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

ON Semiconductor®

http://onsemi.com

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

P-CHANNEL MOSFET

MAXIMUM RATINGS (T_J = 25°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	T_A = 25°C	I_D	-2.2	A
		T_A = 85°C		-1.6	
	t ≤ 5 s	T_A = 25°C		-3.6	
Power Dissipation (Note 1)	Steady State	T_A = 25°C	P_D	0.48	W
	t ≤ 5 s			1.25	
Pulsed Drain Current	t_p = 10 μs		I_{DM}	-10.7	A
Operating Junction and Storage Temperature			T_J, T_{stg}	-55 to 150	°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	°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	°C/W
Junction-to-Ambient - t < 10 s (Note 1)	$R_{\theta JA}$	100	

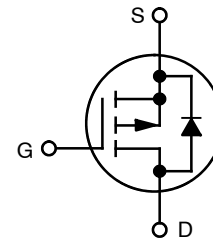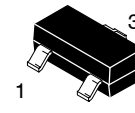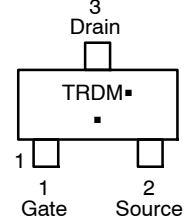1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).

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.

NTR3162P

ELECTRICAL CHARACTERISTICS (T_J = 25°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 V, I_D = –250 µA	–20			V
Drain-to-Source Breakdown Voltage Temperature Coefficient	$V_{(BR)DSS}/T_J$	I_D = –250 µA, Reference to 25°C		14.5		mV/°C
Zero Gate Voltage Drain Current	I_{DSS}	V_{GS} = 0 V, V_{DS} = –16 V, T_J = 25°C V_{GS} = 0 V, V_{DS} = –16 V, T_J = 85°C			–1.0 –5.0	µA
Gate-to-Source Leakage Current	I_{GSS}	V_{DS} = 0 V, V_{GS} = ±8 V			±100	nA
ON CHARACTERISTICS (Note 3)						
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = –250 µA	–0.3	–0.6	–1.0	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$			2.5		mV/°C
Drain-to-Source On-Resistance	$R_{DS(on)}$	V_{GS} = –4.5 V, I_D = –2.2 A		48	70	mΩ
		V_{GS} = –2.5 V, I_D = –1.9 A		57	95	
		V_{GS} = –1.8 V, I_D = –1.7 A		72	120	
		V_{GS} = –1.5 V, I_D = –1.0 A		88		
Forward Transconductance	g_{FS}	V_{DS} = –5.0 V, I_D = –2.2 A		9.0		S
CHARGES, CAPACITANCES AND GATE RESISTANCE						
Input Capacitance	C_{iss}	V_{GS} = 0 V, f = 1.0 MHz, V_{DS} = –10 V		940		pF
Output Capacitance	C_{oss}			140		
Reverse Transfer Capacitance	C_{rss}			100		
Total Gate Charge	$Q_{G(TOT)}$	V_{GS} = –4.5 V, V_{DS} = –10 V, I_D = –3.6 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		Ω
SWITCHING CHARACTERISTICS (Note 4)						
Turn-On Delay Time	$t_{d(on)}$	V_{GS} = –4.5 V, V_{DD} = –10 V, I_D = –3.6 A, R_G = 6 Ω		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 V, I_S = –1.0 A, T_J = 25°C		0.7	1.2	V
Reverse Recovery Time	t_{RR}	V_{GS} = 0 V, I_D = –1.0 A, dI_{SD}/d_t = 100 A/µs		25		ns
Charge Time	t_a			8.0		
Discharge Time	t_b			17		
Reverse Recovery Charge	Q_{RR}			11		nC

2. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [2 oz] including traces).
3. Pulse Test: Pulse Width ≤ 300 µs, Duty Cycle ≤ 2%.
4. Switching characteristics are independent of operating junction temperatures.
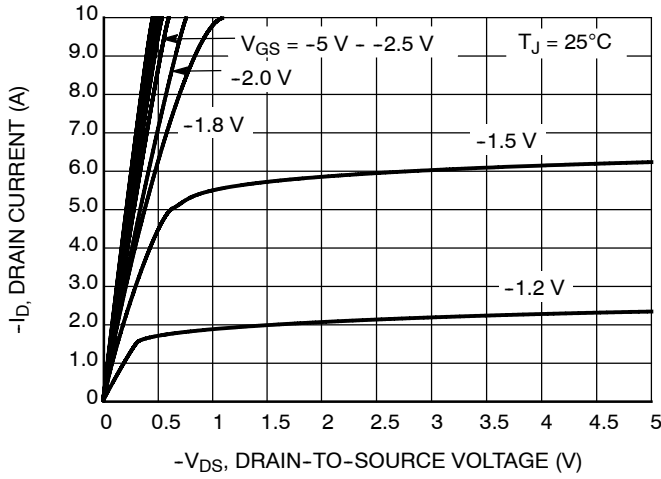
P-CHANNEL TYPICAL CHARACTERISTICS
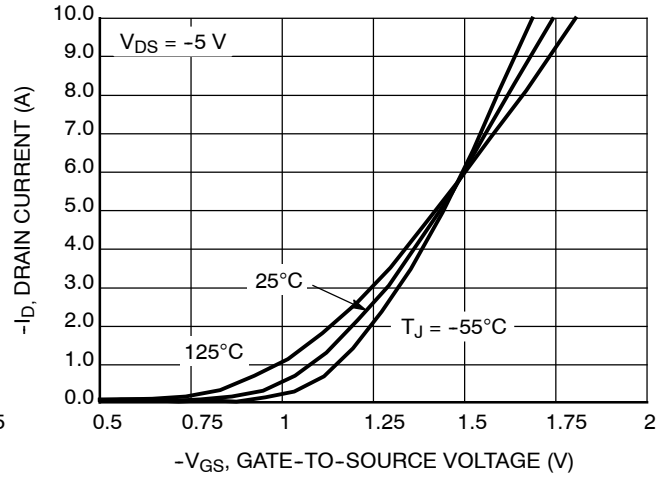

Figure 1. On-Region Characteristics

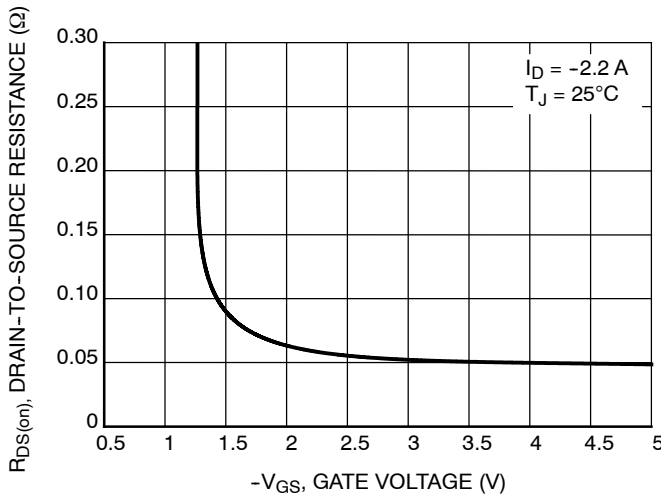**Figure 2. Transfer Characteristics**

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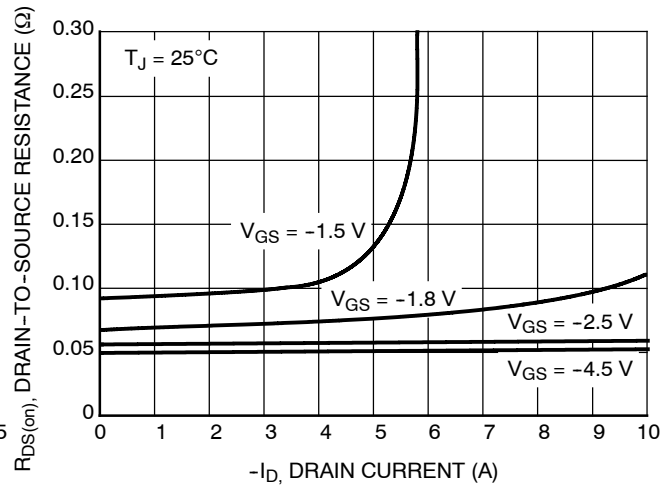

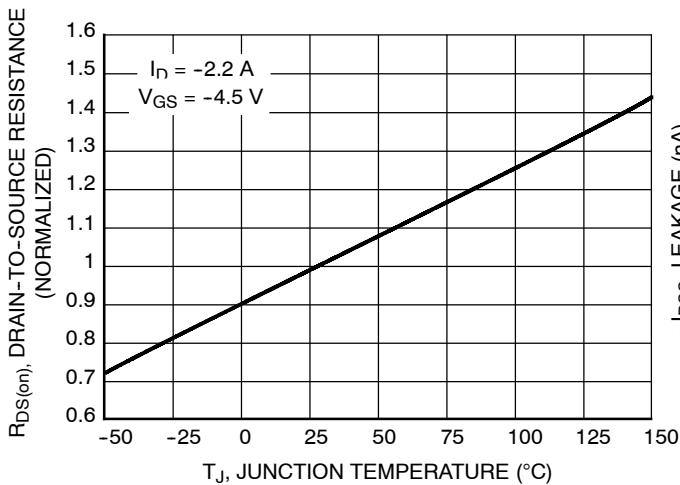**Figure 4. On-Resistance vs. Drain Current and Gate Voltage**
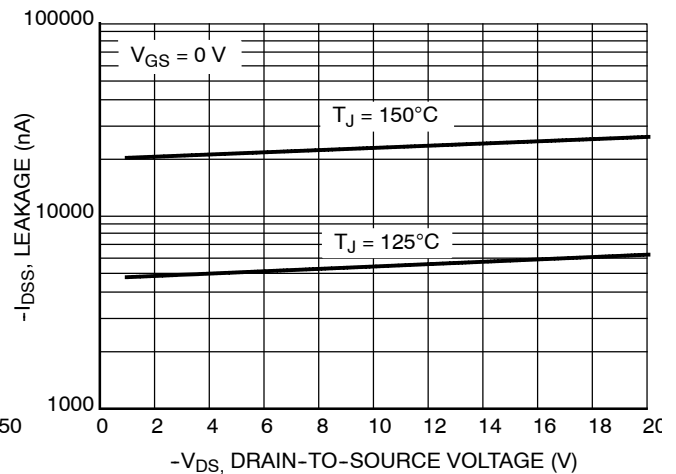

Figure 5. On-Resistance Variation with Temperature
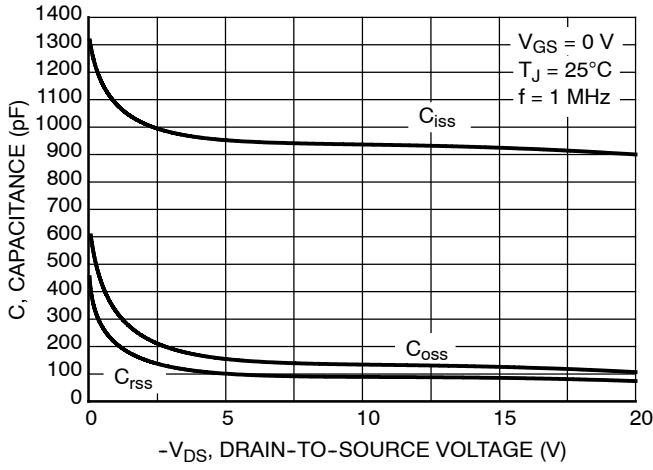

Figure 6. Drain-to-Source Leakage Current vs. Voltage

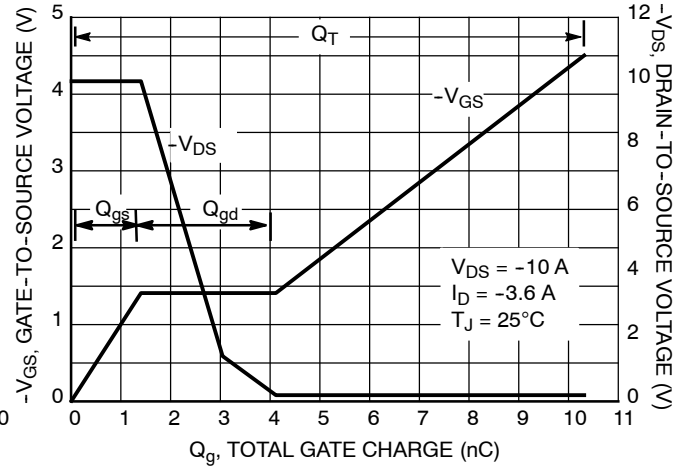# NTR3162P

Figure 7. Capacitance Variation

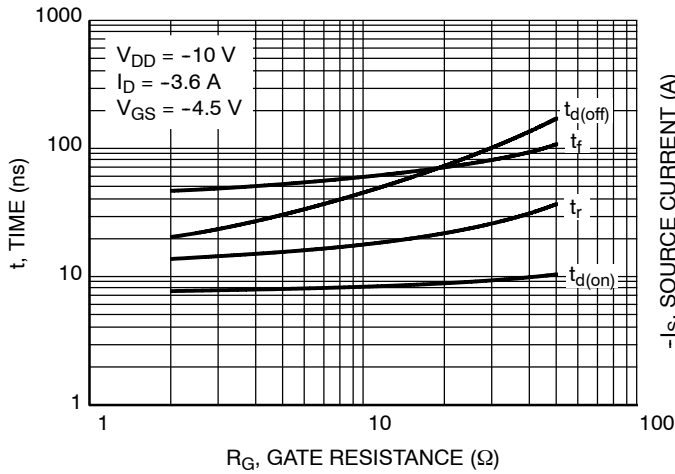**Figure 8. Gate-to-Source and Drain-to-Source
Voltage vs. Total Gate Charge**

**Figure 9. Resistive Switching Time Variation
vs. Gate Resistance**
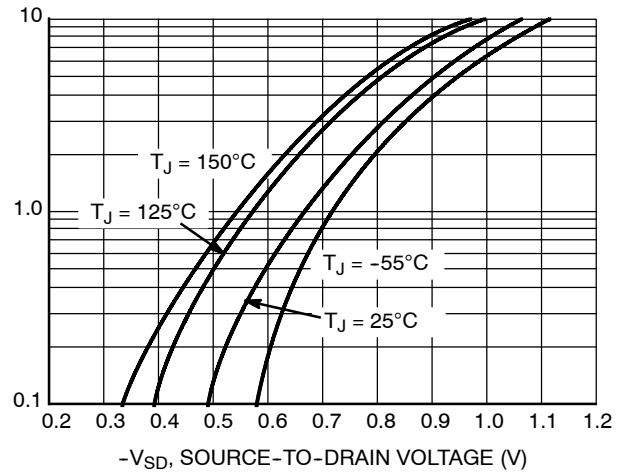
Figure 10. Diode Forward Voltage vs. Current
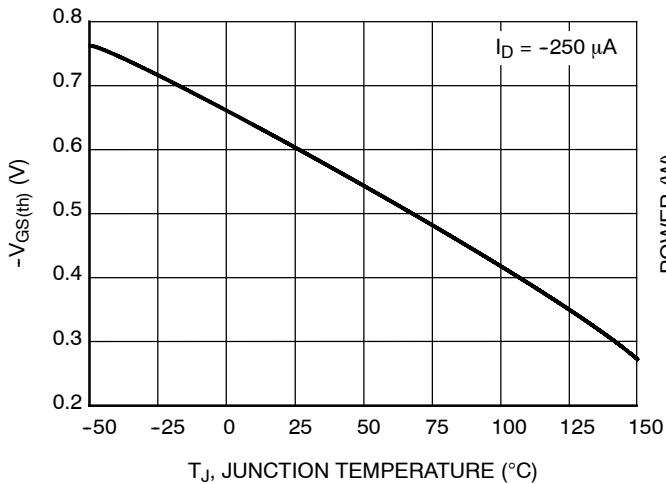
Figure 11. Threshold Voltage
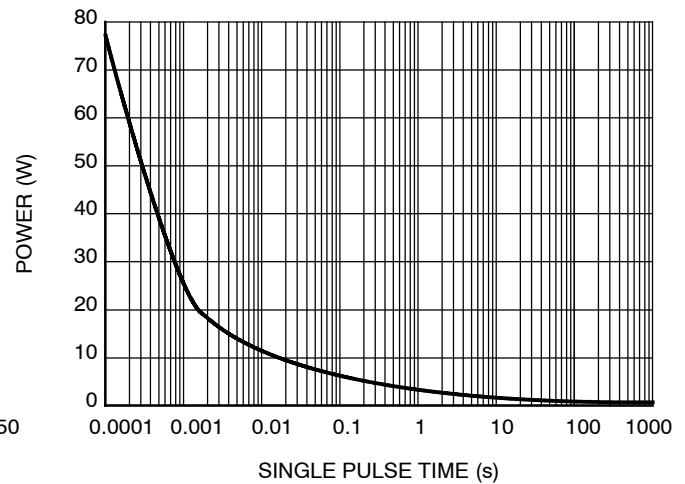
**Figure 12. Single Pulse Maximum Power
Dissipation**

NTR3162P
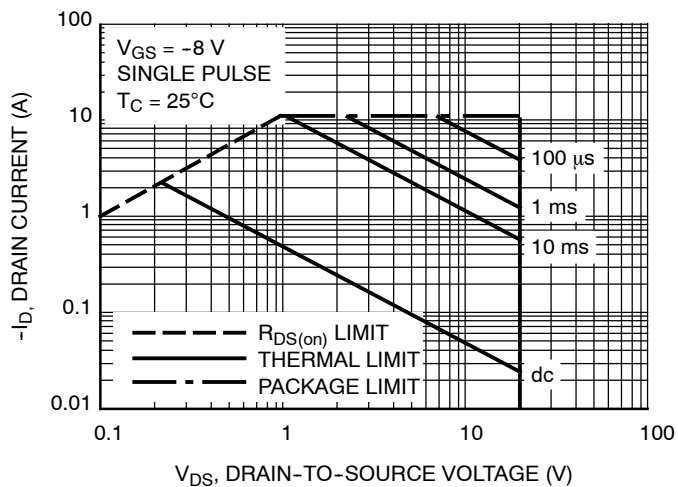
**Figure 13. Maximum Rated Forward Biased
Safe Operating Area**
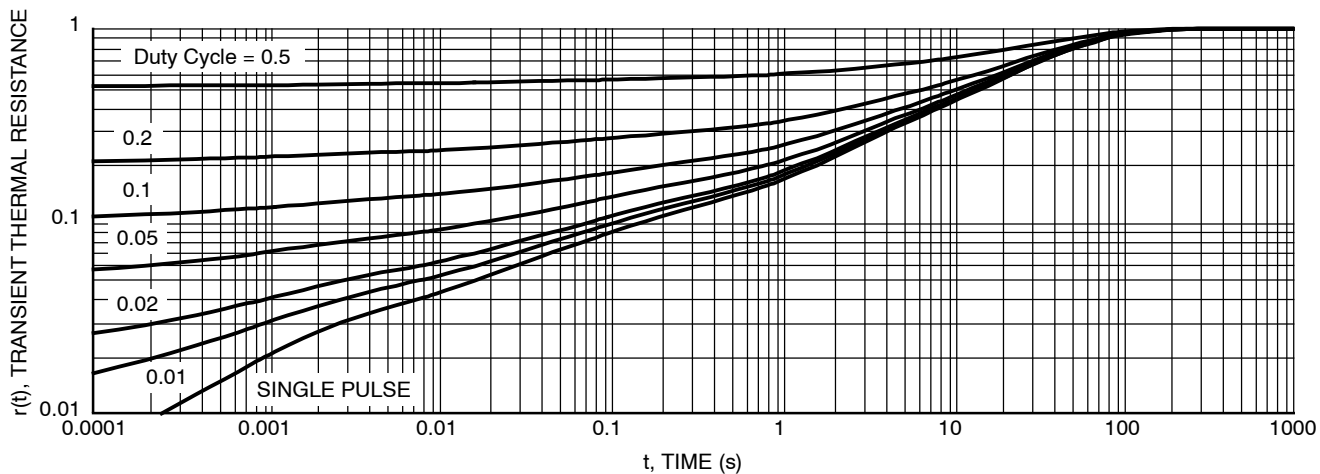
Figure 14. Thermal Response

SOT−23 (TO−236)
CASE 318
ISSUE AT

DATE 01 MAR 2023

SCALE 4:1

TOP VIEW

DETAIL A

SIDE VIEW

DETAIL A   END VIEW

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
H_E	2.10	2.40	2.64	0.083	0.094	0.104
T	0°	---	10°	0°	---	10°

**GENERIC
MARKING DIAGRAM***

XXXM▪
▪

1

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. Some products may not follow the Generic Marking.

2.90

3X
0.95

3X 0.56

0.95

PITCH

RECOMMENDED
MOUNTING FOOTPRINT

❋ For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

STYLES ON PAGE 2

DOCUMENT NUMBER:	98ASB42226B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	SOT−23 (TO−236)		PAGE 1 OF 2

SOT−23 (TO−236)
CASE 318
ISSUE AT

DATE 01 MAR 2023

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

DOCUMENT NUMBER:	98ASB42226B	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.	
DESCRIPTION:	SOT−23 (TO−236)		PAGE 2 OF 2

ADDITIONAL INFORMATION

◊