FSS130D, FSS130R

11A, 100V, 0.210 Ohm, Rad Hard, SEGR Resistant, N-Channel Power MOSFETs

June 1998

Features

- 11A, 100V, $r_{DS(ON)} = 0.210\Omega$
- Total Dose
 - Meets Pre-RAD Specifications to 100K RAD (Si)
- Single Event
- Safe Operating Area Curve for Single Event Effects
- SEE Immunity for LET of 36MeV/mg/cm² with V_{DS} up to 80% of Rated Breakdown and V_{GS} of 10V Off-Bias
- Dose Rate
 - Typically Survives 3E9 RAD (Si)/s at 80% BVDSS
 - Typically Survives 2E12 if Current Limited to IDM
- Photo Current
 - 1.5nA Per-RAD(Si)/s Typically
- Neutron
 - Maintain Pre-RAD Specifications for 3E13 Neutrons/cm²
 - Usable to 3E14 Neutrons/cm²

Ordering Information

RAD LEVEL	SCREENING LEVEL	PART NUMBER/BRAND
10K	Commercial	FSS130D1
10K	TXV	FSS130D3
100K	Commercial	FSS130R1
100K	TXV	FSS130R3
100K	Space	FSS130R4

Formerly available as type TA17636.

Description

The Discrete Products Operation of Intersil has developed a series of Radiation Hardened MOSFETs specifically designed for commercial and military space applications. Enhanced Power MOSFET immunity to Single Event Effects (SEE), Single Event Gate Rupture (SEGR) in particular, is combined with 100K RADS of total dose hardness to provide devices which are ideally suited to harsh space environments. The dose rate and neutron tolerance necessary for military applications have not been sacrificed.

The Intersil portfolio of SEGR resistant radiation hardened MOSFETs includes N-Channel and P-Channel devices in a variety of voltage, current and on-resistance ratings. Numerous packaging options are also available.

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 be radiation tolerant. The MOSFET is well suited for applications exposed to radiation environments such as switching regulation, switching converters, motor drives, relay drivers and drivers for high-power bipolar switching transistors requiring high speed and low gate drive power. This type can be operated directly from integrated circuits.

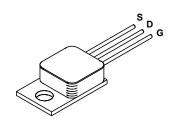
Reliability screening is available as either commercial, TXV equivalent of MIL-S-19500, or Space equivalent of MIL-S-19500. Contact Intersil for any desired deviations from the data sheet.

Symbol



Package

TO-257AA



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

FSS130D, FSS130R

Absolute Maximum Ratings $T_C = 25^{\circ}C$, Unless Otherwise Specified

	FSS130D, FSS130R	UNITS
Drain to Source Voltage	100	V
Drain to Gate Voltage ($R_{GS} = 20k\Omega$)	100	V
Continuous Drain Current		
$T_C = 25^{\circ}C$ I_D	11	Α
$T_C = 100^{\circ}C$ I_D	7	Α
Pulsed Drain Current	33	Α
Gate to Source VoltageV _{GS}	±20	V
Maximum Power Dissipation		
$T_C = 25^{\circ}C$ P_T	50	W
$T_C = 100^{\circ}CP_T$	20	W
Linear Derating Factor	0.40	W/oC
Single Pulsed Avalanche Current, L = 100μH, (See Test Figure)	33	Α
Continuous Source Current (Body Diode)	11	Α
Pulsed Source Current (Body Diode)	33	Α
Operating and Storage Temperature	-55 to 150	°С
Lead Temperature (During Soldering)	300	oC

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Electrical Specifications $T_C = 25^{\circ}C$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS $I_D = 1 \text{mA}, V_{GS} = 0 \text{V}$		MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	BV _{DSS}			100	-	-	V
Gate Threshold Voltage	V _{GS(TH)}	$V_{GS} = V_{DS}$	$T_{C} = -55^{\circ}C$	-	-	5.0	V
		I _D = 1mA	$T_{C} = 25^{\circ}C$	1.5	-	4.0	V
			$T_{C} = 125^{\circ}C$	0.5	-	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 80V,	$T_{C} = 25^{\circ}C$	-	-	25	μΑ
		$V_{GS} = 0V$	$T_{\rm C} = 125^{\rm o}{\rm C}$	-	-	250	μΑ
Gate to Source Leakage Current	I _{GSS}	$V_{GS} = \pm 20V$	$T_{C} = 25^{\circ}C$	-	-	100	nA
			$T_{\rm C} = 125^{\rm o}{\rm C}$		-	200	nA
Drain to Source On-State Voltage	V _{DS(ON)}	$V_{GS} = 12V, I_D = 11$	A		-	2.43	V
Drain to Source On Resistance	r _{DS(ON)12} I _E	I _D = 7A,	$T_{C} = 25^{\circ}C$	-	0.140	0.210	Ω
		$V_{GS} = 12V$	$T_{\rm C} = 120^{\circ}$	-	-	0.351	Ω
Turn-On Delay Time	t _{d(ON)}	$V_{DD} = 50V, I_{D} = 11A,$ $R_{L} = 4.55\Omega, V_{GS} = 12V,$ $R_{GS} = 7.5\Omega$		-	-	65	ns
Rise Time	t _r			-	-	200	ns
Turn-Off Delay Time	t _{d(OFF)}	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		-	-	130	ns
Fall Time	t _f	1		-	-	90	ns
Total Gate Charge	Q _{g(TOT)}	V _{GS} = 0V to 20V	V _{DD} = 50V,	-	-	63	nC
Gate Charge at 12V	Q _{g(12)}	V _{GS} = 0V to 12V	I _D = 11A	-	32	42	nC
Threshold Gate Charge	Q _{g(TH)}	V _{GS} = 0V to 2V		-	-	2.4	nC
Gate Charge Source	Q _{gs}			-	8.0	11	nC
Gate Charge Drain	Q _{gd}]		-	17	23	nC
Plateau Voltage	V _(PLATEAU)	I _D =11A, V _{DS} = 15	V	-	9	-	V
Input Capacitance	C _{ISS}	$V_{DS} = 25V, V_{GS} = 0$	OV,	-	800	-	pF
Output Capacitance	Coss	f = 1MHz		-	300	-	pF
Reverse Transfer Capacitance	C _{RSS}			-	90	-	pF
Thermal Resistance Junction to Case	$R_{ heta JC}$			-	-	2.5	°C/W
Thermal Resistance Junction to Ambient	$R_{ heta JA}$			-	-	60	°C/W

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Forward Voltage	V_{SD}	I _{SD} = 11A	0.6	-	1.8	V
Reverse Recovery Time	t _{rr}	$I_{SD} = 11A$, $dI_{SD}/dt = 100A/\mu s$	-	-	280	ns

Electrical Specifications up to 100K RAD $T_C = 25^{\circ}C$, Unless Otherwise Specified

PARAMETER		SYMBOL	TEST CONDITIONS	MIN	MAX	UNITS
Drain to Source Breakdown Volts	(Note 3)	BV _{DSS}	$V_{GS} = 0, I_{D} = 1mA$	100	-	V
Gate to Source Threshold Volts	(Note 3)	V _{GS(TH)}	$V_{GS} = V_{DS}$, $I_D = 1mA$	1.5	4.0	V
Gate to Body Leakage	(Notes 2, 3)	I _{GSS}	$V_{GS} = \pm 20V, V_{DS} = 0V$	-	100	nA
Zero Gate Leakage	(Note 3)	I _{DSS}	$V_{GS} = 0, V_{DS} = 80V$	-	25	μΑ
Drain to Source On-State Volts	(Notes 1, 3)	V _{DS(ON)}	V _{GS} = 12V, I _D = 11A	-	2.43	V
Drain to Source On Resistance	(Notes 1, 3)	r _{DS(ON)12}	$V_{GS} = 12V, I_D = 7A$	=	0.210	Ω

NOTES:

- 1. Pulse test, 300μs Max.
- 2. Absolute value.
- 3. Insitu Gamma bias must be sampled for both $V_{GS} = 12V$, $V_{DS} = 0V$ and $V_{GS} = 0V$, $V_{DS} = 80\%$ BV_{DSS}.

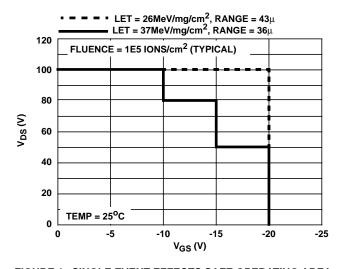
Single Event Effects (SEB, SEGR) (Note 4)

		EN	ENVIRONMENT (NOTE 5)			(NOTE 6)
TEST	SYMBOL	ION SPECIES	TYPICAL LET (MeV/mg/cm)	TYPICAL RANGE (μ)	APPLIED V _{GS} BIAS (V)	MAXIMUM V _{DS} BIAS (V)
Single Event Effects Safe Operating	SEESOA	Ni	26	43	-20	100
Area		Br	37	36	-10	100
		Br	37	36	-15	80
		Br	37	36	-20	50

NOTES:

- 4. Testing conducted at Brookhaven National Labs; sponsored by Naval Surface Warfare Center (NSWC), Crane, IN.
- 5. Fluence = $1E5 \text{ ions/cm}^2 \text{ (typical)}, T = <math>25^{\circ}\text{C}$.
- 6. Does not exhibit Single Event Burnout (SEB) or Single Event Gate Rupture (SEGR).

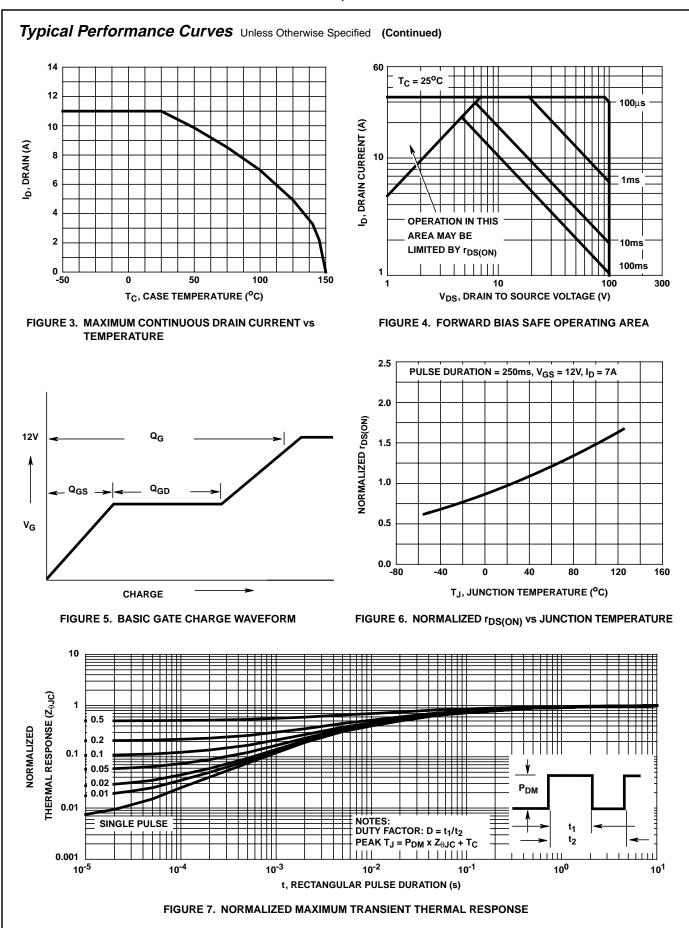
Typical Performance Curves Unless Otherwise Specified



1E-3 **LIMITING INDUCTANCE (HENRY)** 1E-4 **ILM** = 10A 30A 1E-5 100A 300A 1E-6 1E-7 10 30 100 300 1000 **DRAIN SUPPLY (V)**

FIGURE 1. SINGLE EVENT EFFECTS SAFE OPERATING AREA

FIGURE 2. DRAIN INDUCTANCE REQUIRED TO LIMIT GAMMA DOT CURRENT TO IAS



Typical Performance Curves Unless Otherwise Specified (Continued)

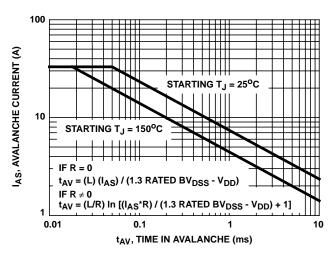


FIGURE 8. UNCLAMPED INDUCTIVE SWITCHING

Test Circuits and Waveforms

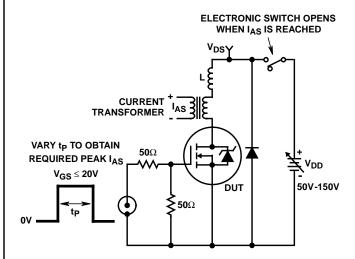


FIGURE 9. UNCLAMPED ENERGY TEST CIRCUIT

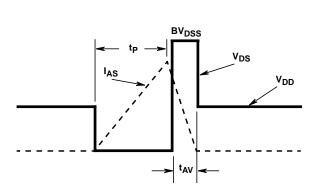


FIGURE 10. UNCLAMPED ENERGY WAVEFORMS

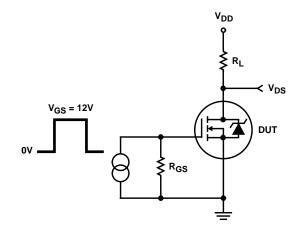


FIGURE 11. RESISTIVE SWITCHING TEST CIRCUIT

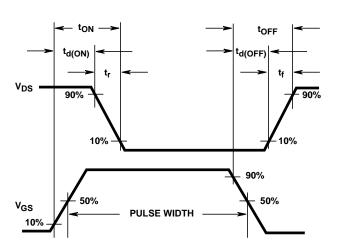


FIGURE 12. RESISTIVE SWITCHING WAVEFORMS

Screening Information

Screening is performed in accordance with the latest revision in effect of MIL-S-19500, (Screening Information Table).

Delta Tests and Limits (JANTXV Equivalent, JANS Equivalent) T_C = 25°C, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MAX	UNITS
Gate to Source Leakage Current	I _{GSS}	$V_{GS} = \pm 20V$	±20 (Note 7)	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 80% Rated Value	±25 (Note 7)	μΑ
Drain to Source On Resistance	r _{DS(ON)}	T _C = 25°C at Rated I _D	±20% (Note 8)	Ω
Gate Threshold Voltage	V _{GS(TH)}	I _D = 1.0mA	±20% (Note 8)	V

NOTES:

- 7. Or 100% of Initial Reading (whichever is greater).
- 8. Of Initial Reading.

Screening Information

TEST	JANTXV EQUIVALENT	JANS EQUIVALENT
Gate Stress	$V_{GS} = 30V, t = 250\mu s$	V _{GS} = 30V, t = 250μs
Pind	Optional	Required
Pre Burn-In Tests (Note 9)	MIL-S-19500 Group A, Subgroup 2 (All Static Tests at 25°C)	MIL-S-19500 Group A, Subgroup 2 (All Static Tests at 25°C)
Steady State Gate Bias (Gate Stress)	MIL-STD-750, Method 1042, Condition B $V_{GS} = 80\%$ of Rated Value, $T_A = 150^{\circ}\text{C}$, Time = 48 hours	MIL-STD-750, Method 1042, Condition B $V_{GS} = 80\%$ of Rated Value, $T_A = 150^{\circ}$ C, Time = 48 hours
Interim Electrical Tests (Note 9)	All Delta Parameters Listed in the Delta Tests and Limits Table	All Delta Parameters Listed in the Delta Tests and Limits Table
Steady State Reverse Bias (Drain Stress)	MIL-STD-750, Method 1042, Condition A $V_{DS} = 80\%$ of Rated Value, $T_A = 150^{\circ}\text{C}$, Time = 160 hours	MIL-STD-750, Method 1042, Condition A $V_{DS} = 80\%$ of Rated Value, $T_A = 150^{\circ}$ C, Time = 240 hours
PDA	10%	5%
Final Electrical Tests (Note 9)	MIL-S-19500, Group A, Subgroup 2	MIL-S-19500, Group A, Subgroups 2 and 3

NOTE:

Additional Screening Tests

PARAMETER	SYMBOL	TEST CONDITIONS	MAX	UNITS
Safe Operating Area	SOA	V _{DS} = 80V, t = 10ms	2.35	А
Unclamped Inductive Switching	I _{AS}	V _{GS(PEAK)} = 15V, L = 0.1mH	33	А
Thermal Response	ΔV _{SD}	t _H = 100ms; V _H = 25V; I _H = 1A	90	mV
Thermal Impedance	ΔV _{SD}	t _H = 500ms; V _H = 25V; I _H = 1A	125	mV

^{9.} Test limits are identical pre and post burn-in.

Rad Hard Data Packages - Intersil 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
 - Date
- D. Group A Attributes Data Sheet
 - Group A Lot Traveler
- E. Group B Attributes Data Sheet
 - Group B Lot TravelerPre 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
 G. Group B
 H. Group C
 I. Group D
 Attributes Data Sheet
 Attributes Data Sheet
 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

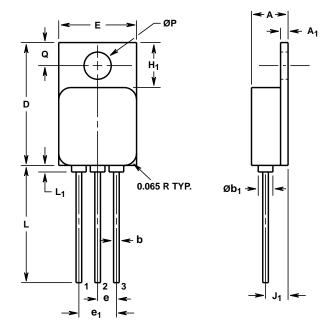
I. Group D - Attributes Data Sheet

- Hi-Rel Lot Traveler

- Pre and Post Radiation Data

TO-257AA

3 LEAD JEDEC TO-257AA HERMETIC METAL PACKAGE



	INC	HES	MILLIM	MILLIMETERS		
SYMBOL	MIN	MAX	MIN	MAX	NOTES	
Α	0.190	0.200	4.83	5.08	-	
A ₁	0.035	0.045	0.89	1.14	-	
Øb	0.025	0.035	0.64	0.88	2, 3	
Øb ₁	0.060	0.090	1.53	2.28	-	
D	0.645	0.665	16.39	16.89	-	
E	0.410	0.420	10.42	10.66	-	
е	0.100	TYP	2.54 TYP		4	
e ₁	0.200	BSC	5.08 BSC		4	
H ₁	0.230	0.250	5.85	6.35	-	
J ₁	0.110	0.130	2.80	3.30	4	
L	0.600	0.650	15.24	16.51	-	
L ₁	-	0.035	-	0.88	-	
ØP	0.140	0.150	3.56	3.81	-	
Q	0.113	0.133	2.88	3.37	-	

NOTES:

- These dimensions are within allowable dimensions of Rev. B of JEDEC TO-257AA dated 9-88.
- 2. Add typically 0.002 inches (0.05mm) for solder coating.
- 3. Lead dimension (without solder).
- 4. Position of lead to be measured 0.150 inches (3.81mm) from bottom of dimension D.
- 5. Die to base BeO isolated, terminals to case ceramic isolated.
- 6. Controlling dimension: Inch.
- 7. Revision 1 dated 1-93.

WARNING!

BERYLLIA WARNING PER MIL-S-19500

Packages containing beryllium oxide (BeO) shall not be ground, machined, sandblasted, or subject to any mechanical operation which will produce dust containing any beryllium compound. Packages containing any beryllium compound shall not be subjected to any chemical process (etching, etc.) which will produce fumes containing beryllium or its' compounds.

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