

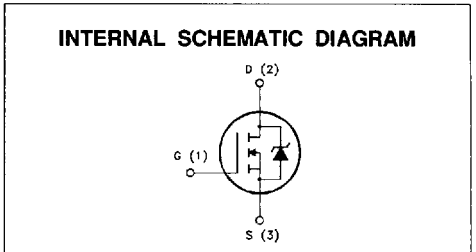
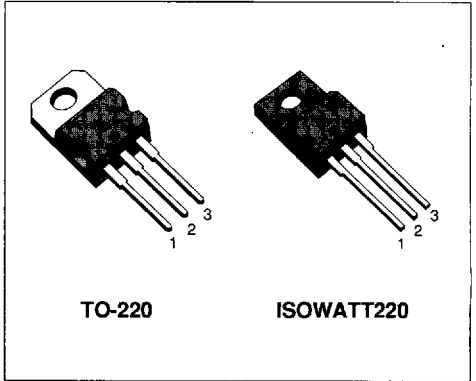
**N - CHANNEL ENHANCEMENT MODE  
POWER MOS TRANSISTOR**

TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub>
STP4N40	400 V	< 2.1 Ω	4 A
STP4N40FI	400 V	< 2.1 Ω	3 A

- TYPICAL R<sub>DS(on)</sub> = 1.65 Ω
- AVALANCHE RUGGED TECHNOLOGY
- 100% AVALANCHE TESTED
- REPETITIVE AVALANCHE DATA AT 100°C
- APPLICATION ORIENTED CHARACTERIZATION

**APPLICATIONS**

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- CHOPPER REGULATORS, CONVERTERS, MOTOR CONTROL, LIGHTING FOR INDUSTRIAL AND CONSUMER ENVIRONMENT



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value		Unit
		STP4N40	STP4N40FI	
V <sub>DS</sub>	Drain-source Voltage (V <sub>GS</sub> = 0)	400		V
V <sub>DGR</sub>	Drain- gate Voltage (R <sub>GS</sub> = 20 kΩ)	400		V
V <sub>GS</sub>	Gate-source Voltage	± 20		V
I <sub>D</sub>	Drain Current (continuous) at T <sub>c</sub> = 25 °C	4	3	A
I <sub>D</sub>	Drain Current (continuous) at T <sub>c</sub> = 100 °C	2.5	1.9	A
I <sub>DM</sub> (*)	Drain Current (pulsed)	16	16	A
P <sub>tot</sub>	Total Dissipation at T <sub>c</sub> = 25 °C	75	35	W
	Derating Factor	0.6	0.28	W/°C
V <sub>ISO</sub>	Insulation Withstand Voltage (DC)	—	2000	V
T <sub>stg</sub>	Storage Temperature	-65 to 150		°C
T <sub>j</sub>	Max. Operating Junction Temperature	150		°C

(\*) Pulse width limited by safe operating area

## THERMAL DATA

			TO-220	ISOWATT220	
$R_{thj-case}$	Thermal Resistance Junction-case	Max	1.67	3.57	$^{\circ}\text{C}/\text{W}$
$R_{thj-amb}$	Thermal Resistance Junction-ambient	Max	62.5		$^{\circ}\text{C}/\text{W}$
$R_{thc-sink}$	Thermal Resistance Case-sink	Typ	0.5		$^{\circ}\text{C}/\text{W}$
$T_j$	Maximum Lead Temperature For Soldering Purpose		300		$^{\circ}\text{C}$

## AVALANCHE CHARACTERISTICS

Symbol	Parameter	Max Value	Unit
$I_{AR}$	Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by $T_j$ max, $\delta < 1\%$ )	4	A
$E_{AS}$	Single Pulse Avalanche Energy (starting $T_j = 25^{\circ}\text{C}$ , $I_D = I_{AR}$ , $V_{DD} = 50\text{V}$ )	110	mJ
$E_{AR}$	Repetitive Avalanche Energy (pulse width limited by $T_j$ max, $\delta < 1\%$ )	7	mJ
$I_{AR}$	Avalanche Current, Repetitive or Not-Repetitive ( $T_c = 100^{\circ}\text{C}$ , pulse width limited by $T_j$ max, $\delta < 1\%$ )	2.5	A

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

OFF

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{(BR)DSS}$	Drain-source Breakdown Voltage	$I_D = 250\ \mu\text{A}$ $V_{GS} = 0$	400			V
$I_{DSS}$	Zero Gate Voltage Drain Current ( $V_{GS} = 0$ )	$V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating} \times 0.8$ $T_c = 125^{\circ}\text{C}$			250 1000	$\mu\text{A}$ $\mu\text{A}$
$I_{GSS}$	Gate-body Leakage Current ( $V_{DS} = 0$ )	$V_{GS} = \pm 20\text{V}$			$\pm 100$	nA

ON (\*)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}$ $I_D = 250\ \mu\text{A}$	2	3	4	V
$R_{DS(on)}$	Static Drain-source On Resistance	$V_{GS} = 10\text{V}$ $I_D = 2\text{A}$ $V_{GS} = 10\text{V}$ $I_D = 2\text{A}$ $T_c = 100^{\circ}\text{C}$		1.65	2.1 4.2	$\Omega$ $\Omega$
$I_{D(on)}$	On State Drain Current	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $V_{GS} = 10\text{V}$	4			A

DYNAMIC

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$g_{fs} (*)$	Forward Transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on)max}$ $I_D = 2\text{A}$	1	2.1		S
$C_{iss}$	Input Capacitance	$V_{DS} = 25\text{V}$ $f = 1\text{MHz}$ $V_{GS} = 0$		350	450	pF
$C_{oss}$	Output Capacitance			68	90	pF
$C_{rss}$	Reverse Transfer Capacitance			32	45	pF

**ELECTRICAL CHARACTERISTICS** (continued)

**SWITCHING ON**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{d(on)}$	Turn-on Time	$V_{DD} = 175\text{ V}$ $I_D = 2\text{ A}$		25	33	ns
$t_r$	Rise Time	$R_G = 50\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 3)		70	90	ns
$(di/dt)_{on}$	Turn-on Current Slope	$V_{DD} = 320\text{ V}$ $I_D = 4\text{ A}$ $R_G = 50\ \Omega$ $V_{GS} = 10\text{ V}$ (see test circuit, figure 5)		110		A/ $\mu$ s
$Q_g$	Total Gate Charge	$V_{DD} = 320\text{ V}$ $I_D = 4\text{ A}$ $V_{GS} = 10\text{ V}$		25	35	nC
$Q_{gs}$	Gate-Source Charge			7		nC
$Q_{gd}$	Gate-Drain Charge			11		nC

**SWITCHING OFF**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$t_{r(off)}$	Off-voltage Rise Time	$V_{DD} = 320\text{ V}$ $I_D = 4\text{ A}$		50	65	ns
$t_f$	Fall Time	$R_G = 50\ \Omega$ $V_{GS} = 10\text{ V}$		28	35	ns
$t_c$	Cross-over Time	(see test circuit, figure 5)		75	95	ns

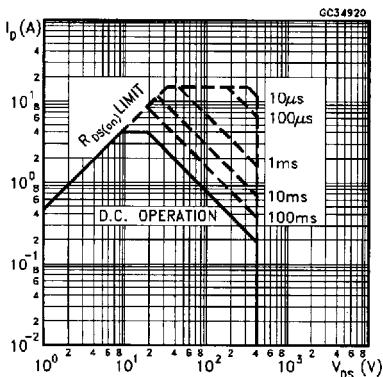
**SOURCE DRAIN DIODE**

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$	Source-drain Current				4	A
$I_{SDM}(\ast)$	Source-drain Current (pulsed)				16	A
$V_{SD}(\ast)$	Forward On Voltage	$I_{SD} = 4\text{ A}$ $V_{GS} = 0$			2	V
$t_{rr}$	Reverse Recovery Time	$I_{SD} = 4\text{ A}$ $di/dt = 100\text{ A}/\mu\text{s}$ $V_{DD} = 100\text{ V}$ $T_j = 150\text{ }^\circ\text{C}$		400		ns
$Q_{rr}$	Reverse Recovery Charge	(see test circuit, figure 5)		5.9		$\mu$ C
$I_{RRM}$	Reverse Recovery Current			29.5		A

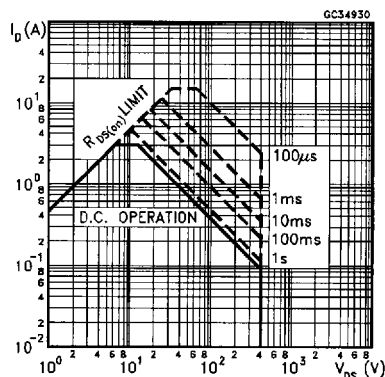
(\*) Pulsed: Pulse duration = 300  $\mu$ s, duty cycle 1.5 %

(\*) Pulse width limited by safe operating area

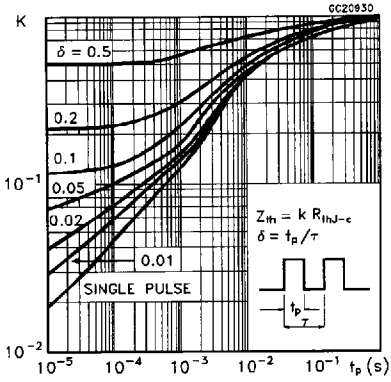
Safe Operating Areas For TO-220



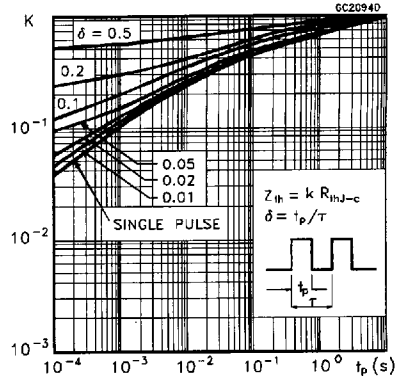
Safe Operating Areas For ISOWATT220



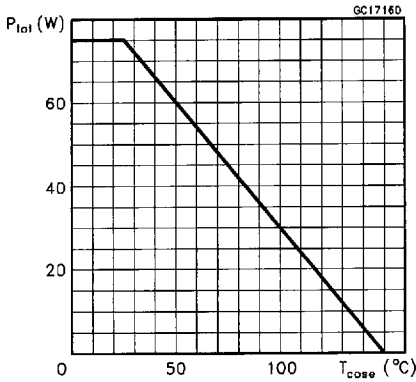
Thermal Impedance For TO-220



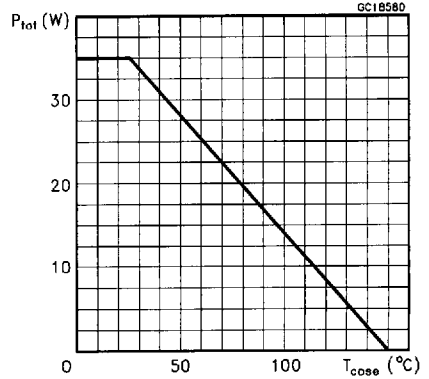
Thermal Impedance For ISOWATT220



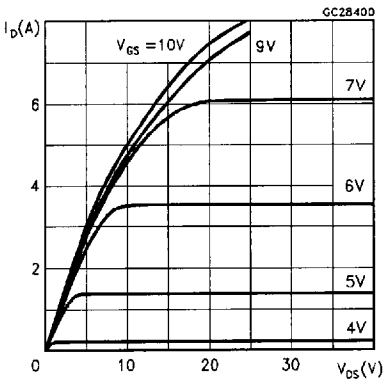
Derating Curve For TO-220



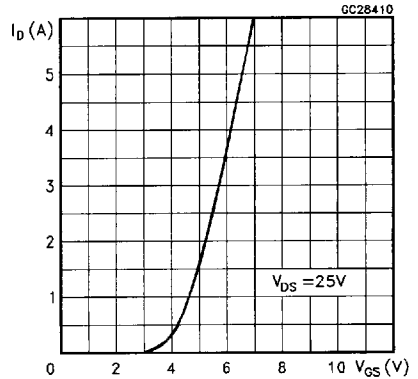
Derating Curve For ISOWATT220



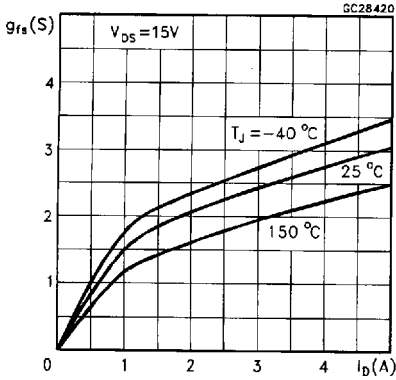
Output Characteristics



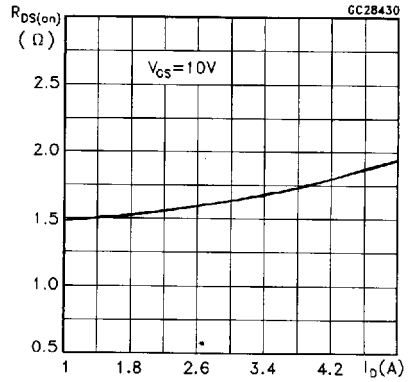
Transfer Characteristics



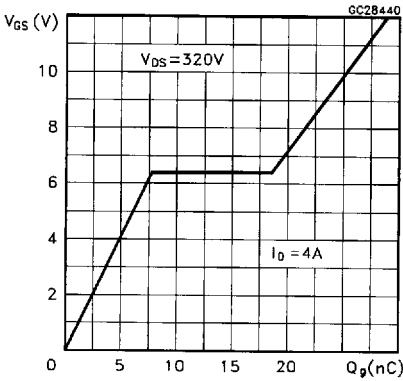
Transconductance



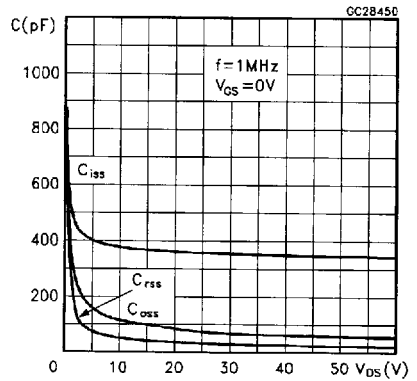
Static Drain-source On Resistance



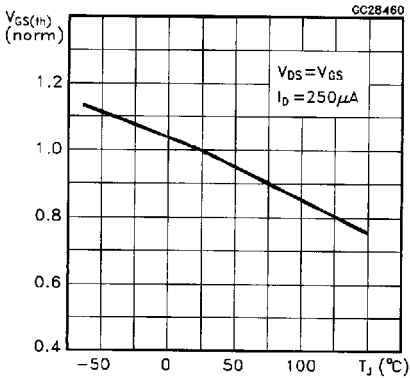
Gate Charge vs Gate-source Voltage



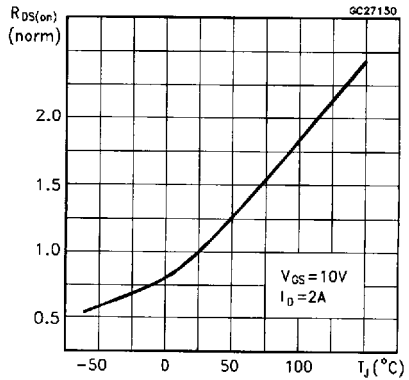
Capacitance Variations



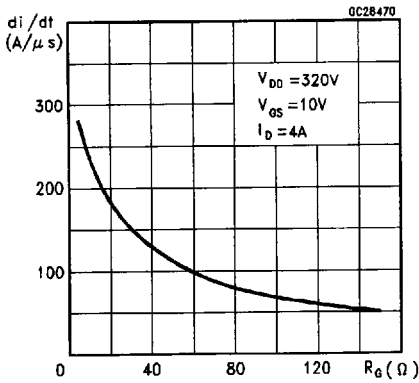
Normalized Gate Threshold Voltage vs Temperature



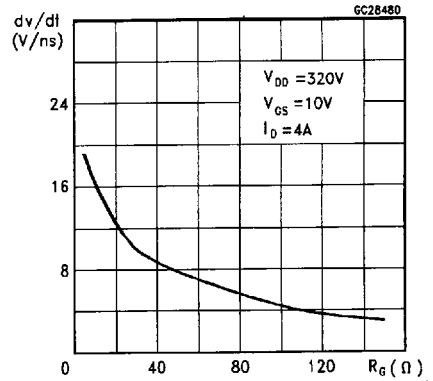
Normalized On Resistance vs Temperature



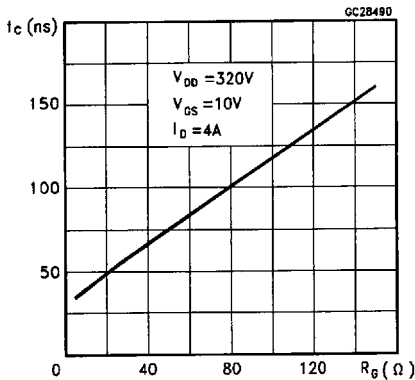
## Turn-on Current Slope



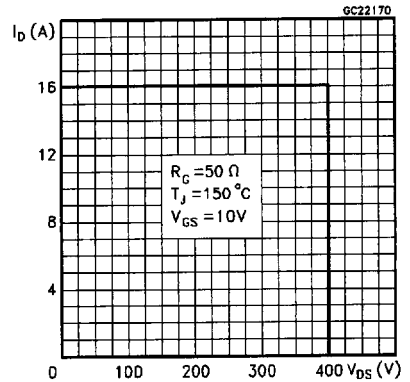
## Turn-off Drain-source Voltage Slope



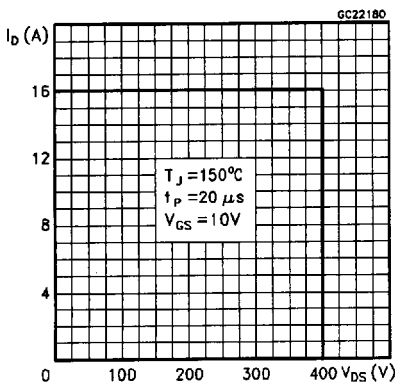
## Cross-over Time



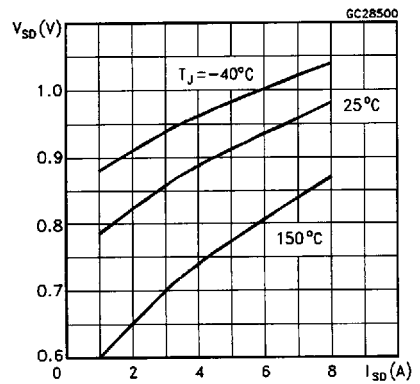
## Switching Safe Operating Area



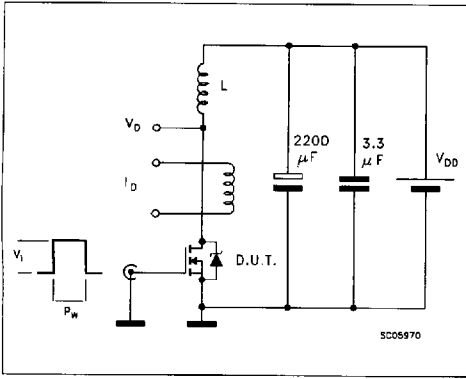
## Accidental Overload Area



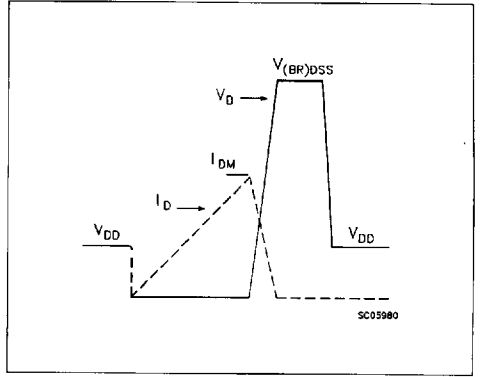
## Source-drain Diode Forward Characteristics



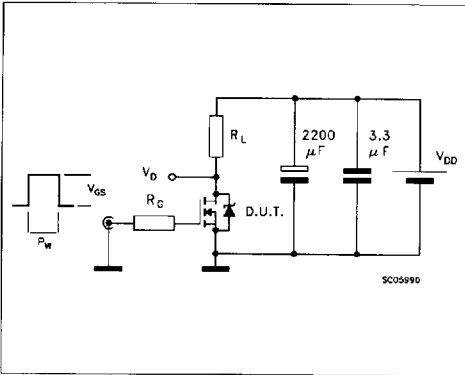
**Fig. 1: Unclamped Inductive Load Test Circuits**



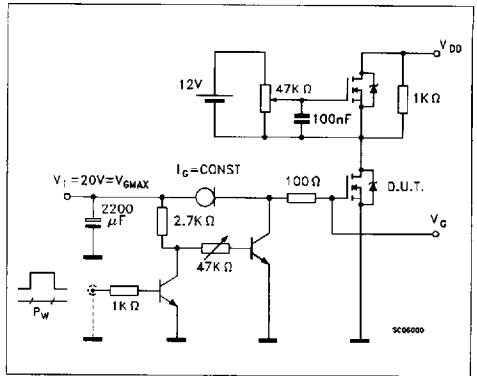
**Fig. 2: Unclamped Inductive Waveforms**



**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 Reverse Recovery Time**

