NGTB40N65IHRWG

IGBT with Monolithic Reverse Conducting Diode

This Insulated Gate Bipolar Transistor (IGBT) features robust and cost effective Field Stop (FS2) trench construction with a monolithic RC Diode. It provides a cost effective Solution for applications where diode losses are minimal. The IGBT is optimized for low conduction losses (low V_{CEsat}) and is well suited for resonant or soft switching applications.

Features

- Extremely Efficient Trench with Fieldstop Technology
- Low Conduction Design for Soft Switching Application
- Reduced Power Dissipation in Inducting Heating Application
- Reliable and Cost Effective Single Die Solution
- This is a Pb−Free Device

Typical Applications

- Inductive Heating
- Air Conditioning PFC
- Welding

ON Semiconductor®

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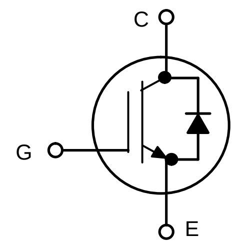
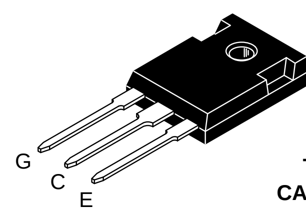
40 A, 650 V
V_{CEsat} = 1.55 V
E_{off} = 0.42 mJ





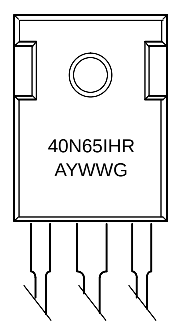
TO−247
CASE 340AL

ABSOLUTE MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−emitter voltage	V_{CES}	650	V
Collector current @ T_C = 25°C @ T_C = 100°C	I_C	 80 40	A
Pulsed collector current, T_{pulse} limited by T_{Jmax}, 10 μs pulse, V_{GE} = 15 V	I_{CM}	160	A
Diode forward current @ T_C = 25°C @ T_C = 100°C	I_F	 80 40	A
Diode pulsed current, T_{pulse} limited by T_{Jmax}, 10 μs pulse, V_{GE} = 0 V	I_{FM}	160	A
Power Dissipation @ T_C = 25°C @ T_C = 100°C	P_D	 405 202	W
Operating junction temperature range	T_J	−40 to +175	°C
Storage temperature range	T_{stg}	−55 to +175	°C
Lead temperature for soldering, 1/8″ from case for 5 seconds	T_{SLD}	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.

MARKING DIAGRAM



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

ORDERING INFORMATION

Device	Package	Shipping
NGTB40N65IHRWG	TO−247 (Pb−Free)	30 Units / Rail

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction−to−case	$R_{\theta JC}$	0.37	°C/W
Thermal resistance junction−to−ambient	$R_{\theta JA}$	40	°C/W

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

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
STATIC CHARACTERISTIC						
Collector−emitter breakdown voltage, gate−emitter short−circuited	V_{GE} = 0 V, I_C = 500 μA	$V_{(BR)CES}$	650	−	−	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 40 A V_{GE} = 15 V, I_C = 40 A, T_J = 175°C	V_{CEsat}	− −	1.55 1.95	1.7 −	V
Gate−emitter threshold voltage	V_{GE} = V_{CE}, I_C = 350 μA	$V_{GE(th)}$	4.5	5.5	6.5	V
Collector−emitter cut−off current, gate−emitter short−circuited	V_{GE} = 0 V, V_{CE} = 650 V V_{GE} = 0 V, V_{CE} = 1200 V, T_J = 175°C	I_{CES}	− −	− 1.0	0.3 −	mA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	−	−	100	nA
DYNAMIC CHARACTERISTIC						
Input capacitance	V_{CE} = 20 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	−	4628	−	pF
Output capacitance		C_{oes}	−	148	−	
Reverse transfer capacitance		C_{res}	−	126	−	
Gate charge total	V_{CE} = 400 V, I_C = 40 A, V_{GE} = 15 V	Q_g	−	190	−	nC
Gate to emitter charge		Q_{ge}	−	38	−	
Gate to collector charge		Q_{gc}	−	90	−	
SWITCHING CHARACTERISTIC, INDUCTIVE LOAD						
Turn−off delay time	T_J = 25°C V_{CC} = 400 V, I_C = 40 A R_g = 10 Ω V_{GE} = 0 V/ 15V	$t_{d(off)}$	−	197	−	ns
Fall time		t_f	−	74	−	
Turn−off switching loss		E_{off}	−	0.42	−	mJ
Turn−off delay time	T_J = 175°C V_{CC} = 400 V, I_C = 40 A R_g = 10 Ω V_{GE} = 0 V/ 15V	$t_{d(off)}$	−	210	−	ns
Fall time		t_f	−	106	−	
Turn−off switching loss		E_{off}	−	0.7	−	mJ
DIODE CHARACTERISTIC						
Forward voltage	V_{GE} = 0 V, I_F = 40 A V_{GE} = 0 V, I_F = 40 A, T_J = 175°C	V_F	− −	1.50 1.70	1.80 −	V

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

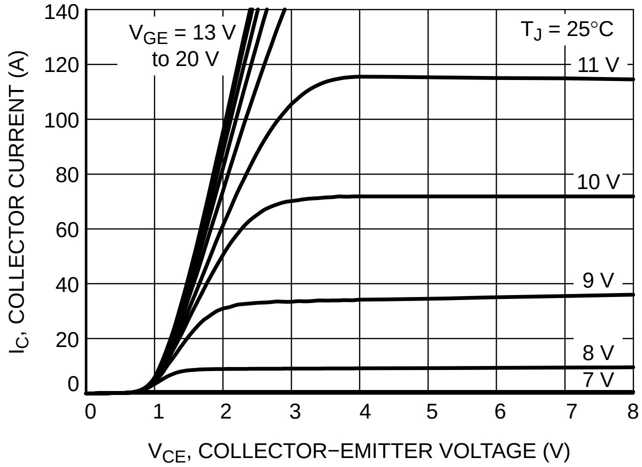


Figure 1. Output Characteristics

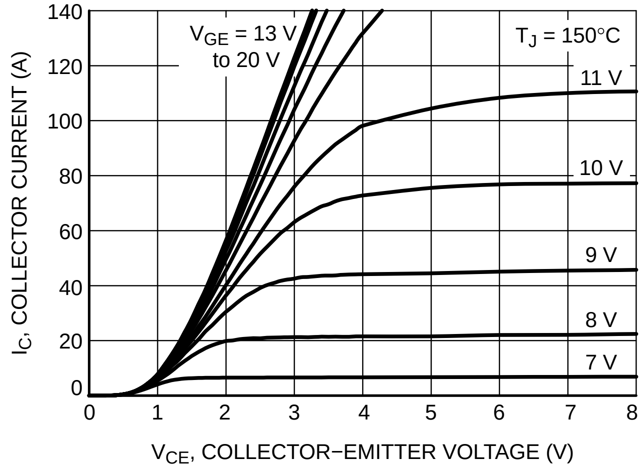


Figure 2. Output Characteristics

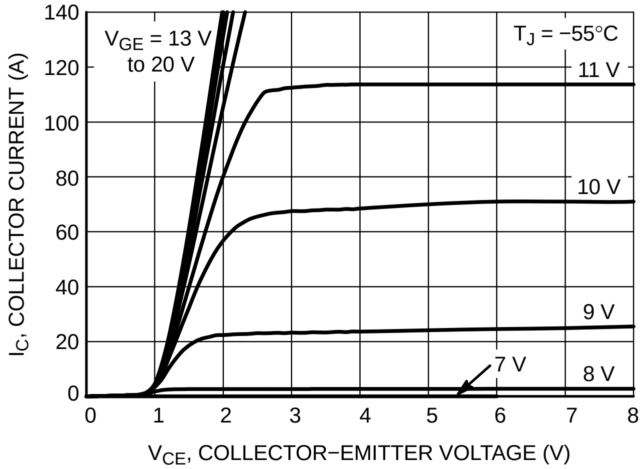


Figure 3. Output Characteristics

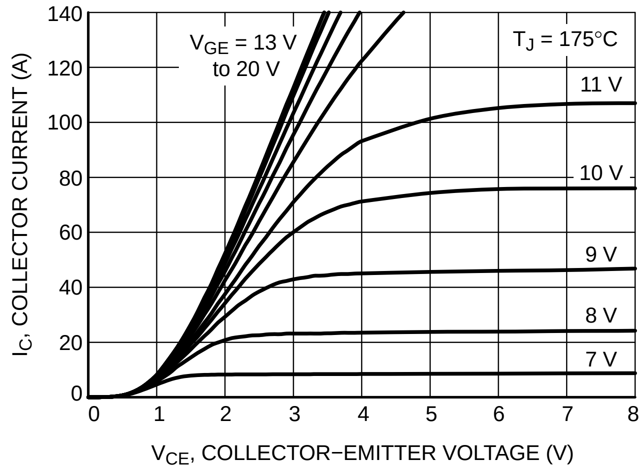


Figure 4. Output Characteristics

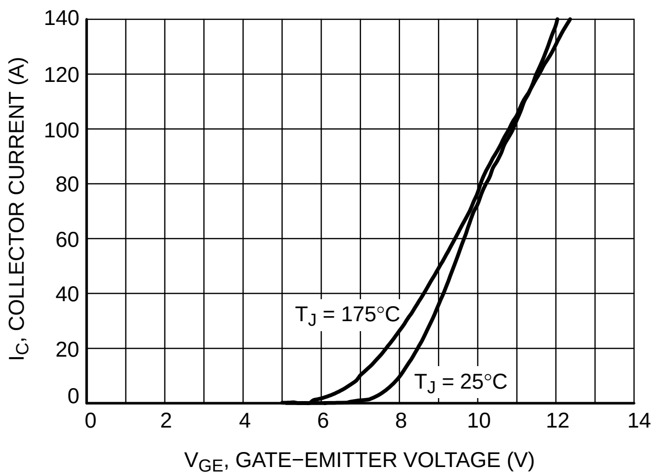


Figure 5. Typical Transfer Characteristics

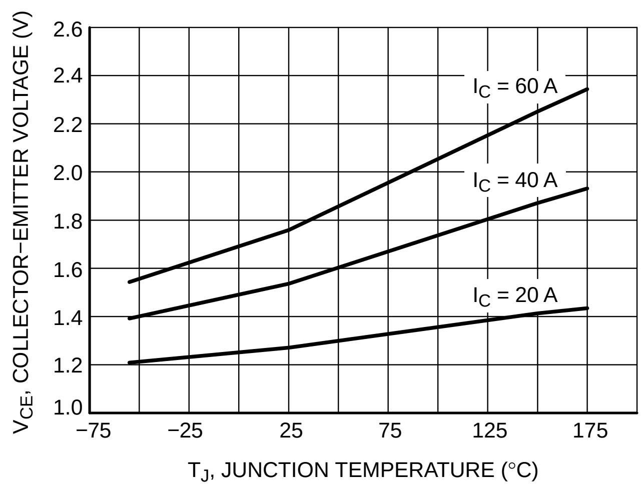


Figure 6. $V_{CE(sat)}$ vs. T_J

TYPICAL CHARACTERISTICS

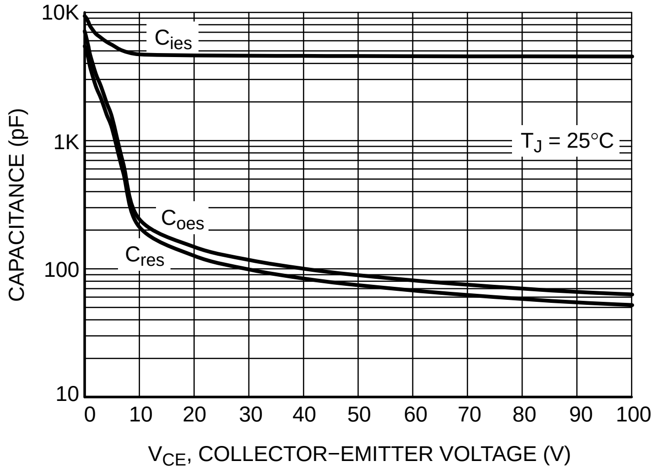


Figure 7. Typical Capacitance

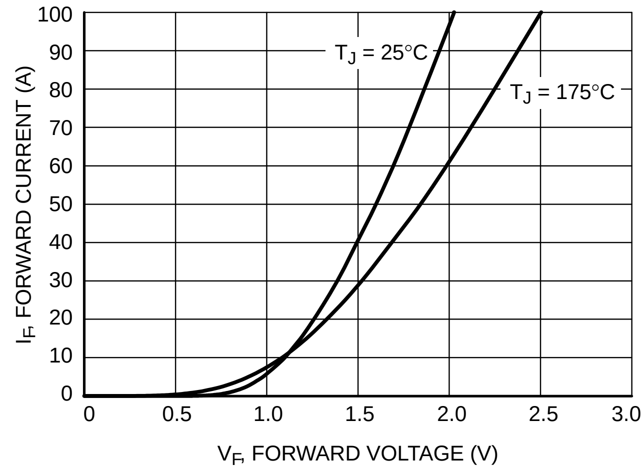


Figure 8. Diode Forward Characteristics

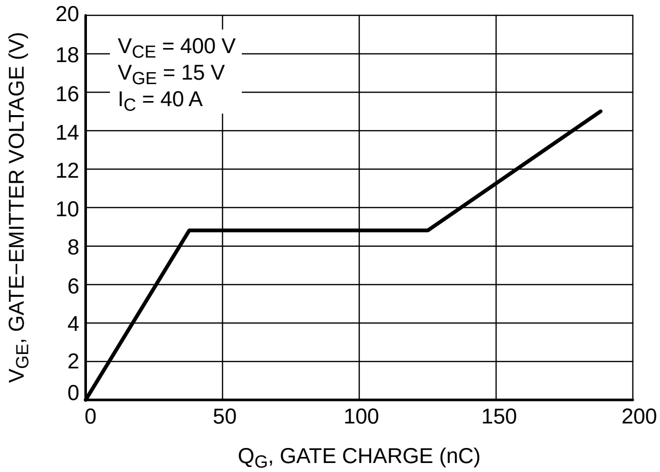


Figure 9. Typical Gate Charge

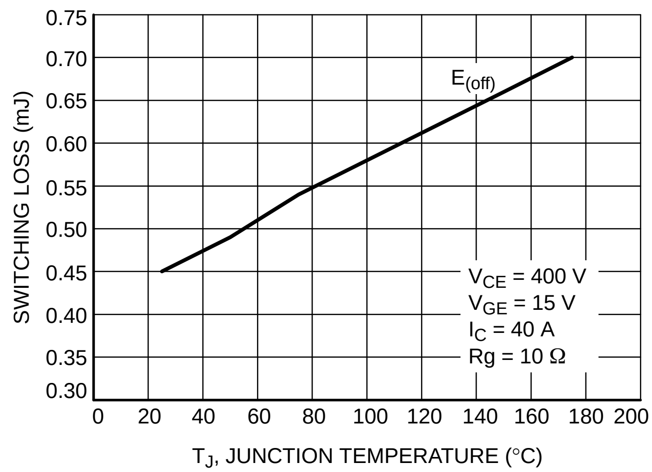


Figure 10. Switching Loss vs. Temperature

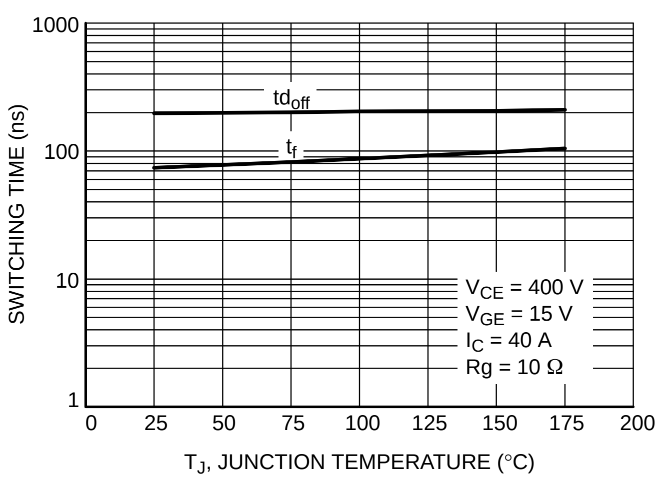


Figure 11. Switching Time vs. Temperature

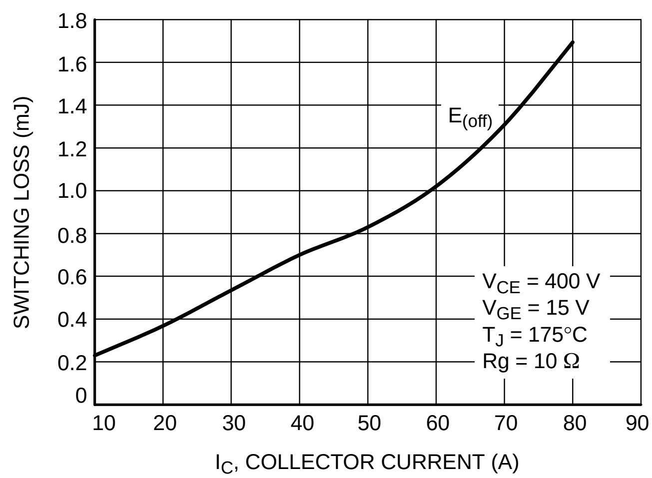


Figure 12. Switching Loss vs. I_C

TYPICAL CHARACTERISTICS

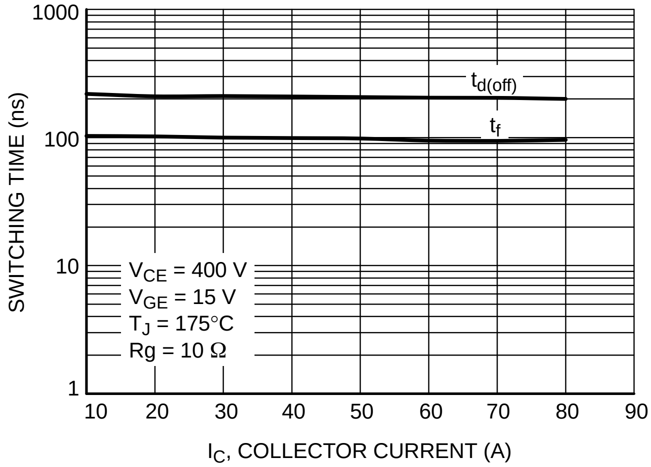


Figure 13. Switching Time vs. I_C

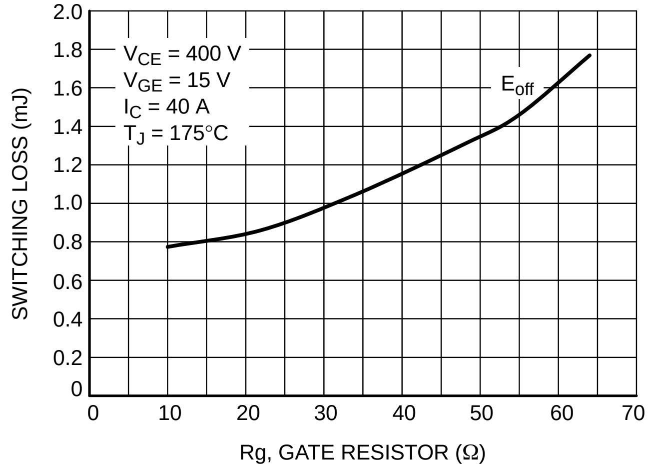


Figure 14. Switching Loss vs. Rg

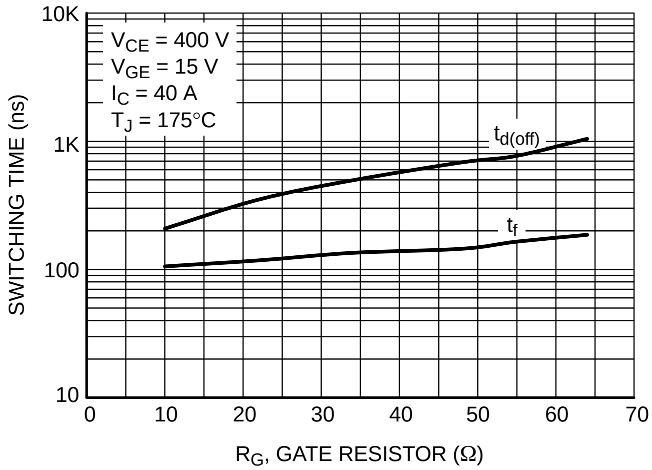


Figure 15. Switching Time vs. Rg

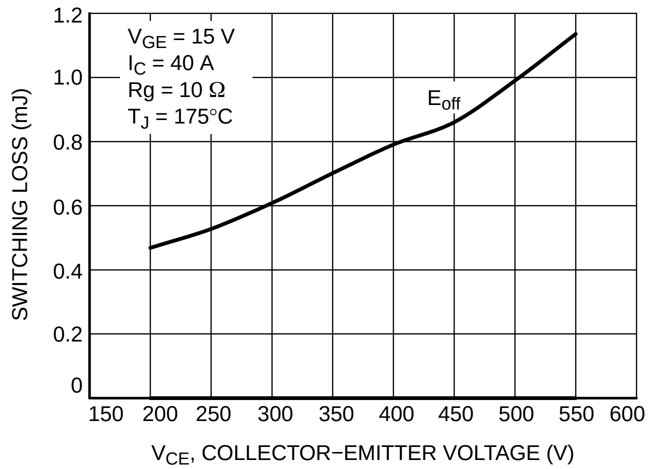


Figure 16. Switching Loss vs. V_{CE}

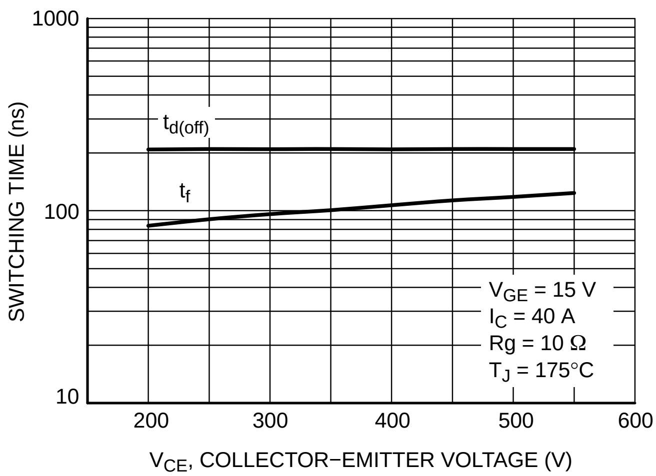


Figure 17. Switching Time vs. V_{CE}

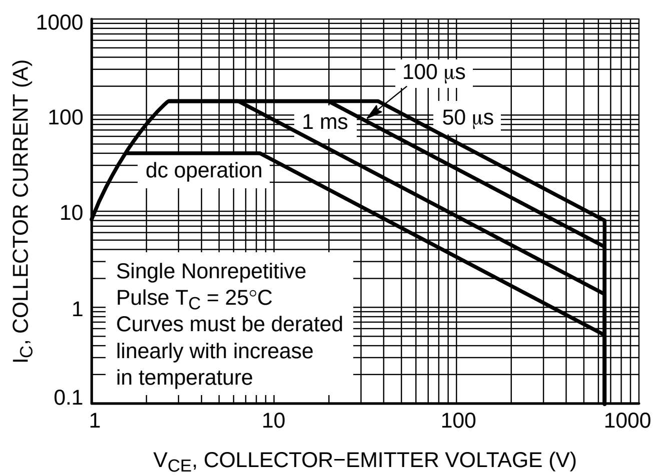


Figure 18. Safe Operating Area

TYPICAL CHARACTERISTICS

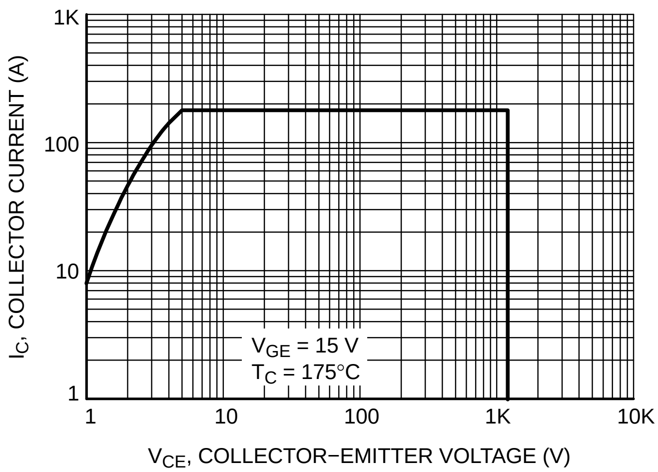


Figure 19. Reverse Bias Safe Operating Area

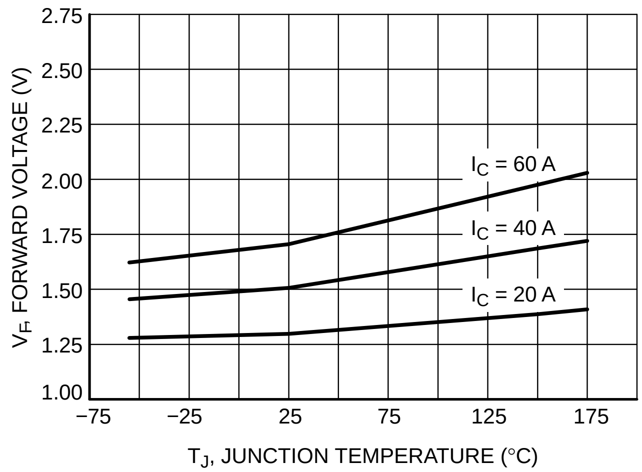
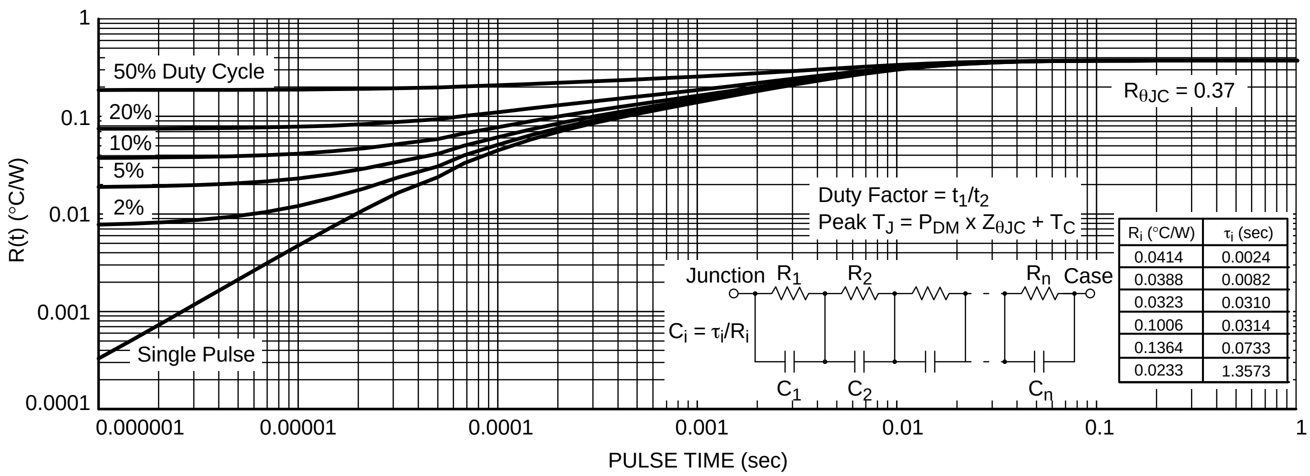


Figure 20. Forward Voltage vs. Junction Temperature



R_i (°C/W)	τ_i (sec)
0.0414	0.0024
0.0388	0.0082
0.0323	0.0310
0.1006	0.0314
0.1364	0.0733
0.0233	1.3573

Figure 21. IGBT Transient Thermal Impedance

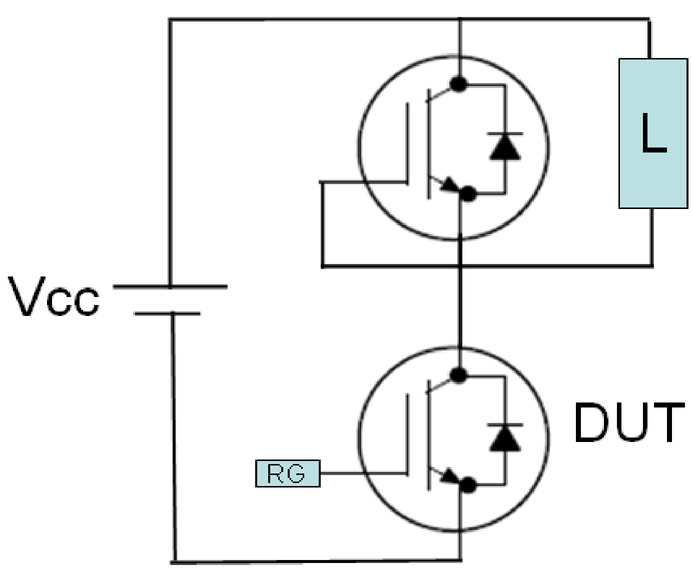


Figure 22. Test Circuit for Switching Characteristics

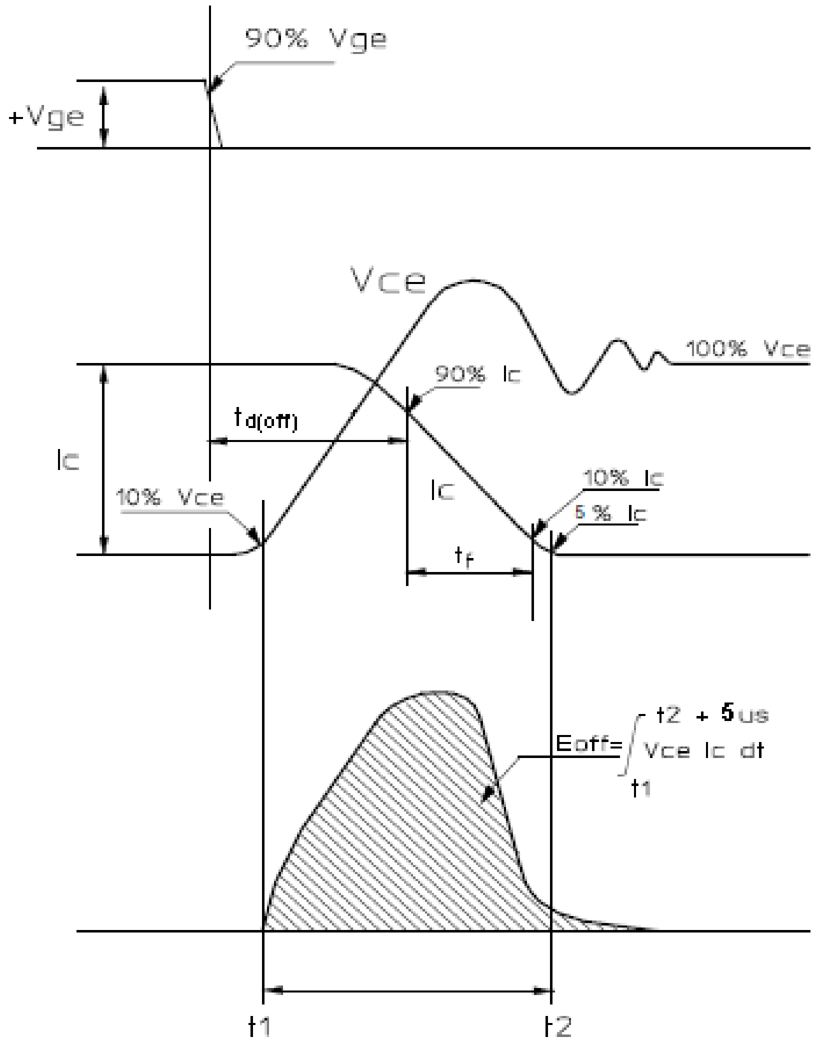
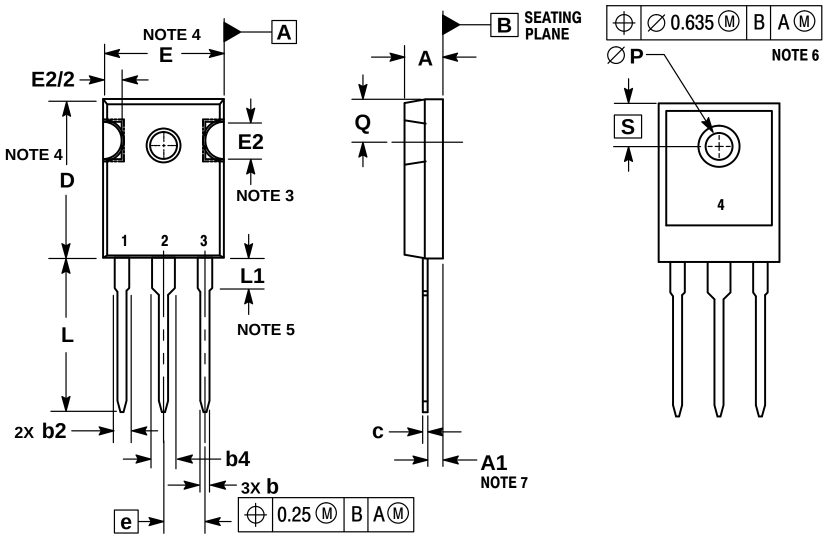


Figure 23. Definition of Turn Off Waveform

PACKAGE DIMENSIONS

TO−247
CASE 340AL
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. SLOT REQUIRED, NOTCH MAY BE ROUNDED.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.13 PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREME OF THE PLASTIC BODY.
5. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.
6. ∅P SHALL HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM DIAMETER OF 3.91.
7. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.

	MILLIMETERS	
DIM	MIN	MAX
A	4.70	5.30
A1	2.20	2.60
b	1.00	1.40
b2	1.65	2.35
b4	2.60	3.40
c	0.40	0.80
D	20.30	21.40
E	15.50	16.25
E2	4.32	5.49
e	5.45 BSC	
L	19.80	20.80
L1	3.50	4.50
P	3.55	3.65
Q	5.40	6.20
S	6.15 BSC	

PUBLICATION ORDERING INFORMATION

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