

# MMFT960T1

Preferred Device

## Power MOSFET 300 mA, 60 Volts

### N-Channel SOT-223

This Power MOSFET is designed for high speed, low loss power switching applications such as switching regulators, dc-dc converters, solenoid and relay drivers. The device is housed in the SOT-223 package which is designed for medium power surface mount applications.

#### Features

- Silicon Gate for Fast Switching Speeds
- Low Drive Requirement
- The SOT-223 Package can be Soldered Using Wave or Reflow
- The Formed Leads Absorb Thermal Stress During Soldering Eliminating the Possibility of Damage to the Die
- Pb-Free Package is Available

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

| Rating                                                                                            | Symbol         | Value      | Unit                      |
|---------------------------------------------------------------------------------------------------|----------------|------------|---------------------------|
| Drain-to-Source Voltage                                                                           | $V_{DS}$       | 60         | V                         |
| Gate-to-Source Voltage – Non-Repetitive                                                           | $V_{GS}$       | $\pm 30$   | V                         |
| Drain Current                                                                                     | $I_D$          | 300        | mAdc                      |
| Total Power Dissipation @ $T_A = 25^\circ\text{C}$<br>(Note 1)<br>Derate above $25^\circ\text{C}$ | $P_D$          | 0.8<br>6.4 | W<br>mW/ $^\circ\text{C}$ |
| Operating and Storage Temperature Range                                                           | $T_J, T_{stg}$ | -65 to 150 | $^\circ\text{C}$          |

#### THERMAL CHARACTERISTICS

|                                                                      |                 |           |                       |
|----------------------------------------------------------------------|-----------------|-----------|-----------------------|
| Thermal Resistance, Junction-to-Ambient                              | $R_{\theta JA}$ | 156       | $^\circ\text{C/W}$    |
| Maximum Temperature for Soldering<br>Purposes<br>Time in Solder Bath | $T_L$           | 260<br>10 | $^\circ\text{C}$<br>S |

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. Device mounted on a FR-4 glass epoxy printed circuit board using minimum recommended footprint.

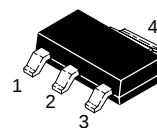
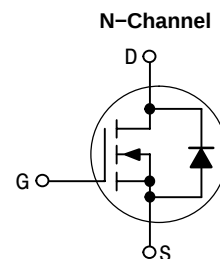


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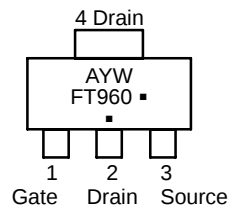
300 mA, 60 VOLTS

$R_{DS(on)} = 1.7 \Omega$



TO-261AA  
CASE 318E  
STYLE 3

#### MARKING DIAGRAM AND PIN ASSIGNMENT



A = Assembly Location  
Y = Year  
W = Work Week  
▪ = Pb-Free Package  
FT960 = Device Code  
(Note: Microdot may be in either location)

#### ORDERING INFORMATION

| Device     | Package              | Shipping†        |
|------------|----------------------|------------------|
| MMFT960T1  | SOT-223              | 1000 Tape & Reel |
| MMFT960T1G | SOT-223<br>(Pb-Free) | 1000 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.

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

# MMFT960T1

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

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

### OFF CHARACTERISTICS

|                                                                                 |               |    |   |    |                    |
|---------------------------------------------------------------------------------|---------------|----|---|----|--------------------|
| Drain-to-Source Breakdown Voltage<br>( $V_{GS} = 0$ , $I_D = 10\ \mu\text{A}$ ) | $V_{(BR)DSS}$ | 60 | – | –  | Vdc                |
| Zero Gate Voltage Drain Current<br>( $V_{DS} = 60\ \text{V}$ , $V_{GS} = 0$ )   | $I_{DSS}$     | –  | – | 10 | $\mu\text{A}_{dc}$ |
| Gate-Body Leakage Current<br>( $V_{GS} = 15\ \text{Vdc}$ , $V_{DS} = 0$ )       | $I_{GSS}$     | –  | – | 50 | $\text{nA}_{dc}$   |

### ON CHARACTERISTICS (Note 2)

|                                                                                                                                          |              |        |        |            |                |
|------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------|--------|------------|----------------|
| Gate Threshold Voltage<br>( $V_{DS} = V_{GS}$ , $I_D = 1.0\ \text{mA}_{dc}$ )                                                            | $V_{GS(th)}$ | 1.0    | –      | 3.5        | Vdc            |
| Static Drain-to-Source On-Resistance<br>( $V_{GS} = 10\ \text{Vdc}$ , $I_D = 1.0\ \text{A}$ )                                            | $R_{DS(on)}$ | –      | –      | 1.7        | $\Omega$       |
| Drain-to-Source On-Voltage<br>( $V_{GS} = 10\ \text{V}$ , $I_D = 0.5\ \text{A}$ )<br>( $V_{GS} = 10\ \text{V}$ , $I_D = 1.0\ \text{A}$ ) | $V_{DS(on)}$ | –<br>– | –<br>– | 0.8<br>1.7 | Vdc            |
| Forward Transconductance<br>( $V_{DS} = 25\ \text{V}$ , $I_D = 0.5\ \text{A}$ )                                                          | $g_{fs}$     | –      | 600    | –          | $\text{mmhos}$ |

### DYNAMIC CHARACTERISTICS

|                      |                                                                       |           |   |     |   |    |
|----------------------|-----------------------------------------------------------------------|-----------|---|-----|---|----|
| Input Capacitance    | $(V_{DS} = 25\ \text{V}, V_{GS} = 0, f = 1.0\ \text{MHz})$            | $C_{iss}$ | – | 65  | – | pF |
| Output Capacitance   |                                                                       | $C_{oss}$ | – | 33  | – |    |
| Transfer Capacitance |                                                                       | $C_{rss}$ | – | 7.0 | – |    |
| Total Gate Charge    | $(V_{GS} = 10\ \text{V}, I_D = 1.0\ \text{A}, V_{DS} = 48\ \text{V})$ | $Q_g$     | – | 3.2 | – | nC |
| Gate-Source Charge   |                                                                       | $Q_{gs}$  | – | 1.2 | – |    |
| Gate-Drain Charge    |                                                                       | $Q_{gd}$  | – | 2.0 | – |    |

2. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

## TYPICAL ELECTRICAL CHARACTERISTICS

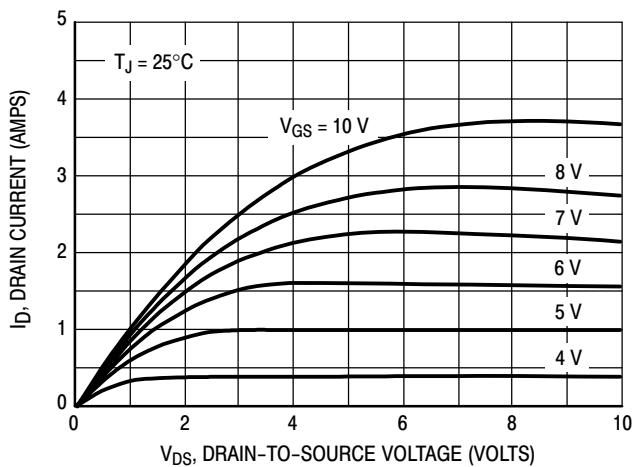


Figure 1. On-Region Characteristics

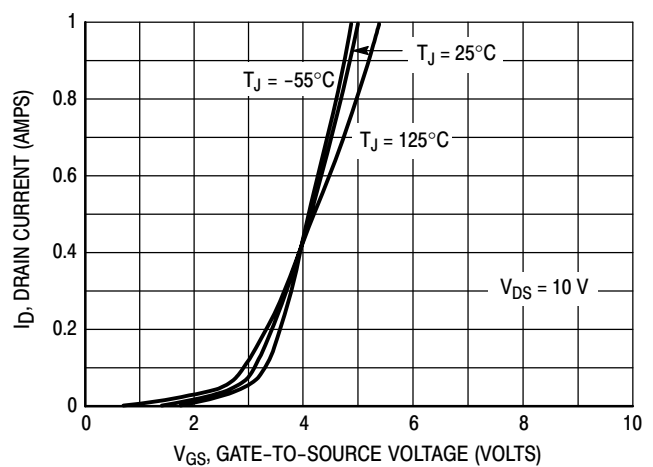


Figure 2. Transfer Characteristics

# MMFT960T1

## TYPICAL ELECTRICAL CHARACTERISTICS

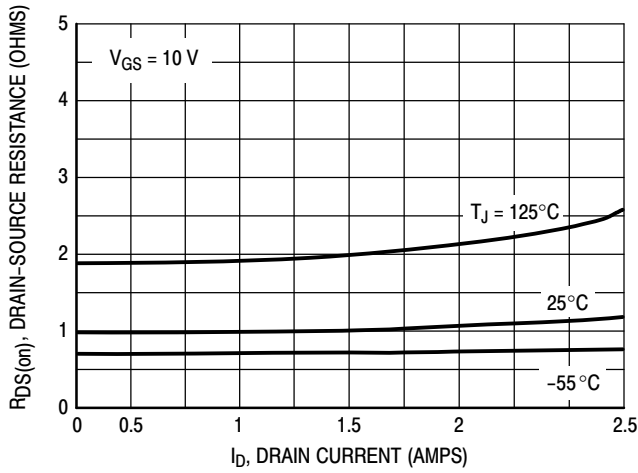


Figure 3. On-Resistance versus Drain Current

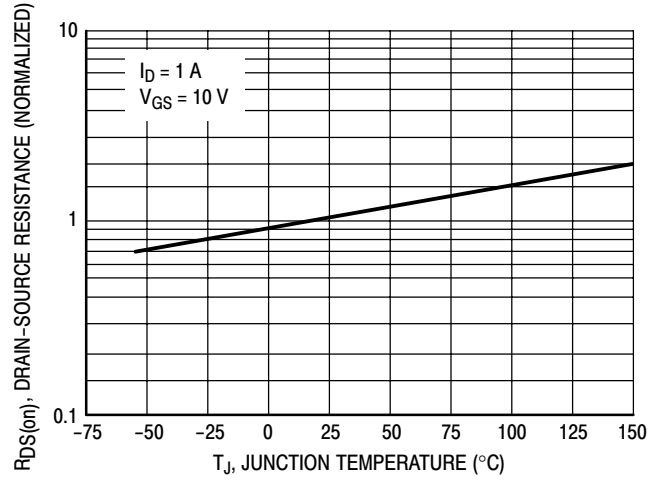


Figure 4. On-Resistance Variation with Temperature

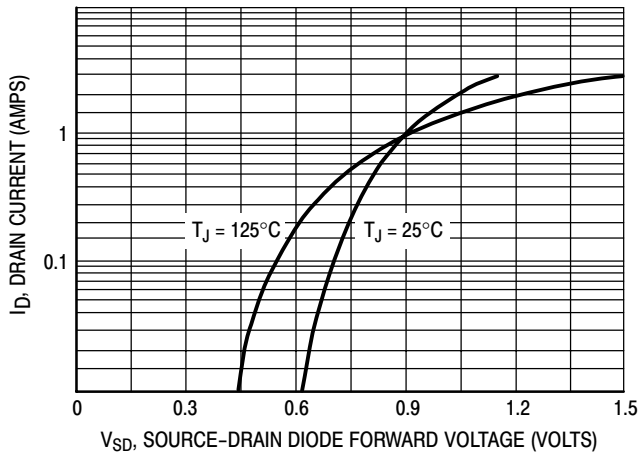


Figure 5. Source-Drain Diode Forward Voltage

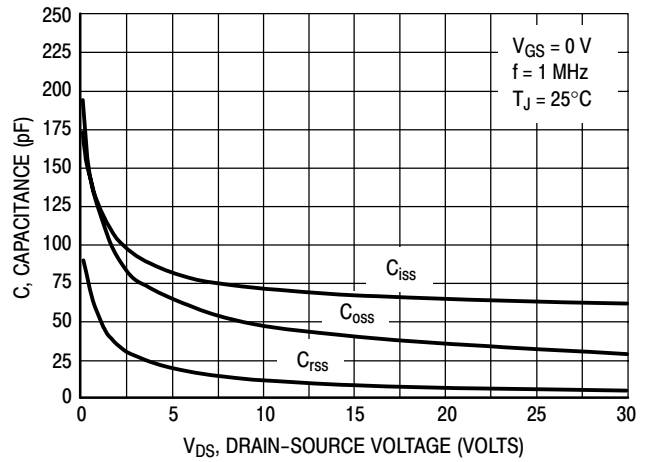


Figure 6. Capacitance Variation

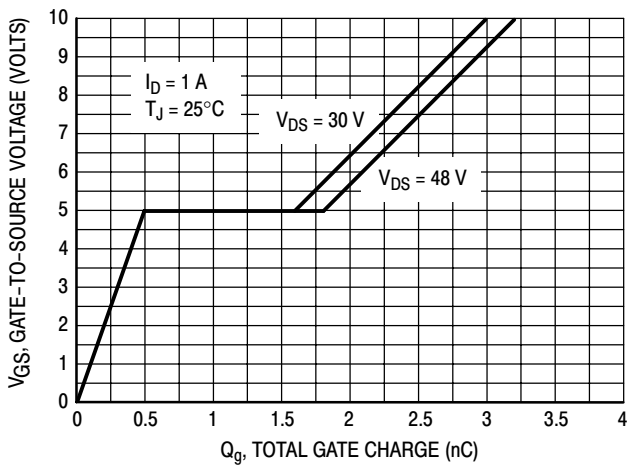


Figure 7. Gate Charge versus Gate-to-Source Voltage

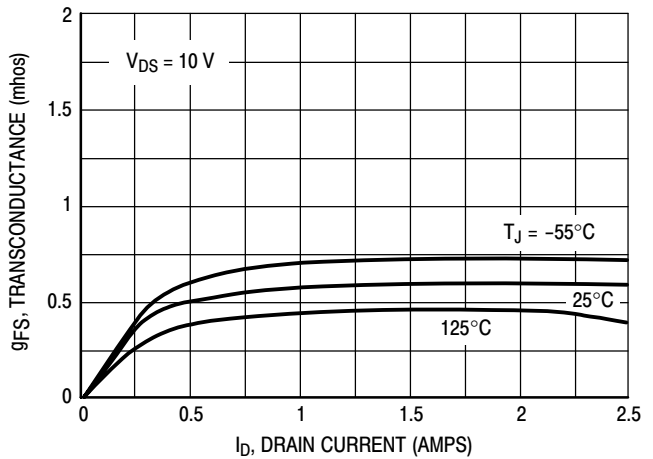


Figure 8. Transconductance

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

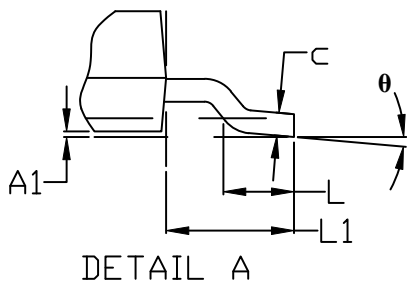
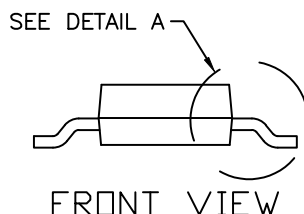
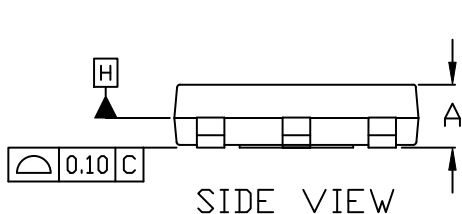
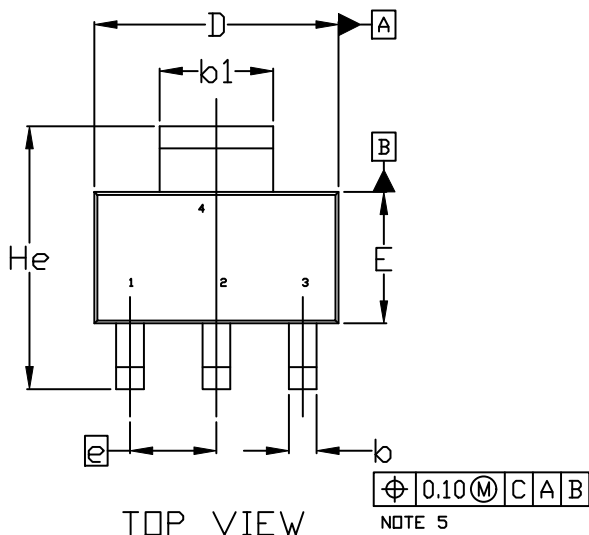
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SCALE 1:1

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

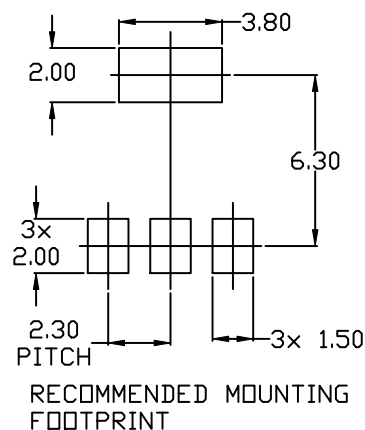
DATE 02 OCT 2018



### 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 |
| θ           | 0°       | ---  | 10°  |



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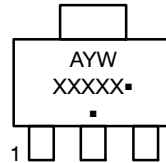
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**SOT-223 (TO-261)**  
**CASE 318E-04**  
**ISSUE R**

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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