SGS-THOMSON MICROELECTRONICS

IRFP 450/FI-451/FI
IRFP 452/FI-453/FI

N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTORS

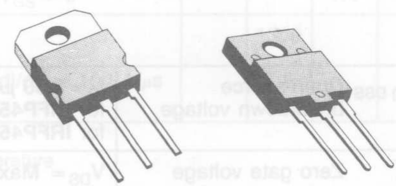
TYPE	V_{DSS}	$R_{DS(on)}$	I_D ▪
IRFP450	500 V	0.4 Ω	14 A
IRFP450FI	500 V	0.4 Ω	9 A
IRFP451	450 V	0.4 Ω	14 A
IRFP451FI	450 V	0.4 Ω	9 A
IRFP452	500 V	0.5 Ω	12 A
IRFP452FI	500 V	0.5 Ω	8 A
IRFP453	450 V	0.5 Ω	12 A
IRFP453FI	450 V	0.5 Ω	8 A

- HIGH VOLTAGE - 450V FOR OFF LINE SMPS
- HIGH CURRENT - 12A FOR UP TO 350W SMPS
- ULTRA FAST SWITCHING - FOR OPERATION AT > 100 KHz
- EASY DRIVE - REDUCES COST AND SIZE

INDUSTRIAL APPLICATIONS:

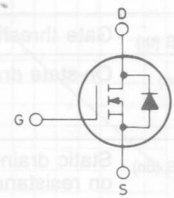
- SWITCHING MODE POWER SUPPLIES
- MOTOR CONTROLS

N - channel enhancement mode POWER MOS field effect transistors. Easy drive and very fast switching times make these POWER MOS transistors ideal for high speed switching applications.



TO-218 ISOWATT218

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

		IRFP				
	TO-218	450	451	452	453	
	ISOWATT218	450FI	451FI	452FI	453FI	
V_{DS} *	Drain-source voltage ($V_{GS} = 0$)	500	450	500	450	V
V_{DGR} *	Drain-gate voltage ($R_{GS} = 20\ K\Omega$)	500	450	500	450	V
V_{GS}	Gate-source voltage	± 20				V
I_{DM} (•)	Drain current (pulsed)	56	56	48	48	A
I_{DLM}	Drain inductive current, clamped ($L = 100\ \mu H$)	56	56	48	48	A
		450	451	452	453	
I_D	Drain current (cont.) at $T_c = 25°C$	14	14	12	12	A
I_D	Drain current (cont.) at $T_c = 100°C$	8.8	8.8	7.9	7.9	A
		450FI	451FI	452FI	453FI	
I_D▪	Drain current (cont.) at $T_c = 25°C$	9	9	8	8	A
I_D▪	Drain current (cont.) at $T_c = 100°C$	5.6	5.6	5	5	A
		TO-218		ISOWATT218		
P_{tot}▪	Total dissipation at $T_c < 25°C$	180		70		W
	Derating factor	1.44		0.55		W/°C
T_{stg}	Storage temperature	− 55 to 150				°C
T_j	Max. operating junction temperature	150				°C

* $T_j = 25°C$ to $125°C$
(•) Repetitive Rating: Pulse width limited by max junction temperature.
▪ See note on ISOWATT218 on this datasheet.

THERMAL DATA ▪

			TO-218	ISOWATT218	
$R_{thj-case}$	Thermal resistance junction-case	max	0.69	1.8	°C/W
R_{thc-s}	Thermal resistance case-sink	typ	0.1		°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	max	30		°C/W
T_l	Maximum lead temperature for soldering purpose		300		°C

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

	Parameters	Test Conditions	Min.	Typ.	Max.	Unit

OFF

$V_{(BR)\,DSS}$	Drain-source breakdown voltage	$I_D = 250\ \mu A$ $V_{GS} = 0$ for **IRFP450/452/450FI/452FI** for **IRFP451/453/451FI/453FI**	 500 450			 V V
I_{DSS}	Zero gate voltage drain current ($V_{GS} = 0$)	V_{DS} = Max Rating V_{DS} = Max Rating x 0.8 $T_c = 125°C$			250 1000	μA μA
I_{GSS}	Gate-body leakage current ($V_{DS} = 0$)	$V_{GS} = \pm 20$ V			±500	nA

ON **

$V_{GS\,(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$ $I_D = 250\ \mu A$	2		4	V
$I_{D(on)}$	On-state drain current	$V_{DS} > I_{D\,(on)} \times R_{DS(on)\,max}$ $V_{GS} = 10$ V for **IRFP450/451/450FI/451FI** for **IRFP452/453/452FI/453FI**	 14 12			 A A
$R_{DS\,(on)}$	Static drain-source on resistance	$V_{GS} = 10$ V $I_D = 7.9$ A for **IRFP450/451/450FI/451FI** for **IRFP452/453/452FI/453FI**			 0.4 0.5	 Ω Ω

DYNAMIC

g_{fs} **	Forward transconductance	$V_{DS} > I_{D\,(on)} \times R_{DS\,(on)\,max}$ $I_D = 7.9$ A	9.3			mho
C_{iss} C_{oss} C_{rss}	Input capacitance Output capacitance Reverse transfer capacitance	$V_{DS} = 25$ V f = 1 MHz $V_{GS} = 0$			3000 600 200	pF pF pF

SWITCHING

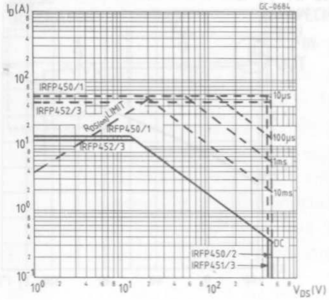
$t_{d\,(on)}$ t_r $t_{d\,(off)}$ t_f	Turn-on time Rise time Turn-off delay time Fall time	$V_{DD} = 210$ V $I_D = 7.0$ A $R_i = 4.7\ \Omega$ (see test circuit)			35 50 150 70	ns ns ns ns
Q_g	Total Gate Charge	$V_{GS} = 10$ V $I_D = 13$ A V_{DS} = Max Rating × 0.8 (see test circuit)			120	nC

ELECTRICAL CHARACTERISTICS (Continued)

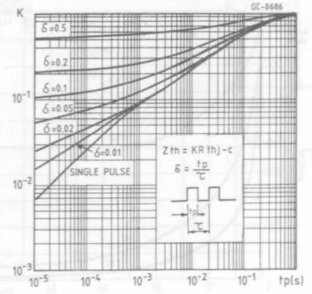
Parameters		Test Conditions	Min.	Typ.	Max.	Unit
SOURCE DRAIN DIODE						
I_{SD} I_{SDM} (•)	Source-drain current Source-drain current (pulsed)				14 56	A A
V_{SD}	Forward on voltage	I_{SD} = 14 A V_{GS} = 0			1.4	V
t_{rr} Q_{rr}	Reverse recovery time Reverse recovered charge	T_j = 150°C I_{SD} = 14 A di/dt = 100 A/μs		1300 7.4		ns μC

** Pulsed: Pulse duration ⩽ 300 μs, duty cycle ⩽ 1.5%
(•) Repetitive Rating: Pulse width limited by max junction temperature
■ See note on ISOWATT218 in this datasheet.

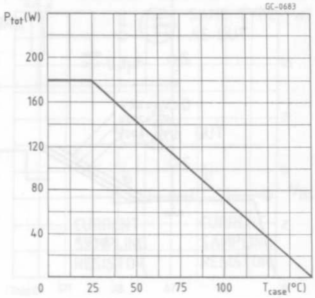
Safe operating areas (standard package)



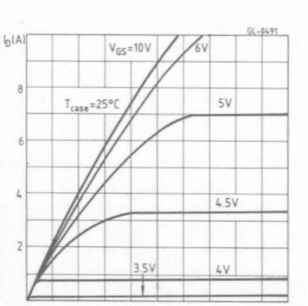
Thermal impedance (standard package)



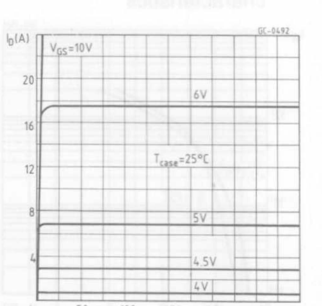
Derating curve (standard package)



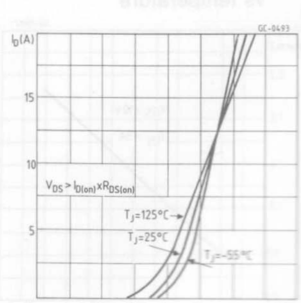
Output characteristics



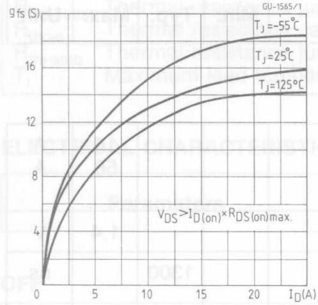
Output characteristics



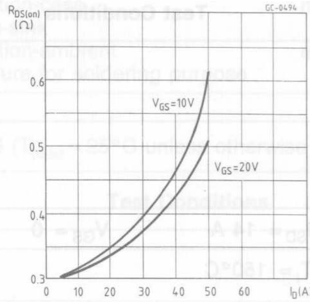
Transfer characteristics



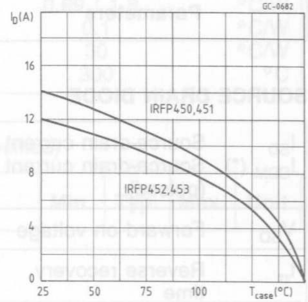
Transconductance



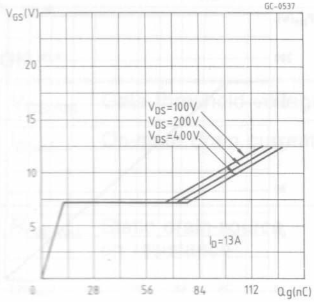
Static drain-source on resistance



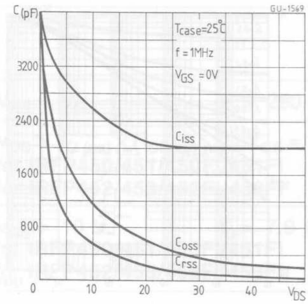
Maximum drain current vs temperature



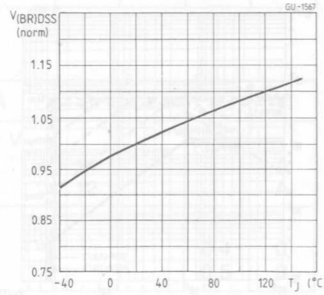
Gate charge vs gate-source voltage



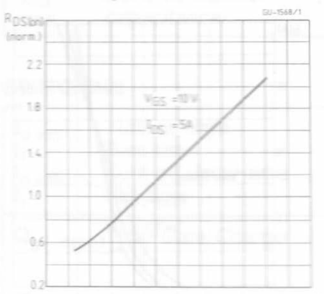
Capacitance variation



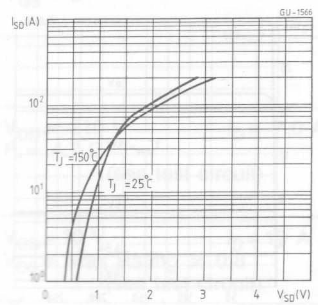
Normalized breakdown voltage vs temperature



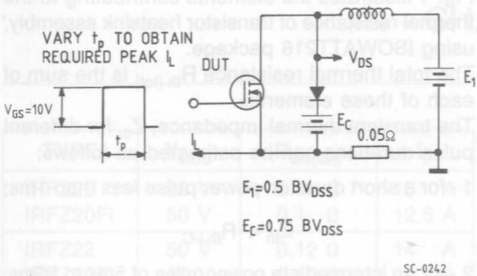
Normalized on resistance vs temperature



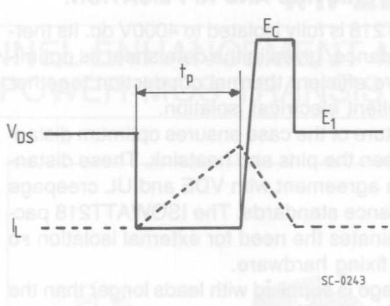
Source-drain diode forward characteristics



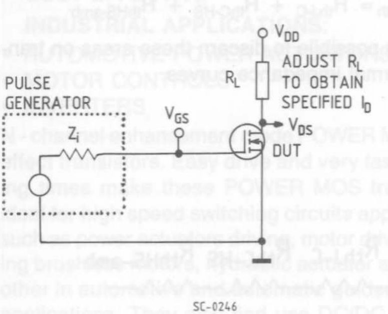
Clamped inductive test circuit



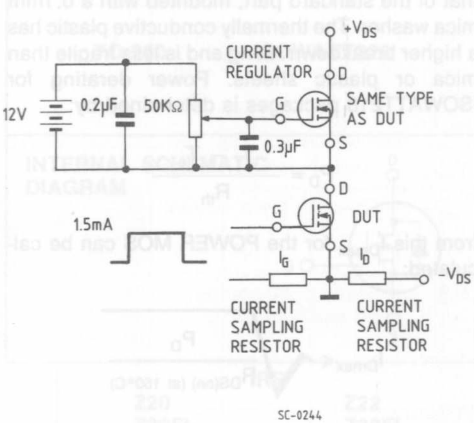
Clamped inductive waveforms



Switching times test circuit



Gate charge test circuit



ISOWATT218 PACKAGE CHARACTERISTICS AND APPLICATION.

ISOWATT218 is fully isolated to 4000V dc. Its thermal impedance, given in the data sheet, is optimised to give efficient thermal conduction together with excellent electrical isolation.
The structure of the case ensures optimum distances between the pins and heatsink. These distances are in agreement with VDE and UL creepage and clearance standards. The ISOWATT218 package eliminates the need for external isolation so reducing fixing hardware.
The package is supplied with leads longer than the standard TO-218 to allow easy mounting on pcbs. Accurate moulding techniques used in manufacture assures consistent heat spreader-to-heatsink capacitance
ISOWATT218 thermal performance is better than that of the standard part, mounted with a 0.1mm mica washer. The thermally conductive plastic has a higher breakdown rating and is less fragile than mica or plastic sheets. Power derating for ISOWATT218 packages is determined by:

$$P_D = \frac{T_j - T_c}{R_{th}}$$

from this I_{Dmax} for the POWER MOS can be calculated:

$$I_{Dmax} \leq \sqrt{\frac{P_D}{R_{DS(on)}\ (\text{at } 150°C)}}$$

THERMAL IMPEDANCE OF ISOWATT218 PACKAGE

Fig. 1 illustrates the elements contributing to the thermal resistance of transistor heatsink assembly, using ISOWATT218 package.
The total thermal resistance $R_{th\ (tot)}$ is the sum of each of these elements.
The transient thermal impedance, Z_{th} for different pulse durations can be estimated as follows:

1 - for a short duration power pulse less than 1ms;

$$Z_{th} < R_{thJ\text{-}C}$$

2 - for an intermediate power pulse of 5ms to 50ms:

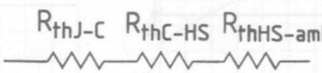
$$Z_{th} = R_{thJ\text{-}C}$$

3 - for long power pulses of the order of 500ms or greater:

$$Z_{th} = R_{thJ\text{-}C} + R_{thC\text{-}HS} + R_{thHS\text{-}amb}$$

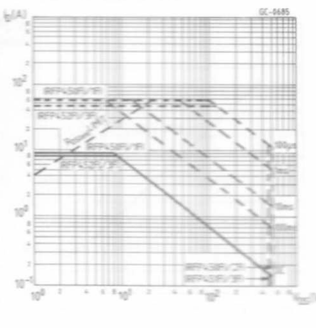
It is often possibile to discern these areas on transient thermal impedance curves.

Fig. 1

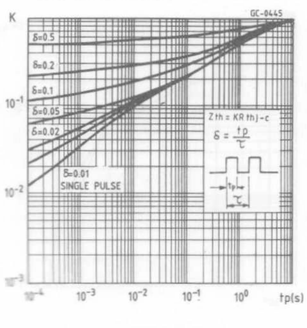


ISOWATT DATA

Safe operating areas



Thermal impedance



Derating curve