

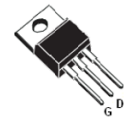
650V N-Channel Super Junction power MOSFET

DESCRIPTION

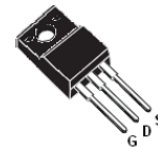
SJ MOSFET is an advanced technology for high voltage power MOSFETs, designed according to the super junction principle by P&S. The offered devices provide all benefits of a fast switching and low on resistance, making it especially suitable for applications which require more efficient, more compact,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

V_{DS}	650	V
$R_{DS(ON)}$	190	m Ω
I_D	20	A

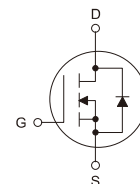
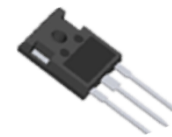
TO-220



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	CWS20N65AC	50 PCS/Tube
	TO-220F		CWS20N65AF	50 PCS/Tube
	TO-247		CWS20N65AZ	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}	650	V
Gate-Source Voltage ($V_{DS}=0\text{V}$, static)	V_{GS}	± 30	V
Continuous Drain Current ($T_C=25^{\circ}\text{C}$)(Note 1)	$I_{D(DC)}$	20	A
Continuous Drain Current ($T_C=100^{\circ}\text{C}$) (Note 1)	$I_{D(DC)}$	13	A
Pulsed Drain Current (Note 2)	I_{DM}	60	A
MOSFET dv/dt ruggedness, $V_{DS}\leq 480\text{V}$	dv/dt	50	V/nS
Single Pulsed Avalanche Energy (Note 3)	E_{AS}	500	mJ
Avalanche Energy, Repetitive (Note 1)	E_{AR}	1.3	mJ
Avalanche Current, Repetitive (Note 1)	I_{AR}	10	A
Maximum Power Dissipation ($T_C=25^{\circ}\text{C}$)	P_D	TO-220: 96 TO-220F: 33 TO-247: 130	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: 1.3 TO-220F: 3.75 TO-247: 0.96	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	-	-	TO-220: 62 TO-220F: 80 TO-247: 57	$^{\circ}\text{C}/\text{W}$

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	μA
Gate-Source Leakage Current	I_{GSS}	$V_{GS}=\pm 30\text{V}, V_{DS}=0\text{V}$	-	-	± 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	$R_{DS(on)}$	$V_{GS}=10\text{V}, I_D=10\text{A}$	-	0.17	0.19	Ω
Gate Resistance	R_g	F=1MHZ, open drain	-	5.3	-	Ω



Dynamic Characteristics

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

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Input capacitance	C_{iss}	$V_{DS}=100\text{V}, V_{GS}=0\text{V},$ $f=1\text{MHz}$	-	1580	-	pF
Output capacitance	C_{oss}		-	60.9	-	
Reverse transfer capacitance	C_{rss}		-	2.73	-	
Turn-on delay Time	$t_{d(on)}$	$V_{DD}=520\text{V}, I_D=20\text{A}$ $R_G=6.8\Omega, V_{GS}=10\text{V}$	-	40	-	ns
Rise time	t_r		-	173		
Turn-off delay time	$t_{d(off)}$		-	72		
Fall time	t_f		-	137		

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}	$V_{DD}=520\text{V}, I_D=20\text{A}$ $V_{GS}=0 \text{ to } 10\text{V}$	-	11	-	nC
Gate to Drain Charge	Q_{gd}		-	12	-	
Gate Charge Total	Q_g		-	37.1	-	
Gate Plateau Voltage	$V_{plateau}$		-	6.4	-	V

Reverse diode characteristics

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

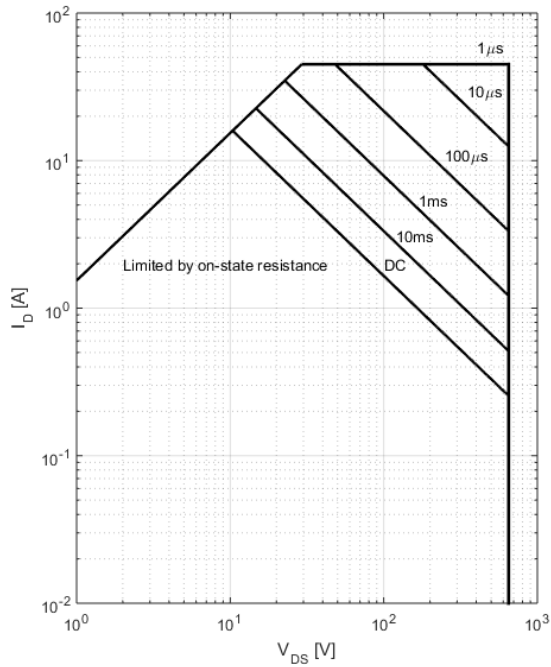
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Body Diode Forward Voltage	V_{SD}	$V_{GS}=0\text{V}, I_{SD}=20\text{A}$	-	0.9	-	V
Reverse Recovery Time	t_{rr}	$V_R=520\text{V}, I_F=20\text{A}$ $di_F/dt=100\text{A}/\mu\text{s}$	-	350	-	nS
Reverse Recovery Charge	Q_{rr}		-	6.4	-	μC
Peak Reverse Recovery Current	I_{rrm}		-	29	-	A

Notes:

1. Limited by maximum junction temperature;
2. Pulse width limited by maximum junction temperature;
3. $I_{AS} = 10 \text{ A}$, $V_{DD} = 50 \text{ V}$, $R_G = 25 \Omega$, Starting $T_j = 25^\circ\text{C}$.

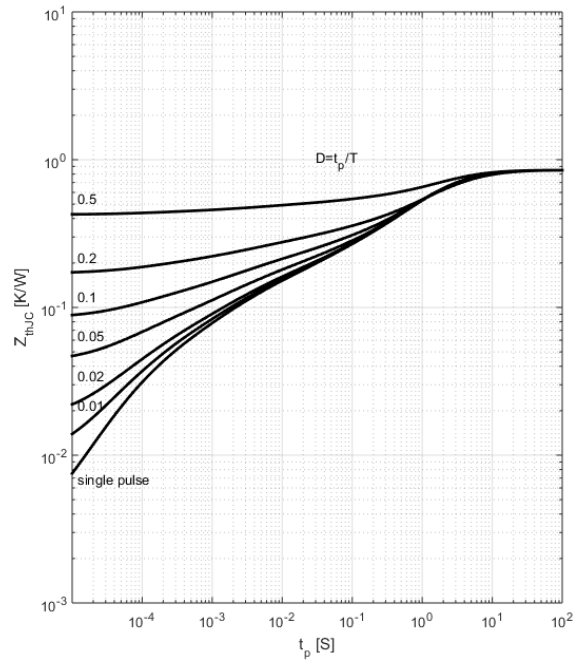
Electrical Characteristics Diagrams

Figure 1. Safe operating area



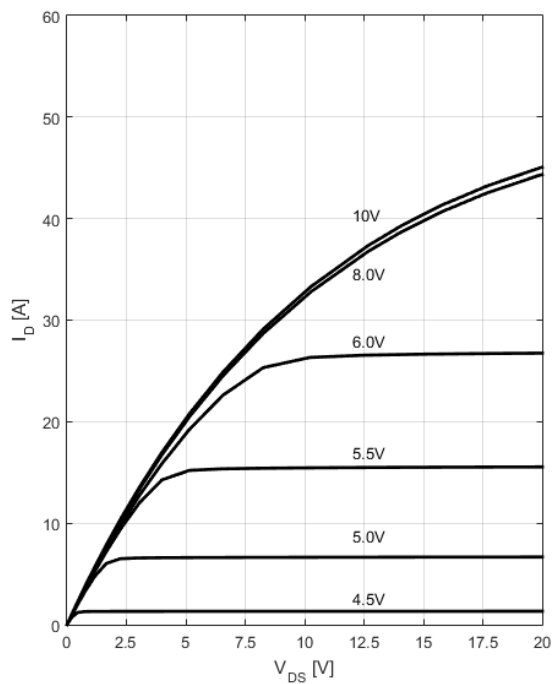
$I_D = f(V_{DS}); T_c = 25^\circ\text{C};$ parameter t_p

Figure 2. Transient thermal impedance



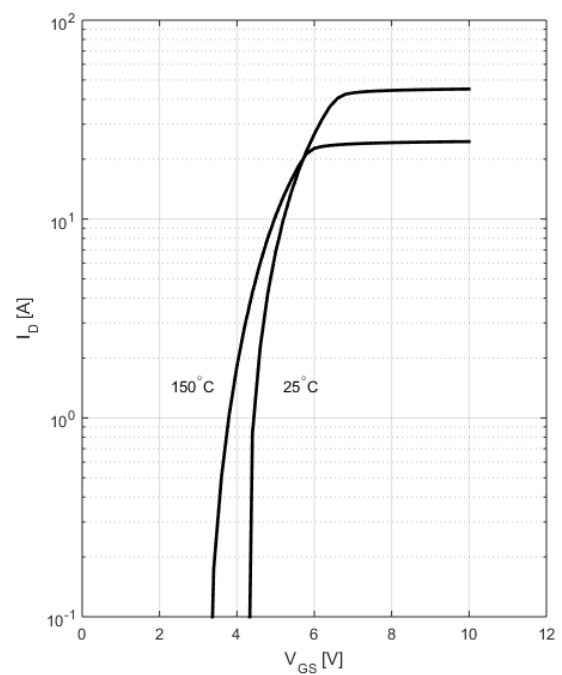
$Z_{(thJC)} = f(t_p);$ parameter: $D = t_p / T$

Figure 3. Typ. output characteristics



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

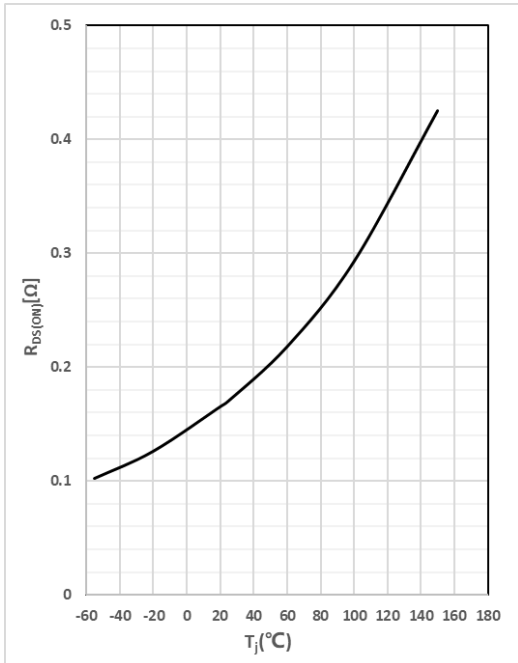
Figure 4. Typ. transfer characteristics



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

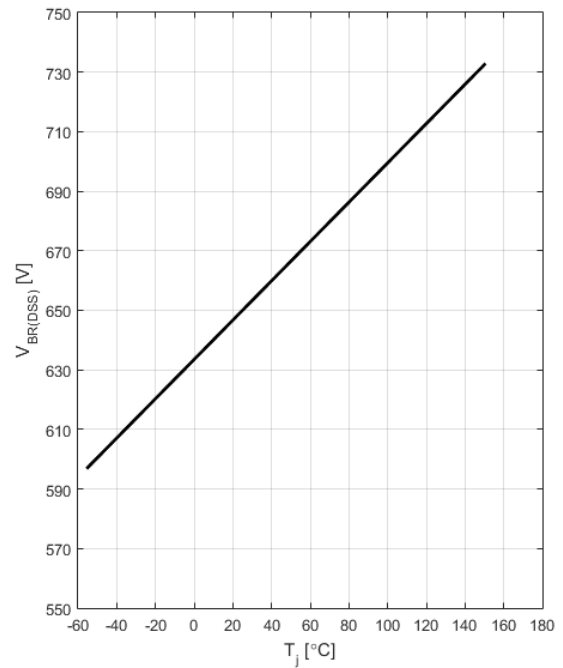


Figure 5. Drain-source on-state resistance



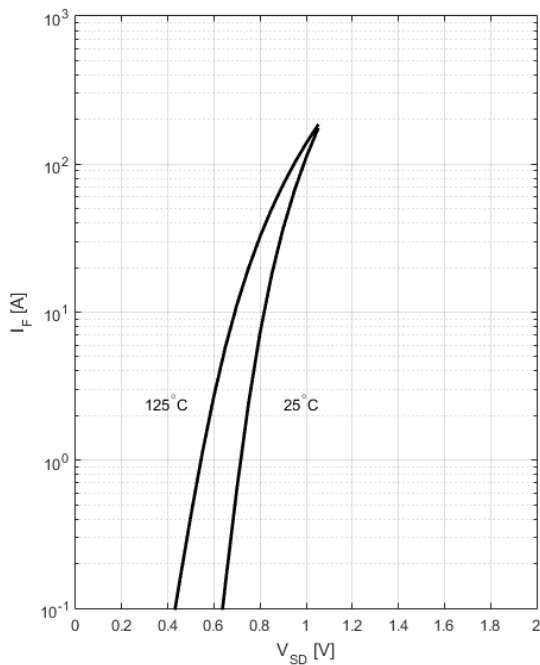
$$R_{DS(ON)}=f(T_j); I_D=20A; V_{GS}=10V$$

Figure6. Drain-source breakdown voltage



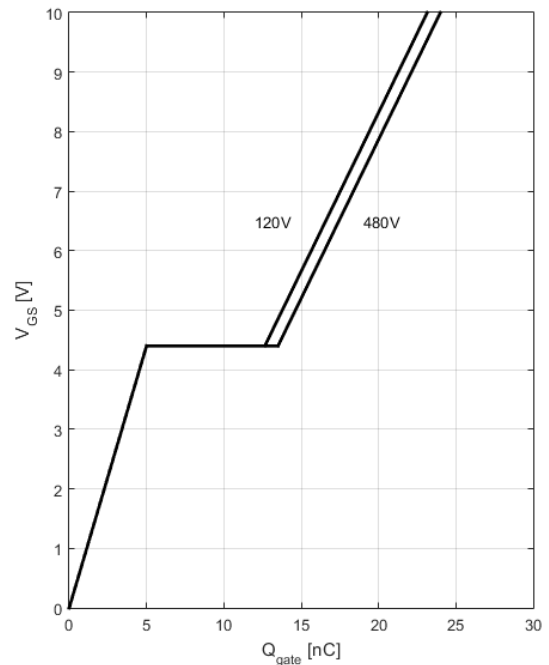
$$V_{BR(DSS)}=f(T_j); I_D=10mA$$

Figure7. Forward characteristics of reverse diode



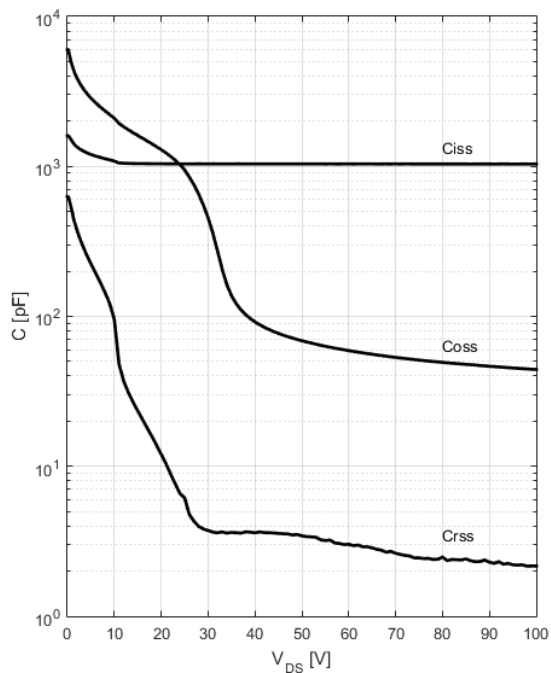
$$I_F=f(V_{SD}); \text{parameter: } T_j$$

Figure 8. Typ. gate charge



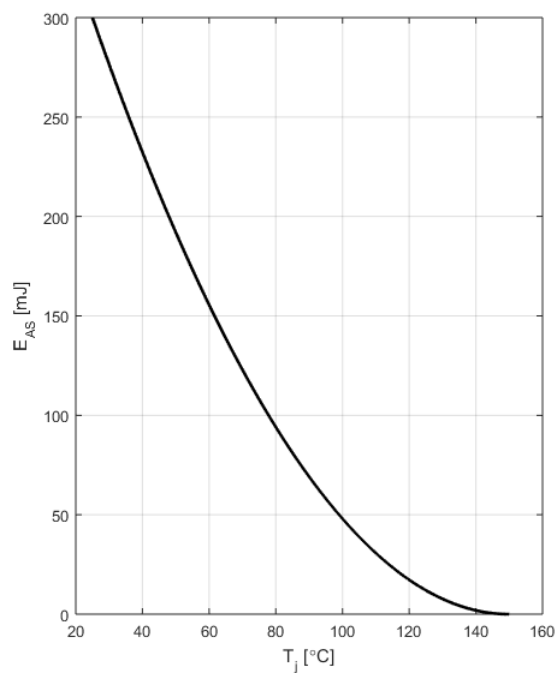
$$V_{GS}=f(Q_{gate}), I_D=20A \text{ pulsed}$$

Figure 9: Typ. capacitances



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

Figure 10: Avalanche energy

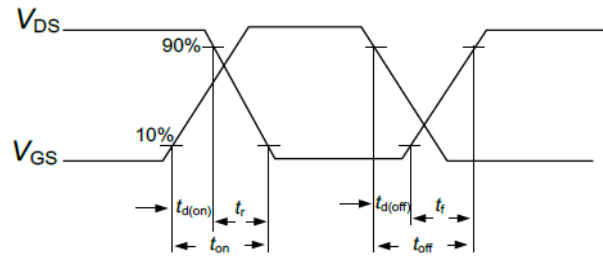
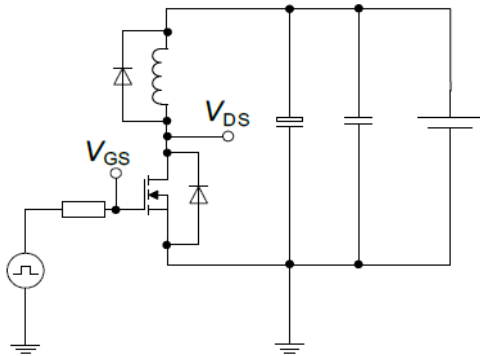


$E_{AS}=f(T_j); I_D=10A; V_{DD}=50V$

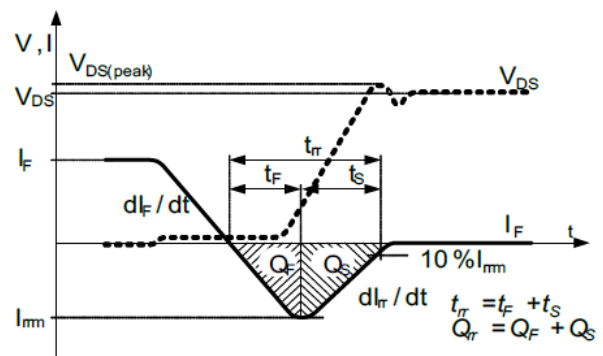
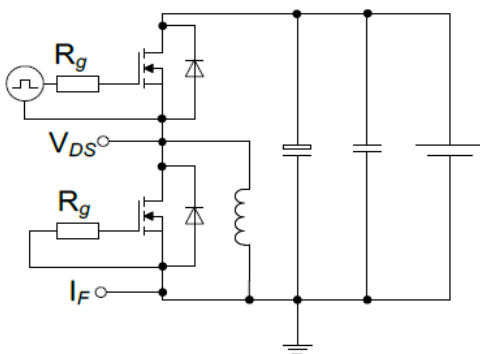


Test Circuits

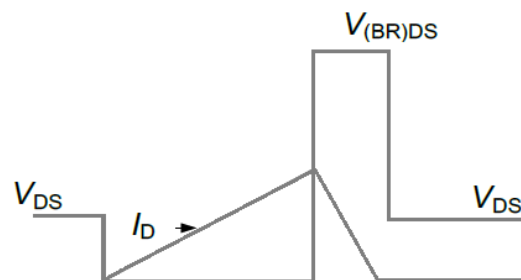
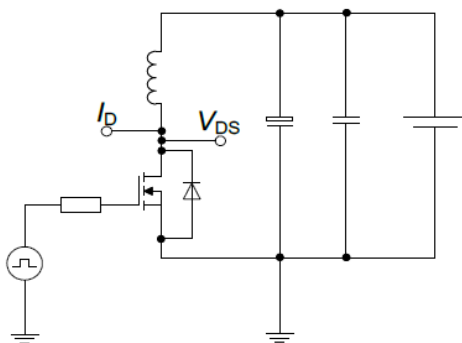
Switch time test circuit



Reverse diode characteristics test circuit and waveform

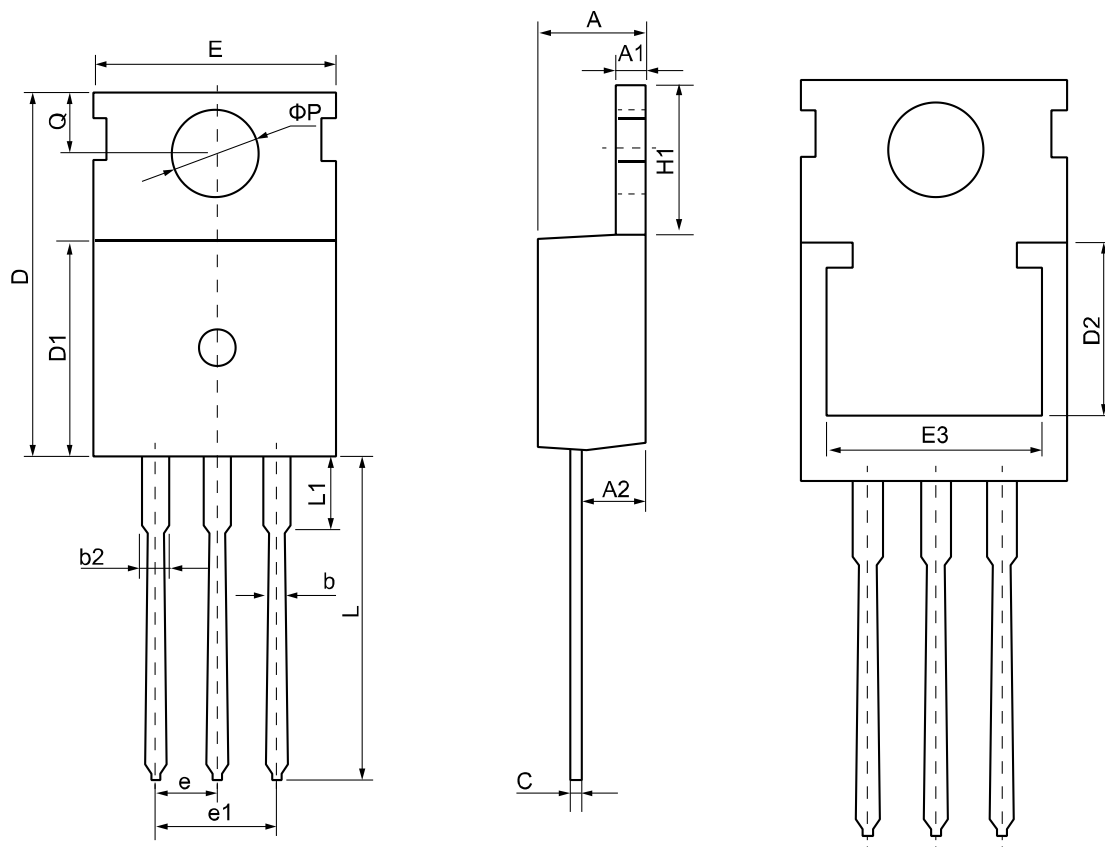


Unclaimed inductive switching test circuit & waveform



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

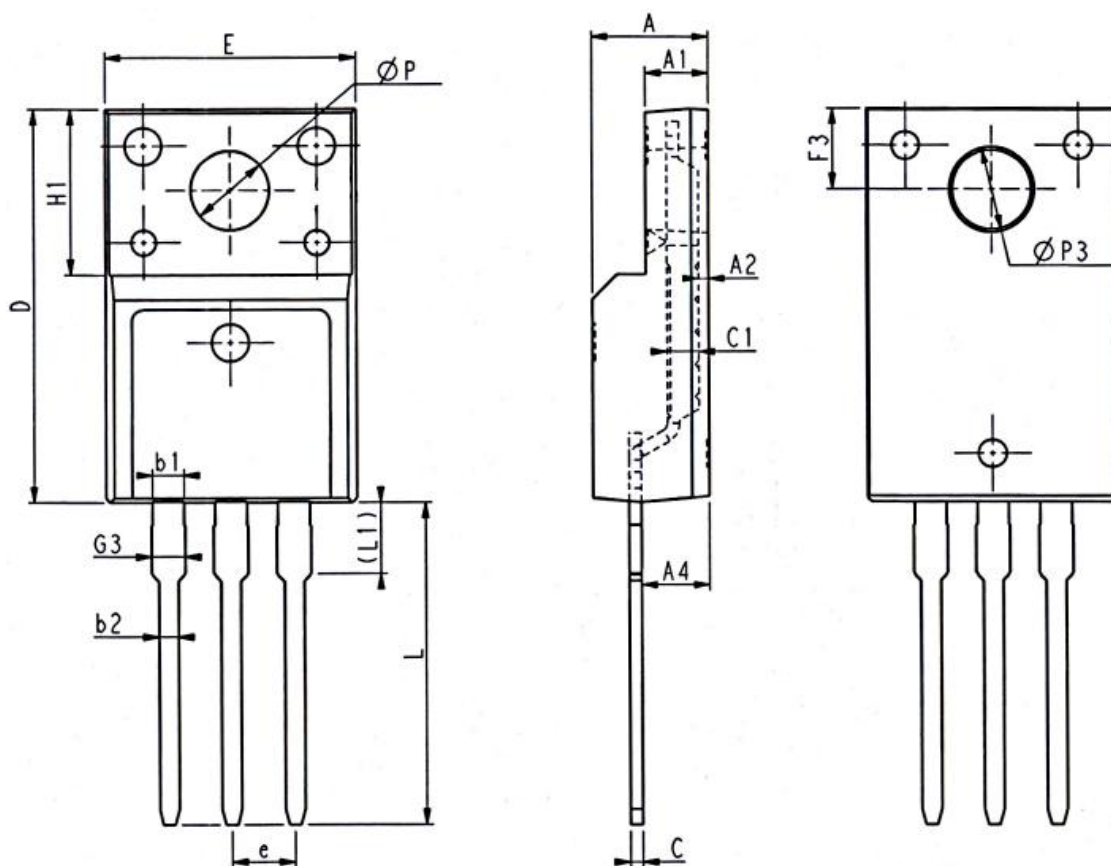


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TO-220F



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	ØP	3.03	3.18	3.38
A4	2.56	2.76	2.96	ØP3	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

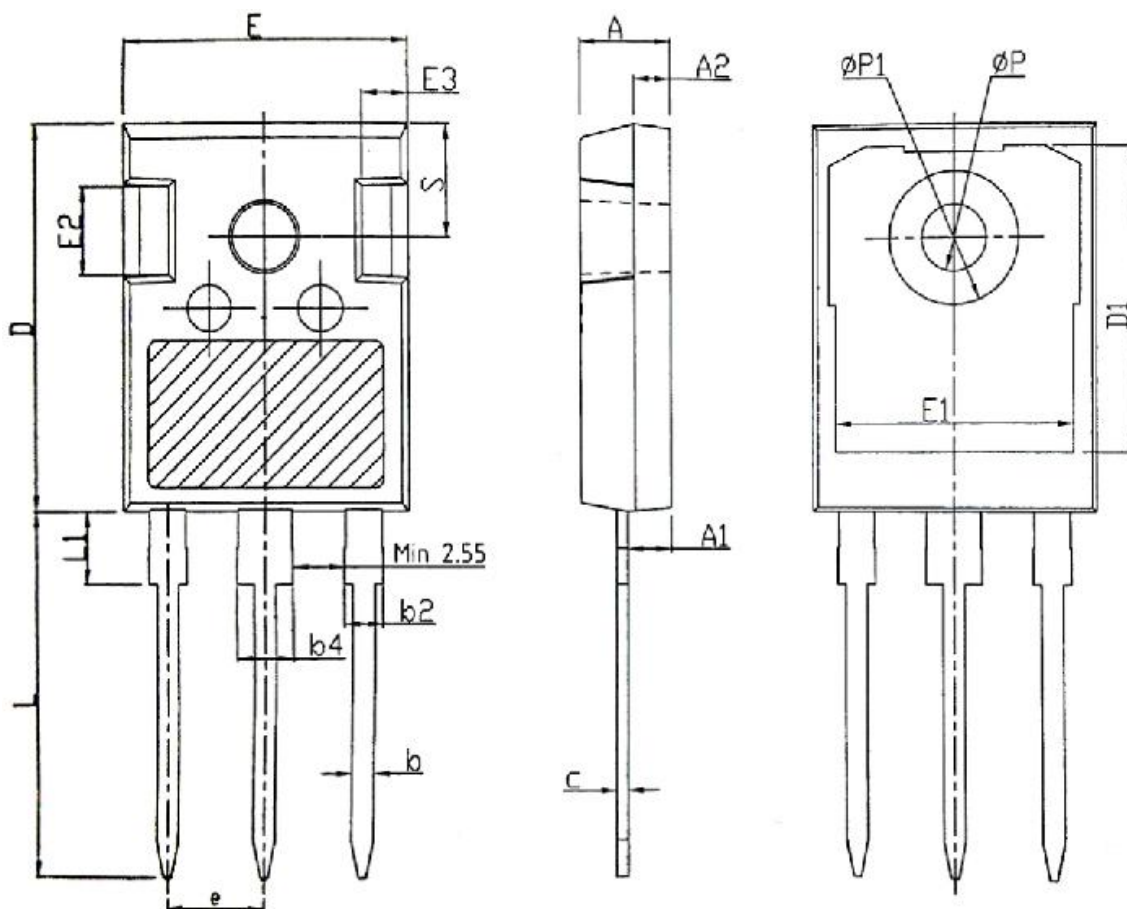


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TO-247



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	$\phi P1$	-	-	7.30
D1	16.25	16.55	16.85	S	6.15(BSC)		
E	15.50	15.80	16.10	-	-	-	-

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