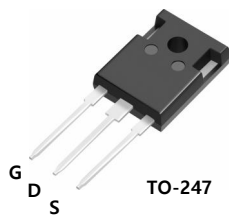


General Description

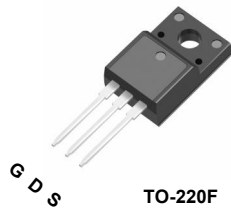
This Power MOSFET is produced using WPMtek's advanced Super-Junction MOSFET technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency switched mode power supplies.

Features

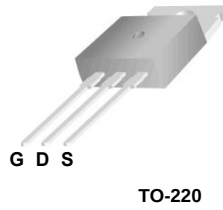
- 20A, 650V, $R_{DS(on)} = 190m\Omega @ V_{GS} = 10V$
- Low gate charge (typ. $Q_g = 30.2nC$)
- High ruggedness Ultra
- Fast switching
- 100% avalanche tested
- Improved dv/dt capability



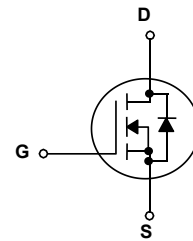
WTM20N65AMP



WTM20N65AF



WTM20N65AP



Absolute Maximum Ratings

$T_C = 25^\circ C$ unless otherwise noted

Symbol	Parameter	WTM20N65AMP / AF / AP	Units
V_{DSS}	Drain-Source Voltage	650	V
I_D	Drain Current - Continuous ($T_C = 25^\circ C$)	20 *	A
	- Continuous ($T_C = 100^\circ C$)	12*	A
I_{DM}	Drain Current - Pulsed (Note 1)	57 *	A
V_{GSS}	Gate-Source Voltage	± 30	V
EAS	Single Pulsed Avalanche Energy (Note 2)	76	mJ
I_{AR}	Avalanche Current (Note 1)	4	A
E_{AR}	Repetitive Avalanche Energy (Note 1)	1.62	mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	20	V/ns
	MOSFET dv/dt	100	
P_D	Power Dissipation ($T_C = 25^\circ C$)	36	W
	- Derate above $25^\circ C$	0.29	
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	$^\circ C$
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	$^\circ C$

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	WTM20N65AMP / AF / AP	Units
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	3.5	$^\circ C/W$
$R_{\theta JS}$	Thermal Resistance, Case-to-Sink Typ.	-	$^\circ C/W$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62.5	$^\circ C/W$

Electrical Characteristics

$T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
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Off Characteristics

BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 0.25\text{mA}$	650	--	--	V
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 0.25\text{mA}, T_J = 150^\circ\text{C}$	650	--	--	V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	--	--	1	μA
		$V_{DS} = 480\text{ V}, T_C = 125^\circ\text{C}$	--	2	--	μA
I_{GSSF}	Gate-Body Leakage Current, Forward	$V_{GS} = 30\text{ V}, V_{DS} = 0\text{ V}$	--	--	100	nA
I_{GSSR}	Gate-Body Leakage Current, Reverse	$V_{GS} = -30\text{ V}, V_{DS} = 0\text{ V}$	--	--	-100	nA

On Characteristics

$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 0.25\text{mA}$	2.5	--	4.5	V
$R_{DS(on)}$	Static Drain-Source On-Resistance	$V_{GS} = 10\text{ V}, I_D = 10\text{ A}$	--	160	190	m Ω

Dynamic Characteristics

C_{iss}	Input Capacitance	$V_{DS} = 400\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{MHz}$	--	1240	--	pF
C_{oss}	Output Capacitance		--	34	--	pF
C_{rss}	Reverse Transfer Capacitance		--	--	--	pF

Switching Characteristics

$t_{d(on)}$	Turn-On Delay Time	$V_{DS} = 400\text{ V}, I_D = 10\text{ A}, R_G = 10\text{ }\Omega, V_{GS} = 10\text{ V}$ (Note 4, 5)	--	12	--	ns
t_r	Turn-On Rise Time		--	8	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	53	--	ns
t_f	Turn-Off Fall Time		--	10	--	ns
Q_g	Total Gate Charge	$V_{DS} = 400\text{ V}, I_D = 10\text{ A}, V_{GS} = 10\text{ V}$ (Note 4, 5)	--	30.2	--	nC
Q_{gs}	Gate-Source Charge		--	5.8	--	nC
Q_{gd}	Gate-Drain Charge		--	15.4	--	nC
R_G	Gate Resistance	$f = 1\text{MHz}$		1.3		Ω

Drain-Source Diode Characteristics and Maximum Ratings

I _S	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
I _{SM}	Maximum Pulsed Drain-Source Diode Forward Current		--	--	57	A
V _{SD}	Drain-Source Diode Forward Voltage	V _{GS} = 0 V, I _S = 10 A	--	--	1.2	V
t _{rr}	Reverse Recovery Time	V _{DD} = 400 V, I _S = 10A, dI _F / dt = 100 A/us (Note 4)	--	274	--	ns
Q _{rr}	Reverse Recovery Charge		--	3.33	--	uC

Notes:

1. Repetitive Rating : Pulse width limited by maximum junction temperature
2. $I_{AS} = 4\text{ A}, V_{DD} = 50\text{ V}, R_G = 25\text{ }\Omega$, Starting $T_J = 25^\circ\text{C}$
3. $I_{SD} \leq 10\text{ A}, di/dt \leq 200\text{ A/us}, V_{DD} \leq 400$, Starting $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse width $\leq 300\text{ }\mu\text{s}$, Duty cycle $\leq 2\%$
5. Essentially independent of operating temperature

Typical Characteristics

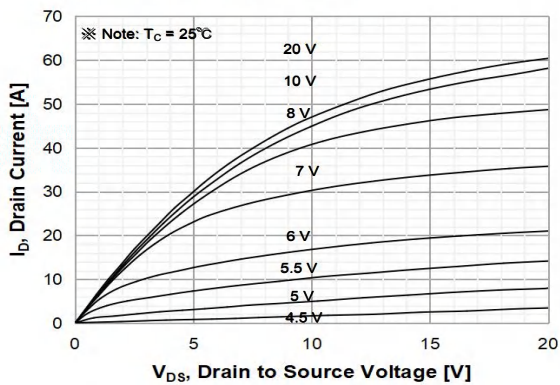


Figure 1. On-Region Characteristics

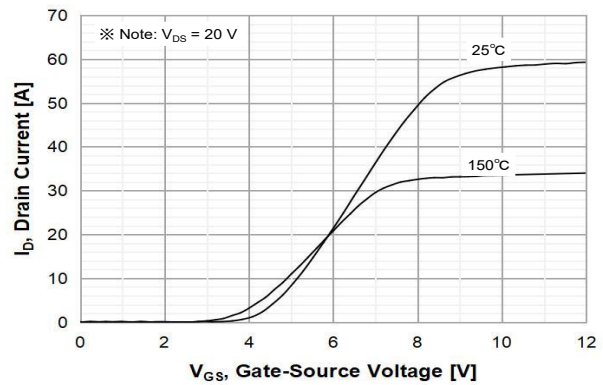


Figure 2. Transfer Characteristics

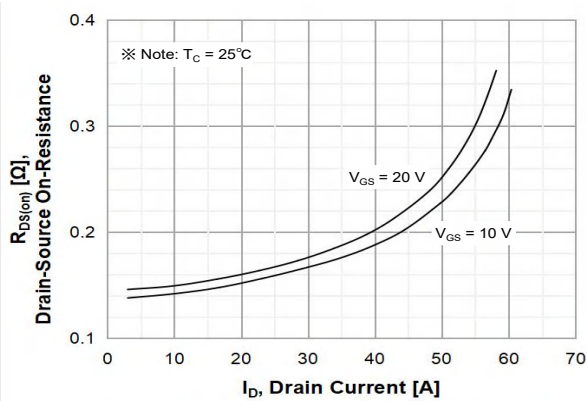


Figure 3. On-Resistance Variation vs Drain Current and Gate Voltage

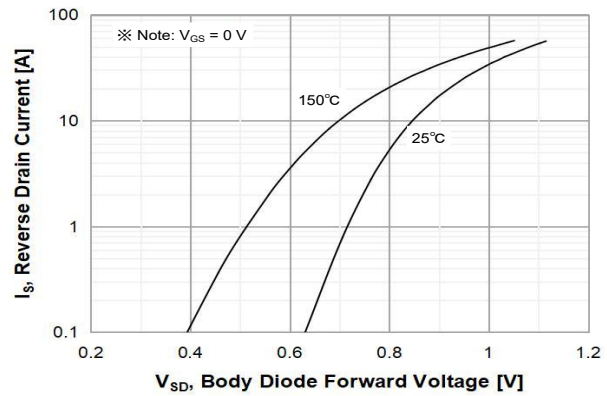


Figure 4. Body Diode Forward Voltage Variation with Source Current and Temperature

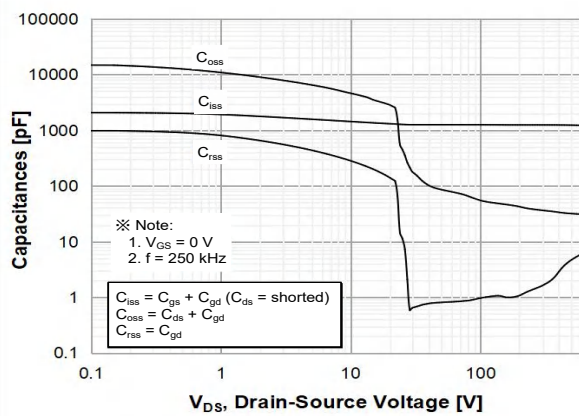


Figure 5. Capacitance Characteristics

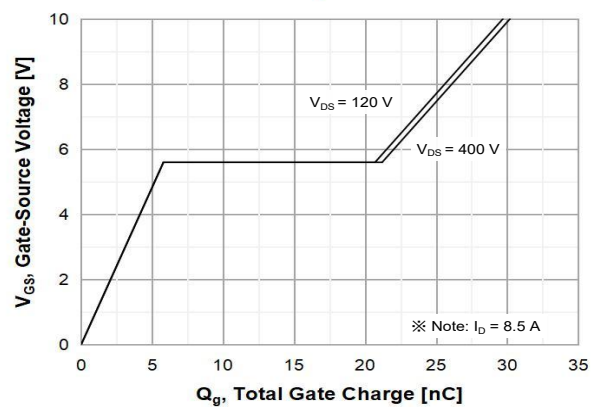


Figure 6. Gate Charge Characteristics

Typical Characteristics (Continued)

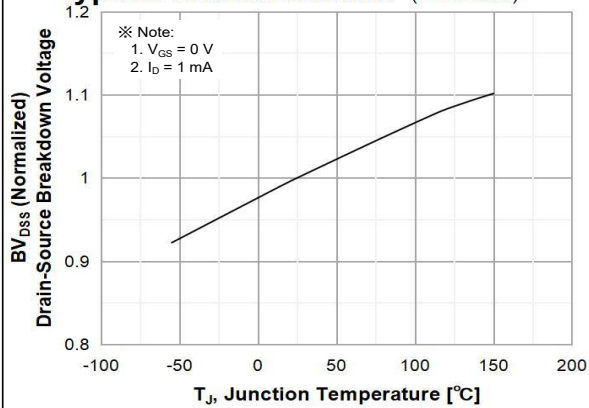


Figure 7. Breakdown Voltage Variation vs Temperature

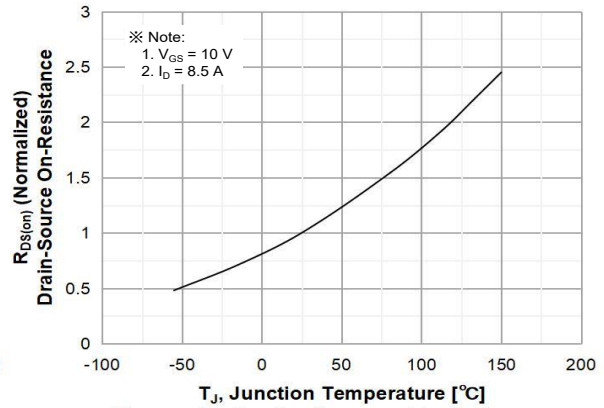


Figure 8. On-Resistance Variation vs Temperature

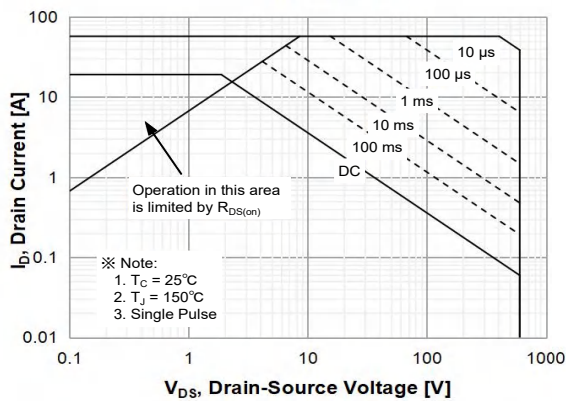


Figure 9. Maximum Safe Operating Area

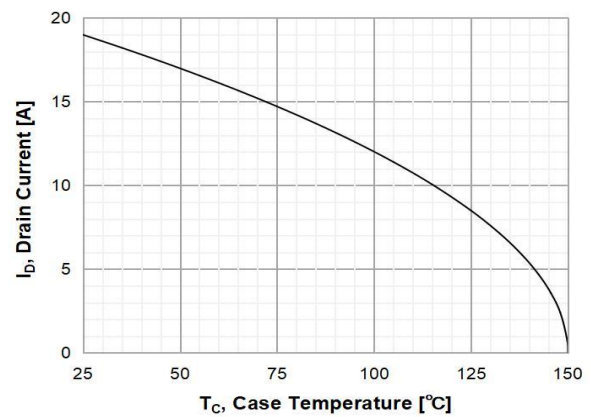


Figure 10. Maximum Drain Current vs. Case Temperature

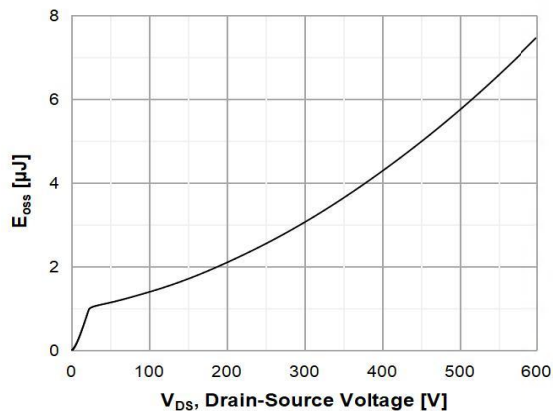


Figure 11. E_{OSS} vs. Drain to Source Voltage

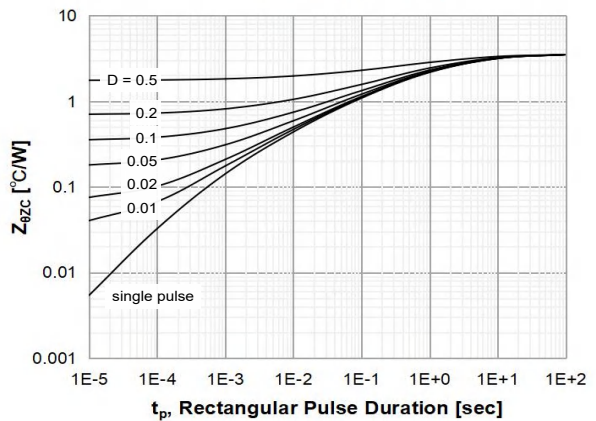
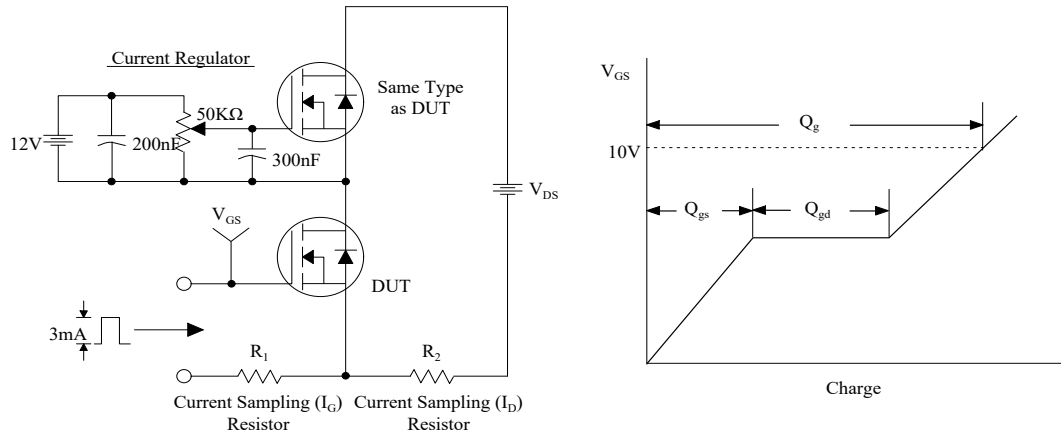
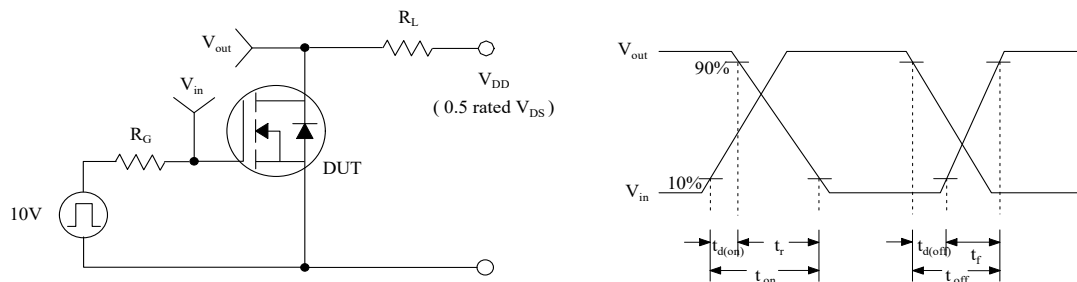


Figure 12. Transient Thermal Response Curve

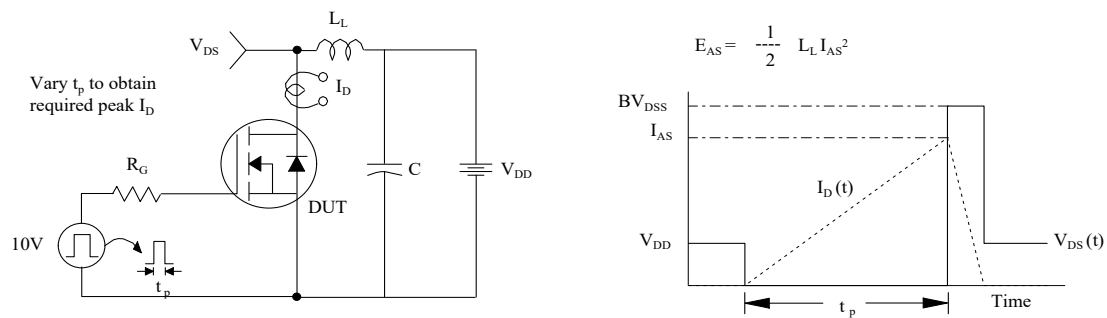
Gate Charge Test Circuit & Waveform



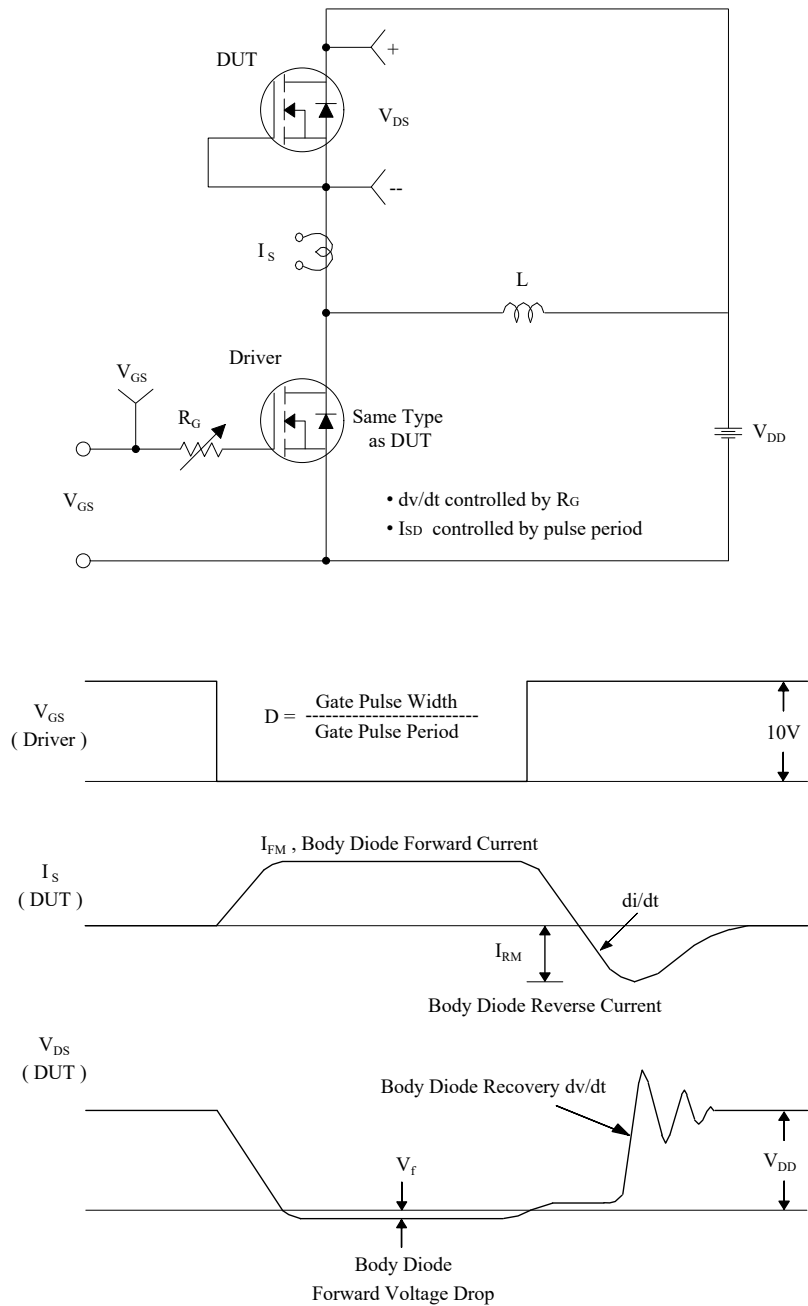
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching Test Circuit & Waveforms

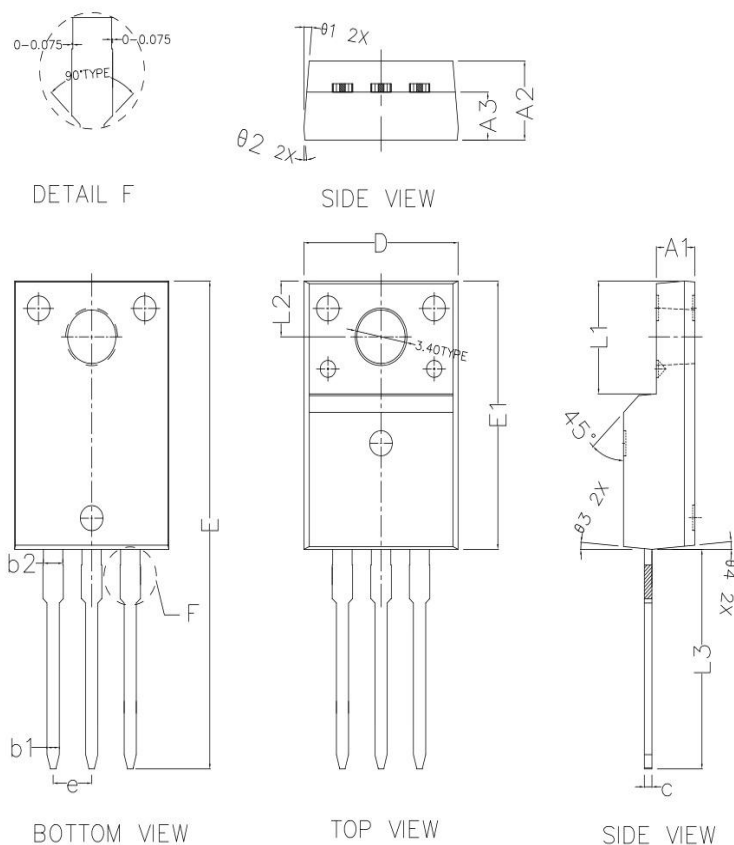


Peak Diode Recovery dv/dt Test Circuit & Waveforms



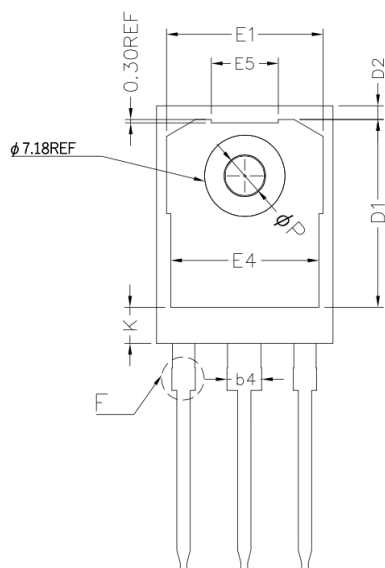
Package Outline

TO-220F Outline

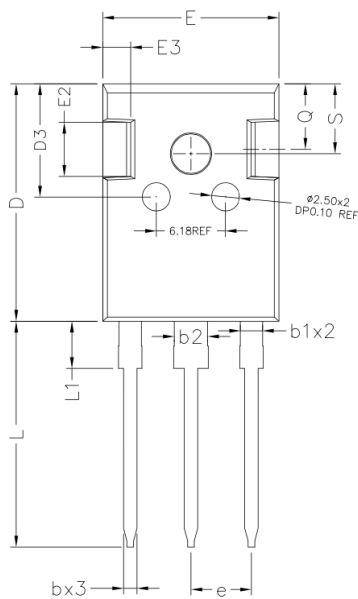


COMMON DIMENSIONS (UNITS OF MEASURE IS mm)			
	MIN	NORMAL	MAX
A1	2.440	2.540	2.640
A2	4.600	4.700	4.800
A3	2.730	2.830	2.930
b1	0.750	0.800	0.850
b2	1.230	1.280	1.330
c	0.450	0.500	0.550
D	10.060	10.160	10.260
E	28.650	28.850	29.050
E1	15.770	15.870	15.970
e	2.54 TYPE		
L1	6.68 REF		
L2	3.30 REF		
L3	12.830	12.980	13.130
$\theta 1$	5° TYPE		
$\theta 2$	5° TYPE		
$\theta 3$	5° TYPE		
$\theta 4$	5° TYPE		

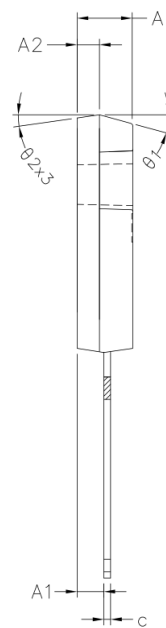
TO-247 Outline



BOTTOM VIEW



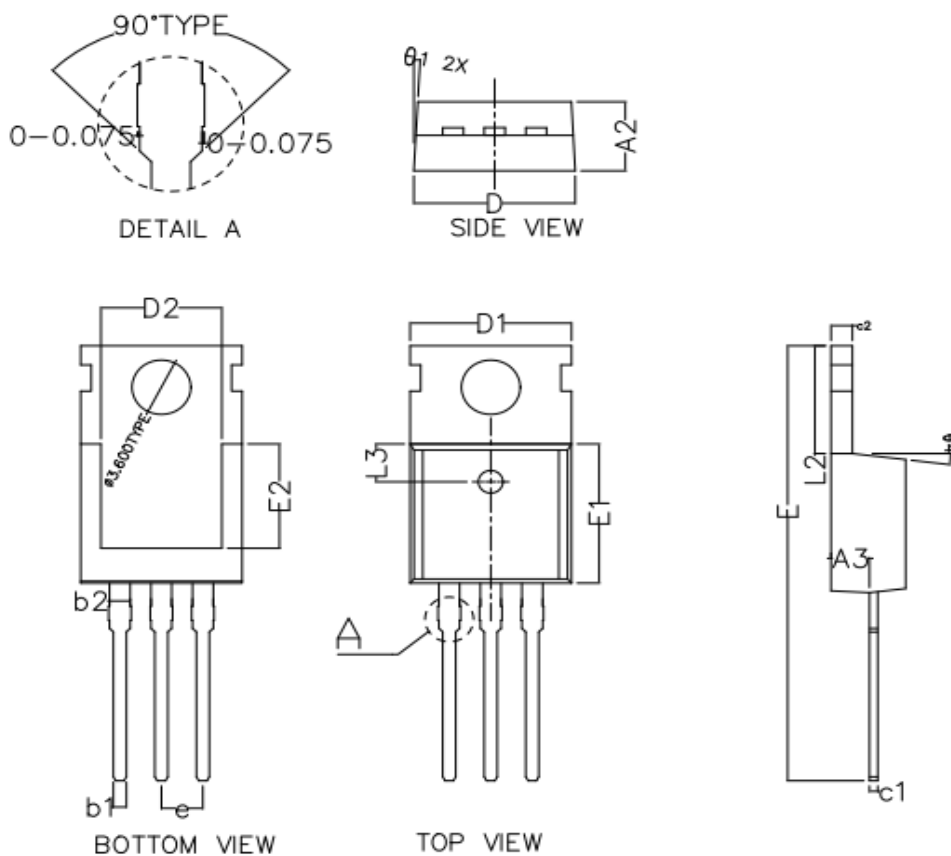
TOP VIEW



SIDE VIEW

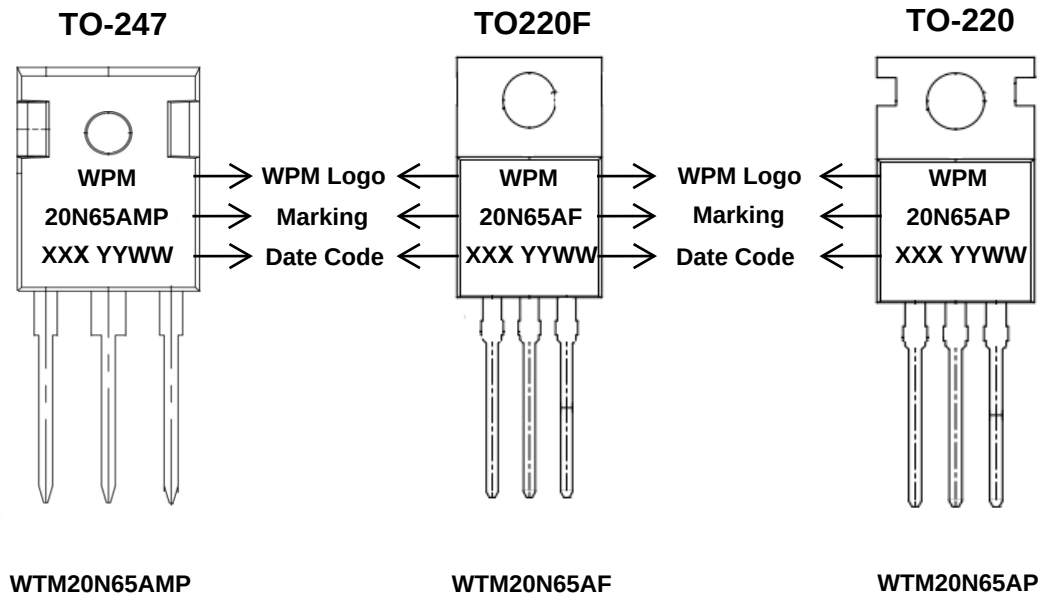
COMMON DIMENSIONS (UNITS OF MEASURE IS mm)			
	MIN	NORMAL	MAX
A	4.900	5.000	5.100
A1	2.300	2.400	2.500
A2	1.900	2.000	2.100
b	1.070	1.200	1.330
b1	1.910	2.000	2.160
b2	2.870	3.000	3.160
b3	1.910	2.100	2.410
b4	2.870	3.000	3.380
c	0.550	0.600	0.680
D	20.000	21.000	21.100
D1	16.250	16.950	17.650
D2	1.200REF		
D3	10.000REF		
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	5.990REF		
e	5.440BSC		
L	19.810	19.950	20.320
L1	4.100	—	4.400
phi P	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	3.190REF		

TO220 Outline



COMMON DIMENSIONS (UNITS OF MEASURE IS mm)			
	MIN	NORMAL	MAX
A2	4.470	4.570	4.670
A3	2.300	2.350	2.400
b1	0.750	0.800	0.850
b2	1.27 TYPE		
c1	0.450	0.500	0.550
c2	1.250	1.300	1.380
▲ D	9.900	10.000	10.100
▲ D1	10.000TYPE		
▲ D2	8.000TYPE		
▲ E	28.660	28.860	29.060
▲ E1	9.000	9.100	9.200
▲ E2	7.000TYPE		
e	2.540TYPE		
L2	6.350	6.500	6.650
L3	2.50TYPE		
θ1	3° TYPE		
θ2	3° TYPE		
θ3	7° TYPE		
θ4	7° TYPE		

Marking



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