

## N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTORS

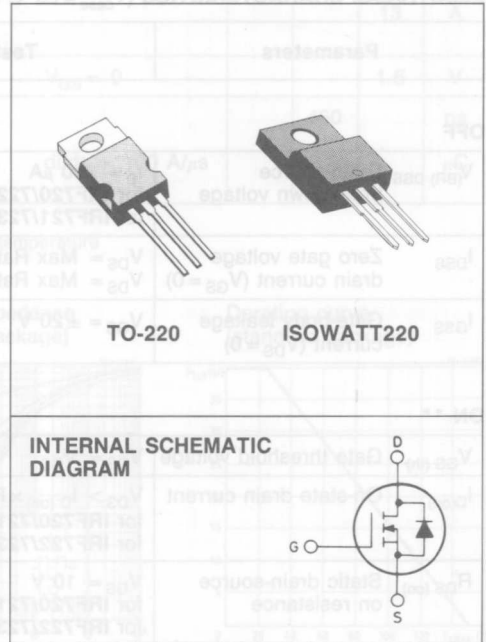
TYPE	V <sub>DSS</sub>	R <sub>DS(on)</sub>	I <sub>D</sub> *
IRF720	400 V	1.8 Ω	3.3 A
IRF720FI	400 V	1.8 Ω	2.5 A
IRF721	350 V	1.8 Ω	3.3 A
IRF721FI	350 V	1.8 Ω	2.5 A
IRF722	400 V	2.5 Ω	2.8 A
IRF722FI	400 V	2.5 Ω	2.0 A
IRF723	350 V	2.5 Ω	2.8 A
IRF723FI	350 V	2.5 Ω	2.0 A

- HIGH VOLTAGE - FOR OFF LINE APPLICATIONS
- ULTRA FAST SWITCHING
- EASY DRIVE - FOR REDUCED COST AND SIZE

### INDUSTRIAL APPLICATIONS:

- ELECTRONIC LAMP BALLAST
- DC SWITCH

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. Applications include off-line use, constant current source, ultrasonic equipment and switching powers supplies start-up circuits.



### ABSOLUTE MAXIMUM RATINGS

		IRF					
		TO-220 ISOWATT220	720 720FI	721 721FI	722 722FI		723 723FI
V <sub>DS</sub> *	Drain-source voltage (V <sub>GS</sub> = 0)		400	350	400	350	V
V <sub>DGR</sub> *	Drain-gate voltage (R <sub>GS</sub> = 20 KΩ)		400	350	400	350	V
V <sub>GS</sub>	Gate-source voltage		±20				V
I <sub>DM</sub> (●)	Drain current (pulsed)		13	13	11	11	A
I <sub>DLM</sub>	Drain inductive current, clamped (L = 100 μH)		13	13	11	11	A
I <sub>D</sub>	Drain current (cont.) at T <sub>c</sub> = 25°C		720 3.3	721 3.3	722 2.8	723 2.8	A
I <sub>D</sub>	Drain current (cont.) at T <sub>c</sub> = 100°C		2.1	2.1	1.8	1.8	A
I <sub>D</sub> ■	Drain current (cont.) at T <sub>c</sub> = 25°C		720FI 2.5	721FI 2.5	722FI 2	723FI 2	A
I <sub>D</sub> ■	Drain current (cont.) at T <sub>c</sub> = 100°C		1.5	1.5	1.2	1.2	A
P <sub>tot</sub> ■	Total dissipation at T <sub>c</sub> < 25°C		TO-220		ISOWATT220		W
	Derating factor		50		30		W/°C
			0.40		0.24		
T <sub>stg</sub>	Storage temperature		-55 to 150				°C
T <sub>j</sub>	Max. operating junction temperature		150				°C

\* T<sub>j</sub> = 25°C to 125°C

(●) Repetitive Rating: Pulse width limited by max junction temperature.

■ See note on ISOWATT220 on this datasheet.

## THERMAL DATA \*

			TO-220	ISOWATT220	
$R_{thj - case}$	Thermal resistance junction-case	max	2.50	4.16	°C/W
$R_{thc-s}$	Thermal resistance case-sink	typ		0.5	°C/W
$R_{thj-amb}$	Thermal resistance junction-ambient	max		80	°C/W
$T_l$	Maximum lead temperature for soldering purpose			300	°C

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

Parameters	Test Conditions	Min.	Typ.	Max.	Unit
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## OFF

$V_{(BR) DSS}$	Drain-source breakdown voltage	$I_D = 250 \mu\text{A}$ for IRF720/722/720FI/722FI for IRF721/723/721FI/723FI	$V_{GS} = 0$	400 350	V 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 ( $V_{DS} = 0$ )	$V_{GS} = \pm 20 \text{ V}$			$\pm 500$ nA

## ON \*\*

$V_{GS(th)}$	Gate threshold voltage	$V_{DS} = V_{GS}$	$I_D = 250 \mu\text{A}$	2	4	V
$I_{D(on)}$	On-state drain current	$V_{DS} > I_{D(on)} \times R_{DS(on) max}$ for IRF720/721/720FI/721FI for IRF722/723/722FI/723FI	$V_{GS} = 10 \text{ V}$	3.3 2.8		A A
$R_{DS(on)}$	Static drain-source on resistance	$V_{GS} = 10 \text{ V}$ for IRF720/721/720FI/721FI for IRF722/723/722FI/723FI	$I_D = 1.8 \text{ A}$		1.8 2.5	$\Omega$ $\Omega$

## DYNAMIC

$g_{fs} **$	Forward transconductance	$V_{DS} > I_{D(on)} \times R_{DS(on) max}$ $I_D = 1.8 \text{ A}$		1.0		mho
$C_{iss}$	Input capacitance	$V_{DS} = 25 \text{ V}$	$f = 1 \text{ MHz}$		600	pF
$C_{oss}$	Output capacitance	$V_{GS} = 0$			200	pF
$C_{riss}$	Reverse transfer capacitance				40	pF

## SWITCHING

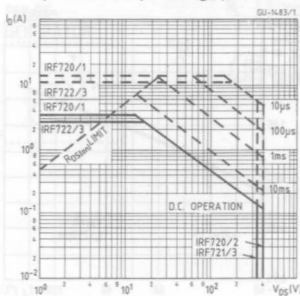
$t_{r(on)}$	Turn-on time	$V_{DD} = 175 \text{ V}$	$I_D = 1.5 \text{ A}$		40	ns
$t_{r(rise)}$	Rise time	$R_l = 50 \Omega$			50	ns
$t_{d(off)}$	Turn-off delay time	(see test circuit)			100	ns
$t_{f(fall)}$	Fall time				50	ns
$Q_g$	Total Gate Charge	$V_{GS} = 10 \text{ V}$ $V_{DS} = \text{Max Rating} \times 0.8$	$I_D = 3.3 \text{ A}$		15	nC
		(see test circuit)				

ELECTRICAL CHARACTERISTICS (Continued)

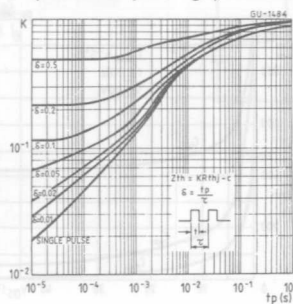
Parameters	Test Conditions	Min.	Typ.	Max.	Unit
$I_{SD}$ $I_{SDM}$ (*)	Source-drain current Source-drain current (pulsed)			3.3 13	A A
$V_{SD}$	Forward on voltage	$I_{SD} = 3.3$ A	$V_{GS} = 0$	1.6	V
$t_{rr}$ $Q_{rr}$	Reverse recovery time Reverse recovered charge	$I_{SD} = 3.3$ A	$di/dt = 100$ A/ $\mu$ s	450 3.1	ns $\mu$ C

- \*\* Pulsed: Pulse duration  $\leq 300 \mu$ s, duty cycle  $\leq 1.5\%$
- (\*) Repetitive Rating: Pulse width limited by max junction temperature
- See note on ISOWATT220 in this datasheet

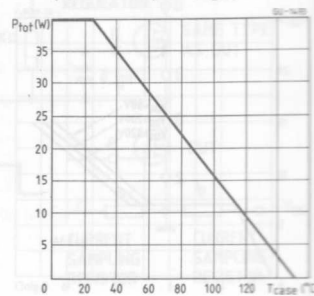
Safe operating areas  
(standard package)



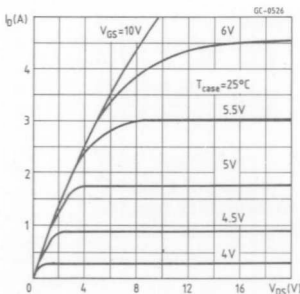
Thermal impedance  
(standard package)



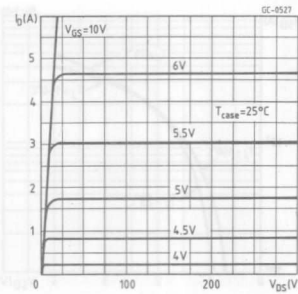
Derating curve  
(standard package)



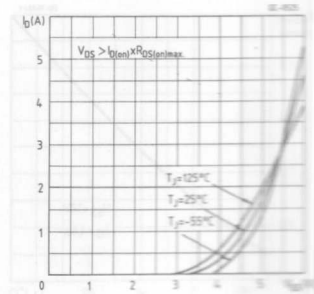
Output characteristics



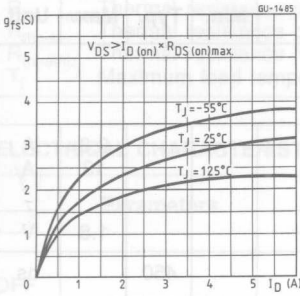
Output characteristics



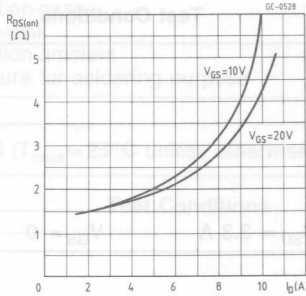
Transfer characteristics



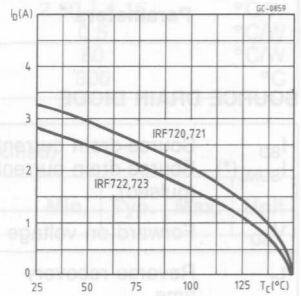
Transconductance



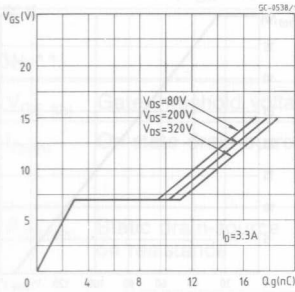
Static drain-source on resistance



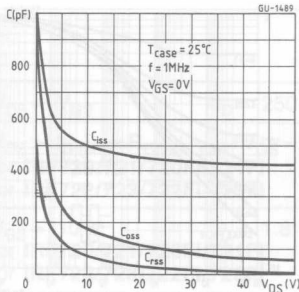
Maximum drain current vs temperature



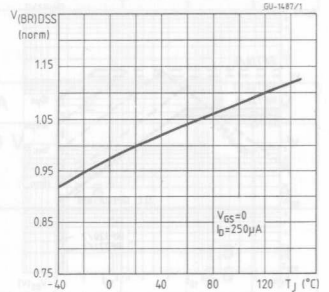
Gate charge vs gate-source voltage



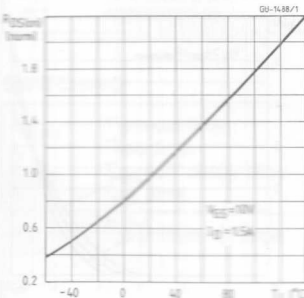
Capacitance variation



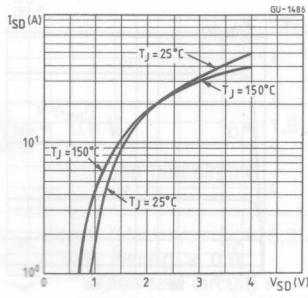
Normalized breakdown voltage vs temperature



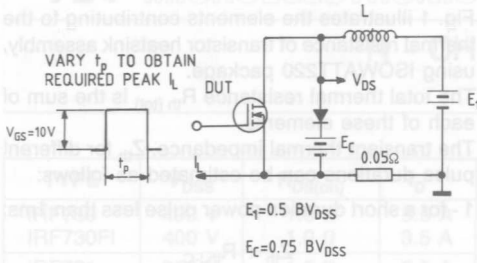
Normalized on resistance vs temperature



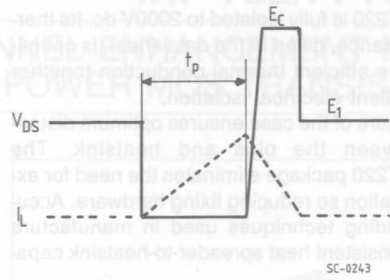
Source-drain diode forward characteristics



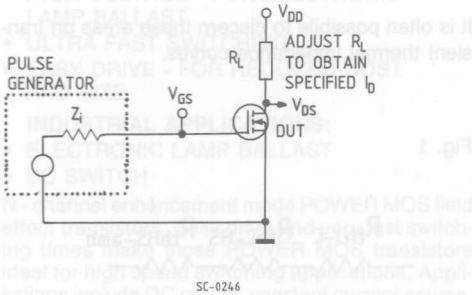
Clamped inductive test circuit



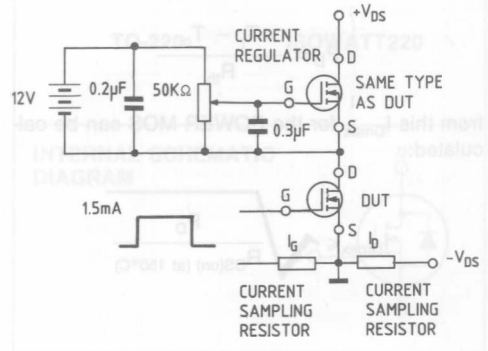
Clamped inductive waveforms



Switching times test circuit



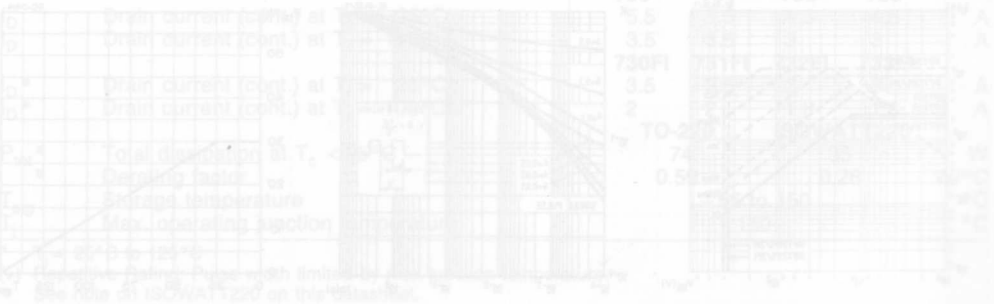
Gate charge test circuit



ABSOLUTE MAXIMUM RATINGS

$V_{DS}$	Drain-source voltage ( $V_{GS} = 0$ )
$V_{DGS}$	Drain-gate voltage ( $R_{DG} = 20 \text{ K}\Omega$ )
$V_{GS}$	Gate-source voltage
$I_{DM}$ (*)	Drain current (pulsed)
$I_{DM}$	Drain inductive current, clamped ( $L = 100 \mu\text{H}$ )

		IRF			
		730	731	732	733
		730FI	731FI	732FI	733FI
$V_{DS}$	V	400	350	400	350
$V_{DGS}$	V	400	350	400	350
$V_{GS}$	V	±20			
$I_{DM}$ (*)	A	20	20	20	18
$I_{DM}$	A	20	20	18	18



**ISOWATT220 PACKAGE CHARACTERISTICS AND APPLICATION.**

ISOWATT220 is fully isolated to 2000V 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. The ISOWATT220 package eliminates the need for external isolation so reducing fixing hardware. Accurate moulding techniques used in manufacture assure consistent heat spreader-to-heatsink capacitance.

ISOWATT220 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 ISOWATT220 packages is determined by:

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

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

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

**THERMAL IMPEDANCE OF ISOWATT220 PACKAGE**

Fig. 1 illustrates the elements contributing to the thermal resistance of transistor heatsink assembly, using ISOWATT220 package.

The total thermal resistance  $R_{th \text{ (tot)}}$  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;

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

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

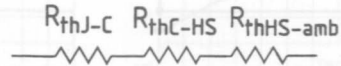
$$Z_{th} = R_{thJ-C}$$

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

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

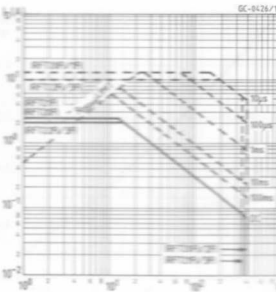
It is often possible to discern these areas on transient thermal impedance curves.

Fig. 1

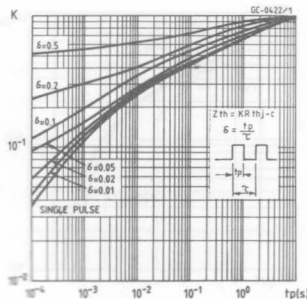


**ISOWATT DATA**

**Safe operating areas**



**Thermal impedance**



**Derating curve**

