# MTP12P10

**Preferred Device**

# Power MOSFET
# 12 Amps, 100 Volts

## P−Channel TO−220

This Power MOSFET is designed for medium voltage, high speed power switching applications such as switching regulators, converters, solenoid and relay drivers.

### Features

- Silicon Gate for Fast Switching Speeds − Switching Times Specified at 100°C
- Designer's Data − $I_{DSS}$, $V_{DS(on)}$, $V_{GS(th)}$ and SOA Specified at Elevated Temperature
- Rugged − SOA is Power Dissipation Limited
- Source−to−Drain Diode Characterized for Use With Inductive Loads
- Pb−Free Package is Available*

**MAXIMUM RATINGS** ($T_C$ = 25°C unless otherwise noted)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Drain−Source Voltage | $V_{DSS}$ | 100 | Vdc |
| Drain−Gate Voltage ($R_{GS}$ = 1.0 MΩ) | $V_{DGR}$ | 100 | Vdc |
| Gate−Source Voltage<br>− Continuous<br>− Non−repetitive ($t_p \le 50$ μs) | <br>$V_{GS}$<br>$V_{GSM}$ | <br>±20<br>±40 | <br>Vdc<br>Vpk |
| Drain Current − Continuous<br>− Pulsed | $I_D$<br>$I_{DM}$ | 12<br>28 | Adc |
| Total Power Dissipation<br>Derate above 25°C | $P_D$ | 75<br>0.6 | W<br>W/°C |
| Operating and Storage Temperature Range | $T_J$, $T_{stg}$ | −65 to 150 | °C |
| Thermal Resistance<br>− Junction−to−Case<br>− Junction−to−Ambient | <br>$R_{\theta JC}$<br>$R_{\theta JA}$ | <br>1.67<br>62.5 | °C/W |
| Maximum Lead Temperature for Soldering Purposes, 1/8″ from case for 10 seconds | $T_L$ | 260 | °C |

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.

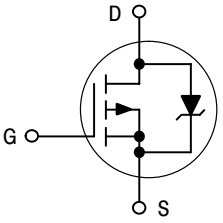
*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**ON Semiconductor®**

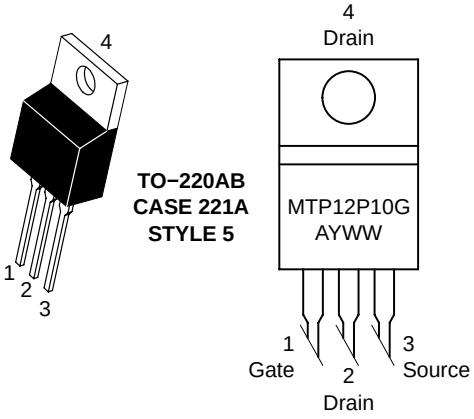
**http://onsemi.com**

**12 AMPERES, 100 VOLTS**
**$R_{DS(on)}$ = 300 mΩ**

**P−Channel**




**MARKING DIAGRAM AND PIN ASSIGNMENT**




MTP12P10 = Device Code
A = Location Code
Y = Year
WW = Work Week
G = Pb−Free Package

**ORDERING INFORMATION**

| Device | Package | Shipping |
|---|---|---|
| MTP12P10 | TO−220AB | 50 Units/Rail |
| MTP12P10G | TO−220AB<br>(Pb−Free) | 50 Units/Rail |

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

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**ELECTRICAL CHARACTERISTICS** ($T_J$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Max | Unit |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | |
| Drain−Source Breakdown Voltage ($V_{GS}$ = 0, $I_D$ = 0.25 mA) | | $V_{(BR)DSS}$ | 100 | − | Vdc |
| Zero Gate Voltage Drain Current<br>($V_{DS}$ = Rated $V_{DSS}$, $V_{GS}$ = 0)<br>($V_{DS}$ = Rated $V_{DSS}$, $V_{GS}$ = 0, $T_J$ = 125°C) | | $I_{DSS}$ | <br>−<br>− | <br>10<br>100 | μAdc |
| Gate−Body Leakage Current, Forward ($V_{GSF}$ = 20 Vdc, $V_{DS}$ = 0) | | $I_{GSSF}$ | − | 100 | nAdc |
| Gate−Body Leakage Current, Reverse ($V_{GSR}$ = 20 Vdc, $V_{DS}$ = 0) | | $I_{GSSR}$ | − | 100 | nAdc |
| **ON CHARACTERISTICS** (Note 1) | | | | | |
| Gate Threshold Voltage ($V_{DS}$ = $V_{GS}$, $I_D$ = 1.0 mA)<br>$T_J$ = 100°C | | $V_{GS(th)}$ | 2.0<br>1.5 | 4.5<br>4.0 | Vdc |
| Static Drain−Source On−Resistance ($V_{GS}$ = 10 Vdc, $I_D$ = 6.0 Adc) | | $R_{DS(on)}$ | − | 0.3 | Ω |
| Drain−Source On−Voltage ($V_{GS}$ = 10 V)<br>($I_D$ = 12 Adc)<br>($I_D$ = 6.0 Adc, $T_J$ = 100°C) | | $V_{DS(on)}$ | <br>−<br>− | <br>4.2<br>3.8 | Vdc |
| Forward Transconductance ($V_{DS}$ = 15 V, $I_D$ = 6.0 A) | | $g_{FS}$ | 2.0 | − | mhos |
| **DYNAMIC CHARACTERISTICS** | | | | | |
| Input Capacitance | ($V_{DS}$ = 25 V, $V_{GS}$ = 0, f = 1.0 MHz)<br>See Figure 10 | $C_{iss}$ | − | 920 | pF |
| Output Capacitance | | $C_{oss}$ | − | 575 | |
| Reverse Transfer Capacitance | | $C_{rss}$ | − | 200 | |
| **SWITCHING CHARACTERISTICS** (Note 1) ($T_J$ = 100°C) | | | | | |
| Turn−On Delay Time | ($V_{DD}$ = 25 V, $I_D$ = 0.5 Rated $I_D$, $R_G$ = 50 Ω)<br>See Figures 12 and 13 | $t_{d(on)}$ | − | 50 | ns |
| Rise Time | | $t_r$ | − | 150 | |
| Turn−Off Delay Time | | $t_{d(off)}$ | − | 150 | |
| Fall Time | | $t_f$ | − | 150 | |
| Total Gate Charge | ($V_{DS}$ = 0.8 Rated $V_{DSS}$, $I_D$ = Rated $I_D$, $V_{GS}$ = 10 V)<br>See Figure 11 | $Q_g$ | 33 (Typ) | 50 | nC |
| Gate−Source Charge | | $Q_{gs}$ | 16 (Typ) | − | |
| Gate−Drain Charge | | $Q_{gd}$ | 17 (Typ) | − | |
| **SOURCE−DRAIN DIODE CHARACTERISTICS** (Note 1) | | | | | |
| Forward On−Voltage | ($I_S$ = Rated $I_D$, $V_{GS}$ = 0) | $V_{SD}$ | 4.0 (Typ) | 5.5 | Vdc |
| Forward Turn−On Time | | $t_{on}$ | Limited by stray inductance | | |
| Reverse Recovery Time | | $t_{rr}$ | 300<br>(Typ) | − | ns |
| **INTERNAL PACKAGE INDUCTANCE (TO−204)** | | | | | |
| Internal Drain Inductance, (Measured from the contact screw on the header closer to the source pin and the center of the die) | | $L_d$ | 5.0 (Typ) | − | nH |
| Internal Source Inductance<br>(Measured from the source pin, 0.25″ from the package to the source bond pad) | | $L_s$ | 12.5<br>(Typ) | − | |
| **INTERNAL PACKAGE INDUCTANCE (TO−220)** | | | | | |
| Internal Drain Inductance<br>(Measured from the contact screw on tab to center of die)<br>(Measured from the drain lead 0.25″ from package to center of die) | | $L_d$ | <br>3.5 (Typ)<br>4.5 (Typ) | <br>−<br>− | nH |
| Internal Source Inductance<br>(Measured from the source lead 0.25″ from package to source bond pad) | | $L_s$ | 7.5 (Typ) | − | |

1. Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.

## TYPICAL ELECTRICAL CHARACTERISTICS

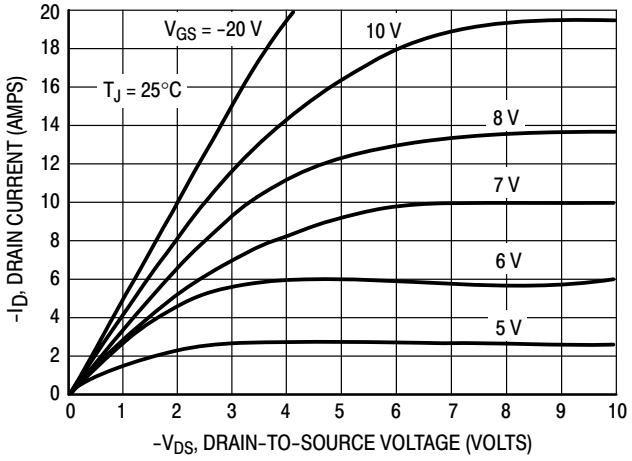



**Figure 1. On−Region Characteristics**

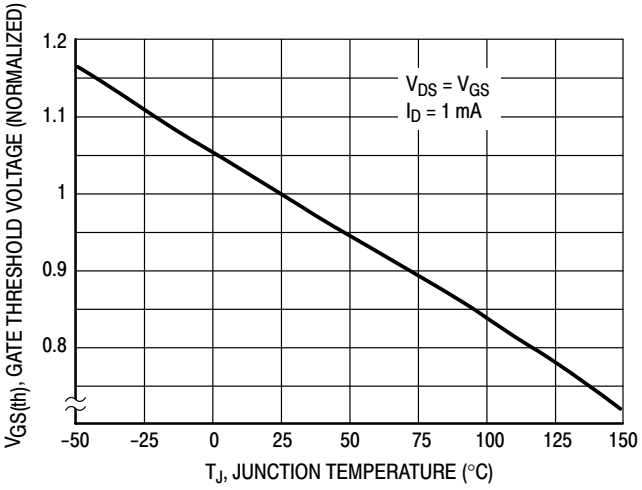



**Figure 2. Gate−Threshold Voltage Variation With Temperature**

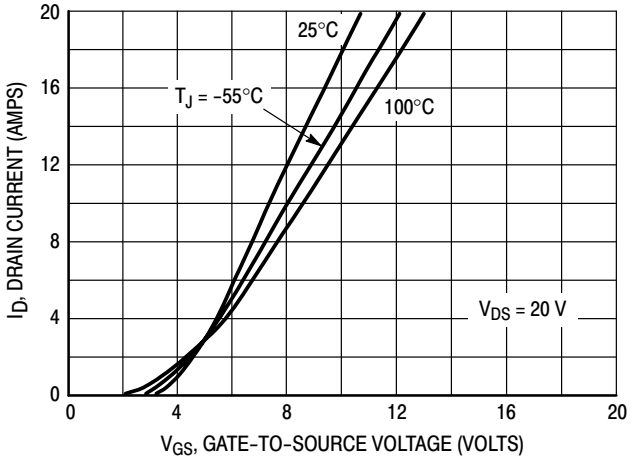



**Figure 3. Transfer Characteristics**

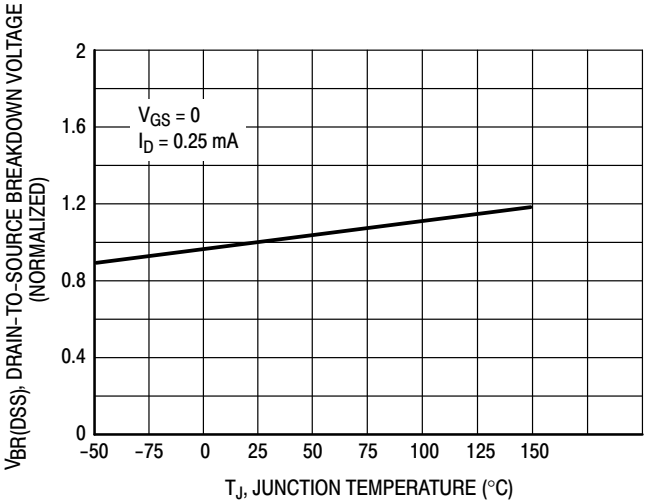



**Figure 4. Normalized Breakdown Voltage versus Temperature**

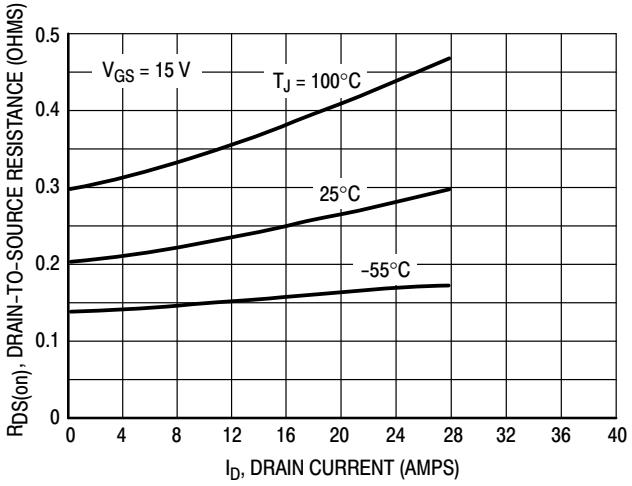



**Figure 5. On−Resistance versus Drain Current**

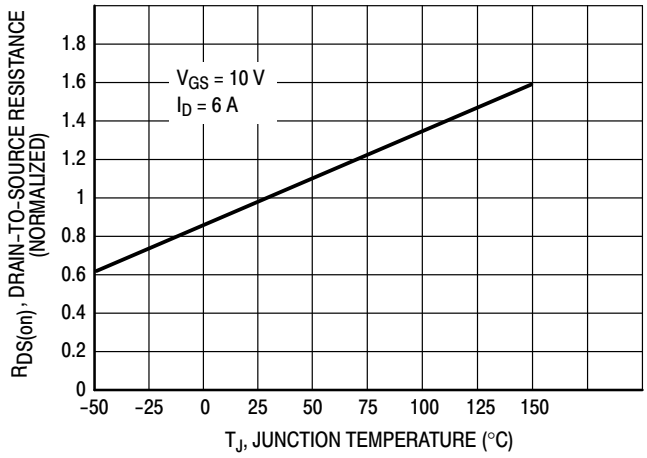



**Figure 6. On−Resistance Variation With Temperature**

## SAFE OPERATING AREA INFORMATION

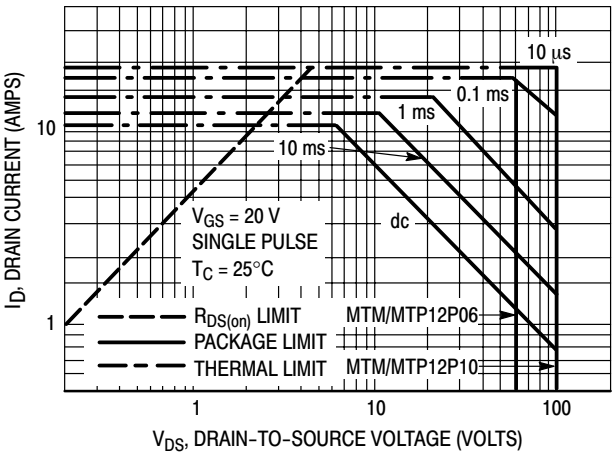



**Figure 7. Maximum Rated Forward Biased Safe Operating Area**

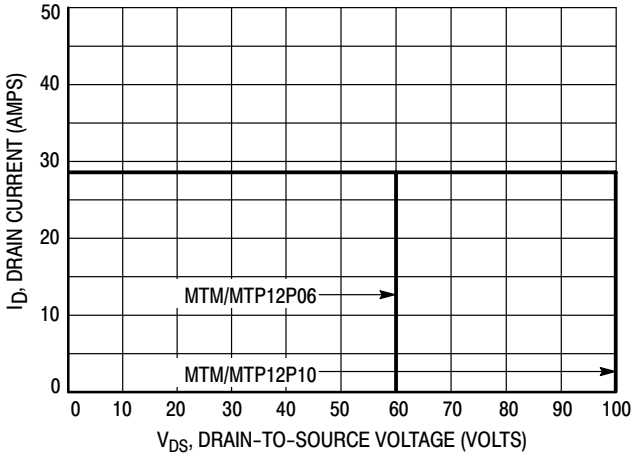



**Figure 8. Maximum Rated Switching Safe Operating Area**

### FORWARD BIASED SAFE OPERATING AREA

The FBSOA curves define the maximum drain−to−source voltage and drain current that a device can safely handle when it is forward biased, or when it is on, or being turned on. Because these curves include the limitations of simultaneous high voltage and high current, up to the rating of the device, they are especially useful to designers of linear systems. The curves are based on a case temperature of 25°C and a maximum junction temperature of 150°C. Limitations for repetitive pulses at various case temperatures can be determined by using the thermal response curves. ON Semiconductor Application Note, AN569, “Transient Thermal Resistance−General Data and Its Use” provides detailed instructions.

### SWITCHING SAFE OPERATING AREA

The switching safe operating area (SOA) of Figure 8 is the boundary that the load line may traverse without incurring damage to the MOSFET. The fundamental limits are the peak current, $I_{DM}$ and the breakdown voltage, $V_{(BR)DSS}$. The switching SOA shown in Figure 8 is applicable for both turn−on and turn−off of the devices for switching times less than one microsecond.

The power averaged over a complete switching cycle must be less than:

$$\frac{T_{J(max)} - T_C}{R_{\theta JC}}$$

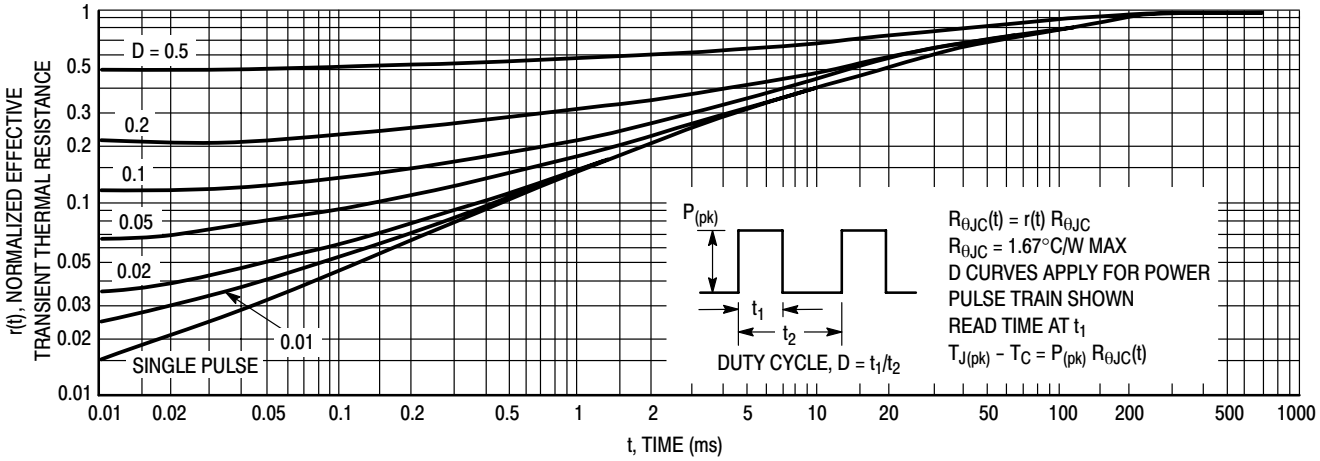



**Figure 9. Thermal Response**

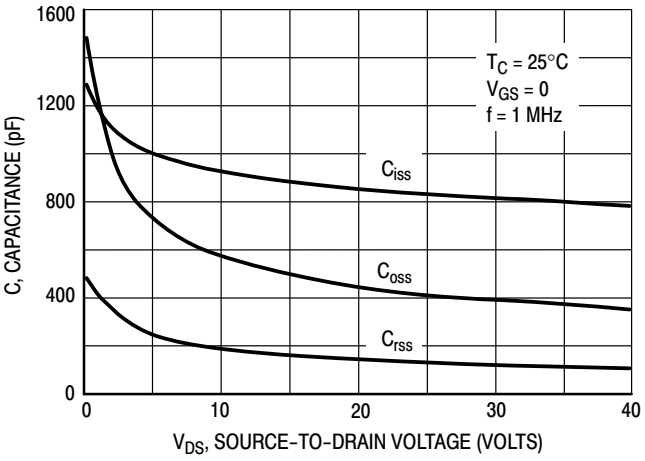



**Figure 10. Capacitance Variation**

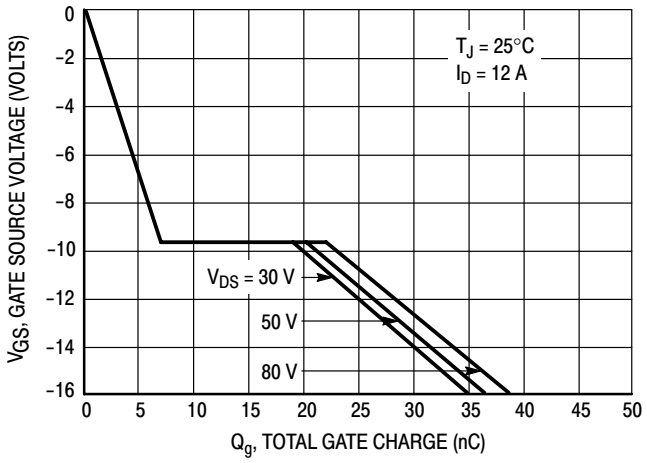



**Figure 11. Gate Charge versus Gate−To−Source Voltage**

## RESISTIVE SWITCHING

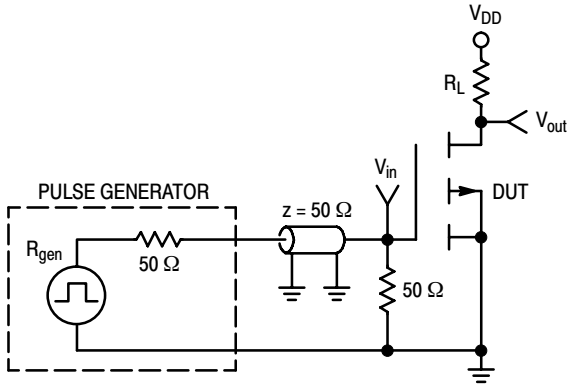



**Figure 12. Switching Test Circuit**

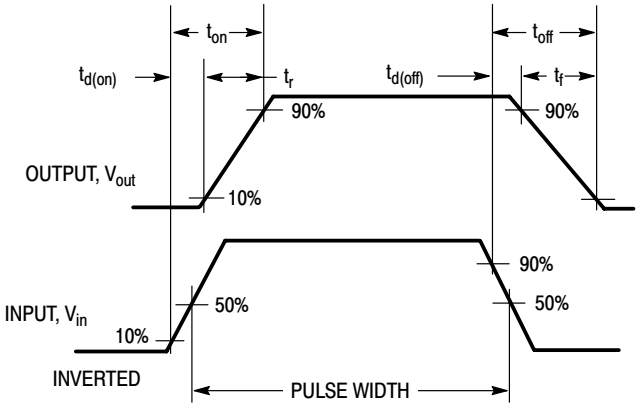
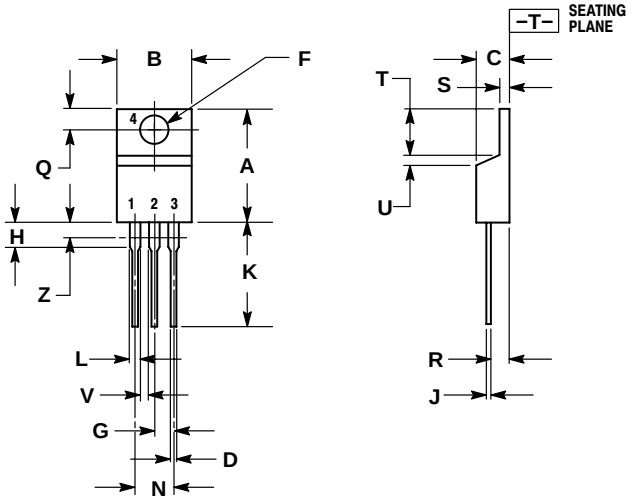



**Figure 13. Switching Waveforms**

# MTP12P10

## PACKAGE DIMENSIONS

**TO−220**
CASE 221A−09
ISSUE AB




NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

| | INCHES | | MILLIMETERS | |
|---|---|---|---|---|
| DIM | MIN | MAX | MIN | MAX |
| A | 0.570 | 0.620 | 14.48 | 15.75 |
| B | 0.380 | 0.405 | 9.66 | 10.28 |
| C | 0.160 | 0.190 | 4.07 | 4.82 |
| D | 0.025 | 0.035 | 0.64 | 0.88 |
| F | 0.142 | 0.147 | 3.61 | 3.73 |
| G | 0.095 | 0.105 | 2.42 | 2.66 |
| H | 0.110 | 0.155 | 2.80 | 3.93 |
| J | 0.018 | 0.025 | 0.46 | 0.64 |
| K | 0.500 | 0.562 | 12.70 | 14.27 |
| L | 0.045 | 0.060 | 1.15 | 1.52 |
| N | 0.190 | 0.210 | 4.83 | 5.33 |
| Q | 0.100 | 0.120 | 2.54 | 3.04 |
| R | 0.080 | 0.110 | 2.04 | 2.79 |
| S | 0.020 | 0.055 | 0.508 | 1.39 |
| T | 0.235 | 0.255 | 5.97 | 6.47 |
| U | 0.000 | 0.050 | 0.00 | 1.27 |
| V | 0.045 | --- | 1.15 | --- |
| Z | --- | 0.080 | --- | 2.04 |

STYLE 5:
PIN 1. GATE
2. DRAIN
3. SOURCE
4. DRAIN

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