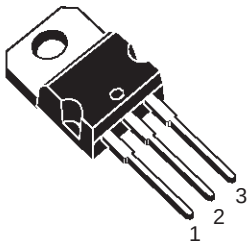
STP60NS04Z

N - CHANNEL CLAMPED 10mΩ - 60A - TO-220
FULLY PROTECTED MESH OVERLAY™ MOSFET

PRELIMINARY DATA

TYPE	V_{DSS}	$R_{DS(on)}$	I_D
STP60NS04Z	CLAMPED	<0.015 Ω	60 A

- TYPICAL $R_{DS(on)}$ = 0.010 Ω
- 100% AVALANCHE TESTED
- LOW CAPACITANCE AND GATE CHARGE
- 175 °C MAXIMUM JUNCTION TEMPERATURE



TO-220

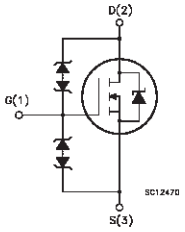
DESCRIPTION

This fully clamped Mosfet is produced by using the latest advanced Company's Mesh Overlay process which is based on a novel strip layout.
The inherent benefits of the new technology coupled with the extra clamping capabilities make this product particularly suitable for the harshest operation conditions such as those encountered in the automotive environment. Any other application requiring extra ruggedness is also recommended.

APPLICATIONS

- ABS, SOLENOID DRIVERS
- MOTOR CONTROL
- DC-DC CONVERTERS

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{DS}	Drain-source Voltage (V_{GS} = 0)	CLAMPED	V
V_{DG}	Drain- gate Voltage	CLAMPED	V
V_{GS}	Gate-source Voltage	CLAMPED	V
I_D	Drain Current (continuous) at T_c = 25 °C	60	A
I_D	Drain Current (continuous) at T_c = 100 °C	42	A
I_{DG}	Drain Gate Current (continuous)	± 50	mA
I_{GS}	Gate Source Current (continuous)	± 50	mA
I_{DM}(•)	Drain Current (pulsed)	240	A
P_{tot}	Total Dissipation at T_c = 25 °C	140	W
	Derating Factor	0.93	W/°C
$V_{ESD(G-S)}$	Gate-Source ESD (HBM - C= 100pF, R=1.5 kΩ)	2	kV
$V_{ESD(G-D)}$	Gate-Drain ESD (HBM - C= 100pF, R=1.5 kΩ)	4	kV
$V_{ESD(D-S)}$	Drain-Source ESD (HBM - C= 100pF, R=1.5 kΩ)	4	kV
T_{stg}	Storage Temperature	-65 to 175	°C
T_j	Max. Operating Junction Temperature	-40 to 175	°C

(•) Pulse width limited by safe operating area

(1) I_{SD} ≤60 A, di/dt ≤ 300 A/µs, V_{DD} ≤ $V_{(BR)DSS}$, T_j ≤ T_{JMAX}

THERMAL DATA

$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Max	1.07	°C/W
$R_{thj\text{-}case}$	Thermal Resistance Junction-case	Typ	0.85	°C/W
$R_{thj\text{-}amb}$	Thermal Resistance Junction-ambient	Max	62.5	°C/W
$R_{thc\text{-}sink}$	Thermal Resistance Case-sink	Typ	0.5	°C/W
T_l	Maximum Lead Temperature For Soldering Purpose		300	°C

AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
I_{AR}	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max, $\delta < 1\%$)	60	A
E_{AS}	Single Pulse Avalanche Energy (starting $T_j = 25\ ^oC$, $I_D = I_{AR}$, $V_{DD} = 30$ V)	400	mJ

ELECTRICAL CHARACTERISTICS ($T_{case} = 25\ ^oC$ unless otherwise specified)

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{CLAMP}	Drain-Gate Breakdown Voltage	$I_D = 1$ mA $V_{GS} = 0$ $-40 < T_j < 175\ ^oC$	33			V
I_{DSS}	Zero Gate Voltage Drain Current ($V_{GS} = 0$)	$V_{DS} = 16$ V $T_j = 175\ ^oC$			50	µA
I_{GSS}	Gate-body Leakage Current ($V_{DS} = 0$)	$V_{GS} = \pm 10$ V $T_j = 175\ ^oC$ $V_{GS} = \pm 16$ V $T_j = 175\ ^oC$			50 150	µA µA
V_{GSS}	Gate-Source Breakdown Voltage	$I_G = 100$ µA	18			V

ON (*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}$ $I_D = 1$ mA $-40 < T_j < 150\ ^oC$	1.7	3	4.2	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10$V $I_D = 30$ A $V_{GS} = 16$V $I_D = 30$ A		11 10	15 14	mΩ mΩ
$I_{D(on)}$	On State Drain Current	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $V_{GS} = 10$ V	60			A

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
g_{fs} (*)	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 30$ A	20	30		S
C_{iss} C_{oss} C_{rss}	Input Capacitance Output Capacitance Reverse Transfer Capacitance	$V_{DS} = 25$ V f = 1 MHz $V_{GS} = 0$		2500 800 150	3400 1100 200	pF pF pF

ELECTRICAL CHARACTERISTICS (continued)

SWITCHING ON

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Q_g	Total Gate Charge	V_{DD} = 16 V I_D = 60 A V_{GS} = 10 V		70	100	nC
Q_{gs}	Gate-Source Charge			20		nC
Q_{gd}	Gate-Drain Charge			22		nC

SWITCHING OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(Voff)}$	Off-voltage Rise Time	V_{CLAMP} = 30 V I_D = 60 A		25	35	ns
t_f	Fall Time	R_G =4.7 Ω V_{GS} = 10 V		110	150	ns
t_c	Cross-over Time	(see test circuit, figure 5)		150	200	ns

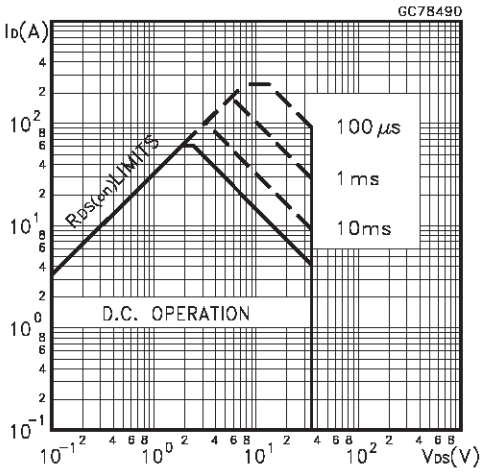
SOURCE DRAIN DIODE

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{SD}	Source-drain Current				60	A
I_{SDM} (•)	Source-drain Current (pulsed)				240	A
V_{SD} (*)	Forward On Voltage	I_{SD} = 60 A V_{GS} = 0			1.5	V
t_{rr}	Reverse Recovery Time	I_{SD} = 60 A di/dt = 100 A/µs V_r = 25 V T_j = 150 °C		65		ns
Q_{rr}	Reverse Recovery Charge	(see test circuit, figure 5)		0.15		µC
I_{RRM}	Reverse Recovery Current			4.5		A

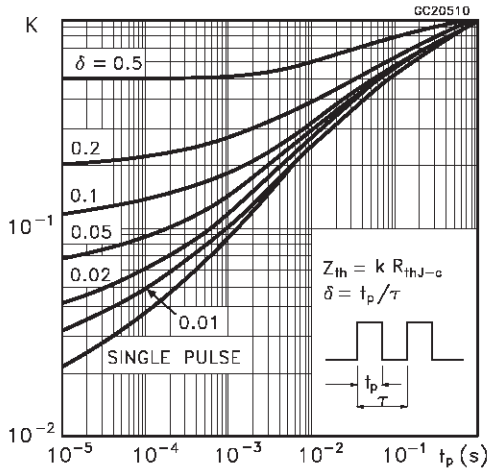
(*) Pulsed: Pulse duration = 300 µs, duty cycle 1.5 %

(•) Pulse width limited by safe operating area

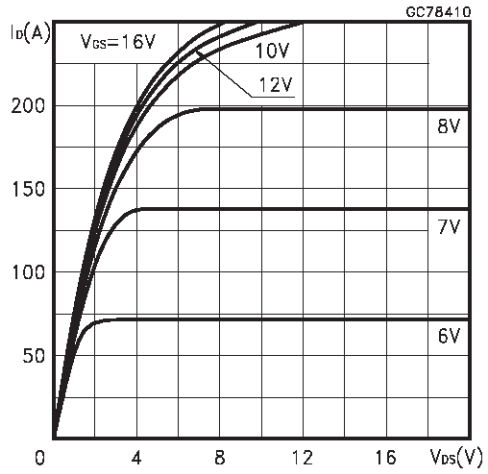
Safe Operating Area



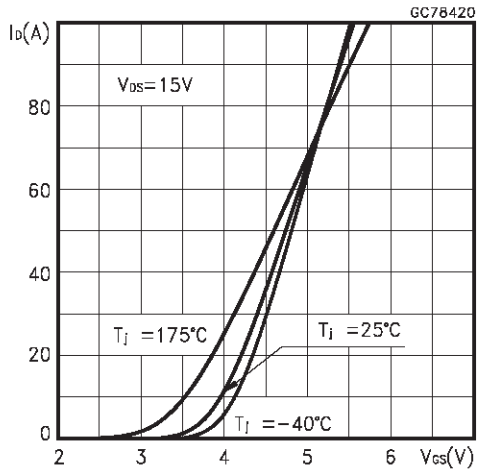
Thermal Impedance



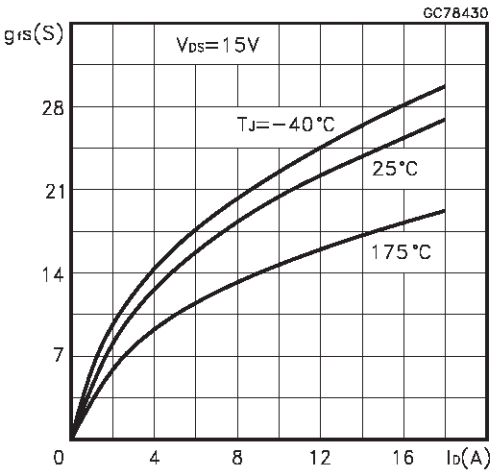
Output Characteristics



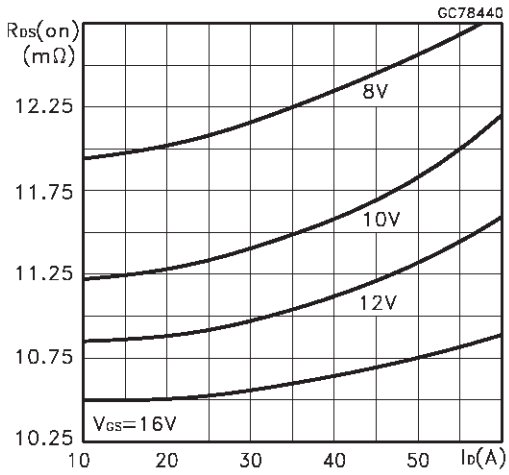
Transfer Characteristics



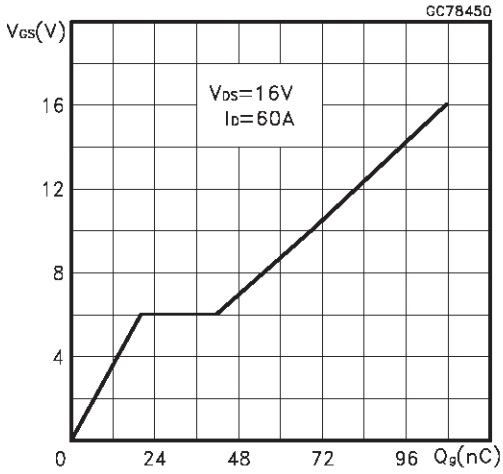
Transconductance



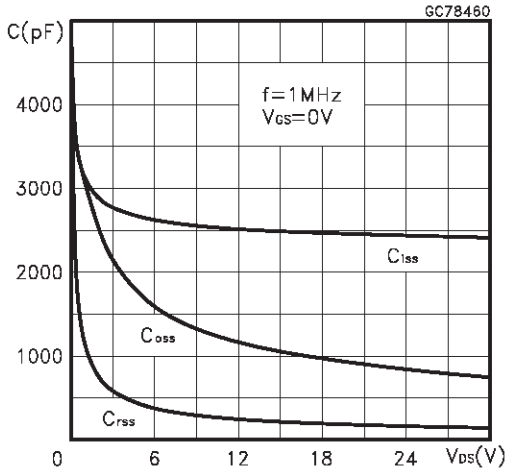
Static Drain-source On Resistance



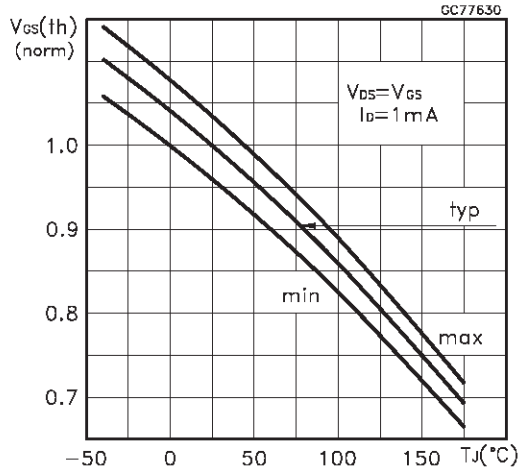
Gate Charge vs Gate-source Voltage



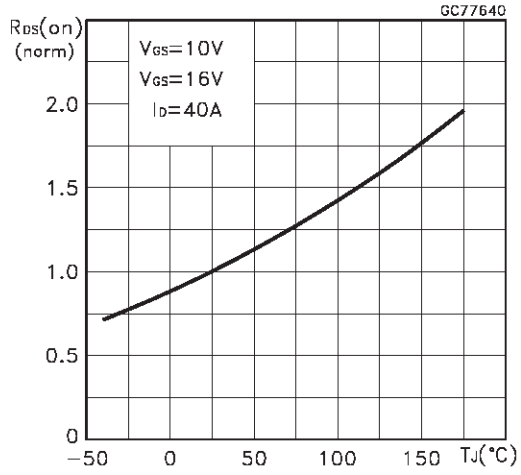
Capacitance Variations



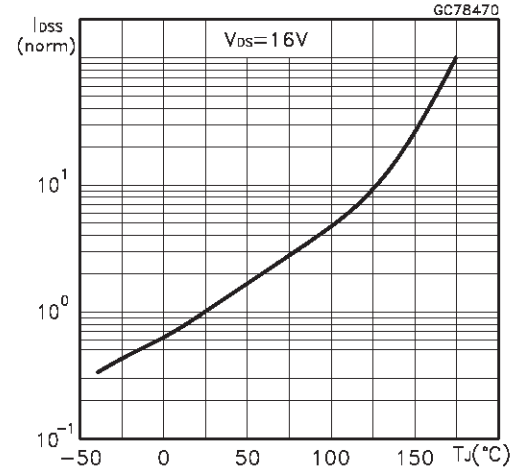
Normalized Gate Threshold Voltage vs Temperature



Normalized On Resistance vs Temperature



Zero Gate Voltage Drain Current vs Temperature



Source-drain Diode Forward Characteristics

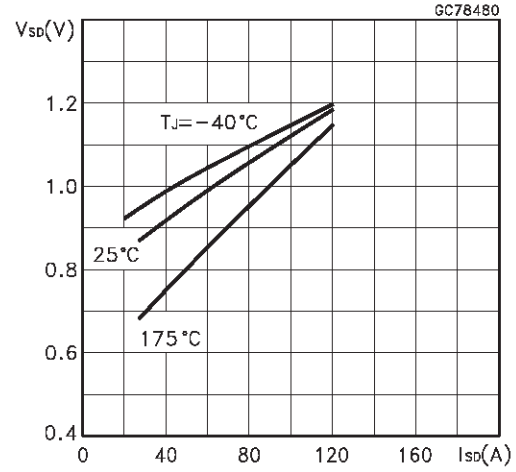


Fig. 1: Unclamped Inductive Load Test Circuit

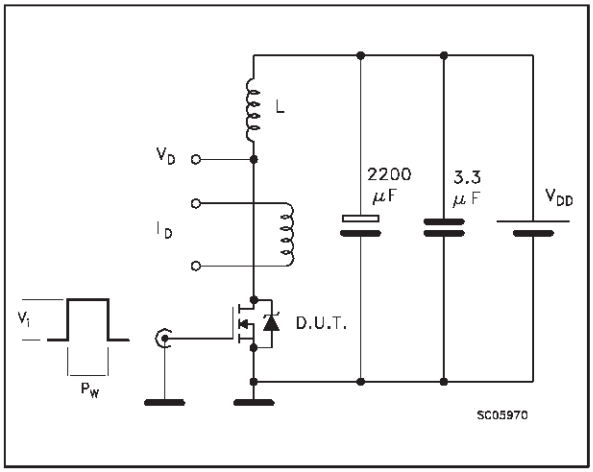


Fig. 2: Unclamped Inductive Waveform

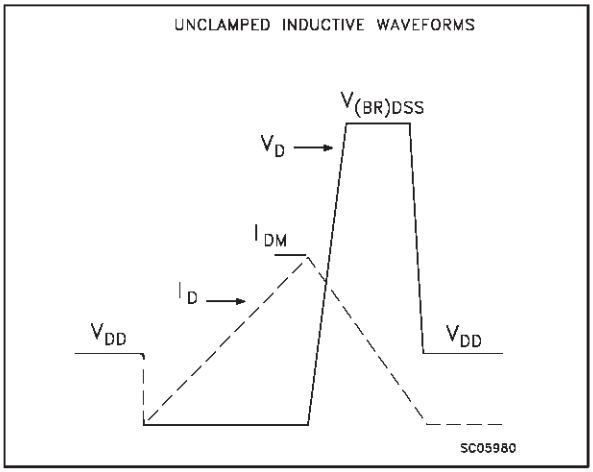


Fig. 3: Switching Times Test Circuits For Resistive Load

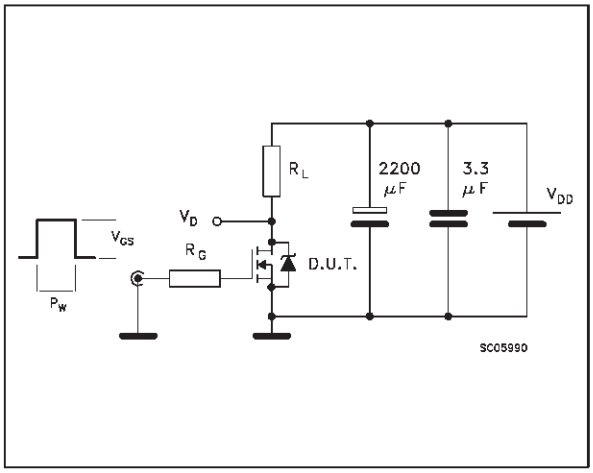


Fig. 4: Gate Charge test Circuit

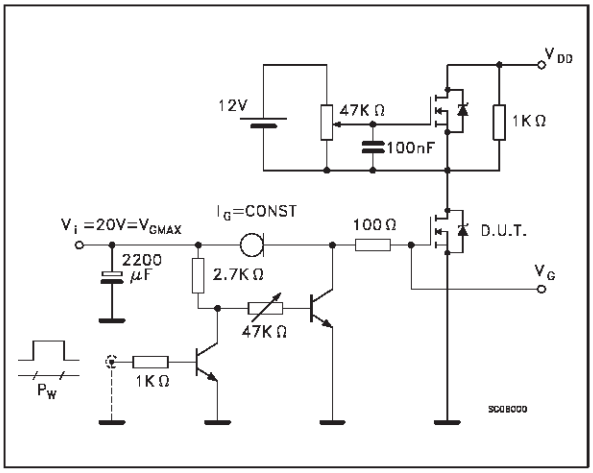
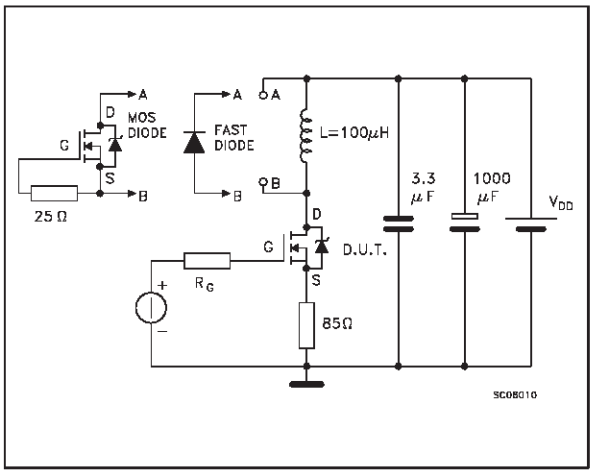


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



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