

## 2SK3416-MLT-TL-VB Datasheet

### N-Channel 60 V (D-S) MOSFET

#### PRODUCT SUMMARY

$V_{DS}$ (V)	$R_{DS(on)}$ ( $\Omega$ ) Max.	$I_D$ (A)	$Q_g$ (Typ.)
60	0.073 at $V_{GS} = 10$ V	18	19.8
	0.085 at $V_{GS} = 4.5$ V	15	

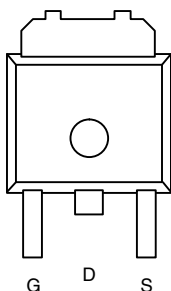
#### FEATURES

- Trench Power MOSFET
- 100 %  $R_g$  and UIS Tested
- Material categorization:  
For definitions of compliance please see



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

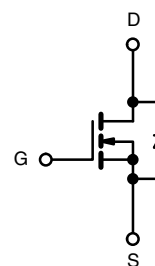
TO-252



Drain Connected to Tab

#### APPLICATIONS

- DC/DC Converters
- DC/AC Inverters
- Motor Drives



N-Channel MOSFET

#### ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	60	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	
Continuous Drain Current	$I_D$	18	A
		14	
Pulsed Drain Current ( $t = 300$ $\mu$ s)	$I_{DM}$	25	
Avalanche Current	$I_{AS}$	15	
Single Avalanche Energy <sup>a</sup>	$E_{AS}$	11.25	mJ
Maximum Power Dissipation <sup>a</sup>	$P_D$	41.7 <sup>b</sup>	W
		2.1	
Operating Junction and Storage Temperature Range	$T_J, T_{stg}$	- 55 to 150	°C

#### THERMAL RESISTANCE RATINGS

Parameter	Symbol	Limit	Unit
Junction-to-Ambient (PCB Mount) <sup>c</sup>	$R_{thJA}$	60	°C/W
Junction-to-Case (Drain)	$R_{thJC}$	3	

Notes:

- Duty cycle  $\leq 1$  %.
- See SOA curve for voltage derating.
- When mounted on 1" square PCB (FR-4 material).
- Base on  $T_C = 25$  °C.

SPECIFICATIONS (T <sub>J</sub> = 25 °C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V <sub>DS</sub>	V <sub>GS</sub> = 0 V, I <sub>D</sub> = 250 μA	60			V
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA	1.0		3.0	
Gate-Body Leakage	I <sub>GSS</sub>	V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ± 20 V			± 250	nA
Zero Gate Voltage Drain Current	I <sub>DSS</sub>	V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V			1	μA
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 125 °C			50	
		V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = 150 °C			250	
On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	V <sub>DS</sub> ≥ 10 V, V <sub>GS</sub> = 10 V	20			A
Drain-Source On-State Resistance <sup>a</sup>	R <sub>DS(on)</sub>	V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6.6 A		0.073		Ω
		V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 6 A		0.085		
Forward Transconductance <sup>a</sup>	g <sub>fs</sub>	V <sub>DS</sub> = 15 V, I <sub>D</sub> = 6.6 A		25		S
Dynamic <sup>b</sup>						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V, f = 1 MHz		660		pF
Output Capacitance	C <sub>oss</sub>			85		
Reverse Transfer Capacitance	C <sub>rss</sub>			40		
Total Gate Charge <sup>c</sup>	Q <sub>g</sub>	V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 10 V, I <sub>D</sub> = 6.6 A		19.8	30	nC
Gate-Source Charge <sup>c</sup>	Q <sub>gs</sub>			3.6		
Gate-Drain Charge <sup>c</sup>	Q <sub>gd</sub>			4.1		
Gate Resistance	R <sub>g</sub>	f = 1 MHz	0.4	2	4	Ω
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = 30 V, R <sub>L</sub> = 9.6 Ω I <sub>D</sub> ≅ 5.2 A, V <sub>GEN</sub> = 10 V, R <sub>g</sub> = 1 Ω		8	16	ns
Rise Time <sup>c</sup>	t <sub>r</sub>			11	20	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>			18	27	
Fall Time <sup>c</sup>	t <sub>f</sub>			5	10	
Turn-On Delay Time <sup>c</sup>	t <sub>d(on)</sub>	V <sub>DD</sub> = 30 V, R <sub>L</sub> = 9.6 Ω I <sub>D</sub> ≅ 5.2 A, V <sub>GEN</sub> = 4.5 V, R <sub>g</sub> = 1 Ω		38	57	
Rise Time <sup>c</sup>	t <sub>r</sub>			58	87	
Turn-Off Delay Time <sup>c</sup>	t <sub>d(off)</sub>			18	27	
Fall Time <sup>c</sup>	t <sub>f</sub>			8	16	
Drain-Source Body Diode Ratings and Characteristics <sup>b</sup> T <sub>C</sub> = 25 °C						
Continuous Current	I <sub>S</sub>				18	A
Pulsed Current	I <sub>SM</sub>				25	
Forward Voltage <sup>a</sup>	V <sub>SD</sub>	I <sub>F</sub> = 5.2 A, V <sub>GS</sub> = 0 V		0.8	1.5	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> = 5.2 A, dI/dt = 100 A/μs		34	51	ns
Peak Reverse Recovery Current	I <sub>RM(REC)</sub>			3	5	A
Reverse Recovery Charge	Q <sub>rr</sub>				50	75

**Notes:**

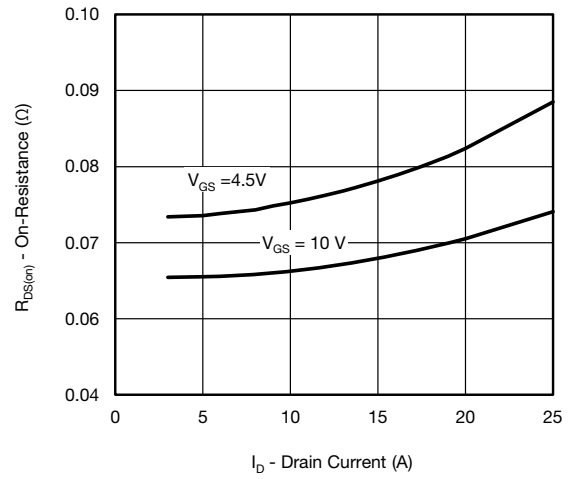
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
 b. Guaranteed by design, not subject to production testing.  
 c. Independent of operating temperature.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



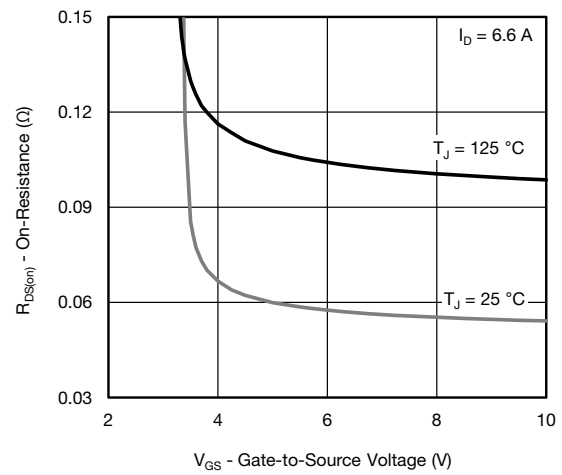
**Output Characteristics**



**On-Resistance vs. Drain Current**



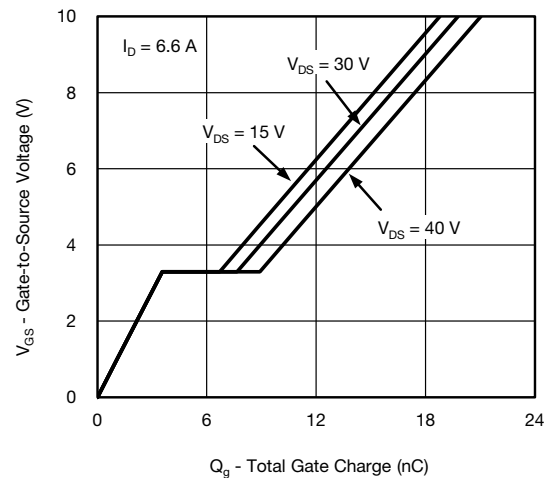
**Transfer Characteristics**



**On-Resistance vs. Gate-to-Source Voltage**



**Transconductance**

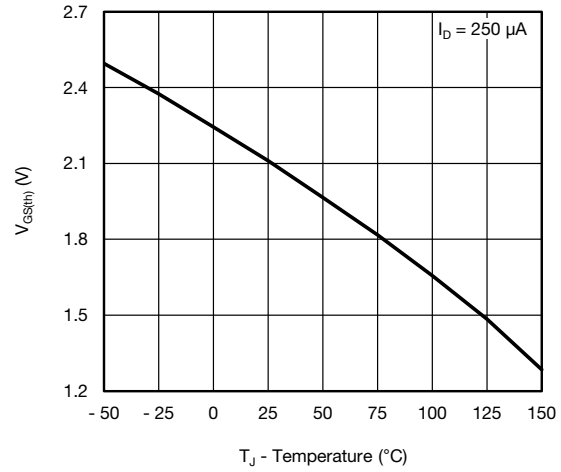


**Gate Charge**

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



**Source-Drain Diode Forward Voltage**



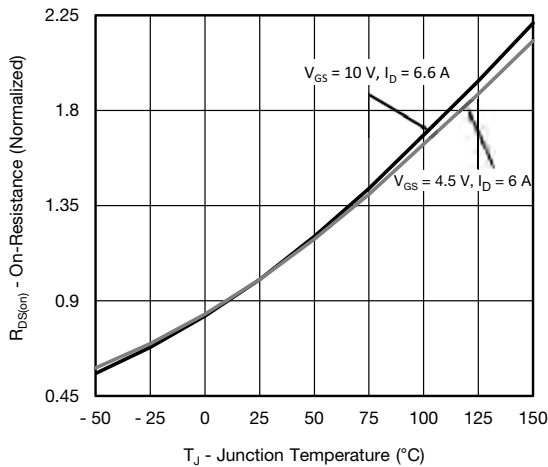
**Threshold Voltage**



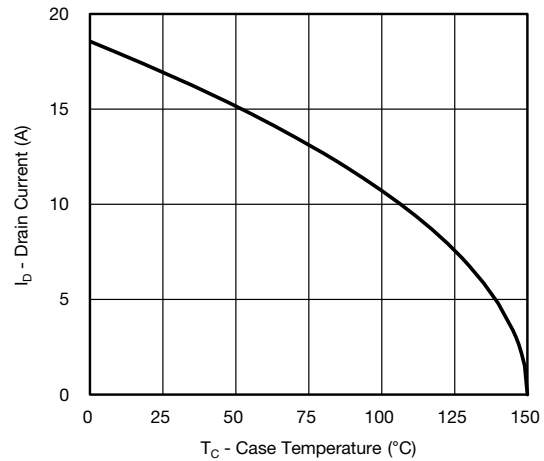
**Capacitance**



**Drain Source Breakdown vs. Junction Temperature**



**On-Resistance vs. Junction Temperature**



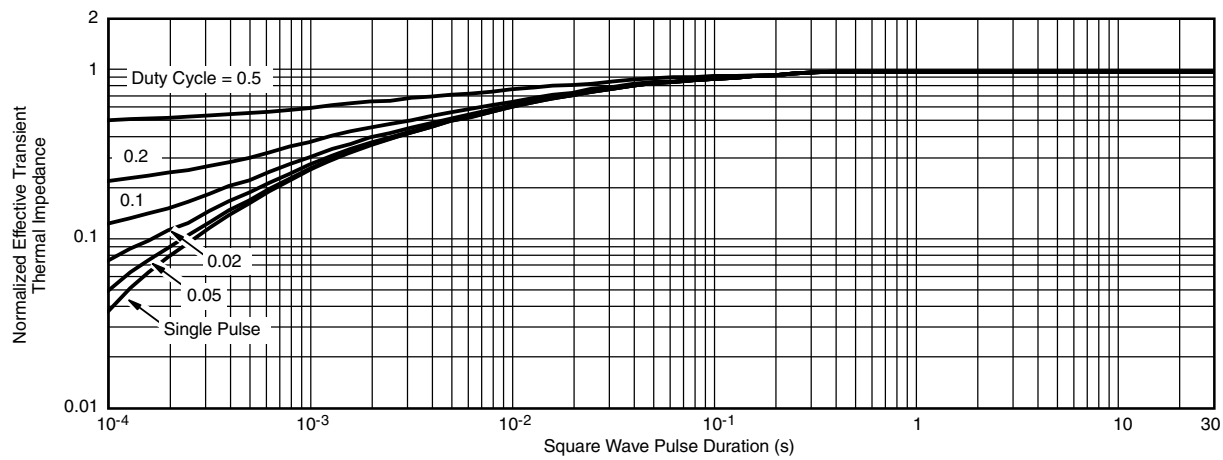
**Current Derating**

**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



Single Pulse Avalanche Current Capability vs. Time

Safe Operating Area



Normalized Thermal Transient Impedance, Junction-to-Case

## TO-252AA Case Outline



DIM.	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A	2.18	2.38	0.086	0.094
A1	-	0.127	-	0.005
b	0.64	0.88	0.025	0.035
b2	0.76	1.14	0.030	0.045
b3	4.95	5.46	0.195	0.215
C	0.46	0.61	0.018	0.024
C2	0.46	0.89	0.018	0.035
D	5.97	6.22	0.235	0.245
D1	4.10	-	0.161	-
E	6.35	6.73	0.250	0.265
E1	4.32	-	0.170	-
H	9.40	10.41	0.370	0.410
e	2.28 BSC		0.090 BSC	
e1	4.56 BSC		0.180 BSC	
L	1.40	1.78	0.055	0.070
L3	0.89	1.27	0.035	0.050
L4	-	1.02	-	0.040
L5	1.01	1.52	0.040	0.060
ECN: T16-0236-Rev. P, 16-May-16 DWG: 5347				

### Notes

- Dimension L3 is for reference only.

RECOMMENDED MINIMUM PADS FOR DPAK (TO-252)



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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