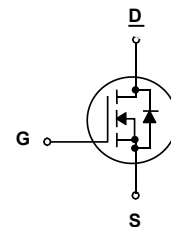
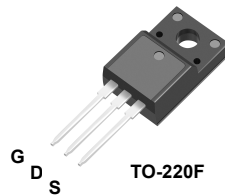
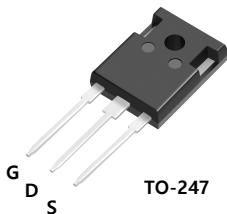


Features

- 650V Super-Junction MOSFET
- Ultra fast body diode: $t_{rr}=180\text{ns}(\text{typ.})$
- Low drain-source On-resistance: $R_{DS(\text{on})}=0.078\Omega$ (Max.)
- 100% avalanche tested
- RoHS compliant device



Absolute maximum ratings ($T_c=25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Rating	Unit
Drain-source voltage	V_{DSS}	650	V
Gate-source voltage	V_{GSS}	± 30	V
Drain current (DC) (Note 1)	I_D	$T_c=25^\circ\text{C}$	47
		$T_c=100^\circ\text{C}$	25
Drain current (Pulsed) (Note 1)	I_{DM}	160	A
Single pulsed avalanche energy (Note 2)	E_{AS}	980	mJ
Repetitive avalanche current (Note 1)	I_{AR}	9	A
Repetitive avalanche energy (Note 1)	E_{AR}	2.3	mJ
Power dissipation	P_D	230	W
Diode dv/dt ruggedness (Note 3)	dv/dt	50	V/ns
MOSFET dv/dt ruggedness (Note 4)	dv/dt	50	V/ns
Junction temperature	T_J	150	$^\circ\text{C}$
Storage temperature range	T_{stg}	-55~150	$^\circ\text{C}$

Thermal Characteristics

Characteristic	Symbol	Rating	Unit
Thermal resistance, junction to case	$R_{th(j-c)}$	Max. 0.543	°C/W
Thermal resistance, junction to ambient	$R_{th(j-a)}$	Max. 50	

Electrical Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Drain-source breakdown voltage	BV_{DSS}	$I_D=250\mu\text{A}$, $V_{GS}=0$	650	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$I_D=250\mu\text{A}$, $V_{DS}=V_{GS}$	3	4	5	V
Drain-source cut-off current	I_{DSS}	$V_{DS}=650\text{V}$, $V_{GS}=0\text{V}$	-	-	10	μA
Gate leakage current	I_{GSS}	$V_{DS}=0\text{V}$, $V_{GS}=\pm 30\text{V}$	-	-	1000	nA
Drain-source on-resistance	$R_{DS(ON)}$	$V_{GS}=10\text{V}$, $I_D=15.4\text{A}$	-	0.062	0.078	Ω
Internal gate resistance	R_g	$F=1\text{MHz}$, open drain	-	10	-	Ω
Input capacitance	C_{iss}	$V_{DS}=100\text{V}$, $V_{GS}=0\text{V}$, $f=1\text{MHz}$	-	3680	-	pF
Output capacitance	C_{oss}		-	390	-	
Reverse transfer capacitance	C_{rss}		-	15	-	
Turn-on delay time (Note 5)	$t_{d(on)}$	$V_{DS}=400\text{V}$, $I_D=15.4\text{A}$, $R_G=10\Omega$	-	120	-	ns
Rise time (Note 5)	t_r		-	80	-	
Turn-off delay time (Note 5)	$t_{d(off)}$		-	165	-	
Fall time (Note 5)	t_f		-	8.5	-	
Total gate charge (Note 6)	Q_g	$V_{DS}=480\text{V}$, $V_{GS}=10\text{V}$, $I_D=47\text{A}$	-	72	-	nC
Gate-source charge (Note 6)	Q_{gs}		-	14	-	
Gate-drain charge (Note 6)	Q_{gd}		-	24	-	
Gate plateau voltage (Note 6)	$V_{plateau}$		-	7.2	-	V

Source-Drain Diode Ratings and Characteristics ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

Characteristic	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Source current (DC)	I_S	Integral reverse diode in the MOSFET	-	-	47	A
Source current (Pulsed)	I_{SM}		-	-	160	A
Forward voltage	V_{SD}	$V_{GS}=0\text{V}$, $I_S=47\text{A}$	-	-	1.2	V
Reverse recovery time (Note 5, 6)	t_{rr}	$I_S=15.4\text{A}$, $V_{GS}=0\text{V}$, $dI_S/dt=100\text{A}/\mu\text{s}$	-	180	-	ns
Reverse recovery charge (Note 5, 6)	Q_{rr}		-	0.51	-	μC

Note:

1. Calculated continuous current based on maximum allowable junction temperature
2. $L=10\text{mH}$, $I_{AS}=9\text{A}$, $V_{DD}=90\text{V}$, Starting $T_J=25^{\circ}\text{C}$
3. $I_S \leq 9\text{A}$, $V_{DS} \leq 400\text{V}$, $dI_S/dt \leq 100\text{A}/\mu\text{s}$, $T_J=25^{\circ}\text{C}$
4. $V_{DS} \leq 400\text{V}$, $T_J=25^{\circ}\text{C}$
5. Guaranteed by design, not subject to production testing
6. Pulse test: Pulse width $\leq 300\mu\text{s}$, Duty cycles $\leq 2\%$

Typical Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

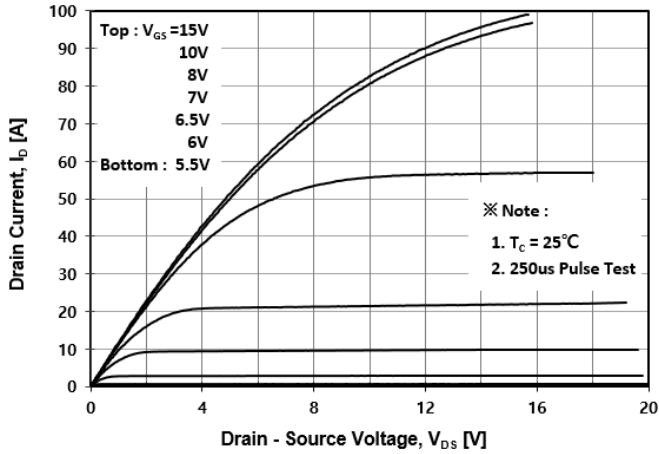


Fig. 2 Typical Transfer Characteristics

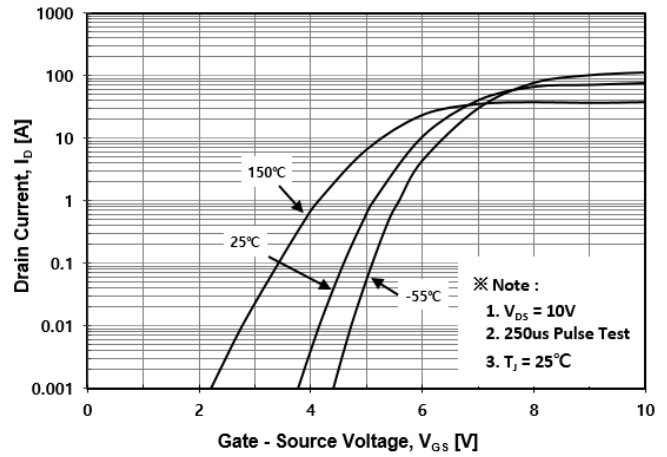


Fig.3 On-Resistance Variation with Drain Current and Gate Voltage

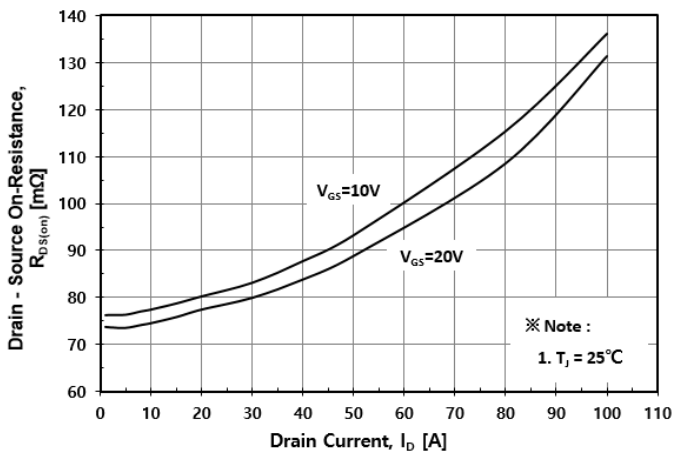


Fig. 4 Body Diode Forward Voltage Variation with Source Current

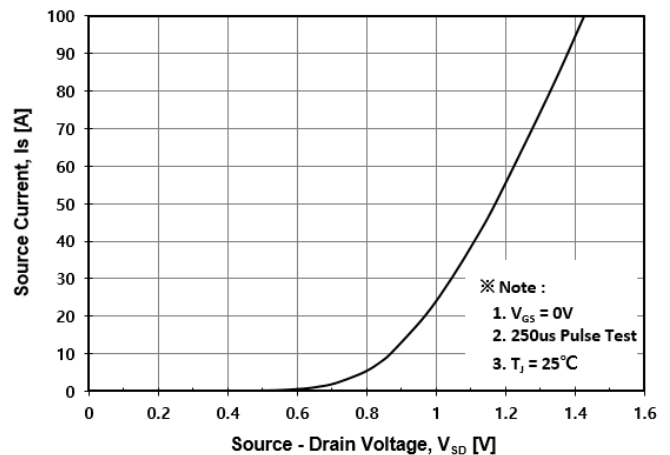


Fig. 5 Typical Capacitance Characteristics

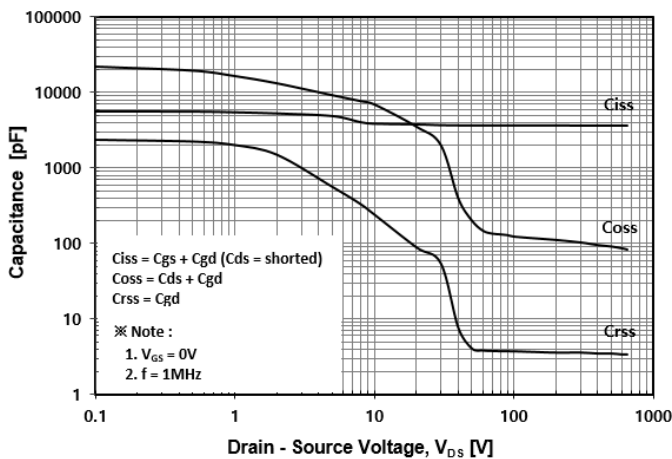


Fig. 6 Typical Total Gate Charge Characteristics

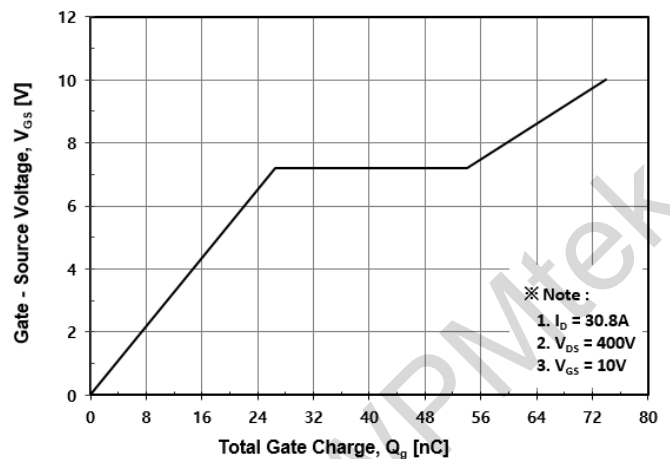


Fig. 7 Breakdown Voltage Variation vs. Temperature

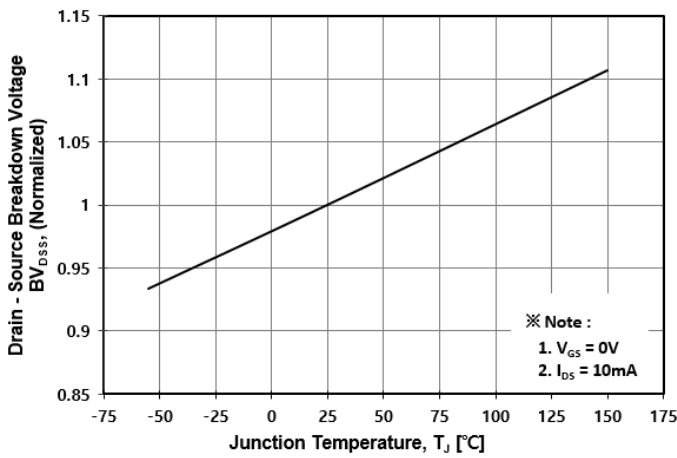


Fig. 8 On-Resistance Variation vs. Temperature

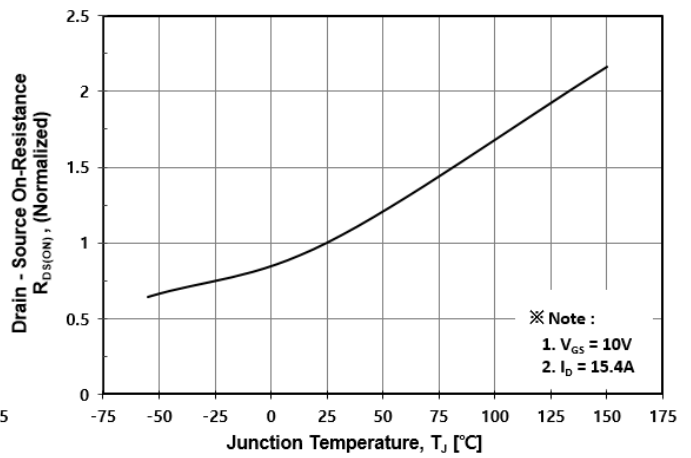


Fig. 9 Maximum Drain Current vs. Case Temperature

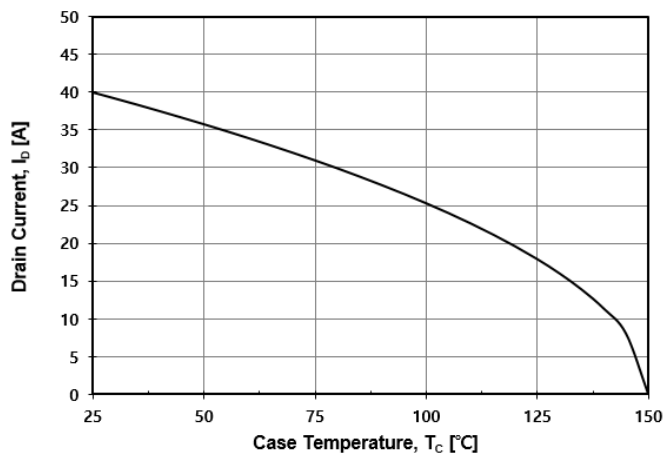


Fig. 10 Maximum Safe Operating Area

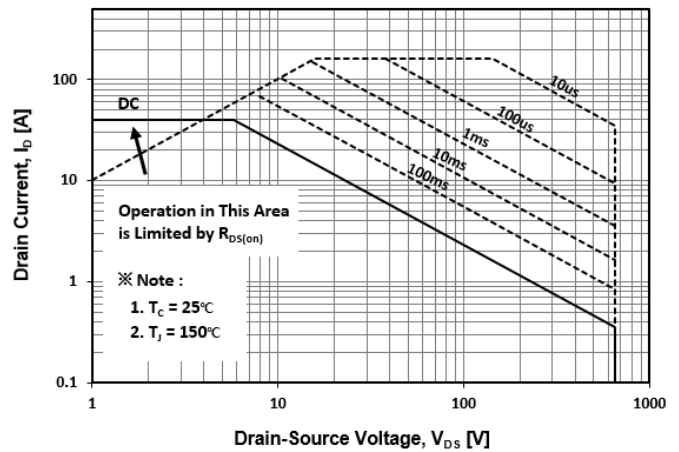


Fig. 11 Transient Thermal Impedance

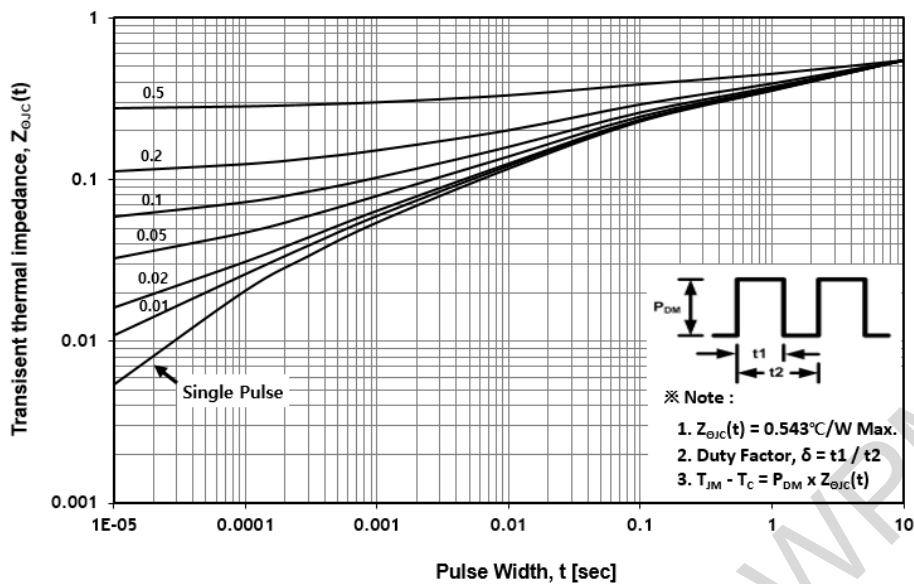


Fig. 12 Gate Charge Test Circuit & Waveform

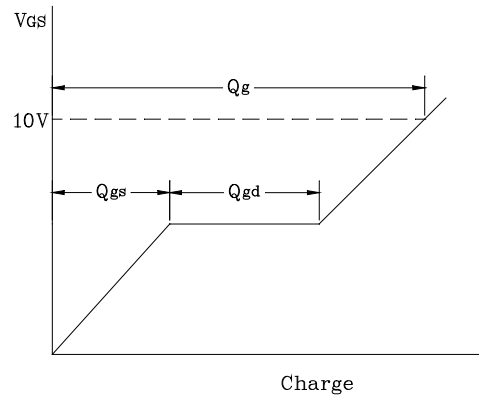
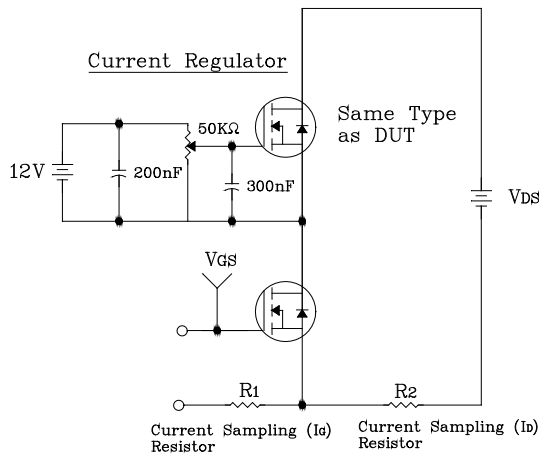


Fig. 13 Resistive Switching Test Circuit & Waveform

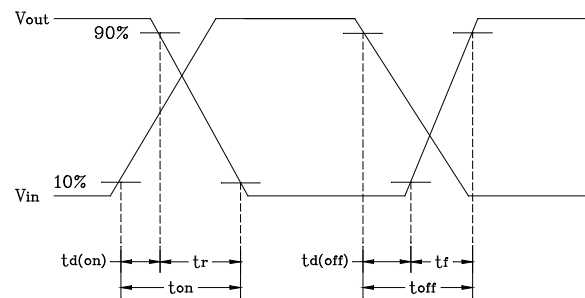
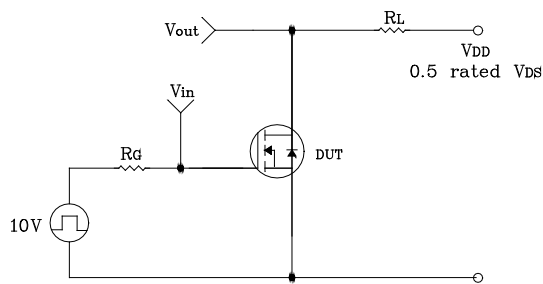


Fig. 14 E_{AS} Test Circuit & Waveform

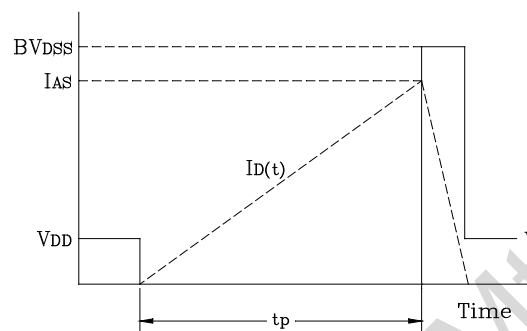
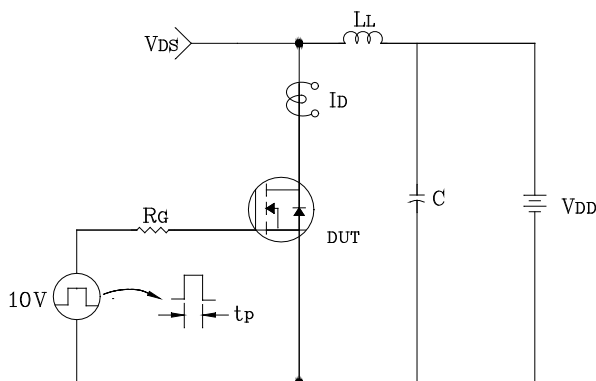
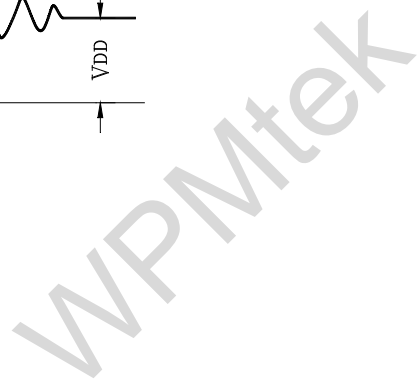
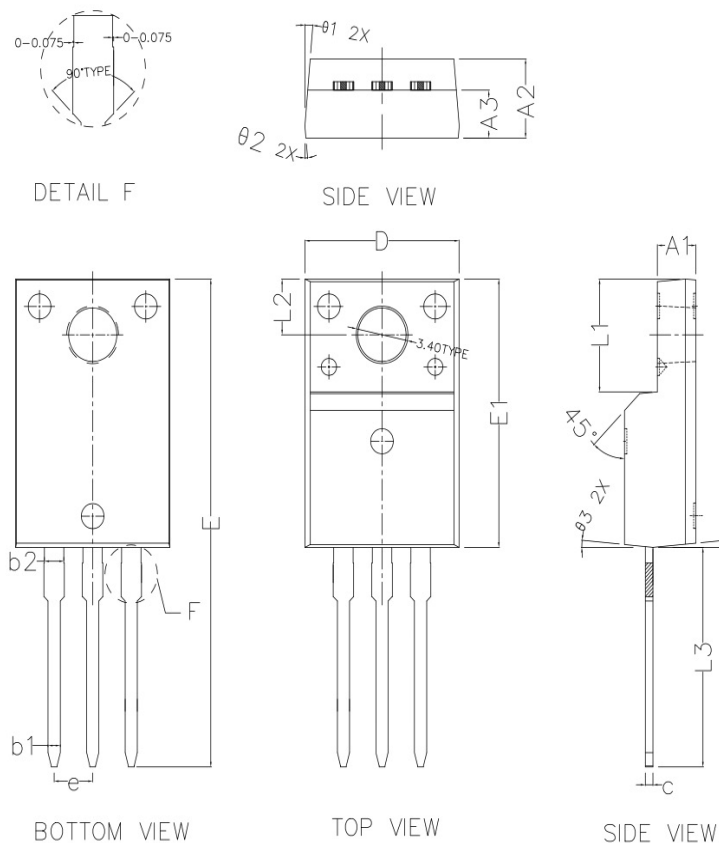


Fig. 15 Diode Reverse Recovery Time Test Circuit & Waveform



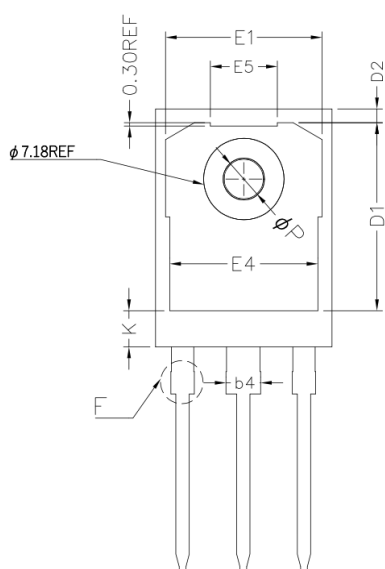
Package Outline

TO-220F Outline

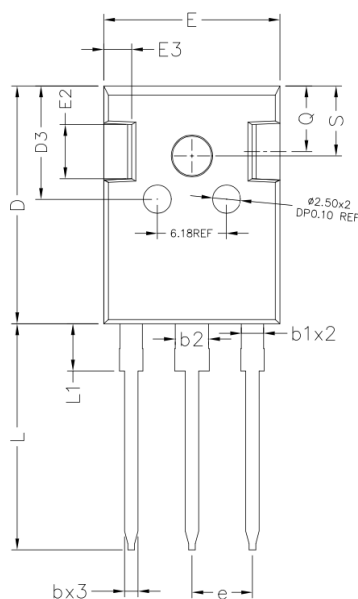


COMMON DIMENSIONS (UNITS OF MEASURE IS mm)			
	MIN	NORMAL	MAX
A1	2.440	2.540	2.640
A2	4.600	4.700	4.800
A3	2.730	2.830	2.930
b1	0.750	0.800	0.850
b2	1.230	1.280	1.330
c	0.450	0.500	0.550
D	10.060	10.160	10.260
E	28.650	28.850	29.050
E1	15.770	15.870	15.970
e	2.54 TYPE		
L1	6.68 REF		
L2	3.30 REF		
L3	12.830	12.980	13.130
θ1	5° TYPE		
θ2	5° TYPE		
θ3	5° TYPE		
θ4	5° TYPE		

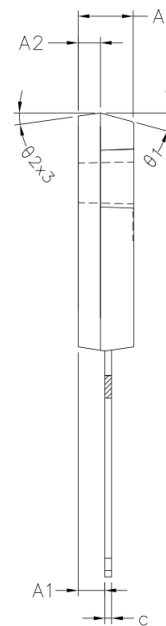
TO-247 Outline



BOTTOM VIEW



TOP VIEW

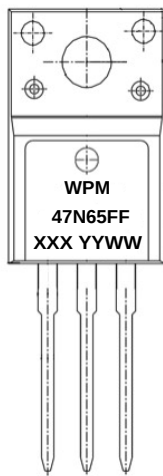


SIDE VIEW

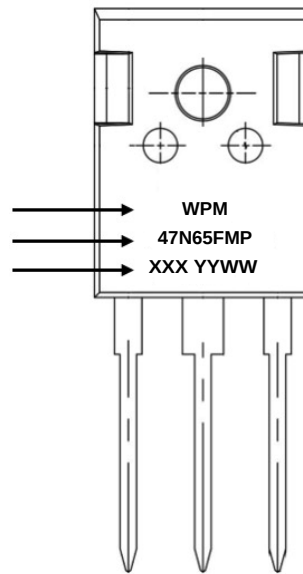
COMMON DIMENSIONS (UNITS OF MEASURE IS mm)			
	MIN	NORMAL	MAX
A	4.900	5.000	5.100
A1	2.300	2.400	2.500
A2	1.900	2.000	2.100
b	1.070	1.200	1.330
b1	1.910	2.000	2.160
b2	2.870	3.000	3.160
b3	1.910	2.100	2.410
b4	2.870	3.000	3.380
c	0.550	0.600	0.680
D	20.000	21.000	21.100
D1	16.250	16.950	17.650
D2	1.200 REF		
D3	10.000 REF		
E	15.700	15.800	15.900
E1	13.100	14.020	14.150
E2	3.680	—	5.100
E3	1.000	—	1.900
E4	12.380	13.260	13.430
E5	5.990 REF		
e	5.440 BSC		
L	19.810	19.950	20.320
L1	4.100	—	4.400
ϕP	3.500	—	3.650
Q	5.490	—	6.000
S	6.040	—	6.300
$\theta 1$	15.0° REF		
$\theta 2$	8.0° REF		
$\theta 3$	8.0° REF		
K	3.190 REF		

Marking Information

TO-220F



TO-247



**WPM Logo
Marking
Date Code**

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