Wuxi Unigroup Microelectronics Co.,Ltd

650V Super-junction Power MOSFET

DESCRIPTION

650V Super-junction Power MOSFET

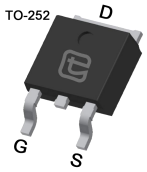
Super-junction power MOSFET is a revolutionary technology for high voltage power MOSFETs，designed according to the SJ principle. The Multi-EPI SJ MOSFET provide an extremely low switching, communication and conduction losses device with highest robustness make especially resonant switching applications more reliable, more efficient, lighter and cooler, designed by Wuxi Unigroup Microelectronics Company.

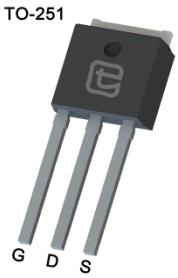
FEATURES

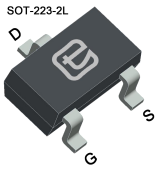
- Very low FOM $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- Easy to use/drive
- RoHS compliant
- Integrated ESD protection diode

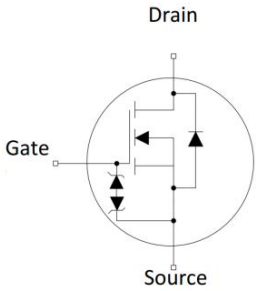
APPLICATIONS

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









Device Marking and Package Information

Device	Package	Marking
TPA65R1K5M	TO-220F	65R1K5M
TPD65R1K5M	TO-252	65R1K5M
TPU65R1K5M	TO-251	65R1K5M
TPY65R1K5MB	SOT-223-2L	65R1K5M

Key Performance Parameters

Parameter	Value	Unit
V_{DS} @ $T_{j,max}$	650	V
$R_{DS(on),max}$	1.5	Ω
I_D	3	A
$Q_{g,typ}$	7	nC
I_{DM}	9	A
ESD class（HBM）	1C	

Absolute Maximum Ratings T_C = 25ºC, unless otherwise noted						
Parameter		**Symbol**	**Value**			**Unit**
			TO-220F	**TO-252/TO-251**	**SOT-223-2L**	
Drain-Source Voltage (V_{GS} = 0V)		V_{DSS}	650			V
Continuous Drain Current	T_C = 25ºC	I_D	3			A
	TC = 100ºC		1.8			
Pulsed Drain Current (note1)		I_{DM}	9			A
Gate-Source Voltage		V_{GSS}	±20			V
Single Pulse Avalanche Energy (note2)		E_{AS}	26			mJ
Repetitive Avalanche Energy (note2)		E_{AR}	0.10			mJ
Avalanche Current		I_{AR}	0.6			A
MOSFET dv/dt ruggedness, V_{DS} = 0...480V		dv/dt	50			V/ns
Power Dissipation		P_D	25	28	6.2	W
Continuous Body Diode Current		I_S	2.5			A
Pulsed Diode Forward Current (note1)		I_{SM}	33			
Reverse diode dv/dt (note3)		dv/dt	15			V/ns
Maximum diode commutation speed (note3)		di_f/dt	500			A/us
Operating Junction and Storage Temperature Range		T_J, T_{stg}	-55~+150			ºC

Thermal Resistance				
Parameter	**Symbol**	**Value**		**Unit**
		TO-220F	**TO-252/TO-251**	**SOT-223-2L**	
Thermal Resistance, Junction-to-Case	R_{thJC}	5	4.4	20	ºC/W
Thermal Resistance, Junction-to-Ambient	R_{thJA}	80	62	160	

Specifications T_J = 25ºC, unless otherwise noted

Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	V_{GS} = 0V, I_D = 250μA	650	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 650V, V_{GS} = 0V, T_J = 25ºC	--	--	1	μA
		V_{DS} = 650V, V_{GS} = 0V, T_J = 150ºC	--	--	100	
Gate-Source Leakage	I_{GSS}	V_{GS} = ±20V	--	--	±1	μA
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250μA	2.5	--	4.0	V
Drain-Source On-Resistance	$R_{DS(on)}$	V_{GS} = 10V, I_D = 1.5A	--	1.3	1.5	Ω
Gate resistance	R_G	f = 1.0MHz open drain	--	5.5	--	Ω
Dynamic						
Input Capacitance	C_{iss}	V_{GS} = 0V, V_{DS} = 100V, f = 1.0MHz	--	225	--	pF
Output Capacitance	C_{oss}		--	10	--	
Reverse Transfer Capacitance	C_{rss}		--	0.4	--	
Total Gate Charge	Q_g	V_{DD} = 560V, I_D = 3A, V_{GS} = 10V	--	7	--	nC
Gate-Source Charge	Q_{gs}		--	1.3	--	
Gate-Drain Charge	Q_{gd}		--	3.5	--	
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 400V, I_D = 3A, R_G = 25Ω	--	8.5	--	ns
Turn-on Rise Time	t_r		--	7.7	--	
Turn-off Delay Time	$t_{d(off)}$		--	19.0	--	
Turn-off Fall Time	t_f		--	16.5	--	
Drain-Source Body Diode Characteristics						
Body Diode Voltage	V_{SD}	T_J = 25ºC, I_{SD} = 1.5A, V_{GS} = 0V	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	V_R = 400V, I_F = 3A, di_F/dt = 100A/μs	--	155	--	ns
Reverse Recovery Charge	Q_{rr}		--	0.85	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	11	--	A

Notes

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. I_{AS} = 0.6A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3. Identical low side and high side switch with identical R_G

Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 1. Output Characteristics

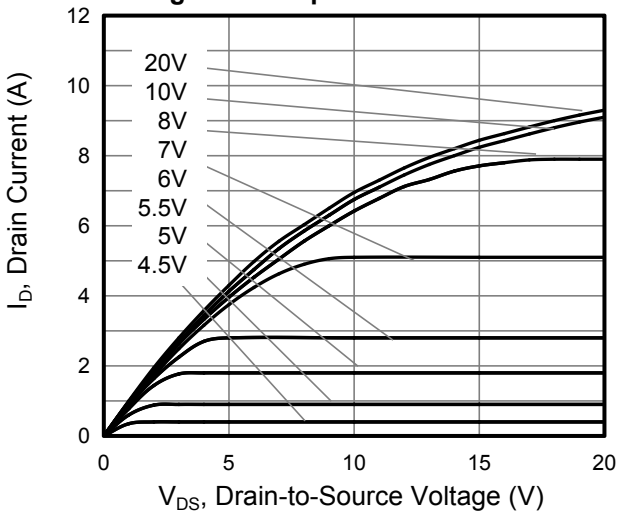


Figure 2. Transfer Characteristics

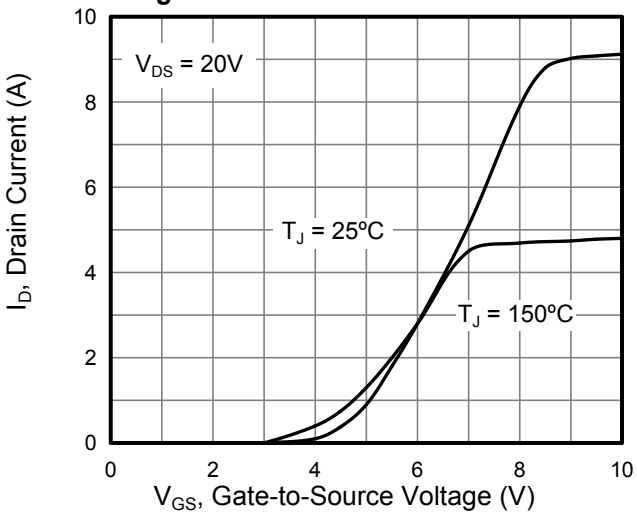


Figure 3. On-Resistance vs. Drain Current

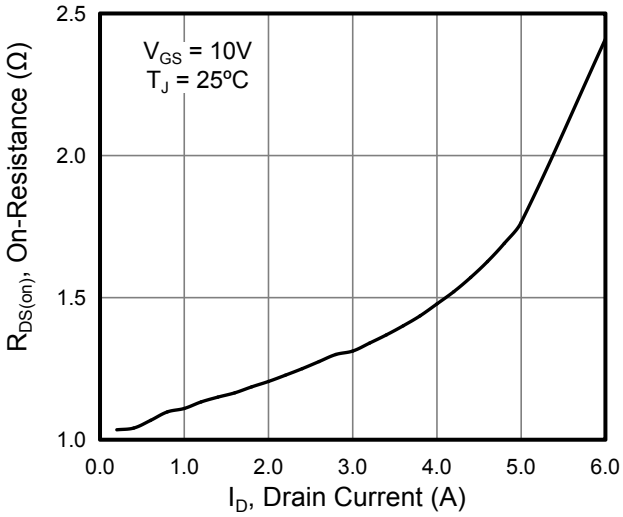


Figure 4. Capacitance

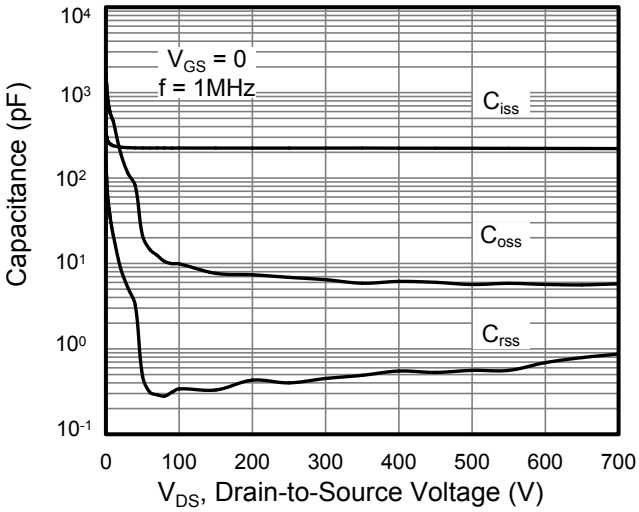


Figure 5. Gate Charge

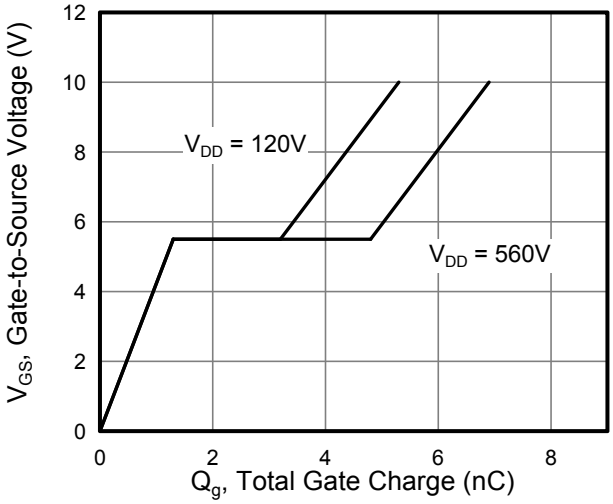
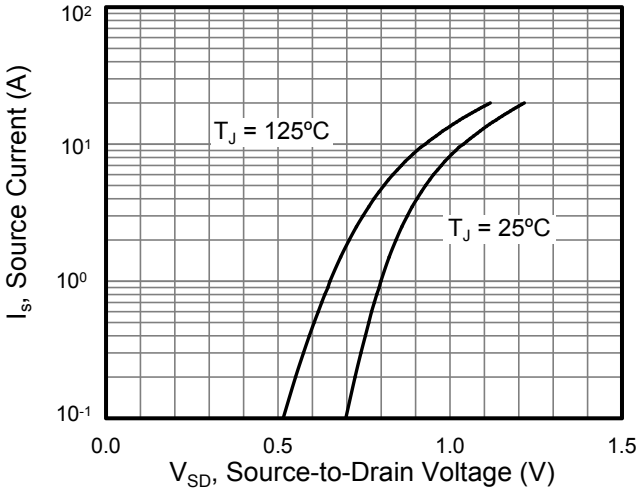


Figure 6. Body Diode Forward Voltage



Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 7. On-Resistance vs. Junction Temperature

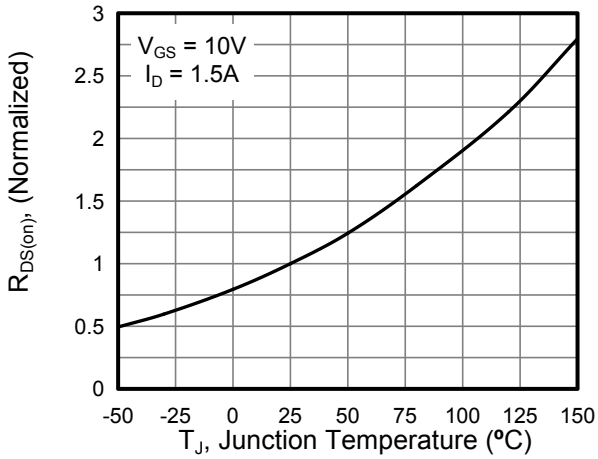


Figure 8. Breakdown voltage vs. Junction Temperature

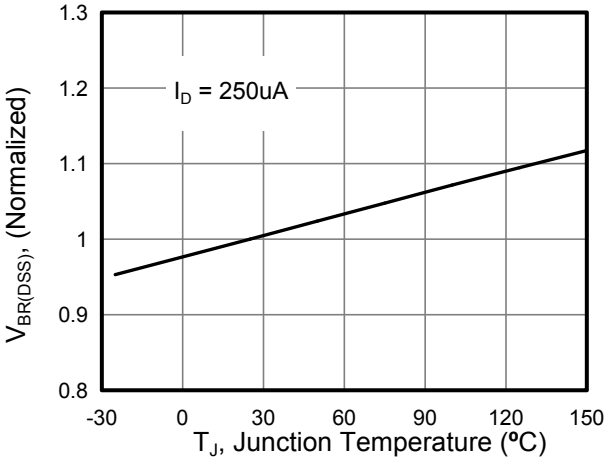


Figure 9. Transient Thermal Impedance for TO-220F

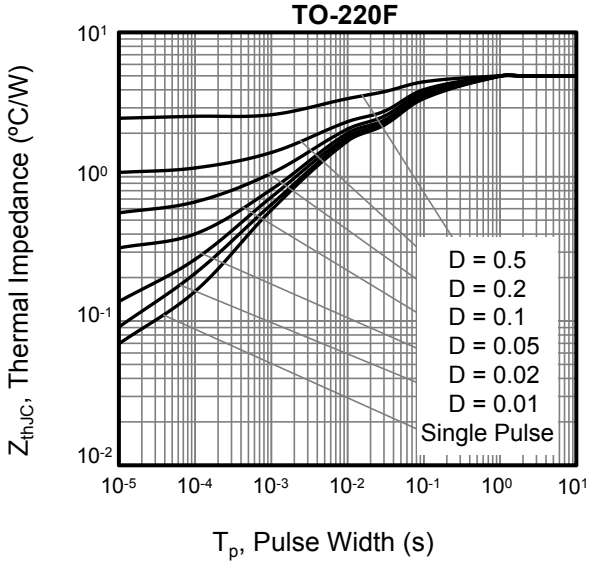


Figure 10. Safe operation area for TO-220F

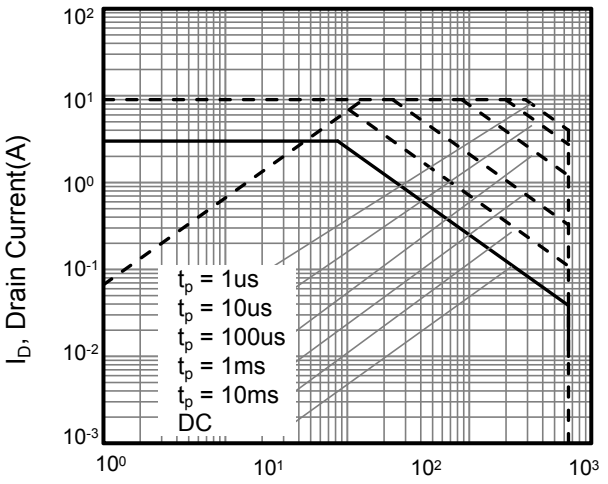


Figure 11. Transient Thermal Impedance for TO-252/TO-251

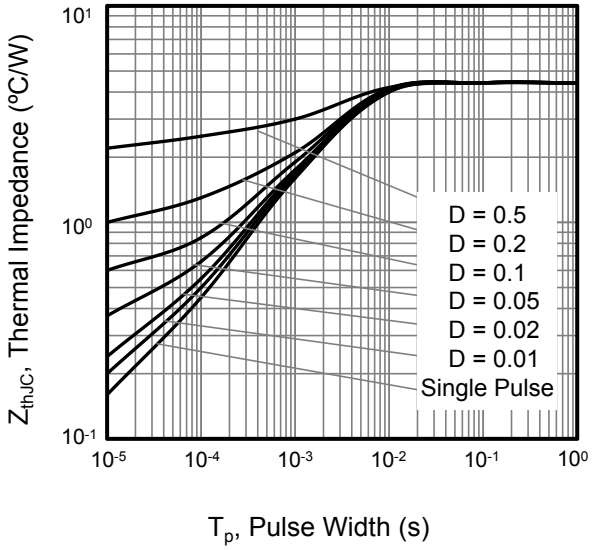
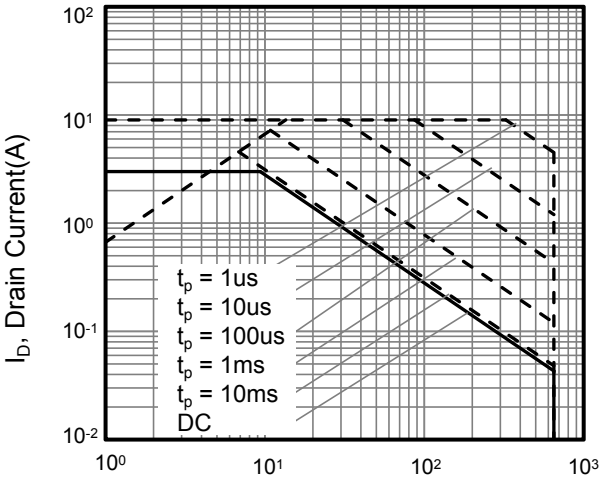


Figure 12. Safe operation area for TO-252/TO-251



Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 13. Transient Thermal Impedance for SOT-223-2L

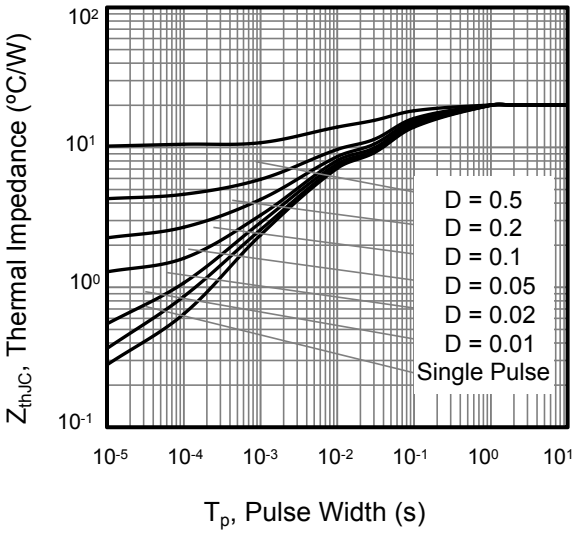


Figure 14. Safe operation area for SOT-223-2L

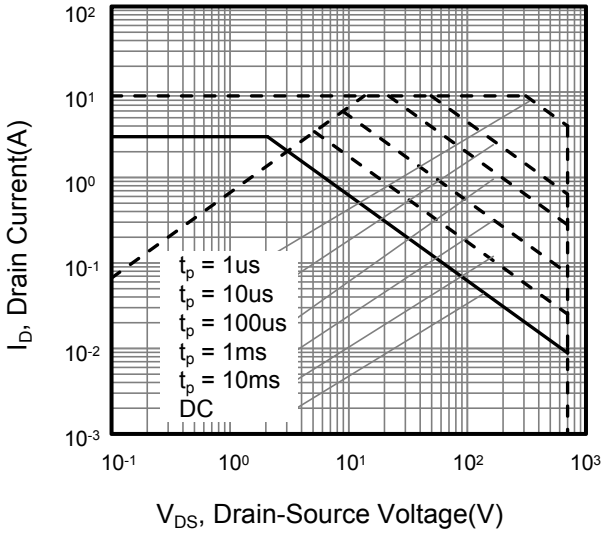


Figure A：Gate Charge Test Circuit and Waveform

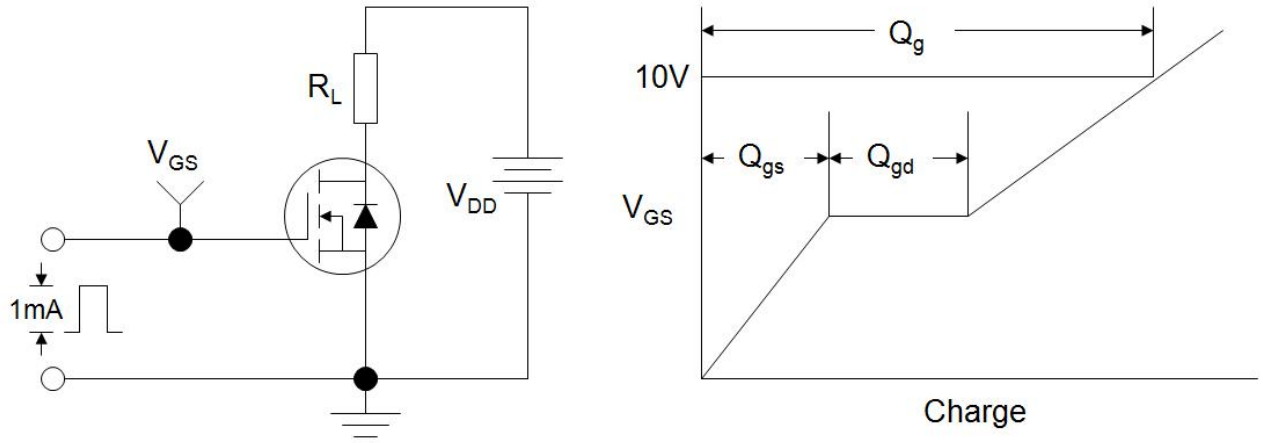


Figure B：Resistive Switching Test Circuit and Waveform

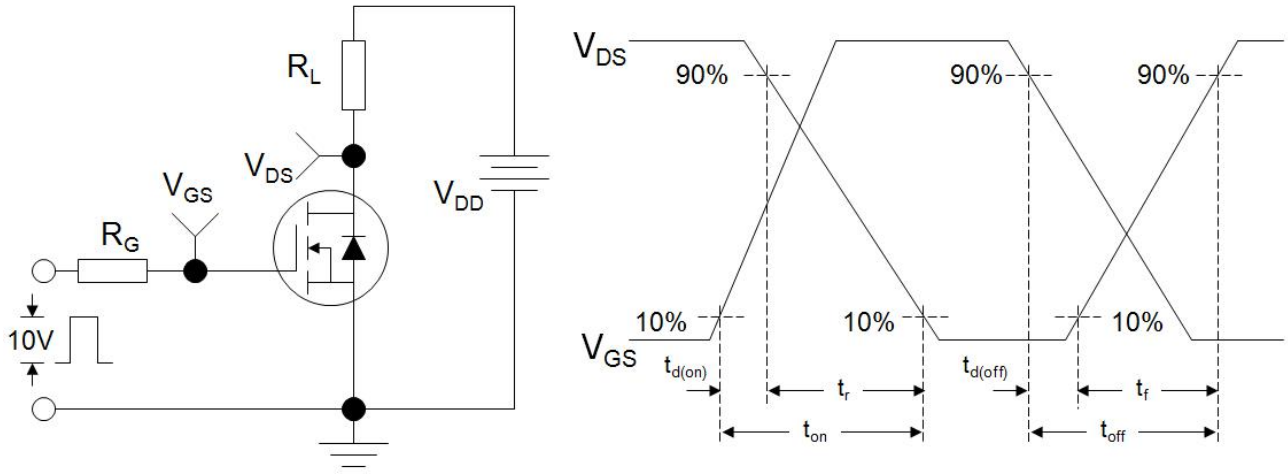
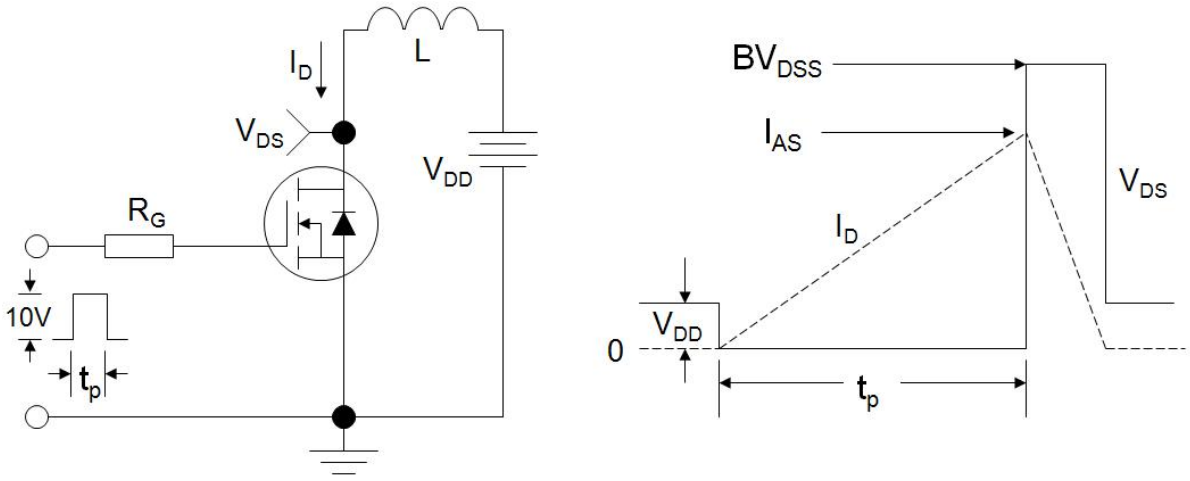
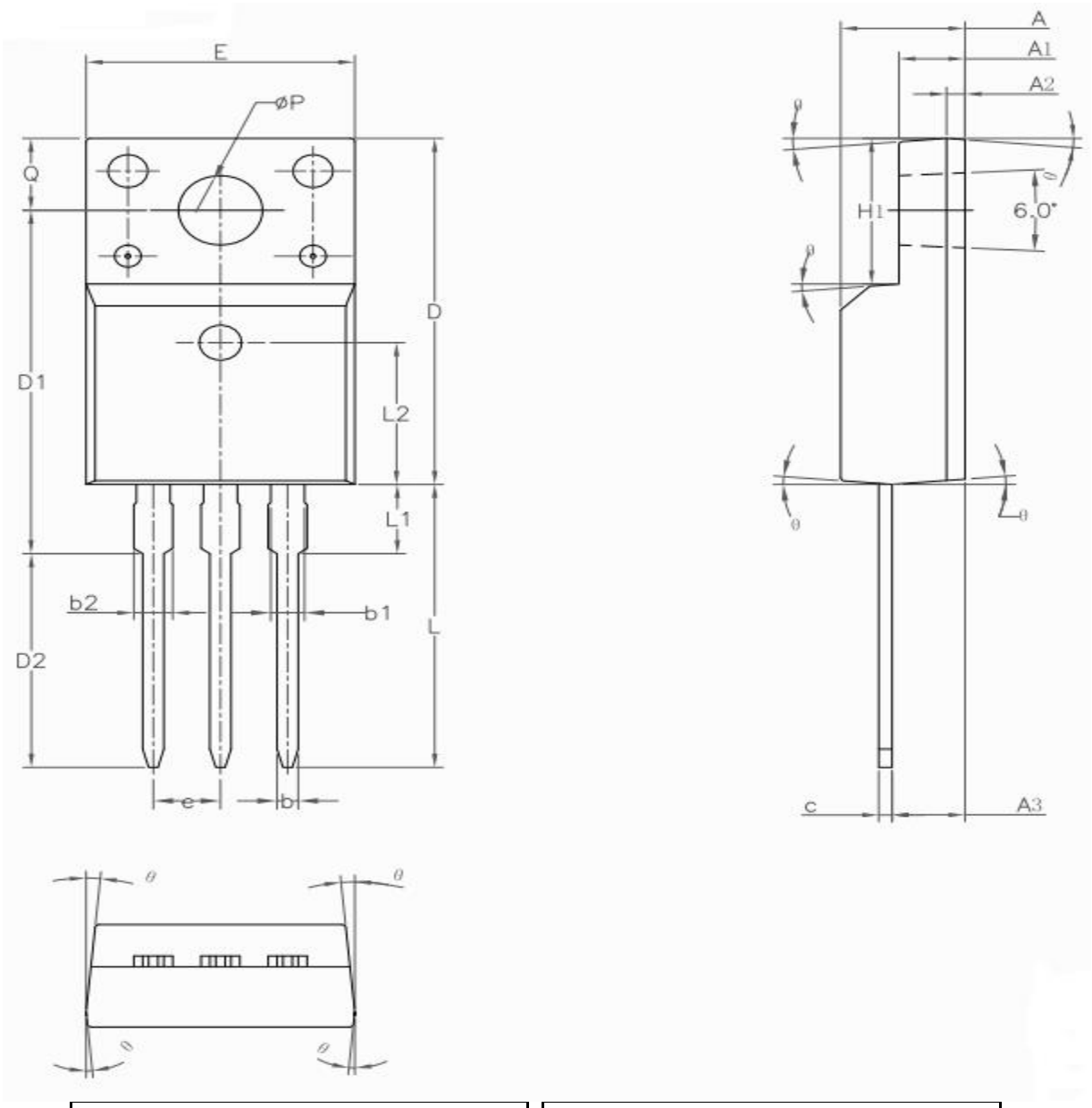


Figure C：Unclamped Inductive Switching Test Circuit and Waveform



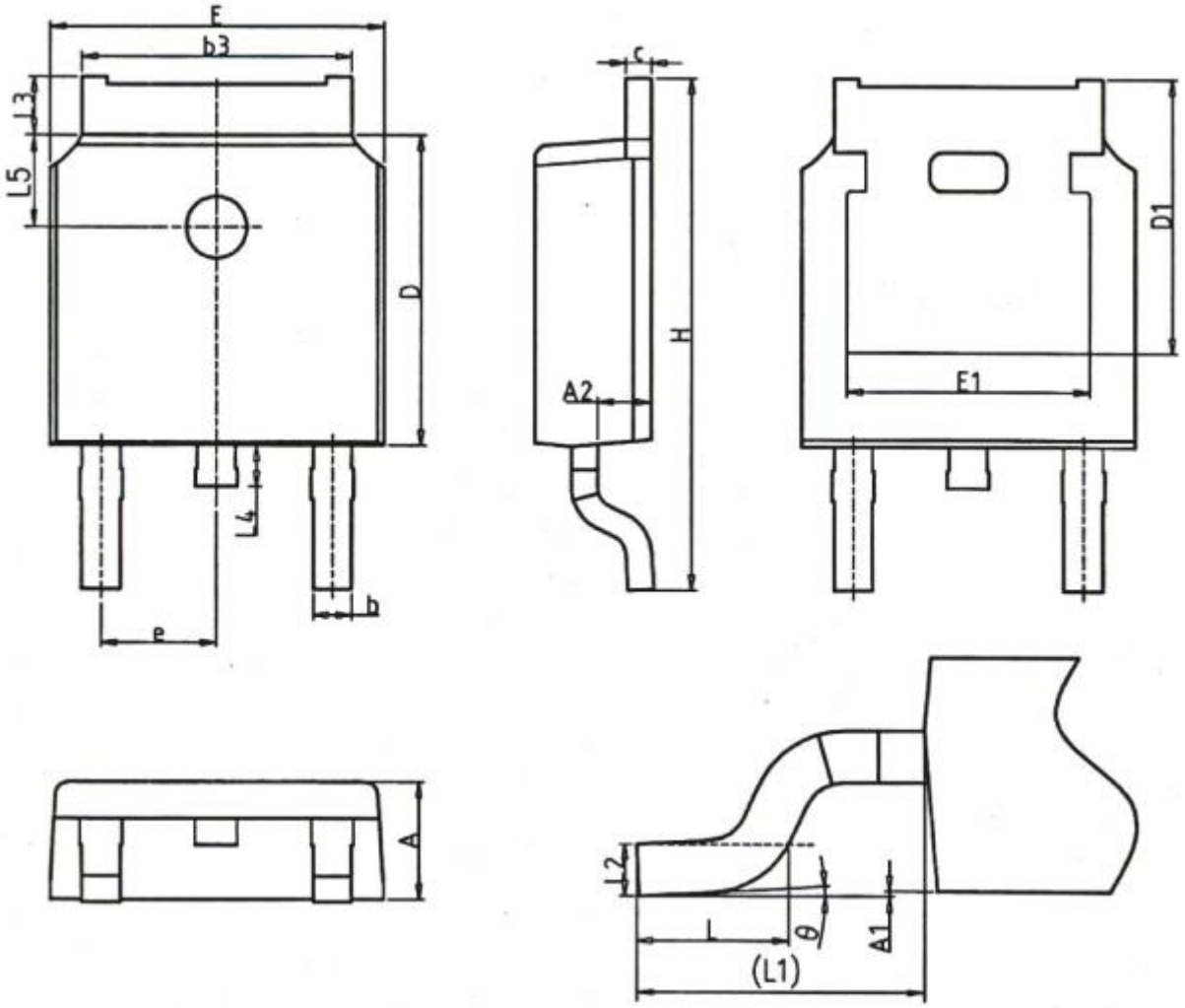
TO-220F



Unit:mm			
Symbol	Min.	Nom	Max.
A	4.5	4.70	4.83
A1	2.34	2.54	2.74
A2	0.70 REF		
b	0.70	-	0.90
b1	1.18	-	1.38
b2	-	-	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	9.60	9.80	10.00

Unit:mm			
Symbol	Min.	Nom	Max.
E	9.96	10.16	10.36
e	2.54 BSC		
H1	6.48	6.68	6.88
L	12.68	12.98	13.28
L1	-	-	3.50
L2	6.50 REF		
ØP	3.08	3.18	3.28
Q	3.20	-	3.40
θ1	1°	3°	5°

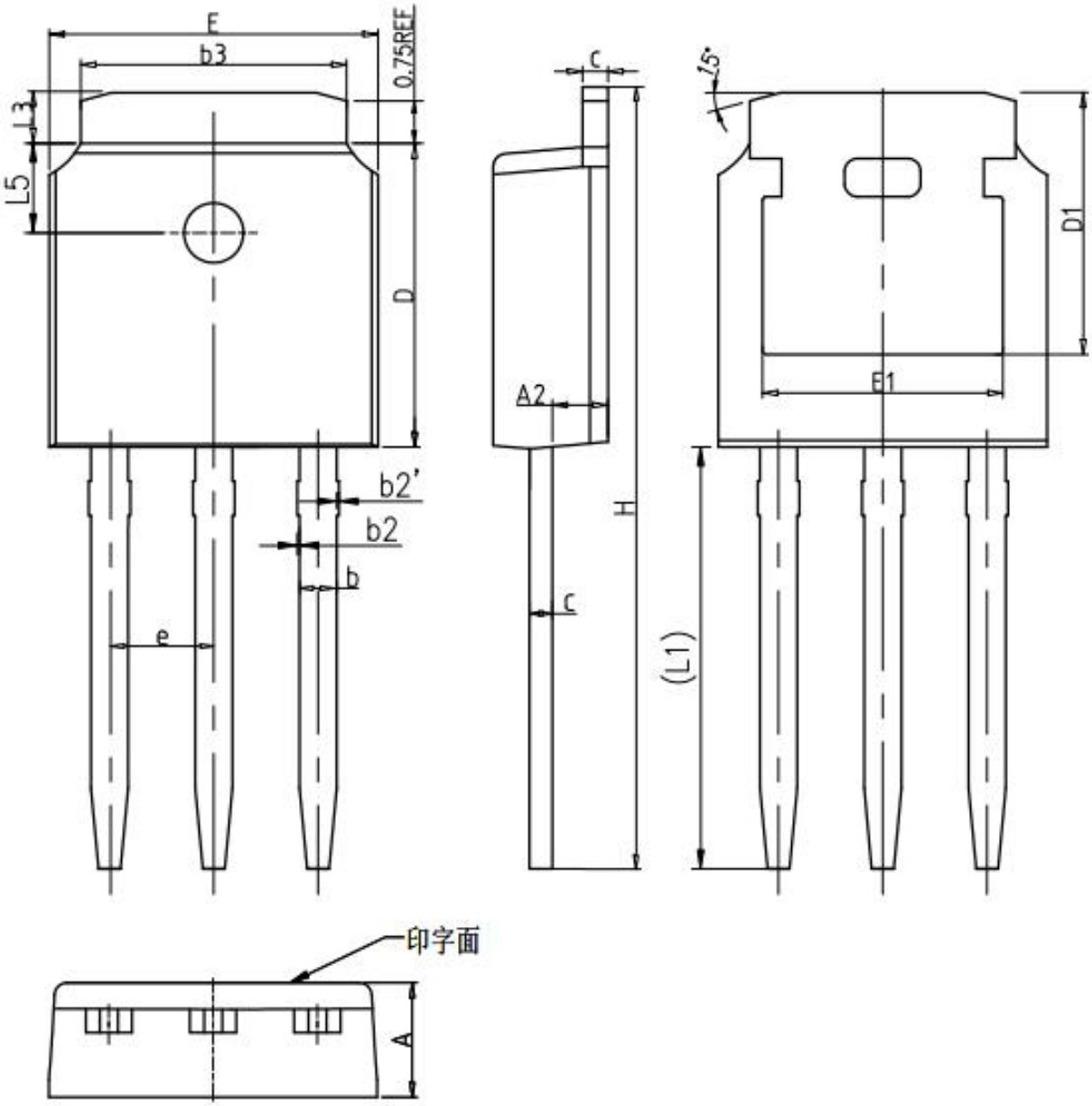
TO-252



Unit:mm			
Symbol	Min.	Nom	Max.
A	2.20	2.30	2.40
A1	0.00	-	0.20
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b3	5.20	5.33	5.50
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30 REF		
E	6.40	6.60	6.80
E1	4.63	-	-

Unit:mm			
Symbol	Min.	Nom	Max.
e	2.286 BSC		
H	9.40	10.10	10.50
L	1.38	1.50	1.75
L1	2.90 REF		
L2	0.51 BSC		
L3	0.88	-	1.28
L4	-	-	1.00
L5	1.65	1.80	1.95
θ	0°	-	8°

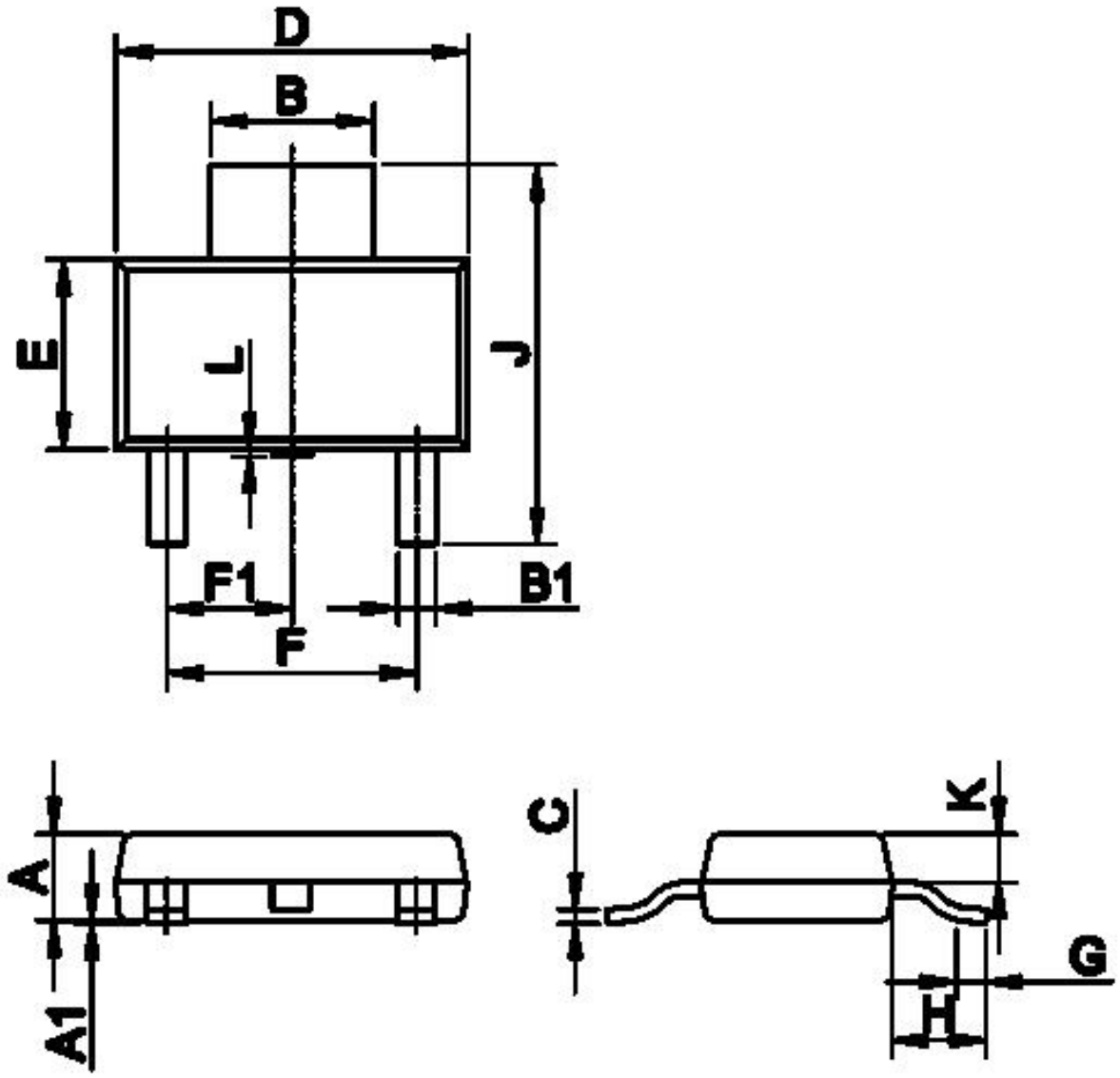
TO-251



Unit:mm			
Symbol	Min.	Nom	Max.
A	2.20	2.30	2.38
A2	0.97	1.07	1.17
b	0.68	0.78	0.90
b2	0.00	0.04	0.10
b2′	0.00	0.04	0.10
b3	5.20	5.33	5.46
c	0.43	0.53	0.61
D	5.98	6.10	6.22

Unit:mm			
Symbol	Min.	Nom	Max.
D1	5.30 REF		
E	6.40	6.60	6.73
E1	4.63	-	-
e	2.286 BSC		
H	16.22	16.52	16.82
L1	9.15	9.40	9.65
L3	0.88	1.02	1.28
L5	1.65	1.80	1.95

SOT-223-2L



Unit:mm			
Symbol	Min.	Typ.	Max.
A	1.50	1.60	1.80
A1	0.01	0.06	0.10
B	2.90	3.00	3.10
B1	0.60	0.07	0.80
C	0.22	0.254	0.32
D	6.30	6.50	6.70
E	3.30	3.50	3.70

Unit:mm			
Symbol	Min.	Typ.	Max.
F		4.60	
F1		2.30	
G	0.70	0.90	1.10
H	1.50	1.75	2.00
J	6.70	7.00	7.30
K		0.90	
L	0	0.10	0.20

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