

## 650V 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..

### Features

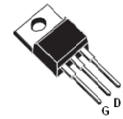
- Extremely low losses due to very low  $R_{ds(on)} * Q_g$
- Superior Avalanche Rugged Technology
- Fast switching capability
- 100% Avalanche Tested
- Pb-free lead plating; ROHS compliant

### APPLICATIONS

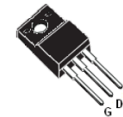
- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)
- High Performance Adapter
- LED Lighting Power

$V_{DS}$	650	V
$R_{DS(ON)}$	280	mΩ
$I_D$	15	A

TO-220



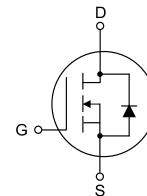
TO-220F



TO-252



TO-263-2L



### ORDERING INFORMATION

Temperature Range	Package	Orderable Device	Package Qty.
-55°C ~ +125°C	TO-220	CWS15N65AC	50 PCS/Tube
	TO-220F	CWS15N65AF	50 PCS/Tube
	TO-252	CWS15N65AD	75 PCS/Tube
		CWS15N65ADR	2500 PCS/ R&T
	TO-263-2L	CWS15N65AX	50 PCS/Tube



## ABSOLUTE MAXIMUM RATINGS

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0\text{V}$ )	$V_{DSS}$	650	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)	$I_{D(DC)}$	15	A
Continuous Drain Current ( $T_C=100^{\circ}\text{C}$ ) (Note 1)	$I_{D(DC)}$	10	A
Pulsed Drain Current (Note 2)	$I_{DM}$	45	A
MOSFET dv/dt ruggedness, $V_{DS}\leq 480\text{V}$	dv/dt	50	V/nS
Single Pulsed Avalanche Energy (Note 3)	$E_{AS}$	400	mJ
Avalanche Energy, Repetitive (Note 1)	$E_{AR}$	0.7	mJ
Avalanche Current, Repetitive (Note 1)	$I_{AR}$	7.5	A
Maximum Power Dissipation ( $T_C=25^{\circ}\text{C}$ )	$P_D$	33	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	$R_{thJC}$	-	-	3.8	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	$R_{thJA}$	-	-	80	$^{\circ}\text{C}/\text{W}$

## ELECTRICAL CHARACTERISTICS

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

Parameter	Symbol	Test Conditions	Min.	TYP.	Max.	Unit
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0\text{V}, I_D=250\mu\text{A}$	650	-	-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=650\text{V}, V_{GS}=0\text{V}$	-	-	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	$R_{DS(on)}$	$V_{GS}=10\text{V}, I_D=7.5\text{A}$	-	0.25	0.28	$\Omega$
Gate Resistance	$R_g$	F=1MHZ, open drain	-	10.3	-	$\Omega$



## Dynamic Characteristics

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

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Input capacitance	$C_{iss}$	$V_{DS}=100\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}$	-	1036	-	pF
Output capacitance	$C_{oss}$		-	44.2	-	
Reverse transfer capacitance	$C_{rss}$		-	2.16	-	
Turn-on delay Time	$t_{d(on)}$	$V_{DD}=480\text{V}, I_D=15\text{A}$ $R_G=6.8\Omega, V_{GS}=10\text{V}$	-	26	-	ns
Rise time	$t_r$		-	34		
Turn-off delay time	$t_{d(off)}$		-	109		
Fall time	$t_f$		-	36		

## Gate charge characteristics

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

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Gate to Source Charge	$Q_{gs}$	$V_{DD}=480\text{V}, I_D=15\text{A}$ $V_{GS}=0$ to $10\text{V}$	-	5.0	-	nC
Gate to Drain Charge	$Q_{gd}$		-	8.4	-	
Gate Charge Total	$Q_g$		-	24	-	
Gate Plateau Voltage	$V_{plateau}$		-	4.4	-	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	$t_{rr}$	$V_R=480\text{V}, I_F=15\text{A}$ $di_F/dt=100\text{A}/\mu\text{s}$	-	270	-	nS
Reverse Recovery Charge	$Q_{rr}$		-	4.1	-	$\mu\text{C}$
Peak Reverse Recovery Current	$I_{rrm}$		-	22.8	-	A

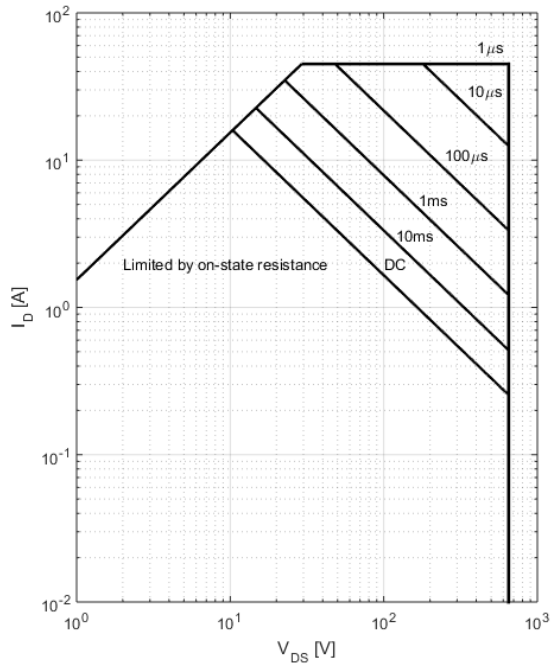
### Notes:

- Limited by maximum junction temperature;
- Pulse width limited by maximum junction temperature;
- $I_{AS} = 9\text{ A}$ ,  $V_{DD} = 50\text{ V}$ ,  $R_G = 25\ \Omega$ , Starting  $T_j = 25^\circ\text{C}$ .



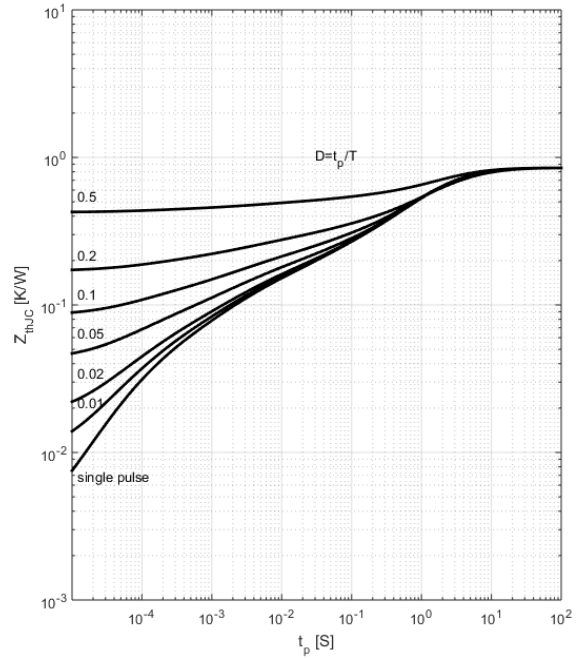
## ELECTRICAL CHARACTERISTICS DIAGRAMS

**Figure 1. Safe operating area**



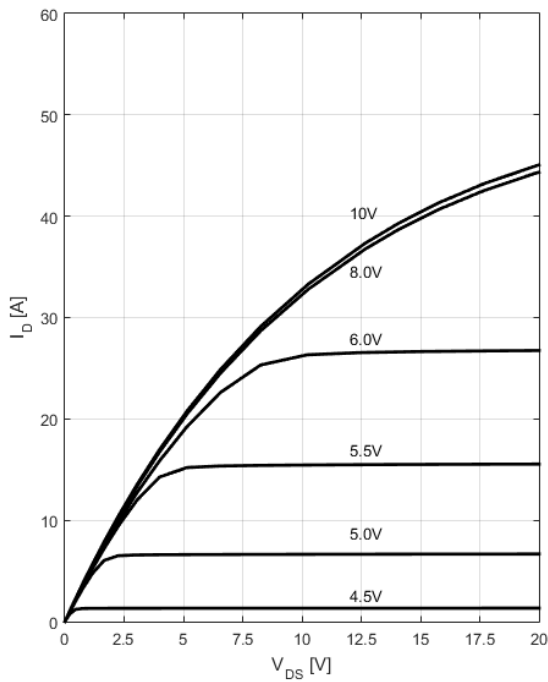
$I_D=f(V_{DS})$ ;  $T_c=25\text{ }^\circ\text{C}$ ; parameter  $t_p$

**Figure 2. Transient thermal impedance**



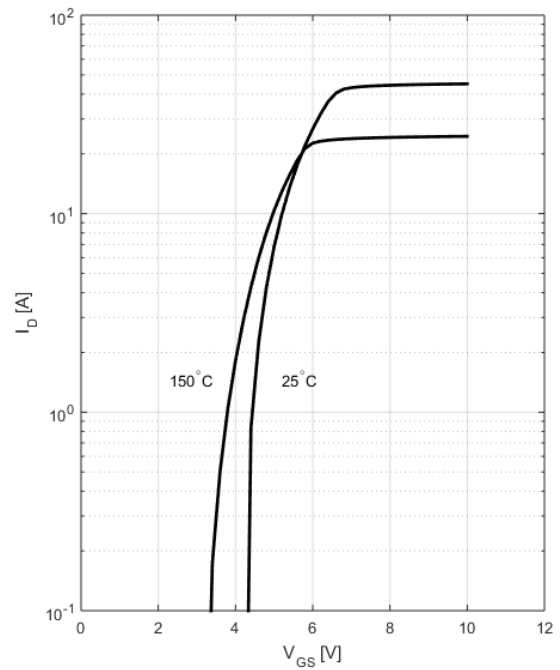
$Z_{(thJC)}=f(t_p)$ ; parameter:  $D=t_p/T$

**Figure3. Typ. output characteristics**



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

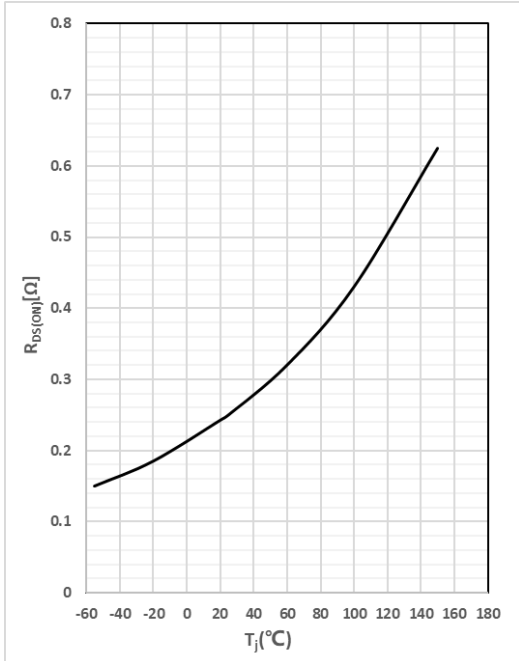
**Figure 4. Typ. transfer characteristics**



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

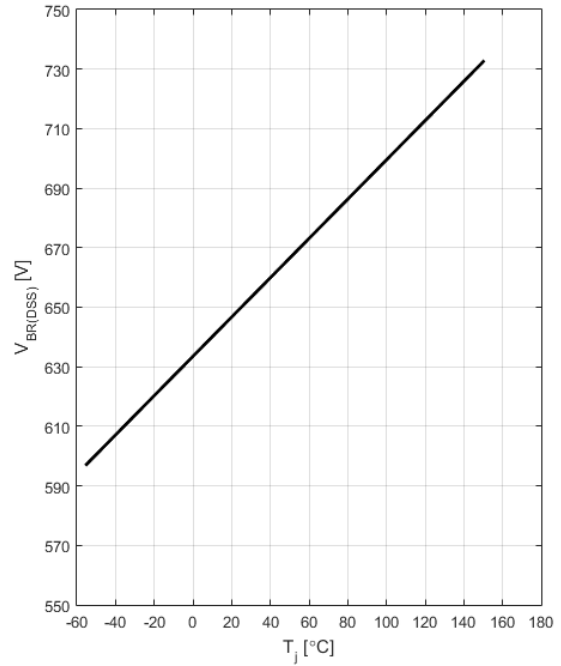


**Figure 5. Drain-source on-state resistance**



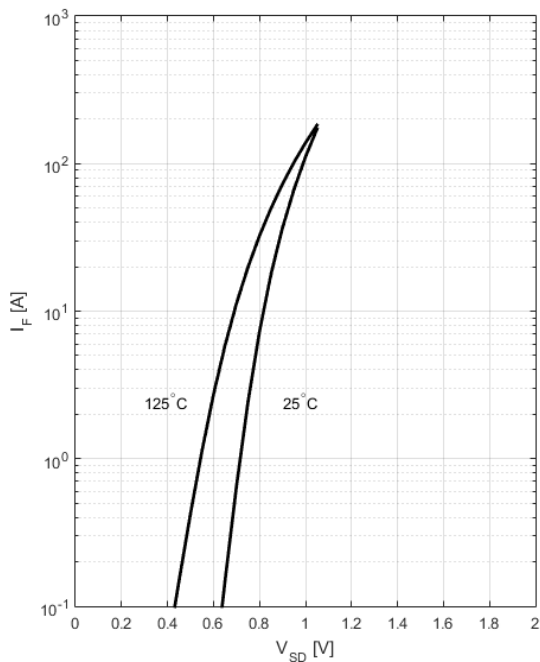
$R_{DS(ON)}=f(T_j); I_D=15A; V_{GS}=10V$

**Figure 6. Drain-source breakdown voltage**



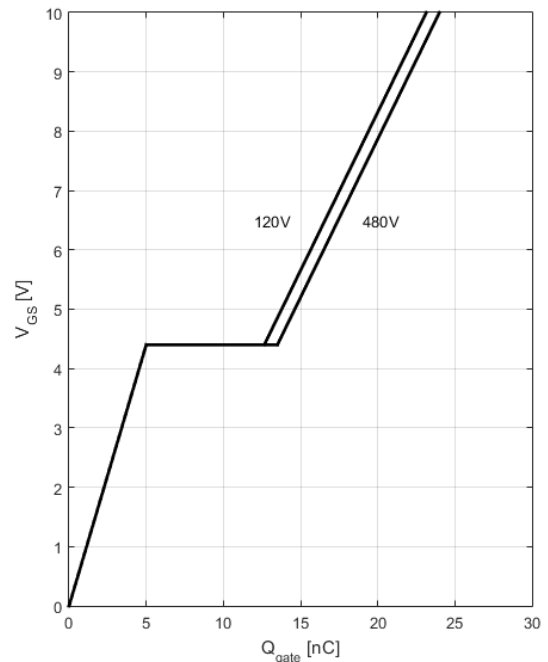
$V_{BR(DSS)}=f(T_j); I_D=10mA$

**Figure 7. Forward characteristics of reverse diode**



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

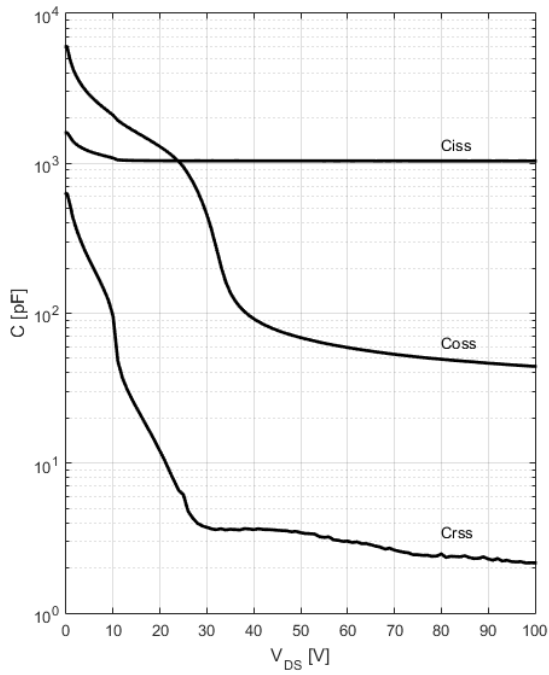
**Figure 8. Typ. gate charge**



$V_{GS}=f(Q_{gate}), I_D=15A \text{ pulsed}$

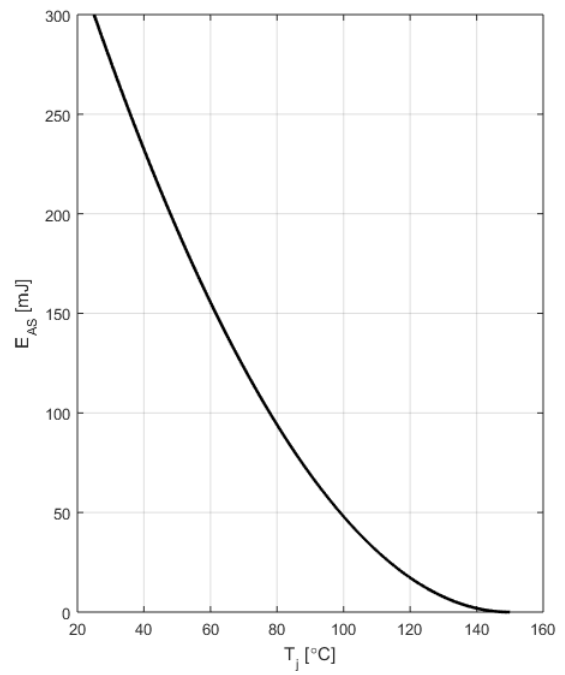


**Figure 9: Typ. capacitances**



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

**Figure 10: Avalanche energy**

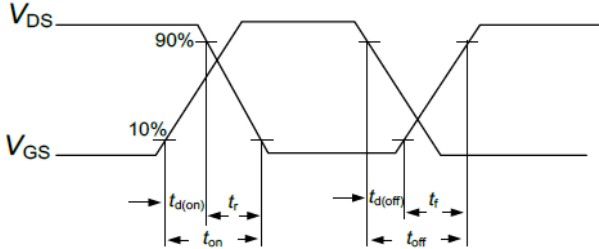
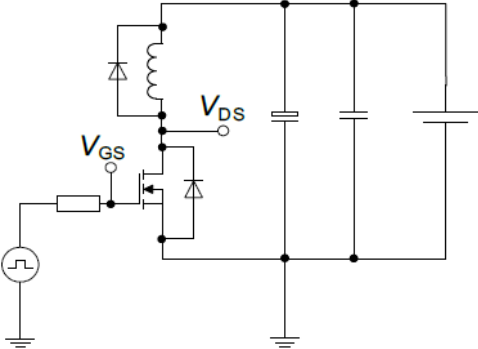


**$E_{AS}=f(T_j); I_D=7.5\text{A}; V_{DD}=50\text{V}$**

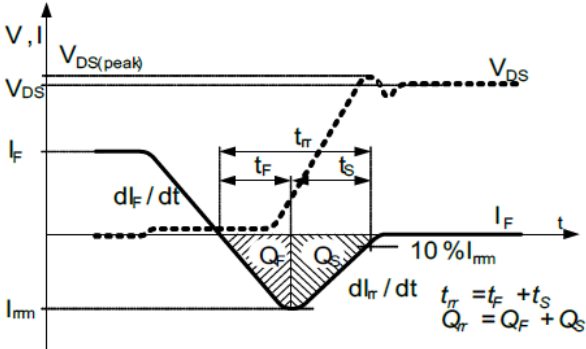
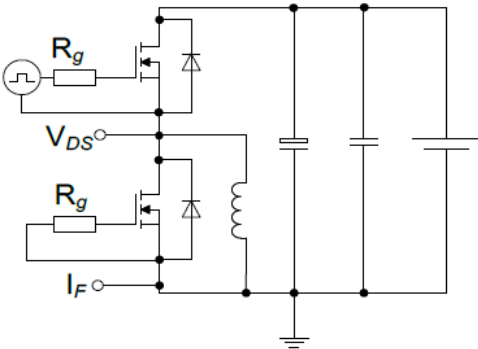


Test Circuits

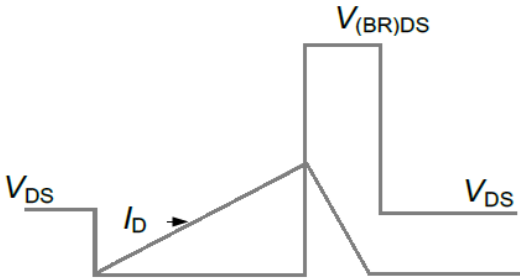
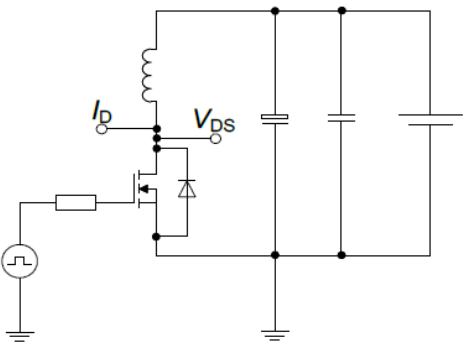
Switch time test circuit



Reverse diode characteristics test circuit and waveform

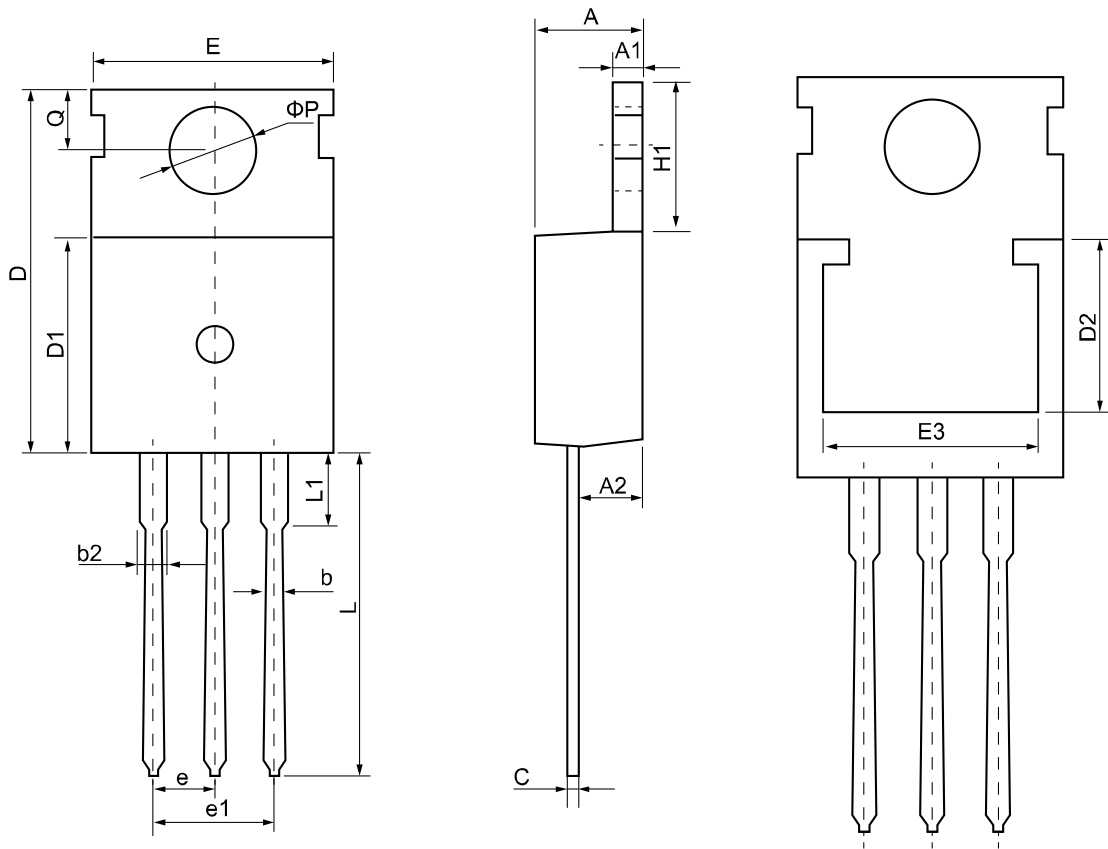


Unclaimed inductive switching test circuit & waveform



## PHYSICAL DIMENSIONS

TO-220



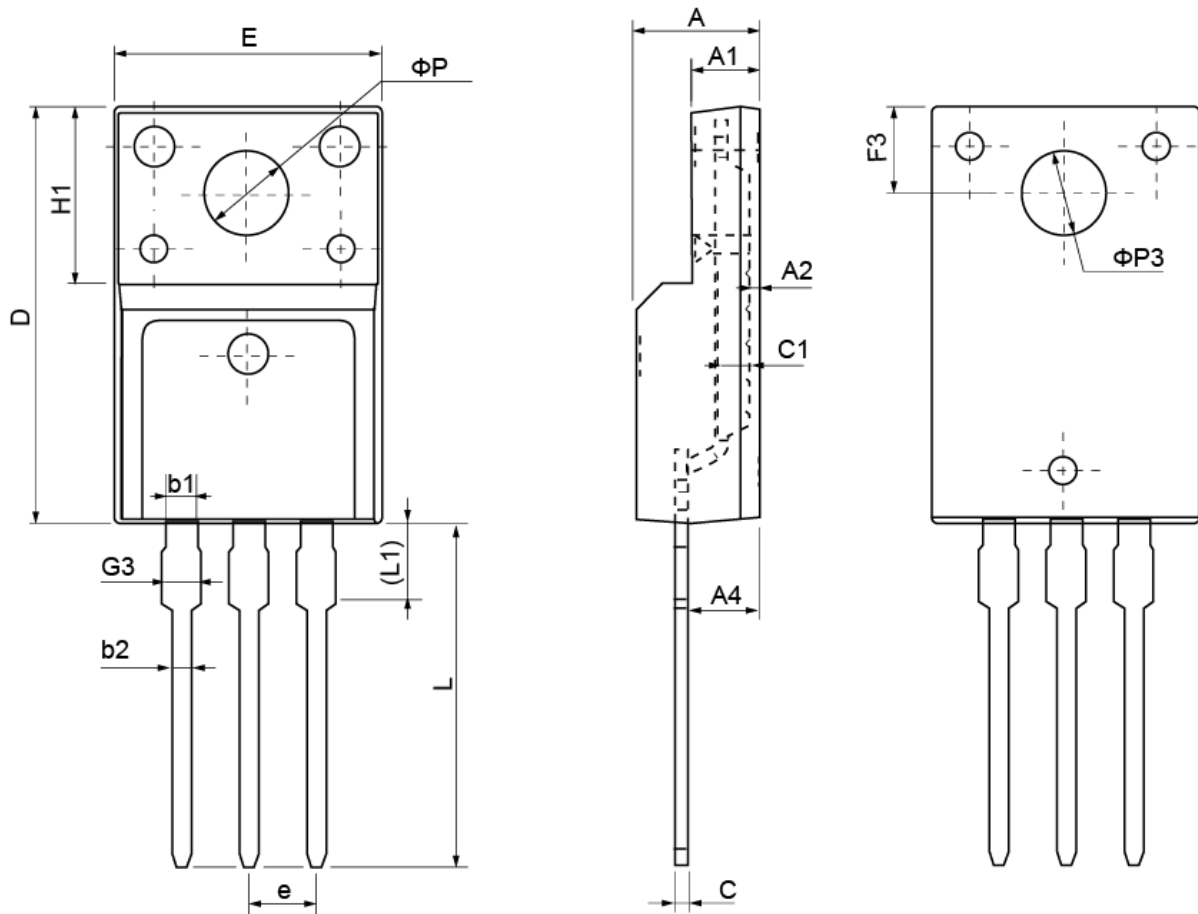
Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	Min	Nom	Max		Min	Nom	Max
A	4.37	4.57	4.77	E	9.80	10.00	10.20
A1	1.25	1.30	1.45	E3	7.00	-	-
A2	2.20	2.40	2.60	e	2.54(BSC)		
b	0.70	0.80	0.95	e1	5.08(BSC)		
b2	1.17	1.27	1.47	H1	6.30	6.50	6.80
c	0.40	0.50	0.65	L	12.75	13.50	13.80
D	15.30	15.60	15.90	L1	-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





# CWS15N65A

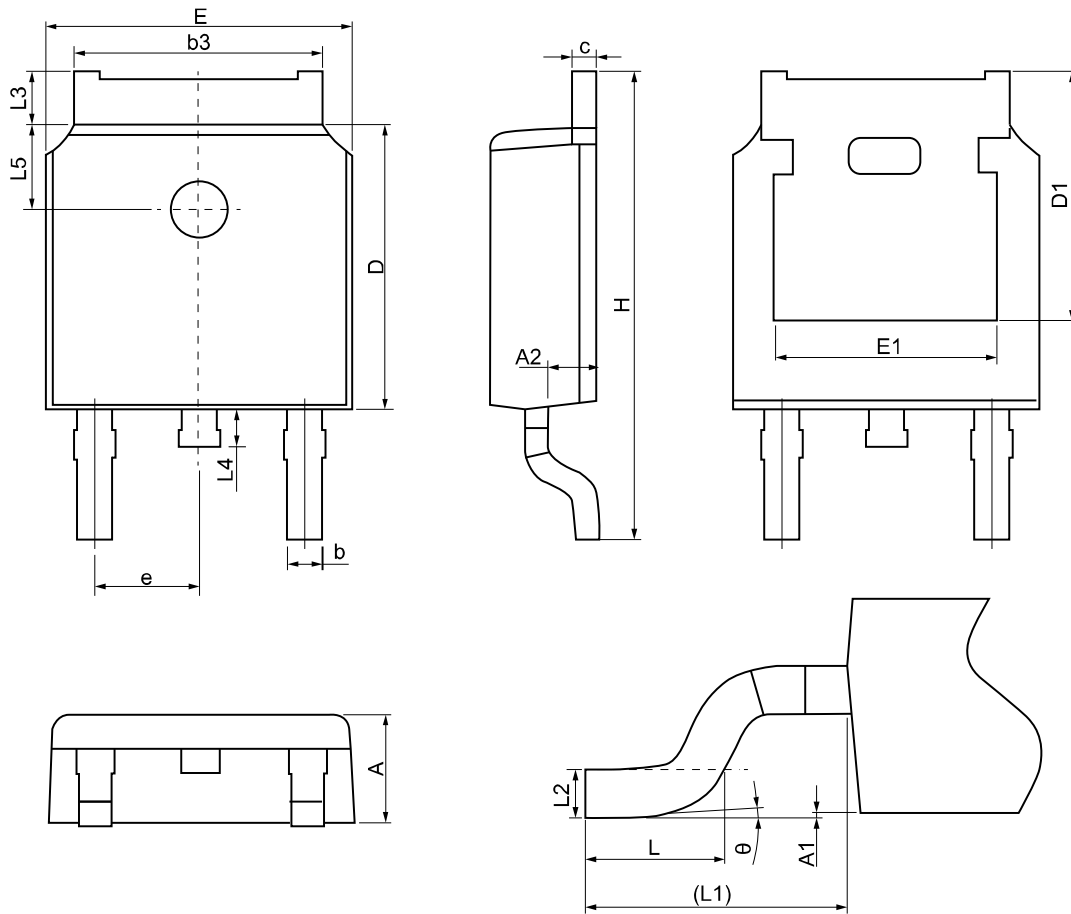
TO-220F



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	$\Phi P$	3.03	3.18	3.38
A4	2.56	2.76	2.96	$\Phi P3$	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



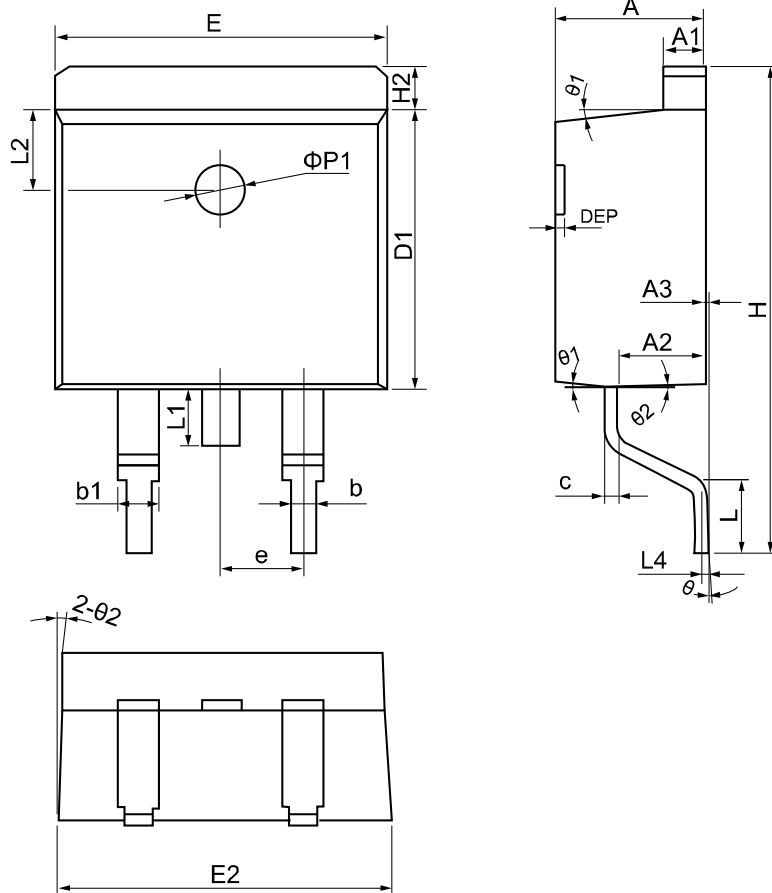
## TO-252



Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	Min	Nom	Max		Min	Nom	Max
A	2.20	2.30	2.40	e	2.286(BSC)		
A1	0.00	-	0.20	H	9.40	10.10	10.50
A2	0.97	1.07	1.17	L	1.38	1.50	1.75
b	0.68	0.78	0.90	L1	2.90(REF)		
b3	5.20	5.33	5.50	L2	0.51(BSC)		
c	0.43	0.53	0.63	L3	0.88	-	1.28
D	5.98	6.10	6.22	L4	0.50	-	1.00
D1	5.30(REF)			L5	1.65	1.80	1.95
E	6.40	6.60	6.80	θ	0°	-	8°
E1	4.63	-	-	-	-	-	-



## TO-263-2L



Symbol	Dimension (mm)			Symbol	Dimension (mm)		
	Min	Nom	Max		Min	Nom	Max
A	4.40	4.57	4.70	H	14.70	15.10	15.50
A1	1.22	1.27	1.32	H2	1.17	1.27	1.40
A2	2.59	2.69	2.79	L	2.00	2.30	2.60
A3	0.00	0.10	0.20	L1	1.45	1.55	1.70
b	0.77	0.813	0.90	L2	2.50(REF)		
b1	1.20	1.270	1.36	L4	0.25(BSC)		
c	0.34	0.381	0.47	θ	0°	5°	8°
D1	8.60	8.70	8.80	θ1	5°	7°	9°
E	10.00	10.16	10.26	θ2	1°	3°	5°
E2	10.00	10.10	10.20	ΦP1	1.40	1.50	1.60
e	2.54(BSC)			DEP	0.05	0.10	0.20

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