

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

Rating	Symbol	Value	Unit
Drain-Source Voltage	$V_{DSS}$	100	Vdc
Drain-Gate Voltage ( $R_{GS} = 1.0\text{ M}\Omega$ )	$V_{DGR}$	100	Vdc
Gate-Source Voltage – Continuous – Non-repetitive ( $t_p \leq 50\ \mu\text{s}$ )	$V_{GS}$ $V_{GSM}$	$\pm 20$ $\pm 40$	Vdc Vpk
Drain Current – Continuous – Pulsed	$I_D$ $I_{DM}$	12 28	Adc
Total Power Dissipation Derate above 25°C	$P_D$	75 0.6	W W/°C
Operating and Storage Temperature Range	$T_J, T_{stg}$	-65 to 150	°C
Thermal Resistance – Junction-to-Case – Junction-to-Ambient	$R_{\theta JC}$ $R_{\theta JA}$	1.67 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.

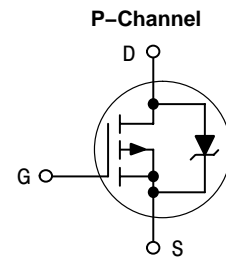


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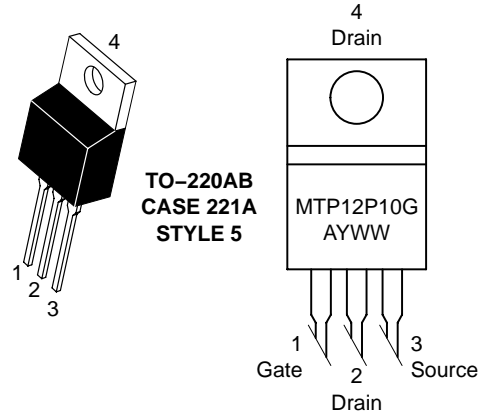
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12 AMPERES, 100 VOLTS

$R_{DS(on)} = 300\text{ m}\Omega$



#### 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 (Pb-Free)	50 Units/Rail

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

\*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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## ELECTRICAL CHARACTERISTICS (T<sub>J</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
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### OFF CHARACTERISTICS

Drain–Source Breakdown Voltage (V <sub>GS</sub> = 0, I <sub>D</sub> = 0.25 mA)	V <sub>(BR)DSS</sub>	100	–	Vdc
Zero Gate Voltage Drain Current (V <sub>DS</sub> = Rated V <sub>DSS</sub> , V <sub>GS</sub> = 0) (V <sub>DS</sub> = Rated V <sub>DSS</sub> , V <sub>GS</sub> = 0, T <sub>J</sub> = 125°C)	I <sub>DSS</sub>	–	10 100	μAdc
Gate–Body Leakage Current, Forward (V <sub>GSF</sub> = 20 Vdc, V <sub>DS</sub> = 0)	I <sub>GSSF</sub>	–	100	nAdc
Gate–Body Leakage Current, Reverse (V <sub>GSR</sub> = 20 Vdc, V <sub>DS</sub> = 0)	I <sub>GSSR</sub>	–	100	nAdc

### ON CHARACTERISTICS (Note 1)

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1.0 mA) T <sub>J</sub> = 100°C	V <sub>GS(th)</sub>	2.0 1.5	4.5 4.0	Vdc
Static Drain–Source On–Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 6.0 Adc)	R <sub>DS(on)</sub>	–	0.3	Ω
Drain–Source On–Voltage (V <sub>GS</sub> = 10 V) (I <sub>D</sub> = 12 Adc) (I <sub>D</sub> = 6.0 Adc, T <sub>J</sub> = 100°C)	V <sub>DS(on)</sub>	–	4.2 3.8	Vdc
Forward Transconductance (V <sub>DS</sub> = 15 V, I <sub>D</sub> = 6.0 A)	g <sub>FS</sub>	2.0	–	mhos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 25 V, V <sub>GS</sub> = 0, f = 1.0 MHz) See Figure 10	C <sub>iss</sub>	–	920	pF
Output Capacitance		C <sub>oss</sub>	–	575	
Reverse Transfer Capacitance		C <sub>rss</sub>	–	200	

### SWITCHING CHARACTERISTICS (Note 1) (T<sub>J</sub> = 100°C)

Turn–On Delay Time	(V <sub>DD</sub> = 25 V, I <sub>D</sub> = 0.5 Rated I <sub>D</sub> , R <sub>G</sub> = 50 Ω) See Figures 12 and 13	t <sub>d(on)</sub>	–	50	ns
Rise Time		t <sub>r</sub>	–	150	
Turn–Off Delay Time		t <sub>d(off)</sub>	–	150	
Fall Time		t <sub>f</sub>	–	150	
Total Gate Charge	(V <sub>DS</sub> = 0.8 Rated V <sub>DSS</sub> , I <sub>D</sub> = Rated I <sub>D</sub> , V <sub>GS</sub> = 10 V) See Figure 11	Q <sub>g</sub>	33 (Typ)	50	nC
Gate–Source Charge		Q <sub>gs</sub>	16 (Typ)	–	
Gate–Drain Charge		Q <sub>gd</sub>	17 (Typ)	–	

### SOURCE–DRAIN DIODE CHARACTERISTICS (Note 1)

Forward On–Voltage	(I <sub>S</sub> = Rated I <sub>D</sub> , V <sub>GS</sub> = 0)	V <sub>SD</sub>	4.0 (Typ)	5.5	Vdc
Forward Turn–On Time		t <sub>on</sub>	Limited by stray inductance		
Reverse Recovery Time		t <sub>rr</sub>	300 (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 <sub>d</sub>	5.0 (Typ)	–	nH
Internal Source Inductance (Measured from the source pin, 0.25" from the package to the source bond pad)	L <sub>s</sub>	12.5 (Typ)	–	

### INTERNAL PACKAGE INDUCTANCE (TO–220)

Internal Drain Inductance (Measured from the contact screw on tab to center of die) (Measured from the drain lead 0.25" from package to center of die)	L <sub>d</sub>	3.5 (Typ) 4.5 (Typ)	–	nH
Internal Source Inductance (Measured from the source lead 0.25" from package to source bond pad)	L <sub>s</sub>	7.5 (Typ)	–	

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

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## TYPICAL ELECTRICAL CHARACTERISTICS

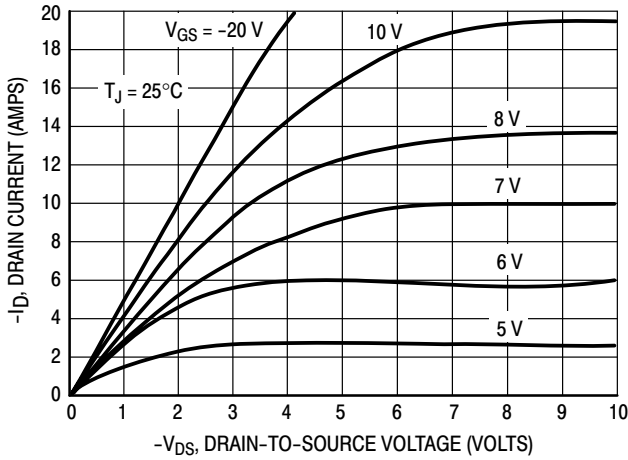


Figure 1. On-Region Characteristics

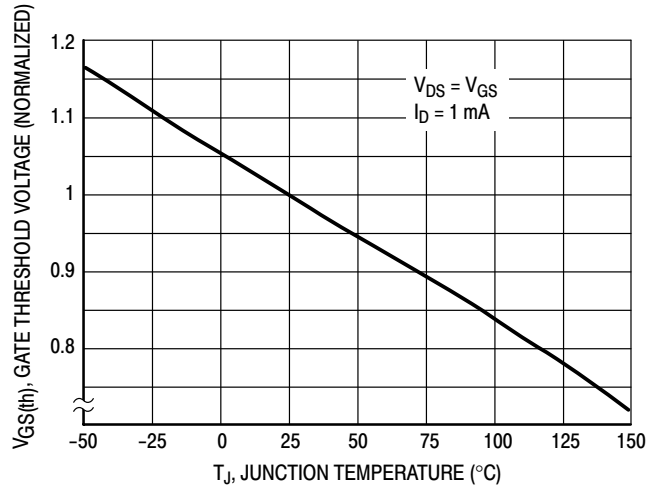


Figure 2. Gate-Threshold Voltage Variation With Temperature

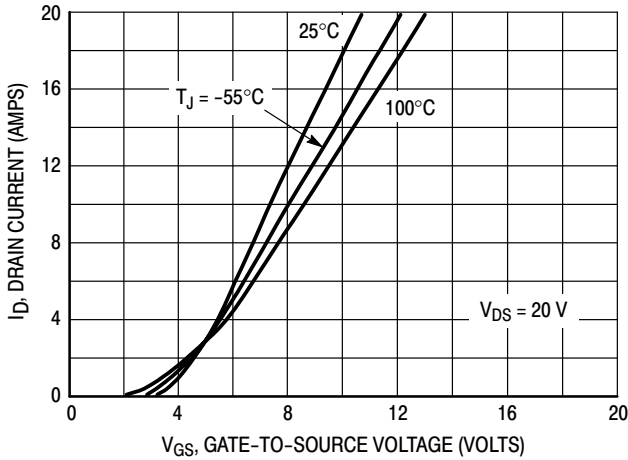


Figure 3. Transfer Characteristics

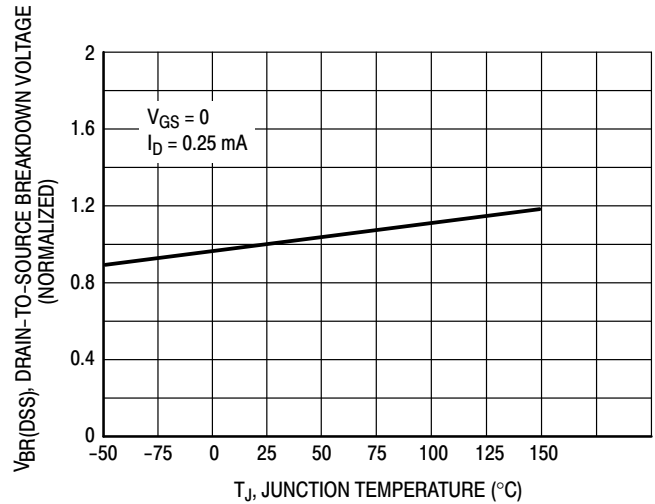


Figure 4. Normalized Breakdown Voltage versus Temperature

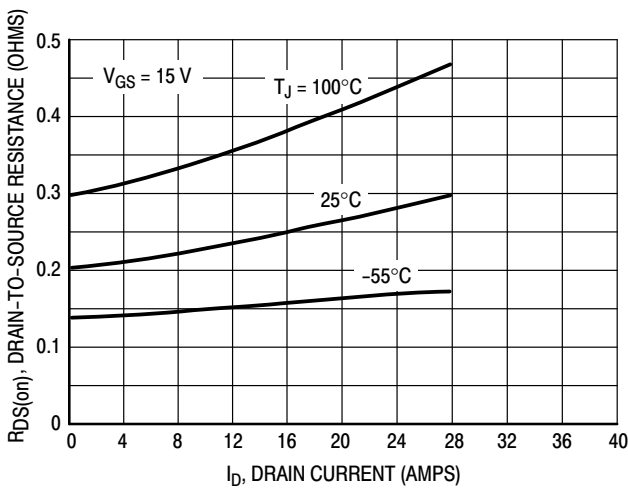


Figure 5. On-Resistance versus Drain Current

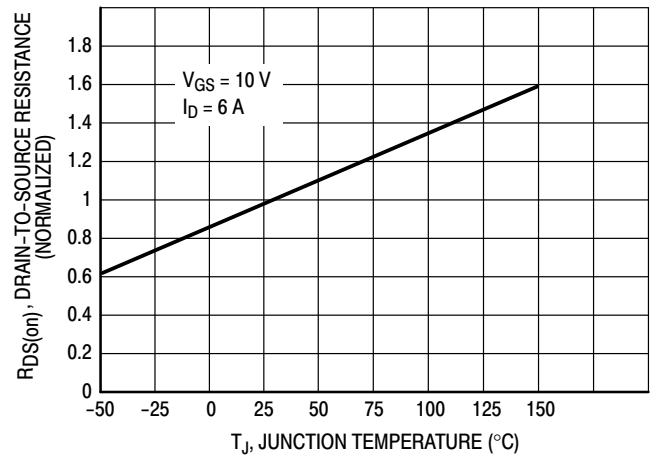


Figure 6. On-Resistance Variation With Temperature

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## SAFE OPERATING AREA INFORMATION

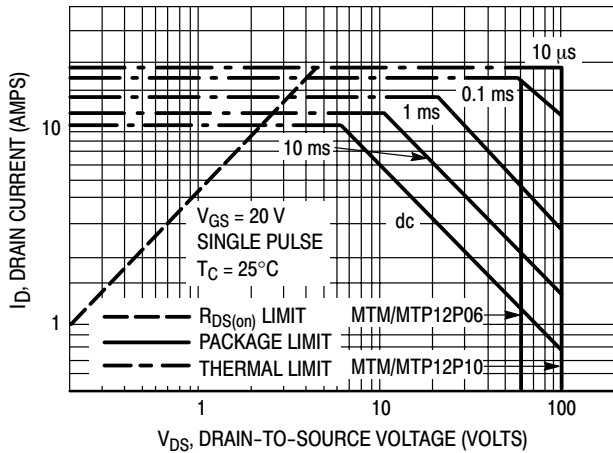


Figure 7. Maximum Rated Forward Biased Safe Operating Area

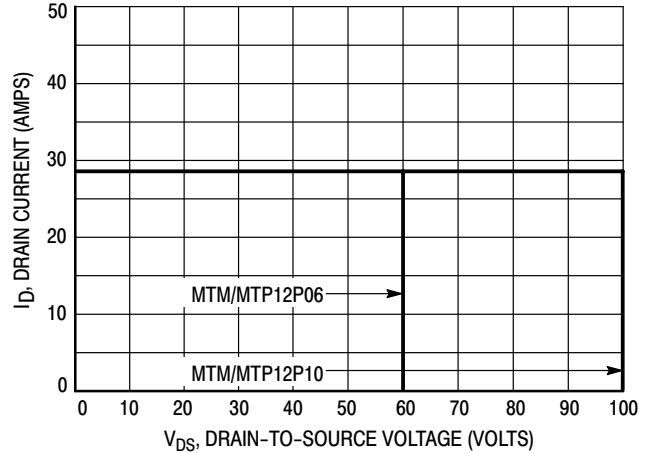


Figure 8. Maximum Rated Switching Safe Operating Area

### 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:

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

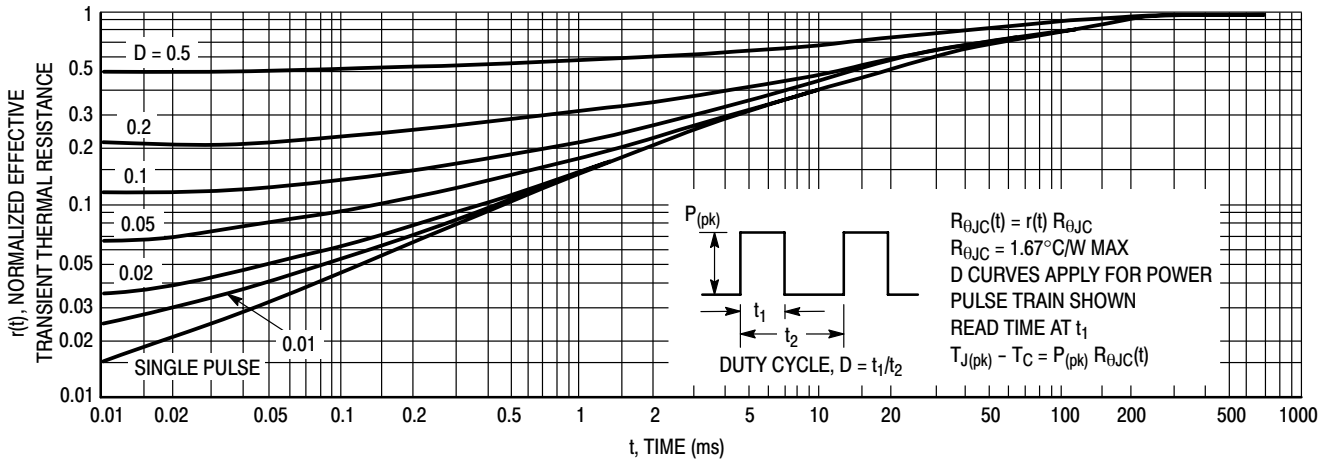


Figure 9. Thermal Response

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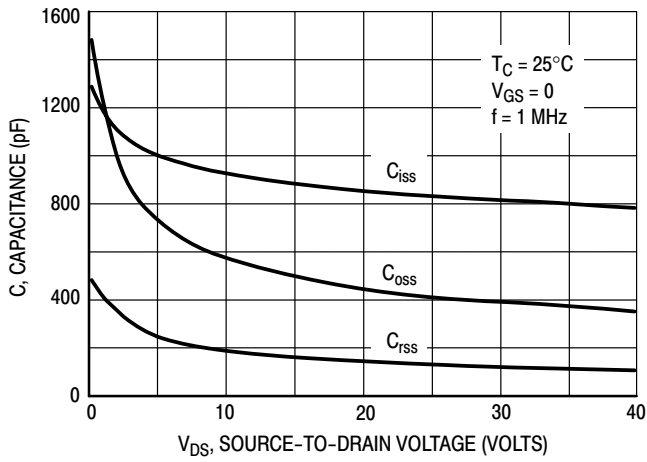


Figure 10. Capacitance Variation

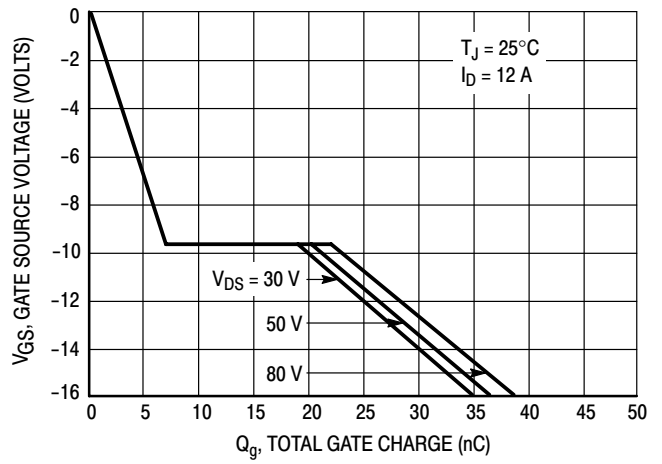


Figure 11. Gate Charge versus Gate-To-Source Voltage

## RESISTIVE SWITCHING

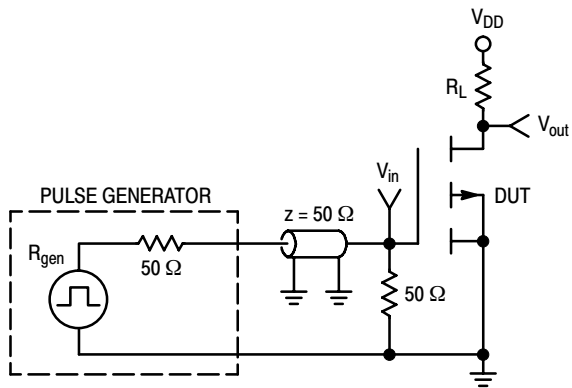


Figure 12. Switching Test Circuit

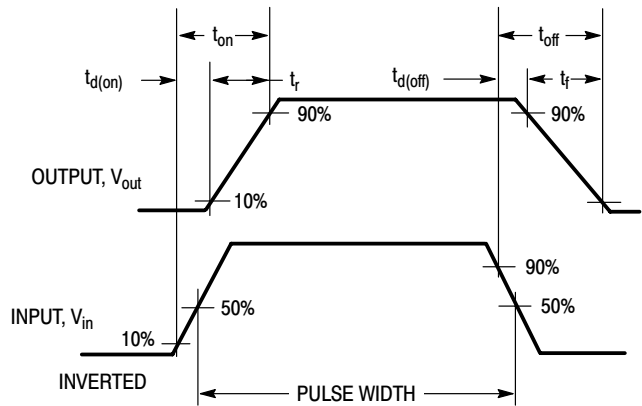
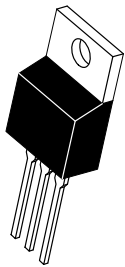


Figure 13. Switching Waveforms

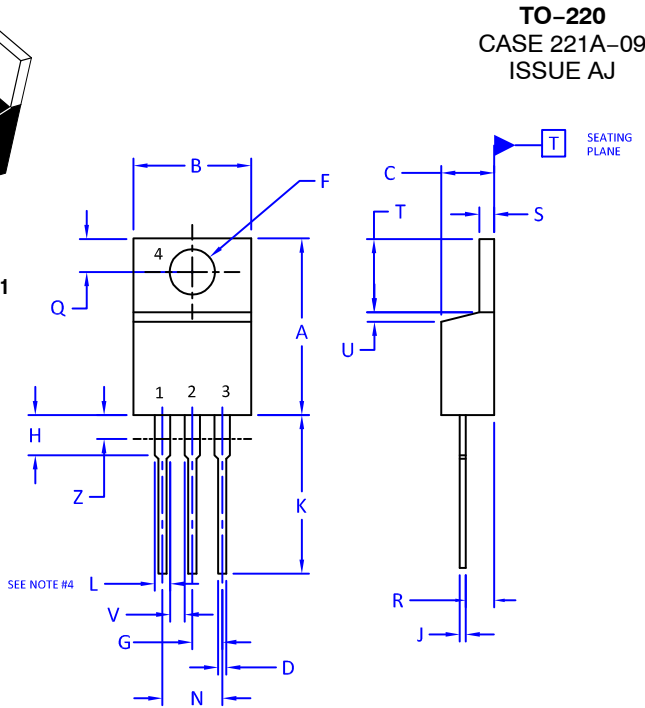
# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 1:1



**TO-220**  
CASE 221A-09  
ISSUE AJ

DATE 05 NOV 2019

**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 2009.
2. CONTROLLING DIMENSION: INCHES
3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.
4. MAX WIDTH FOR F102 DEVICE = 1.35MM

DIM	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	0.570	0.620	14.48	15.75
B	0.380	0.415	9.66	10.53
C	0.160	0.190	4.07	4.83
D	0.025	0.038	0.64	0.96
F	0.142	0.161	3.60	4.09
G	0.095	0.105	2.42	2.66
H	0.110	0.161	2.80	4.10
J	0.014	0.024	0.36	0.61
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	0.045	0.055	1.15	1.41
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 1:**

- PIN 1. BASE
- 2. COLLECTOR
- 3. EMITTER
- 4. COLLECTOR

**STYLE 2:**

- PIN 1. BASE
- 2. EMITTER
- 3. COLLECTOR
- 4. EMITTER

**STYLE 3:**

- PIN 1. CATHODE
- 2. ANODE
- 3. GATE
- 4. ANODE

**STYLE 4:**

- PIN 1. MAIN TERMINAL 1
- 2. MAIN TERMINAL 2
- 3. GATE
- 4. MAIN TERMINAL 2

**STYLE 5:**

- PIN 1. GATE
- 2. DRAIN
- 3. SOURCE
- 4. DRAIN

**STYLE 6:**

- PIN 1. ANODE
- 2. CATHODE
- 3. ANODE
- 4. CATHODE

**STYLE 7:**

- PIN 1. CATHODE
- 2. ANODE
- 3. CATHODE
- 4. ANODE

**STYLE 8:**

- PIN 1. CATHODE
- 2. ANODE
- 3. EXTERNAL TRIP/DELAY
- 4. ANODE

**STYLE 9:**

- PIN 1. GATE
- 2. COLLECTOR
- 3. EMITTER
- 4. COLLECTOR

**STYLE 10:**

- PIN 1. GATE
- 2. SOURCE
- 3. DRAIN
- 4. SOURCE

**STYLE 11:**

- PIN 1. DRAIN
- 2. SOURCE
- 3. GATE
- 4. SOURCE

**STYLE 12:**

- PIN 1. MAIN TERMINAL 1
- 2. MAIN TERMINAL 2
- 3. GATE
- 4. NOT CONNECTED

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