FAIRCHILD
SEMICONDUCTOR®

FRS430D, FRS430R, FRS430H

3A, 500V, 2.52 Ohm, Rad Hard, N-Channel Power MOSFETs

December 2001

Features

- **3A, 500V, RDS(on) = 2.52Ω**
- **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**
  - **8.0nA Per-RAD(Si)/sec Typically**
- **Neutron**
  - **Pre-RAD Specifications for 3E12 Neutrons/cm^2**
  - **Usable to 3E13 Neutrons/cm^2**

Description

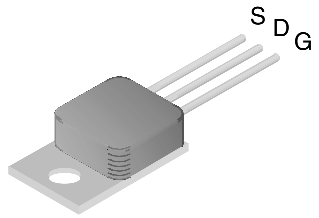
Fairchild has designed a series of SECOND GENERATION hardened power MOSFETs of both N and P channel enhancement types with ratings from 100V to 500V, 1A to 60A, and on resistance as low as 25mΩ. Total dose hardness is offered at 100K RAD(Si) and 1000KRAD(Si) with neutron hardness ranging from 1E13n/cm^2 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 Fairchild High-Reliability Marketing group for any desired deviations from the data sheet.

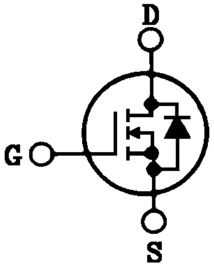
Package

TO-257AA



CAUTION: Beryllia Warning per MIL-S-19500 refer to package specifications.

Symbol



Absolute Maximum Ratings (TC = +25^{o}C) Unless Otherwise Specified

		FRS430D, R, H	UNITS
Drain-Source Voltage	VDS	500	V
Drain-Gate Voltage (RGS = 20kΩ)	VDGR	500	V
Continuous Drain Current			
TC = +25^{o}C	ID	3	A
TC = +100^{o}C	ID	2	A
Pulsed Drain Current	IDM	9	A
Gate-Source Voltage	VGS	±20	V
Maximum Power Dissipation			
TC = +25^{o}C	PT	50	W
TC = +100^{o}C	PT	20	W
Derated Above +25^{o}C		0.40	W/^{o}C
Inductive Current, Clamped, L = 100µH, (See Test Figure)	ILM	9	A
Continuous Source Current (Body Diode)	IS	3	A
Pulsed Source Current (Body Diode)	ISM	9	A
Operating And Storage Temperature	TJC, TSTG	-55 to +150	^{o}C
Lead Temperature (During Soldering)			
Distance > 0.063 in. (1.6mm) From Case, 10s Max	TL	300	^{o}C

Pre-Radiation Electrical Specifications TC = +25^{o}C, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	LIMITS		UNITS
			MIN	MAX	
Drain-Source Breakdown Volts	BVDSS	VGS = 0, ID = 1mA	500	-	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 = 500V, VGS = 0 VDS = 400V, VGS = 0 VDS = 400V, VGS = 0, TC = +125^{o}C	- - -	1 0.025 0.25	mA
Rated Avalanche Current	IAR	Time = 20μs	-	9	A
Drain-Source On-State Volts	VDS(on)	VGS = 10V, ID = 3A	-	7.94	V
Drain-Source On Resistance	RDS(on)	VGS = 10V, ID = 2A	-	2.52	Ω
Turn-On Delay Time	td(on)	VDD = 250V, ID = 3A	-	34	ns
Rise Time	tr	Pulse Width = 3μs	-	60	
Turn-Off Delay Time	td(off)	Period = 300μs, Rg = 25Ω	-	224	
Fall Time	tf	0 ≤ VGS ≤ 10 (See Test Circuit)	-	60	
Gate-Charge Threshold	QG(th)	VDD = 250V, ID = 3A IGS1 = IGS2 0 ≤ VGS ≤ 20	0.5	3	nc
Gate-Charge On State	QG(on)		17	68	
Gate-Charge Total	QGM		32	128	
Plateau Voltage	VGP		3	12	V
Gate-Charge Source	QGS		2	8	nc
Gate-Charge Drain	QGD		10	40	
Diode Forward Voltage	VSD	ID = 3A, VGD = 0	0.6	1.8	V
Reverse Recovery Time	TT	I = 3A; di/dt = 100A/μs	-	1600	ns
Junction-To-Case	Rθjc		-	2.5	^{o}C/W
Junction-To-Ambient	Rθja	Free Air Operation	-	60	

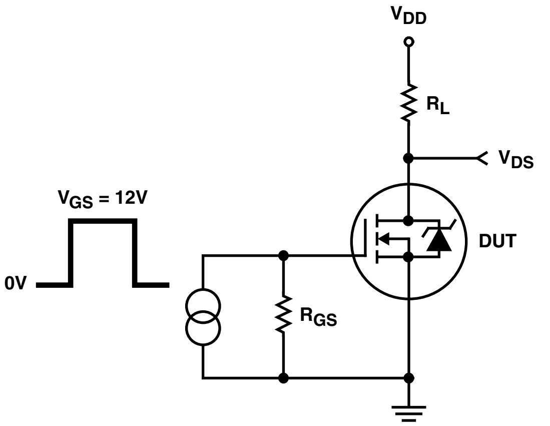


FIGURE 1. RESISTIVE SWITCHING TEST CIRCUIT

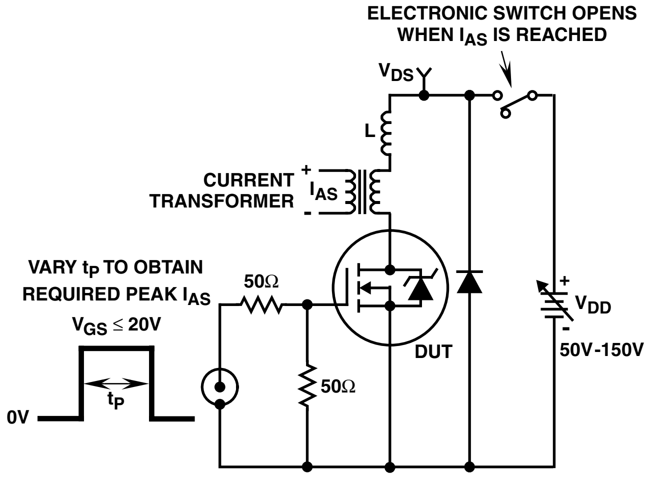


FIGURE 2. UNCLAMPED ENERGY TEST CIRCUIT

Post-Radiation Electrical Specifications

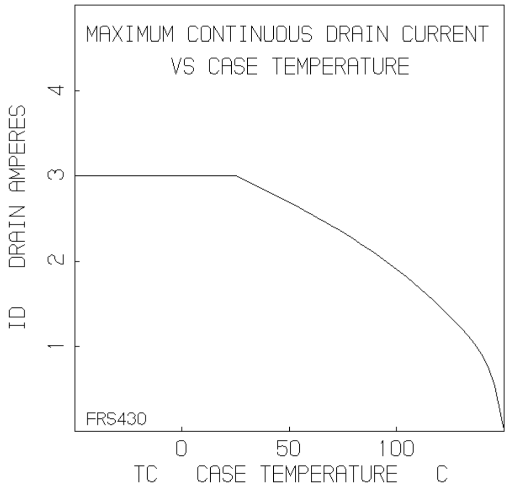
TC = +25°C, Unless Otherwise Specified

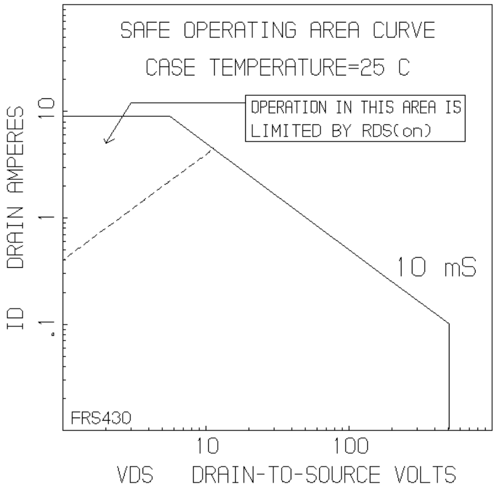
PARAMETER		SYMBOL	TYPE	TEST CONDITIONS	LIMITS		UNITS
					MIN	MAX	
Drain-Source Breakdown Volts	(Note 4, 6)	BVDSS	FRS430D, R	VGS = 0, ID = 1mA	500	-	V
	(Note 5, 6)	BVDSS	FRS430H	VGS = 0, ID = 1mA	475	-	V
Gate-Source Threshold Volts	(Note 4, 6)	VGS(th)	FRS430D, R	VGS = VDS, ID = 1mA	2.0	4.0	V
	(Note 3, 5, 6)	VGS(th)	FRS430H	VGS = VDS, ID = 1mA	1.5	4.5	V
Gate-Body Leakage Forward	(Note 4, 6)	IGSSF	FRS430D, R	VGS = 20V, VDS = 0	-	100	nA
	(Note 5, 6)	IGSSF	FRS430H	VGS = 20V, VDS = 0	-	200	nA
Gate-Body Leakage Reverse	(Note 2, 4, 6)	IGSSR	FRS430D, R	VGS = -20V, VDS = 0	-	100	nA
	(Note 2, 5, 6)	IGSSR	FRS430H	VGS = -20V, VDS = 0	-	200	nA
Zero-Gate Voltage Drain Current	(Note 4, 6)	IDSS	FRS430D, R	VGS = 0, VDS = 400V	-	25	µA
	(Note 5, 6)	IDSS	FRS430H	VGS = 0, VDS = 400V	-	100	µA
Drain-Source On-State Volts	(Note 1, 4, 6)	VDS(on)	FRS430D, R	VGS = 10V, ID = 3A	-	7.94	V
	(Note 1, 5, 6)	VDS(on)	FRS430H	VGS = 16V, ID = 3A	-	11.91	V
Drain-Source On Resistance	(Note 1, 4, 6)	RDS(on)	FRS430D, R	VGS = 10V, ID = 2A	-	2.52	Ω
	(Note 1, 5, 6)	RDS(on)	FRS430H	VGS = 14V, ID = 2A	-	3.78	Ω

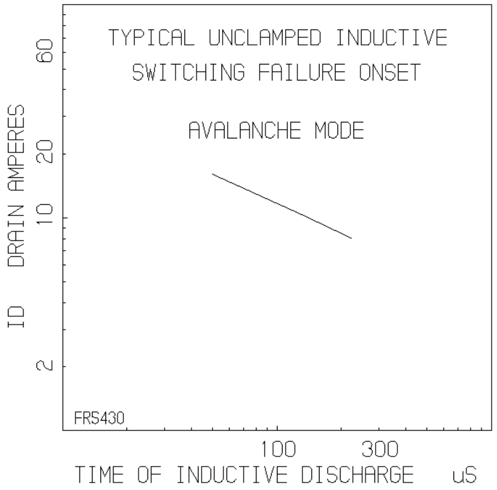
NOTES:

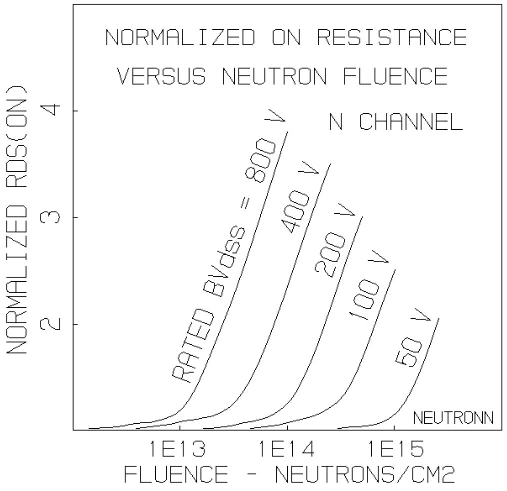
1. Pulse test, 300µs max
2. Absolute value
3. Gamma = 300KRAD(Si)
4. Gamma = 10KRAD(Si) for “D”, 100KRAD(Si) for “R”. Neutron = 3E12
5. Gamma = 1000KRAD(Si). Neutron = 3E12
6. Insitu Gamma bias must be sampled for both VGS = +10V, VDS = 0V and VGS = 0V, VDS = 80% BVDSS
7. Gamma data taken 10/29/90 on TA 17635 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, Fairchild Application note AN-8831, Oct. 1988

Typical Performance Characteristics

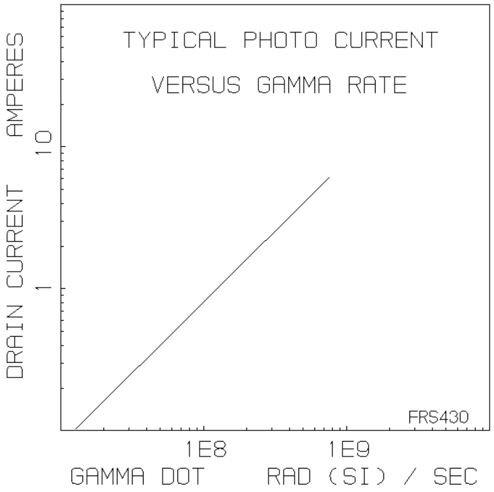


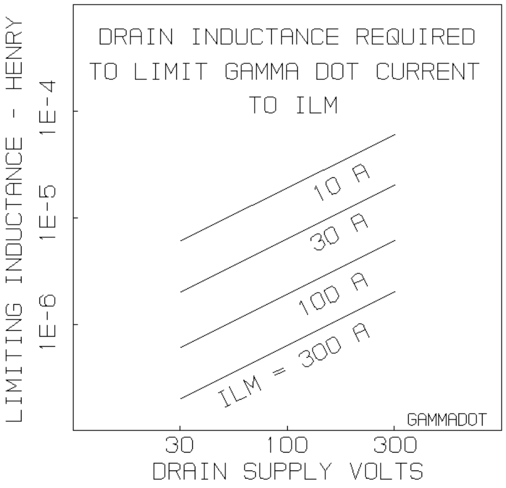






Typical Performance Characteristics (Continued)





Rad Hard Data Packages - Fairchild Power Transistors

TXV Equivalent

1. Rad Hard TXV Equivalent - Standard Data Package

A. Certificate of Compliance
B. Assembly Flow Chart
C. Preconditioning - Attributes Data Sheet
D. Group A - Attributes Data Sheet
E. Group B - Attributes Data Sheet
F. Group C - Attributes Data Sheet
G. Group D - Attributes Data Sheet

2. Rad Hard TXV Equivalent - Optional Data Package

A. Certificate of Compliance
B. Assembly Flow Chart
C. Preconditioning
  - Attributes Data Sheet
  - Precondition Lot Traveler
  - Pre and Post Burn-In Read and Record Data
D. Group A
  - Attributes Data Sheet
  - Group A Lot Traveler
E. Group B
  - Attributes Data Sheet
  - Group B Lot Traveler
  - Pre and Post Read and Record Data for Intermittent Operating Life (Subgroup B3)
  - Bond Strength Data (Subgroup B3)
  - Pre and Post High Temperature Operating Life Read and Record Data (Subgroup B6)
F. Group C
  - Attributes Data Sheet
  - Group C Lot Traveler
  - Pre and Post Read and Record Data for Intermittent Operating Life (Subgroup C6)
  - Bond Strength Data (Subgroup C6)
G. Group D
  - Attributes Data Sheet
  - Group D Lot Traveler
  - Pre and Post RAD Read and Record Data

Class S - Equivalents

1. Rad Hard “S” Equivalent - Standard Data Package

A. Certificate of Compliance
B. Serialization Records
C. Assembly Flow Chart
D. SEM Photos and Report
E. Preconditioning
  Attributes Data Sheet
  Hi-Rel Lot Traveler
  HTRB - Hi Temp Gate Stress Post Reverse Bias Data and Delta Data
  HTRB - Hi Temp Drain Stress Post Reverse Bias Delta Data
F. Group A - Attributes Data Sheet
G. Group B - Attributes Data Sheet
H. Group C - Attributes Data Sheet
I. Group D - Attributes Data Sheet

2. Rad Hard Max. “S” Equivalent - Optional Data Package

A. Certificate of Compliance
B. Serialization Records
C. Assembly Flow Chart
D. SEM Photos and Report
E. Preconditioning
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - HTRB - Hi Temp Gate Stress Post Reverse Bias Data and Delta Data
  - HTRB - Hi Temp Drain Stress Post Reverse Bias Delta Data
  - X-Ray and X-Ray Report
F. Group A
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Subgroups A2, A3, A4, A5 and A7 Data
G. Group B
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Subgroups B1, B3, B4, B5 and B6 Data
H. Group C
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Subgroups C1, C2, C3 and C6 Data
I. Group D
  - Attributes Data Sheet
  - Hi-Rel Lot Traveler
  - Pre and Post Radiation Data

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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Datasheet Identification	Product Status	Definition
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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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