

NTR3162P

Power MOSFET

-20 V, -3.6 A, Single P-Channel, SOT-23

Features

- Low $R_{DS(on)}$ at Low Gate Voltage
- -0.3 V Low Threshold Voltage
- Fast Switching Speed
- This is a Pb-Free Device

Applications

- Battery Management
- Load Switch in PWM
- Battery Protection

MAXIMUM RATINGS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter		Symbol	Value	Unit	
Drain-to-Source Voltage		V_{DSS}	-20	V	
Gate-to-Source Voltage		V_{GS}	± 8	V	
Continuous Drain Current (Note 1)	Steady State	I_D	$T_A = 25^\circ\text{C}$	-2.2	A
			$T_A = 85^\circ\text{C}$	-1.6	
	$t \leq 5 \text{ s}$	$T_A = 25^\circ\text{C}$	-3.6		
Power Dissipation (Note 1)	Steady State	P_D	$T_A = 25^\circ\text{C}$	0.48	W
	$t \leq 5 \text{ s}$			1.25	
Pulsed Drain Current	$t_p = 10 \mu\text{s}$	I_{DM}	-10.7	A	
Operating Junction and Storage Temperature		T_J, T_{stg}	-55 to 150	$^\circ\text{C}$	
Source Current (Body Diode)		I_S	-0.6	A	
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		T_L	260	$^\circ\text{C}$	

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Max	Unit
Junction-to-Ambient - Steady State (Note 1)	$R_{\theta JA}$	260	$^\circ\text{C}/\text{W}$
Junction-to-Ambient - $t < 10 \text{ s}$ (Note 1)	$R_{\theta JA}$	100	

1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).

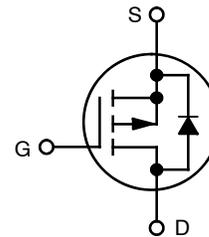


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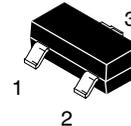
<http://onsemi.com>

$V_{(BR)DSS}$	$R_{DS(on)}$ MAX	I_D MAX
-20 V	70 m Ω @ -4.5 V	-2.2 A
	95 m Ω @ -2.5 V	-1.9 A
	120 m Ω @ -1.8 V	-1.7 A

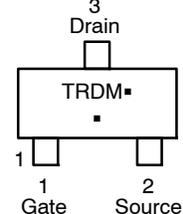
P-CHANNEL MOSFET



MARKING DIAGRAM/ PIN ASSIGNMENT



SOT-23
CASE 318
STYLE 21



TRD = Specific Device Code
M = Date Code
▪ = Pb-Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
NTR3162PT1G	SOT-23 (Pb-Free)	3000 / Tape & Reel
NTR3162PT3G	SOT-23 (Pb-Free)	10000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

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ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
OFF CHARACTERISTICS						
Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = -250\ \mu\text{A}$	-20			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	$I_D = -250\ \mu\text{A}$, Reference to 25°C		14.5		mV/ $^\circ\text{C}$
Zero Gate Voltage Drain Current	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}, T_J = 25^\circ\text{C}$ $V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}, T_J = 85^\circ\text{C}$			-1.0 -5.0	μA
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 8\text{ V}$			± 100	nA

ON CHARACTERISTICS (Note 3)

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$	-0.3	-0.6	-1.0	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			2.5		mV/ $^\circ\text{C}$
Drain-to-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -2.2\text{ A}$		48	70	m Ω
		$V_{GS} = -2.5\text{ V}, I_D = -1.9\text{ A}$		57	95	
		$V_{GS} = -1.8\text{ V}, I_D = -1.7\text{ A}$		72	120	
		$V_{GS} = -1.5\text{ V}, I_D = -1.0\text{ A}$		88		
Forward Transconductance	g_{FS}	$V_{DS} = -5.0\text{ V}, I_D = -2.2\text{ A}$		9.0		S

CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	C_{iss}	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -10\text{ V}$		940		pF
Output Capacitance	C_{oss}			140		
Reverse Transfer Capacitance	C_{rss}			100		
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}, I_D = -3.6\text{ A}$		10.3		nC
Threshold Gate Charge	$Q_{G(TH)}$			0.5		
Gate-to-Source Charge	Q_{GS}			1.4		
Gate-to-Drain Charge	Q_{GD}			2.7		
Gate Resistance	R_G			6.0		

SWITCHING CHARACTERISTICS (Note 4)

Turn-On Delay Time	$t_{d(on)}$	$V_{GS} = -4.5\text{ V}, V_{DD} = -10\text{ V}, I_D = -3.6\text{ A}, R_G = 6\ \Omega$		8.0		ns
Rise Time	t_r			15		
Turn-Off Delay Time	$t_{d(off)}$			31		
Fall Time	t_f			50		

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V}, I_S = -1.0\text{ A}, T_J = 25^\circ\text{C}$		0.7	1.2	V
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}, I_D = -1.0\text{ A}, dI_{SD}/dt = 100\text{ A}/\mu\text{s}$		25		ns
Charge Time	t_a			8.0		
Discharge Time	t_b			17		
Reverse Recovery Charge	Q_{RR}			11		

- Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).
- Pulse Test: Pulse Width $\leq 300\ \mu\text{s}$, Duty Cycle $\leq 2\%$.
- Switching characteristics are independent of operating junction temperatures.

P-CHANNEL TYPICAL CHARACTERISTICS

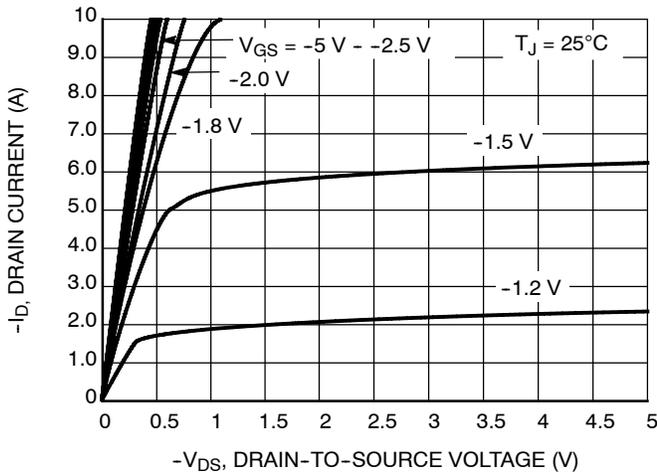


Figure 1. On-Region Characteristics

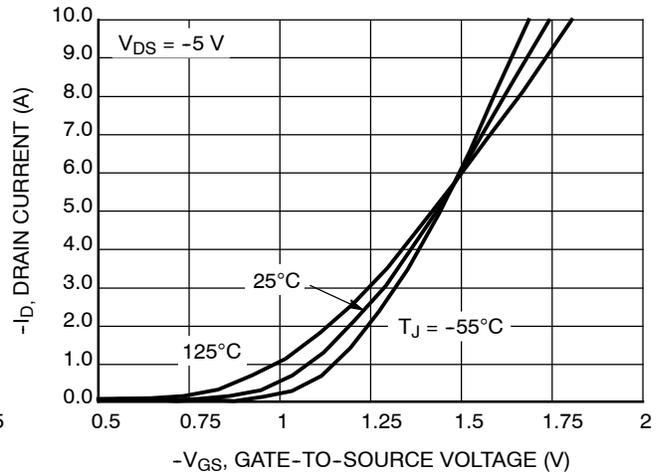


Figure 2. Transfer Characteristics

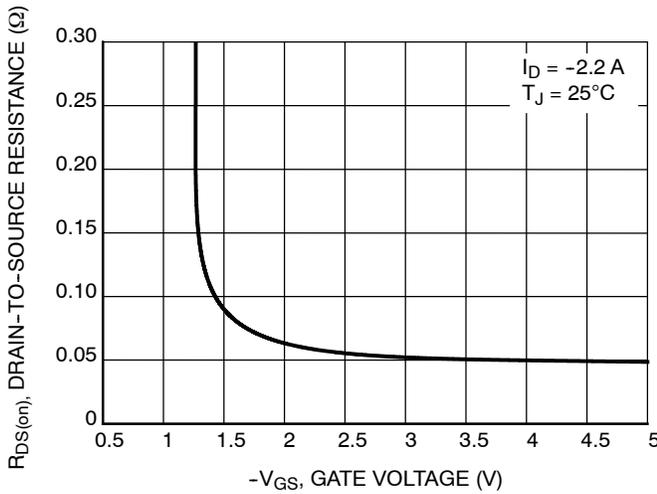


Figure 3. On-Resistance vs. Gate-to-Source Voltage

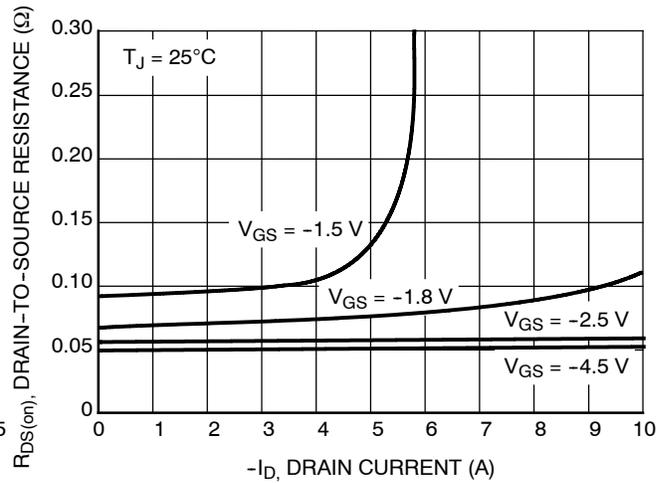


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

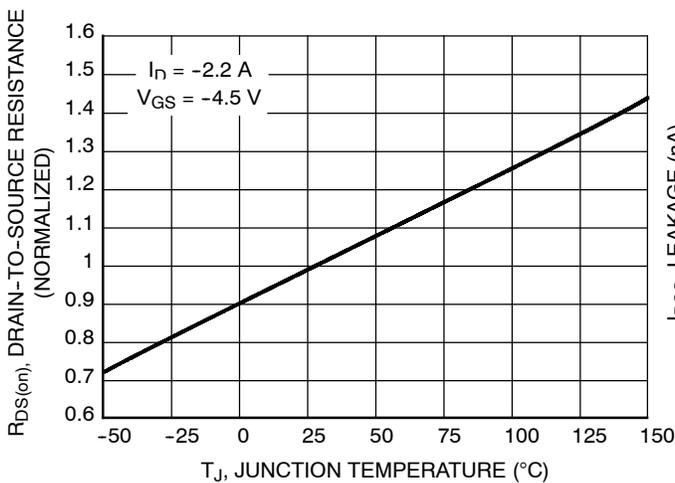


Figure 5. On-Resistance Variation with Temperature

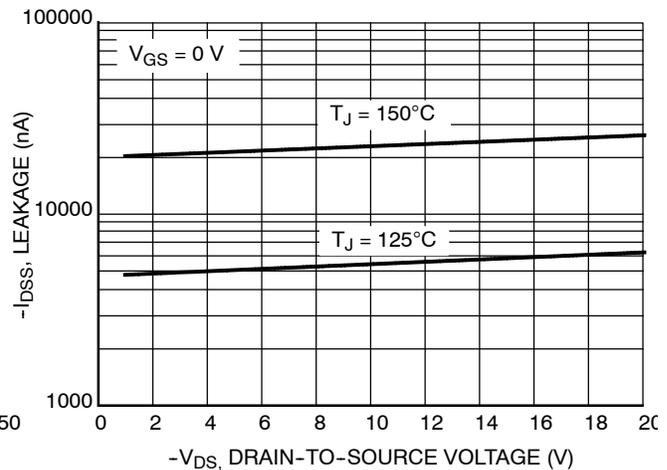


Figure 6. Drain-to-Source Leakage Current vs. Voltage

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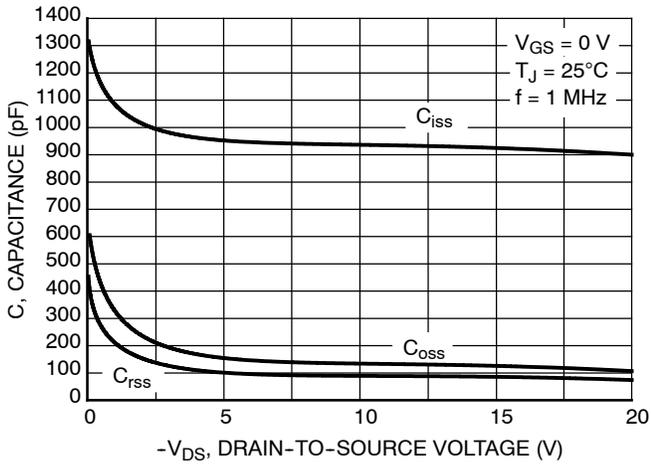


Figure 7. Capacitance Variation

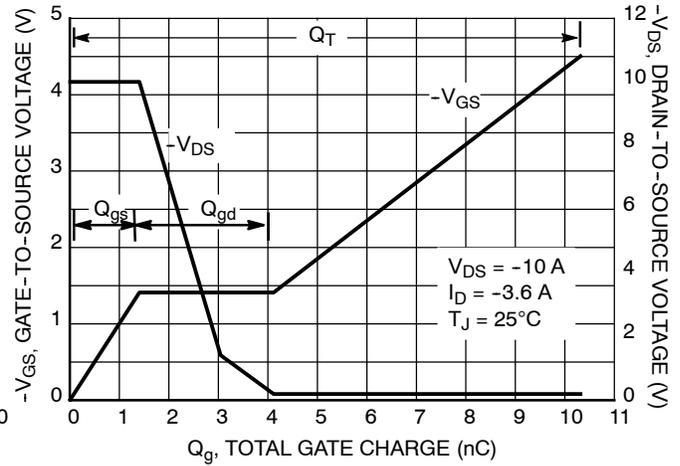


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Gate Charge

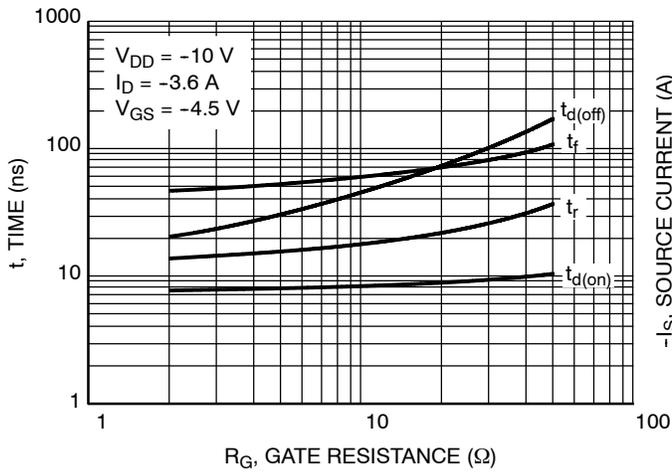


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

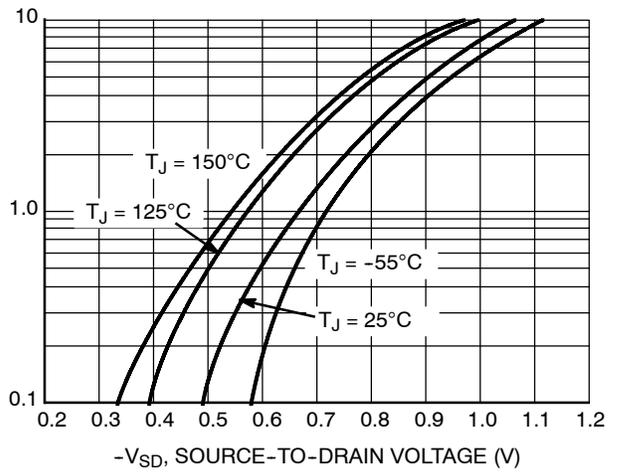


Figure 10. Diode Forward Voltage vs. Current

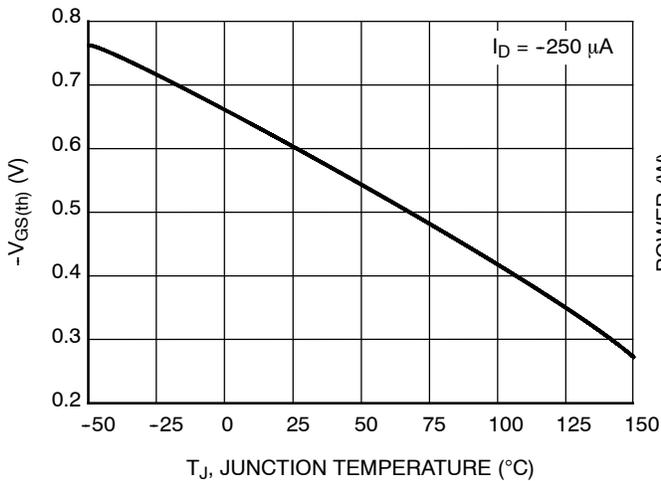


Figure 11. Threshold Voltage

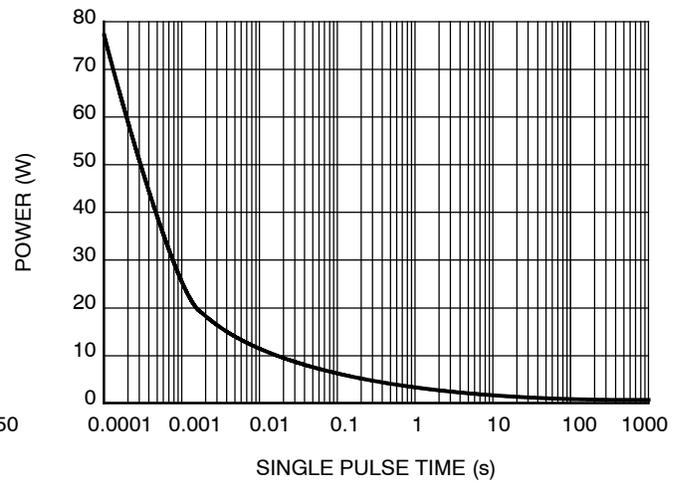


Figure 12. Single Pulse Maximum Power Dissipation

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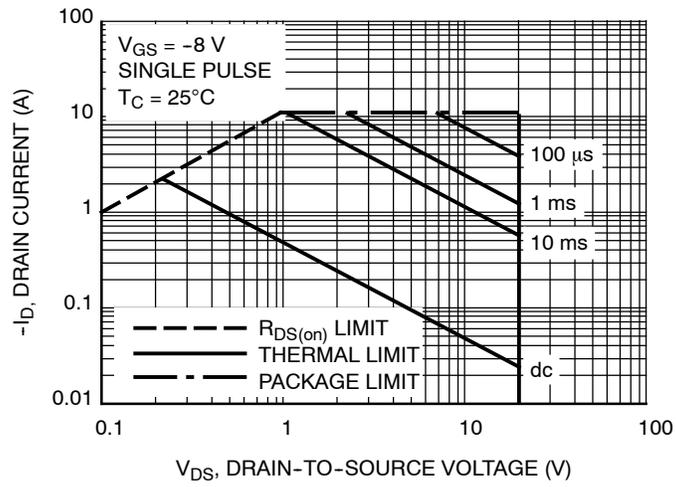


Figure 13. Maximum Rated Forward Biased Safe Operating Area

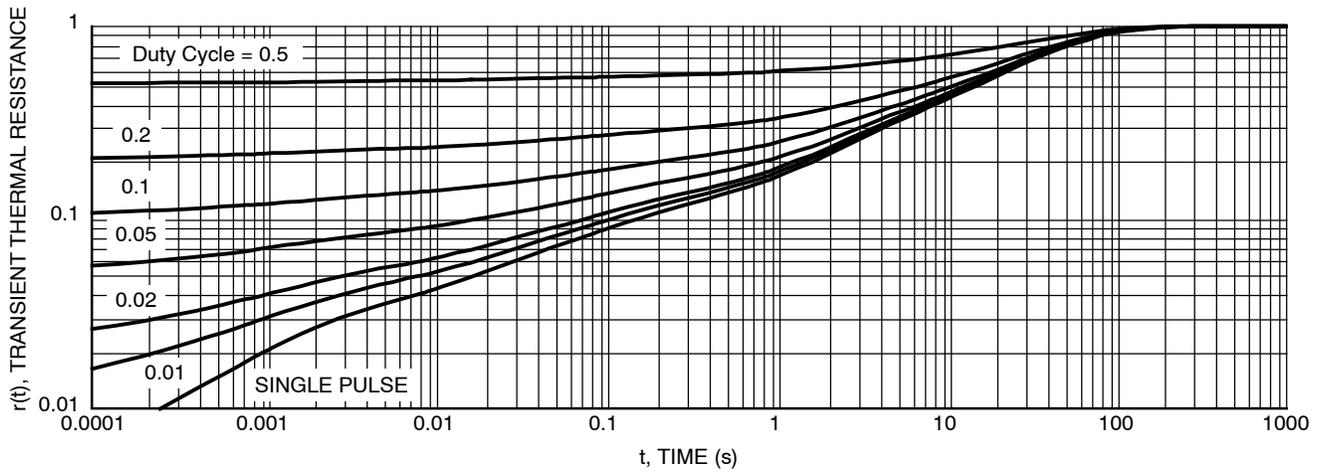
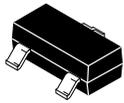


Figure 14. Thermal Response

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

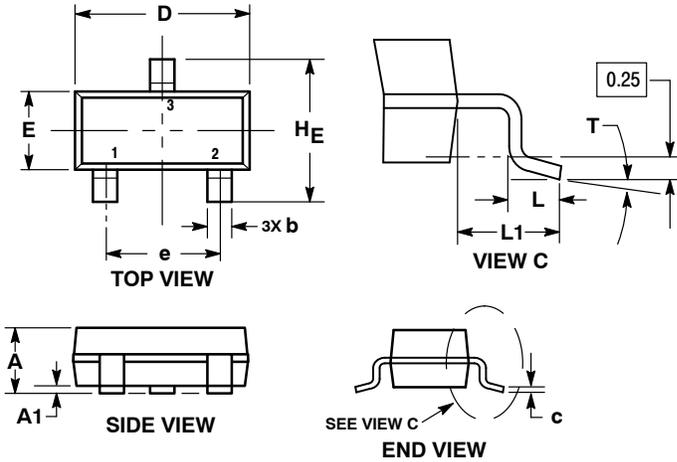
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SOT-23 (TO-236) CASE 318-08 ISSUE AS

DATE 30 JAN 2018

SCALE 4:1

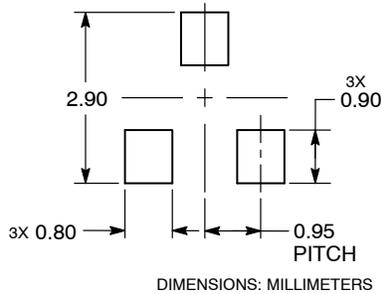


NOTES:

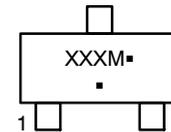
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.89	1.00	1.11	0.035	0.039	0.044
A1	0.01	0.06	0.10	0.000	0.002	0.004
b	0.37	0.44	0.50	0.015	0.017	0.020
c	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.04	0.110	0.114	0.120
E	1.20	1.30	1.40	0.047	0.051	0.055
e	1.78	1.90	2.04	0.070	0.075	0.080
L	0.30	0.43	0.55	0.012	0.017	0.022
L1	0.35	0.54	0.69	0.014	0.021	0.027
HE	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

RECOMMENDED SOLDERING FOOTPRINT



GENERIC MARKING DIAGRAM*



XXX = Specific Device Code
M = Date Code
▪ = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present.

STYLE 1 THRU 5:
CANCELLED

STYLE 6:
PIN 1. BASE
2. EMITTER
3. COLLECTOR

STYLE 7:
PIN 1. EMITTER
2. BASE
3. COLLECTOR

STYLE 8:
PIN 1. ANODE
2. NO CONNECTION
3. CATHODE

STYLE 9:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 10:
PIN 1. DRAIN
2. SOURCE
3. GATE

STYLE 11:
PIN 1. ANODE
2. CATHODE
3. CATHODE-ANODE

STYLE 12:
PIN 1. CATHODE
2. CATHODE
3. ANODE

STYLE 13:
PIN 1. SOURCE
2. DRAIN
3. GATE

STYLE 14:
PIN 1. CATHODE
2. GATE
3. ANODE

STYLE 15:
PIN 1. GATE
2. CATHODE
3. ANODE

STYLE 16:
PIN 1. ANODE
2. CATHODE
3. CATHODE

STYLE 17:
PIN 1. NO CONNECTION
2. ANODE
3. CATHODE

STYLE 18:
PIN 1. NO CONNECTION
2. CATHODE
3. ANODE

STYLE 19:
PIN 1. CATHODE
2. ANODE
3. CATHODE-ANODE

STYLE 20:
PIN 1. CATHODE
2. ANODE
3. GATE

STYLE 21:
PIN 1. GATE
2. SOURCE
3. DRAIN

STYLE 22:
PIN 1. RETURN
2. OUTPUT
3. INPUT

STYLE 23:
PIN 1. ANODE
2. ANODE
3. CATHODE

STYLE 24:
PIN 1. GATE
2. DRAIN
3. SOURCE

STYLE 25:
PIN 1. ANODE
2. CATHODE
3. GATE

STYLE 26:
PIN 1. CATHODE
2. ANODE
3. NO CONNECTION

STYLE 27:
PIN 1. CATHODE
2. CATHODE
3. CATHODE

STYLE 28:
PIN 1. ANODE
2. ANODE
3. ANODE

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