

# NTHD5903

## Power MOSFET

–20 V, –3.0 A, Dual P–Channel ChipFET™

### Features

- Low  $R_{DS(on)}$  for Higher Efficiency
- Logic Level Gate Drive
- Miniature ChipFET Surface Mount Package Saves Board Space
- Pb–Free Package is Available

### Applications

- Power Management in Portable and Battery–Powered Products; i.e., Cellular and Cordless Telephones and PCMCIA Cards

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

Rating	Symbol	5 secs	Steady State	Unit
Drain–Source Voltage	$V_{DS}$	–20		V
Gate–Source Voltage	$V_{GS}$	$\pm 12$		V
Continuous Drain Current ( $T_J = 150^\circ\text{C}$ ) (Note 1) $T_A = 25^\circ\text{C}$ $T_A = 85^\circ\text{C}$	$I_D$	$\pm 3.0$ $\pm 2.2$	$\pm 2.2$ $\pm 1.6$	A
Pulsed Drain Current	$I_{DM}$	$\pm 10$		A
Continuous Source Current (Diode Conduction) (Note 1)	$I_S$	–3.0	–2.2	A
Maximum Power Dissipation (Note 1) $T_A = 25^\circ\text{C}$ $T_A = 85^\circ\text{C}$	$P_D$	2.1 1.1	1.1 0.6	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	–55 to +150		$^\circ\text{C}$

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

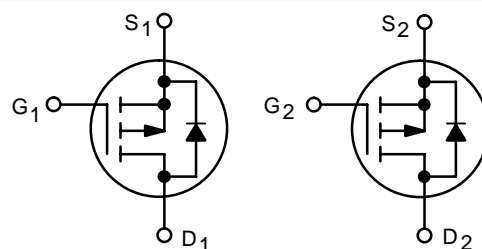
1. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.27 in sq [1 oz] including traces).



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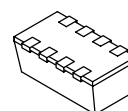
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$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	$I_D$ MAX
–20 V	130 m $\Omega$ @ –4.5 V	–3.0 A
	215 m $\Omega$ @ –2.5 V	



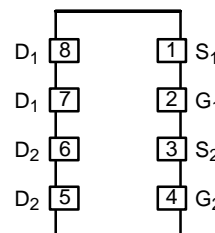
P–Channel MOSFET

P–Channel MOSFET

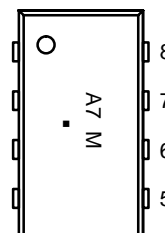


ChipFET  
CASE 1206A  
STYLE 2

### PIN CONNECTIONS



### MARKING DIAGRAM



- A7 = Specific Device Code
- M = Month Code
- = Pb–Free Package

### ORDERING INFORMATION

Device	Package	Shipping†
NTHD5903T1	ChipFET	3000/Tape & Reel
NTHD5903T1G	ChipFET (Pb–Free)	3000/Tape & Reel

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

**THERMAL CHARACTERISTICS**

Characteristic	Symbol	Typ	Max	Unit
Maximum Junction-to-Ambient (Note 2) $t \leq 5$ s Steady State	$R_{\theta JA}$	50 90	60 110	$^{\circ}\text{C/W}$
Maximum Junction-to-Foot (Drain) Steady State	$R_{\theta JF}$	30	40	$^{\circ}\text{C/W}$

2. Surface Mounted on FR4 Board using 1 in sq pad size (Cu area = 1.27 in sq [1 oz] including traces).

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

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
<b>Static</b>						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = -250 \mu\text{A}$	-0.6			V
Gate-Body Leakage	$I_{GSS}$	$V_{DS} = 0$ V, $V_{GS} = \pm 12$ V			$\pm 100$	nA
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = -16$ V, $V_{GS} = 0$ V			-1.0	$\mu\text{A}$
		$V_{DS} = -16$ V, $V_{GS} = 0$ V, $T_J = 85^{\circ}\text{C}$			-5.0	
On-State Drain Current (Note 3)	$I_{D(on)}$	$V_{DS} \leq -5.0$ V, $V_{GS} = -4.5$ V	-10			A
Drain-Source On-State Resistance (Note 3)	$r_{DS(on)}$	$V_{GS} = -4.5$ V, $I_D = -2.2$ A		0.130	0.155	$\Omega$
		$V_{GS} = -3.6$ V, $I_D = -2.0$ A		0.150	0.180	
		$V_{GS} = -2.5$ V, $I_D = -1.7$ A		0.215	0.260	
Forward Transconductance (Note 3)	$g_{fs}$	$V_{DS} = -10$ V, $I_D = -2.2$ A		5.0		S
Diode Forward Voltage (Note 3)	$V_{SD}$	$I_S = -2.2$ A, $V_{GS} = 0$ V		-0.8	-1.2	V

**Dynamic** (Note 4)

Total Gate Charge	$Q_g$	$V_{DS} = -10$ V, $V_{GS} = -4.5$ V, $I_D = -2.2$ A		3.7	7.4	nC
Gate-Source Charge	$Q_{gs}$			0.8		
Gate-Drain Charge	$Q_{gd}$			1.3		
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = -10$ V, $R_L = 10 \Omega$ $I_D \cong -1.0$ A, $V_{GEN} = -4.5$ V, $R_G = 6 \Omega$		13	20	ns
Rise Time	$t_r$			35	55	
Turn-Off Delay Time	$t_{d(off)}$			25	40	
Fall Time	$t_f$			25	40	
Source-Drain Reverse Recovery Time	$t_{rr}$	$I_F = -2.2$ A, $di/dt = 100$ A/ $\mu\text{s}$		40	80	

3. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

4. Guaranteed by design, not subject to production testing.

TYPICAL ELECTRICAL CHARACTERISTICS

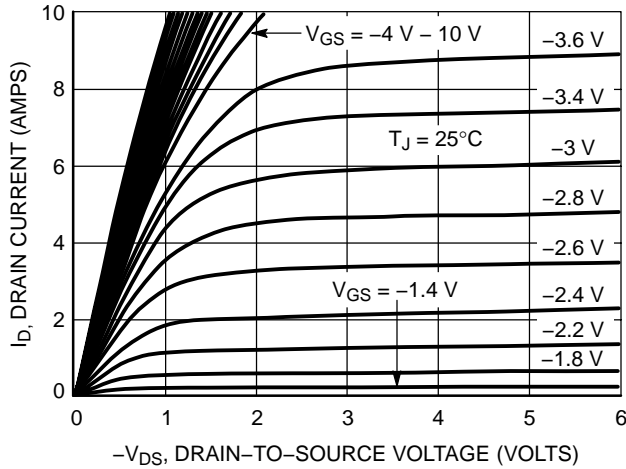


Figure 1. On-Region Characteristics

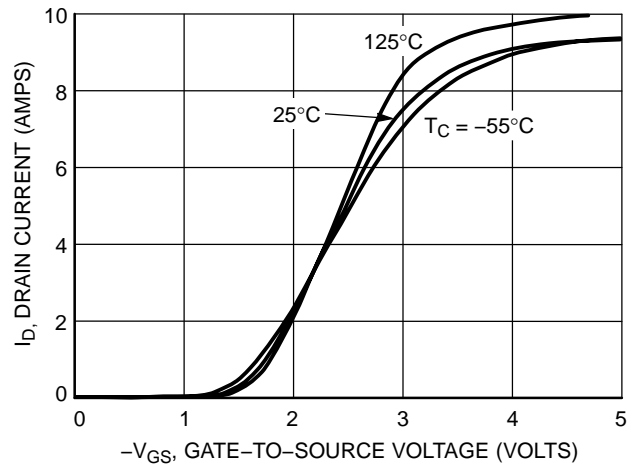


Figure 2. Transfer Characteristics

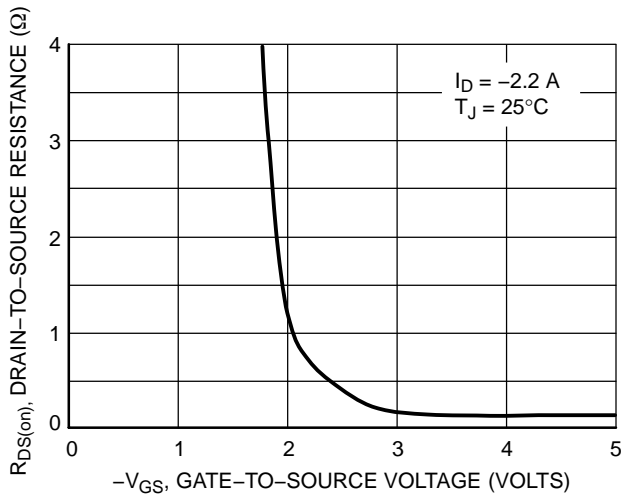


Figure 3. On-Resistance vs. Gate-to-Source Voltage

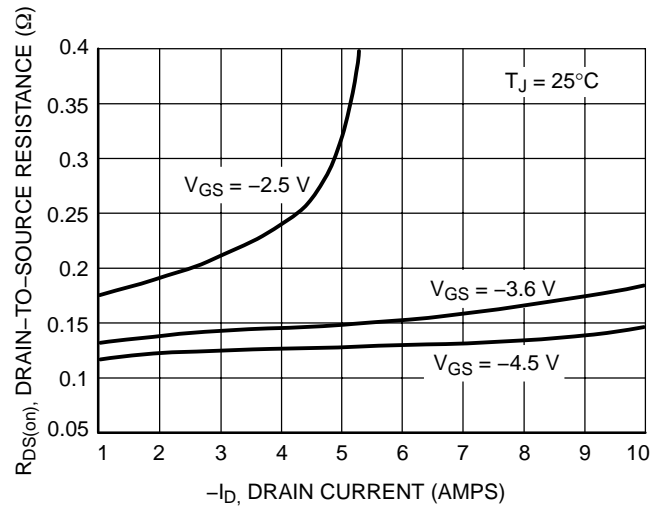


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

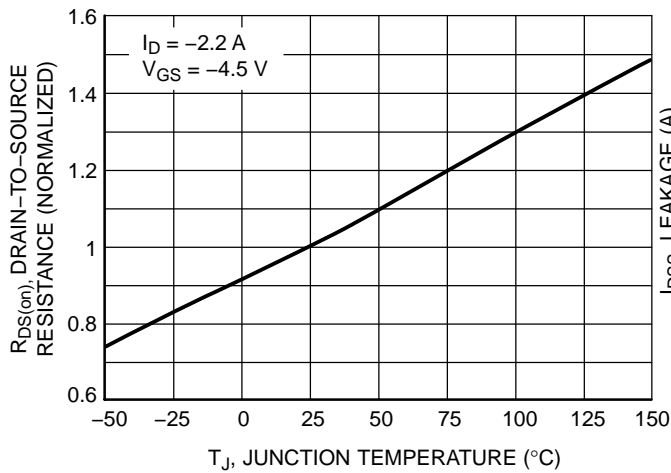


Figure 5. On-Resistance Variation with Temperature

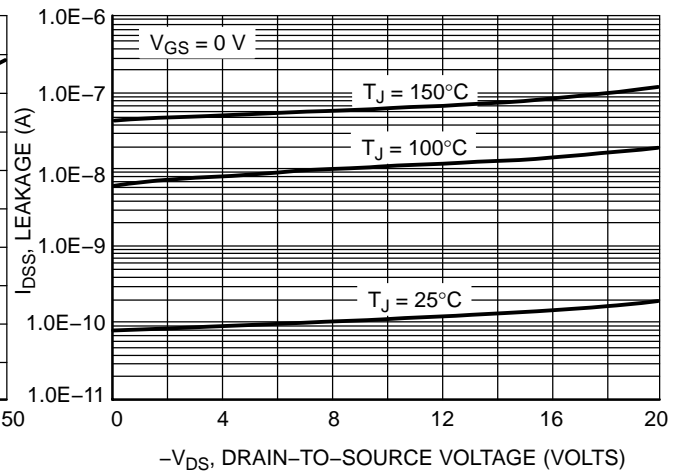


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

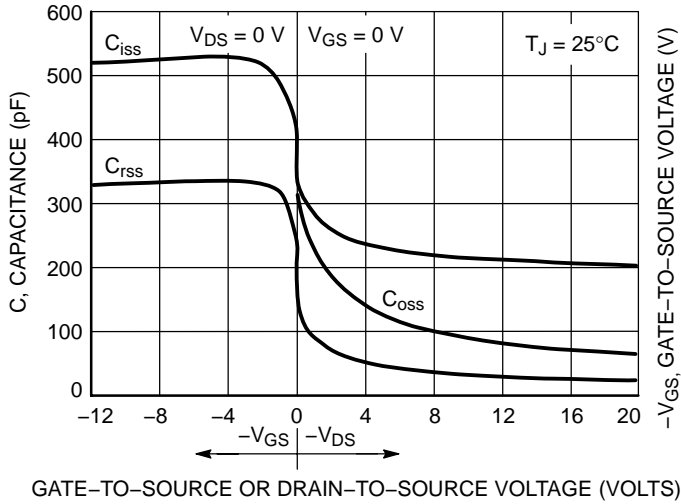


Figure 7. Capacitance Variation

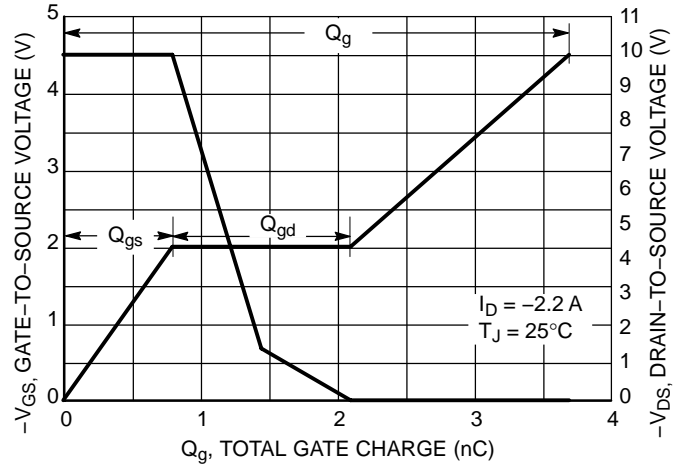


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

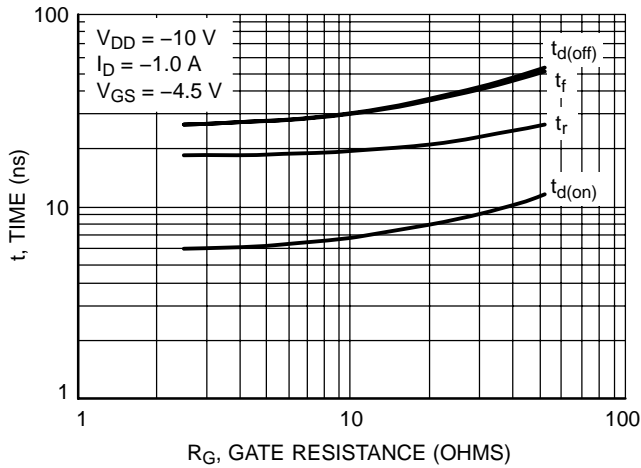


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

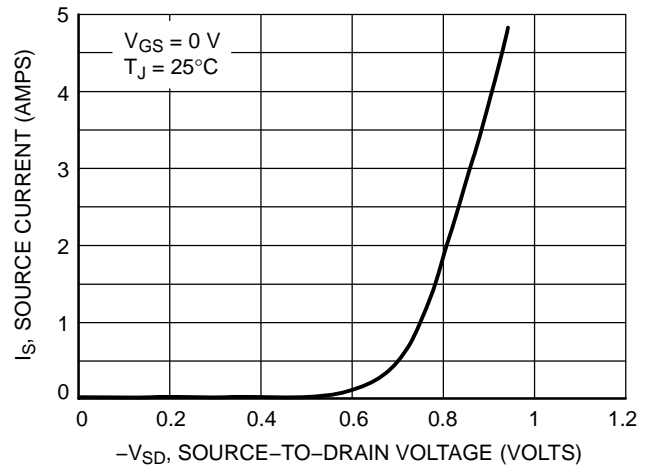


Figure 10. Diode Forward Voltage vs. Current

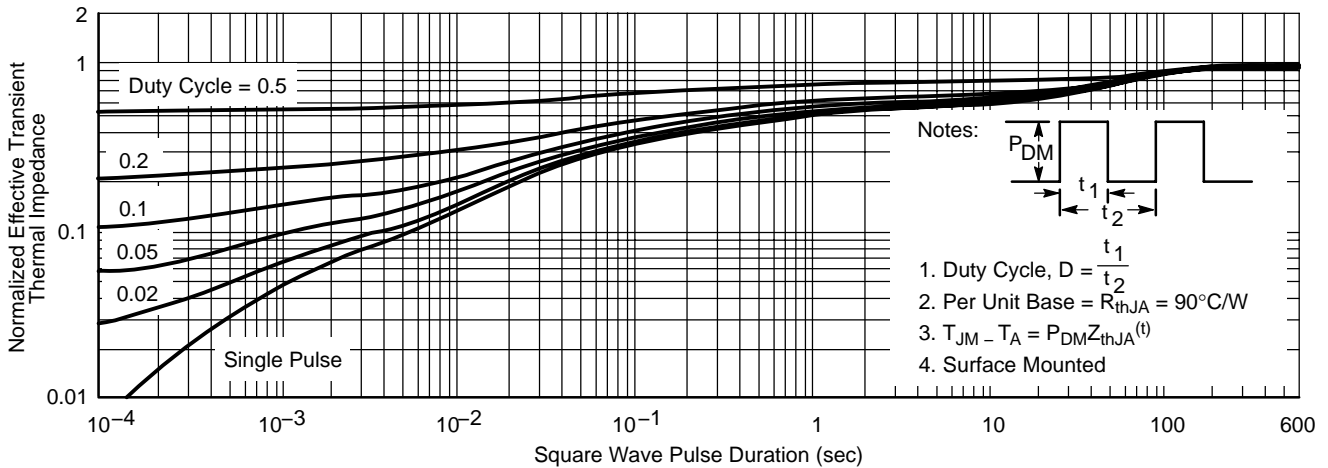
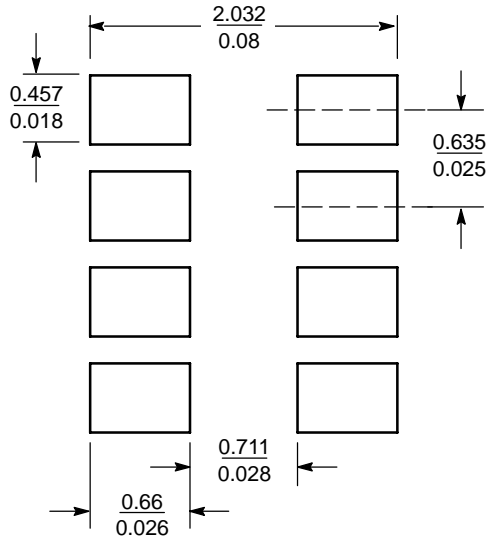
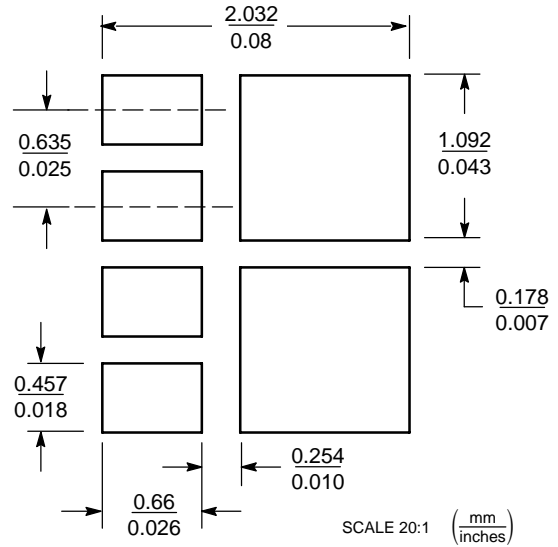


Figure 11. Normalized Thermal Transient Impedance, Junction-to-Ambient

**SOLDERING FOOTPRINT\***



**Figure 12. Basic**



**Figure 13. Style 2**

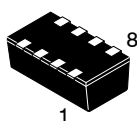
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**BASIC PAD PATTERNS**

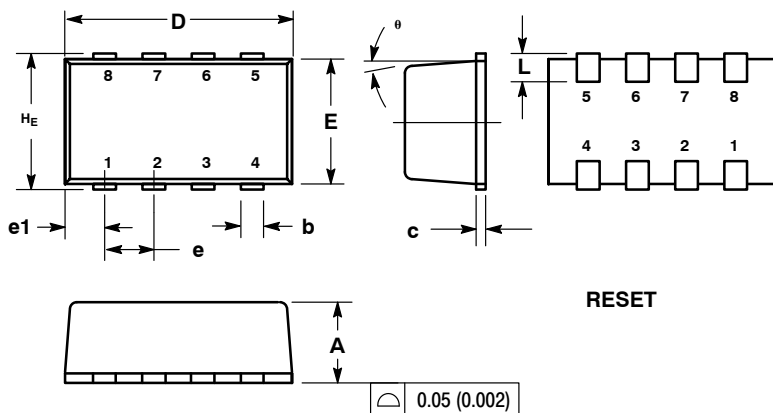
The basic pad layout with dimensions is shown in Figure 12. This is sufficient for low power dissipation MOSFET applications, but power semiconductor performance requires a greater copper pad area, particularly for the drain leads.

The minimum recommended pad pattern shown in Figure 13 improves the thermal area of the drain connections (pins 5, 6, 7, 8) while remaining within the

confines of the basic footprint. The drain copper area is 0.0019 sq. in. (or 1.22 sq. mm). This will assist the power dissipation path away from the device (through the copper leadframe) and into the board and exterior chassis (if applicable) for the single device. The addition of a further copper area and/or the addition of vias to other board layers will enhance the performance still further.



SCALE 1:1



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MOLD GATE BURRS SHALL NOT EXCEED 0.13 MM PER SIDE.
4. LEADFRAME TO MOLDED BODY OFFSET IN HORIZONTAL AND VERTICAL SHALL NOT EXCEED 0.08 MM.
5. DIMENSIONS A AND B EXCLUSIVE OF MOLD GATE BURRS.
6. NO MOLD FLASH ALLOWED ON THE TOP AND BOTTOM LEAD SURFACE.

DIM	MILLIMETERS			INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.00	1.05	1.10	0.039	0.041	0.043
b	0.25	0.30	0.35	0.010	0.012	0.014
c	0.10	0.15	0.20	0.004	0.006	0.008
D	2.95	3.05	3.10	0.116	0.120	0.122
E	1.55	1.65	1.70	0.061	0.065	0.067
e	0.65 BSC			0.025 BSC		
e1	0.55 BSC			0.022 BSC		
L	0.28	0.35	0.42	0.011	0.014	0.017
HE	1.80	1.90	2.00	0.071	0.075	0.079
θ	5° NOM			5° NOM		

### STYLE 1:

- PIN 1. DRAIN  
2. DRAIN  
3. DRAIN  
4. GATE  
5. SOURCE  
6. DRAIN  
7. DRAIN  
8. DRAIN

### STYLE 2:

- PIN 1. SOURCE 1  
2. GATE 1  
3. SOURCE 2  
4. GATE 2  
5. DRAIN 2  
6. DRAIN 2  
7. DRAIN 1  
8. DRAIN 1

### STYLE 3:

- PIN 1. ANODE  
2. ANODE  
3. SOURCE  
4. GATE  
5. DRAIN  
6. DRAIN  
7. CATHODE  
8. CATHODE

### STYLE 4:

- PIN 1. COLLECTOR  
2. COLLECTOR  
3. COLLECTOR  
4. BASE  
5. EMITTER  
6. COLLECTOR  
7. COLLECTOR  
8. COLLECTOR

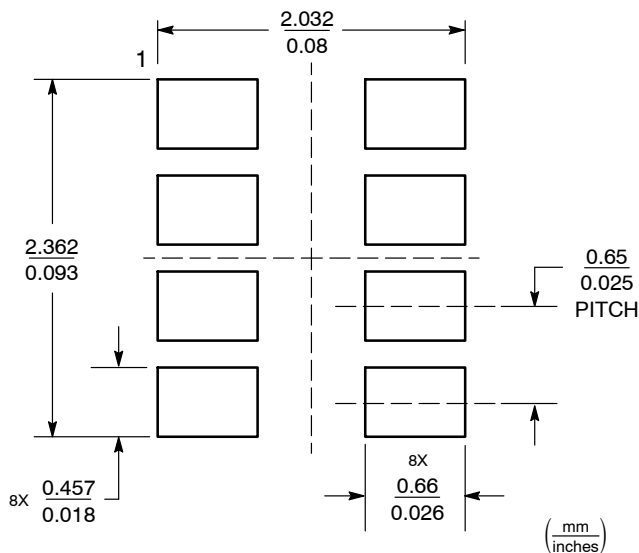
### STYLE 5:

- PIN 1. ANODE  
2. ANODE  
3. DRAIN  
4. DRAIN  
5. SOURCE  
6. GATE  
7. CATHODE  
8. CATHODE

### STYLE 6:

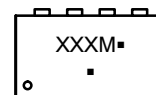
- PIN 1. ANODE  
2. DRAIN  
3. DRAIN  
4. GATE  
5. SOURCE  
6. DRAIN  
7. DRAIN  
8. CATHODE / DRAIN

## SOLDERING FOOTPRINT



Basic Style

## GENERIC MARKING DIAGRAM\*



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

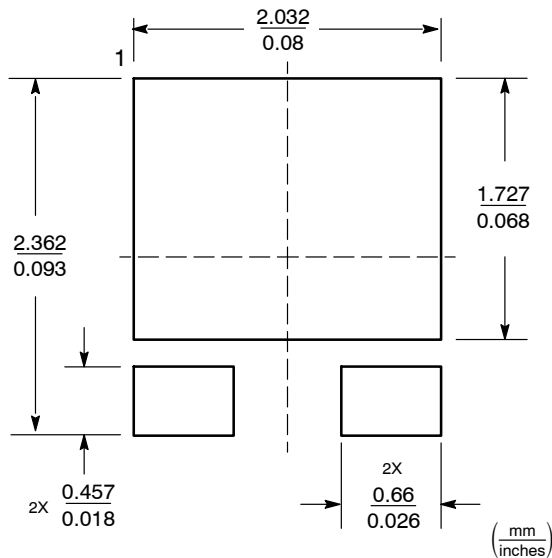
\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

## OPTIONAL SOLDERING FOOTPRINTS ON PAGE 2

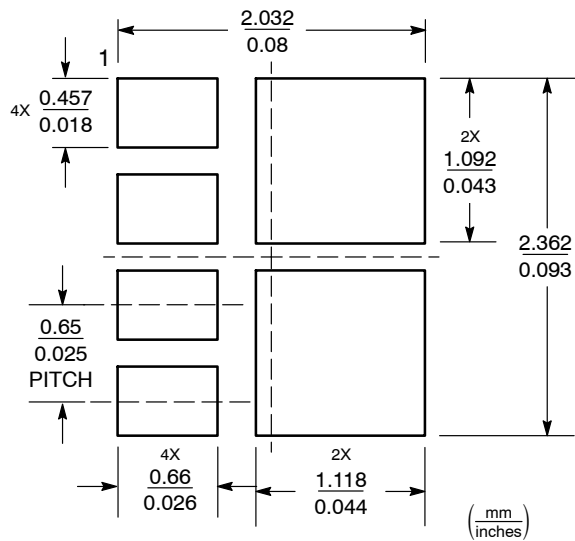
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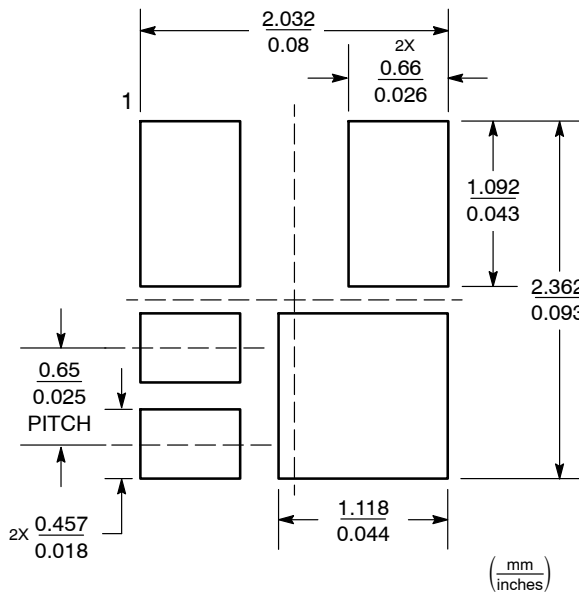
ADDITIONAL SOLDERING FOOTPRINTS\*



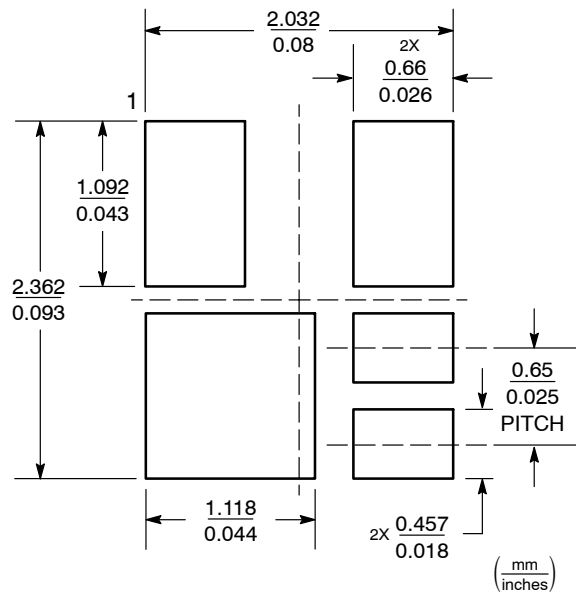
Styles 1 and 4



Style 2



Style 3



Style 5

\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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