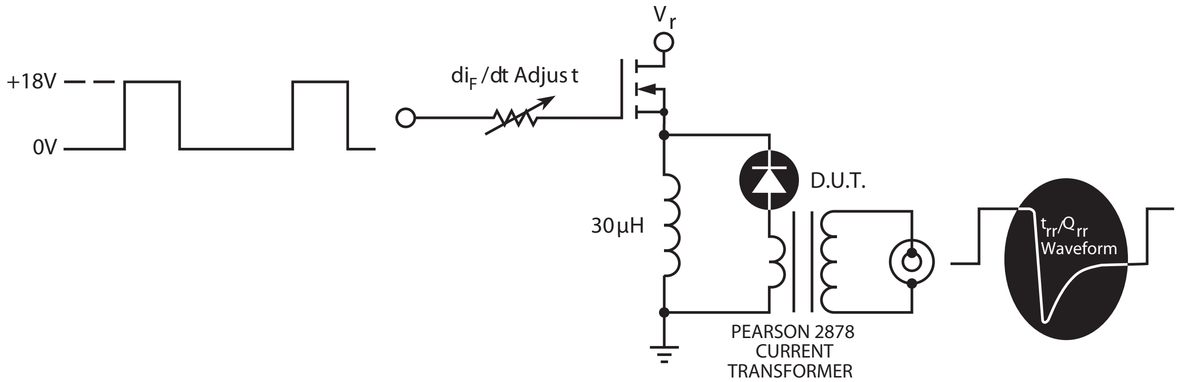


FIGURE 25. Diodе Test Circuit

1. I_F - Forward Conduction Current
2. di_F/dt - Rate of Diode Current Change Through Zero Crossing.
3. I_{RRM} - Maximum Reverse Recovery Current
4. t_a - Time to reach Maximum Reverse Recovery Current (I_{RRM}).
5. t_b - Time from Maximum Reverse Recovery Current (I_{RRM}) to projected zero crossing based on a straight line from I_{RRM} through 25% I_{RRM}.
6. t_{rr} - Reverse Recovery Time measured from zero crossing where diode current goes from positive to negative, to the point at which the straight line through I_{RRM} and 0.25, I_{RRM} passes through zero.
7. Q_{rr} - Area Under the Curve Defined by I_{RRM} and t_{RR}.

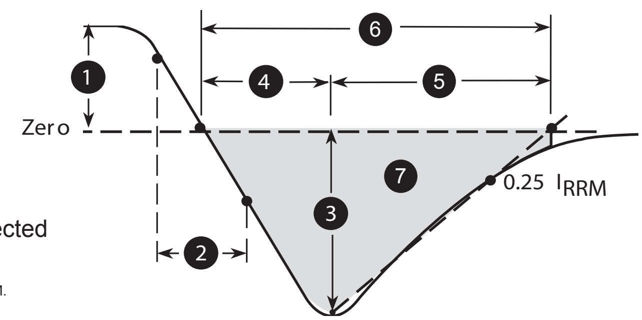
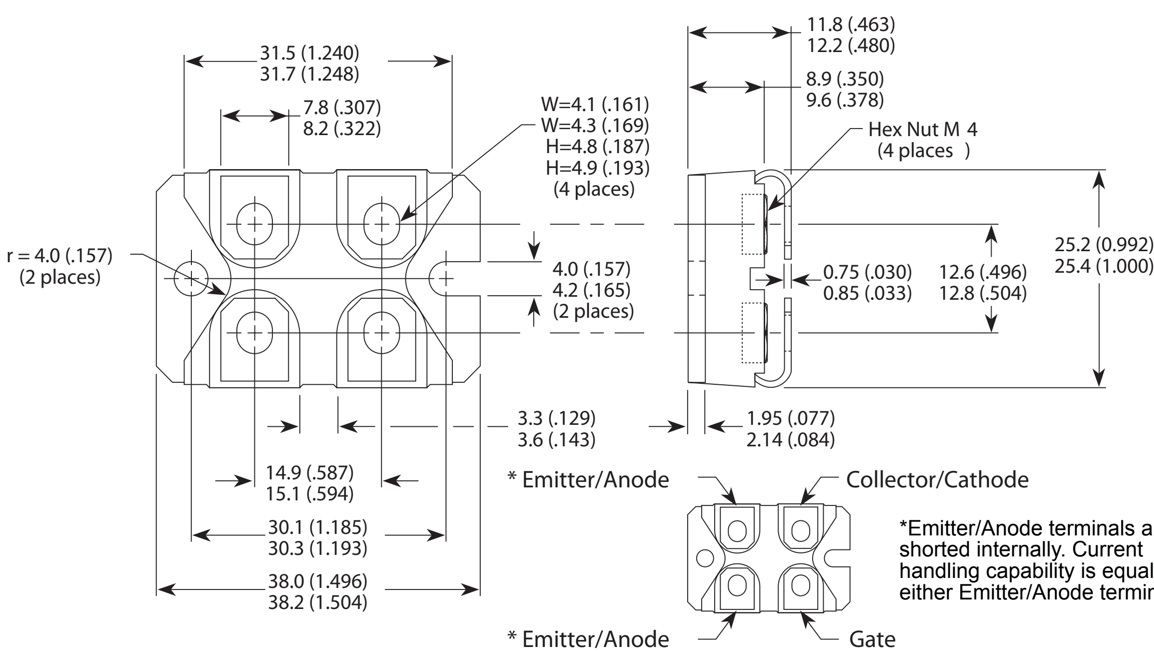


FIGURE 26. Diode Reverse Recovery Waveform Definition

SOT-227 (ISOTOP®) Package Outline



*Emitter/Anode terminals are shorted internally. Current handling capability is equal for either Emitter/Anode terminal.

Dimensions in Millimeters and (Inches)

Disclaimer:

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