

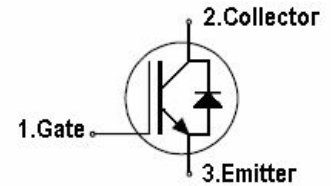
TSG20N60

20A 600V high speed trench gate field-stop IGBT

DRAWING



G C E



Features

- * High speed switching
- * Tight parameters distribution
- * Safe paralleling
- * Low thermal resistance
- * Short-circuit rated
- * Ultrafast soft recovery antiparallel diode

General Description

- * Package:TO-220C
- * This device is an IGBT developed using an advanced proprietary trench gate and field stop structure. This IGBT series offers the optimum compromise between conduction and switching losses maximizing the efficiency of very high frequency converters. Furthermore, a positive $V_{CE(sat)}$ temperature coefficient and very tight parameter distribution result in easier paralleling operation.

Absolute Maximum Ratings

Symbol	Parameter	Spec	Units
V_{CES}	Collector-emitter voltage ($V_{GE}=0$)	600	V
I_C	Continuous collector current at $T_C=25^\circ C$	40	A
I_C	Continuous collector current at $T_C=100^\circ C$	20	A
$I_{CP}^{(2)}$	Pulsed collector current	80	A
V_{GE}	Gate-emitter voltage	± 20	V
I_F	Continuous forward current $T_C=25^\circ C$	40	A
I_F	Continuous forward current $T_C=100^\circ C$	20	A
$I_{FP}^{(1)}$	Pulsed forward current	80	A
P_{TOT}	Total dissipation at $T_C=25^\circ C$	167	W
T_{STG}	Storage Temperature range	-55 to 150	$^\circ C$
T_J	Operating Junction temperature	-55 to 175	$^\circ C$

Note1: Pulse width limited by maximum junction temperature and turn-off within RBSOA

Thermal Characteristics

Symbol	Parameter	Spec	Units
R_{thJC}	Thermal resistance junction-case IGBT	0.9	$^\circ C/W$
R_{thJC}	Thermal resistance junction-case diode	2.5	$^\circ C/W$
R_{thJA}	Thermal resistance junction-ambient	62.5	$^\circ C/W$

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

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$V_{(BR)CES}$	Collector-emitter breakdown voltage($V_{GE}=0$)	$I_C=2mA$	600	-	-	V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE}=15V, I_C=20A$	-	1.6	2.0	V
		$V_{GE}=15V, I_C=20A, T_J=125^\circ C$	-	1.75	-	
		$V_{GE}=15V, I_C=20A, T_J=175^\circ C$	0	1.8	1	
$V_{GE(th)}$	Gate threshold voltage	$V_{CE}=V_{GE}, I_C=1mA$	5.0	6.0	7.0	V
I_{CES}	Collector cut-off current ($V_{GE}=0$)	$V_{CE}=600V$	-	-	25	μA
I_{GES}	Gate-emitter leakage current ($V_{CE}=0$)	$V_{GE}=\pm 20V$	-	-	250	nA

Dynamic characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
C_{ies}	Input capacitance	$V_{CE}=25V,$	-	2750	-	pF
C_{oes}	Output capacitance	$f=1MHz,$	-	110	-	pF
C_{res}	Reverse transfer capacitance	$V_{GE}=0$	-	65	-	pF
Q_g	Total gate charge	$V_{CC}=400V,$	-	115	-	nC
Q_{ge}	Gate-emitter charge	$I_C=20A,$	-	22	-	nC
Q_{gc}	Gate-collector charge	$V_{GE}=15V$	-	45	-	nC

Switching characteristics(inductive load)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$t_{d(on)}$	Turn-on delay time	$V_{CE}=400V, I_C=20A,$ $R_G=10\Omega, V_{GE}=15V$	-	42.5	-	ns
t_r	Current rise time		-	11.9	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1345	-	A/us
$t_{d(on)}$	Turn-on delay time	$V_{CE}=400V, I_C=20A,$ $R_G=10\Omega, V_{GE}=15V$ $T_J=175^\circ C$	-	42.5	-	ns
t_r	Current rise time		-	13.4	-	ns
$(di/dt)_{on}$	Turn-on current slope		-	1180	-	A/us
$t_{r(Voff)}$	Off voltage rise time	$V_{CE}=400V, I_C=20A,$ $R_G=10\Omega, V_{GE}=15V$	-	20	-	ns
$t_{d(off)}$	Turn-off delay time		-	177	-	ns
t_f	Current fall time		-	55	-	ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CE}=400V, I_C=20A,$ $R_G=10\Omega, V_{GE}=15V$ $T_J=175^\circ C$	-	26	-	ns
$t_{d(off)}$	Turn-off delay time		-	173	-	ns
t_f	Current fall time		-	86	-	ns
t_{sc}	Short-circuit withstand time	$V_{CC}\leq 360V, V_{GE}=15V$	3	5	-	us

Switching energy(inductive load)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$E_{on(1)}$	Turn-on switching losses	$V_{CE}=400V, I_C=20A, R_G=10\Omega, V_{GE}=15V$	-	209	-	μJ
$E_{off(2)}$	Turn-off switching losses		-	261	-	μJ
E_{is}	Total switching losses		-	470	-	μJ
$E_{on(1)}$	Turn-on switching losses	$V_{CE}=400V, I_C=20A,$ $R_G=10\Omega, V_{GE}=15V$ $T_J=175^\circ C$	-	480	-	μJ
$E_{off(2)}$	Turn-off switching losses		-	416	-	μJ
E_{is}	Total switching losses		-	896	-	μJ

Notes: 1. Energy losses include reverse recovery of the diode .

2. Turn-off losses include also the tail of the collector current .

Collector-emitter diode

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V_F	Forward on-voltage	$I_F=20A$		1.8	2.2	V
		$I_F=20A, T_J=175^\circ C$		1.3		
t_{rr}	Reverse recovery time	$V_r=60V, I_F=20A$ $diF/dt = 100 A / \mu s$	-	90	-	ns
Q_{rr}	Reverse recovery charge		-	110	-	nC
I_{rm}	Reverse recovery current		-	2.4	-	A
t_{rr}	Reverse recovery time	$V_r=60V, I_F=20A$ $diF/dt = 100 A / \mu s$ $T_J=175^\circ C$	-	188	-	ns
Q_{rr}	Reverse recovery charge		-	466	-	nC
I_{rm}	Reverse recovery current		-	5.2	-	A

Typical Characteristics

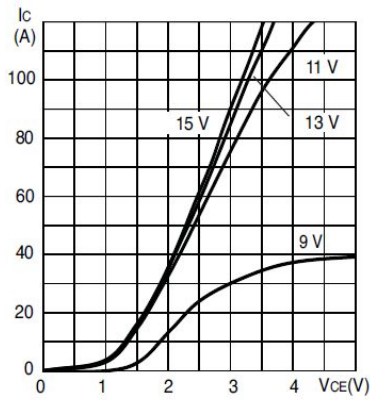


Figure 1. Output characteristics ($T_J=25^\circ C$)

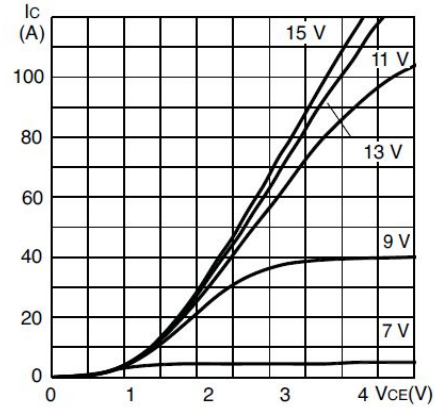


Figure 2. Output characteristics ($T_J=175^\circ C$)

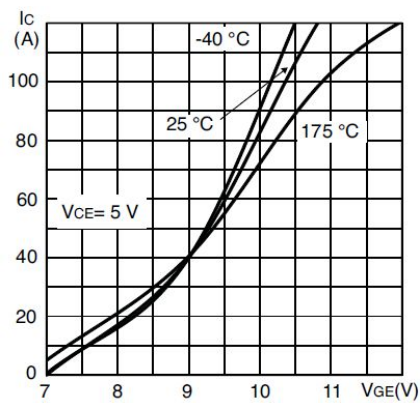


Figure 3. Transfer characteristics

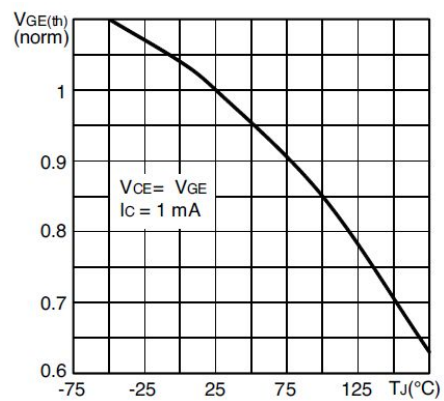


Figure 4. Normalized $V_{GE(th)}$ VS junction temperature

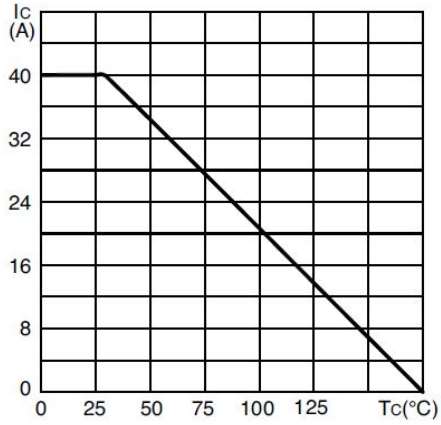


Figure 5. Collector current vs. case temperature

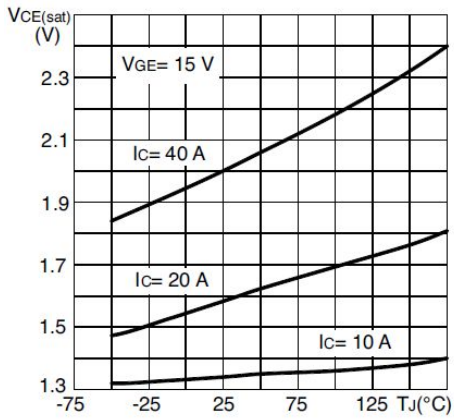


Figure 6. $V_{CE(sat)}$ VS junction temperature

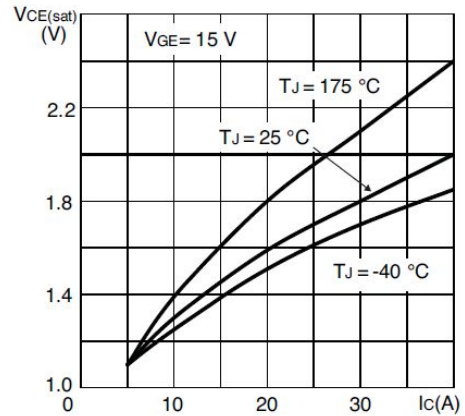


Figure 7. $V_{CE(sat)}$ VS .collector current

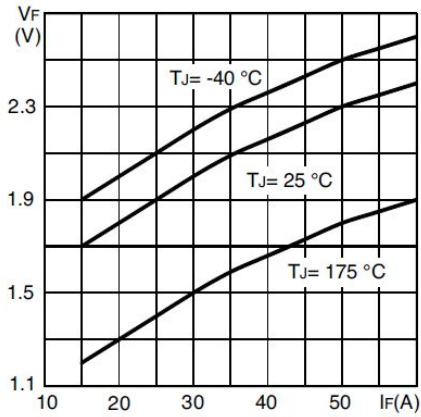


Figure 8. Diode VF vs. forward current

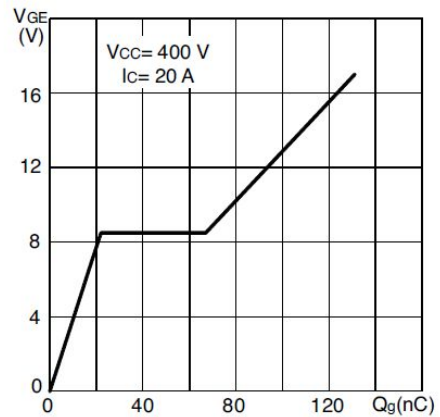


Figure 9. Gate charge vs. gate-emitter voltage

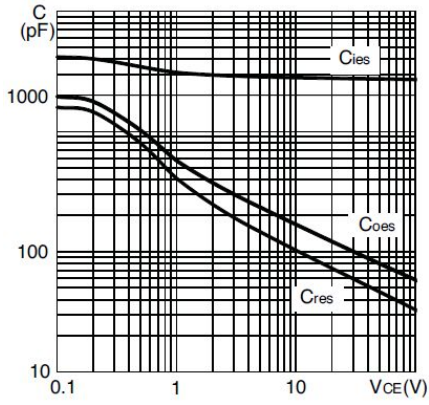


Figure 10. Capacitance variations vs. V_{CE}

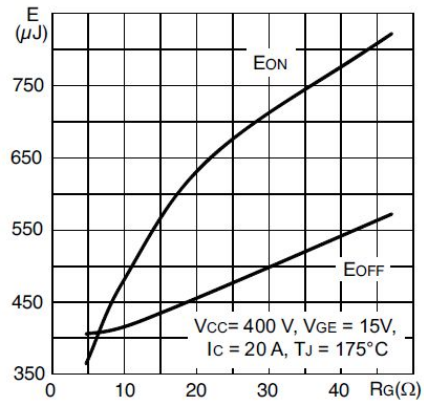


Figure 11. Switching losses vs. gate resistance

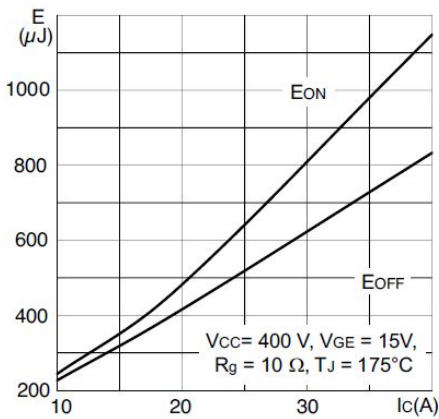


Figure 11. Switching losses vs. collector current

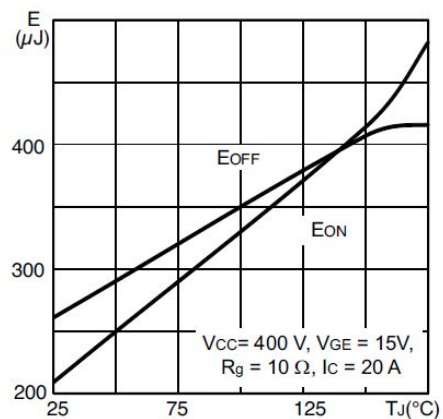


Figure 12. Switching losses vs. temperature

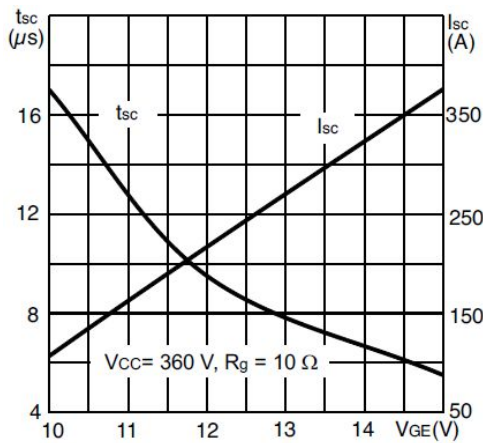


Figure 13. Short-circuit time and current vs. V_{GE}

Test circuits and waveforms

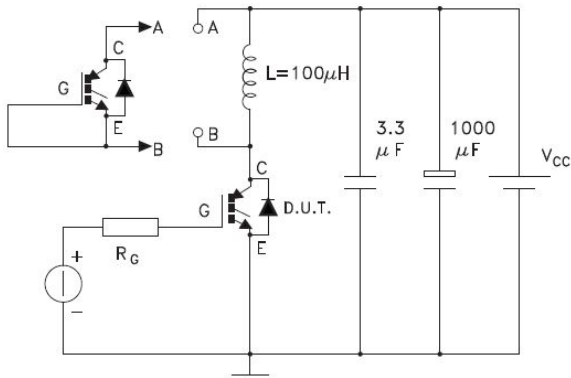


Figure 1. Test circuit for inductive load switching

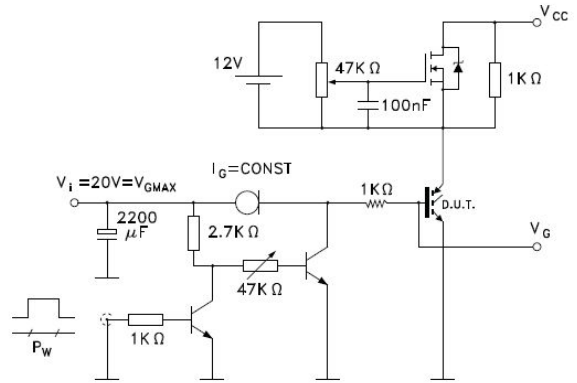


Figure 2. Gate charge test circuit

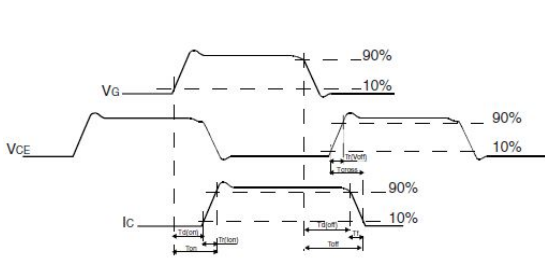


Figure 3. Switching waveform

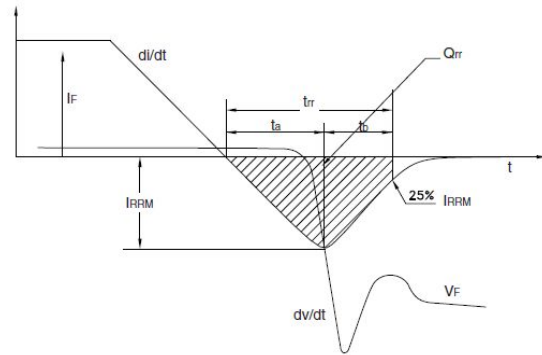


Figure 4. Diode recovery time waveform

Mechanical Dimensions

