



60V N-Channel Power MOSFET

<p>Features</p> <ul style="list-style-type: none"> • Low FOM $R_{DS(on)} \times Q_{gd}$ • 100% avalanche tested • Easy to use/drive • RoHS compliant 	
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<p>Applications</p> <ul style="list-style-type: none"> • DC/DC Converter • Battery Protection Charge/Discharge • Load Switch • Synchronous Rectification 	
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Key Performance Parameters

Parameter	Value	Unit
$V_{DS@Tc=25^{\circ}C}$	60	V
$R_{DS(on),max@10V}$	17	mΩ
$R_{DS(on),max@4.5V}$	23	mΩ
$Q_{g,typ}$	40	nC
$I_D@Tc=25^{\circ}C$	50	A
$I_{D,pulse}$	200	A
$E_{AS}^{1)}$	98	mJ

Device Marking and Package Information

Device	Package	Marking
E50N06	TO-263	BCE5N06
D50N06	TO-252	BCD5N06
H50N06	TO-251	BCH5N06
T50N06	TO-220	BCT5N06

**60V N-Channel Power MOSFET**

Absolute Maximum Ratings $T_A = 25^\circ\text{C}$, unless otherwise noted			
Parameter	Symbol	Values	Unit
Drain-Source Voltage($V_{GS}=0\text{V}$)	V_{DS}	60	V
Continuous Drain Current ²⁾	I_D	$T_C = 25^\circ\text{C}$	50
		$T_C = 100^\circ\text{C}$	32
Pulsed Drain Current ³⁾	$I_{D,pulse}$	200	A
Gate-Source Voltage	V_{GSS}	± 20	V
Single Pulse Avalanche Energy ¹⁾	E_{AS}	98	mJ
Power Dissipation	P_D	62.5	W
Operating Junction and Storage Temperature Range	T_J, T_{stg}	-55~+150	$^\circ\text{C}$

Thermal Resistance			
Parameter	Symbol	Max.	Unit
Thermal Resistance, Junction-to-Case	R_{thJC}	2	$^\circ\text{C/W}$
Thermal Resistance, Junction-to-Ambient	R_{thJA}	62	$^\circ\text{C/W}$

Notes

- 1) $L=0.5\text{mH}$, $V_{DD}=30\text{V}$, Start $T_J=25^\circ\text{C}$.
- 2) Limited by maximum junction temperature.
- 3) Repetitive Rating: Pulse width limited by maximum junction temperature.



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Electrical Characteristics $T_J = 25^\circ\text{C}$, unless otherwise noted						
Parameter	Symbol	Test Conditions	Value			Unit
			Min.	Typ.	Max.	
Static Characteristics						
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0V, I_D = 250\mu A$	60	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	$V_{DS} = 60V$ $V_{GS} = 0V, T_J = 25^\circ\text{C}$	--	--	1	μA
		$V_{DS} = 60V$ $V_{GS} = 0V, T_J = 125^\circ\text{C}$	--	--	100	
Gate-Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20V$	--	--	± 100	nA
Gate-Source Threshold Voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}, I_D = 250\mu A$	1.2	1.8	2.5	V
Drain-Source On-State-Resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 20A$	--	13.5	17	$m\Omega$
		$V_{GS} = 4.5V, I_D = 20A$	--	18	23	$m\Omega$
Gate Resistance	R_G	$f = 1.0\text{MHz}$ open drain	--	1.4	--	Ω
Dynamic Characteristics						
Input Capacitance	C_{iss}	$V_{GS} = 0V, V_{DS} = 30V$ $f = 1.0\text{MHz}$	--	1889	--	μF
Output Capacitance	C_{oss}		--	113	--	
Reverse Transfer Capacitance	C_{rss}		--	92	--	
Total Gate Charge	Q_g	$V_{DS} = 30V, I_D = 20A$ $V_{GS} = 10V$	--	40	--	nC
Gate-Source Charge	Q_{gs}		--	7.8	--	
Gate-Drain Charge	Q_{gd}		--	8.3	--	
Gate Plateau Voltage	$V_{plateau}$		--	3.7	--	V
Turn-on Delay Time	$t_{d(on)}$	$V_{DS} = 30V, V_{GS} = 10V$ $R_G = 3\Omega, I_D = 20A$	--	13	--	ns
Turn-on Rise Time	t_r		--	25	--	
Turn-off Delay Time	$t_{d(off)}$		--	60	--	
Turn-off Fall Time	t_f		--	9	--	
Drain-Source Body Diode Characteristics						
Body Diode Forward Voltage	V_{SD}	$T_J = 25^\circ\text{C}, I_{SD} = 20A$ $V_{GS} = 0V$	--	--	1.2	V
Continuous Diode Forward Current	I_S		--	--	50	A
Reverse Recovery Time	t_{rr}	$I_F = 20A, di_F/dt = 100A/\mu s$	--	29	--	ns
Reverse Recovery Charge	Q_{rr}		--	21	--	nC



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

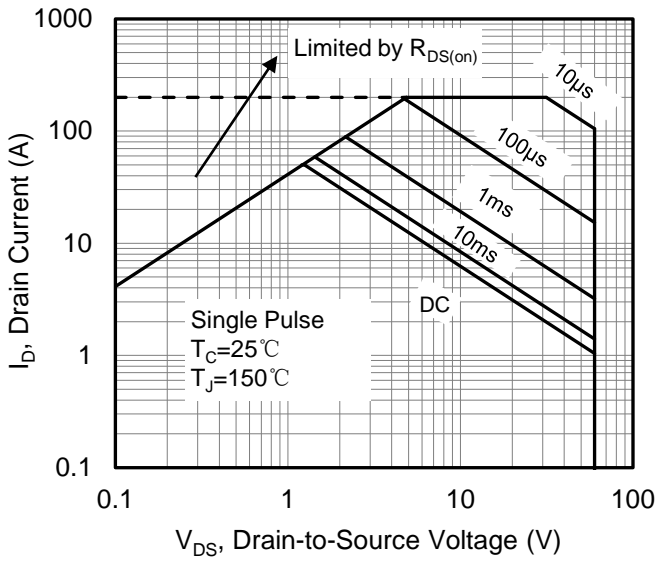


Figure 1. Maximum Safe Operating Area

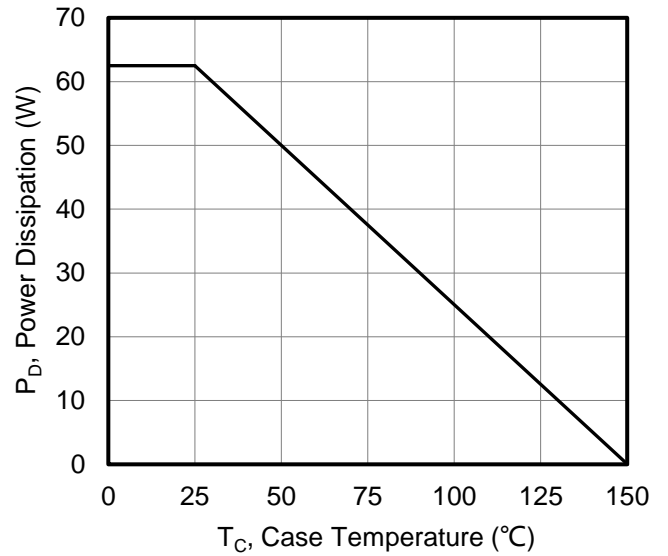


Figure 2. Maximum Power Dissipation vs. Case Temperature

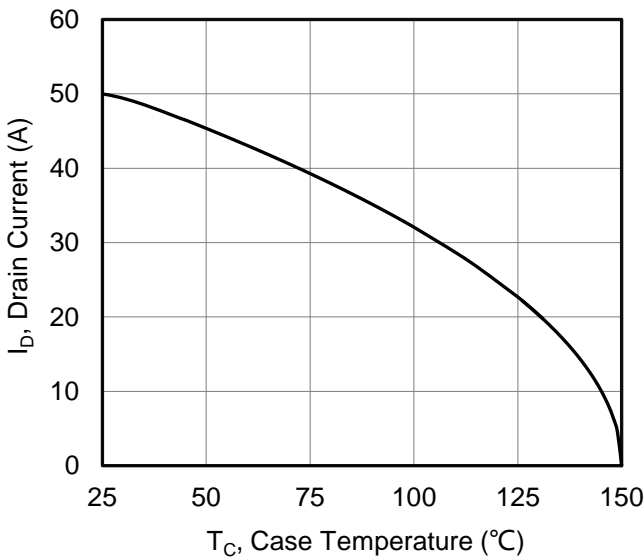


Figure 3. Maximum Continuous Drain Current vs. Case Temperature

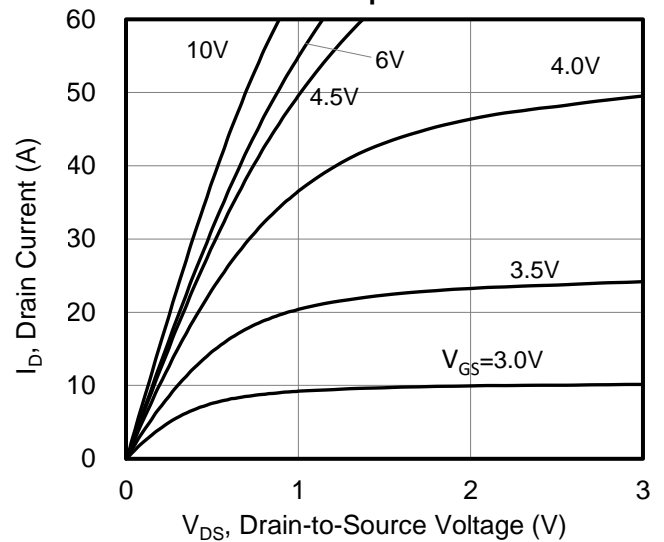


Figure 4. Typical output Characteristics

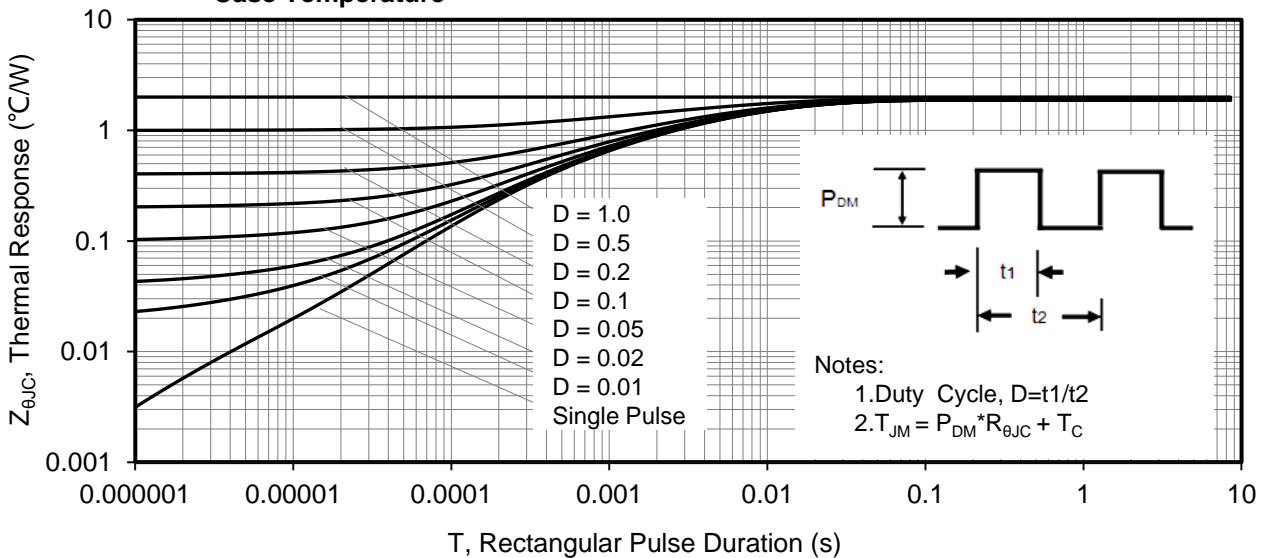


Figure 5. Maximum Effective Thermal Impedance, Junction to Case



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

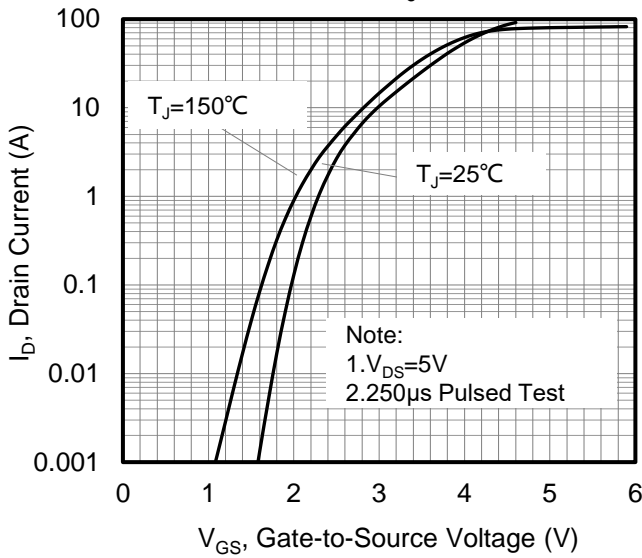


Figure 6. Typical Transfer Characteristics

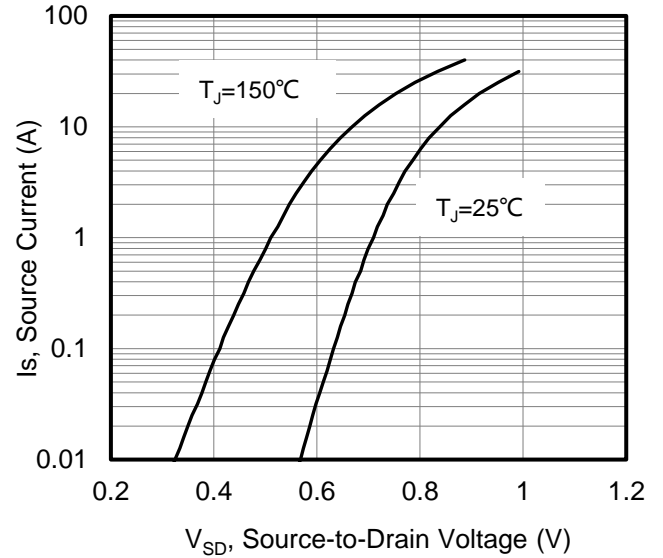


Figure 7. Typical Body Diode Transfer Characteristics

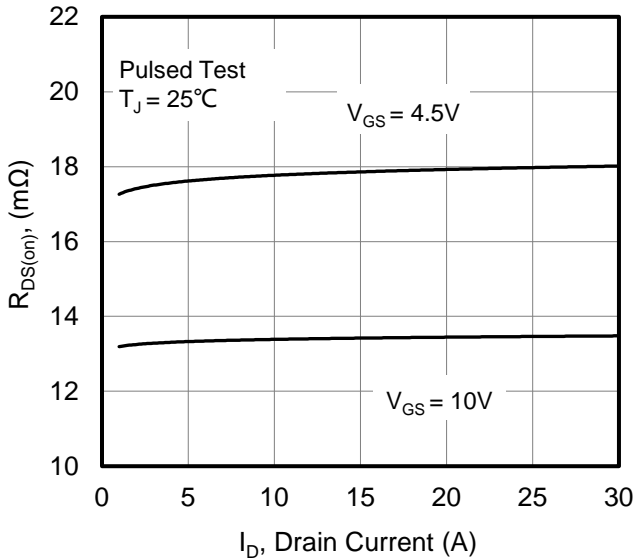


Figure 8. Drain-to-Source On Resistance vs Drain Current

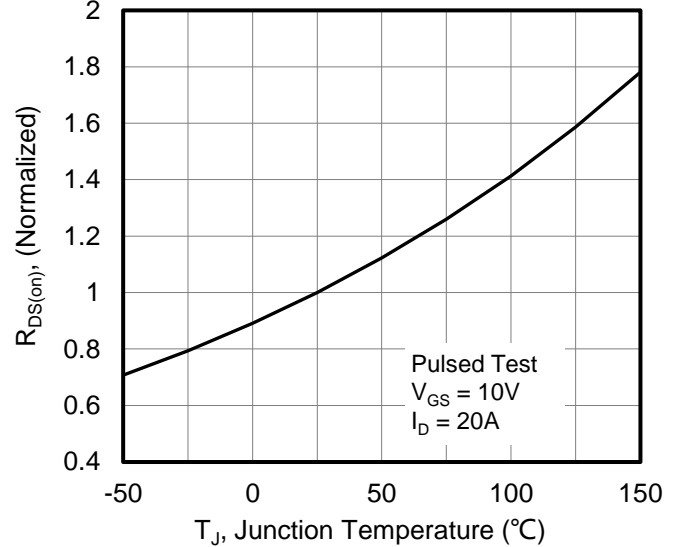


Figure 9. Normalized On Resistance vs Junction Temperature

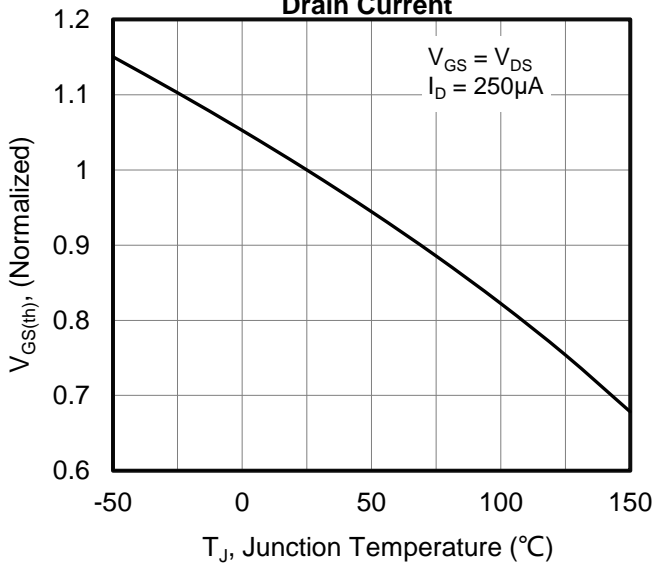


Figure 10. Normalized Threshold Voltage vs Junction Temperature

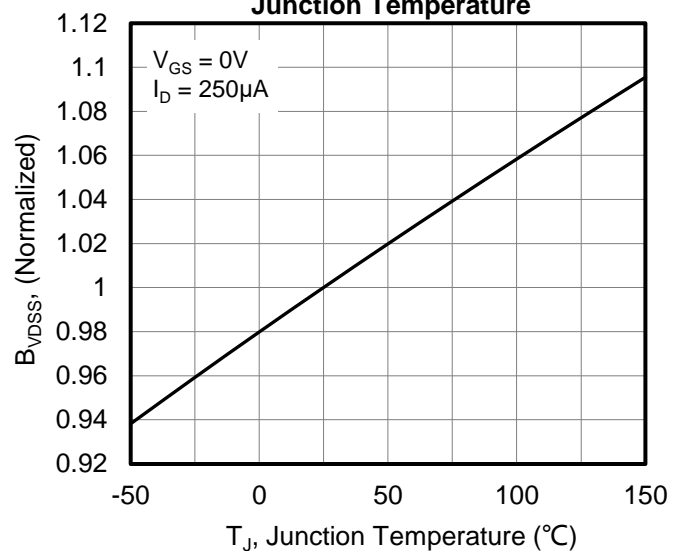


Figure 11. Normalized Breakdown Voltage vs Junction Temperature



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

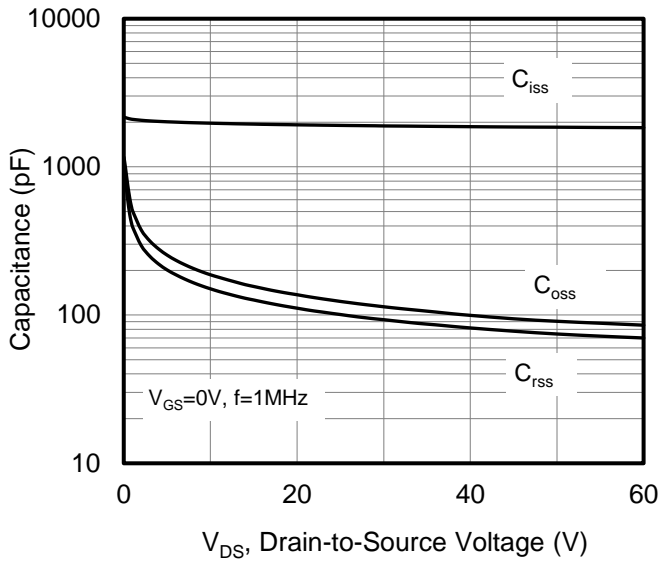


Figure 12. Capacitance Characteristics

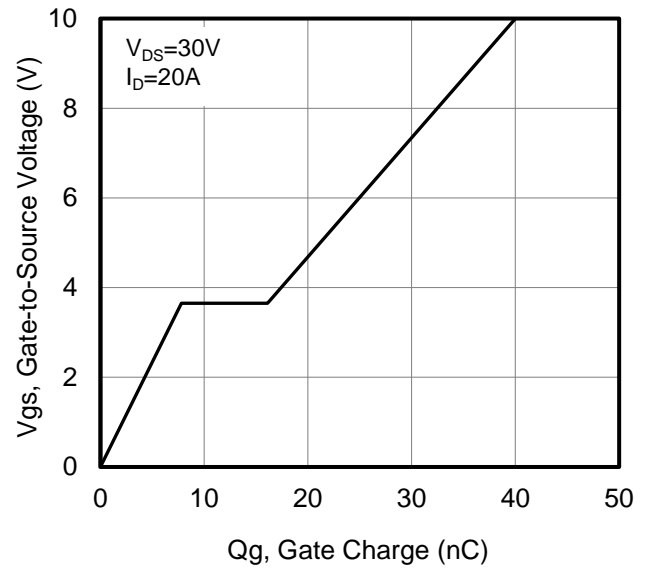


Figure 13. Typical Gate Charge vs Gate to Source Voltage



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Figure A: Gate Charge Test Circuit and Waveform

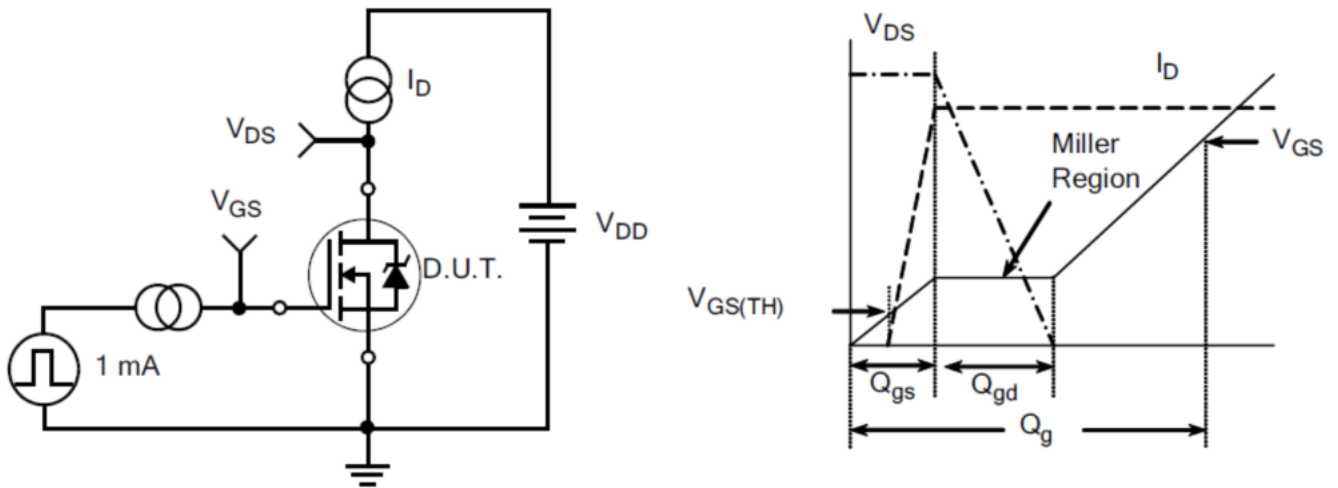


Figure B: Resistive Switching Test Circuit and Waveform

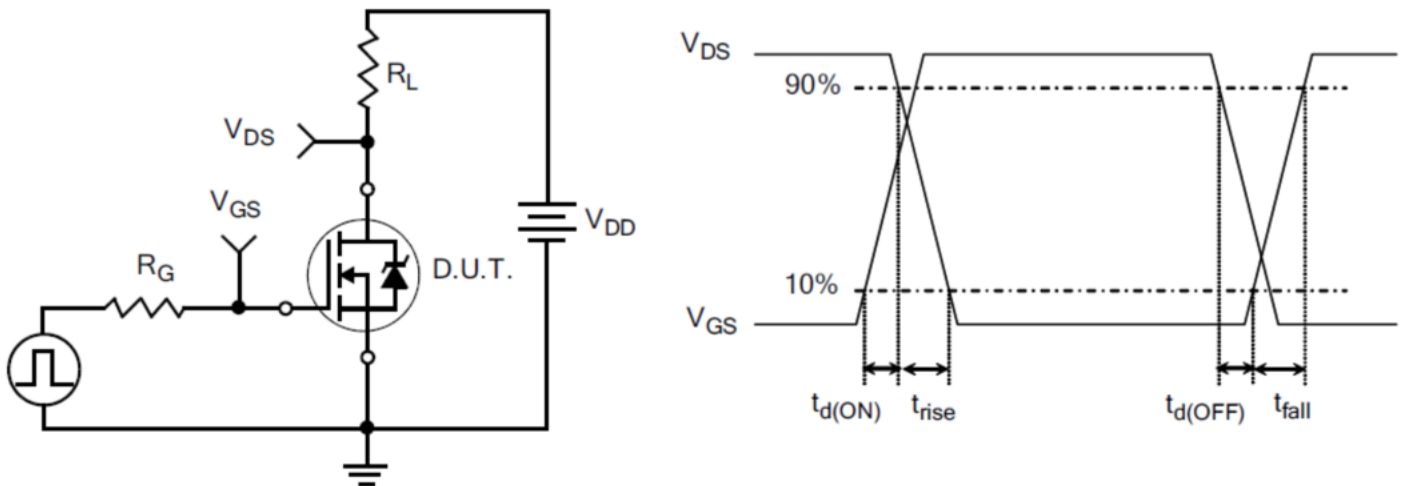
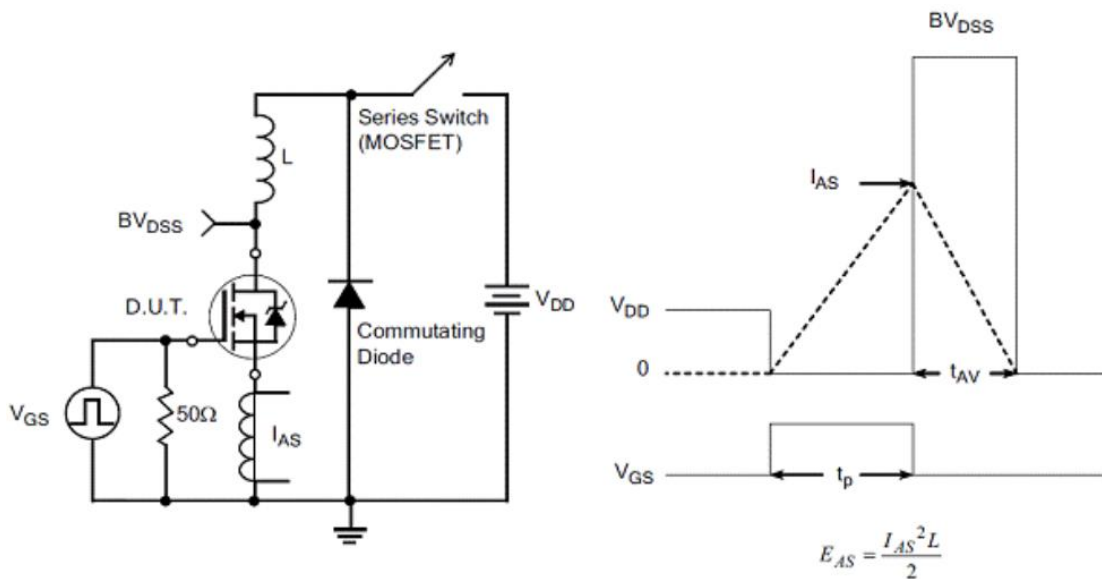


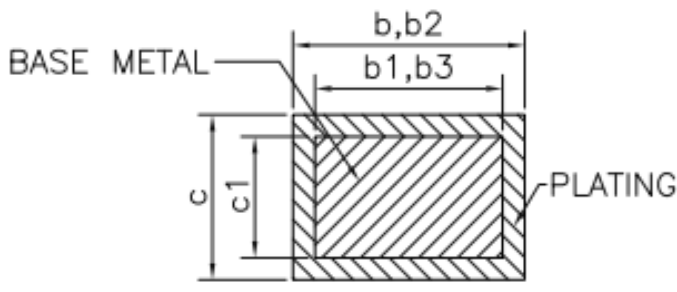
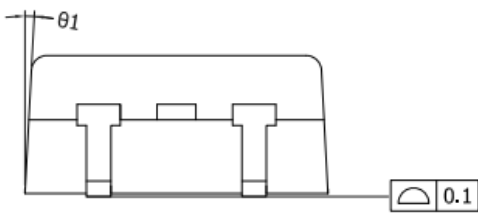
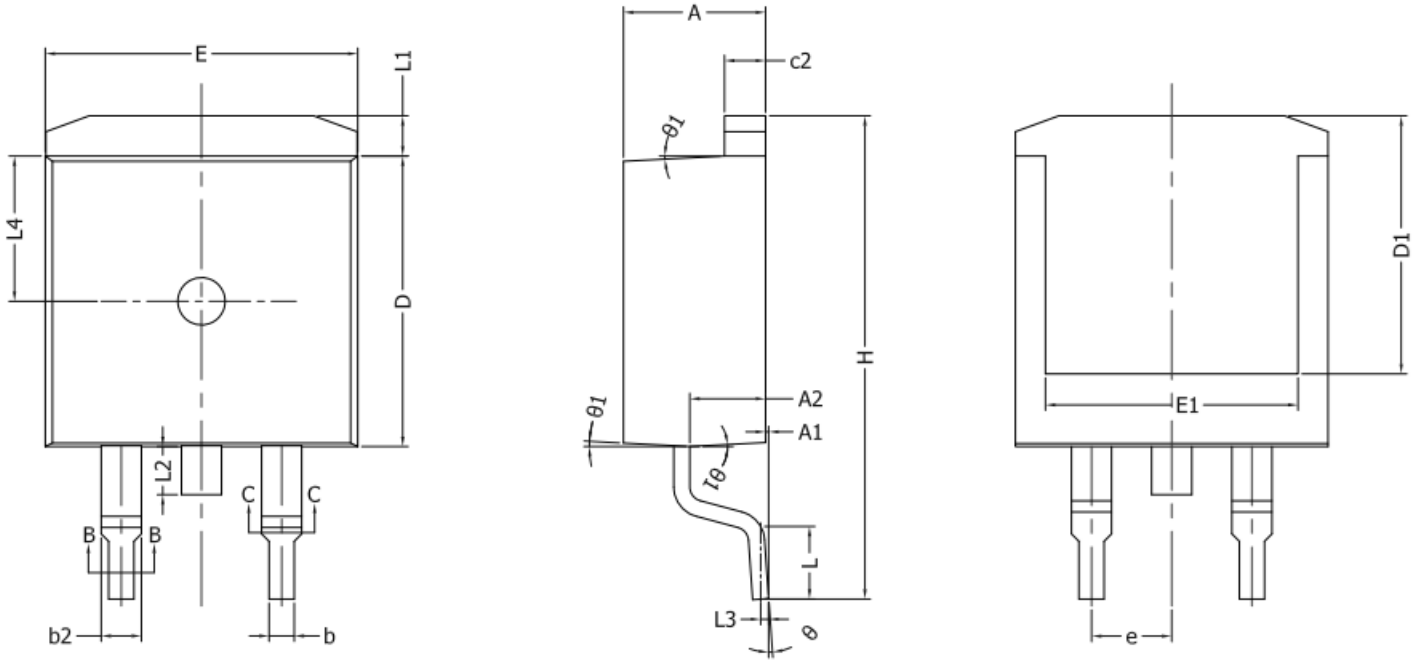
Figure C: Unclamped Inductive Switching Test Circuit and Waveform





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Outlines TO-263 Package



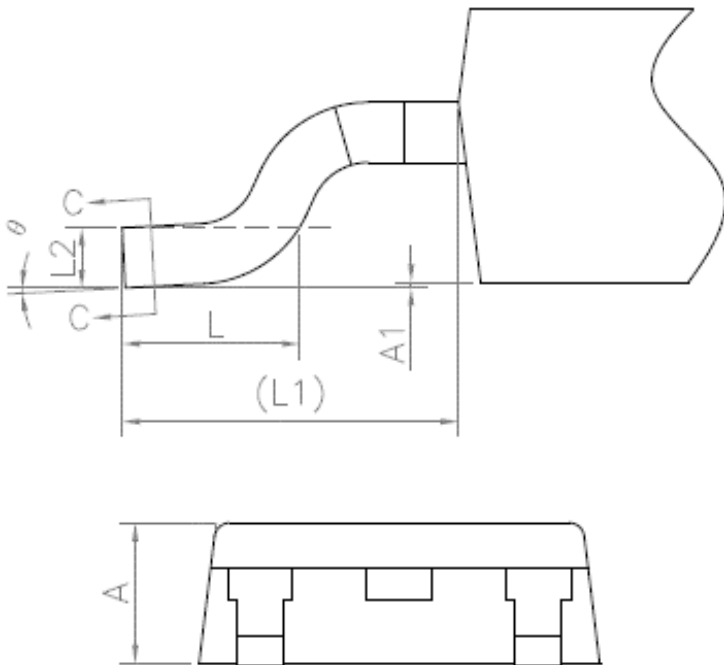
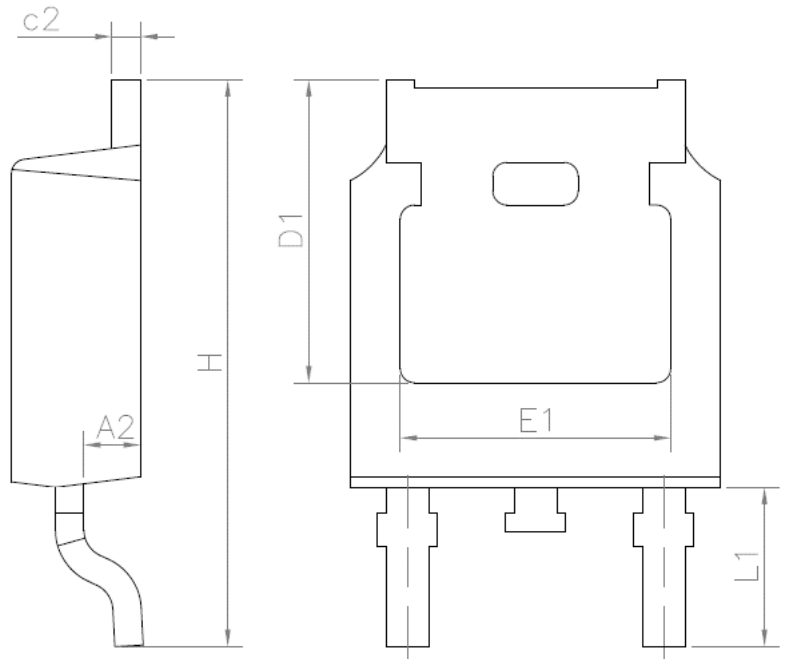
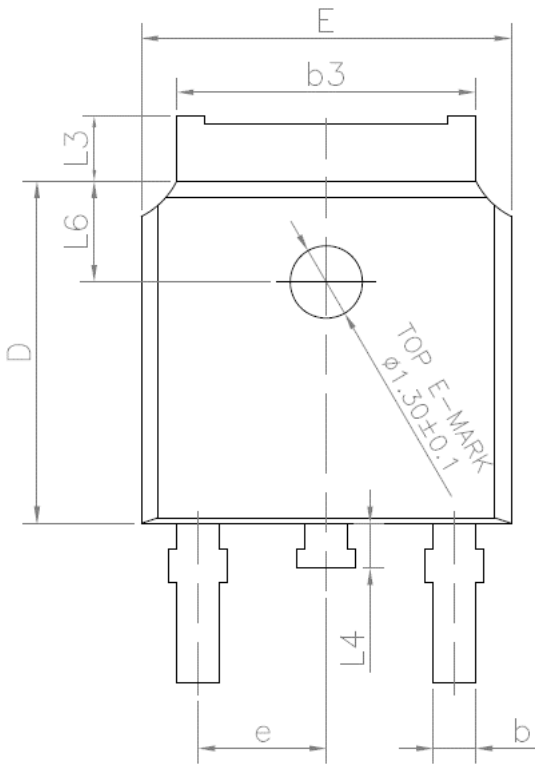
SECTION B-B&C-C

SYMBOL	MIN	NOM	MAX
A	4.4	4.5	4.6
A1	0	0.1	0.25
A2	2.2	2.4	2.6
b	0.76	--	0.89
b1	0.75	0.8	0.85
b2	1.23	--	1.37
b3	1.22	1.27	1.32
c	0.47	--	0.6
c1	0.46	0.51	0.56
c2	1.25	1.3	1.35
D	9.1	9.2	9.3
D1	8	--	--
E	9.8	9.9	10
E1	7.8	--	--
e	2.54 BSC		
H	14.9	15.3	15.7
L	2	2.3	2.6
L1	1.17	1.27	1.4
L2	--	--	1.75
L3	0.25 BSC		
L4	4.60 REF		
θ	0°	--	8°
θ1	1°	3°	5°



60V N-Channel Power MOSFET

Outlines TO-252 Package

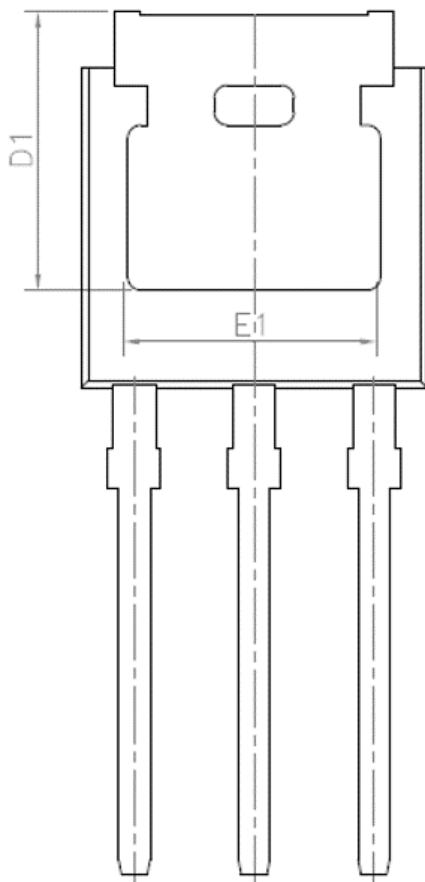
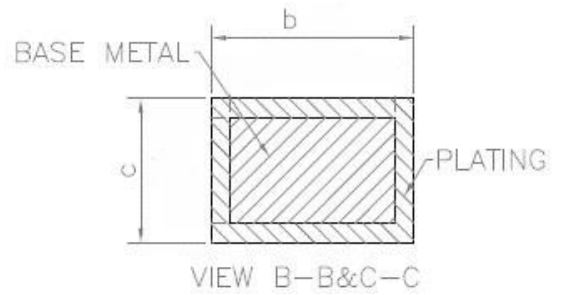
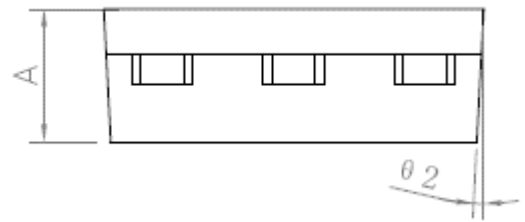
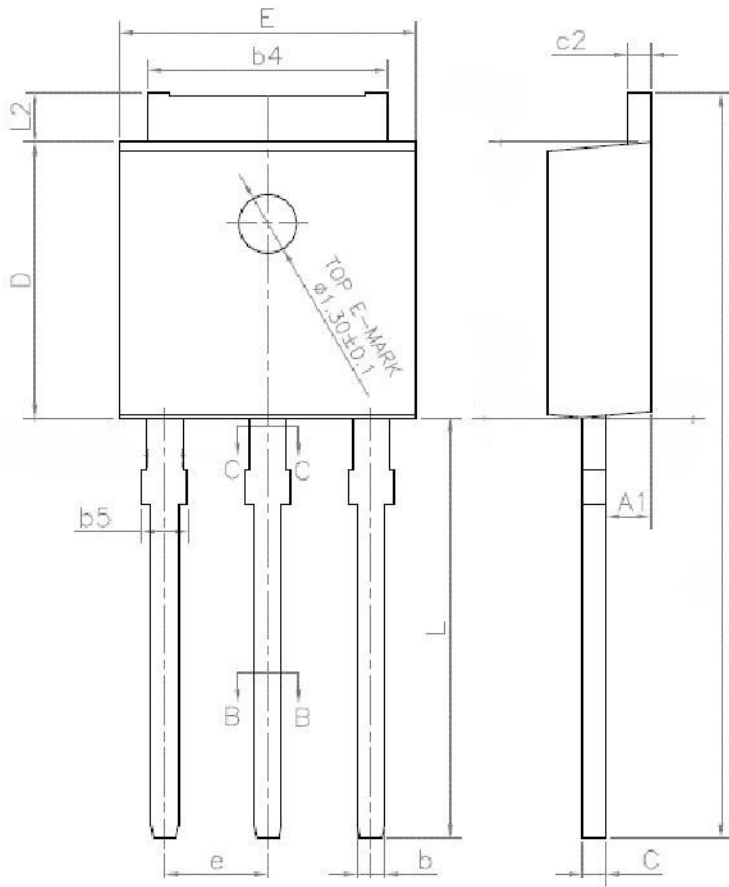


SYMBOL	MIN	NOM	MAX
A	2.2	2.3	2.4
A1	0	--	0.2
A2	0.9	1.035	1.17
b	0.645	--	0.9
b3	5.13	5.326	5.46
c	0.43	--	0.61
c2	0.41	--	0.61
D	5.98	6.1	6.22
D1	5.244	--	--
E	6.4	6.6	6.73
E1	4.63	--	--
e	2.186	2.286	2.386
H	9.4	10.04	10.5
L	1.38	1.5	1.75
L1	2.6	2.872	3
L2	0.5	0.509	0.52
L3	0.88	--	1.28
L4	0.5	--	1
L6	1.5	1.7	1.95
θ	0°	--	10°



60V N-Channel Power MOSFET

Outlines TO-251 Package

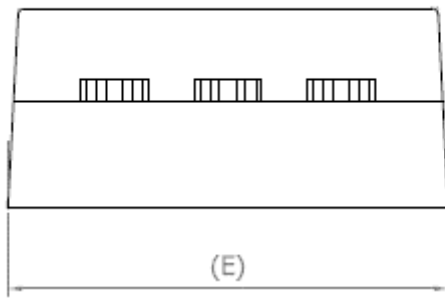
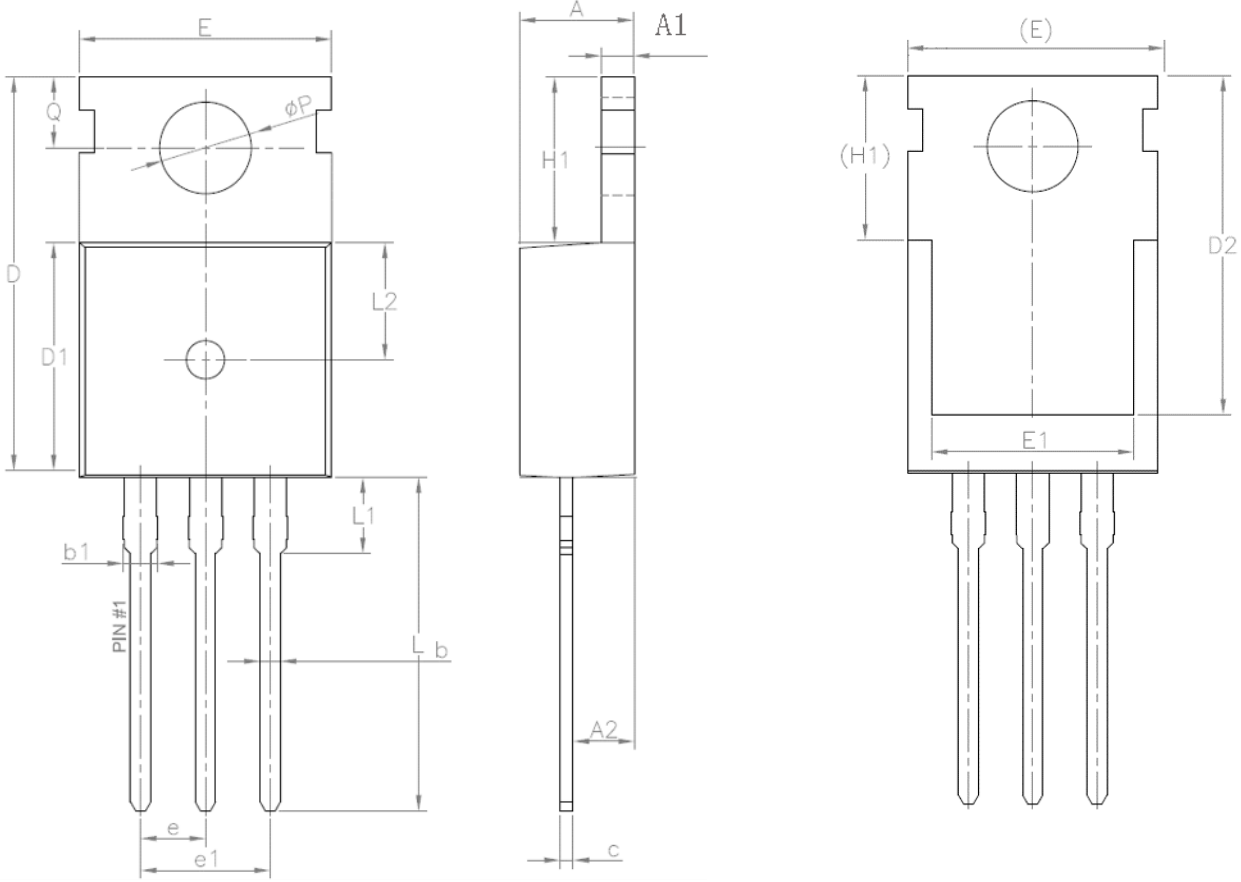


SYMBOL	MIN	NOM	MAX
A	2.20	2.30	2.38
A1	0.90	1.04	1.17
b	0.56	--	0.90
b4	5.20	5.33	5.46
b5	--	--	1.05
c	0.43	--	0.61
c2	0.43	--	0.61
D	5.98	6.10	6.22
D1	5.2	--	--
E	6.40	6.60	6.73
E1	4.60	--	--
e	2.24	2.29	2.34
e1	4.47	4.57	4.67
H	16.18	16.50	16.82
L	9	9.35	9.65
L2	0.88	1.05	1.28



60V N-Channel Power MOSFET

Outlines TO-220 Package



SYMBOL	MIN	NOM	MAX
A	4.37	4.535	4.7
A1	1.25	1.3	1.4
A2	2.2	2.4	2.6
b	0.7	---	0.95
b1	1.17	---	1.47
c	0.45	0.5	0.6
D	15.1	15.65	16.1
D1	8.8	9.15	9.4
D2	11.8	---	---
E	9.7	9.95	10.3
E1	7	---	---
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.5	6.85
L	12.75	13.29	13.8
L1	---	---	3.5
ΦP	3.4	3.67	3.8
Q	2.6	---	3