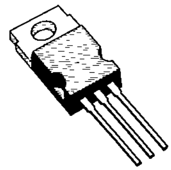
# SGS-THOMSON MICROELECTRONICS

# IRF 730/FI-731/FI
# IRF 732/FI-733/FI

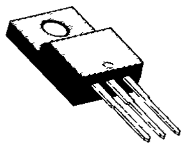
S G S-THOMSON

## N - CHANNEL ENHANCEMENT MODE POWER MOS TRANSISTORS

| TYPE | $V_{DSS}$ | $R_{DS(on)}$ | $I_D$ ▪ |
|---|---|---|---|
| IRF730 | 400 V | 1.0 Ω | 5.5 A |
| IRF730FI | 400 V | 1.0 Ω | 3.5 A |
| IRF731 | 350 V | 1.0 Ω | 5.5 A |
| IRF731FI | 350 V | 1.0 Ω | 3.5 A |
| IRF732 | 400 V | 1.5 Ω | 4.5 A |
| IRF732FI | 400 V | 1.5 Ω | 3.0 A |
| IRF733 | 350 V | 1.5 Ω | 4.5 A |
| IRF733FI | 350 V | 1.5 Ω | 3.0 A |



TO-220



ISOWATT220

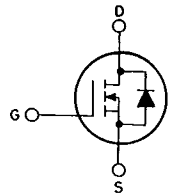
- HIGH VOLTAGE - FOR ELECTRONIC LAMP BALLAST
- ULTRA FAST SWITCHING
- EASY DRIVE - FOR REDUCED COST AND SIZE

**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 DC switch, constant current source, ultrasonic equipment and electronic ballast for fluorescent lamps.

**INTERNAL SCHEMATIC DIAGRAM**




**ABSOLUTE MAXIMUM RATINGS**

| | TO-220 ISOWATT220 | IRF 730 730FI | 731 731FI | 732 732FI | 733 733FI | |
|---|---|---|---|---|---|---|
| $V_{DS}$ * | Drain-source voltage ($V_{GS}=0$) | 400 | 350 | 400 | 350 | V |
| $V_{DGR}$ * | Drain-gate voltage ($R_{GS}=20$ KΩ) | 400 | 350 | 400 | 350 | V |
| $V_{GS}$ | Gate-source voltage | ±20 | | | | V |
| $I_{DM}$ (•) | Drain current (pulsed) | 20 | 20 | 16 | 16 | A |
| $I_{DLM}$ | Drain inductive current, clamped (L= 100 μH) | 20 | 20 | 16 | 16 | A |
| | | **730** | **731** | **732** | **733** | |
| $I_D$ | Drain current (cont.) at $T_c$= 25°C | 5.5 | 5.5 | 4.5 | 4.5 | A |
| $I_D$ | Drain current (cont.) at $T_c$= 100°C | 3.5 | 3.5 | 3 | 3 | A |
| | | **730FI** | **731FI** | **732FI** | **733FI** | |
| $I_D$▪ | Drain current (cont.) at $T_c$= 25°C | 3.5 | 3.5 | 3 | 3 | A |
| $I_D$▪ | Drain current (cont.) at $T_c$= 100°C | 2 | 2 | 1.8 | 1.8 | A |
| | | **TO-220** | | **ISOWATT220** | | |
| $P_{tot}$▪ | Total dissipation at $T_c$ <25°C | 74 | | 35 | | W |
| ▪ | Derating factor | 0.59 | | 0.28 | | 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 ISOWATT220 on this datasheet.

**THERMAL DATA**▪

| | | | TO-220 | ISOWATT220 | |
|---|---|---|---|---|---|
| $R_{thj-case}$ | Thermal resistance junction-case | max | 1.69 | 3.57 | °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°C unless otherwise specified)

| Parameters | | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **OFF** | | | | | | |
| $V_{(BR)DSS}$ | Drain-source breakdown voltage | $I_D$ = 250 μA $V_{GS}$ = 0<br>for **IRF730/732/730FI/732FI**<br>for **IRF731/733/731FI/733FI** | <br>400<br>350 | | | <br>V<br>V |
| $I_{DSS}$ | Zero gate voltage drain current ($V_{GS}$ = 0) | $V_{DS}$ = Max Rating<br>$V_{DS}$ = Max Rating x 0.8 $T_c$ = 125°C | | | 250<br>1000 | μA<br>μA |
| $I_{GSS}$ | Gate-body leakage current ($V_{DS}$ = 0) | $V_{GS}$ = ±20 V | | | ±500 | nA |
| **ON** ** | | | | | | |
| $V_{GS(th)}$ | Gate threshold voltage | $V_{DS}$ = $V_{GS}$ $I_D$ = 250 μA | 2 | | 4 | V |
| $I_{D(on)}$ | On-state drain current | $V_{DS}$ > $I_{D(on)}$ × $R_{DS(on)max}$ $V_{GS}$ = 10 V<br>for **IRF730/731/730FI/731FI**<br>for **IRF732/733/732FI/733FI** | <br>5.5<br>4.5 | | | <br>A<br>A |
| $R_{DS(on)}$ | Static drain-source on resistance | $V_{GS}$ = 10 V $I_D$ = 3.0 A<br>for **IRF730/731/730FI/731FI**<br>for **IRF732/733/732FI/733FI** | | | <br>1.0<br>1.5 | <br>Ω<br>Ω |
| **DYNAMIC** | | | | | | |
| $g_{fs}$ ** | Forward transconductance | $V_{DS}$ > $I_{D(on)}$ × $R_{DS(on)max}$<br>$I_D$ = 3.0 A | 2.9 | | | mho |
| $C_{iss}$<br>$C_{oss}$<br>$C_{rss}$ | Input capacitance<br>Output capacitance<br>Reverse transfer capacitance | $V_{DS}$ = 25 V f = 1 MHz<br>$V_{GS}$ = 0 | | | 800<br>300<br>80 | pF<br>pF<br>pF |
| **SWITCHING** | | | | | | |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$ | Turn-on time<br>Rise time<br>Turn-off delay time<br>Fall time | $V_{DD}$ = 175 V $I_D$ = 3.0 A<br>$R_i$ = 15 Ω<br>(see test circuit) | | | 30<br>35<br>55<br>35 | ns<br>ns<br>ns<br>ns |
| $Q_g$ | Total Gate Charge | $V_{GS}$ = 10 V $I_D$ = 5.5 A<br>$V_{DS}$ = Max Rating × 0.8<br>(see test circuit) | | | 35 | nC |

**ELECTRICAL CHARACTERISTICS** (Continued)

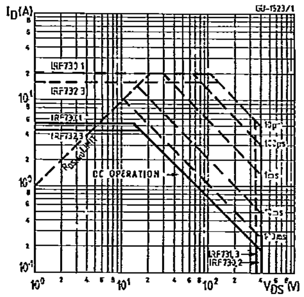
| Parameters | | Test Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|

## SOURCE DRAIN DIODE

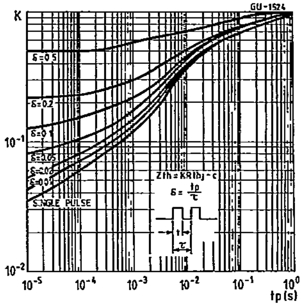
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $I_{SD}$<br>$I_{SDM}$ (•) | Source-drain current<br>Source-drain current (pulsed) | | | | | 5.5<br>20 | A<br>A |
| $V_{SD}$ | Forward on voltage | $I_{SD}$ = 5.5 A | $V_{GS}$ = 0 | | | 1.6 | V |
| $t_{rr}$<br>$Q_{rr}$ | Reverse recovery time<br>Reverse recovered charge | $T_j$ = 150°C<br>$I_{SD}$ = 5.5 A | <br>di/dt = 100 A/μs | | 600<br>4 | | ns<br>μC |

** Pulsed: Pulse duration ⩽ 300 μs, duty cycle ⩽ 1.5%
(•) Repetitive Rating: Pulse width limited by max junction temperature
■ See note on ISOWATT220 in this datasheet

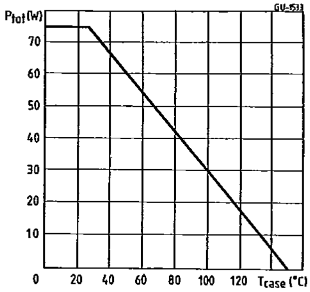
Safe operating areas (standard package)



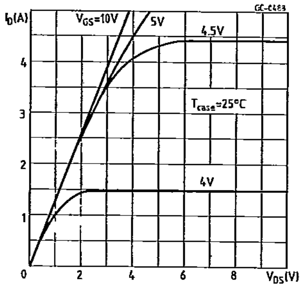

Thermal impedance (standard package)



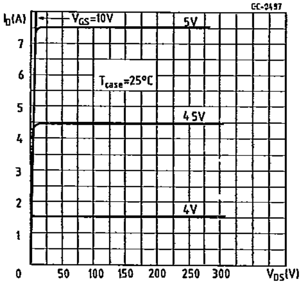

Derating curve (standard package)



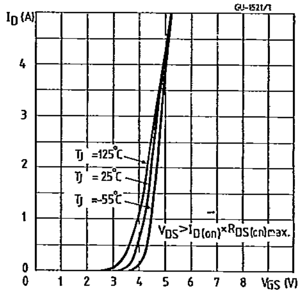

Output characteristics



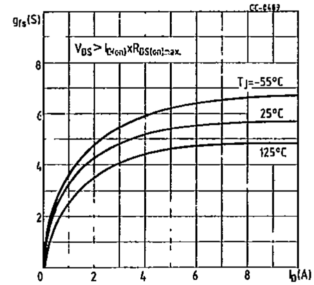

Output characteristics



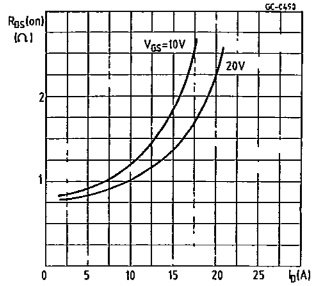

Transfer characteristics



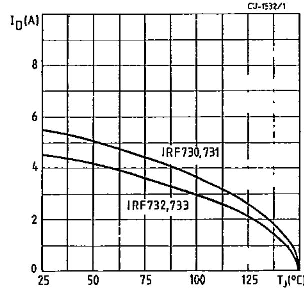
Transconductance



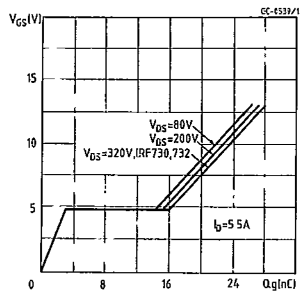

Static drain-source on resistance



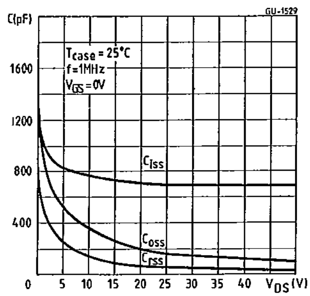

Maximum drain current vs temperature



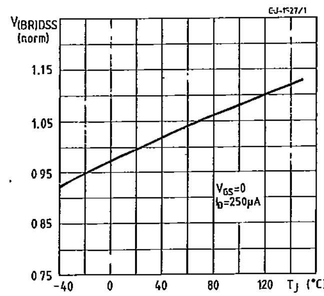

Gate charge vs gate-source voltage



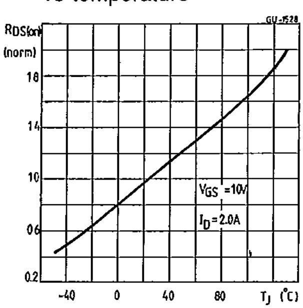

Capacitance variation



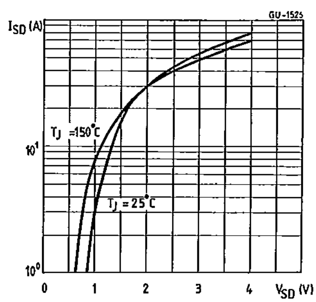

Normalized breakdown voltage vs temperature



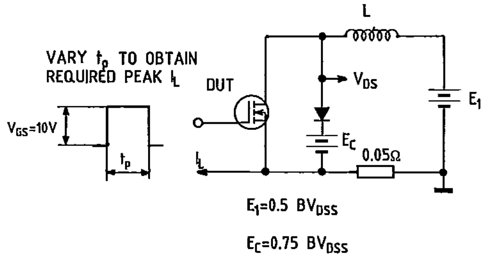

Normalized on resistance vs temperature




Source-drain diode forward characteristics

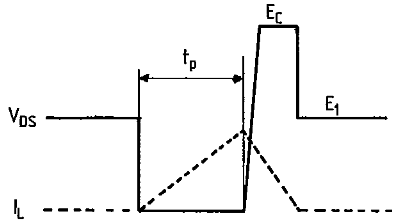


Clamped inductive test circuit



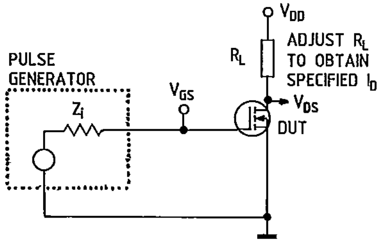

SC-0242

Clamped inductive waveforms



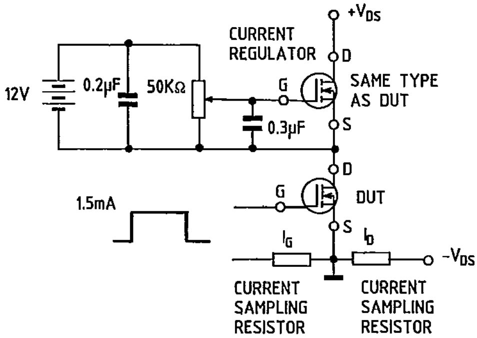

SC-0243

Switching times test circuit




SC-0246

Gate charge test circuit




SC-0244

## 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:

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

## 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 $R_{th\ (tot)}$ 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:

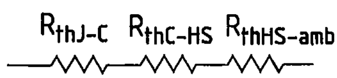
$$Z_{th} = R_{thJ\text{-}C}$$

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

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

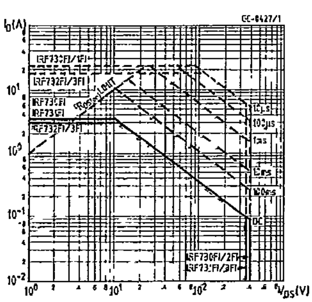
It is often possibile to discern these areas on transient thermal impedance curves.

Fig. 1

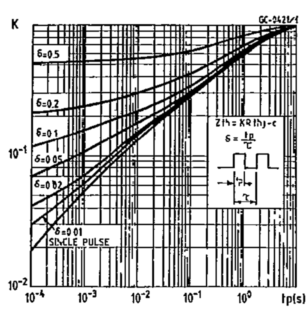



## ISOWATT DATA

Safe operating areas




Thermal impedance




Derating curve