



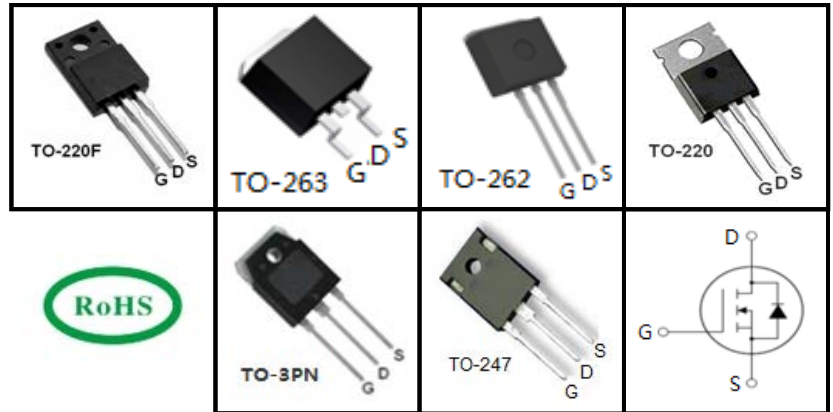
700V Super-Junction Power MOSFET

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	TPA70R170M	TPB70R170M	TPC70R170M	TPP70R170M	TPV70R170M	TPW70R170M
Package	TO-220F	TO-263	TO-262	TO-220	TO-3PN	TO-247
Marking	70R170M	70R170M	70R170M	70R170M	70R170M	70R170M

Absolute Maximum Ratings $T_C = 25^\circ\text{C}$, unless otherwise noted				
Parameter	Symbol	Value		Unit
		TO-220, TO-263, TO-262, TO-3PN, TO-247	TO-220F	
Drain-Source Voltage ($V_{GS} = 0\text{V}$)	V_{DSS}	700		V
Continuous Drain Current	I_D	$T_C = 25^\circ\text{C}$	20	A
		$T_C = 100^\circ\text{C}$	12	
Pulsed Drain Current (note1)	I_{DM}	60		A
Gate-Source Voltage	V_{GSS}	± 30		V
Single Pulse Avalanche Energy (note2)	E_{AS}	484		mJ
Avalanche Current (note1)	I_{AR}	3.5		A
Repetitive Avalanche Energy (note1)	E_{AR}	0.7		mJ
MOSFET dv/dt ruggedness, $V_{DS} = 0 \dots 480\text{V}$	dv/dt	50		V/ns
Reverse diode dv/dt, $V_{DS} = 0 \dots 480\text{V}$, $I_{SD} \leq I_D$	dv/dt	15		V/ns
Power Dissipation ($T_C = 25^\circ\text{C}$)	P_D	151	34	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55~+150		$^\circ\text{C}$

Thermal Resistance						
Parameter	Symbol	Value				Unit
		TO-220	TO-3PN	TO-247	TO-220F	
Thermal Resistance, Junction-to-Case	R_{thJC}	0.83			3.7	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62			80	



Specifications $T_J = 25^\circ\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	700	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 700V, V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	μA
		$V_{DS} = 700V, V_{GS} = 0V, T_J = 150^\circ\text{C}$	--	--	100	
Gate-Source Leakage	I_{GSS}	$V_{GS} = \pm 30V$	--	--	± 100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	2.5	--	4.5	V
Drain-Source On-Resistance (Note3)	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 10A$	--	0.15	0.17	Ω
Gate resistance	R_G	$f = 1.0\text{MHz}$ open drain	--	12	--	Ω
Dynamic						
Input Capacitance	C_{iss}	$V_{GS} = 0V,$ $V_{DS} = 100V,$ $f = 1.0\text{MHz}$	--	1724	--	μF
Output Capacitance	C_{oss}		--	61	--	
Reverse Transfer Capacitance	C_{rss}		--	6	--	
Total Gate Charge	Q_g	$V_{DD} = 520V, I_D = 20A,$ $V_{GS} = 10V$	--	38.5	--	nC
Gate-Source Charge	Q_{gs}		--	8	--	
Gate-Drain Charge	Q_{gd}		--	15	--	
Turn-on Delay Time	$t_{d(on)}$	$V_{DD} = 400V, I_D = 20A,$ $R_G = 25\Omega$	--	15	--	ns
Turn-on Rise Time	t_r		--	59	--	
Turn-off Delay Time	$t_{d(off)}$		--	121	--	
Turn-off Fall Time	t_f		--	44	--	
Drain-Source Body Diode Characteristics						
Continuous Body Diode Current	I_S	$T_C = 25^\circ\text{C}$	--	--	20	A
Pulsed Diode Forward Current	I_{SM}		--	--	60	
Body Diode Voltage	V_{SD}	$T_J = 25^\circ\text{C}, I_{SD} = 20A, V_{GS} = 0V$	--	0.9	1.2	V
Reverse Recovery Time	t_{rr}	$V_R = 400V, I_F = I_S,$ $di_F/dt = 100A/\mu s$	--	423	--	ns
Reverse Recovery Charge	Q_{rr}		--	5.3	--	μC
Peak Reverse Recovery Current	I_{rrm}		--	25	--	A

Notes

1. Repetitive Rating: Pulse Width limited by maximum junction temperature
2. $I_{AS} = 3.5A, V_{DD} = 50V, R_G = 25\Omega$, Starting $T_J = 25^\circ\text{C}$
3. Pulse Test: Pulse Width $\leq 300\mu s$, Duty Cycle $\leq 1\%$



Typical Characteristics $T_J = 25^\circ\text{C}$, unless otherwise noted

Figure 1. Output Characteristics

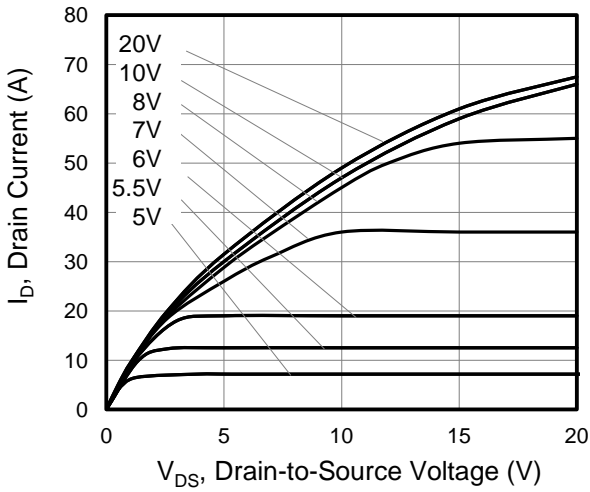


Figure 2. Transfer Characteristics

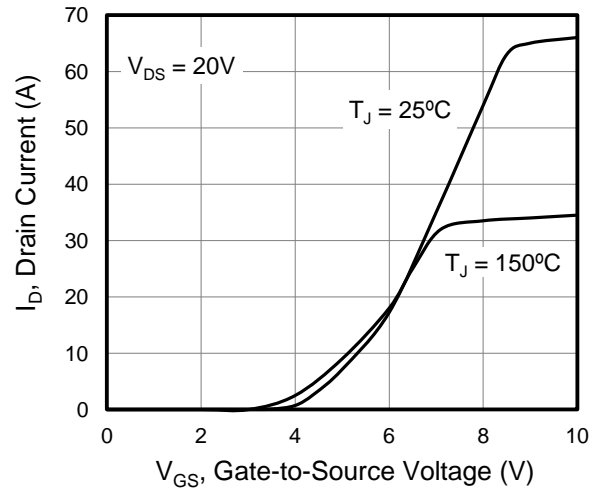


Figure 3. On-Resistance vs. Drain Current

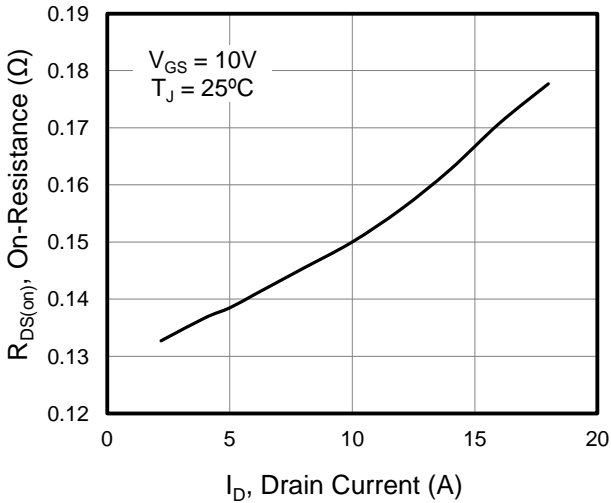


Figure 4. Capacitance

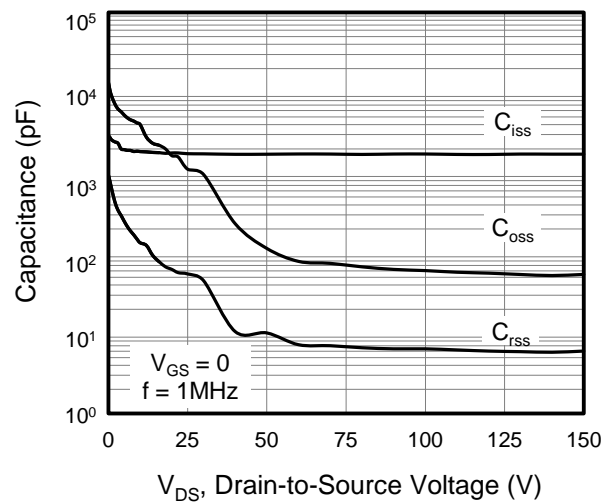


Figure 5. Gate Charge

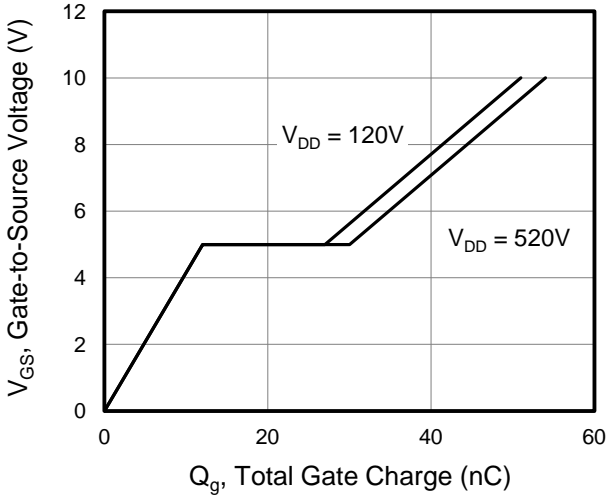
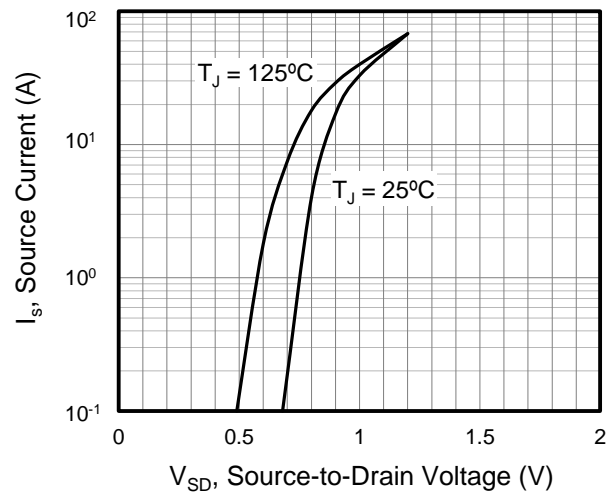


Figure 6. Body Diode Forward Voltage





Typical Characteristics $T_J = 25^\circ\text{C}$, unless otherwise noted

Figure 7. On-Resistance vs. Junction Temperature

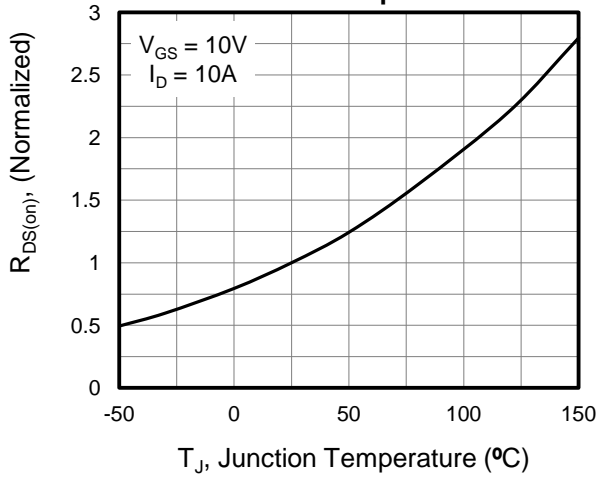


Figure 8. Threshold Voltage vs. Junction Temperature

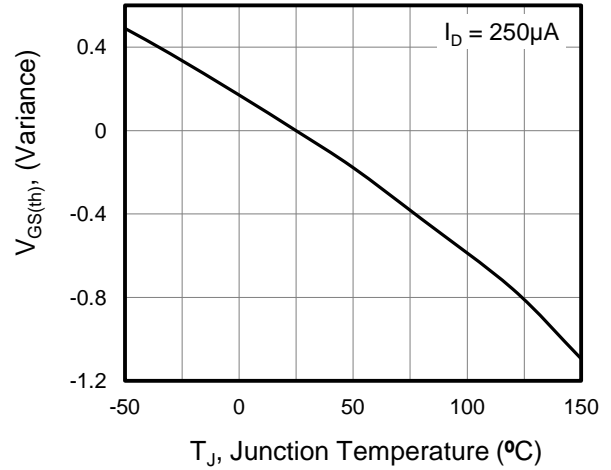


Figure 9. Transient Thermal Impedance TO-263/TO-262/TO-220/TO-3PN/TO-247

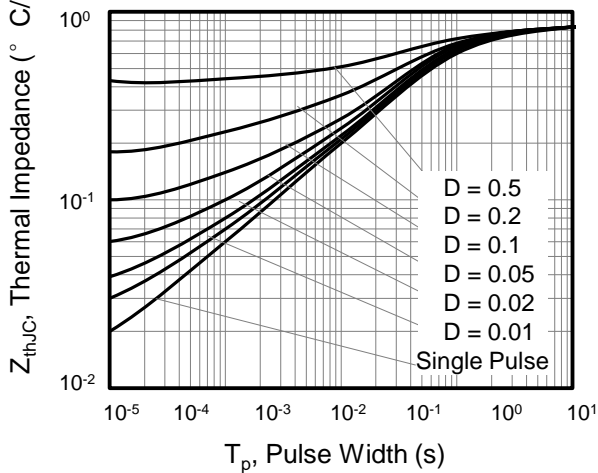


Figure 10. Transient Thermal Impedance TO-220F

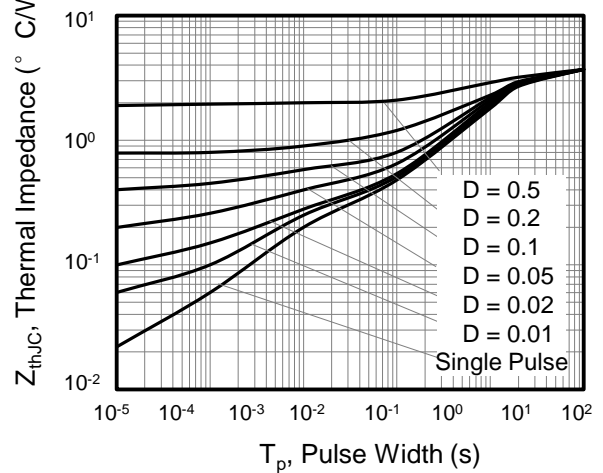


Figure 11. Safe operation area for TO-263/TO-262/TO-220/TO-3PN/TO-247

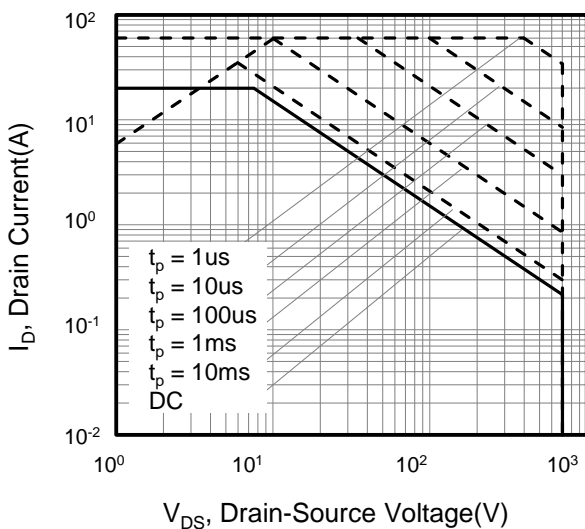


Figure 12. Safe operation area for TO-220F

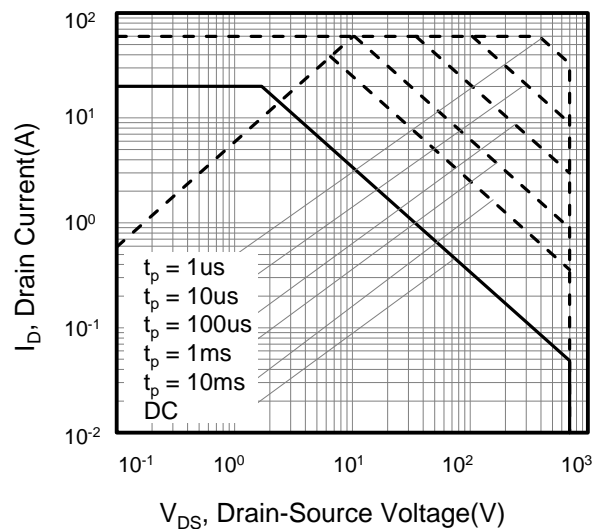




Figure A: Gate Charge Test Circuit and Waveform

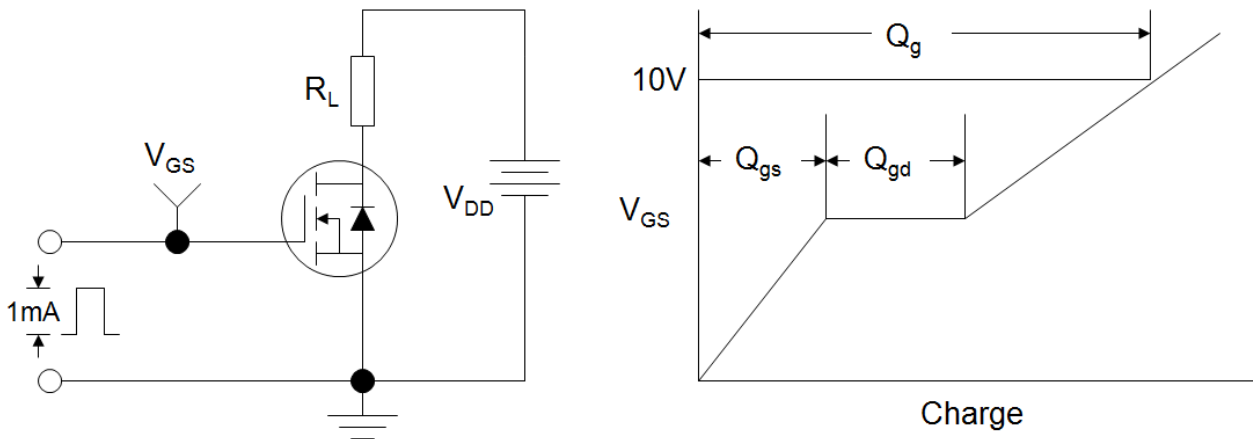


Figure B: Resistive Switching Test Circuit and Waveform

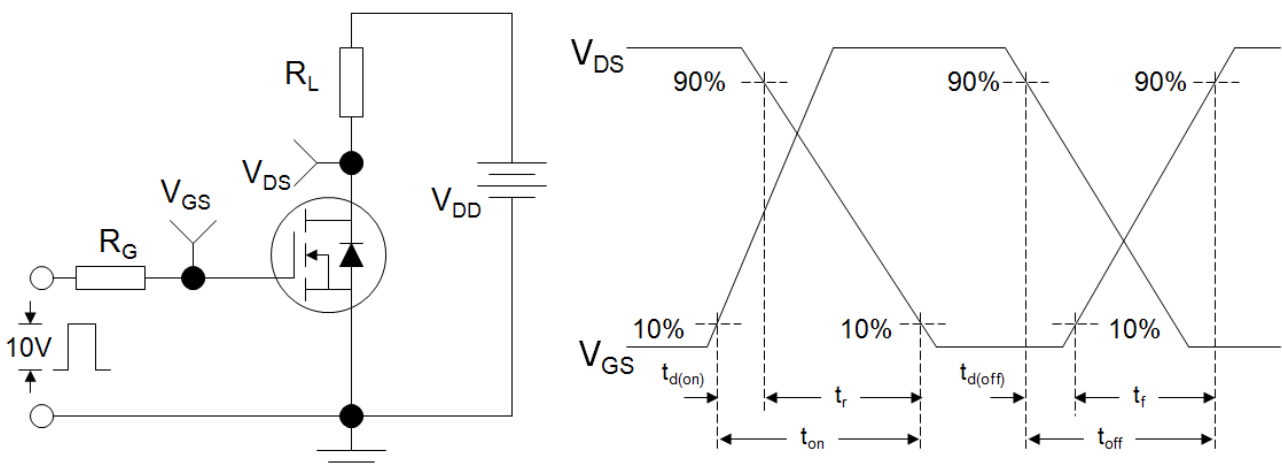
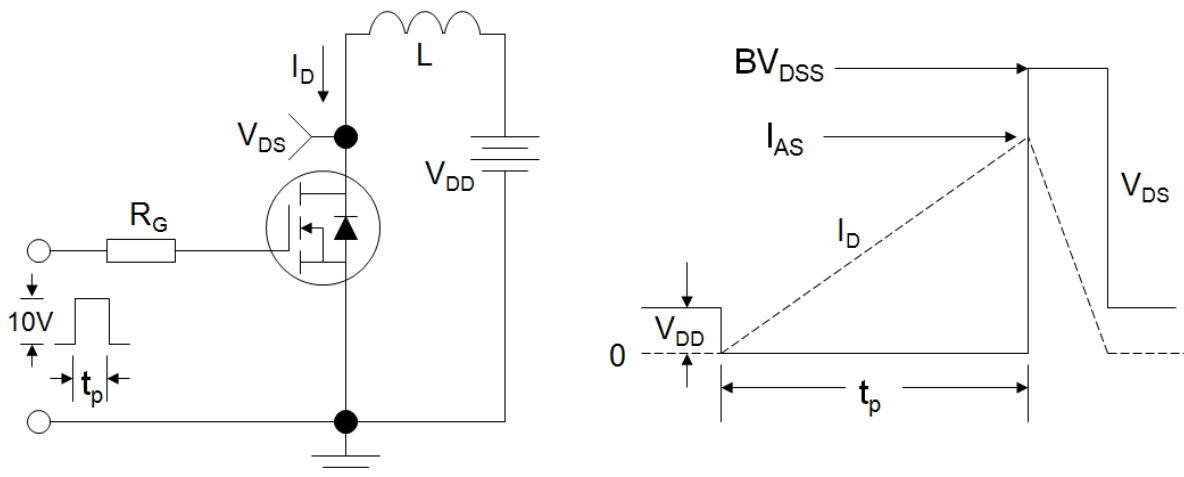
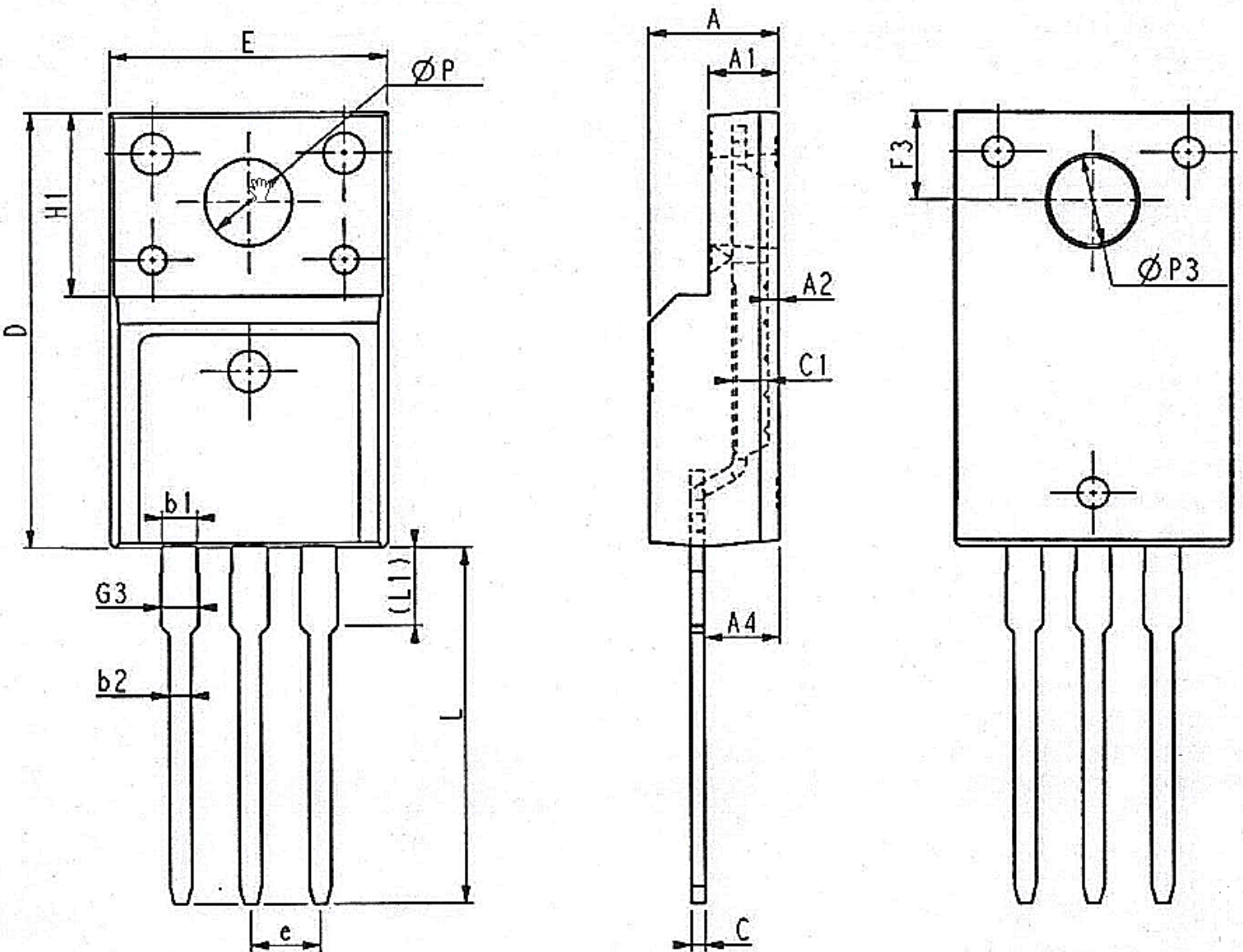


Figure C: Unclamped Inductive Switching Test Circuit and Waveform





TO-220F

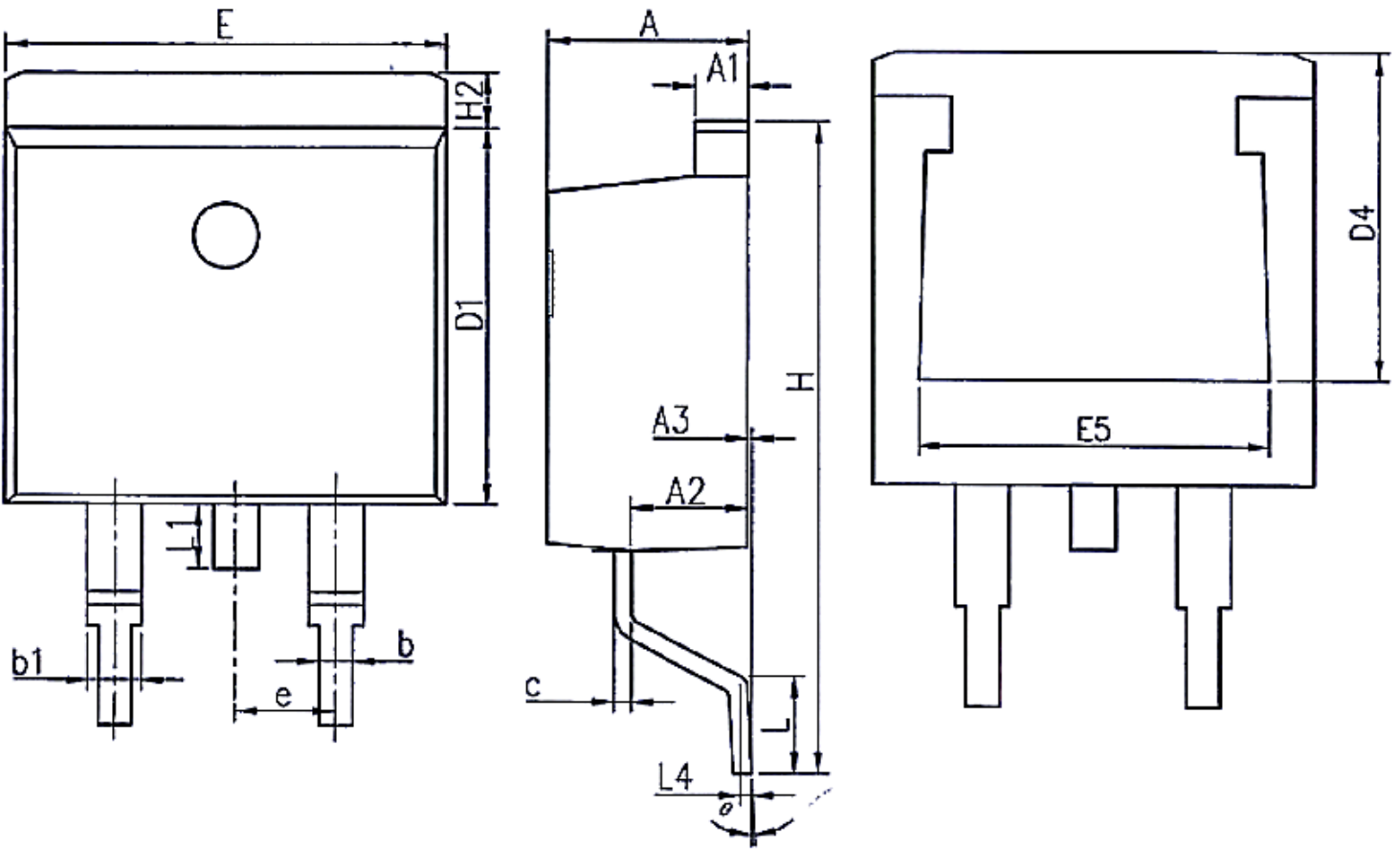


Symbol	Min.	Nom	Max.
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.65
c1	1.20	1.30	1.35
D	15.57	15.87	16.17
H1	6.70REF		

Symbol	Min.	Nom	Max.
e	2.54BSC		
L	12.68	12.98	13.28
L1	2.88	3.03	3.18
ØP	3.03	3.18	3.38
ØP3	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



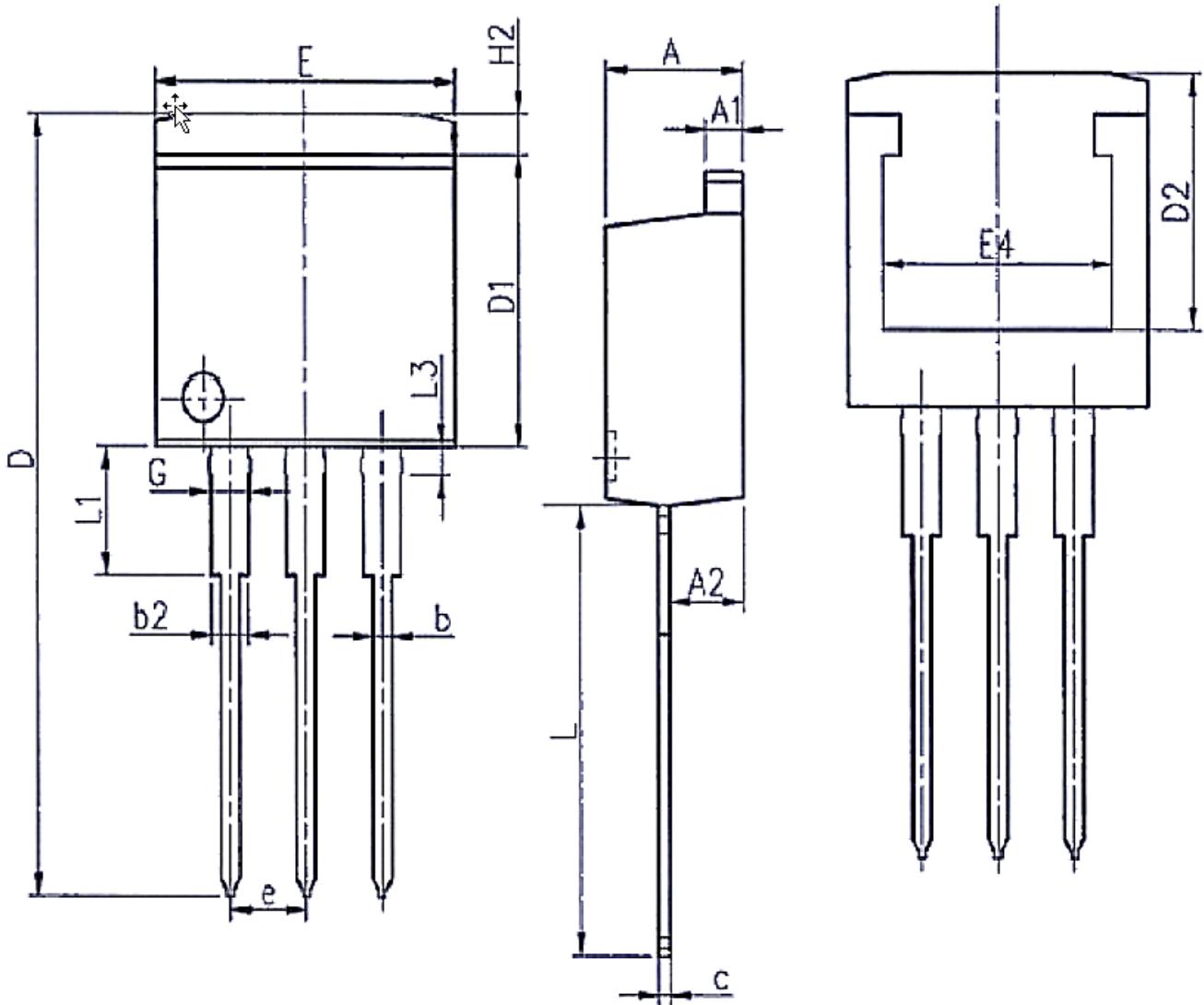
TO-263



Unit:mm				Unit:mm			
Symbol	Min.	Nom	Max.	Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77	E	9.86	10.16	10.36
A1	1.22	1.27	1.42	E5	7.06	-	-
A2	2.49	2.69	2.89	e	2.54BSC		
A3	0.00	0.13	0.25	H	14.70	15.10	15.50
b	0.70	0.81	0.96	H2	1.07	1.27	1.47
b1	1.17	1.27	1.47	L	2.00	2.30	2.60
c	0.30	0.38	0.53	L1	1.40	1.55	1.70
D1	8.50	8.70	8.90	L4	0.25BSC		
D4	6.60	-	-	θ	0°	5°	9°



TO-262

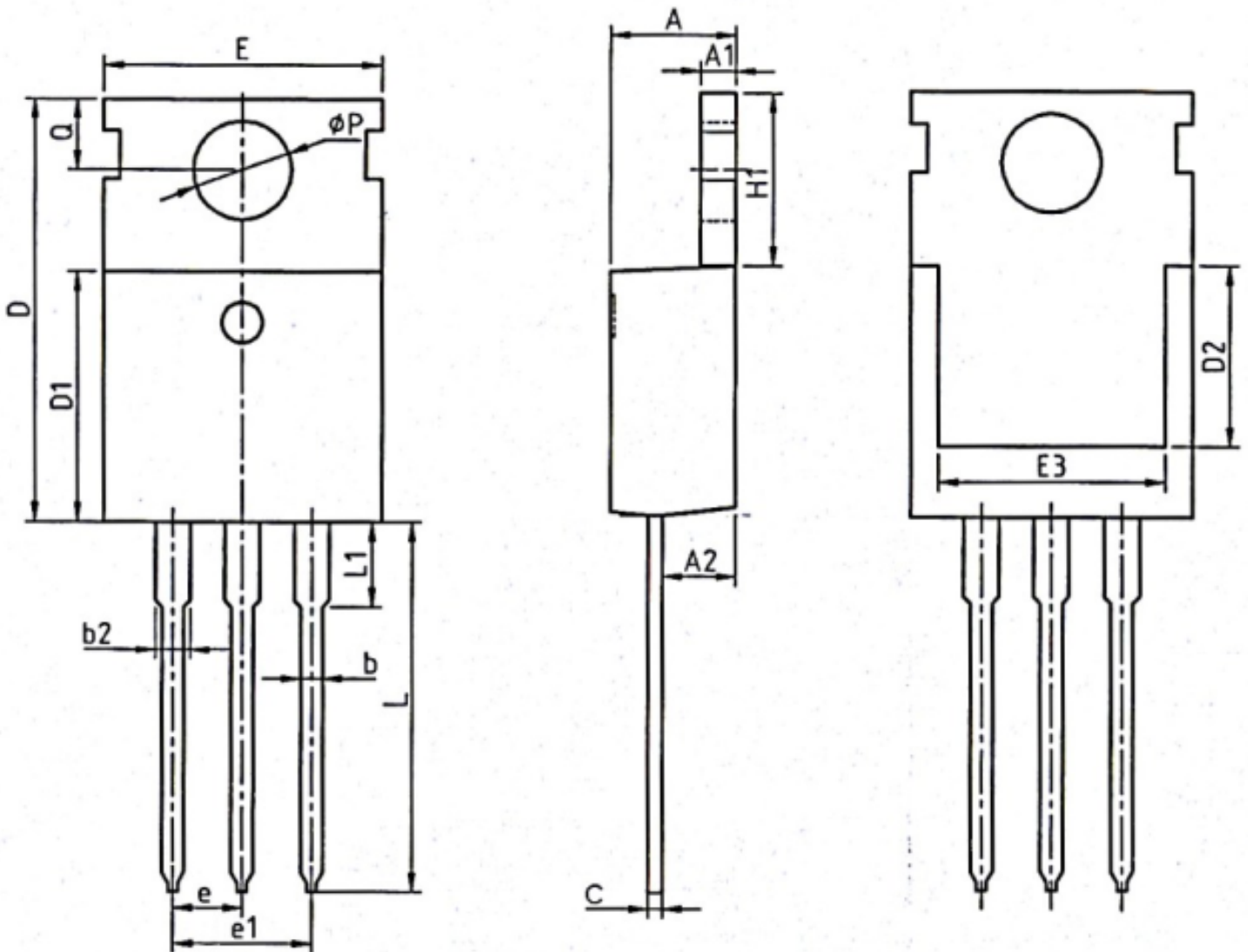


Unit:mm			
Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
b	0.70	0.81	0.96
b2	1.17	1.27	1.42
c	0.28	0.38	0.53
D	23.20	23.7	24.02
D1	8.50	8.70	8.90
D2	6.00	-	-

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

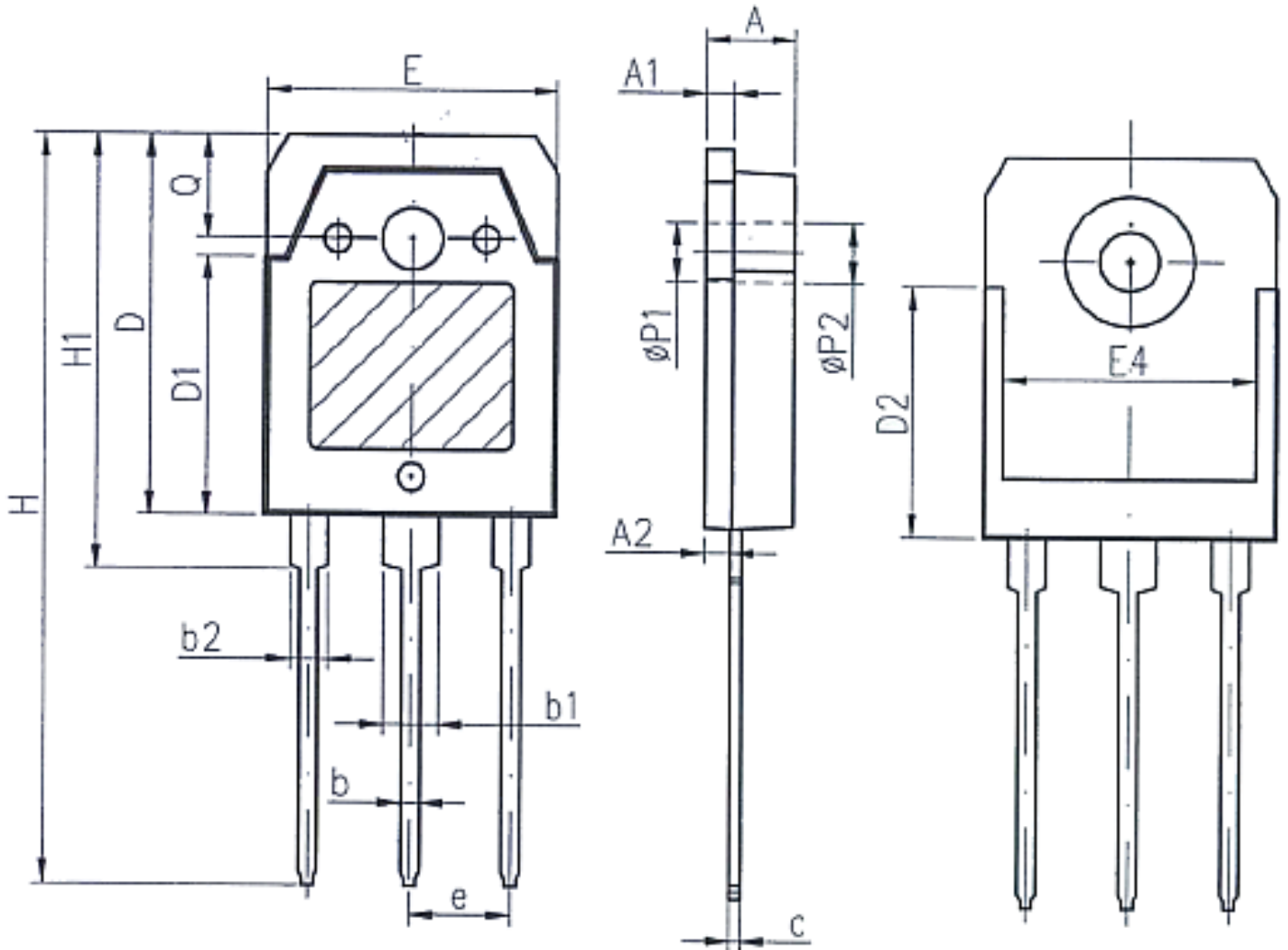


Unit:mm			
Symbol	Min.	Nom	Max.
A	4.37	4.57	4.77
A1	1.25	1.30	1.45
b	2.20	2.40	2.60
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	-	-
E	9.70	10.00	10.30

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



TO-3PN

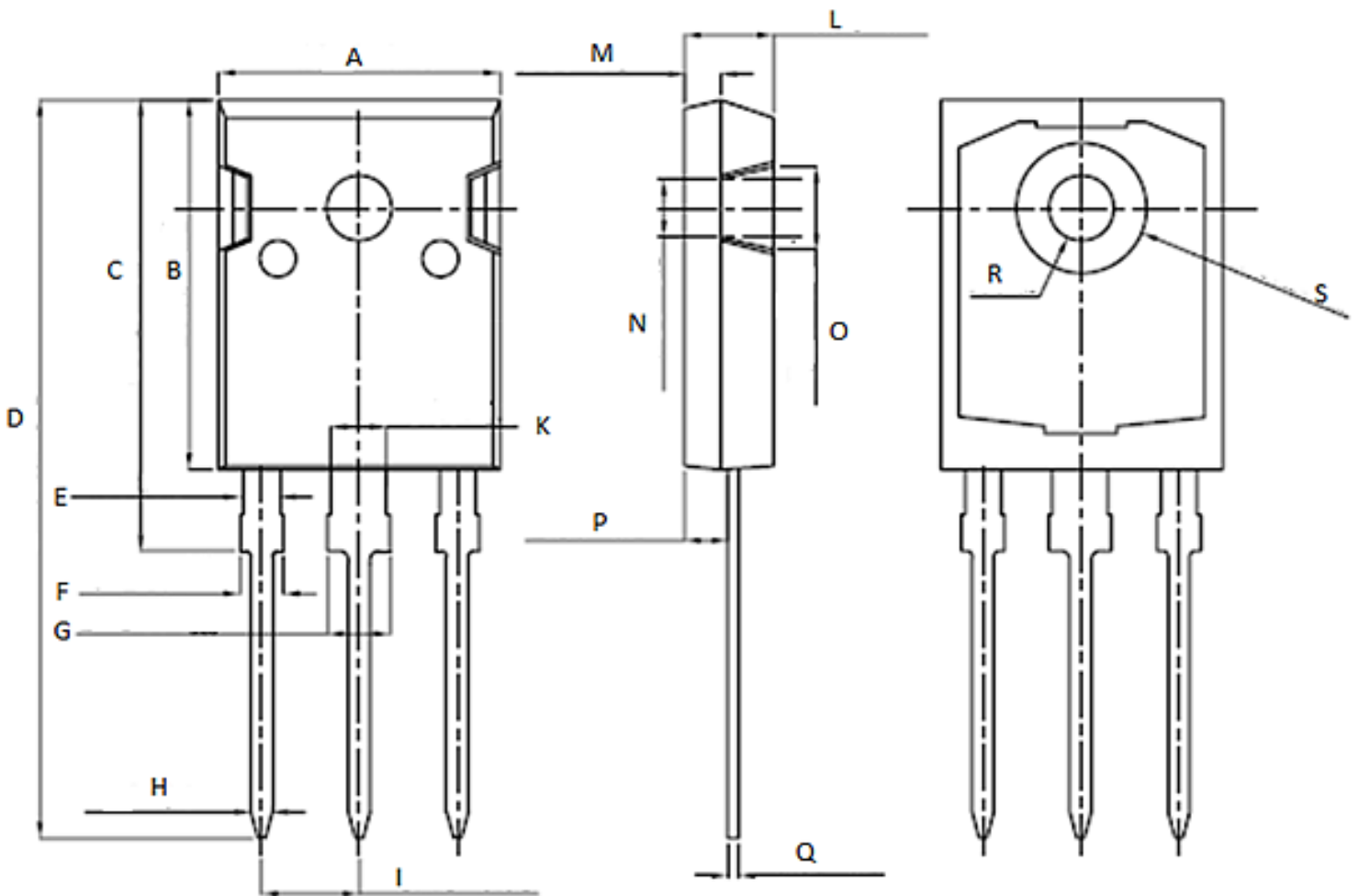


Unit:mm			
Symbol	Min.	Nom	Max.
A	4.60	4.80	4.50
A1	1.40	1.50	1.65
A2	1.18	1.38	1.58
b	0.80	1.00	1.20
b1	2.80	3.00	3.20
b2	1.80	2.00	2.20
c	0.50	0.60	0.75
D	19.60	19.90	20.20
D1	13.55	13.90	14.25

Unit:mm			
Symbol	Min.	Nom	Max.
D2	12.90 REF		
E	15.35	15.60	15.85
E4	12.60	-	-
e	5.45 TYP		
H	40.10	40.50	40.90
H1	23.15	23.40	23.65
phi P1	3.20 REF		
phi P2	3.50REF		



TO-247



Unit:mm		
Symbol	Min.	Max.
A	15.95	16.25
B	20.85	21.25
C	20.95	21.35
D	40.50	40.90
E	1.90	2.10
F	2.10	2.25
G	3.10	3.25
H	1.10	1.30
I	5.40	5.50

Unit:mm		
Symbol	Min.	Max.
K	2.90	3.10
L	4.90	5.30
M	1.90	2.10
N	4.50	4.70
O	5.40	5.60
P	2.29	2.49
Q	0.51	0.71
R	Φ3.50	Φ3.70
S	Φ7.10	Φ7.30



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