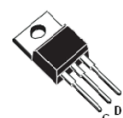
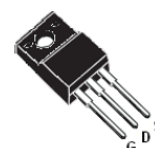
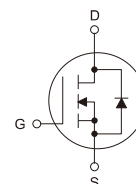


600V N-Channel Super Junction power MOSFET

DESCRIPTION

SJ MOSFET is an advanced technology for high voltage power MOSFETs, designed according to the super junction principle by 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}	600	V
$R_{DS(ON)}$	150	m Ω
I_D	24	A

TO-220**TO-220F****TO-247**

Features

- Extremely low losses due to very low $R_{ds(on)} \cdot Q_g$
- 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	CWS24N60AC	50 PCS/Tube
	TO-220F		CWS24N60AF	50 PCS/Tube
	TO-247		CWS24N60AZ	30 PCS/Tube

ABSOLUTE MAXIMUM RATINGS(T_J=25°C, unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage (V _{GS} =0V)	V _{DSS}	600	V
Gate-Source Voltage (V _{DS} =0V, static)	V _{GS}	±30	V
Continuous Drain Current (T _C =25 °C)(Note 1)	I _{D(DC)}	24	A
Continuous Drain Current (T _C =100 °C) (Note 1)	I _{D(DC)}	18	A
Pulsed Drain Current (Note 2)	I _{DM}	89	A
MOSFET dv/dt ruggedness, V _{DS} ≤480 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 °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	°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	°C /W
Thermal Resistance, Junction-to-Ambient	R _{thJA}	-	-	TO-220: 62 TO-220F: 80 TO-247: 62	°C /W

ELECTRICAL CHARACTERISTICS(T_J = 25°C, unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	TYP.	Max.	Unit
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V, I _D =250μA	600	-	-	V
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} =600V, V _{GS} =0V	-	-	1	μA
Gate-Source Leakage Current	I _{GSS}	V _{GS} =±30V, V _{DS} =0V	-	-	±100	nA
Gate Threshold Voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250μA	2.5	3.0	3.5	V
Drain-Source On-state Resistance	R _{DS(on)}	V _{GS} =10V, I _D =12A	-	0.12	0.15	Ω
Gate Resistance	R _g	F=1MHZ, open drain	-	5.6	-	Ω



Dynamic Characteristics(T_j = 25°C, unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Input capacitance	C _{iss}	V _{DS} =100V, V _{GS} =0V, f=1MHz	-	2039	-	pF
Output capacitance	C _{oss}		-	127	-	
Reverse transfer capacitance	C _{rss}		-	2.5	-	
Turn-on delay Time	t _{d(on)}	V _{DD} =400V, I _D =15A R _G =3.3Ω, V _{GS} =10V	-	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°C, unless otherwise noted)

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Gate to Source Charge	Q _{gs}	V _{DD} =480V, I _D =15A V _{GS} =0 to 10V	-	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°C, unless otherwise noted)

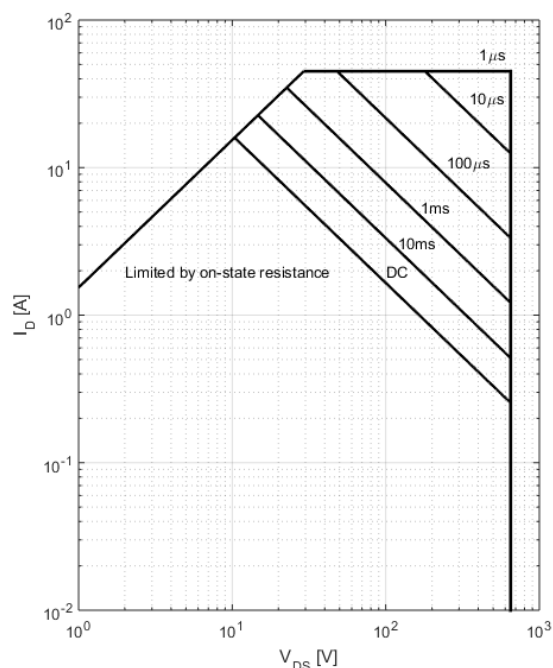
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Body Diode Forward Voltage	V _{SD}	V _{GS} =0V, I _{SD} =15A	-	0.9	-	V
Reverse Recovery Time	t _{rr}	V _R =400V, I _F =15A dI _F /dt=100A/μs	-	409	-	nS
Reverse Recovery Charge	Q _{rr}		-	8.5	-	μC
Peak Reverse Recovery Current	I _{rrm}		-	30	-	A

Notes:

1. Limited by maximum junction temperature;
2. Pulse width limited by maximum junction temperature;
3. I_{AS} = 12A, V_{DD} = 50 V, R_G = 25 Ω, Starting T_j = 25°C.

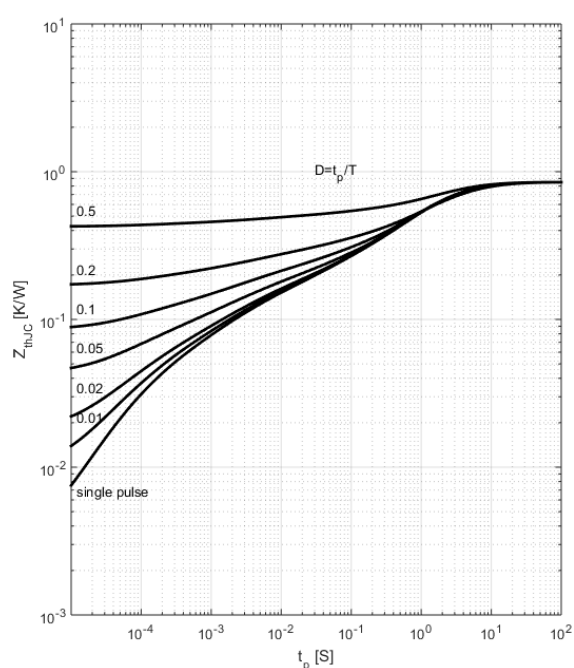
Electrical Characteristics Diagrams

Figure 1. Safe operating area



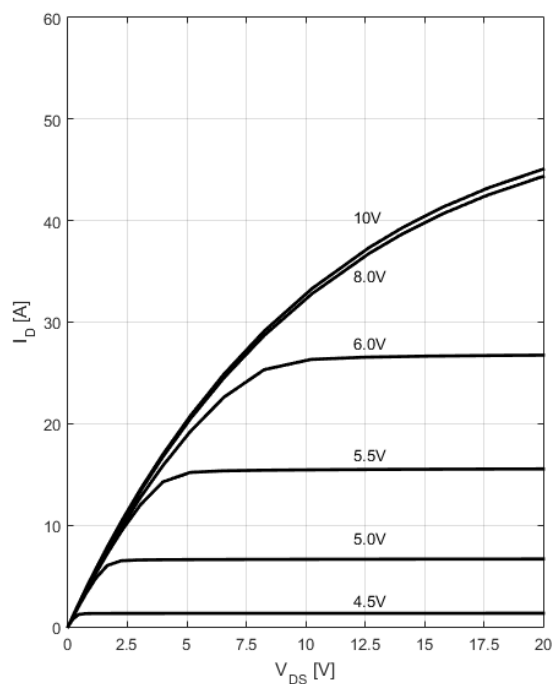
$I_D = f(V_{DS})$; $T_c = 25^\circ\text{C}$; parameter t_p

Figure 2. Transient thermal impedance



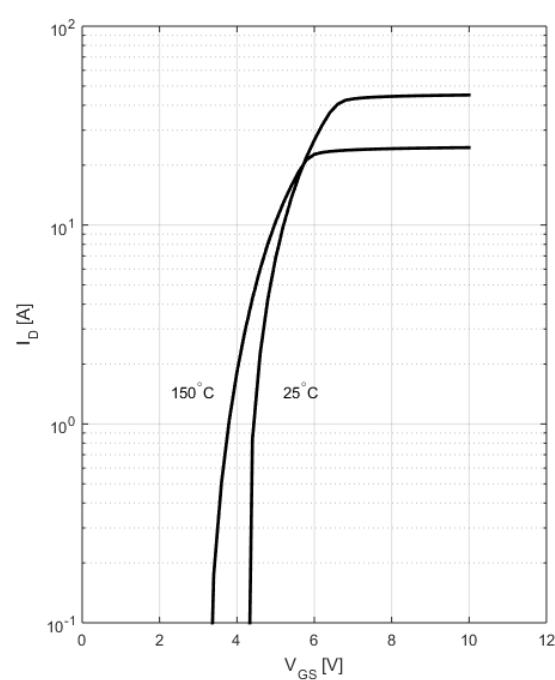
$Z_{thJC} = f(t_p)$; parameter: $D = t_p / T$

Figure 3. Typ. output characteristics



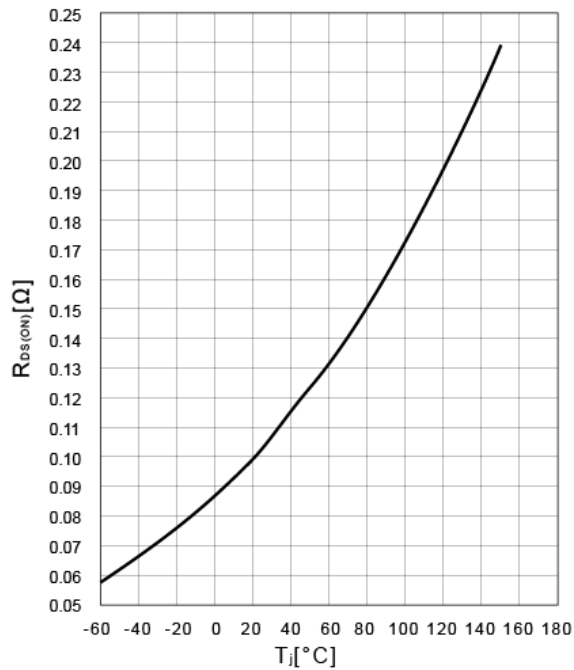
$I_D = f(V_{DS})$; $T_j = 25^\circ\text{C}$; parameter: V_{GS}

Figure 4. Typ. transfer characteristics



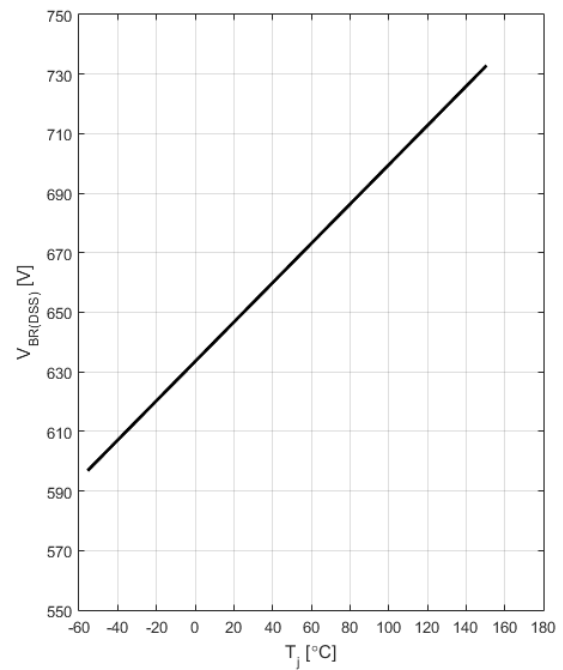
$I_D = f(V_{GS})$; $V_{DS} = 20\text{V}$

Figure 5. Drain-source on-state resistance



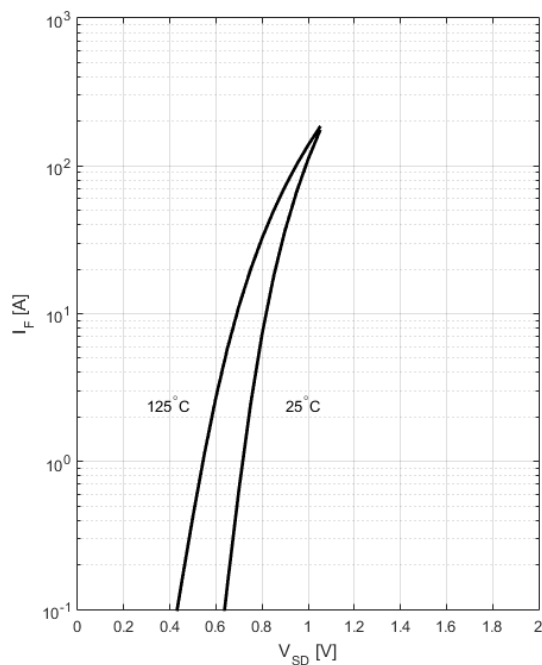
$$R_{DS(ON)}=f(T_j); I_D=30A; V_{GS}=10V$$

Figure6. Drain-source breakdown voltage



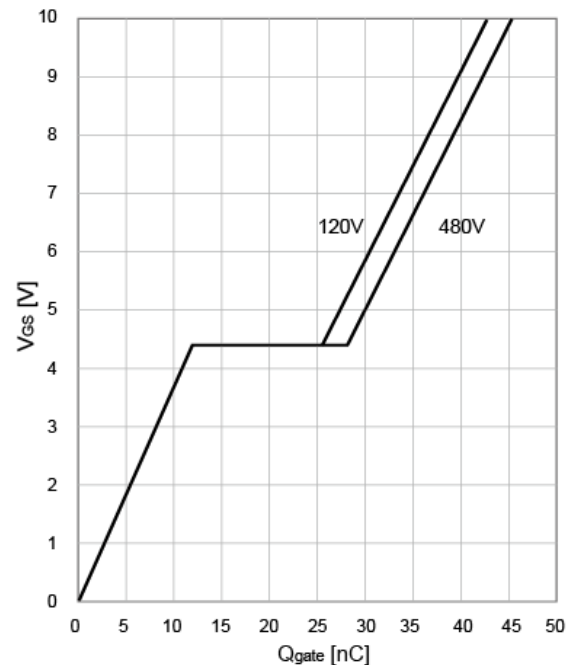
$$V_{BR(DSS)}=f(T_j); I_D=10mA$$

Figure7. Forward characteristics of reverse diode



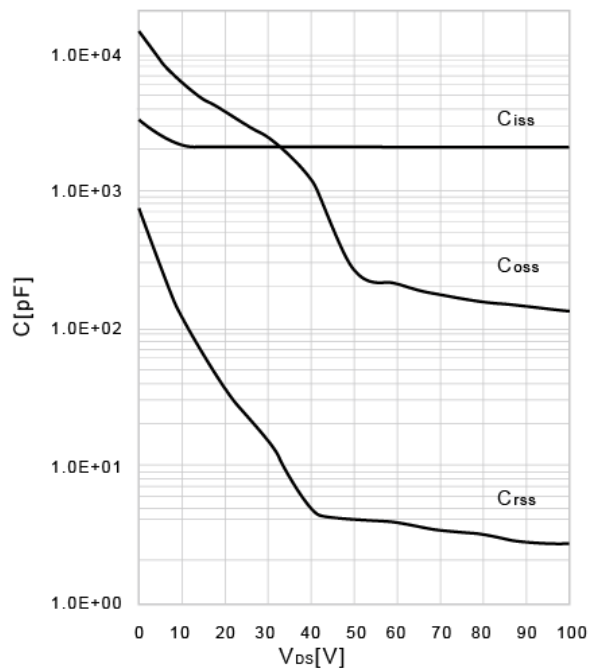
$$I_F=f(V_{SD}); \text{ parameter: } T_j$$

Figure 8. Typ. gate charge



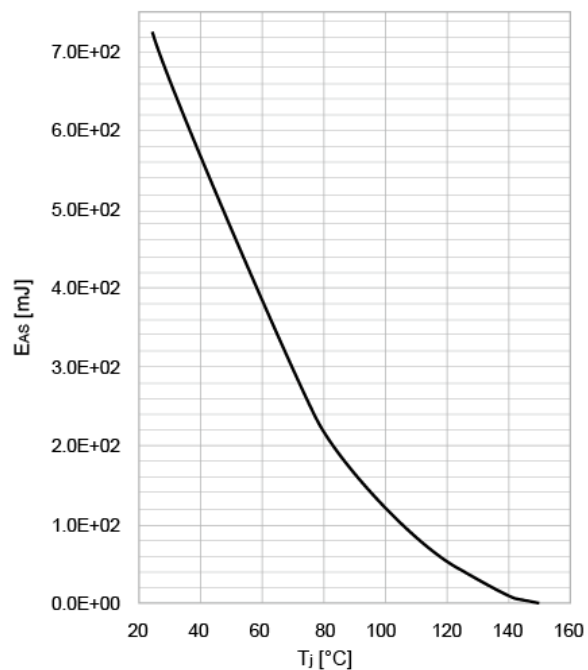
$$V_{GS}=f(Q_{gate}), I_D=30A \text{ pulsed}$$

Figure 9: Typ. capacitances



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

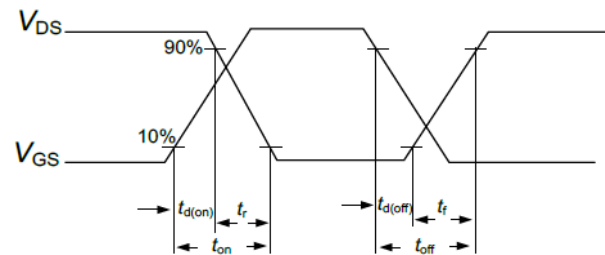
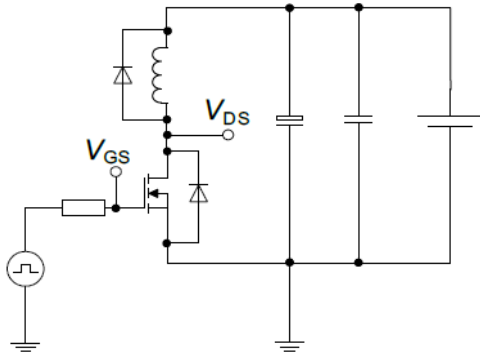
Figure 10: Avalanche energy



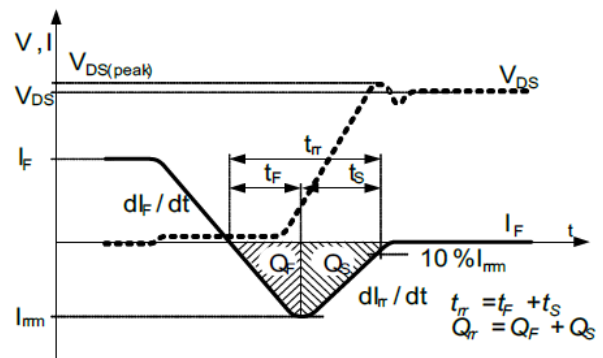
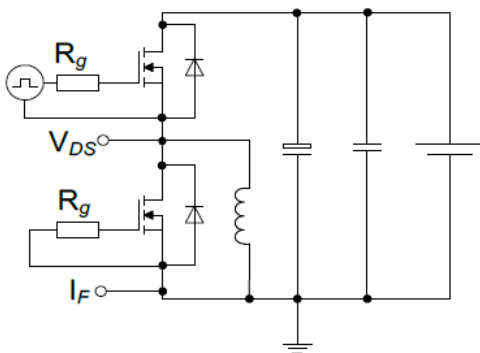
$$E_{AS}=f(T_j); I_D=13\text{A}; V_{DD}=50\text{V}$$

Test Circuits

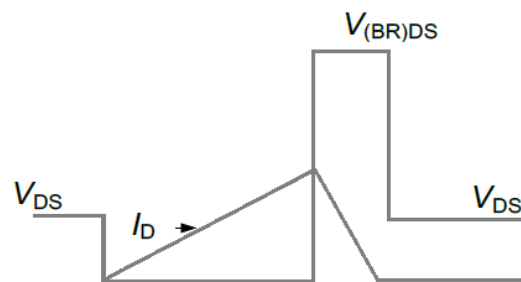
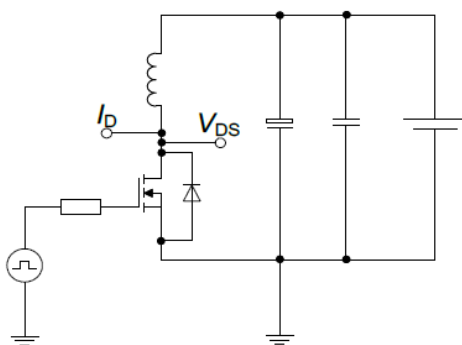
Switch time test circuit



Reverse diode characteristics test circuit and waveform

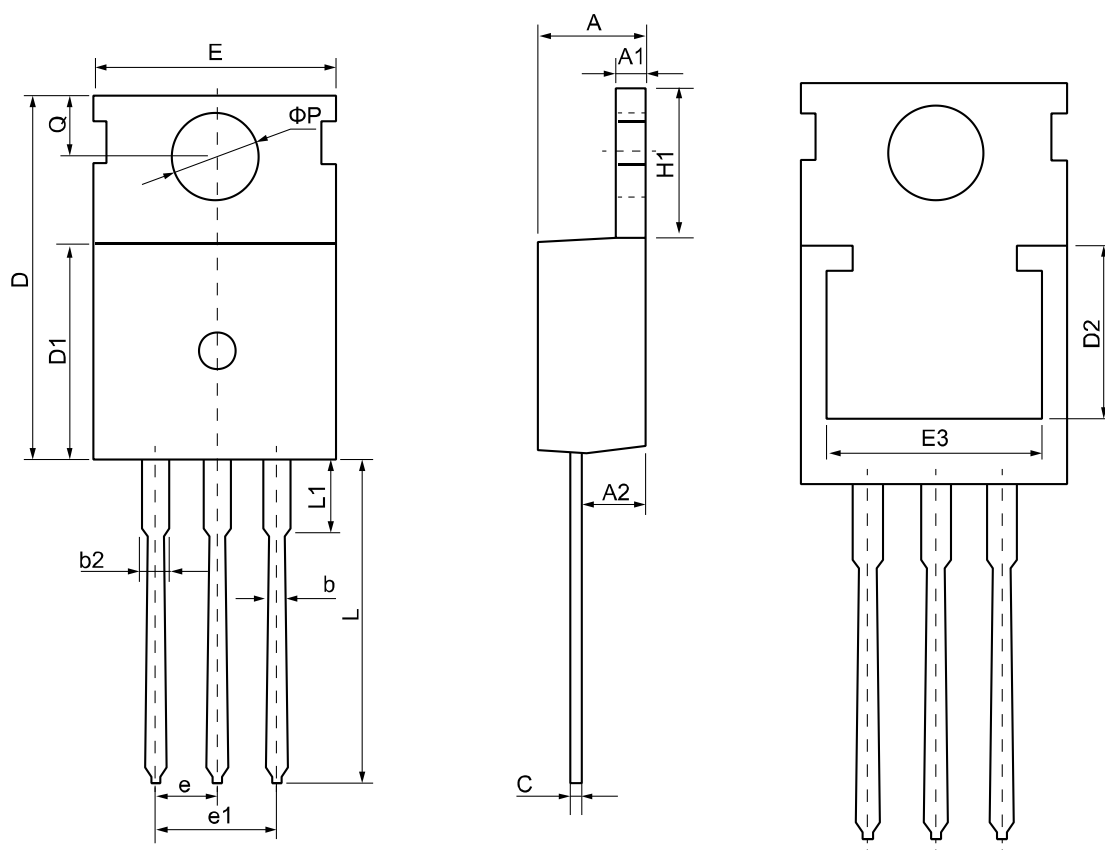


Unclamped inductive switching test circuit & waveform



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

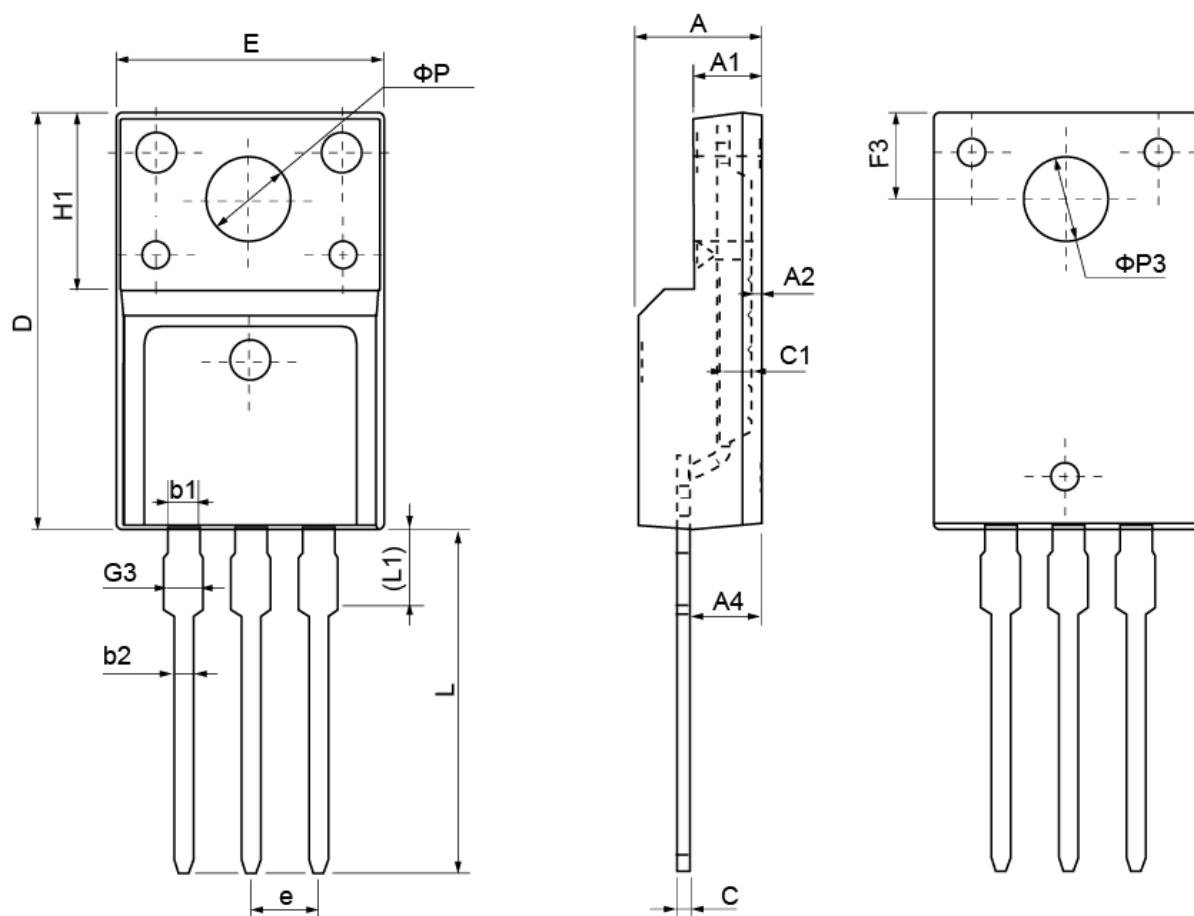


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TO-220F



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	ΦP	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

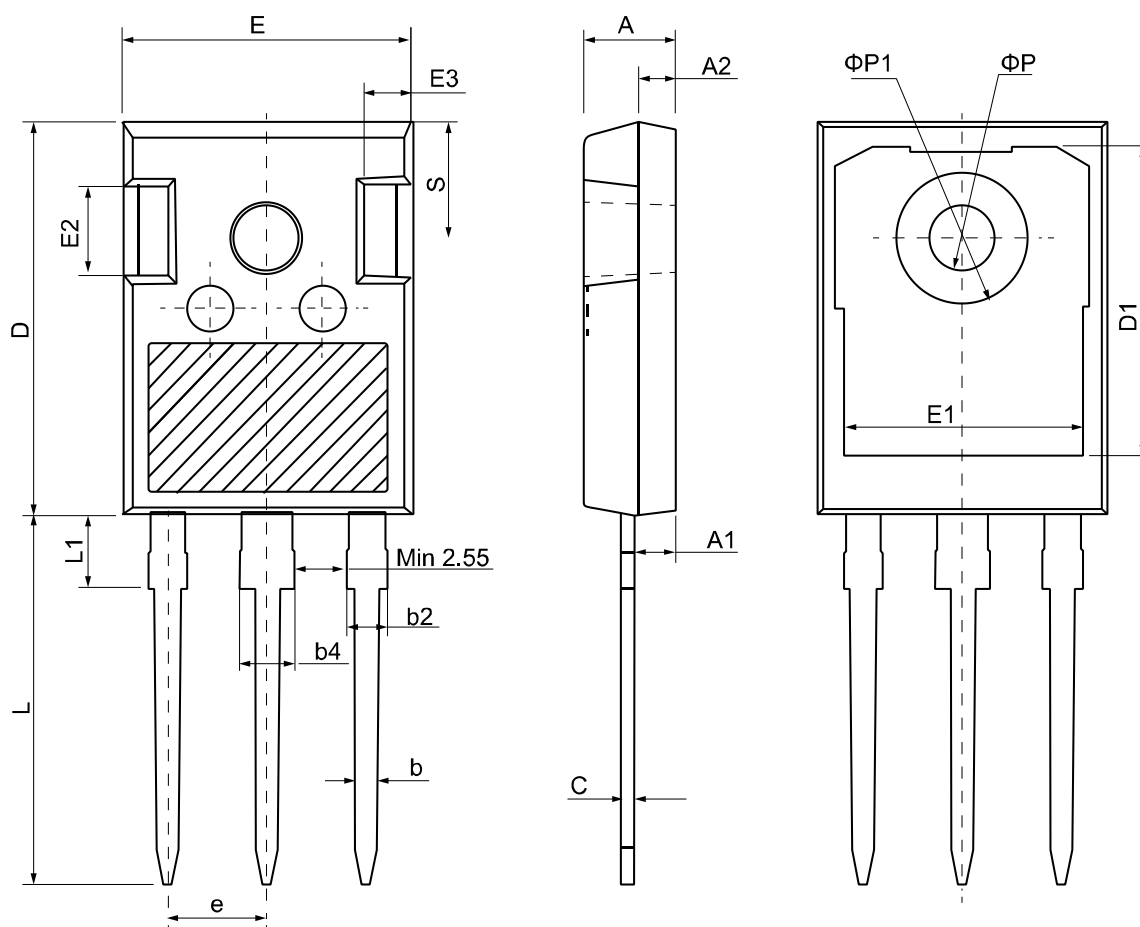


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TO-247



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	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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