

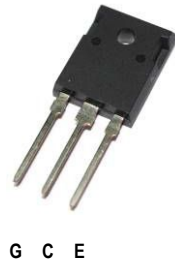
TSG40N120

IGBT trench process

DRAWING

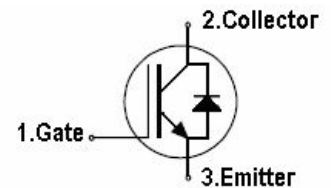
Features

- ◆ 1200V,40A
- ◆ $V_{CE(sat)}(typ.)=2.24V@V_{GE}=15V, I_C=40A$
- ◆ High speed switching
- ◆ Higher system efficiency
- ◆ built-in FRD



General Description

- ◆ Package:TO-247
- ◆ TS IGBTs with trench process offer lower losses and higher energy efficiency for application such as IH (induction heating),UPS, general inverter and other soft switching applications.



Absolute Maximum Ratings

Symbol	Parameter	Spec	Units
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Continuous Collector Current	(TC=25 °C)	60
		(TC=100°C)	40
I_{CM}	Pulsed Collector Current (Note 1)	120	A
I_F	Diode Continuous Forward Current	(TC=25 °C)	30
		(TC=100°C)	30
I_{FM}	Diode Maximum Forward Current (Note 1)	80	A
t_{sc}	Short Circuit Withstand Time $V_{GE}=15V, V_{CC}=600V, T_J=25\text{ °C}$	3	μs
P_D	Maximum Power Dissipation	(TC=25 °C)	297
		(TC=100°C)	119
T_J	Operating Junction Temperature Range	-55 to +150	°C
T_{STG}	Storage Temperature Range	-55 to +150	°C

Note1: Repetitive Rating: Pulse width limited by maximum junction temperature

Thermal Characteristics

Symbol	Parameter	Spec	Units
Rth j-c	Thermal Resistance, Junction to case for IGBT	0.6	KW
Rth j-c	Thermal Resistance, Junction to case for Diode	2	
Rth j-a	Thermal Resistance, Junction to Ambient	40	

Electrical Characteristics (TC=25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Static characteristics						
BV_{CES}	Collector-Emitter Breakdown Voltage	$V_{GE}=0V, I_C=250\mu A$	1200			V
I_{CES}	Collector-Emitter Leakage Current	$V_{CE}=1200V, V_{GE}=0V$	$T_j=25\text{ }^\circ\text{C}$		0.4	mA
			$T_j=150\text{ }^\circ\text{C}$		4.0	
I_{GES}	Gate Leakage Current, Forward	$V_{GE}=20V, V_{CE}=0V$			200	nA
	Gate Leakage Current, Reverse	$V_{GE}=-20V, V_{CE}=0V$			-200	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=250\mu A$	5.0	6.0	7.0	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=40A$	$T_j=25\text{ }^\circ\text{C}$	2.24	2.4	V
			$T_j=150\text{ }^\circ\text{C}$	2.5		
V_F	Diode Forward Voltage	$V_{GE}=0V, I_F=40A$	$T_j=25\text{ }^\circ\text{C}$	3.0		V
			$T_j=150\text{ }^\circ\text{C}$	3.3		
g_{FS}	transconductance	$V_{CE}=20V, I_C=40A$		18.5		S
Dynamic characteristics						
C_{iss}	Input Capacitance	$V_{CE}=25V$		8450		pF
C_{oss}	Output Capacitance	$V_{GE}=0V$		160		
C_{rss}	Reverse Transfer Capacitance	$f=1\text{MHz}$		120		
Q_G	Gate Charge	$V_{CC}=750V, I_C=40A, V_{GE}=15V$				nc
IGBT switching characteristic(Inductive Load)						
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600V, I_C=40A, V_{GE}=15V/0V, R_G=12\ \Omega, L_{Load}=500\ \mu H, TC=25\text{ }^\circ\text{C}$		45		ns
t_r	Turn-on Rise Time			50		
$t_{d(off)}$	Turn-off Delay Time			165		
t_f	Turn-off Fall Time			98		
E_{on}	Turn-on Switching Loss	$L_{Load}=500\ \mu H, TC=25\text{ }^\circ\text{C}$		1.33		mJ
E_{off}	Turn-off Switching Loss			0.82		
E_{ts}	Total Switching Loss			2.15		
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=600V, I_C=40A, V_{GE}=15V, R_G=12\ \Omega, L_{Load}=500\ \mu H, TC=150\text{ }^\circ\text{C}$		35		ns
t_r	Turn-on Rise Time			52		
$t_{d(off)}$	Turn-off Delay Time			200		
t_f	Turn-off Fall Time			225		
E_{on}	Turn-on Switching Loss	$L_{Load}=500\ \mu H, TC=150\text{ }^\circ\text{C}$		1.35		mJ
E_{off}	Turn-off Switching Loss			1.60		
E_{ts}	Total Switching Loss			2.95		

Typical Characteristics

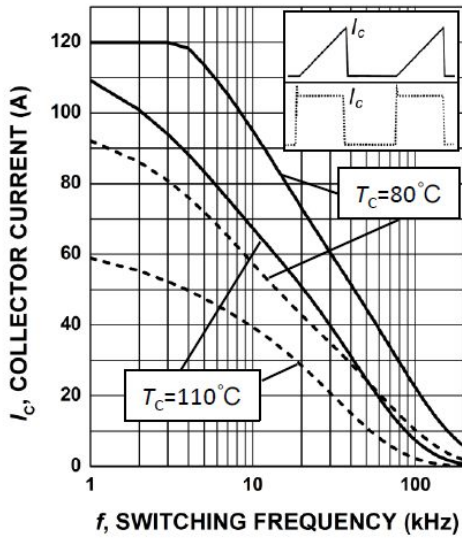


Figure 1. Collector current as a function of switching frequency
 ($T_j \leq 150^\circ\text{C}$, $D = 0.5$, $V_{CE} = 600\text{V}$,
 $V_{GE} = 0/+15\text{V}$, $R_G = 12\Omega$)

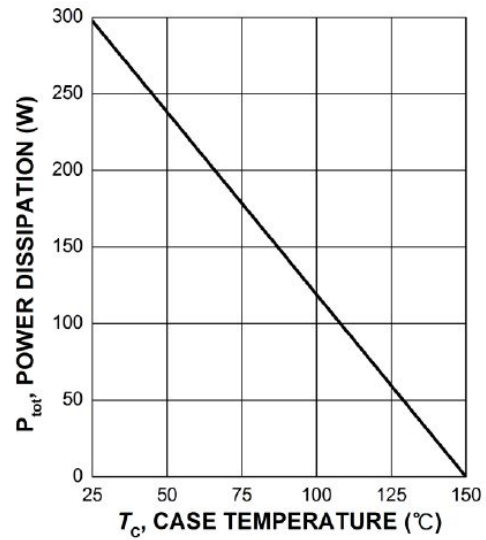


Figure 2. Maximum power dissipation as a function of case temperature
 ($T_j \leq 150^\circ\text{C}$)

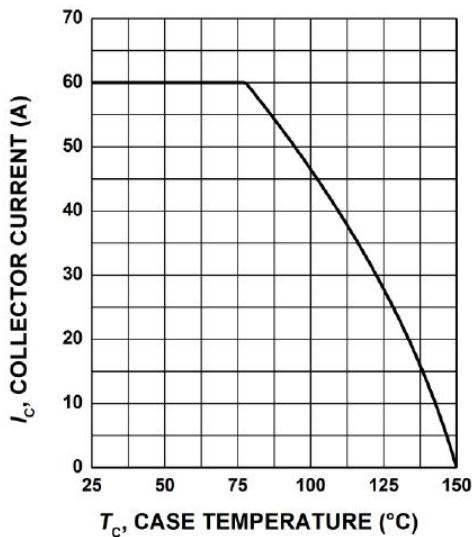


Figure 3. Maximum collector current as a function of case temperature
 ($V_{GE} \geq 15\text{V}$, $T_j \leq 150^\circ\text{C}$)

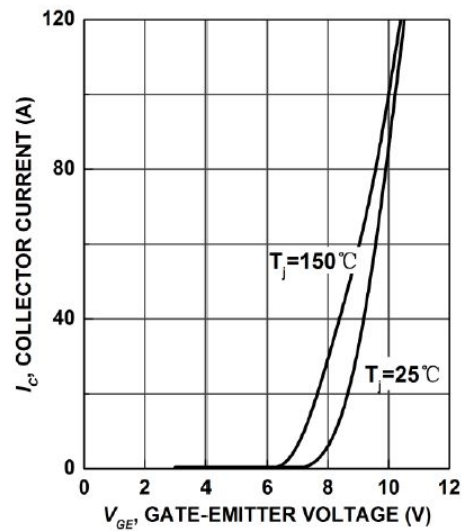


Figure 4. Typical transfer characteristic
 ($V_{CE} = 15\text{V}$)

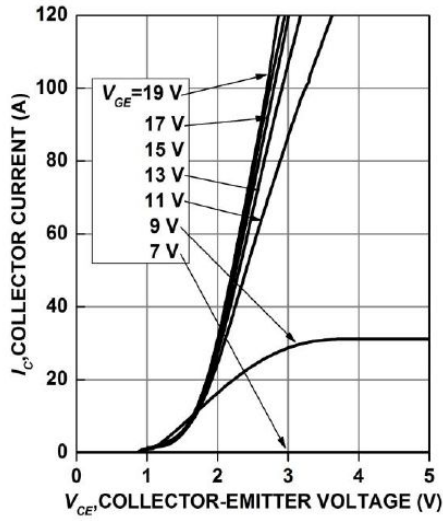


Figure 5. Typical output characteristic ($T_j = 25^\circ\text{C}$)

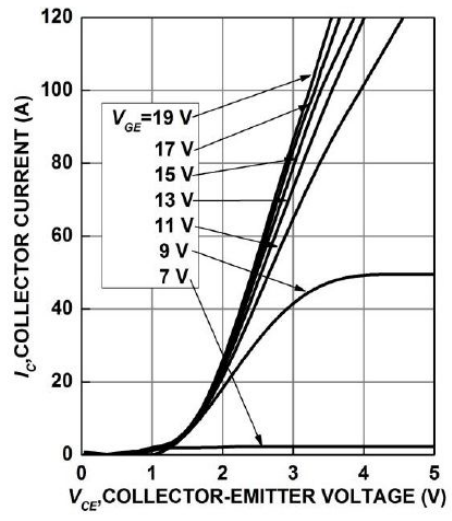


Figure 6. Typical output characteristic ($T_j = 150^\circ\text{C}$)

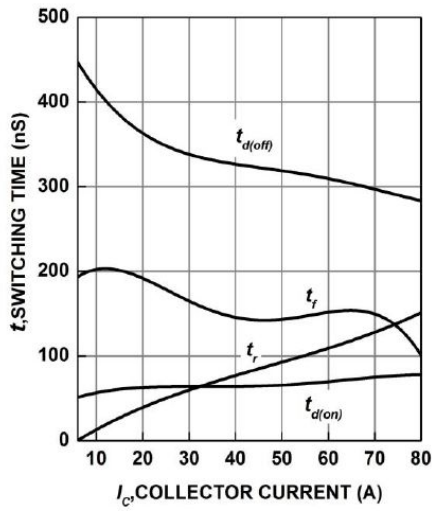


Figure 7. Typical switching times as a function of collector current (inductive load, $T_j=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=12\Omega$, Dynamic test circuit in Figure D)

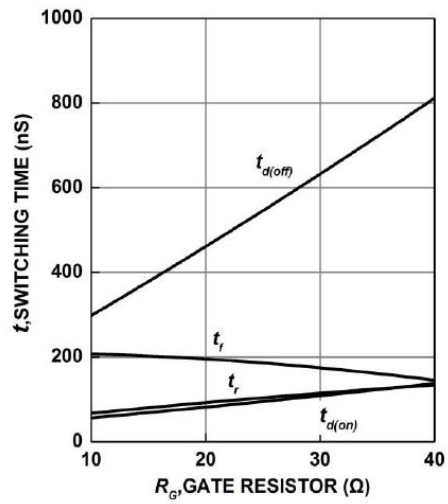


Figure 8. Typical switching times as a function of gate resistor (inductive load, $T_j=150^\circ\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure D)

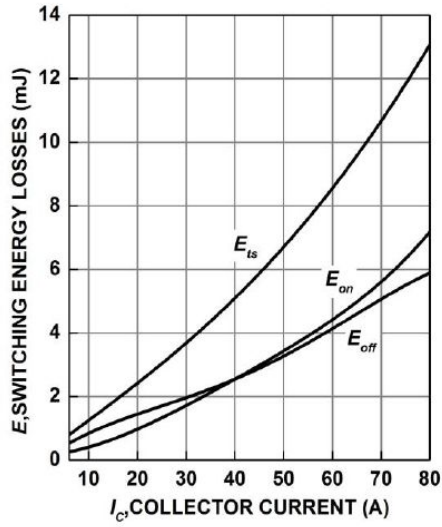


Figure 9. Typical switching energy losses as a function of collector current (inductive load, $T_j=150^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $R_G=12\Omega$, Dynamic test circuit in Figure D)

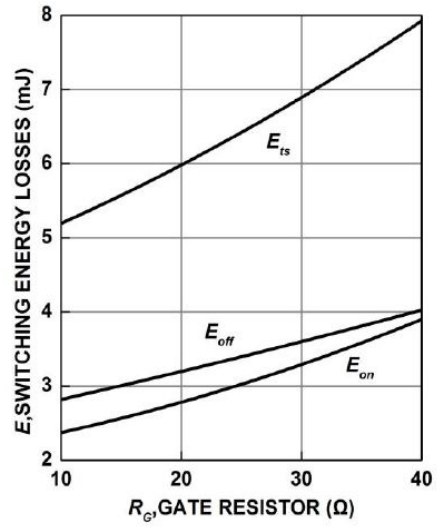


Figure 10. Typical switching energy losses as a function of gate resistor (inductive load, $T_j=150^{\circ}\text{C}$, $V_{CE}=600\text{V}$, $V_{GE}=0/15\text{V}$, $I_C=40\text{A}$, Dynamic test circuit in Figure D)

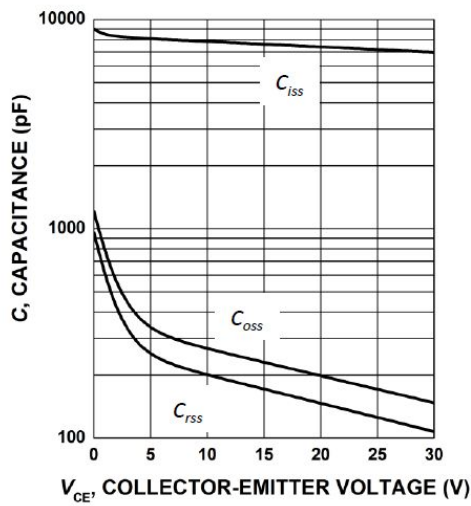


Figure 11. Typical capacitance as a function of collector-emitter voltage ($V_{GE}=0\text{V}$, $f = 1\text{ MHz}$)

Test circuits and waveforms

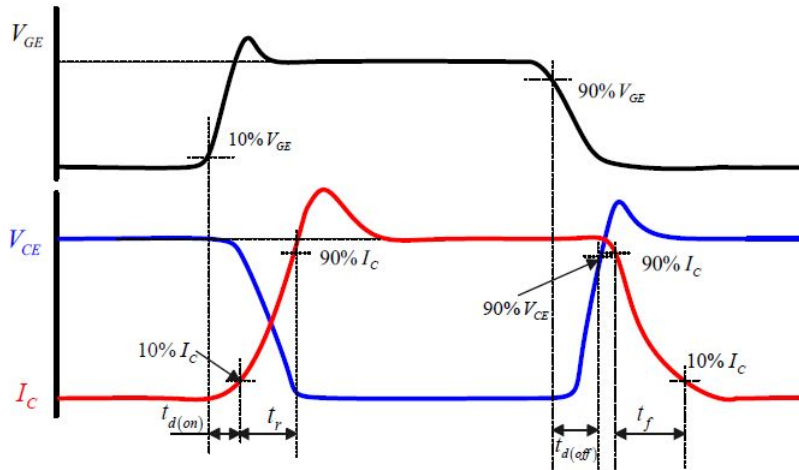


Figure A. Definition of switching times

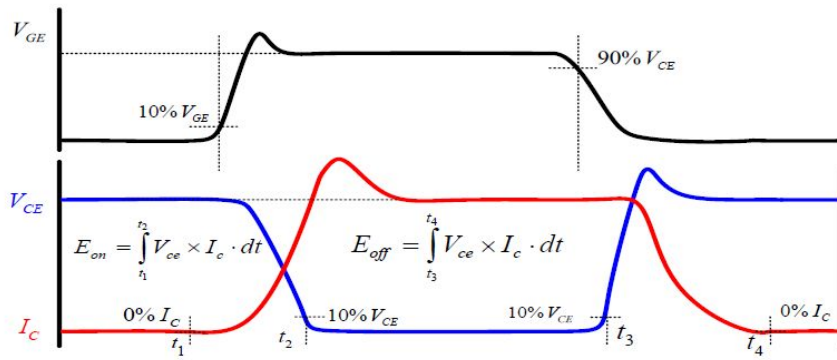


Figure B. Definition of switching losses

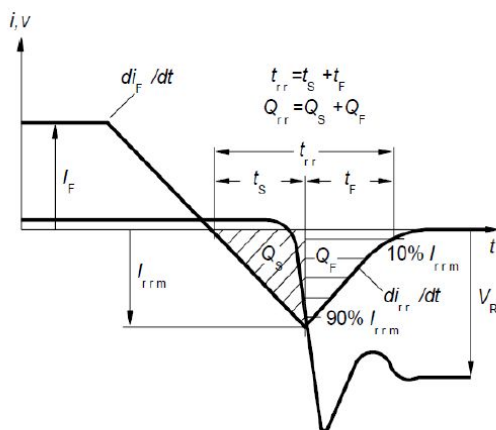


Figure C. Definition of diodes switching characteristics

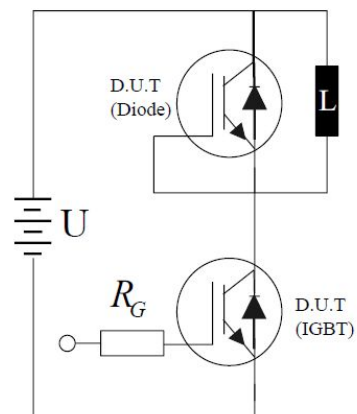


Figure D. Dynamic test circuit

Mechanical Dimensions

