

MMFTP6401-HAF

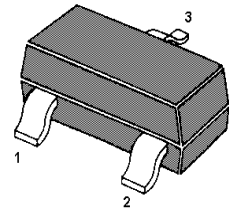
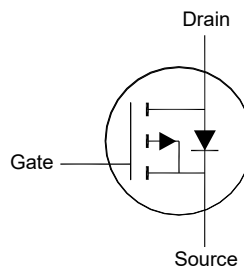
P-Channel Enhancement Mode MOSFET

Features

- Surface-mounted package
- Halogen and Antimony Free(HAF), RoHS compliant

Application

- Portable appliances
- Low power DC to DC Converter



1.Gate 2.Source 3.Drain
TO-236 Plastic Package

Absolute Maximum Ratings(at $T_a = 25^\circ\text{C}$ unless otherwise specified)

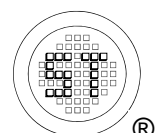
| Parameter | Symbol | Value | Unit |
|--|----------------|---------------|------------------|
| Drain-Source Voltage | $-V_{DS}$ | 12 | V |
| Gate-Source Voltage | V_{GS} | ± 10 | V |
| Drain Current | $-I_D$ | 4.3 | A |
| Peak Drain Current, Pulsed ¹⁾ | $-I_{DM}$ | 34 | A |
| Power Dissipation ²⁾ | P_D | 1.3 | W |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to + 150 | $^\circ\text{C}$ |

Thermal Resistance Ratings

| Parameter | Symbol | Max. | Unit |
|---|-----------------|------|--------------------|
| Thermal Resistance from Junction to Ambient ²⁾ | $R_{\theta JA}$ | 100 | $^\circ\text{C/W}$ |

¹⁾ Pulse Test: Pulse Width $\leq 100 \mu\text{s}$, Duty Cycle $\leq 2\%$, Repetitive rating, pulse width limited by junction temperature $T_{J(\text{MAX})} = 150^\circ\text{C}$.

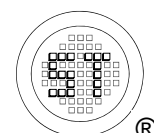
²⁾ Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.



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Characteristics at $T_a = 25^\circ\text{C}$ unless otherwise specified

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|----------------|------|------------|-----------------|---------------|
| STATIC PARAMETERS | | | | | |
| Drain-Source Breakdown Voltage at $-I_D = 250 \mu\text{A}$ | $-V_{(BR)DSS}$ | 12 | - | - | V |
| Drain-Source Leakage Current at $-V_{DS} = 12 \text{ V}$ | $-I_{DSS}$ | - | - | 1 | μA |
| Gate Leakage Current at $V_{GS} = \pm 8 \text{ V}$ | I_{GSS} | - | - | ± 100 | nA |
| Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $-I_D = 250 \mu\text{A}$ | $-V_{GS(th)}$ | 0.4 | - | 0.95 | V |
| Drain-Source On-State Resistance at $-V_{GS} = 4.5 \text{ V}$, $-I_D = 4.3 \text{ A}$ at $-V_{GS} = 2.5 \text{ V}$, $-I_D = 2.5 \text{ A}$ at $-V_{GS} = 1.8 \text{ V}$, $-I_D = 2 \text{ A}$ | $R_{DS(on)}$ | - | - | 50 85 125 | m Ω |
| DYNAMIC PARAMETERS | | | | | |
| Gate Resistance at $V_{DS} = 0 \text{ V}$, $f = 1 \text{ MHz}$ | R_g | - | 3.6 | - | Ω |
| Forward Transconductance at $-V_{DS} = 5 \text{ V}$, $-I_D = 4 \text{ A}$ | g_{FS} | - | 10.5 | - | S |
| Input Capacitance at $-V_{DS} = 10 \text{ V}$, $V_{GS} = 0 \text{ V}$, $f = 1 \text{ MHz}$ | C_{iss} | - | 794 | - | pF |
| Output Capacitance at $-V_{DS} = 10 \text{ V}$, $V_{GS} = 0 \text{ V}$, $f = 1 \text{ MHz}$ | C_{oss} | - | 92 | - | pF |
| Reverse Transfer Capacitance at $-V_{DS} = 10 \text{ V}$, $V_{GS} = 0 \text{ V}$, $f = 1 \text{ MHz}$ | C_{rss} | - | 63 | - | pF |
| Total Gate Charge at $-V_{DS} = 10 \text{ V}$, $-I_D = 1 \text{ A}$, $-V_{GS} = 4.5 \text{ V}$ at $-V_{DS} = 10 \text{ V}$, $-I_D = 1 \text{ A}$, $-V_{GS} = 2.5 \text{ V}$ | Q_g | - | 8.9 5.8 | - | nC |
| Gate-Source Charge at $-V_{DS} = 10 \text{ V}$, $-I_D = 1 \text{ A}$, $-V_{GS} = 4.5 \text{ V}$ | Q_{gs} | - | 2 | - | nC |
| Gate-Drain Charge at $-V_{DS} = 10 \text{ V}$, $-I_D = 1 \text{ A}$, $-V_{GS} = 4.5 \text{ V}$ | Q_{gd} | - | 2.7 | - | nC |
| Turn-On Delay Time at $-V_{DS} = 10 \text{ V}$, $-V_{GS} = 5 \text{ V}$, $-I_D = 1 \text{ A}$, $R_G = 4.7 \Omega$ | $t_{d(on)}$ | - | 8.8 | - | ns |
| Turn-On Rise Time at $-V_{DS} = 10 \text{ V}$, $-V_{GS} = 5 \text{ V}$, $-I_D = 1 \text{ A}$, $R_G = 4.7 \Omega$ | t_r | - | 9 | - | ns |
| Turn-Off Delay Time at $-V_{DS} = 10 \text{ V}$, $-V_{GS} = 5 \text{ V}$, $-I_D = 1 \text{ A}$, $R_G = 4.7 \Omega$ | $t_{d(off)}$ | - | 34 | - | ns |
| Turn-Off Fall Time at $-V_{DS} = 10 \text{ V}$, $-V_{GS} = 5 \text{ V}$, $-I_D = 1 \text{ A}$, $R_G = 4.7 \Omega$ | t_f | - | 18 | - | ns |
| Body-Diode PARAMETERS | | | | | |
| Body Diode Voltage at $-I_s = 1.3 \text{ A}$, $V_{GS} = 0 \text{ V}$ | $-V_{SD}$ | - | - | 1.2 | V |
| Body-Diode Continuous Current | $-I_s$ | - | - | 4.3 | A |
| Body Diode Reverse Recovery Time at $-I_s = 1 \text{ A}$, $di/dt = 100 \text{ A} / \mu\text{s}$ | t_{rr} | - | 8 | - | ns |
| Body Diode Reverse Recovery Charge at $-I_s = 1 \text{ A}$, $di/dt = 100 \text{ A} / \mu\text{s}$ | Q_{rr} | - | 2.3 | - | nC |



Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

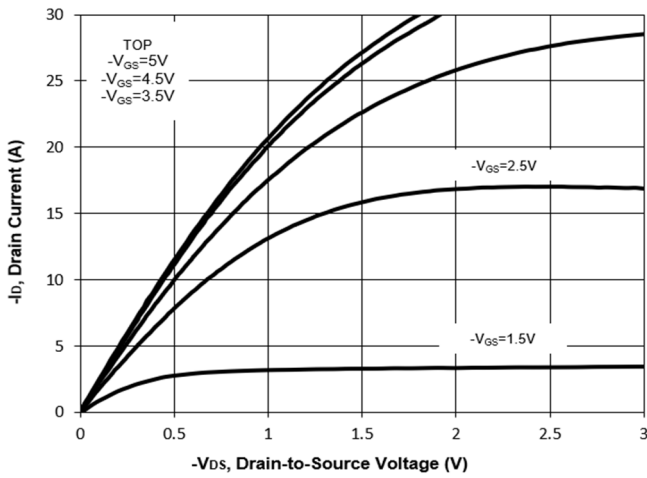


Fig. 2 Typical Transfer Characteristics

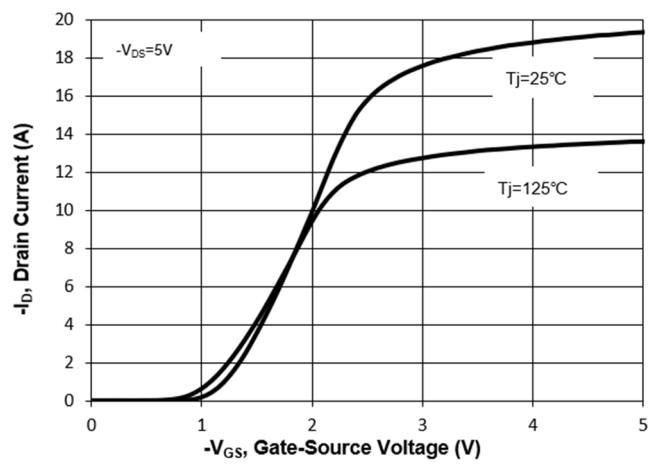


Fig. 3 on-Resistance vs. Drain Current

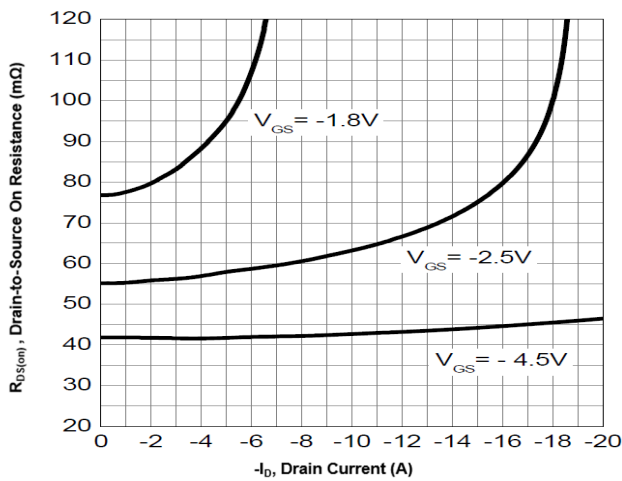


Fig. 4 on-Resistance vs. Gate Voltage

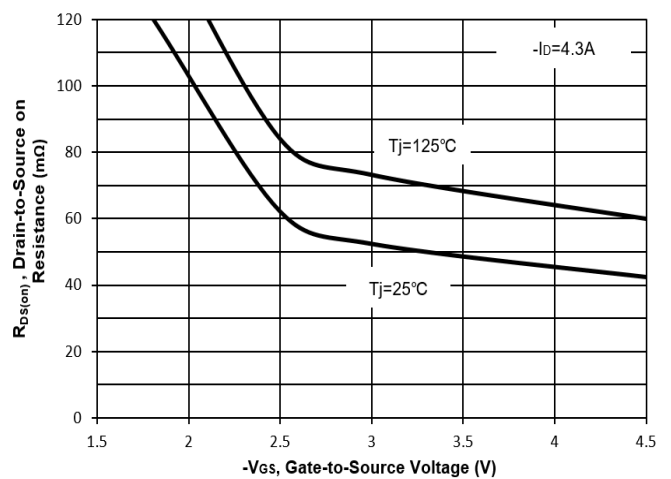


Fig. 5 on-Resistance vs. Tj

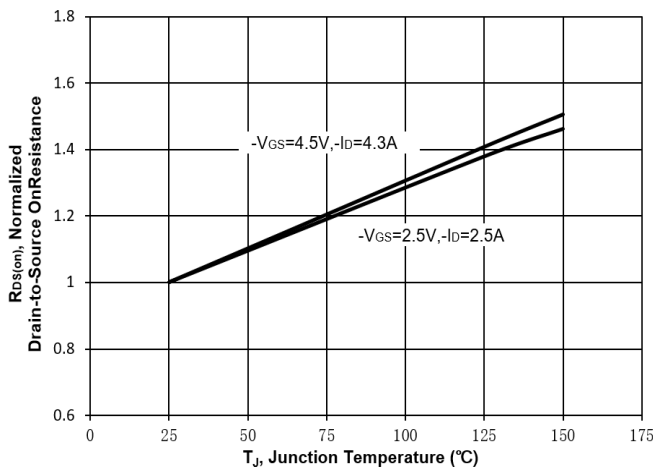
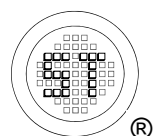
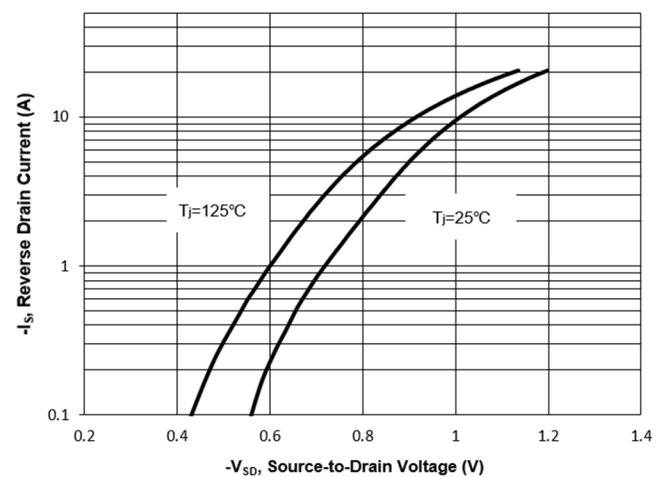


Fig. 6 Typical Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

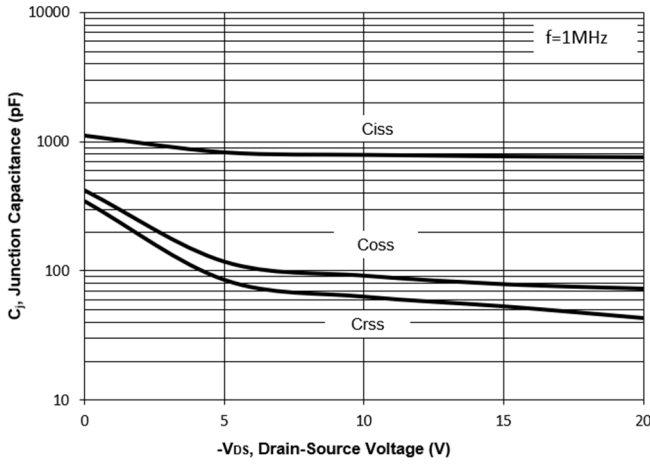


Fig. 8 Drain-Source Leakage Current vs. T_j

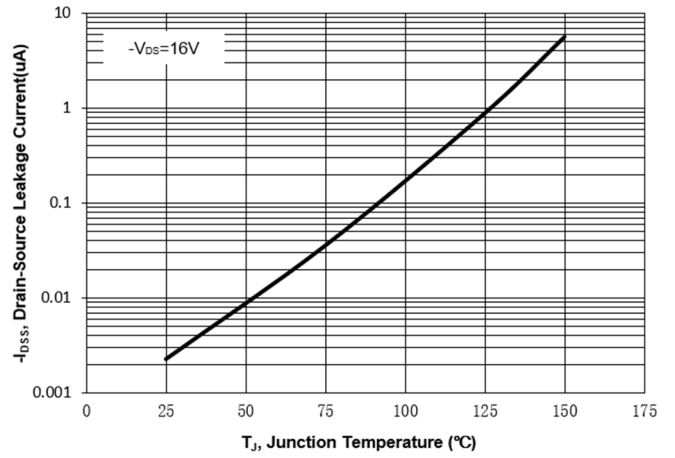


Fig. 9 $V_{(BR)DSS}$ vs. Junction Temperature

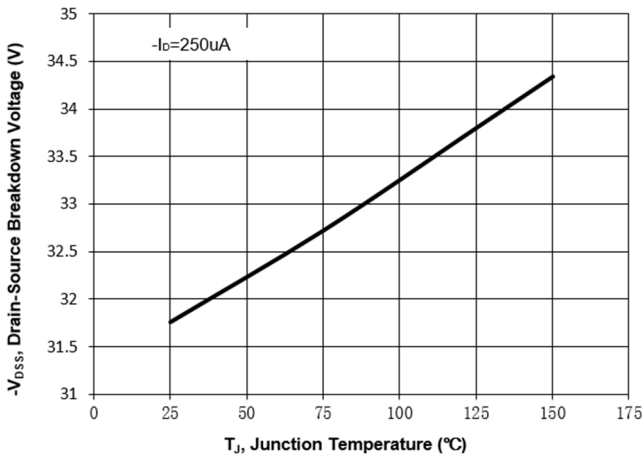


Fig. 10 Gate Threshold Variation vs. T_j

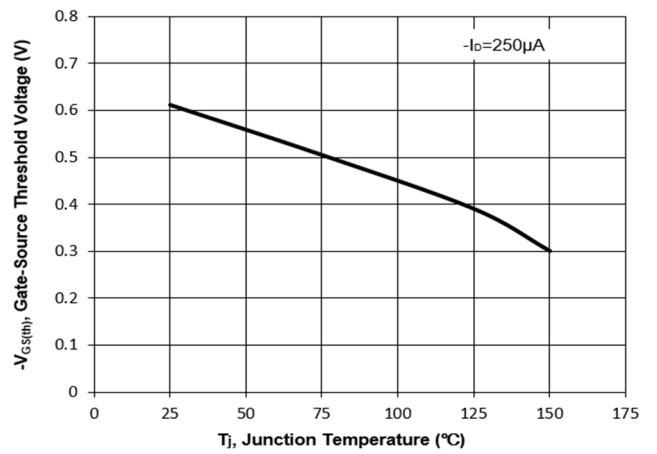
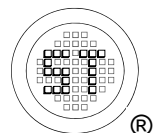
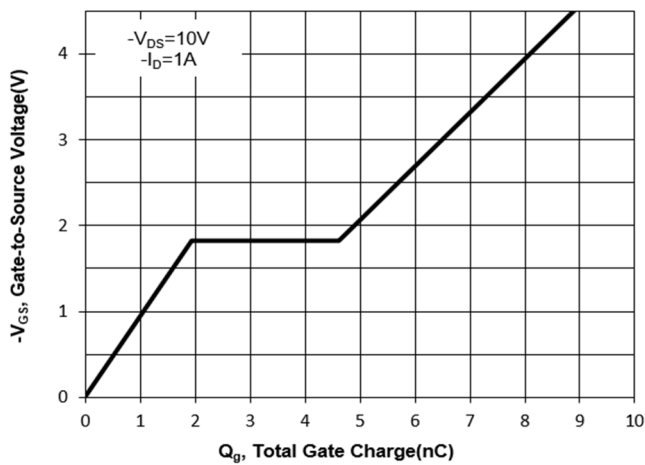


Fig. 11 Gate Charge



Test Circuits

Fig.1-1 Switching times test circuit

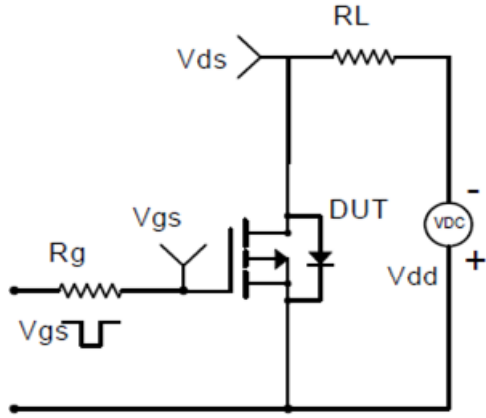


Fig.1-2 Switching Waveform

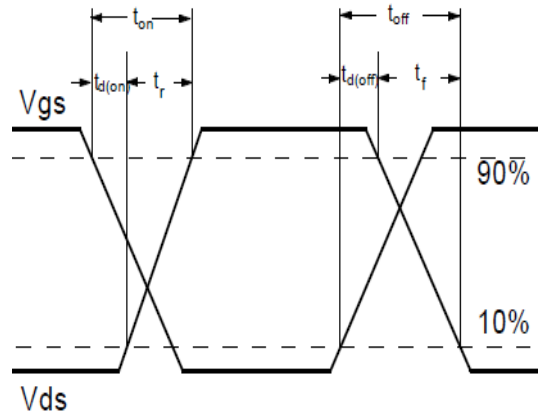


Fig.2-1 Gate charge test circuit

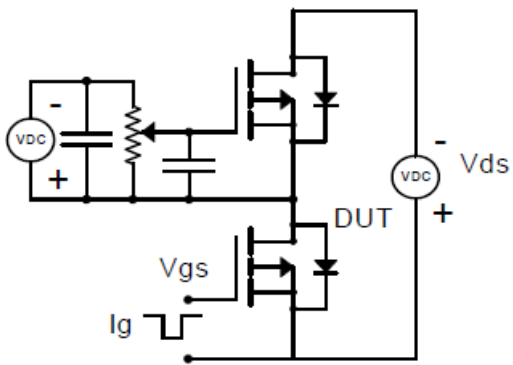
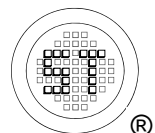
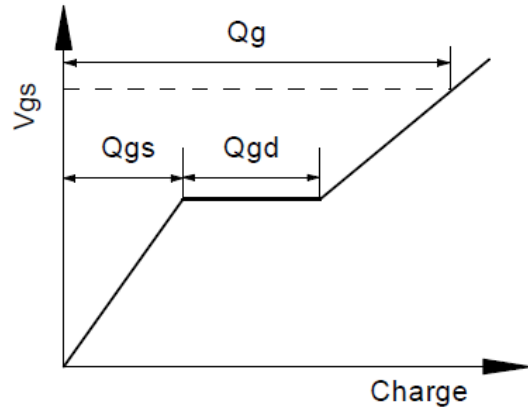


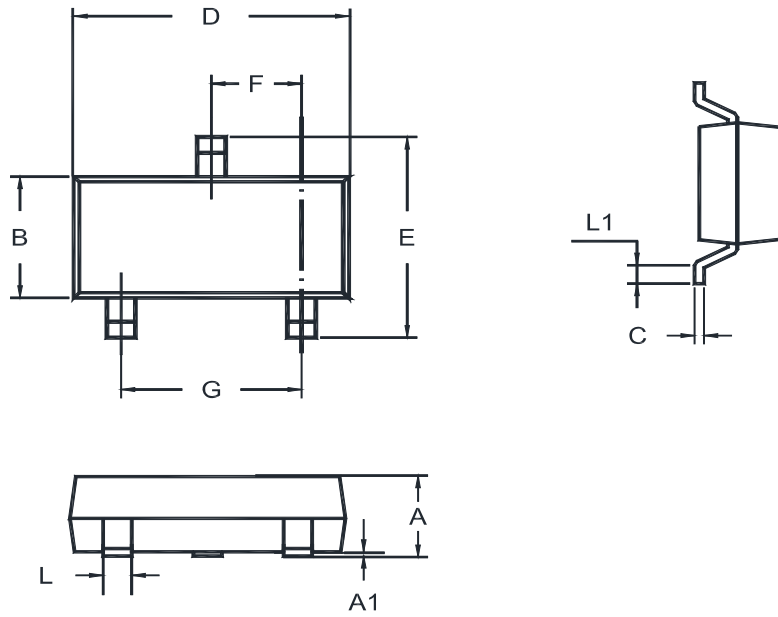
Fig.2-2 Gate charge waveform



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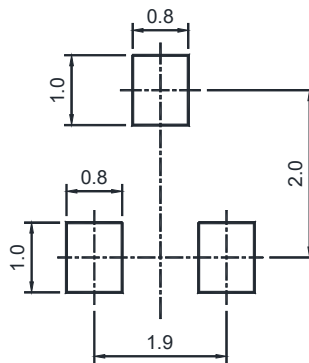
Package Outline (Dimensions in mm)

TO-236



| Unit | A | A1 | B | C | D | E | F | G | L | L1 |
|------|------|-------|------|------|------|-----|------|------|------|-----|
| mm | 1.20 | 0.100 | 1.40 | 0.19 | 3.04 | 2.6 | 1.02 | 2.04 | 0.51 | 0.2 |
| | 0.89 | 0.013 | 1.20 | 0.08 | 2.80 | 2.2 | 0.89 | 1.78 | 0.37 | MIN |

Recommended Soldering Footprint



Packing information

| Package | Tape Width (mm) | Pitch | | Reel Size | | Per Reel Packing Quantity |
|---------|-----------------|---------|---------------|-----------|------|---------------------------|
| | | mm | inch | mm | inch | |
| TO-236 | 8 | 4 ± 0.1 | 0.157 ± 0.004 | 178 | 7 | 3,000 |

Marking information

- " WE " = Part No.
- " • " = HAF (Halogen and Antimony Free)
- "YM" = Date Code Marking
- "Y" = Year
- "M" = Month
- Font type: Arial

