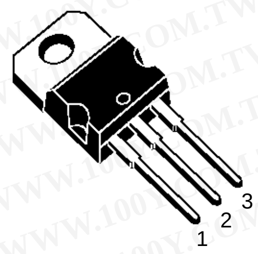
SGS-THOMSON MICROELECTRONICS

VNP10N06

”OMNIFET”: FULLY AUTOPROTECTED POWER MOSFET

TYPE	V_{clamp}	$R_{DS(on)}$	I_{lim}
VNP10N06	60 V	0.3 Ω	10 A

- LINEAR CURRENT LIMITATION
- THERMAL SHUT DOWN
- SHORT CIRCUIT PROTECTION
- INTEGRATED CLAMP
- LOW CURRENT DRAWN FROM INPUT PIN
- LOGIC LEVEL INPUT THRESHOLD
- ESD PROTECTION
- SCHMITT TRIGGER ON INPUT
- HIGH NOISE IMMUNITY
- STANDARD TO-220 PACKAGE

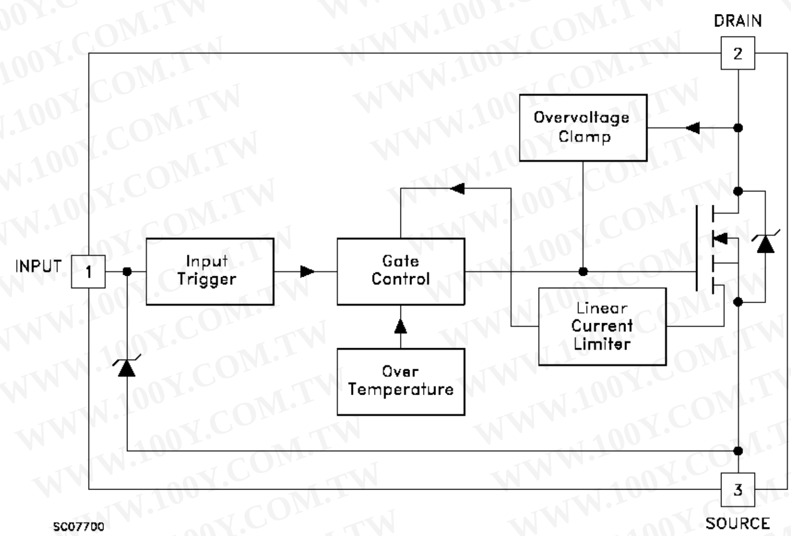


TO-220

DESCRIPTION

The VNP10N06 is a monolithic device made using SGS-THOMSON Vertical Intelligent Power M0 Technology, intended for replacement of standard power MOSFETS in DC to 50 KHz applications. Built-in thermal shut-down, linear current limitation and overvoltage clamp protect the chip in harsh enviroments.

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATING

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source Voltage (V_{in} = 0)	Internally Clamped	V
V_{in}	Input Voltage	Internally Clamped	V
I_{in}	Input Current	± 20	mA
I_D	Drain Current	Internally Limited	A
I_R	Reverse DC Output Current	-15	A
V_{esd}	Electrostatic Discharge (C= 100 pF, R=1.5 KΩ)	4000	V
P_{tot}	Total Dissipation at T_c = 25 °C	42	W
T_j	Operating Junction Temperature	Internally Limited	°C
T_c	Case Operating Temperature	Internally Limited	°C
T_{stg}	Storage Temperature	-55 to 150	°C

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	3	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W

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

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{CLAMP}	Drain-source Clamp Voltage	I_D = 200 mA V_{in} = 0	50	60	70	V
V_{IL}	Input Low Level Voltage	I_D = 100 µA V_{DS} = 16 V			1.5	V
V_{IH}	Input High Level Voltage	R_L = 27 Ω V_{DD} = 16 V V_{DS} = 0.5 V	3.2			V
V_{INCL}	Input-Source Reverse Clamp Voltage	I_{in} = -1 mA I_{in} = 1 mA	-1 8		-0.3 11	V V
I_{DSS}	Zero Input Voltage Drain Current (V_{in} = 0)	V_{DS} = 50 V V_{in} = V_{IL} V_{DS} < 35 V V_{in} = V_{IL}			250 100	µA µA
I_{ISS}	Supply Current from Input Pin	V_{DS} = 0 V V_{in} = 5 V		150	300	µA

ON (*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$R_{DS(on)}$	Static Drain-source On Resistance	V_{in} = 7 V I_D = 1 A T_J < 125 °C		0.15	0.3	Ω

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
C_{oss}	Output Capacitance	V_{DS} = 13 V f = 1 MHz V_{in} = 0		350	500	pF

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING (**)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	V_{DD} = 16 V I_d = 1 A V_{gen} = 7 V R_{gen} = 10 Ω (see figure 3)		1100 550 200 100	1600 900 400 200	ns ns ns ns
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Turn-on Delay Time Rise Time Turn-off Delay Time Fall Time	V_{DD} = 16 V I_d = 1 A V_{gen} = 7 V R_{gen} = 1000 Ω (see figure 3)		1.2 1 1.6 1.2	1.8 1.5 2.3 1.8	µs µs µs µs
$(di/dt)_{on}$	Turn-on Current Slope	V_{DD} = 16 V I_D = 1 A V_{in} = 7 V R_{gen} = 10 Ω		1.5		A/µs
Q_i	Total Input Charge	V_{DD} = 12 V I_D = 1 A V_{in} = 7 V		13		nC

SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{SD} (*)	Forward On Voltage	I_{SD} = 1 A V_{in} = V_{IL}		0.8	1.6	V
t_{rr} (**) Q_{rr} (**) I_{RRM} (**)	Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current	I_{SD} = 1 A di/dt = 100 A/µs V_{DD} = 30 V T_j = 25 °C (see test circuit, figure 5)		125 0.22 3.5		ns µC A

PROTECTION

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{lim}	Drain Current Limit	V_{in} = 7 V V_{DS} = 13 V	6	10	15	A
t_{dlim} (**)	Step Response Current Limit	V_{in} = 7 V V_{DS} step from 0 to 13 V		12	20	µs
T_{jsh} (**)	Overtemperature Shutdown		150			°C
T_{jrs} (**)	Overtemperature Reset		135			°C
E_{as} (**)	Single Pulse Avalanche Energy	starting T_j = 25 °C V_{DD} = 24 V V_{in} = 7 V R_{gen} = 1 KΩ L = 10 mH	250			mJ

(*) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %
(**) Parameters guaranteed by design/characterization

PROTECTION FEATURES

During Normal Operation, the INPUT pin is electrically connected to the gate of the internal power MOSFET through a low impedance path as soon as $V_{IN} > V_{IH}$.

The device then behaves like a standard power MOSFET and can be used as a switch from DC to 50KHz. The only difference from the user's standpoint is that a small DC current (typically 150 µA) flows into the INPUT pin in order to supply the internal circuitry.

During turn-off of an unclamped inductive load the output voltage is clamped to a safe level by an integrated Zener clamp between DRAIN pin and the gate of the internal Power MOSFET.

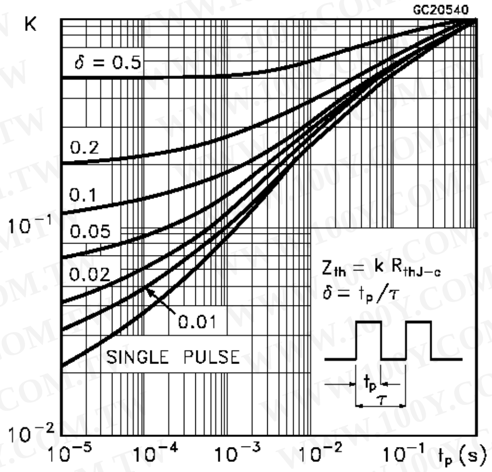
In this condition, the Power MOSFET gate is set to a voltage high enough to sustain the inductive load current even if the INPUT pin is driven to 0V.

The device integrates an active current limiter circuit which limits the drain current I_D to I_{lim} whatever the INPUT pin Voltage.

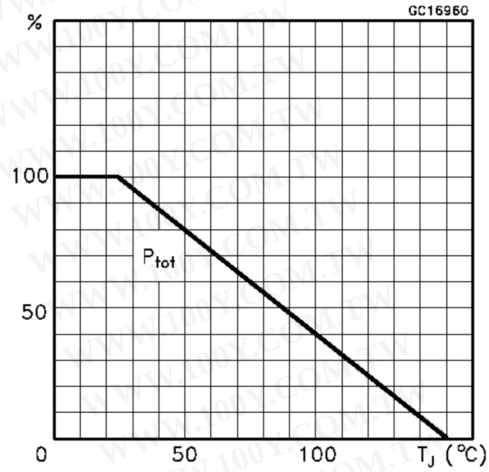
When the current limiter is active, the device operates in the linear region, so power dissipation may exceed the heatsinking capability. Both case and junction temperatures increase, and if this phase lasts long enough, junction temperature may reach the overtemperature threshold T_{jsh}.

If T_j reaches T_{jsh}, the device shuts down whatever the INPUT pin voltage. The device will restart automatically when T_j has cooled down to T_{jrs}

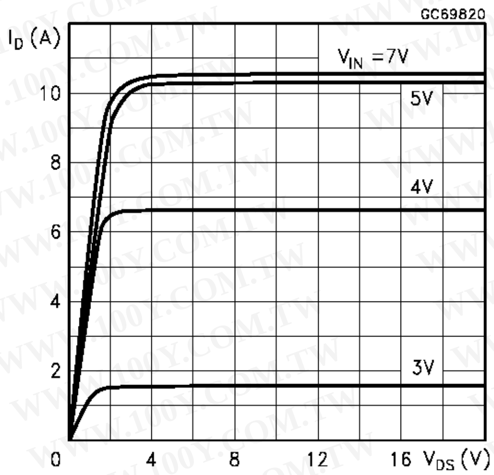
Thermal Impedance



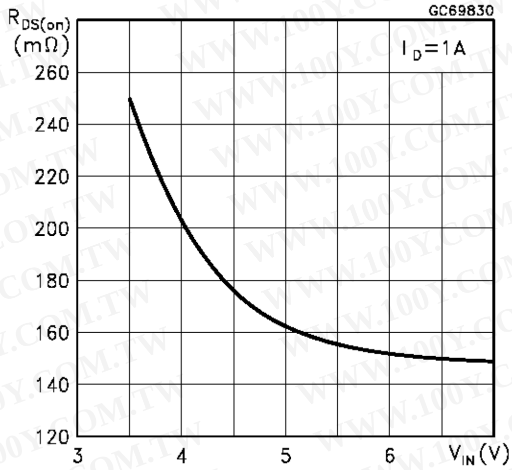
Derating Curve



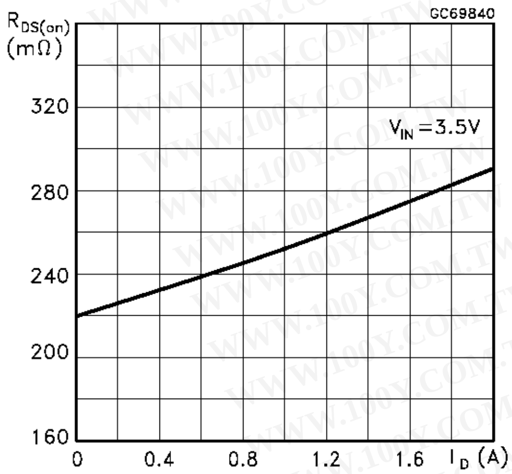
Output Characteristics



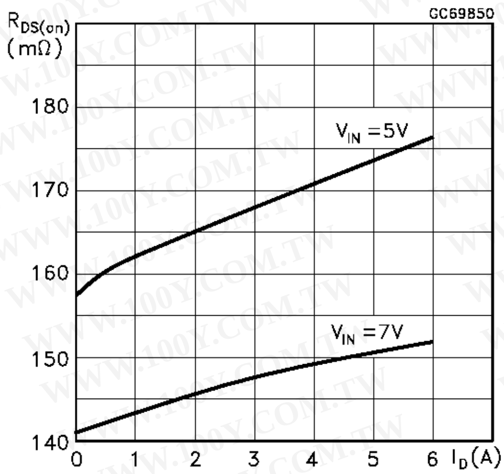
Static Drain-Source On Resistance vs Input Voltage



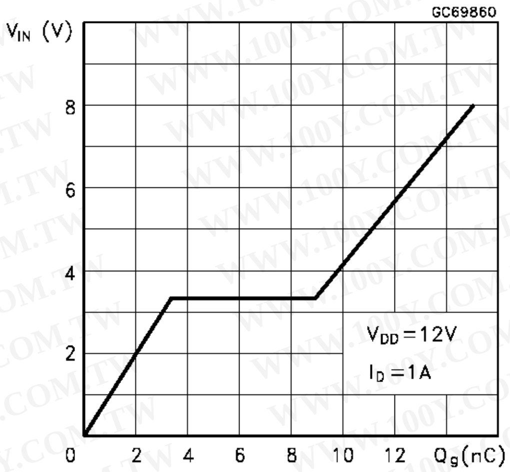
Static Drain-Source On Resistance



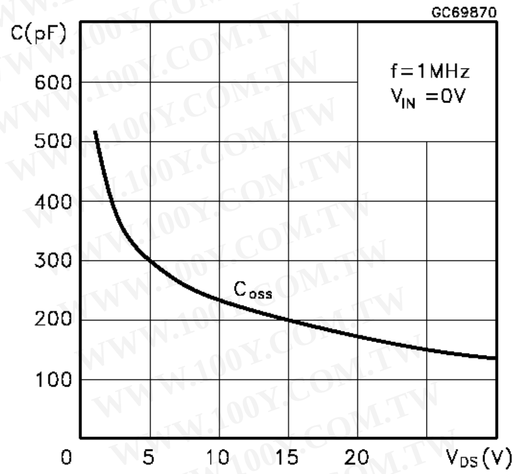
Static Drain-Source On Resistance



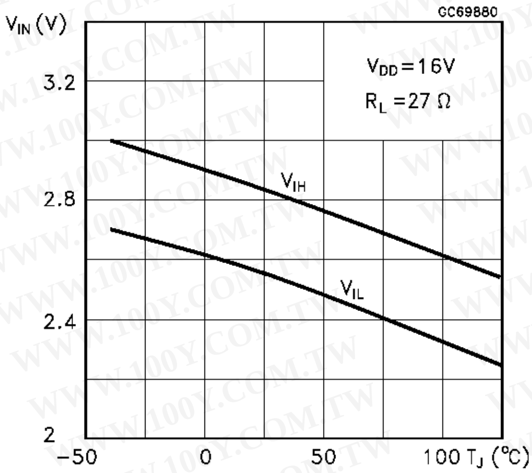
Input Charge vs Input Voltage



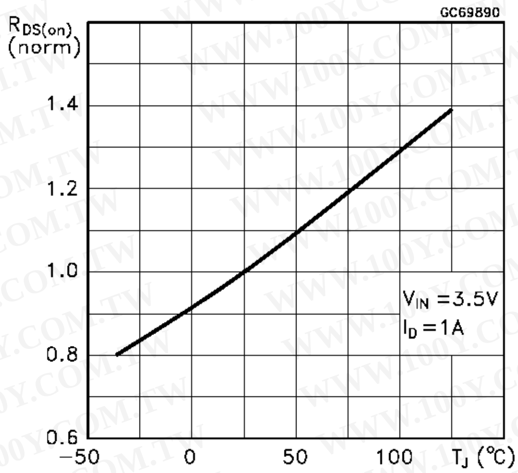
Capacitance Variations



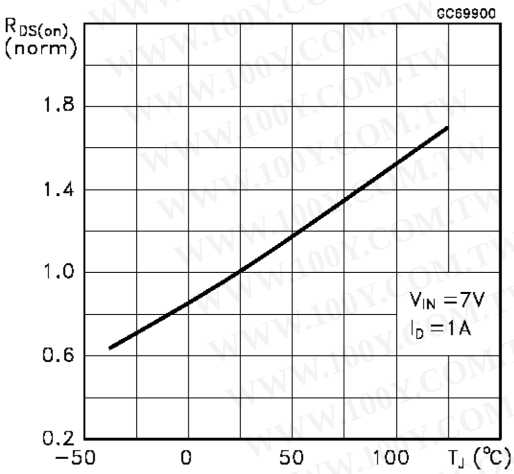
Normalized Input Threshold Voltage vs Temperature



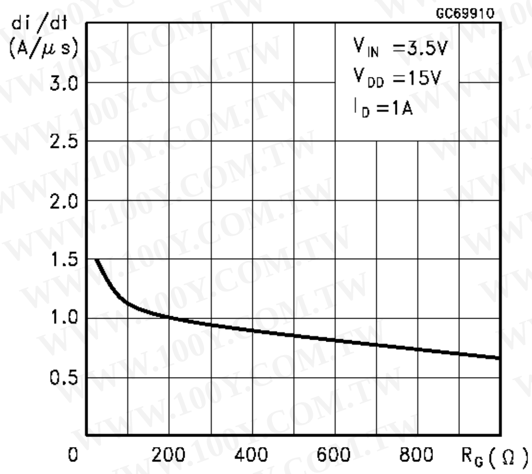
Normalized On Resistance vs Temperature



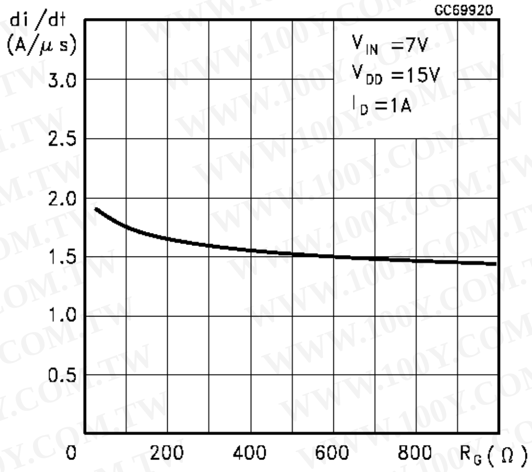
Normalized On Resistance vs Temperature



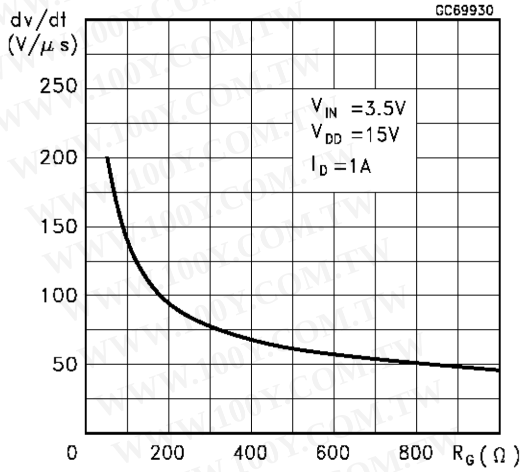
Turn-on Current Slope



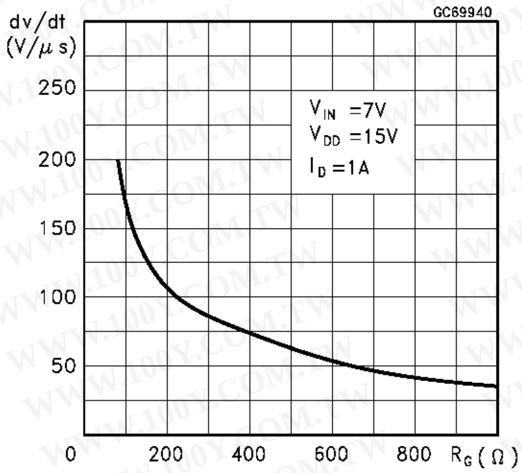
Turn-on Current Slope



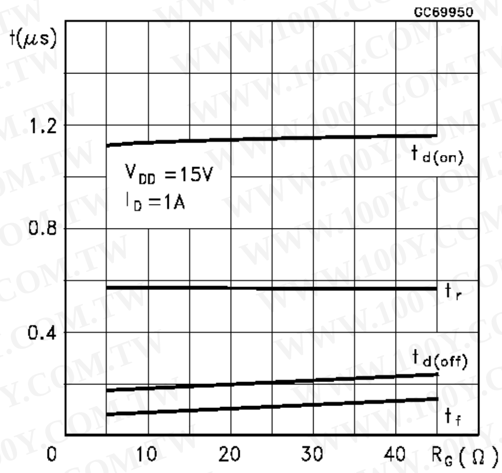
Turn-off Drain-Source Voltage Slope



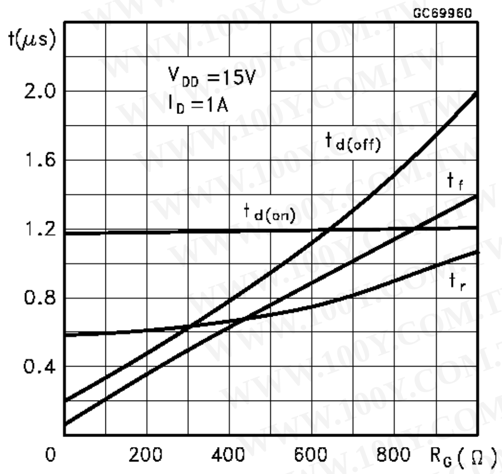
Turn-off Drain-Source Voltage Slope



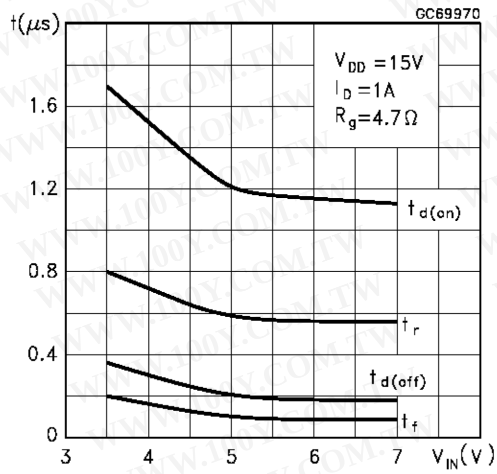
Switching Time Resistive Load



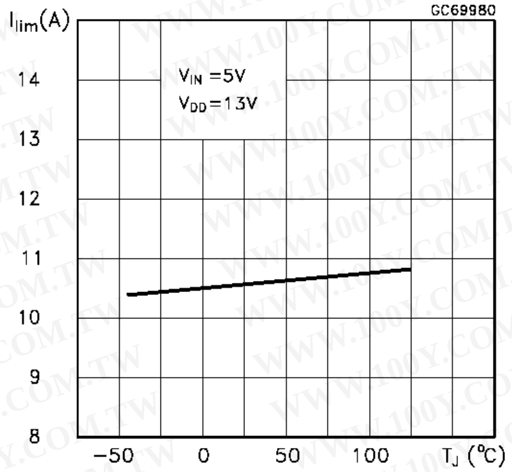
Switching Time Resistive Load



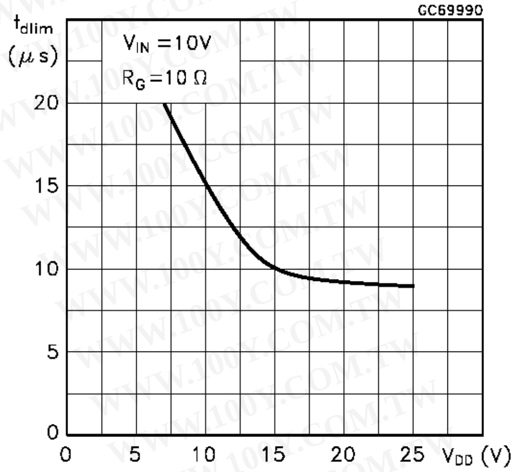
Switching Time Resistive Load



Current Limit vs Junction Temperature



Step Response Current Limit



Source Drain Diode Voltage vs Junction Temperature

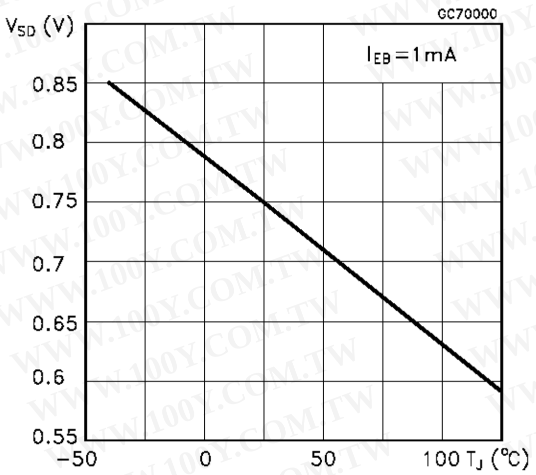


Fig. 1: Unclamped Inductive Load Test Circuits

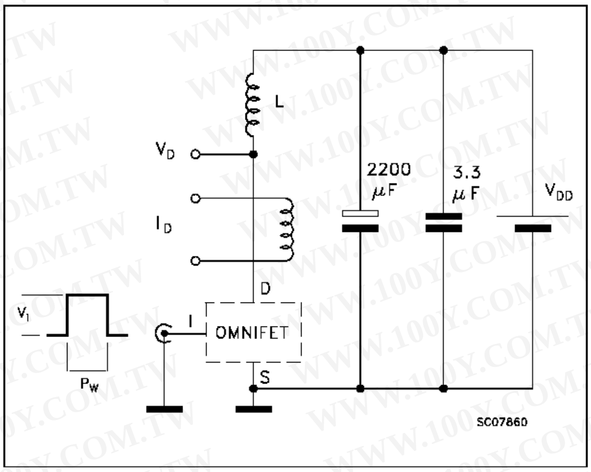


Fig. 2: Unclamped Inductive Waveforms

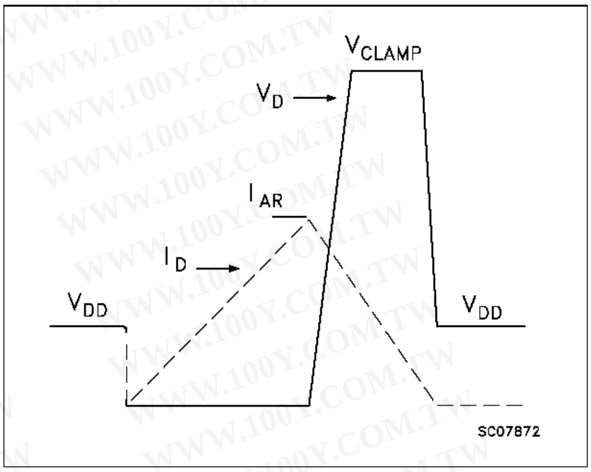


Fig. 3: Switching Times Test Circuits For Resistive Load

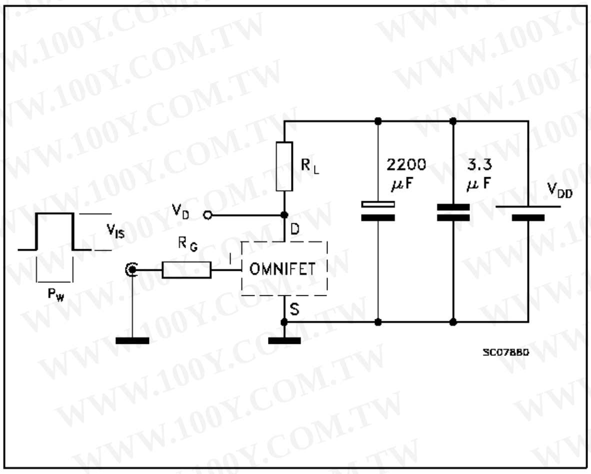


Fig. 4: Input Charge Test Circuit

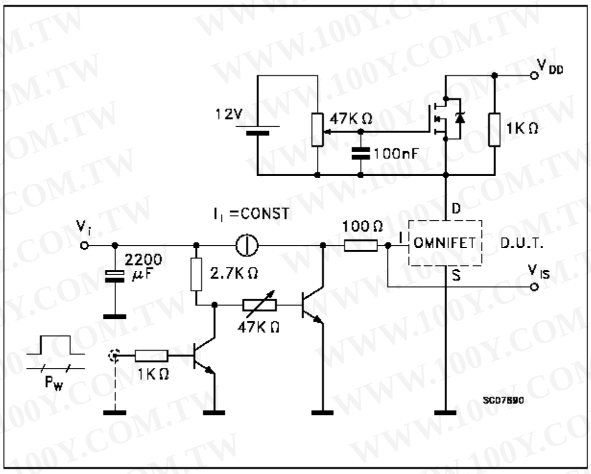


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times

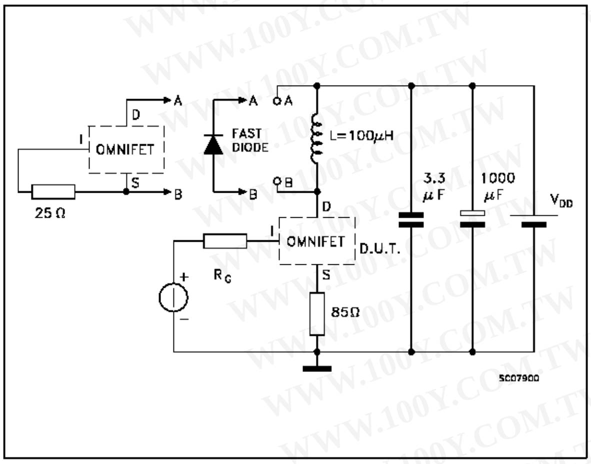
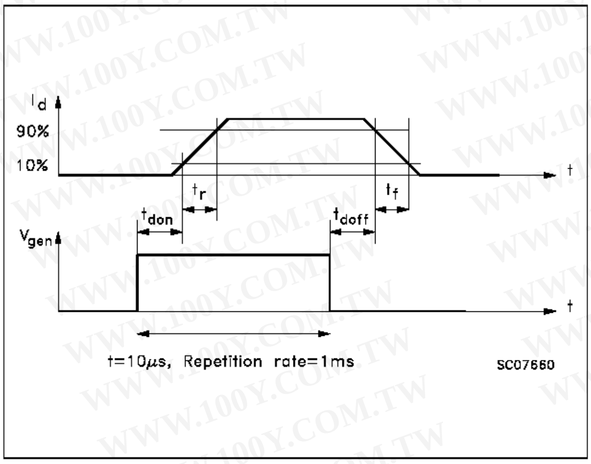
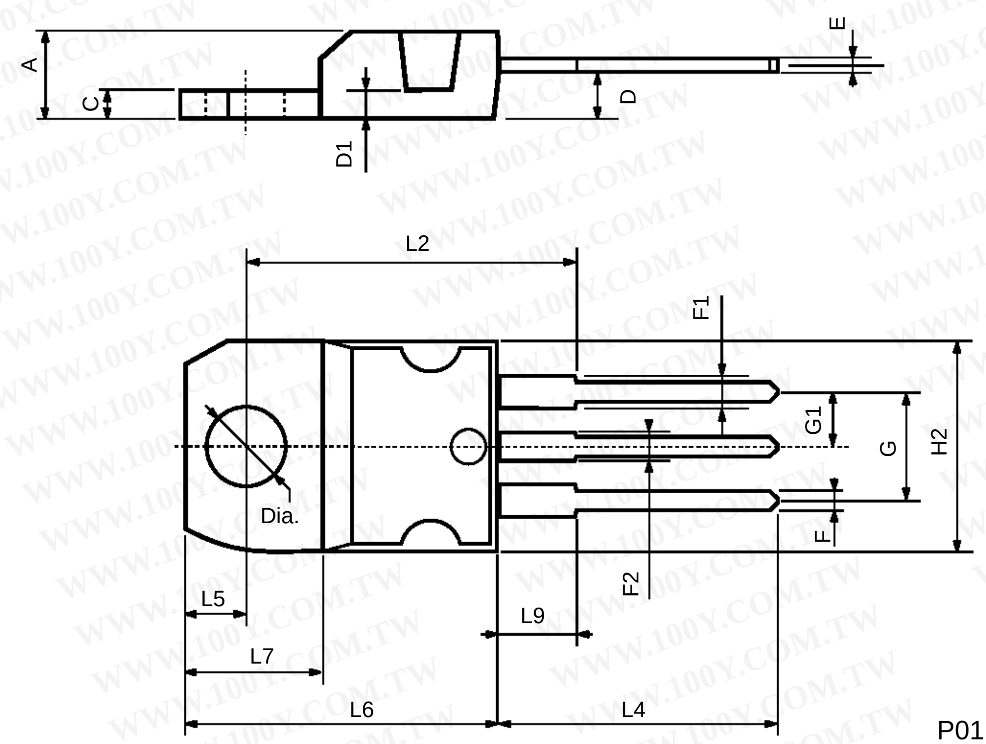


Fig. 6: Waveforms



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



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