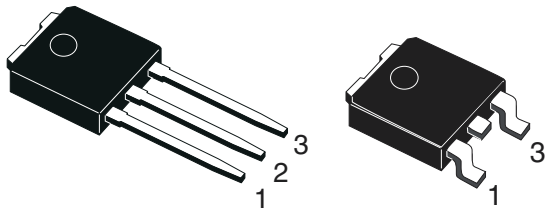
STD9N10
STD9N10-1

N-CHANNEL 100V - 0.23 Ω - 9A DPAK/IPAK
POWER MOS TRANSISTOR

Table 1. General Features

Type	V_{DSS}	$R_{DS(on)}$	I_D
STD9N10	100 V	< 0.27 Ω	9 A
STD9N10-1	100 V	< 0.27 Ω	9 A

Figure 1. Package



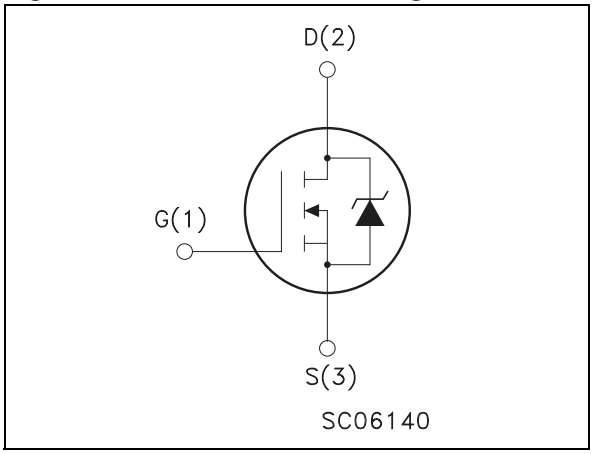
IPAK
TO-251

DPAK
TO-252

FEATURES SUMMARY

- TYPICAL $R_{DS(on)}$ = 0.23 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- 175°C OPERATING TEMPERATURE
- APPLICATION ORIENTED CHARACTERIZATION
- THROUGH-HOLE IPAK (TO-251) POWER PACKAGE IN TUBE (SUFFIX "-1")
- SURFACE-MOUNTING DPAK (TO-252) POWER PACKAGE IN TAPE & REEL (SUFFIX "T4")

Figure 2. Internal Schematic Diagram



APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SOLENOID AND RELAY DRIVERS
- REGULATORS
- DC-DC & DC-AC CONVERTERS
- MOTOR CONTROL, AUDIO AMPLIFIERS
- AUTOMOTIVE ENVIRONMENT (INJECTION, ABS, AIR-BAG, LAMPDRIVERS, Etc.)

Table 2. Order Codes

Part Number	Marking	Package	Packaging
STD9N10T4	D9N10	DPAK	TAPE & REEL
STD9N10-1	D9N10	IPAK	TUBE

Table 3. Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source Voltage (V_{GS} = 0)	100	V
V_{DGR}	Drain- gate Voltage (R_{GS} = 20 kΩ)	100	V
V_{GS}	Gate-source Voltage	± 20	V
I_D	Drain Current (cont.) at T_C = 25 °C	9	A
I_D	Drain Current (cont.) at T_C = 100 °C	6	A
I_{DM} (1)	Drain Current (pulsed)	36	A
P_{tot}	Total Dissipation at T_C = 25 °C	45	W
	Derating Factor	0.3	W°/C
T_{stg}	Storage Temperature	-65 to 175	°C
T_j	Max. Operating Junction Temperature	175	°C

Note: 1. Pulse width limited by safe operating area.

Table 4. Thermal Data

Symbol	Parameter		Value	Unit
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	3.33	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	100	°C/W
T_l	Maximum Lead Temperature For Soldering Purpose		275	°C

Table 5. Avalanche Characteristics

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max, δ < 1%)	9	A
E_{AS}	Single Pulse Avalanche Energy (starting T_j = 25 °C; I_D = I_{AR}; V_{DD} = 25 V)	30	mJ
E_{AR}	Repetitive Avalanche Energy (pulse width limited by T_j max, δ < 1%)	7	mJ
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (T_c = 100 °C, pulse width limited by T_j max, δ < 1%)	6	A

ELECTRICAL CHARACTERISTICS (T_{case} = 25°C unless otherwise specified)

Table 6. Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	I_D = 250 µA; V_{GS} = 0	100			V
I_{DSS}	Zero Gate Voltage	V_{DS} = Max Rating			250	µA
	Drain Current (V_{GS} = 0)	V_{DS} = Max Rating x 0.8; Tc = 125 °C			1000	µA
I_{GSS}	Gate-body Leakage Current (V_{DS} = 0)	V_{GS} = ± 20 V			± 100	nA

Table 7. On (1)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	V_{DS} = V_{GS}; I_D = 250 µA	2	3	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	V_{GS} = 10V; I_D = 4.5 A V_{GS} = 10V; I_D = 4.5 A; Tc = 100 °C		0.23	0.27 0.54	Ω Ω

Note: 1. Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

Table 8. Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (1)	Forward Transconductance	V_{DS} > $I_{D(on)}$ x $R_{DS(on)max}$; I_D = 4.5 A	2	4		S
C_{iss}	Input Capacitance	V_{DS} = 25 V; f = 1 MHz; V_{GS} = 0		330	450	pF
C_{oss}	Output Capacitance			90	120	pF
C_{rss}	Reverse Transfer Capacitance			25	40	pF

Note: 1. Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

Table 9. Switching On

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
td(on)	Turn-on Time	V_{DD} = 50 V; I_D = 4.5 A; R_G = 4.7 Ω		10	15	ns
tr	Rise Time	V_{GS} = 10 V (see test circuit, Figure 22)		40	60	ns
(di/dt)on	Turn-on Current Slope	V_{DD} = 80 V; I_D = 9 A; R_G = 4.7 Ω V_{GS} = 10 V (see test circuit, Figure 22)		440		A/µs
Q_g	Total Gate Charge	V_{DD} = 80 V; I_D = 9 A; V_{GS} = 10 V		15	25	nC
Q_{gs}	Gate-Source Charge			6		nC
Q_{gd}	Gate-Drain Charge			5		nC

Table 10. Switching Off

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	V_{DD} = 80 V; I_D = 9 A; R_G = 4.7 Ω		15	25	ns
t_f	Fall Time	V_{GS} = 10 V (see test circuit, Figure 24)		25	35	ns
t_c	Cross-over Time			50	70	ns

Table 11. Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				9	A
I_{SDM} (1)	Source-drain Current (pulsed)				36	A
V_{SD} (2)	Forward On Voltage	I_{SD} = 9 A; V_{GS} = 0			1.5	V
t_{rr}	Reverse Recovery Time	I_{SD} = 9 A; di/dt = 100 A/µs V_{DD} = 20 V; T_j = 150 °C (see test circuit, Figure 24)		80		ns
Q_{rr}	Reverse RecoveryCharge			0.2		µC
I_{RRAM}	Reverse RecoveryCurrent			5		A

Note: 1. Pulse width limited by safe operating area
2. Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

Figure 3. Safe Operating Area

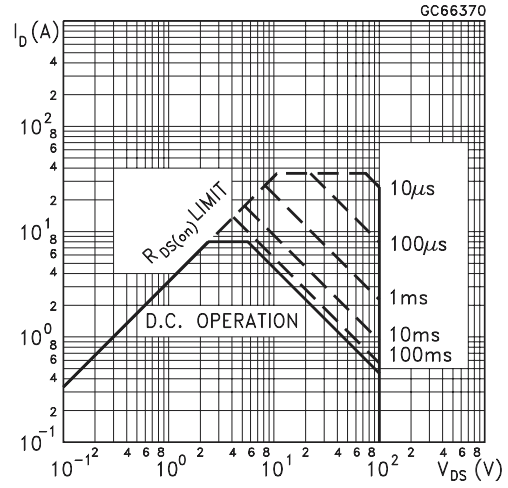


Figure 4. Thermal Impedance

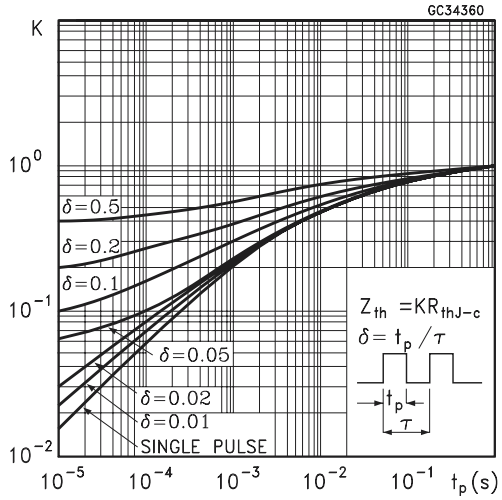


Figure 5. Derating Curve

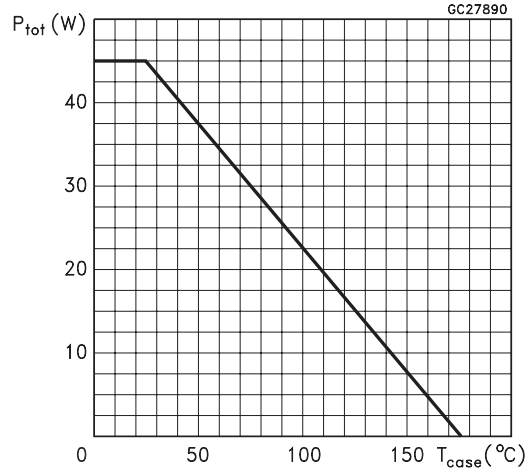


Figure 6. Output Characteristics

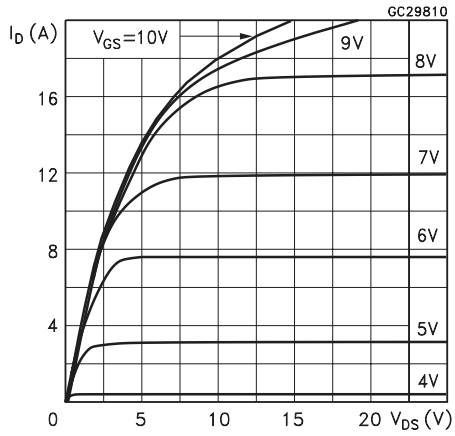


Figure 7. Transfer Characteristics

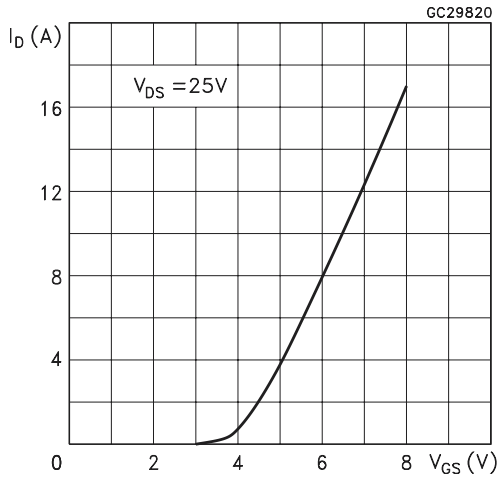


Figure 8. Transconductance

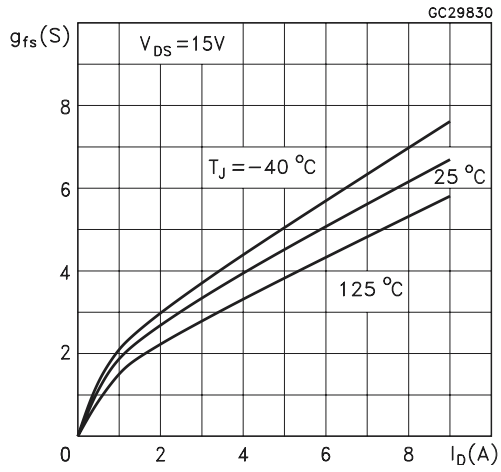


Figure 9. Static Drain-source On Resistance

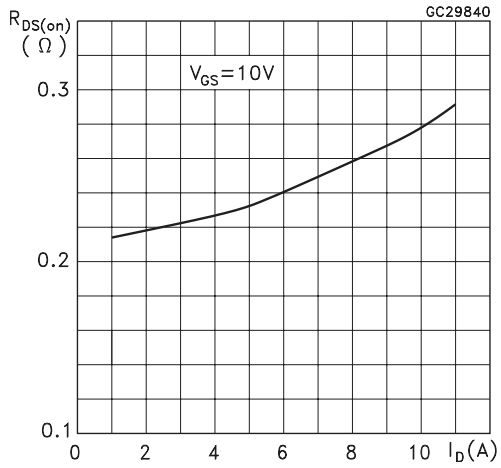


Figure 10. Gate Charge vs Gate-source Voltage

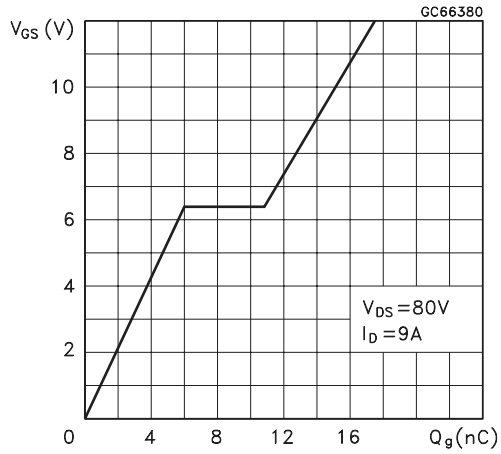


Figure 11. Capacitance Variations

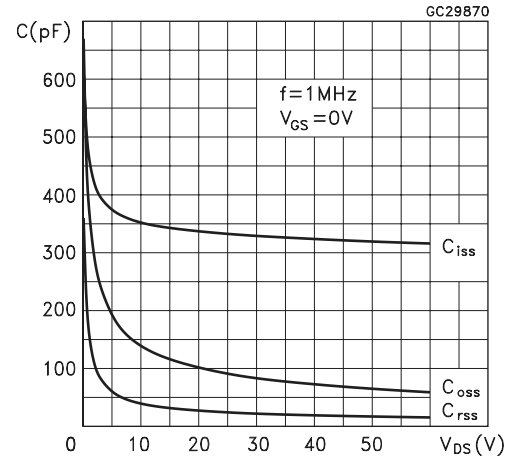


Figure 12. Normalized Gate Threshold Voltage vs Temperature

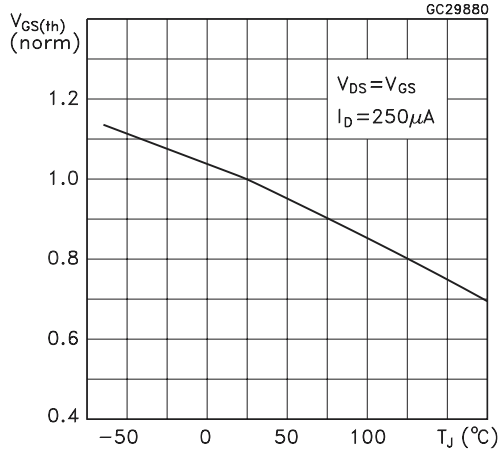


Figure 13. Normalized On Resistance vs Temperature

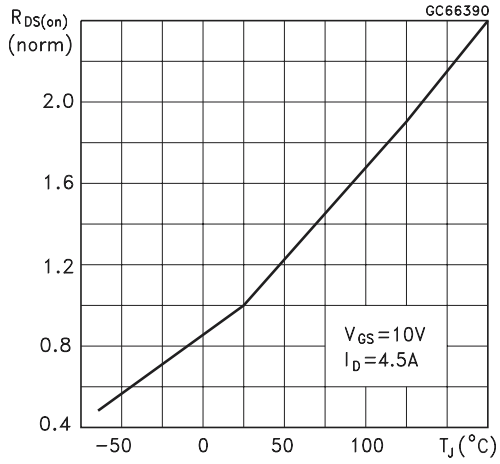


Figure 14. Turn-on Current Slope

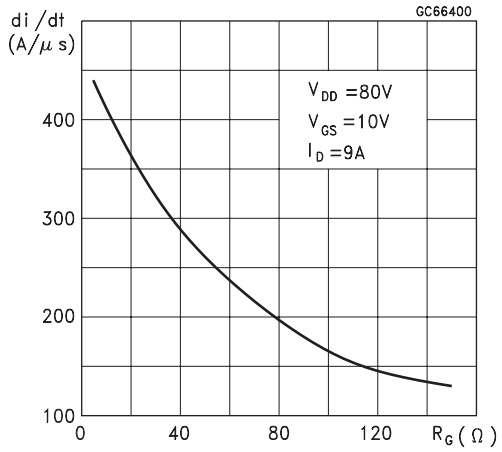


Figure 15. Turn-off Drain-source Voltage Slope

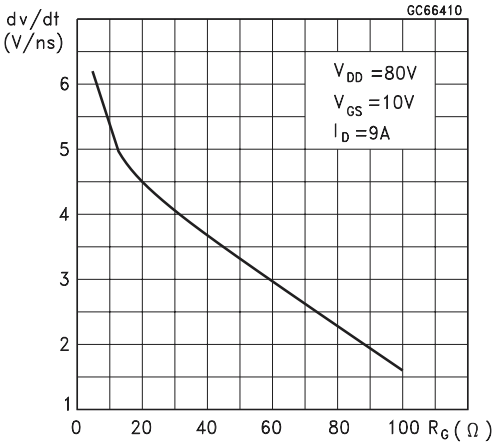


Figure 16. Cross-over Time

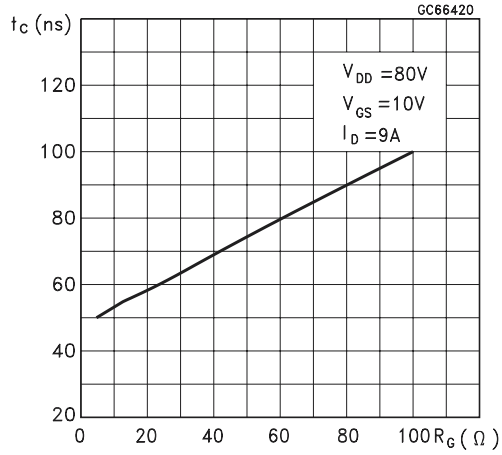


Figure 17. Switching Safe Operating Area

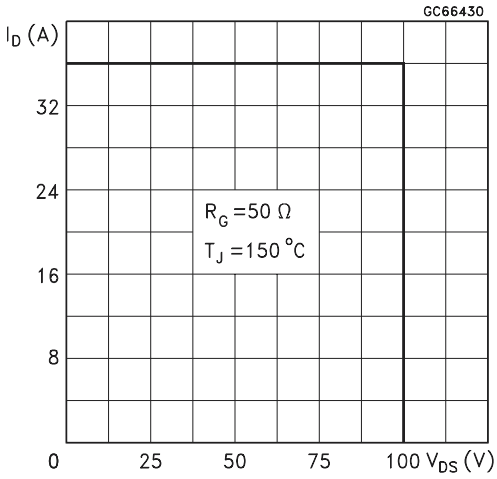


Figure 18. Accidental Overload Area

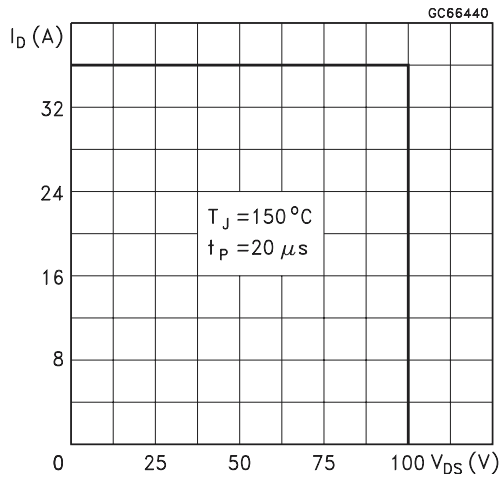


Figure 19. Source-drain Diode Forward Characteristics

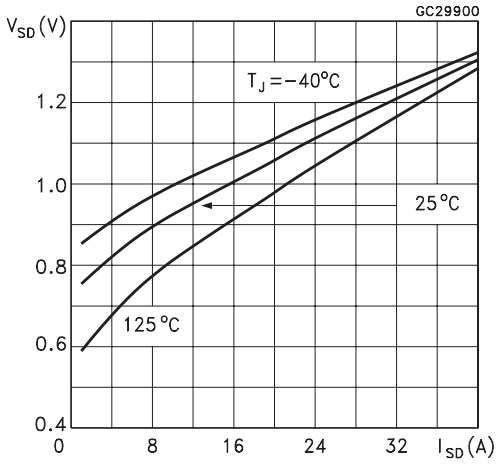


Figure 20. Unclamped Inductive Load Test Circuit

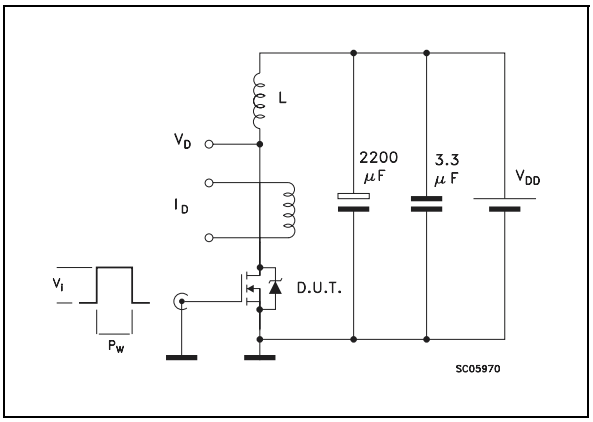


Figure 21. Unclamped Inductive Waveforms

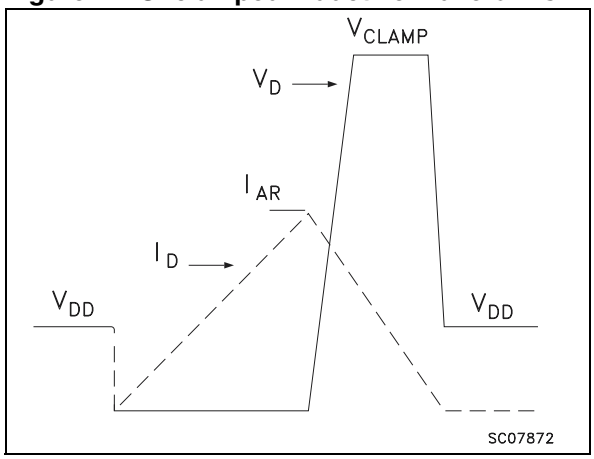


Figure 22. Switching Times Test Circuits For Resistive Load

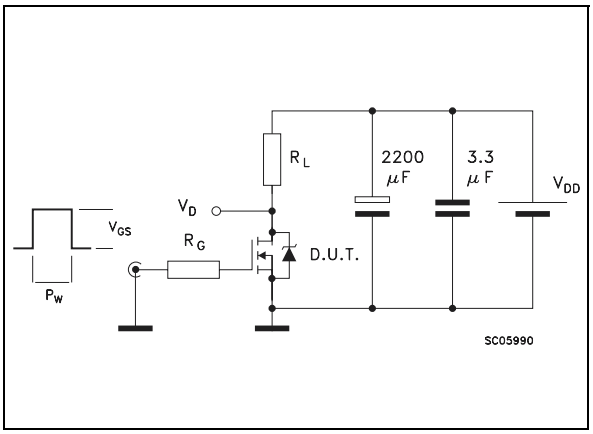


Figure 23. Gate Charge Test Circuit

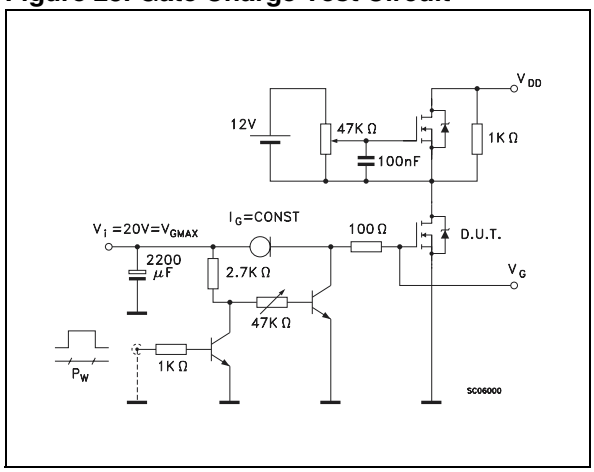
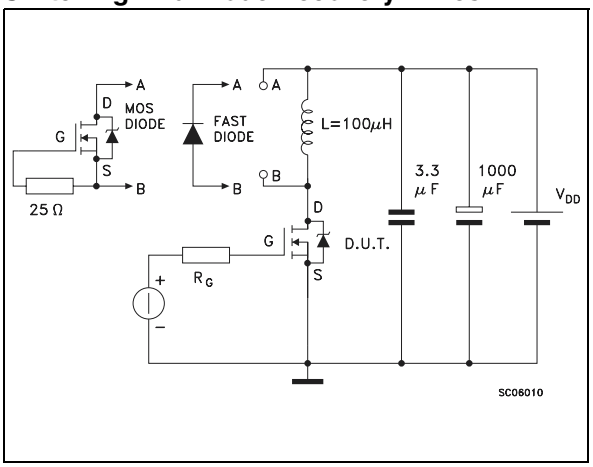


Figure 24. Test Circuit For Inductive Load Switching And Diode Recovery Times

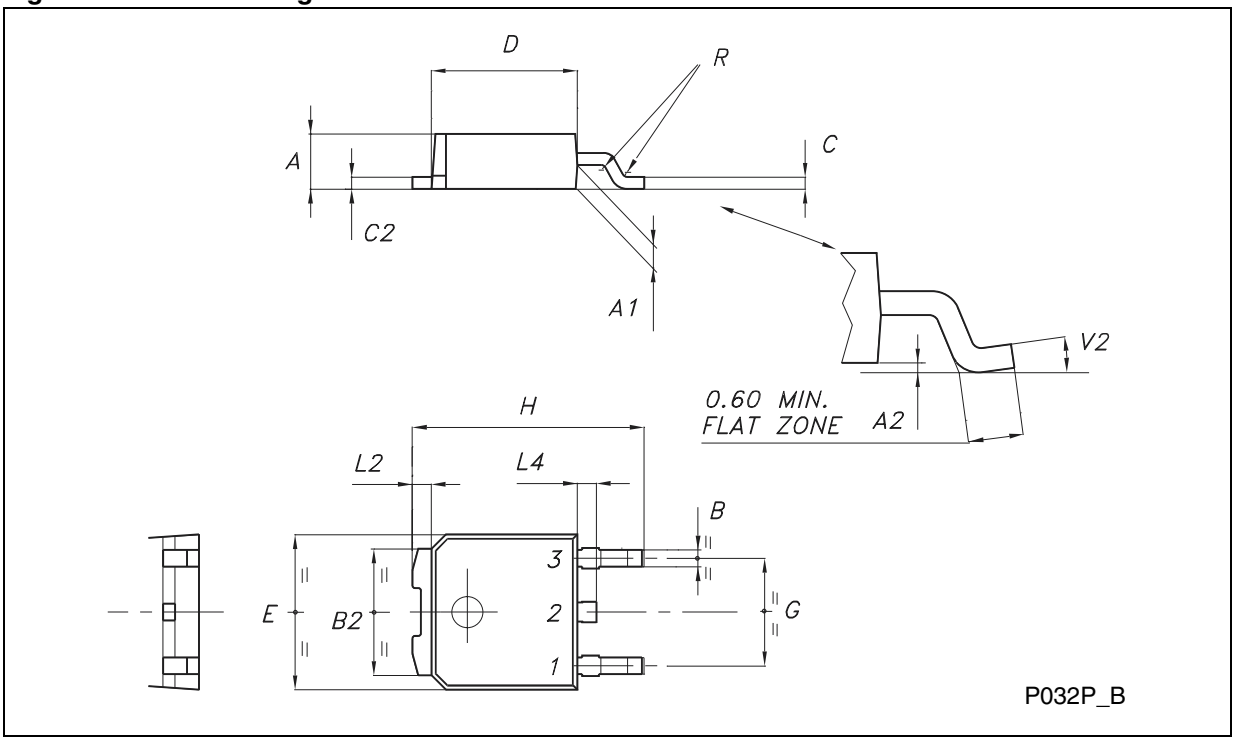


PACKAGE MECHANICAL

Table 12. DPAK Mechanical Data

Symbol	millimeters			inches		
	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°

Figure 25. DPAK Package Dimensions

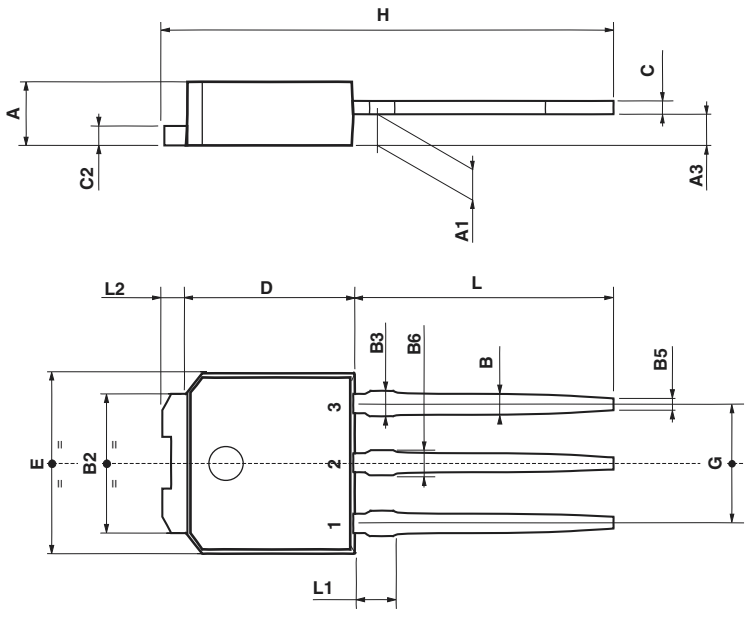


Note: Drawing is not to scale.

Table 13. IPAK Mechanical Data

Symbol	millimeters			inches		
	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		0.63			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

Figure 26. IPAK Package Dimensions



Note: Drawing is not to scale.

REVISION HISTORY

Table 14. Revision History

Date	Revision	Description of Changes
March-1996	1	First Issue
3-May-2004	2	Stylesheet update. No content change.