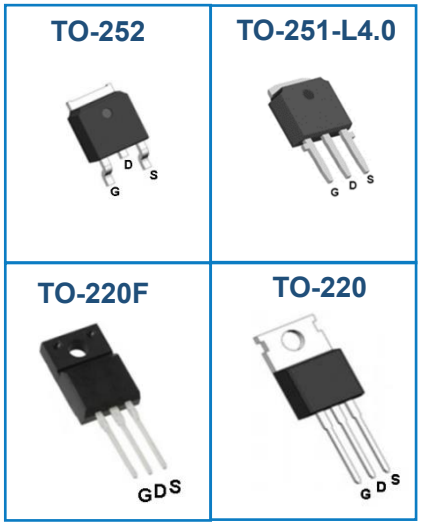
WMK4N60DM1 WML4N60DM1 WMD4N60DM1 WMAH4N60DM1

N-CHANNEL Power Mosfet

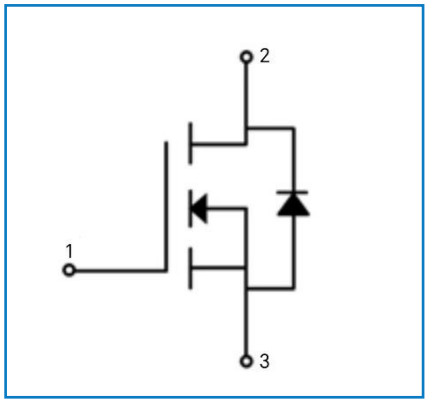
Description

WMOS D is Wayon's 1st generation VDMOS family that is dramatic reduction in on-resistance and ultra-low gate charge for applications requiring high power density and high efficiency. And it is very robust and RoHS compliant.



Features

- V_{DSS}=600V, I_D=4A
- Typ.$R_{DS(on)}$=2.1Ω@V_{GS}=10V
- 100% avalanche tested
- RoHS Compliant
- Halogen Free



Applications

- SMPS
- Charger
- DC-DC

Package pin definition	1	2	3	-
	Gate	Drain	Source	-

Part	Package	Marking	Packing method	MPQ
WMK4N60DM1	TO-220	K4N60DM1	Tube	50/Tube
WML4N60DM1	TO-220F	L4N60DM1	Tube	50/Tube
WMD4N60DM1	TO-252	D4N60DM1	Tape and reel	2.5K/Reel
WMAH4N60DM1	TO-251-L4.0	AH4N60DM1	Tube	80/Tube

Absolute Maximum Ratings

Table 1 Maximum rated Values(T_C=25℃ unless otherwise specified)

Parameter	Symbol	WML	WMK	WMD/WMAH	Unit
Drain-source voltage	V_{DSS}	600			V
Gate-source voltage	V_{GS}	±30			V
Continuous drain current	$I_{D(TC=25℃)}$	4			A
	$I_{D(TC=100℃)}$	2.6			A
Pulsed drain current [1]	I_{DM}	16			A
Continuous diode forward current	I_S	4			A
Diode pulse current [1]	I_{Spulse}	16			A
Avalanche energy, single pulse [2]	E_{AS}	90			mJ
Power dissipation	P_D	36	100	54	W
Derate above 25°C		0.3	0.8	0.4	W/℃
Operating junction temperature	T_J	-55~150			℃
Storage temperature	T_{stg}	-55~150			℃
Thermal resistance,junction-to-case	$R_{th(J-C)}$	3.47	1.25	2.3	℃/W
Thermal resistance,junction-to-ambient	$R_{th(J-A)}$	62.5		160	℃/W

Notes:

1. Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)}$ =150°C.
2. The E_{AS} data shows Max. rating . The test condition is V_{DD} =50V, V_{GS} =10V, L=10mH, I_{AS} =4A,Tc=25℃.

Electrical Characteristics of MOSFET

Parameter	Symbol	Test Condition		Min.	Typ.	Max.	Unit
Drain-source break down voltage	BV_{DSS}	I_D=250uA，V_{GS}=0V	T_C=25℃	600	-	-	V
Gate threshold voltage	$V_{GS(th)}$	I_D=250uA，V_{DS}=V_{GS}	T_J=25℃	2.0	-	4.0	V
Drain-source leakage current	I_{DSS}	V_{DS}=600V，V_{GS}=0V	T_J=25℃	-	-	1	μA
		V_{DS}=480V，V_{GS}=0V	T_J=125℃	-	-	10	μA
Gate-source leakage current,forward	I_{GSSF}	V_{DS}=0V，V_{GS}=30V	T_J=25℃	-	-	100	nA
Gate-source leakage current,reverse	I_{GSSR}	V_{DS}=0V，V_{GS}=-30V	T_J=25℃	-	-	-100	nA
Drain-source on-state resistance [3]	$R_{DS(ON)}$	V_{GS}=10V，I_D=2A	T_J=25℃	-	2.1	2.7	Ω

Dynamic Characteristics of MOSFET（T_C=25℃）

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{iss}	f=1MHz	-	585	-	pF
Output capacitance	C_{oss}	V_{DS}=150V	-	21	-	pF
Reverse transfer capacitance	C_{rss}	V_{GS}=0V	-	1.7	-	pF
Gate to source charge	Q_{gs}	V_{DD}=300V	-	4.6	-	nC
Gate to drain charge	Q_{gd}	I_D=4A	-	1.6	-	nC
Total gate charge	Q_g	V_{GS}= 0 to 10V	-	10.2	-	nC

Switching Characteristics of MOSFET（T_C=25℃）

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Turn-on delay time	$t_{d\ on}$	V_{DS}=300V，I_D=4A R_G=25Ω，V_{GS}=0 to 10V	-	8.4	-	ns
Rise time	t_r		-	11.2	-	ns
Turn-off delay time	$t_{d\ off}$		-	22	-	ns
Fall time	t_f		-	16	-	ns

Characteristics of Body Diode（T_C=25℃）

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Forward voltage	V_{SD}	I_{SD}=4A，V_{GS}=0V	-	-	1.4	V
Reverse recovery time	t_{rr}	V_{DS}=50V，I_S=4A	-	178	-	ns
Reverse recovery current	I_{rr}	V_{GS}=10V	-	10.3	-	A
Recovery charge	Q_{rr}	di/dt=100A/μs	-	0.92	-	μC

Notes:

3. The data tested by pulsed , pulse width ≤ 300μs , duty cycle ≤ 2%.

Typical Characteristics

Figure 1.On-Region Characteristics

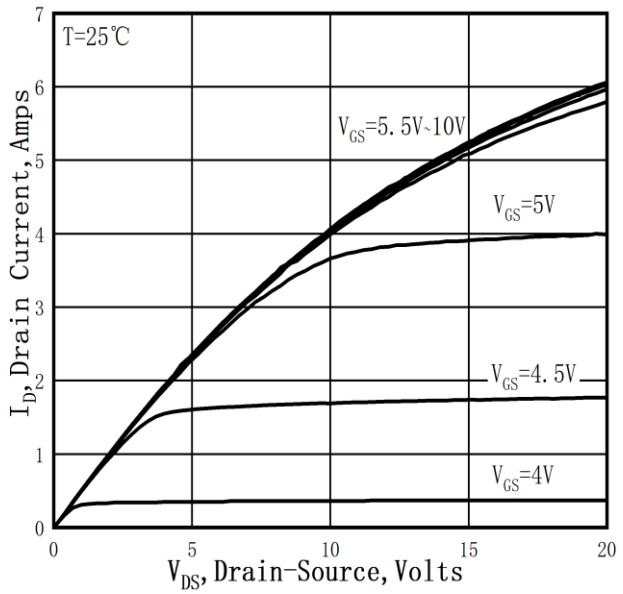


Figure 2. Transfer Characteristics

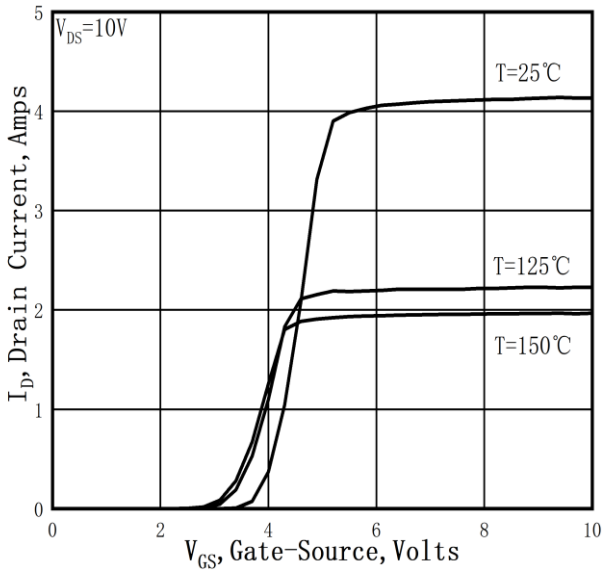


Figure 3.Static Drain-Source On Resistance

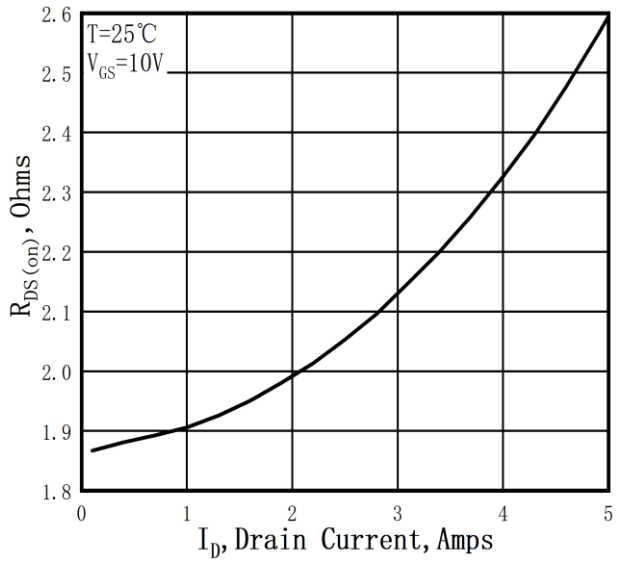


Figure 4. Typical Body Diode Transfer Characteristics

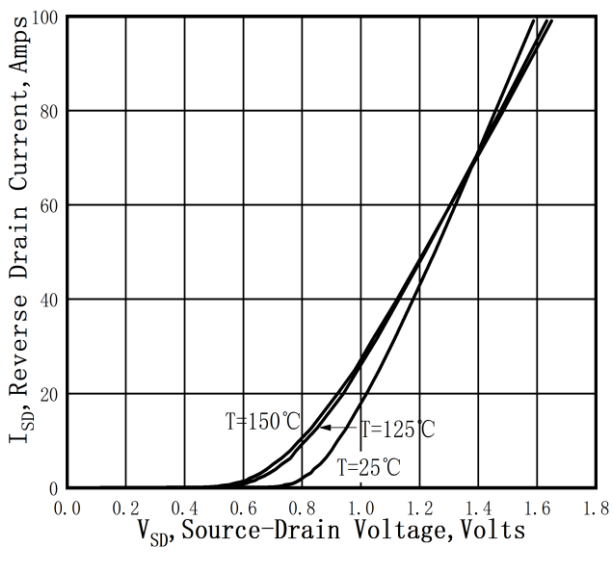


Figure 5. Normalized $R_{DS(on)}$ vs.Temperature

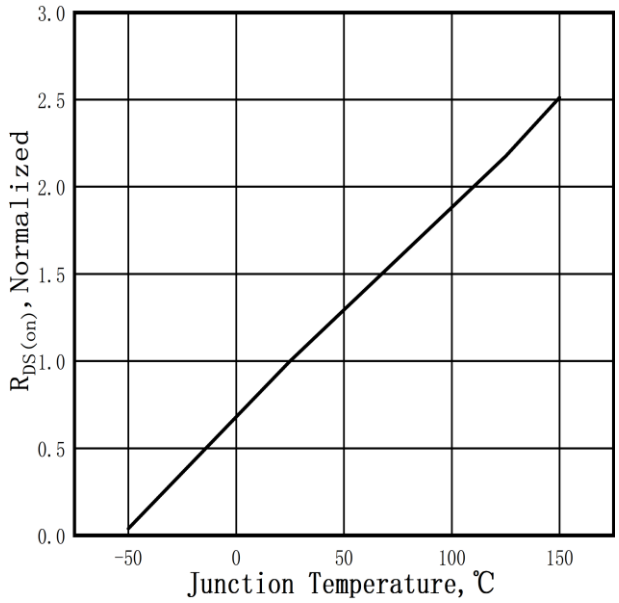


Figure 6. Normalized BV_{DSS} vs.Temperature

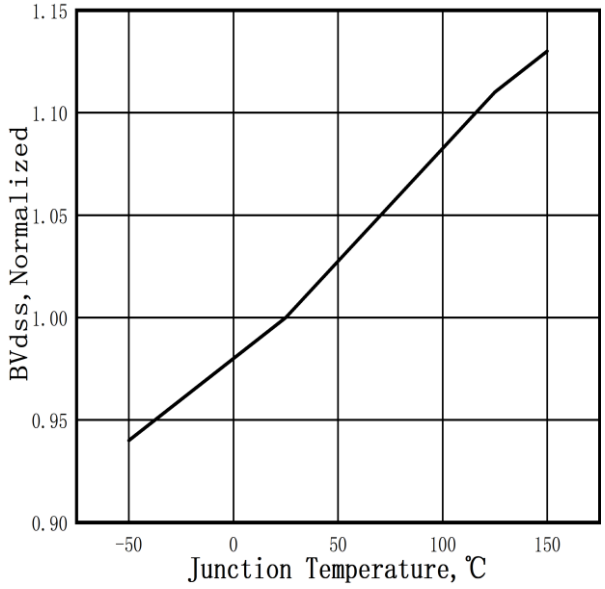


Figure 7. Capacitance Characteristics

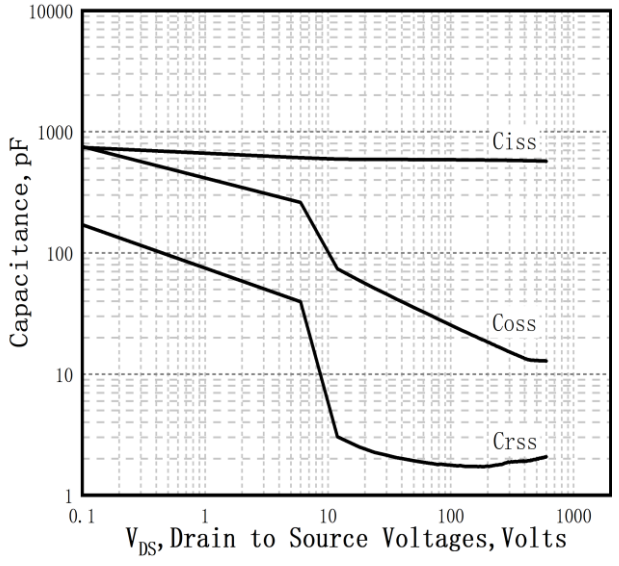


Figure 8. Gate Charge Characteristics

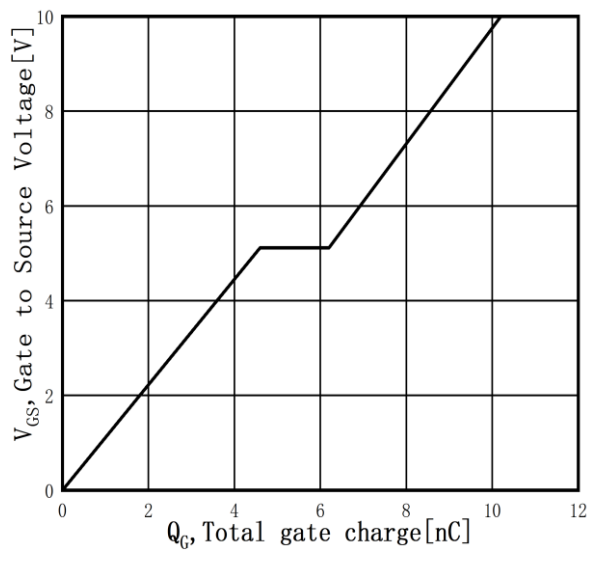


Figure 9. Maximum Safe Operating Area (TO-220)

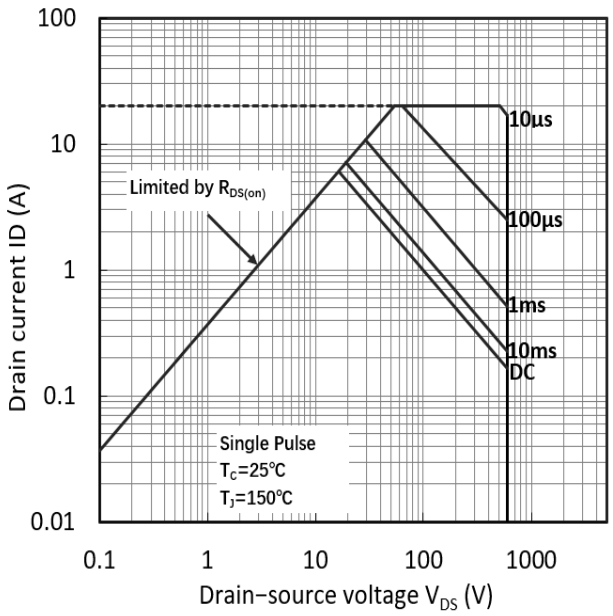


Figure 10. Transient Thermal Response Curve (TO-220)

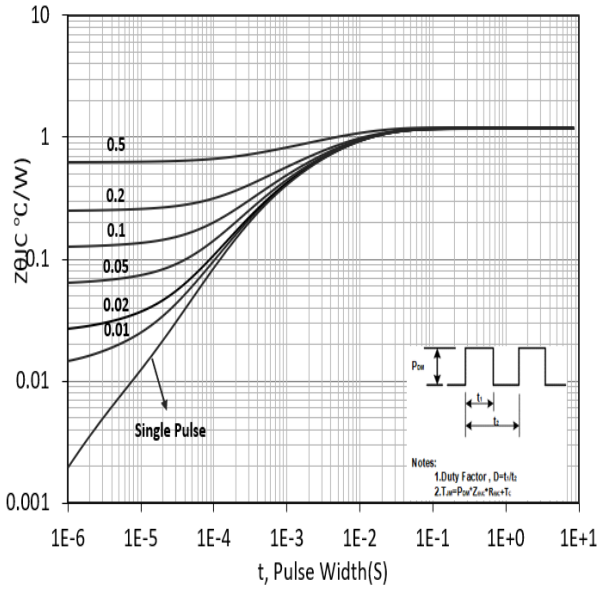


Figure 9. Maximum Safe Operating Area （TO-220F）

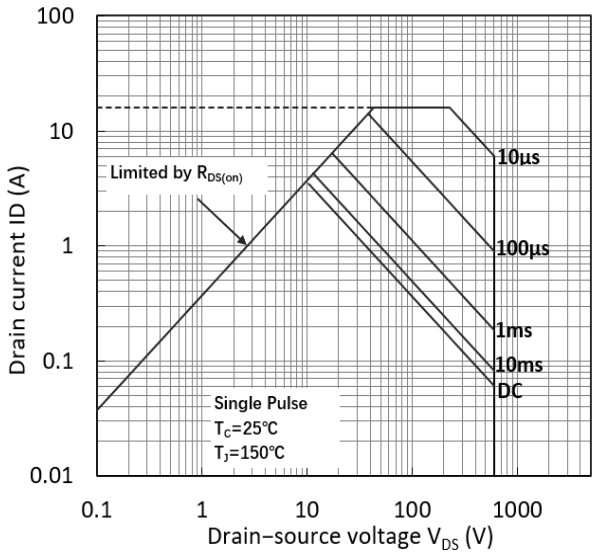


Figure 10. Transient Thermal Response Curve (TO-220F)

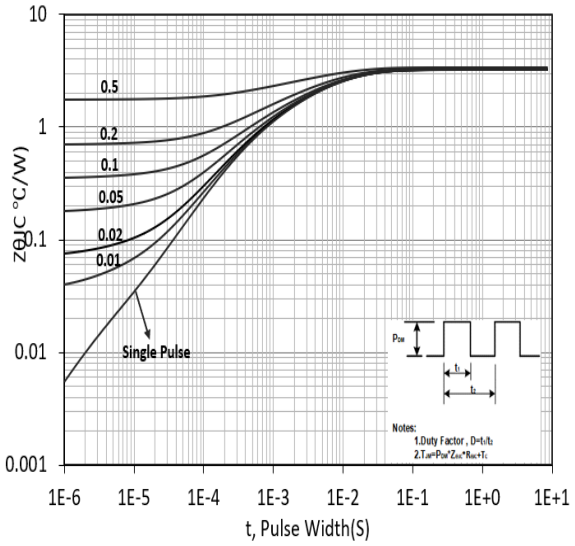


Figure 13. Maximum Safe Operating Area (TO-252/TO-251-L4.0)

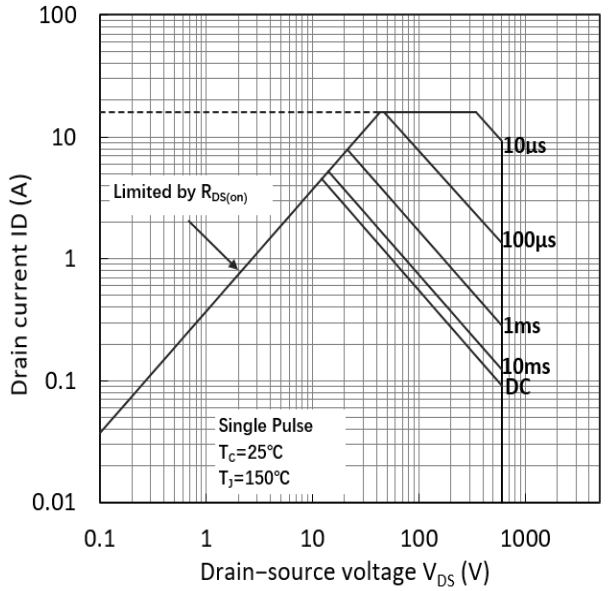
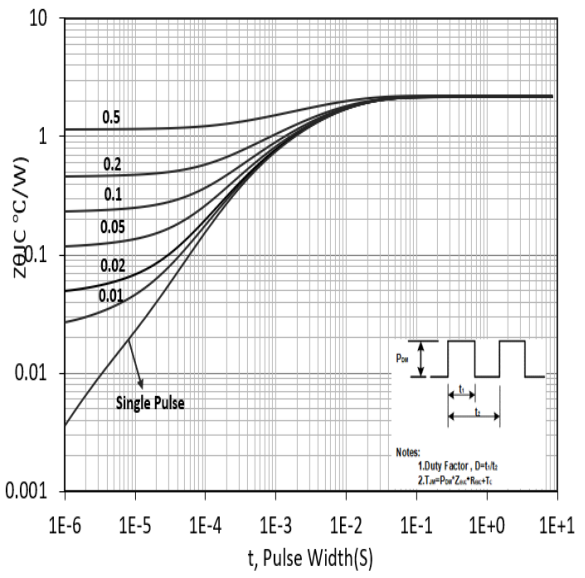
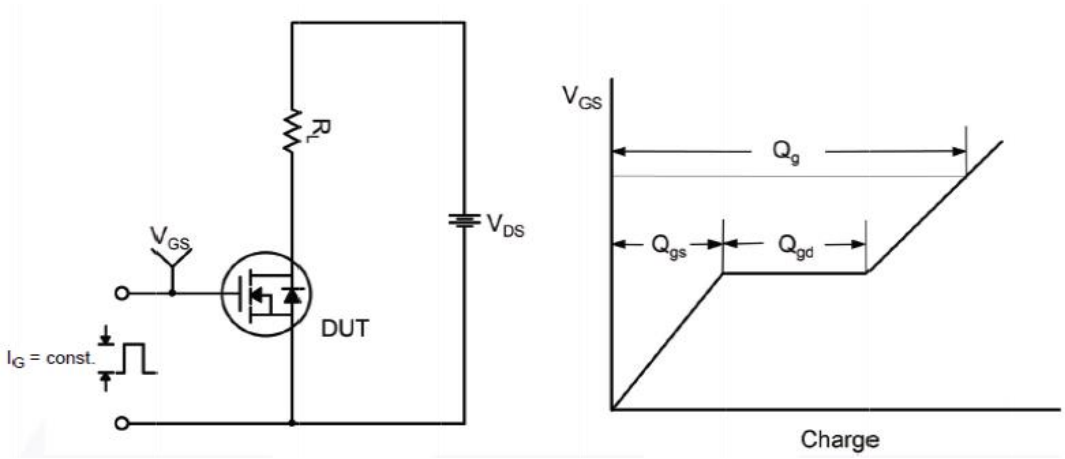


Figure 14. Transient Thermal Response Curve (TO-252/TO-251-L4.0)

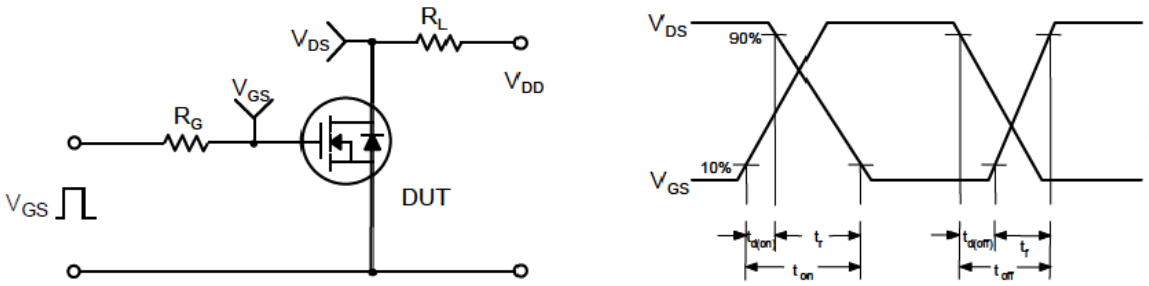


Test Circuit

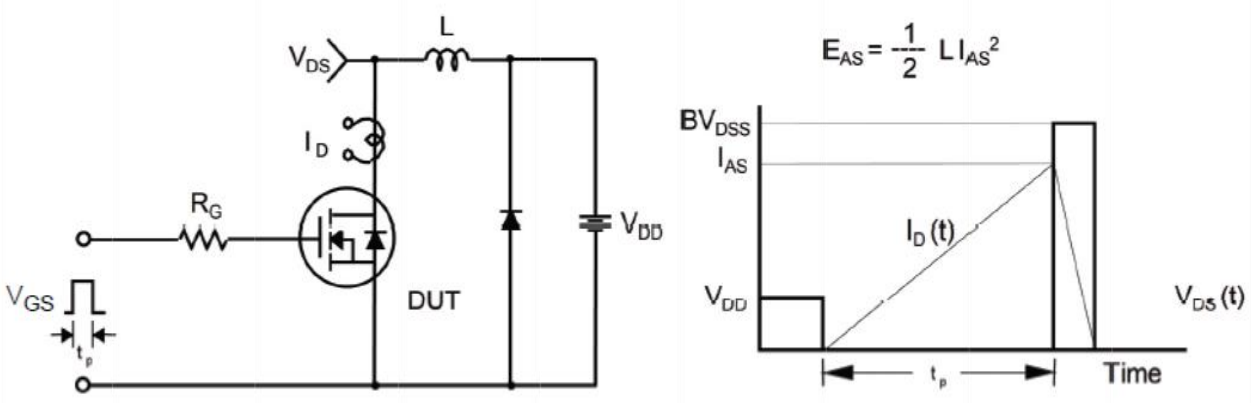
Gate Charge Test Circuit &Waveform



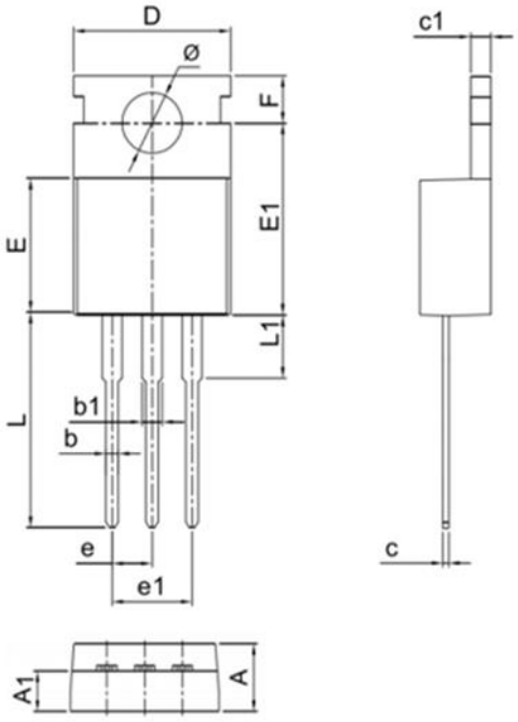
Switching Test Circuit &Waveforms



Unclamped Inductive Switching Test Circuit &Waveforms



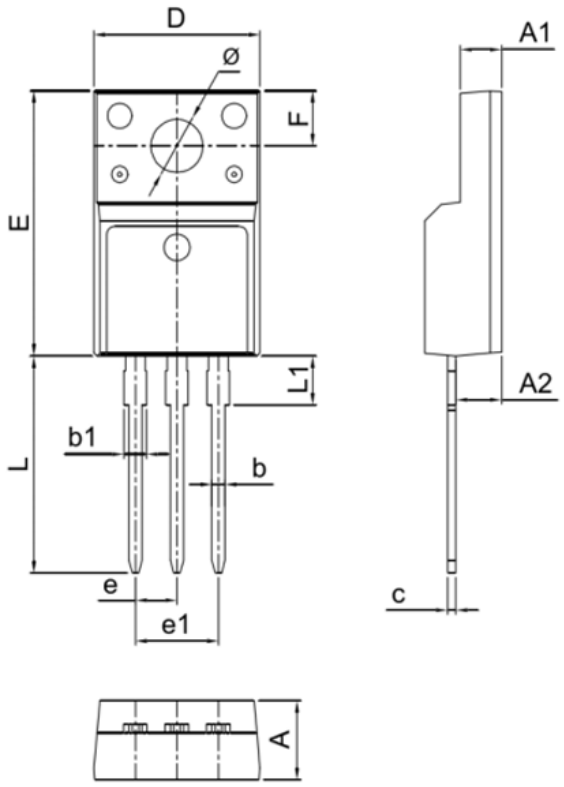
Mechanical Dimensions for TO-220



COMMON DIMENSIONS

SYMBOL	MM	
	MIN	MAX
A	4.30	4.80
A1	2.20	2.90
b	0.60	1.00
b1	1.10	1.50
c	0.30	0.70
c1	1.10	1.50
D	9.70	10.30
E	8.50	9.40
E1	12.00	12.50
e	2.40	2.70
e1	4.80	5.30
F	2.60	3.00
L	13.00	14.00
L1	2.60	4.20
Φ	3.40	4.00

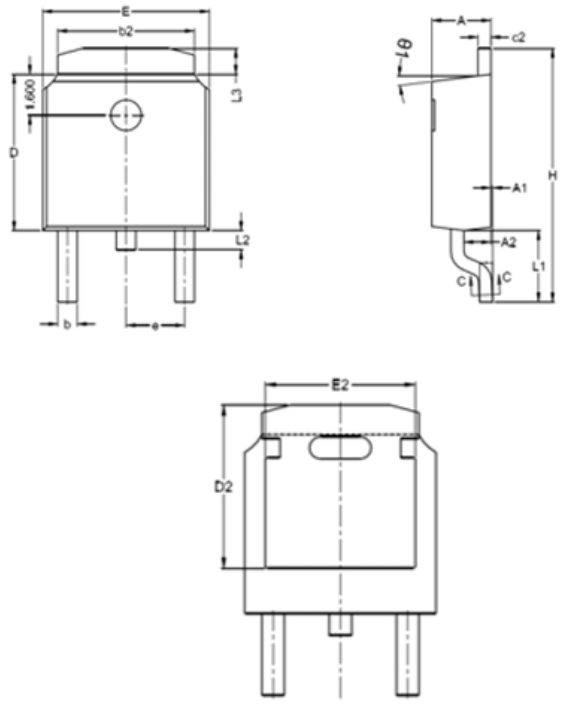
Mechanical Dimensions for TO-220F



COMMON DIMENSIONS

SYMBOL	MM	
	MIN	MAX
A	4.5	5
A1	2.3	2.8
A2	2.5	3.1
b	0.6	1
b1	1.1	1.6
c	0.4	0.65
D	9.9	10.4
E	15.4	16.2
e	2.4	2.7
e1	4.8	5.3
F	2.9	3.6
L	12.6	13.5
L1	2.8	3.8
Φ	3.0	3.4

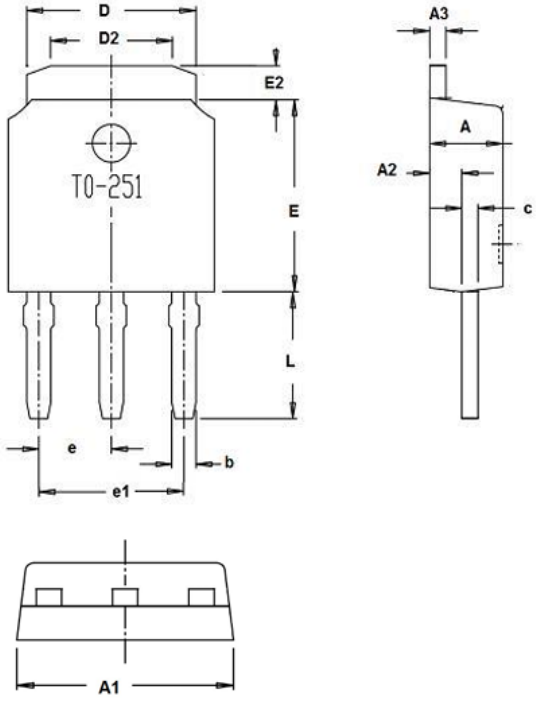
Mechanical Dimensions for TO-252



COMMON DIMENSIONS

SYMBOL	MM	
	MIN	MAX
A	2.10	2.50
A1	-	0.15
b	0.60	1.00
b2	5.10	5.60
c	0.40	0.70
c2	0.40	0.70
D	5.80	6.30
D2	5.30	5.80
E	6.30	6.90
E2	4.90	5.30
e	2.286 BSC	
H	9.70	10.50
L1	2.50	3.20
L2	0.60	1.30
L3	0.80	1.50

Mechanical Dimensions for TO-251-L4.0



COMMON DIMENSIONS

SYMBOL	MM	
	MIN	MAX
A	2.10	2.50
A1	6.30	6.90
A2	0.90	1.20
A3	Typ0.5	
b	0.6	0.95
c	0.4	0.65
D	5.10	5.55
D2	3.65	4.05
E	5.90	6.25
E2	0.80	1.40
e	Typ2.29	
e1	Typ4.58	
L	3.7	4.3

Contact Information

No.1001, Shiwan(7) Road, Pudong District, Shanghai, P.R.China.201207
Tel: 86-21-50310888 Fax: 86-21-50757680 Email: market@way-on.com
WAYON website: http://www.way-on.com
For additional information, please contact your local Sales Representative.
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Product Specification Statement

1.The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

2.The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.

3.WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.

4.Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

5.The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.

6.Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. WAYON shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.