



2N7291D, 2N7291R 2N7291H

REGISTRATION PENDING

Currently Available as FRK150(D, R, H)

December 1992

Radiation Hardened
N-Channel Power MOSFETs

Features

- 40A, 100V, $R_{DS(on)} = 0.055\Omega$
- 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
 - 7.0nA Per-RAD(Si)/sec Typically
- Neutron
 - Pre-RAD Specifications for 3E13 Neutrons/cm²
 - Usable to 3E14 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.

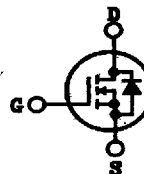
This part may be supplied as a die or in various packages other than shown above. Reliability screening is available as either non TX (commercial), TX equivalent of MIL-S-19500, TXV equivalent of MIL-S-19500, or space equivalent of MIL-S-19500. Contact the Harris Semiconductor High-Reliability Marketing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

Package

TO-204AE



Symbol



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

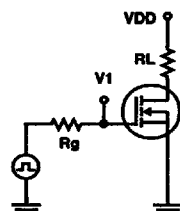
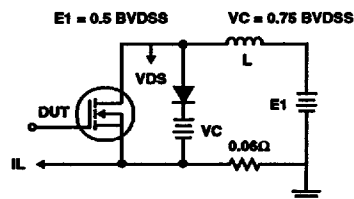
	2N7291D, R, H	UNITS
Drain-Source Voltage.....	VDS	V
Drain-Gate Voltage (RGS = 20k Ω).....	VDGR	V
Continuous Drain Current		
TC = +25°C.....	ID	A
TC = +100°C.....	ID	A
Pulsed Drain Current.....	IDM	A
Gate-Source Voltage.....	VGS	V
Maximum Power Dissipation		
TC = +25°C.....	PT	W
TC = +100°C.....	PT	W
Derated Above +25°C.....		W/°C
Inductive Current, Clamped, L = 100 μH , (See Test Figure).....	ILM	A
Continuous Source Current (Body Diode).....	IS	A
Pulsed Source Current (Body Diode).....	ISM	A
Operating And Storage Temperature.....	TJC, TSTG	°C
Lead Temperature (During Soldering)		
Distance > 0.063 in. (1.6mm) From Case, 10s Max.....	TL	°C

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper E.C. Handling Procedures.
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File Number 3221

Specifications 2N7291D, 2N7291R, 2N7291H - Registration Pending**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	100	-	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 = 100V, VGS = 0	-	1	mA
	IDSS2	VDS = 80V, VGS = 0	-	0.025	
	IDSS3	VDS = 80V, VGS = 0, TC = +125°C	-	0.25	
Rated Avalanche Current	IAR	Time = 20µs	-	100	A
Drain-Source On-State Volts	VDS(on)	VGS = 10V, ID = 40A	-	2.32	V
Drain-Source On Resistance	RDS(on)	VGS = 10V, ID = 25A	-	0.055	Ω
Turn-On Delay Time	td(on)	VDD = 50V, ID = 40A	-	170	ns
Rise Time	tr	Pulse Width = 3µs	-	1120	
Turn-Off Delay Time	td(off)	Period = 300µs, Rg = 25Ω	-	420	
Fall Time	tf	0 ≤ VGS ≤ 10 (See Test Circuit)	-	380	
Gate-Charge Threshold	QG(th)	VDD = 50V, ID = 40A IGS1 = IGS2 0 ≤ VGS ≤ 20	3.5	15	nC
Gate-Charge On State	QG(on)		58	230	
Gate-Charge Total	QGM		140	560	
Plateau Voltage	VGP		4	16	V
Gate-Charge Source	QGS		15	63	nC
Gate-Charge Drain	QGD		30	123	
Diode Forward Voltage	VSD	ID = 40A, VGD = 0	0.6	1.8	V
Reverse Recovery Time	TT	I = 40A; dI/dt = 100A/µs	-	1400	ns
Junction-To-Case	Rθjc		-	0.83	°C/W
Junction-To-Ambient	Rθja	Free Air Operation	-	30	

**FIGURE 1. SWITCHING TIME TESTING****FIGURE 2. CLAMPED INDUCTIVE SWITCHING, ILM**

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	2N7291D, R	VGS = 0, ID = 1mA	100	-	V
	(Note 5, 6) BVDSS	2N7291H	VGS = 0, ID = 1mA	95	-	V
Gate-Source Threshold Volts	(Note 4, 6) VGS(th)	2N7291D, R	VGS = VDS, ID = 1mA	2.0	4.0	V
	(Note 3, 5, 6) VGS(th)	2N7291H	VGS = VDS, ID = 1mA	1.5	4.5	V
Gate-Body Leakage Forward	(Note 4, 6) IGSSF	2N7291D, R	VGS = 20V, VDS = 0	-	100	nA
	(Note 5, 6) IGSSF	2N7291H	VGS = 20V, VDS = 0	-	200	nA
Gate-Body Leakage Reverse	(Note 2, 4, 6) IGSSR	2N7291D, R	VGS = -20V, VDS = 0	-	100	nA
	(Note 2, 5, 6) IGSSR	2N7291H	VGS = -20V, VDS = 0	-	200	nA
Zero-Gate Voltage Drain Current	(Note 4, 6) IDSS	2N7291D, R	VGS = 0, VDS = 80V	-	25	μA
	(Note 5, 6) IDSS	2N7291H	VGS = 0, VDS = 80V	-	100	μA
Drain-Source On-State Volts	(Note 1, 4, 6) VDS(on)	2N7291D, R	VGS = 10V, ID = 40A	-	2.31	V
	(Note 1, 5, 6) VDS(on)	2N7291H	VGS = 16V, ID = 40A	-	3.47	V
Drain-Source On Resistance	(Note 1, 4, 6) RDS(on)	2N7291D, R	VGS = 10V, ID = 25A	-	0.055	Ω
	(Note 1, 5, 6) RDS(on)	2N7291H	VGS = 14V, ID = 25A	-	0.083	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 = 3E13
5. Gamma = 1000KRAD(Si). Neutron = 3E13
6. Insitu Gamma bias must be sampled for both VGS = +10V, VDS = 0V and VGS = 0V, VDS = 80% BVDSS
7. Gamma data taken 11/6/89 on TA 17651 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

