



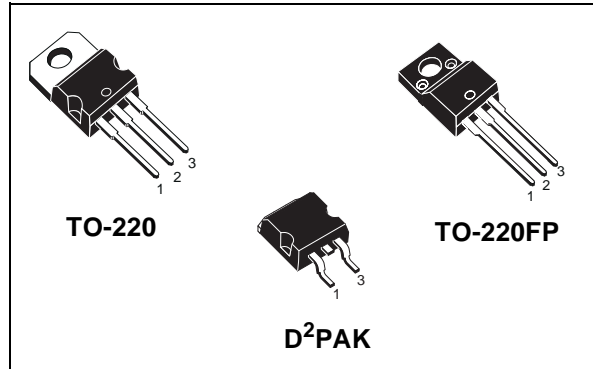
# STGP3NB60HD - STGP3NB60HDFP STGB3NB60HD

N-CHANNEL 3A - 600V - TO-220/TO-220FP/D<sup>2</sup>PAK

PowerMESH™ IGBT

TYPE	V <sub>CES</sub>	V <sub>CE(sat)</sub> (Max) @ 25°C	I <sub>c</sub> (#) @ 100°C
STGB3NB60HD	600 V	< 2.8 V	6 A
STGP3NB60HD	600 V	< 2.8 V	6 A
STGP3NB60HDFP	600 V	< 2.8 V	6 A

- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW GATE CHARGE
- HIGH FREQUENCY OPERATION
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- CO-PACKAGED WITH TURBOSWITCH™ ANTIPARALLEL DIODE



## DESCRIPTION

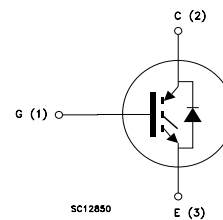
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances.

The suffix "H" identifies a family optimized for high frequency applications (up to 50kHz) in order to achieve very high switching performances (reduced fall) maintaining a low voltage drop.

## APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS and PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES

## INTERNAL SCHEMATIC DIAGRAM



## ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STGB3NB60HDT4	GB3NB60HD	D <sup>2</sup> PAK	TAPE & REEL
STGP3NB60HD	GP3NB60HD	TO-220	TUBE
STGP3NB60HDFP	GP3NB60HDFP	TO-220FP	TUBE

## STGP3NB60HD - STGP3NB60HDFP - STGB3NB60HD

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
		STGP3NB60HD STGB3NB60HD	STGP3NB60HDFP	
V <sub>CES</sub>	Collector-Emitter Voltage (V <sub>GS</sub> = 0)	600		V
V <sub>GE</sub>	Gate-Emitter Voltage	± 20		V
I <sub>C</sub>	Collector Current (continuous) at T <sub>C</sub> = 25°C (#)	10		A
I <sub>C</sub>	Collector Current (continuous) at T <sub>C</sub> = 100°C (#)	6		A
I <sub>CM</sub> (■)	Collector Current (pulsed)	24		A
P <sub>TOT</sub>	Total Dissipation at T <sub>C</sub> = 25°C	50	25	W
	Derating Factor	0.4	0.2	W/°C
T <sub>stg</sub>	Storage Temperature	-55 to 150		°C
T <sub>j</sub>	Operating Junction Temperature			

(■) Pulse width limited by safe operating area

### THERMAL DATA

		TO-220/D <sup>2</sup> PAK	TO-220FP	
R <sub>thj-case</sub>	Thermal Resistance Junction-case Max	2.5	5	°C/W
R <sub>thj-amb</sub>	Thermal Resistance Junction-ambient Max	62.5		°C/W

### ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25 °C UNLESS OTHERWISE SPECIFIED)

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>BR(CES)</sub>	Collector-Emitter Breakdown Voltage	I <sub>C</sub> = 250 μA, V <sub>GE</sub> = 0	600			V
I <sub>CES</sub>	Collector cut-off (V <sub>GE</sub> = 0)	V <sub>CE</sub> = Max Rating, T <sub>C</sub> = 25 °C V <sub>CE</sub> = Max Rating, T <sub>C</sub> = 125 °C			50 100	μA μA
I <sub>GES</sub>	Gate-Emitter Leakage Current (V <sub>CE</sub> = 0)	V <sub>GE</sub> = ±20V, V <sub>CE</sub> = 0			±100	nA

ON (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GE(th)</sub>	Gate Threshold Voltage	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA	3		5	V
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	V <sub>GE</sub> = 15V, I <sub>C</sub> = 3 A V <sub>GE</sub> = 15V, I <sub>C</sub> = 3 A, T <sub>j</sub> = 125°C		2.4 1.9	2.8	V V

(#) Calculated according to the iterative formula:

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

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**DYNAMIC**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$	Forward Transconductance	$V_{CE} = 25\text{ V}, I_C = 3\text{ A}$		2.4		S
$C_{ies}$ $C_{oes}$ $C_{res}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$		235 33 6.6		pF pF pF
$Q_g$ $Q_{ge}$ $Q_{gc}$	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	$V_{CE} = 480\text{ V}, I_C = 3\text{ A},$ $V_{GE} = 15\text{ V}$		21 6 7.6	27	nC nC nC
$I_{CL}$	Latching Current	$V_{clamp} = 480\text{ V}, T_j = 125^\circ\text{C}$ $R_G = 10\ \Omega$	12			A

**SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{CC} = 480\text{ V}, I_C = 3\text{ A}$ $R_G = 10\ \Omega, V_{GE} = 15\text{ V}$		5 11		ns ns
$(di/dt)_{on}$ $E_{on}$	Turn-on Current Slope Turn-on Switching Losses	$V_{CC} = 480\text{ V}, I_C = 3\text{ A}, R_G = 10\ \Omega$ $V_{GE} = 15\text{ V}, T_j = 125^\circ\text{C}$		400 77		A/ $\mu\text{s}$ $\mu\text{J}$

**SWITCHING OFF**

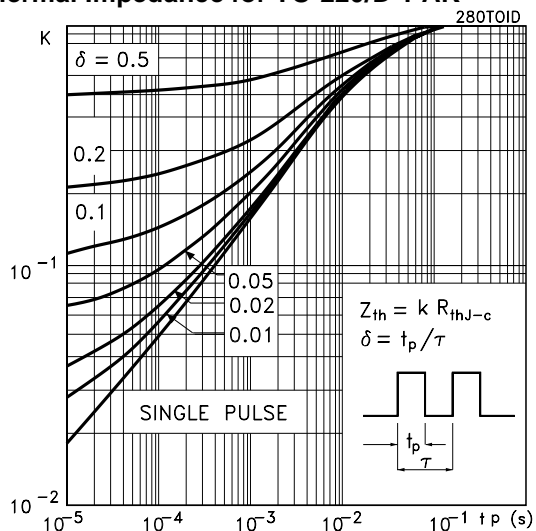
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_c$ $t_r(V_{off})$ $t_{d(off)}$ $t_f$ $E_{off(**)}$ $E_{ts}$	Cross-over Time Off Voltage Rise Time Delay Time Fall Time Turn-off Switching Loss Total Switching Loss	$V_{CC} = 480\text{ V}, I_C = 3\text{ A},$ $R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V}$		76 36 53 77 33 110		ns ns ns ns $\mu\text{J}$ $\mu\text{J}$
$t_c$ $t_r(V_{off})$ $t_{d(off)}$ $t_f$ $E_{off(**)}$ $E_{ts}$	Cross-over Time Off Voltage Rise Time Delay Time Fall Time Turn-off Switching Loss Total Switching Loss	$V_{CC} = 480\text{ V}, I_C = 3\text{ A},$ $R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V}$ $T_j = 125^\circ\text{C}$		180 82 58 110 88 165		ns ns ns ns $\mu\text{J}$ $\mu\text{J}$

Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.  
2. Pulse width limited by max. junction temperature.  
(\*\*)Losses include Also the Tail (Jedec Standardization)

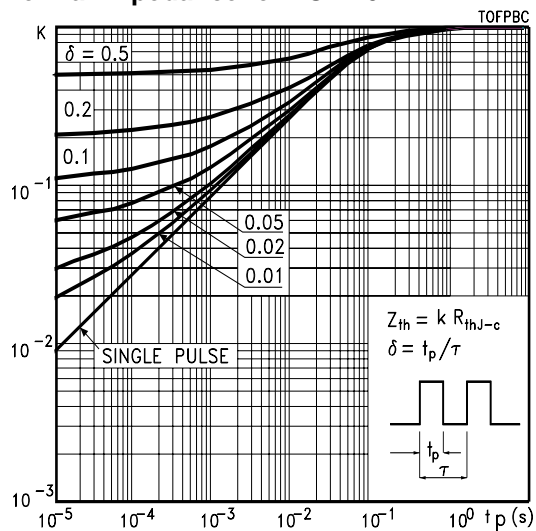
**COLLECTOR-EMITTER DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_f$ $I_{fm}$	Forward Current Forward Current pulsed				3 24	A A
$V_f$	Forward On-Voltage	$I_f = 3\text{ A}$ $I_f = 3\text{ A}, T_j = 125^\circ\text{C}$		1.6 1.4	2.0	V V
$t_{rr}$ $Q_{rr}$ $I_{rrm}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_f = 3\text{ A}, V_R = 35\text{ V},$ $T_j = 125^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$		45 70 2.7		ns nC A

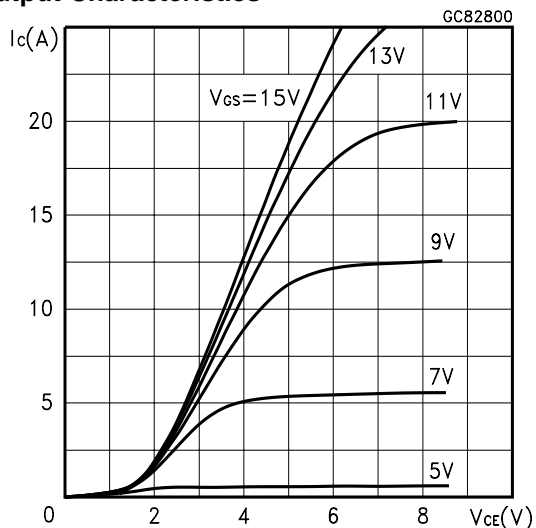
Thermal Impedance for TO-220/D<sup>2</sup>PAK



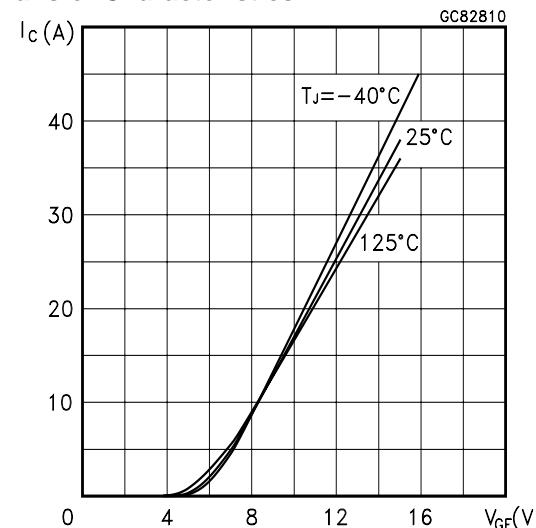
Thermal Impedance for TO-220FP



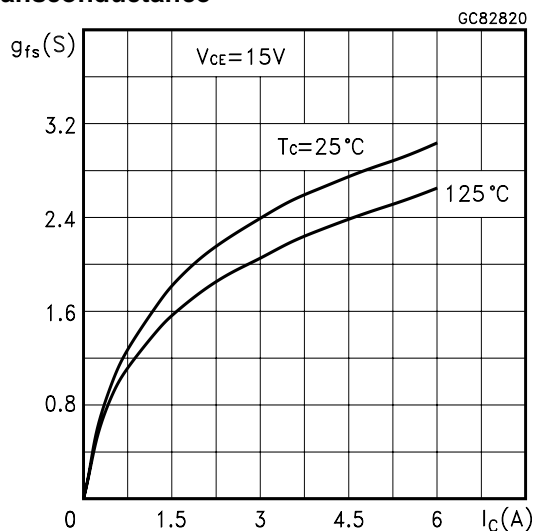
Output Characteristics



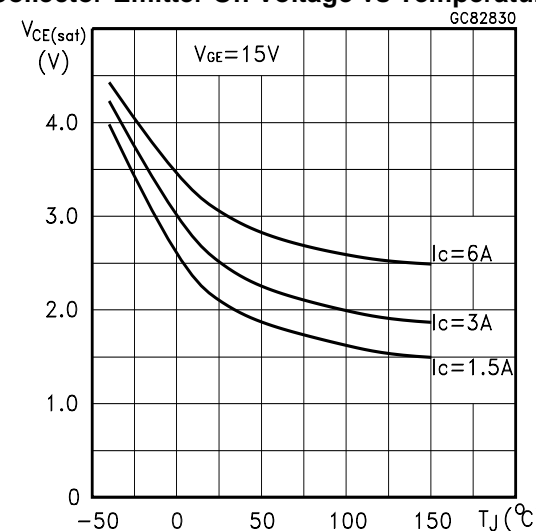
Transfer Characteristics



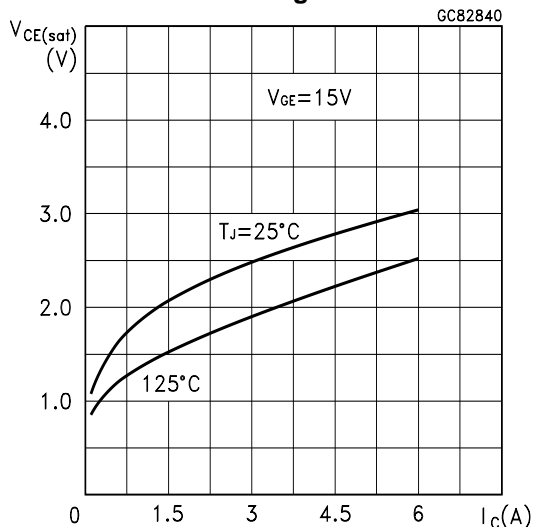
Transconductance



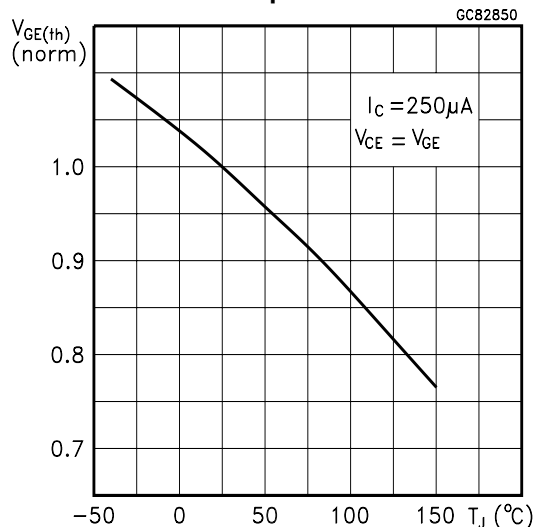
Collector-Emitter On Voltage vs Temperature



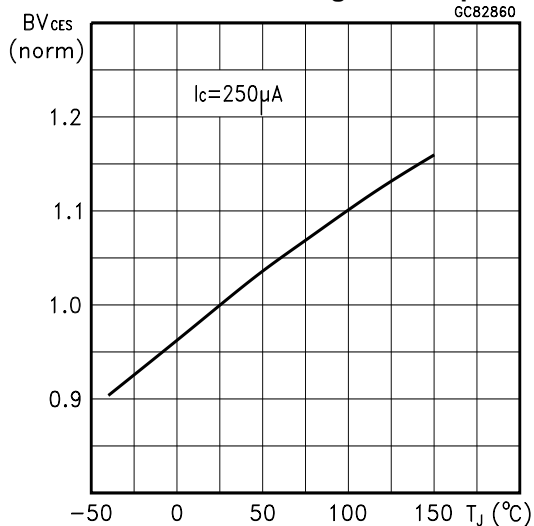
Collector-Emitter On Voltage vs Collector Current



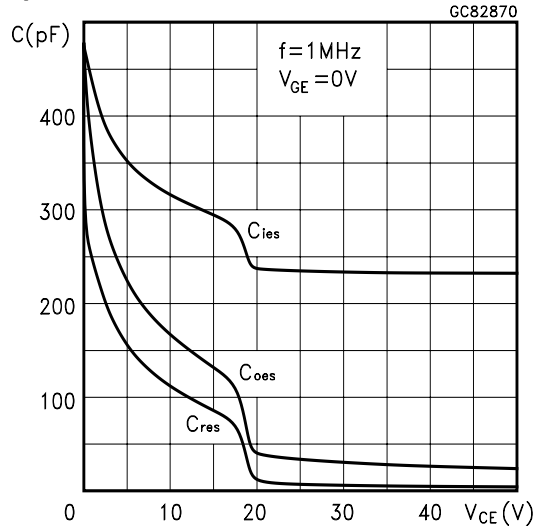
Gate Threshold vs Temperature



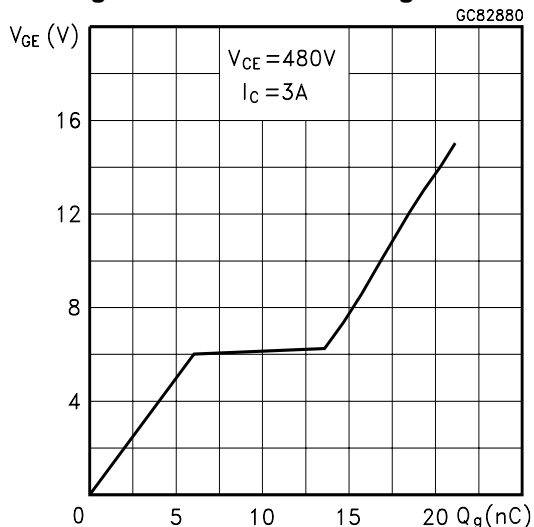
Normalized Breakdown Voltage vs Temperature



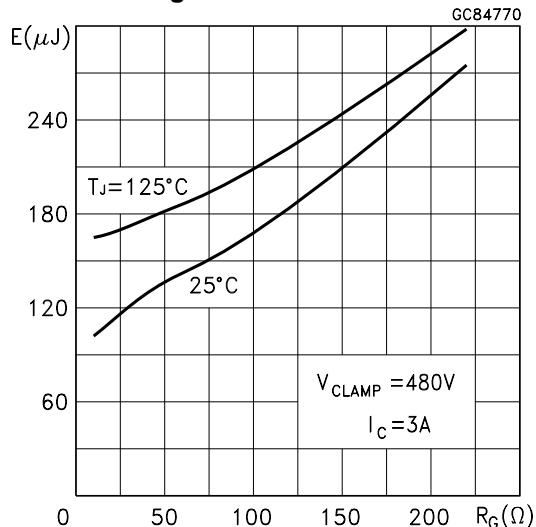
Capacitance Variations



Gate Charge vs Gate-Emitter Voltage

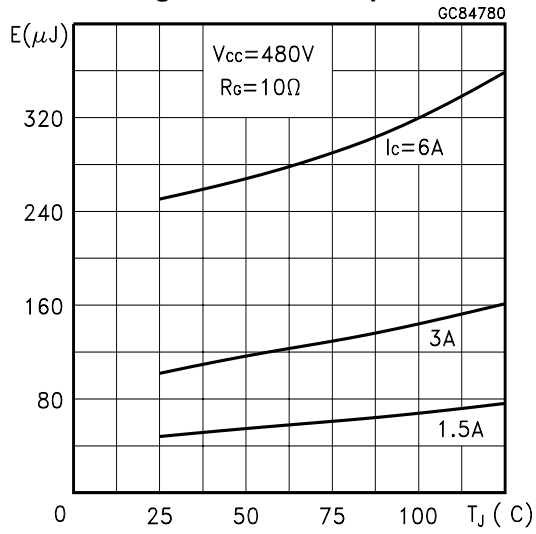


Total Switching Losses vs Gate Resistance

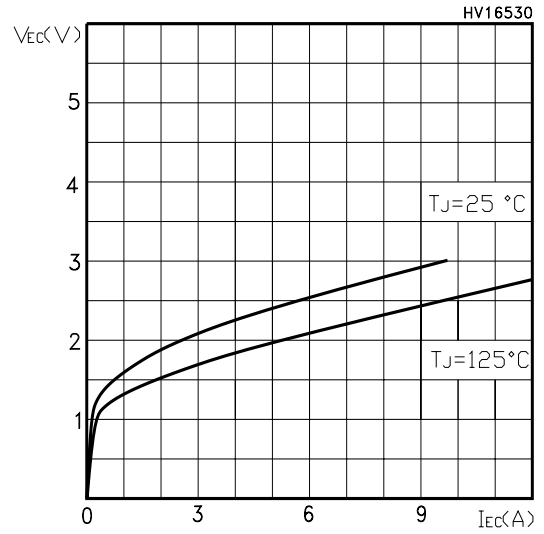


# STGP3NB60HD - STGP3NB60HDFP - STGB3NB60HD

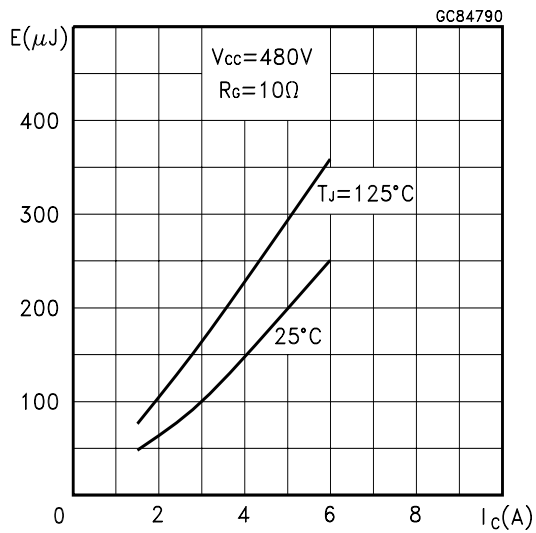
**Total Switching Losses vs Temperature**



**Emitter-collector Diode Characteristics**



**Total Switching Losses vs Collector Current**



**Switching Off Safe Operating Area**

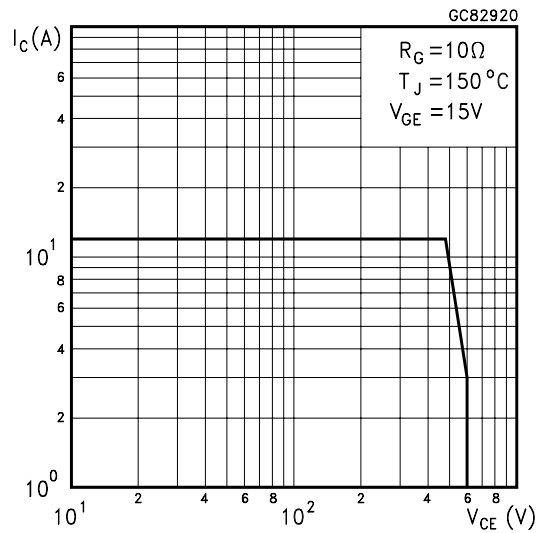


Fig. 1: Gate Charge test Circuit

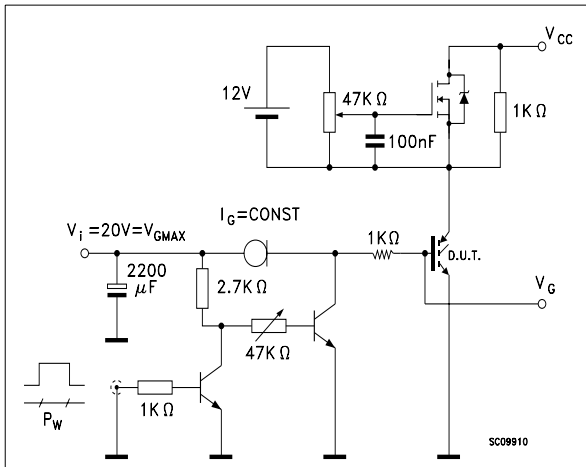
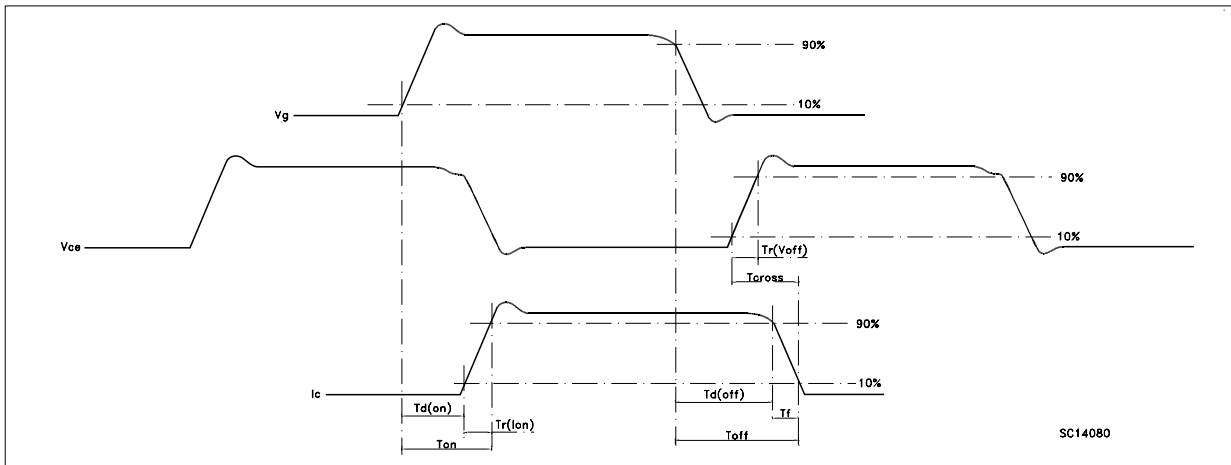
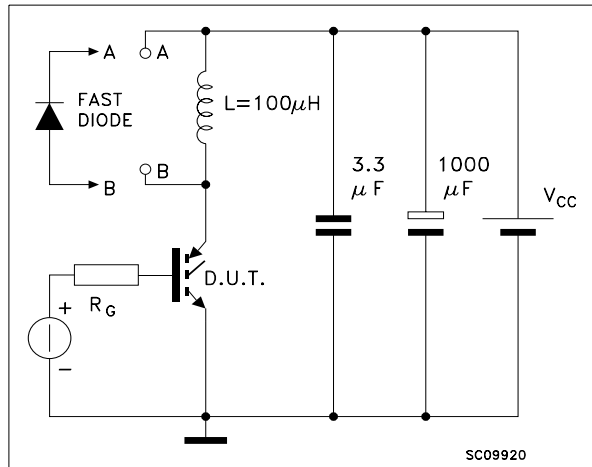
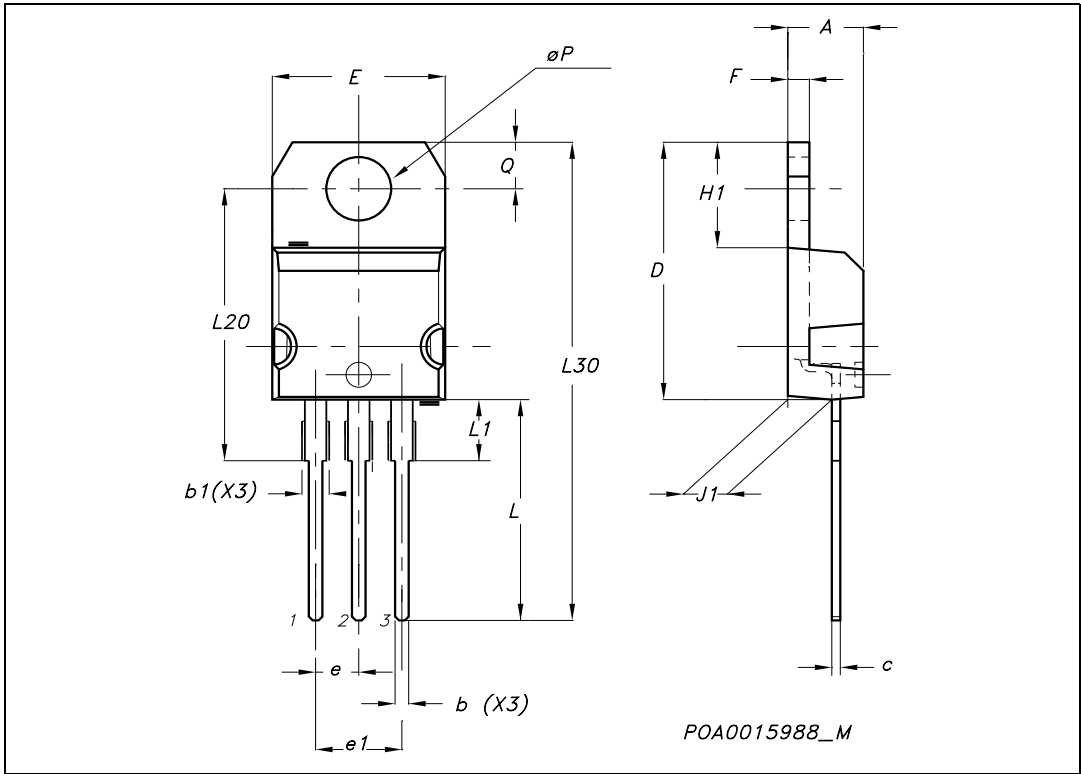


Fig. 2: Test Circuit For Inductive Load Switching



**TO-220 MECHANICAL DATA**

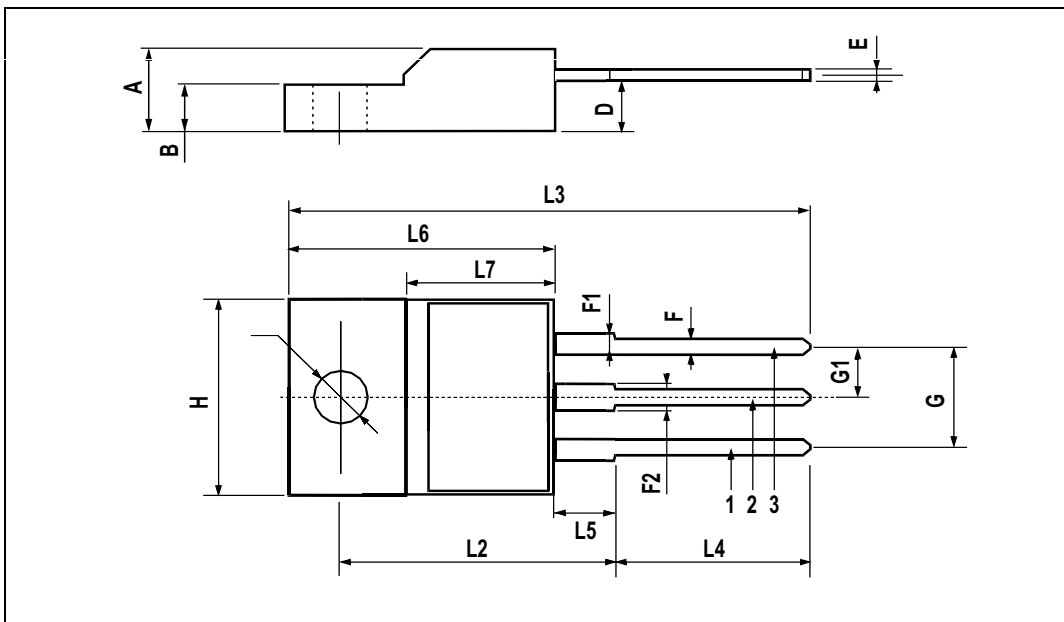
DIM.	mm.			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244		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	
øP	3.75		3.85	0.147		0.151
Q	2.65		2.95	0.104		0.116





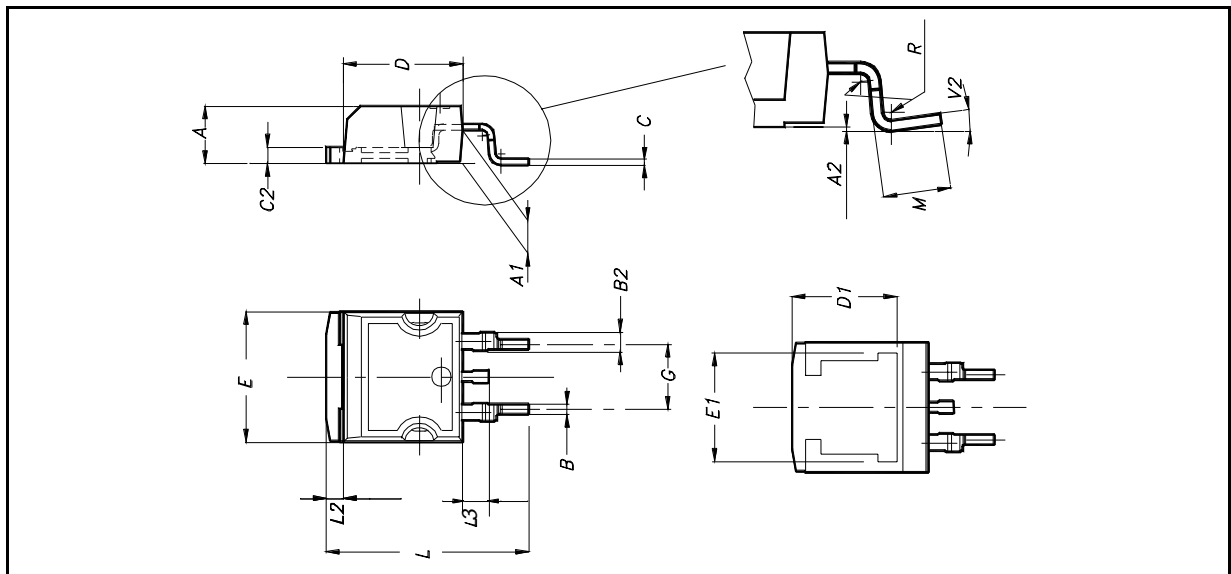
**TO-220FP MECHANICAL DATA**

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
B	2.5		2.7	0.098		0.106
D	2.5		2.75	0.098		0.108
E	0.45		0.7	0.017		0.027
F	0.75		1	0.030		0.039
F1	1.15		1.7	0.045		0.067
F2	1.15		1.7	0.045		0.067
G	4.95		5.2	0.195		0.204
G1	2.4		2.7	0.094		0.106
H	10		10.4	0.393		0.409
L2		16			0.630	
L3	28.6		30.6	1.126		1.204
L4	9.8		10.6	.0385		0.417
L5	2.9		3.6	0.114		0.141
L6	15.9		16.4	0.626		0.645
L7	9		9.3	0.354		0.366
Ø	3		3.2	0.118		0.126

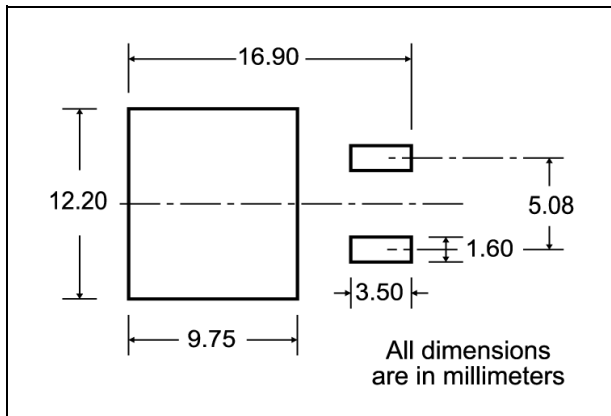


**D<sup>2</sup>PAK MECHANICAL DATA**

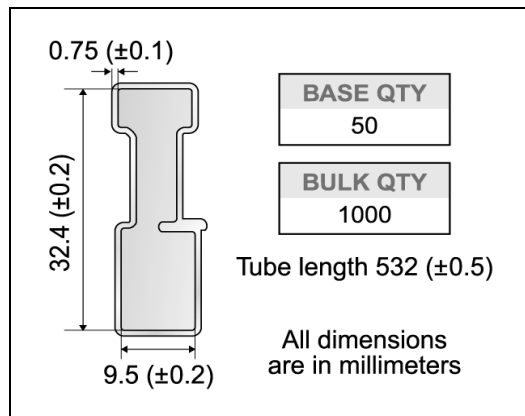
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
G	4.88		5.28	0.192		0.208
L	15		15.85	0.590		0.625
L2	1.27		1.4	0.050		0.055
L3	1.4		1.75	0.055		0.068
M	2.4		3.2	0.094		0.126
R		0.4			0.015	
V2	0°		4°			



### D<sup>2</sup>PAK FOOTPRINT



### TUBE SHIPMENT (no suffix)\*



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

Diagram showing the tape mechanical data. Dimensions A, B, C, D, G, N, and T are indicated. 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.

#### REEL MECHANICAL DATA

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	24.4	26.4	0.960	1.039
N	100		3.937	
T		30.4		1.197

<b>BASE QTY</b>	1000
<b>BULK QTY</b>	1000

#### TAPE MECHANICAL DATA

DIM.	mm		inch	
	MIN.	MAX.	MIN.	MAX.
A0	10.5	10.7	0.413	0.421
B0	15.7	15.9	0.618	0.626
D	1.5	1.6	0.059	0.063
D1	1.59	1.61	0.062	0.063
E	1.65	1.85	0.065	0.073
F	11.4	11.6	0.449	0.456
K0	4.8	5.0	0.189	0.197
P0	3.9	4.1	0.153	0.161
P1	11.9	12.1	0.468	0.476
P2	1.9	2.1	0.075	0.082
R	50		1.574	
T	0.25	0.35	0.0098	0.0137

Diagram showing the tape and reel shipment details. Dimensions A0, B0, D, D1, E, F, K0, P0, P1, P2, R, and T are indicated. The diagram shows the top cover tape, the user direction of feed, the center line of the cavity, and the bending radius (R min.).

\* on sales type

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