



# 650V N-Channel MOSFET

## Description

### 650V N-Channel MOSFET

VDMOSFET is a double-diffusion device which the current flows is vertically, and is a voltage-controlled device. Under the control of the appropriate gate voltage, the semiconductor surface is inverted, forming a conductive channel and an appropriate amount of current flows between Drain and Source. Compared with bipolar transistor, its switching speed and switching loss are small. High input impedance, low driving power, good frequency characteristics, In particular, it has a negative temperature coefficient.

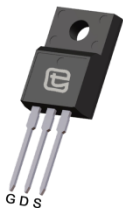
## Features

- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

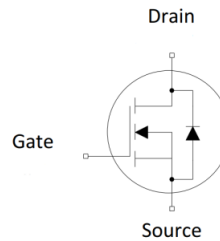
## Applications

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

TO-220F



TO-247



## Device Marking and Package Information

Device	Package	Marking
TMA20N65HG	TO-220F	A20N65HG
TMW20N65HG	TO-247	W20N65HG



<b>Absolute Maximum Ratings</b> $T_C = 25^{\circ}\text{C}$ , unless otherwise noted			
Parameter	Symbol	Values	Unit
Drain-Source Voltage ( $V_{GS} = 0\text{V}$ )	$V_{DSS}$	650	V
Continuous Drain Current	$I_D$	20	A
Pulsed Drain Current (note1)	$I_{DM}$	80	A
Gate-Source Voltage	$V_{GSS}$	$\pm 30$	V
Single Pulse Avalanche Energy (note2)	$E_{AS}$	605	mJ
Avalanche Current (note1)	$I_{AR}$	11	A
Repetitive Avalanche Energy (note1)	$E_{AR}$	363	mJ
Power Dissipation For TO-220F	$P_D$	120	W
Power Dissipation For TO-247		120	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	-55~+150	$^{\circ}\text{C}$

<b>Thermal Resistance For TO-220F</b>			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{thJC}$	1.04	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	62.5	

<b>Thermal Resistance For TO-247</b>			
Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case	$R_{thJC}$	1.04	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	50	



Electrical Characteristics $T_J = 25^\circ\text{C}$ , unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	650	--	--	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = 650V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	$\mu A$
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 30V$	--	--	$\pm 100$	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	3.0	--	4.0	V
Drain-Source On-State Resistance (Note3)	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 10A$	--	0.35	0.4	$\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{GS} = 0V,$ $V_{DS} = 25V,$ $f = 1.0\text{MHz}$	--	2701	--	pF
Output Capacitance	$C_{oss}$		--	249.5	--	
Reverse Transfer Capacitance	$C_{rss}$		--	24.8	--	
Total Gate Charge	$Q_g$	$V_{DD} = 520V,$ $I_D = 20A,$ $V_{GS} = 10V$	--	80	--	nC
Gate-Source Charge	$Q_{gs}$		--	12	--	
Gate-Drain Charge	$Q_{gd}$		--	34	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 325V,$ $I_D = 20A,$ $R_G = 25\Omega$	--	54	--	ns
Turn-on Rise Time	$t_r$		--	48.4	--	
Turn-off Delay Time	$t_{d(off)}$		--	301	--	
Turn-off Fall Time	$t_f$		--	85	--	
<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	$I_{SM}$		--	--	80	
Body Diode Voltage	$V_{SD}$	$T_J = 25^\circ\text{C}, I_{SD} = 10A, V_{GS} = 0V$	--	--	1.4	V
Reverse Recovery Time	$t_{rr}$	$V_{GS} = 0V, I_S = 20A,$ $di_F/dt = 100A/\mu s$	--	741	--	ns
Reverse Recovery Charge	$Q_{rr}$		--	4.71	--	$\mu C$

**Notes**

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L=10\text{mH}, V_{DD} = 50V, R_G = 25\Omega, \text{Starting } T_J = 25^\circ\text{C}$
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

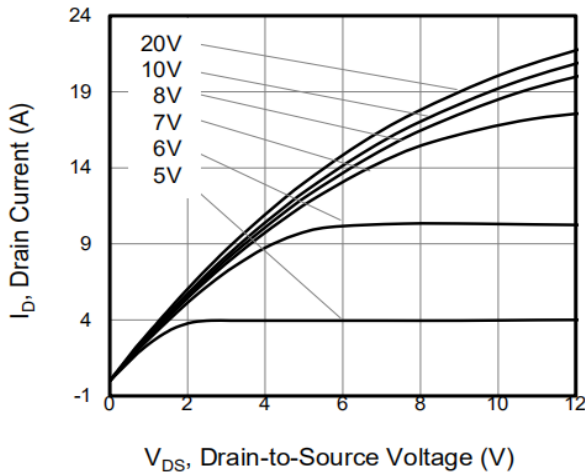


Figure 2. Body Diode Forward Voltage

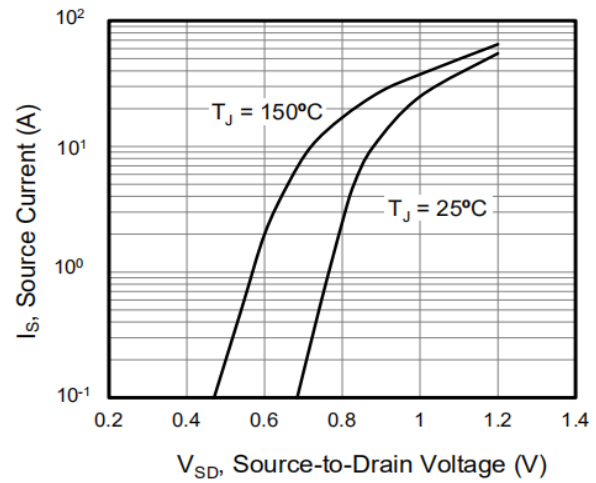


Figure 3. Drain Current vs. Temperature

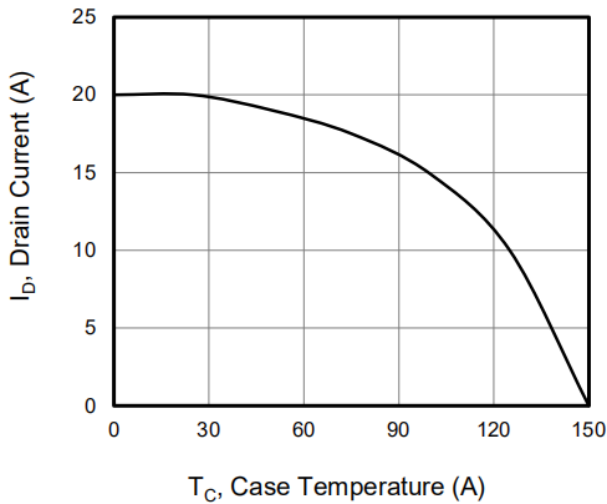


Figure 4.  $BV_{DSS}$  Variation vs. Temperature

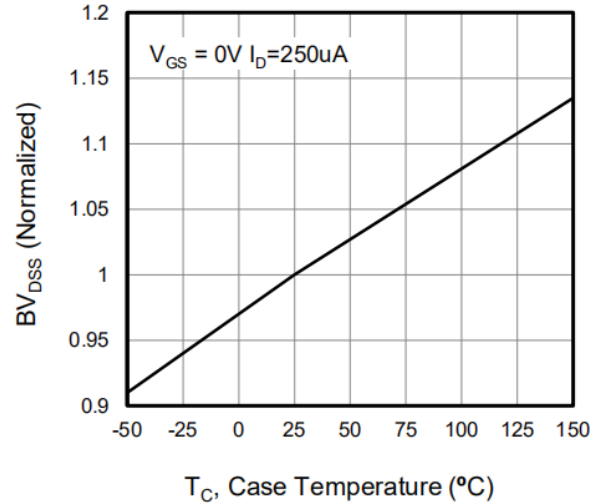


Figure 5. Transfer Characteristics

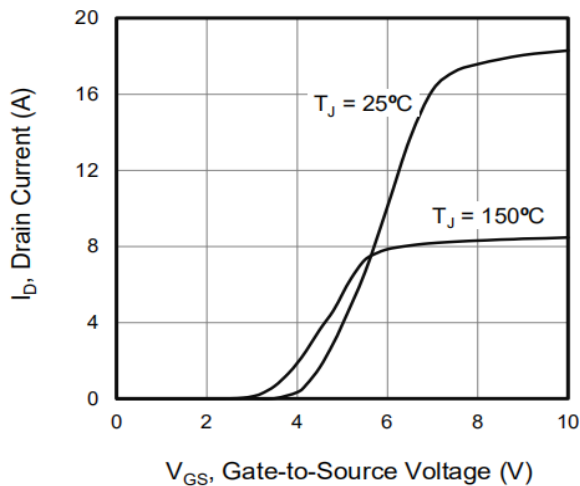
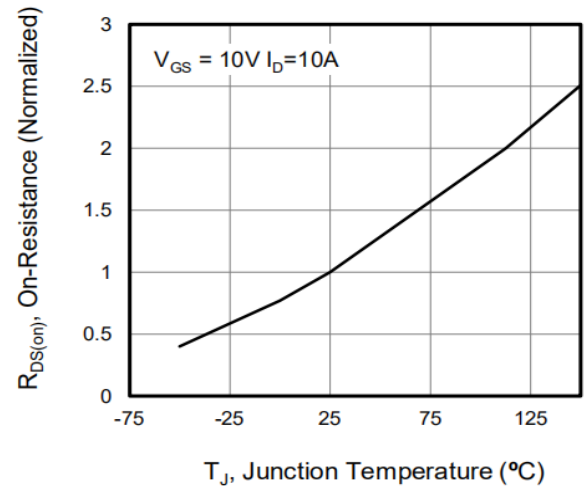


Figure 6. On-Resistance vs. Temperature





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

Figure 7. Capacitance

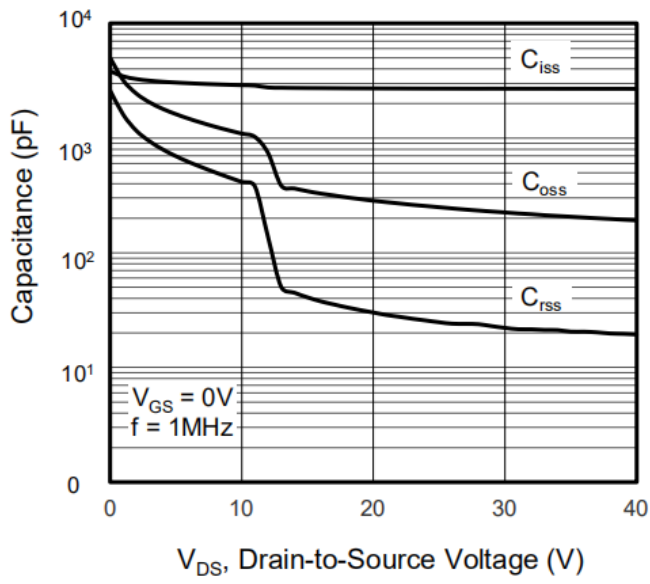


Figure 8. Gate Charge

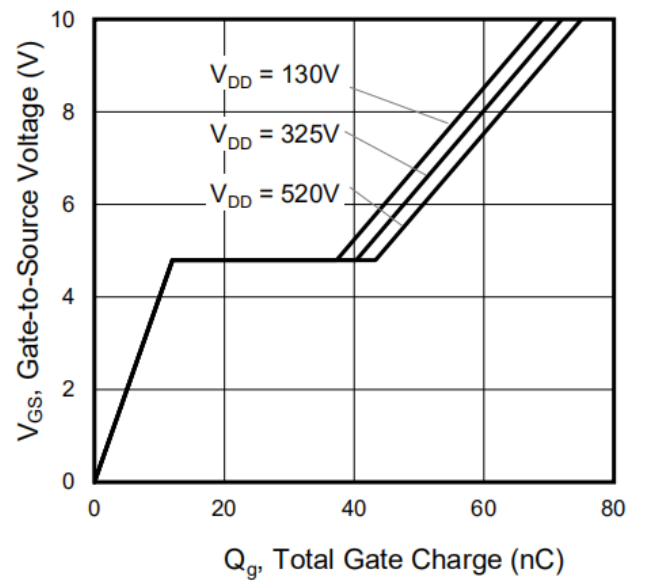




Figure A: Gate Charge Test Circuit and Waveform

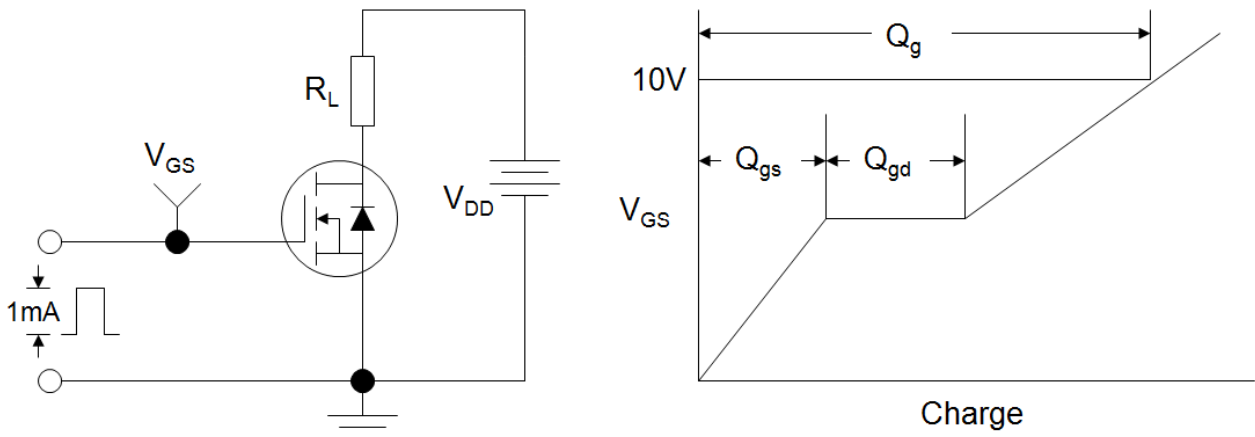


Figure B: Resistive Switching Test Circuit and Waveform

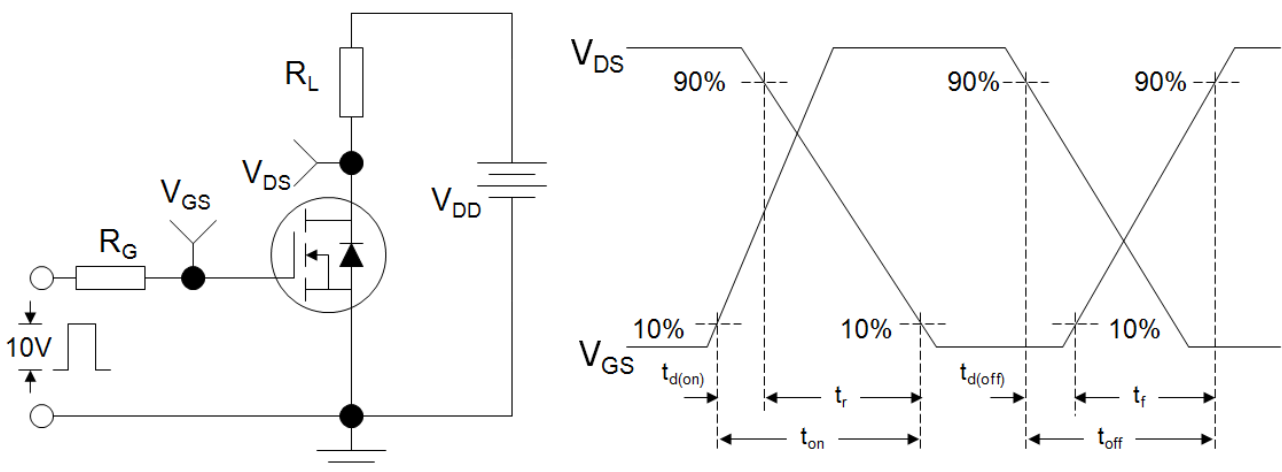
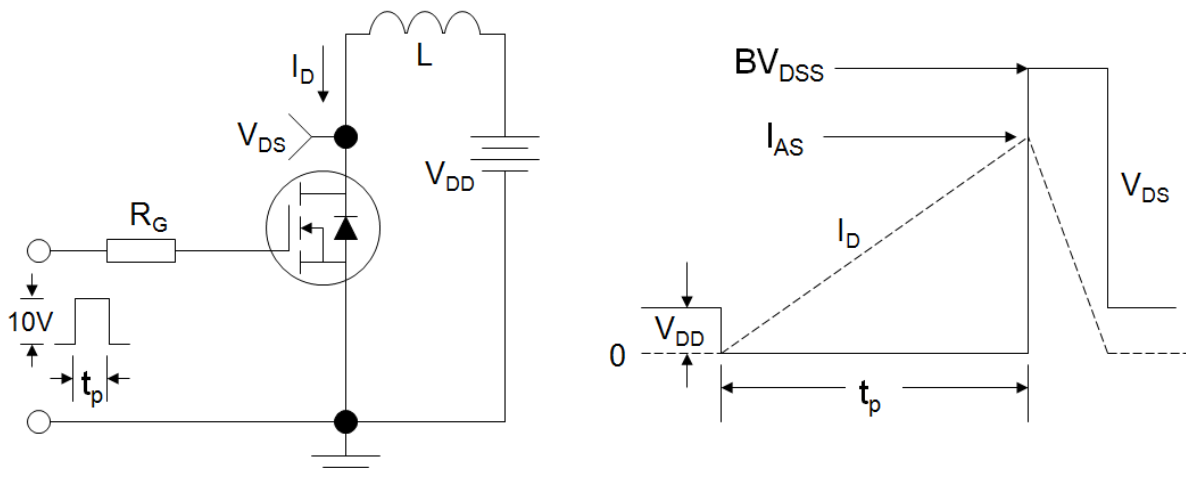
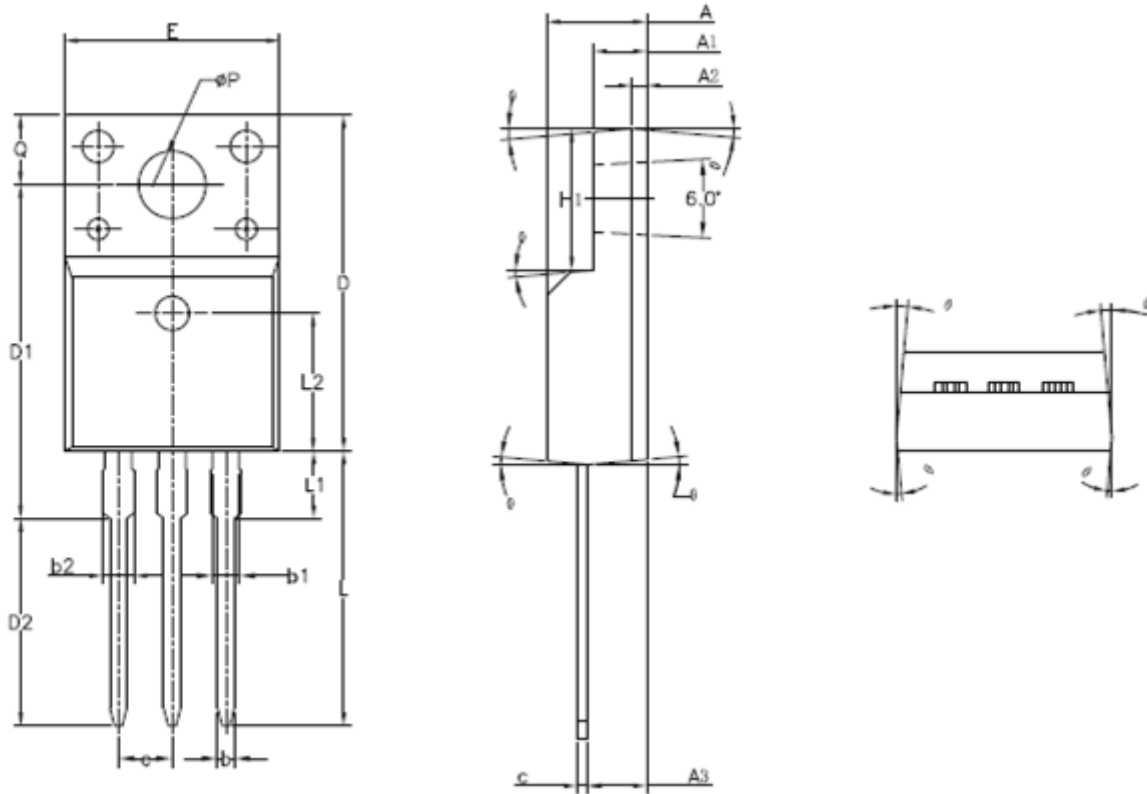


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





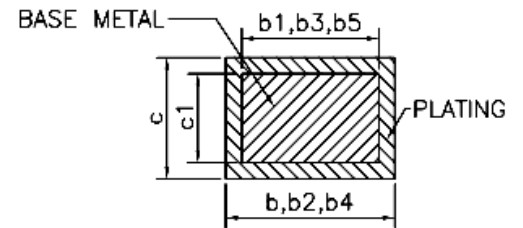
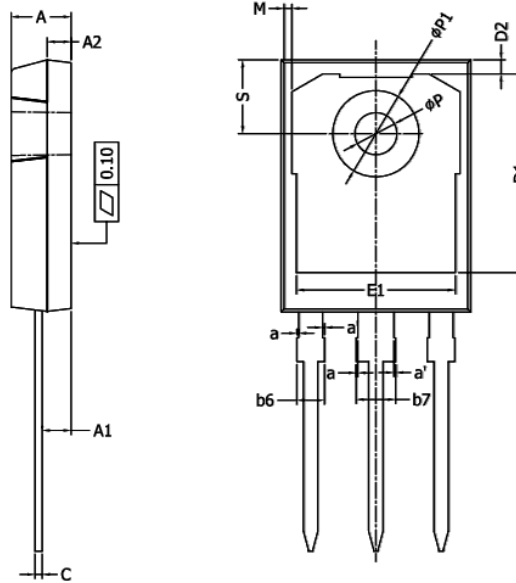
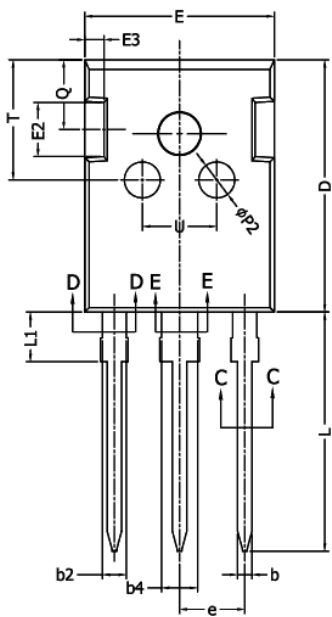
# TO-220F



SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
A3	2.56	2.76	2.93
b	0.70	—	0.90
b1	1.18	—	1.38
b2	—	—	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	9.60	9.80	10.0
E	9.96	10.16	10.36
e	2.54BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	—	—	3.50
L2	6.50REF		
$\phi P$	3.08	3.18	3.28
Q	3.20	—	3.40
$\theta$	1°	3°	5°



# TO-247



SYMBOL	MIN	NOM	MAX
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
a	0	---	0.15
a'	0	---	0.15
b	1.16	---	1.26
b1	1.15	1.2	1.22
b2	1.96	---	2.06
b3	1.95	2.00	2.02
b4	2.96	---	3.06
b5	2.96	3.00	3.02
b6	---	---	2.25
b7	---	---	3.25
c	0.59	---	0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.17	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.40	4.50	4.60
E3	2.40	2.50	2.60
e	5.436 BSC		
L	19.80	19.92	20.10
L1	---	---	4.30
M	0.35	---	0.95
P	3.40	3.50	3.60
P1	7.00	---	7.40
P2	2.40	2.50	2.60
Q	5.60	---	6.00
S	6.05	6.15	6.25
T	9.80	---	10.20
U	6.00	---	6.40





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