1. Description

HM40N120AT is obtained by advanced Trench Field Stop (T-FS) technology which reduces the conduction loss, improves switching performance, and enhances the avalanche energy. The IGBT is suitable device for UPS, Welding, and high-speed switching.

KEY CHARACTERISTICS

Parameter	Value	Unit
V_{CES}	1200	V
I_C	40	A
$V_{CE(sat).typ}$	2.0	V

FEATURES

- Fast Switching
- Low $V_{CE(sat)}$
- Positive temperature coefficient
- Very soft, fast recovery anti-parallel diode
- RoHS product

APPLICATIONS

- UPS
- Welding Converters
- Converters with high switching frequency
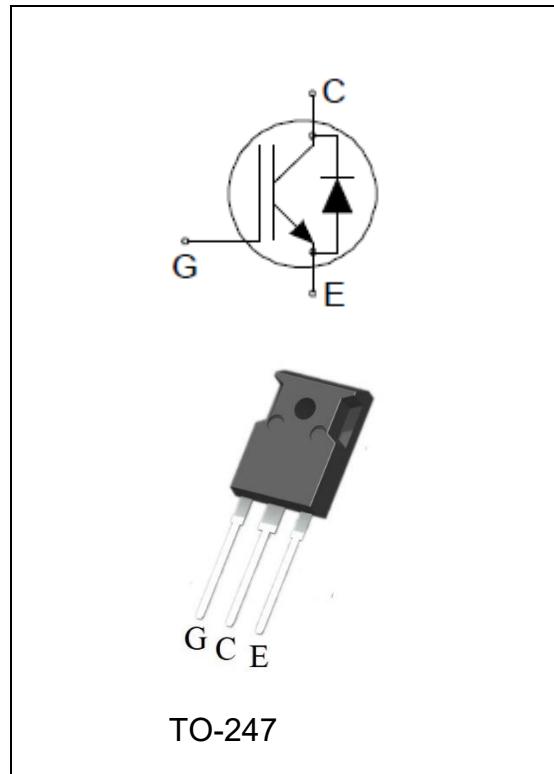
TO-247

ORDERING INFORMATION

Device Marking	Ordering Codes	Package	Product Code	Packing
HM40N120AT YYWW	HM40N120AT	TO-247	HM40N120AT	Tube

HM40N120AT
YYWW

HM40N120AT：Product Code

YYWW：Year & Week
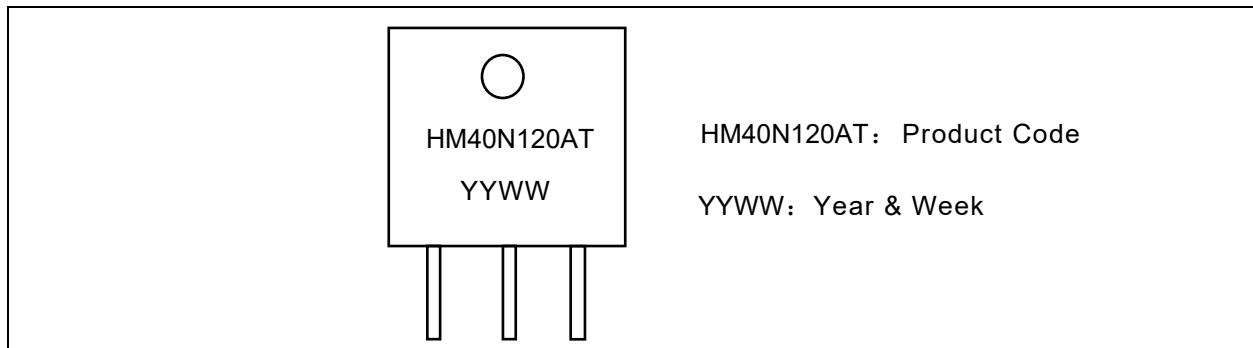
2. ABSOLUTE RATINGS

Symbol	Parameter	Values	Units
V_{CES}	Collector-Emitter Voltage	1200	V
I_C	Collector Current @T_C=25°C	80	A
	Collector Current @T_C=100°C	40	A
I_{CM}	Pulsed Collector Current, tp limited by T_{Jmax}	160	A
I_F	Diode Continuous Forward Current @T_C=25°C	80	A
	Diode Continuous Forward Current @T_C=100°C	40	A
I_{FM}	Diode Maximum Forward Current, limited by T_{Jmax}	160	A
V_{GES}	Gate-Emitter Voltage	±20	V
t_{SC}	Short circuit withstand time V_{GE}=15V, V_{CC}≤600V, Allowed number of short circuits<1000,Times between short circuits: ≥ 1.0s,T_J ≤ 150℃	10.0	μs
P_D	Power Dissipation @T_C=25°C	367	W
T_{Jmax}, T_{stg}	Operating Junction and Storage Temperature Range	150, −55 to 150	℃
T_L	Maximum Temperature for Soldering	260	℃

3. Thermal characteristics

Symbol	Parameter	Values	Units
$R_{\theta JC}$	Junction-to-Case (IGBT)	0.34	℃/W
$R_{\theta JC}$	Junction-to-Case (Diode)	0.6	℃/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 = 250μA	1200	--	--	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE} = 15V,I_C = 40A T_J=25℃ T_J=100℃ T_J=150℃	-- -- --	2.0 2.25 2.35	2.4	V

$V_{GE(TH)}$	Gate Threshold Voltage	V_{CE} = V_{GE},I_C = 1mA	5.0	5.8	6.5	V
V_F	Diode Forward Voltage	I_F=40A T_J=25℃ T_J=100℃ T_J=150℃	-- -- --	2.10 2.00 1.90	2.80 -- --	V
I_{CES}	Collector-Emitter Leakage Current	V_{CE} = 1200V, V_{GE} = 0V	--	--	35	μA
$I_{GES(F)}$	Gate-Emitter Forward Leakage Current	V_{GE} = +20V	--	--	200	nA
$I_{GES(R)}$	Gate-Emitter Reverse Leakage Current	V_{GE} = -20V	--	--	-200	nA
Pulse width tp≤300μs, δ≤2%						

Dynamic Characteristics

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
C_{iss}	Input Capacitance	V_{GE}=0V V_{CE}=25V f =1.0MHz	--	3640	--	pF
C_{oss}	Output Capacitance		--	168	--	
C_{rss}	Reverse Transfer Capacitance		--	89	--	
Q_G	Gate charge	V_{CC}=960V I_{CE}=40A V_{GE}=15V	--	259	--	nC
Q_{GE}	Gate-emitter charge		--	19	--	
Q_{GC}	Gate-collector charge		--	181	--	
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits, Times between short circuits: ≥ 1.0s	V_{GE}=15.0V,V_{CC}≤600V ， t_{SC}≤10us，T_J≤150℃		160		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 =40A V_{CC} = 600V V_{GE} = 15V R_G =5Ω T_J=25°C Inductive Load	--	45	--	ns
tr	Rise Time		--	81	--	
$t_{d(off)}$	Turn-Off Delay Time		--	295	--	
t_f	Fall Time		--	40	--	
E_{on}	Turn-On Switching Loss		--	3.5	--	mJ
E_{off}	Turn-Off Switching Loss		--	1.1	--	
E_{ts}	Total Switching Loss		--	4.6	--	

IGBT Switching Characteristics, at T$_J$=150℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
t$_{d(on)}$	Turn-on Delay Time	I$_C$ =40A V$_{CC}$ = 600V V$_{GE}$ = 15V R$_G$ =5Ω T$_J$=150℃ Inductive Load	--	42	--	ns
tr	Rise Time		--	80	--	
t$_{d(off)}$	Turn-Off Delay Time		--	335	--	
t$_f$	Fall Time		--	86	--	
E$_{on}$	Turn-On Switching Loss		--	3.8	--	mJ
E$_{off}$	Turn-Off Switching Loss		--	1.7	--	
E$_{ts}$	Total Switching Loss		--	5.5	--	

Diode Characteristics, at T$_J$=25℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T$_{rr}$	Reverse Recovery Time	I$_F$=20A, di/dt=200A/μs, T$_J$=25°C	--	40	--	ns
Q$_{rr}$	Reverse Recovery Charge		--	251	--	nC
I$_{rrm}$	Reverse Recovery Current		--	8	--	A
T$_{rr}$	Reverse Recovery Time	I$_F$=40A, di/dt=200A/μs, T$_J$=25°C	--	44	--	ns
Q$_{rr}$	Reverse Recovery Charge		--	320	--	nC
I$_{rrm}$	Reverse Recovery Current		--	10	--	A

Diode Characteristics, at T$_J$=150℃

Symbol	Parameter	Test Conditions	Values			Units
			Min.	Typ.	Max.	
T$_{rr}$	Reverse Recovery Time	I$_F$=20A, di/dt=200A/μs, T$_J$=150℃	--	53	--	ns
Q$_{rr}$	Reverse Recovery Charge		--	264	--	nC
I$_{rrm}$	Reverse Recovery Current		--	17	--	A
T$_{rr}$	Reverse Recovery Time	I$_F$=40A, di/dt=200A/μs, T$_J$=150℃	--	63	--	ns
Q$_{rr}$	Reverse Recovery Charge		--	353	--	nC
I$_{rrm}$	Reverse Recovery Current		--	18	--	A

5. Characteristics Curves

| Figure 1. Forward Bias Safe Operating Area	Figure 2. Power Dissipation vs Case Temperature
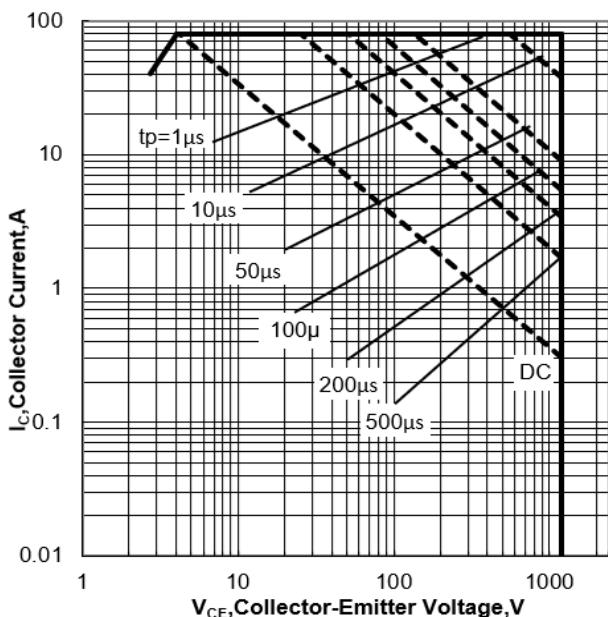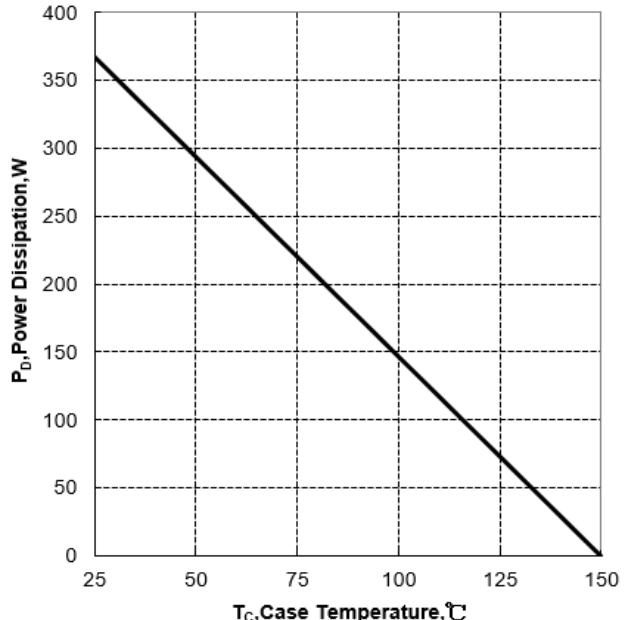
| Figure 3. Collector Current vs Case Temperature	Figure 4. Typical Transfer Characteristics
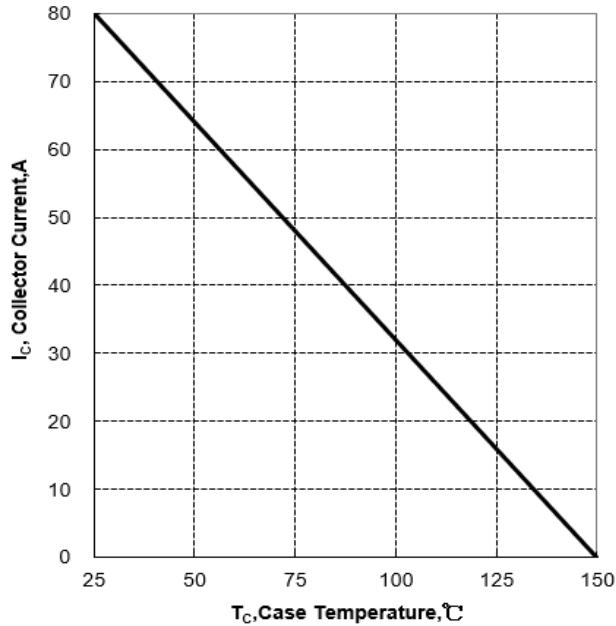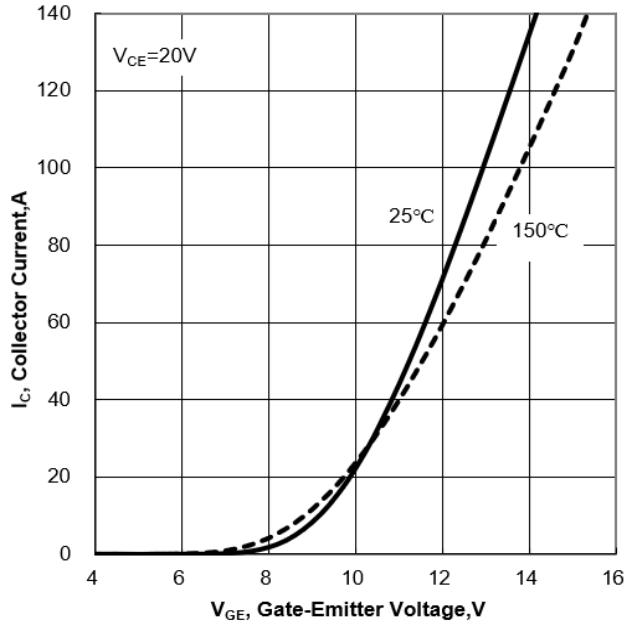
**Figure 5. Typical Output Characteristics (T$_J$=25℃)**
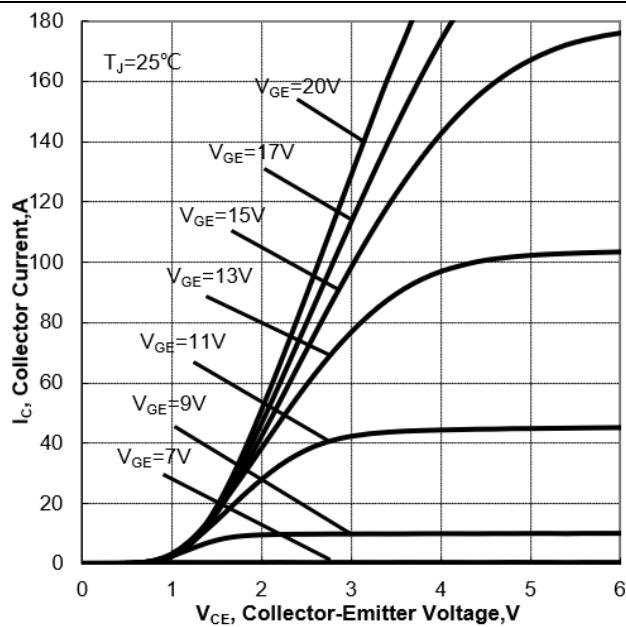
Figure 6. Typical Output Characteristics (T$_J$=150℃)
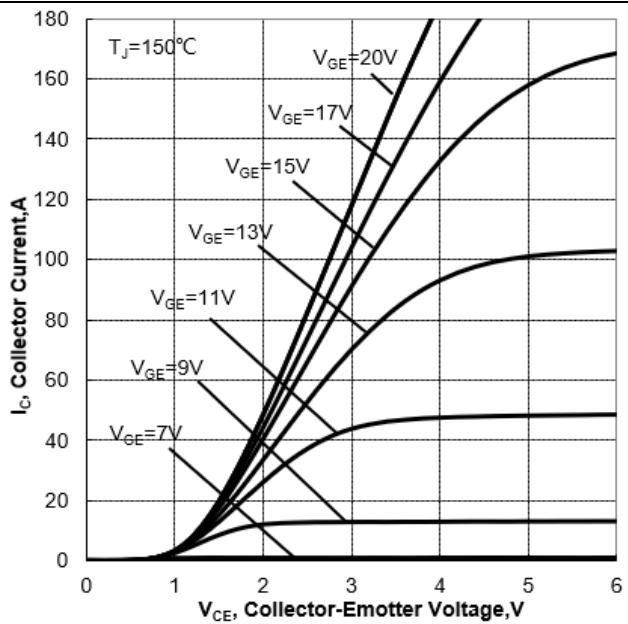
**Figure 7. Typical Collector-Emitter Saturation Voltage vs Junction Temperature**
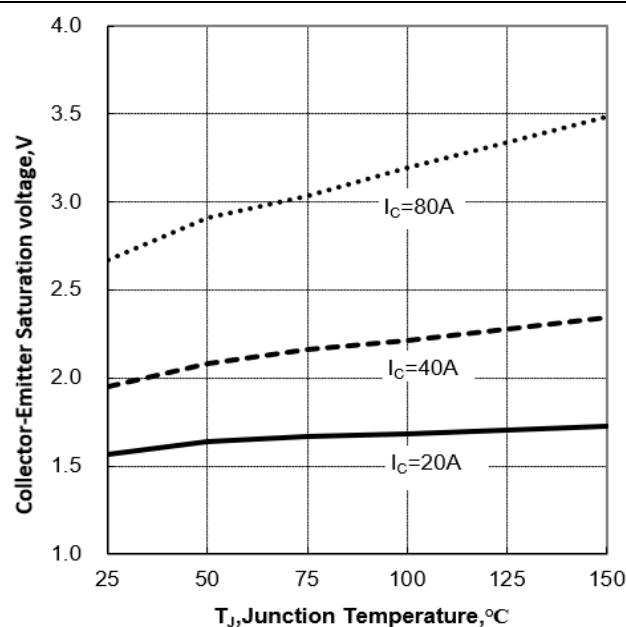
Figure 8. Typical Gate-Emitter Threshold Voltage vs Junction Temperature
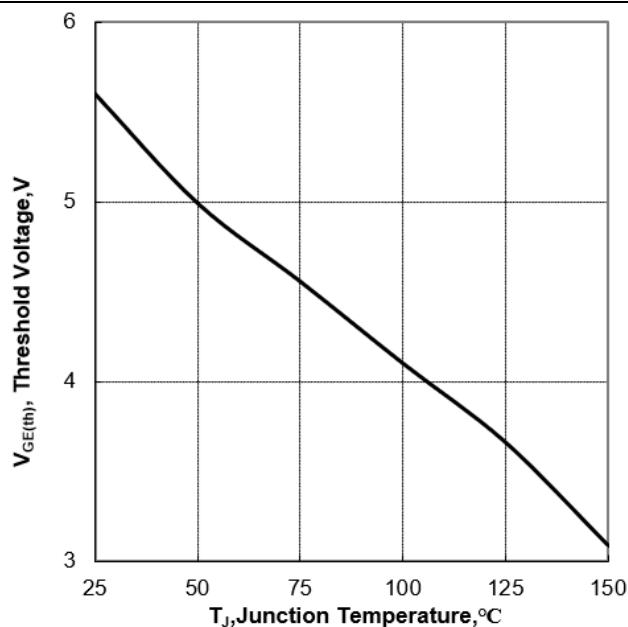
Figure 9. Typical Switching Times vs Gate Resistor (T$_J$=25℃, V$_{CE}$=600V, V$_{GE}$=15/0V, I$_C$=40A)
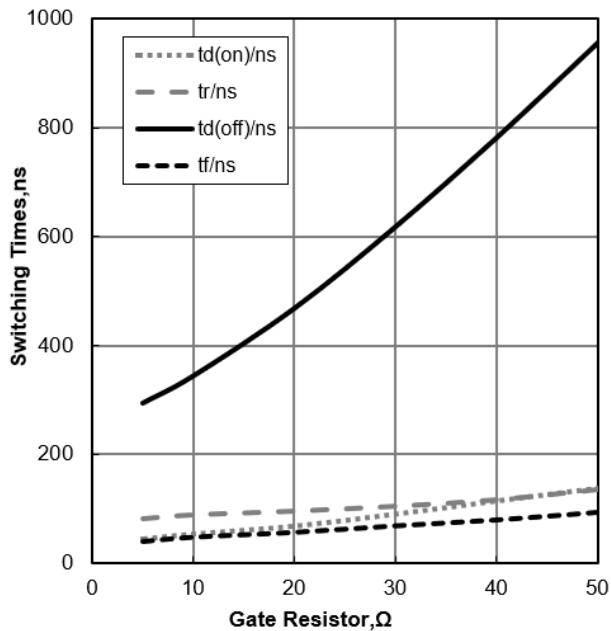
Figure 10. Typical Switching Energy vs Gate Resistor (T$_J$=25℃, V$_{CE}$=600V, V$_{GE}$=15/0V, I$_C$=40A)
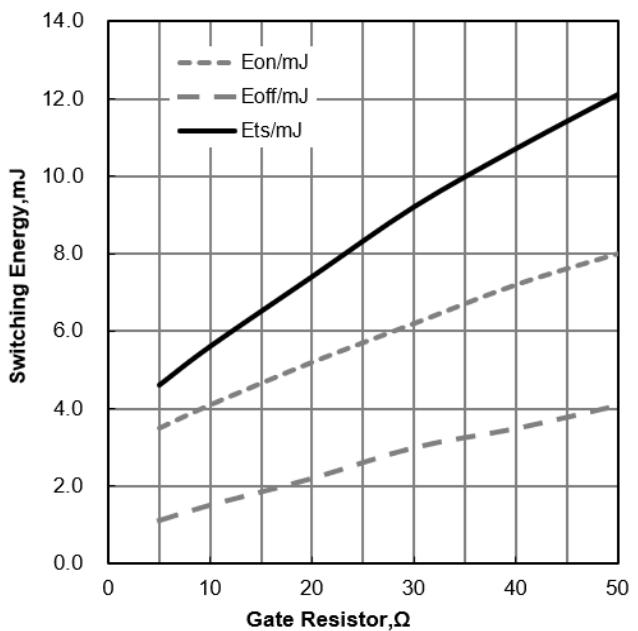
Figure 11. Typical Switching Times vs Junction Temperature (V$_{CE}$=600V, V$_{GE}$=15/0V, I$_C$=40A)
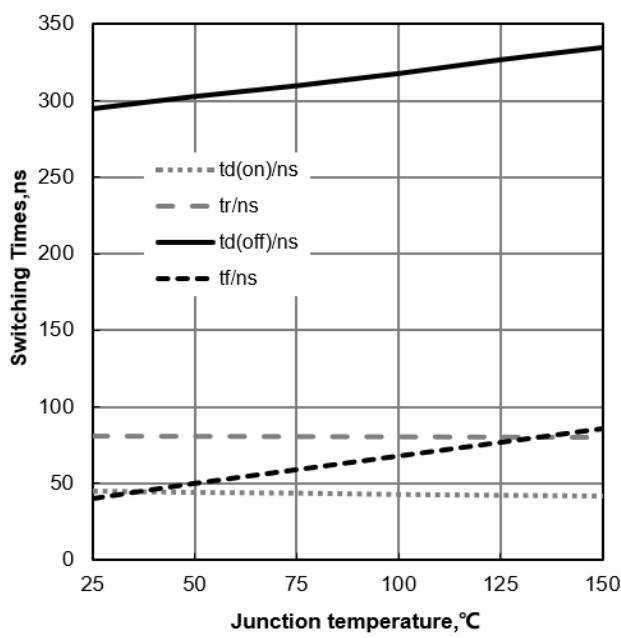
Figure 12. Typical Switching Energy vs Junction Temperature (V$_{CE}$=600V, V$_{GE}$=15/0V, I$_C$=40A)
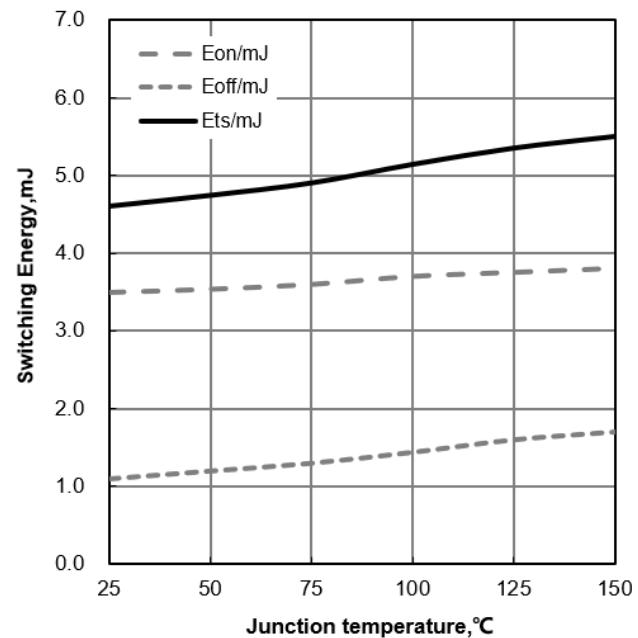
Figure 13. Typical Switching Times vs Collector Current (T$_J$=25℃, V$_{CE}$=600V, V$_{GE}$=15/0V)
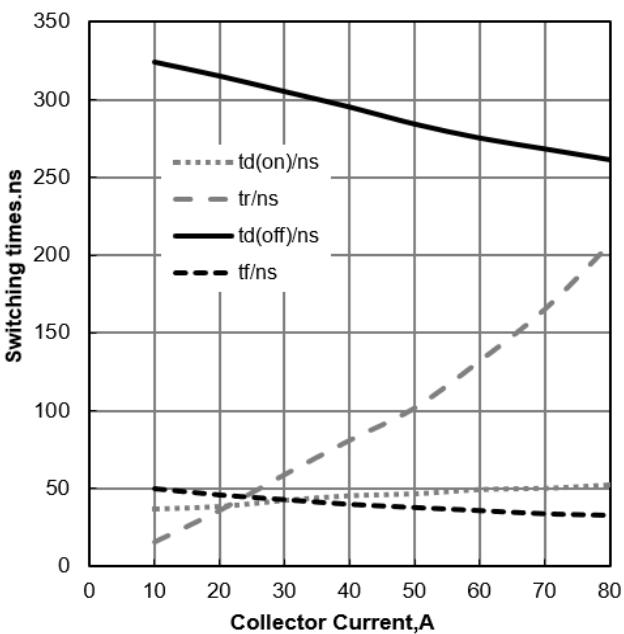
Figure 14. Typical Switching Energy vs Collector Current (T$_J$=25℃, V$_{CE}$=600V, V$_{GE}$=15/0V)
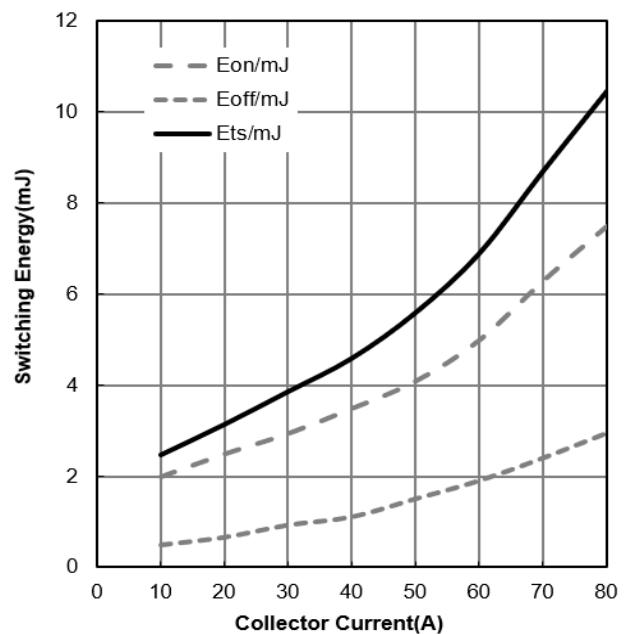
Figure 15. Typical Switching Times vs V$_{CE}$ (T$_J$=25℃, V$_{GE}$=15/0V, I$_C$=40A)
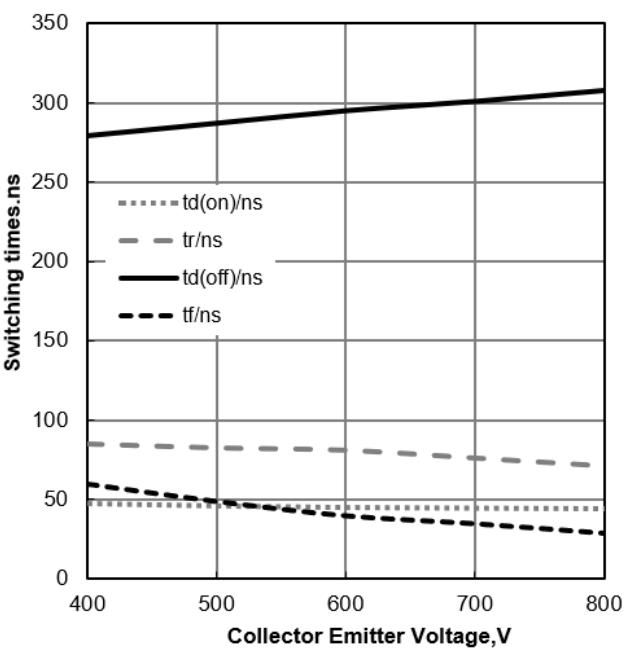
Figure 16. Typical Switching Energy vs V$_{CE}$ (T$_J$=25℃, V$_{GE}$=15/0V, I$_C$=40A)

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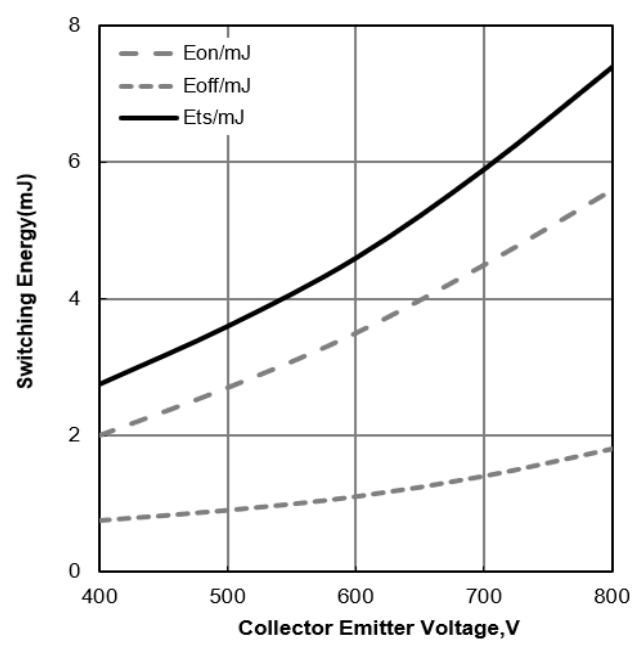
Figure 17. Typical Gate Charge

$V_{CE} = 960V$
$V_{CE} = 240V$

$I_C = 40A$

Y-axis: V_{GE}, Gate-to-Emitter Voltage, V (0 to 16)
X-axis: Q_G, Total Gate Charge, nC (0 to 300)
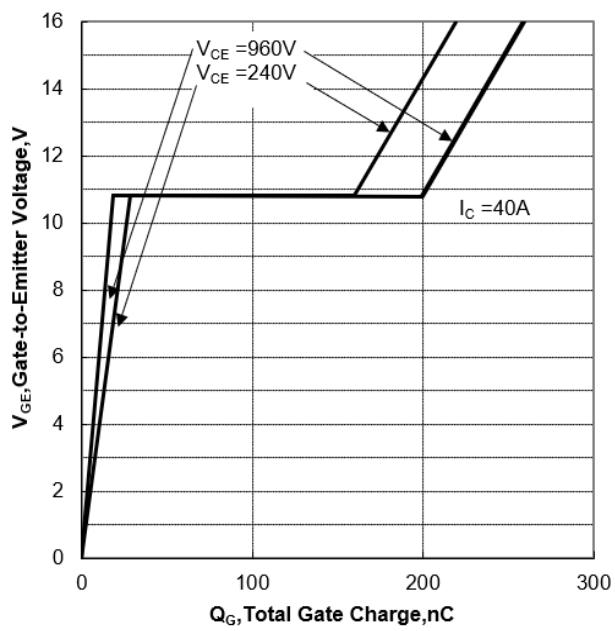
Figure 18. Typical Capacitance vs Collector-Emitter Voltage

C_{iss}
C_{oss}
C_{rss}

Y-axis: Capacitance, pF (1 to 10000)
X-axis: V_{CE}, Collector-Emirrer Voltage, V (0 to 30)
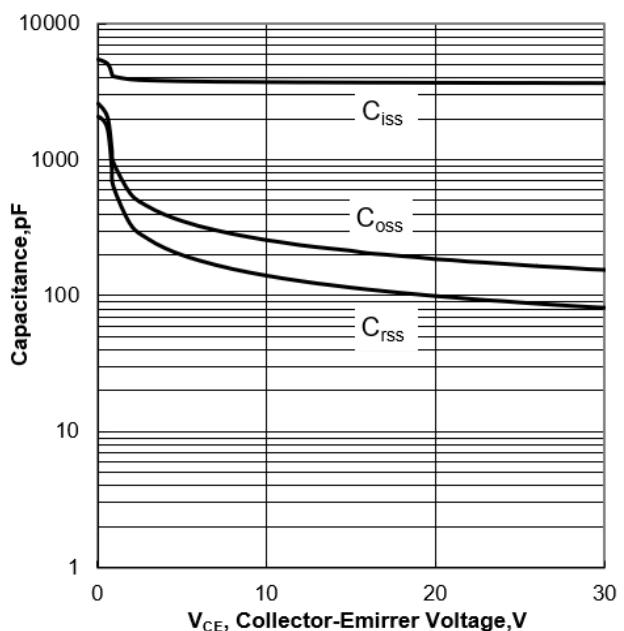
Figure 19. IGBT Transient Thermal Impedance vs Pulse Width

D=1, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01
Single Pulse

$D = T_{on}/T$
$T_{JM} = P_{DM} \cdot R_{\theta JC} + T_C$
$R_{\theta JC} = 0.34°C/W$

Y-axis: $Z_{\theta JC}$ Thermal Response[°C/W]
X-axis: T , Pulse Wideh [s]
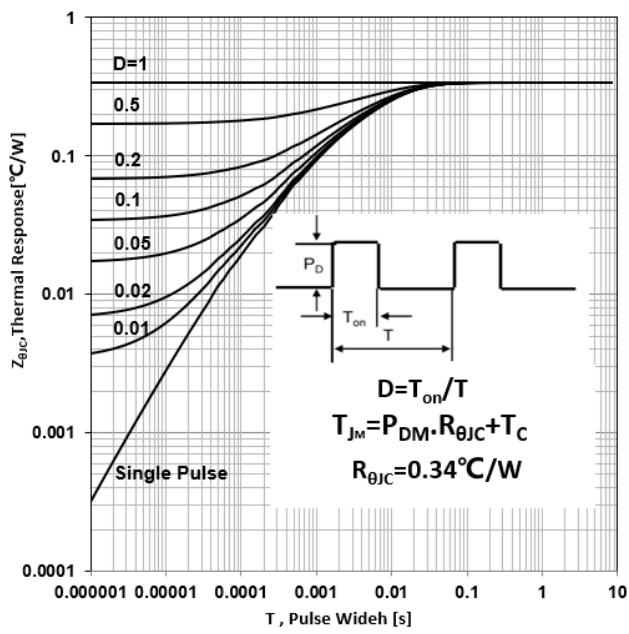
Figure 20. Diode Transient Thermal Impedance vs Pulse Width

D=1, 0.5, 0.2, 0.1, 0.05, 0.02, 0.01
Single Pulse

$D = T_{on}/T$
$T_{JM} = P_{DM} \cdot R_{\theta JC} + T_C$
$R_{\theta JC} = 0.6°C/W$

Y-axis: $Z_{\theta JC}$ Thermal Response[°C/W]
X-axis: T , Pulse Wideh [s]
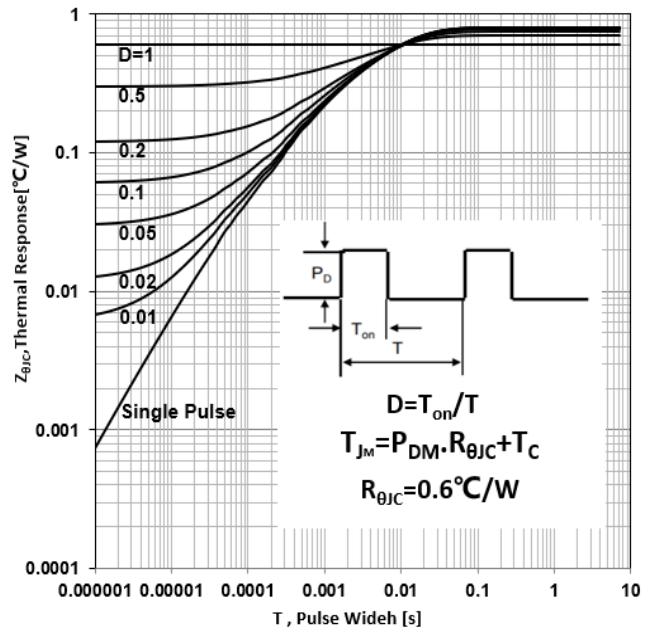
Figure 21. Typical Diode Forward Current vs Forward Voltage
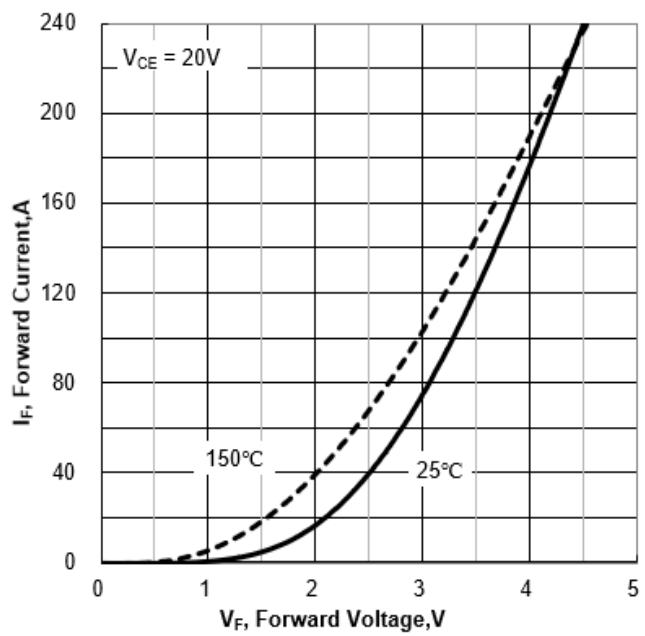
6. Test Circuit and Waveform

| Figure 22. Inductive Switching Test Circuit	Figure 23. Definition of switching times
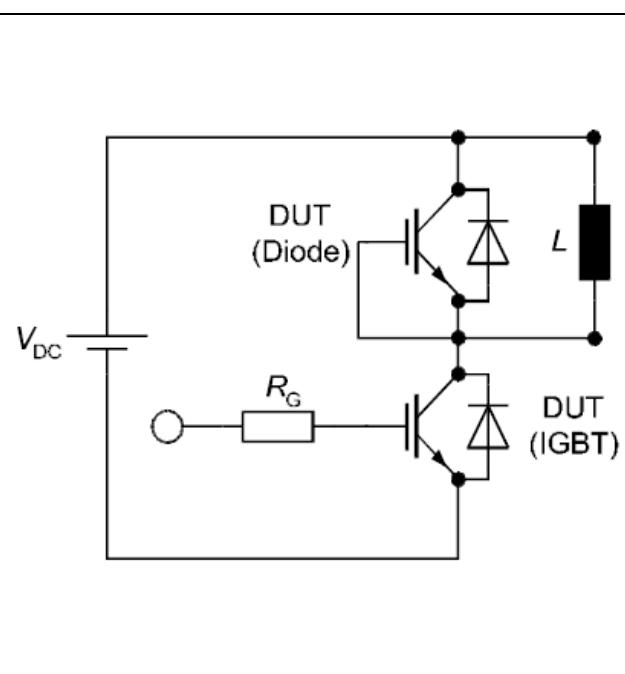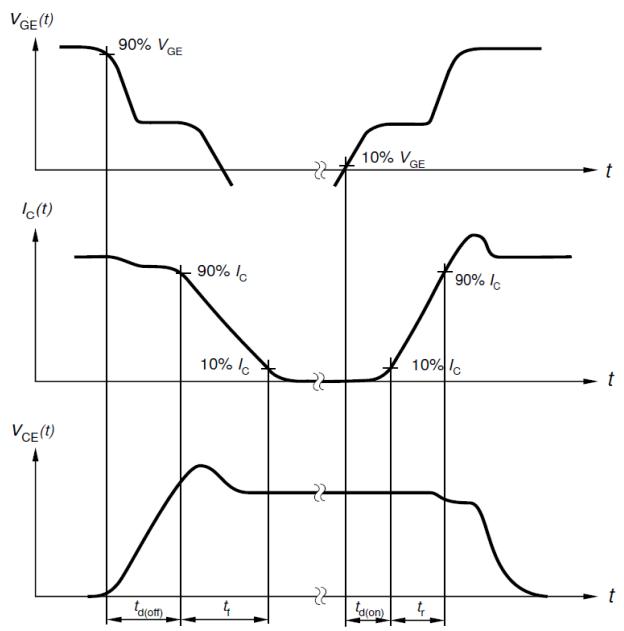
| Figure 24. Definition of switching losses	Figure 25. Definition of diode switching characteristics
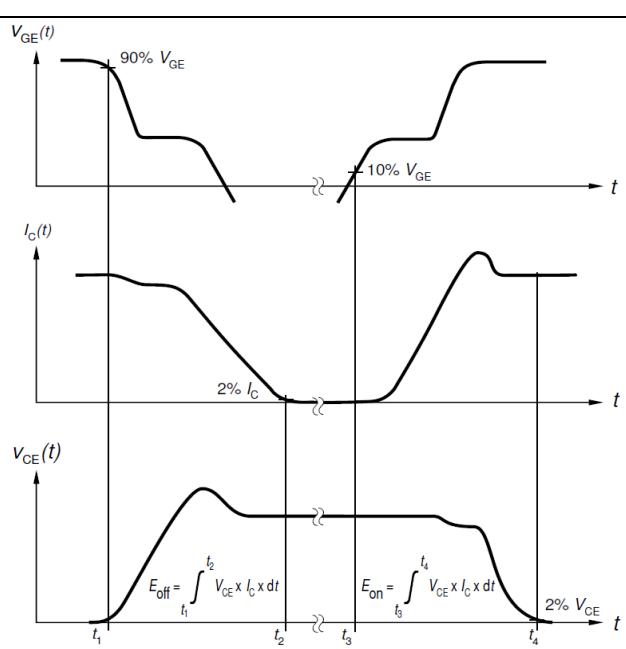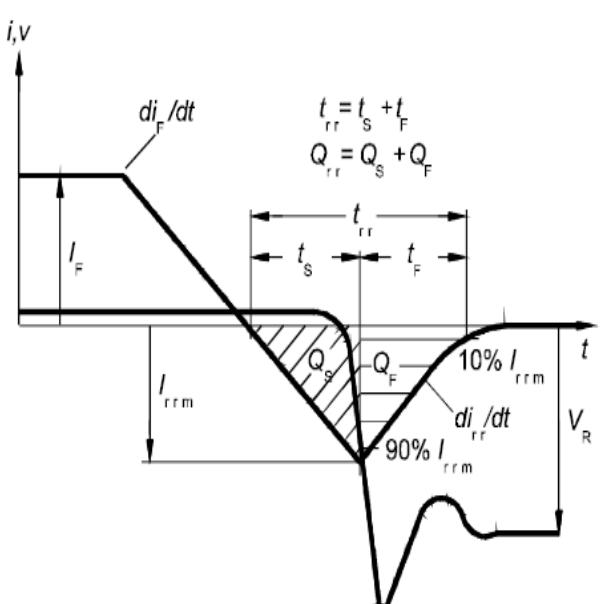
7. Package Description
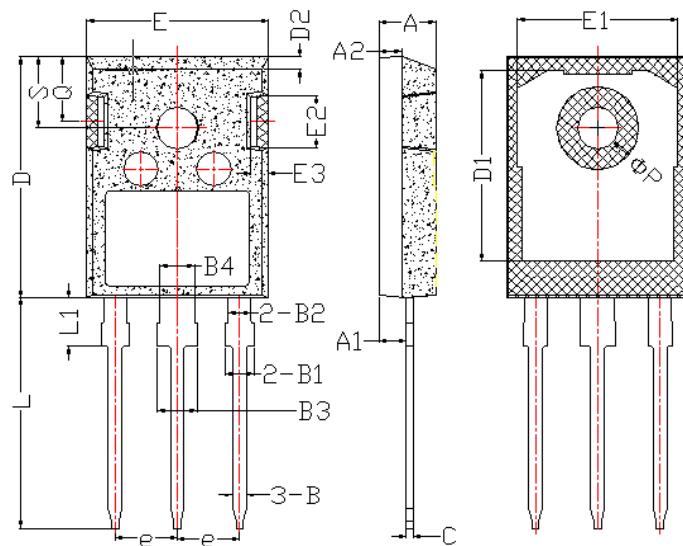
TO-247 Package

Items	Values(mm)	
	MIN	MAX
A	4.90	5.16
A1	2,27	2.53
A2	1.85	2.11
B	1.07	1.33
B1	1.90	2.41
B2	1.75	2.15
B3	2.87	3.38
B4	2.87	3.13
C	0.55	0.68
D	20.82	21.10
D1	16.25	17.65
D2	1.05	1.35
E	15.70	16.03
E1	13.10	14.15
E2	3.68	5.10
E3	1.68	2.60
e	5.44	
L	19.80	20.31
L1	4.17	4.47
ΦP	3.50	3.70
Q	5.49	6.00
S	6.04	6.30