

EM6K31N-VB Datasheet

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

PRODUCT SUMMARY

V_{DS} (V)	$R_{DS(on)}$ (Ω)	I_D (A)	Q_g (Typ.)
60	1.200 at $V_{GS} = 10$ V	0.3	0.75
	1.300 at $V_{GS} = 8$ V	0.28	
	1.500 at $V_{GS} = 4.5$ V	0.25	
	1.650 at $V_{GS} = 2.5$ V	0.15	

FEATURES

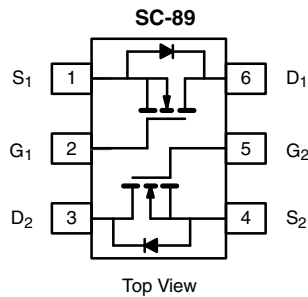
- Trench Power MOSFET
- 100 % R_g Tested



RoHS
COMPLIANT

APPLICATIONS

- Load/Power Switching for Portable Devices
- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories
- Battery Operated Systems
- Power Supply Converter Circuits



ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$, unless otherwise noted)

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	V_{DS}	60	V
Gate-Source Voltage	V_{GS}	± 12	
Continuous Drain Current ($T_J = 150^\circ\text{C}$) ^a	$T_A = 25^\circ\text{C}$	I_D	A
	$T_A = 70^\circ\text{C}$	0.30 ^{a, b} 0.25 ^{a, b}	
Pulsed Drain Current	I_{DM}	2	
Continuous Source-Drain Diode Current	$T_A = 25^\circ\text{C}$	I_S	A
Maximum Power Dissipation ^a	$T_A = 25^\circ\text{C}$	P_D	W
	$T_A = 70^\circ\text{C}$		
Operating Junction and Storage Temperature Range	T_J, T_{stg}	- 55 to 150	$^\circ\text{C}$

THERMAL RESISTANCE RATINGS

Parameter	Symbol	Typ.	Max.	Unit
Maximum Junction-to-Ambient ^b	R_{thJA}	470	565	$^\circ\text{C/W}$
		560	675	

Notes:

a. Surface mounted on 1" x 1" FR4 board.

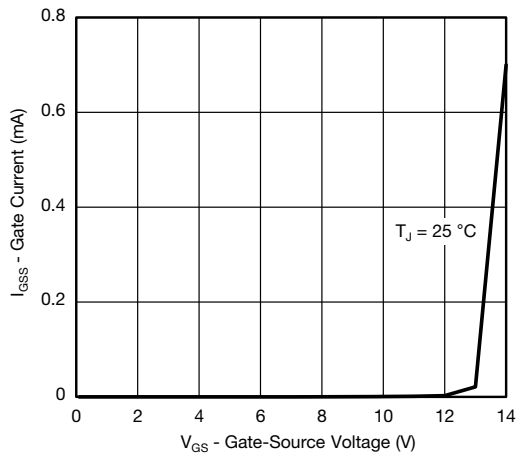
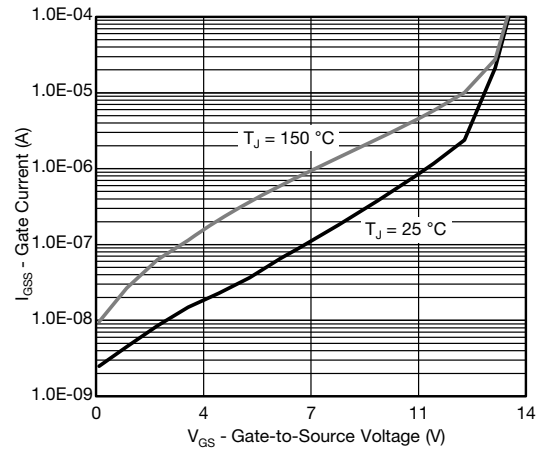
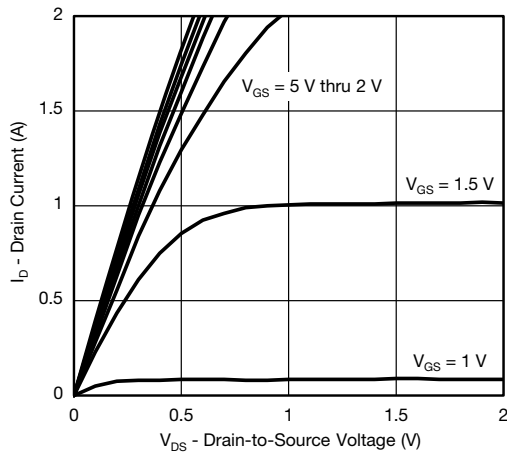
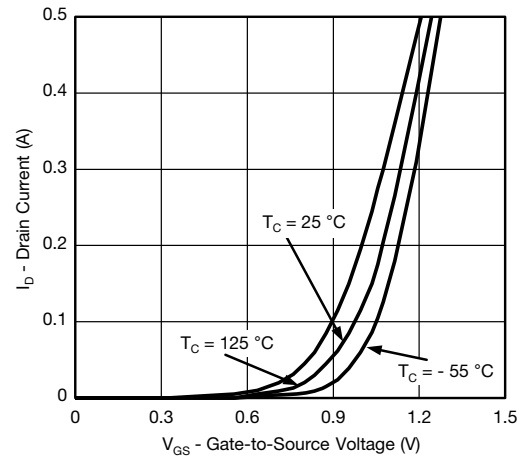
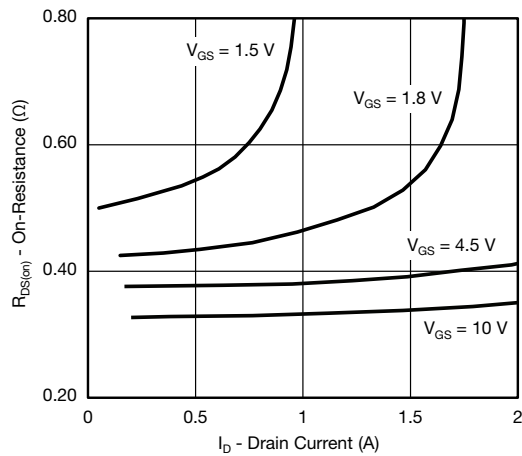
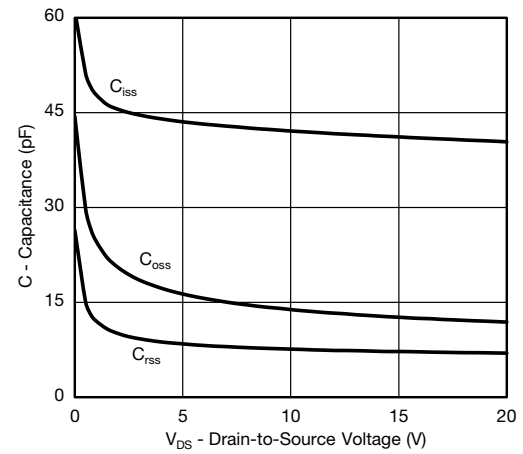
b. $t = 5$ s.

SPECIFICATIONS (T _J = 25 °C, unless otherwise noted)						
Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Static						
Drain-Source Breakdown Voltage	V _{DS}	V _{GS} = 0 V, I _D = 250 μA	60			V
V _{DS} Temperature Coefficient	ΔV _{DS} /T _J	I _D = 250 μA		17		mV/°C
V _{GS(th)} Temperature Coefficient	ΔV _{GS(th)} /T _J			- 1.8		
Gate-Source Threshold Voltage	V _{GS(th)}	V _{DS} = V _{GS} , I _D = 250 μA		1.6		V
Gate-Source Leakage	I _{GSS}	V _{DS} = 0 V, V _{GS} = ± 8 V			± 30	μA
		V _{DS} = 0 V, V _{GS} = ± 4.5 V			± 1	
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = 60 V, V _{GS} = 0 V			1	
		V _{DS} = 60 V, V _{GS} = 0 V, T _J = 85 °C			3	
On-State Drain Current ^a	I _{D(on)}	V _{DS} ≥ 5 V, V _{GS} = 4.5 V	2			A
Drain-Source On-State Resistance ^a	R _{DS(on)}	V _{GS} = 10 V, I _D = 0.3A		1.200		Ω
		V _{GS} = 8 V, I _D = 0.2 A		1.300		
		V _{GS} = 4.5 V, I _D = 0.2 A		1.500		
		V _{GS} = 2.5 V, I _D = 0.15A		1.650		
Forward Transconductance	g _{fs}	V _{DS} = 10 V, I _D = 0.5 A		7.5		S
Dynamic ^b						
Input Capacitance	C _{iss}	V _{DS} = 10 V, V _{GS} = 0 V, f = 1 MHz		40		pF
Output Capacitance	C _{oss}			14		
Reverse Transfer Capacitance	C _{rss}			8		
Total Gate Charge	Q _g	V _{DS} = 10 V, V _{GS} = 8 V, I _D = 0.6 A		1.3	2	nC
Gate-Source Charge	Q _{gs}	V _{DS} = 10 V, V _{GS} = 4.5 V, I _D = 0.6 A		0.75	1.2	
Gate-Drain Charge	Q _{gd}			0.15		
				0.13		
Gate Resistance	R _g	f = 1 MHz	2.4	12.2	24.4	Ω
Turn-On Delay Time	t _{d(on)}	V _{DD} = 10 V, R _L = 20 Ω I _D ≅ 0.5 A, V _{GEN} = 4.5 V, R _g = 1 Ω		11	20	ns
Rise Time	t _r			16	24	
Turn-Off Delay Time	t _{d(off)}			26	39	
Fall Time	t _f			11	20	
Drain-Source Body Diode Characteristics						
Pulse Diode Forward Current ^a	I _{SM}				2	A
Body Diode Voltage	V _{SD}	I _S = 0.5 A		0.8	1.2	V
Body Diode Reverse Recovery Time	t _{rr}	I _F = 0.5 A, dI/dt = 100 A/μs		10	15	ns
Body Diode Reverse Recovery Charge	Q _{rr}			2	4	nC
Reverse Recovery Fall Time	t _a			5		ns
Reverse Recovery Rise Time	t _b			5		

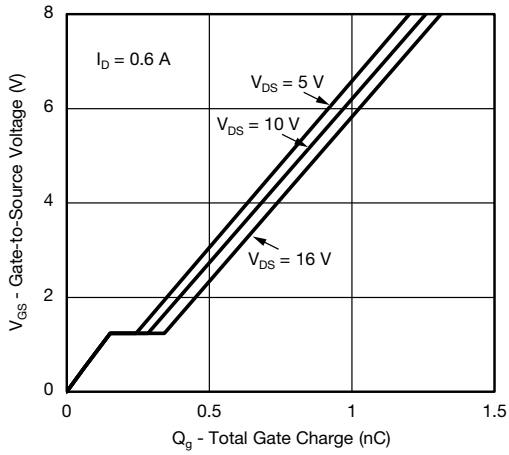
Notes:

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

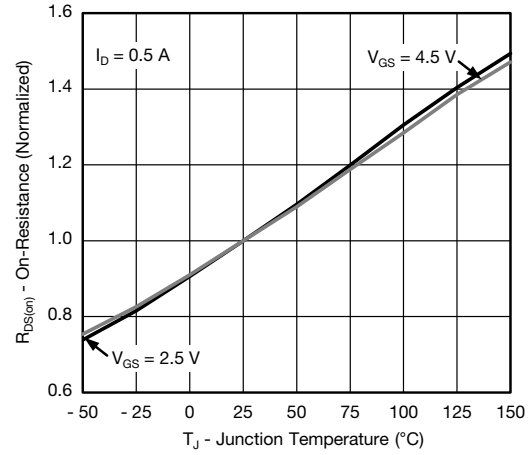
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure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

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Gate Current vs. Gate-Source Voltage

Gate Current vs. Gate-Source Voltage

Output Characteristics

Transfer Characteristics

On-Resistance vs. Drain Current

Capacitance

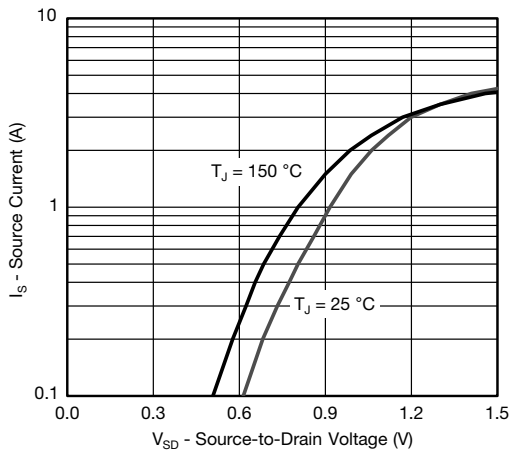
TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



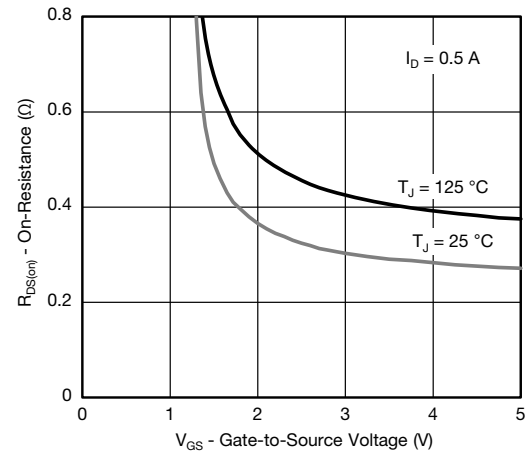
Gate Charge



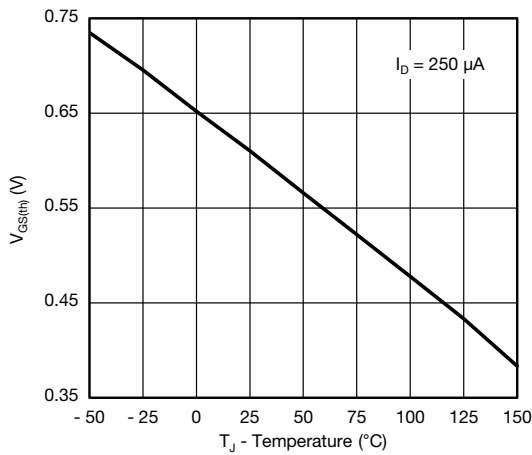
On-Resistance vs. Junction Temperature



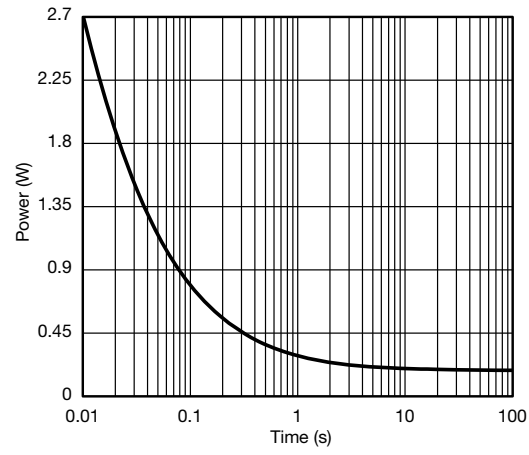
Source-Drain Diode Forward Voltage



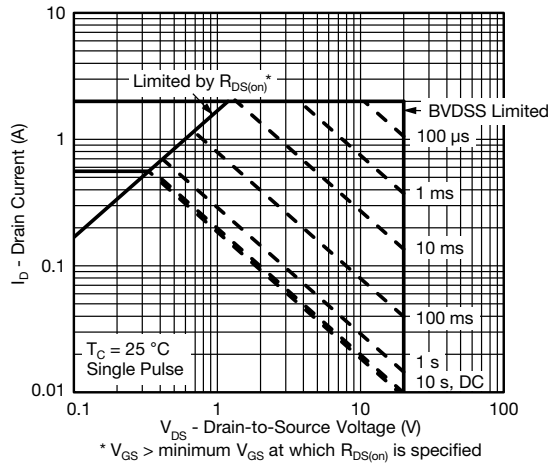
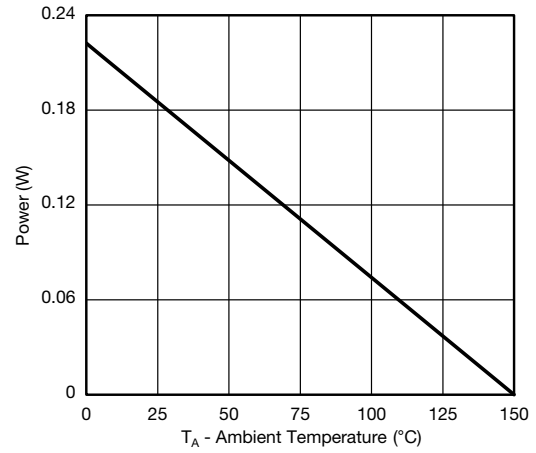
On-Resistance vs. Gate-to-Source Voltage



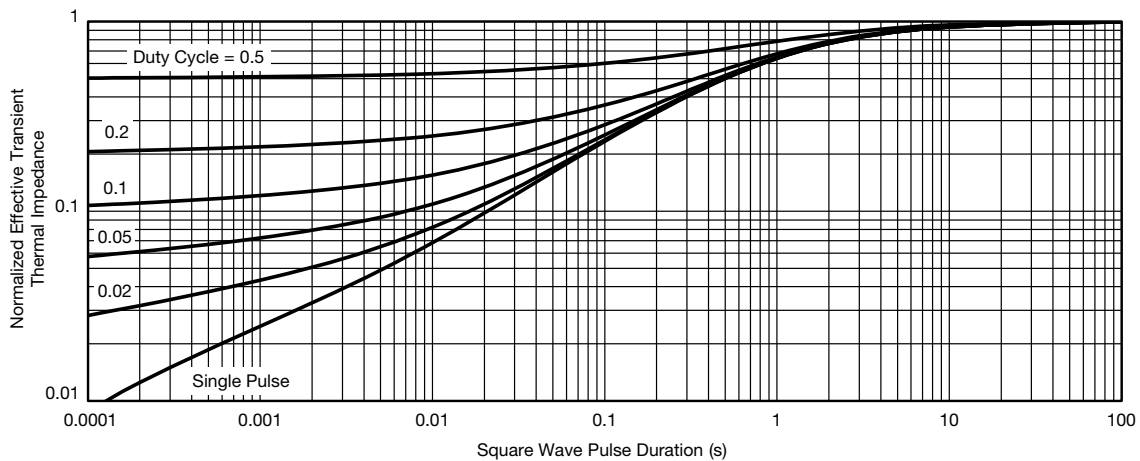
Threshold Voltage



Single Pulse Power, Junction-to-Ambient

TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)

Safe Operating Area, Junction-to-Ambient

Power Derating, Junction-to-Ambient

* The power dissipation P_D is based on $T_{J(max)} = 150^\circ\text{C}$, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.


Normalized Thermal Transient Impedance, Junction-to-Ambient

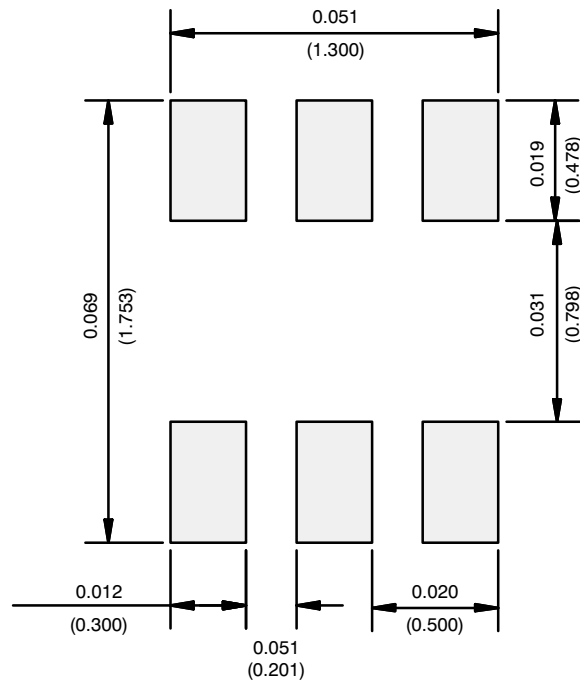
The drawing includes the following views and details:

- Main View:** A top-down view of a rectangular part with a central rectangular cutout. It features six rectangular features (1-6) arranged in two rows of three. Dimensions include overall width D , overall height E , and various offsets like $E/2$, $E/2$, e , $e1$, $2x$, and $6x\ b$. Section lines A-A, B-B, and C-C are indicated.
- SECTION B-B:** A cross-sectional view showing a rectangular profile with width B and height C . It includes a section line 6-6.
- DETAIL "A":** A detailed view of a corner or edge, showing a profile with a curved top and a flat base. It includes a section line A1-A1.
- DETAIL "A" (SEE DETAIL "A"):** A detailed view of a corner or edge, showing a profile with a curved top and a flat base. It includes a section line A1-A1.
- Other Views:** A side view showing the profile of the part with dimensions L and $L1$. A bottom view showing the base of the part with dimensions A and $6x\ b$.

1. Dimensions in millimeters.

- | DIM. | MILLIMETERS | | |
|------|-------------|------|------|
| | MIN. | NOM. | MAX. |
| A | 0.56 | 0.58 | 0.60 |
| A1 | 0 | 0.02 | 0.10 |
| b | 0.15 | 0.22 | 0.30 |
| c | 0.10 | 0.14 | 0.18 |
| D | 1.50 | 1.60 | 1.70 |
| E | 1.50 | 1.60 | 1.70 |
| E1 | 1.15 | 1.20 | 1.25 |
| e | 0.45 | 0.50 | 0.55 |
| e1 | 0.95 | 1.00 | 1.05 |
| L | 0.25 | 0.35 | 0.50 |
| L1 | 0.10 | 0.20 | 0.30 |

RECOMMENDED MINIMUM PADS FOR SC-89: 6-Lead



Recommended Minimum Pads
Dimensions in Inches/(mm)

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