

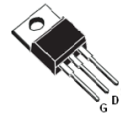
## 600V N-Channel Super Junction power MOSFET

### DESCRIPTION

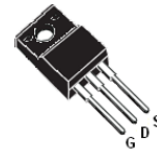
SJ MOSFET is an advanced technology for high voltage power MOSFETs, designed according to the super junction principle by Xinyuan semiconductor. The offered devices provide all benefits of a fast switching and low on resistance, making it especially suitable for applications which require more efficient, more compact, LED Lighting, High Performance Adapter etc..

$V_{DS}$	600	V
$R_{DS(ON)}$	125	m $\Omega$
$I_D$	30	A

TO-220



TO-220F



TO-247

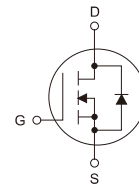


### Features

- Extremely low losses due to very low  $R_{dson} * Q_g$
- Superior Avalanche Rugged Technology
- Fast switching capability
- 100% Avalanche Tested
- Pb-free lead plating; ROHS compliant

### APPLICATIONS

- Power factor correction (PFC)
- Switched mode power supplies (SMPS)
- Uninterruptible Power Supply (UPS)
- High Performance Adapter
- LED Lighting Power



### ORDERING INFORMATION

Temperature Range	Package		Orderable Device	Package Qty.
-55°C ~ +125°C	TO-220	Pb-Free	CWS60R125AC	50 PCS/Tube
	TO-220F		CWS60R125AF	50 PCS/Tube
	TO-247		CWS60R125AZ	30 PCS/Tube



## ABSOLUTE MAXIMUM RATINGS

( $T_j=25^{\circ}\text{C}$ , unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0\text{V}$ )	$V_{DSS}$	600	V
Gate-Source Voltage ( $V_{DS}=0\text{V}$ , static)	$V_{GS}$	$\pm 30$	V
Continuous Drain Current ( $T_C=25^{\circ}\text{C}$ )(Note 1)	$I_{D(DC)}$	30	A
Continuous Drain Current ( $T_C=100^{\circ}\text{C}$ ) (Note 1)	$I_{D(DC)}$	19	A
Pulsed Drain Current (Note 2)	$I_{DM}$	89	A
MOSFET dv/dt ruggedness, $V_{DS}\leq 480\text{V}$	dv/dt	50	V/nS
Single Pulsed Avalanche Energy (Note 3)	$E_{AS}$	720	mJ
Avalanche Energy, Repetitive(Note1)	$E_{AR}$	1.2	mJ
Avalanche Current, Single Pulsed (Note 3)	$I_{AS}$	12	A
Maximum Power Dissipation ( $T_C=25^{\circ}\text{C}$ ) for TO-220, TO-220F, TO-247	$P_D$	TO-220: 219 TO-220F: 34 TO-247: 219	W
Operating, Storage Temperature Range	$T_J, T_{STG}$	-55~150	$^{\circ}\text{C}$

## THERMAL CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Units
Thermal Resistance, Junction-to-Case	$R_{thJC}$	-	-	TO-220: 0.57 TO-220F: 3.65 TO-247: 0.57	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	-	-	TO-220: 62 TO-220F: 80 TO-247: 62	$^{\circ}\text{C}/\text{W}$

## ELECTRICAL CHARACTERISTICS

( $T_j = 25^{\circ}\text{C}$ , unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	TYP.	Max.	Unit
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0\text{V}, I_D=250\mu\text{A}$	600	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=600\text{V}, V_{GS}=0\text{V}$	-	-	1	$\mu\text{A}$
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30\text{V}, V_{DS}=0\text{V}$	-	-	$\pm 100$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu\text{A}$	2.5	3.0	3.5	V
Drain-Source On-state Resistance	$R_{DS(on)}$	$V_{GS}=10\text{V}, I_D=15\text{A}$	-	0.10	0.125	$\Omega$
Gate Resistance	$R_g$	F=1MHZ, open drain	-	5.6	-	$\Omega$



## Dynamic Characteristics

( $T_j = 25^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Input capacitance	$C_{iss}$	$V_{DS}=100\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}$	-	2039	-	pF
Output capacitance	$C_{oss}$		-	127	-	
Reverse transfer capacitance	$C_{rss}$		-	2.5	-	
Turn-on delay Time	$t_{d(on)}$	$V_{DD}=400\text{V}, I_D=15\text{A}$ $R_G=3.3\Omega, V_{GS}=10\text{V}$	-	49	-	ns
Rise time	$t_r$		-	77		
Turn-off delay time	$t_{d(off)}$		-	182		
Fall time	$t_f$		-	61		

## Gate charge characteristics

( $T_j = 25^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Gate to Source Charge	$Q_{gs}$	$V_{DD}=400\text{V}, I_D=15\text{A}$ $V_{GS}=0 \text{ to } 10\text{V}$	-	12.6	-	nC
Gate to Drain Charge	$Q_{gd}$		-	16	-	
Gate Charge Total	$Q_g$		-	45.5	-	
Gate Plateau Voltage	$V_{plateau}$		-	6.4	-	V

## Reverse diode characteristics

( $T_j = 25^\circ\text{C}$ , unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Body Diode Forward Voltage	$V_{SD}$	$V_{GS}=0\text{V}, I_{SD}=15\text{A}$	-	0.9	-	V
Reverse Recovery Time	$t_{rr}$	$V_R=400\text{V}, I_F=15\text{A}$ $di_F/dt=100\text{A}/\mu\text{s}$	-	409	-	nS
Reverse Recovery Charge	$Q_{rr}$		-	8.5	-	$\mu\text{C}$
Peak Reverse Recovery Current	$I_{rrm}$		-	30	-	A

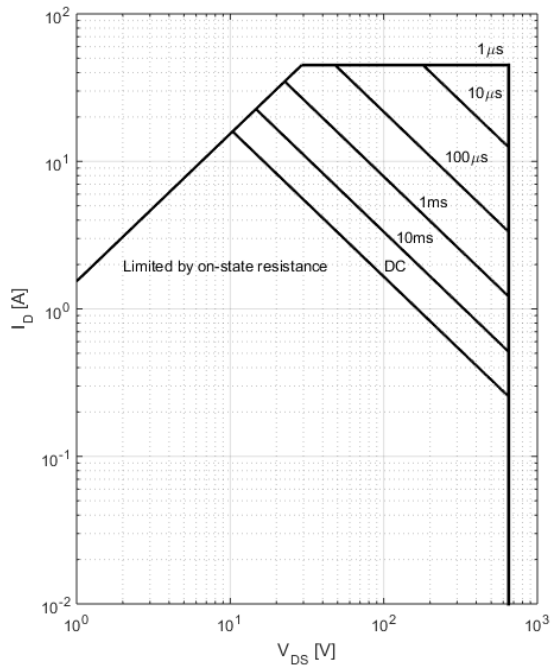
### Notes:

1. Limited by maximum junction temperature;
2. Pulse width limited by maximum junction temperature;
3.  $I_{AS} = 12\text{A}, V_{DD} = 50\text{V}, R_G = 25\Omega$ , Starting  $T_j = 25^\circ\text{C}$ .



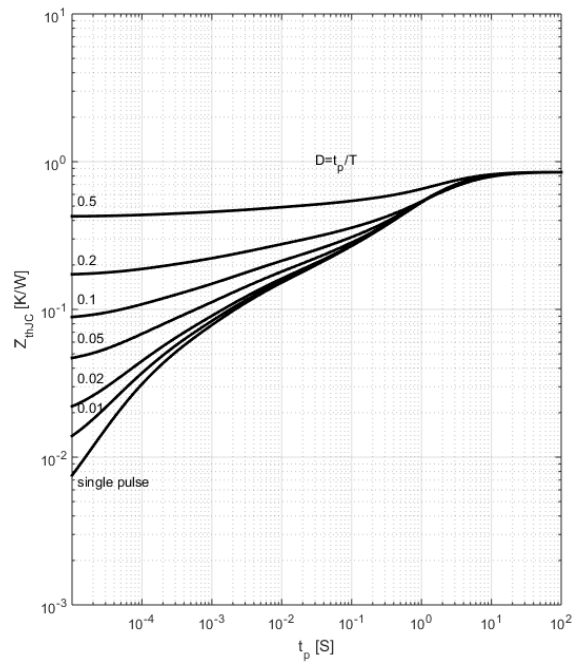
## Electrical Characteristics Diagrams

Figure 1. Safe operating area



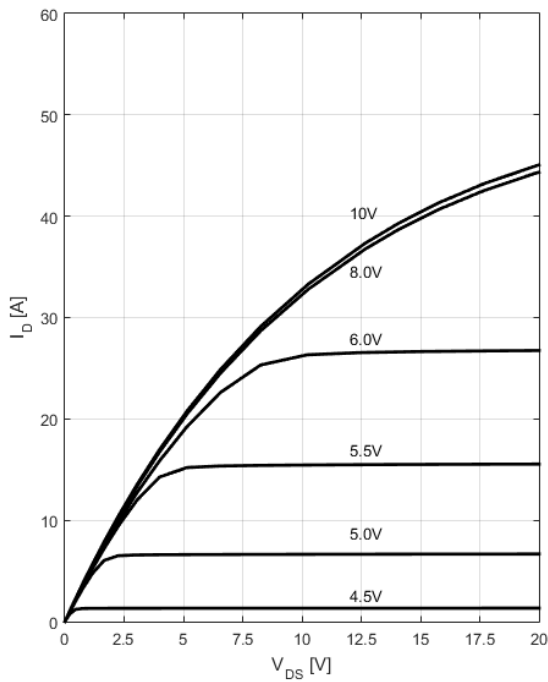
$I_D=f(V_{DS}); T_c=25\text{ }^\circ\text{C};$  parameter  $t_p$

Figure 2. Transient thermal impedance



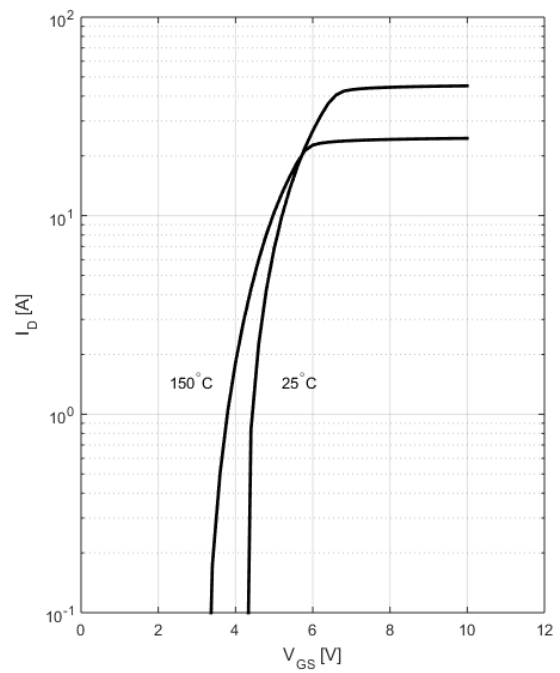
$Z_{(thJC)}=f(t_p);$  parameter:  $D=t_p/T$

Figure3. Typ. output characteristics



$I_D=f(V_{DS}); T_j=25\text{ }^\circ\text{C};$  parameter:  $V_{GS}$

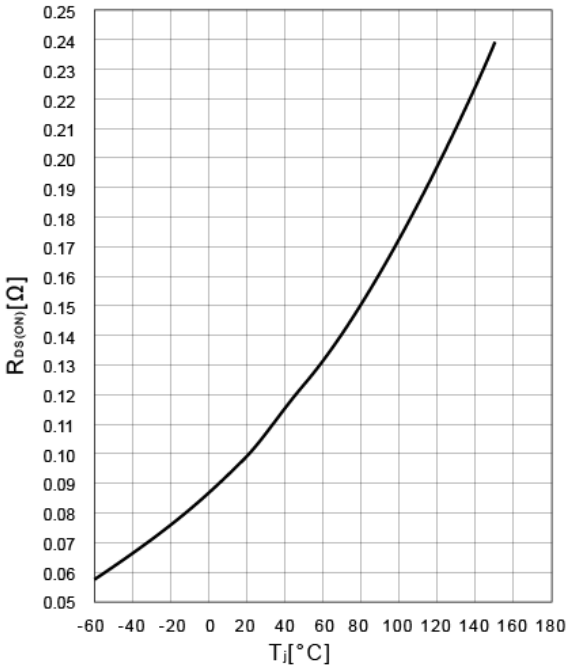
Figure 4. Typ. transfer characteristics



$I_D=f(V_{GS}); V_{DS}=20\text{V}$

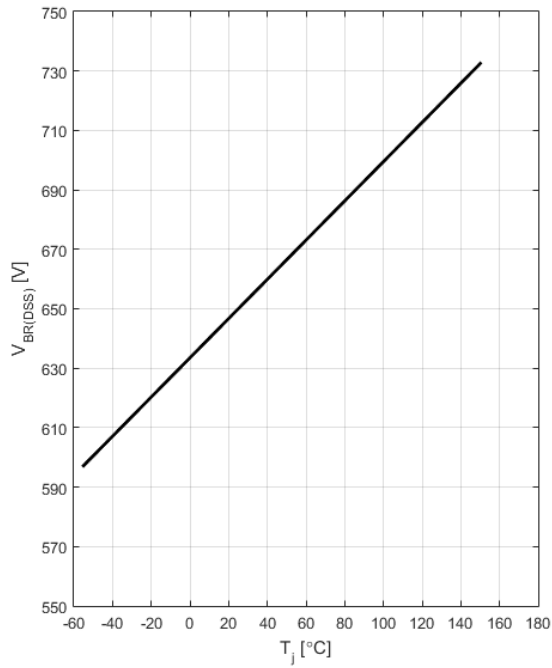


**Figure 5. Drain-source on-state resistance**



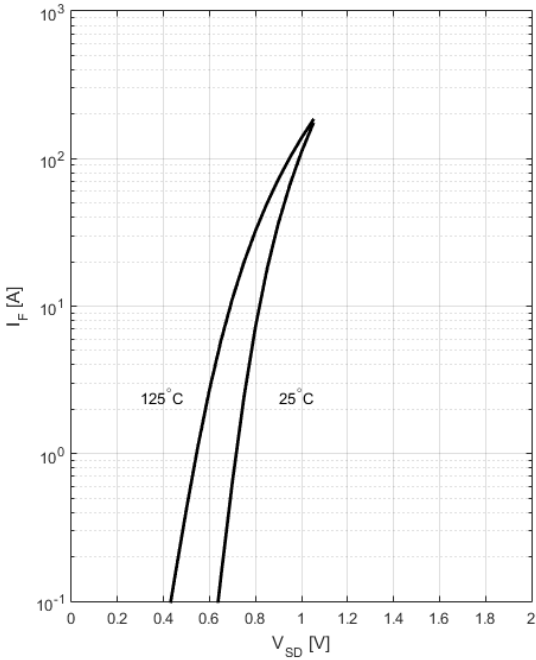
$R_{DS(ON)}=f(T_j); I_D=30A; V_{GS}=10V$

**Figure6. Drain-source breakdown voltage**



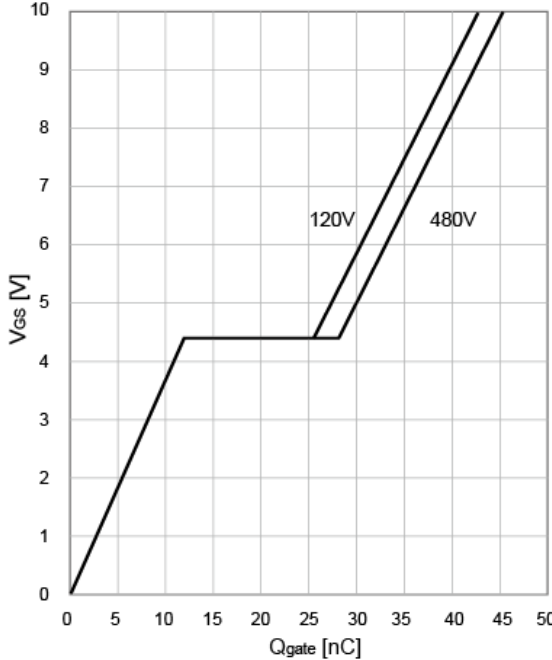
$V_{BR(DSS)}=f(T_j); I_D=10mA$

**Figure7. Forward characteristics of reverse diode**



$I_F=f(V_{SD}); \text{parameter: } T_j$

**Figure 8. Typ. gate charge**

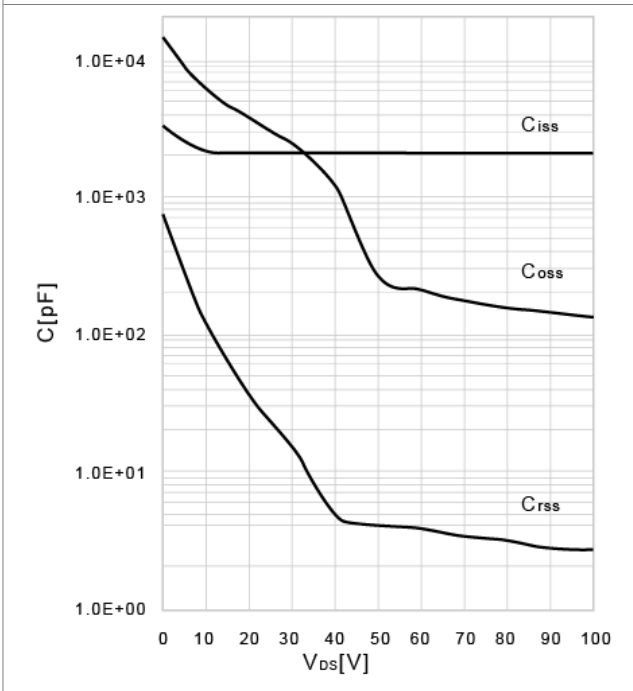


$V_{GS}=f(Q_{gate}), I_D=30A \text{ pulsed}$



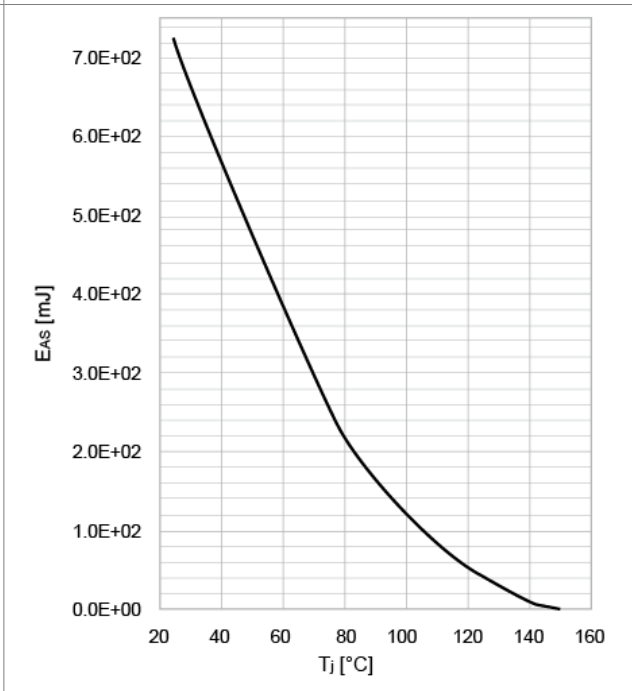
# CWS60R125A

Figure 9: Typ. capacitances



$C=f(V_{DS}); V_{GS}=0; f=1MHz$

Figure 10: Avalanche energy

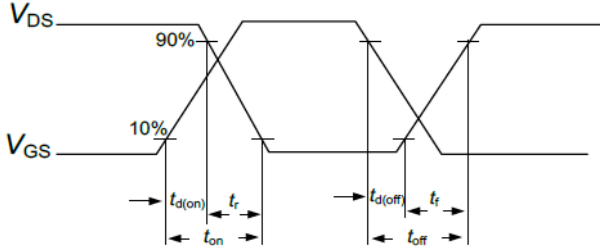
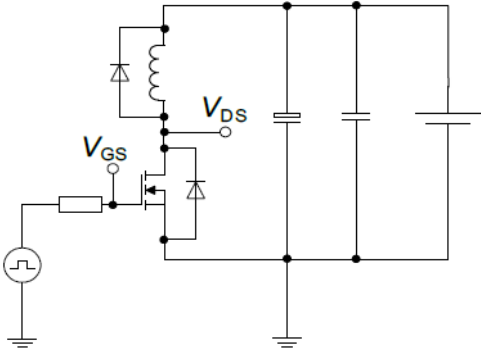


$E_{AS}=f(T_J); I_D=13A; V_{DD}=50V$

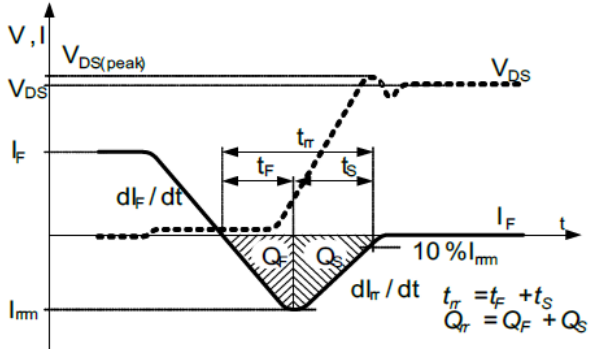
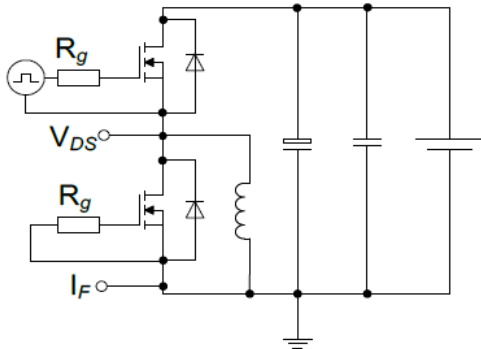


## Test Circuits

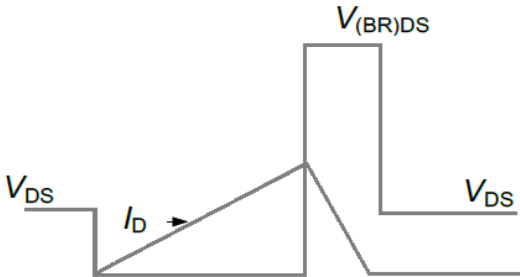
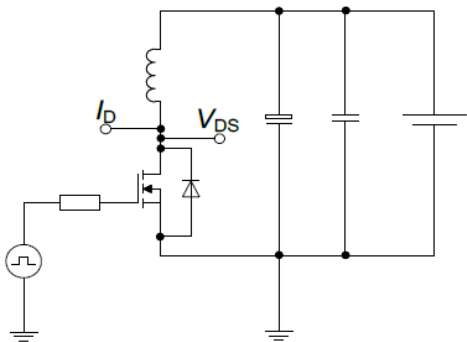
### Switch time test circuit



### Reverse diode characteristics test circuit and waveform

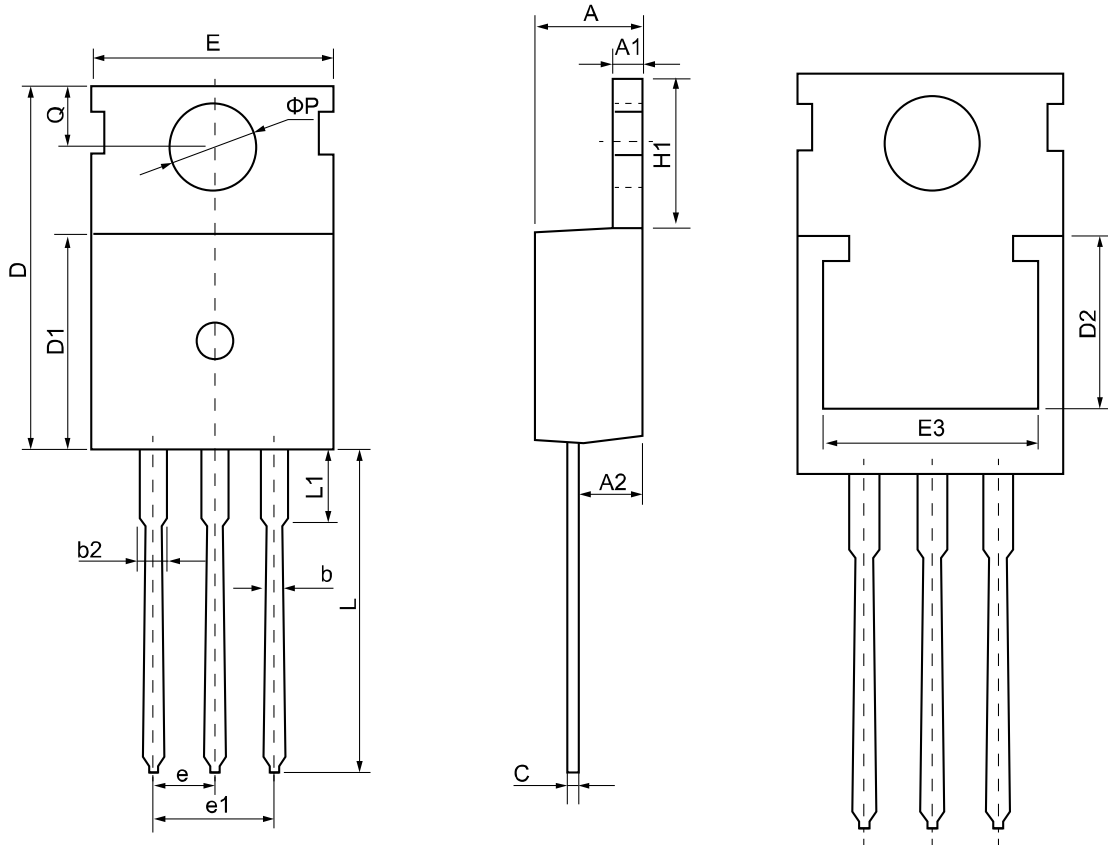


### Unclaimed inductive switching test circuit & waveform



## PHYSICAL DIMENSIONS

TO-220

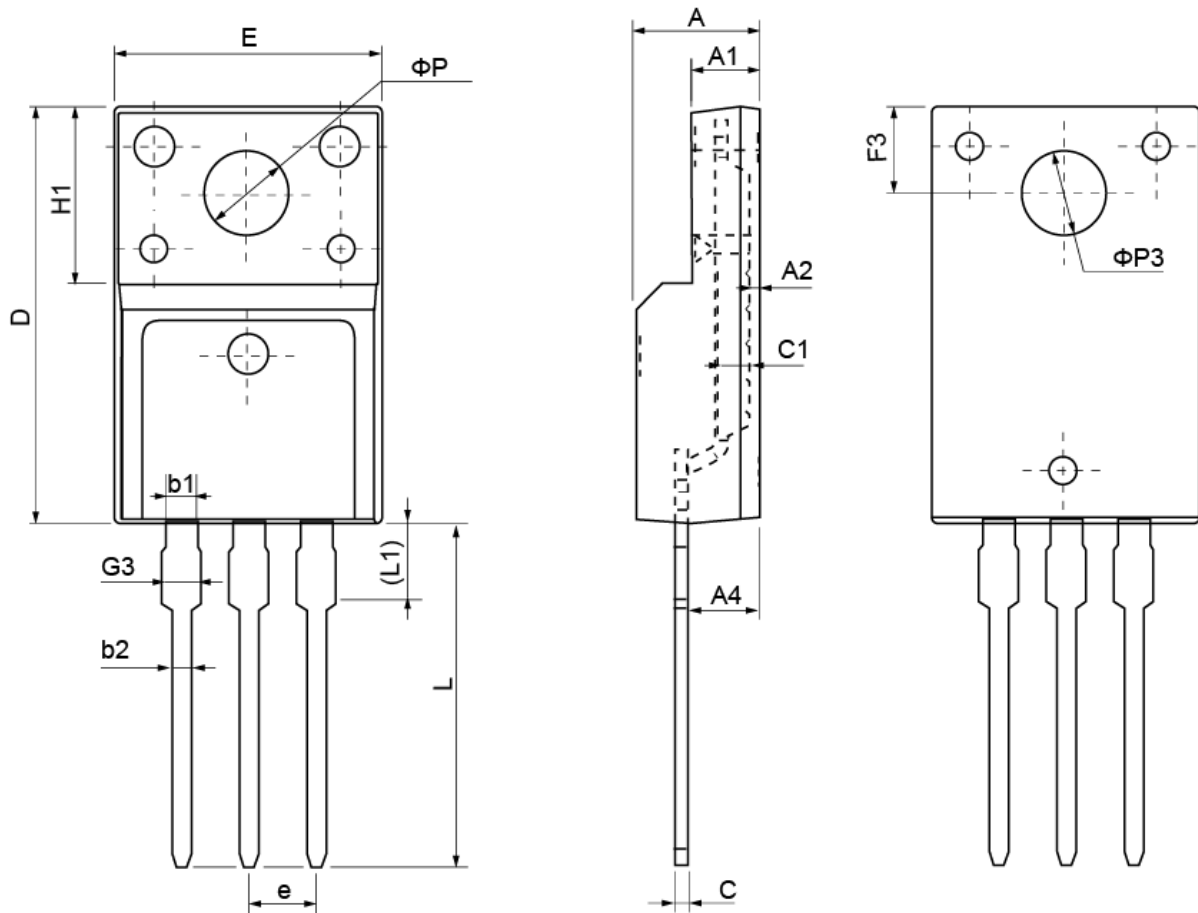


Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	Min	Nom	Max		Min	Nom	Max
A	4.37	4.57	4.77	E	9.80	10.00	10.20
A1	1.25	1.30	1.45	E3	7.00	-	-
A2	2.20	2.40	2.60	e	2.54(BSC)		
b	0.70	0.80	0.95	e1	5.08(BSC)		
b2	1.17	1.27	1.47	H1	6.30	6.50	6.80
c	0.40	0.50	0.65	L	12.75	13.50	13.80
D	15.30	15.60	15.90	L1	-	3.10	3.40
D1	8.90	9.10	9.30	ΦP	3.40	3.60	3.80
D2	5.50	-	-	Q	2.60	2.80	3.00





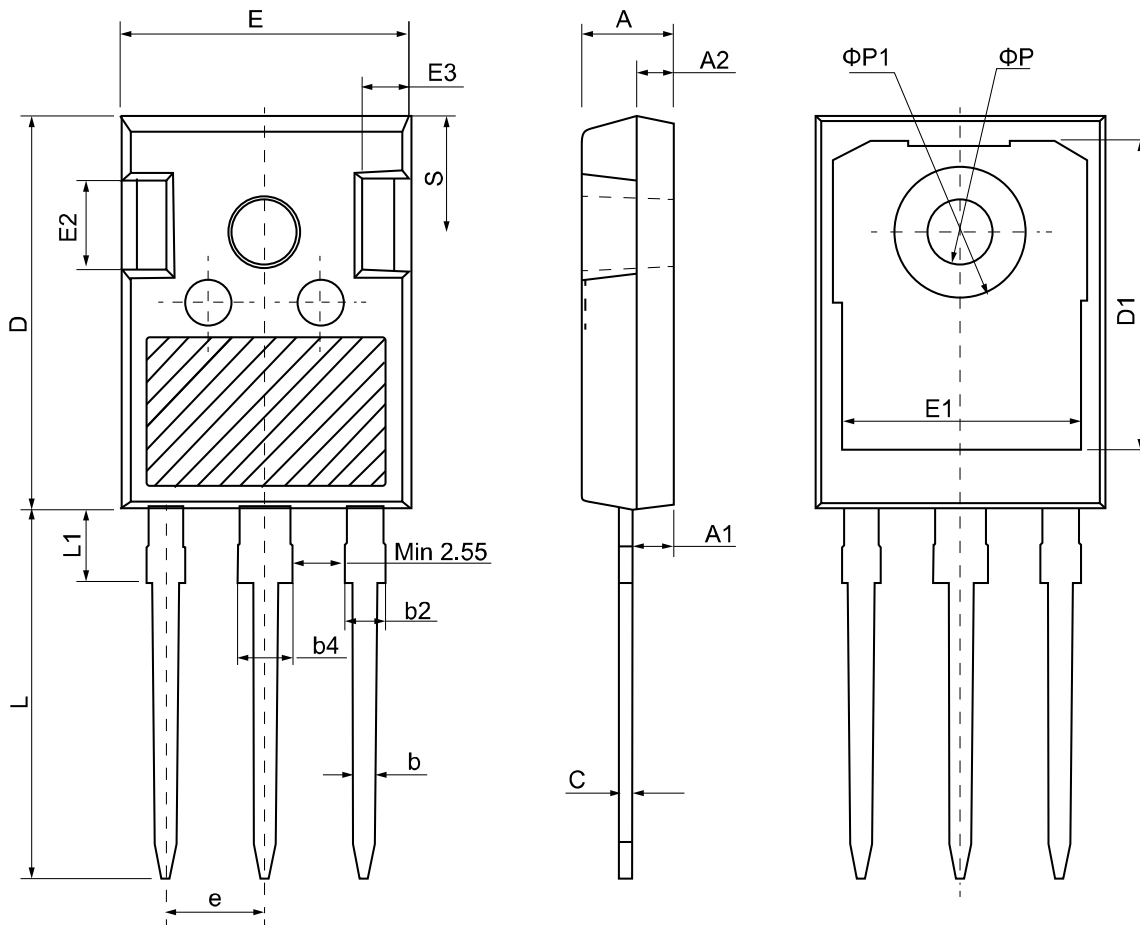
TO-220F



Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	Min	Nom	Max		Min	Nom	Max
E	9.96	10.16	10.36	e	2.54(BSC)		
A	4.50	4.70	4.90	L	12.68	12.98	13.28
A1	2.34	2.54	2.74	L1	2.93	3.03	3.13
A2	0.30	0.45	0.60	ΦP	3.03	3.18	3.38
A4	2.56	2.76	2.96	ΦP3	3.15	3.45	3.65
c	0.40	0.50	0.65	F3	3.15	3.30	3.45
c1	1.20	1.30	1.35	G3	1.25	1.35	1.55
D	15.57	15.87	16.17	b1	1.18	1.28	1.43
H1	6.70(REF)			b2	0.70	0.80	0.95



TO-247



Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	Min	Nom	Max		Min	Nom	Max
A	4.80	5.00	5.20	E1	13.00	13.30	13.60
A1	2.21	2.41	2.59	E2	4.80	5.00	5.20
A2	1.85	2.00	2.15	E3	2.30	2.50	2.70
b	1.11	1.21	1.36	e	5.44(BSC)		
b2	1.91	2.01	2.21	L	19.82	19.92	20.22
b4	2.91	3.01	3.21	L1	-	-	4.30
c	0.51	0.61	0.75	ΦP	3.40	3.60	3.80
D	20.80	21.00	21.30	ΦP1	-	-	7.30
D1	16.25	16.55	16.85	S	6.15(BSC)		
E	15.50	15.80	16.10	-	-	-	-

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