STGB19NC60S
STGP19NC60S

20 A, 600 V fast IGBT

Features

- Very low on-voltage drop ($V_{CE(sat)}$)
- Minimum power losses at 5 kHz in hard switching
- Optimized performance for medium operating frequencies.

Application

- Medium frequency motor drives

Description

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

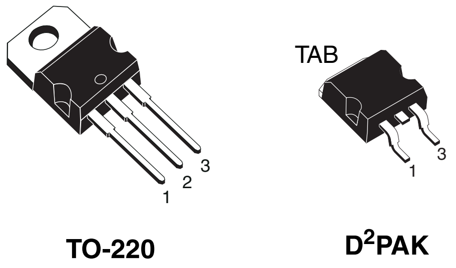

Figure 1. Internal schematic diagram

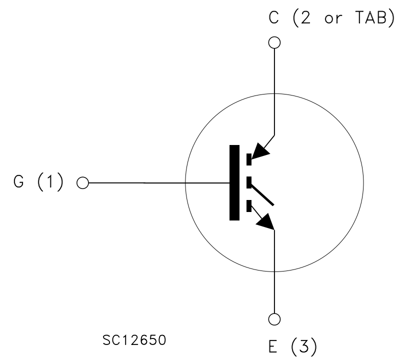

Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB19NC60ST4	GB19NC60S	D^2PAK	Tape and reel
STGP19NC60S	GP19NC60S	TO-220	Tube

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1 Electrical ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CES}	Collector-emitter voltage (V_{GE} = 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_{CL} (3)	Turn-off latching current	80	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

$$I_C(T_C) = \frac{T_{j(max)} - T_C}{R_{thj-c} \times V_{CE(sat)(max)}(T_{j(max)}, I_C(T_C))}$$

2. Pulse width limited by maximum junction temperature and turn-off within RBSOA
3. Vclamp = 80% of V_{CES}, T_j =150 °C, R_G=10 Ω, V_{GE}=15 V

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thj-c}	Thermal resistance junction-case	1	°C/W
R_{thj-a}	Thermal resistance junction-ambient	62.5	°C/W

2 Electrical characteristics

(T_j = 25°C unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage (V_{GE}= 0)	I_C= 1mA	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	V_{GE}= 15V, I_C= 12A V_{GE}= 15V, I_C=12A,T_j =125°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}= 600 V V_{CE}= 600 V, T_j =125°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 5. 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 6. 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 7. 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

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

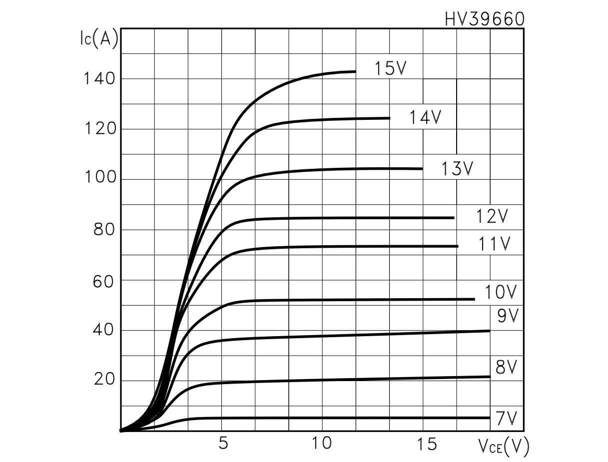


Figure 3. Transfer characteristics

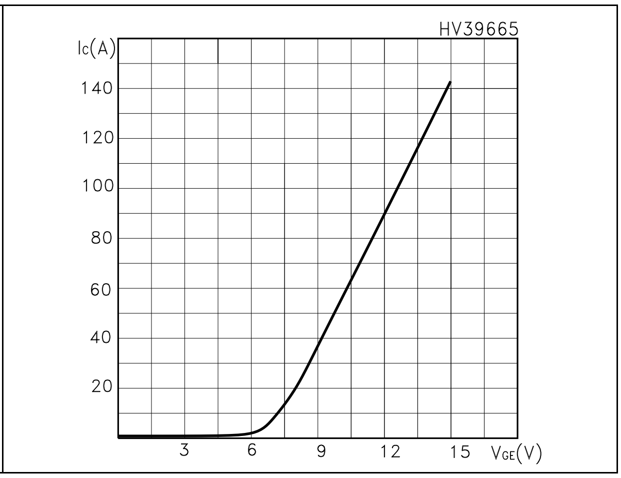


Figure 4. Transconductance

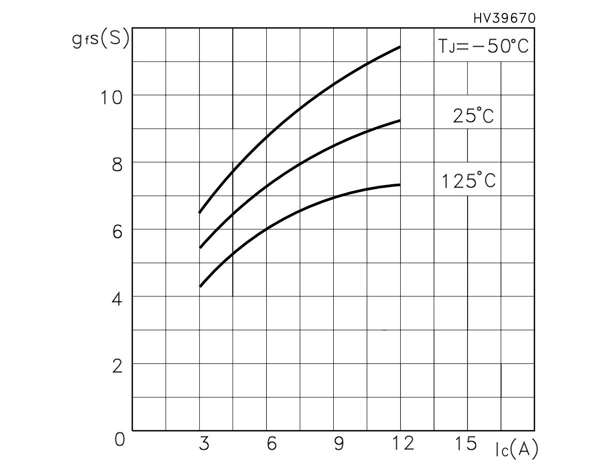


Figure 5. Collector-emitter on voltage vs temperature

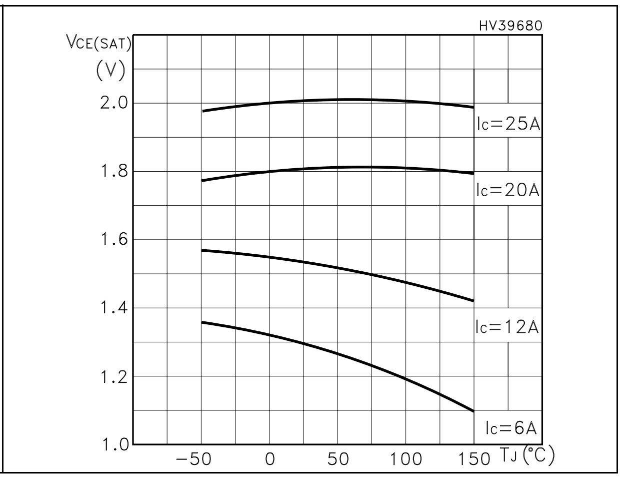


Figure 6. Gate charge vs gate-source voltage

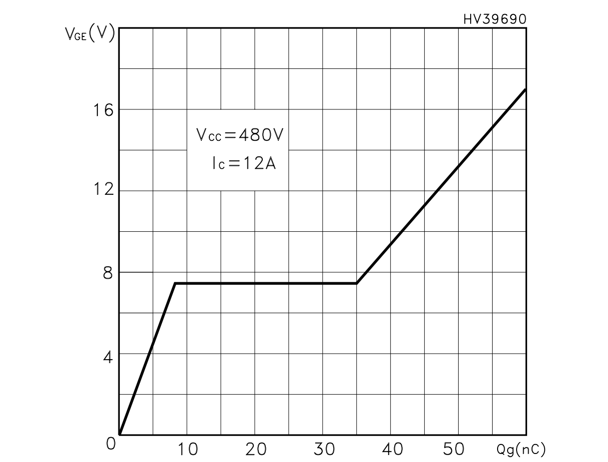


Figure 7. Capacitance variations

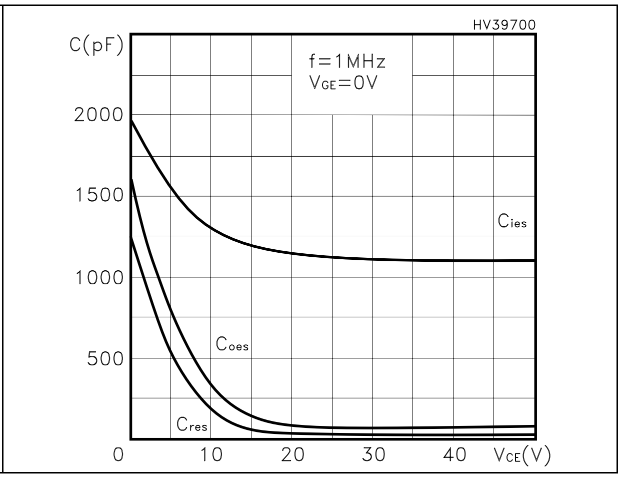


Figure 8. Normalized gate threshold voltage vs temperature

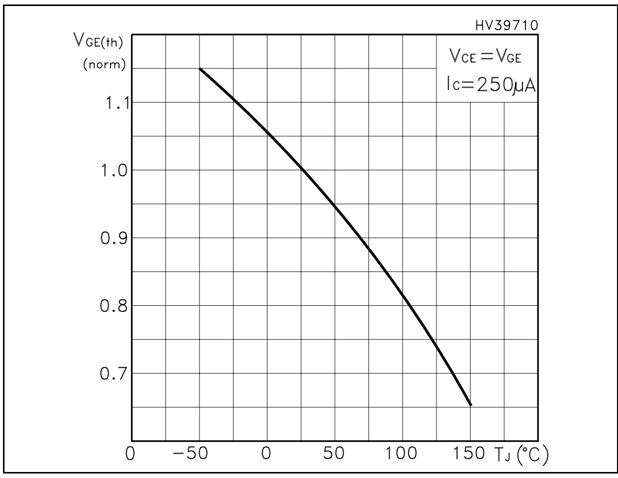


Figure 9. Collector-emitter on voltage vs collector current

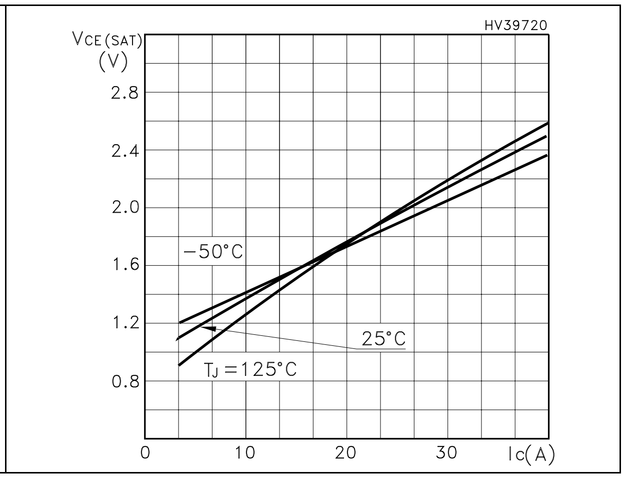


Figure 10. Normalized breakdown voltage vs temperature

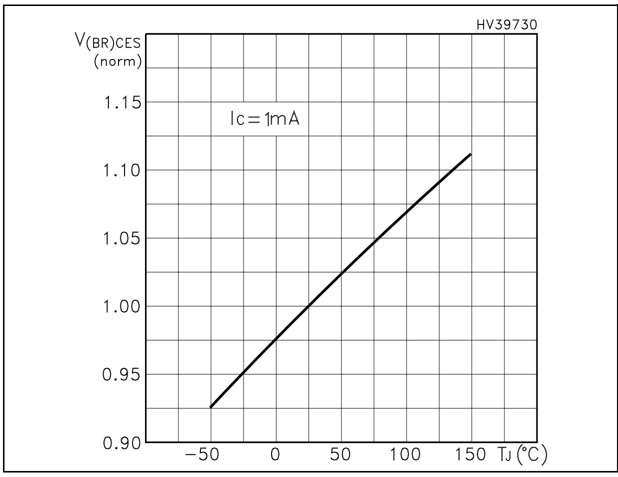


Figure 11. Switching losses vs temperature

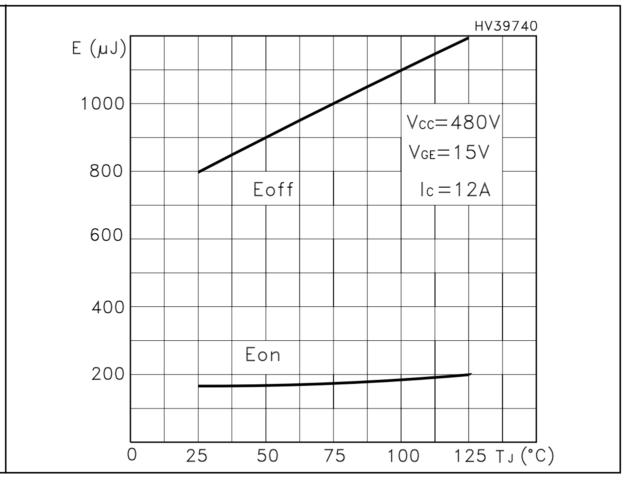


Figure 12. Switching losses vs gate resistance

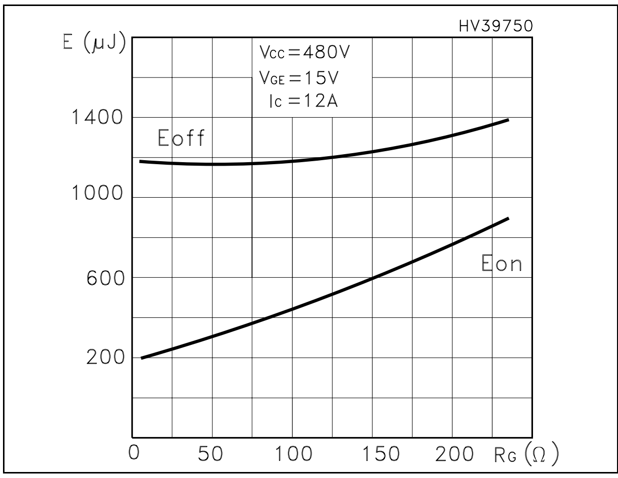


Figure 13. Switching losses vs collector current

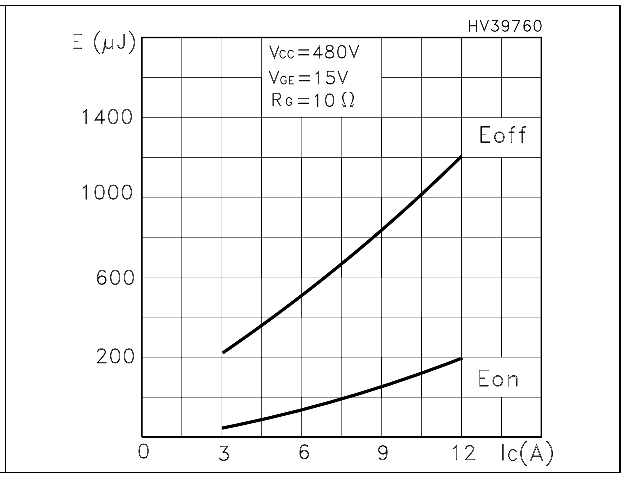


Figure 14. Turn-off SOA

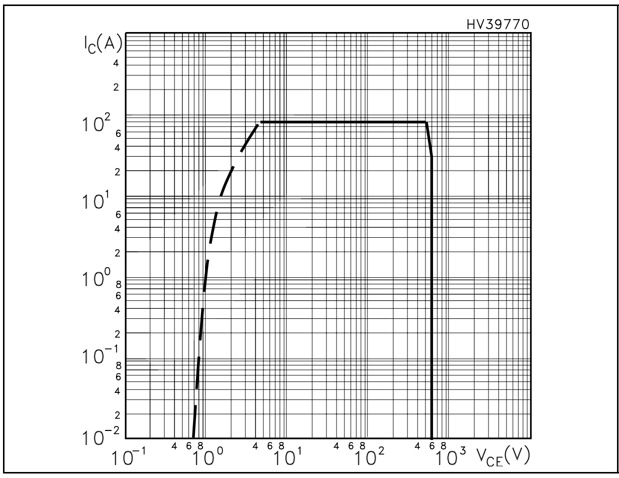


Figure 15. Thermal impedance

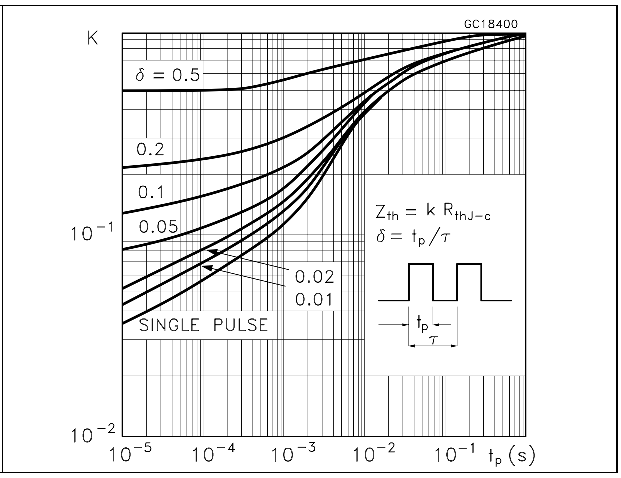
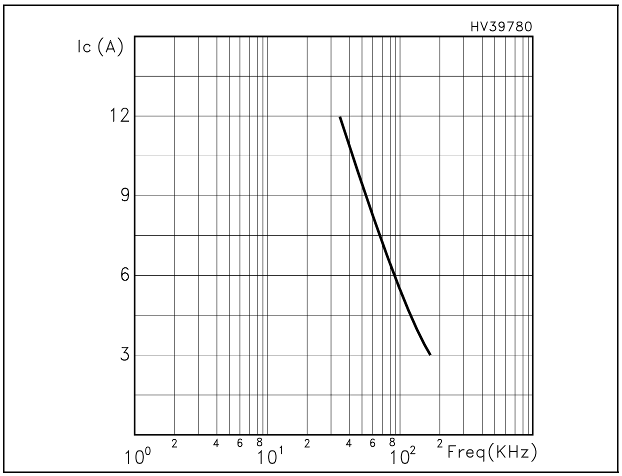


Figure 16. I_C vs. frequency



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

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

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 circuits

Figure 17. Test circuit for inductive load switching

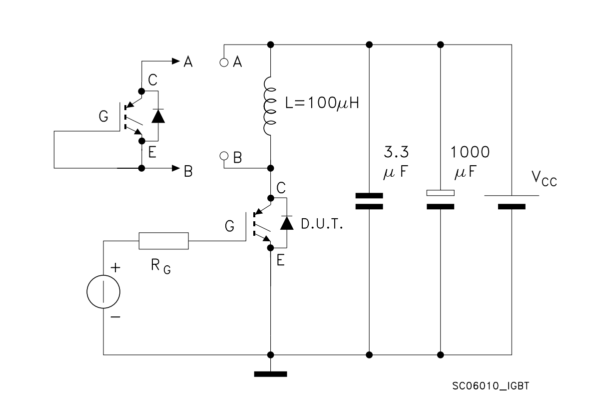


Figure 18. Gate charge test circuit

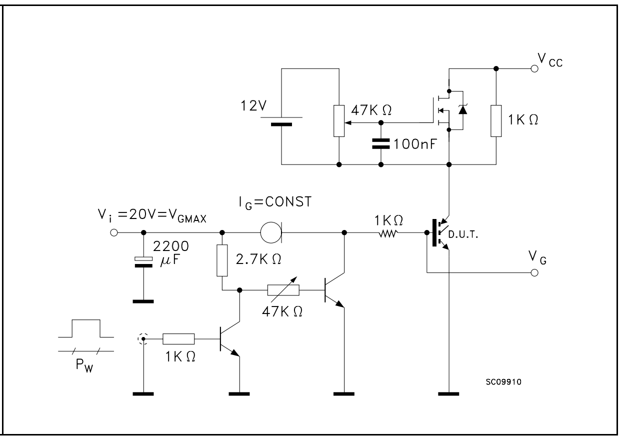
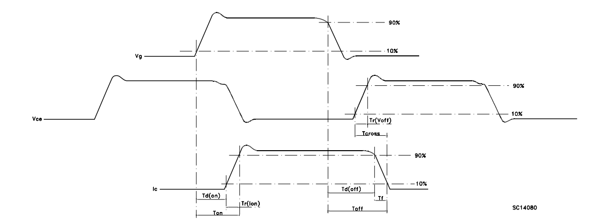


Figure 19. Switching waveform

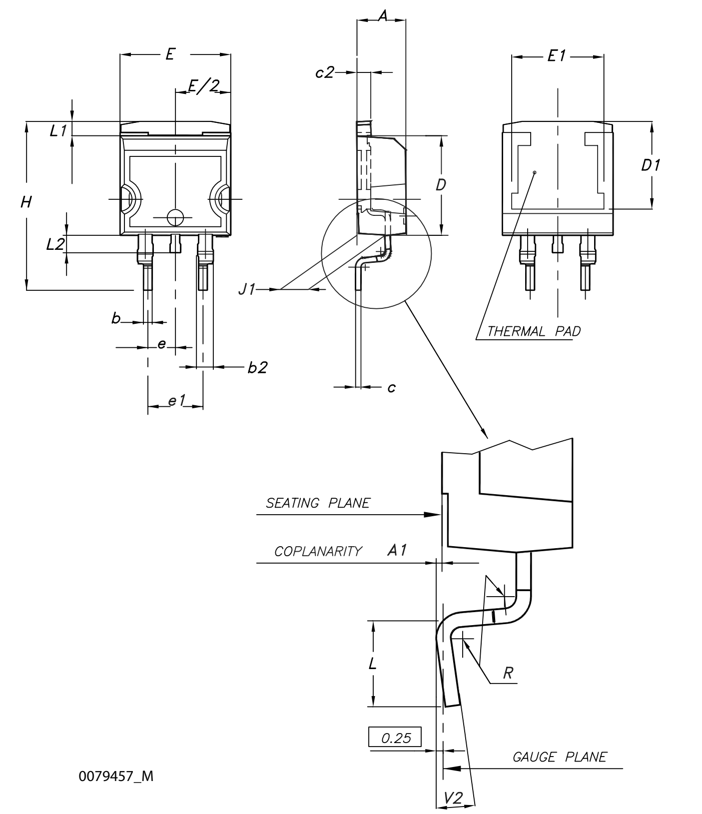


4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

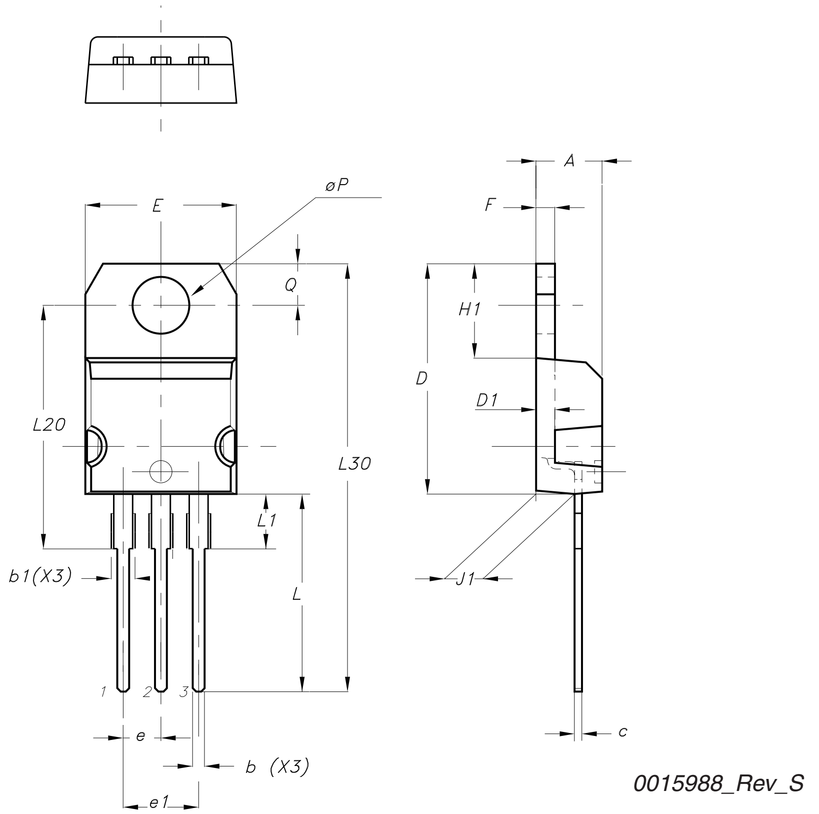
D^2PAK (TO-263) mechanical data

Dim	mm			inch		
	Min	Typ	Max	Min	Typ	Max
A	4.40		4.60	0.173		0.181
A1	0.03		0.23	0.001		0.009
b	0.70		0.93	0.027		0.037
b2	1.14		1.70	0.045		0.067
c	0.45		0.60	0.017		0.024
c2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1	7.50			0.295		
E	10		10.40	0.394		0.409
E1	8.50			0.334		
e		2.54			0.1	
e1	4.88		5.28	0.192		0.208
H	15		15.85	0.590		0.624
J1	2.49		2.69	0.099		0.106
L	2.29		2.79	0.090		0.110
L1	1.27		1.40	0.05		0.055
L2	1.30		1.75	0.051		0.069
R		0.4			0.016	
V2	0°		8°	0°		8°



TO-220 type A mechanical data

Dim	mm		
	Min	Typ	Max
A	4.40		4.60
b	0.61		0.88
b1	1.14		1.70
c	0.48		0.70
D	15.25		15.75
D1		1.27	
E	10		10.40
e	2.40		2.70
e1	4.95		5.15
F	1.23		1.32
H1	6.20		6.60
J1	2.40		2.72
L	13		14
L1	3.50		3.93
L20		16.40	
L30		28.90	
∅P	3.75		3.85
Q	2.65		2.95



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)*
18-Aug-2009	4	Inserted D^2PAK package