


HARRIS
SEMICONDUCTOR

HARRIS SEMICOND SECTOR

2N7310D, 2N7310R 2N7310H

REGISTRATION PENDING

Currently Available as FRM9230 (D, R, H)

June 1993

**Radiation Hardened
P-Channel Power MOSFETs**

Features

- 4A, -200V, $R_{DS(on)} = 1.30\Omega$
- 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
 - 3nA Per-RAD(Si)/sec Typically
- Neutron
 - Pre-RAD Specifications for 1E13 Neutrons/cm²
 - Usable to 1E14 Neutrons/cm²
- Single Event
 - Typically Survives 1E5ions/cm² Having an LET $\leq 35\text{MeV/mg/cm}^2$ and a Range $\geq 30\mu\text{m}$ at 80% BVDSS

Description

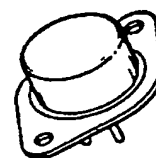
The Harris Semiconductor Sector has designed a series of SECOND GENERATION hardened power MOSFETs of both N and P channel enhancement types with ratings from 100V to 500V, 1A to 60A, and on resistance as low as 25m Ω . Total dose hardness is offered at 100K RAD(Si) and 1000KRAD(Si) with neutron hardness ranging from 1E13n/cm² for 500V product to 1E14n/cm² for 100V product. Dose rate hardness (GAMMA DOT) exists for rates to 1E9 without current limiting and 2E12 with current limiting. Heavy ion survival from signal event drain burn-out exists for linear energy transfer (LET) of 35 at 80% of rated voltage.

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.

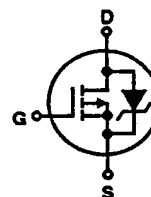
This part may be supplied as a die or in various packages other than shown above. Reliability screening is available as either non TX (commercial), TX equivalent of MIL-S-19500, TXV equivalent of MIL-S-19500, or space equivalent of MIL-S-19500. Contact the Harris Semiconductor High-Reliability Marketing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

Package

TO-204AA



Symbol



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

	2N7310D, R, H	UNITS
Drain-Source Voltage.....VDS	-200	V
Drain-Gate Voltage (RGS = 20k Ω).....VDGR	-200	V
Continuous Drain Current		
TC = +25°CID	4	A
TC = +100°CID	2	A
Pulsed Drain Current.....IDM	12	A
Gate-Source Voltage.....VGS	± 20	V
Maximum Power Dissipation		
TC = +25°CPT	75	W
TC = +100°CPT	30	W
Derated Above +25°C	0.60	W/°C
Inductive Current, Clamped, L = 100 μH , (See Test Figure).....ILM	12	A
Continuous Source Current (Body Diode).....IS	4	A
Pulsed Source Current (Body Diode).....ISM	12	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 I.C. Handling Procedures.

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File Number **3263.1**

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

PARAMETER	SYMBOL	TEST CONDITIONS	LIMITS		UNITS
			MIN	MAX	
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	VDS = -200V, VGS = 0	-	1	mA
	IDSS2	VDS = -160V, VGS = 0	-	0.025	
	IDSS3	VDS = -160V, VGS = 0, TC = +125°C	-	0.25	
Rated Avalanche Current	IAR	Time = 20μs	-	12	A
Drain-Source On-State Volts	VDS(on)	VGS = -10V, ID = 4A	-	-5.46	V
Drain-source On Resistance	RDS(on)	VGS = -10V, ID = 2A	-	1.30	Ω
Turn-On Delay Time	td(on)	VDD = -100V, ID = 4A	-	46	ns
Rise Time	tr	Pulse Width = 3μs	-	74	
Turn-Off Delay Time	td(off)	Period = 300μs, Rg = 25Ω	-	110	
Fall Time	tf	0 ≤ VGS ≤ 10 (See Test Circuit)	-	54	
Gate-Charge Threshold	QG(th)	VDD = -100V, ID = 4A IGS1 = IGS2 0 ≤ VGS ≤ 20	1	4	nc
Gate-Charge On State	QG(on)		14	58	
Gate-Charge Total	QGM		30	120	
Plateau Voltage	VGP		-3	-12	V
Gate-Charge Source	QGS		3	12	nc
Gate-Charge Drain	QGD		5	20	
Diode Forward Voltage	VSD	ID = 4A, VGD = 0	-0.6	-1.8	V
Reverse Recovery Time	TT	I = 4A; di/dt = 100A/μs	-	TBD	ns
Junction-To-Case	Rθjc		-	1.67	°C/W
Junction-To-Ambient	Rθja	Free Air Operation,	-	60	

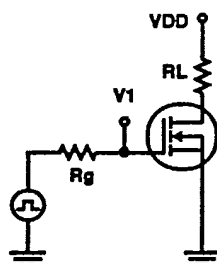


FIGURE 1. SWITCHING TIME TESTING

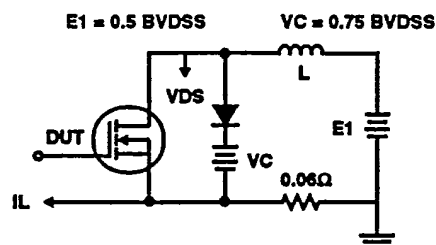


FIGURE 2. CLAMPED INDUCTIVE SWITCHING, ILM

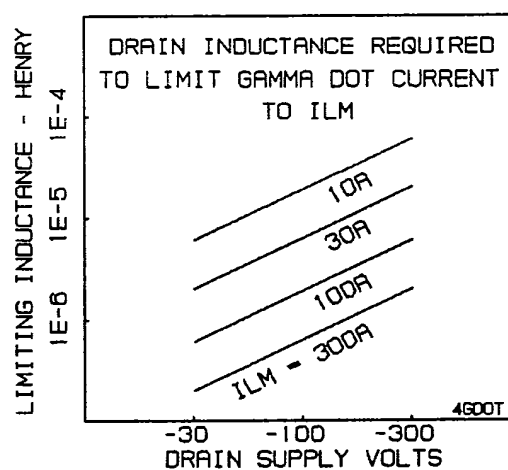
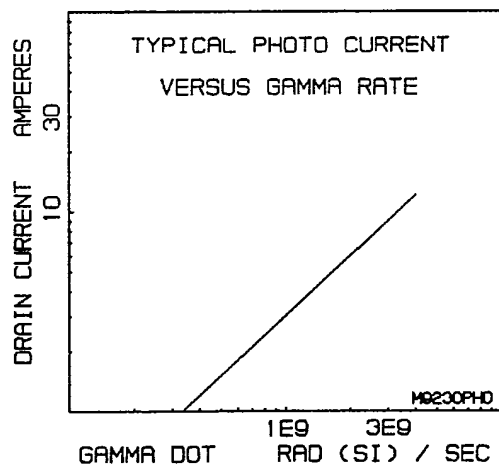
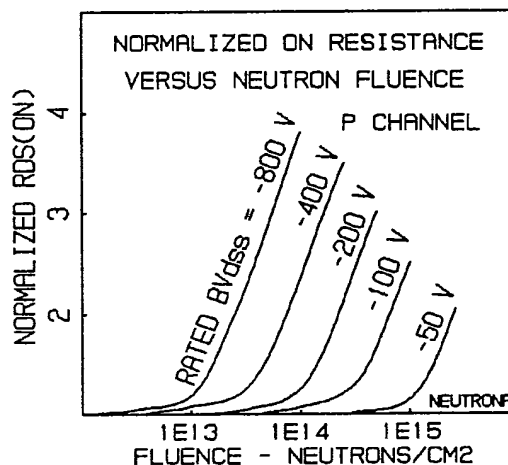
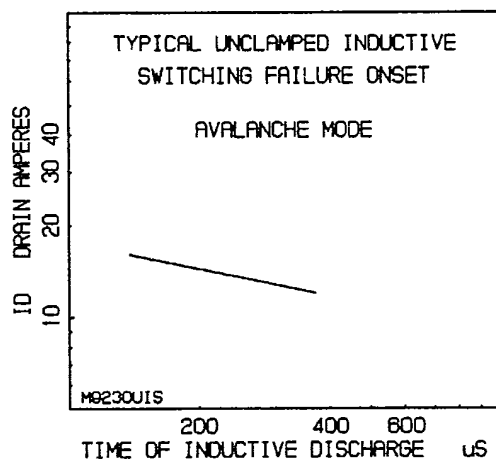
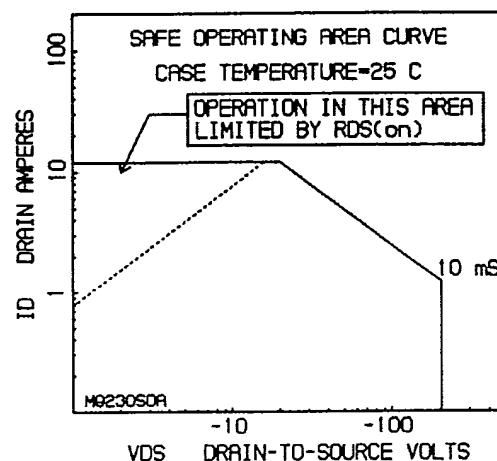
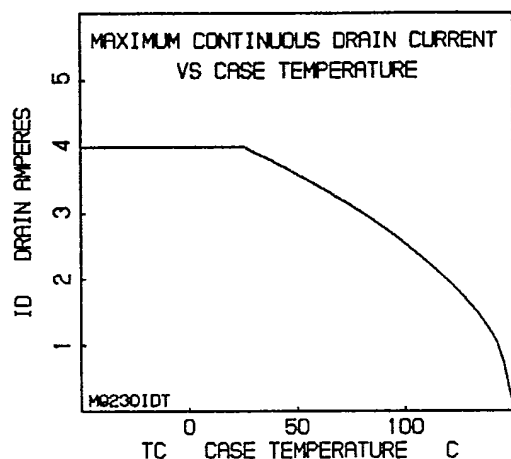
2N7310D, 2N7310R, 2N7310H - Registration Pending**Post-Radiation Electrical Specifications** TC = +25°C, Unless Otherwise Specified

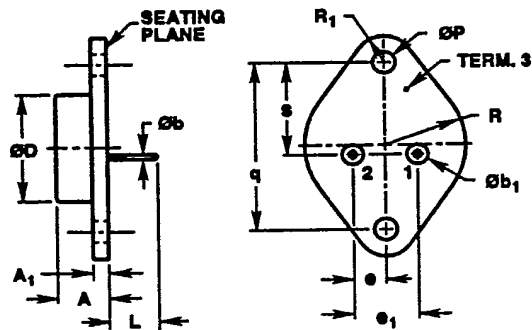
PARAMETER		SYMBOL	TYPE	TEST CONDITIONS	LIMITS		UNITS
					MIN	MAX	
Drain-Source Breakdown Volts	(Note 4, 6)	BVDSS	2N7310D, R	VGS = 0, ID = 1mA	-200	-	V
	(Note 5, 6)	BVDSS	2N7310H	VGS = 0, ID = 1mA	-190	-	V
Gate-Source Threshold Volts	(Note 4, 6)	VGS(th)	2N7310D, R	VGS = VDS, ID = 1mA	-2.0	-4.0	V
	(Note 3, 5, 6)	VGS(th)	2N7310H	VGS = VDS, ID = 1mA	-2.0	-6.0	V
Gate-Body Leakage Forward	(Note 4, 6)	IGSSF	2N7310D, R	VGS = -20V, VDS = 0	-	100	nA
	(Note 5, 6)	IGSSF	2N7310H	VGS = -20V, VDS = 0	-	200	nA
Gate-Body Leakage Reverse	(Note 2, 4, 6)	IGSSR	2N7310D, R	VGS = +20V, VDS = 0	-	100	nA
	(Note 2, 5, 6)	IGSSR	2N7310H	VGS = +20V, VDS = 0	-	200	nA
Zero-Gate Voltage Drain Current	(Note 4, 6)	IDSS	2N7310D, R	VGS = 0, VDS = -160V	-	25	μA
	(Note 5, 6)	IDSS	2N7310H	VGS = 0, VDS = -160V	-	100	μA
Drain-Source On-state Volts	(Note 1, 4, 6)	VDS(on)	2N7310D, R	VGS = -10V, ID = 4A	-	-5.46	V
	(Note 1, 5, 6)	VDS(on)	2N7310H	VGS = -16V, ID = 4A	-	-8.19	V
Drain-Source On Resistance	(Note 1, 4, 6)	RDS(on)	2N7310D, R	VGS = -10V, ID = 2A	-	1.30	Ω
	(Note 1, 5, 6)	RDS(on)	2N7310H	VGS = -14V, ID = 2A	-	1.95	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. In situ Gamma bias must be sampled for both VGS = -10V, VDS = 0V and VGS = 0V, VDS = 80% BVDSS
7. Gamma data taken 2/19/90 on TA17732 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



2N7310D, 2N7310R, 2N7310H - Registration Pending**Packaging****NOTES:**

1. These dimensions are within allowable dimensions of Rev. C of JEDEC TO-204AA outline dated 11-82.
2. Lead dimension (without solder).
3. Add typically 0.002 inches (0.05mm) for solder coating.
4. Position of lead to be measured 0.250 inches (6.35mm) from bottom of seating plane.
5. Controlling dimension: Inch.
6. Revision 1 dated 1-93.

TO-204AA**JEDEC TO-204AA HERMETIC STEEL PACKAGE**

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.310	0.330	7.88	8.38	-
A ₁	0.060	0.065	1.53	1.65	-
$\varnothing b$	0.038	0.042	0.97	1.06	2, 3
$\varnothing b_1$	0.138	0.145	3.51	3.68	-
$\varnothing D$	-	0.800	-	20.32	-
e	0.215 TYP		5.46 TYP		4
e ₁	0.430 BSC		10.92 BSC		4
L	0.440	0.460	11.18	11.68	-
$\varnothing P$	0.155	0.160	3.94	4.06	-
q	1.187 BSC		30.15 BSC		-
R	0.495	0.525	12.58	13.33	-
R ₁	0.131	0.185	3.33	4.69	-
s	0.655	0.675	16.64	17.14	-