60V N-CHANNEL ENHANCEMENT MODE MOSFET

Product Summary

BV_{DSS}	Max $R_{DS(on)}$	Max I_D T_A = 25°C (Note 3)
60V	40mΩ @ V_{GS} = 10V	7.7A
	60mΩ @ V_{GS} = 4.5V	6.3A

Features and Benefits

- Low on-resistance
- Fast switching speed
- Low gate drive
- **Lead-Free Finish; RoHS compliant (Note 1)**
- **Halogen and Antimony Free. "Green" Device (Note 2)**
- **Qualified to AEC-Q101 Standards for High Reliability**

Description and Applications

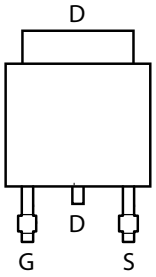
This MOSFET has been designed to minimize the on-state resistance ($R_{DS(on)}$) and yet maintain superior switching performance, making it ideal for high efficiency power management applications.

- DC-DC converters
- Power management functions
- Disconnect switches
- Motor control

Mechanical Data

- Case: TO252
- Case Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0 (Note 1)
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Matte Tin Finish. Solderable per MIL-STD-202, Method 208
- Weight: 0.33 grams (approximate)

TO252



Top View | Pin Out -Top View | Equivalent Circuit

Ordering Information (Note 1 & 2)

Product	Marking	Reel size (inches)	Tape width (mm)	Quantity per reel
ZXMN6A09KTC	ZXMN6A09	13	16	2,500

Notes: 1. EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant. All applicable RoHS exemptions applied.
2. Halogen and Antimony free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Marking Information

ZXMN6A09 = Product Type Marking Code
YYWW = Date Code Marking
YY = Year (ex: 10 = 2010)
WW = Week (01 - 53)

Maximum Ratings @T_A = 25°C unless otherwise specified

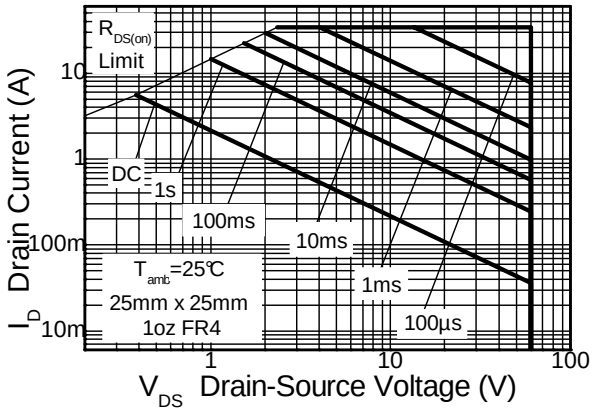
Characteristic			Symbol	Value	Unit
Drain-Source voltage			V_{DSS}	60	V
Gate-Source voltage			V_{GS}	±20	V
Continuous Drain current	V_{GS} = 10V	(Note 4)	I_D	11.8	A
		T_A = 70°C (Note 4)		9.6	
		(Note 3)		7.7	
Pulsed Drain current		(Note 5)	I_{DM}	43	A
Continuous Source current (Body diode)		(Note 4)	I_S	10.8	A
Pulsed Source current (Body diode)		(Note 5)	I_{SM}	43	A

Thermal Characteristics @T_A = 25°C unless otherwise specified

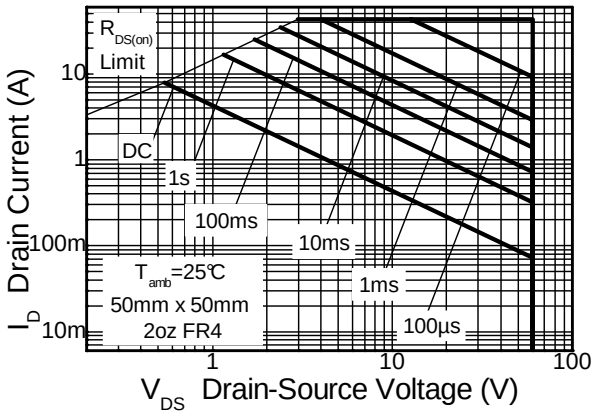
Characteristic		Symbol	Value	Unit
Power dissipation Linear derating factor	(Note 3)	P_D	4.3 34.4	W mW/°C
	(Note 4)		10.1 80.8	
	(Note 6)		2.15 17.2	
Thermal Resistance, Junction to Ambient	(Note 3)	$R_{\theta JA}$	29	°C/W
	(Note 4)		12.3	
	(Note 6)		58.1	
Thermal Resistance, Junction to Lead	(Note 7)	$R_{\theta JL}$	1.04	
Operating and storage temperature range		T_J, T_{STG}	-55 to 150	°C

Notes:
3. For a device surface mounted on 50mm x 50mm x 1.6mm FR4 PCB with high coverage of single sided 2oz copper, in still air conditions; the device is measured when operating in a steady-state condition.
4. For a device surface mounted on FR4 PCB measured at t ≤ 10 sec.
5. Repetitive rating 50mm x 50mm x 1.6mm FR4 PCB, D = 0.02 and pulse width 300 µs. The pulse current is limited by the maximum junction temperature.
6. For a device surface mounted on 25mm x 25mm x 1.6mm FR4 PCB with high coverage of single sided 1oz copper, in still air conditions; the device is measured when operating in a steady-state condition.
7. Thermal resistance from junction to solder-point (at the end of the drain lead).

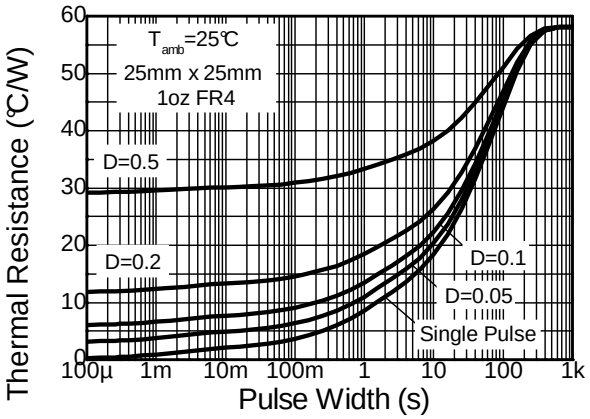
Thermal Characteristics



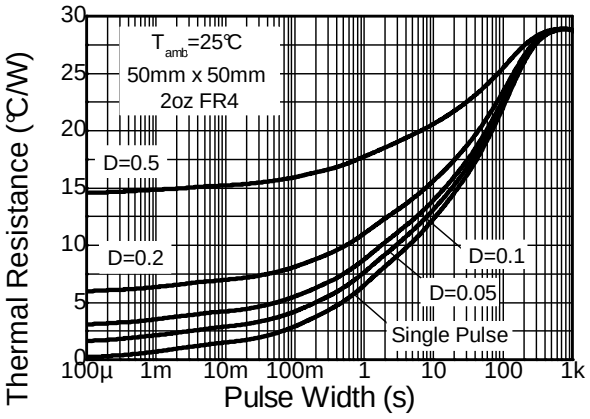
Safe Operating Area



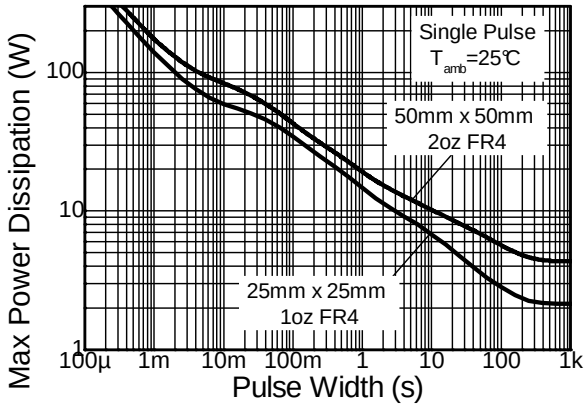
Safe Operating Area



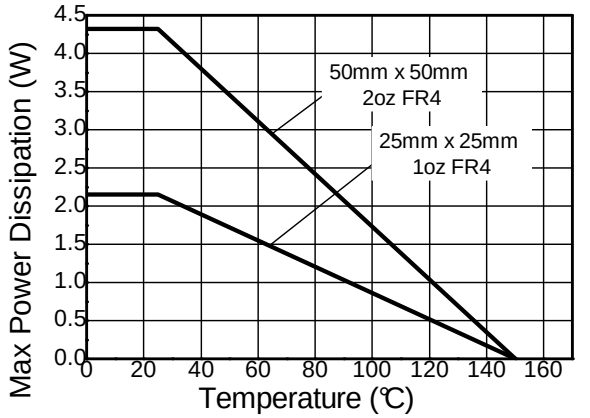
Transient Thermal Impedance



Transient Thermal Impedance



Pulse Power Dissipation



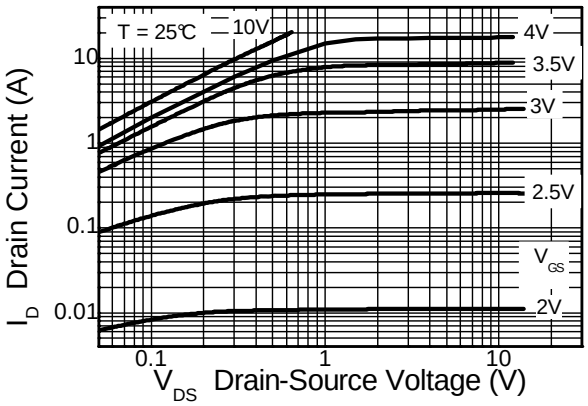
Derating Curve

Electrical Characteristics @T_A = 25°C unless otherwise specified

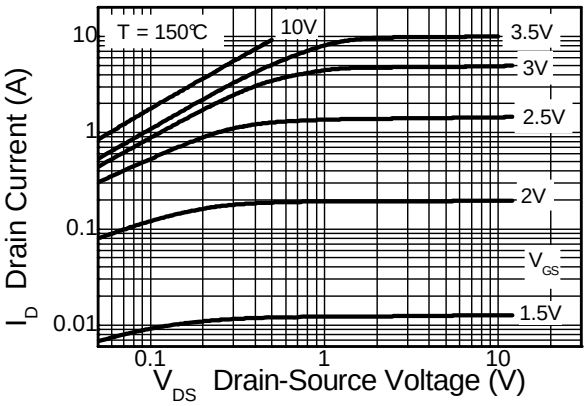
Characteristic	Symbol	Min	Typ	Max	Unit	Test Condition
OFF CHARACTERISTICS						
Drain-Source Breakdown Voltage	BV_{DSS}	60	—	—	V	I_D = 250μA, V_{GS} = 0V
Zero Gate Voltage Drain Current	I_{DSS}	—	—	1	μA	V_{DS} = 60V, V_{GS} = 0V
Gate-Source Leakage	I_{GSS}	—	—	±100	nA	V_{GS} = ±20V, V_{DS} = 0V
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(th)}$	1.0	—	3.0	V	I_D = 250μA, V_{DS} = V_{GS}
Static Drain-Source On-Resistance (Note 8)	$R_{DS\ (ON)}$	—	—	40	mΩ	V_{GS} = 10V, I_D = 7.3A
				60		V_{GS} = 4.5V, I_D = 5.6A
Forward Transconductance (Notes 8 & 9)	g_{fs}	—	15	—	S	V_{DS} = 15V, I_D = 7.3A
Diode Forward Voltage (Note 8)	V_{SD}	—	0.85	0.95	V	I_S = 6.6A, V_{GS} = 0V, T_J = 25°C
Reverse recovery time (Note 9)	t_{rr}		25.6	—	ns	I_S = 3A, di/dt = 100A/μs
Reverse recovery charge (Note 9)	Q_{rr}	—	26.0	—	nC	T_J = 25°C
DYNAMIC CHARACTERISTICS (Note 9)						
Input Capacitance	C_{iss}	—	1426	—	pF	V_{DS} = 30V, V_{GS} = 0V f = 1MHz
Output Capacitance	C_{oss}	—	134	—	pF	
Reverse Transfer Capacitance	C_{rss}	—	64	—	pF	
Total Gate Charge (Note 10)	Q_g	—	15	—	nC	V_{GS} = 4.5V, V_{DS} = 30V, I_D = 5.6A
Total Gate Charge (Note 10)	Q_g	—	29	—	nC	V_{GS} = 10V, V_{DS} = 30V I_D = 7.3A
Gate-Source Charge (Note 10)	Q_{gs}	—	7.0	—	nC	
Gate-Drain Charge (Note 10)	Q_{gd}	—	4.7	—	nC	
Turn-On Delay Time (Note 10)	$t_{D(on)}$	—	4.8	—	ns	V_{DD} = 30V, V_{GS} = 10V I_D = 1A, $R_G \cong 6.0\Omega$
Turn-On Rise Time (Note 10)	t_r	—	4.6	—	ns	
Turn-Off Delay Time (Note 10)	$t_{D(off)}$	—	32.5	—	ns	
Turn-Off Fall Time (Note 10)	t_f	—	14.5	—	ns	

Notes: 8. Measured under pulsed conditions. Pulse width ≤ 300μs; duty cycle ≤ 2%
9. For design aid only, not subject to production testing.
10. Switching characteristics are independent of operating junction temperatures.

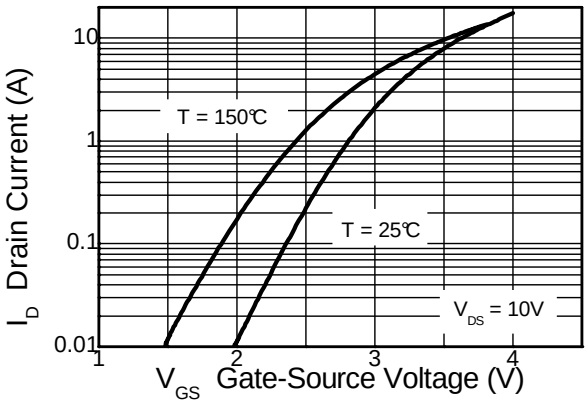
Typical Characteristics



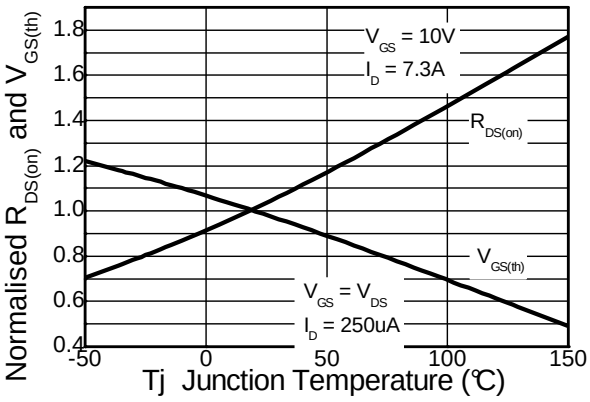
Output Characteristics



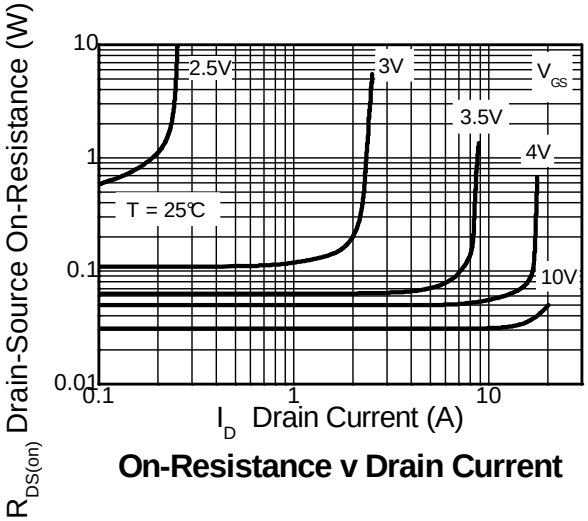
Output Characteristics



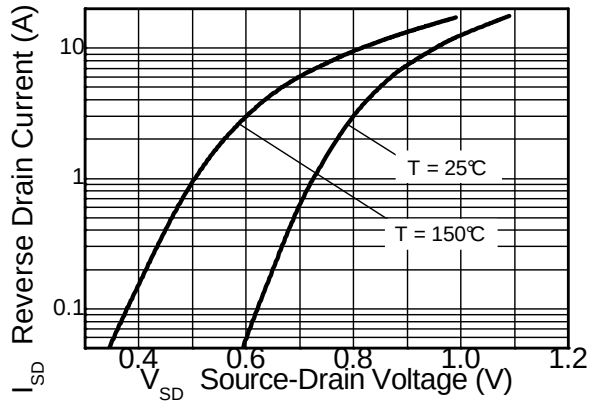
Typical Transfer Characteristics



Normalised Curves v Temperature

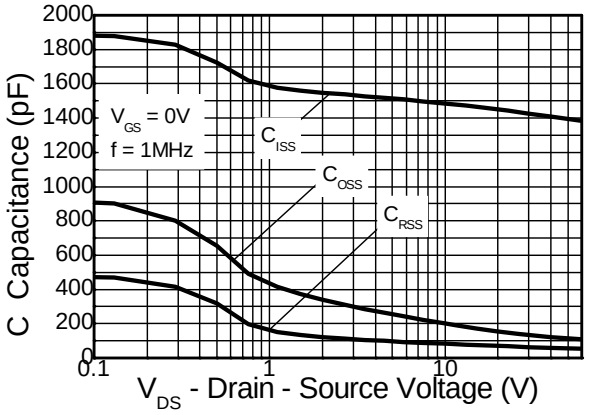


On-Resistance v Drain Current

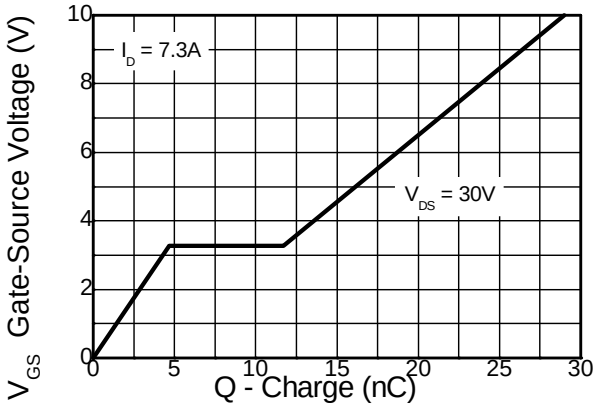


Source-Drain Diode Forward Voltage

Typical Characteristics - continued

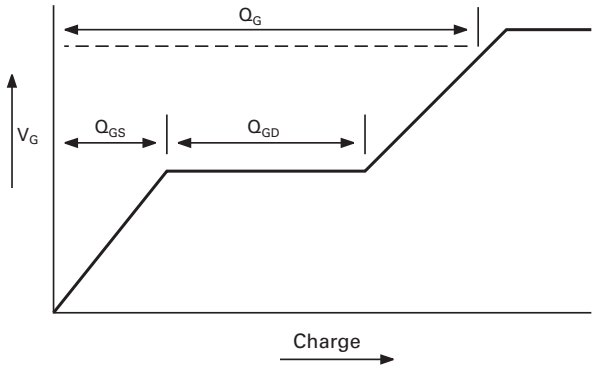


Capacitance v Drain-Source Voltage

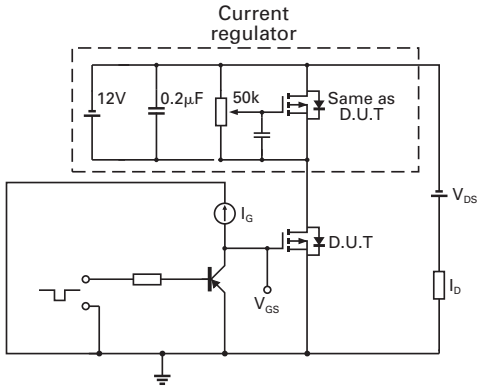


Gate-Source Voltage v Gate Charge

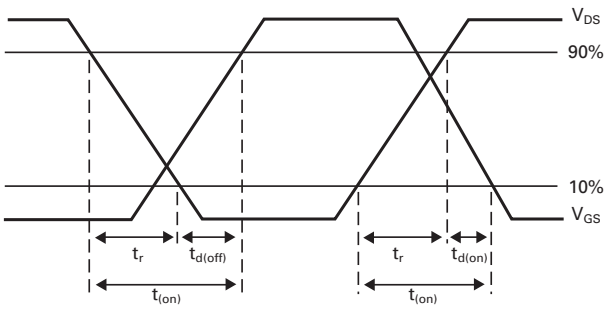
Test Circuits



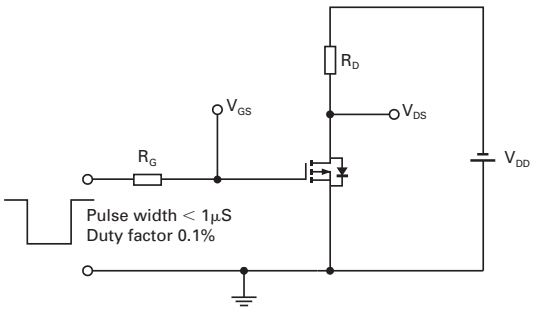
Basic gate charge waveform



Gate charge test circuit

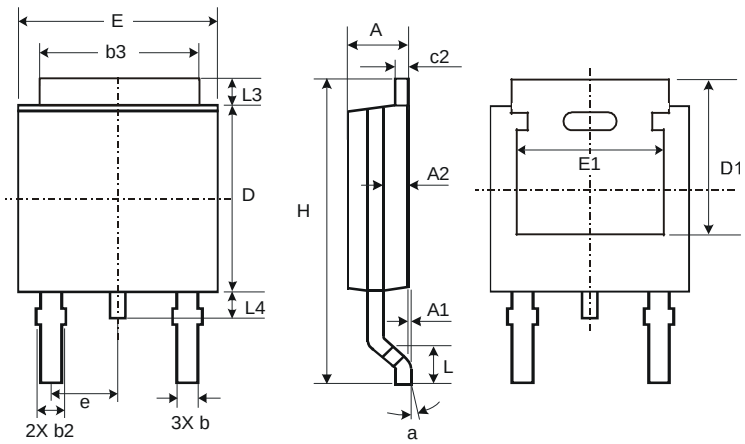


Switching time waveforms



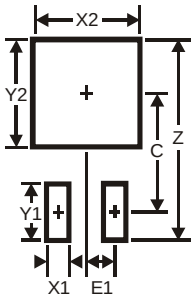
Switching time test circuit

Package Outline Dimensions



TO252			
Dim	**Min**	**Max**	**Typ**
A	2.19	2.39	2.29
A1	0.00	0.13	0.08
A2	0.97	1.17	1.07
b	0.64	0.88	0.783
b2	0.76	1.14	0.95
b3	5.21	5.46	5.33
c2	0.45	0.58	0.531
D	6.00	6.20	6.10
D1	5.21	–	–
e	–	–	2.286
E	6.45	6.70	6.58
E1	4.32	–	–
H	9.40	10.41	9.91
L	1.40	1.78	1.59
L3	0.88	1.27	1.08
L4	0.64	1.02	0.83
a	0°	10°	–
All Dimensions in mm			

Suggested Pad Layout



Dimensions	Value (in mm)
Z	11.6
X1	1.5
X2	7.0
Y1	2.5
Y2	7.0
C	6.9
E1	2.3

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