

IGBT - Ultra Field Stop

NGTB40N120FL3WG

This Insulated Gate Bipolar Transistor (IGBT) features a robust and cost effective Ultra Field Stop Trench construction, and provides superior performance in demanding switching applications, offering both low on-state voltage and minimal switching loss. The IGBT is well suited for UPS and solar applications. Incorporated into the device is a soft and fast co-packaged free wheeling diode with a low forward voltage.

Features

- Extremely Efficient Trench with Field Stop Technology
- $T_{Jmax} = 175^{\circ}C$
- Soft Fast Reverse Recovery Diode
- Optimized for High Speed Switching
- These are Pb-Free Devices

Typical Applications

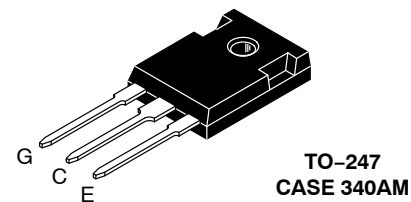
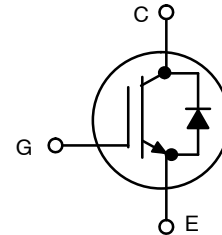
- Solar Inverter
- Uninterruptible Power Inverter Supplies (UPS)
- Welding

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-emitter voltage	V_{CES}	1200	V
Collector current @ $T_c = 25^{\circ}C$ @ $T_c = 100^{\circ}C$	I_C	80 40	A
Pulsed collector current, T_{pulse} limited by T_{Jmax}	I_{CM}	160	A
Diode forward current @ $T_c = 25^{\circ}C$ @ $T_c = 100^{\circ}C$	I_F	80 40	A
Diode pulsed current, T_{pulse} limited by T_{Jmax}	I_{FM}	160	A
Gate-emitter voltage Transient gate-emitter voltage ($T_{pulse} = 5 \mu s$, $D < 0.10$)	V_{GE}	± 20 ± 30	V
Power Dissipation @ $T_c = 25^{\circ}C$ @ $T_c = 100^{\circ}C$	P_D	454 227	W
Operating junction temperature range	T_J	-55 to $+175$	$^{\circ}C$
Storage temperature range	T_{stg}	-55 to $+175$	$^{\circ}C$
Lead temperature for soldering, 1/8" from case for 5 seconds	T_{SLD}	260	$^{\circ}C$

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.

40 A, 1200 V
 $V_{CEsat} = 1.7 V$
 $E_{off} = 1.1 mJ$



MARKING DIAGRAM



A = Assembly Location
Y = Year
WW = Work Week
G = Pb-Free Package

ORDERING INFORMATION

Device	Package	Shipping
NGTB40N120FL3WG	TO-247 (Pb-Free)	30 Units / Rail

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THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction-to-case, for IGBT	$R_{\theta JC}$	0.33	$^{\circ}\text{C/W}$
Thermal resistance junction-to-case, for Diode	$R_{\theta JC}$	0.61	$^{\circ}\text{C/W}$
Thermal resistance junction-to-ambient	$R_{\theta JA}$	40	$^{\circ}\text{C/W}$

ELECTRICAL CHARACTERISTICS ($T_J = 25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
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STATIC CHARACTERISTIC

Collector-emitter breakdown voltage, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, I_C = 500\text{ }\mu\text{A}$	$V_{(BR)CES}$	1200	–	–	V
Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}, I_C = 40\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 40\text{ A}, T_J = 175^{\circ}\text{C}$	V_{CEsat}	– –	1.7 2.3	1.95 –	V
Gate-emitter threshold voltage	$V_{GE} = V_{CE}, I_C = 400\text{ }\mu\text{A}$	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector-emitter cut-off current, gate-emitter short-circuited	$V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}$ $V_{GE} = 0\text{ V}, V_{CE} = 1200\text{ V}, T_J = 175^{\circ}\text{C}$	I_{CES}	– –	– 0.5	0.4 –	mA
Gate leakage current, collector-emitter short-circuited	$V_{GE} = 20\text{ V}, V_{CE} = 0\text{ V}$	I_{GES}	–	–	200	nA

Input capacitance	$V_{CE} = 20\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	C_{ies}	–	4912	–	pF
Output capacitance		C_{oes}	–	140	–	
Reverse transfer capacitance		C_{res}	–	80	–	
Gate charge total	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	Q_g	–	212	–	nC
Gate to emitter charge		Q_{ge}	–	43	–	
Gate to collector charge		Q_{gc}	–	102	–	

SWITCHING CHARACTERISTIC, INDUCTIVE LOAD

Turn-on delay time	$T_J = 25^{\circ}\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\text{ }\Omega$ $V_{GE} = 15\text{ V}$	$t_{d(on)}$	–	18	–	ns
Rise time		t_r	–	31	–	
Turn-off delay time		$t_{d(off)}$	–	145	–	
Fall time		t_f	–	107	–	
Turn-on switching loss		E_{on}	–	1.6	–	mJ
Turn-off switching loss		E_{off}	–	1.1	–	
Total switching loss		E_{ts}	–	2.7	–	
Turn-on delay time	$T_J = 175^{\circ}\text{C}$ $V_{CC} = 600\text{ V}, I_C = 40\text{ A}$ $R_g = 10\text{ }\Omega$ $V_{GE} = 15\text{ V}$	$t_{d(on)}$	–	20	–	ns
Rise time		t_r	–	31	–	
Turn-off delay time		$t_{d(off)}$	–	153	–	
Fall time		t_f	–	173	–	
Turn-on switching loss		E_{on}	–	2.2	–	mJ
Turn-off switching loss		E_{off}	–	1.7	–	
Total switching loss		E_{ts}	–	3.9	–	

DIODE CHARACTERISTIC

Forward voltage	$V_{GE} = 0\text{ V}, I_F = 40\text{ A}$ $V_{GE} = 0\text{ V}, I_F = 40\text{ A}, T_J = 175^{\circ}\text{C}$	V_F	– –	3.0 2.8	3.4 –	V
Reverse recovery time	$T_J = 25^{\circ}\text{C}$ $I_F = 40\text{ A}, V_R = 600\text{ V}$ $di_F/dt = 500\text{ A}/\mu\text{s}$	t_{rr}	–	86	–	ns
Reverse recovery charge		Q_{rr}	–	0.56	–	μC
Reverse recovery current		I_{rrm}	–	12	–	A
Diode peak rate of fall of reverse recovery current during t_b		dl_{rrm}/dt	–	–210	–	A/ μs

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ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise specified) (continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
DIODE CHARACTERISTIC						
Reverse recovery time	$T_J = 125^\circ\text{C}$ $I_F = 40\text{ A}$, $V_R = 600\text{ V}$ $di_F/dt = 500\text{ A}/\mu\text{s}$	t_{rr}	–	136	–	ns
Reverse recovery charge		Q_{rr}	–	1.47	–	μC
Reverse recovery current		I_{rrm}	–	20	–	A
Diode peak rate of fall of reverse recovery current during t_b		dl_{rrm}/dt	–	–212	–	$\text{A}/\mu\text{s}$

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

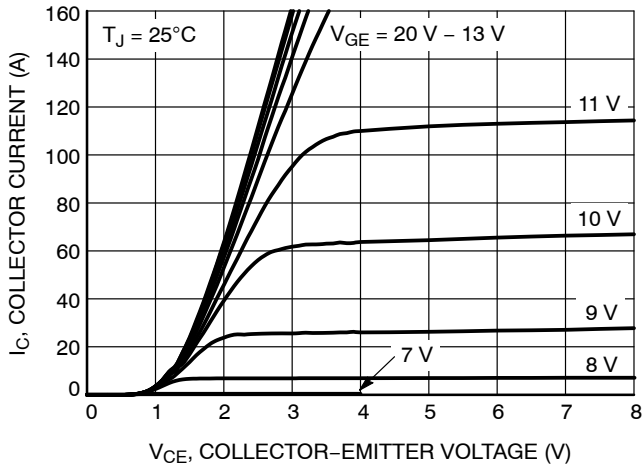


Figure 1. Output Characteristics

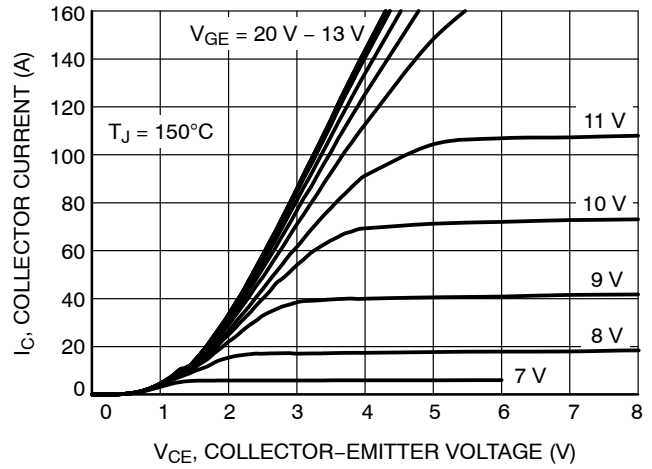


Figure 2. Output Characteristics

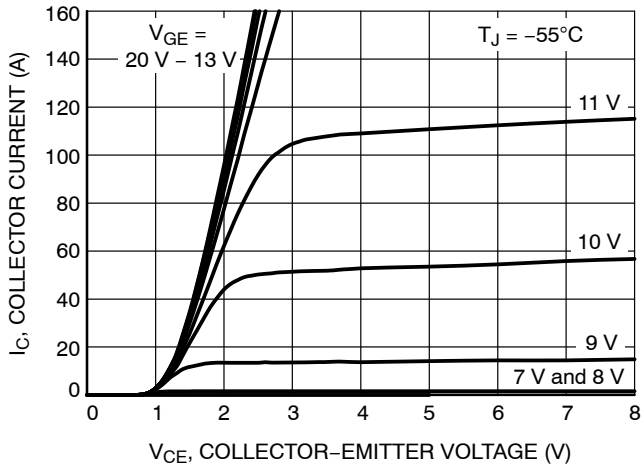


Figure 3. Output Characteristics

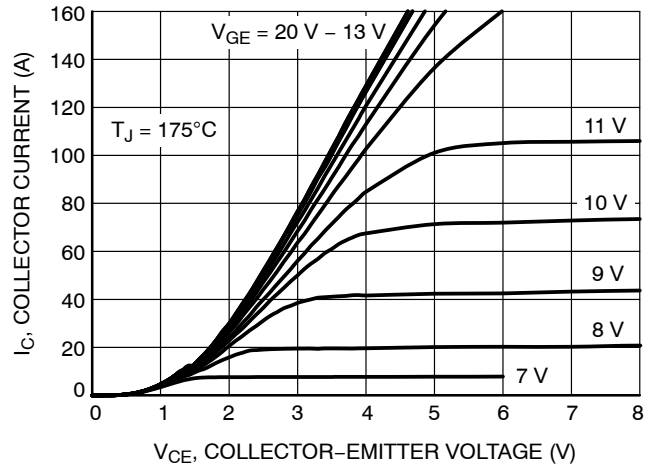


Figure 4. Output Characteristics

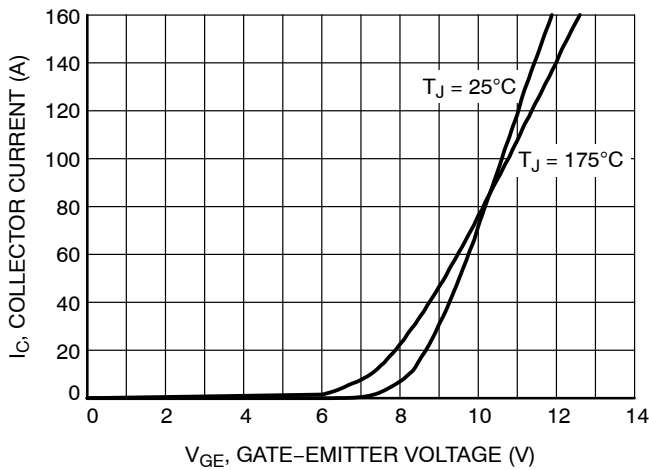


Figure 5. Typical Transfer Characteristics

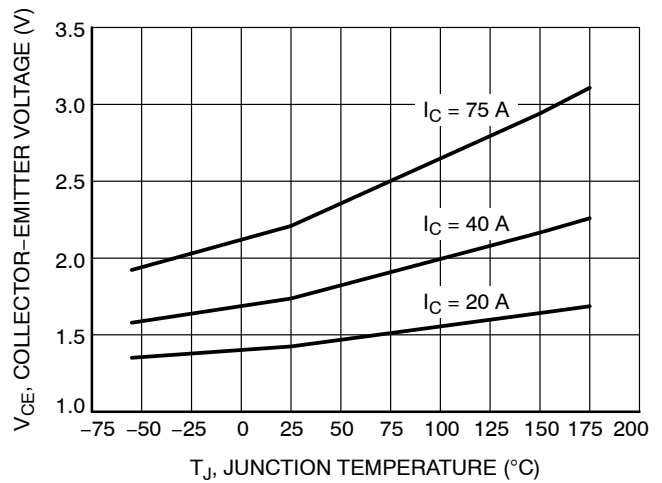


Figure 6. $V_{CE(sat)}$ vs. T_J

TYPICAL CHARACTERISTICS (CONTINUED)

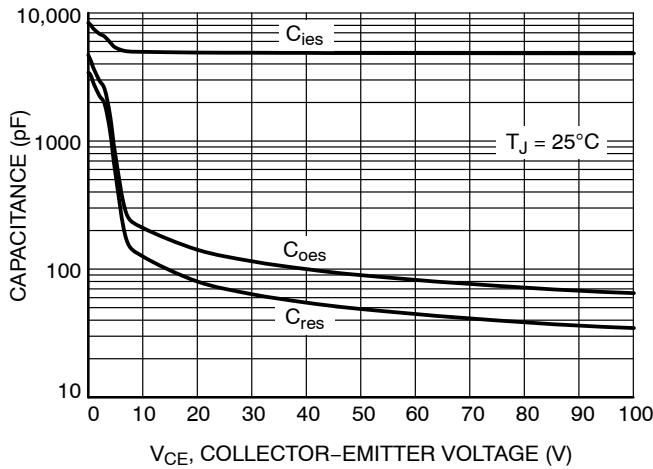


Figure 7. Typical Capacitance

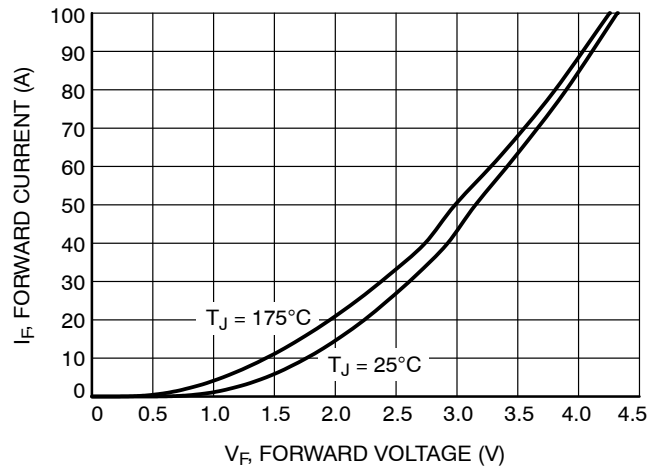


Figure 8. Diode Forward Characteristics

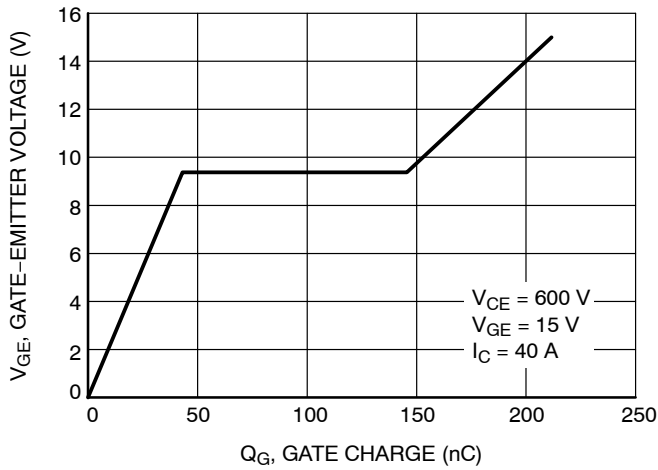


Figure 9. Typical Gate Charge

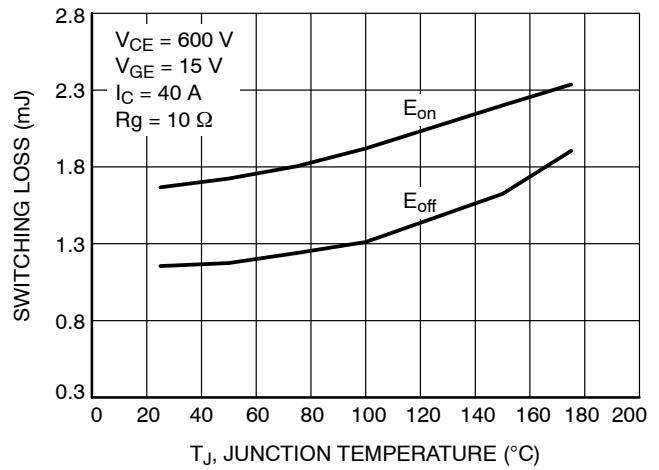


Figure 10. Switching Loss vs. Temperature

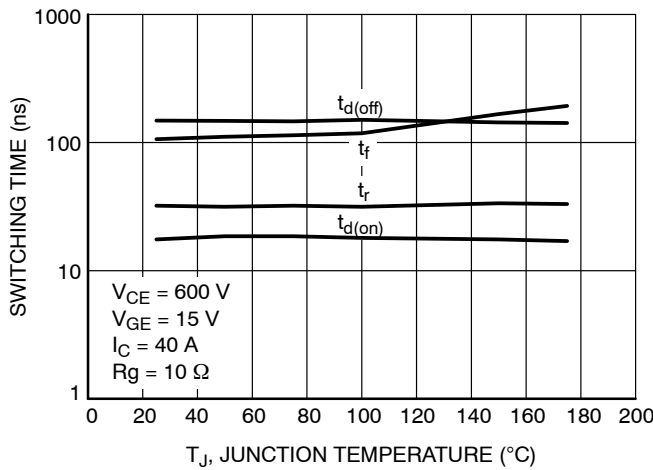


Figure 11. Switching Time vs. Temperature

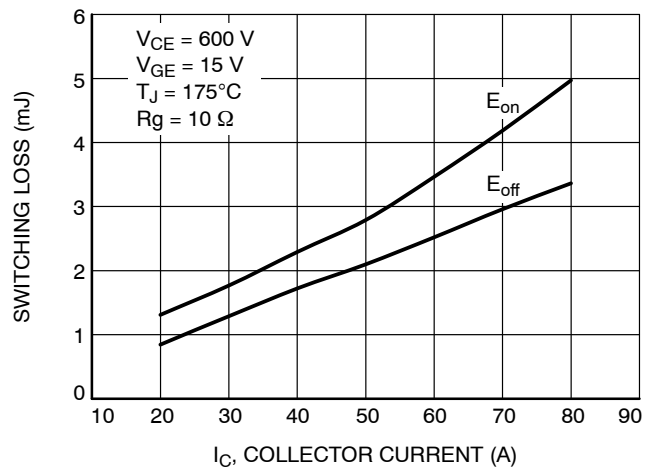


Figure 12. Switching Loss vs. IC

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TYPICAL CHARACTERISTICS (CONTINUED)

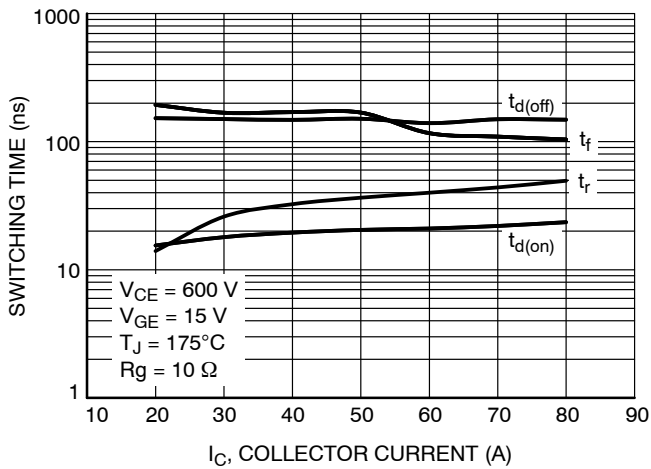


Figure 13. Switching Time vs. I_C

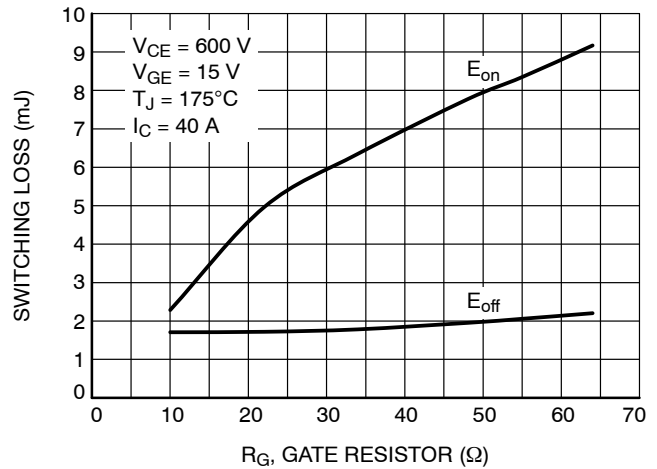


Figure 14. Switching Loss vs. R_G

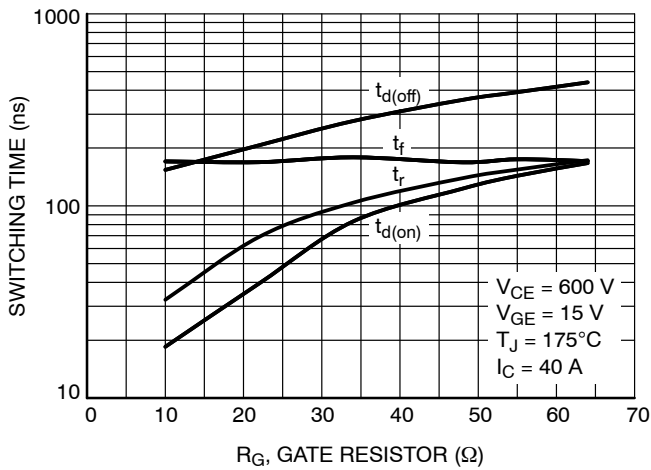


Figure 15. Switching Time vs. R_G

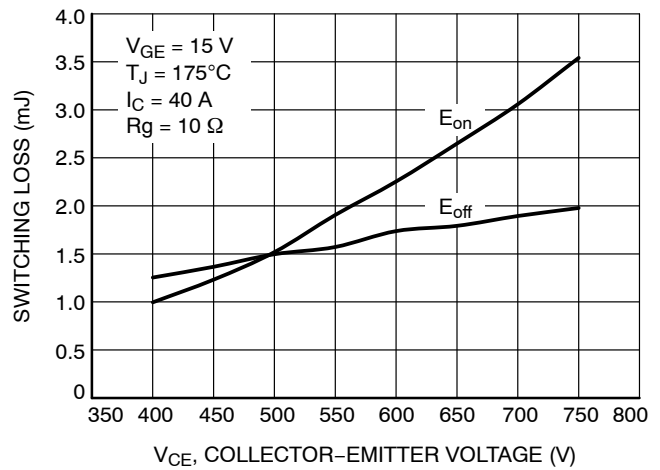


Figure 16. Switching Loss vs. V_{CE}

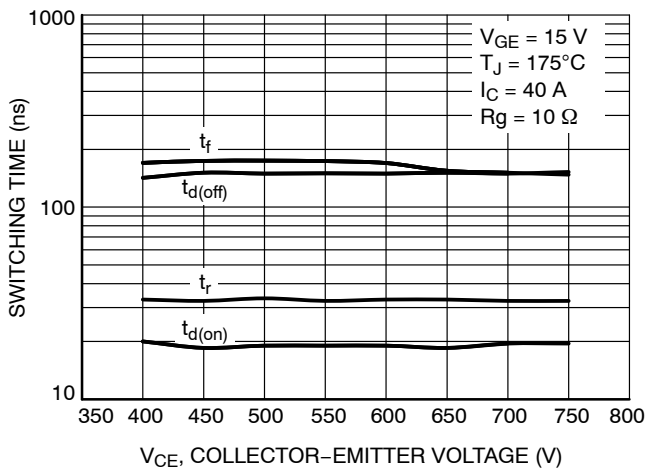


Figure 17. Switching Time vs. V_{CE}

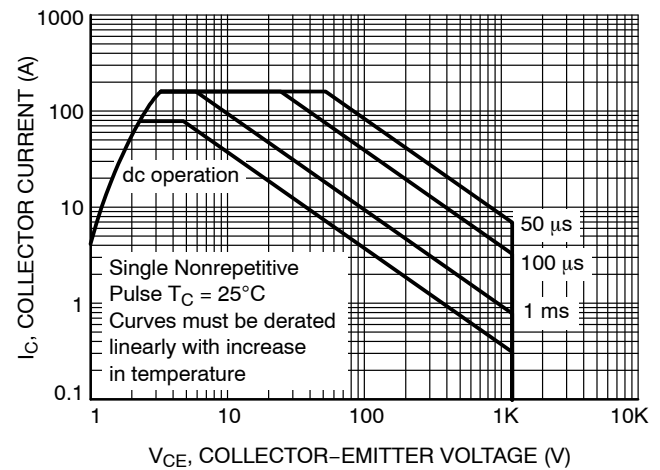


Figure 18. Safe Operating Area

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TYPICAL CHARACTERISTICS (CONTINUED)

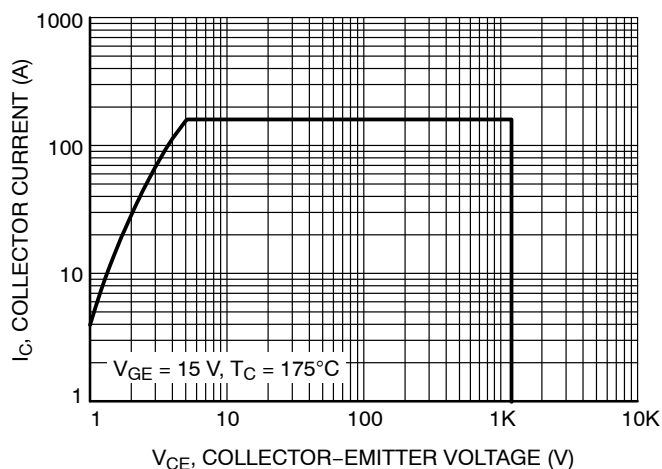


Figure 19. Reverse Bias Safe Operating Area

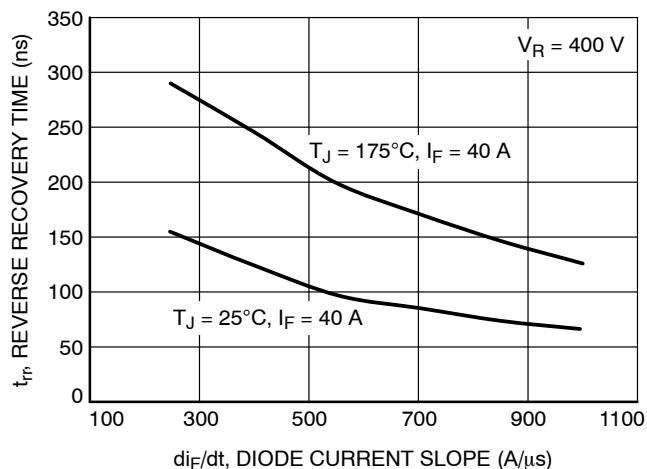


Figure 20. t_{rr} vs. di_F/dt

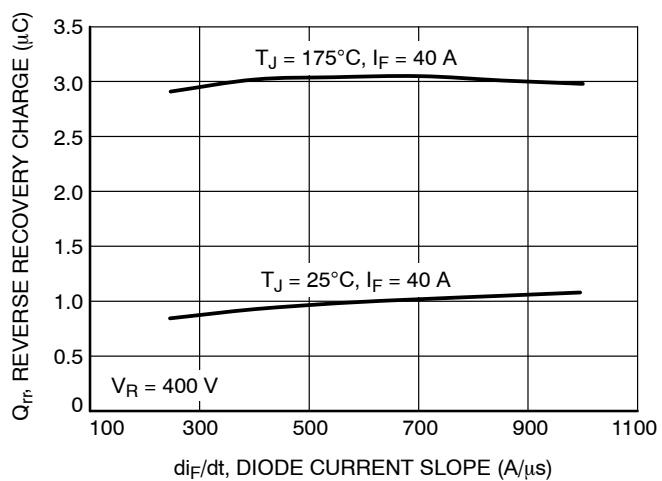


Figure 21. Q_{rr} vs. di_F/dt

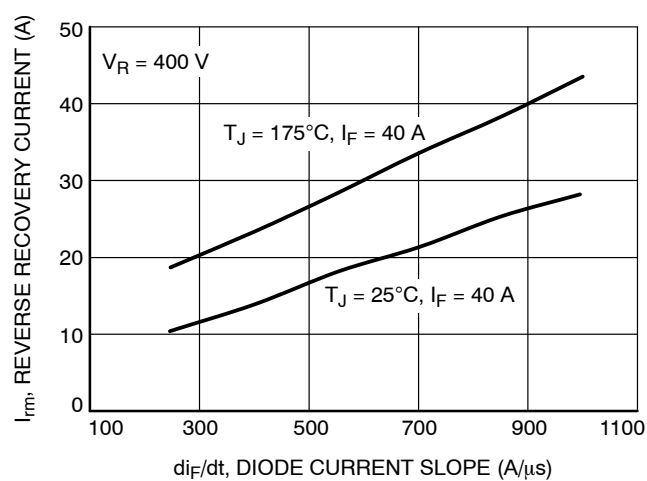


Figure 22. I_{rm} vs. di_F/dt

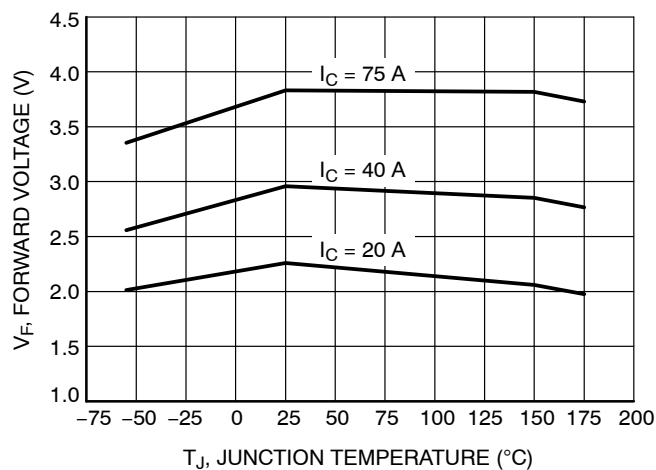
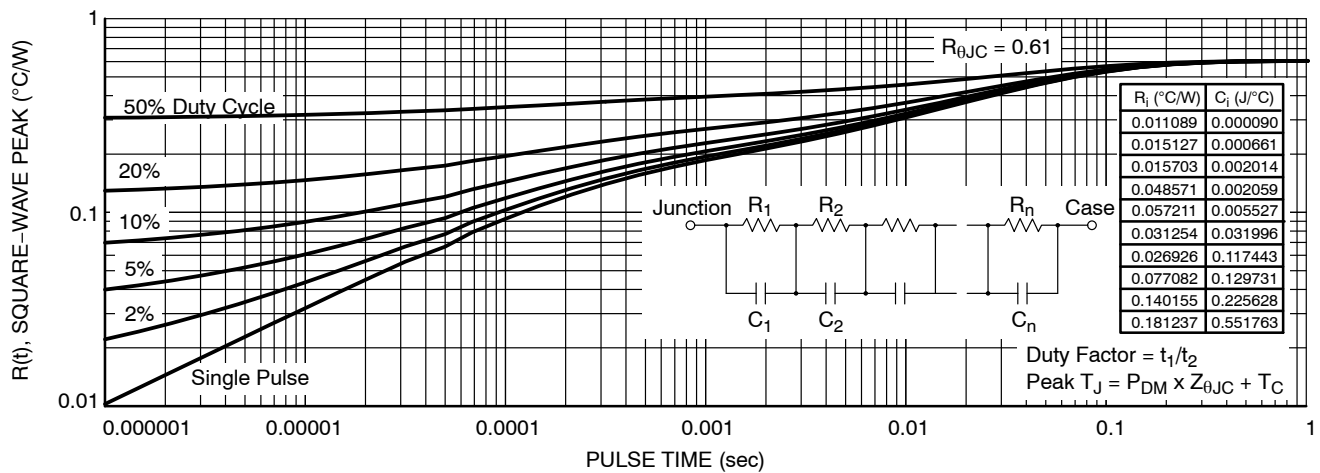
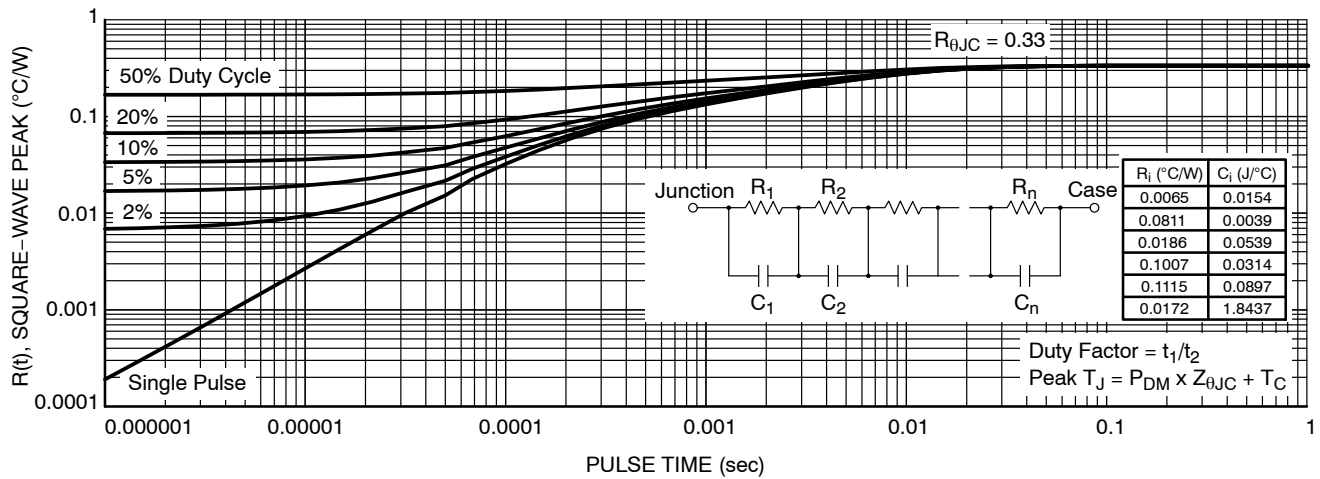
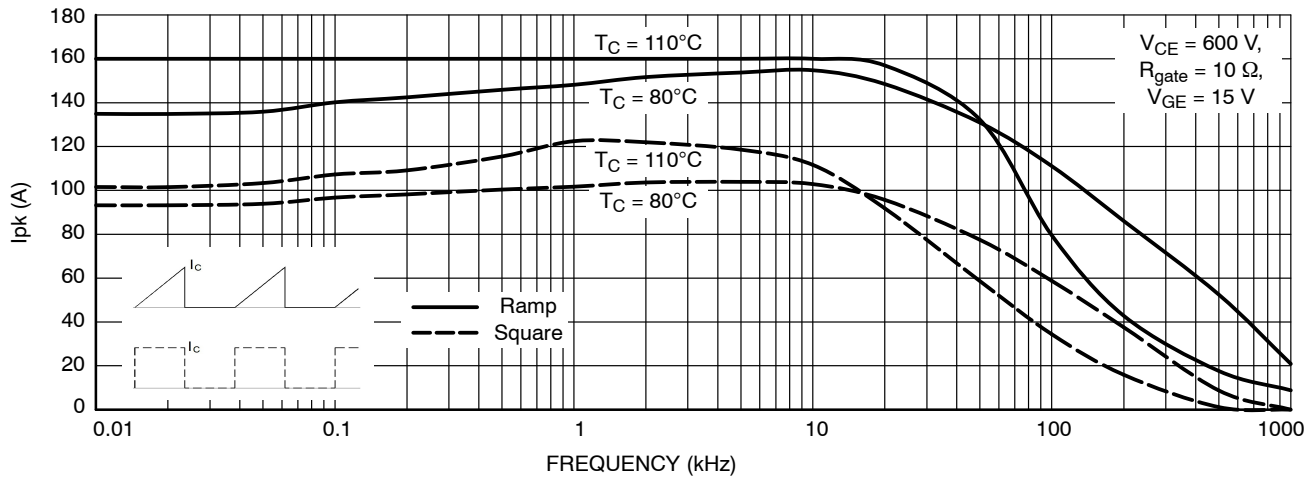


Figure 23. V_F vs. T_J

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TYPICAL CHARACTERISTICS (CONTINUED)



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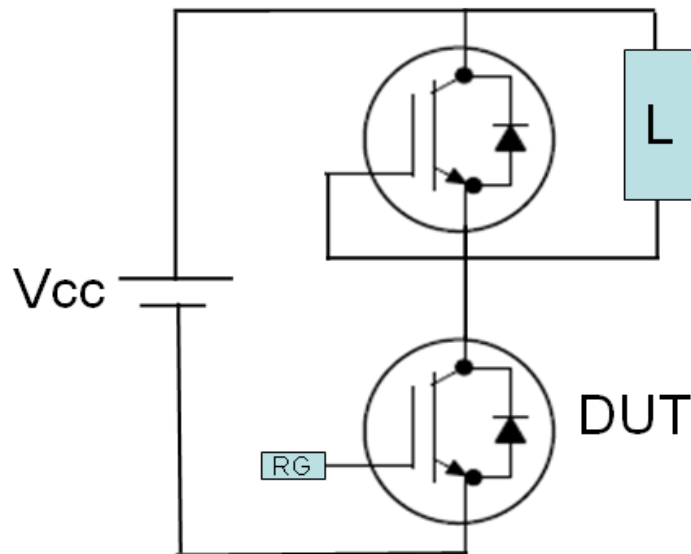


Figure 27. Test Circuit for Switching Characteristics

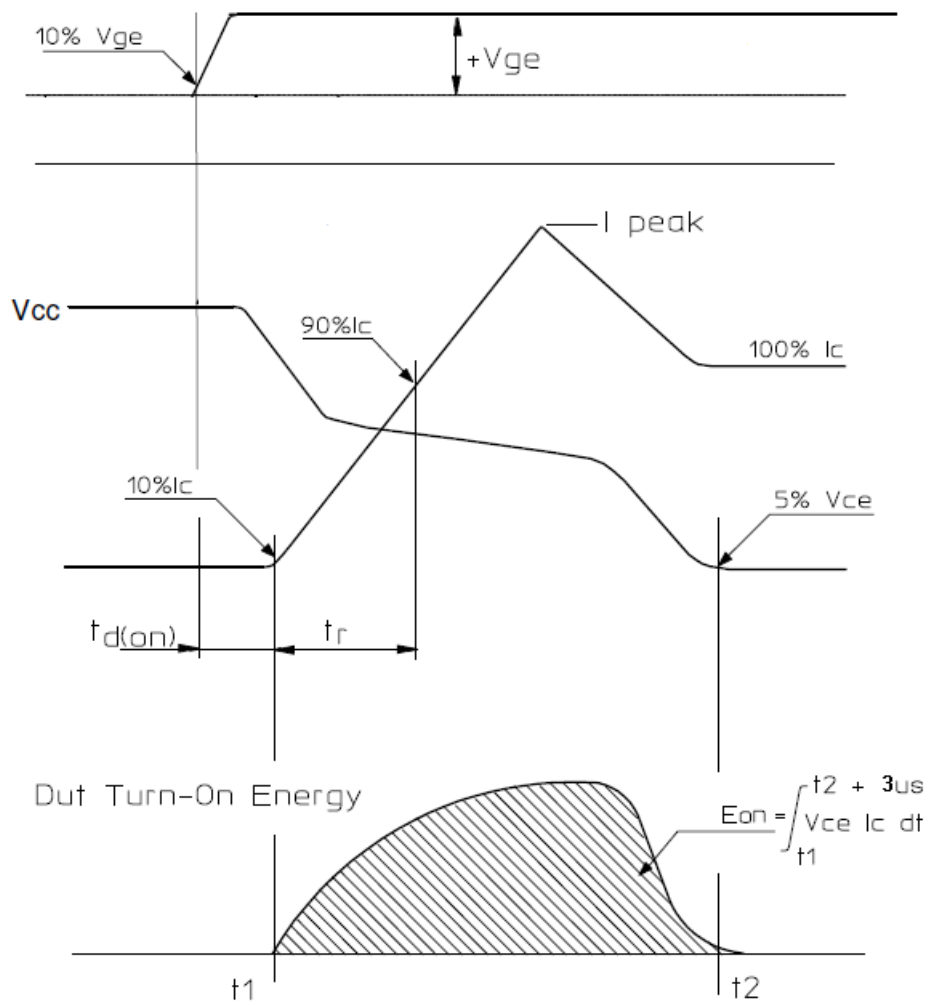


Figure 28. Definition of Turn On Waveform

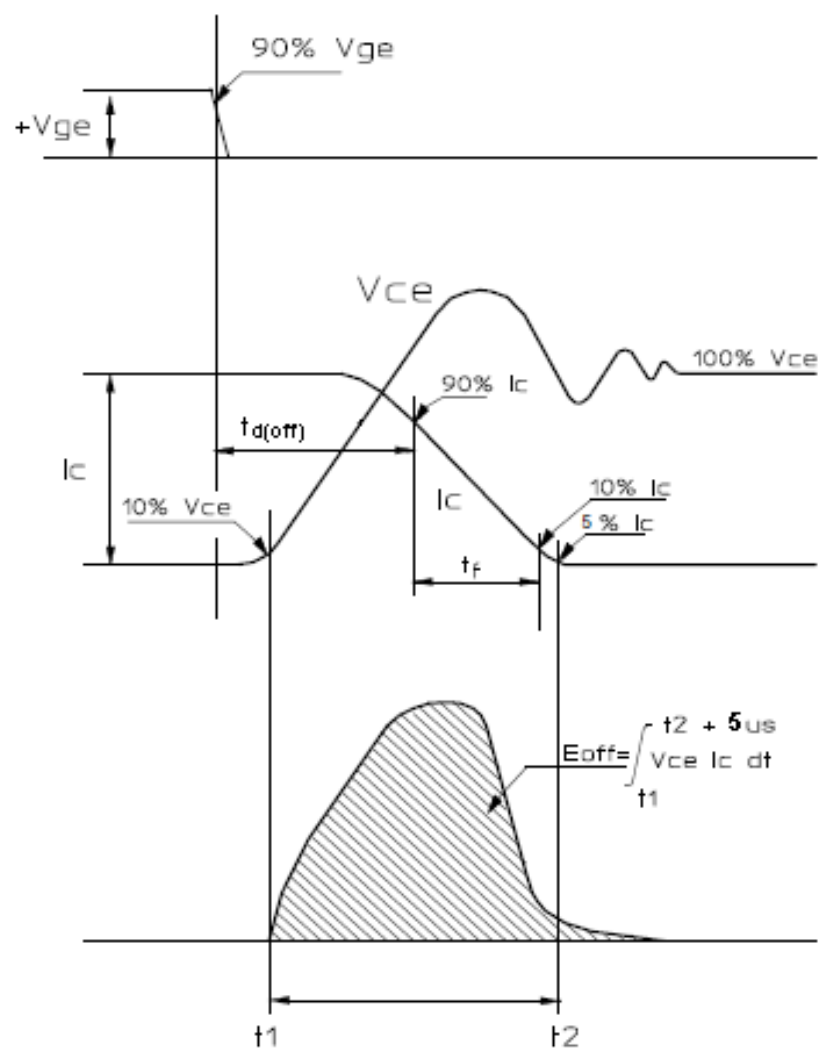
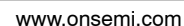


Figure 29. Definition of Turn Off Waveform

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