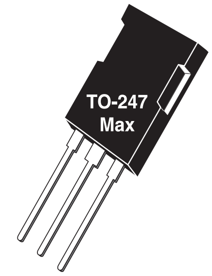
APT70GR65B2DU40

650V, 70A, $V_{CE(on)}$ = 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.

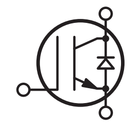


Combi (IGBT and Diode)

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	134	A
I_{C2}	Continuous Collector Current @ T_C = 110°C	65	
I_{CM}	Pulsed Collector Current ①	280	
SCWT	Short Circuit Withstand Time: V_{CE} = 600V, V_{GE} = 15V, T_C=125°C	10	μs
P_D	Total Power Dissipation @ T_C = 25°C	595	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 = 350μA)	650			Volts
$V_{GE(TH)}$	Gate Threshold Voltage (V_{CE} = V_{GE}, I_C = 1.0mA, T_j = 25°C)	3.5	5.0	6.5	
$V_{CE(ON)}$	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 70A, T_j = 25°C)		1.9	2.4	
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 70A, T_j = 125°C)		2.4		
	Collector-Emitter On Voltage (V_{GE} = 15V, I_C = 140A, 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		4250		pF
C_{oes}	Output Capacitance	V_{GE} = 0V, V_{CE} = 25V		847		
C_{res}	Reverse Transfer Capacitance	f = 1MHz		415		
V_{GEP}	Gate to Emitter Plateau Voltage	Gate Charge		7.0		V
Q_g (3)	Total Gate Charge	V_{GE} = 15V		226	305	nC
Q_{ge}	Gate-Emitter Charge	V_{CE}= 325V		26	35	
Q_{gc}	Gate- Collector Charge	I_C = 70A		104	140	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (25°C)		18		ns
t_r	Current Rise Time	V_{CC} = 433V		49		
$t_{d(off)}$	Turn-Off Delay Time	V_{GE} = 15V		170		
t_f	Current Fall Time	I_C = 70A		67		
E_{on2} (5)	Turn-On Switching Energy	R_G = 4.3Ω (4)		1868	2800	μJ
E_{off} (6)	Turn-Off Switching Energy	T_J = +25°C		1470	2205	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching (125°C)		17		ns
t_r	Current Rise Time	V_{CC} = 433V		51		
$t_{d(off)}$	Turn-Off Delay Time	V_{GE} = 15V		190		
t_f	Current Fall Time	I_C = 70A		74		
E_{on2} (5)	Turn-On Switching Energy	R_G = 4.3Ω (4)		2616	3920	μJ
E_{off} (6)	Turn-Off Switching Energy	T_J = +125°C		1900	2865	

THERMAL AND MECHANICAL CHARACTERISTICS

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction to Case Thermal Resistance (IGBT)			0.21	°C/W
	Junction to Case Thermal Resistance (Diode)			0.61	
$R_{\theta JA}$	Junction to Ambient Thermal Resistance			40	
W_T	Package Weight		0.22		oz
			6.2		g

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.

TYPICAL PERFORMANCE CURVES

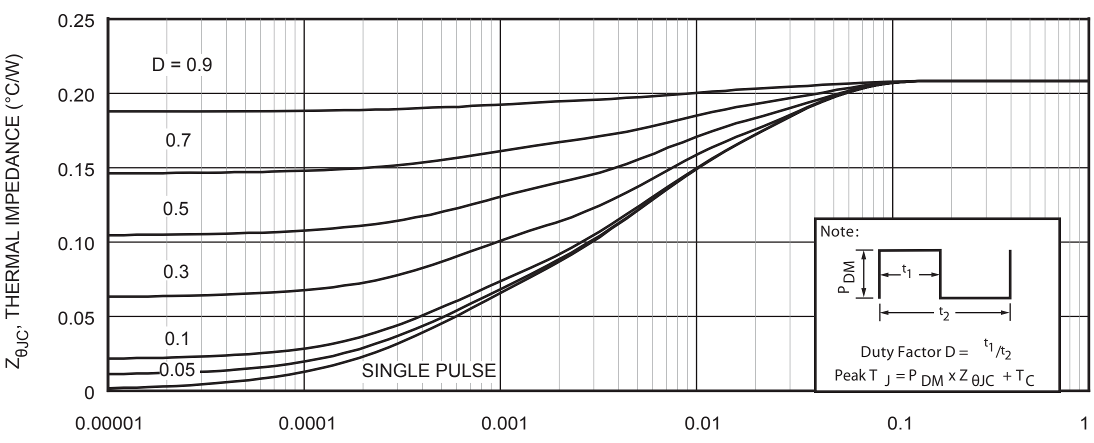


Figure 1, Maximum Effective Transient Thermal Impedance, Junction-To-Case vs Pulse Duration

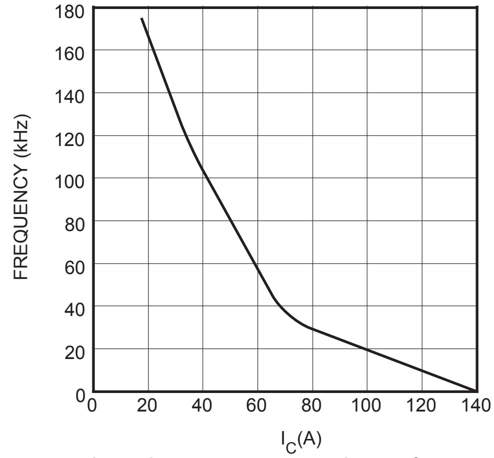


FIGURE 2, Max Frequency vs Current (T_{case} = 75°C)

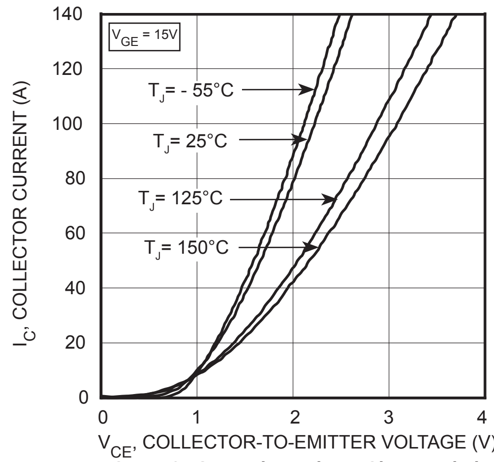


FIGURE 3, Saturation Voltage Characteristics

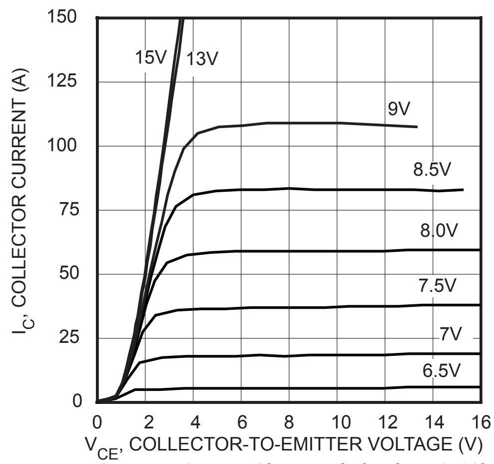


FIGURE 4, Output Characteristics (T_J = 25°C)

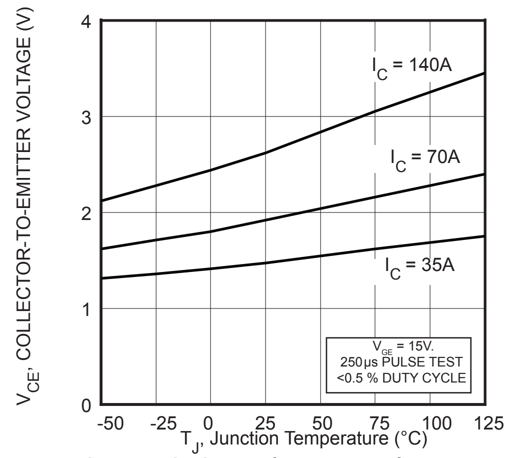


FIGURE 5, On State Voltage vs Junction Temperature

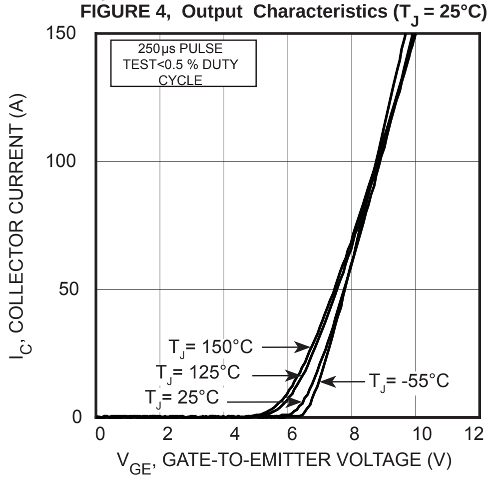


FIGURE 6, Transfer Characteristics

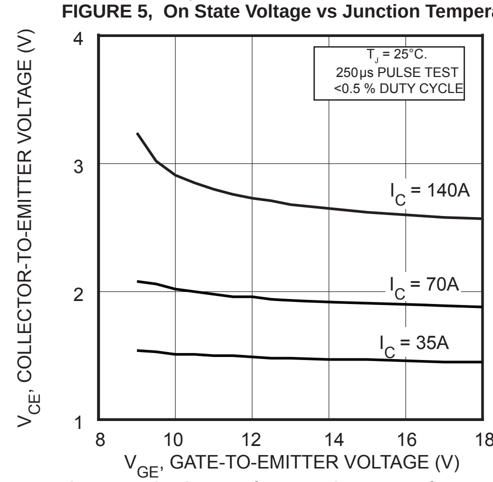


FIGURE 7, On State Voltage vs Gate-to-Emitter Voltage

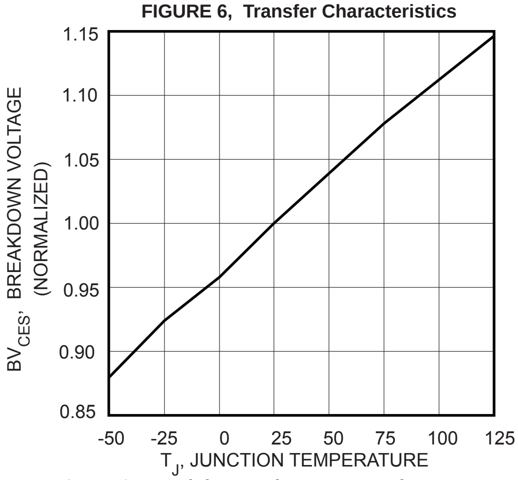


FIGURE 8, Breakdown Voltage vs Junction Temperature

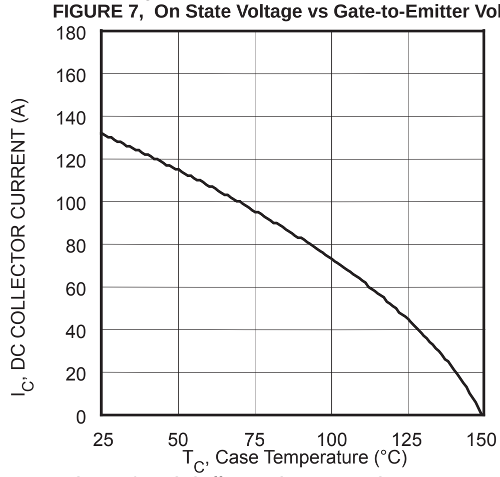


FIGURE 9, DC Collector Current vs Case Temperature

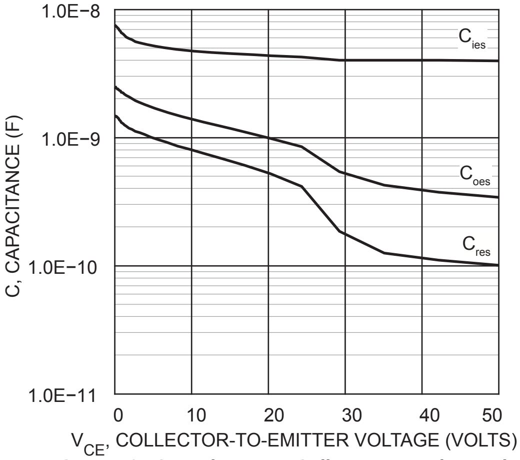


FIGURE 10, Capacitance vs Collector-To-Emitter Voltage

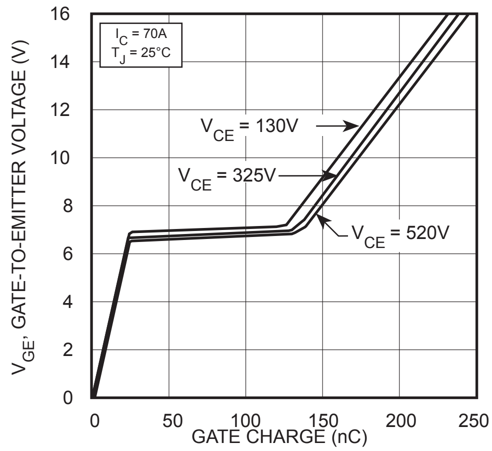


FIGURE 11, Gate charge

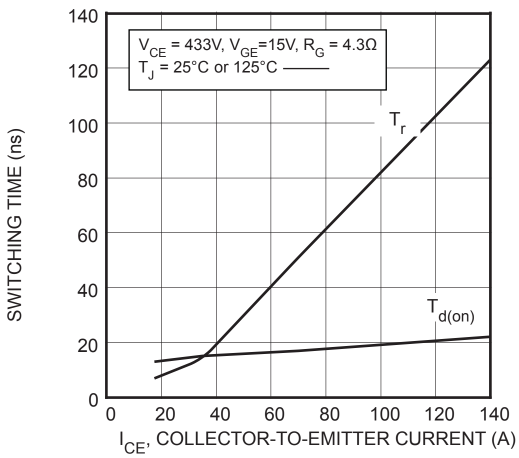


FIGURE 12, Turn-On Time vs Collector Current

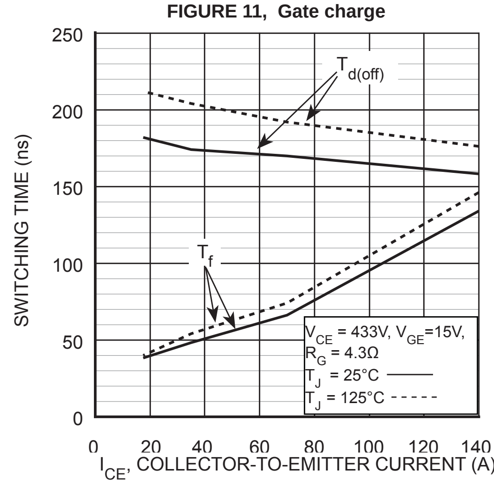


FIGURE 13, Turn-Off Time vs Collector Current

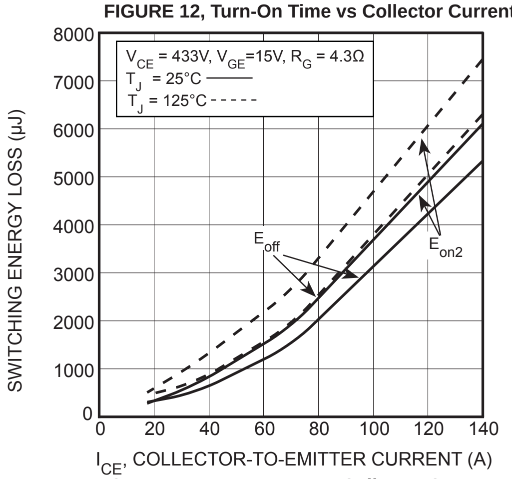


FIGURE 14, Energy Loss vs Collector Current

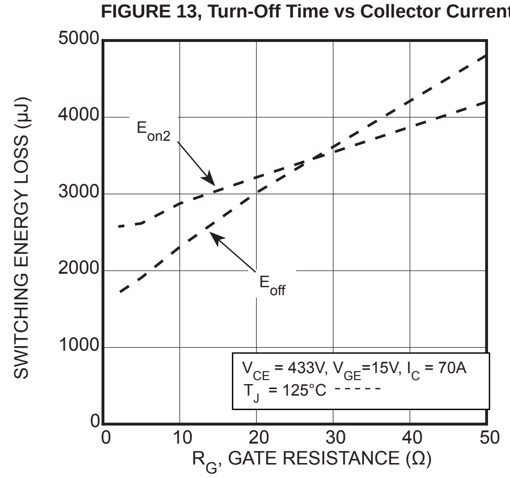


FIGURE 15, Energy Loss vs Gate Resistance

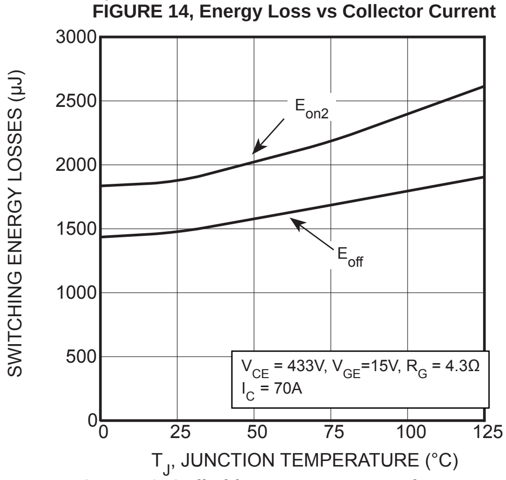


FIGURE 16, Swiitching Energy vs Junction Temperature

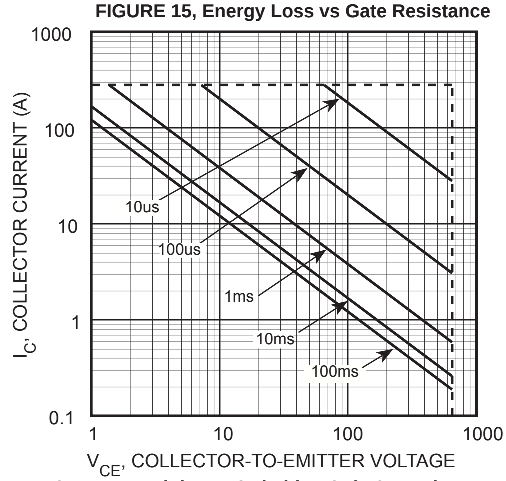


FIGURE 17, Minimum Switching Safe Operating Area

ULTRA SOFT RECOVERY ANTI-PARALLEL DIODE

MAXIMUM RATINGS

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

Symbol	Characteristic / Test Conditions		Ratings	Unit
I_F	Maximum D.C. Forward Current	T_C = 25°C	57	Amps
		T_C = 75°C	40	
I_{FSM}	Non-Repetitive Forward Surge Current (T_J = 25°C, t_p = 10ms, Half Sine)		210	

STATIC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic / Test Conditions		Min	Typ	Max	Unit
V_F	Forward Voltage	I_F = 40A		3.0		Volts
		I_F = 80A		3.9		
		I_F = 40A, T_J = 125°C		2.3		

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		25		ns
t_{rr}	Reverse Recovery Time	I_F = 40 Amps dif/dt= -200 A/µs V_R = 433 Volts T_j = 25°C		75		ns
Q_{rr}	Reverse Recovery Charge			111		nC
I_{rrm}	Maximum Reverse Recovery Current			4		Amps
E_{rr}	Reverse Recovery Energy			2		µJ
t_{rr}	Reverse Recovery	I_F = 40 Amps dif/dt= -200 A/µs V_R = 433 Volts T_j = 125°C		362		ns
Q_{rr}	Reverse Recovery Charge			1062		nC
I_{rrm}	Maximum Reverse Recovery Current			8		Amps
E_{rr}	Reverse Recovery Energy			83		µJ
t_{rr}	Reverse Recovery	I_F = 40 Amps dif/dt= -1000 A/µs V_R= 433 Volts T_j= 125°C		160		ns
Q_{rr}	Reverse Recovery Charge			1648		nC
I_{rrm}	Maximum Reverse Recovery Current			25		Amps
E_{rr}	Reverse Recovery Energy			261		µJ
S	Softness Factor (tb/ta)	I_F = 20A, dif/dt= -1000 A/µs, V_R= 433V, T_j = 125°C		3		

TYPICAL PERFORMANCE CURVES

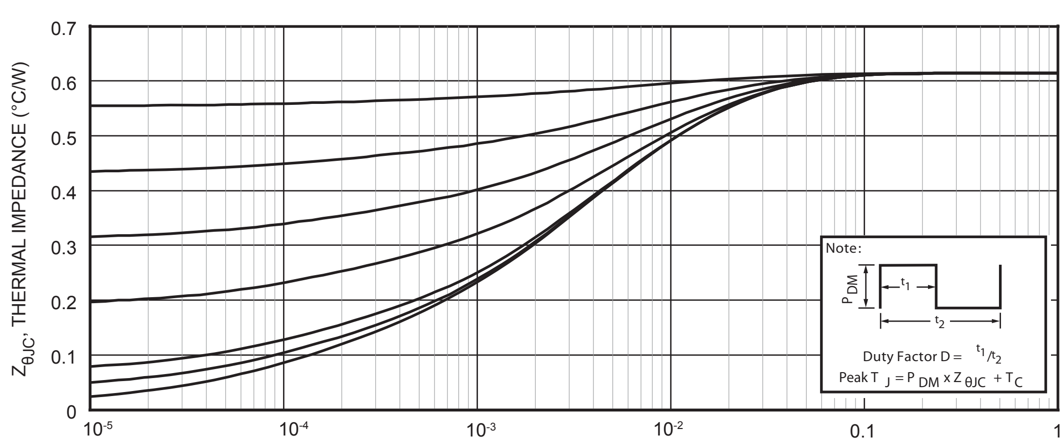


FIGURE 18. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs. PULSE DURATION

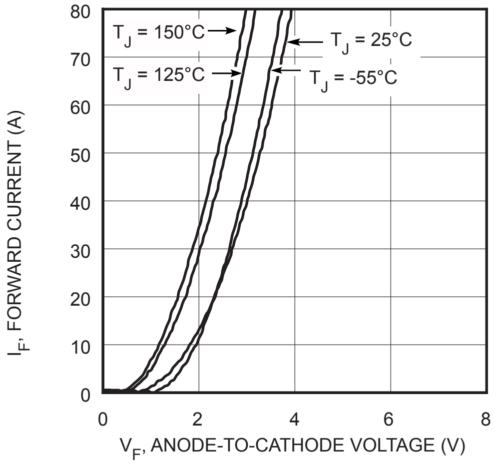


FIGURE 19, Forward Current vs. Forward Voltage

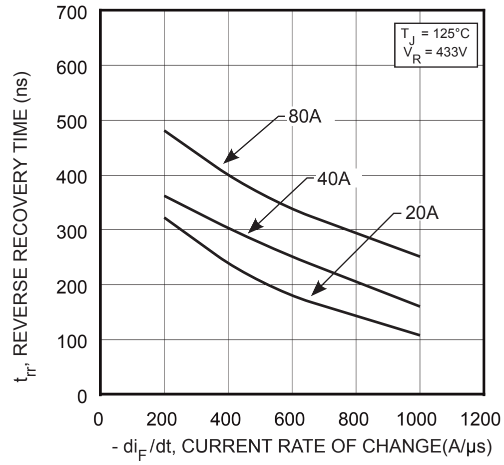


Figure 20. Reverse Recovery Time vs. Current Rate of Change

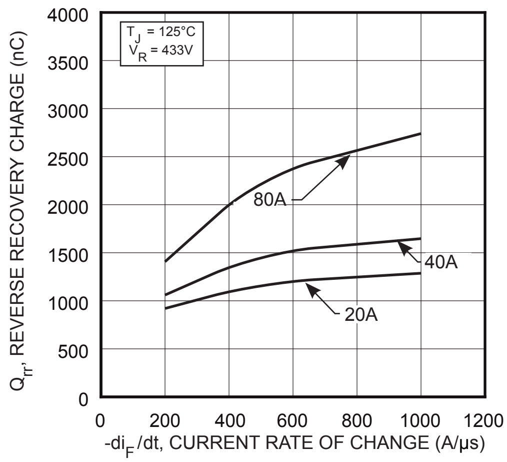


Figure 21. Reverse Recovery Charge vs. Current Rate of Change

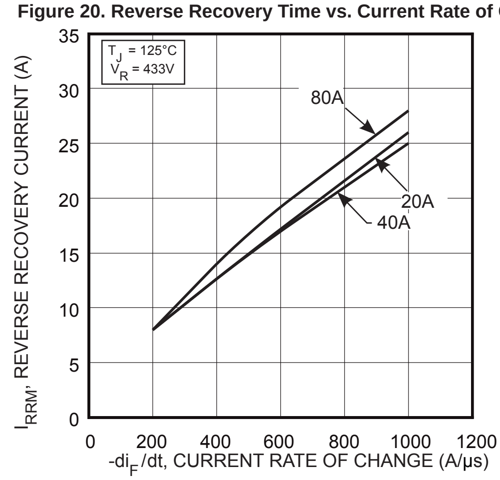


Figure 22. Reverse Recovery Current vs. Current Rate of Change

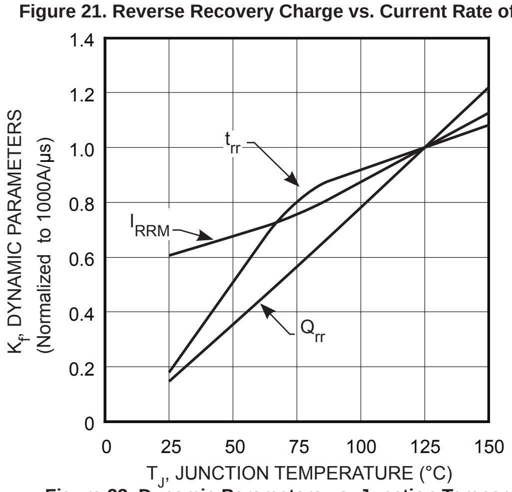


Figure 23. Dynamic Parameters vs. Junction Temperature

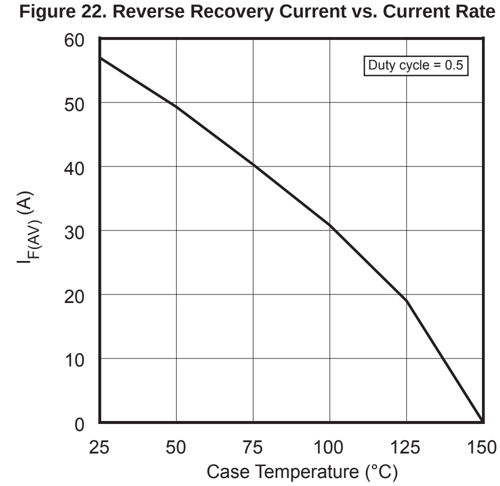


Figure 24. Max Average Forward Current vs. CaseTemperature

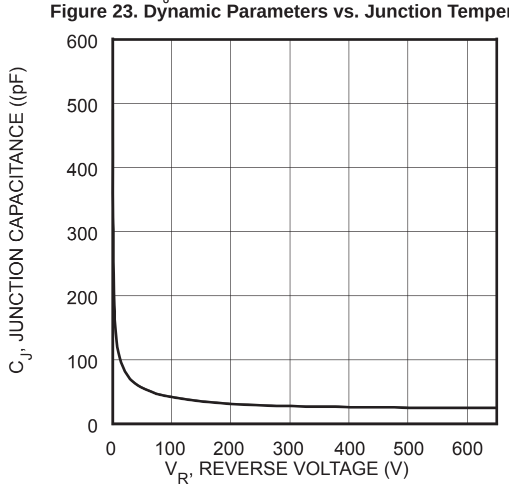


Figure 25. Junction Capacitance vs. Reverse Voltage

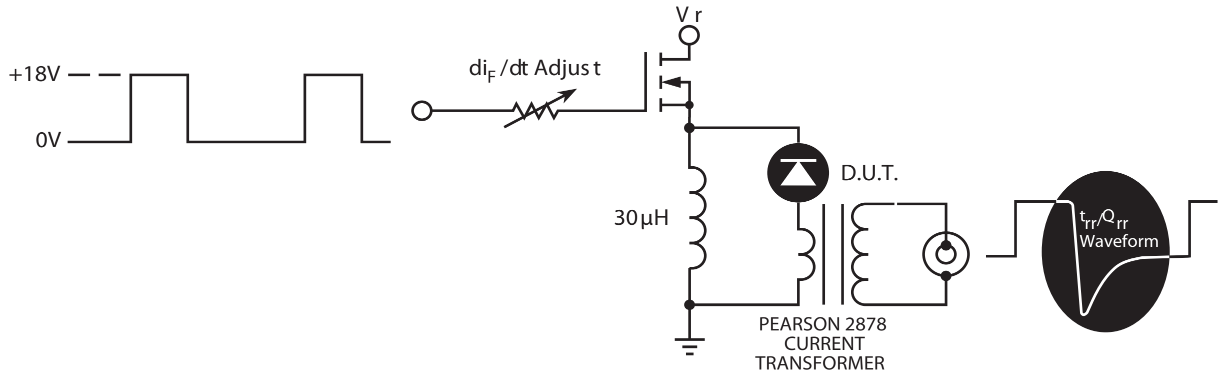


Figure 26. Diode Test Circuit

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 $t_{RR.}$

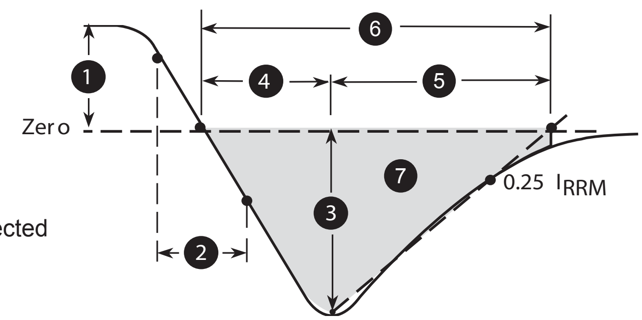
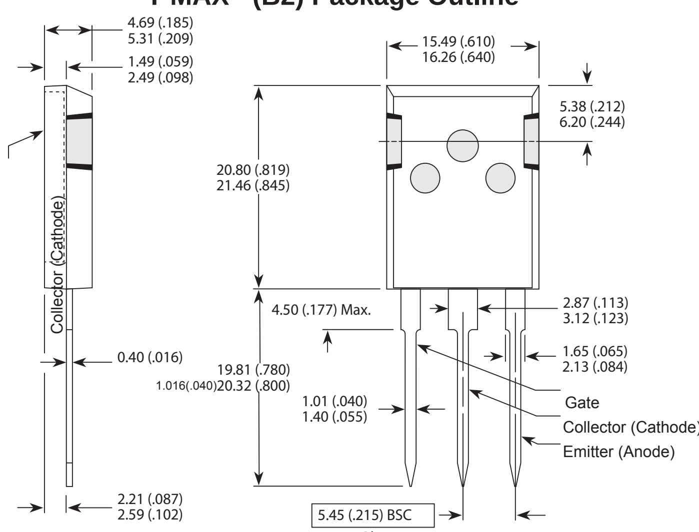


Figure 27. Diode Reverse Recovery Waveform Definition

T-MAX® (B2) Package Outline



These dimensions are equal to the TO-247 without the mounting hole.

Dimensions in Millimeters and (Inches)

Disclaimer:

052-6436 Rev A 5-2014