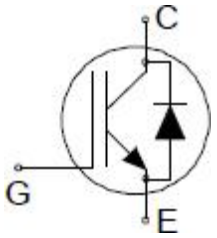
1. Description

AOK50B65M2 is obtained by advanced Trench and Field Stop (T-FS) technology which reduces the conduction loss, improves switching performance and enhances the avalanche energy.

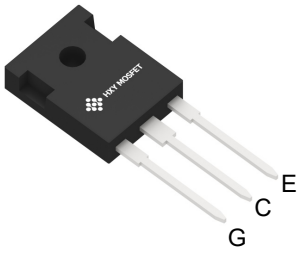


Device Per Unit

Package Type	Unit	Quantity
TO-247	Tube	30

Key Characteristics

Parameter	Value	Unit
V_{CES}	650	V
I_C	50	A
$V_{CE(sat).typ}$	1.65	V



TO-247

Features

- Positive temperature coefficient
- Fast Switching
- Low $V_{CE(sat)}$
- Reliable and Rugged
- Halogen Free and Green Devices Available
- (RoHS Compliant)

Applications

- UPS
- Motor drives
- Boost
- Portable power station

2. Absolute ratings

Symbol	Parameter	Values	Units
V_{CES}	Collector-Emitter Voltage	650	V
I_C	Collector Current @T_C=25°C	100	A
	Collector Current @T_C=100°C	50	A
I_{CM}	Pulsed Collector Current, tp limited by T_{Jmax}	200	A
I_F	Diode Continuous Forward Current @T_C=25°C	100	A
	Diode Continuous Forward Current @T_C=100°C	50	A
I_{FM}	Diode Maximum Forward Current, limited by T_{Jmax}	200	A
V_{GES}	Gate-Emitter Voltage	±30	V
t_{SC}	Short circuit withstand time V_{GE}=15V, V_{CC}≤400V, allowed number of short circuits<1000,times between short circuits≥1.0s,T_J≤175°C	4	μs
P_D	Power Dissipation @T_C=25°C	300	W
T_{Jmax}, T_{stg}	Operating Junction and Storage Temperature Range	–55 to 175	℃
T_L	Maximum Temperature for Soldering	260	℃

3. Thermal characteristics

Symbol	Parameter	Values	Units
$R_{\theta JC}$	Junction-to-Case (IGBT)	0.50	℃/W
$R_{\theta JC}$	Junction-to-Case (Diode)	0.65	℃/W
$R_{\theta JA}$	Junction-to-Ambient	40	℃/W

4. Electrical Characteristics （at T_c = 25°C, unless otherwise specified）

Static Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
V_{CES}	Collector-Emitter Breakdown Voltage	V_{GE}=0V I_C=1mA	650	--	--	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE} =15V I_C =50A T_J=25℃ T_J=125℃ T_J=175℃	 -- -- --	 1.65 1.80 2.00	 1.95	 V

$V_{GE(TH)}$	Gate Threshold Voltage	$V_{CE}=V_{GE}, I_C=1mA$	4.5	5.3	6.5	V
V_F	Diode Forward Voltage	$I_F=50A$ $T_J=25℃$ $T_J=125℃$ $T_J=175℃$	-- -- --	1.45 1.26 1.23	1.85 -- --	V
I_{CES}	Collector-Emitter Leakage Current	$V_{CE}=650V$ $V_{GE}=0V$	--	--	10	μA
$I_{GES(F)}$	Gate-Emitter Forward Leakage Current	$V_{GE}=+20V$	--	--	100	nA
$I_{GES(R)}$	Gate-Emitter Reverse Leakage Current	$V_{GE}=-20V$	--	--	-100	nA
Pulse width tp≤300μs, δ≤2%						

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
C_{ies}	Input Capacitance	$V_{GE}=0V$ $V_{CE}=25V$ f=1.0MHz	--	3363	--	pF
C_{oes}	Output Capacitance		--	206	--	
C_{res}	Reverse Transfer Capacitance		--	92	--	
Q_g	Gate charge	$V_{CC}=520V$ $I_{CE}=50A$ $V_{GE}=15V$	--	179	--	nC
Q_{ge}	Gate-emitter charge		--	31	--	
Q_{gc}	Gate-collector charge		--	87	--	
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits, times between short circuits≥1.0s	$V_{GE}=15V, V_{CC}≤400V$ $t_{SC}≤4μs, T_J≤175℃$		469		A

IGBT Switching Characteristics, at $T_J=25℃$

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on Delay Time	$I_C=50A$ $V_{CC}=400V$ $V_{GE}=15V$ $R_g=5Ω$ Inductive Load	--	24	--	ns
t_r	Rise Time		--	86	--	
$t_{d(off)}$	Turn-Off Delay Time		--	122	--	
t_f	Fall Time		--	74	--	
E_{on}	Turn-On Switching Loss		--	1.38	--	mJ
E_{off}	Turn-Off Switching Loss		--	1.14	--	
E_{ts}	Total Switching Loss		--	2.52	--	

IGBT Switching Characteristics, at T_J=175℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
$t_{d(on)}$	Turn-on Delay Time	I_C=50A V_{CC}=400V V_{GE}=15V R_g=5Ω Inductive Load	--	33	--	ns
t_r	Rise Time		--	97	--	
$t_{d(off)}$	Turn-Off Delay Time		--	146	--	
t_f	Fall Time		--	84	--	
E_{on}	Turn-On Switching Loss		--	1.65	--	mJ
E_{off}	Turn-Off Switching Loss		--	1.32	--	
E_{ts}	Total Switching Loss		--	2.97	--	

Diode Characteristics, at T_J=25℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T_{rr}	Reverse Recovery Time	I_F=50A V_{CC}=400V di/dt=200A/μs	--	98	--	ns
Q_{rr}	Reverse Recovery Charge		--	1580	--	μC
I_{rrm}	Reverse Recovery Current		--	26	--	A

Diode Characteristics, at T_J=175℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T_{rr}	Reverse Recovery Time	I_F=50A V_{CC}=400V di/dt=200A/μs	--	104	--	ns
Q_{rr}	Reverse Recovery Charge		--	1640	--	μC
I_{rrm}	Reverse Recovery Current		--	27	--	A

5. Characteristics Curves

Figure 1: Power Dissipation

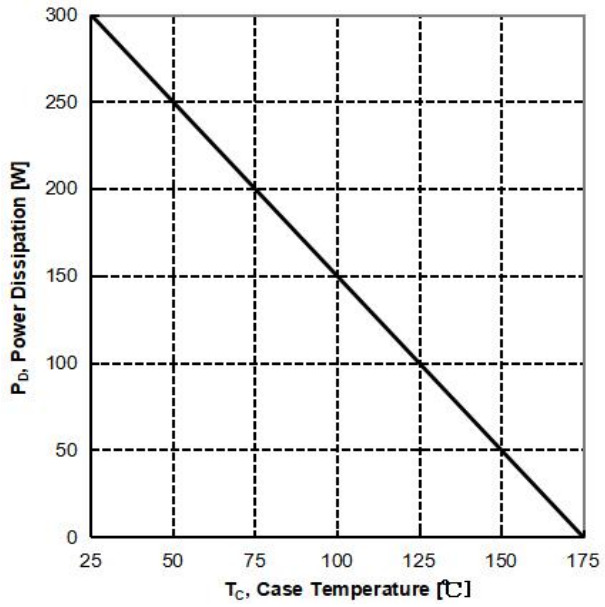


Figure 2: Collector Current vs. Case Temperature

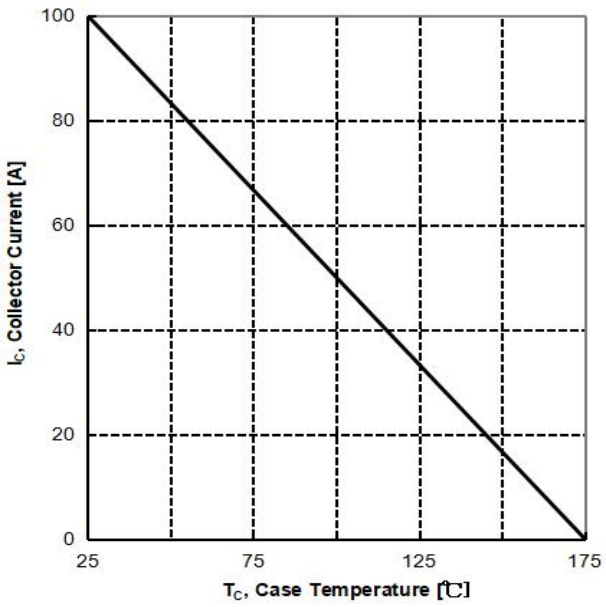


Figure 3: Safe Operation Area

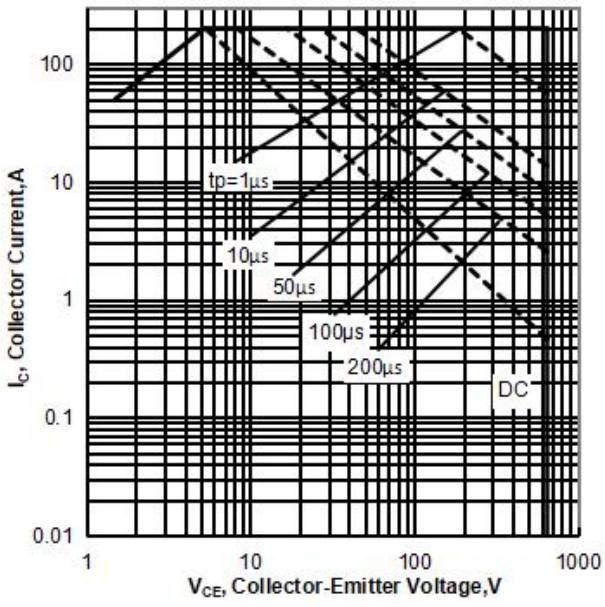


Figure 4: Typical Transfer Characteristics

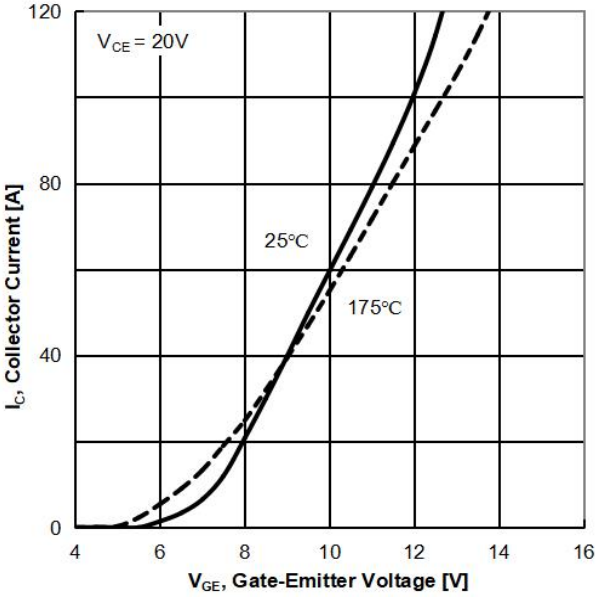


Figure 5: Typical Output Characteristics

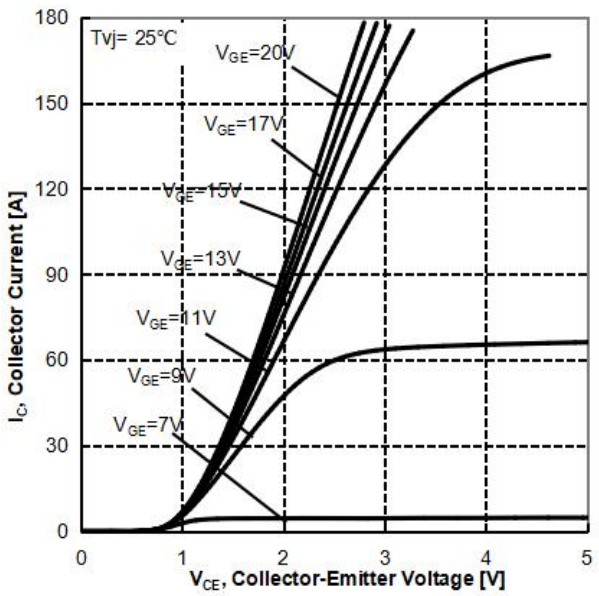


Figure 6: Typical Output Characteristics

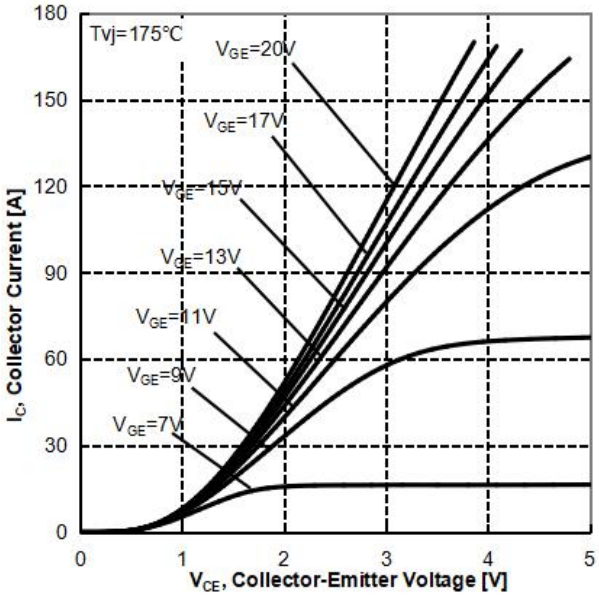


Figure 7: Typical Collector-Emitter Saturation Voltage vs. Junction Temperature

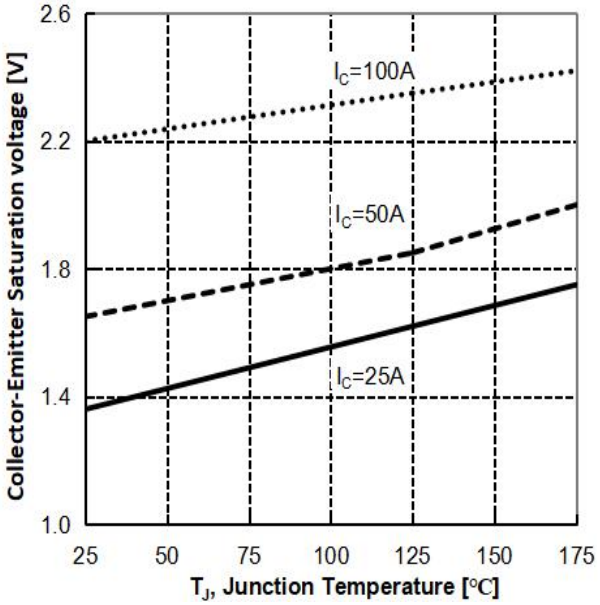


Figure 8: Typical Gate-Emitter Threshold Voltage vs. Junction Temperature

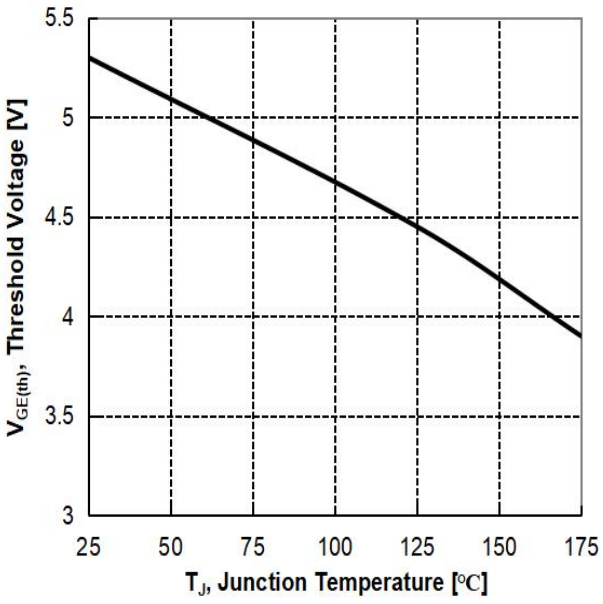


Figure 9: Typical Switching Times vs. Gate Resistor (T_J=25℃, V_{CE}=400V, V_{GE}=15V, I_C=50A)

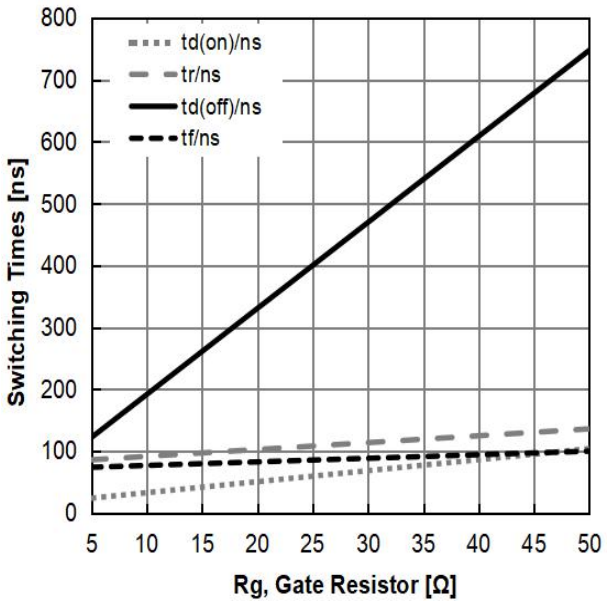


Figure 10: Typical Switching Energy vs. Gate Resistor (T_J=25℃, V_{CE}=400V, V_{GE}=15V, I_C=50A)

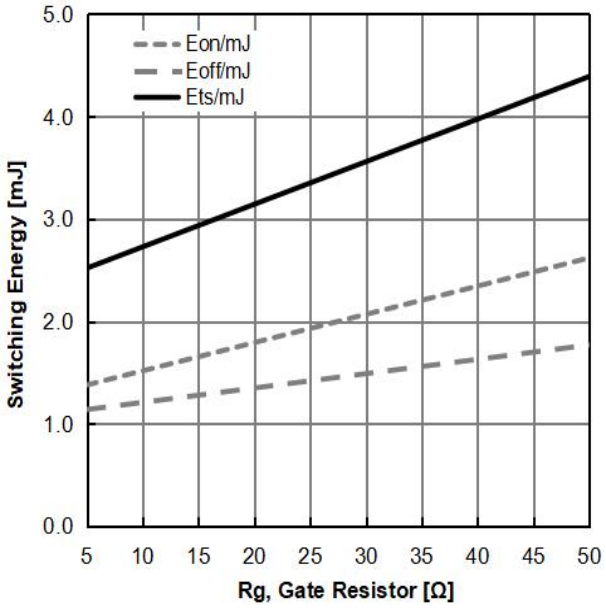


Figure 11: Typical Switching Times vs. Junction Temperature (V_{CE}=400V, V_{GE}=15V, I_C=50A,Rg=5Ω)

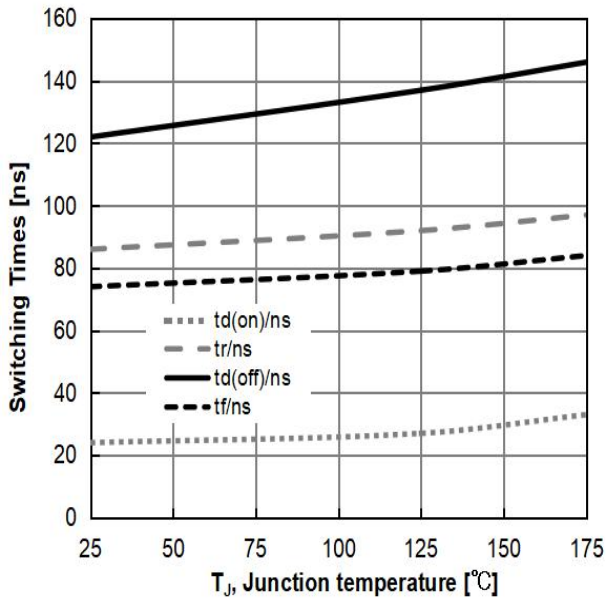


Figure 12: Typical Switching Energy vs. Junction Temperature (V_{CE}=400V, V_{GE}=15V, I_C=50A,Rg=5Ω)

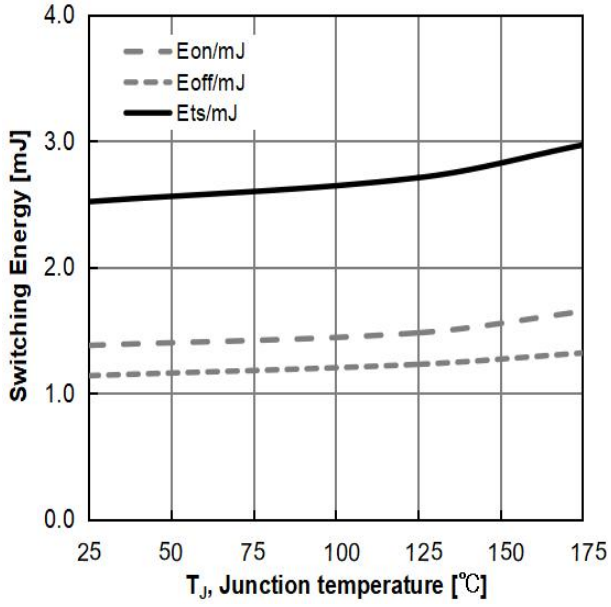


Figure 13: Typical Switching Times vs. Collector Current (T_J=25℃, V_{CE}=400V, V_{GE}=15V,Rg=5Ω)

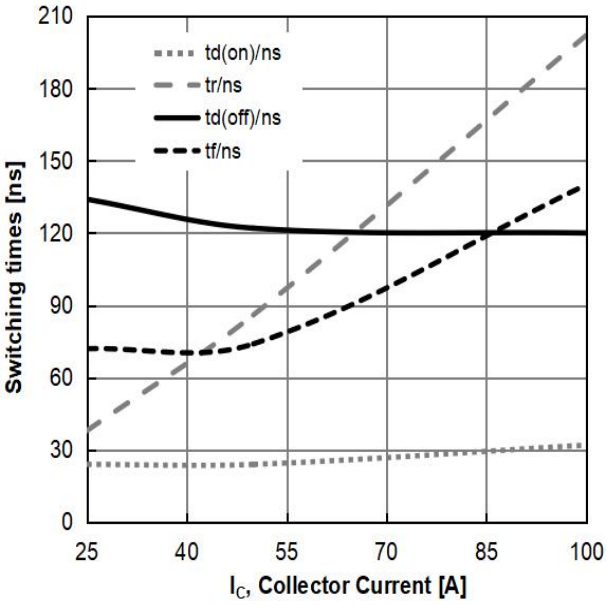


Figure 14: Typical Switching Energy vs. Collector Current (T_J=25℃, V_{CE}=400V, V_{GE}=15V,Rg=5Ω)

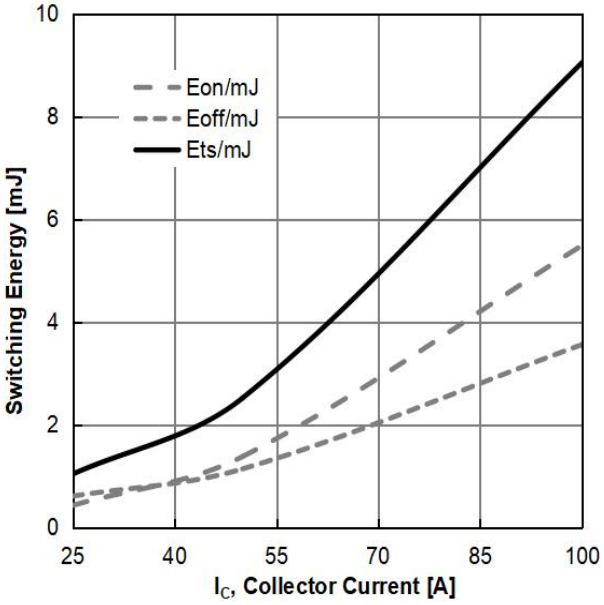


Figure 15: Typical Switching Times vs. VCE (T_J=25℃, V_{GE}=15V, I_C=50A,Rg=5Ω)

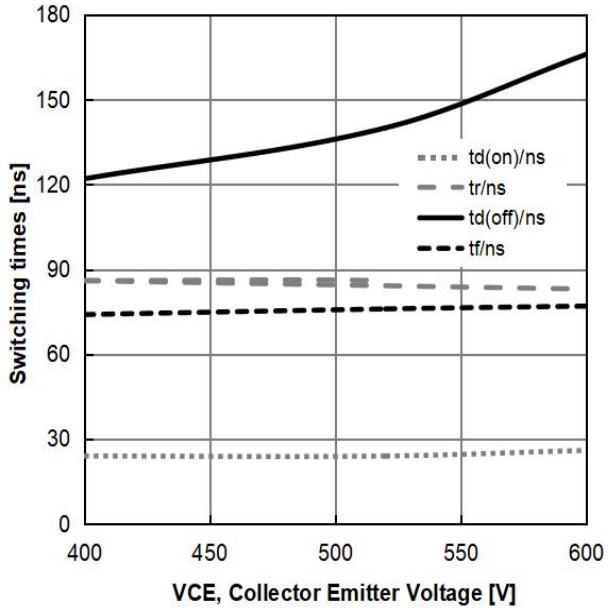


Figure 16: Typical Switching Energy vs. VCE (T_J=25℃, V_{GE}=15V, I_C=50A,Rg=5Ω)

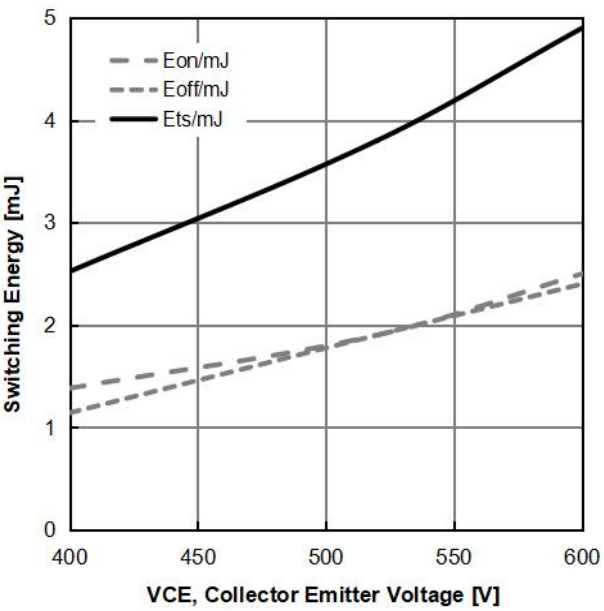


Figure 17: Typical Capacitance vs. Collector- Emitter Voltage

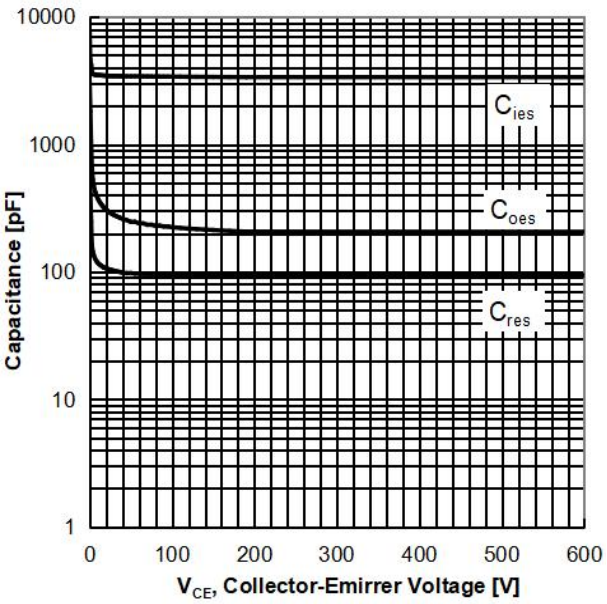


Figure 18: Typical Gate Charge

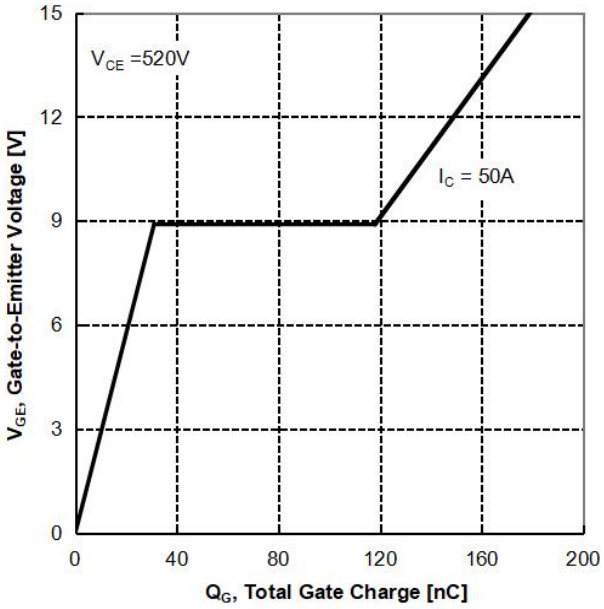


Figure 19: IGBT Transient Thermal Impedance vs. Pulse Width

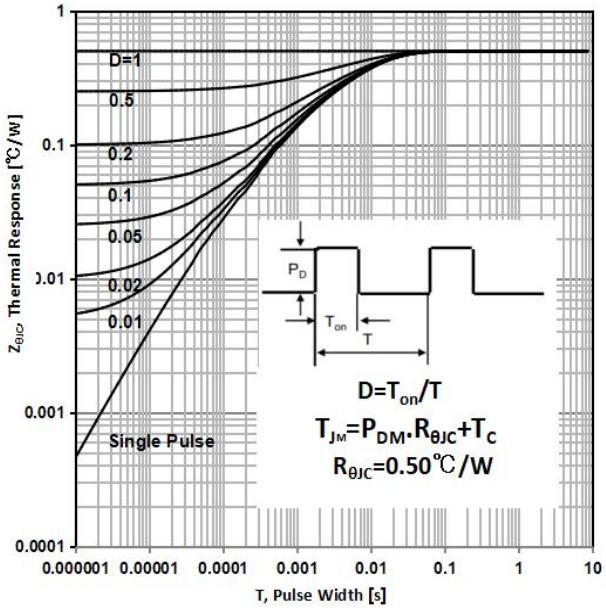


Figure 20: Diode Transient Thermal Impedance vs. Pulse Width

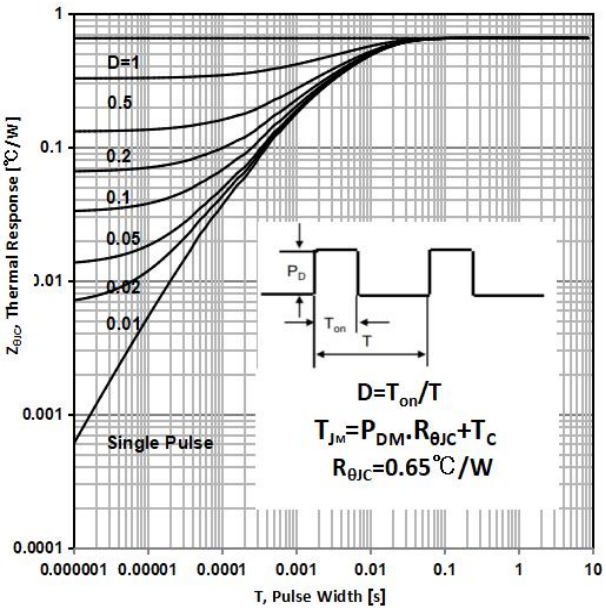
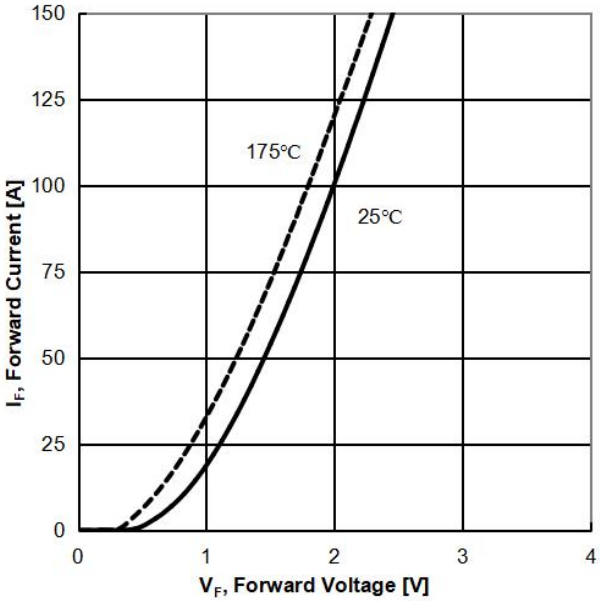


Figure 21: Typical Capacitance vs.
Collector- Emitter Voltage



6. Test Circuit and Waveform

Figure 22. Inductive Switching Test Circuit

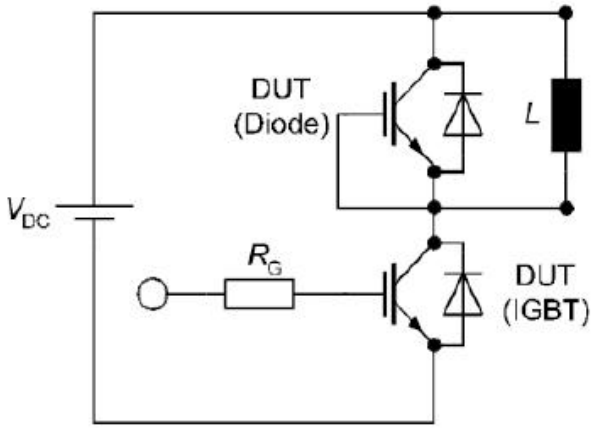


Figure 23. Definition of switching times

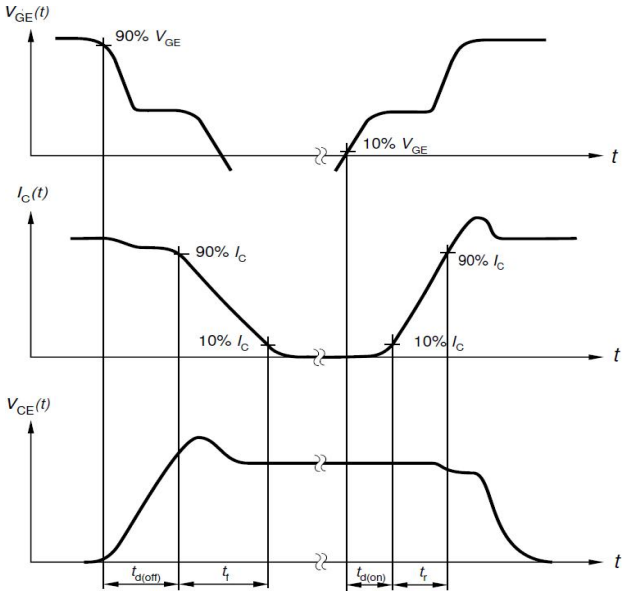


Figure 24. Definition of switching losses

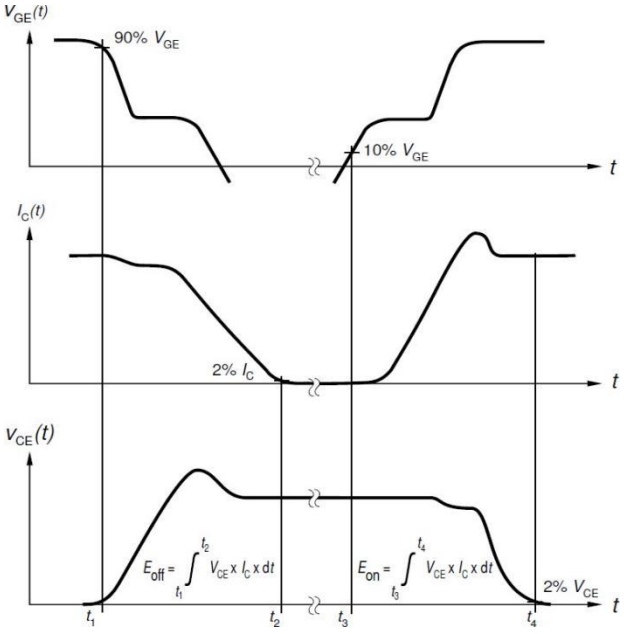
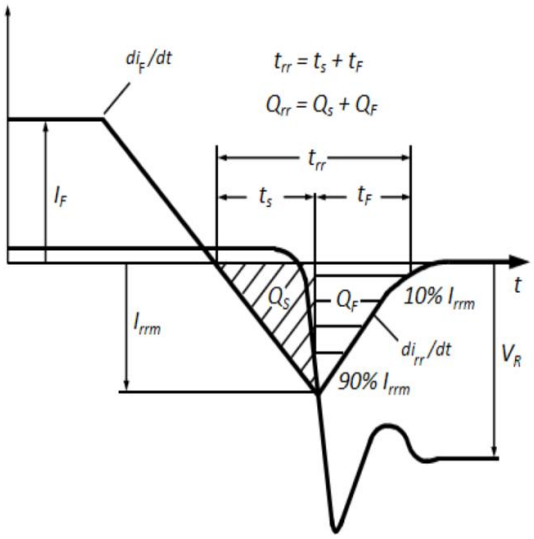
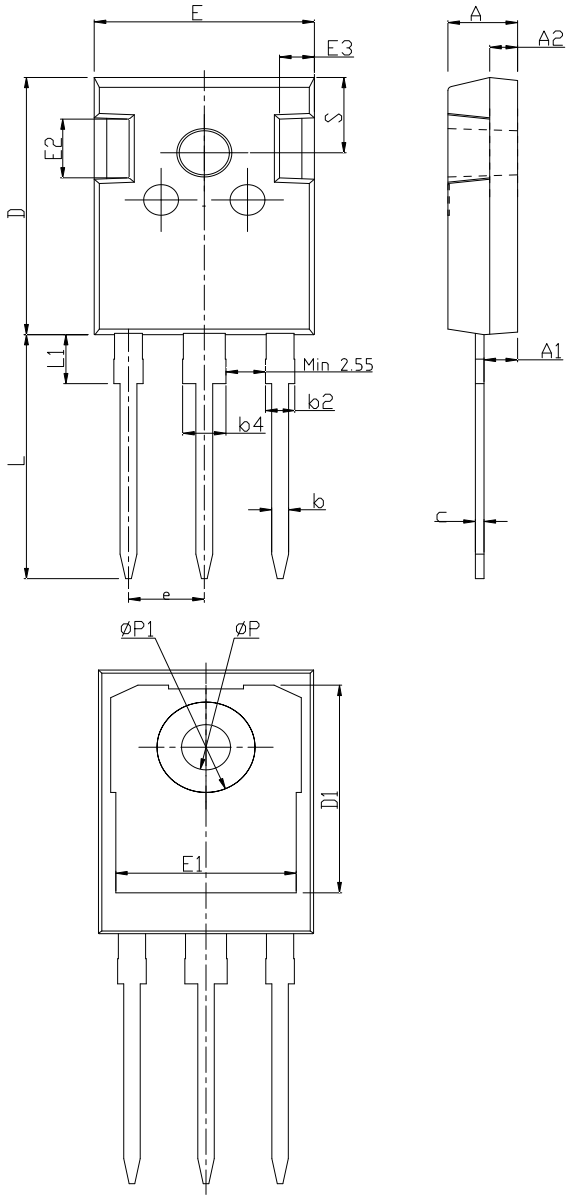


Figure 25. Definition of diode switching characteristics



7. Package Information

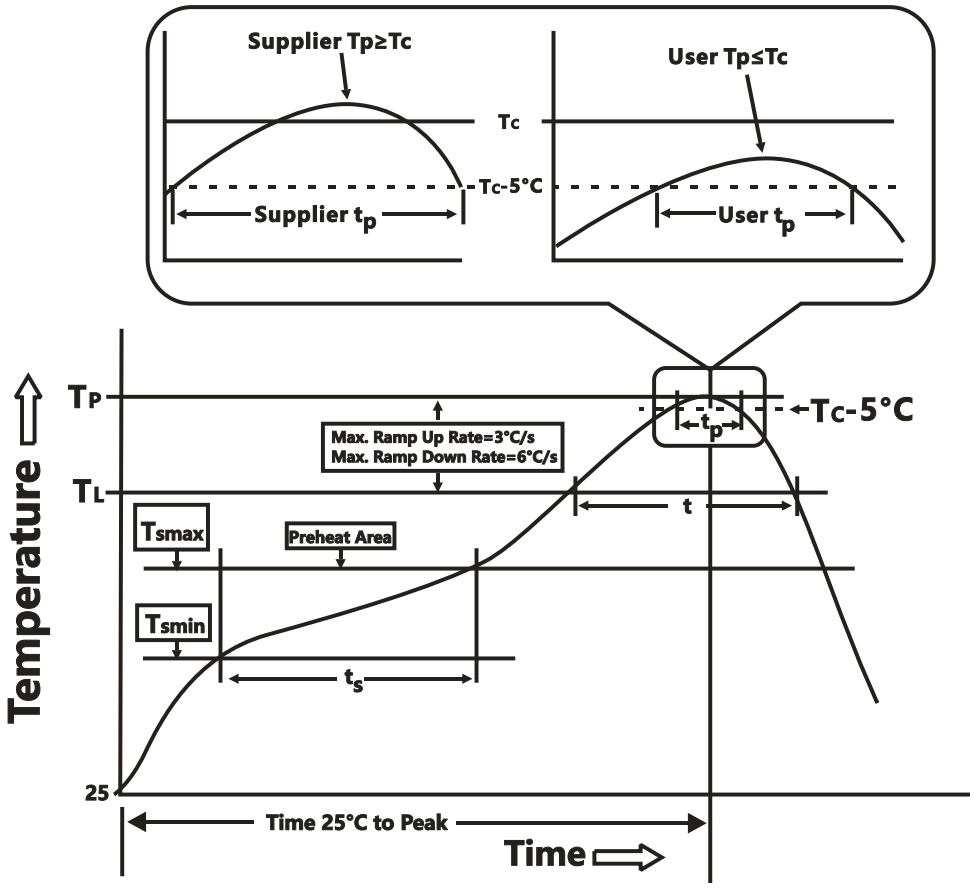
TO-247



COMMON DIMENSIONS

SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
ΦP1	-	-	7.30
S	6.15BSC		

8. Classification Profile



9. Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (Tsmin) Temperature max (Tsmax) Time (Tsmin to Tsmax) (Ts)	100 °C 150 °C 60-120 seconds	150 °C 200 °C 60-120 seconds
Average ramp-up rate (T_{smax} to T_P)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L) Time at liquidous (t_L)	183 °C 60-150 seconds	217 °C 60-150 seconds

Peak package body temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_P)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds
Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
*Tolerance for peak profile Temperature (T_p) is defined as a supplier minimum and a user maximum. ** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1.Sn-Pb Eutectic Process – Classification Temperatures (Tc)

Package Thickness	**Volume mm³ <350**	**Volume mm³ ≥350**
＜2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2.Pb-free Process – Classification Temperatures (Tc)

Package Thickness	**Volume mm³ <350**	**Volume mm³ 350-2000**	**Volume mm³ ≥2000**
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
≥2.5 mm	250 °C	245 °C	245 °C

10. Reliability Test Program

Test item	**Method**	**Description**
HTRB	JESD-22, A108	168/500 Hrs, Bias @ 150°C
HTGB	JESD-22, A108	168 /500 Hrs, 100%V_{GE} @ 150°C
PCT	JESD-22, A102	96 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	250/500 Cycles, -55°C~150°C

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give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.

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