

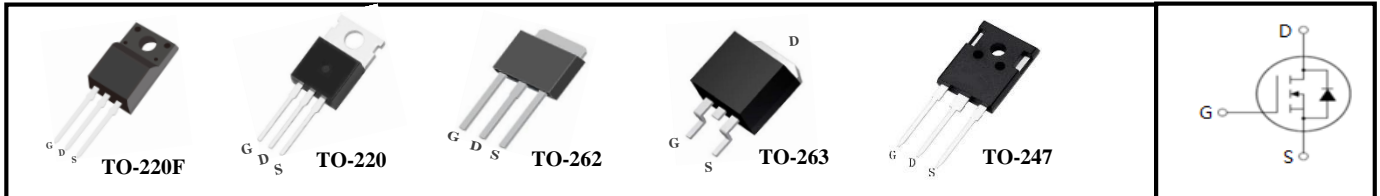
# MPSA60M160, MPSP60M160, MPSC60M160, MPSH60M160, MPSW60M160

## FEATURES

- $BV_{DSS}=600V, I_D=20A$
- $R_{DS(on)}:0.16\Omega(\text{Max})@V_{GS}=10V$
- Very low FOM  $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- RoHS compliant

## APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



Device Marking and Package Information		
Ordering code	Package	Marking
MPSA60M160	TO-220F	MP60M160
MPSP60M160	TO-220	MP60M160
MPSH60M160	TO-262	MP60M160
MPSC60M160	TO-263	MP60M160
MPSW60M160	TO-247	MP60M160

Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , unless otherwise noted				
Parameter	Symbol	Value		Unit
		TO-220F	TO-220, TO-263, TO-262, TO-247	
Drain-Source Voltage ( $V_{GS} = 0V$ )	$V_{DSS}$	600		V
Continuous Drain Current	$I_D$	20		A
Pulsed Drain Current (note1)	$I_{DM}$	60		A
Gate-Source Voltage	$V_{GSS}$	$\pm 30$		V
Single Pulse Avalanche Energy (note2)	$E_{AS}$	480		mJ
Avalanche Current (note1)	$I_{AR}$	3.5		A
Repetitive Avalanche Energy (note1)	$E_{AR}$	0.7		mJ
MOSFET dv/dt ruggedness, $V_{DS}=0\dots 400V$	dv/dt	50		V/ns
Reverse diode dv/dt, $V_{DS}=0\dots 400V, I_{SD} \leq I_D$	dv/dt	50		V/ns
Power Dissipation ( $T_C = 25^\circ\text{C}$ )	$P_D$	34	150	W
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150		$^\circ\text{C}$

Thermal Resistance				
Parameter	Symbol	Value		Unit
		TO-220F	TO-220, TO-262, TO-263, TO-247	
Thermal Resistance, Junction-to-Case	$R_{thJC}$	4	0.83	K/W
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	80	62	



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# MPSA60M160, MPSP60M160, MPSC60M160, MP SH60M160, MPSW60M160

Specifications $T_J = 25^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
<b>Static</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	600	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 600V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	$\mu A$
		$V_{DS} = 600V, V_{GS} = 0V, T_J = 150^\circ\text{C}$	--	--	100	
Gate-Source Leakage	$I_{GSS}$	$V_{GS} = \pm 30V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 0.25mA$	2.5	--	3.5	V
Drain-Source On-Resistance (Note3)	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 10A$	--	0.14	0.16	$\Omega$
Gate Resistance	$R_G$	$f = 1.0MHz, \text{open drain}$	--	8	--	$\Omega$
<b>Dynamic</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V, V_{DS} = 100V, f = 1.0MHz$	--	1724	--	$\mu F$
Output Capacitance	$C_{oss}$		--	72	--	
Reverse Transfer Capacitance	$C_{rss}$		--	6	--	
Total Gate Charge	$Q_g$	$V_{DD} = 400V, I_D = 20A, V_{GS} = 10V$	--	38.5	--	nC
Gate-Source Charge	$Q_{gs}$		--	8	--	
Gate-Drain Charge	$Q_{gd}$		--	15	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V, I_D = 20A, V_{GS} = 10V, R_G = 25\Omega$	--	25	--	ns
Turn-on Rise Time	$t_r$		--	59	--	
Turn-off Delay Time	$t_{d(off)}$		--	121	--	
Turn-off Fall Time	$t_f$		--	44	--	
<b>Drain-Source Body Diode Characteristics</b>						
Continuous Body Diode Current	$I_S$	$T_C = 25^\circ\text{C}$	--	--	20	A
Pulsed Diode Forward Current	$I_{SM}$		--	--	60	
Body Diode Voltage	$V_{SD}$	$T_J = 25^\circ\text{C}, I_{SD} = 20A, V_{GS} = 0V$	--	0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$V_R = 400V, I_F = 20A, di_F/dt = 100A/\mu s$	--	453	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	5.1	--	$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$		--	22	--	A

### Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $I_{AS} = 3.5A, V_{DD} = 50V, R_G = 25\Omega, \text{Starting } T_J = 25^\circ\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s, \text{Duty Cycle } \leq 1\%$

Typical Characteristics  $T_J = 25^\circ\text{C}$ , unless otherwise noted

Figure 1. Output Characteristics

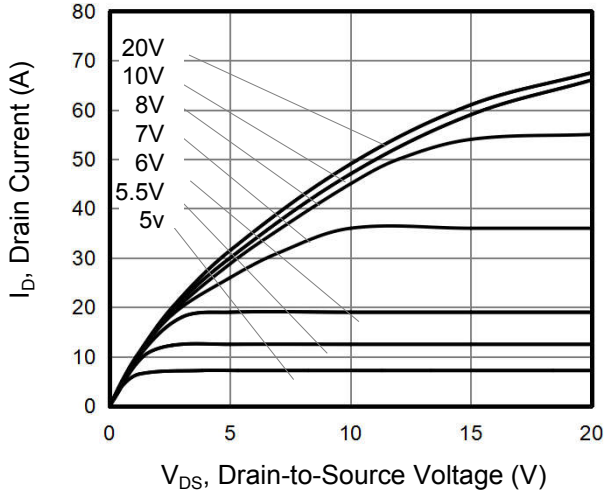


Figure 2. Transfer Characteristics

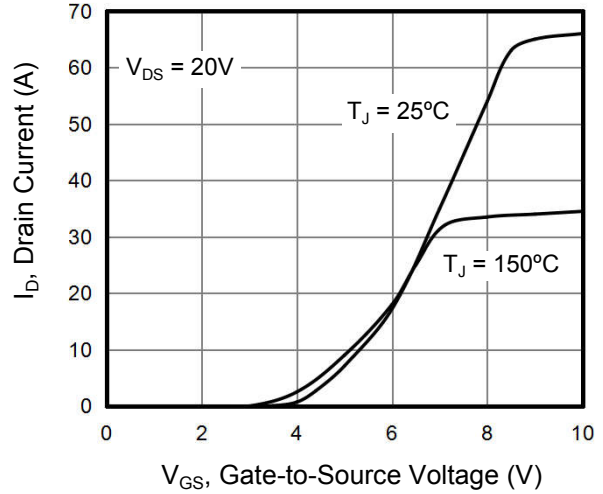


Figure 3. On-Resistance vs. Drain Current

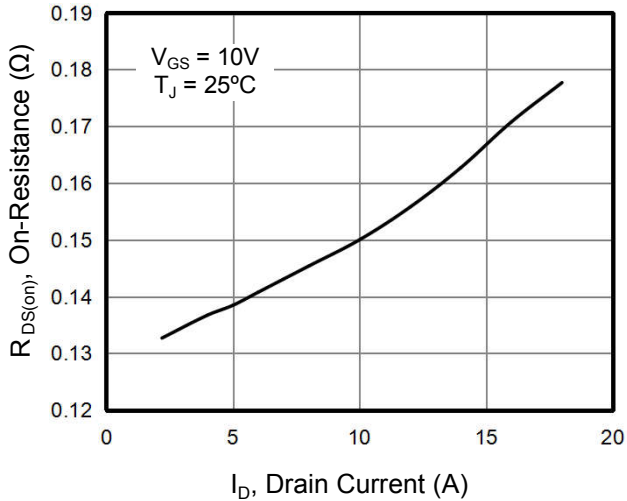


Figure 4. Capacitance

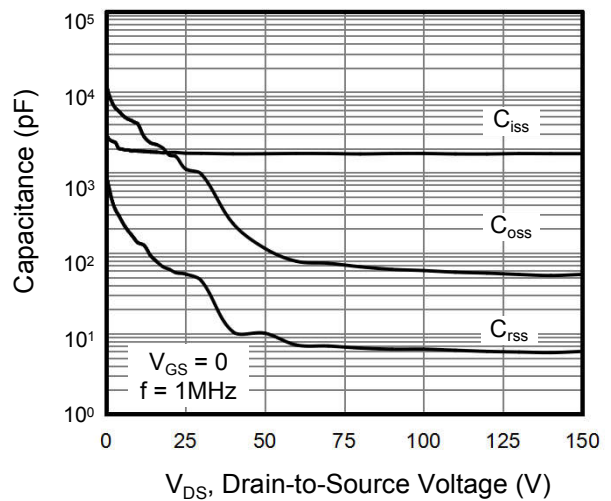


Figure 5. Gate Charge

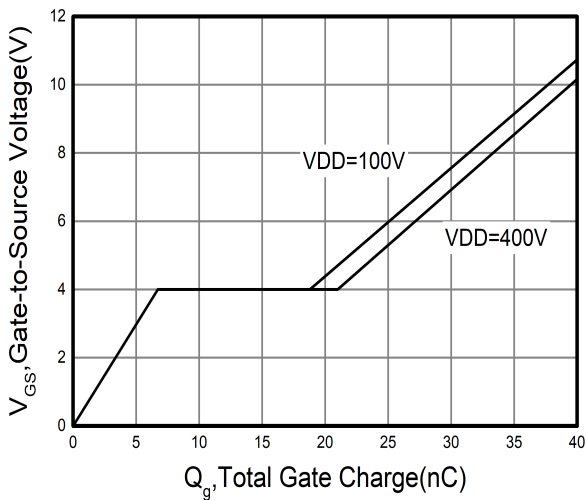
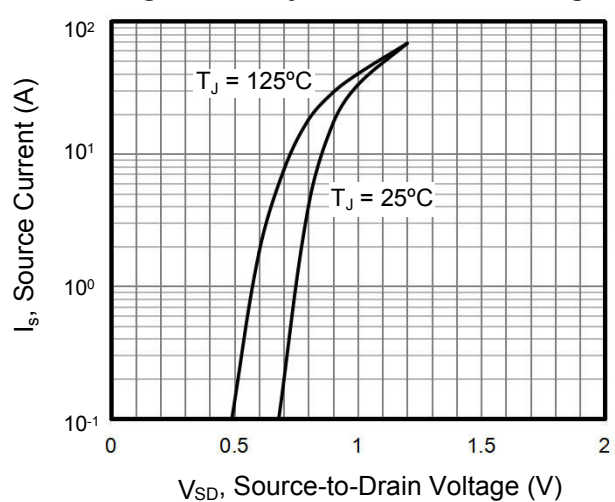


Figure 6. Body Diode Forward Voltage



Typical Characteristics  $T_J = 25^\circ\text{C}$ , unless otherwise noted

Figure 7. On-Resistance vs. Junction Temperature

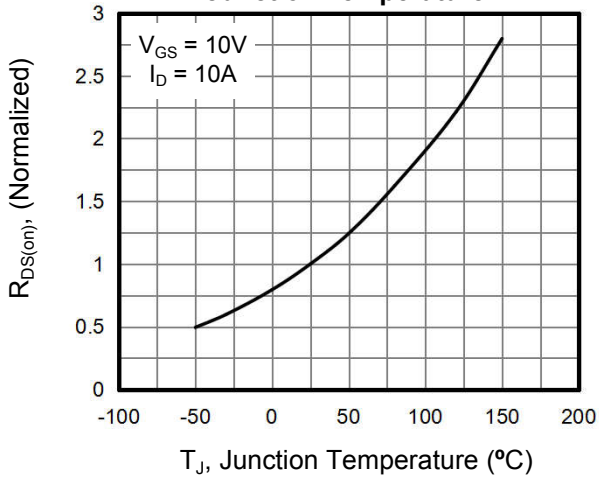


Figure 8. Threshold Voltage vs. Junction Temperature

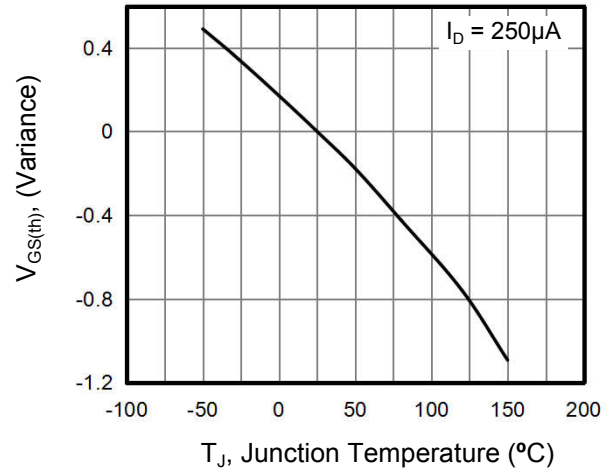


Figure 9. Transient Thermal Impedance TO-220/TO-263/TO-262/TO-247

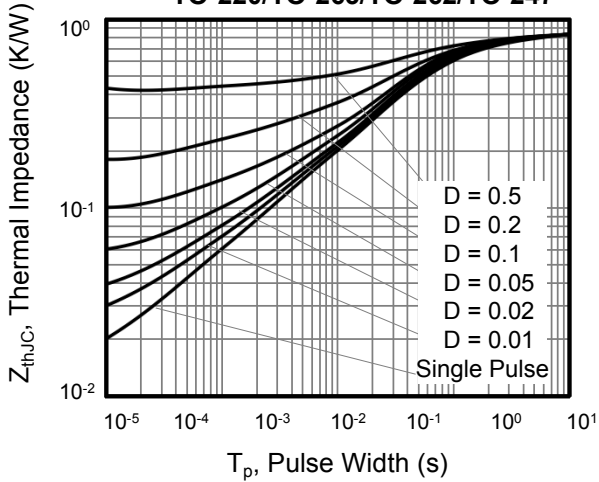


Figure 10. Transient Thermal Impedance TO-220F

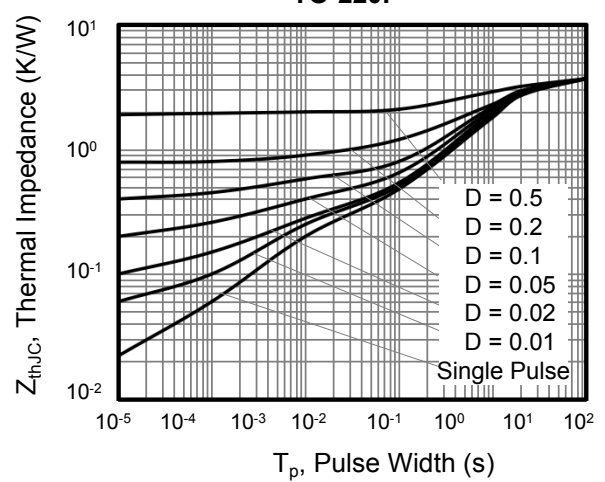


Figure A: Gate Charge Test Circuit and Waveform

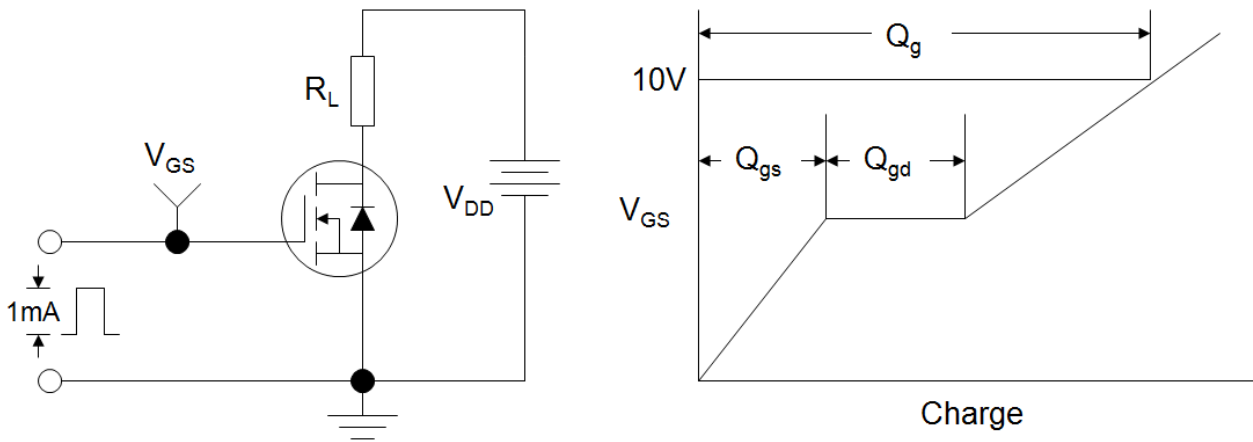


Figure B: Resistive Switching Test Circuit and Waveform

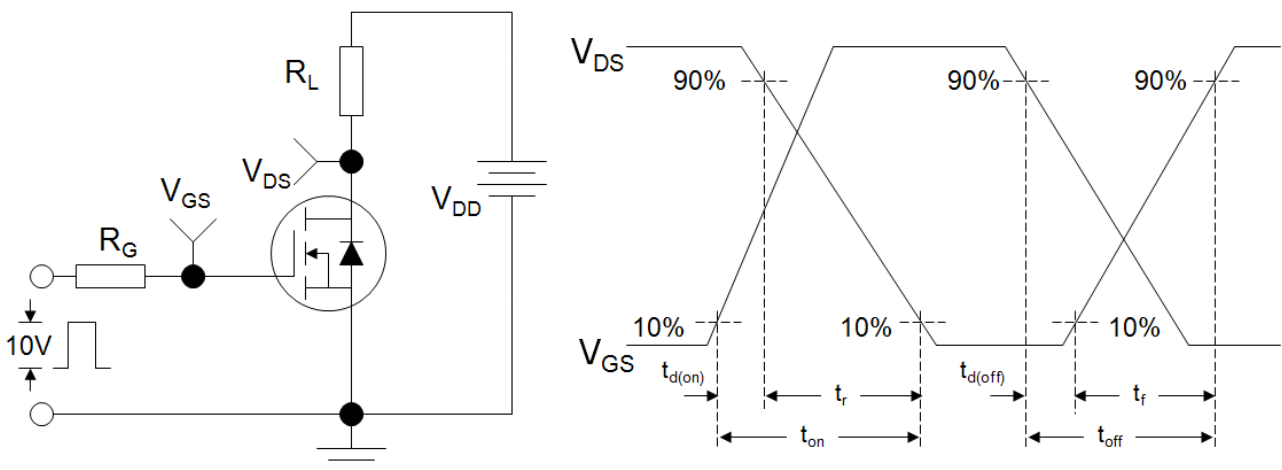
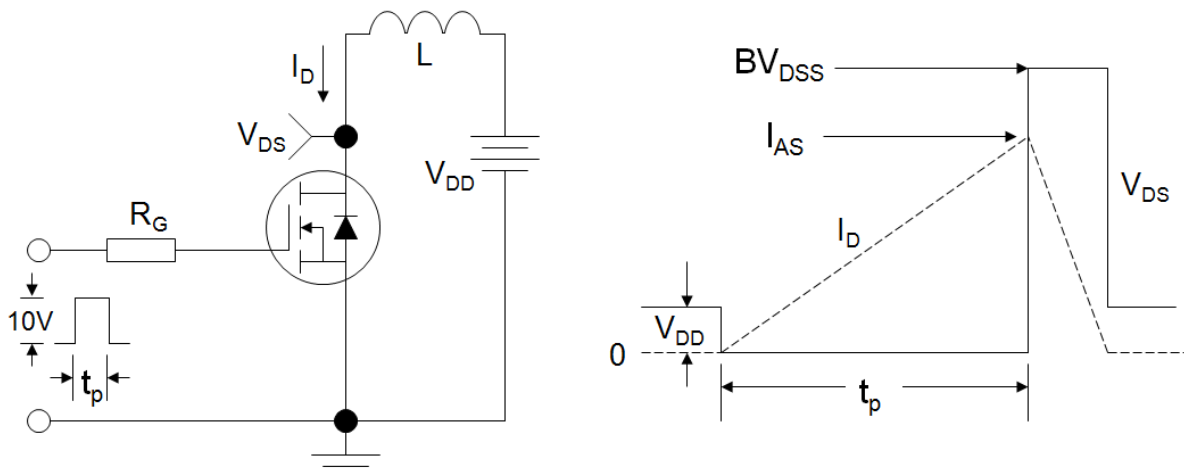
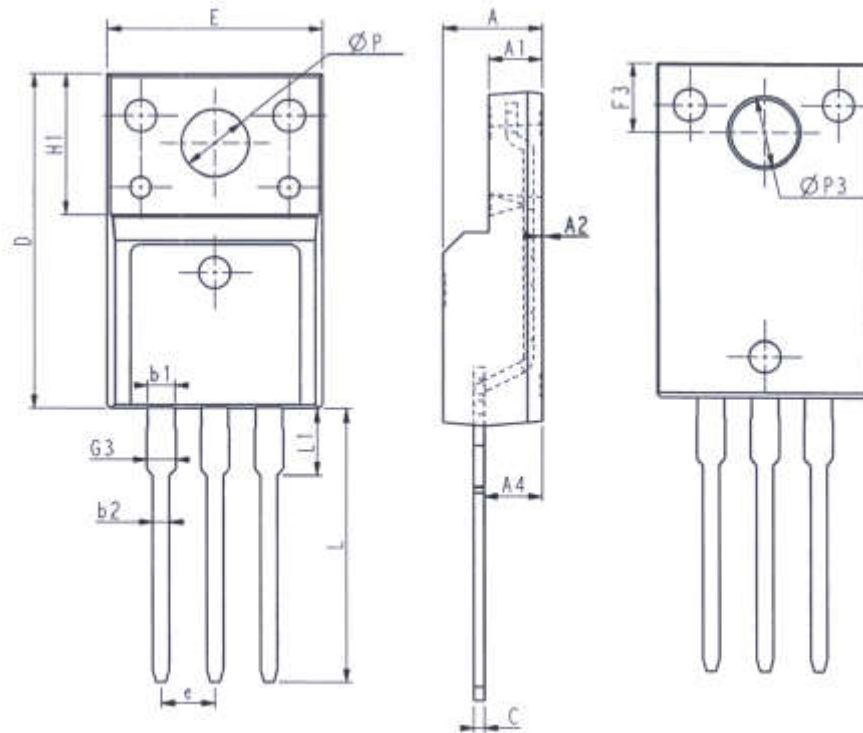


Figure C: Unclamped Inductive Switching Test Circuit and Waveform

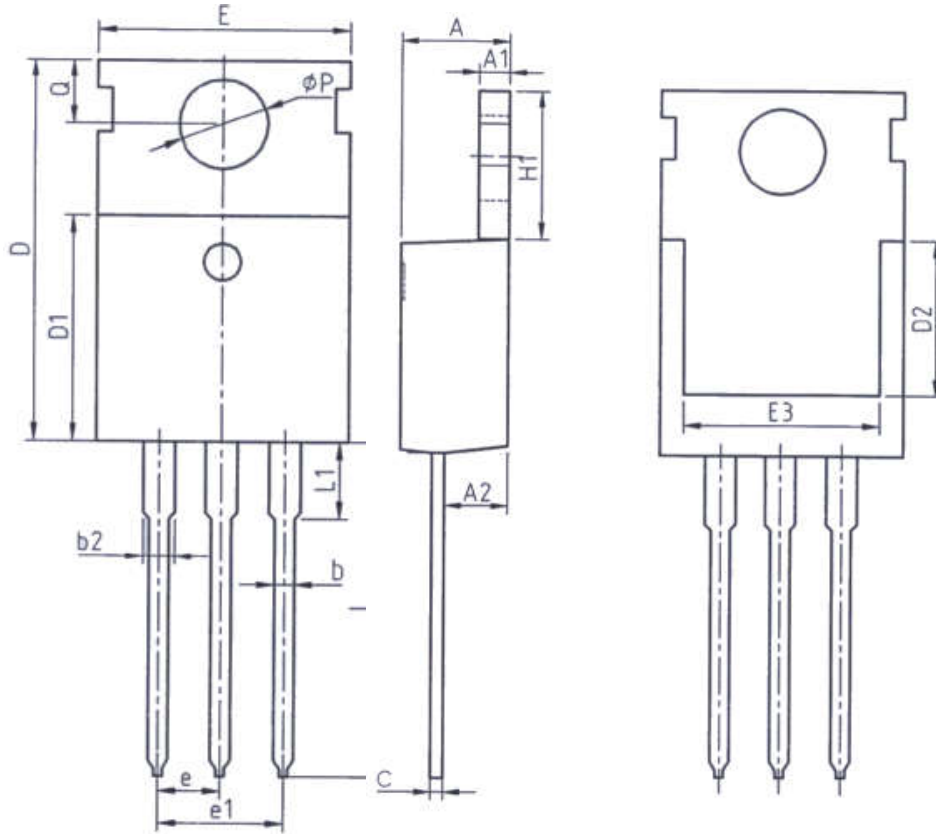


## TO-220F



Unit: mm			Unit: mm		
Symbol	Min.	Max.	Symbol	Min.	Max.
E	9.96	10.36	L	12.68	13.28
A	4.50	4.90	L1	2.93	3.13
A1	2.34	2.74	P	3.03	3.38
A2	0.30	0.60	P3	3.15	3.65
A4	2.56	2.96	F3	3.15	3.45
c	0.40	0.65	G3	1.25	1.55
D	15.57	16.17	b1	1.18	1.43
H1	6.70REF		b2	0.70	0.95
e	2.54BSC				

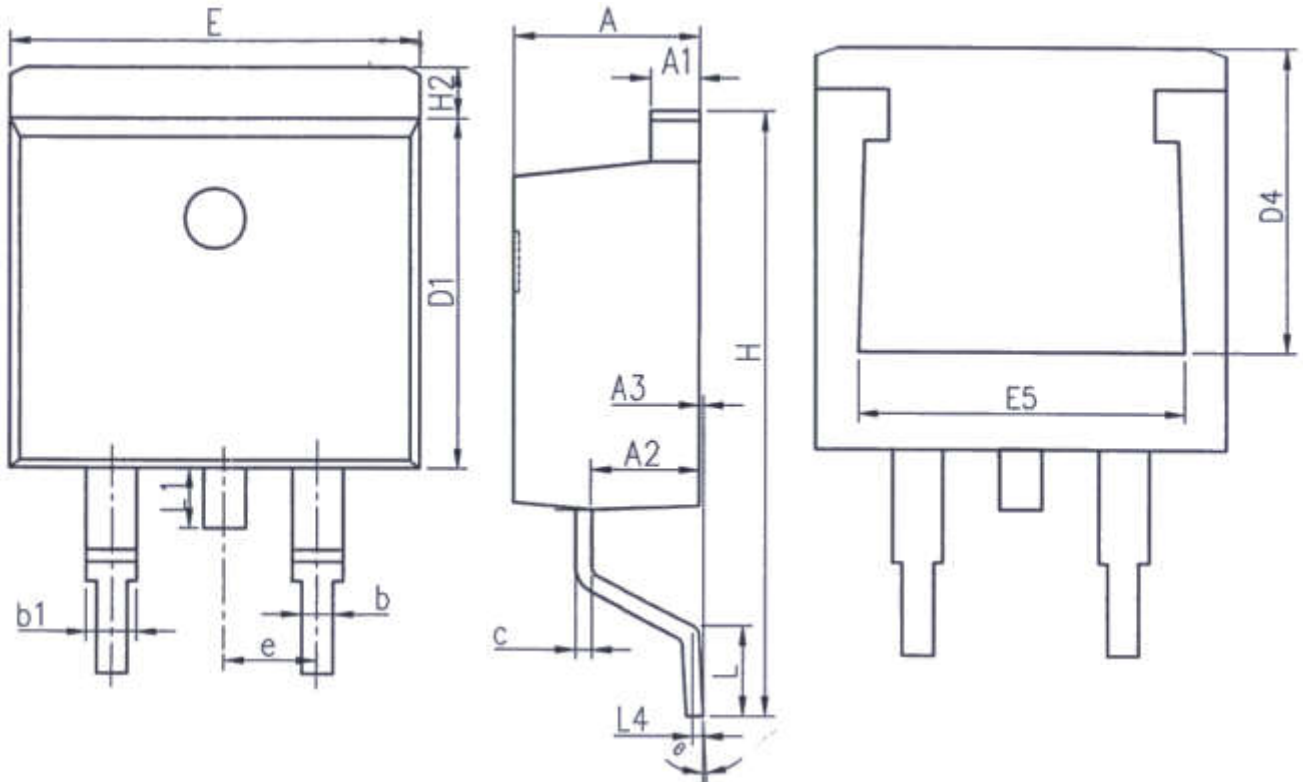
## TO-220



Unit: mm		
Symbol	Min.	Max.
A	4.37	4.77
A1	1.25	1.45
A2	2.20	2.60
b	0.70	0.95
b2	1.17	1.47
c	0.40	0.65
D	15.10	16.10
D1	8.80	9.40
D2	5.50	-

Unit: mm		
Symbol	Min.	Max.
E	9.70	10.30
E3	7.00	-
e	2.54BSC	
e1	5.08BSC	
H1	6.25	6.85
L	12.75	13.80
L1	-	3.40
P	3.40	3.80
Q	2.60	3.00

## TO-263

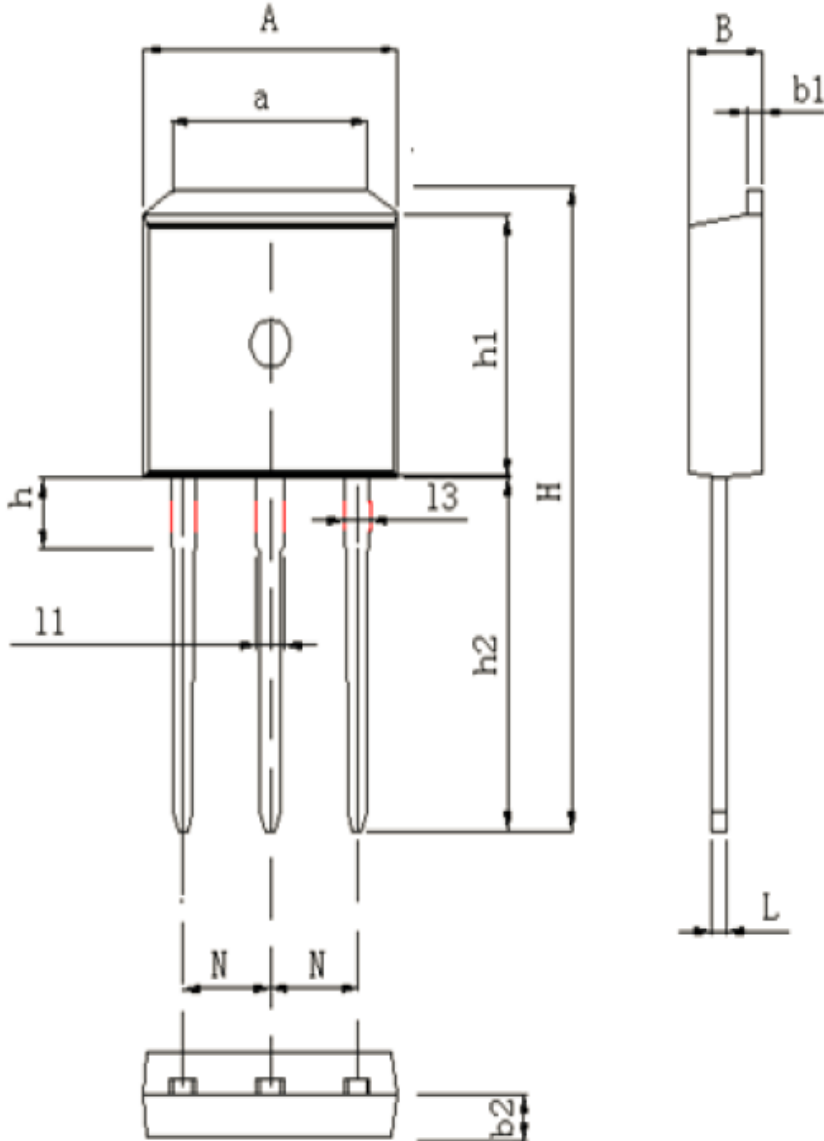


Unit: mm		
Symbol	Min.	Max.
A	4.37	4.77
A1	1.22	1.42
A2	2.49	2.89
A3	0.00	0.25
b	0.70	0.96
b1	1.17	1.47
c	0.30	0.53
D1	8.50	8.90
D4	6.60	-

Unit: mm		
Symbol	Min.	Max.
E	9.86	10.36
E5	7.06	-
e	2.54BSC	
H	14.70	15.50
H2	1.07	1.47
L	2.00	2.60
L1	1.40	1.70
L4	0.25BSC	
θ	0°	9°



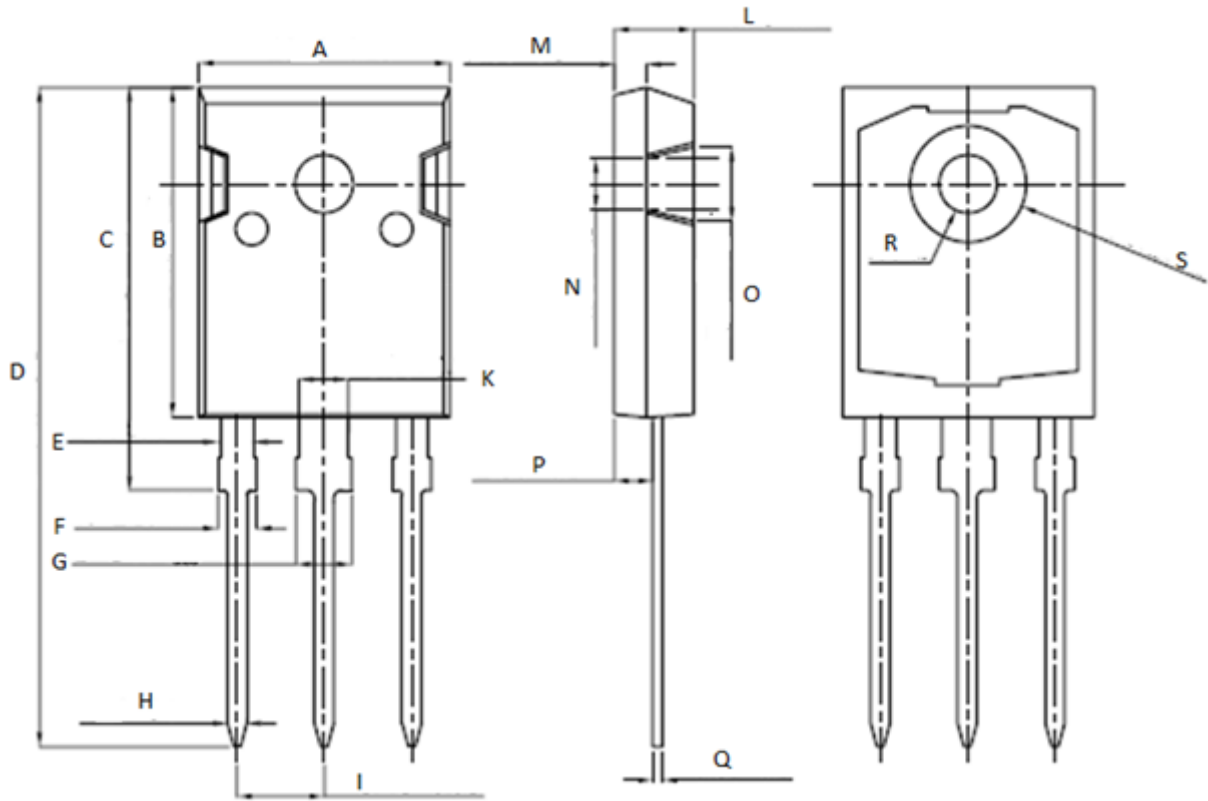
## TO-262



DIM	MILLIMETERS
A	$9.98 \pm 0.2$
a	$7.4 \pm 0.4$
B	$4.5 \pm 0.2$
b1	$1.3 \pm 0.05$
b2	$2.4 \pm 0.2$
H	$23.9 \pm 0.3$
h	$3.1 \pm 0.2$
h1	$9.16 \pm 0.2$
h2	$13.2 \pm 0.2$
L	$0.5 \pm 0.1$
11	$1.3 \pm 0.1$
12	$0.8 \pm 0.1$
N	$2.45 \pm 0.1$

Unit :mm

## TO-247



Unit: mm		
Symbol	Min.	Max.
A	15.95	16.25
B	20.85	21.25
C	20.95	21.35
D	40.5	40.9
E	1.9	2.1
F	2.1	2.25
G	3.1	3.25
H	1.1	1.3
I	5.40	5.50

Unit: mm		
Symbol	Min.	Max.
K	2.90	3.10
L	4.90	5.30
M	1.90	2.10
N	4.50	4.70
O	5.40	5.60
P	2.29	2.49
Q	0.51	0.71
R	φ 3.5	φ 3.7
S	φ 7.1	φ 7.3