



SMSW40P120AXA

INSULATED GATE BIPOLAR TRANSISTOR

Preliminary Data

Features:

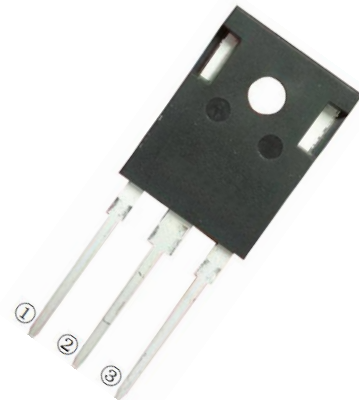
- Low $V_{CE(sat)}$ Planar IGBT Technology
- Low Switching Loss
- Square RBSOA
- 100% of The Parts Tested for I_{LM} ^①
- Positive $V_{CE(sat)}$ Temperature Co-efficient
- Lead Free, Compliant with RoHS Requirement
- Automotive Qualified

Benefits:

- Device Optimized for Soft Switching Applications
- High Efficiency due to Low $V_{CE(sat)}$, Low Switching Loss
- Rugged Transient Performance for Increased Reliability
- Excellent Current Sharing in Parallel Operation
- Low EMI

Applications:

- PTC Heater
- Relay Replacement



- ① GATE
- ② COLLECTOR
- ③ EMITTER



Absolute Maximum Rated Values ($T_J=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Description	Conditions	Values	Units
V_{CES}	Collector-Emitter Blocking Voltage		1200	V
V_{GES}	Continuous Gate-Emitter Voltage		± 20	V
	Transient Gate-Emitter Voltage		± 30	
I_C	Continuous Collector Current	$T_C=100^{\circ}\text{C}$	40	A
		$T_C=25^{\circ}\text{C}$	80	A
I_{CM}	Pulse Collector Current	$V_{GE}=15\text{V}^{(2)}$	99	A
I_{LM}	Clamped Inductive Load Current	$V_{GE}=20\text{V}^{(1)}$	99	A
t_{sc}	Short Circuit Withstand Time	$V_{CC}=600\text{V}$, $V_{GE}=15\text{V}$ $T_J=150^{\circ}\text{C}$	>10	μs
P_D	Maximum Power Dissipation	$T_C=25^{\circ}\text{C}$	543	W
		$T_C=100^{\circ}\text{C}$	217	W
T_J	Operating Junction Temperature Range		$-55\sim 150$	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range		$-55\sim 150$	$^{\circ}\text{C}$
	Soldering Temperature, for 10 sec.		300 (0.063 in. (1.6mm) from case)	$^{\circ}\text{C}$
	Mounting Torque, 6-32 or M3 Screw		10 lbf·in (1.1 N·m)	

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

Symbol	Description	Conditions	Min.	Typ.	Max.	Units
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	$V_{GE}=0\text{V}$, $I_C=250\mu\text{A}$	1200			V
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff of Breakdown Voltage	$V_{GE}=0\text{V}$, $I_C=1\text{mA}$ ($25^{\circ}\text{C}\sim 150^{\circ}\text{C}$)		1.2		$\text{V}/^{\circ}\text{C}$
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=250\mu\text{A}$, $V_{CE}=V_{GE}$	3.0		6.0	V
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	$V_{CE}=V_{GE}$, $I_C=250\mu\text{A}$ ($25^{\circ}\text{C}\sim 150^{\circ}\text{C}$)		-15		$\text{mV}/^{\circ}\text{C}$
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C=33\text{A}$, $V_{GE}=15\text{V}$	$T_J=25^{\circ}\text{C}$	1.39	1.59	V
			$T_J=150^{\circ}\text{C}$	1.47		V
g_{fs}	Forward Transconductance	$V_{CE}=50\text{V}$, $I_C=33\text{A}$, $PW=20\mu\text{s}$		30		S
I_{CES}	Collector-Emitter Leakage Current	$V_{GE}=0\text{V}$, $V_{CE}=1200\text{V}$	$T_J=25^{\circ}\text{C}$		250	μA
			$T_J=150^{\circ}\text{C}$		1000	μA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=\pm 20\text{V}$	$T_J=25^{\circ}\text{C}$		± 100	nA



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

Symbol	Description	Conditions		Min.	Typ.	Max.	Units
C _{ies}	Input Capacitance	V _{CC} =30V, V _{GE} =0V, f=1MHz			3804		pF
C _{oes}	Output Capacitance				161		pF
C _{res}	Reverse Transfer Capacitance				31		pF
t _{d(off)}	Turn-off Delay Time	V _{CC} =600V, I _C =33A, R _G =5Ω, V _{GE} =15V, L=400μH, Energy losses include tail	T _J =25℃		485		ns
			T _J =150℃		689		
t _f	Fall Time		T _J =25℃		1193		ns
			T _J =150℃		2462		
E _{off}	Turn-off Switching Loss		T _J =25℃		15		mJ
			T _J =150℃		29		
Q _g	Total Gate Charge (turn on)	I _C =33A, V _{GE} =15V, V _{CC} =600V			151	227	nC
Q _{ge}	Gate-to-Emitter Charge (turn on)				26	39	nC
Q _{gc}	Gate-to-Collector Charge (turn on)				62	93	nC
RBSOA	I _C =99A, V _{CC} =960V, V _p ≤1200V, R _g =5Ω, V _{GE} =+20V to 0V, T _J =150℃			Full Square			

Thermal Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Description	Min	Typ	Max	Units
$R_{\theta JC}(\text{IGBT})$	Thermal Resistance: Junction-to-Case(each IGBT)③			0.23	$^{\circ}\text{C/W}$
$R_{\theta CS}$	Thermal Resistance: Case-to-Sink (flat, greased surface)		0.50		$^{\circ}\text{C/W}$
$R_{\theta JA}$	Thermal Resistance: Junction-to-Ambient (typical socket mount)		62		$^{\circ}\text{C/W}$

Notes:

- ① $V_{CC}=80\%(V_{CES})$, $V_{GE}=20\text{V}$, $L=400\mu\text{A}$, $R_G=50\Omega$.
- ② Pulse width limited by max. junction temperature.
- ③ R_{θ} is measured at T_J of approximately 90°C .



Qualification Information

Qualification Level		Automotive (per AEC-Q101)	
		Comments: This part number(s) passed Automotive qualification. NJSME's Industrial and Consumer qualification level is granted by extension of the higher Automotive level.	
Moisture Sensitivity Level		TO-247	N/A
ESD	Machine Model	Class M4 (+/-800V) (per AEC-Q101-002)	
	Human Body Model	Class H3A (+/-6000V) (per AEC-Q101-001)	
	Charged Device Model	Class C5 (+/-2000V) (per AEC-Q101-005)	
RoHS Compliant		Yes	

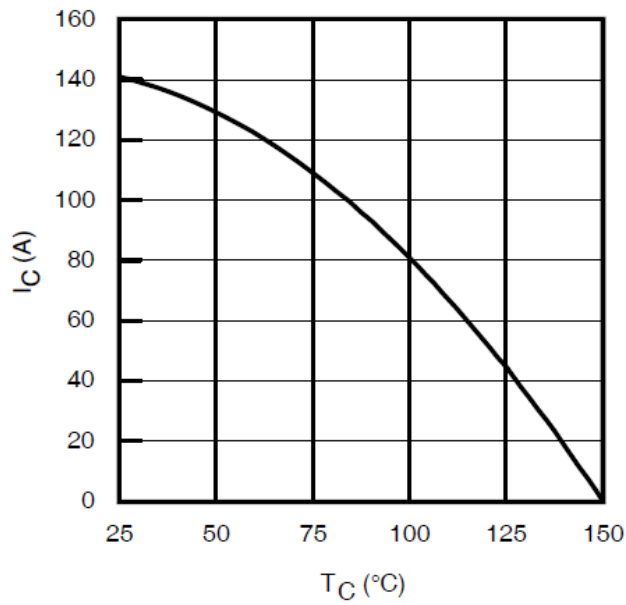


Fig. 1 Maximum DC Collector Current vs. Case Temperature

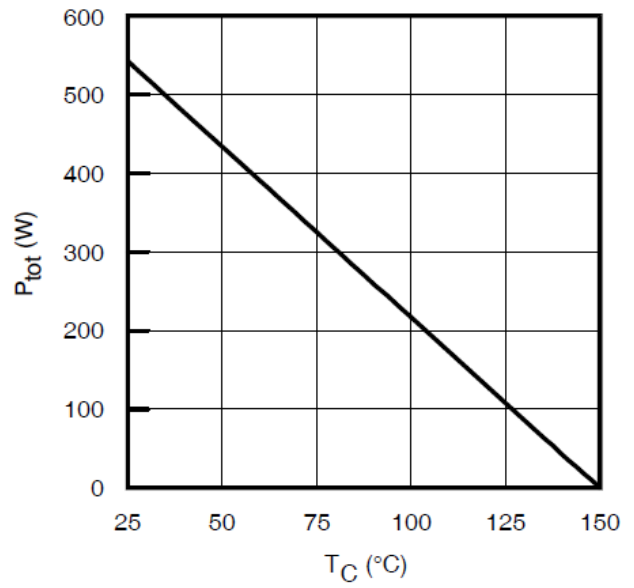


Fig. 2 Power Dissipation vs. Case Temperature

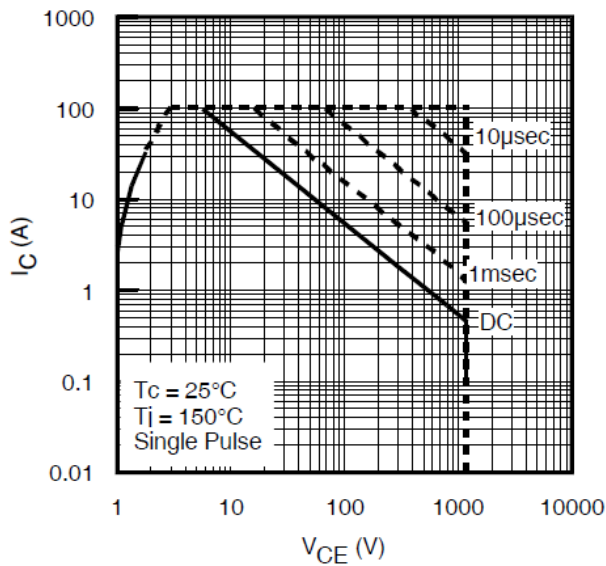


Fig. 3 Forward SOA
 $T_C=25^{\circ}\text{C}$, $T_J \leq 150^{\circ}\text{C}$; $V_{GE}=15\text{V}$

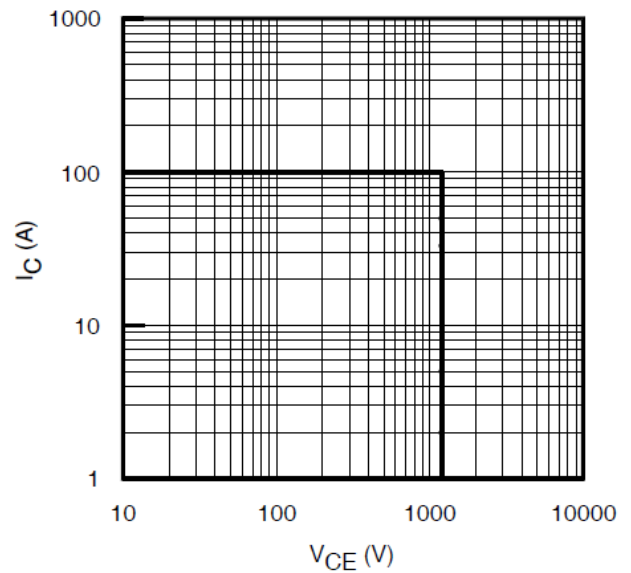


Fig. 4 Reverse Bias SOA
 $T_J=150^{\circ}\text{C}$; $V_{GE}=20\text{V}$

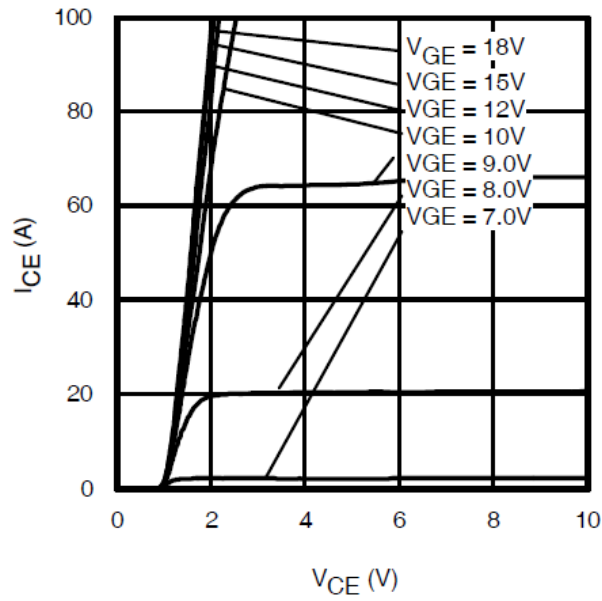


Fig. 5 Typ. IGBT Output Characteristics
 $T_J = -40^{\circ}\text{C}$; $t_p = 20\mu\text{s}$

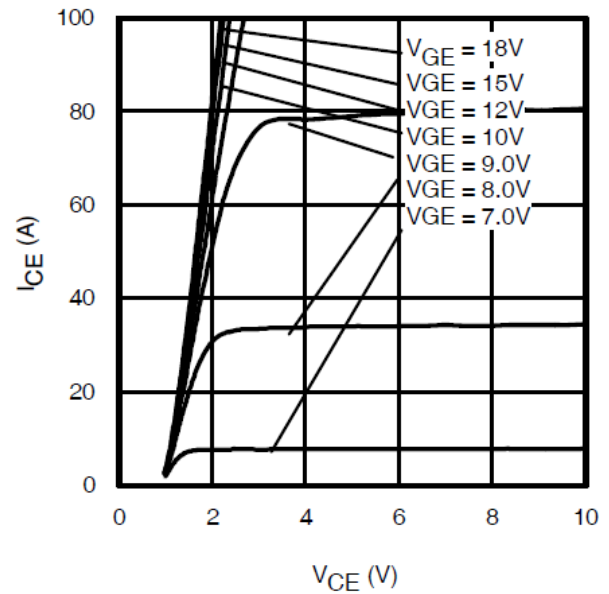


Fig. 6 Typ. IGBT Output Characteristics
 $T_J = 25^{\circ}\text{C}$; $t_p = 20\mu\text{s}$

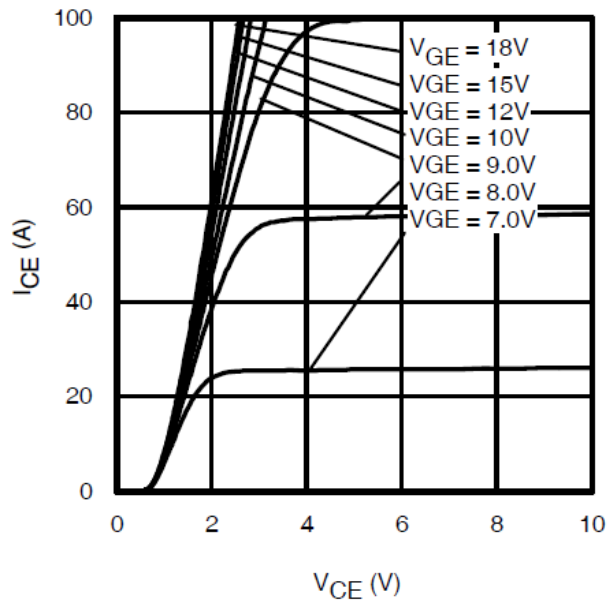


Fig. 7 Typ. IGBT Output Characteristics
 $T_J = 150^{\circ}\text{C}$; $t_p = 20\mu\text{s}$

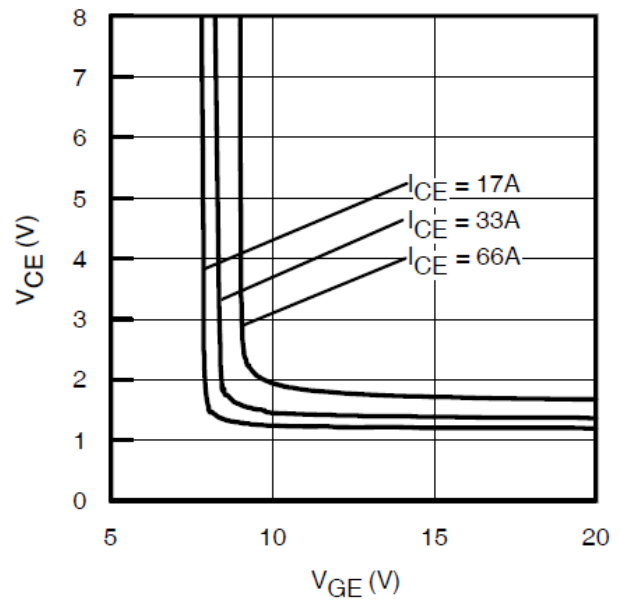


Fig. 8 Typical V_{CE} vs. V_{GE}
 $T_J = -40^{\circ}\text{C}$

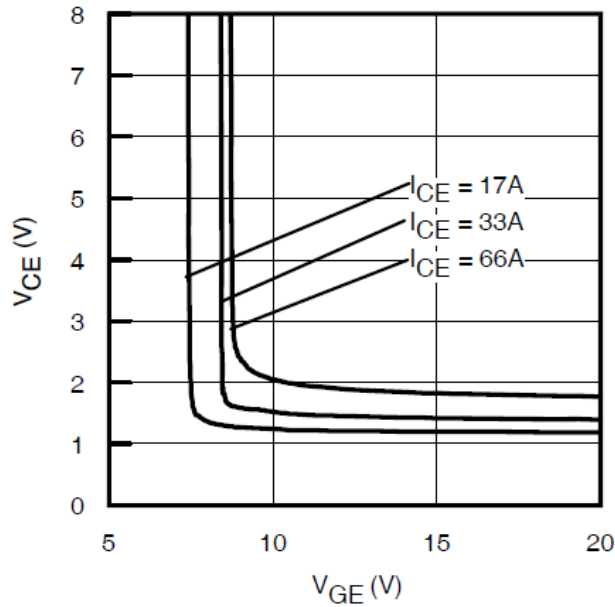


Fig. 9 Typical V_{CE} vs. V_{GE}
 $T_J=25^{\circ}\text{C}$

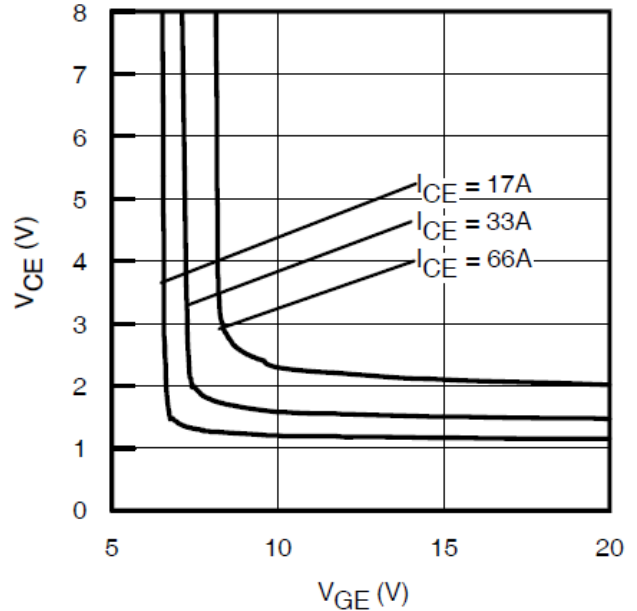


Fig. 10 Typical V_{CE} vs. V_{GE}
 $T_J=150^{\circ}\text{C}$

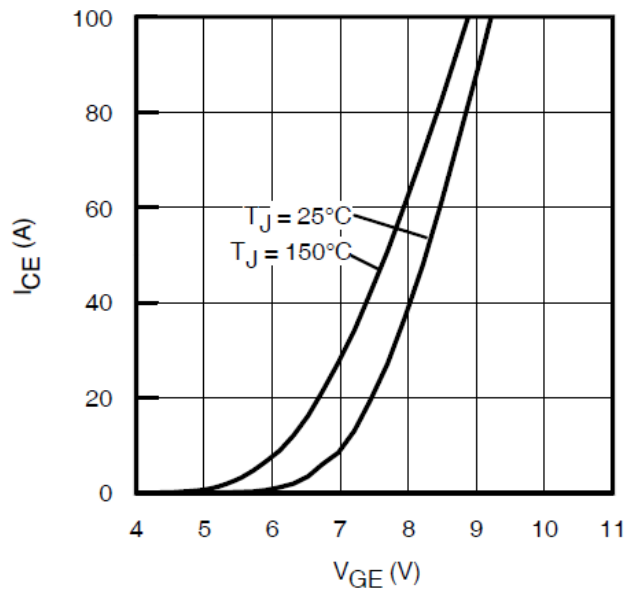


Fig. 11 Typ. Transfer Characteristics
 $V_{CE}=50\text{V}$; $t_p=20\mu\text{s}$

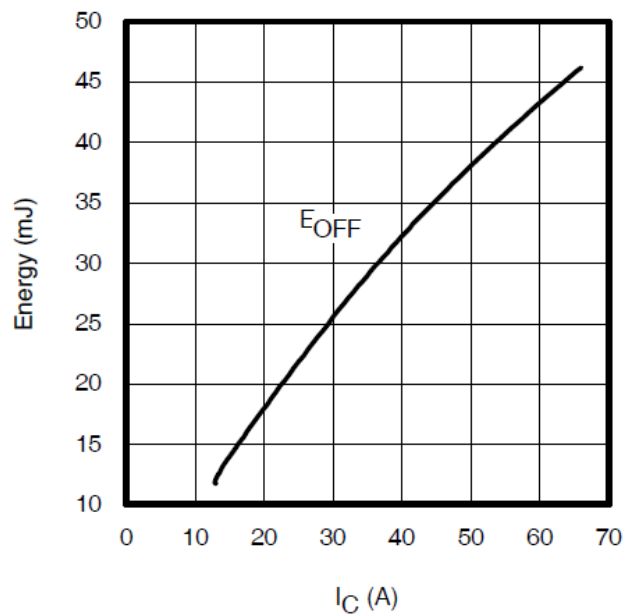


Fig. 12 Typ. Energy Loss vs. I_C
 $T_J=150^{\circ}\text{C}$; $L=400\mu\text{H}$; $V_{CE}=600\text{V}$, $R_G=5\Omega$; $V_{GE}=15\text{V}$

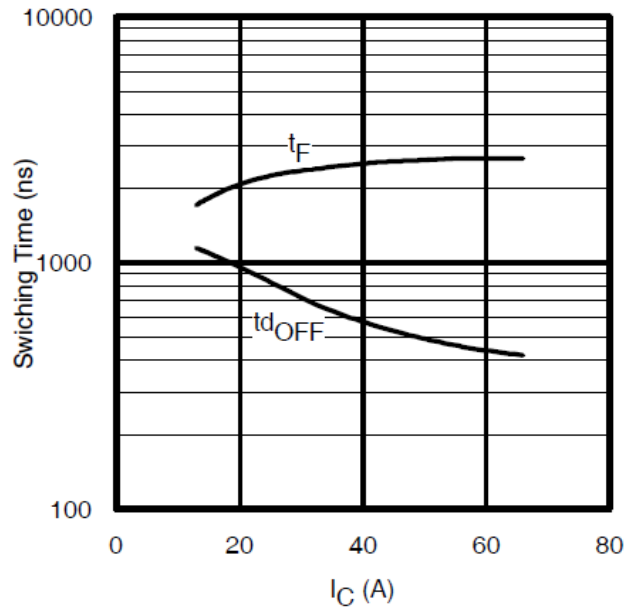


Fig. 13 Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $R_G = 5\Omega$; $V_{GE} = 15\text{V}$

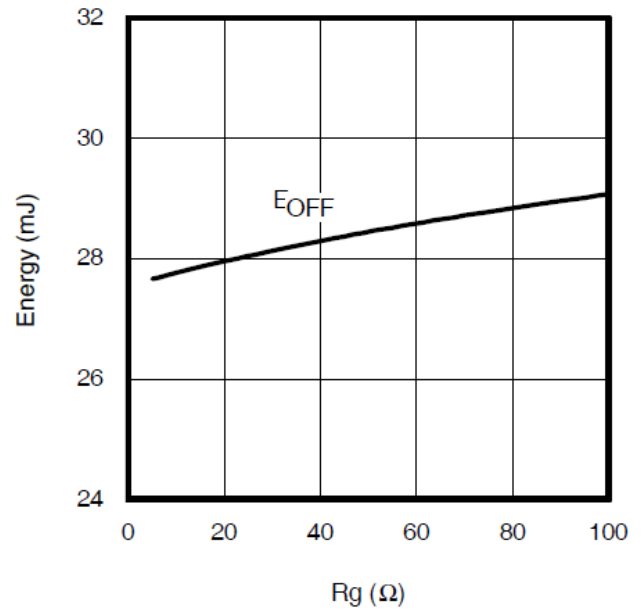


Fig. 14 Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $I_{CE} = 33\text{A}$; $V_{GE} = 15\text{V}$

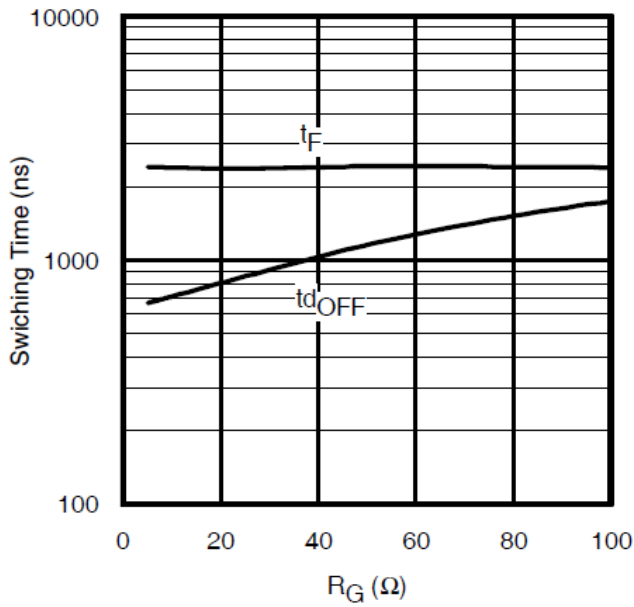


Fig. 15 Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 400\mu\text{H}$; $V_{CE} = 600\text{V}$, $I_{CE} = 33\text{A}$; $V_{GE} = 15\text{V}$

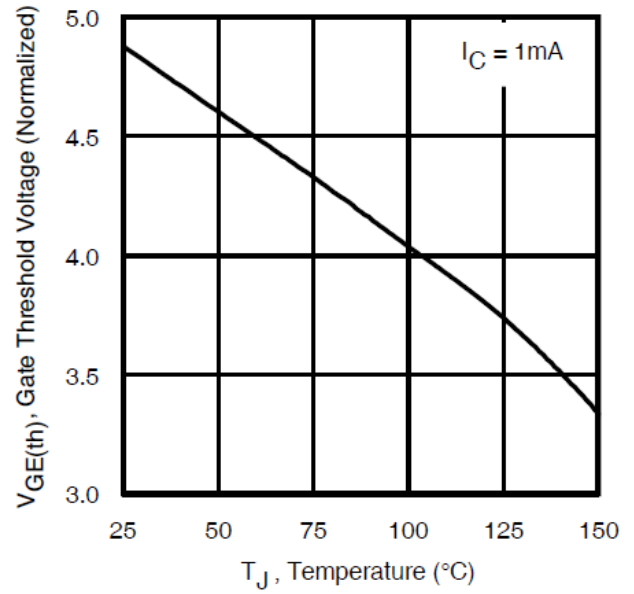


Fig. 16 Typical Gate Threshold Voltage (Normalized) vs. Junction Temperature

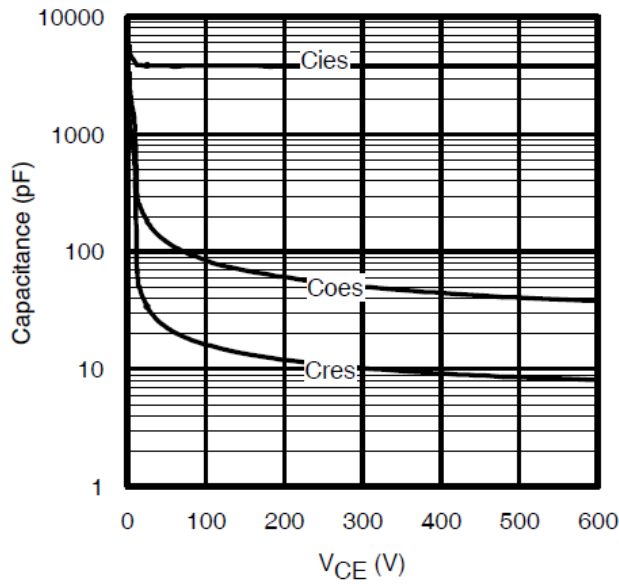


Fig. 17 Typ. Capacitance vs. V_{CE}
V_{GE}=0V; f=1MHz

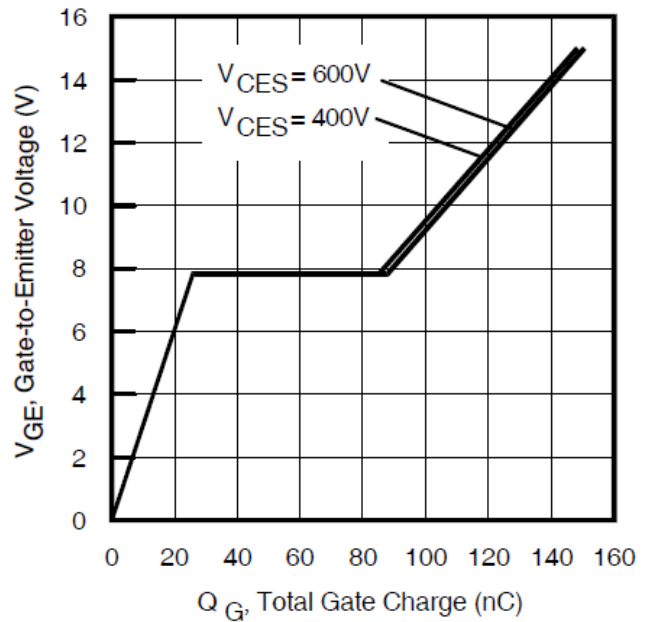


Fig. 18 Typical Gate Charge vs. V_{GE}
I_{CE}=33A; L=2.0mH

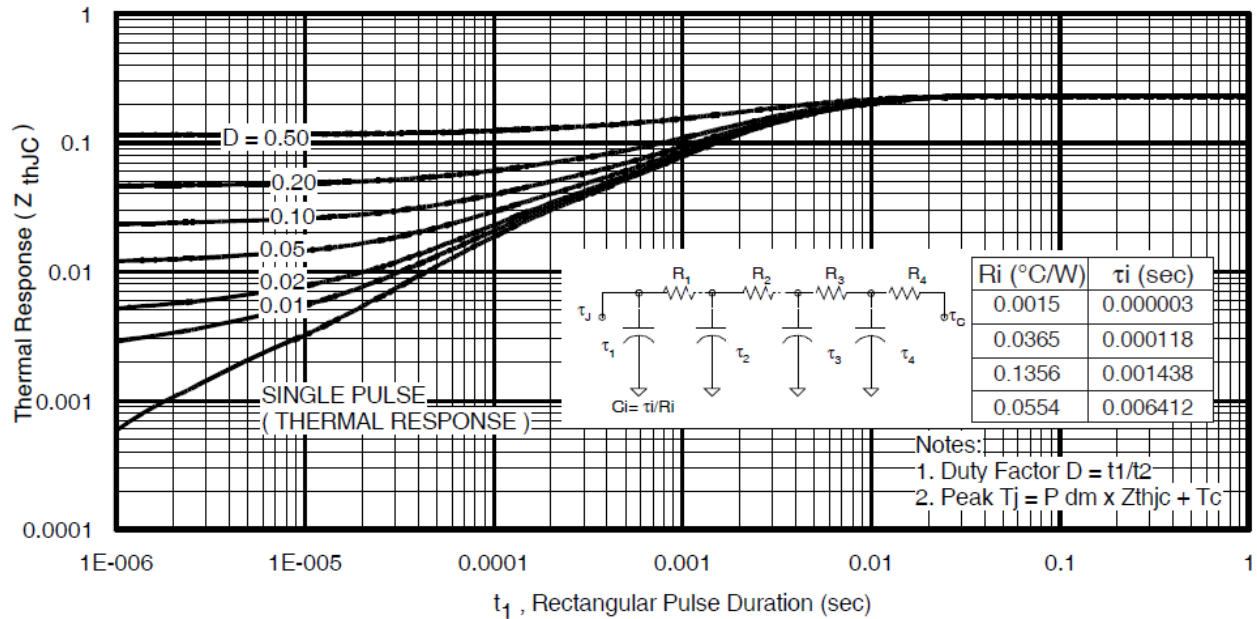


Fig.19 Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)



Test Circuit:

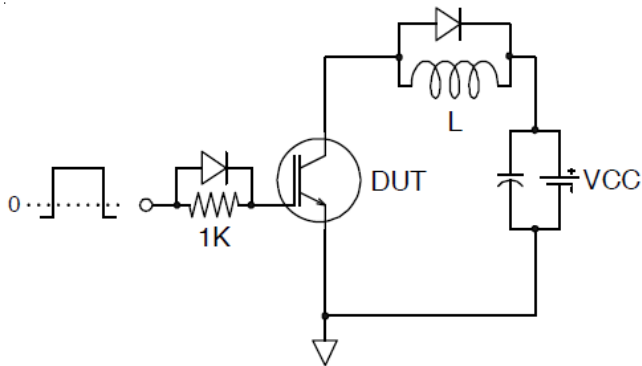


Fig.20 Gate Charge Circuit (turn-off)

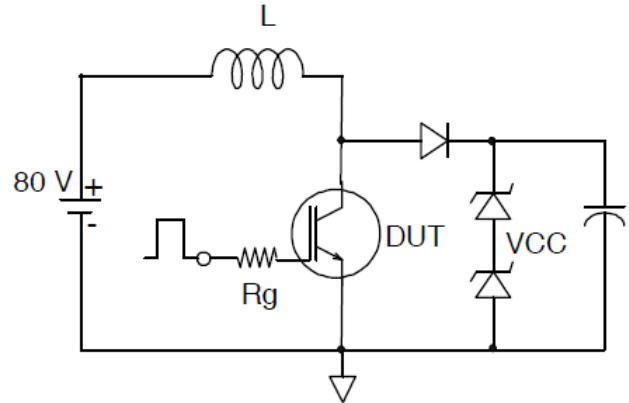


Fig.21 RBSOA Circuit

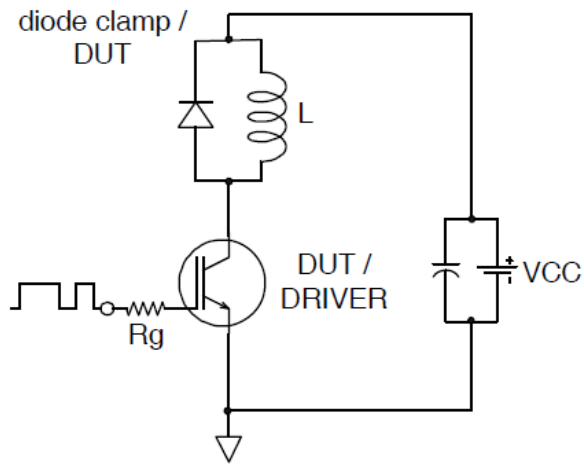


Fig.22 Switching Loss Circuit

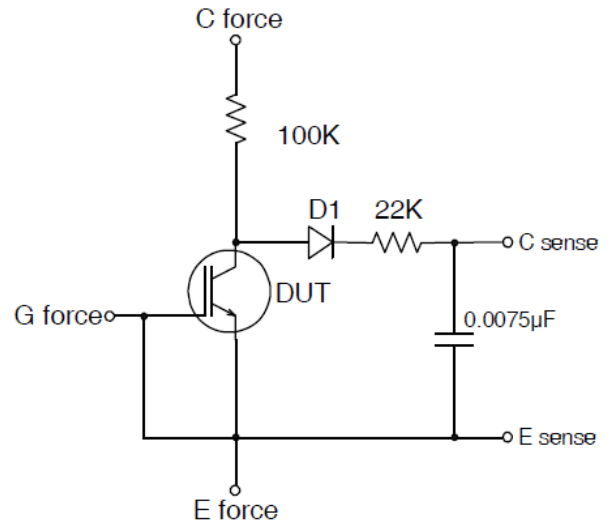


Fig.23 BVces Filter Circuit



Test Waveform:

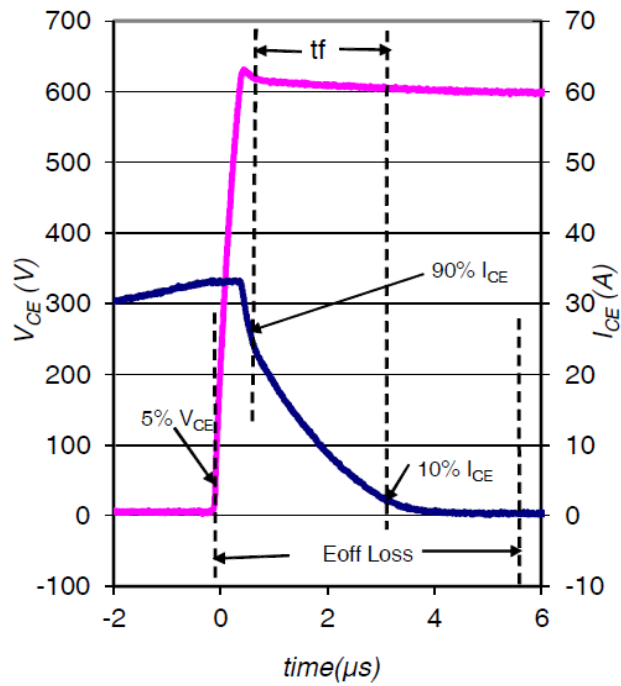
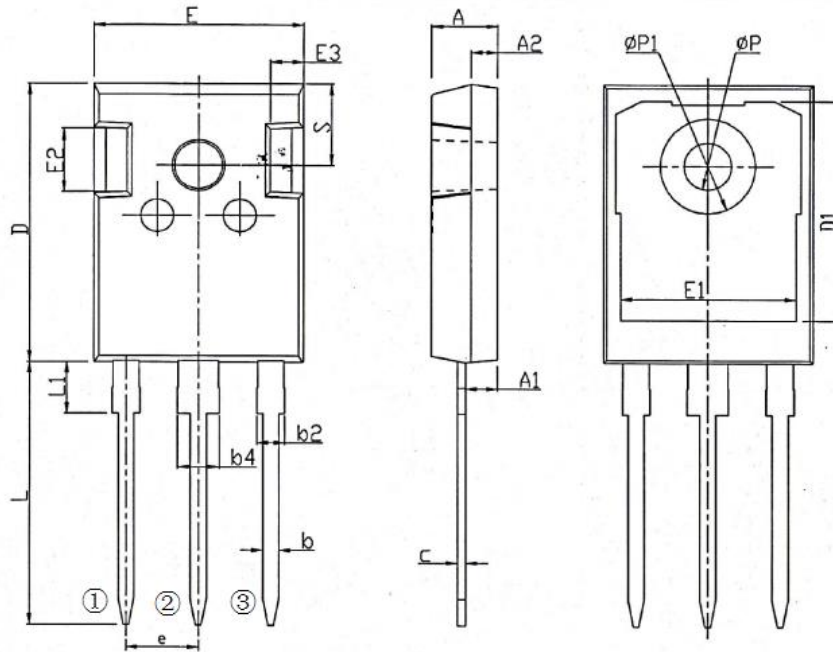


Fig.24 Typ. Turn-off Loss Waveform
@ $T_J=150^{\circ}\text{C}$ using Fig.22



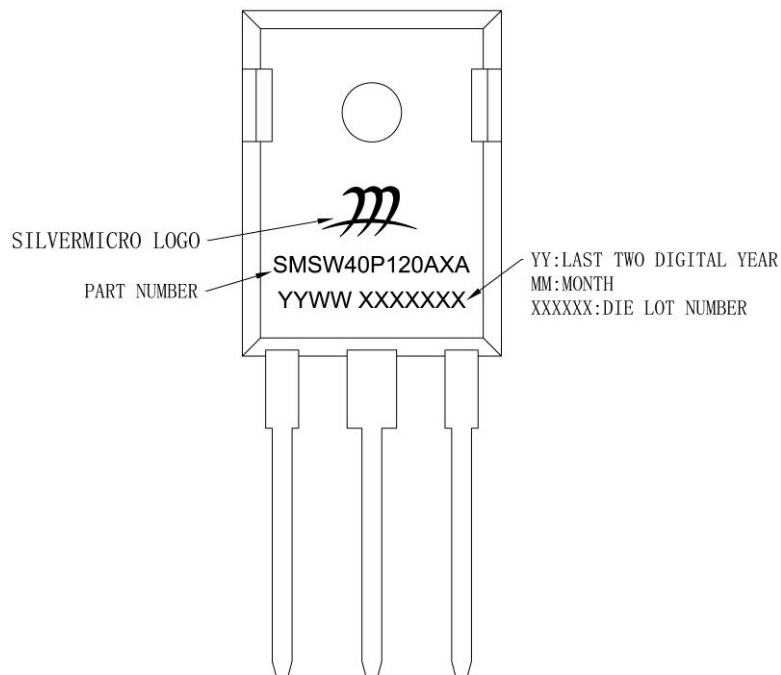
TO-247 Package Outline (Unit: mm):



CONNECTION
 ① GATE
 ② COLLECTOR
 ③ EMITTER

SYMBOL	COMMON DIMENSION		
	mm		
	MIN.	NOM.	MAX.
A	4.80	5.00	5.20
A1	2.21	2.41	2.61
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
$\phi P1$	-	-	7.30
S	6.15BSC		

TO-247 Part Marking Information:





Revision	Notes
01	Initial Release
02	Added 'Short Circuit Withstand Time'

Announcement

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The released datasheet would be issued with “REV.” + “alphabet characters”.