



2N7276D, 2N7276R 2N7276H

REGISTRATION PENDING

Currently Available as FRS230(D, R, H)

December 1992

Radiation Hardened
N-Channel Power MOSFETs

Features

- 7A, 200V, $R_{DS(on)} = 0.515\Omega$
- 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% BVDS 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/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% BVDS

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.

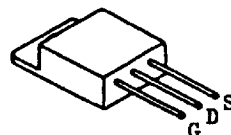
This MOSFET is an enhancement-mode silicon-gate power field effect transistor of the vertical DMOS (VDMOS) structure. It is specially designed and processed to exhibit minimal characteristic changes to total dose (GAMMA) and neutron (n^o) exposures. Design and processing efforts are also directed to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

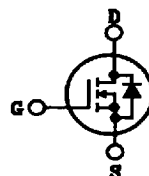
Package

T-39-11

TO-257AA



Symbol



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

	2N7276D, R, H	UNITS
Drain-Source Voltage.....	200	V
Drain-Gate Voltage (RGS = 20k Ω).....	200	V
Continuous Drain Current		
TC = +25°C.....	7	A
TC = +100°C.....	4	A
Pulsed Drain Current.....	21	A
Gate-Source Voltage.....	± 20	V
Maximum Power Dissipation		
TC = +25°C.....	50	W
TC = +100°C.....	20	W
Derated Above +25°C.....	0.40	W/°C
Inductive Current, Clamped, L = 100 μH , (See Test Figure).....	21	A
Continuous Source Current (Body Diode).....	7	A
Pulsed Source Current (Body Diode).....	21	A
Operating And Storage Temperature.....	-55 to +150	°C
Lead Temperature (During Soldering)		
Distance > 0.063 in. (1.6mm) From Case, 10s Max.....	300	°C
		TL

CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper E.C. Handling Procedures.
Copyright © Harris Corporation 1992

12-26

File Number 3224

Specifications 2N7276D, 2N7276R, 2N7276H - 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	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	-	21	A
Drain-Source On-State Volts	VDS(on)	VGS = 10V, ID = 7A	-	3.79	V
Drain-Source On Resistance	RDS(on)	VGS = 10V, ID = 4A	-	0.515	Ω
Turn-On Delay Time	td(on)	VDD = 100V, ID = 7A	-	42	ns
Rise Time	tr	Pulse Width = 3μs	-	214	
Turn-Off Delay Time	td(off)	Period = 300μs, Rg = 25Ω	-	152	
Fall Time	tf	0 ≤ VGS ≤ 10 (See Test Circuit)	-	66	
Gate-Charge Threshold	QG(th)	VDD = 100V, ID = 7A IGS1 = IGS2 0 ≤ VGS ≤ 20	1	4	nC
Gate-Charge On State	QG(on)		17	68	
Gate-Charge Total	QGM		30	122	
Plateau Voltage	VGP		3	13	V
Gate-Charge Source	QGS		3	13	nC
Gate-Charge Drain	QGD		8	34	
Diode Forward Voltage	VSD	ID = 7A, VGD = 0	0.6	1.8	V
Reverse Recovery Time	TT	I = 7A; di/dt = 100A/μs	-	TBD	ns
Junction-To-Case	Rθjc		-	2.5	°C/W
Junction-To-Ambient	Rθja	Free Air Operation	-	60	

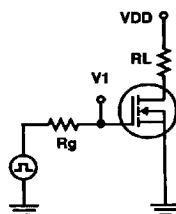


FIGURE 1. SWITCHING TIME TESTING

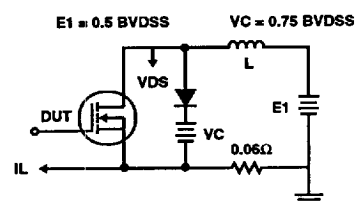


FIGURE 2. CLAMPED INDUCTIVE SWITCHING, ILM

Specifications 2N7276D, 2N7276R, 2N7276H - 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	2N7276D, R	VGS = 0, ID = 1mA	200	-	V
	(Note 5, 6)	BVDSS	2N7276H	VGS = 0, ID = 1mA	190	-	V
Gate-Source Threshold Volts	(Note 4, 6)	VGS(th)	2N7276D, R	VGS = VDS, ID = 1mA	2.0	4.0	V
	(Note 3, 5, 6)	VGS(th)	2N7276H	VGS = VDS, ID = 1mA	1.5	4.5	V
Gate-Body Leakage Forward	(Note 4, 6)	IGSSF	2N7276D, R	VGS = 20V, VDS = 0	-	100	nA
	(Note 5, 6)	IGSSF	2N7276H	VGS = 20V, VDS = 0	-	200	nA
Gate-Body Leakage Reverse	(Note 2, 4, 6)	IGSSR	2N7276D, R	VGS = -20V, VDS = 0	-	100	nA
	(Note 2, 5, 6)	IGSSR	2N7276H	VGS = -20V, VDS = 0	-	200	nA
Zero-Gate Voltage Drain Current	(Note 4, 6)	IDSS	2N7276D, R	VGS = 0, VDS = 160V	-	25	μA
	(Note 5, 6)	IDSS	2N7276H	VGS = 0, VDS = 160V	-	100	μA
Drain-Source On-State Volts	(Note 1, 4, 6)	VDS(on)	2N7276D, R	VGS = 10V, ID = 7A	-	3.79	V
	(Note 1, 5, 6)	VDS(on)	2N7276H	VGS = 16V, ID = 7A	-	5.69	V
Drain-Source On Resistance	(Note 1, 4, 6)	RDS(on)	2N7276D, R	VGS = 10V, ID = 4A	-	0.515	Ω
	(Note 1, 5, 6)	RDS(on)	2N7276H	VGS = 14V, ID = 4A	-	0.773	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

2N7276D, 2N7276R, 2N7276H - Registration Pending**Typical Performance Characteristics**