



# STGD5NB120SZ-1 STGD5NB120SZ

## N-CHANNEL 5A - 1200V DPAK/IPAK INTERNALLY CLAMPED PowerMESH™ IGBT

**Table 1: General Features**

TYPE	V <sub>CES</sub>	V <sub>CE(sat)</sub>	I <sub>C</sub>
STGD5NB120SZ	1200 V	< 2.0 V	5 A
STGD5NB120SZ-1	1200 V	< 2.0 V	5 A

- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW ON-VOLTAGE DROP (V<sub>cesat</sub>)
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- HIGH VOLTAGE CLAMPING FEATURES

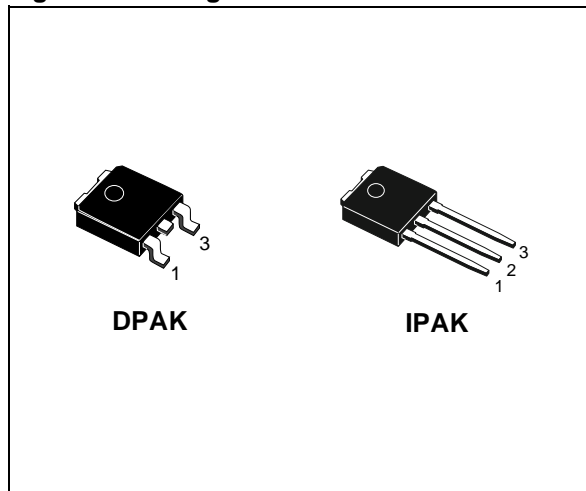
### DESCRIPTION

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "S" identifies a family optimized achieve minimum on-voltage drop for low frequency applications (<1kHz). The built in collector-gate zener exhibits a very precise active clamping.

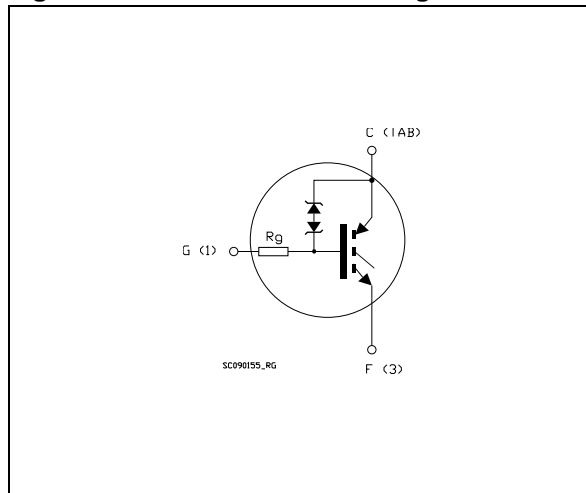
### APPLICATIONS

- LIGHT DIMMER
- INRUSH CURRENT LIMITATION
- PRE-HEATING FOR ELECTRONIC LAMP BALLAST

**Figure 1: Package**



**Figure 2: Internal Schematic Diagram**



**Table 2: Order Code**

PART NUMBER	MARKING	PACKAGE	PACKAGING
STGD5NB120SZT4	GD5NB120SZ	DPAK	TAPE & REEL
STGD5NB120SZ-1	GD5NB120SZ	IPAK	TUBE

**Table 3: Absolute Maximum ratings**

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-Emitter Voltage ( $V_{GS} = 0$ )	1200	V
$V_{ECR}$	Emitter-Collector Voltage	20	V
$V_{GE}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current (continuous) at $T_C = 25^\circ\text{C}$	10	A
$I_C$	Collector Current (continuous) at $T_C = 100^\circ\text{C}$	5	A
$I_{CM}$ (■)	Collector Current (pulsed)	20	A
$P_{TOT}$	Total Dissipation at $T_C = 25^\circ\text{C}$	55	W
	Derating Factor	0.44	W/°C
Eas (1)	Single Pulse Avalanche Energy at $T_j = 25^\circ\text{C}$	10	mJ
	Single Pulse Avalanche Energy at $T_j = 100^\circ\text{C}$	7	mJ
$T_{stg}$	Storage Temperature	-55 to 150	°C
$T_j$	Operating Junction Temperature range	150	°C

(■) Pulse width limited by safe operating area

(1)  $V_{CE} = 50\text{ V}$ ,  $I_{AV} = 3.3\text{ A}$

**Table 4: Thermal Data**

		Min.	Typ.	Max.	
Rthj-case	Thermal Resistance Junction-case			2.27	°C/W
Rthj-amb	Thermal Resistance Junction-ambient			100	°C/W

**ELECTRICAL CHARACTERISTICS ( $T_{CASE} = 25^\circ\text{C}$  UNLESS OTHERWISE SPECIFIED)**
**Table 5: On/Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	$I_C = 10\text{ mA}$ , $V_{GE} = 0\text{ V}$	1200			V
$I_{CES}$	Collector cut-off Current ( $V_{GE} = 0$ )	$V_{CE} = 900\text{ V}$ $V_{CE} = 900\text{ V}$ , $T_j = 125^\circ\text{C}$			50 250	$\mu\text{A}$ $\mu\text{A}$
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{ V}$ , $V_{CE} = 0\text{ V}$			$\pm 100$	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{CE} = V_{GE}$ , $I_C = 250\text{ }\mu\text{A}$	2		5	V
$V_{GE}$	Gate Emitter Voltage	$V_{CE} = 2.5\text{ V}$ , $I_C = 2\text{ A}$ , $T_j = 25\div 125^\circ\text{C}$			6.5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{ V}$ , $I_C = 5\text{ A}$		1.3	2.0	V
		$V_{GE} = 15\text{ V}$ , $I_C = 5\text{ A}$ , $T_j = 125^\circ\text{C}$		1.2		V

## ELECTRICAL CHARACTERISTICS (CONTINUED)

Table 6: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$	Forward Transconductance	$V_{CE} = 25\text{ V}$ , $I_C = 5\text{ A}$		5		S
$C_{ies}^{(*)}$	Input Capacitance	$V_{CE} = 25\text{ V}$ , $f = 1\text{ MHz}$ , $V_{GE} = 0\text{ V}$		430		pF
$C_{oes}^{(*)}$	Output Capacitance			40		pF
$C_{res}^{(*)}$	Reverse Transfer Capacitance			7		pF
$R_g$	Gate Resistance			4		K $\Omega$

(1) Pulsed: Pulse duration= 300  $\mu\text{s}$ , duty cycle 1.5%

Table 7: Switching On

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Delay Time	$I_C = 5\text{ A}$ , $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$ , $R_{drive} = 1\text{ K}\Omega$ $T_j = 25^\circ\text{C}$		690		ns
$t_r$	Current Rise Time			170		ns
$(di/dt)_{on}$	Turn-on Current Slope			39.6		A/ $\mu\text{s}$
$t_{d(on)}$	Dealy Time	$I_{CC} = 5\text{ A}$ , $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$ , $R_{drive} = 1\text{ K}\Omega$ $T_j = 125^\circ\text{C}$		600		ns
$t_r$	Current Rise Time			185		ns
$(di/dt)_{on}$	Turn-on Current Slope			39		A/ $\mu\text{s}$

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_c$	Cross-over Time	$I_C = 5\text{ A}$ , $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$ , $R_{drive} = 1\text{ K}\Omega$ $T_j = 25^\circ\text{C}$		4		$\mu\text{s}$
$t_r(V_{off})$	Off Voltage Rise Time			2.2		$\mu\text{s}$
$t_{d(off)}$	Delay Time			12.1		$\mu\text{s}$
$t_f$	Current Fall Time			1.13		$\mu\text{s}$
$t_c$	Cross-over Time	$I_C = 5\text{ A}$ , $V_{CC} = 960\text{ V}$ $V_{GE} = 15\text{ V}$ , $R_{drive} = 1\text{ K}\Omega$ $T_j = 125^\circ\text{C}$		5		$\mu\text{s}$
$t_r(V_{off})$	Off Voltage Rise Time			2.2		$\mu\text{s}$
$t_{d(off)}$	Delay Time			12.1		$\mu\text{s}$
$t_f$	Current Fall Time			2		$\mu\text{s}$

Table 9: Switching Energy

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
$E_{on(2)}$	Turn-on Switching Losses	$V_{CC} = 800\text{ V}$ , $I_C = 3\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_j = 25^\circ\text{C}$ (see Figure 18)		2.59		mJ
$E_{off(3)}$	Turn-off Switching Loss			9		mJ
$E_{ts}$	Total Switching Loss			11.59		mJ
$E_{on(2)}$	Turn-on Switching Losses	$V_{CC} = 800\text{ V}$ , $I_C = 3\text{ A}$ $R_G = 10\ \Omega$ , $V_{GE} = 15\text{ V}$ , $T_j = 125^\circ\text{C}$ (see Figure 18)		2.64		mJ
$E_{off(3)}$	Turn-off Switching Loss			10.2		mJ
$E_{ts}$	Total Switching Loss			12.68		mJ

(2)  $E_{on}$  is the turn-on losses when a typical diode is used in the test circuit in figure 2.

(3) Turn-off losses include also the tail of the collector current.

**Table 10: Functional Test**

<b>Symbol</b>	<b>Parameter</b>	<b>Test Conditions</b>	<b>Min.</b>	<b>Typ.</b>	<b>Max</b>	<b>Unit</b>
I <sub>as</sub>	Unclamped inductive switching current	V <sub>CC</sub> = 50 V, L = 1.8 mH T <sub>start</sub> = 25°C, R <sub>drive</sub> = 1KΩ	3.3			A
I <sub>CL</sub>	Latching Current	V <sub>CLAMP</sub> = 960 V, T <sub>j</sub> = 125°C R <sub>drive</sub> = 1KΩ		10		A

Figure 3: Output Characteristics

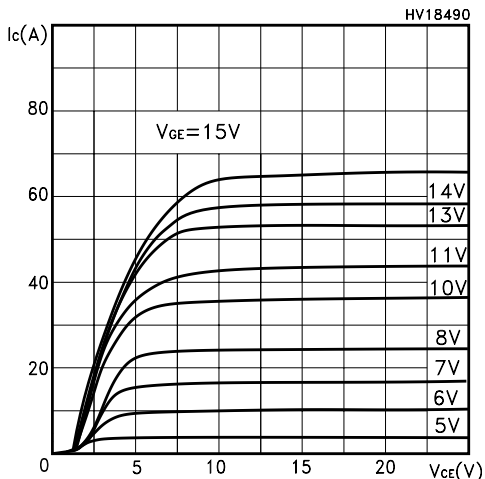


Figure 4: Transconductance

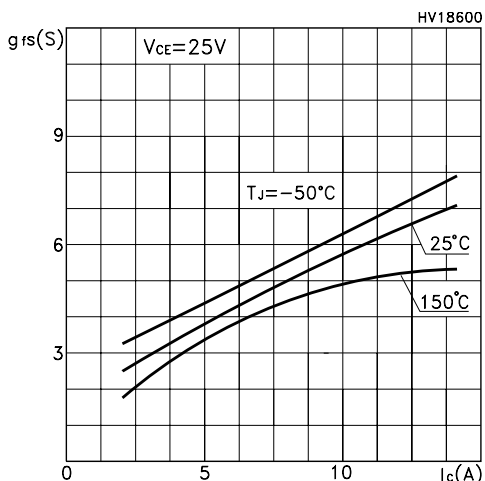


Figure 5: Collector-Emitter On Voltage vs Collector Current

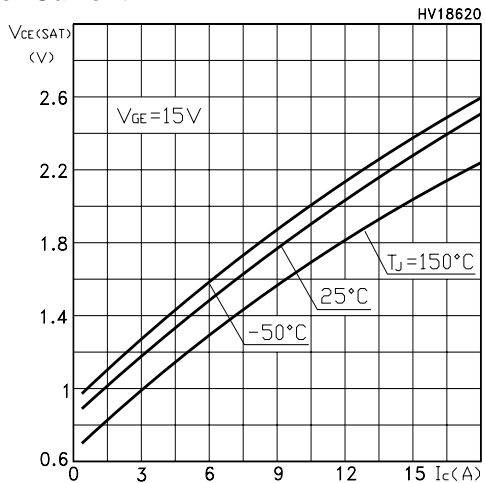


Figure 6: Transfer Characteristics

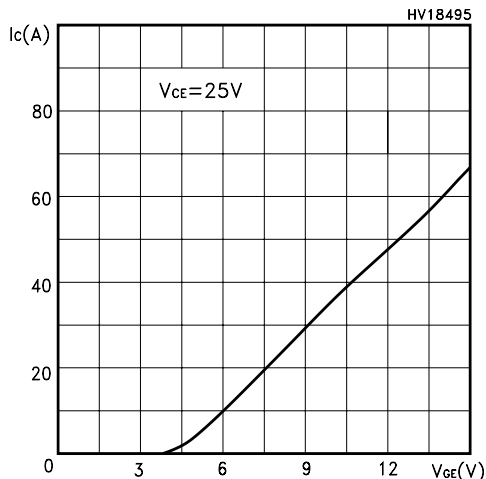


Figure 7: Collector-Emitter On Voltage vs Temperature

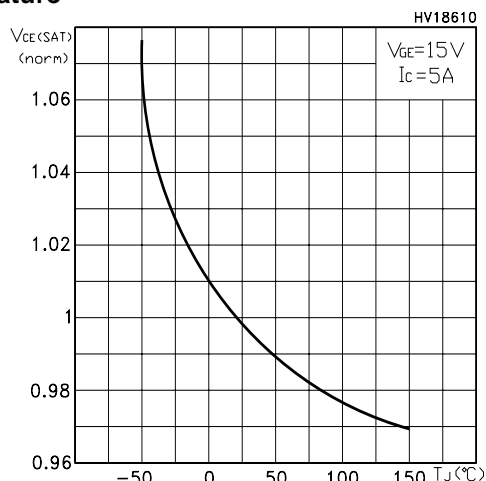


Figure 8: Normalized Gate Threshold vs Temperature

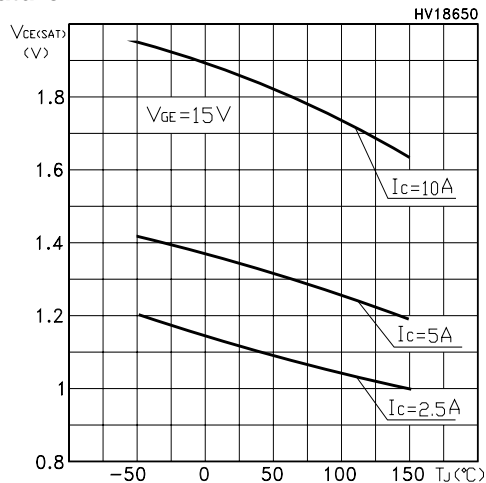


Figure 9: Gate Threshold vs Temperature

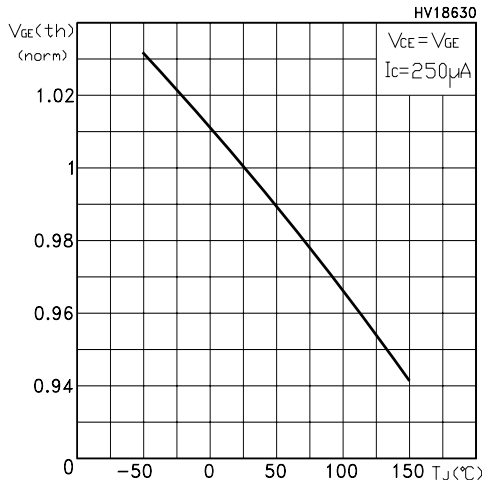


Figure 10: Capacitance Variations

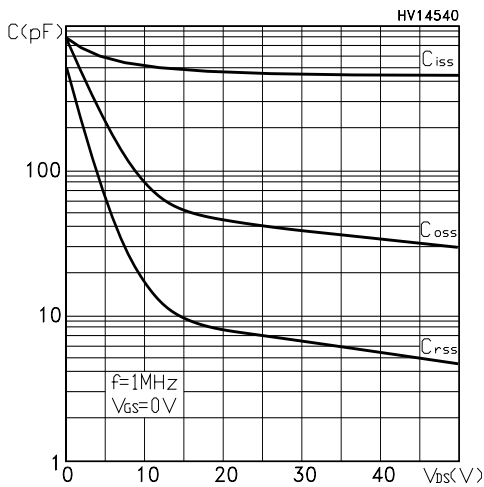


Figure 11: Switching Losses vs Gate Resistance

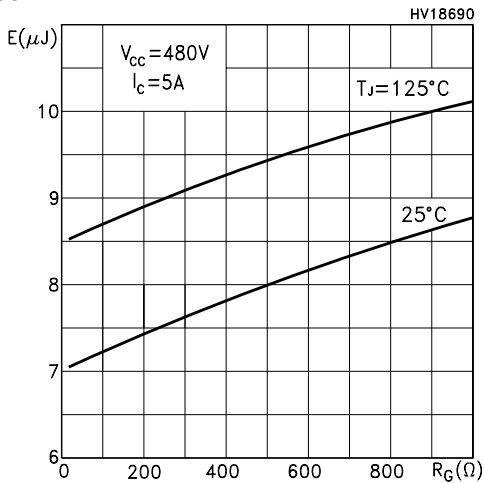


Figure 12: Breakdown Voltage vs Temperature

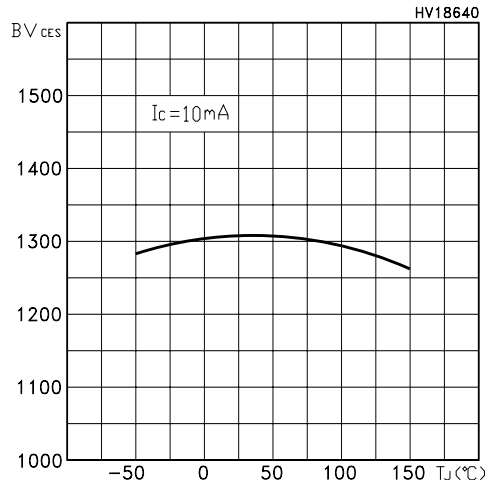


Figure 13: Gate-Charge vs Gate-Emitter Voltage

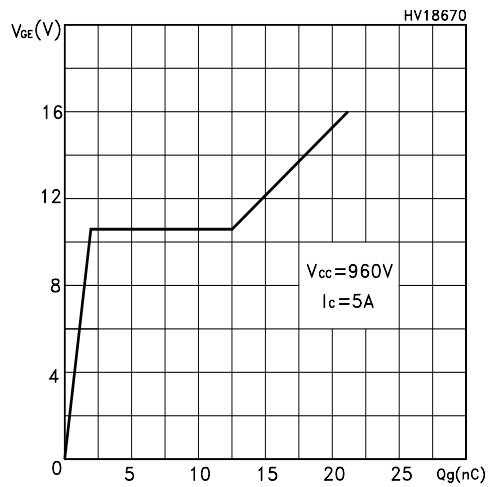


Figure 14: Switching Losses vs Collector Current

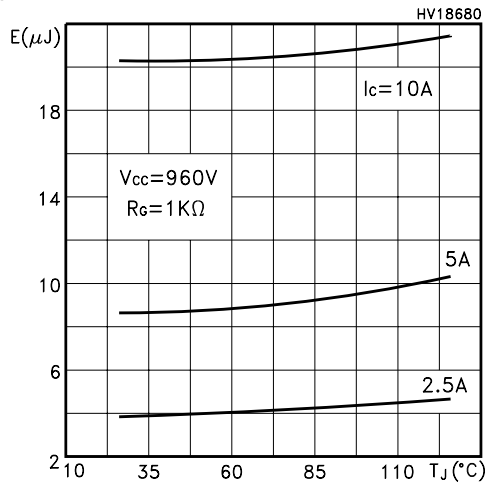


Figure 15: Thermal Impedance

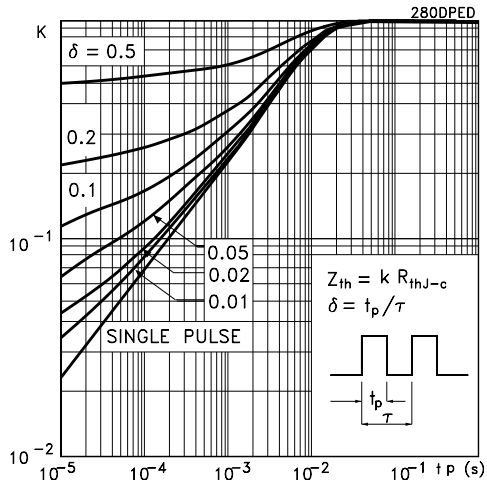


Figure 16: Turn-Off SOA

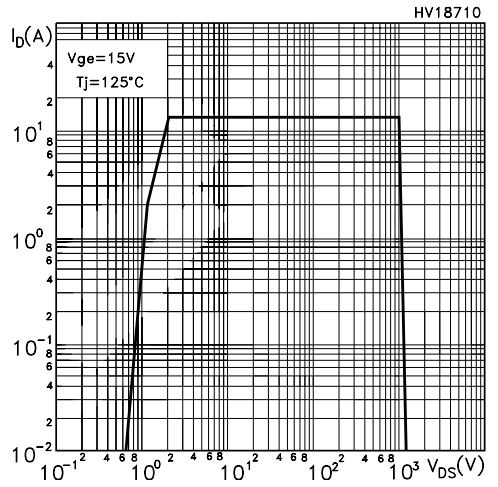


Figure 17: Test Circuit for Inductive Load Switching

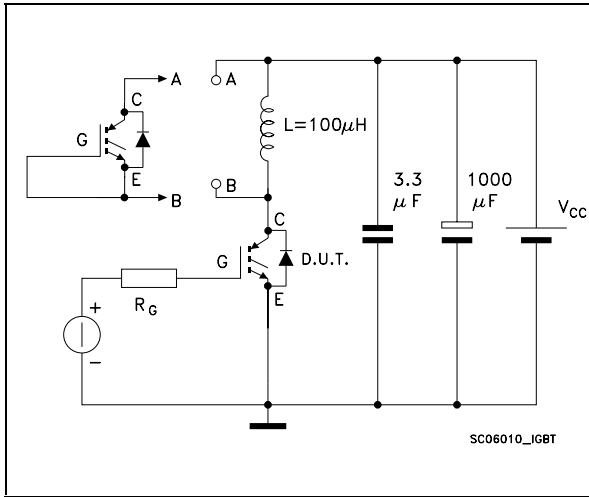


Figure 18: Switching Waveforms

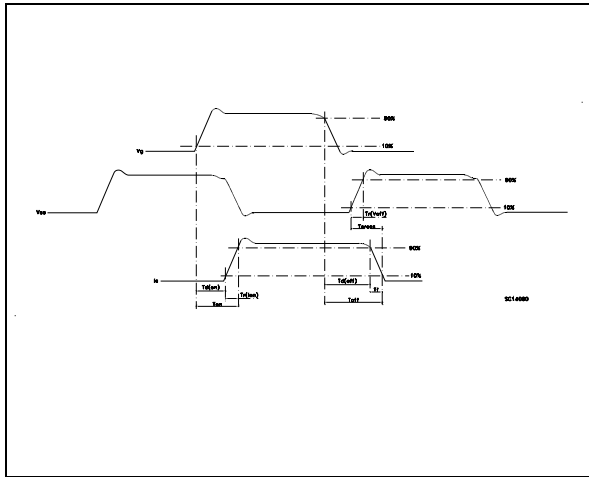


Figure 19: Gate Charge Test Circuit

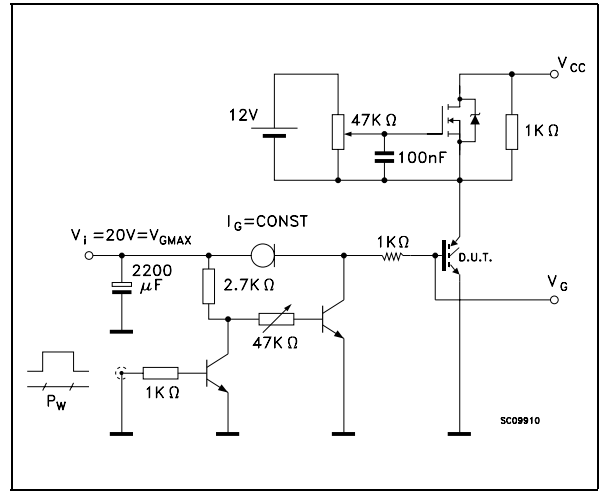
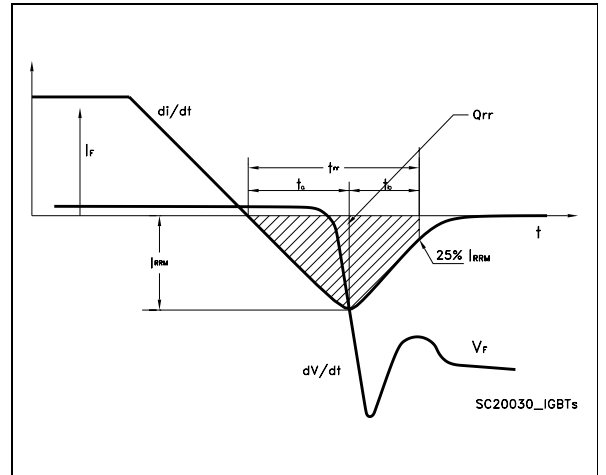


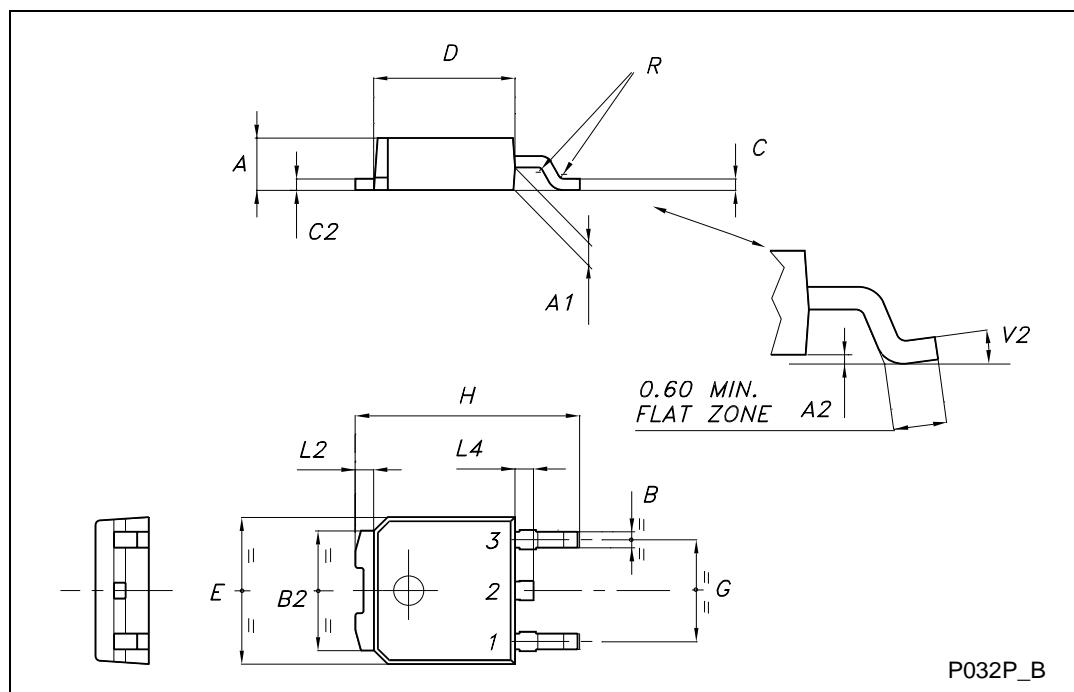
Figure 20: Diode Recovery Time Waveforms





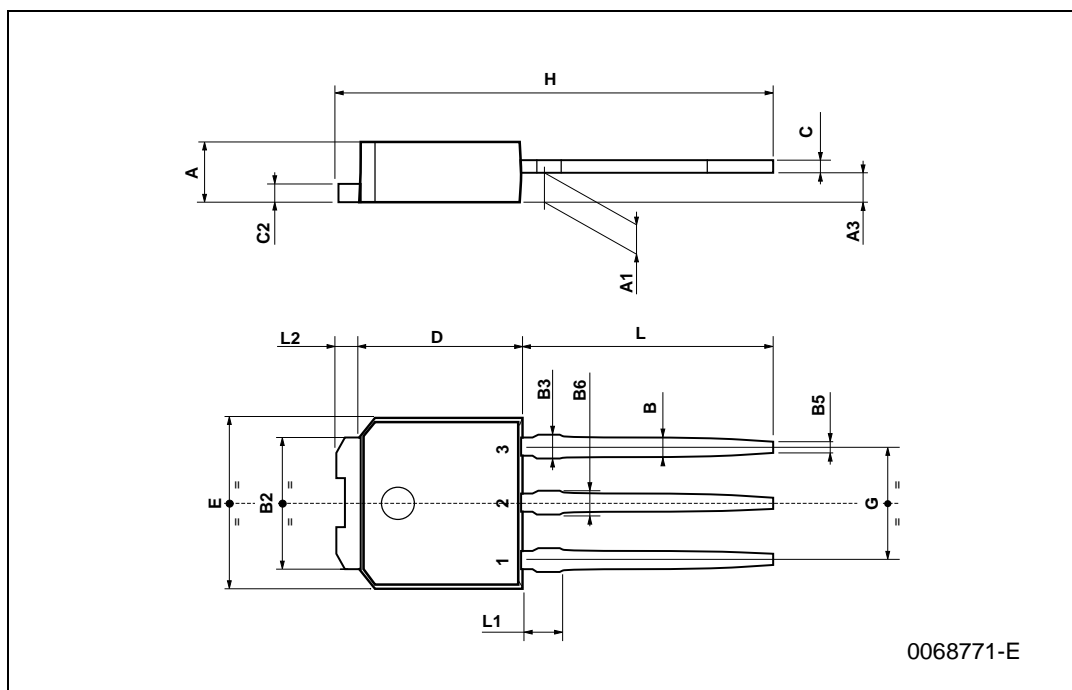
## TO-252 (DPAK) MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.20		2.40	0.087		0.094
A1	0.90		1.10	0.035		0.043
A2	0.03		0.23	0.001		0.009
B	0.64		0.90	0.025		0.035
B2	5.20		5.40	0.204		0.213
C	0.45		0.60	0.018		0.024
C2	0.48		0.60	0.019		0.024
D	6.00		6.20	0.236		0.244
E	6.40		6.60	0.252		0.260
G	4.40		4.60	0.173		0.181
H	9.35		10.10	0.368		0.398
L2		0.8			0.031	
L4	0.60		1.00	0.024		0.039
V2	0°		8°	0°		0°

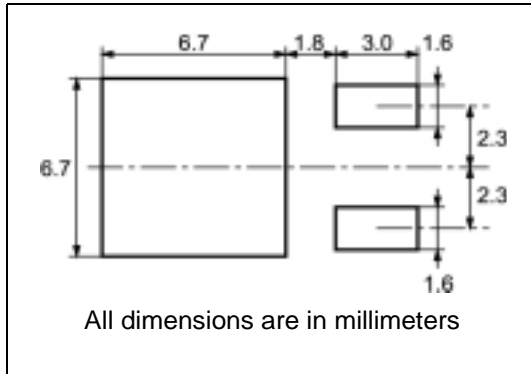


TO-251 (IPAK) MECHANICAL DATA

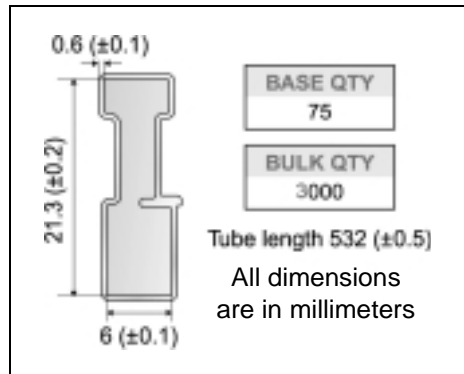
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.2		2.4	0.086		0.094
A1	0.9		1.1	0.035		0.043
A3	0.7		1.3	0.027		0.051
B	0.64		0.9	0.025		0.031
B2	5.2		5.4	0.204		0.212
B3			0.85			0.033
B5		0.3			0.012	
B6			0.95			0.037
C	0.45		0.6	0.017		0.023
C2	0.48		0.6	0.019		0.023
D	6		6.2	0.236		0.244
E	6.4		6.6	0.252		0.260
G	4.4		4.6	0.173		0.181
H	15.9		16.3	0.626		0.641
L	9		9.4	0.354		0.370
L1	0.8		1.2	0.031		0.047
L2		0.8	1		0.031	0.039



**DPAK FOOTPRINT**



**TUBE SHIPMENT (no suffix)\***



**TAPE AND REEL SHIPMENT (suffix "T4")\***

Diagram showing the mechanical data for tape and reel shipment. It includes a top view of the reel with dimensions A, B, C, D, G, N, and T. A 40 mm min. access hole is shown at the slot location. The tape slot in the core has a 2.5 mm min. width. The full radius is also indicated. A side view shows dimensions C, N, and G measured at the hub.

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A		330		12.992
B	1.5		0.059	
C	12.8	13.2	0.504	0.520
D	20.2		0.795	
G	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

BASE QTY	BULK QTY
2500	2500

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	6.8	7	0.267	0.275
B0	10.4	10.6	0.409	0.417
B1		12.1		0.476
D	1.5	1.6	0.059	0.063
D1	1.5		0.059	
E	1.65	1.85	0.065	0.073
F	7.4	7.6	0.291	0.299
K0	2.55	2.75	0.100	0.108
P0	3.9	4.1	0.153	0.161
P1	7.9	8.1	0.311	0.319
P2	1.9	2.1	0.075	0.082
R	40		1.574	
W	15.7	16.3	0.618	0.641

Diagram showing the mechanical data for the tape. It includes a side view of the tape with dimensions B<sub>0</sub>, B<sub>1</sub>, D, D<sub>1</sub>, E, F, K<sub>0</sub>, P<sub>1</sub>, P<sub>2</sub>, and W. The top cover tape is shown with dimensions D, P<sub>2</sub>, P<sub>0</sub>, and E. The center line of the cavity is also indicated. The user direction of feed is shown. The tape is shown with a bending radius R min. and a feed direction.

\* on sales type

**Table 11: Revision History**

<b>Date</b>	<b>Revision</b>	<b>Description of Changes</b>
06-Oct-2003	1	First release
18-Jan-2005	2	Final datasheet

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