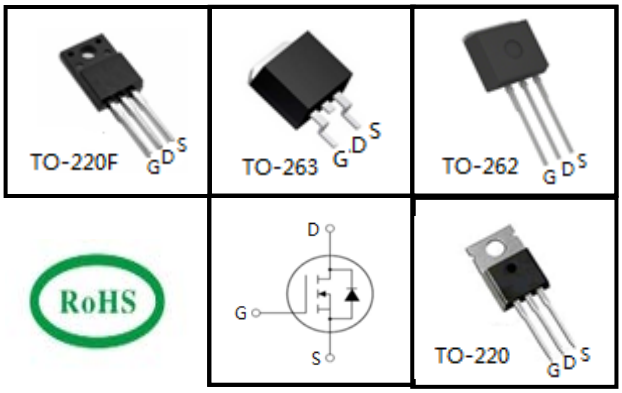
600V Super-Junction Power MOSFET

FEATURES

- Very low FOM $R_{DS(on)} \times Q_g$
- 100% avalanche tested
- RoHS compliant



APPLICATIONS

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

Device Marking and Package Information				
Device	TPA60R240M	TPB60R240M	TPC60R240M	TPP60R240M
Package	TO-220F	TO-263	TO-262	TO-220
Marking	60R240M	60R240M	60R240M	60R240M

Absolute Maximum Ratings T_C = 25ºC, unless otherwise noted

Parameter	Symbol	Value		Unit
		TO-263, TO-262, TO-220	TO-220F	
Drain-Source Voltage (V_{GS} = 0V)	V_{DSS}	600		V
Continuous Drain Current	I_D	15		A
Pulsed Drain Current (note1)	I_{DM}	45		A
Gate-Source Voltage	V_{GSS}	±30		V
Single Pulse Avalanche Energy (note2)	E_{AS}	284		mJ
Avalanche Current (note1)	I_{AR}	2.4		A
Repetitive Avalanche Energy (note1)	E_{AR}	0.44		mJ
MOSFET dv/dt ruggedness, V_{DS} = 0...480V	dv/dt	50		V/ns
Reverse diode dv/dt, V_{DS} = 0…480V, $I_{SD} \le I_D$	dv/dt	15		V/ns
Power Dissipation (T_C = 25ºC)	P_D	104	32	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55~+150		ºC

Thermal Resistance

Parameter	Symbol	Value		Unit
		TO-263, TO-262, TO-220	TO-220F	
Thermal Resistance, Junction-to-Case	R_{thJC}	1.2	3.9	ºC/W
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	80	

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	600	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 600V, V_{GS} = 0V, T_J = 25ºC	--	--	1	μA
		V_{DS} = 600V, V_{GS} = 0V, T_J = 150ºC	--	--	50	
Gate-Source Leakage	I_{GSS}	V_{GS} = ±30V	--	--	±100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS}, I_D = 250μA	2.5	--	4.5	V
Drain-Source On-Resistance (Note3)	$R_{DS(on)}$	V_{GS} = 10V, I_D = 7.5A	--	0.21	0.24	Ω
Forward Transconductance (Note3)	R_G	f = 1.0MHz open drain	--	12.5	--	S
Dynamic						
Input Capacitance	C_{iss}	V_{GS} = 0V, V_{DS} = 100V, f = 1.0MHz	--	1306	--	pF
Output Capacitance	C_{oss}		--	62	--	
Reverse Transfer Capacitance	C_{rss}		--	7	--	
Total Gate Charge	Q_g	V_{DD} = 480V, I_D = 15A, V_{GS} = 10V	--	27	--	nC
Gate-Source Charge	Q_{gs}		--	5.5	--	
Gate-Drain Charge	Q_{gd}		--	10.5	--	
Turn-on Delay Time	$t_{d(on)}$	V_{DD} = 400V, I_D = 15A, R_G = 25Ω	--	23	--	ns
Turn-on Rise Time	t_r		--	65	--	
Turn-off Delay Time	$t_{d(off)}$		--	105	--	
Turn-off Fall Time	t_f		--	50	--	
Drain-Source Body Diode Characteristics						
Continuous Body Diode Current	I_S	T_C = 25ºC	--	--	15	A
Pulsed Diode Forward Current	I_{SM}		--	--	45	
Body Diode Voltage	V_{SD}	T_J = 25ºC, I_{SD} = 15A, V_{GS} = 0V	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	V_R = 400V, I_F = I_S, di_F/dt = 100A/μs	--	410	--	ns
Reverse Recovery Charge	Q_{rr}		--	4.1	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	20	--	A

Notes

1. Repetitive Rating: Pulse Width limited by maximum junction temperature
2. I_{AS} = 2.4A, V_{DD} = 50V, R_G = 25Ω, Starting T_J = 25°C
3. Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 1%

Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 1. Output Characteristics

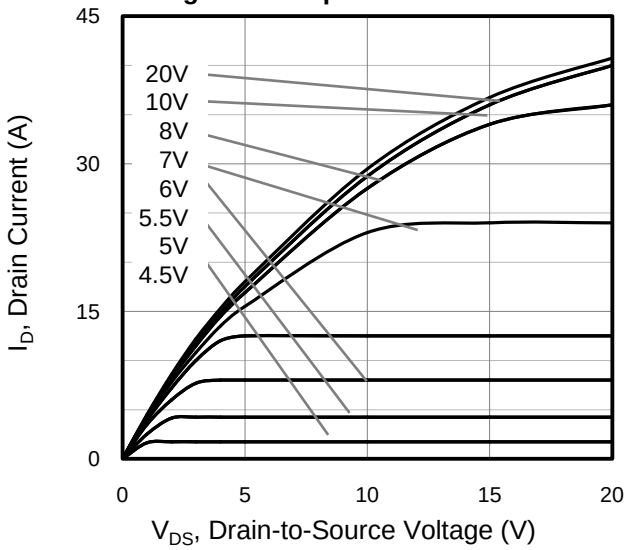


Figure 2. Transfer Characteristics

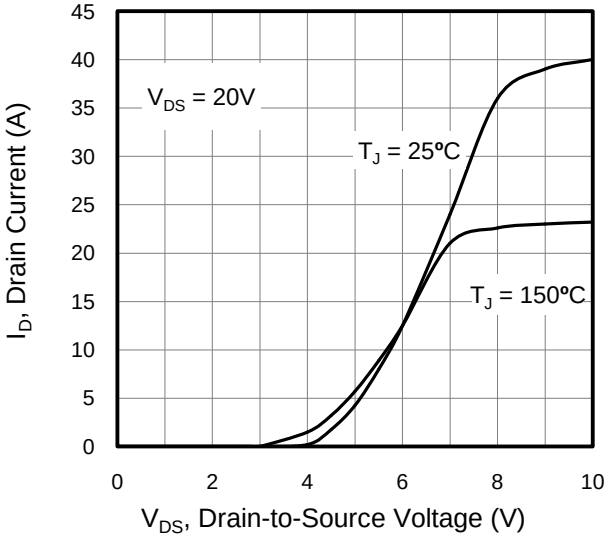


Figure 3. On-Resistance vs. Drain Current

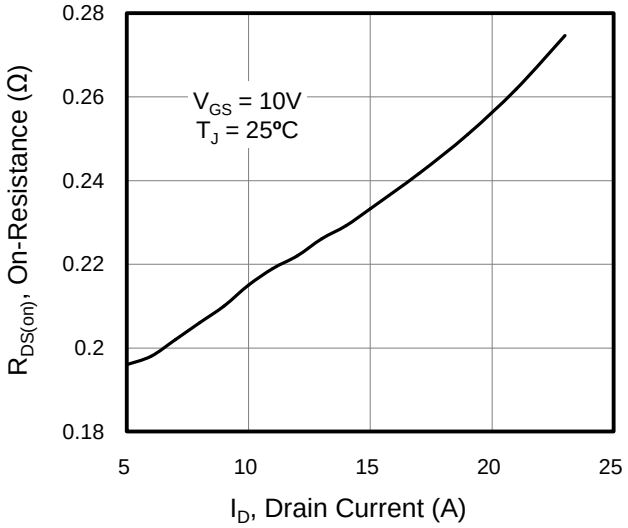


Figure 4. Capacitance

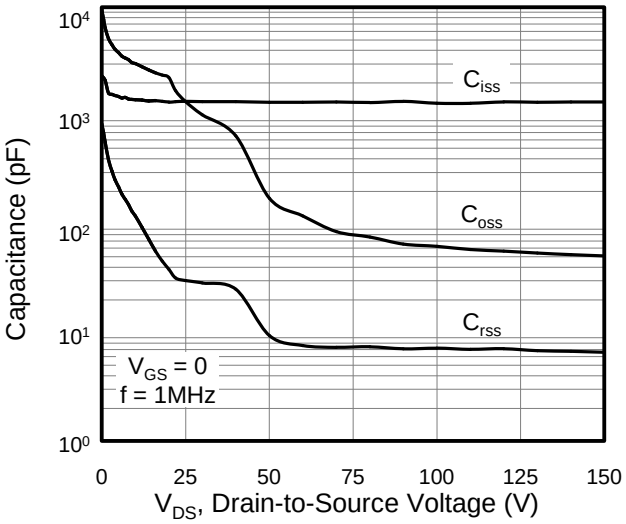


Figure 5. Gate Charge

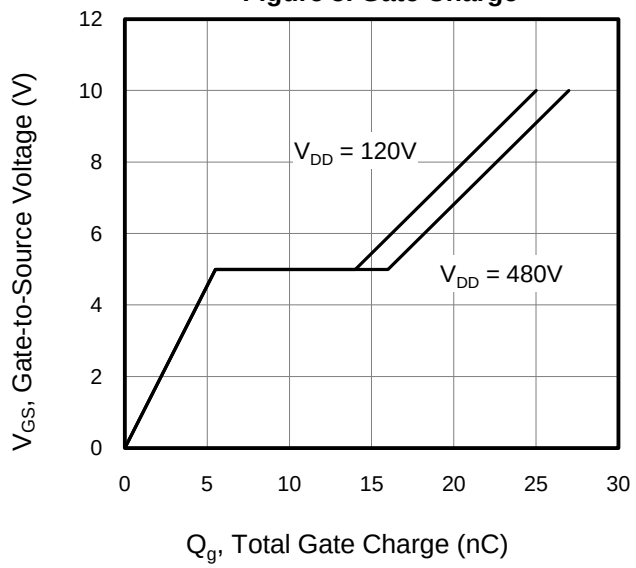
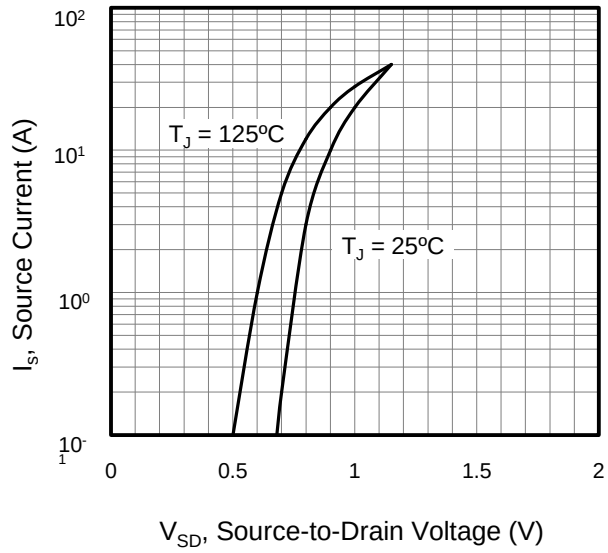


Figure 6. Body Diode Forward Voltage



Typical Characteristics T_J = 25ºC, unless otherwise noted

Figure 7. On-Resistance vs. Junction Temperature

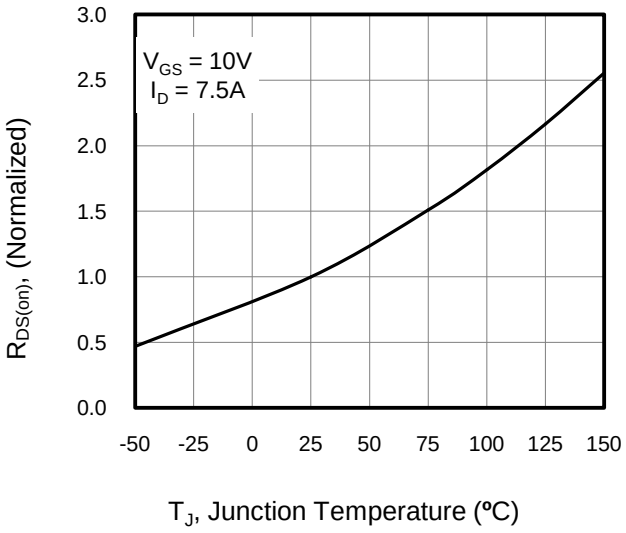


Figure 8. Breakdown voltage vs. Junction Temperature

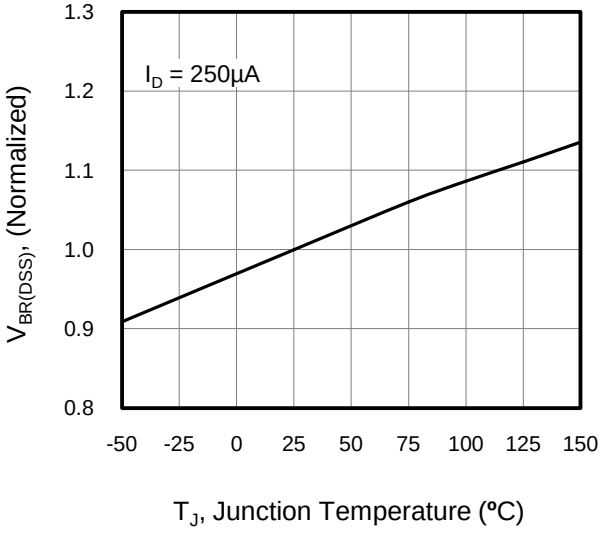


Figure 9. Transient Thermal Impedance TO-263/TO-262/TO-220

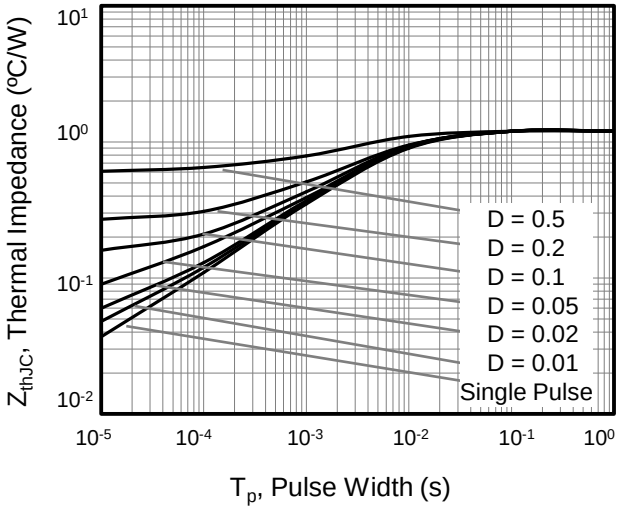


Figure 10. Transient Thermal Impedance TO-220F

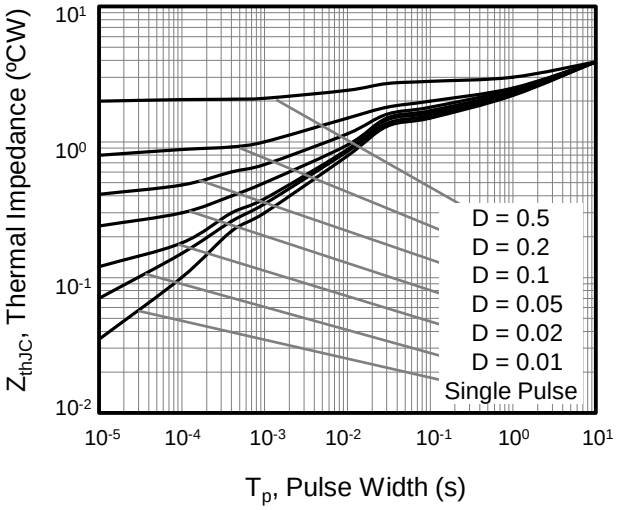


Figure 11. Safe operation area for TO-263/TO-262/TO-220

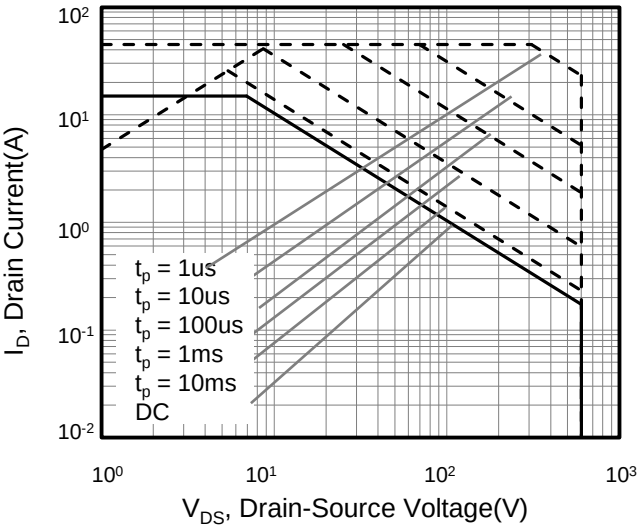


Figure 12. Safe operation area for TO-220F

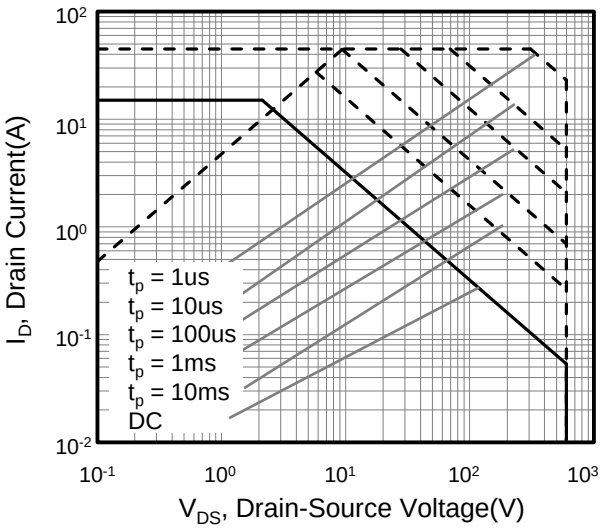


Figure A：Gate Charge Test Circuit and Waveform

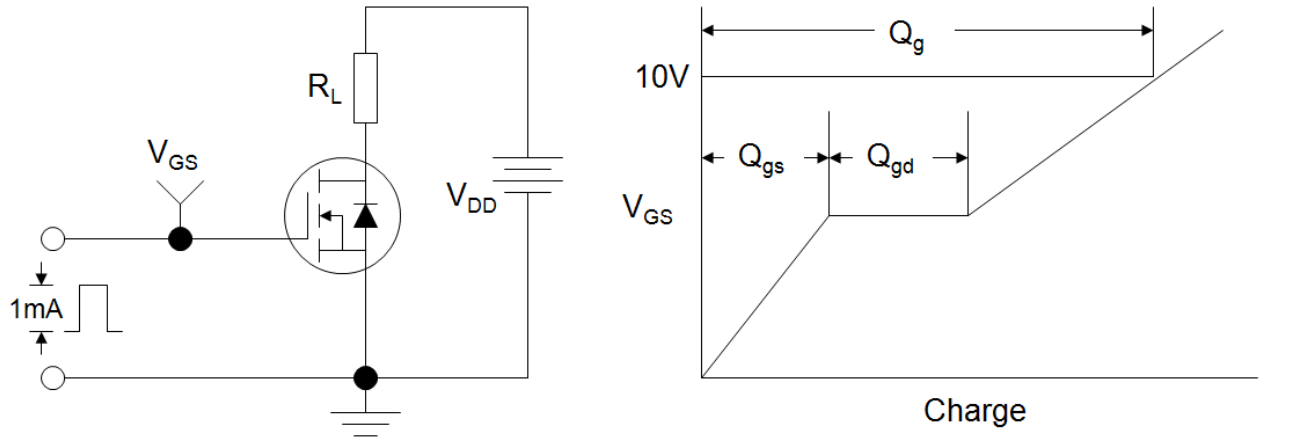


Figure B：Resistive Switching Test Circuit and Waveform

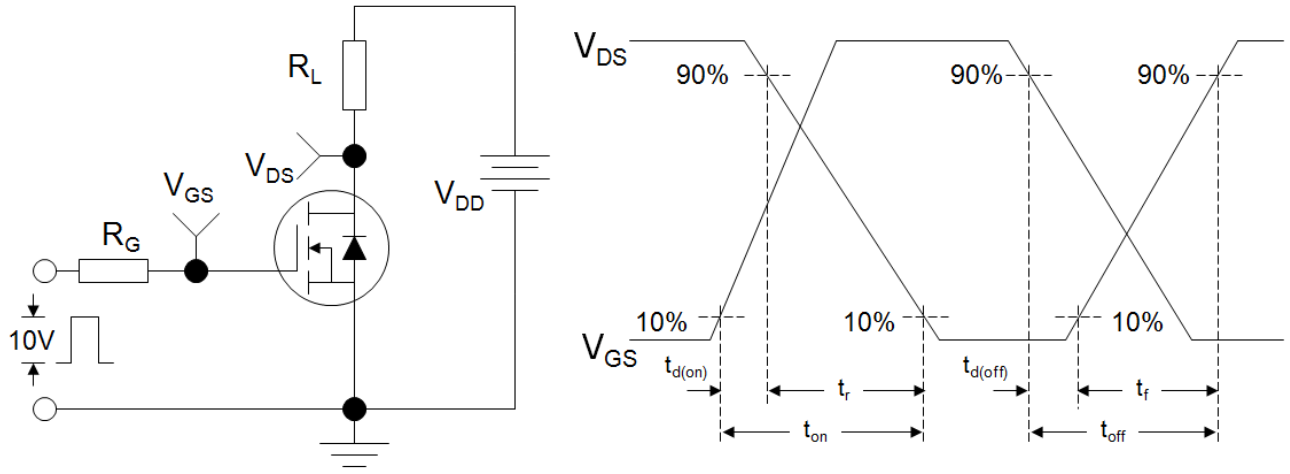
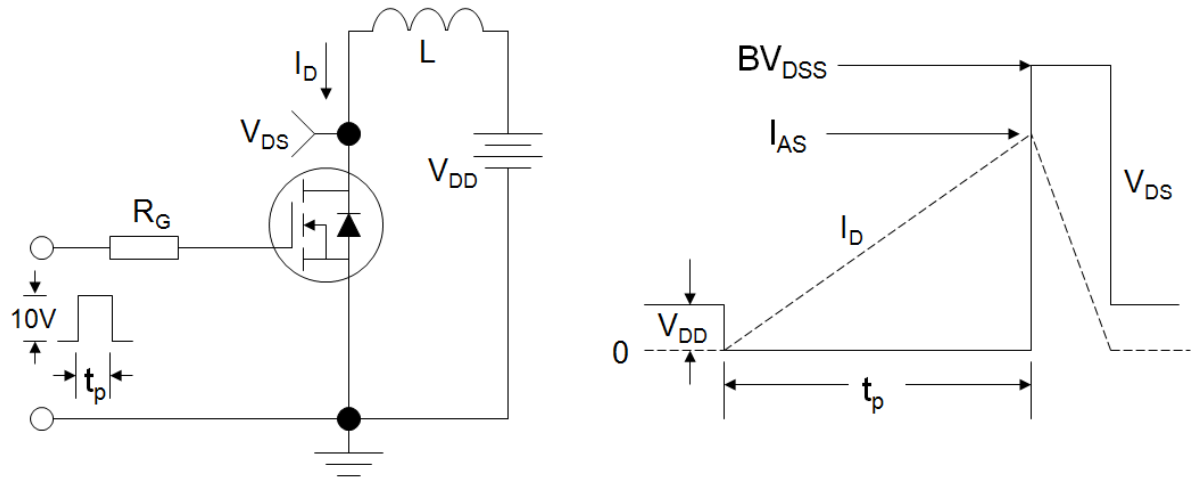
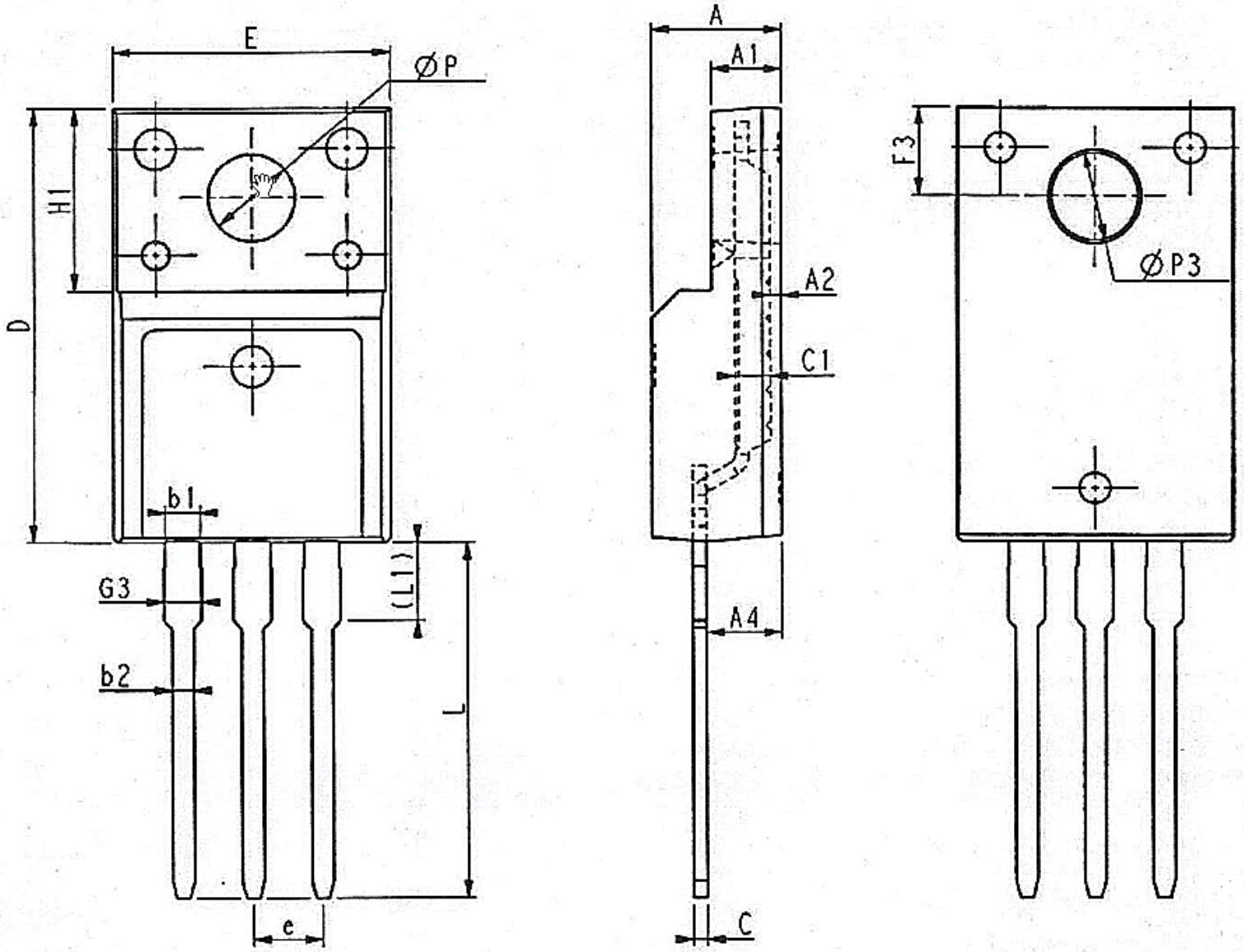


Figure C：Unclamped Inductive Switching Test Circuit and Waveform



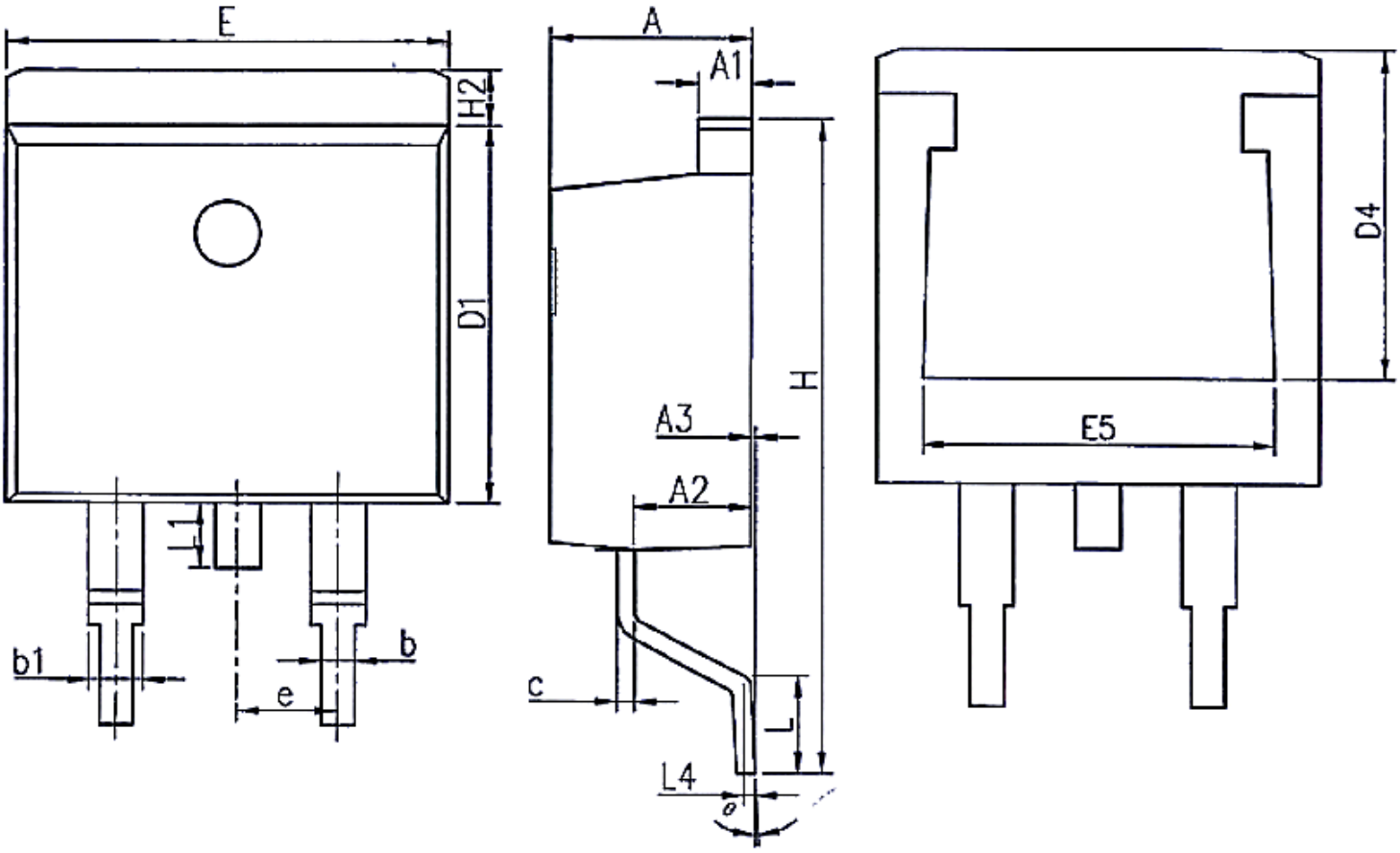
TO-220F



Symbol	Min.	Nom	Max.
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
c1	1.20	1.30	1.35
D	15.57	15.87	16.17
H1	6.70REF		

Symbol	Min.	Nom	Max.
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.88	3.03	3.18
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.55
b1	1.18	1.28	1.43
b2	0.70	0.80	0.95

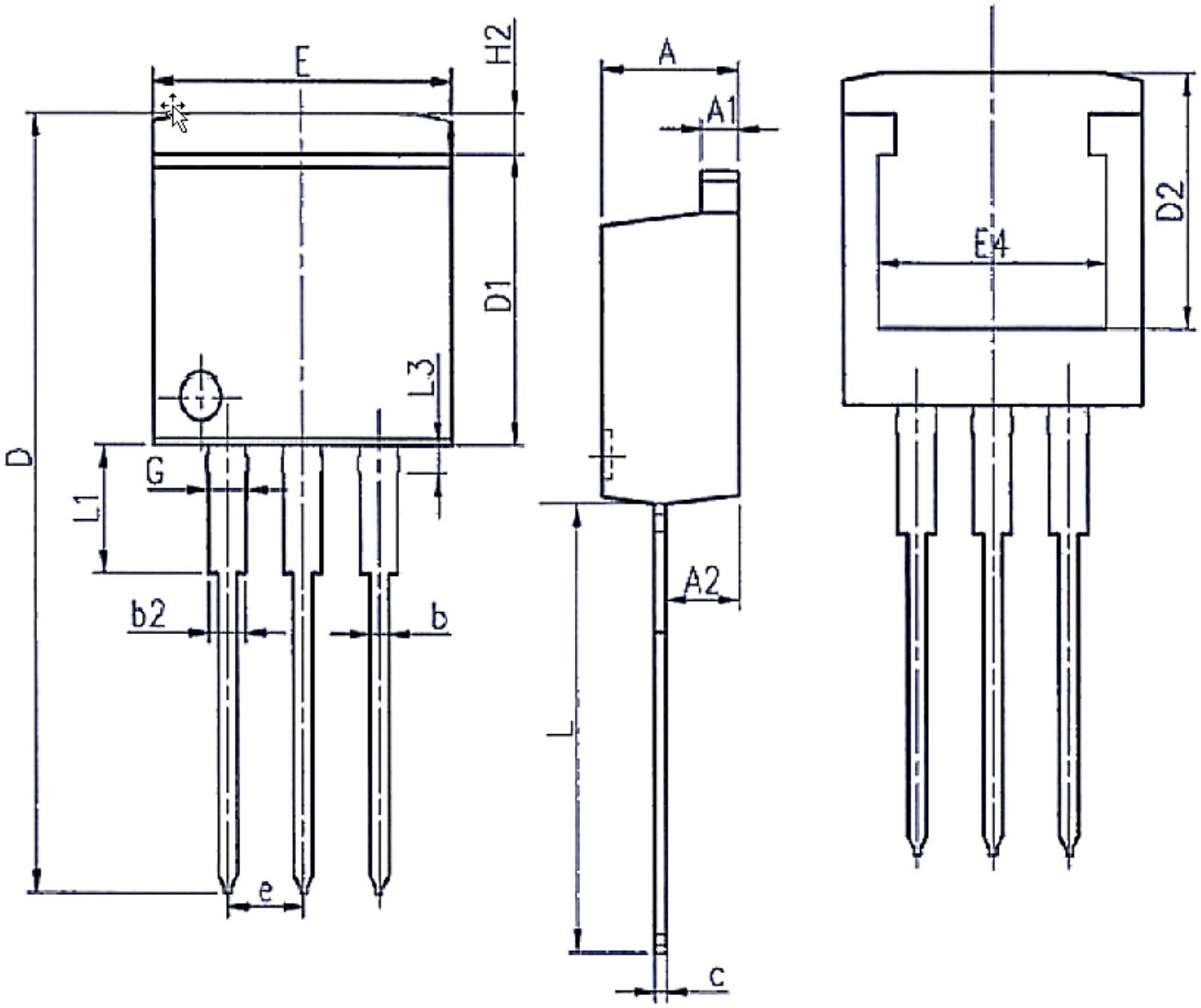
TO-263



Unit:mm			
Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0.00	0.13	0.25
b	0.70	0.81	0.96
b1	1.17	1.27	1.47
c	0.30	0.38	0.53
D1	8.50	8.70	8.90
D4	6.60	-	-

Unit:mm			
Symbol	Min.	Nom	Max.
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54BSC		
H	14.70	15.10	15.50
H2	1.07	1.27	1.47
L	2.00	2.30	2.60
L1	1.40	1.55	1.70
L4	0.25BSC		
θ	0°	5°	9°

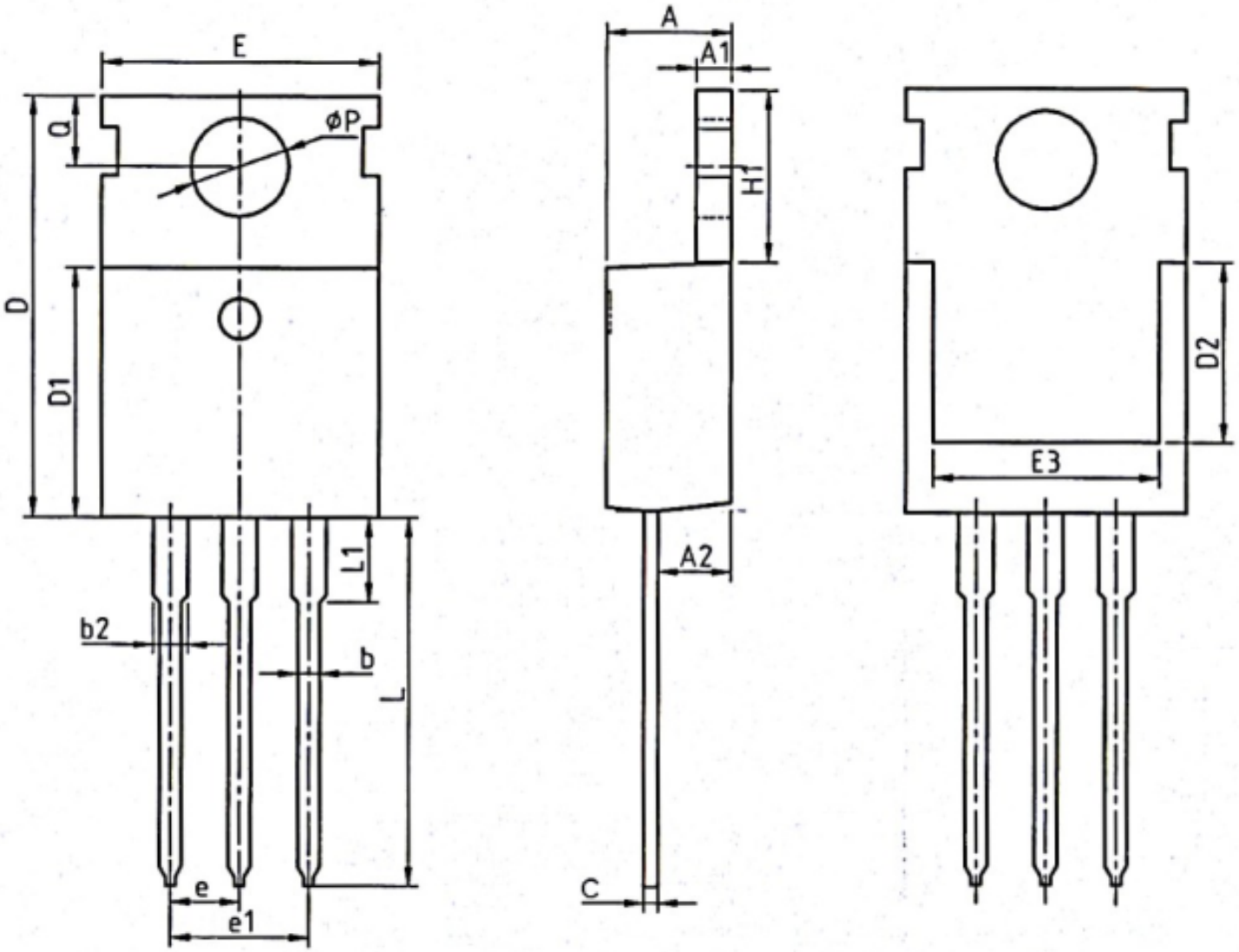
TO-262



Unit:mm			
Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
b	0.70	0.81	0.96
b2	1.17	1.27	1.42
c	0.28	0.38	0.53
D	23.20	23.7	24.02
D1	8.50	8.70	8.90
D2	6.00	-	-

Unit:mm			
Symbol	Min.	Nom	Max.
E	9.86	10.16	10.36
E4	7.06	-	-
e	2.54BSC		
G	1.25	1.35	1.50
H2	-	-	1.50
L	13.33	13.73	14.13
L1	3.50	3.75	4.00
L3	1.28	1.43	1.58

TO-220



Unit:mm			
Symbol	**Min.**	**Nom**	**Max.**
A	4.37	4.57	4.77
A1	1.25	1.30	1.45
b	2.20	2.40	2.60
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30

Unit:mm			
Symbol	**Min.**	**Nom**	**Max.**
E3	7.00	-	-
e	2.54BSC		
e1	5.08BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ΦP	3.40	3.60	3.80
Q	2.60	2.80	3.00

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