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STGP7NC60H - STGD7NC60H

N-CHANNEL 14A - 600V TO-220/DPAK
Very Fast PowerMESH™ IGBT

Table 1: General Features

TYPE	V_{CES}	$V_{CE(sat)}$ (Max) @25°C	I_C @100°C
STGP7NC60H STGD7NC60HT4	600 V 600 V	< 2.5 V < 2.5 V	14 A 14 A

- LOWER ON-VOLTAGE DROP (V_{cesat})
- OFF LOSSES INCLUDE TAIL CURRENT
- LOWER C_{RES}/C_{IES} RATIO
- HIGH FREQUENCY OPERATION UP TO 70 KHz
- NEW GENERATION PRODUCTS WITH TIGHTER PARAMETER DISTRIBUTION

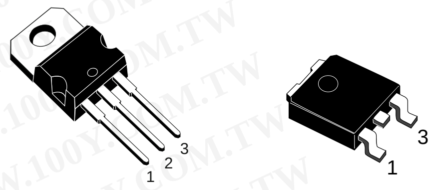
DESCRIPTION

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 in order to achieve very high switching performances (reduced tfall) maintaining a low voltage drop.

APPLICATIONS

- HIGH FREQUENCY INVERTERS
- SMPS AND PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES
- MOTOR DRIVERS

Figure 1: Package



TO-220 DPAK

Weight for TO-220: 1.92gr ± 0.01
Weight for DPAK: 0.38gr ± 0.01

Figure 2: Internal Schematic Diagram

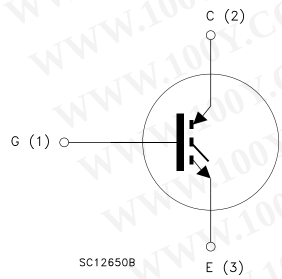


Table 2: Order Code

PART NUMBER	MARKING	PACKAGE	PACKAGING
STGP7NC60H	GP7NC60H	TO-220	TUBE
STGD7NC60HT4	D7NC60H	DPAK	TAPE & REEL

Rev. 2

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value		Unit
		TO-220	DPAK	
V_{CES}	Collector-Emitter Voltage (V_{GS} = 0)	600		V
V_{ECR}	Emitter-Collector Voltage	20		V
V_{GE}	Gate-Emitter Voltage	±20		V
I_C	Collector Current (continuous) at T_C = 25°C (#)	25		A
I_C	Collector Current (continuous) at T_C = 100°C (#)	14		A
I_{CM} (☒)	Collector Current (pulsed)	50		A
P_{TOT}	Total Dissipation at T_C = 25°C	80	70	W
	Derating Factor	0.64	0.56	W/°C
T_{stg}	Storage Temperature	– 55 to 150		°C
T_j	Operating Junction Temperature			

(☒) Pulse width limited by max. junction temperature.

Table 4: Thermal Data

			Min.	Typ.	Max.	
Rthj-case	Thermal Resistance Junction-case	TO-220			1.56	°C/W
		DPAK			1.78	
Rthj-amb	Thermal Resistance Junction-ambient	TO-220			62.5	°C/W
		DPAK			100	
T_L	Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.)	TO-220		300		°C
		DPAK		275		

ELECTRICAL CHARACTERISTICS (T_{CASE} =25°C UNLESS OTHERWISE SPECIFIED)

Table 5: Main Parameters

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	I_C = 1 mA, V_{GE} = 0	600			V
I_{CES}	Collector cut-off Current (V_{GE} = 0)	V_{CE} = Max Rating, T_C= 25 °C V_{CE} = Max Rating, T_C= 125 °C			10 1	µA mA
I_{GES}	Gate-Emitter Leakage Current (V_{CE} = 0)	V_{GE} = ± 20V , V_{CE} = 0			±100	nA
$V_{GE(th)}$	Gate Threshold Voltage	V_{CE} = V_{GE}, I_C = 250 µA	3.75		5.75	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE} = 15V, I_C = 7 A V_{GE} = 15V, I_C = 7 A, Tc= 125°C		1.85 1.7	2.5	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)

Table 6: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	V_{CE} = 15 V , I_C = 7 A		4.30		S
C_{ies} C_{oes} C_{res}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V_{CE} = 25 V, f= 1 MHz, V_{GE} = 0		720 81 17		pF pF pF
Q_g Q_{ge} Q_{gc}	Total Gate Charge Gate-Emitter Charge Gate-Collector Charge	V_{CE} = 390 V, I_C = 7 A, V_{GE} = 15 V (see Figure 21)		35 7 16	48	nC nC nC
I_{CL}	Turn-Off SOA Minimum Current	V_{clamp} = 480 V , Tj = 150°C R_G = 10 Ω, V_{GE} = 15 V	50			A

(1) Pulsed: Pulse duration= 300 µs, duty cycle 1.5%

Table 7: Switching On

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} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 25°C (see Figure 18)		18.5 8.5 1060		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} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 125°C (see Figure 19)		18.5 7 1000		ns ns A/µs

Table 8: Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off Voltage Rise Time Turn-off Delay Time Current Fall Time	V_{cc} = 390 V, I_C = 7 A, R_G = 10 Ω , V_{GE} = 15 V T_J = 25 °C (see Figure 19)		27 72 60		ns ns ns
$t_r(V_{off})$ $t_d(_{off})$ t_f	Off Voltage Rise Time Turn-off Delay Time Current Fall Time	V_{cc} = 390 V, I_C = 7 A, R_G = 10 Ω , V_{GE} = 15 V Tj = 125 °C (see Figure 19)		56 116 105		ns ns ns

Table 9: Switching Energy

Symbol	Parameter	Test Conditions	Min.	Typ.	Max	Unit
Eon (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss	V_{CC} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 25°C (see Figure 19)		95 115 210	125 150 275	µJ µJ µJ
Eon (2) E_{off} (3) E_{ts}	Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss	V_{CC} = 390 V, I_C = 7 A R_G= 10 Ω, V_{GE}= 15V, Tj= 125°C (see Figure 19)		140 215 355		µJ µJ µJ

2) Eon is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & DIODE are at the same temperature (25°C and 125°C)
(3)Turn-off losses include also the tail of the collector current.

Figure 3: Output Characteristics

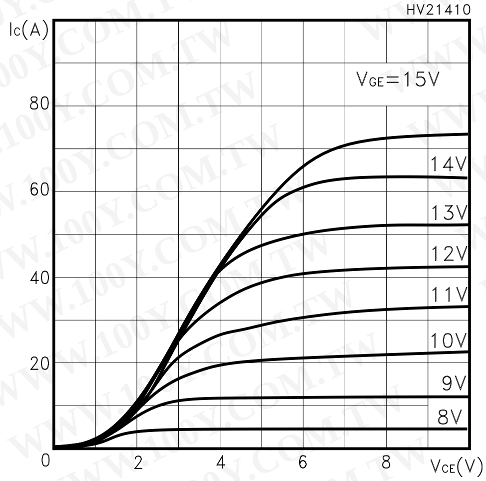


Figure 6: Transfer Characteristics

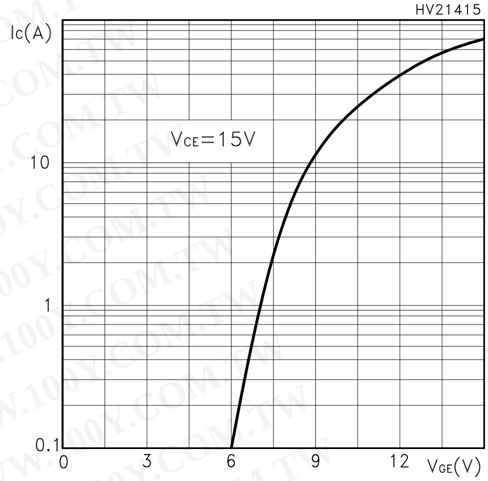


Figure 4: Transconductance

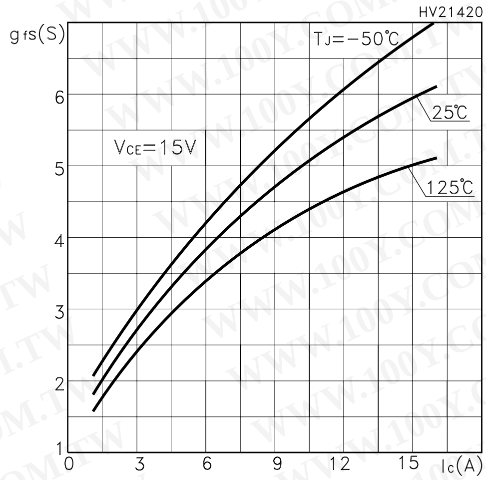


Figure 7: Collector-Emitter On Voltage vs Temperature

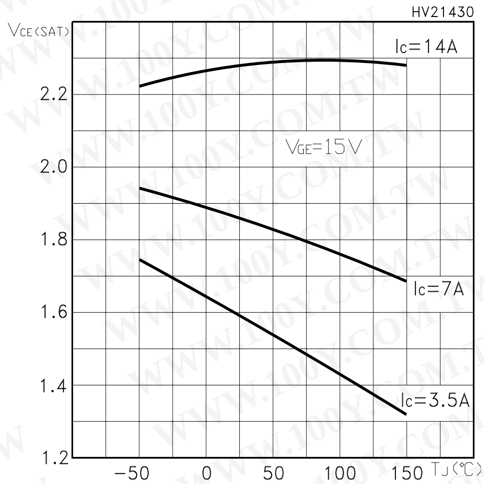


Figure 5: Collector-Emitter On Voltage vs Collector Current

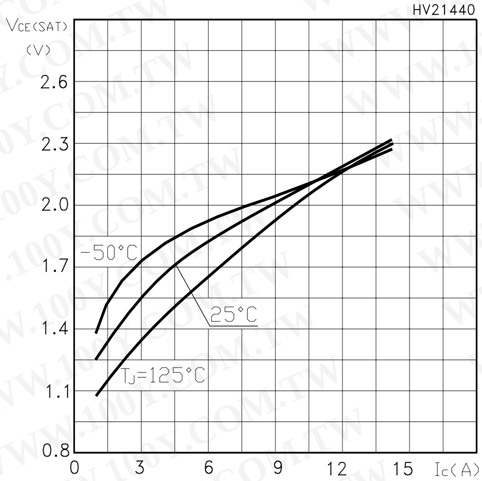


Figure 8: Normalized Gate Threshold vs Temperature

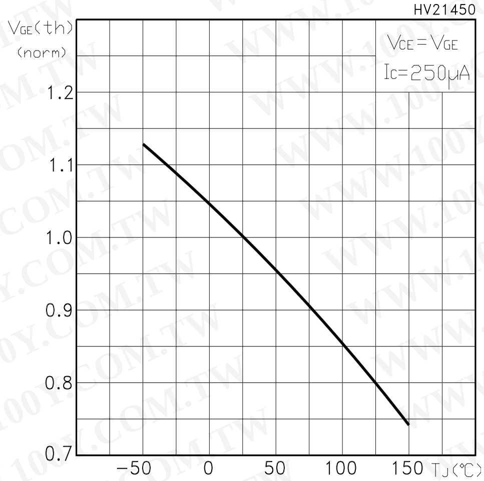


Figure 9: Normalized Breakdown Voltage vs Temperature

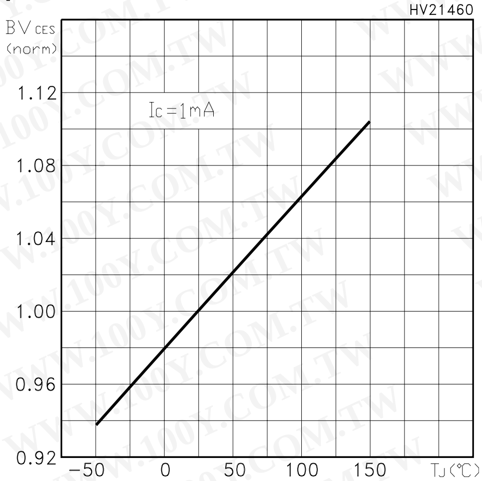


Figure 12: Gate Charge vs Gate-Emitter Voltage

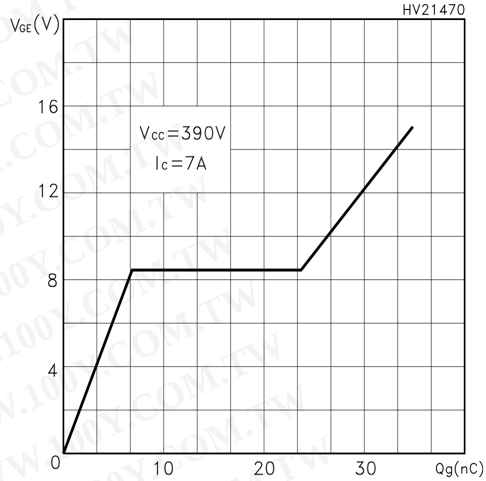


Figure 10: Capacitance Variations

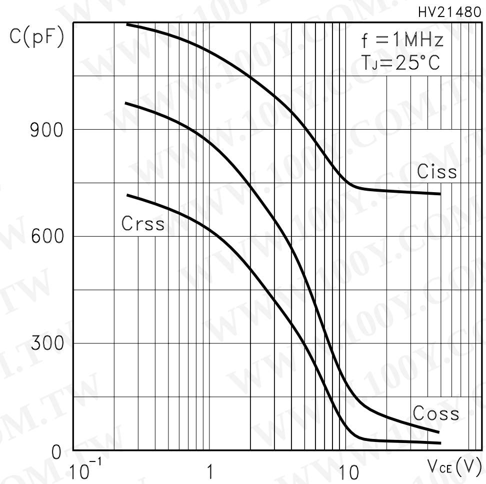


Figure 13: Total Switching Losses vs Temperature

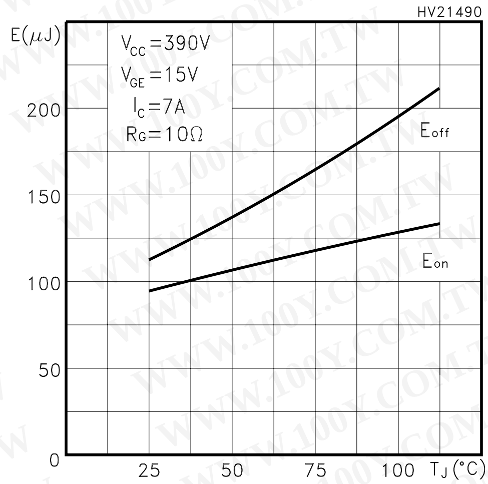


Figure 11: Total Switching Losses vs Gate Resistance

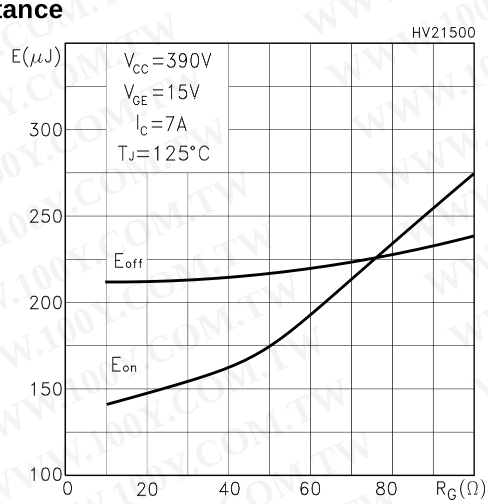


Figure 14: Total Switching Losses vs Collector Current

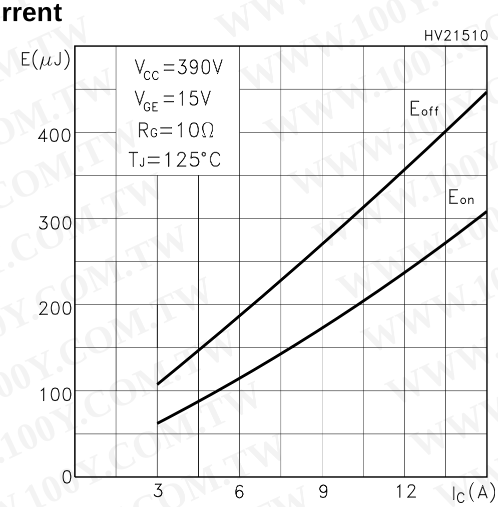


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Figure 15: Thermal Impedance for TO-220

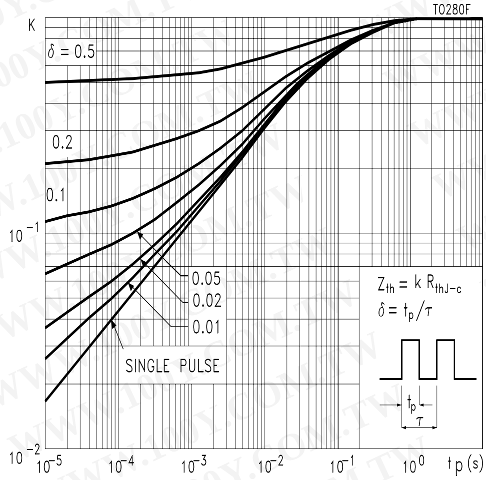


Figure 16: Thermal Impedance for DPAK

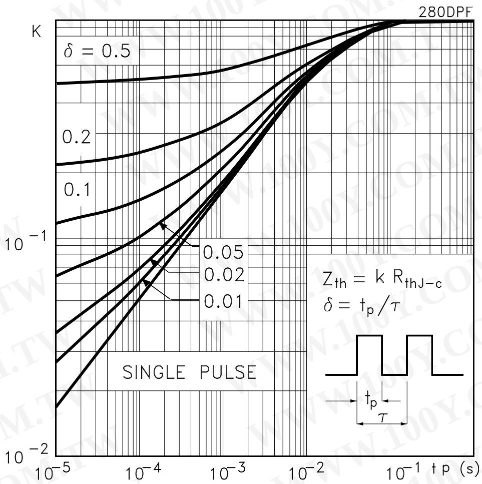


Figure 17: Turn-Off SOA

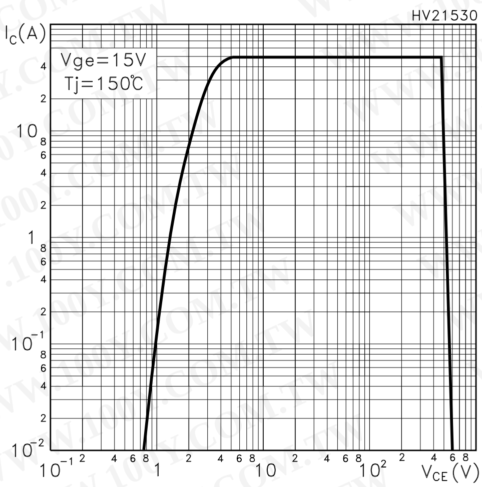
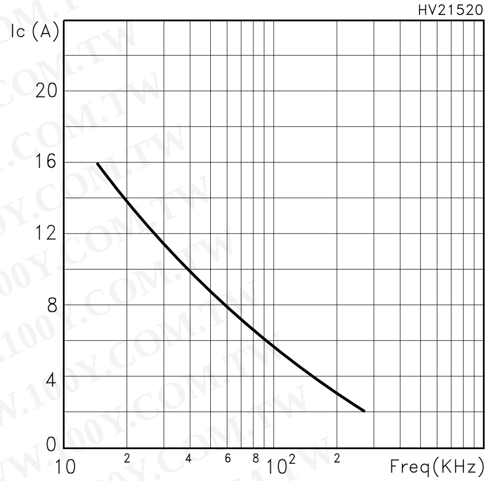


Figure 18: Ic vs Frequency



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:

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

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

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

considering $\Delta T = T_J - T_C$ = 125 °C- 75 °C = 50°C

2) The conduction losses are:

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

with 50% of duty cycle, V_{CESAT} typical value @125°C.

3) Power dissipation during ON & OFF commutations is due to the switching frequency:

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

4) Typical values @ 125°C for switching losses are used (test conditions: V_{CE} = 390V, V_{GE} = 15V, R_G = 3.3 Ohm). Furthermore, diode recovery energy is included in the E_{ON} (see note 2), while the tail of the collector current is included in the E_{OFF} measurements (see note 3).

Figure 19: Test Circuit for Inductive Load Switching

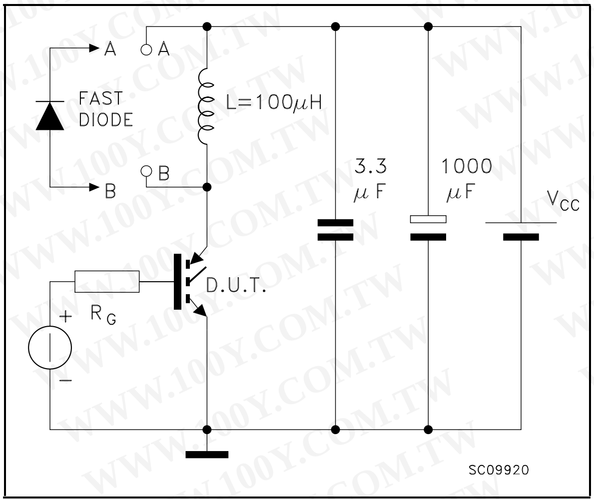


Figure 21: Gate Charge Test Circuit

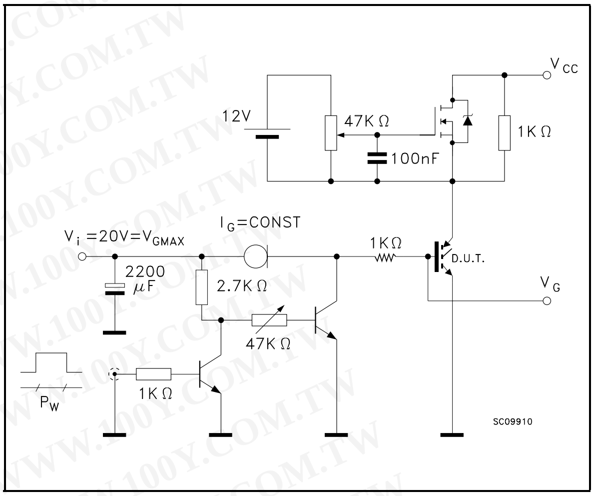
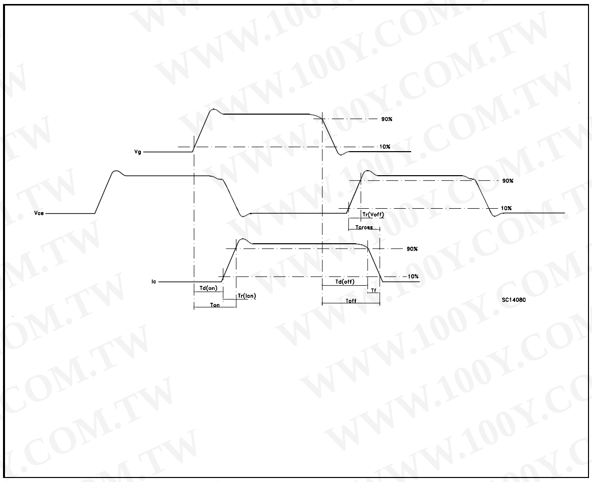
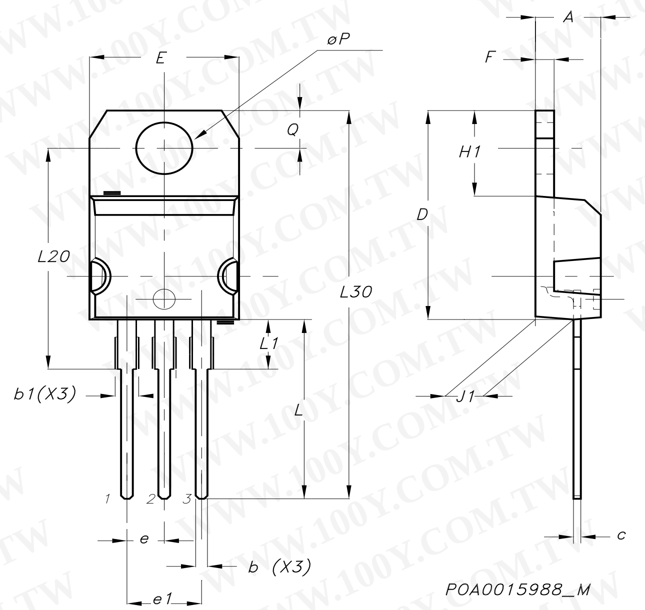


Figure 20: Switching Waveforms



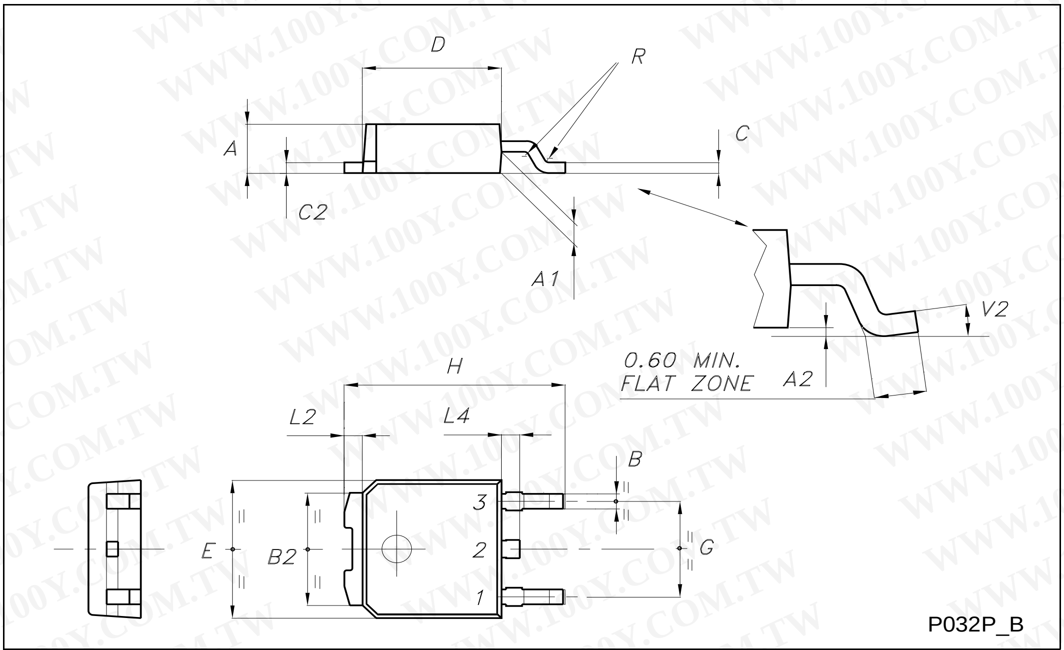
TO-220 MECHANICAL DATA

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

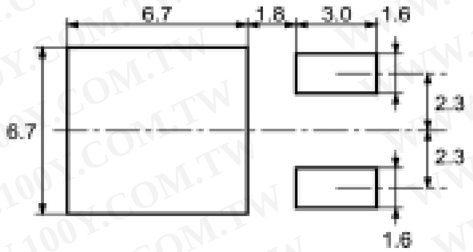


TO-252 (DPAK) MECHANICAL DATA

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^{o}		8^{o}	0^{o}		0^{o}

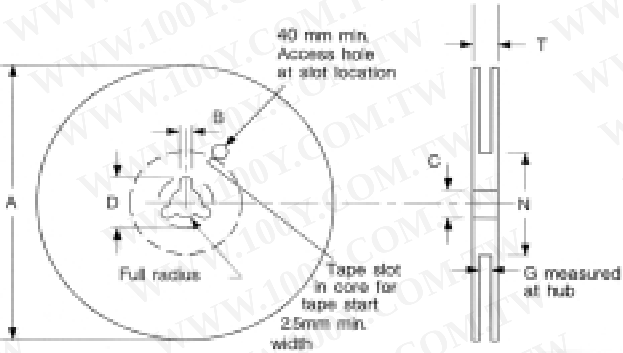


DPAK FOOTPRINT



All dimensions are in millimeters

TAPE AND REEL SHIPMENT



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	16.4	18.4	0.645	0.724
N	50		1.968	
T		22.4		0.881

BASE QTY	BULK QTY
2500	2500

TAPE MECHANICAL DATA

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

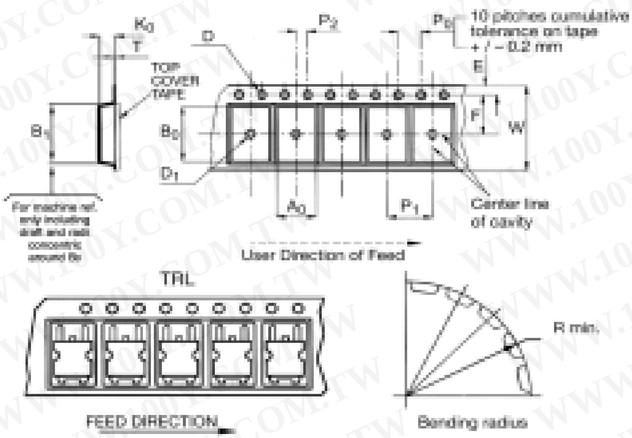


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Table 10: Revision History

Date	Revision	Description of Changes
20-Aug-2004	1	New datasheet
09-Jun-2005	2	Modified title

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