HARRIS SEMICONDUCTOR

FRL230D, FRL230R, FRL230H

5A, 200V, 0.500 Ohm, Rad Hard, N-Channel Power MOSFETs

June 1998

Features

- 5A, 200V, RDS(on) = 0.500Ω
- Second Generation Rad Hard MOSFET Results From New Design Concepts
- Gamma
  - Meets Pre-Rad Specifications to 100KRAD(Si)
  - Defined End Point Specs at 300KRAD(Si) and 1000KRAD(Si)
  - Performance Permits Limited Use to 3000KRAD(Si)
- Gamma Dot
  - Survives 3E9RAD(Si)/sec at 80% BVDSS Typically
  - Survives 2E12 Typically If Current Limited to IDM
- Photo Current
  - 3.0nA Per-RAD(Si)/sec Typically
- Neutron
  - Pre-RAD Specifications for 1E13 Neutrons/cm^2
  - Usable to 1E14 Neutrons/cm^2

Description

The Harris Semiconductor Sector has designed a series of SECOND GENERATION hardened power MOSFETs of both N and P channel enhancement types with ratings from 100V to 500V, 1A to 60A, and on resistance as low as 25mΩ. Total dose hardness is offered at 100K RAD(Si) and 1000KRAD(Si) with neutron hardness ranging from 1E13n/cm^2 for 500V product to 1E14n/cm^2 for 100V product. Dose rate hardness (GAMMA DOT) exists for rates to 1E9 without current limiting and 2E12 with current limiting.

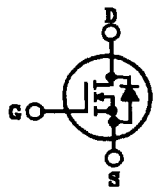
This MOSFET is an enhancement-mode silicon-gate power field effect transistor of the vertical DMOS (VDMOS) structure. It is specially designed and processed to exhibit minimal characteristic changes to total dose (GAMMA) and neutron (n^o) exposures. Design and processing efforts are also directed to enhance survival to heavy ion (SEE) and/or dose rate (GAMMA DOT) exposure.

This part may be supplied as a die or in various packages other than shown above. Reliability screening is available as either non TX (commercial), TX equivalent of MIL-S-19500, TXV equivalent of MIL-S-19500, or space equivalent of MIL-S-19500. Contact the Harris Semiconductor High-Reliability Marketing group for any desired deviations from the data sheet.

Package

TO-205AF

Symbol



Absolute Maximum Ratings (T_C = +25°C) Unless Otherwise Specified

		FRL230D, R, H	UNITS
Drain-Source Voltage	VDS	200	V
Drain-Gate Voltage (RGS = 20kΩ)	VDGR	200	V
Continuous Drain Current			
TC = +25°C	ID	5	A
TC = +100°C	ID	3	A
Pulsed Drain Current	IDM	15	A
Gate-Source Voltage	VGS	±20	V
Maximum Power Dissipation			
TC = +25°C	PT	25	W
TC = +100°C	PT	10	W
Derated Above +25°C		0.20	W/°C
Inductive Current, Clamped, L = 100μH, (See Test Figure)	ILM	15	A
Continuous Source Current (Body Diode)	IS	5	A
Pulsed Source Current (Body Diode)	ISM	15	A
Operating And Storage Temperature	TJC, TSTG	-55 to +150	°C
Lead Temperature (During Soldering)			
Distance > 0.063 in. (1.6mm) From Case, 10s Max	TL	300	°C

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper IC Handling Procedures.

File Number **3223.1**

Pre-Radiation Electrical Specifications TC = +25°C, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	LIMITS MIN	LIMITS MAX	UNITS
Drain-Source Breakdown Volts	BVDSS	VGS = 0, ID = 1mA	200	-	V
Gate-Threshold Volts	VGS(th)	VDS = VGS, ID = 1mA	2.0	4.0	V
Gate-Body Leakage Forward	IGSSF	VGS = +20V	-	100	nA
Gate-Body Leakage Reverse	IGSSR	VGS = -20V	-	100	nA
Zero-Gate Voltage Drain Current	IDSS1 IDSS2 IDSS3	VDS = 200V, VGS = 0 VDS = 160V, VGS = 0 VDS = 160V, VGS = 0, TC = +125°C	- - -	1 0.025 0.25	mA
Rated Avalanche Current	IAR	Time = 20µs	-	15	A
Drain-Source On-State Volts	VDS(on)	VGS = 10V, ID = 5A	-	2.63	V
Drain-Source On Resistance	RDS(on)	VGS = 10V, ID = 3A	-	0.500	Ω
Turn-On Delay Time	td(on)	VDD = 100V, ID = 5A	-	34	ns
Rise Time	tr	Pulse Width = 3µs	-	140	
Turn-Off Delay Time	td(off)	Period = 300µs, Rg = 25Ω	-	172	
Fall Time	tf	0 ≤ VGS ≤ 10 (See Test Circuit)	-	80	
Gate-Charge Threshold	QG(th)	VDD = 100V, ID = 5A IGS1 = IGS2 0 ≤ VGS ≤ 20	1	3	nc
Gate-Charge On State	QG(on)		15	60	
Gate-Charge Total	QGM		30	120	
Plateau Voltage	VGP		3	13	V
Gate-Charge Source	QGS		3	12	nc
Gate-Charge Drain	QGD		7	29	
Diode Forward Voltage	VSD	ID = 5A, VGD = 0	0.6	1.8	V
Reverse Recovery Time	TT	I = 5A; di/dt = 100A/µs	-	600	ns
Junction-To-Case	Rθjc		-	5.0	°C/W
Junction-To-Ambient	Rθja	Free Air Operation	-	175	

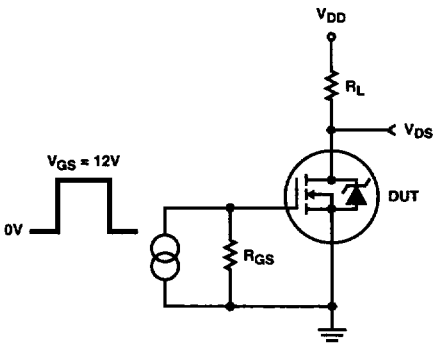


FIGURE 1. RESISTIVE SWITCHING TEST CIRCUIT

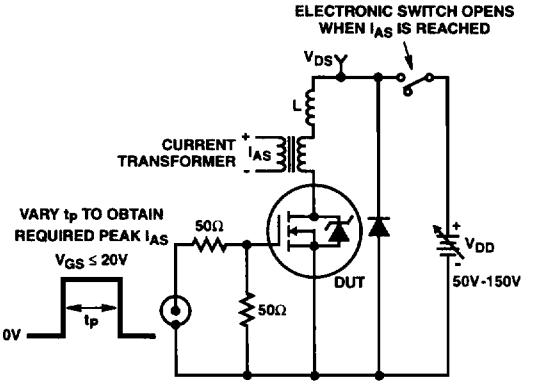


FIGURE 2. UNCLAMPED ENERGY TEST CIRCUIT

Post-Radiation Electrical Specifications TC = +25°C, Unless Otherwise Specified

PARAMETER		SYMBOL	TYPE	TEST CONDITIONS	LIMITS MIN	LIMITS MAX	UNITS
Drain-Source Breakdown Volts	(Note 4, 6)	BVDSS	FRL230D, R	VGS = 0, ID = 1mA	200	-	V
	(Note 5, 6)	BVDSS	FRL230H	VGS = 0, ID = 1mA	190	-	V
Gate-Source Threshold Volts	(Note 4, 6)	VGS(th)	FRL230D, R	VGS = VDS, ID = 1mA	2.0	4.0	V
	(Note 3, 5, 6)	VGS(th)	FRL230H	VGS = VDS, ID = 1mA	1.5	4.5	V
Gate-Body Leakage Forward	(Note 4, 6)	IGSSF	FRL230D, R	VGS = 20V, VDS = 0	-	100	nA
	(Note 5, 6)	IGSSF	FRL230H	VGS = 20V, VDS = 0	-	200	nA
Gate-Body Leakage Reverse	(Note 2, 4, 6)	IGSSR	FRL230D, R	VGS = -20V, VDS = 0	-	100	nA
	(Note 2, 5, 6)	IGSSR	FRL230H	VGS = -20V, VDS = 0	-	200	nA
Zero-Gate Voltage Drain Current	(Note 4, 6)	IDSS	FRL230D, R	VGS = 0, VDS = 160V	-	25	μA
	(Note 5, 6)	IDSS	FRL230H	VGS = 0, VDS = 160V	-	100	μA
Drain-Source On-State Volts	(Note 1, 4, 6)	VDS(on)	FRL230D, R	VGS = 10V, ID = 5A	-	2.63	V
	(Note 1, 5, 6)	VDS(on)	FRL230H	VGS = 16V, ID = 5A	-	3.94	V
Drain-Source On Resistance	(Note 1, 4, 6)	RDS(on)	FRL230D, R	VGS = 10V, ID = 3A	-	0.500	Ω
	(Note 1, 5, 6)	RDS(on)	FRL230H	VGS = 14V, ID = 3A	-	0.750	Ω

NOTES:

1. Pulse test, 300μs max
2. Absolute value
3. Gamma = 300KRAD(Si)
4. Gamma = 10KRAD(Si) for "D", 100KRAD(Si) for "R". Neutron = 1E13
5. Gamma = 1000KRAD(Si). Neutron = 1E13
6. Insitu Gamma bias must be sampled for both VGS = +10V, VDS = 0V and VGS = 0V, VDS = 80% BVDSS
7. Gamma data taken 3/03/90 on TA 17632 devices by GE ASTRO SPACE; EMC/SURVIVABILITY LABORATORY; KING OF PRUSSIA, PA 19401
8. Single event drain burnout testing by Titus, J.L., et al of NWSC, Crane, IN at Brookhaven Nat. Lab. Dec 11-14, 1989
9. Neutron derivation, HARRIS Application note AN-8831, Oct. 1988

Typical Performance Characteristics