

# NIF5002N

Preferred Device

## Self-Protected FET with Temperature and Current Limit

42 V, 2.0 A, Single N-Channel, SOT-223

HDPlus™ devices are an advanced series of power MOSFETs which utilize ON Semiconductors latest MOSFET technology process to achieve the lowest possible on-resistance per silicon area while incorporating smart features. Integrated thermal and current limits work together to provide short circuit protection. The devices feature an integrated Drain-to-Gate Clamp that enables them to withstand high energy in the avalanche mode. The Clamp also provides additional safety margin against unexpected voltage transients. Electrostatic Discharge (ESD) protection is provided by an integrated Gate-to-Source Clamp.

### Features

- Current Limitation
- Thermal Shutdown with Automatic Restart
- Short Circuit Protection
- $I_{DSS}$  Specified at Elevated Temperature
- Avalanche Energy Specified
- Slew Rate Control for Low Noise Switching
- Overvoltage Clamped Protection
- Pb-Free Packages are Available

### Applications

- Lighting
- Solenoids
- Small Motors

### MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Drain-to-Source Voltage Internally Clamped	V <sub>DSS</sub>	42	V
Drain-to-Gate Voltage Internally Clamped (R <sub>G</sub> = 1.0 MΩ)	V <sub>DGR</sub>	42	V
Gate-to-Source Voltage	V <sub>GS</sub>	±14	V
Continuous Drain Current	I <sub>D</sub>	Internally Limited	
Power Dissipation	P <sub>D</sub>	1.1 1.7 8.9	W
		@ T <sub>A</sub> = 25°C (Note 1)	
		@ T <sub>A</sub> = 25°C (Note 2)	
		@ T <sub>T</sub> = 25°C (Note 3)	
Operating Junction and Storage Temperature	T <sub>J</sub> , T <sub>stg</sub>	-55 to 150	°C
Single Pulse Drain-to-Source Avalanche Energy (V <sub>DD</sub> = 32 V, V <sub>G</sub> = 5.0 V, I <sub>PK</sub> = 1.0 A, L = 300 mH, R <sub>G(ext)</sub> = 25 Ω)	E <sub>AS</sub>	150	mJ

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.

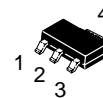
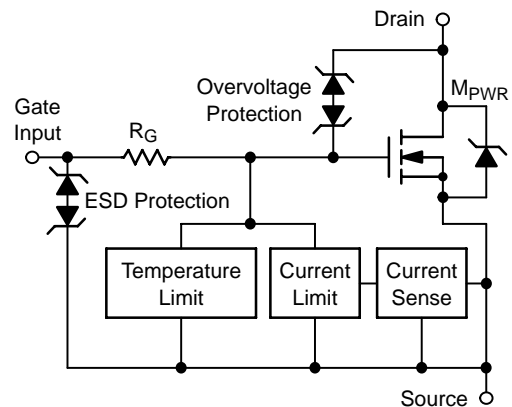


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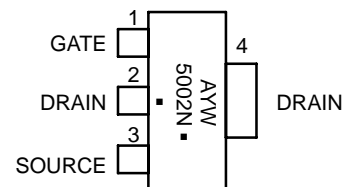
V <sub>(BR)DSS (Clamped)</sub>	R <sub>DS(ON) TYP</sub>	I <sub>D MAX</sub>
42 V	165 mΩ @ 10 V	2.0 A*

\*Max current limit value is dependent on input condition.



SOT-223  
CASE 318E  
STYLE 3

### MARKING DIAGRAM



A = Assembly Location  
Y = Year  
W = Work Week  
5002N = Specific Device Code  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

Preferred devices are recommended choices for future use and best overall value.

# NIF5002N

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Value	Unit
Junction-to-Ambient – Steady State (Note 1)	$R_{\theta JA}$	114	$^{\circ}\text{C/W}$
Junction-to-Ambient – Steady State (Note 2)	$R_{\theta JA}$	72	
Junction-to-Tab – Steady State (Note 3)	$R_{\theta JT}$	14	

1. Surface-mounted onto min pad FR4 PCB, (2 oz. Cu, 0.06" thick).
2. Surface-mounted onto 2" sq. FR4 board (1" sq., 1 oz. Cu, 0.06" thick).
3. Surface-mounted onto min pad FR4 PCB, (2 oz. Cu, 0.06" thick).

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

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 4)	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}, I_D = 10\text{ mA}$	$T_J = 25^{\circ}\text{C}$	42	46	55	V
			$T_J = 150^{\circ}\text{C}$	40	45	55	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{GS} = 0\text{ V}, V_{DS} = 32\text{ V}$	$T_J = 25^{\circ}\text{C}$		0.25	4.0	$\mu\text{A}$
			$T_J = 150^{\circ}\text{C}$		1.1	20	
Gate Input Current	$I_{GSSF}$	$V_{DS} = 0\text{ V}, V_{GS} = 5.0\text{ V}$		50	100	$\mu\text{A}$	

### ON CHARACTERISTICS (Note 4)

Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}, I_D = 150\text{ }\mu\text{A}$	1.3	1.8	2.2	V	
Gate Threshold Temperature Coefficient	$V_{GS(th)}/T_J$			4.0	6.0	$-\text{mV}/^{\circ}\text{C}$	
Static Drain-to-Source On-Resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}, I_D = 1.7\text{ A}$	$T_J = 25^{\circ}\text{C}$		165	200	$\text{m}\Omega$
			$T_J = 150^{\circ}\text{C}$		305	400	
		$V_{GS} = 5.0\text{ V}, I_D = 1.7\text{ A}$	$T_J = 25^{\circ}\text{C}$		195	230	
			$T_J = 150^{\circ}\text{C}$		360	460	
		$V_{GS} = 5.0\text{ V}, I_D = 0.5\text{ A}$	$T_J = 25^{\circ}\text{C}$		190	230	
			$T_J = 150^{\circ}\text{C}$		350	460	
Source-Drain Forward On Voltage	$V_{SD}$	$V_{GS} = 0\text{ V}, I_S = 7.0\text{ A}$		1.0		V	

### SWITCHING CHARACTERISTICS

Turn-on Time	$t_{d(on)}$	$V_{GS} = 10\text{ V}, V_{DD} = 12\text{ V}, I_D = 2.5\text{ A}, R_L = 4.7\text{ }\Omega, (10\% V_{in} \text{ to } 90\% I_D)$		20	30	$\mu\text{s}$
Turn-off Time	$t_{d(off)}$			65	100	
Slew Rate On	$dV_{DS}/dt_{on}$	$R_L = 4.7\text{ }\Omega, V_{in} = 0 \text{ to } 10\text{ V}, V_{DD} = 12\text{ V}, 70\% \text{ to } 50\%$		1.2		$\text{V}/\mu\text{s}$
Slew-Rate Off	$dV_{DS}/dt_{off}$	$R_L = 4.7\text{ }\Omega, V_{in} = 0 \text{ to } 10\text{ V}, V_{DD} = 12\text{ V}, 50\% \text{ to } 70\%$		0.5		

### SELF PROTECTION CHARACTERISTICS ( $T_J = 25^{\circ}\text{C}$ unless otherwise noted) (Note 5)

Current Limit	$I_{LIM}$	$V_{DS} = 10\text{ V}, V_{GS} = 5.0\text{ V}$	$T_J = 25^{\circ}\text{C}$	3.1	4.7	6.3	A
			$T_J = 150^{\circ}\text{C}$	2.0	3.2	4.3	
		$V_{DS} = 10\text{ V}, V_{GS} = 10\text{ V}$	$T_J = 25^{\circ}\text{C}$	3.8	5.7	7.6	
			$T_J = 150^{\circ}\text{C}$	2.8	4.3	5.7	
Temperature Limit (Turn-off)	$T_{LIM(off)}$	$V_{GS} = 5.0\text{ V}$	150	175	200	$^{\circ}\text{C}$	
Temperature Limit (Circuit Reset)	$T_{LIM(on)}$	$V_{GS} = 5.0\text{ V}$	135	160	185		
Temperature Limit (Turn-off)	$T_{LIM(off)}$	$V_{GS} = 10\text{ V}$	150	165	185		
Temperature Limit (Circuit Reset)	$T_{LIM(on)}$	$V_{GS} = 10\text{ V}$	135	150	170		

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

Electro-Static Discharge Capability	ESD	Human Body Model (HBM)	4000			V
		Machine Model (MM)	400			

4. Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .
5. Fault conditions are viewed as beyond the normal operating range of the part.

TYPICAL PERFORMANCE CURVES

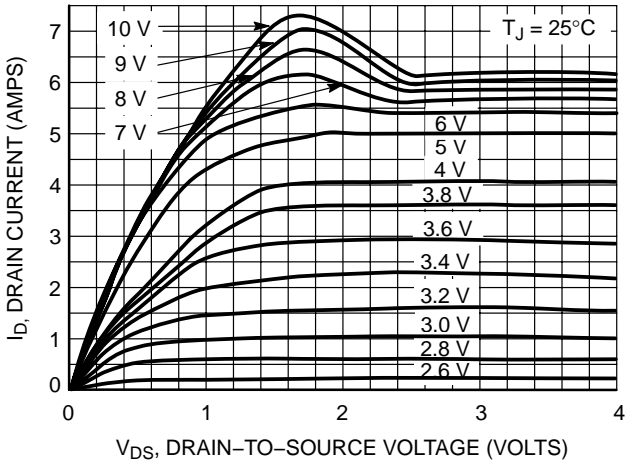


Figure 1. On-Region Characteristics

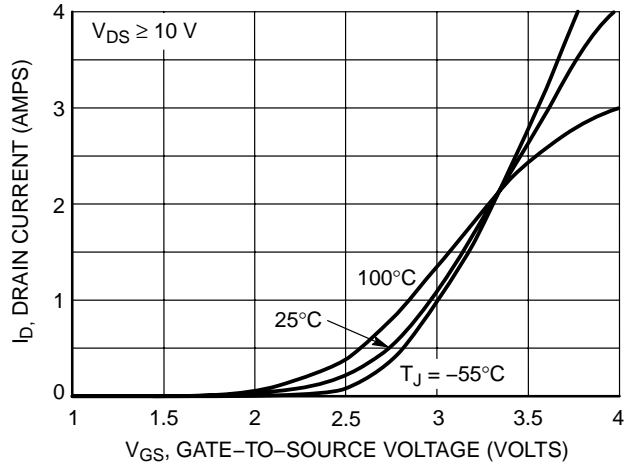


Figure 2. Transfer Characteristics

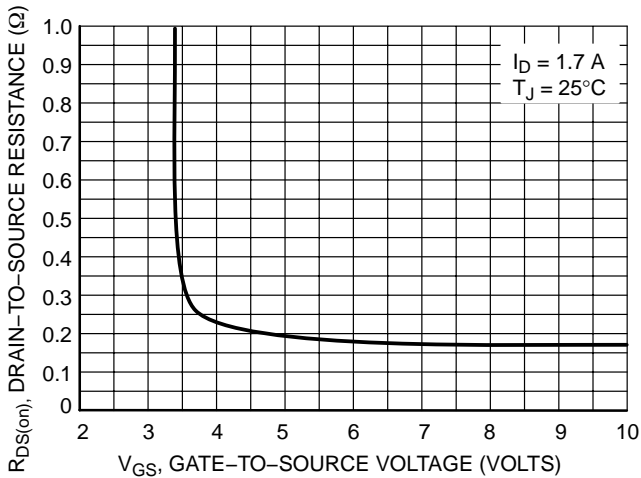


Figure 3. On-Resistance vs. Gate-to-Source Voltage

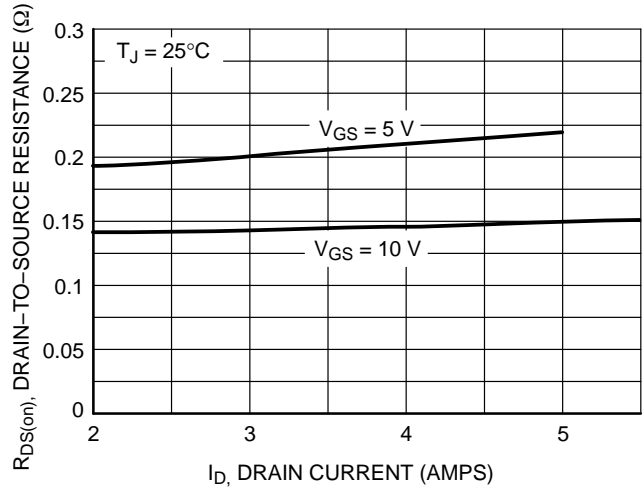


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

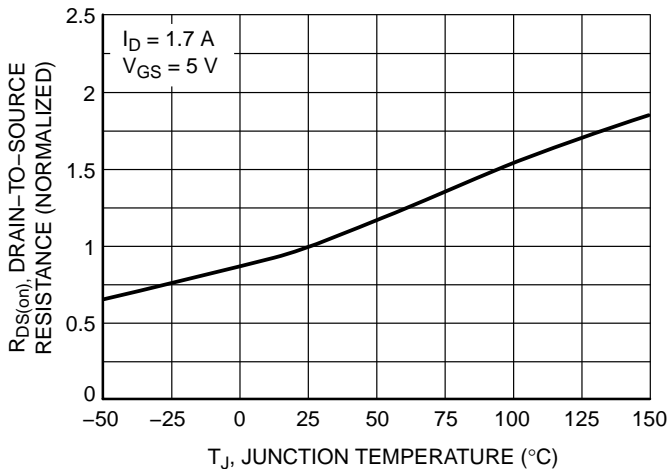


Figure 5. On-Resistance Variation with Temperature

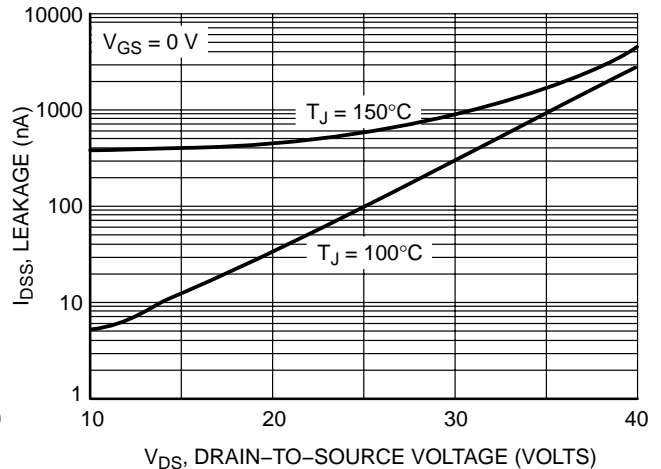


Figure 6. Drain-to-Source Leakage Current vs. Voltage

# NIF5002N

## TYPICAL PERFORMANCE CURVES

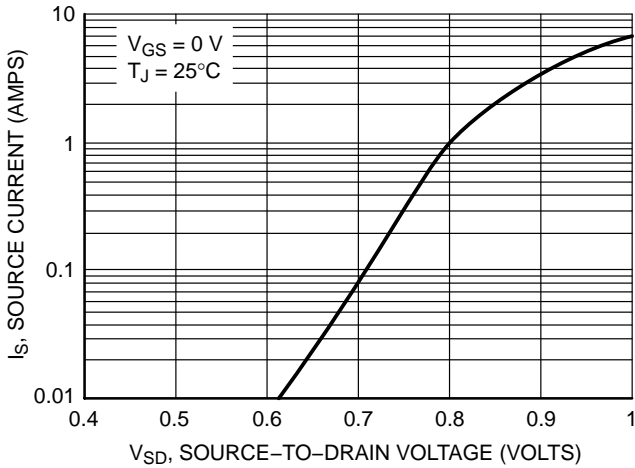


Figure 7. Diode Forward Voltage vs. Current

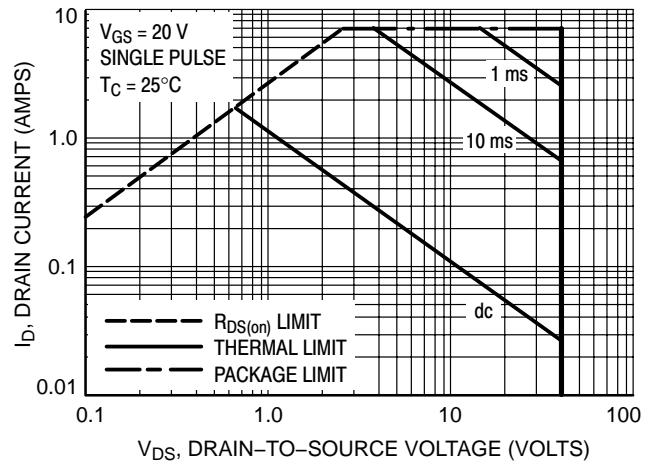


Figure 8. Maximum Rated Forward Biased Safe Operating Area

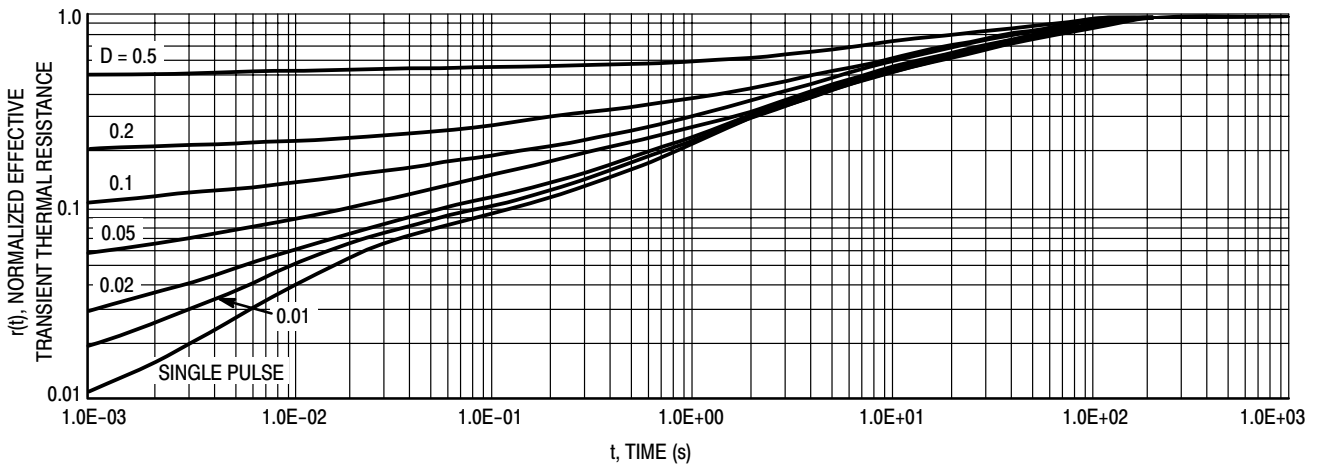


Figure 9. Thermal Response

### ORDERING INFORMATION

Device	Package	Shipping†
NIF5002NT1	SOT-223	1000 / Tape & Reel
NIF5002NT1G	SOT-223 (Pb-Free)	1000 / Tape & Reel
NIF5002NT3	SOT-223	4000 / Tape & Reel
NIF5002NT3G	SOT-223 (Pb-Free)	4000 / 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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

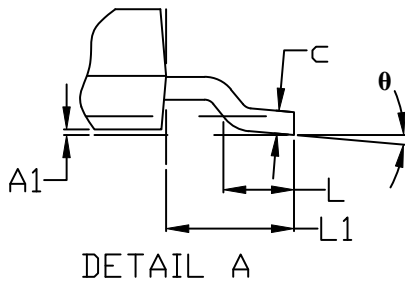
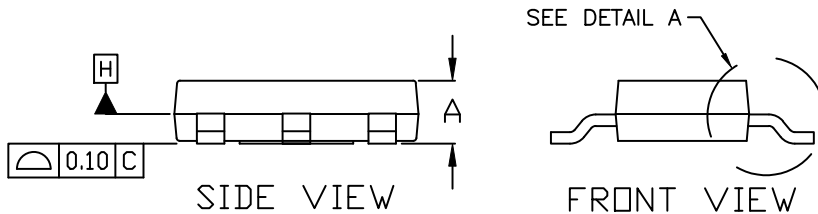
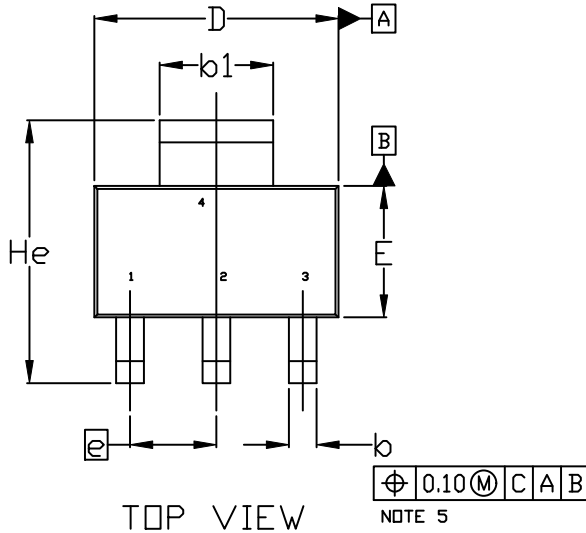
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SCALE 1:1

SOT-223 (TO-261)  
CASE 318E-04  
ISSUE R

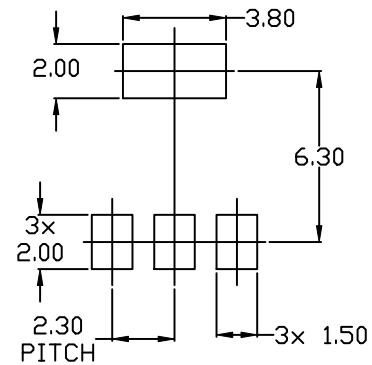
DATE 02 OCT 2018



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSIONS D & E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.200MM PER SIDE.
4. DATUMS A AND B ARE DETERMINED AT DATUM H.
5. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT OF THE PACKAGE BODY.
6. POSITIONAL TOLERANCE APPLIES TO DIMENSIONS b AND b1.

MILLIMETERS			
DIM	MIN.	NOM.	MAX.
A	1.50	1.63	1.75
A1	0.02	0.06	0.10
b	0.60	0.75	0.89
b1	2.90	3.06	3.20
c	0.24	0.29	0.35
D	6.30	6.50	6.70
E	3.30	3.50	3.70
e	2.30 BSC		
L	0.20	---	---
L1	1.50	1.75	2.00
He	6.70	7.00	7.30
$\theta$	0°	---	10°



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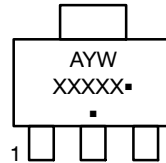
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**SOT-223 (TO-261)**  
**CASE 318E-04**  
**ISSUE R**

DATE 02 OCT 2018

- |  |   |   |   |   |
|--|---|---|---|---|
| <b>STYLE 1:</b><br>PIN 1. BASE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR | <b>STYLE 2:</b><br>PIN 1. ANODE<br>2. CATHODE<br>3. NC<br>4. CATHODE        | <b>STYLE 3:</b><br>PIN 1. GATE<br>2. DRAIN<br>3. SOURCE<br>4. DRAIN           | <b>STYLE 4:</b><br>PIN 1. SOURCE<br>2. DRAIN<br>3. GATE<br>4. DRAIN   | <b>STYLE 5:</b><br>PIN 1. DRAIN<br>2. GATE<br>3. SOURCE<br>4. GATE    |
| <b>STYLE 6:</b><br>PIN 1. RETURN<br>2. INPUT<br>3. OUTPUT<br>4. INPUT        | <b>STYLE 7:</b><br>PIN 1. ANODE 1<br>2. CATHODE<br>3. ANODE 2<br>4. CATHODE | <b>STYLE 8:</b><br>CANCELLED  | <b>STYLE 9:</b><br>PIN 1. INPUT<br>2. GROUND<br>3. LOGIC<br>4. GROUND | <b>STYLE 10:</b><br>PIN 1. CATHODE<br>2. ANODE<br>3. GATE<br>4. ANODE |
| <b>STYLE 11:</b><br>PIN 1. MT 1<br>2. MT 2<br>3. GATE<br>4. MT 2             | <b>STYLE 12:</b><br>PIN 1. INPUT<br>2. OUTPUT<br>3. NC<br>4. OUTPUT         | <b>STYLE 13:</b><br>PIN 1. GATE<br>2. COLLECTOR<br>3. EMITTER<br>4. COLLECTOR |   |   |

**GENERIC  
 MARKING DIAGRAM\***




- A = Assembly Location
- Y = Year
- W = Work Week
- XXXXX = Specific Device 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.

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