Radiation Hardened N-Channel MOSFET

Qualified per MIL-PRF-19500/614

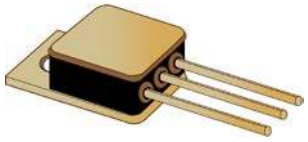
Qualified Levels: JANSD, JANSR and JANSF

QPL RANGE and RAD LEVEL

Radiation Level	JANSD2N7380	JANSR2N7380	JANSF2N7380
TID	10 Krad	100 Krad	300 Krad

DESCRIPTION

These products are well suited for Space level applications requiring Total Dose radiation (TID) tolerance and Single Event capability. This 2N7381 is available in three qualified radiation levels and is packaged in a hermetic TO-257 outline. These products have all the same performance features of industry standard MOSFETs and may be used for most voltage control and fast switching applications.



TO-257AA Package

Important: For the latest information, visit our website http://www.microsemi.com.

FEATURES

- Ease of paralleling
- Hermetically sealed package
- Low gate charge
- Single event hardened for space applications
- RHA level JANS qualifications available per MIL-PRF-19500/614. (See part nomenclature for all available options.)

APPLICATIONS / BENEFITS

- Space level DC-DC converters
- Satellite Motor Control circuits
- Synchronous rectification
- Linear-mode applications

MAXIMUM RATINGS @ T_C = +25 ºC unless otherwise stated

Parameters / Test Conditions	Symbol	Value	Unit
Operating & Storage Junction Temperature Range	T_J & T_{stg}	-55 to +150	°C
Thermal Resistance Junction-to-Case (see Figure 4)	$R_{\Theta JC}$	1.67	°C/W
Total Power Dissipation @ T_A = +25 °C @ T_C = +25 °C (1)	P_T	2 75	W
Gate-Source Voltage, dc	V_{GS}	± 20	V
Drain Current, dc @ T_C = +25 ºC (2) (3)	I_{D1}	14.4	A
Drain Current, dc @ T_C = +100 ºC (2) (3)	I_{D2}	9.1	A
Off-State Current (Peak Total Value) (4)	I_{DM}	57.6	A
Source Current	I_S	14.4	A

NOTES:
1. Derated linearly 0.6 W/ºC for T_C > +25 ºC
2. The following formula derives the maximum theoretical I_D limit. I_D is limited by package and internal wires and may also be limited by pin diameter:

$$I_D = \sqrt{\frac{T_J(max) - T_C}{R_{\Theta JC} \times R_{DS(on)} @ T_J(max)}}$$

3. See Figure 3 for maximum drain current graphs
4. I_{DM} = 4 X I_{D1} as calculated in note (2)

MSC – Lawrence
6 Lake Street,
Lawrence, MA 01841
Tel: 1-800-446-1158 or
(978) 620-2600
Fax: (978) 689-0803

MSC – Ireland
Gort Road Business Park,
Ennis, Co. Clare, Ireland
Tel: +353 (0) 65 6840044
Fax: +353 (0) 65 6822298

Website:
www.microsemi.com

MECHANICAL and PACKAGING

- CASE: Nickel plated copper base & 1020 steel frame
- TERMINALS: Solder dipped copper cored 52 alloy plating
- MARKING: Alpha numeric
- POLARITY: See Schematic on last page
- WEIGHT: Approximately 3.43 grams
- See Package Dimensions on last page.

PART NOMENCLATURE

JANSR **2N7380**

Reliability Level
JANSD = 10K Rads (Si)
JANSR = 100K Rads (Si)
JANSF = 300K Rads (Si)

JEDEC type number

SYMBOLS & DEFINITIONS

Symbol	Definition
di/dt	Rate of change of diode current while in reverse-recovery mode, recorded as maximum value.
I_D	Drain current, dc: The direct current into the drain terminal.
I_{DSS}	Zero-Gate-Voltage Drain Current: The direct current into the gate terminal when the gate-source voltage is zero.
I_F	Forward current: The current flowing from the p-type region to the n-type region.
I_{GSS}	Reverse-Gate Current, Drain Short-Circuited to Source: The direct current into the gate terminal with a forward gate source voltage applied (I_{GSSF}) or reverse gate source voltage applied (I_{GSSF}) and the drain terminal short-circuited to the source terminal.
I_S	Source current, dc: The direct current into the source terminal.
$r_{DS(on)}$	Static Drain-Source On-State Resistance: The dc resistance between the drain and source terminals with a specified gate-source voltage applied to bias the device to the on state.
R_G	Gate drive impedance or Gate resistance
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage: Gate short-circuited to the source terminal.
V_{DD}	Drain supply voltage, dc: The dc supply voltage applied to a circuit connected to the drain terminal.
V_{DG}	Drain-gate voltage, dc: The dc voltage between the drain and gate terminals.
V_{DS}	Drain source voltage, dc: The dc voltage between the drain terminal and the source terminal.
V_{GS}	Gate source voltage, dc: The dc voltage between the gate terminal and the source terminal.

ELECTRICAL CHARACTERISTICS @ T_A = +25 °C, unless otherwise noted

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
PRE-IRRADIATION CHARACTERISTICS				
Drain-Source Breakdown Voltage V_{GS} = 0 V, I_D = 1.0 mA	$V_{(BR)DSS}$	100		V
Gate-Source Voltage (Threshold) $V_{DS} \geq V_{GS}$, I_D = 1 mA $V_{DS} \geq V_{GS}$, I_D = 1 mA, T_J = +125°C $V_{DS} \geq V_{GS}$, I_D = 1 mA, T_J = -55°C	 $V_{GS(th)1}$ $V_{GS(th)2}$ $V_{GS(th)3}$	 2.0 1.0	 4.0 5.0	V
Gate Current V_{GS} = ± 20 V, V_{DS} = 0 V V_{GS} = ± 20 V, V_{DS} = 0 V, T_J = +125°C	 I_{GSS1} I_{GSS2}		 ±100 ±200	nA
Drain Current V_{GS} = 0 V, V_{DS} = 80 V	I_{DSS1}		25	µA
Drain Current V_{GS} = 0 V, V_{DS} = 80 V, T_J = +125 °C	I_{DSS2}		0.25	mA
Static Drain-Source On-State Resistance V_{GS} = 12 V, I_D = 9.1 A pulsed	$r_{DS(on)1}$		0.18	Ω
Static Drain-Source On-State Resistance V_{GS} = 12 V, I_D = 14.4 A pulsed	$r_{DS(on)2}$		0.20	Ω
Static Drain-Source On-State Resistance T_J = +125°C V_{GS} = 12 V, I_D = 9.1 A pulsed	$r_{DS(on)3}$		0.35	Ω
Diode Forward Voltage V_{GS} = 0 V, I_D = 14.4 A pulsed	V_{SD}		1.8	V

DYNAMIC CHARACTERISTICS

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Gate Charge:				
On-State Gate Charge V_{GS} = 12 V, I_D = 14.4 A, V_{DS} = 50 V	$Q_{g(on)}$		40	nC
Gate to Source Charge V_{GS} = 12 V, I_D = 14.4 A, V_{DS} = 50 V	Q_{gs}		10	nC
Gate to Drain Charge V_{GS} = 12 V, I_D = 14.4 A, V_{DS} = 50 V	Q_{gd}		20	nC

SWITCHING CHARACTERISTICS

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-on delay time I_D = 14.4 A, V_{GS} = 12 V, R_G = 7.5 Ω, V_{DD} = 50 V	$t_{d(on)}$		25	ns
Rise time I_D = 14.4 A, V_{GS} = 12 V, R_G = 7.5 Ω, V_{DD} = 50 V	t_r		60	ns
Turn-off delay time I_D = 14.4 A, V_{GS} = 12 V, R_G = 7.5 Ω, V_{DD} = 50 V	$t_{d(off)}$		40	ns
Fall time I_D = 14.4 A, V_{GS} = 12 V, R_G = 7.5 Ω, V_{DD} = 50 V	t_f		30	ns
Diode Reverse Recovery Time di/dt ≤ 100 A/µs, V_{DD} ≤ 50 V, I_F = 14.4 A	t_{rr}		275	ns

ELECTRICAL CHARACTERISTICS @ T_A = +25 °C, unless otherwise noted (continued)

POST-IRRADIATION (1)

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Drain-Source Breakdown Voltage V_{GS} = 0 V, I_D = 1 mA	$V_{(BR)DSS}$	100		V
Gate-Source Voltage (Threshold) $V_{DS} \geq V_{GS}$, I_D = 1.0 mA JANSD, R $V_{DS} \geq V_{GS}$, I_D = 1.0 mA JANSF	$V_{GS(th)1}$ $V_{GS(th)1}$	2.0 1.25	4.0 4.5	V
Gate Current V_{GS} = ±20 V, V_{DS} = 0 V	I_{GSS1}		±100	nA
Drain Current V_{GS} = 0 V, V_{DS} = 80% of V_{DS} (pre-irradiated) JANSD, R V_{GS} = 0 V, V_{DS} = 80% of V_{DS} (pre-irradiated) JANSF	I_{DSS1}		25 50	µA
Static Drain-Source On-State Voltage V_{GS} = 12 V, I_D = 9.1 pulsed JANSD, R V_{GS} = 12 V, I_D = 9.1 pulsed JANSF	$r_{DS(on)}$		1.638 2.184	V
Diode Forward Voltage V_{GS} = 0 V, I_D = 14.4 pulsed	V_{SD}		1.8	V

NOTE: 1. Post-irradiation electrical characteristics apply to devices subjected to steady state total dose irradiation testing in accordance with MIL-STD-750, method 1019. Separate samples are tested for V_{GS} bias (12V), and V_{DS} bias (80V) conditions.

SAFE OPERATING AREA

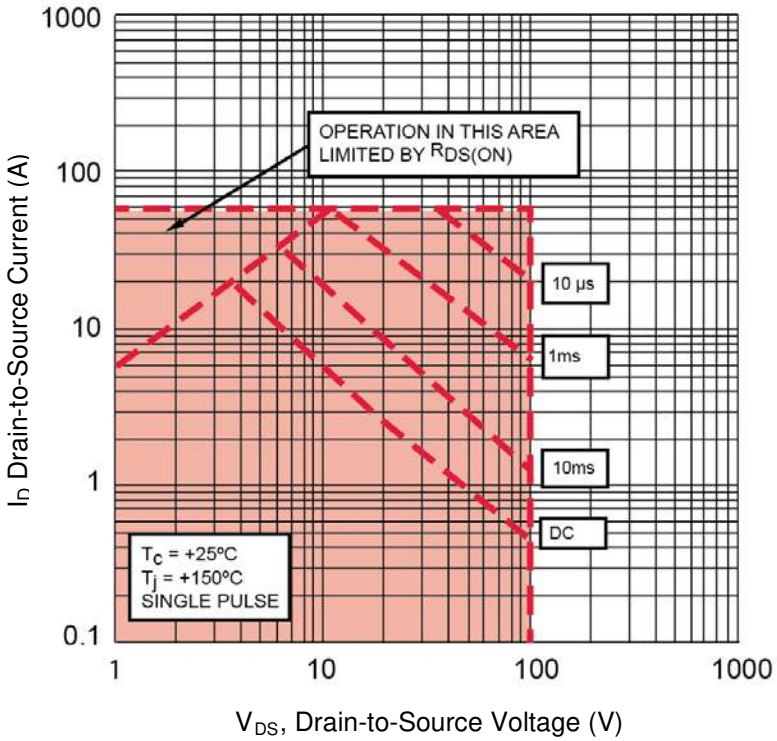
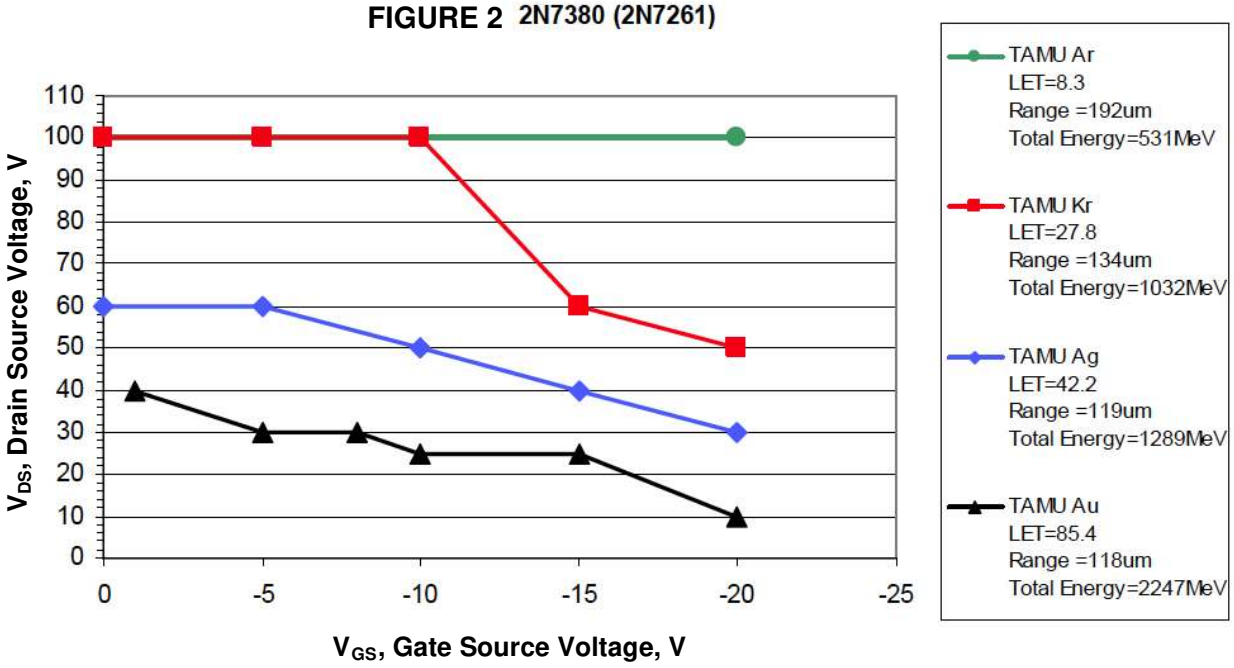


FIGURE 1

GRAPHS

SEE (Single Event Effect) Typical Response:
Heavy Ion testing of the 2N7380 device was completed by similarity of die structure to the 2N7261. The 2N7261 has been characterized at the Texas A&M cyclotron. The following SEE curve has been established using the elements, LET, range, and Total Energy conditions as shown:

FIGURE 2 2N7380 (2N7261)



It should be noted that total energy levels are considered to be a factor in SEE characterization. Comparisons to other datasets should not be based on LET alone. Please consult factory for more information.

GRAPHS

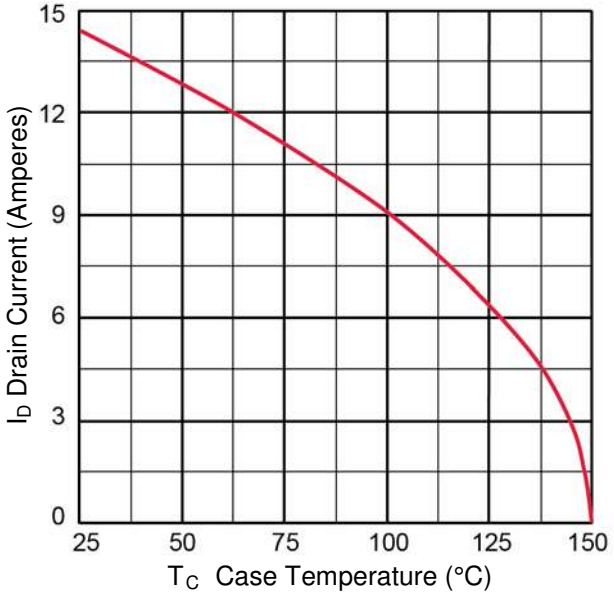


FIGURE 3
Maximum Drain Current vs Case Temperature

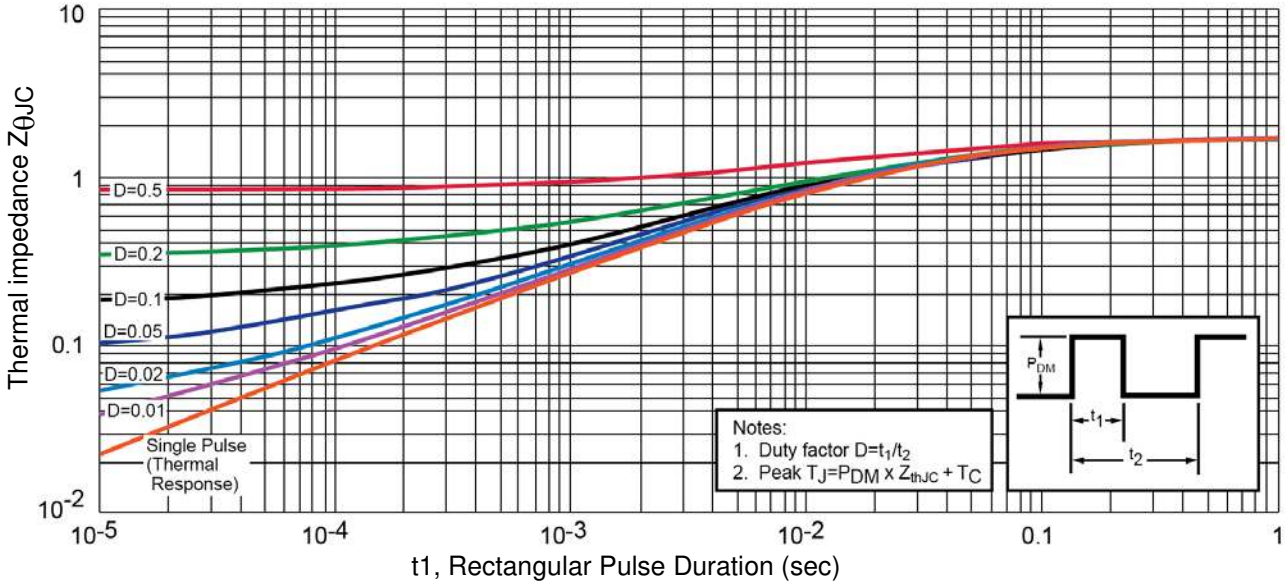
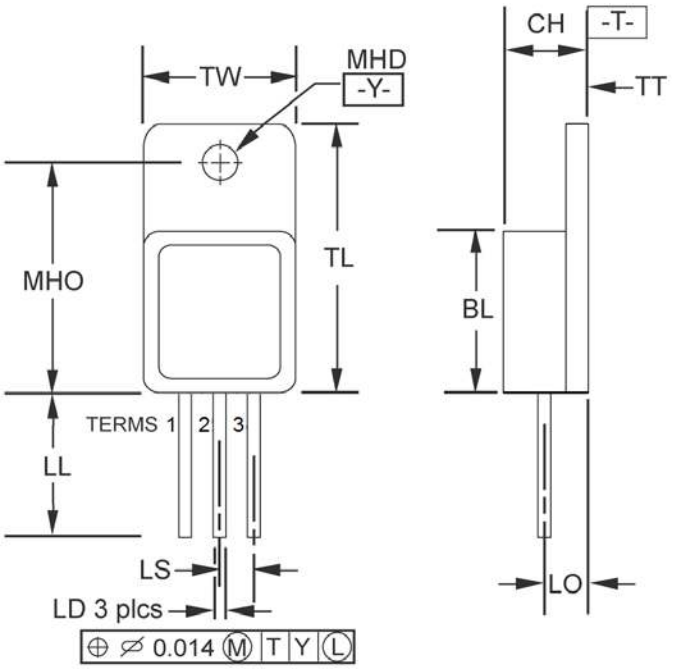


FIGURE 4
Thermal Impedance Curves

PACKAGE DIMENSIONS



Ltr	Dimensions			
	Inch		Millimeters	
	Min	Max	Min	Max
BL	0.410	0.430	10.41	10.92
CH	0.190	0.200	4.83	5.08
LD	0.025	0.035	0.64	0.89
LL	0.505	0.595	12.82	15.11
LO	0.120 BSC		3.05 BSC	
LS	0.100 BSC		2.54 BSC	
MHD	0.140	0.150	3.56	3.81
MHO	0.527	0.537	13.39	13.64
TL	0.645	0.665	16.38	16.89
TT	0.035	0.045	0.89	1.14
TW	0.410	0.420	10.41	10.67
TERM 1	DRAIN			
TERM 2	SOURCE			
TERM 3	GATE			

NOTES:

1. Dimensions are in inches.
2. Millimeter equivalents are given for information only.
3. Glass meniscus included in dimension TL and BL.

SCHEMATIC