



# STP210NF02

## STB210NF02 STB210NF02-1

N-CHANNEL 20V - 0.0026  $\Omega$  - 120A D<sup>2</sup>PAK/I<sup>2</sup>PAK/TO-220

STripFET™ II POWER MOSFET

AUTOMOTIVE SPECIFIC

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>	P <sub>D</sub>
STB210NF02/-1	20 V	<0.0032 $\Omega$	120 A	300 W
STP210NF02	20 V	<0.0032 $\Omega$	120 A	300 W

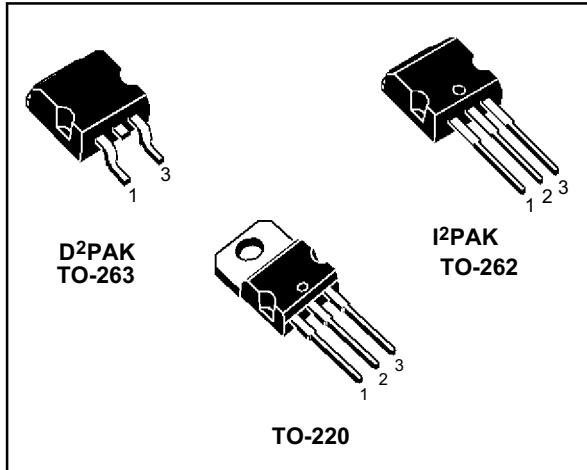
- TYPICAL R<sub>DS(on)</sub> = 0.0026  $\Omega$
- STANDARD THRESHOLD DRIVE
- 100% AVALANCHE TESTED

### DESCRIPTION

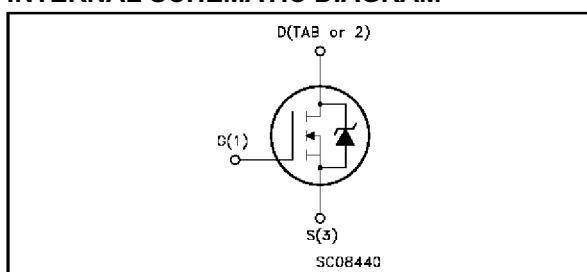
This Power MOSFET is the latest development of STMicroelectronics unique "Single Feature Size™" strip-based process. The resulting transistor shows extremely high packing density for low on-resistance, rugged avalanche characteristics and less critical alignment steps therefore a remarkable manufacturing reproducibility.

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- DC-DC & DC-AC CONVERTERS



### INTERNAL SCHEMATIC DIAGRAM



### Ordering Information

SALES TYPE	MARKING	PACKAGE	PACKAGING
STB210NF02	B210NF02	D <sup>2</sup> PAK	TUBE
STB210NF02T4	B210NF02	D <sup>2</sup> PAK	TAPE & REEL
STP210NF02	P210NF02	TO-220	TUBE
STB210NF02-1	B210NF02	I <sup>2</sup> PAK	TUBE

### ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	20	V
V <sub>DGR</sub>	Drain-gate Voltage (R <sub>GS</sub> = 20 k $\Omega$ )	20	V
V <sub>GS</sub>	Gate-source Voltage	$\pm 20$	V
I <sub>D</sub> (*)	Drain Current (continuos) at T <sub>C</sub> = 25°C	120	A
I <sub>D</sub>	Drain Current (continuos) at T <sub>C</sub> = 100°C	120	A
I <sub>DM</sub> (•)	Drain Current (pulsed)	480	A
P <sub>tot</sub>	Total Dissipation at T <sub>C</sub> = 25°C	300	W
	Derating Factor	2.0	W/ $^{\circ}$ C
dv/dt (1)	Peak Diode Recovery voltage slope	1	V/ns
E <sub>AS</sub> (2)	Single Pulse Avalanche Energy	2.3	J
T <sub>stg</sub>	Storage Temperature	-55 to 175	$^{\circ}$ C
T <sub>j</sub>	Operating Junction Temperature		

(\*) Pulse width limited by safe operating area.

(\*\*) Current Limited by Package

(1) I<sub>SD</sub> ≤ 120A, di/dt ≤ 250A/ $\mu$ s, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>j</sub> ≤ T<sub>JMAX</sub>

(2) Starting T<sub>j</sub> = 25 °C, I<sub>D</sub> = 60 A, V<sub>DD</sub> = 14 V

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### THERMAL DATA

R <sub>thj-case</sub> R <sub>thj-amb</sub> T <sub>I</sub>	Thermal Resistance Junction-case Thermal Resistance Junction-ambient Maximum Lead Temperature For Soldering Purpose	Max Max	0.5 62.5 300	°C/W °C/W °C
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### ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

#### OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>(BR)DSS</sub>	Drain-source Breakdown Voltage	I <sub>D</sub> = 250 μA V <sub>GS</sub> = 0	20			V
I <sub>DSS</sub>	Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0)	V <sub>DS</sub> = Max Rating V <sub>DS</sub> = Max Rating T <sub>C</sub> = 125 °C			1 10	μA μA
I <sub>GSS</sub>	Gate-body Leakage Current (V <sub>DS</sub> = 0)	V <sub>GS</sub> = ± 20V			±100	nA

#### ON (\*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V <sub>GS(th)</sub>	Gate Threshold Voltage	V <sub>DS</sub> = V <sub>GS</sub> I <sub>D</sub> = 250 μA	2		4	V
R <sub>DS(on)</sub>	Static Drain-source On Resistance	V <sub>GS</sub> = 10 V I <sub>D</sub> = 50 A		2.6	3.2	mΩ

#### DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g <sub>fs</sub> (*)	Forward Transconductance	V <sub>DS</sub> = 10 V I <sub>D</sub> = 50 A		130		S
C <sub>iss</sub> C <sub>oss</sub> C <sub>rss</sub>	Input Capacitance Output Capacitance Reverse Transfer Capacitance	V <sub>DS</sub> = 15V, f = 1 MHz, V <sub>GS</sub> = 0		5100 3500 800		pF pF pF

**ELECTRICAL CHARACTERISTICS (continued)**

**SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ $t_r$	Turn-on Delay Time Rise Time	$V_{DD} = 10 \text{ V}$ $I_D = 60 \text{ A}$ $R_G = 4.7 \Omega$ $V_{GS} = 10 \text{ V}$ (Resistive Load, Figure 3)		35 360		ns ns
$Q_g$ $Q_{gs}$ $Q_{gd}$	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 10 \text{ V}$ $I_D = 120 \text{ A}$ $V_{GS} = 10 \text{ V}$		125 40 50	150	nC nC nC

**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(off)}$ $t_f$	Turn-off Delay Time Fall Time	$V_{DD} = 10 \text{ V}$ $I_D = 60 \text{ A}$ $R_G = 4.7 \Omega$ , $V_{GS} = 10 \text{ V}$ (Resistive Load, Figure 3)		75 110		ns ns

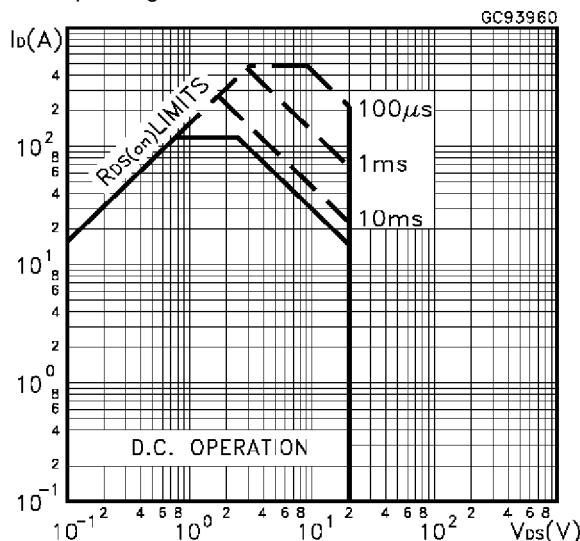
**SOURCE DRAIN DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM} (\bullet)$	Source-drain Current Source-drain Current (pulsed)				120 480	A A
$V_{SD} (*)$	Forward On Voltage	$I_{SD} = 120 \text{ A}$ $V_{GS} = 0$			1.3	V
$t_{rr}$ $Q_{rr}$ $I_{RRM}$	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 120 \text{ A}$ $di/dt = 100 \text{ A}/\mu\text{s}$ $V_{DD} = 15 \text{ V}$ $T_j = 150^\circ\text{C}$ (see test circuit, Figure 5)		70 120 3.5		ns nC A

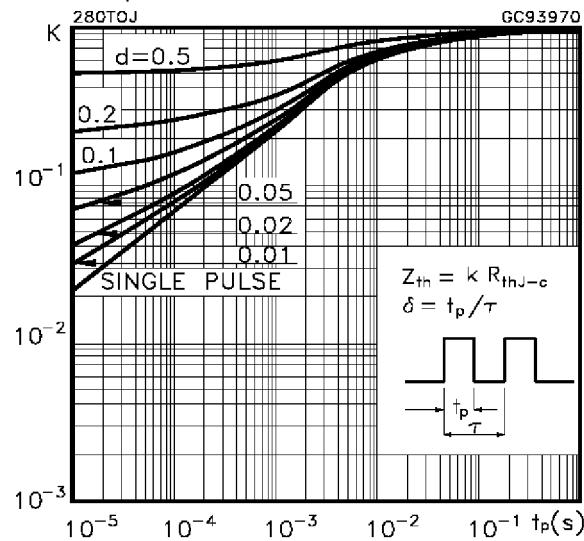
(\*)Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.

(•)Pulse width limited by safe operating area.

Safe Operating Area

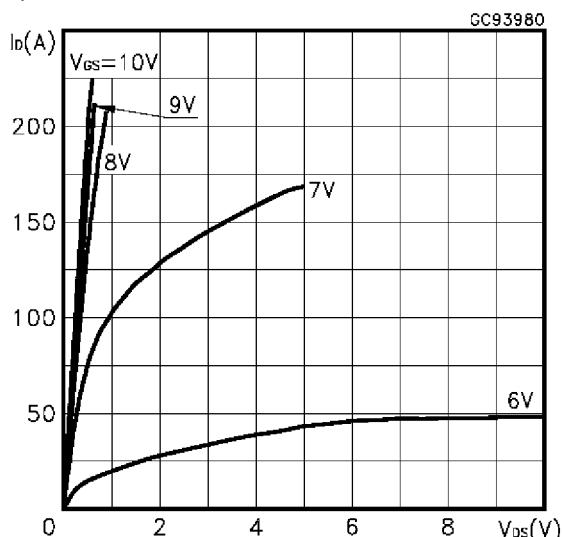


Thermal Impedance

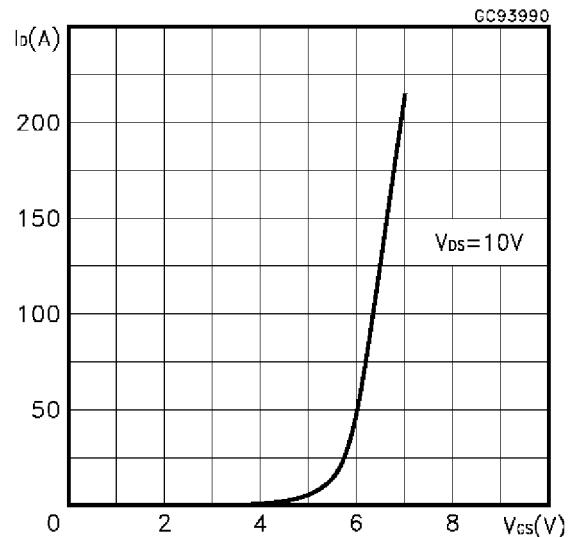


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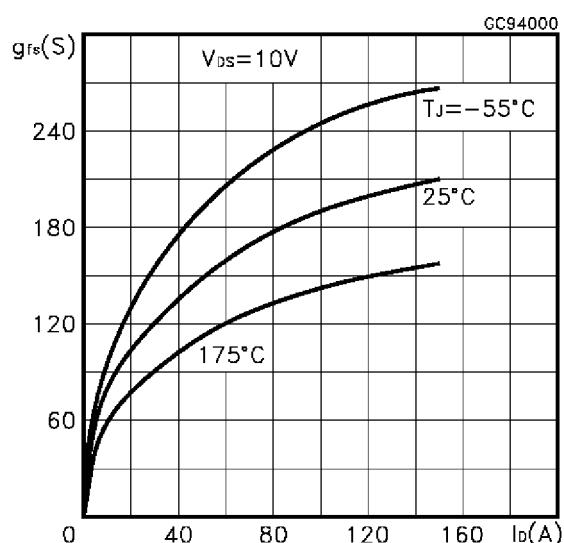
Output Characteristics



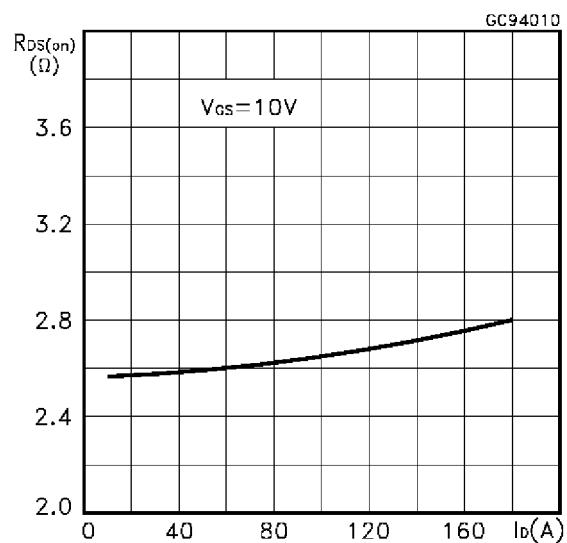
Transfer Characteristics



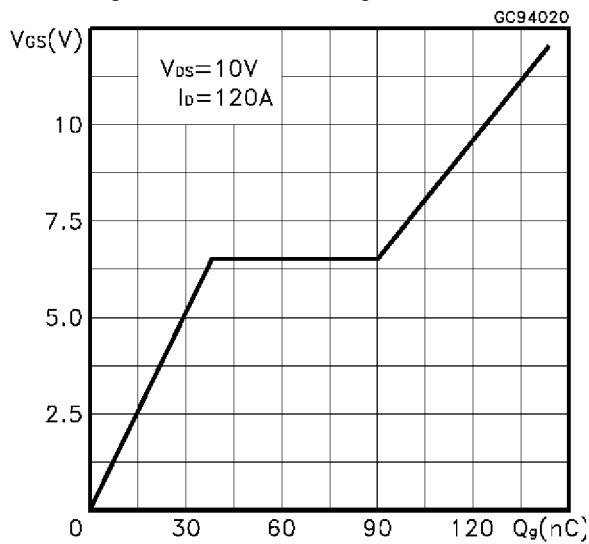
Transconductance



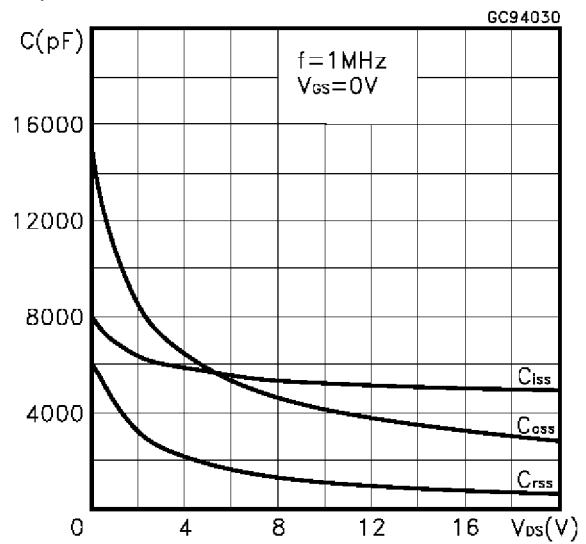
Static Drain-source On Resistance

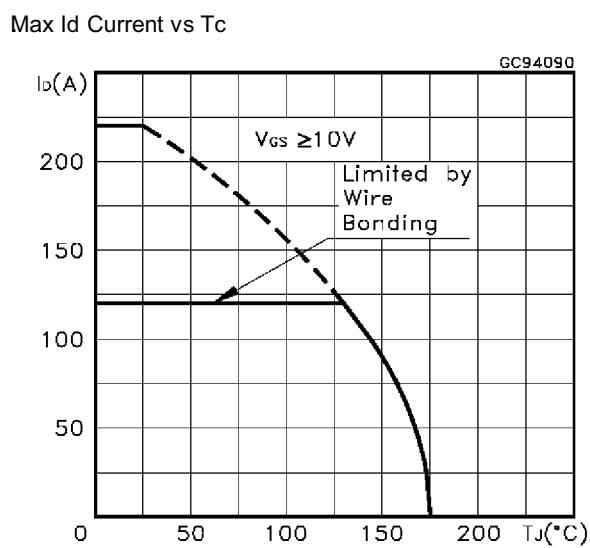
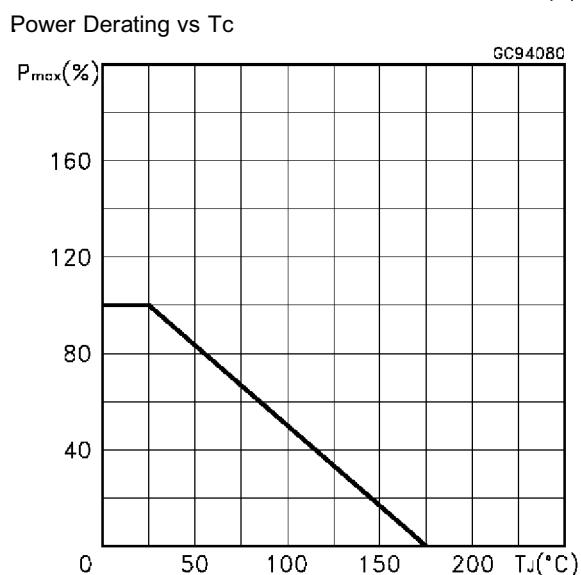
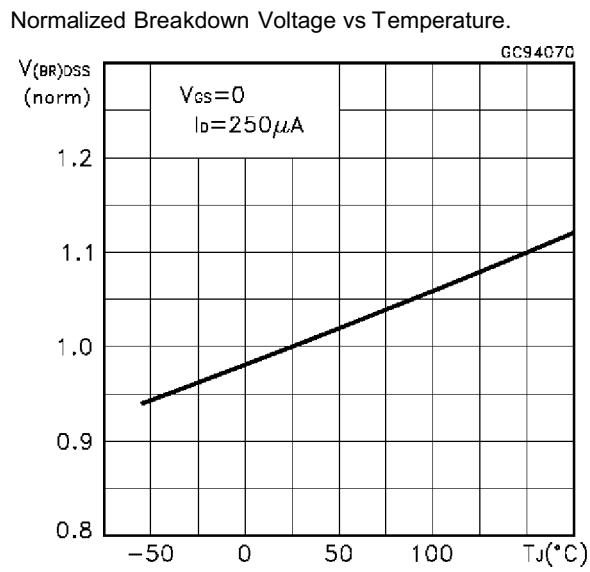
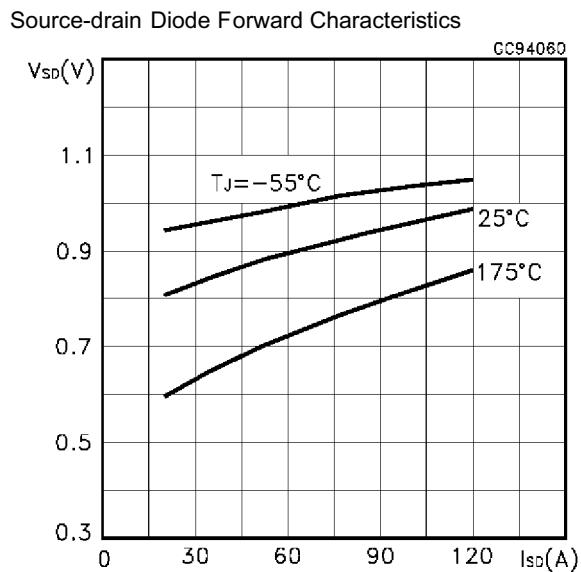
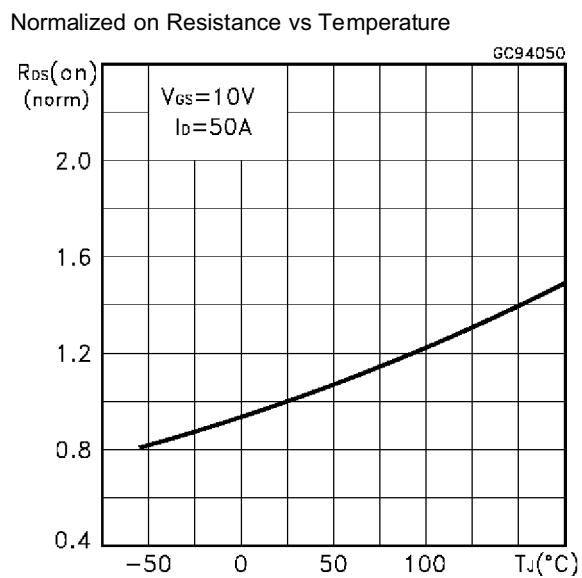
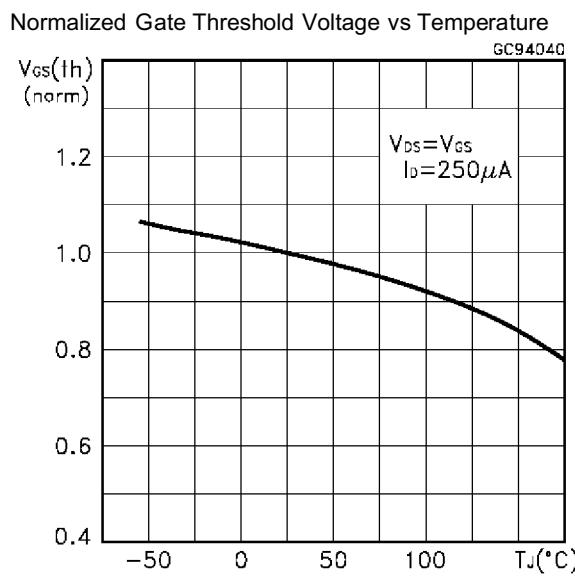


Gate Charge vs Gate-source Voltage



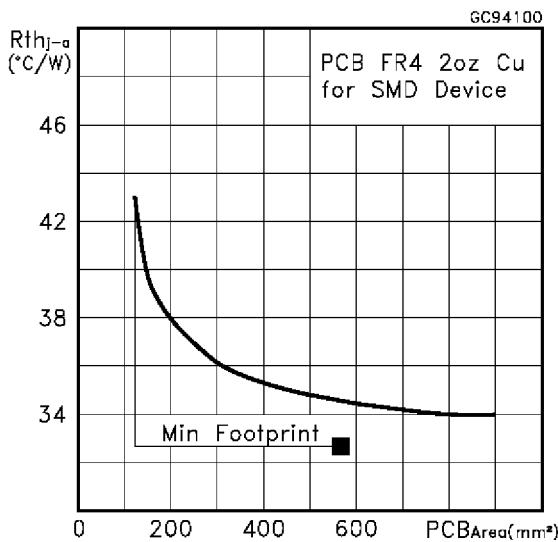
Capacitance Variations



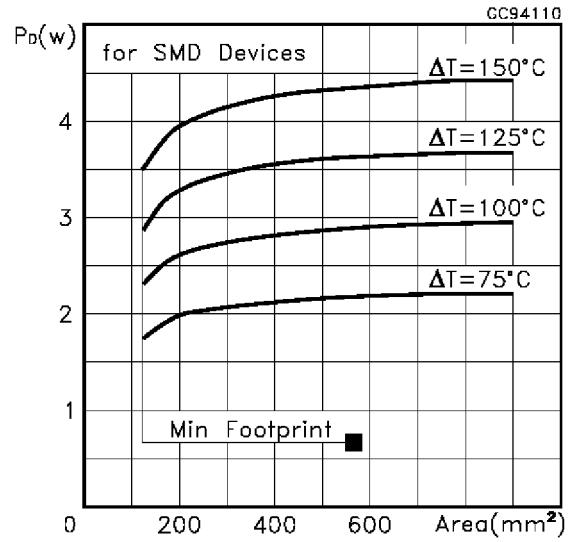


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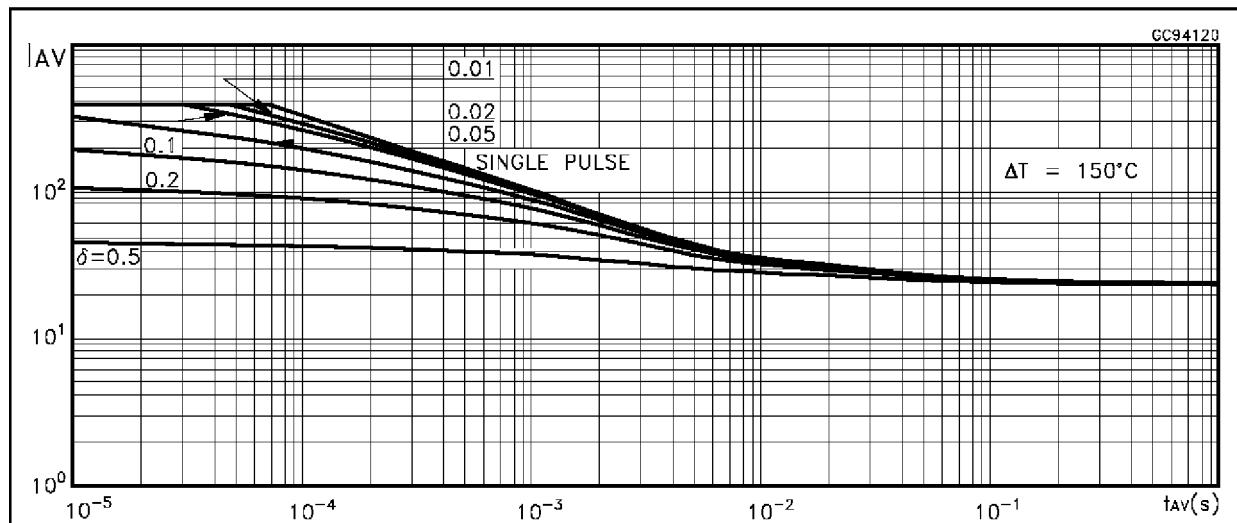
Thermal Resistance R<sub>thj-a</sub> vs PCB Copper Area



Max Power Dissipation vs PCB Copper Area



Allowable I<sub>AV</sub> vs. Time in Avalanche



The previous curve gives the safe operating area for unclamped inductive loads, single pulse or repetitive, under the following conditions:

$$P_{D(AVE)} = 0.5 * (1.3 * BV_{DSS} * I_{AV})$$

$$E_{AS(AR)} = P_{D(AVE)} * t_{AV}$$

Where:

I<sub>AV</sub> is the Allowable Current in Avalanche

P<sub>D(AVE)</sub> is the Average Power Dissipation in Avalanche (Single Pulse)

t<sub>AV</sub> is the Time in Avalanche

To derate above 25 °C, at fixed I<sub>AV</sub>, the following equation must be applied:

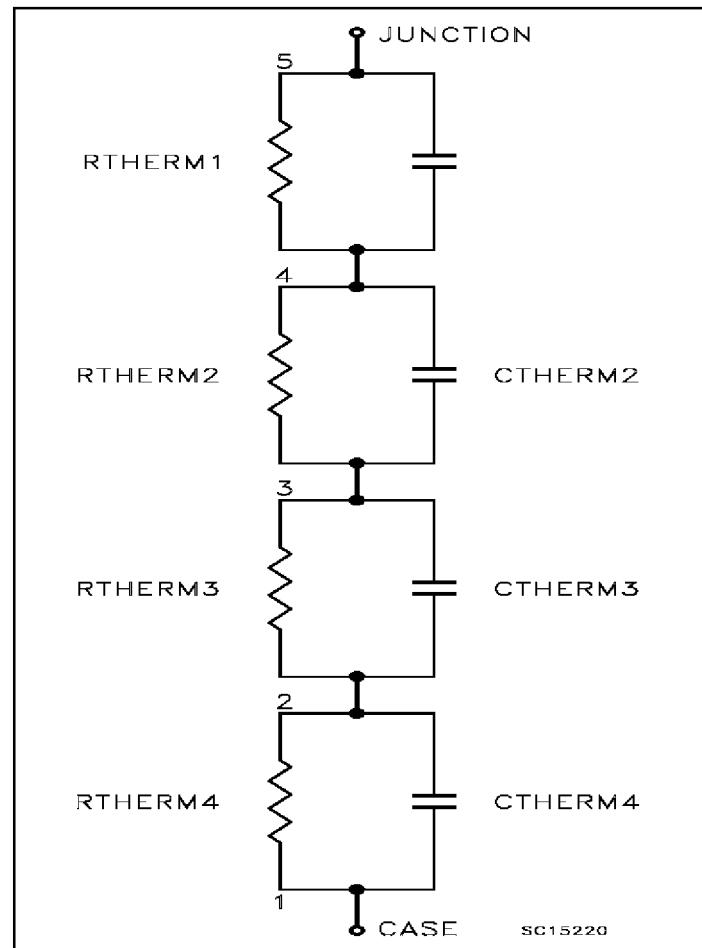
$$I_{AV} = 2 * (T_{jmax} - T_{CASE}) / (1.3 * BV_{DSS} * Z_{th})$$

Where:

Z<sub>th</sub> = K \* R<sub>th</sub> is the value coming from Normalized Thermal Response at fixed pulse width equal to T<sub>AV</sub>.

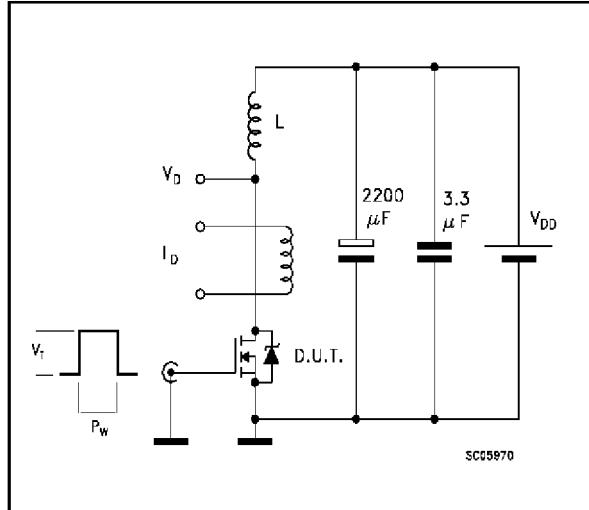
**SPICE THERMAL MODEL**

Parameter	Node	Value
CTHERM1	5 - 4	0.011
CTHERM2	4 - 3	0.0012
CTHERM3	3 - 2	0.05
CTHERM4	2 - 1	0.1
<hr/>		
RTHERM1	5 - 4	0.09
RTHERM2	4 - 3	0.02
RTHERM3	3 - 2	0.11
RTHERM4	2 - 1	0.17

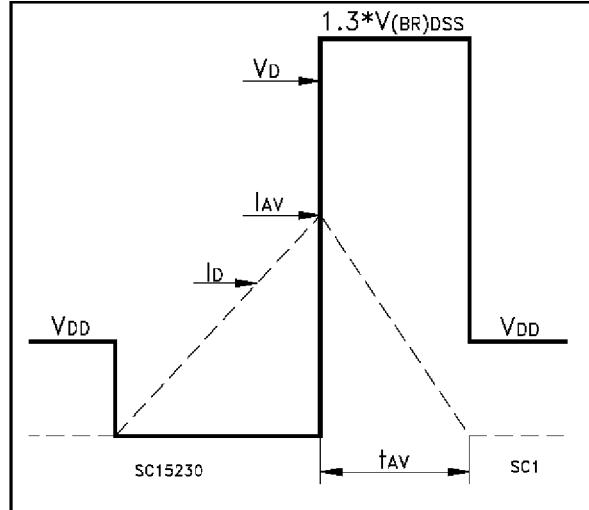


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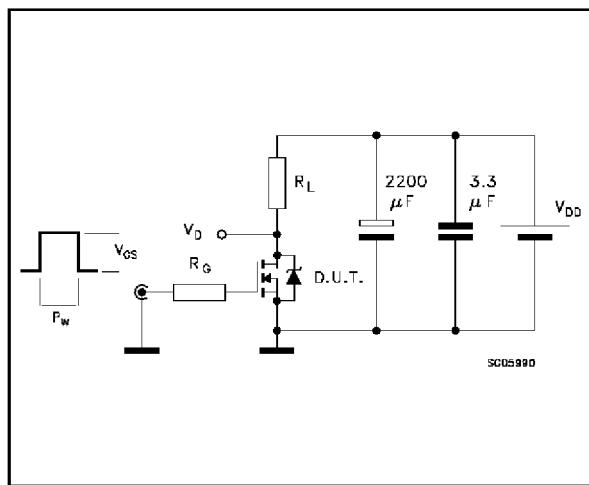
**Fig. 1: Unclamped Inductive Load Test Circuit**



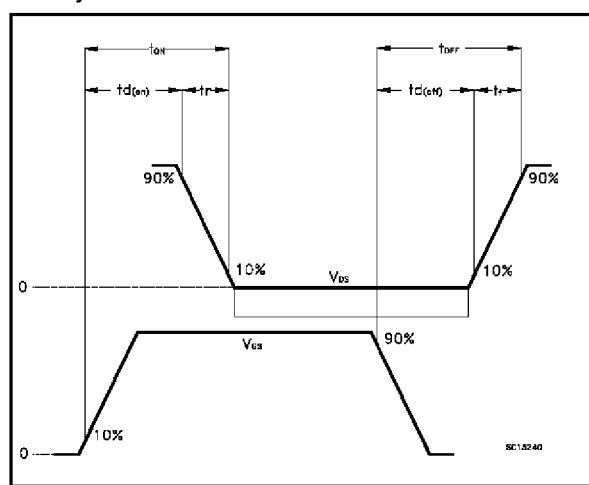
**Fig. 2: Unclamped Inductive Waveform**



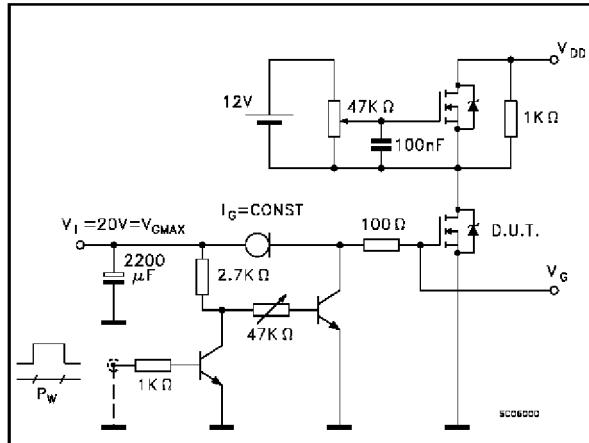
**Fig. 3: Switching Times Test Circuits For Resistive Load**



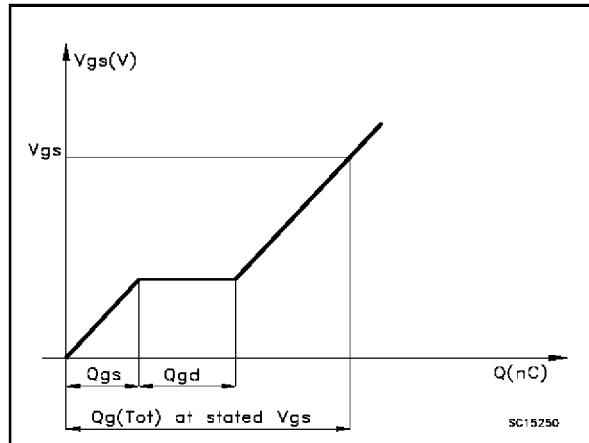
**Fig. 3.1: Inductive Load Switching and Diode Recovery Times Waveform**



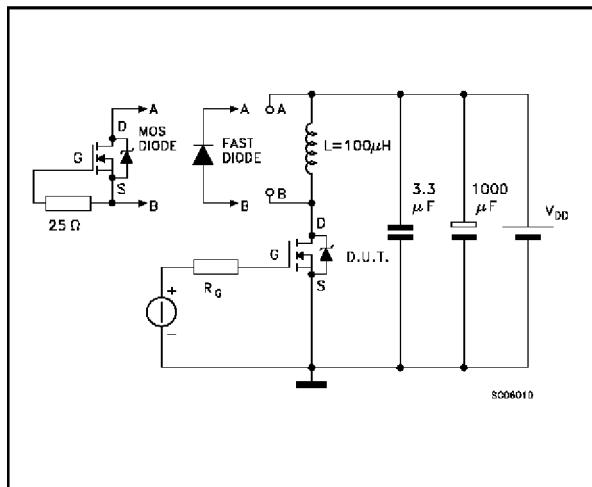
**Fig. 4: Gate Charge Test Circuit**



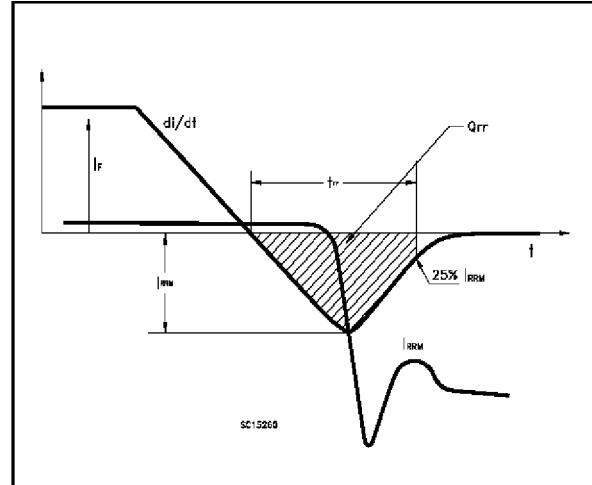
**Fig. 4.1: Gate Charge Test Waveform**



**Fig. 5:** Unclamped Inductive Load Test Circuit

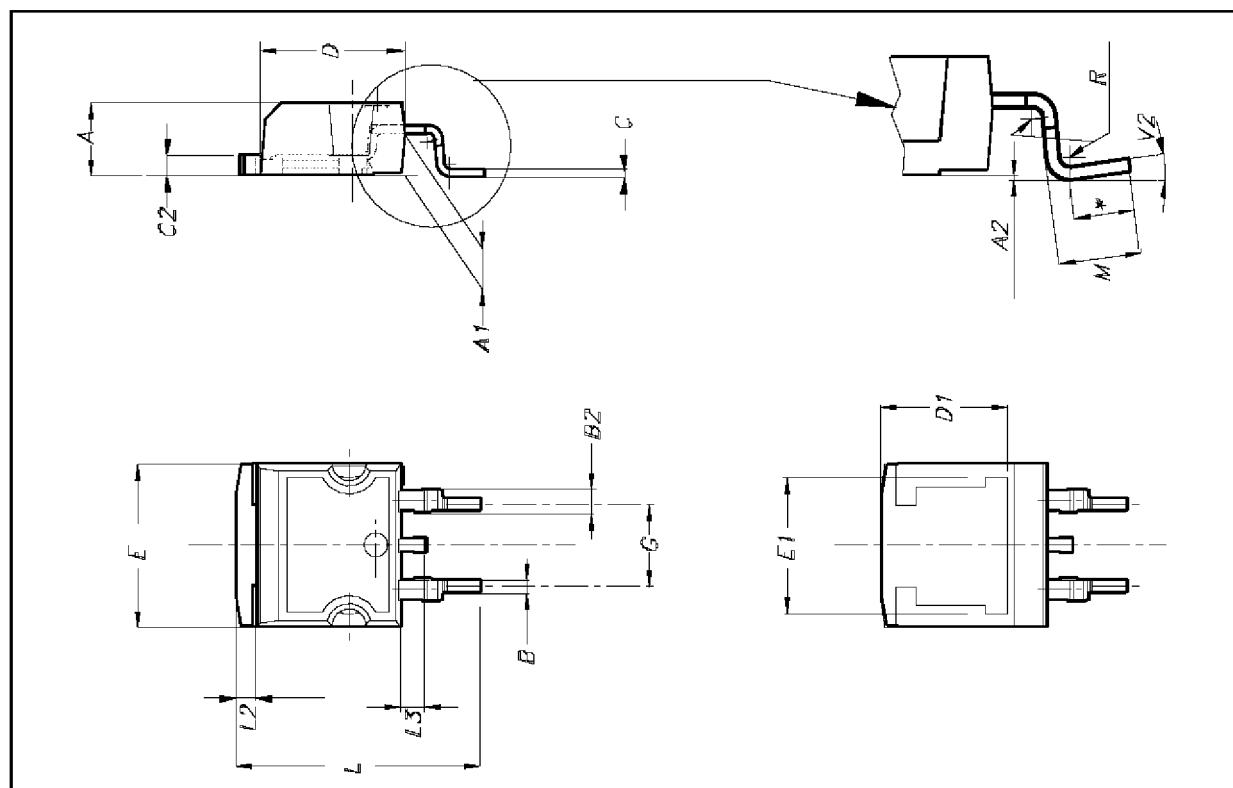


**Fig. 5.1:** Diode Recovery Times Waveform



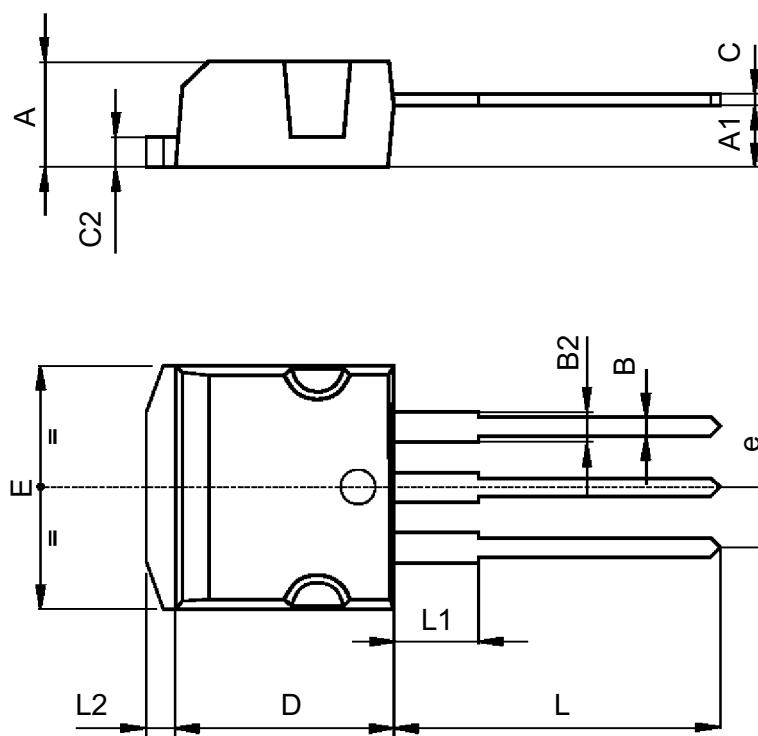
**D<sup>2</sup>PAK MECHANICAL DATA**

DIM.	mm.			inch.		
	MIN.	TYP.	MAX.	MIN.	TYP.	TYP.
<b>A</b>	4.4		4.6	0.173		0.181
<b>A1</b>	2.49		2.69	0.098		0.106
<b>A2</b>	0.03		0.23	0.001		0.009
<b>B</b>	0.7		0.93	0.028		0.037
<b>B2</b>	1.14		1.7	0.045		0.067
<b>C</b>	0.45		0.6	0.018		0.024
<b>C2</b>	1.21		1.36	0.048		0.054
<b>D</b>	8.95		9.35	0.352		0.368
<b>D1</b>		8			0.315	
<b>E</b>	10		10.4	0.394		0.409
<b>E1</b>	8.5				0.334	
<b>G</b>	4.88		5.28	0.192		0.208
<b>L</b>	15		15.85	0.591		0.624
<b>L2</b>	1.27		1.4	0.050		0.055
<b>L3</b>	1.4		1.75	0.055		0.069
<b>M</b>	2.4		3.2	0.094		0.126
<b>R</b>		0.4			0.016	
<b>V2</b>	0°		8°	0°		8°



TO-262 (I<sup>2</sup>PAK) MECHANICAL DATA

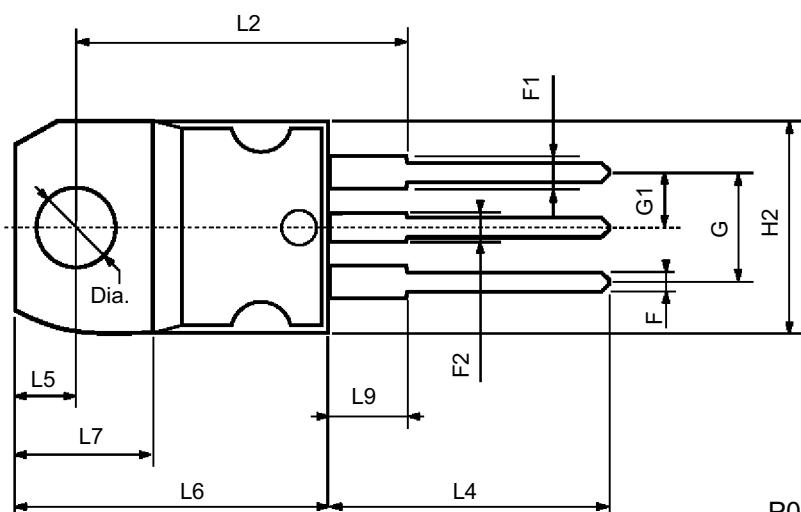
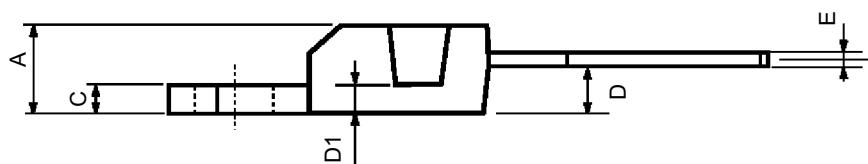
DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.4		4.6	0.173		0.181
A1	2.49		2.69	0.098		0.106
B	0.7		0.93	0.027		0.036
B2	1.14		1.7	0.044		0.067
C	0.45		0.6	0.017		0.023
C2	1.23		1.36	0.048		0.053
D	8.95		9.35	0.352		0.368
e	2.4		2.7	0.094		0.106
E	10		10.4	0.393		0.409
L	13.1		13.6	0.515		0.531
L1	3.48		3.78	0.137		0.149
L2	1.27		1.4	0.050		0.055

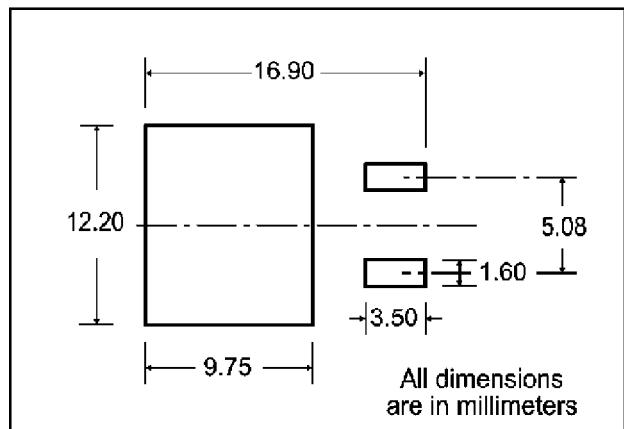
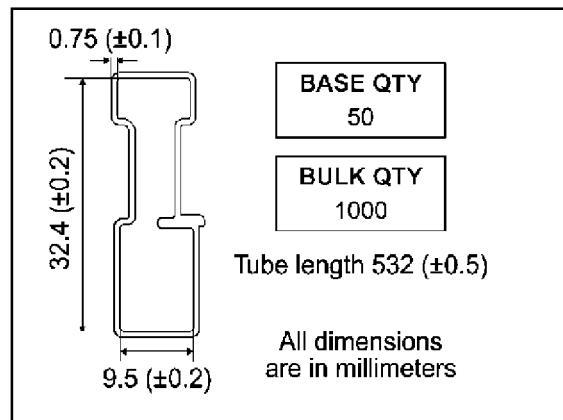
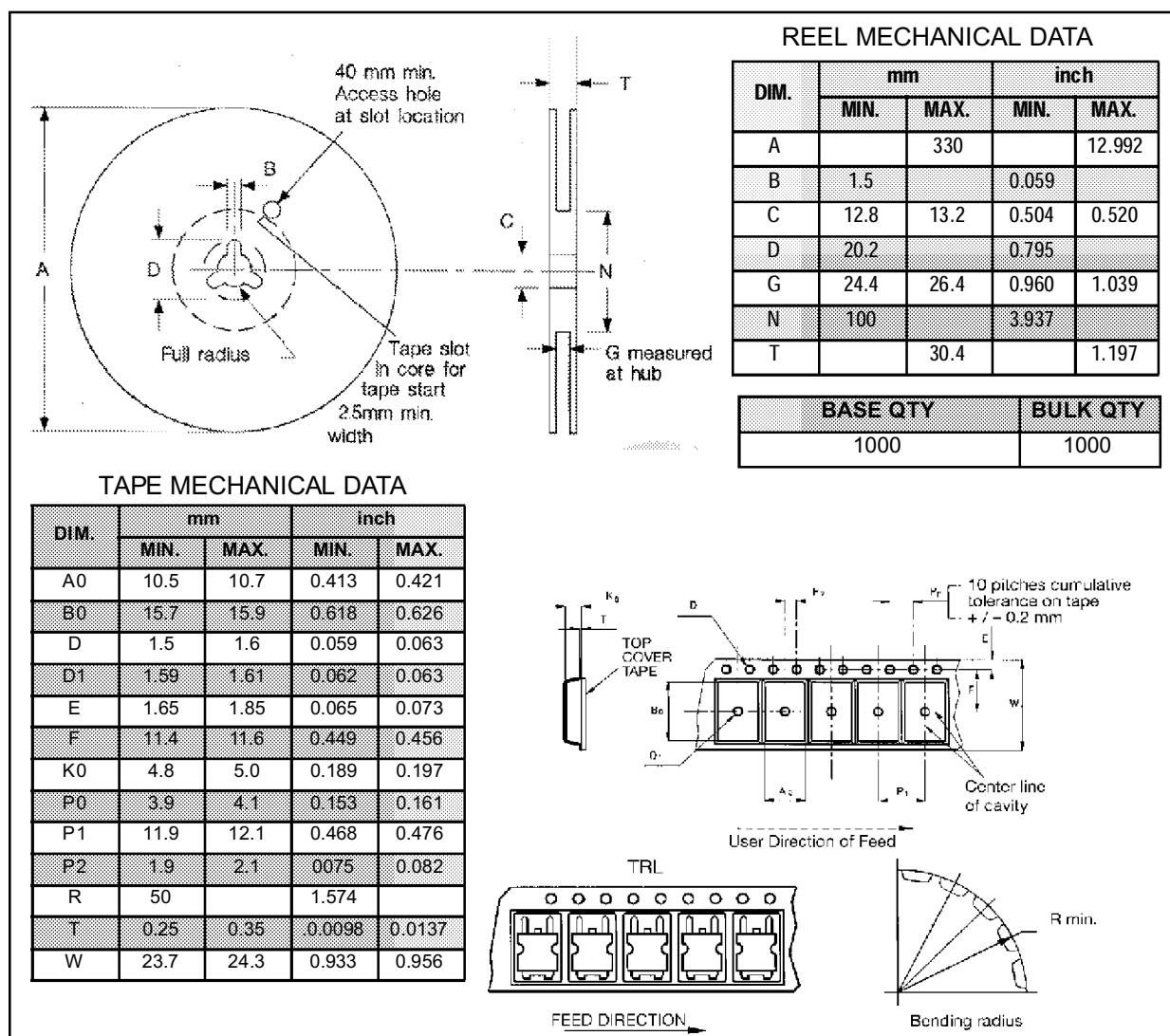


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**TO-220 MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	4.40		4.60	0.173		0.181
C	1.23		1.32	0.048		0.051
D	2.40		2.72	0.094		0.107
D1		1.27			0.050	
E	0.49		0.70	0.019		0.027
F	0.61		0.88	0.024		0.034
F1	1.14		1.70	0.044		0.067
F2	1.14		1.70	0.044		0.067
G	4.95		5.15	0.194		0.203
G1	2.4		2.7	0.094		0.106
H2	10.0		10.40	0.393		0.409
L2		16.4			0.645	
L4	13.0		14.0	0.511		0.551
L5	2.65		2.95	0.104		0.116
L6	15.25		15.75	0.600		0.620
L7	6.2		6.6	0.244		0.260
L9	3.5		3.93	0.137		0.154
DIA.	3.75		3.85	0.147		0.151



**D<sup>2</sup>PAK FOOTPRINT****TUBE SHIPMENT (no suffix)\*****TAPE AND REEL SHIPMENT (suffix "T4")\***

\* on sales type

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