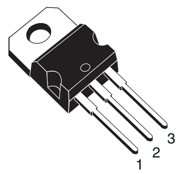
STGP19NC60SD

N-channel 600V - 20A - TO-220
Medium frequency PowerMESH™ IGBT

Features

Type	V_{CES}	$V_{CE(sat)}$ (typ)@150°C	I_C @100°C
STGP19NC60SD	600V	< 1.35V	20A

- Very low on-voltage drop ($V_{CE(sat)}$)
- High input impedance (voltage driven)
- IGBT co-packaged with ultrafast freewheeling diode.
- Minimum power losses at 5 kHz in hard switching
- Optimized performance for medium operating frequencies.



TO-220

Application

- Medium frequency motor control

Description

This IGBT utilizes the advanced PowerMESH™ process resulting in an excellent trade-off between switching performance and low on-state behavior.

Figure 1. Internal schematic diagram

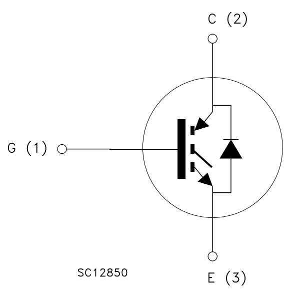


Table 1. Device summary

Order code	Marking	Package	Packaging
STGP19NC60SD	GP19NC60SD	TO-220	Tube

Contents

1 Electrical ratings

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GS} = 0)	600	V
I_C (1)	Collector current (continuous) at T_C = 25°C	50	A
I_C (1)	Collector current (continuous) at T_C = 100°C	20	A
I_{CP} (2)	Pulsed collector current	80	A
I_F	Diode RMS forward current at T_C = 25°C	20	A
I_{FSM}	Surge non repetitive forward current tp = 10ms sinusoidal	50	A
V_{GE}	Gate-emitter voltage	±20	V
P_{TOT}	Total dissipation at T_C = 25°C	125	W
T_j	Operating junction temperature	– 55 to 150	°C

1. Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

2. Pulsed: width limited by max junction temperature allowed

Table 2. Thermal resistance

Symbol	Parameter	Value	Unit
Rthj-case	Thermal resistance junction-case max IGBT	1	°C/W
	Thermal resistance junction-case max DIODE	3.0	°C/W
Rthj -amb	Thermal resistance junction-ambient max	62.5	°C/W

2 Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 3. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-emitter breakdown voltage	I_C= 1mA, V_{GE}= 0	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}= 15V, I_C= 12A V_{GE}= 15V, I_C=12A,Tc=150°C		1.55 1.35	1.9	V V
$V_{GE(th)}$	Gate threshold voltage	V_{CE}= V_{GE}, I_C= 250 µA	3.75		5.75	V
I_{CES}	Collector cut-off current (V_{GE} = 0)	V_{CE}= Max rating,T_C= 25°C V_{CE}= Max rating,T_C= 150°C			150 1	µA mA
I_{GES}	Gate-emitter leakage current (V_{CE} = 0)	V_{GE}= ±20V, V_{CE}= 0			±100	nA
g_{fs}	Forward transconductance	V_{CE} = 15V, I_C= 12A		10		S

Table 4. Dynamic

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
C_{ies} C_{oes} C_{res}	Input capacitance Output capacitance Reverse transfer capacitance	V_{CE} = 25V, f = 1MHz, V_{GE} = 0		1190 135 28.5		pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	V_{CE} = 480V, I_C = 12A, V_{GE} = 15V, *Figure 18*		54.5 8.7 25.8		nC nC nC

Table 5. Switching on/off (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r (di/dt)on	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 480V, I_C = 12A R_G= 10Ω, V_{GE}= 15V, *Figure 19*		17.5 6.2 1870		ns ns A/µs
$t_{d(on)}$ t_r (di/dt)on	Turn-on delay time Current rise time Turn-on current slope	V_{CC} = 480V, I_C = 12A R_G= 10Ω, V_{GE}= 15V, T_j = 125°C *Figure 19*		17 6.5 1700		ns ns A/µs
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 480V, I_C = 12A R_G= 10Ω, V_{GE}= 15V, *Figure 19*		90 175 215		ns ns ns
$t_{r(Voff)}$ $t_{d(Voff)}$ t_f	Off voltage rise time Turn-off delay time Current fall time	V_{CC} = 480V, I_C = 12A R_G= 10Ω, V_{GE}= 15V, T_j = 125°C *Figure 19*		155 245 290		ns ns ns

Table 6. Switching energy (inductive load)

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
E_{on} E_{off}(1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 480V, I_C = 12A R_G= 10Ω, V_{GE}= 15V, *Figure 17*		135 815 995		µJ µJ µJ
E_{on} E_{off}(1) E_{ts}	Turn-on switching losses Turn-off switching losses Total switching losses	V_{CC} = 480V, I_C = 12A R_G= 10Ω, V_{GE}= 15V, T_j = 125°C *Figure 17*		200 1175 1375		µJ µJ µJ

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

Table 7. Collector-emitter diode

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_f	Forward on-voltage	I_f = 12A I_f = 12A, T_j = 125°C		2.3 2.0		V V
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_f = 12A,V_R = 40V, T_j = 25°C, di/dt = 100 A/µs *Figure 20*		31 29.5 1.9		ns nC A
t_{rr} Q_{rr} I_{rrm}	Reverse recovery time Reverse recovery charge Reverse recovery current	I_f = 12A,V_R = 40V, T_j =125°C, di/dt = 100A/µs *Figure 20*		48.5 70.5 3		ns nC A

2.1 Electrical characteristics (curves)

Figure 1. Output characteristics

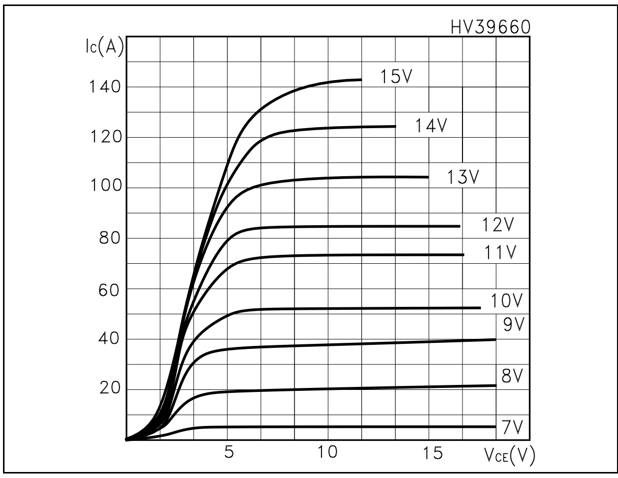


Figure 2. Transfer characteristics

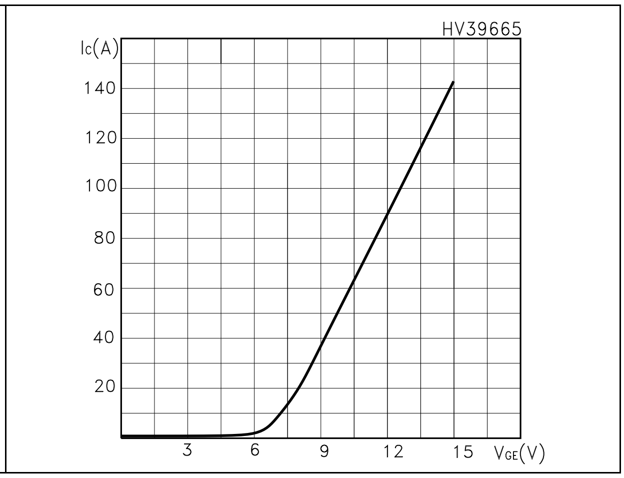


Figure 3. Transconductance

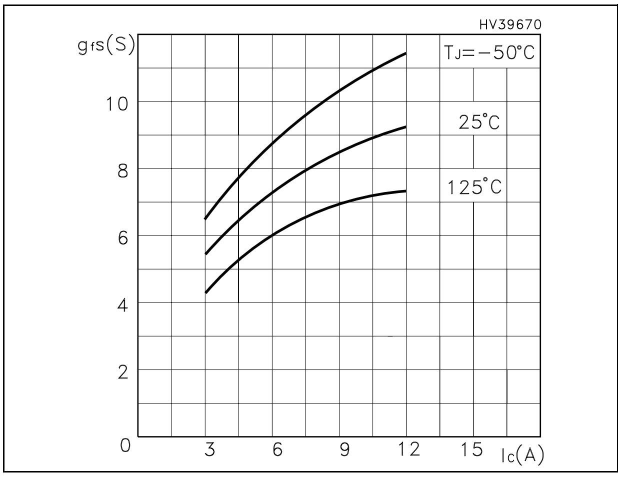


Figure 4. Collector-emitter on voltage vs temperature

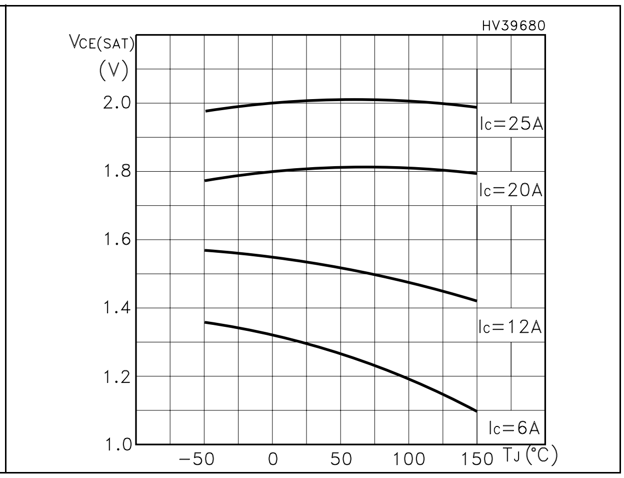


Figure 5. Gate charge vs gate-source voltage

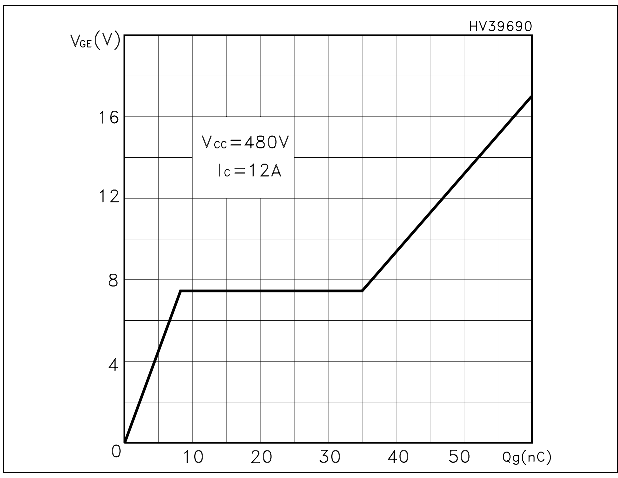


Figure 6. Capacitance variations

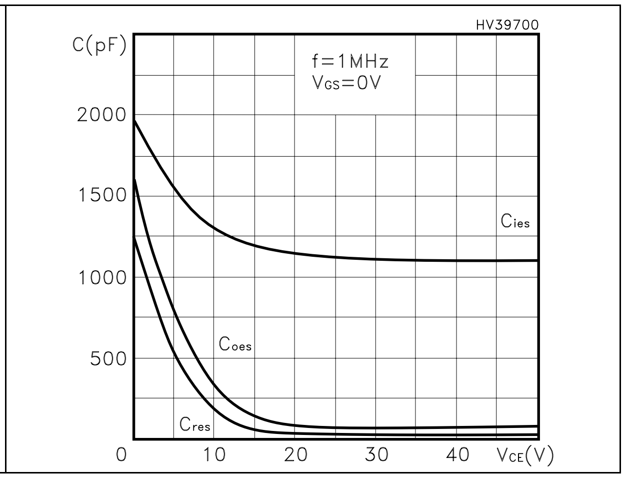


Figure 7. Normalized gate threshold voltage vs temperature

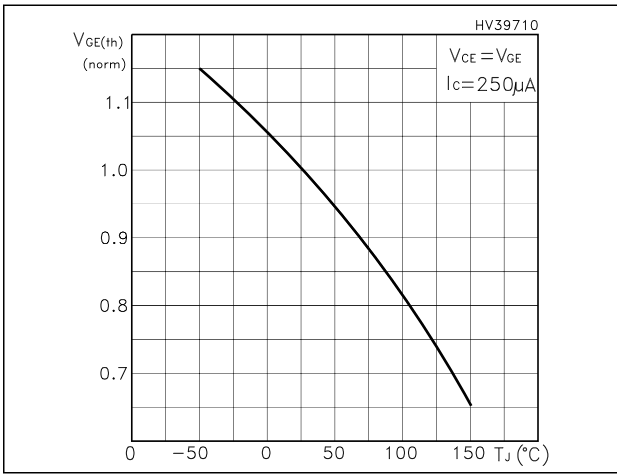


Figure 8. Collector-emitter on voltage vs collector current

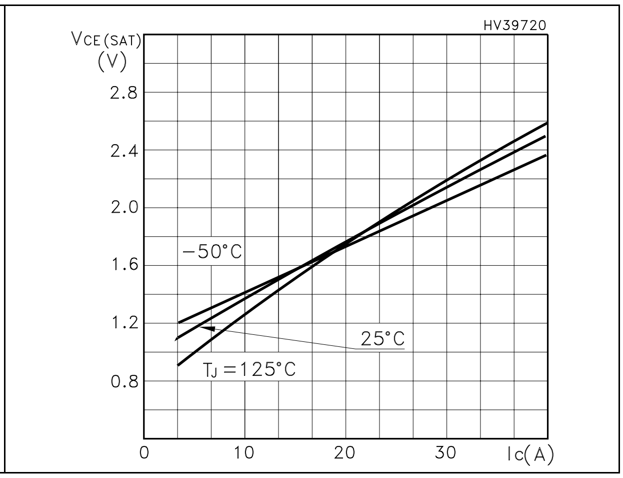


Figure 9. Normalized breakdown voltage vs temperature

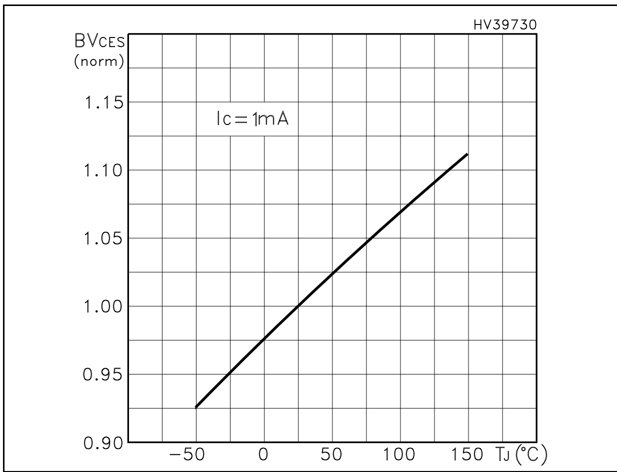


Figure 10. Switching losses vs temperature

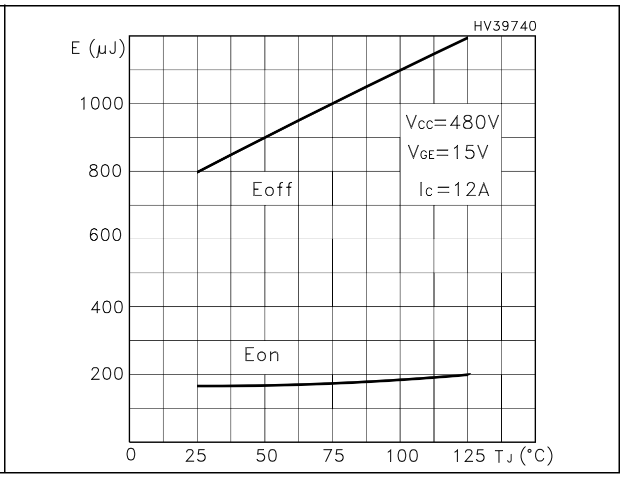


Figure 11. Switching losses vs gate resistance

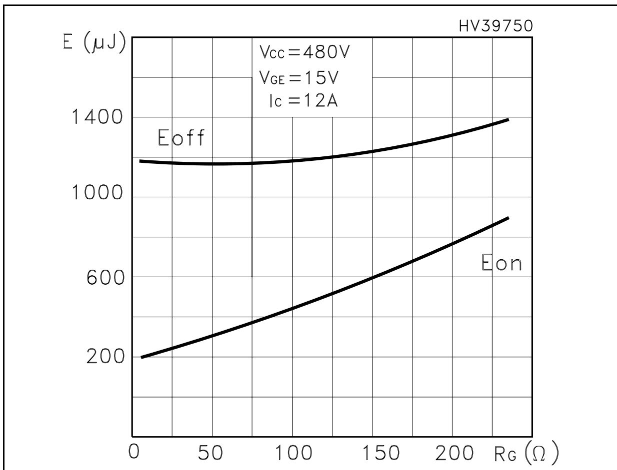


Figure 12. Switching losses vs collector current

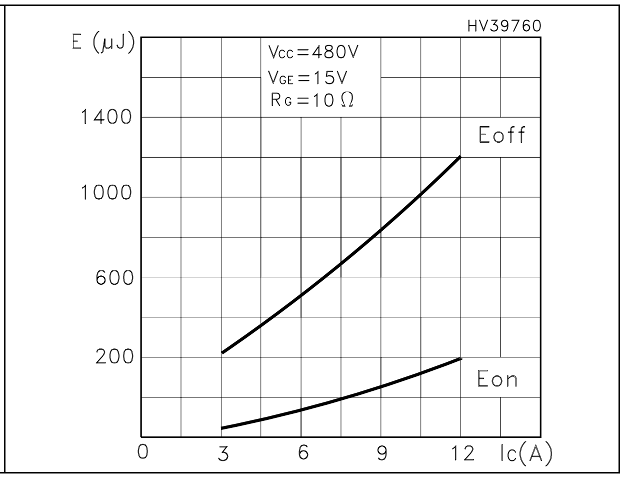


Figure 13. Turn-off SOA

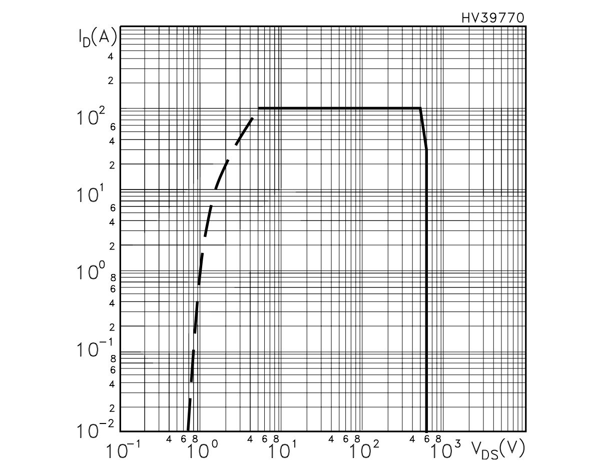


Figure 14. Forward voltage drop versus forward current

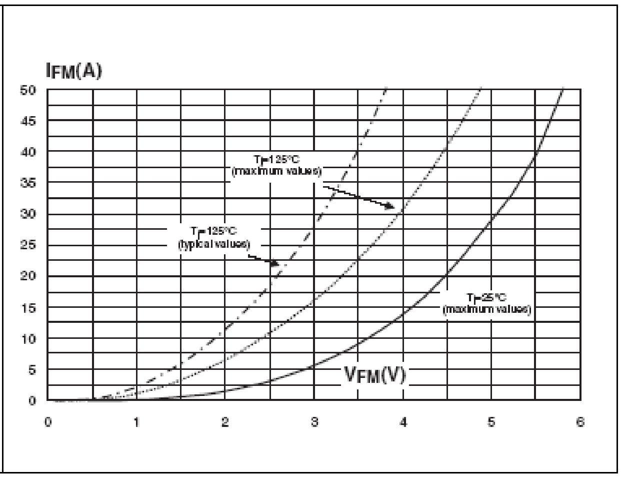


Figure 15. Thermal impedance

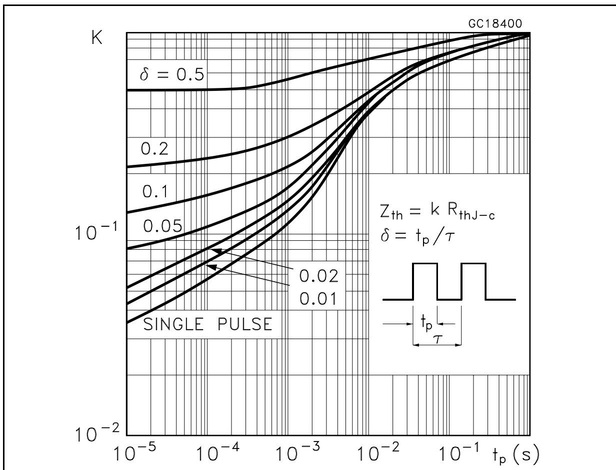
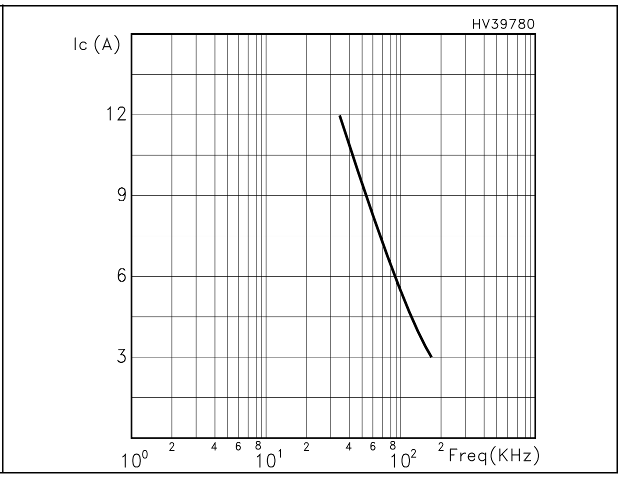


Figure 16. I_C vs. frequency



2.2 Frequency applications

For a fast IGBT suitable for high frequency applications, the typical collector current vs. maximum operating frequency curve is reported. That frequency is defined as follows:

$f_{MAX} = (P_D - P_C) / (E_{ON} + E_{OFF})$

- The maximum power dissipation is limited by maximum junction to case thermal resistance:

Equation 1

$P_D = \Delta T / R_{THJ-C}$

considering $\Delta T = T_J - T_C$ = 125 °C- 75 °C = 50°C

- The conduction losses are:

Equation 2

$P_C = I_C * V_{CE(SAT)} * \delta$

with 50% of duty cycle, V_{CESAT} typical value @125°C.

- Power dissipation during ON & OFF commutations is due to the switching frequency:

Equation 3

$P_{SW} = (E_{ON} + E_{OFF})$ * freq.

Typical values @ 125°C for switching losses are used (test conditions: V_{CE} = 480V, V_{GE}=15V, R_G = 10 Ohm). Furthermore, diode recovery energy is included in the E_{ON} (see *Note 1*), while the tail of the collector current is included in the E_{OFF} measurements.

3 Test circuit

Figure 17. Test circuit for inductive load switching

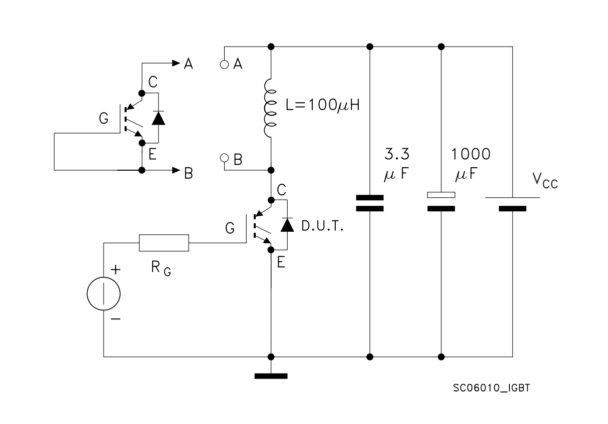


Figure 18. Gate charge test circuit

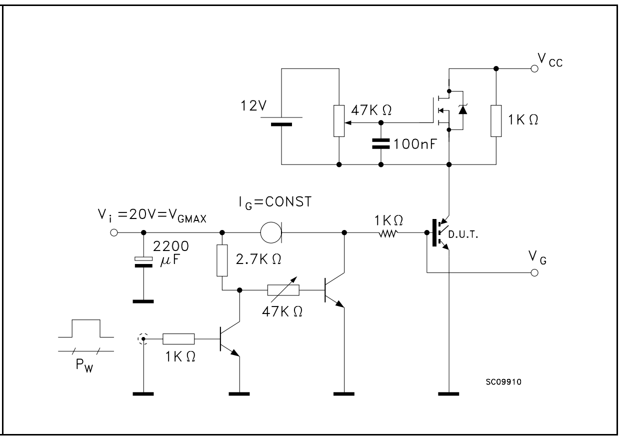


Figure 19. Switching waveform

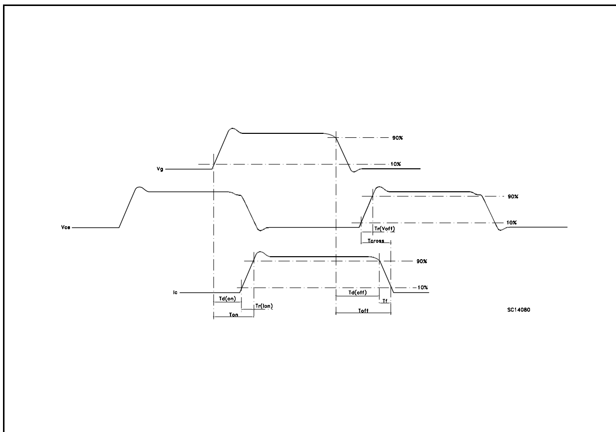
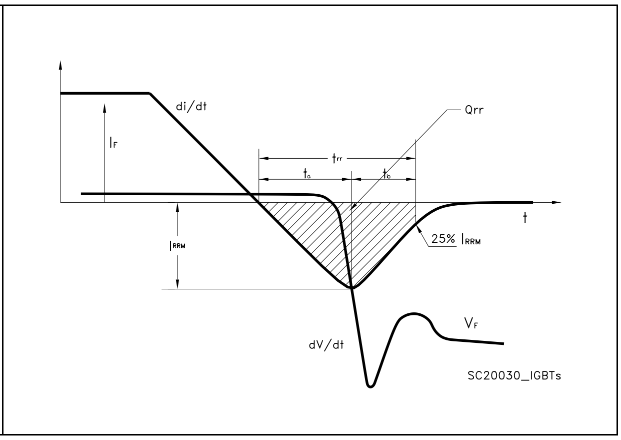


Figure 20. Diode recovery time waveform

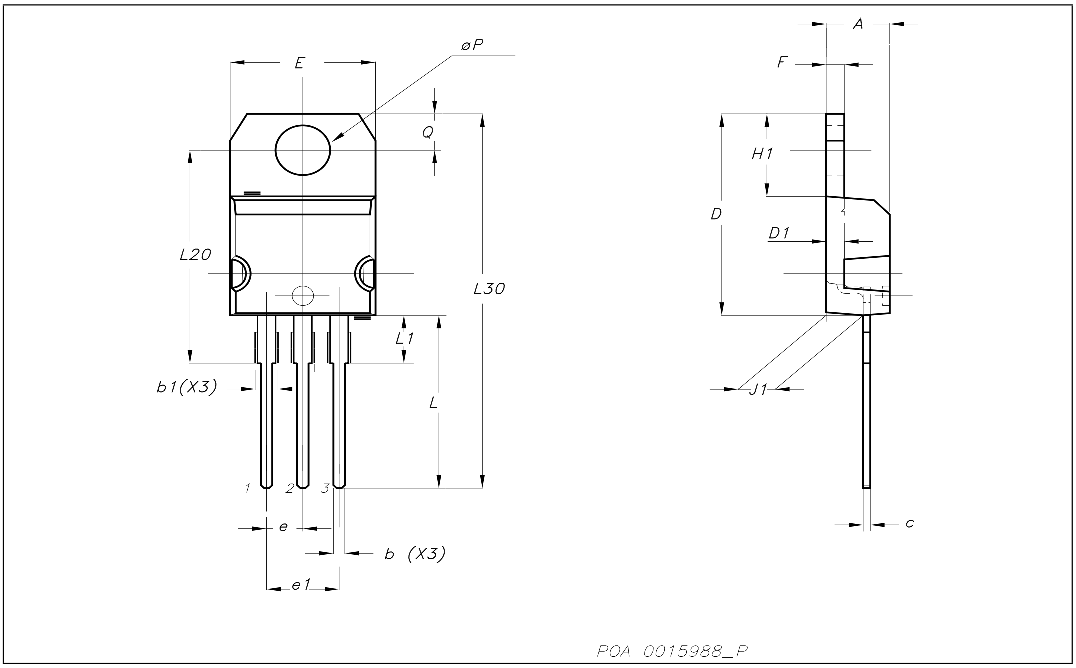


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: *www.st.com*

TO-220 mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.14		1.70	0.044		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.6		0.62
D1		1.27			0.050	
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.051
H1	6.20		6.60	0.244		0.256
J1	2.40		2.72	0.094		0.107
L	13		14	0.511		0.551
L1	3.50		3.93	0.137		0.154
L20		16.40			0.645	
L30		28.90			1.137	
∅P	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116



5 Revision history

Table 8. Document revision history

Date	Revision	Changes
02-Jul-2007	1	First release
13-Aug-2007	2	From target to preliminary version
18-Sep-2007	3	Added new section: *Electrical characteristics (curves)*

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