

N-channel 650V, 20A, 0.19Ω Super-Junction Power MOSFET

Features

- ◆ Ultra-fast body diode
- ◆ Very low FOM $R_{DS(on)} \times Q_g$
- ◆ 100% UIS tested
- ◆ RoHS compliant

Applications

- ◆ Power factor correction (PFC).
- ◆ Switched mode power supplies (SMPS).
- ◆ Uninterrupted power supply (UPS).

Product Summary

$V_{DS} @ T_{j,25^\circ C}$	650V
$R_{DS(on),max}$	0.19Ω
I_D	20A
$Q_{g,typ}$	48.8 nC



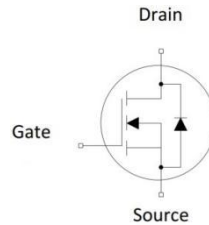
TO-220F



TO-220



TO-247



N-Channel MOSFET

Marking information

Product	Package	Marking	Packing method
SPW20N60AS	TO-220F	20N60A	Tube
SPW20N60BS	TO-220	20N60B	Tube
SPW20N60CS	TO-247	SPW20N60	Tube

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DSS}	650	V
Continuous drain current ($T_C = 25^\circ C$) ($T_C = 100^\circ C$)	I_D	20 13	A
Pulsed drain current ¹⁾	I_{DM}	60	A
Gate-Source voltage	V_{GSS}	± 30	V
Avalanche energy, single pulse ²⁾	E_{AS}	405	mJ
Power Dissipation TO-220/TO-247 ($T_C = 25^\circ C$) - Derate above $25^\circ C$	P_D	338 2.7	W W/ $^\circ C$
Power Dissipation TO-220F ($T_C = 25^\circ C$) - Derate above $25^\circ C$	P_D	50 0.4	W W/ $^\circ C$
Operating and Storage Temperature Range	T_J, T_{STG}	-55 to +150	$^\circ C$
Continuous diode forward current	I_S	20	A
Diode pulse current	$I_{S,pulse}$	60	A
MOSFET dv/dt ruggedness, $V_{DS}=0...480V$	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS}=0...480V$	dv/dt	50	V/ns

Thermal Characteristics

Parameter	Symbol	Value		Unit
		TO-220 TO-247	TO-220F	
Thermal Resistance, Junction-to-Case	$R_{\theta JC}$	0.37	2.5	$^{\circ}\text{C/W}$
Thermal Resistance, Junction-to-Ambient	$R_{\theta JA}$	54.6	48	$^{\circ}\text{C/W}$
Soldering temperature, wave soldering only allowed at leads. (1.6mm from case for 10s)	T_{sold}	260	260	$^{\circ}\text{C}$

Electrical Characteristics

 $T_c = 25^{\circ}\text{C}$ unless otherwise noted

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static characteristics						
Drain-source breakdown voltage	BV _{DSS}	V _{GS} =0 V, I _D =250uA	650	-	-	V
Gate threshold voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250uA	2.5		4.5	V
Drain cut-off current	I _{DSS}	V _{DS} =650 V, V _{GS} =0 V, T _j = 25°C T _j = 125°C	- -	- 10	5	μA
Gate leakage current, Forward	I _{GSSF}	V _{GS} =30 V, V _{DS} =0 V	-	-	100	nA
Gate leakage current, Reverse	I _{GSSR}	V _{GS} =-30 V, V _{DS} =0 V	-	-	-100	nA
Drain-source on-state resistance	R _{DS(on)}	V _{GS} =10 V, I _D =10 A T _j = 25°C	- - -	0.16	0.19	Ω
Dynamic characteristics						
Input capacitance	C _{iss}	V _{DS} = 100 V, V _{GS} = 0 V, f = 1MHz	-	1637	-	pF
Output capacitance	C _{oss}		-	88	-	
Reverse transfer capacitance	C _{rss}		-	0.62	-	
Turn-on delay time	t _{d(on)}	V _{DD} = 400V, I _D = 10A R _G = 10Ω, V _{GS} =10V	-	22	-	ns
Rise time	t _r		-	26	-	
Turn-off delay time	t _{d(off)}		-	60	-	
Fall time	t _f		-	23	-	
Gate charge characteristics						
Gate to source charge	Q _{gs}	V _{DD} =520 V, I _D =10A, V _{GS} =0 to 10 V	-	11	-	nC
Gate to drain charge	Q _{gd}		-	21	-	
Gate charge total	Q _g		-	44	-	
Gate plateau voltage	V _{plateau}		-	5.5	-	V
Reverse diode characteristics						
Diode forward voltage	V _{SD}	V _{GS} =0 V, I _F =10A	-	-	1.2	V
Reverse recovery time	t _{rr}	V _R =400 V, I _F =10A, dI _F /dt=100 A/μs	-	136	-	ns
Reverse recovery charge	Q _{rr}		-	0.74	-	μC
Peak reverse recovery current	I _{rrm}		-	11	-	A

Notes:

- Limited by maximum junction temperature, maximum duty cycle is 0.75.
- $I_{AS} = 9\text{A}$, $V_{DD} = 50\text{V}$, Starting $T_J = 25^{\circ}\text{C}$.

Electrical Characteristics Diagrams

Figure 1. Output Characteristics

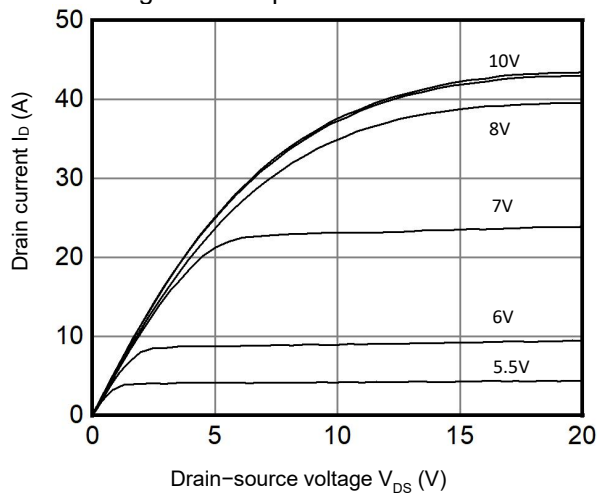


Figure 2. Transfer Characteristics

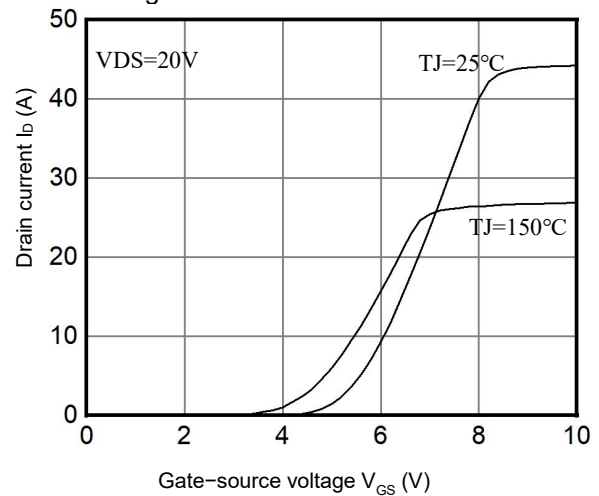


Figure 3. On-Resistance vs. Drain Current

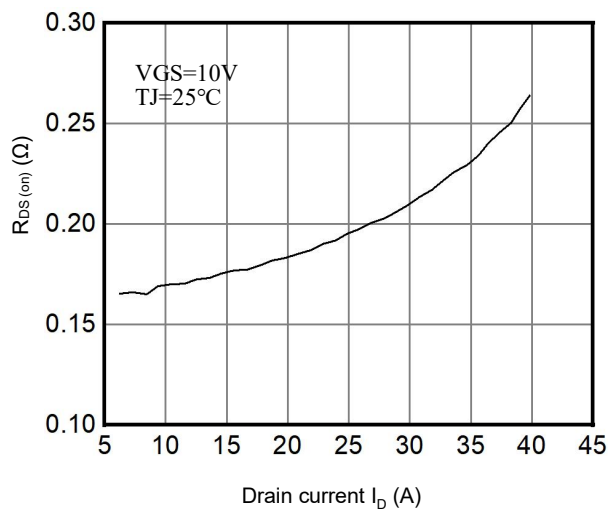


Figure 4. Capacitance Characteristics

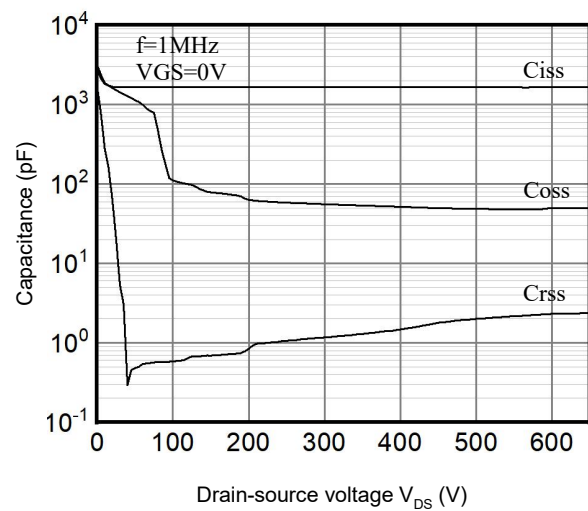


Figure 5. Gate Charge Characteristics

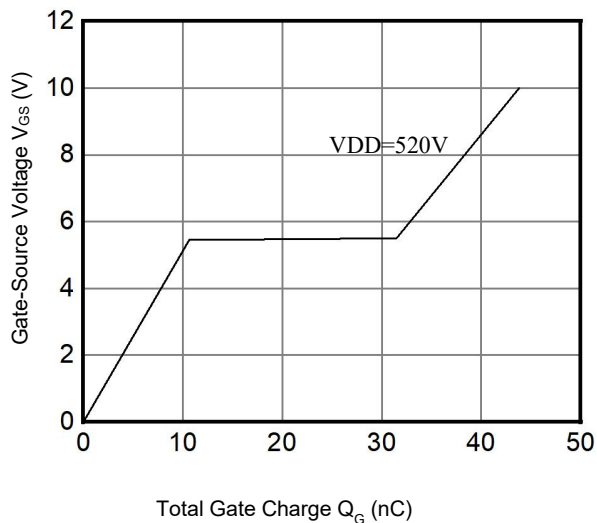


Figure 6. Body Diode Forward Voltage

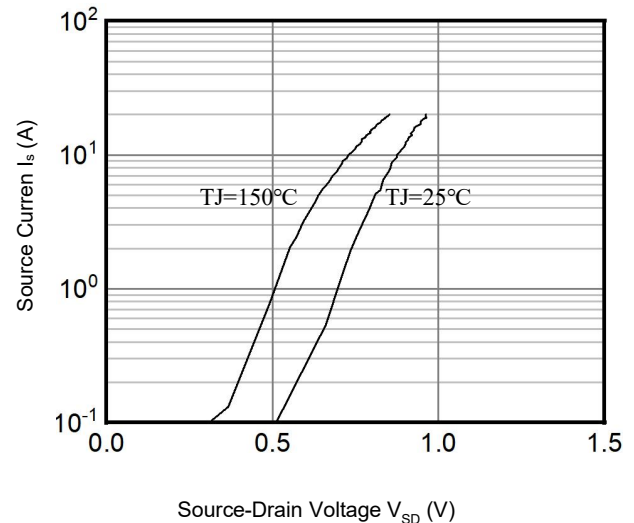


Figure 7. Breakdown Voltage vs. Temperature

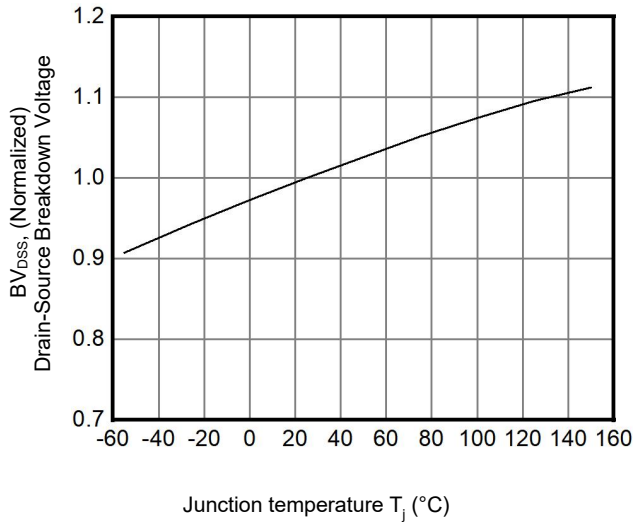
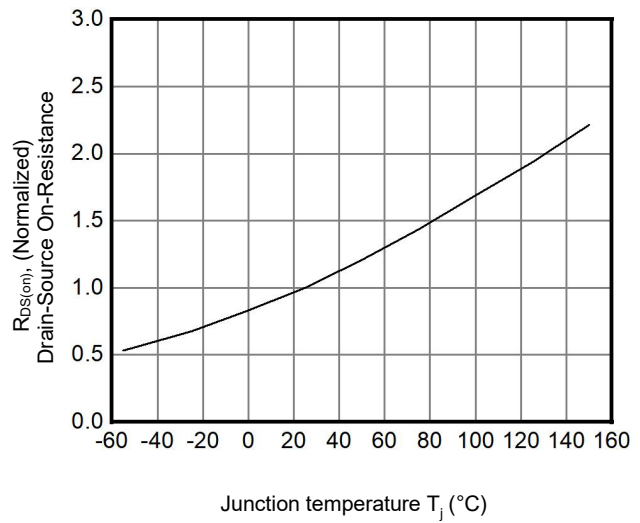
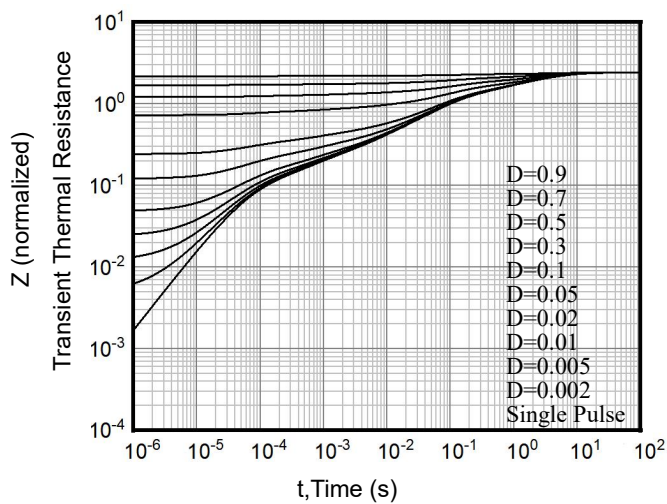
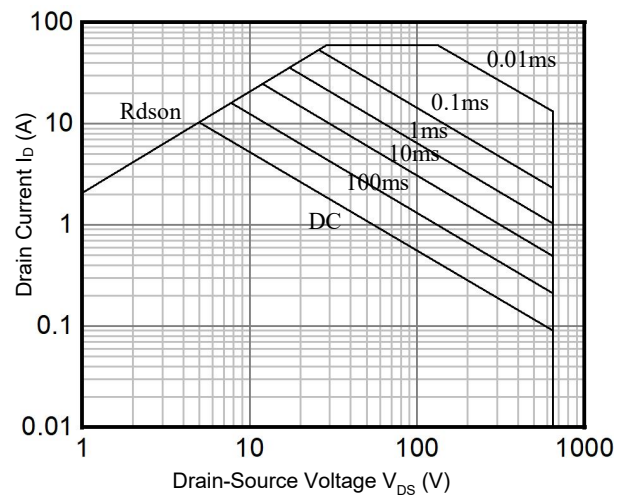
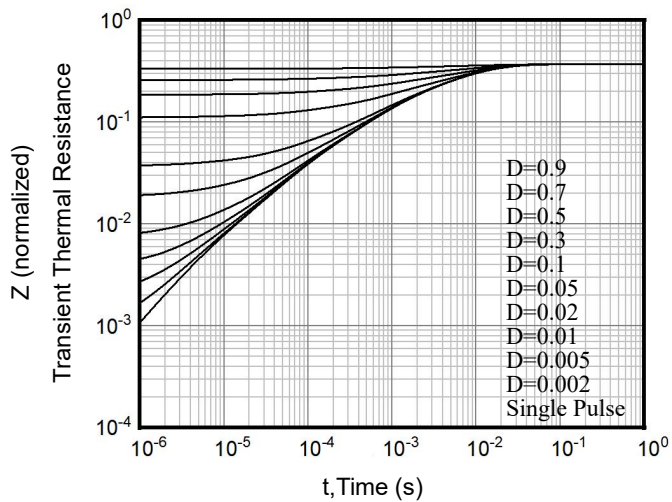
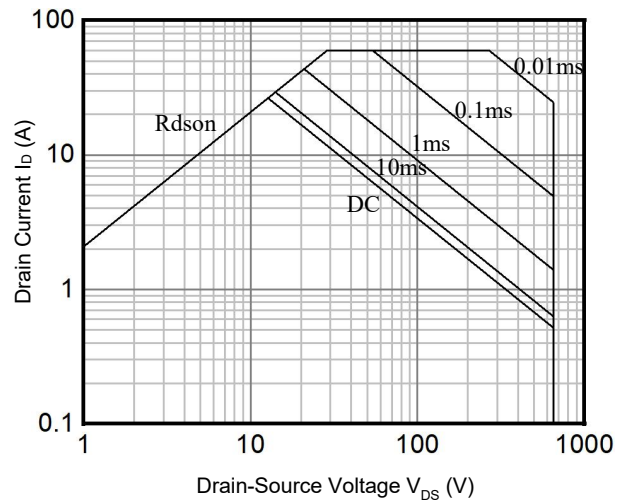
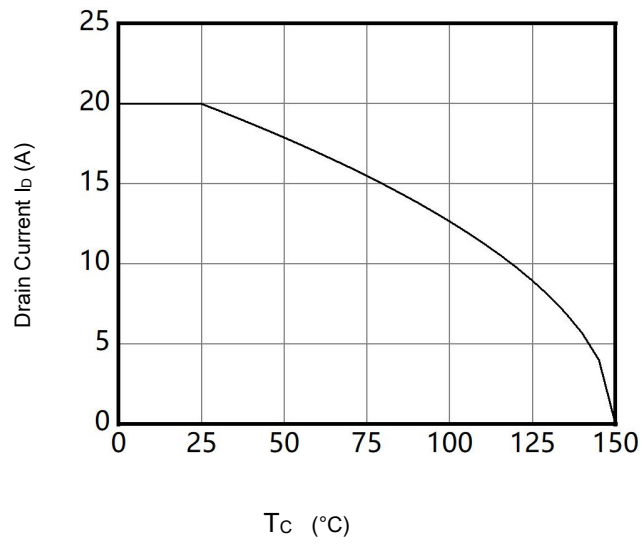
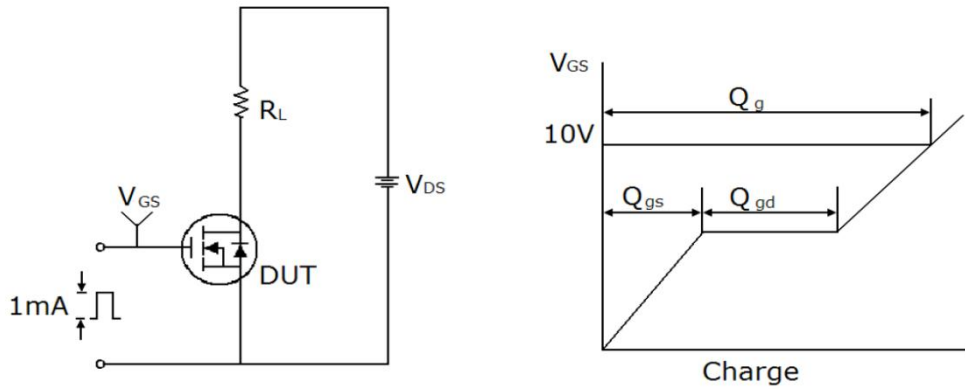


Figure 8. On-Resistance vs. Temperature

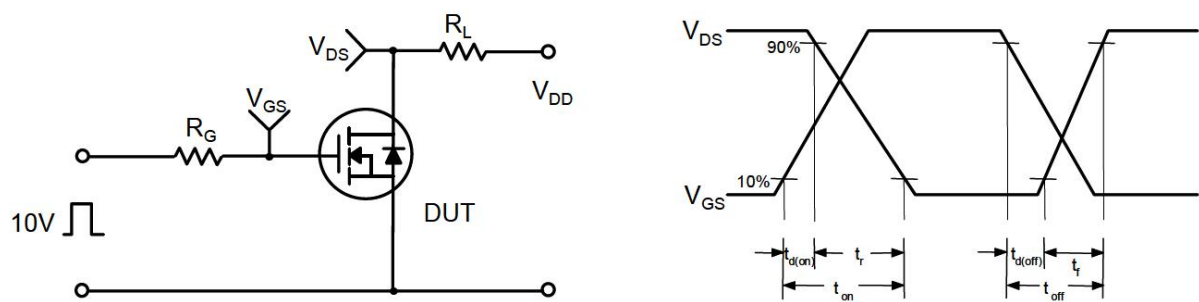

Figure 9. Transient Thermal Impedance
TO-220F

Figure 10. Maximum Safe Operating Area
TO-220F

Figure 11. Transient Thermal Impedance
TO-220/TO-247

Figure 12. Maximum Safe Operating Area
TO-220/TO-247




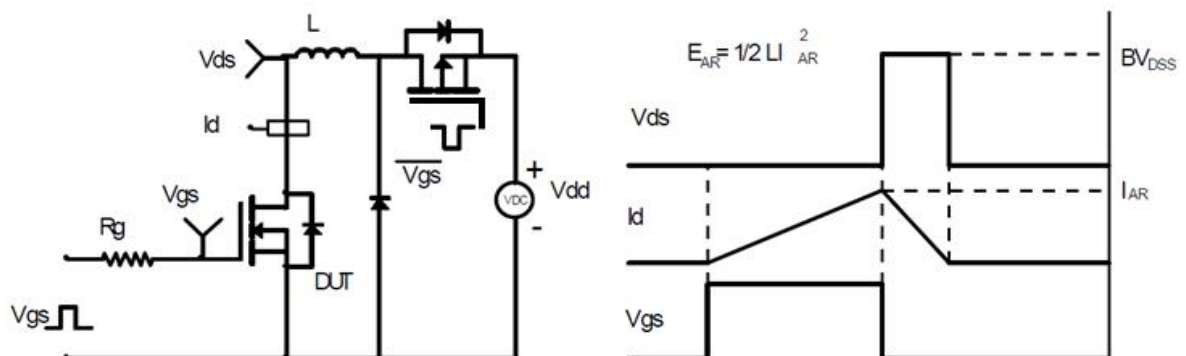
Gate Charge Test Circuit & Waveform



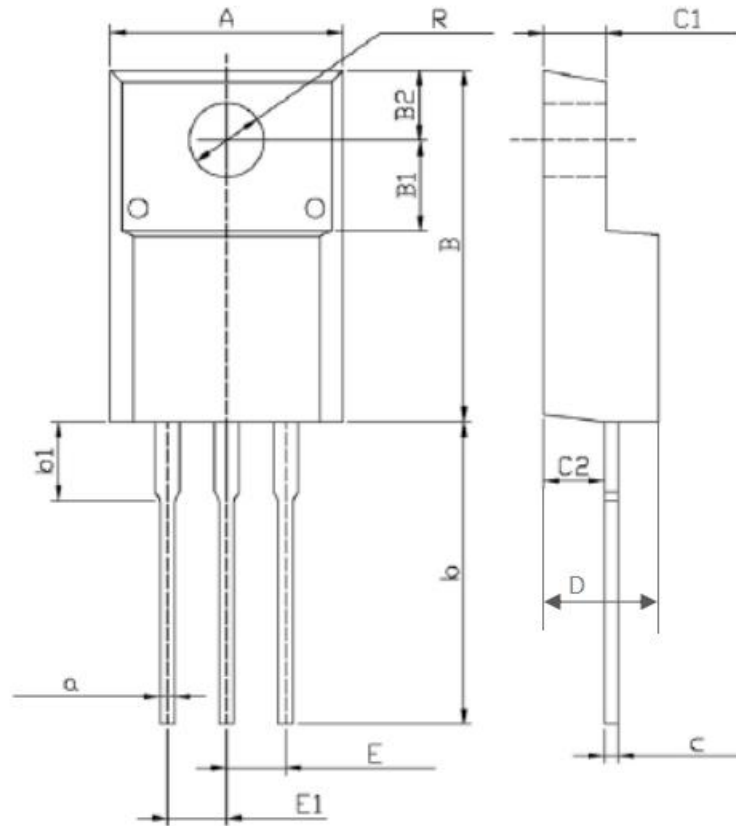
Switching Test Circuit & Waveform



Unclamped Inductive Switching Test Circuit & Waveform

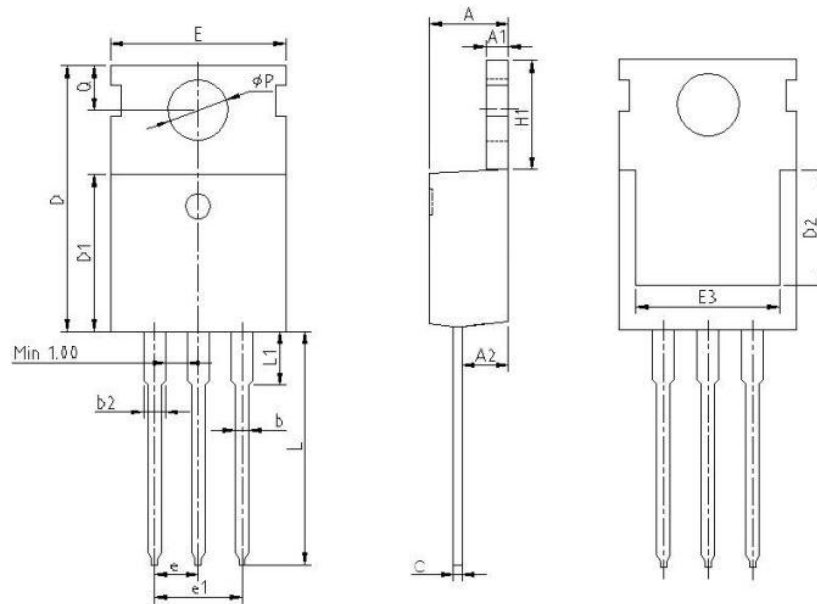


Mechanical Dimensions for TO-220F



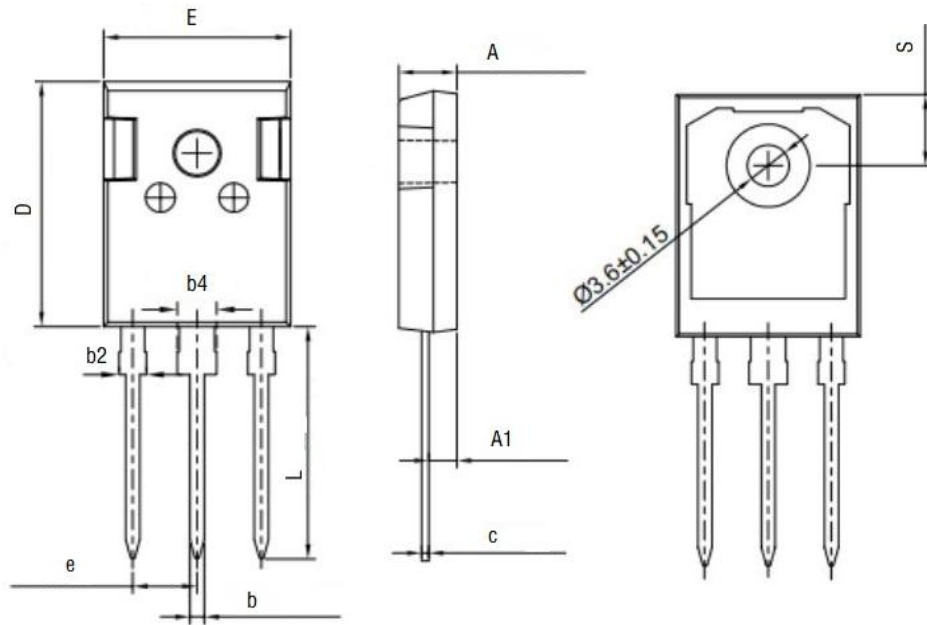
SYMBOL	mm	
	MIN	MAX
D	4.30	5.00
A	9.70	10.50
B	14.70	16.17
B1	3.80	4.00
B2	2.90	3.60
R	3.00	3.62
b	12.50	14.00
b1	1.85	3.90
a	0.55	0.95
E	2.29	2.79
E1	2.29	2.79
C1	2.24	2.90
C2	2.46	3.06
c	0.40	0.70

Mechanical Dimensions for TO-220



SYMBOL	mm	
	MIN	MAX
A	4.30	4.70
A1	1.20	1.40
A2	2.20	2.60
b	0.70	0.90
b2	1.17	1.47
c	0.40	0.60
D	15.10	16.10
D1	9.00	9.40
D2	5.50	—
E	9.70	10.20
E3	7.00	—
e	2.54BSC	
e1	5.08BSC	
H1	6.25	6.85
L	12.58	13.60
L1	3.0REF	
ØP	3.50	3.70
Q	2.60	3.00

Mechanical Dimensions for TO 247



SYMBOL	mm	
	MIN	MAX
A	4.80	5.20
A1	2.41BSC	
b	1.10	1.30
b2	MAX2.20	
b4	MAX3.20	
c	0.50	0.70
D	20.80	21.20
E	15.60	16.00
e	5.44BSC	
L	19.62	20.22
Ø	3.45	3.75
S	6.15BSC	