

Features

- New technology for high voltage device
- Low on-resistance and low conduction losses
- Enhancement mode: $V_{th} = 3$ to $4V$
- Small package
- 100% avalanche tested
- RoHS compliant

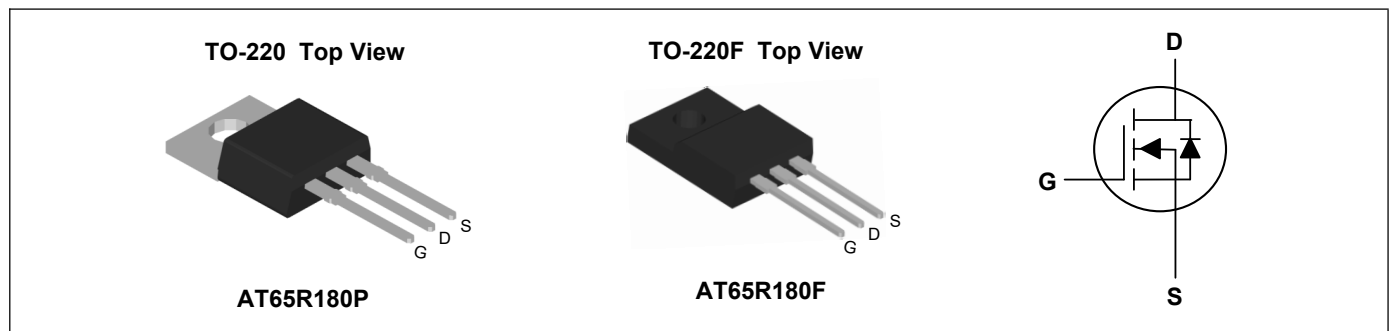
Key Performance Parameters



Parameter	Value	Unit
V_{DS}	650	V
$R_{DS(ON),max}$	180	m Ω
I_D	21	A
$Q_{g,typ}$	48	nC
I_{DM}	84	A

Applications

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



Absolute Maximum Ratings($T_C=25^\circ C$, unless otherwise noted)

Parameter	Symbol	TO-220	TO-220F	Unit
Drain-Source Voltage	V_{DS}	650		V
Gate-Source Voltage	V_{GS}	± 30		V
Continuous Drain Current	$I_D@T_C=25^\circ C$	21		A
Continuous Drain Current	$I_D@T_C=100^\circ C$	13.2		A
Pulsed Drain Current ¹	I_{DM}	84		A
Single Pulse Avalanche Energy ²	EAS	441		mJ
Avalanche Current	I_{AS}	10.5		A
Repetitive Avalanche energy, t_{AR} limited by T_{Jmax}	E_{AR}	0.7		mJ
MOSFET dv/dt ruggedness, $V_{DS} \leq 480V$	dv/dt	50		V/ns
Reverse diode dv/dt $V_{DS} \leq 480V, I_{SD}=I_D$		15		
Total Power Dissipation ($T_C=25^\circ C$)	P_D	188	33.8	W
Storage Temperature Range	T_{STG}	-55 to 150		$^\circ C$
Operating Junction Temperature Range	T_J	-55 to 150		$^\circ C$

Thermal Characteristics

Parameter	Symbol	TO-220	TO-220F	Unit
Thermal Resistance Junction-Ambient (Max)	$R_{\theta JA}$	62.5	80	$^\circ C/W$
Thermal Resistance Junction-Case (Max)	$R_{\theta JC}$	0.66	3.69	$^\circ C/W$

Electrical Characteristics (T_J=25°C, unless otherwise noted)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	BV _{DSS}	V _{GS} =0V, I _D =250uA	650	---	---	V
Static Drain-Source On-Resistance	R _{DS(ON)}	V _{GS} =10V, I _D =10.5A	---	150	180	mΩ
Gate Threshold Voltage	V _{GS(th)}	V _{GS} =V _{DS} , I _D =250uA	3	---	4	V
Drain-Source Leakage Current	I _{DSS}	V _{DS} =650V, V _{GS} =0V, T _C =25°C	---	---	1	uA
		V _{DS} =650V, V _{GS} =0V, T _C =125°C	---	---	100	uA
Gate-Source Leakage Current	I _{GSS}	V _{GS} =±30V, V _{DS} =0V	---	---	±100	nA
Forward Transconductance	g _{fs}	V _{DS} =20V, I _D =10.5A	---	16	---	S
Total Gate Charge	Q _g	V _{DS} =480V, V _{GS} =10V, I _D =21A	---	48	---	nC
Gate-Source Charge	Q _{gs}		---	17	---	
Gate-Drain Charge	Q _{gd}		---	14	---	
Turn-On Delay Time	T _{d(on)}	V _{DD} =380V, V _{GS} =10V, R _G =4Ω, I _D =11A	---	11	---	ns
Rise Time	T _r		---	6	---	
Turn-Off Delay Time	T _{d(off)}		---	61	---	
Fall Time	T _f		---	4.5	---	
Input Capacitance	C _{iss}	V _{DS} =50V, V _{GS} =0V, f=1MHz	---	2600	---	pF
Output Capacitance	C _{oss}		---	95	---	
Reverse Transfer Capacitance	C _{rss}		---	7	---	

Drain-Source Diode Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Source-Drain Current(Body Diode)	I _{SD}	T _C =25°C	---	---	21	A
Pulsed Source-Drain Current	I _{SDM}		---	---	84	A
Forward On Voltage	V _{SD}	V _{GS} =0V, I _{SD} =21A, T _J =25°C	---	0.9	1.3	V
Reverse Recovery Time	t _{rr}	I _F =21A, di/dt=100A/μs, T _J =25°C	---	310	---	ns
Reverse Recovery Charge	Q _{rr}		---	5	---	uC
Peak Reverse Recovery Current	I _{rrm}		---	28	---	A

Note:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. T_J=25°C, V_{DD}=50V, V_{GS}=10V, R_G=25Ω

Typical Characteristics

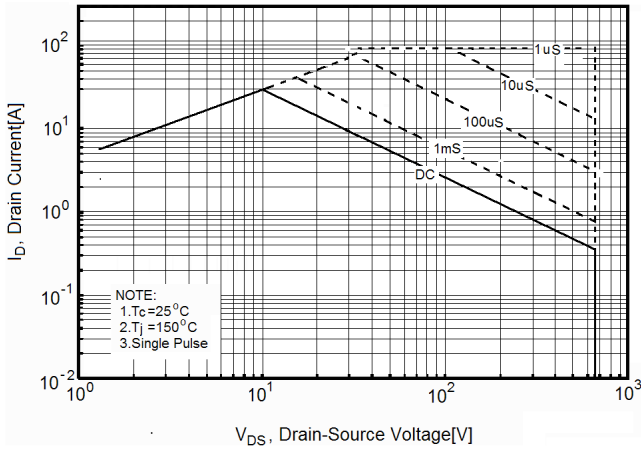


Figure1. Safe operating area for TO-220

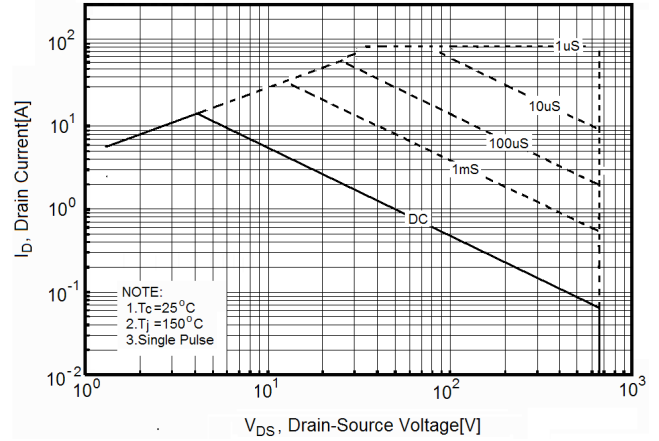


Figure2. Safe operating area for TO-220F

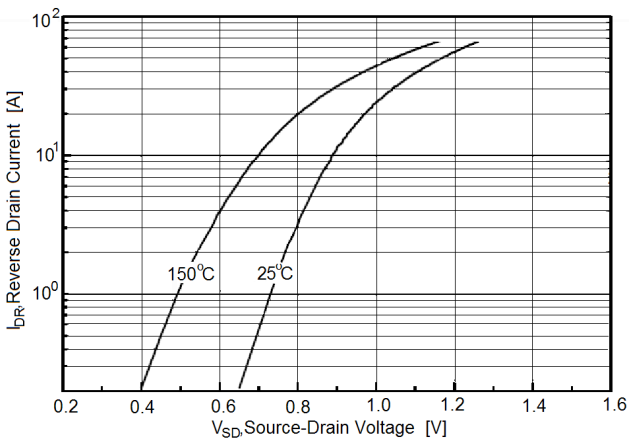


Figure3. Source-Drain Diode Forward Voltage

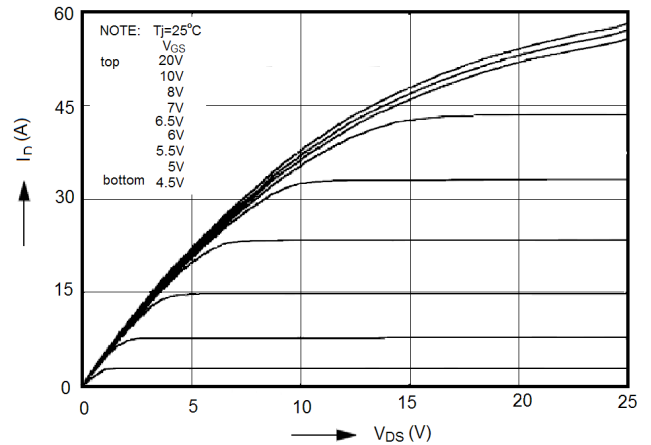


Figure4. Output characteristics

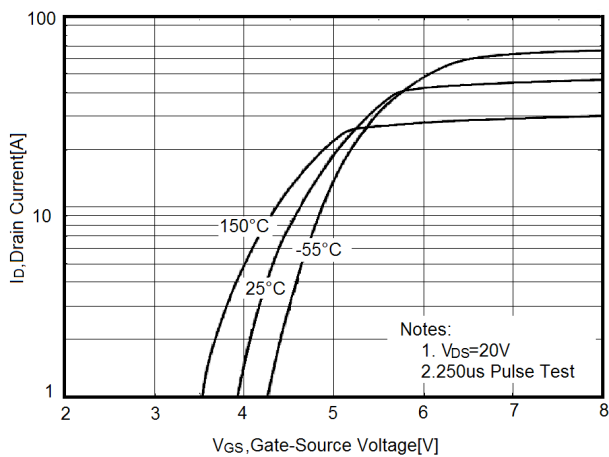


Figure5. Transfer characteristics

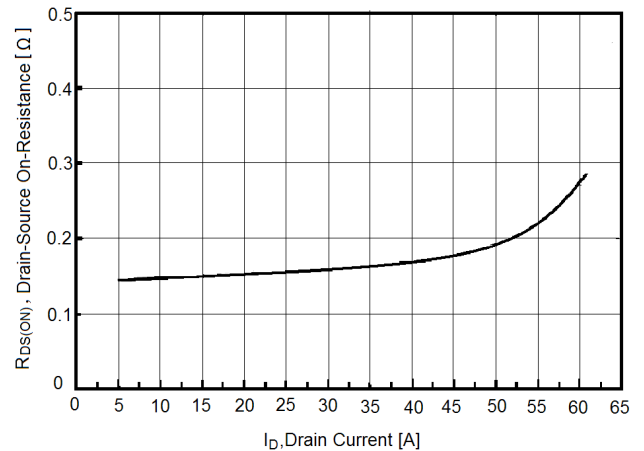


Figure6. Static drain-source on resistance

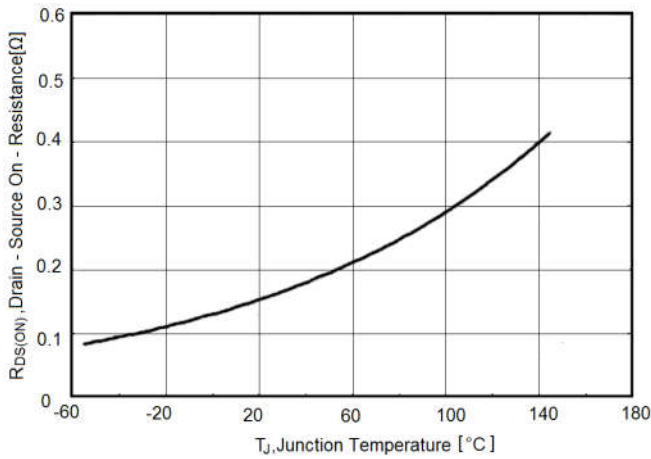


Figure7. $R_{DS(ON)}$ vs Junction Temperature

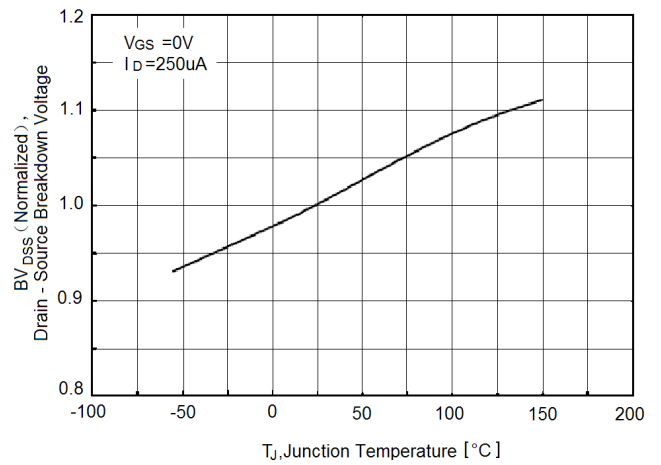


Figure8. BV_{DSS} vs Junction Temperature

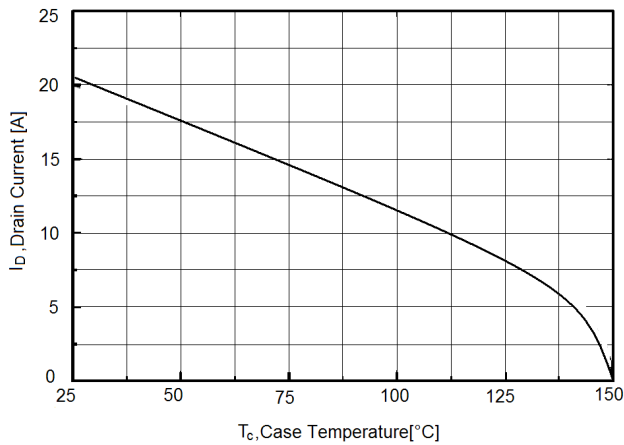


Figure9. Maximum I_D vs Junction Temperature

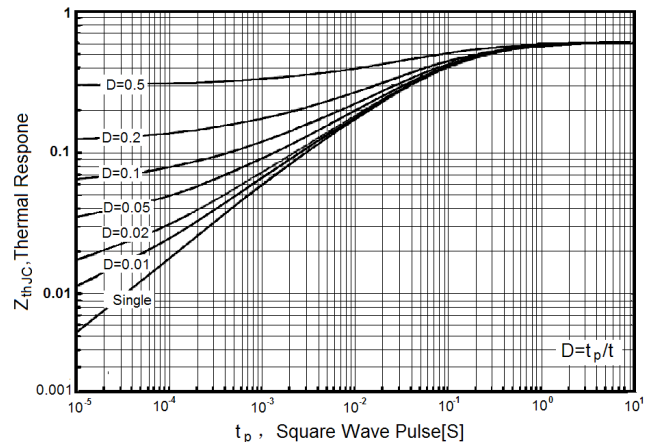


Figure10. Transient Thermal Impedance for TO-220

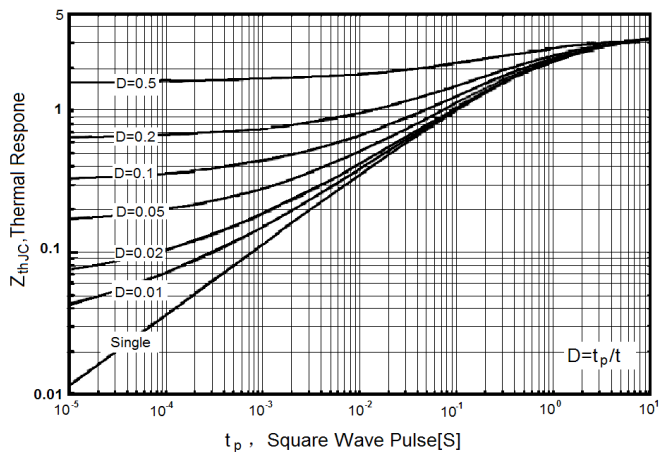
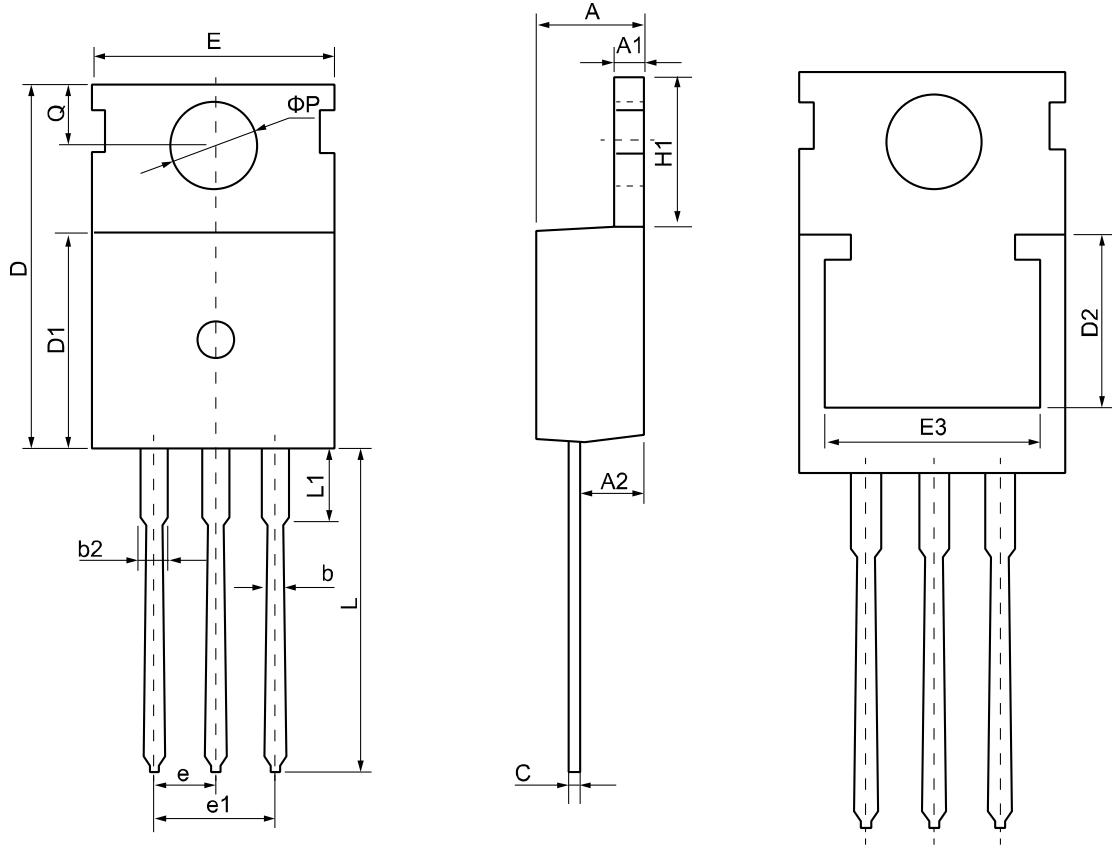


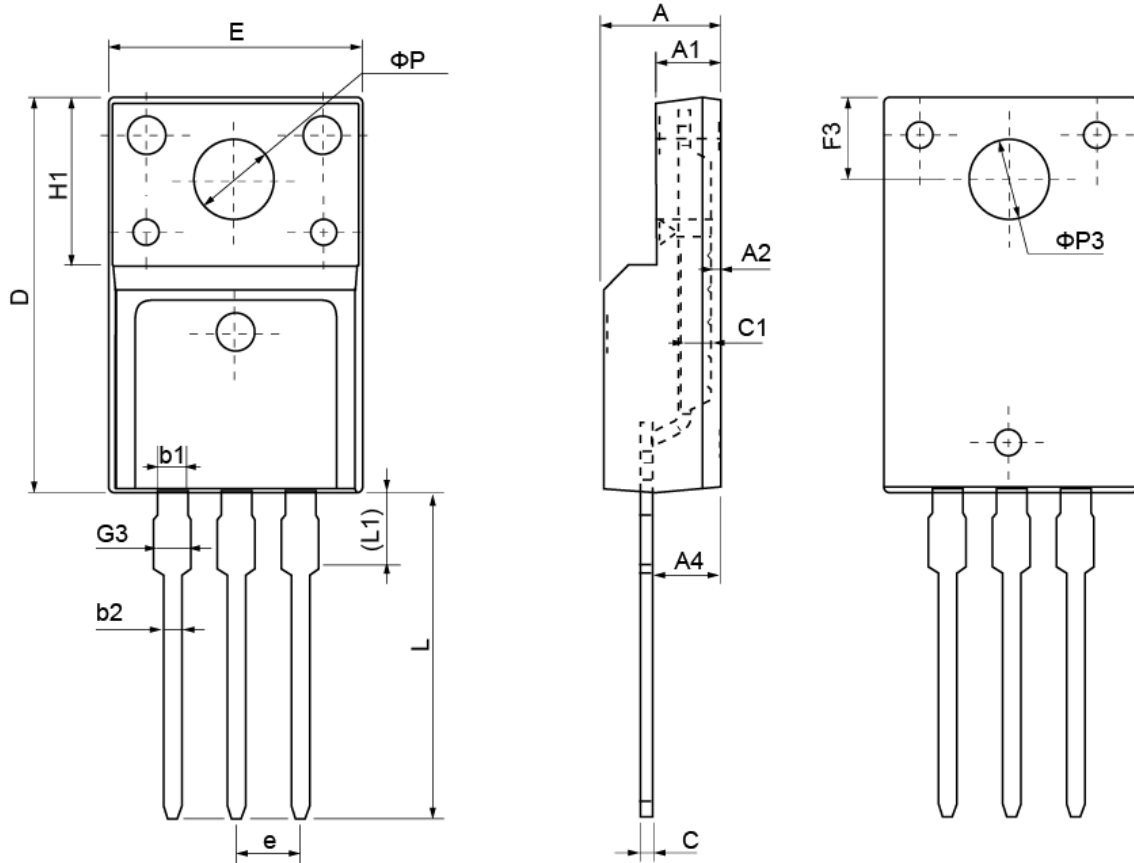
Figure11. Transient Thermal Impedance for TO-220F

TO-220 Package Outline Dimensions



Symbol	Dimensions (unit:mm)			Symbol	Dimensions (unit:mm)		
	Min	Typ	Max		Min	Typ	Max
A	4.30	4.55	4.75	E	9.65	10.00	10.25
A1	1.15	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	12.70	13.50	14.10
D	15.30	15.60	15.90	L1	--	3.20	3.95
D1	8.90	9.10	9.35	phi P	3.40	3.60	3.80
D2	5.50	--	--	Q	2.60	2.80	3.00

TO-220F Package Outline Dimensions



Symbol	Dimensions (unit:mm)			Symbol	Dimensions (unit:mm)		
	Min	Typ	Max		Min	Typ	Max
A	4.40	4.70	5.00	H1	6.70 REF		
A1	2.30	2.55	2.80	L	12.30	12.98	13.30
A2	0.30	0.50	0.70	L1	2.95	3.10	3.50
A4	2.45	2.80	3.05	phi P	3.03	3.20	3.50
c	0.30	0.50	0.70	phi P3	3.15	3.45	3.65
c1	1.20	1.30	1.40	b1	1.10	1.30	1.45
D	15.40	15.90	16.40	b2	0.60	0.80	1.00
E	9.86	10.16	10.46	F3	3.05	3.30	3.55
e	2.54 BSC			G3	1.15	1.35	1.55