



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.

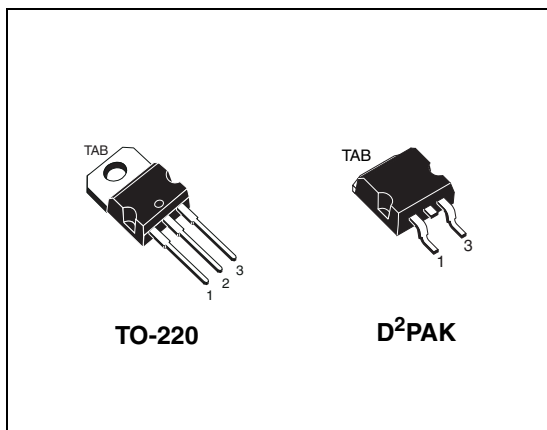


Figure 1. Internal schematic diagram

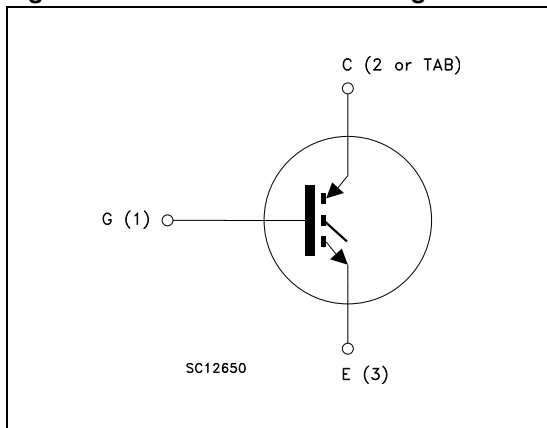


Table 1. Device summary

Order codes	Marking	Package	Packaging
STGB19NC60ST4	GB19NC60S	D²PAK	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
$I_C^{(1)}$	Continuous collector current at $T_C = 25^\circ\text{C}$	40	A
$I_C^{(1)}$	Continuous collector current at $T_C = 100^\circ\text{C}$	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 $T_C = 25^\circ\text{C}$	130	W
T_j	Operating junction temperature	- 55 to 150	$^\circ\text{C}$

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. $V_{clamp} = 80\%$ of V_{CES} , $T_j = 150^\circ\text{C}$, $R_G = 10\ \Omega$, $V_{GE} = 15\ \text{V}$

Table 3. Thermal data

Symbol	Parameter	Value	Unit
R_{thj-c}	Thermal resistance junction-case	0.96	$^\circ\text{C/W}$
R_{thj-a}	Thermal resistance junction-ambient	62.5	$^\circ\text{C/W}$

2 Electrical characteristics

($T_j = 25^\circ\text{C}$ unless otherwise specified)

Table 4. Static

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_{(BR)CES}$	Collector-emitter breakdown voltage ($V_{GE} = 0$)	$I_C = 1\text{ mA}$	600			V
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$ $V_{GE} = 15\text{ V}$, $I_C = 12\text{ A}$, $T_j = 125^\circ\text{C}$		1.55 1.35	1.9	V V
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$	4.2		6.2	V
I_{CES}	Collector cut-off current ($V_{GE} = 0$)	$V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}$, $T_j = 125^\circ\text{C}$			150 1	μA mA
I_{GES}	Gate-emitter leakage current ($V_{CE} = 0$)	$V_{GE} = \pm 20\text{ V}$, $V_{CE} = 0$			± 100	nA
g_{fs}	Forward transconductance	$V_{CE} = 15\text{ V}$, $I_C = 12\text{ A}$		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	$V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$	-	1190 135 28.5	-	pF pF pF
Q_g Q_{ge} Q_{gc}	Total gate charge Gate-emitter charge Gate-collector charge	$V_{CE} = 480\text{ V}$, $I_C = 12\text{ A}$, $V_{GE} = 15\text{ V}$, 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
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480V, I_C = 12A$		17.5		ns
t_r	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$	-	6.2	-	ns
$(di/dt)_{on}$	Turn-on current slope	Figure 19		1870		A/ μs
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 480V, I_C = 12A$		17		ns
t_r	Current rise time	$R_G = 10\Omega, V_{GE} = 15V,$	-	6.5	-	ns
$(di/dt)_{on}$	Turn-on current slope	$T_J = 125^\circ C$ Figure 19		1700		A/ μs
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 480V, I_C = 12A$		90		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\Omega, V_{GE} = 15V,$	-	175	-	ns
t_f	Current fall time	Figure 19		215		ns
$t_{r(Voff)}$	Off voltage rise time	$V_{CC} = 480V, I_C = 12A$		155		ns
$t_{d(Voff)}$	Turn-off delay time	$R_G = 10\Omega, V_{GE} = 15V,$	-	245	-	ns
t_f	Current fall time	$T_J = 125^\circ C$ Figure 19		290		ns

Table 7. Switching energy (inductive load)

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

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

2.1 Electrical characteristics (curves)

Figure 2. Output characteristics

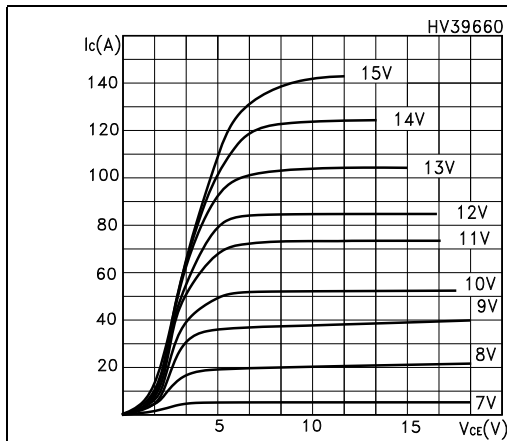


Figure 3. Transfer characteristics

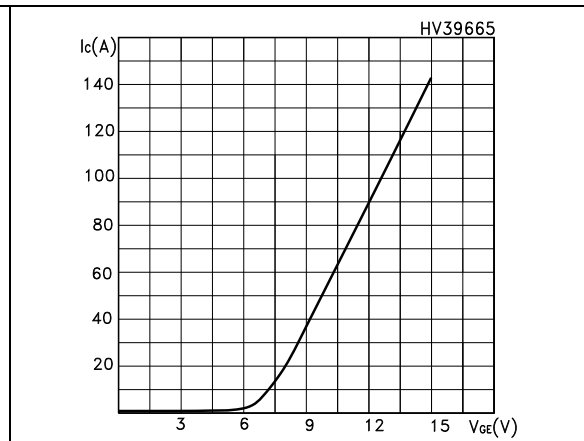


Figure 4. Transconductance

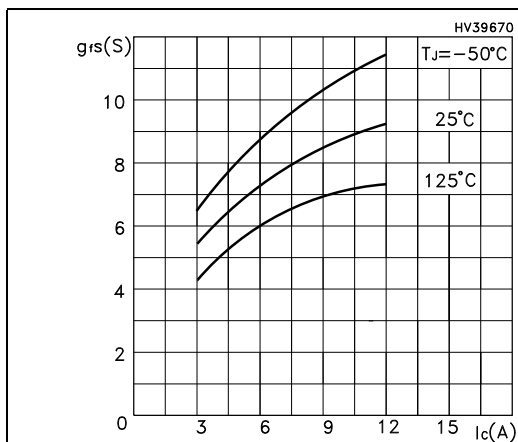


Figure 5. Collector-emitter on voltage vs temperature

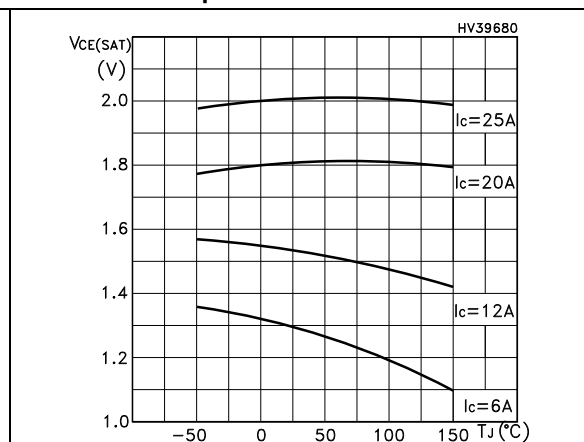


Figure 6. Gate charge vs gate-source voltage

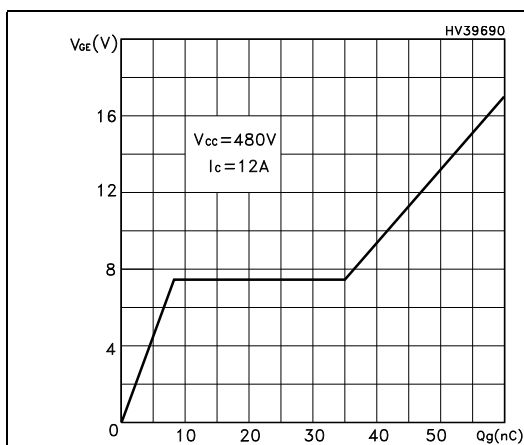


Figure 7. Capacitance variations

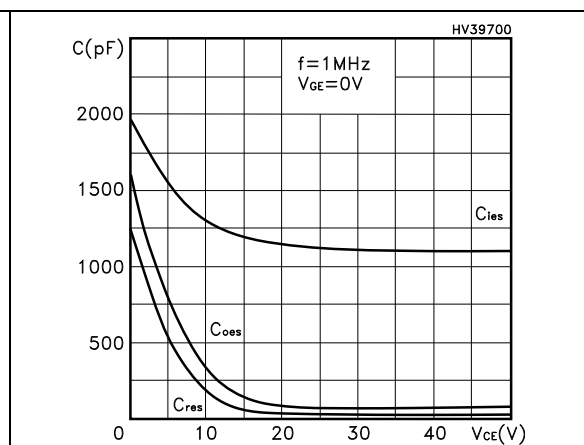


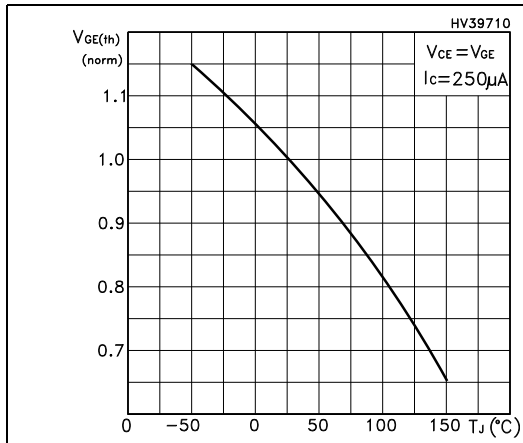
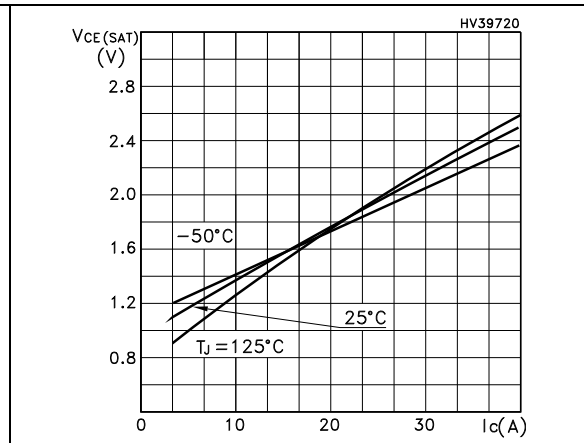
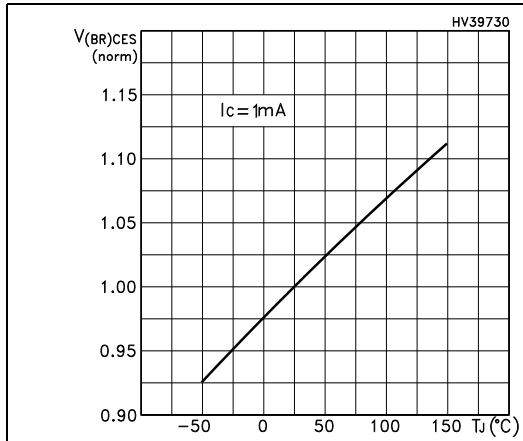
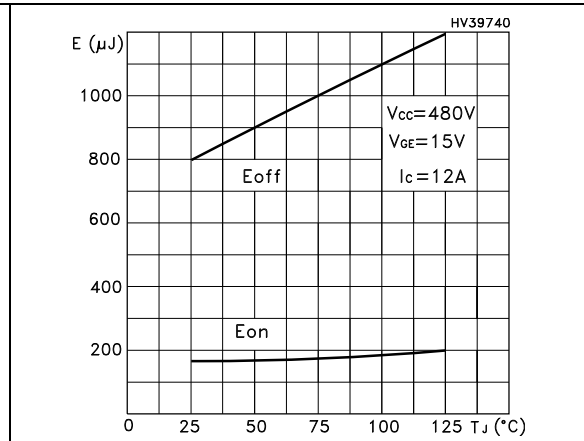
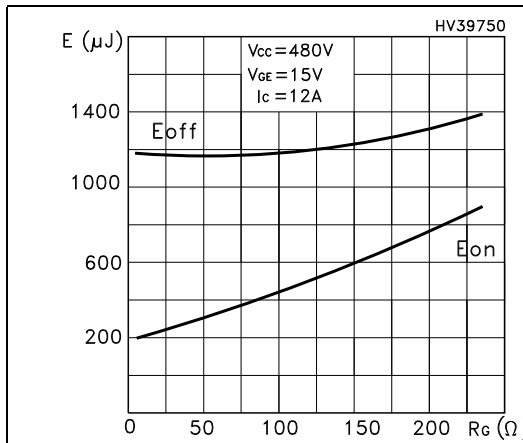
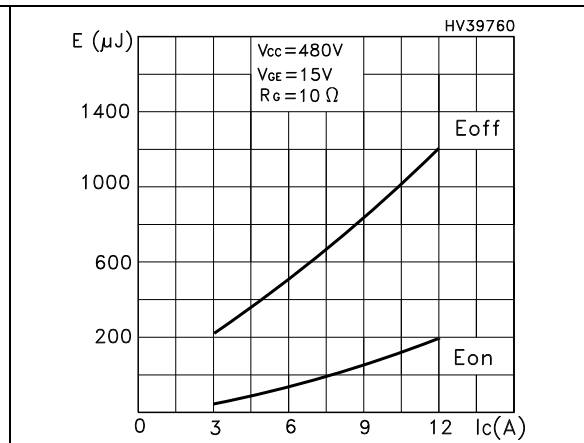
Figure 8. Normalized gate threshold voltage vs temperature**Figure 9. Collector-emitter on voltage vs collector current****Figure 10. Normalized breakdown voltage vs temperature****Figure 11. Switching losses vs temperature****Figure 12. Switching losses vs gate resistance****Figure 13. Switching losses vs collector current**

Figure 14. Turn-off SOA

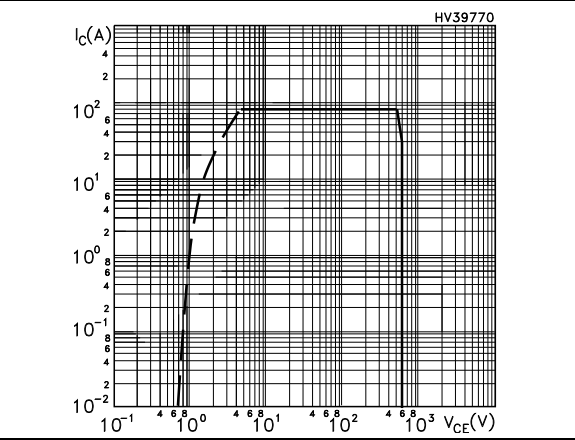


Figure 15. Thermal impedance

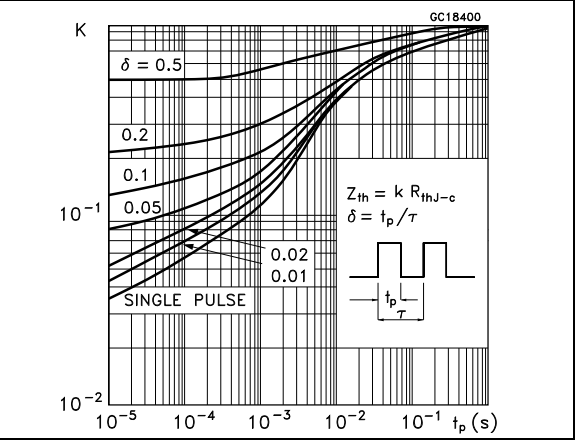
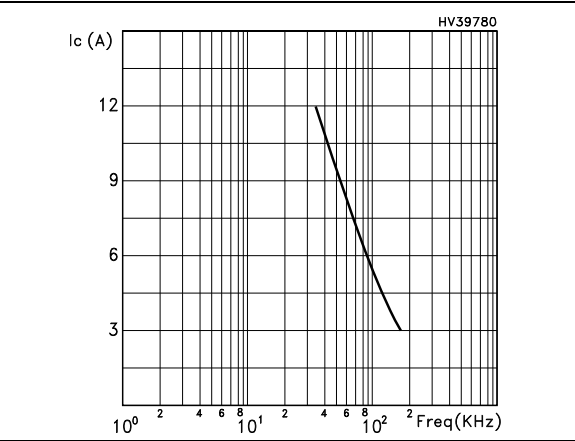


Figure 16. I_C vs. frequency



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:

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

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

Equation 1

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

considering $\Delta T = T_J - T_C = 125^\circ\text{C} - 75^\circ\text{C} = 50^\circ\text{C}$

- The conduction losses are:

Equation 2

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

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

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

Typical values @ 125°C for switching losses are used (test conditions: $V_{\text{CE}} = 480\text{V}$, $V_{\text{GE}} = 15\text{V}$, $R_G = 10\ \Omega$). 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

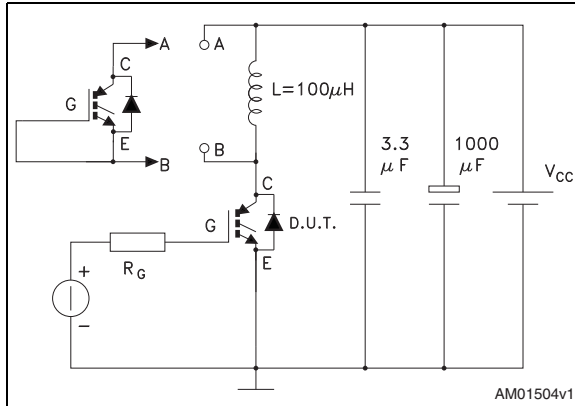


Figure 18. Gate charge test circuit

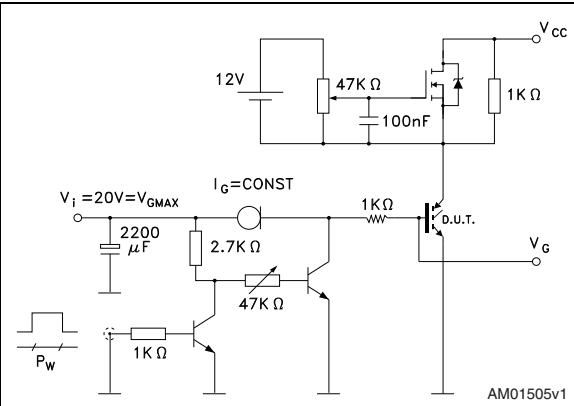
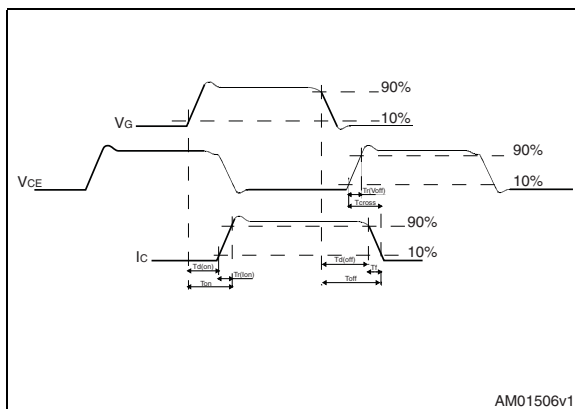


Figure 19. Switching waveform

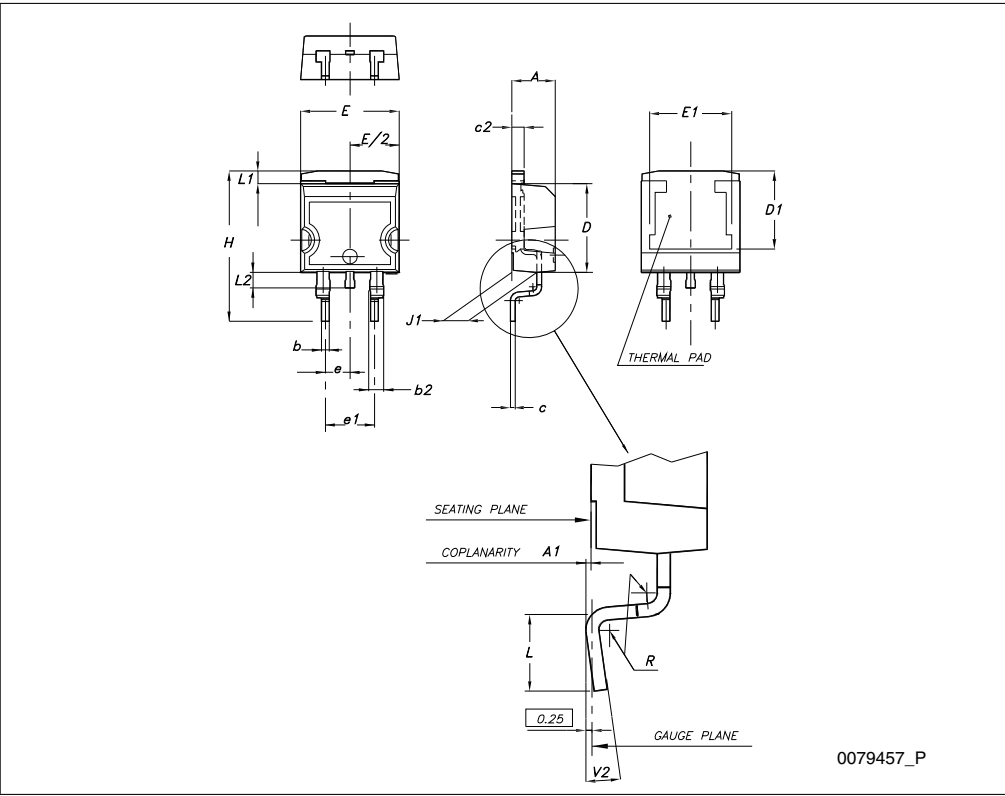


4 Package mechanical data

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.

D²PAK (TO-263) mechanical data

Dim.	mm.		
	Min.	Typ.	Max.
A	4.40		4.60
A1	0.03		0.23
b	0.70		0.93
b2	1.14		1.70
c	0.45		0.60
c2	1.23		1.36
D	8.95		9.35
D1	7.50		
E	10		10.40
E1	8.50		
e		2.54	
e1	4.88		5.28
H	15		15.85
J1	2.49		2.69
L	2.29		2.79
L1	1.27		1.40
L2	1.30		1.75
R		0.4	
V2	0°		8°

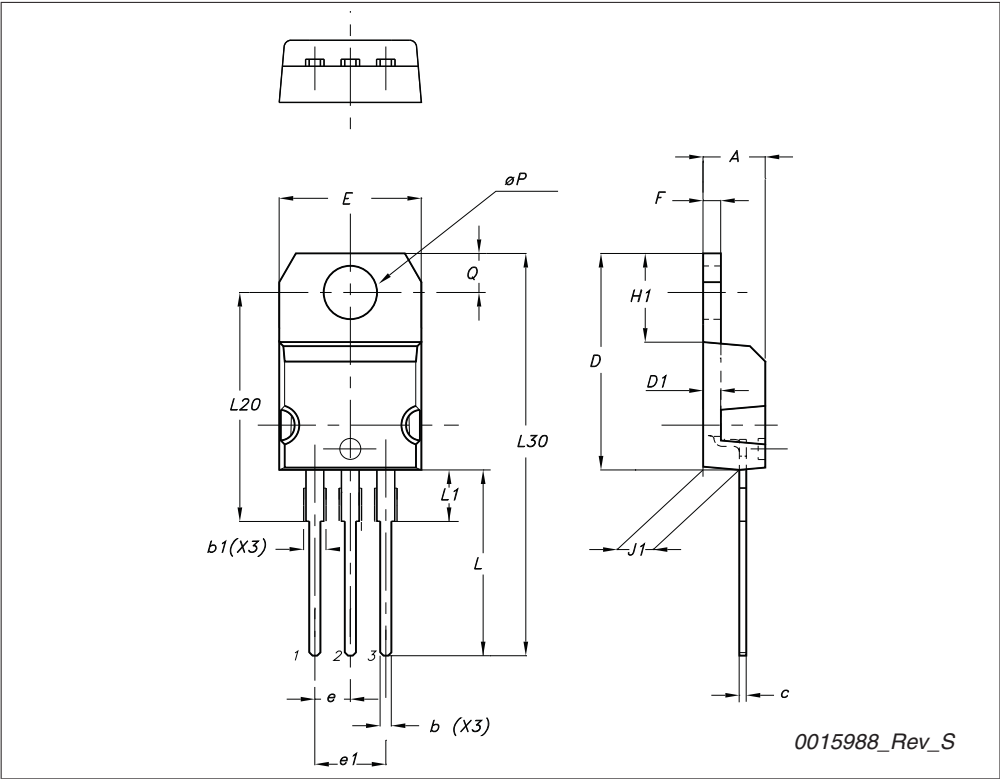


0079457_P



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	
ØP	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 ² PAK package
08-Nov-2010	5	Modified gate threshold voltage range on Table 4: Static

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