



# STGP12NB60KD - STGB12NB60KD

N-CHANNEL 12A - 600V TO-220/D<sup>2</sup>PAK  
SHORT CIRCUIT PROOF PowerMESH™ IGBT

TYPE	V <sub>CES</sub>	V <sub>CE(sat)</sub> (Max) @25°C	I <sub>c</sub> @ 100°C
STGP12NB60KD	600 V	< 2.8 V	12 A
STGB12NB60KD	600 V	< 2.8 V	12 A

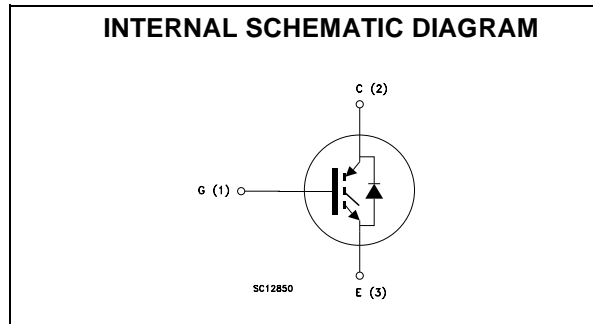
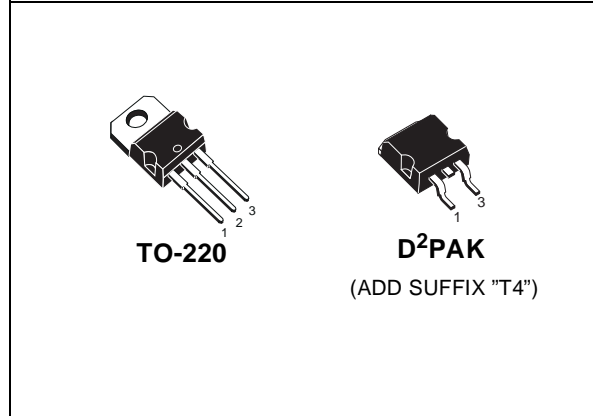
- HIGH INPUT IMPEDANCE
- LOW ON-LOSSES
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- VERY HIGH FREQUENCY OPERATION
- TYPICAL SHORT CIRCUIT WITHSTAND TIME 10 MICROS
- CO-PACKAGED ANTIPARALLEL DIODE

## 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 "K" identifies a family optimized for high frequency applications (up to 50kHz) and short circuit proof in order to achieve very high switching performances (reduced tfall) maintaining a low voltage drop.

## APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS
- UPS



## ORDERING INFORMATION

SALES TYPE	MARKING	PACKAGE	PACKAGING
STGP12NB60KD	GP12NB60KD	TO-220	TUBE
STGB12NB60KD	GB12NB60KD	D <sup>2</sup> PAK	TAPE & REEL

## STGP12NB60KD - STGB12NB60KD

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CES}$	Collector-Emitter Voltage ( $V_{GS} = 0$ )	600	V
$V_{ECR}$	Emitter-Collector Voltage	20	V
$V_{GE}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current (continuous) at $T_C = 25^\circ\text{C}$	24	A
$I_C$	Collector Current (continuous) at $T_C = 100^\circ\text{C}$	12	A
$I_{CM}(\bullet)$	Collector Current (pulsed)	48	A
$T_{sc}$	Short Circuit Withstand	10	$\mu\text{s}$
$P_{TOT}$	Total Dissipation at $T_C = 25^\circ\text{C}$	100	W
	Derating Factor	0.8	$\text{W}/^\circ\text{C}$
$T_{stg}$	Storage Temperature	-65 to 150	$^\circ\text{C}$
$T_j$	Max. Operating Junction Temperature	150	$^\circ\text{C}$

( $\bullet$ ) Pulse width limited by safe operating area

### THERMAL DATA

Rthj-case	Thermal Resistance Junction-case Max	1.25	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal Resistance Junction-ambient Max	62.5	$^\circ\text{C}/\text{W}$

### ELECTRICAL CHARACTERISTICS ( $T_{CASE} = 25^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR}(CES)$	Collector-Emitter Breakdown Voltage	$I_C = 250 \mu\text{A}$ , $V_{GE} = 0$	600			V
$I_{CES}$	Collector cut-off ( $V_{GE} = 0$ )	$V_{CE} = \text{Max Rating}$ , $T_C = 25^\circ\text{C}$ $V_{CE} = \text{Max Rating}$ , $T_C = 125^\circ\text{C}$			50 100	$\mu\text{A}$ $\mu\text{A}$
$I_{GES}$	Gate-Emitter Leakage Current ( $V_{CE} = 0$ )	$V_{GE} = \pm 20\text{V}$ , $V_{CE} = 0$			$\pm 100$	nA

ON (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate Threshold Voltage	$V_{CE} = V_{GE}$ , $I_C = 250 \mu\text{A}$	5		7	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE} = 15\text{V}$ , $I_C = 12\text{A}$ $V_{GE} = 15\text{V}$ , $I_C = 12\text{A}$ , $T_j = 125^\circ\text{C}$		2.2 1.7	2.8	V V

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs}$	Forward Transconductance	$V_{CE} = 25\text{V}$ , $I_C = 12\text{A}$		5		S
$C_{ies}$ $C_{oes}$ $C_{res}$	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{CE} = 25\text{V}$ , $f = 1\text{MHz}$ , $V_{GE} = 0$		890 110 22		pF pF pF
$Q_g$ $Q_{ge}$ $Q_{gc}$	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	$V_{CE} = 480\text{V}$ , $I_C = 12\text{A}$ , $V_{GE} = 15\text{V}$		54 8 31		nC nC nC
$I_{CL}$	Latching Current	$V_{clamp} = 480\text{V}$ , $V_{GE} = 15\text{V}$ , $T_j = 125^\circ\text{C}$ , $R_G = 10\ \Omega$		48		A
$T_{wsc}$	Short Circuit WITHSTAND Time	$V_{CE} = 0.5 BV_{ces}$ , $V_{GE} = 15\text{V}$ $T_j = 125^\circ\text{C}$ , $R_G = 10\ \Omega$	10			$\mu\text{s}$

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Delay Time	$V_{CC} = 480\text{ V}, I_C = 12\text{ A}$		25		ns
$t_r$	Rise Time	$R_G = 10\Omega, V_{GE} = 15\text{ V}$		14.5		ns
$(di/dt)_{on}$	Turn-on Current Slope	$V_{CC} = 480\text{ V}, I_C = 12\text{ A}, R_G = 10\Omega$		590		A/ $\mu$ s
$E_{on}$	Turn-on Switching Losses	$V_{GE} = 15\text{ V}, T_j = 125^\circ\text{C}$		180		$\mu$ J

**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_c$	Cross-over Time	$V_{CC} = 480\text{ V}, I_C = 12\text{ A},$ $R_{GE} = 10\Omega, V_{GE} = 15\text{ V}$		130		ns
$t_r(V_{off})$	Off Voltage Rise Time			25		ns
$t_{d(off)}$	Delay Time			96		ns
$t_f$	Fall Time			100		ns
$E_{off(**)}$	Turn-off Switching Loss			258		$\mu$ J
$E_{ts}$	Total Switching Loss			410		$\mu$ J
$t_c$	Cross-over Time	$V_{CC} = 480\text{ V}, I_C = 12\text{ A},$ $R_{GE} = 10\Omega, V_{GE} = 15\text{ V}$ $T_j = 125^\circ\text{C}$		380		ns
$t_r(V_{off})$	Off Voltage Rise Time			120		ns
$t_{d(off)}$	Delay Time			205		ns
$t_f$	Fall Time			256		ns
$E_{off(**)}$	Turn-off Switching Loss			1100		$\mu$ J
$E_{ts}$	Total Switching Loss			1280		$\mu$ J

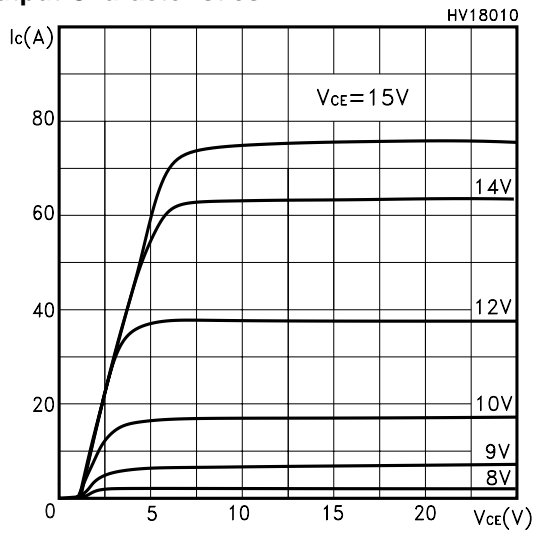
Note: 1. Pulsed: Pulse duration = 300  $\mu$ s, duty cycle 1.5 %.  
 2. Pulse width limited by max. junction temperature.  
 (\*\*)Losses include Also the Tail (Jedec Standardization)

**COLLECTOR-EMITTER DIODE**

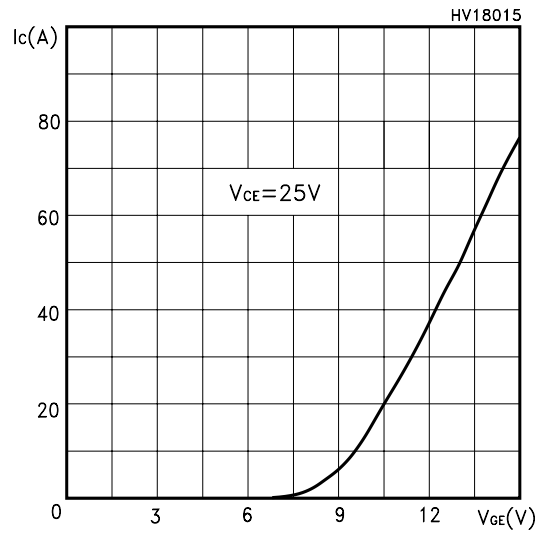
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_f$	Forward Current				12	A
$I_{fm}$	Forward Current pulsed				48	A
$V_f$	Forward On-Voltage	$I_f = 6\text{ A}$ $I_f = 6\text{ A}, T_j = 125^\circ\text{C}$		1.3 1.1	1.9	V V
$t_{rr}$	Reverse Recovery Time	$I_f = 6\text{ A}, V_R = 50\text{ V},$ $T_j = 125^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$		80		ns
$Q_{rr}$	Reverse Recovery Charge			240		nC
$I_{rrm}$	Reverse Recovery Current			5.5		A

# STGP12NB60KD - STGB12NB60KD

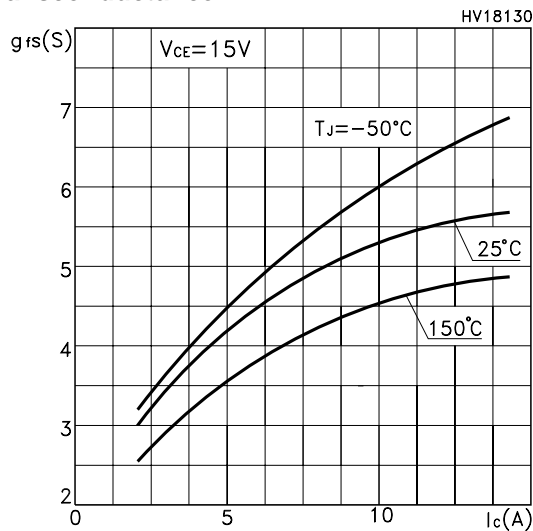
## Output Characteristics



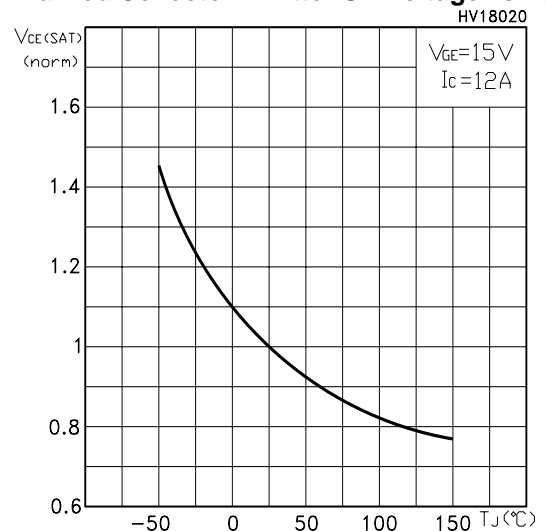
## Transfer Characteristics



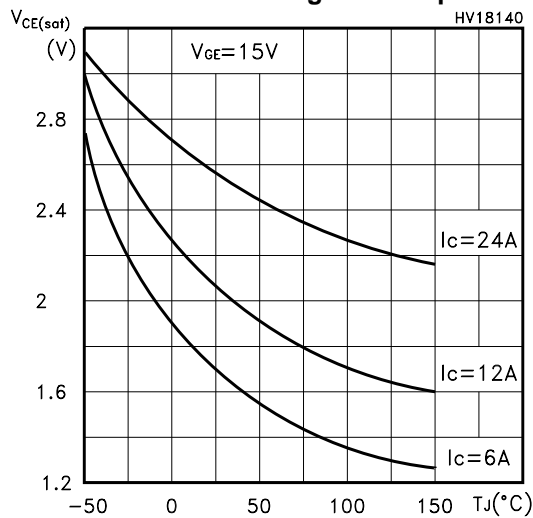
## Transconductance



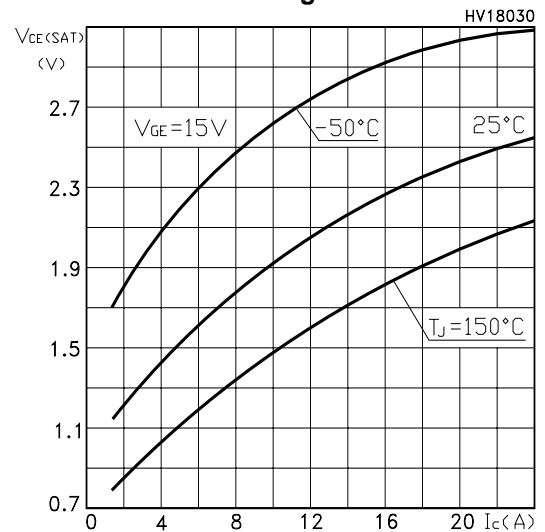
## Normalized Collector-Emitter On Voltage vs Temp.



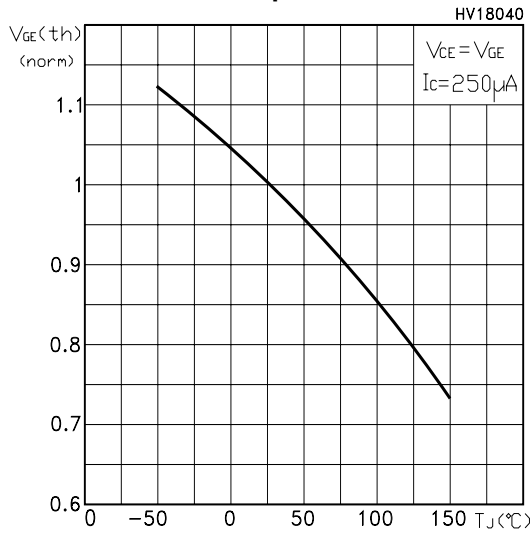
## Collector-Emitter On Voltage vs Temperature



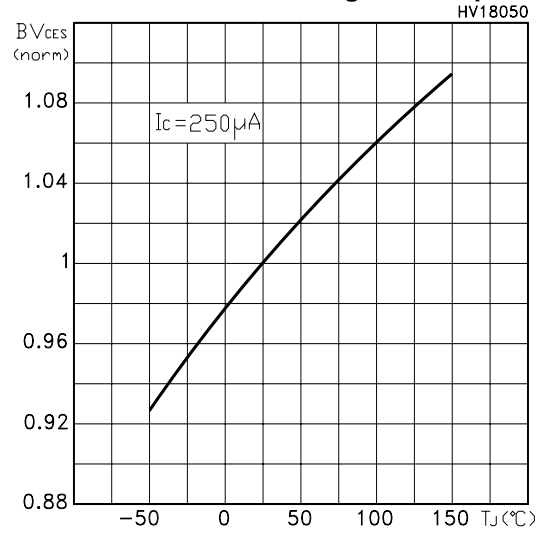
## Collector-Emitter On Voltage vs Collector Current



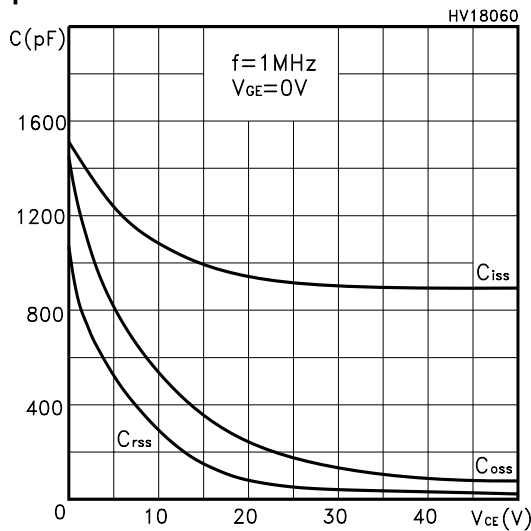
Gate Threshold vs Temperature



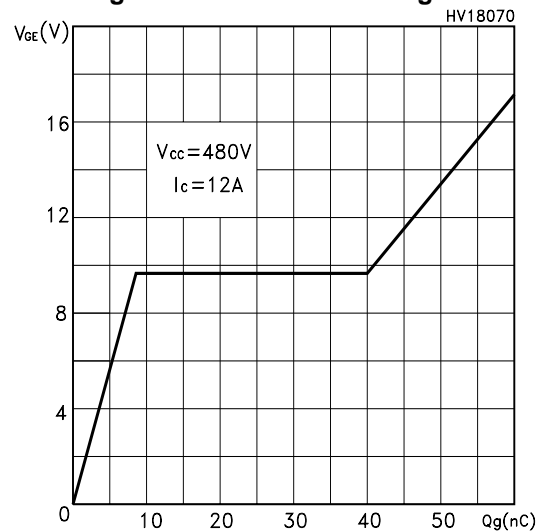
Normalized Breakdown Voltage vs Temperature



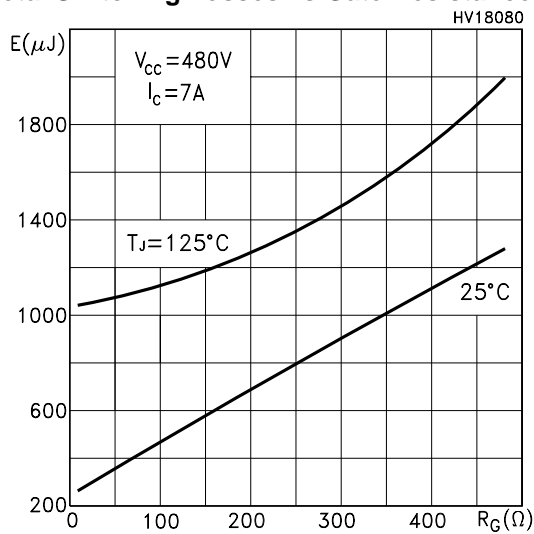
Capacitance Variations



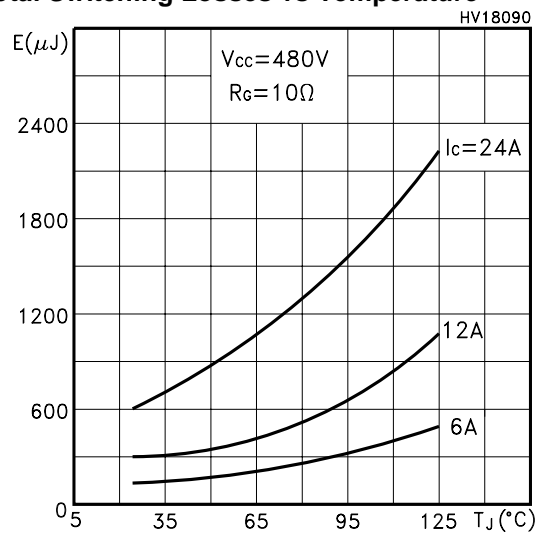
Gate Charge vs Gate-Emitter Voltage



Total Switching Losses vs Gate Resistance

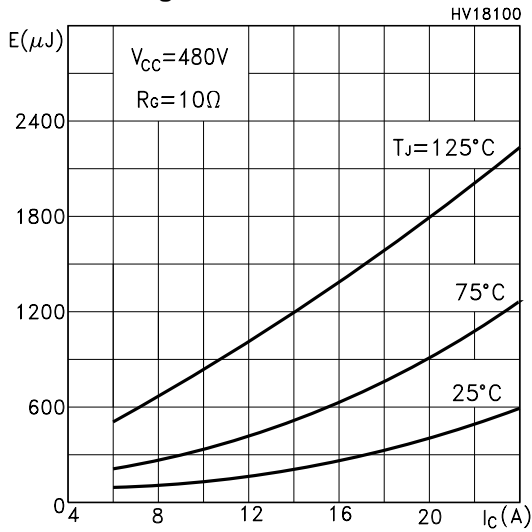


Total Switching Losses vs Temperature

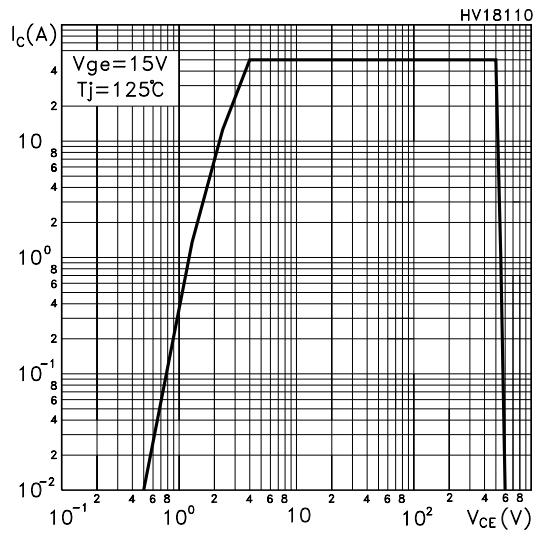


# STGP12NB60KD - STGB12NB60KD

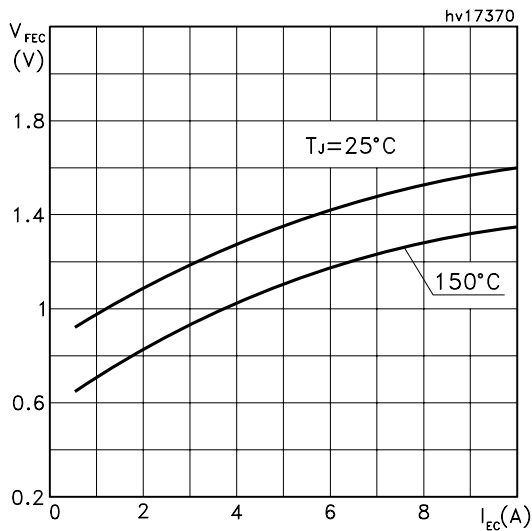
## Total Switching Losses vs Collector Current



## Turn-Off SOA



## Diode Forward Voltage



## Thermal Impedance

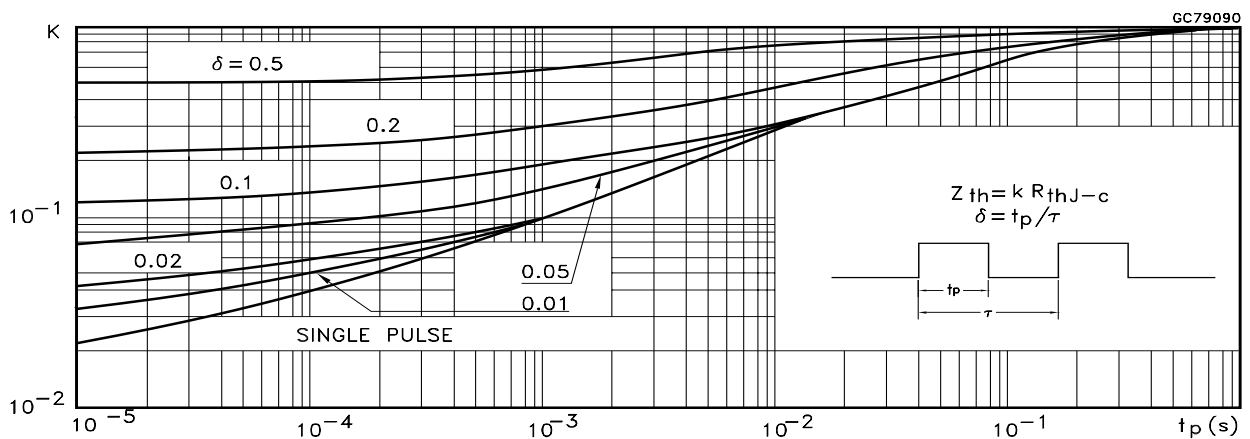


Fig. 1: Gate Charge test Circuit

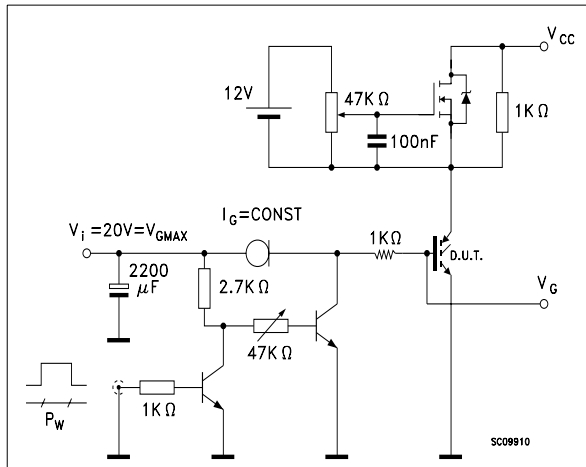
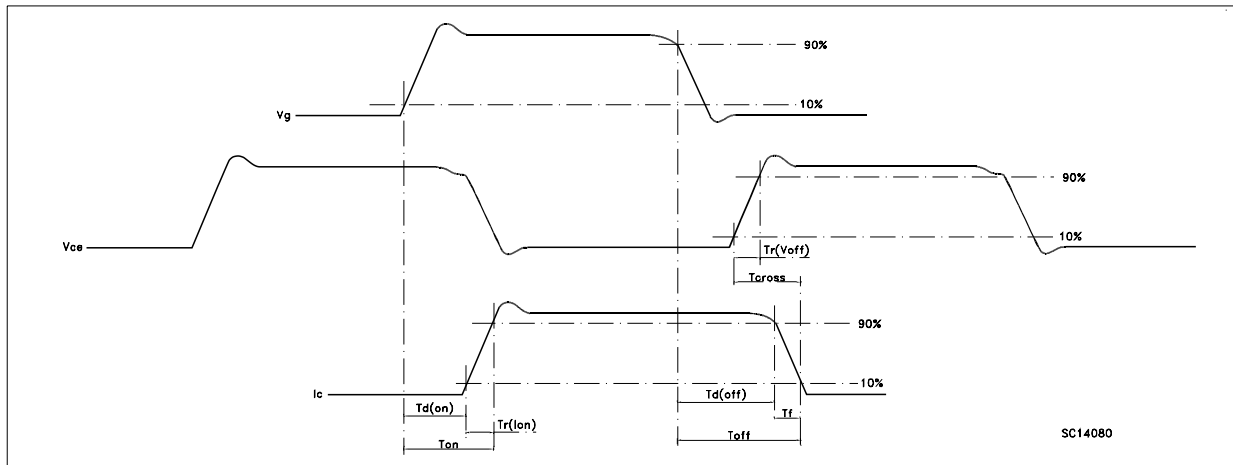
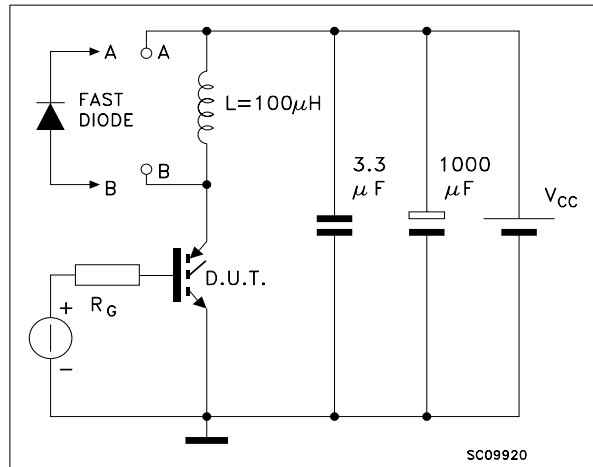
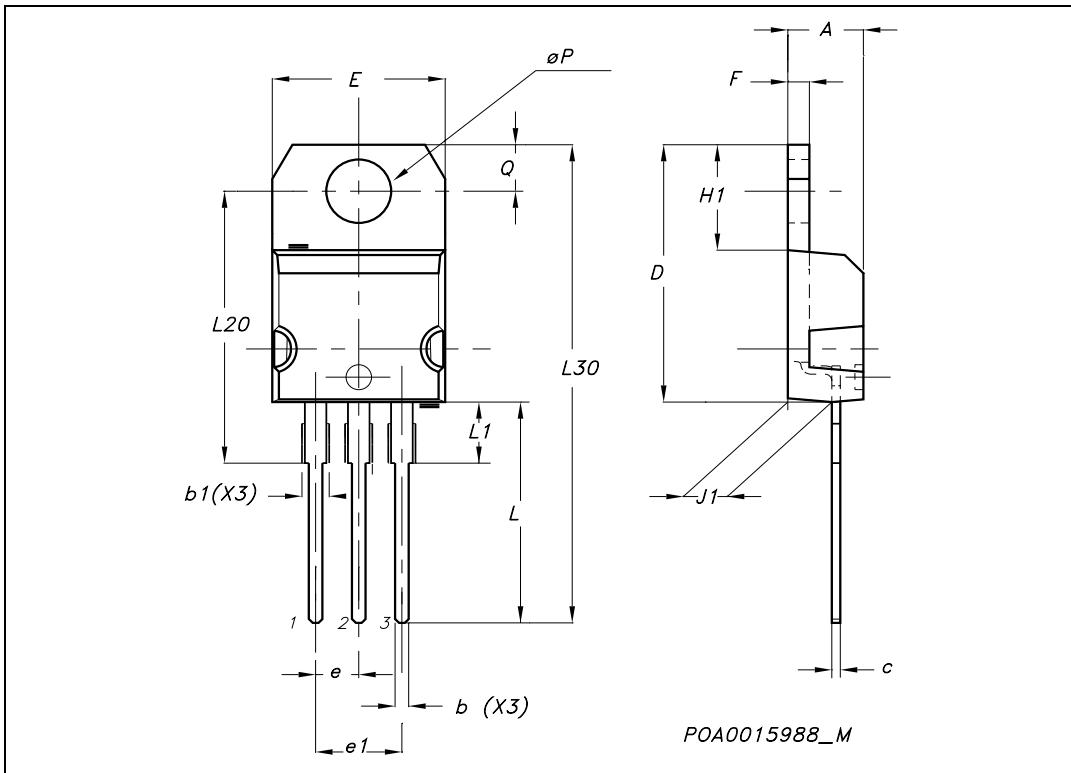


Fig. 2: Test Circuit For Inductive Load Switching (SC09920)



**TO-220 MECHANICAL DATA**

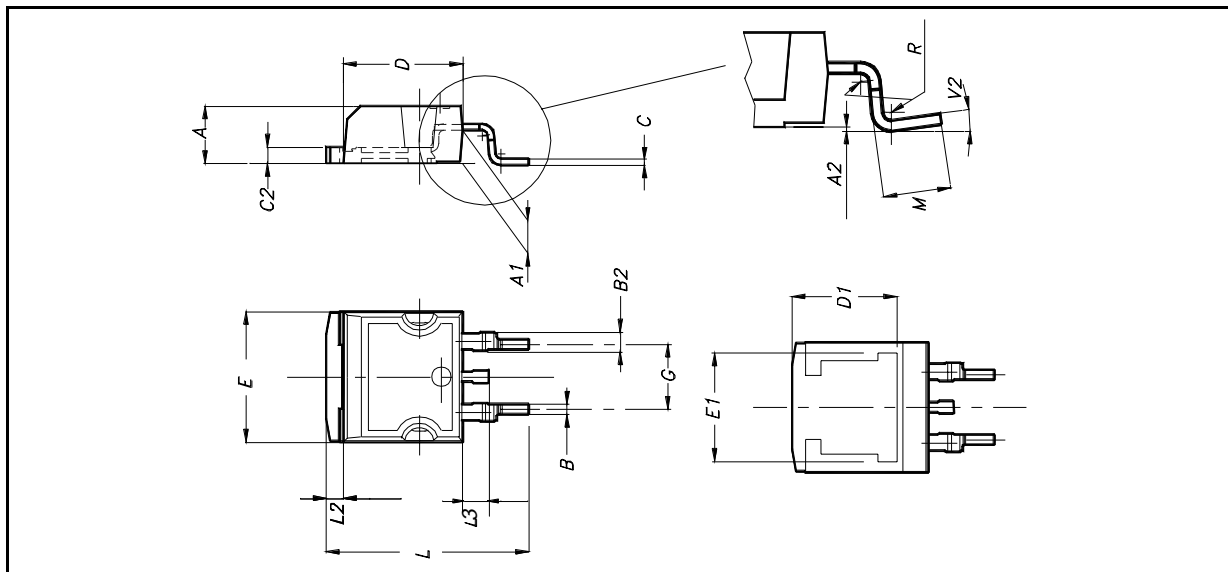
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
b	0.61		0.88	0.024		0.034
b1	1.15		1.70	0.045		0.066
c	0.49		0.70	0.019		0.027
D	15.25		15.75	0.60		0.620
E	10		10.40	0.393		0.409
e	2.40		2.70	0.094		0.106
e1	4.95		5.15	0.194		0.202
F	1.23		1.32	0.048		0.052
H1	6.20		6.60	0.244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



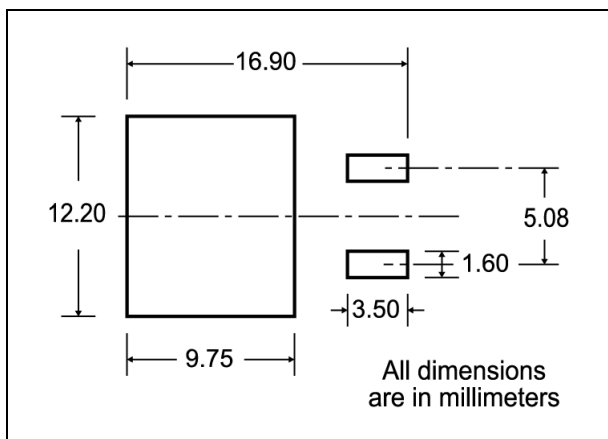


**D<sup>2</sup>PAK MECHANICAL DATA**

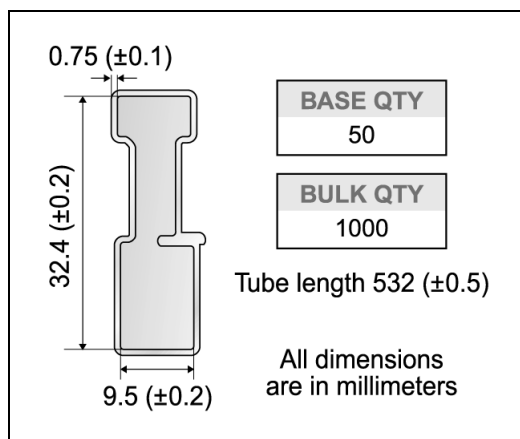
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
A2	0.03		0.23	0.001		0.009
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
D1		8			0.315	
E	10		10.4	0.393		
E1		8.5			0.334	
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°		8°			



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



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



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

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

**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

BASE QTY	BULK QTY
1000	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
W	23.7	24.3	0.933	0.956

TOP COVER TAPE

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

Bending radius R min.

FEED DIRECTION

TRL

\* on sales type



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