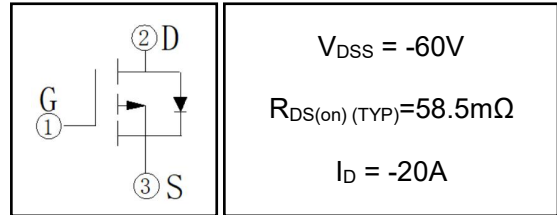


## 20A 60V P-channel Enhancement Mode Power MOSFET

### 1 Description

These P-channel enhanced vdmofets, used advanced trench technology and design, provide to excellent Rdson with low gate charge. Which accords with the RoHS standard.



### 2 Features

- Fast switching
- Low on resistance
- Low gate charge
- Low reverse transfer capacitances
- 100% single pulse avalanche energy test
- 100%  $\Delta V_{DS}$  test

### 3 Applications

- Power switching applications
- Inverter management system
- Power tools
- Automotive electronics



### 4 Electrical Characteristics

#### 4.1 Absolute Maximum Rating (Tc=25°C, unless otherwise noted)

Parameter	Symbol	Value				Unit
		DH9Z24	DHI9Z24 DHE9Z24	DHB9Z24 DHD9Z24	DHF9Z24	
Drain-Source Voltage	$V_{DSS}$	-60				V
Gate-Drain Voltage	$V_{GSS}$	$\pm 20$				V
Drain Current(continuous)	$T_C=25^\circ C$	-20				A
	$T_C=100^\circ C$	-14				A
Drain Current(Pulsed) <sup>(1)</sup>	$I_{DM}$	-80				A
Single Pulse Avalanche Energy <sup>(4)</sup>	$E_{AS}$	96				mJ
Single Pulse Avalanche Current <sup>(4)</sup>	$I_{AS}$	-19.6				A
Total Dissipation	$T_a=25^\circ C$	2	2	1.58	2	W
	$T_C=25^\circ C$	43	43	43	18	W
Junction Temperature	$T_j$	-55~175				°C
storage Temperature	$T_{stg}$	-55~175				°C
Maximum Temperature for soldering	$T_L$	300				°C

#### 4.2 Thermal Characteristics

Parameter	Symbol	Value				Unit
		DH9Z24	DHI9Z24 DHE9Z24	DHB9Z24 DHD9Z24	DHF9Z24	
Thermal Resistance Junction to Case-sink	$R_{thJC}$	3.49	3.49	3.49	8.33	°C/W
Thermal Resistance Junction to Ambient	$R_{thJA}$	75	75	94.88	75	°C/W

**4.3 Electrical Characteristics** (T<sub>c</sub>=25°C, unless otherwise noted)

Parameter	Symbol	Test Condition	Value			Units
			Min	Typ	Max	
<b>Off Characteristics</b>						
Drain-source Breakdown Voltage	BV <sub>DSS</sub>	I <sub>D</sub> =-250μA, V <sub>GS</sub> =0V	-60	--	--	V
Drain-to-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> =-60V, V <sub>GS</sub> =0V, T <sub>C</sub> =25°C	--	--	-1	μA
		V <sub>DS</sub> =-48V, V <sub>GS</sub> =0V, T <sub>C</sub> =125°C	--	--	-100	μA
Gate-to-Source Forward Leakage	I <sub>GSSF</sub>	V <sub>GS</sub> =+20V	--	--	100	nA
Gate-to-Source Reverse Leakage	I <sub>GSSR</sub>	V <sub>GS</sub> =-20V	--	--	-100	nA
<b>On Characteristics</b>						
Gate threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA	-1	-1.6	-2	V
Drain-source on-state Resistance	R <sub>DS(on)</sub>	V <sub>GS</sub> =-10V, I <sub>D</sub> =-10A	--	58	70	mΩ
		V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-10A	--	70	84	
Forward Transfer Conductance	g <sub>fs</sub>	V <sub>DS</sub> =-5V, I <sub>D</sub> =-8A	--	17	--	S
<b>Dynamic Characteristics</b>						
Input Capacitance	C <sub>iss</sub>	V <sub>GS</sub> =0V, V <sub>DS</sub> =-30V, f=1.0MHz	--	1528	--	pF
Output Capacitance	C <sub>oss</sub>		--	90	--	
Reverse Transfer Capacitance	C <sub>rss</sub>		--	60	--	
<b>Switching Characteristics</b>						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =-30V, I <sub>D</sub> =-8A, V <sub>GS</sub> =-10V, R <sub>GEN</sub> =3Ω	--	6.6	--	nS
Turn-on Rise Time	t <sub>r</sub>		--	42	--	
Turn-off Delay Time	t <sub>d(off)</sub>		--	37	--	
Turn-off Fall Time	t <sub>f</sub>		--	63.5	--	
Total Gate Charge	Q <sub>g</sub>	I <sub>D</sub> =-8A, V <sub>DD</sub> =-30V, V <sub>GS</sub> =-10V	--	28.2	--	nC
Gate-to-Source Charge	Q <sub>gs</sub>		--	7.2	--	
Gate-to-Drain("Miller") Charge	Q <sub>gd</sub>		--	3.8	--	
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage <sup>(3)</sup>	V <sub>FSD</sub>	V <sub>GS</sub> =0V, I <sub>S</sub> =-8A	--	--	-1.2	V
Diode Forward Current	I <sub>S</sub>		--	--	-20	A
Reverse Recovery Time <sup>(3)</sup>	t <sub>rr</sub>	T <sub>J</sub> =25°C, I <sub>F</sub> =-8A, dI <sub>F</sub> /dt=100A/μS, V <sub>GS</sub> =0V	--	29	--	nS
Reverse Recovery Charge <sup>(3)</sup>	Q <sub>rr</sub>		--	12.8	--	nC

**Notes:**

- 1: Repetitive rating, pulse width limited by maximum junction temperature.
- 2: Surface mounted on FR4 Board, t<sub>s</sub>≤10sec.
- 3: Pulse width ≤ 300μs, duty cycle ≤ 2%.
- 4: L=0.5mH, I<sub>D</sub>=-19.6A, V<sub>DD</sub>=-50V, V<sub>GATE</sub>=-60V, Start T<sub>J</sub>=25°C.

**5 Typical characteristics diagrams**

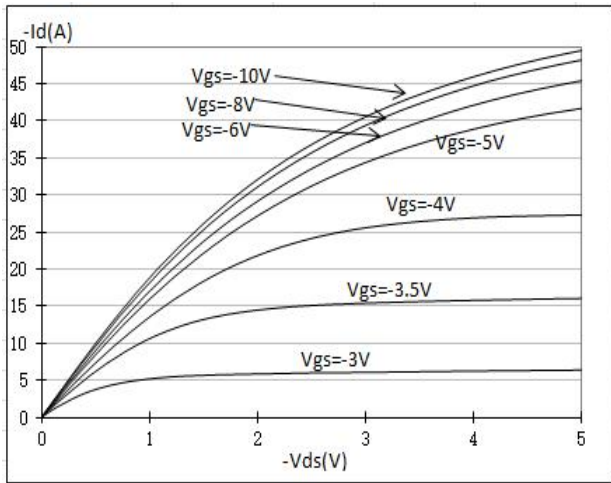


Figure 1 Output Characteristics

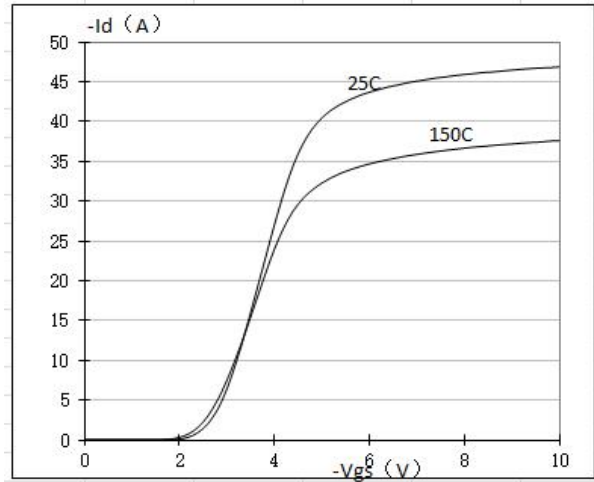


Figure 2 Transfer Characteristics

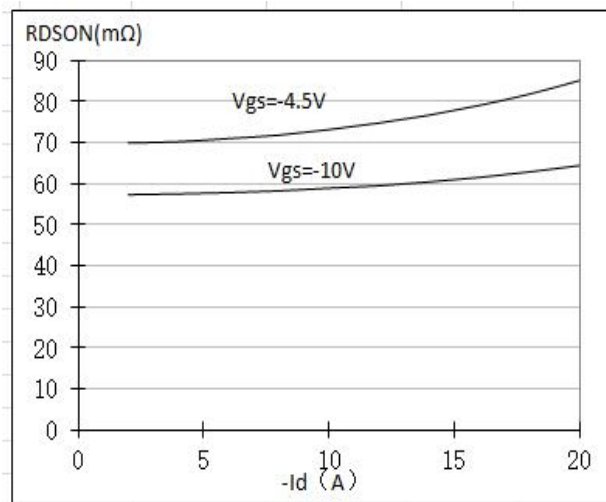


Figure 3. On-resistance vs. Drain Current

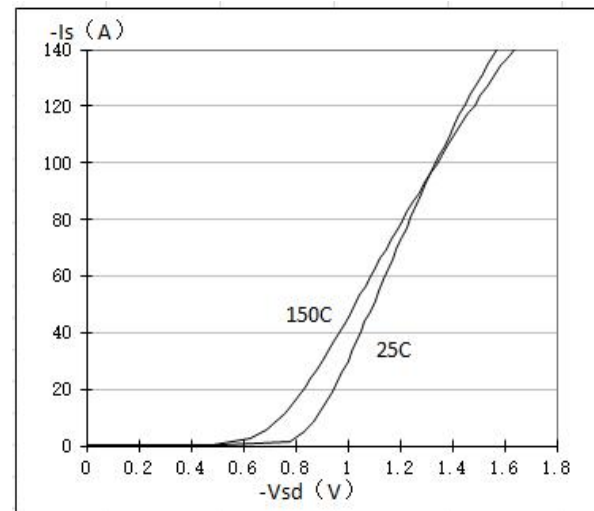


Figure 4. Source- Drain Diode Forward

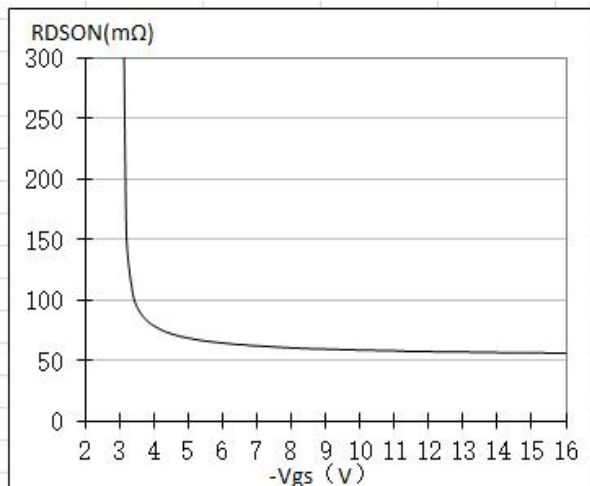


Figure 5. On-resistance vs. Vgs

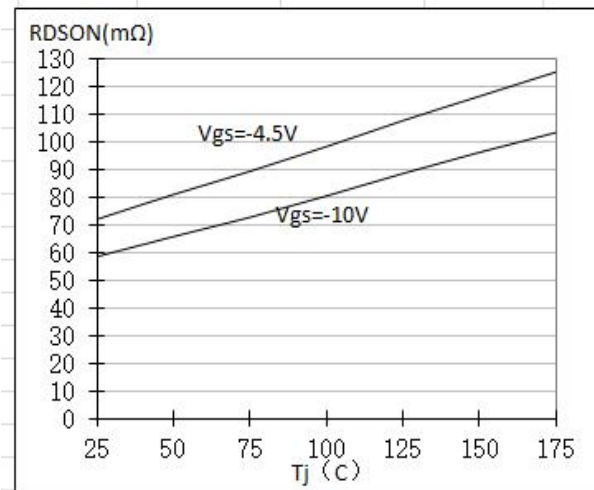


Figure 6. on Resistance vs. Junction Temperature

5 Typical characteristics diagrams(continues)

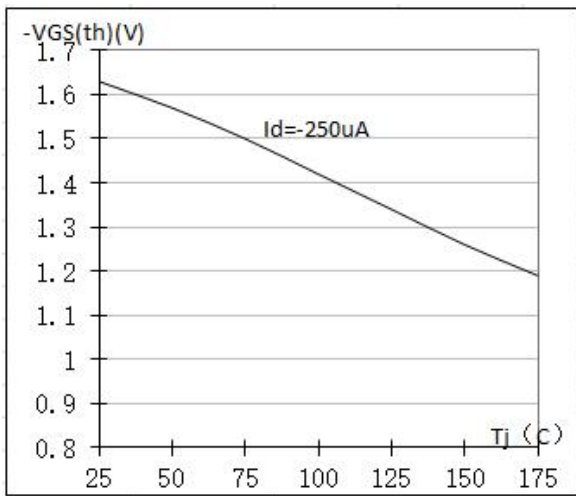


Figure 7. VTH vs. Junction Temperature

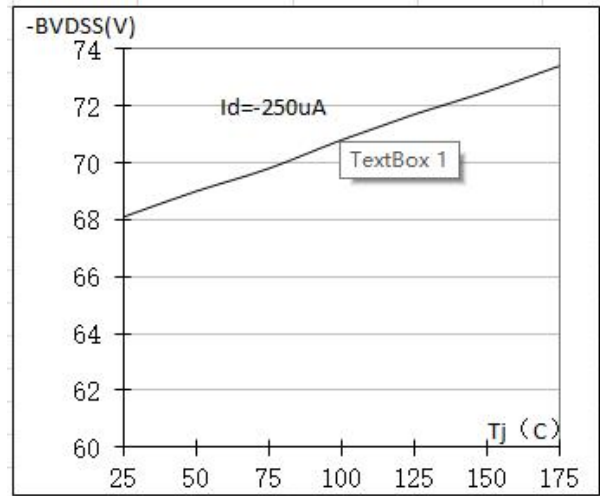


Figure 8. BVdss vs. Junction Temperature

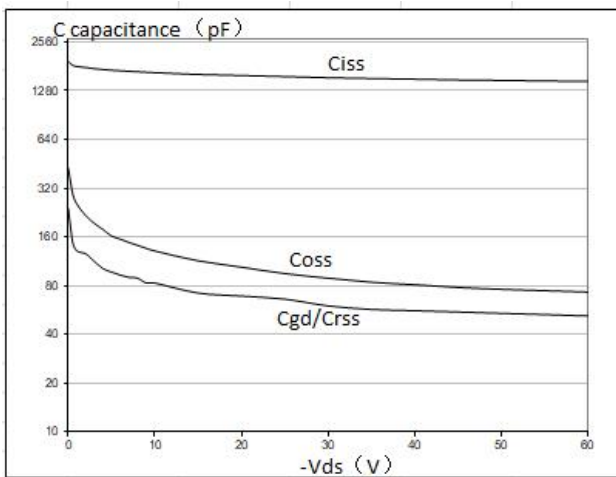


Figure 9. Capacitance vs Vds

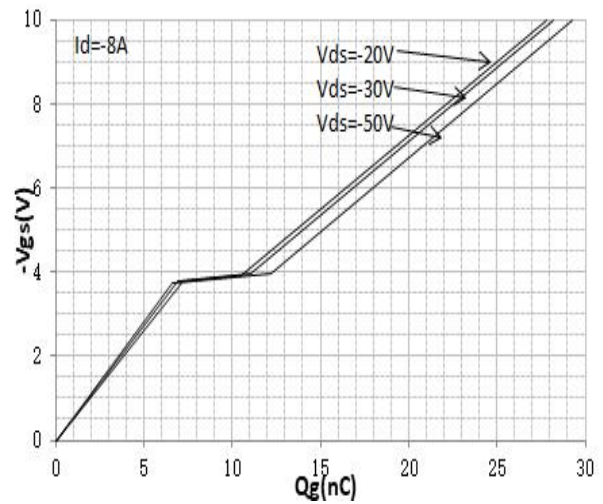


Figure 10. Gate Charge Characteristics

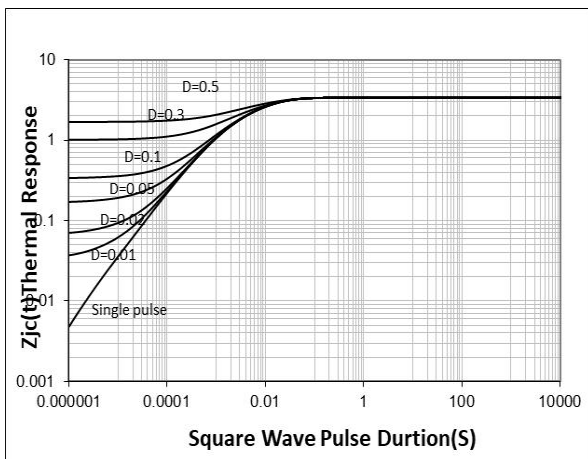


Figure 11. Normalized Maximum Transient Thermal Impedance

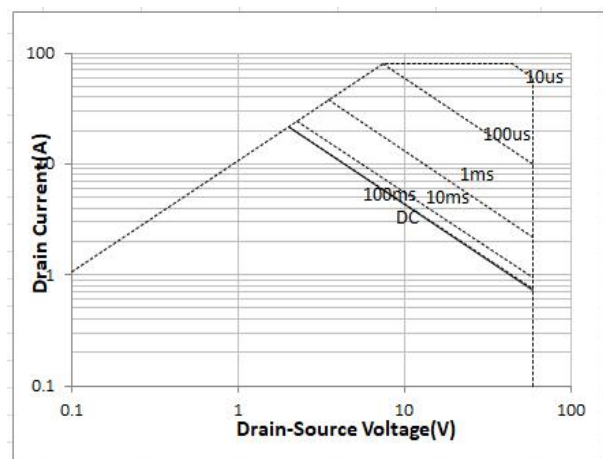
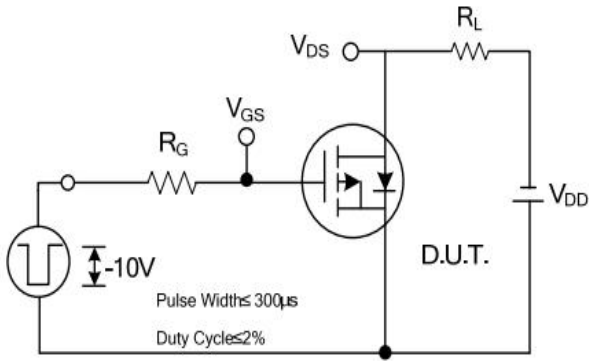
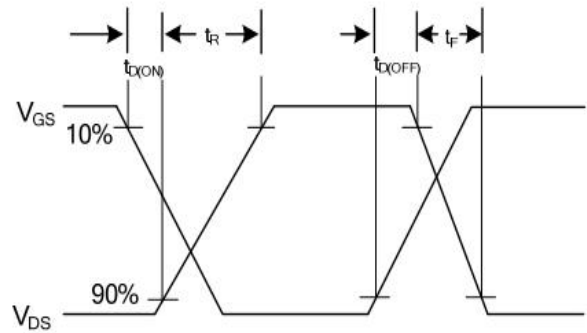


Figure 12. Maximum Safe Operating Area

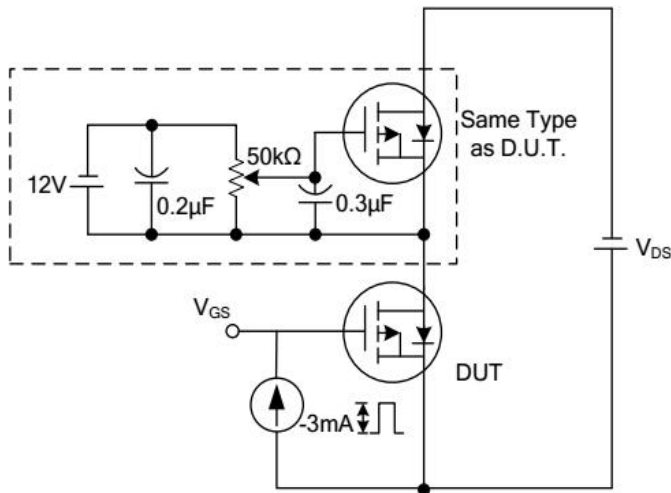
**6 Typical Test Circuit and Waveform**



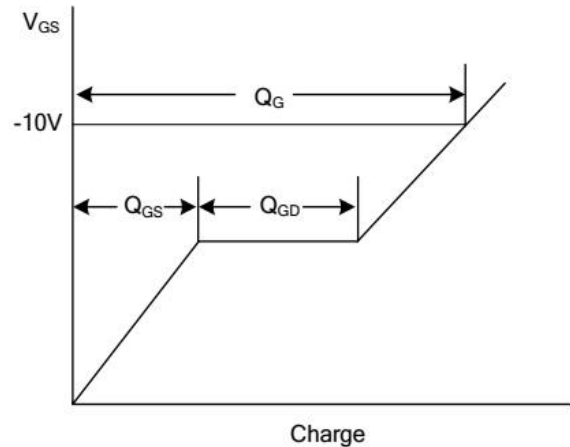
**Switching Test Circuit**



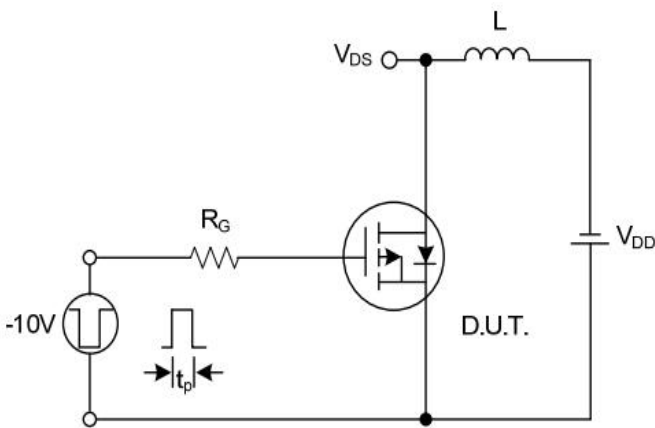
**Switching Waveforms**



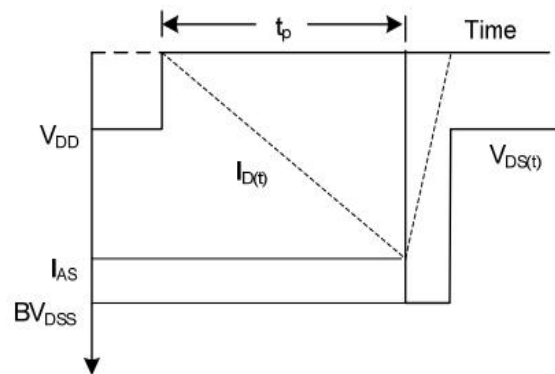
**Gate Charge Test Circuit**



**Gate Charge Waveform**

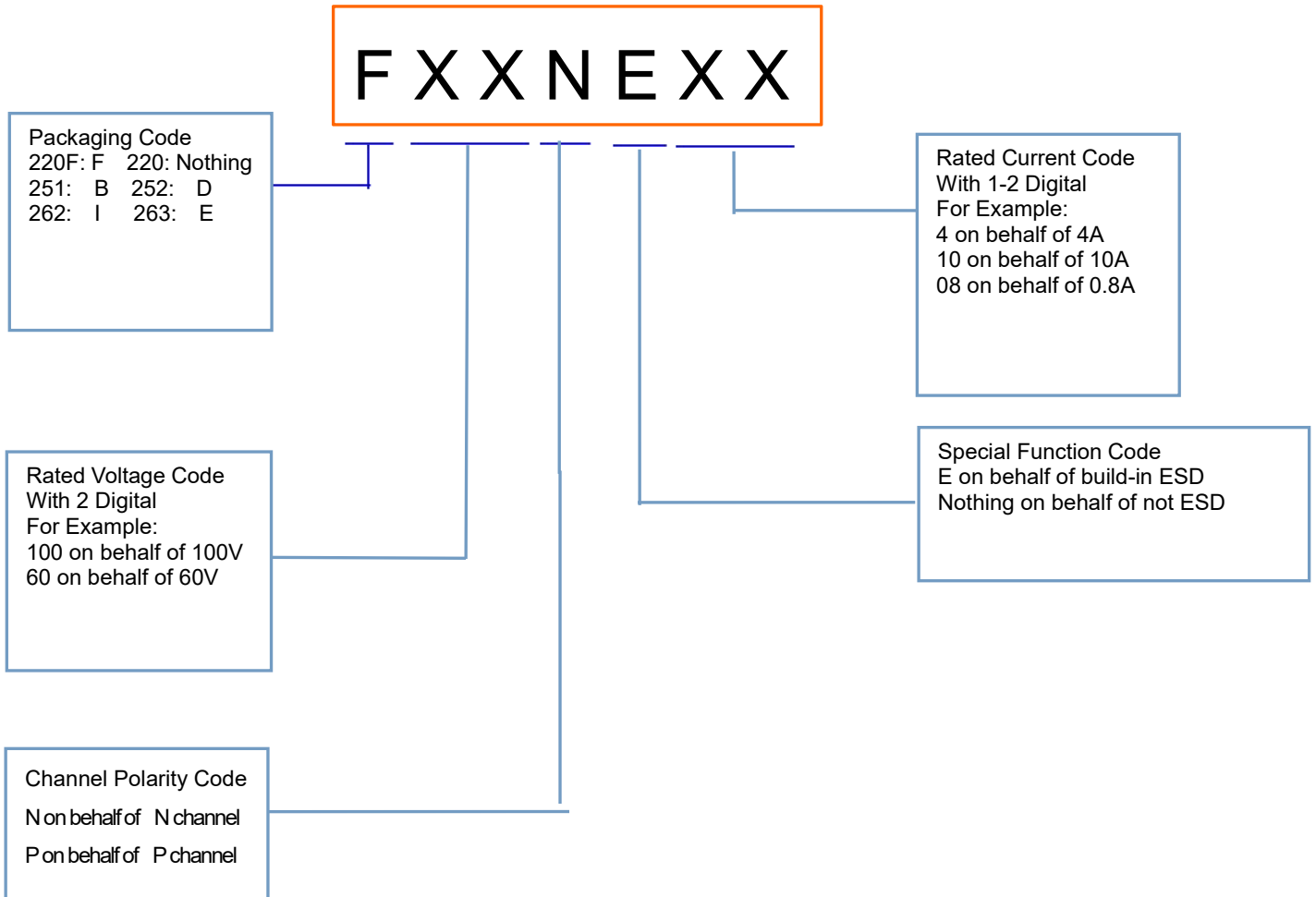


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

## 7 Product Names Rules

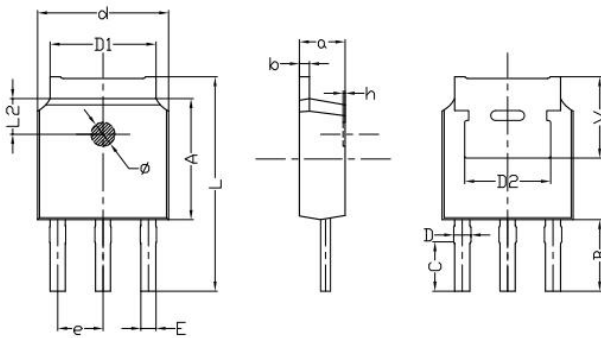


## 8 Product Specifications and Packaging Models

Product Model	Package Type	Mark Name	RoHS	Package	Quantity
DH9Z24	TO-220C	DH9Z24	Pb-free	Tube	1000/box
DHF9Z24	TO-220F	DHF9Z24	Pb-free	Tube	1000/box
DHB9Z24	TO-251	DHB9Z24	Pb-free	Tube	3000/box
DHD9Z24	TO-252	DHD9Z24	Pb-free	Tape & Reel	2500/box
DHI9Z24	TO-262	DHI9Z24	Pb-free	Tube	1000/box
DHE9Z24	TO-263	DHE9Z24	Pb-free	Tape & Reel	800/box

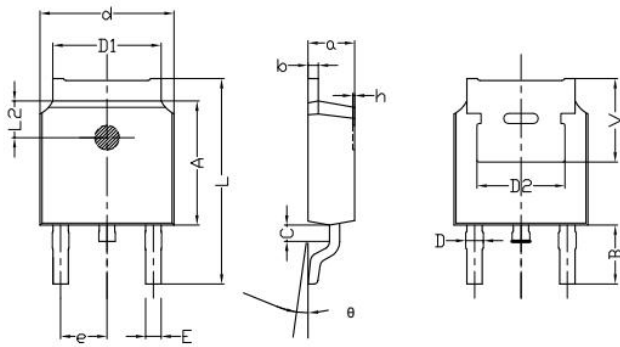
**9 Dimensions**

TO-251B PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
a	2.20	2.40	0.087	0.0946
b	0.46	0.58	0.018	0.023
C	2.45	2.65	0.097	0.104
D	0.80	0.90	0.032	0.035
d	6.30	6.70	0.248	0.264
D1	5.00	5.50	0.197	0.217
D2	TYP 4.83		TYP 0.190	
A	5.80	6.20	0.228	0.244
e	2.19	2.39	0.086	0.094
L	10.40	11.00	0.4098	0.4334
B	3.50	3.70	0.1379	0.1458
L2	1.5	1.8	0.059	0.071
Φ	1.10	1.30	0.0433	0.0512
h	0.00	0.30	0.000	0.012
V	5.25	5.85	0.207	0.230
E	0.60	0.80	0.0236	0.0315

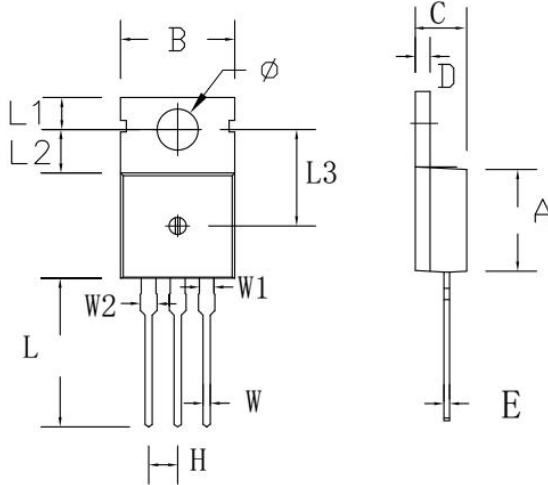
TO-252B PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
a	2.20	2.40	0.087	0.095
b	0.46	0.58	0.018	0.023
c	0.70	0.90	0.028	0.035
D	0.80	1.00	0.032	0.039
d	6.30	6.70	0.248	0.264
D1	5.00	5.50	0.197	0.217
D2	TYP 4.83		TYP 0.190	
A	5.80	6.20	0.228	0.244
e	2.19	2.39	0.086	0.094
L	9.40	10.40	0.370	0.409
B	2.6	3.2	0.102	0.126
L2	1.5	1.8	0.059	0.071
θ	0	8	0	8
h	0	0.3	0	0.012
V	5.25	5.85	0.207	0.230
E	0.6	0.8	0.024	0.032

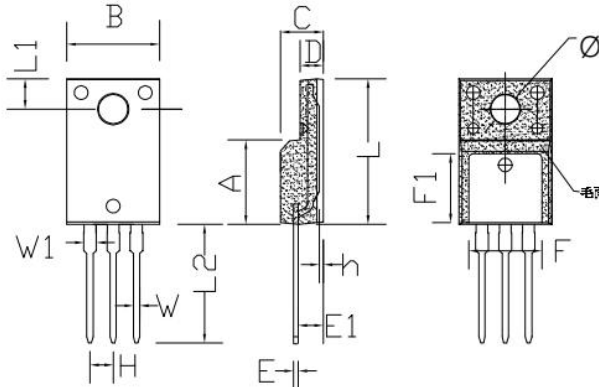
**9 Dimensions(continues)**

TO-220C PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	9.70	10.30	0.382	0.406
C	4.25	4.75	0.167	0.187
D	1.20	1.45	0.047	0.057
E	0.40	0.60	0.016	0.024
H	2.54 TYP		0.100 TYP	
W	0.60	0.95	0.024	0.037
W1	1.05	1.45	0.041	0.057
W2	1.20	1.60	0.047	0.063
L	12.60	13.40	0.496	0.528
L1	2.45	2.95	0.096	0.116
L2	3.45	3.95	0.136	0.156
L3	8.15	8.65	0.321	0.341
Φ	3.50	3.90	0.138	0.154

TO-220F PACKAGE OUTLINE DIMENSIONS

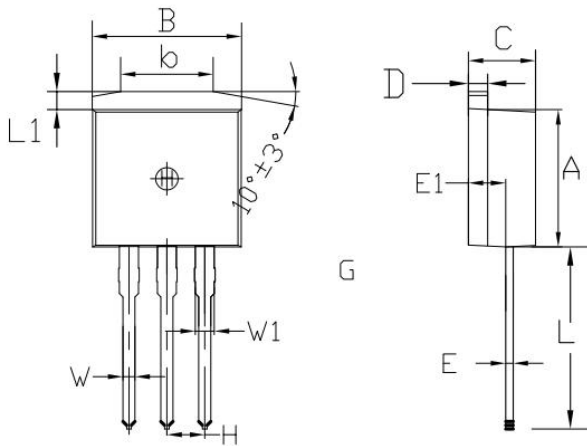


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	10.00	10.50	0.394	0.413
C	4.30	4.90	0.169	0.193
D	2.30	2.70	0.091	0.106
L	15.55	16.15	0.612	0.636
h	0.40	0.60	0.016	0.024
L1	3.15	3.55	0.124	0.140
L2	12.65	13.35	0.498	0.526
W	0.70	0.90	0.028	0.035
W1	1.15	1.55	0.045	0.061
H	2.54 TYP		0.100 TYP	
E	0.48	0.53	0.019	0.021
Φ	2.90	3.40	0.114	0.134
E1	2.40	2.90	0.094	0.114
F	7.75	8.25	0.305	0.325
F1	7.35	7.85	0.289	0.309



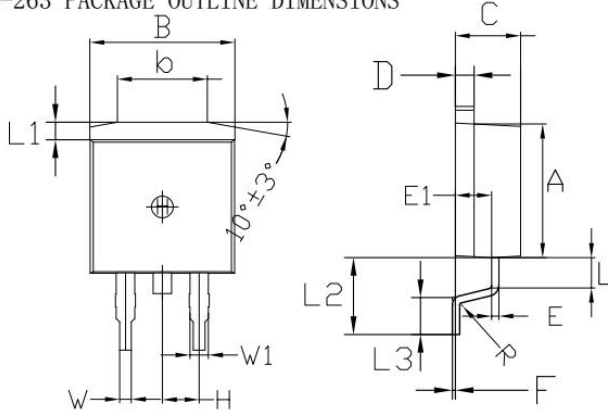
**9 Dimensions(continues)**

TO-262 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	9.70	10.30	0.382	0.406
C	4.25	4.75	0.167	0.187
D	1.20	1.45	0.047	0.057
E	0.40	0.60	0.016	0.024
L	12.25	13.75	0.482	0.541
L1	1.15	1.45	0.045	0.057
E1	2.4	2.6	0.0945	0.1024
W	0.80	0.82	0.0315	0.034
W1	1.20	1.30	0.047	0.051
H	2.54 TYP		0.200 TYP	
b	5.50	6.50	0.216	0.256

TO-263 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	min.	max.	min.	max.
A	8.80	9.30	0.346	0.366
B	9.70	10.30	0.382	0.406
C	4.25	4.75	0.167	0.187
D	1.20	1.45	0.047	0.057
E	0.40	0.60	0.016	0.024
L	1.90	2.30	0.075	0.091
L1	1.15	1.45	0.045	0.057
R	0.24	0.26	0.0095	0.0102
W	0.80	0.82	0.0315	0.0323
W1	1.20	1.30	0.047	0.051
H	2.54 TYP		0.200 TYP	
b	5.50	6.50	0.216	0.256
E1	2.4	2.6	0.0946	0.1024
L2	5.20	5.80	0.205	0.228
L3	2.20	3.20	0.087	0.126
F	0.03	0.23	0.0012	0.0091

## 10 Attentions

- Jiangsu Donghai Semiconductor Technology CO.,LTD. reserves the right to change the specification without prior notice! The customer should obtain the latest version of the information before making the order and verify that the information is complete and up to date.
- It is the responsibility of the purchaser for any failure or failure of any semiconductor product under certain conditions. It is the responsibility of the purchaser to comply with safety standards and to take safety measures in the system design and machine manufacturing of Donghai products in order to avoid potential risk of failure. Injury or property damage.
- Product promotion is endless, our company will be dedicated to provide customers with better products.

## 11 Appendix

Revision history:

Date	REV.	Description	Page
2021.09.25	1.0	Original	