



STE40NK90ZD

N-CHANNEL 900V - 0.14Ω - 40 A ISOTOP Super FREDMesh™ MOSFET

Table 1: General Features

TYPE	V _{DSS}	R _{DS(on)}	I _D	P _w
STE40NK90ZD	900 V	< 0.18 Ω	40 A	600 W

- TYPICAL R_{DS(on)} = 0.14 Ω
- EXTREMELY HIGH dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- VERY LOW INTRINSIC CAPACITANCES
- VERY GOOD MANUFACTURING REPEATIBILITY

DESCRIPTION

The SuperFREDMesh™ series is obtained through an extreme optimization of ST's well established strip-based PowerMESH™ layout. In addition to pushing on-resistance significantly down, special care is taken to ensure a very good dv/dt capability for the most demanding applications. Such series complements ST full range of high voltage MOSFETs including revolutionary MD-mesh™ products.

APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- IDEAL FOR WELDING EQUIPMENT

Figure 1: Package

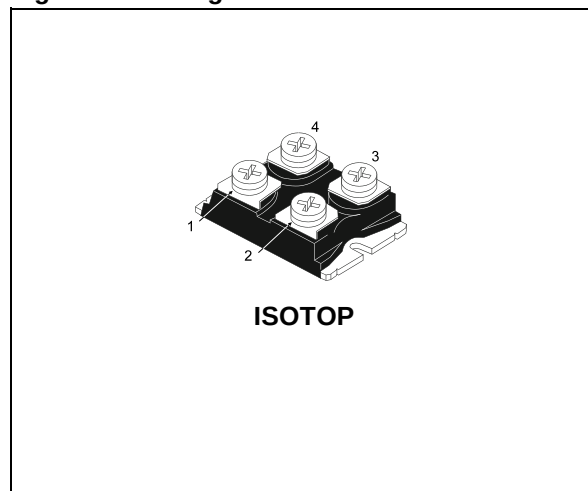


Figure 2: Internal Schematic Diagram

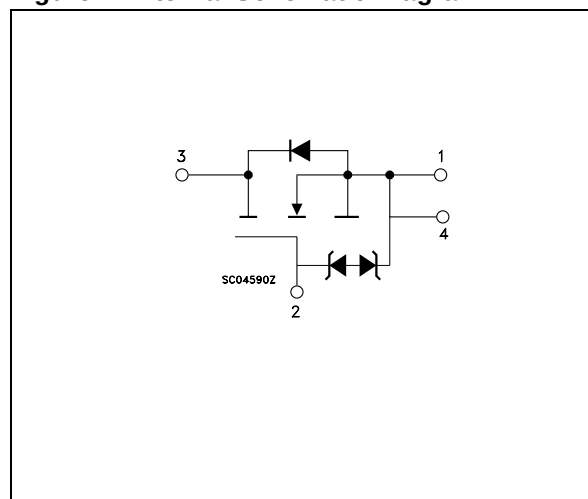


Table 2: Order Codes

SALES TYPE	MARKING	PACKAGE	PACKAGING
STE40NK90ZD	E40NK90ZD	ISOTOP	TUBE

Table 3: Absolute Maximum ratings

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source Voltage ($V_{GS} = 0$)	900	V
V_{DGR}	Drain-gate Voltage ($R_{GS} = 20\text{ k}\Omega$)	900	V
V_{GS}	Gate- source Voltage	± 30	V
I_D	Drain Current (continuous) at $T_C = 25^\circ\text{C}$	40	A
I_D	Drain Current (continuous) at $T_C = 100^\circ\text{C}$	25	A
$I_{DM}(\bullet)$	Drain Current (pulsed)	160	A
P_{TOT}	Total Dissipation at $T_C = 25^\circ\text{C}$	600	W
	Derating Factor	5	W/ $^\circ\text{C}$
$V_{ESD(G-S)}$	Gate source ESD(HBM-C=100pF, R=1.5K Ω)	7	KV
dv/dt (1)	Peak Diode Recovery voltage slope	8	V/ns
V_{ISO}	Insulation Withstand Voltage (AC-RMS) from All Four Terminals to External Heatsink	2500	V
T_j T_{stg}	Operating Junction Temperature Storage Temperature	- 65 to 150	$^\circ\text{C}$

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

(1) $I_{SD} \leq 40\text{A}$, $di/dt \leq 500\text{ A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$.

Table 4: Thermal Data

Rthj-case	Thermal Resistance Junction-case Max	0.2	$^\circ\text{C}/\text{W}$
Rthj-amb	Thermal Resistance Junction-ambient Max	40	$^\circ\text{C}/\text{W}$

Table 5: Avalanche Characteristics

Symbol	Parameter	Max. Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max)	40	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 35\text{ V}$)	1.2	J

Table 6: Gate-Source Zener Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
BV_{GSO}	Gate-Source Breakdown Voltage	$I_{gs} = \pm 1\text{mA}$ (Open Drain)	30			V

PROTECTION FEATURES OF GATE-TO-SOURCE ZENER DIODES

The built-in back-to-back Zener diodes have specifically been designed to enhance not only the device's ESD capability, but also to make them safely absorb possible voltage transients that may occasionally be applied from gate to source. In this respect the Zener voltage is appropriate to achieve an efficient and cost-effective intervention to protect the device's integrity. These integrated Zener diodes thus avoid the usage of external components.

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^{\circ}\text{C}$ UNLESS OTHERWISE SPECIFIED)**Table 7: On/Off**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 1\text{ mA}$, $V_{GS} = 0$	900			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$, $T_C = 125^{\circ}\text{C}$			10 100	μA μA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 20\text{V}$			± 10	μA
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$, $I_D = 150\mu\text{A}$	2.5	3.75	4.5	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10\text{V}$, $I_D = 20\text{ A}$		0.14	0.18	Ω

Table 8: Dynamic

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs} (1)$	Forward Transconductance	$V_{DS} = 15\text{V}$, $I_D = 20\text{ A}$		35		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25\text{V}$, $f = 1\text{ MHz}$, $V_{GS} = 0$		25000 1450 280		pF pF pF
$C_{oss\text{ eq.}} (3)$	Equivalent Output Capacitance	$V_{GS} = 0\text{V}$, $V_{DS} = 0\text{V to } 720\text{V}$		720		pF
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	$V_{DD} = 450\text{ V}$, $I_D = 18\text{ A}$ $R_G = 4.7\Omega$, $V_{GS} = 10\text{ V}$ (Figure 17)		92 102 450 200		ns ns ns ns
Q_g Q_{gs} Q_{gd}	Total Gate Charge Gate-Source Charge Gate-Drain Charge	$V_{DD} = 720\text{ V}$, $I_D = 36\text{ A}$, $V_{GS} = 10\text{V}$		590 89 323	826	nC nC nC

Table 9: Source Drain Diode

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD} $I_{SDM} (2)$	Source-drain Current Source-drain Current (pulsed)				40 160	A A
$V_{SD} (1)$	Forward On Voltage	$I_{SD} = 40\text{ A}$, $V_{GS} = 0$			1.6	V
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 36\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 50\text{ V}$, $T_j = 25^{\circ}\text{C}$ (Figure 18)		450 3.6 16.2		ns μC A
t_{rr} Q_{rr} I_{RRM}	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	$I_{SD} = 36\text{ A}$, $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 50\text{ V}$, $T_j = 150^{\circ}\text{C}$ (Figure 18)		930 12 26		ns μC A

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

2. Pulse width limited by safe operating area.

3. $C_{oss\text{ eq.}}$ is defined as a constant equivalent capacitance giving the same charging time as C_{oss} when V_{DS} increases from 0 to 80% V_{DSS} .

Figure 3: Safe Operating Area

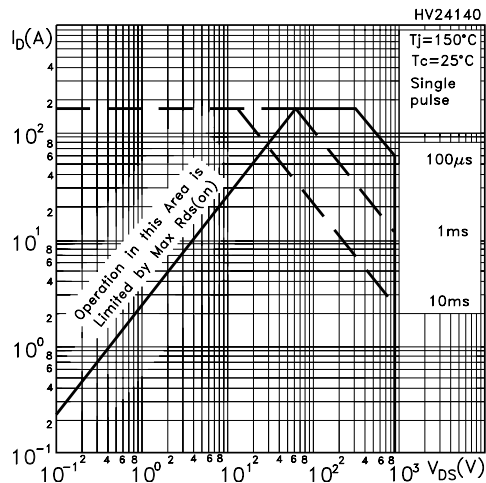


Figure 4: Output Characteristics

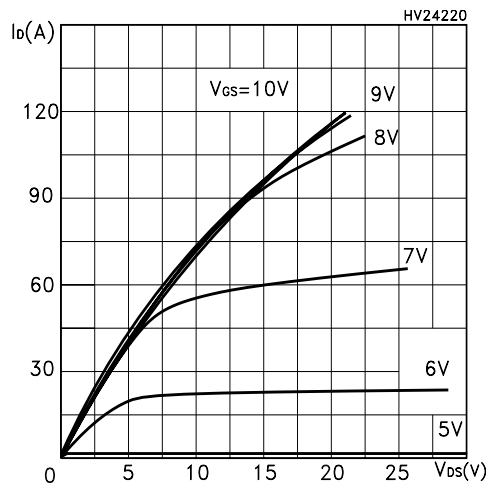


Figure 5: Transconductance

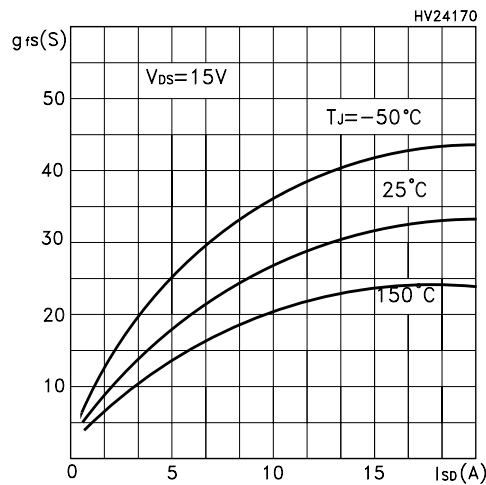


Figure 6: Thermal Impedance

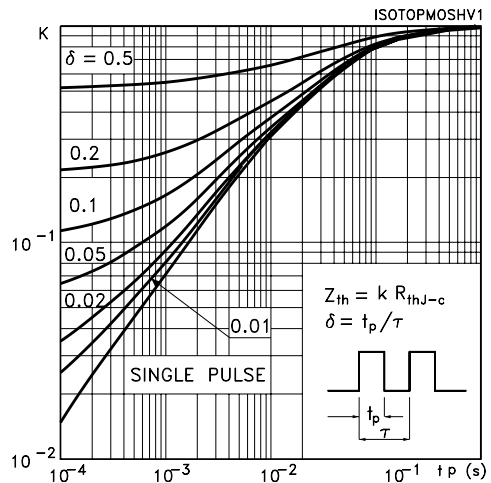


Figure 7: Transfer Characteristics

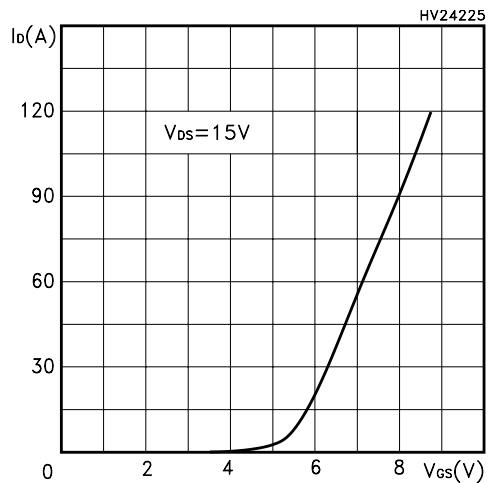


Figure 8: Static Drain-source On Resistance

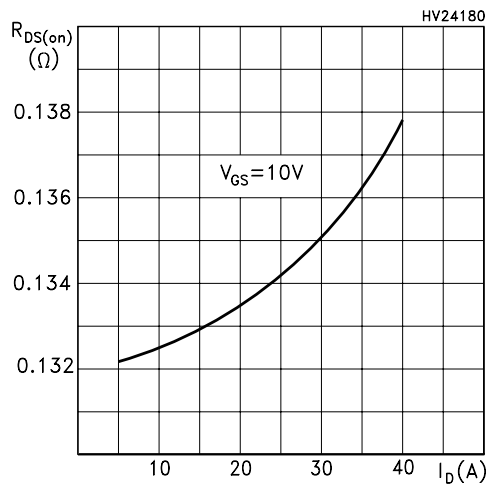


Figure 9: Gate Charge vs Gate-source Voltage

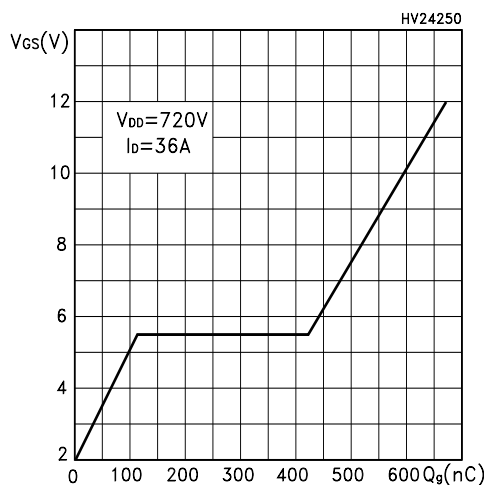


Figure 10: Normalized Gate Threshold Voltage vs Temperature

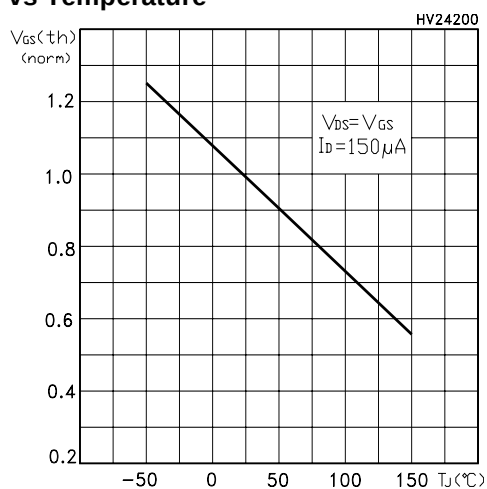


Figure 11: Source-Drain Diode Forward Characteristics

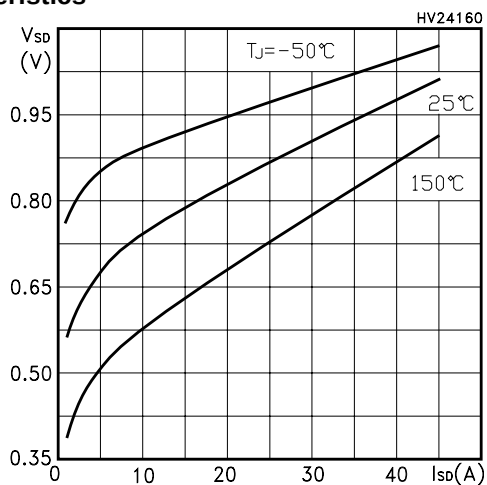


Figure 12: Capacitance Variations

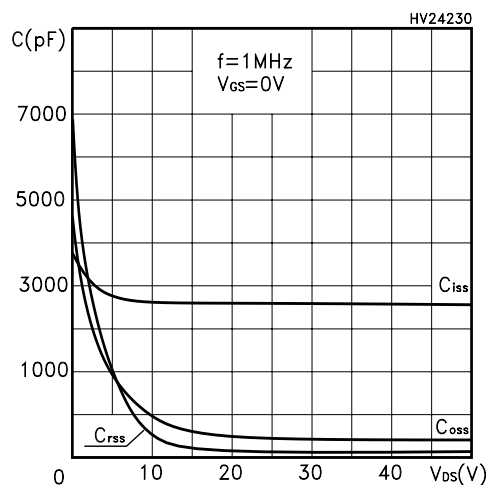


Figure 13: Normalized On Resistance vs Temperature

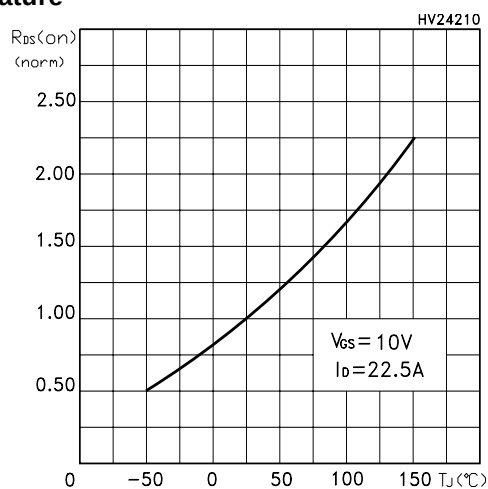


Figure 14: Normalized BVdss vs Temperature

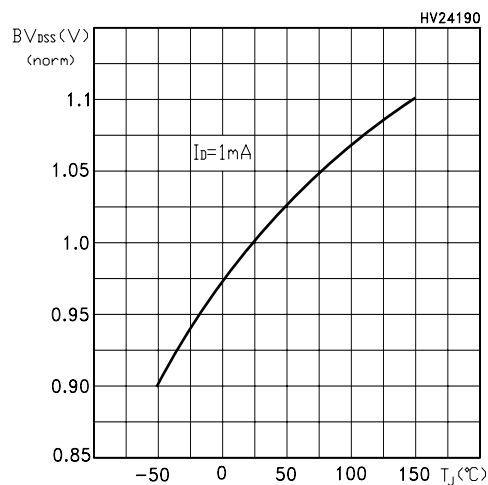


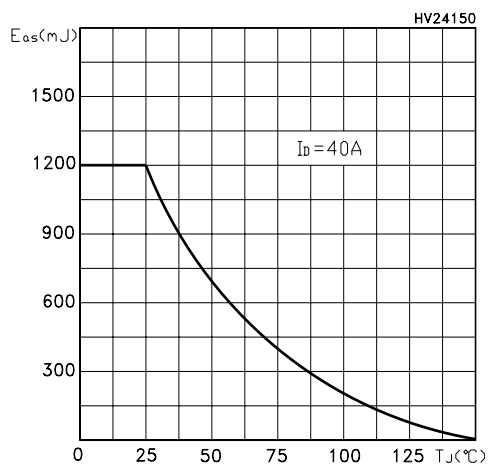
Figure 15: Avalanche Energy vs Starting T_j 

Figure 16: Unclamped Inductive Load Test Circuit

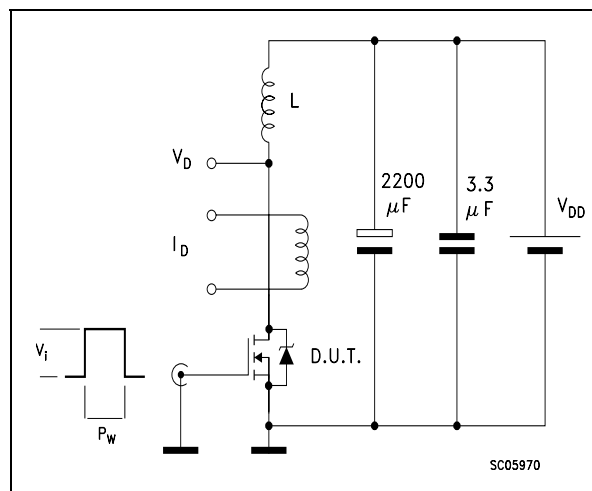


Figure 17: Switching Times Test Circuit For Resistive Load

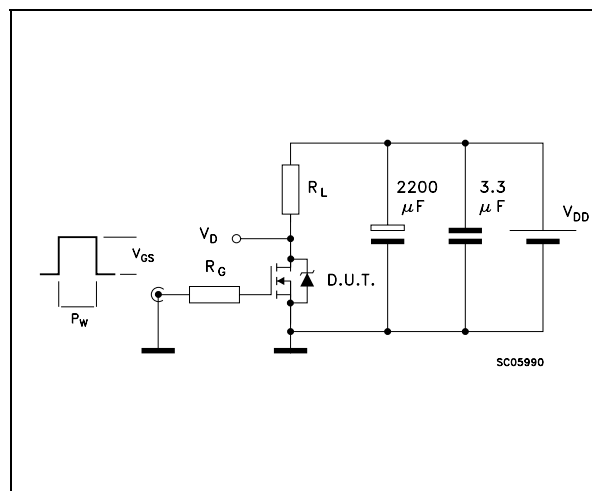


Figure 18: Test Circuit For Inductive Load Switching and Diode Recovery Times

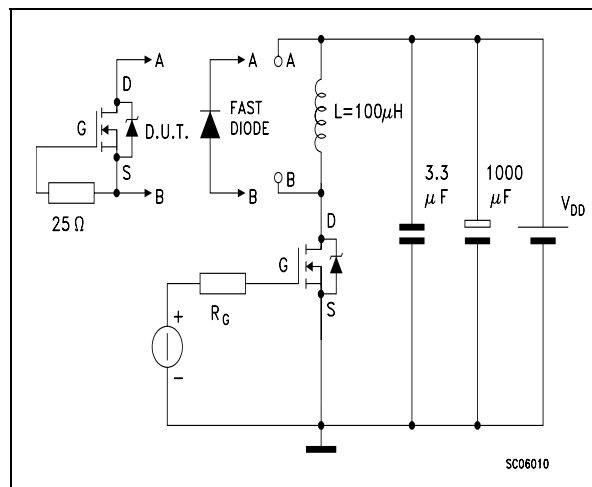


Figure 19: Unclamped Inductive Waform

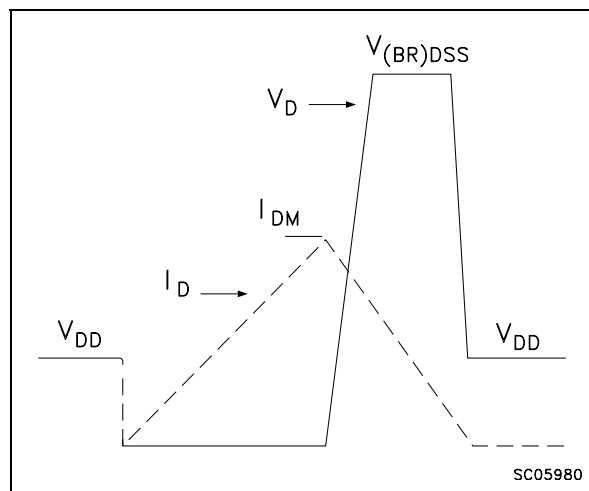
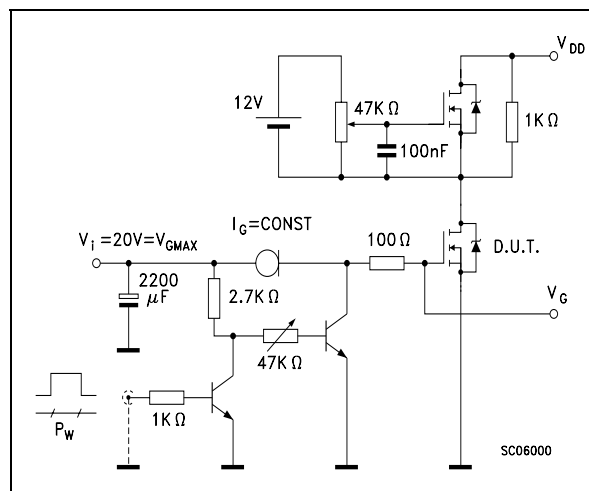


Figure 20: Gate Charge Test Circuit



ISOTOP MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	11.8		12.2	0.466		0.480
B	8.9		9.1	0.350		0.358
C	1.95		2.05	0.076		0.080
D	0.75		0.85	0.029		0.033
E	12.6		12.8	0.496		0.503
F	25.15		25.5	0.990		1.003
G	31.5		31.7	1.240		1.248
H	4			0.157		
J	4.1		4.3	0.161		0.169
K	14.9		15.1	0.586		0.594
L	30.1		30.3	1.185		1.193
M	37.8		38.2	1.488		1.503
N	4			0.157		
O	7.8		8.2	0.307		0.322

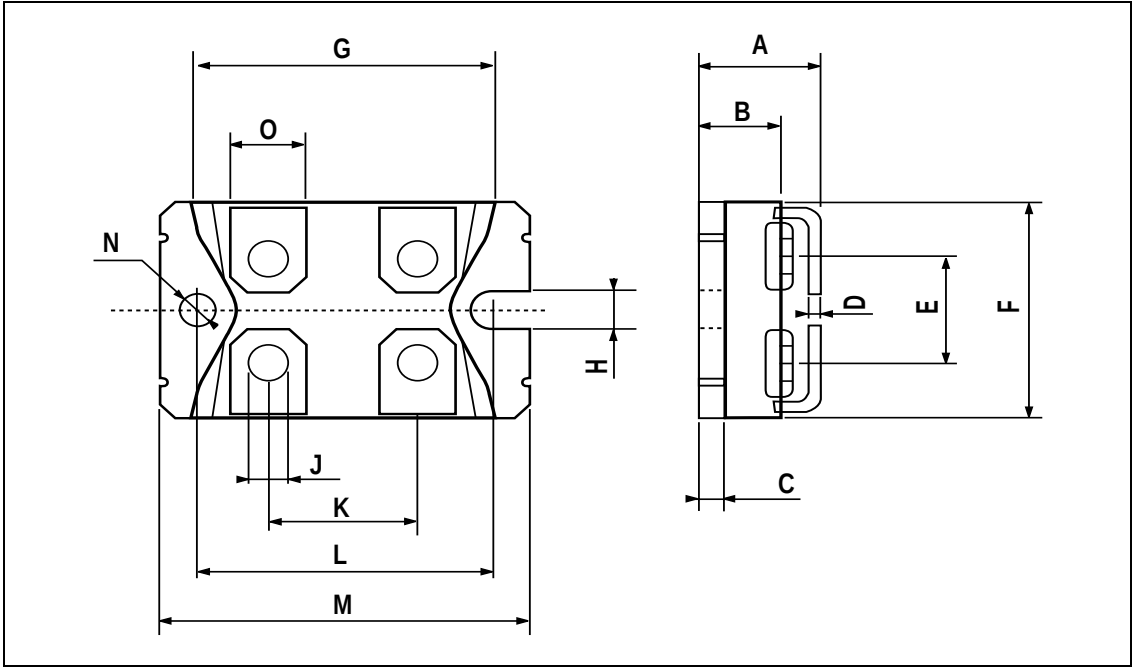


Table 10: Revision History

Date	Revision	Description of Changes
05-Jul-2004	1	First Release.
15-Oct-2004	2	New value inserted in table 3. (V_{ISO})
04-Nov-2004	3	Preliminary Version
13-Dec-2004	4	Final datasheet

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