RoHS Compliant

Radiation Hardened P-Channel MOSFET

Qualified per MIL-PRF-19500/630

Qualified Levels:
JANSR and JANSF

DESCRIPTION

Microsemi's first generation Rad- Hard MOSFET's are designed for Space and Military applications. The devices have been characterized for Total Dose (TID) and Single Event environments (SEE). These products may be used for satellite Power Supplies, Motor Controls and any miscellaneous power applications needed for Space. Microsemi's Rad- hard MOSFET's are qualified to MIL-PRF- 19500 slash sheet specifications. The 2N7389 is qualified to meet Slash Sheet /630 of MIL-PRF-19500.

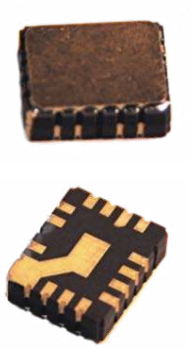
Important: For the latest information, visit our website http://www.microsemi.com.

FEATURES

- JEDEC registered 2N7389 number
- Hermetically sealed package
- Internal metallurgical bonds
- RHA level JANS qualifications available per MIL-PRF-19500/630. (See part nomenclature for all available options.)
- RoHS compliant

APPLICATIONS / BENEFITS

- Low profile surface mount for crowded areas
- Lightweight package
- Military and other high-reliability rad-hard applications



U-18 LCC Package

Also available in:

TO-205AF (TO-39) Package
(leaded top-hat)
JANS 2N7389

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)	$R_{\Theta JC}$	5	°C/W
Total Power Dissipation @ T_A = +25 °C @ T_C = +25 °C (1)	P_T	0.8 25	W
Gate-Source Voltage, dc	V_{GS}	± 20	V
Drain Current, dc @ T_C = +25 ºC (2) (3)	I_{D1}	-6.5	A
Drain Current, dc @ T_C = +100 ºC (2) (3)	I_{D2}	-4.1	A
Off-State Current (Peak Total Value) (4)	I_{DM}	-26	A
Source Current	I_S	-6.5	A

NOTES:
1. Derated linearly 0.2 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)

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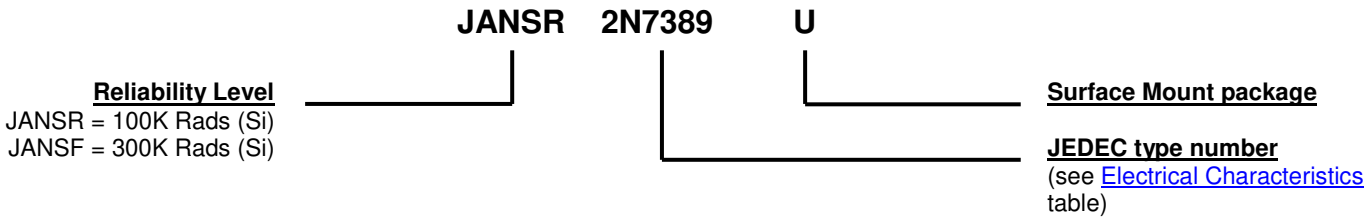
MECHANICAL and PACKAGING

- CASE: Ceramic LCC-18 with kovar gold plated lid
- TERMINALS: Gold plating over nickel
- MARKING: Manufacturer's ID, part number, date code, ESD symbol at pin 1 location
- TAPE & REEL option: Standard per EIA-481-D. Consult factory for quantities
- See Package Dimensions on last page.

PART NOMENCLATURE



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.
$V_{DS(on)}$	Drain-Source On-State Voltage: The voltage between the drain and source terminals with a specified forward gate-source voltage supplied to bias the device to the on-state.
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 = -4.1 A pulsed	$r_{DS(on)1}$		0.30	Ω
Static Drain-Source On-State Resistance V_{GS} = -12 V, I_D = -6.5 A pulsed	$r_{DS(on)2}$		0.35	Ω
Static Drain-Source On-State Resistance T_J = +125°C V_{GS} = -12 V, I_D = -4.1 A pulsed	$r_{DS(on)3}$		0.54	Ω
Diode Forward Voltage V_{GS} = 0 V, I_D = -6.5 A pulsed	V_{SD}		-3.0	V

DYNAMIC CHARACTERISTICS

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Gate Charge:				
On-State Gate Charge V_{GS} = -12 V, I_D = -6.5 A, V_{DS} = -50 V	$Q_{g(on)}$		45	nC
Gate to Source Charge V_{GS} = -12 V, I_D = -6.5 A, V_{DS} = -50 V	Q_{gs}		10	nC
Gate to Drain Charge V_{GS} = -12 V, I_D = -6.5 A, V_{DS} = -50 V	Q_{gd}		25	nC

SWITCHING CHARACTERISTICS

Parameters / Test Conditions	Symbol	Min.	Max.	Unit
Turn-on delay time I_D = -6.5 A, V_{GS} = -12 V, R_G = 7.5 Ω, V_{DD} = -50 V	$t_{d(on)}$		30	ns
Rise time I_D = -6.5 A, V_{GS} = -12 V, R_G = 7.5 Ω, V_{DD} = -50 V	t_r		50	ns
Turn-off delay time I_D = -6.5 A, V_{GS} = -12 V, R_G = 7.5 Ω, V_{DD} = -50 V	$t_{d(off)}$		70	ns
Fall time I_D = -6.5 A, V_{GS} = -12 V, R_G = 7.5 Ω, V_{DD} = -50 V	t_f		70	ns
Diode Reverse Recovery Time di/dt ≤ -100 A/µs, V_{DD} ≤ -50 V, I_F = -6.5 A	t_{rr}		250	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 JANSR $V_{DS} \geq V_{GS}$, I_D = -1.0 mA JANSF	$V_{GS(th)1}$ $V_{GS(th)1}$	-2.0 -2.0	-4.0 -5.0	V
Gate Current V_{GS} = ±20 V, V_{DS} = 0 V	I_{GSS1}		±100	nA
Drain Current V_{GS} = 0 V, V_{DS} = -80 V of V_{DS} (pre-irradiated)	I_{DSS1}		-25	µA
Static Drain-Source On-State Voltage V_{GS} = -12 V, I_D = -4.1 pulsed	$r_{DS(on)}$		1.23	V
Diode Forward Voltage V_{GS} = 0 V, I_D = -6.5 pulsed	V_{SD}		-3.0	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

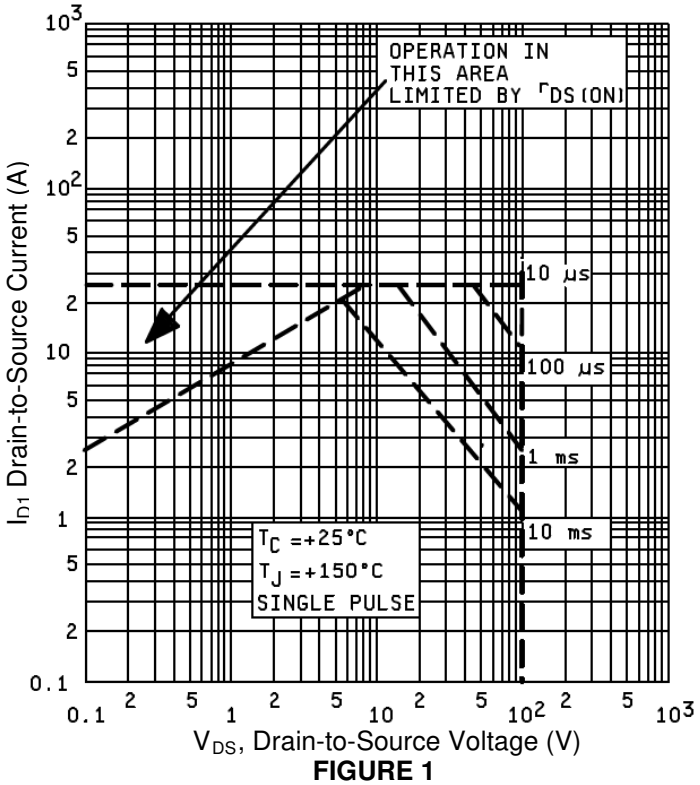
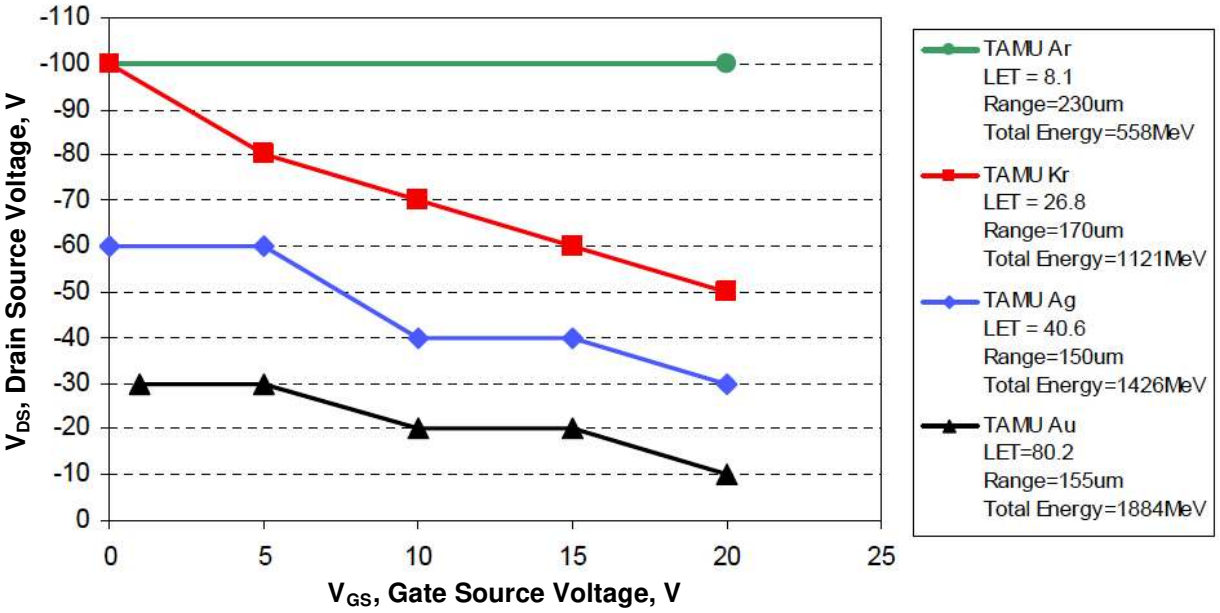


FIGURE 1

GRAPHS

SEE (Single Event Effect) Typical Response:
Heavy Ion testing of the 2N7389U device 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



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.

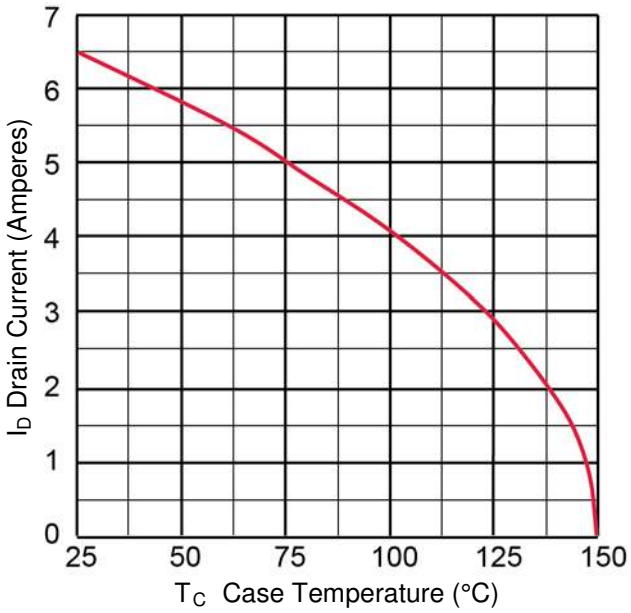


FIGURE 3
Maximum Drain Current vs Case Temperature

GRAPHS (continued)

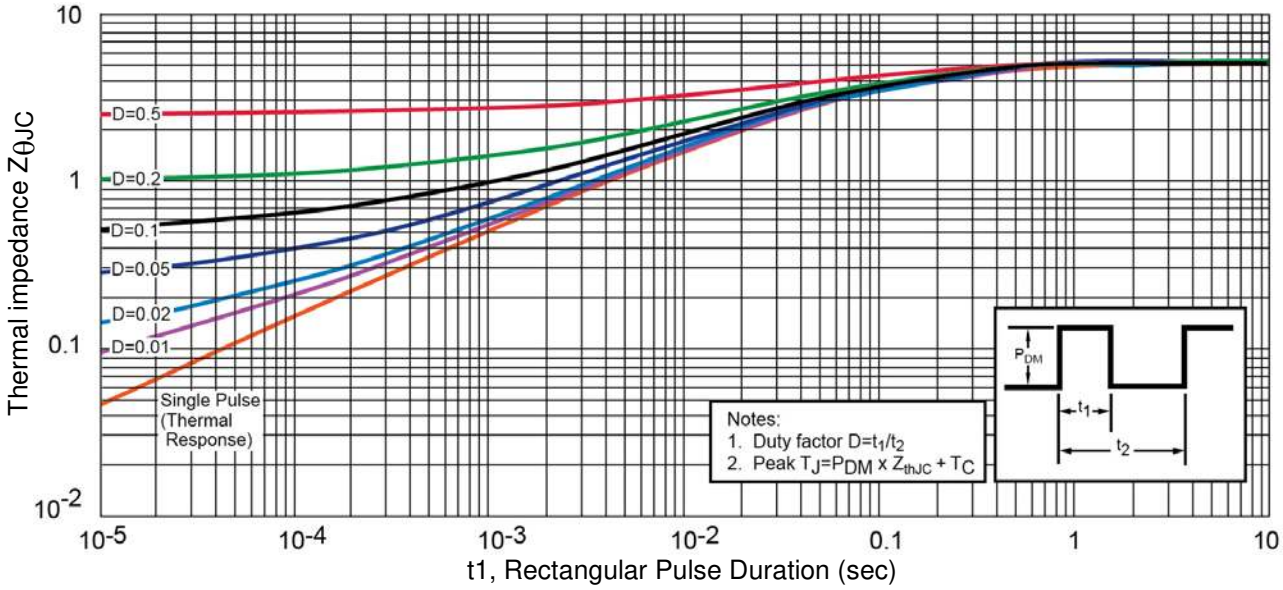
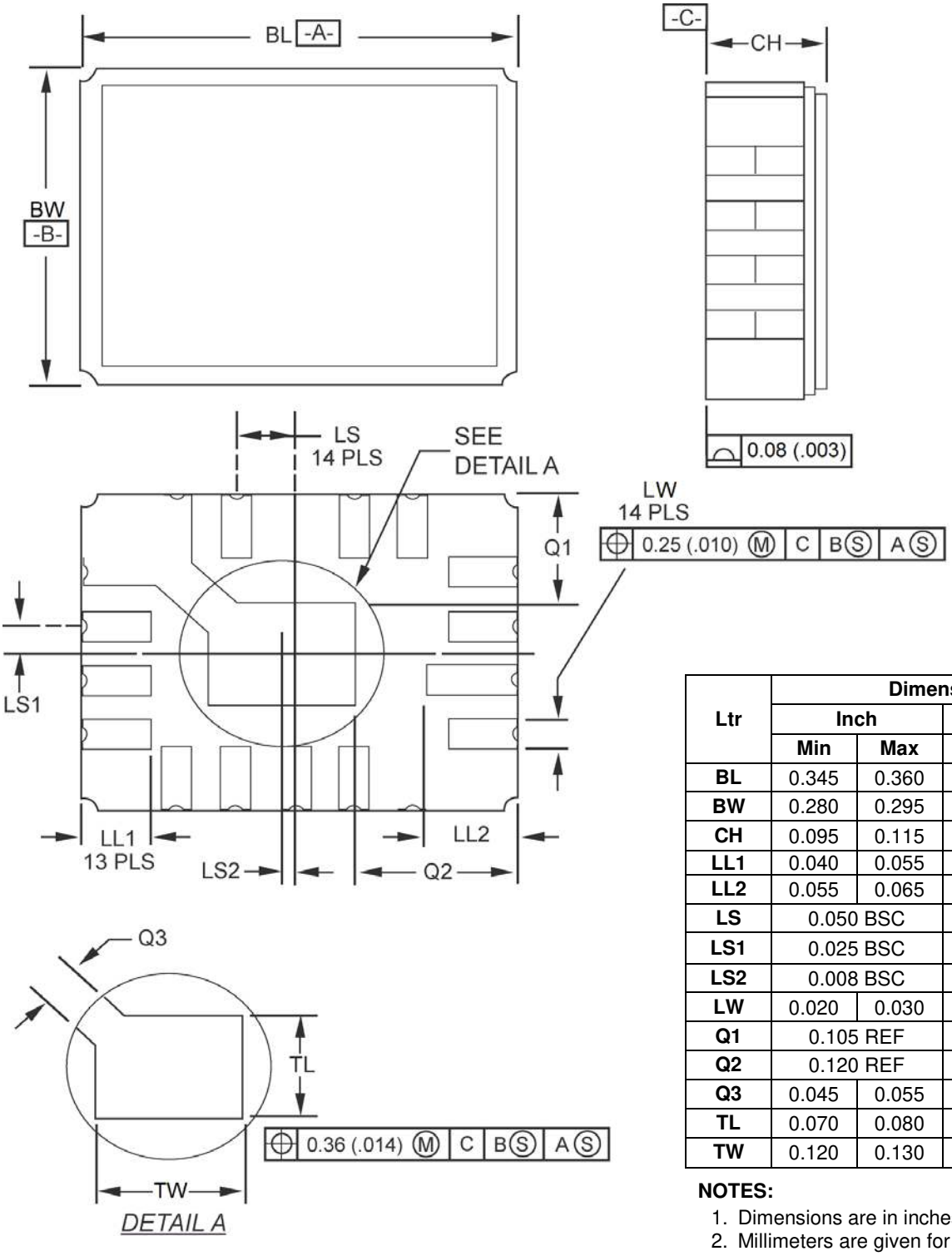


FIGURE 4
Thermal Impedance Curves

PACKAGE DIMENSIONS

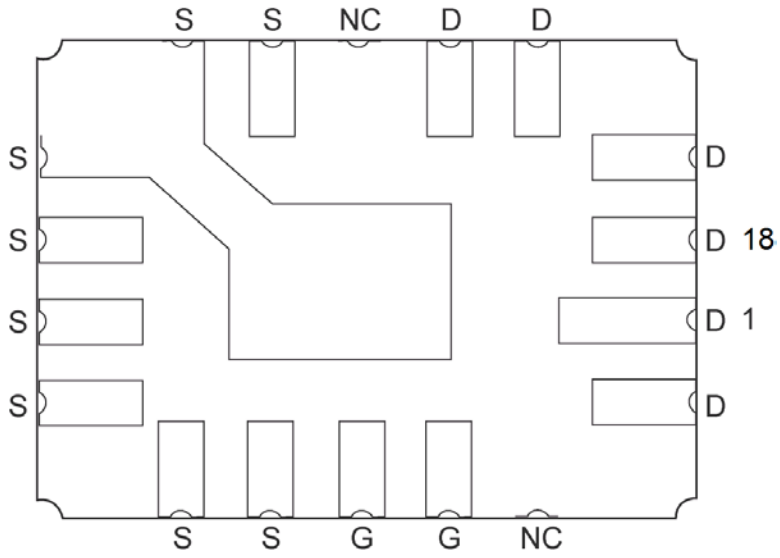


Ltr	Dimensions			
	Inch		Millimeters	
	Min	Max	Min	Max
BL	0.345	0.360	8.77	9.14
BW	0.280	0.295	7.12	7.49
CH	0.095	0.115	2.42	2.92
LL1	0.040	0.055	1.02	1.39
LL2	0.055	0.065	1.40	1.65
LS	0.050 BSC		1.27 BSC	
LS1	0.025 BSC		0.635 BSC	
LS2	0.008 BSC		0.203 BSC	
LW	0.020	0.030	0.51	0.76
Q1	0.105 REF		2.67 REF	
Q2	0.120 REF		3.05 REF	
Q3	0.045	0.055	1.14	1.40
TL	0.070	0.080	1.78	2.03
TW	0.120	0.130	3.05	3.30

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for information only.
3. In accordance with ASME Y14.5M, diameters are equivalent to Φx symbology.

PAD LAYOUT



PAD ASSIGNMENTS

SCHEMATIC