

# Power MOSFET 20 V, 5.1 A Single N-Channel, TSOP6

## NTGS3446

### Features

- Ultra Low  $R_{DS(on)}$
- Higher Efficiency Extending Battery Life
- Logic Level Gate Drive
- Diode Exhibits High Speed, Soft Recovery
- Avalanche Energy Specified
- $I_{DSS}$  Specified at Elevated Temperature
- Pb-Free Package is Available

### Applications

- Power Management in portable and battery-powered products, i.e. computers, printers, PCMCIA cards, cellular and cordless
- Lithium Ion Battery Applications
- Notebook PC

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

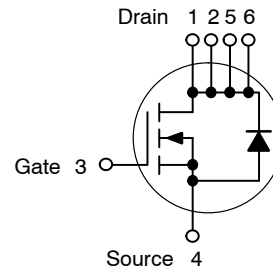
| Rating                                                                                                        | Symbol                   | Value          | Unit                    |
|---------------------------------------------------------------------------------------------------------------|--------------------------|----------------|-------------------------|
| Drain-to-Source Voltage                                                                                       | $V_{DSS}$                | 20             | V                       |
| Gate-to-Source Voltage                                                                                        | $V_{GS}$                 | $\pm 12$       | V                       |
| Thermal Resistance<br>Junction-to-Ambient (Note 1)<br>Total Power Dissipation @ $T_A = 25^\circ\text{C}$      | $R_{\theta JA}$<br>$P_d$ | 244<br>0.5     | $^\circ\text{C/W}$<br>W |
| Drain Current<br>– Continuous @ $T_A = 25^\circ\text{C}$<br>– Pulsed Drain Current ( $t_p < 10 \mu\text{s}$ ) | $I_D$<br>$I_{DM}$        | 2.5<br>10      | A<br>A                  |
| Thermal Resistance<br>Junction-to-Ambient (Note 2)<br>Total Power Dissipation @ $T_A = 25^\circ\text{C}$      | $R_{\theta JA}$<br>$P_d$ | 128<br>1.0     | $^\circ\text{C/W}$<br>W |
| Drain Current<br>– Continuous @ $T_A = 25^\circ\text{C}$<br>– Pulsed Drain Current ( $t_p < 10 \mu\text{s}$ ) | $I_D$<br>$I_{DM}$        | 3.6<br>14      | A<br>A                  |
| Thermal Resistance<br>Junction-to-Ambient (Note 3)<br>Total Power Dissipation @ $T_A = 25^\circ\text{C}$      | $R_{\theta JA}$<br>$P_d$ | 62.5<br>2.0    | $^\circ\text{C/W}$<br>W |
| Drain Current<br>– Continuous @ $T_A = 25^\circ\text{C}$<br>– Pulsed Drain Current ( $t_p < 10 \mu\text{s}$ ) | $I_D$<br>$I_{DM}$        | 5.1<br>20      | A<br>A                  |
| Source Current (Body Diode)                                                                                   | $I_S$                    | 5.1            | A                       |
| Operating and Storage Temperature Range                                                                       | $T_J, T_{stg}$           | $-55$ to $150$ | $^\circ\text{C}$        |
| Maximum Lead Temperature for Soldering<br>Purposes for 10 seconds                                             | $T_L$                    | 260            | $^\circ\text{C}$        |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

- Minimum FR-4 or G-10PCB, operating to steady state.
- Mounted onto a 2" square FR-4 board (1" sq. 2 oz. cu. 0.06" thick single-sided), operating to steady state.
- Mounted onto a 2" square FR-4 board (1" sq. 2 oz. cu. 0.06" thick single-sided),  $t < 5.0$  seconds.

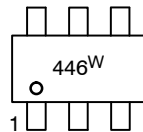
| $V_{(BR)DSS}$ | $R_{DS(on)}$ TYP      | $I_D$ MAX |
|---------------|-----------------------|-----------|
| 20 V          | 36 m $\Omega$ @ 4.5 V | 5.1 A     |

### N-Channel



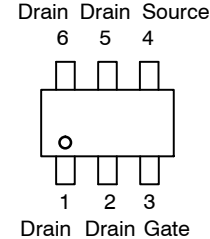
TSOP-6  
CASE 318G  
STYLE 1

### MARKING DIAGRAM



446 = Device Code  
W = Work Week

### PIN ASSIGNMENT



### ORDERING INFORMATION

| Device      | Package             | Shipping <sup>†</sup> |
|-------------|---------------------|-----------------------|
| NTGS3446T1G | TSOP-6<br>(Pb-Free) | 3000/Tape & Reel      |

### DISCONTINUED (Note 1)

|            |        |                  |
|------------|--------|------------------|
| NTGS3446T1 | TSOP-6 | 3000/Tape & Reel |
|------------|--------|------------------|

<sup>†</sup>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](http://BRD8011/D).

- DISCONTINUED:** This device is not recommended for new design. Please contact your onsemi representative for information. The most current information on this device may be available on [www.onsemi.com](http://www.onsemi.com).

# NTGS3446

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

| Characteristic | Symbol | Min | Typ | Max | Unit |
|----------------|--------|-----|-----|-----|------|
|----------------|--------|-----|-----|-----|------|

### OFF CHARACTERISTICS

|                                                                                                                                                                                    |                              |         |         |             |                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|---------|---------|-------------|-----------------------------|
| Drain-to-Source Breakdown Voltage<br>( $V_{GS} = 0\text{ Vdc}$ , $I_D = 0.25\text{ mAdc}$ )<br>Temperature Coefficient (Positive)                                                  | $V_{(BR)DSS}$                | 20<br>– | –<br>22 | –<br>–      | Vdc<br>mV/ $^\circ\text{C}$ |
| Zero Gate Voltage Collector Current<br>( $V_{DS} = 20\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ )<br>( $V_{DS} = 20\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 85^\circ\text{C}$ ) | $I_{DSS}$                    | –<br>–  | –<br>–  | 1.0<br>25   | $\mu\text{Adc}$             |
| Gate-Body Leakage Current ( $V_{GS} = \pm 12\text{ Vdc}$ , $V_{DS} = 0$ )                                                                                                          | $I_{GSS(f)}$<br>$I_{GSS(r)}$ | –<br>–  | –<br>–  | 100<br>–100 | nAdc                        |

### ON CHARACTERISTICS (Note 4)

|                                                                                                                                                          |              |          |              |          |                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------|--------------|----------|-----------------------------|
| Gate Threshold Voltage<br>$I_D = 0.25\text{ mA}$ , $V_{DS} = V_{GS}$<br>Temperature Coefficient (Negative)                                               | $V_{GS(th)}$ | 0.6<br>– | 0.85<br>–2.5 | 1.2<br>– | Vdc<br>mV/ $^\circ\text{C}$ |
| Static Drain-to-Source On-Resistance<br>( $V_{GS} = 4.5\text{ Vdc}$ , $I_D = 5.1\text{ Adc}$ )<br>( $V_{GS} = 2.5\text{ Vdc}$ , $I_D = 4.4\text{ Adc}$ ) | $R_{DS(on)}$ | –<br>–   | 36<br>44     | 45<br>55 | m $\Omega$                  |
| Forward Transconductance ( $V_{DS} = 10\text{ Vdc}$ , $I_D = 5.1\text{ Adc}$ )                                                                           | $g_{FS}$     | –        | 12           | –        | mhos                        |

### DYNAMIC CHARACTERISTICS

|                      |                                                                                 |           |   |     |     |    |
|----------------------|---------------------------------------------------------------------------------|-----------|---|-----|-----|----|
| Input Capacitance    | $(V_{DS} = 10\text{ Vdc}$ , $V_{GS} = 0\text{ Vdc}$ ,<br>$f = 1.0\text{ MHz}$ ) | $C_{iss}$ | – | 510 | 750 | pF |
| Output Capacitance   |                                                                                 | $C_{oss}$ | – | 200 | 350 |    |
| Transfer Capacitance |                                                                                 | $C_{rss}$ | – | 60  | 100 |    |

### SWITCHING CHARACTERISTICS (Note 5)

|                     |                                                                                                                 |              |   |     |    |    |
|---------------------|-----------------------------------------------------------------------------------------------------------------|--------------|---|-----|----|----|
| Turn-On Delay Time  | $(V_{DD} = 10\text{ Vdc}$ , $I_D = 1.0\text{ Adc}$ ,<br>$V_{GS} = 4.5\text{ Vdc}$ , $R_G = 6.0\text{ }\Omega$ ) | $t_{d(on)}$  | – | 9.0 | 16 | ns |
| Rise Time           |                                                                                                                 | $t_r$        | – | 12  | 20 |    |
| Turn-Off Delay Time |                                                                                                                 | $t_{d(off)}$ | – | 35  | 60 |    |
| Fall Time           |                                                                                                                 | $t_f$        | – | 20  | 35 |    |
| Gate Charge         | $(V_{DS} = 10\text{ Vdc}$ , $I_D = 5.1\text{ Adc}$ ,<br>$V_{GS} = 4.5\text{ Vdc}$ )                             | $Q_T$        | – | 8.0 | 15 | nC |
|                     |                                                                                                                 | $Q_{gs}$     | – | 2.0 | –  |    |
|                     |                                                                                                                 | $Q_{gd}$     | – | 2.0 | –  |    |

### SOURCE-DRAIN DIODE CHARACTERISTICS

|                                |                                                                                                                                        |          |        |              |          |               |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|----------|--------|--------------|----------|---------------|
| Forward On-Voltage (Note 4)    | $(I_S = 1.7\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ )<br>( $I_S = 1.7\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ , $T_J = 85^\circ\text{C}$ ) | $V_{SD}$ | –<br>– | 0.74<br>0.66 | 1.1<br>– | Vdc           |
| Reverse Recovery Time          | $(I_S = 1.7\text{ Adc}$ , $V_{GS} = 0\text{ Vdc}$ ,<br>$dis/dt = 100\text{ A}/\mu\text{s}$ )                                           | $t_{rr}$ | –      | 20           | –        | ns            |
|                                |                                                                                                                                        | $t_a$    | –      | 11           | –        |               |
|                                |                                                                                                                                        | $t_b$    | –      | 9.0          | –        |               |
| Reverse Recovery Stored Charge |                                                                                                                                        | $Q_{RR}$ | –      | 0.01         | –        | $\mu\text{C}$ |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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

5. Switching characteristics are independent of operating junction temperature.

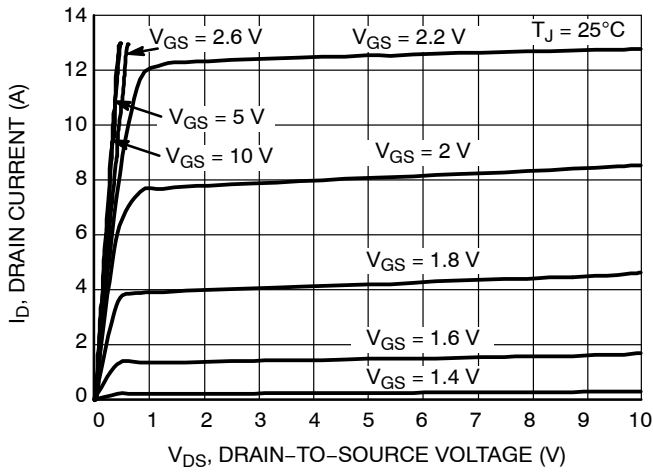


Figure 1. On-Region Characteristics

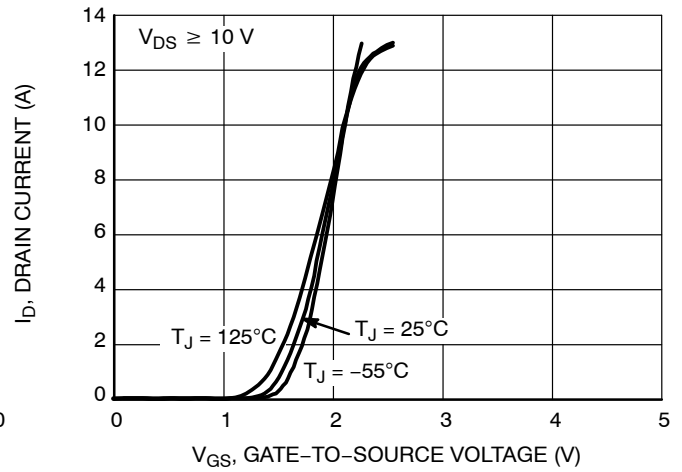


Figure 2. Transfer Characteristics

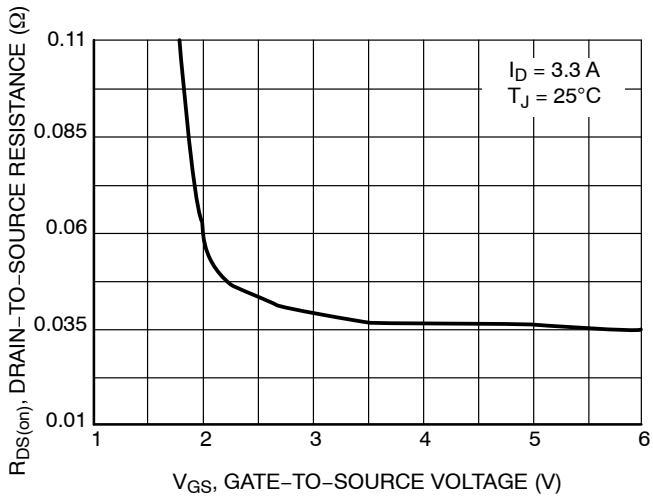


Figure 3. On-Resistance versus Gate-to-Source Voltage

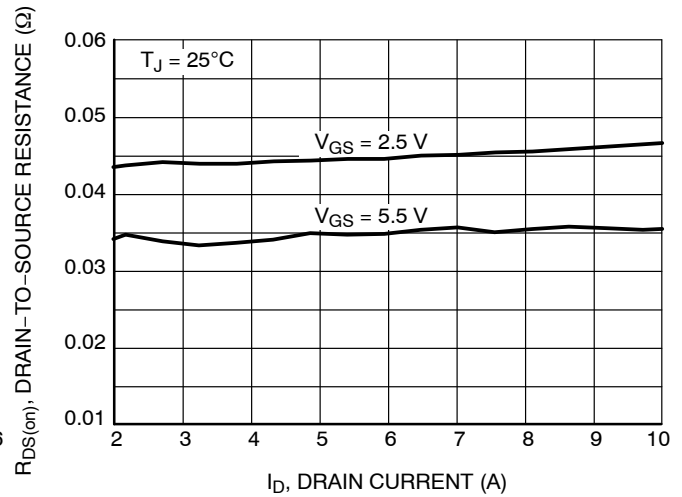


Figure 4. On-Resistance versus Drain Current and Gate Voltage

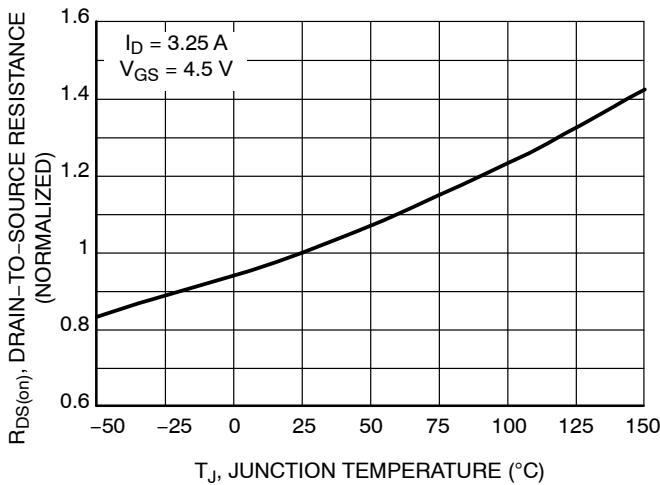


Figure 5. On-Resistance Variation with Temperature

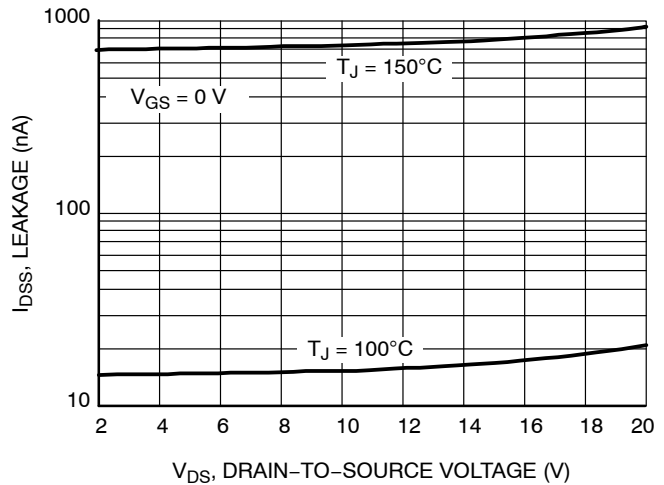
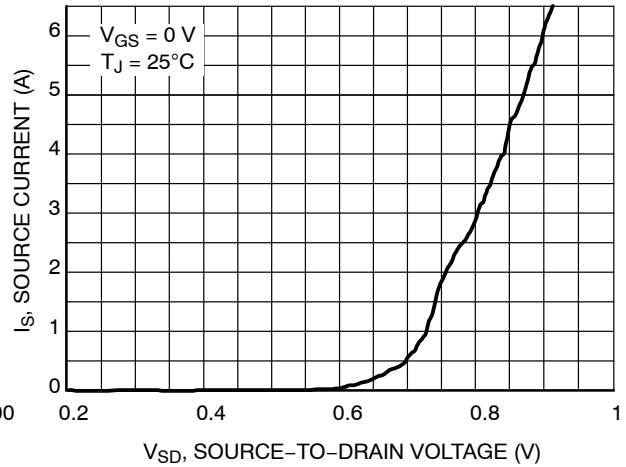
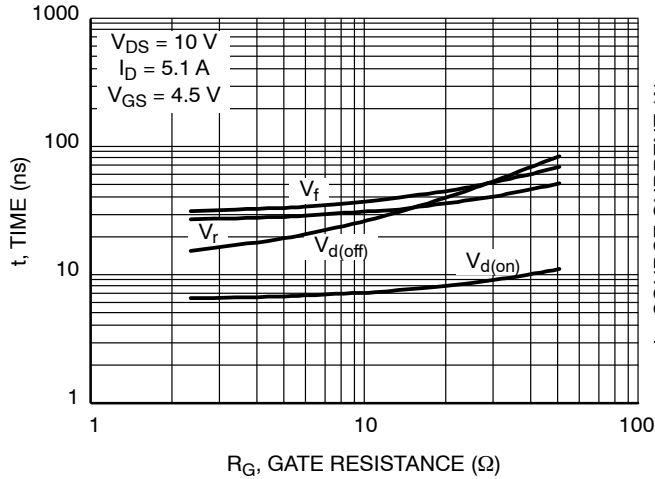
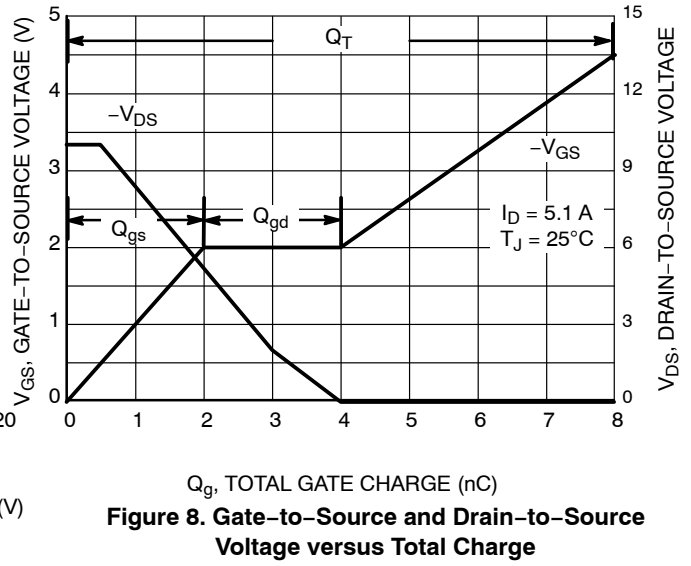
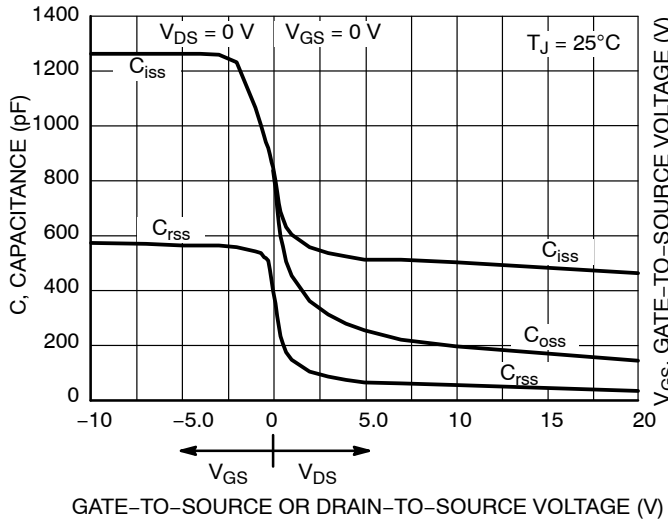
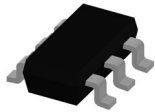
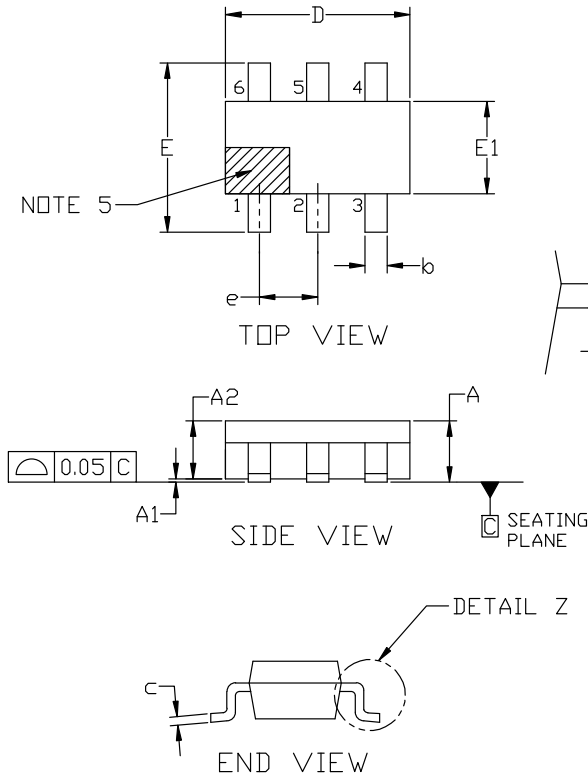


Figure 6. Drain-to-Source Leakage Current versus Voltage



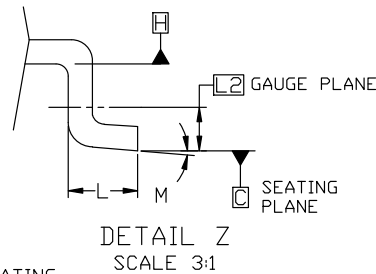

**TSOP-6 3.00x1.50x0.90, 0.95P**  
**CASE 318G**  
**ISSUE W**

DATE 26 FEB 2024

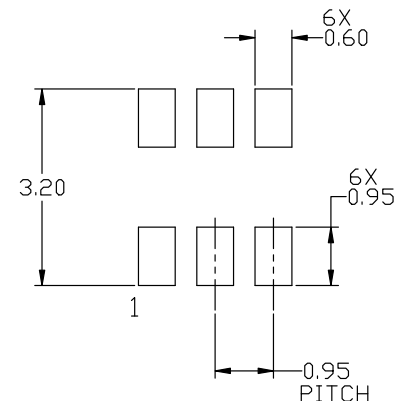


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE. DIMENSIONS D AND E1 ARE DETERMINED AT DATUM H.
5. PIN 1 INDICATOR MUST BE LOCATED IN THE INDICATED ZONE



| MILLIMETERS |          |      |      |
|-------------|----------|------|------|
| DIM         | MIN      | NOM  | MAX  |
| A           | 0.90     | 1.00 | 1.10 |
| A1          | 0.01     | 0.06 | 0.10 |
| A2          | 0.80     | 0.90 | 1.00 |
| b           | 0.25     | 0.38 | 0.50 |
| c           | 0.10     | 0.18 | 0.26 |
| D           | 2.90     | 3.00 | 3.10 |
| E           | 2.50     | 2.75 | 3.00 |
| E1          | 1.30     | 1.50 | 1.70 |
| e           | 0.85     | 0.95 | 1.05 |
| L           | 0.20     | 0.40 | 0.60 |
| L2          | 0.25 BSC |      |      |
| M           | 0°       | ---  | 10°  |


**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.

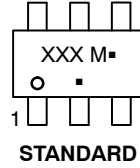
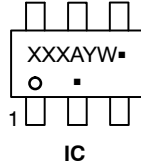
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TSOP-6 3.00x1.50x0.90, 0.95P  
CASE 318G  
ISSUE W

DATE 26 FEB 2024

GENERIC  
MARKING DIAGRAM\*



XXX = Specific Device Code  
A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

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.

|                                                                                                   |                                                                                                               |                                                                                                              |                                                                                                      |                                                                                                            |                                                                                                       |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| STYLE 1:<br>PIN 1. DRAIN<br>2. DRAIN<br>3. GATE<br>4. SOURCE<br>5. DRAIN<br>6. DRAIN              | STYLE 2:<br>PIN 1. EMITTER 2<br>2. BASE 1<br>3. COLLECTOR 1<br>4. EMITTER 1<br>5. BASE 2<br>6. COLLECTOR 2    | STYLE 3:<br>PIN 1. ENABLE<br>2. N/C<br>3. R BOOST<br>4. Vz<br>5. V in<br>6. V out                            | STYLE 4:<br>PIN 1. N/C<br>2. V in<br>3. NOT USED<br>4. GROUND<br>5. ENABLE<br>6. LOAD                | STYLE 5:<br>PIN 1. EMITTER 2<br>2. BASE 2<br>3. COLLECTOR 1<br>4. EMITTER 1<br>5. BASE 1<br>6. COLLECTOR 2 | STYLE 6:<br>PIN 1. COLLECTOR<br>2. COLLECTOR<br>3. BASE<br>4. EMITTER<br>5. COLLECTOR<br>6. COLLECTOR |
| STYLE 7:<br>PIN 1. COLLECTOR<br>2. COLLECTOR<br>3. BASE<br>4. N/C<br>5. COLLECTOR<br>6. EMITTER   | STYLE 8:<br>PIN 1. Vbus<br>2. D(in)<br>3. D(in)+<br>4. D(out)+<br>5. D(out)<br>6. GND                         | STYLE 9:<br>PIN 1. LOW VOLTAGE GATE<br>2. DRAIN<br>3. SOURCE<br>4. DRAIN<br>5. DRAIN<br>6. HIGH VOLTAGE GATE | STYLE 10:<br>PIN 1. D(OUT)+<br>2. GND<br>3. D(OUT)-<br>4. D(IN)-<br>5. VBUS<br>6. D(IN)+             | STYLE 11:<br>PIN 1. SOURCE 1<br>2. DRAIN 2<br>3. DRAIN 2<br>4. SOURCE 2<br>5. GATE 1<br>6. DRAIN 1/GATE 2  | STYLE 12:<br>PIN 1. I/O<br>2. GROUND<br>3. I/O<br>4. I/O<br>5. VCC<br>6. I/O                          |
| STYLE 13:<br>PIN 1. GATE 1<br>2. SOURCE 2<br>3. GATE 2<br>4. DRAIN 2<br>5. SOURCE 1<br>6. DRAIN 1 | STYLE 14:<br>PIN 1. ANODE<br>2. SOURCE<br>3. GATE<br>4. CATHODE/DRAIN<br>5. CATHODE/DRAIN<br>6. CATHODE/DRAIN | STYLE 15:<br>PIN 1. ANODE<br>2. SOURCE<br>3. GATE<br>4. DRAIN<br>5. N/C<br>6. CATHODE                        | STYLE 16:<br>PIN 1. ANODE/CATHODE<br>2. BASE<br>3. EMITTER<br>4. COLLECTOR<br>5. ANODE<br>6. CATHODE | STYLE 17:<br>PIN 1. EMITTER<br>2. BASE<br>3. ANODE/CATHODE<br>4. ANODE<br>5. CATHODE<br>6. COLLECTOR       |                                                                                                       |

|                  |                              |                                                                                                                                                                                     |
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