

# Single P-channel MOSFET

ELM13409CA-S

## General description

ELM13409CA-S uses advanced trench technology to provide excellent  $R_{ds(on)}$ , low gate charge and low gate resistance.

## Features

- $V_{ds} = -30V$
- $I_d = -2.6A$  ( $V_{gs} = -10V$ )
- $R_{ds(on)} < 130m\Omega$  ( $V_{gs} = -10V$ )
- $R_{ds(on)} < 200m\Omega$  ( $V_{gs} = -4.5V$ )

## Maximum absolute ratings

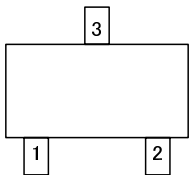
Parameter	Symbol	Limit	Unit	Note	
Drain-source voltage	$V_{ds}$	-30	V		
Gate-source voltage	$V_{gs}$	$\pm 20$	V		
Continuous drain current	$I_d$	$T_a = 25^\circ C$	-2.6	A	1
		$T_a = 70^\circ C$	-2.2		
Pulsed drain current	$I_{dm}$	-20	A	2	
Power dissipation	$P_d$	$T_a = 25^\circ C$	1.4	W	1
		$T_a = 70^\circ C$	1.0		
Junction and storage temperature range	$T_j, T_{stg}$	-55 to 150	$^\circ C$		

## Thermal characteristics

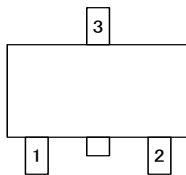
Parameter		Symbol	Typ.	Max.	Unit	Note
Maximum junction-to-ambient	$t \leq 10s$	$R\theta_{ja}$	70	90	$^\circ C/W$	1
Maximum junction-to-ambient	Steady-state		100	125	$^\circ C/W$	
Maximum junction-to-lead	Steady-state	$R\theta_{jl}$	63	80	$^\circ C/W$	3

## Pin configuration

SOT-23 (TOP VIEW)



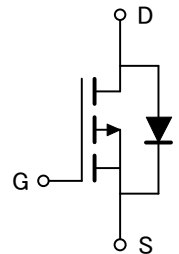
(Without extra bar)



(With extra bar)

Pin No.	Pin name
1	GATE
2	SOURCE
3	DRAIN

## Circuit



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## Electrical characteristics

T<sub>a</sub>=25°C

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
<b>STATIC PARAMETERS</b>						
Drain-source breakdown voltage	BV <sub>dss</sub>	I <sub>d</sub> =-250 μA, V <sub>gs</sub> =0V	-30			V
Zero gate voltage drain current	I <sub>dss</sub>	V <sub>ds</sub> =-24V			-1	μA
		V <sub>gs</sub> =0V		T <sub>j</sub> =55°C	-5	
Gate-body leakage current	I <sub>gss</sub>	V <sub>ds</sub> =0V, V <sub>gs</sub> =±20V			±100	nA
Gate threshold voltage	V <sub>gs(th)</sub>	V <sub>ds</sub> =V <sub>gs</sub> , I <sub>d</sub> =-250 μA	-1.0	-1.9	-3.0	V
On state drain current	I <sub>d(on)</sub>	V <sub>gs</sub> =-4.5V, V <sub>ds</sub> =-5V	-5			A
Static drain-source on-resistance	R <sub>ds(on)</sub>	V <sub>gs</sub> =-10V		97	130	mΩ
		I <sub>d</sub> =-2.6A		135	150	
		V <sub>gs</sub> =-4.5V, I <sub>d</sub> =-2A		166	200	mΩ
Forward transconductance	G <sub>fs</sub>	V <sub>ds</sub> =-5V, I <sub>d</sub> =-2.5A	3.0	3.8		S
Diode forward voltage	V <sub>sd</sub>	I <sub>s</sub> =-1A, V <sub>gs</sub> =0V		-0.82	-1.00	V
Max. body-diode continuous current	I <sub>s</sub>				-2	A
<b>DYNAMIC PARAMETERS</b>						
Input capacitance	C <sub>iss</sub>			302.0	370.0	pF
Output capacitance	C <sub>oss</sub>	V <sub>gs</sub> =0V, V <sub>ds</sub> =-15V, f=1MHz		50.3		pF
Reverse transfer capacitance	C <sub>rss</sub>			37.8		pF
Gate resistance	R <sub>g</sub>	V <sub>gs</sub> =0V, V <sub>ds</sub> =0V, f=1MHz		12	18	Ω
<b>SWITCHING PARAMETERS</b>						
Total gate charge (10V)	Q <sub>g</sub>			6.80	9.00	nC
Total gate charge (4.5V)	Q <sub>g</sub>	V <sub>gs</sub> =-10V, V <sub>ds</sub> =-15V		2.40		nC
Gate-source charge	Q <sub>gs</sub>	I <sub>d</sub> =-2.6A		1.60		nC
Gate-drain charge	Q <sub>gd</sub>			0.95		nC
Turn-on delay time	t <sub>d(on)</sub>			7.5		ns
Turn-on rise time	t <sub>r</sub>	V <sub>gs</sub> =-10V, V <sub>ds</sub> =-15V		3.2		ns
Turn-off delay time	t <sub>d(off)</sub>	R <sub>l</sub> =5.8 Ω, R <sub>gen</sub> =3 Ω		17.0		ns
Turn-off fall time	t <sub>f</sub>			6.8		ns
Body diode reverse recovery time	t <sub>rr</sub>			16.8	22.0	ns
Body diode reverse recovery charge	Q <sub>rr</sub>	I <sub>f</sub> =-2.6A, dl/dt=100A/μs		10.0		nC

### NOTE :

1. The value of R<sub>θja</sub> is measured with the device mounted on 1in<sup>2</sup> FR-4 board of 2oz. Copper, in still air environment with T<sub>a</sub>=25°C. The value in any given applications depends on the user's specific board design, The current rating is based on the t ≤ 10s thermal resistance rating.
2. Repetitive rating, pulse width limited by junction temperature.
3. The R<sub>θja</sub> is the sum of the thermal impedance from junction to lead R<sub>θjl</sub> and lead to ambient.
4. The static characteristics in Figures 1 to 6 are obtained using 80μs pulses, duty cycle 0.5%max.
5. These tests are performed with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with T<sub>a</sub>=25°C. The SOA curve provides a single pulse rating.

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## Typical electrical and thermal characteristics

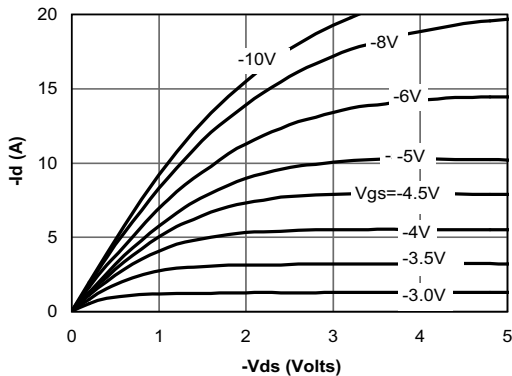


Fig 1: On-Region Characteristics

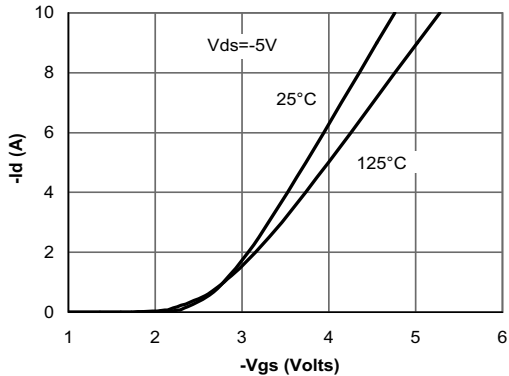


Figure 2: Transfer Characteristics

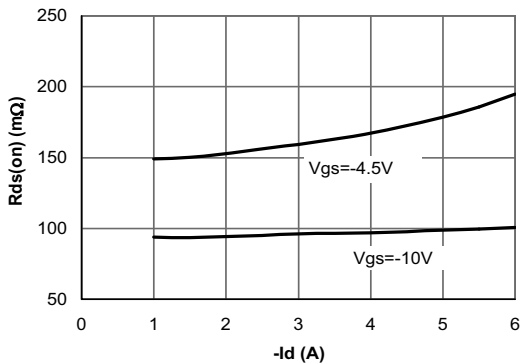


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

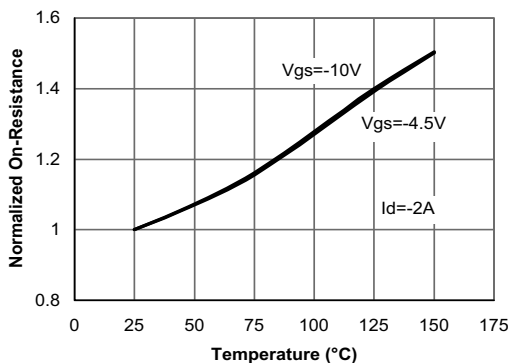


Figure 4: On-Resistance vs. Junction Temperature

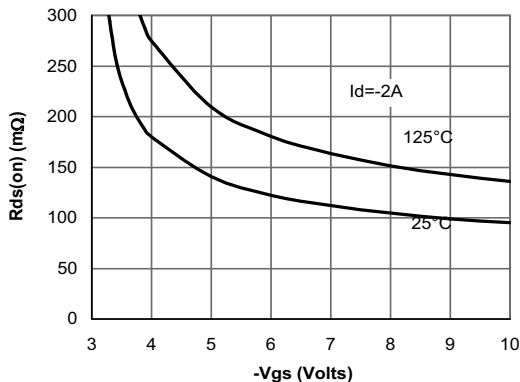


Figure 5: On-Resistance vs. Gate-Source Voltage

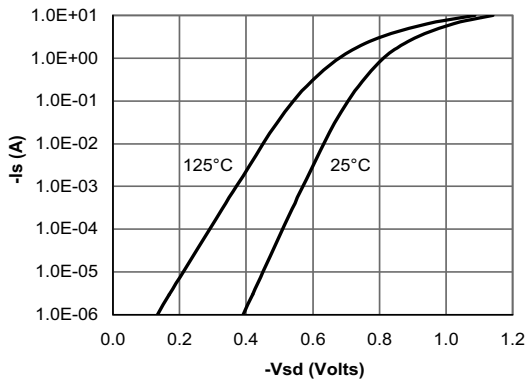


Figure 6: Body-Diode Characteristics

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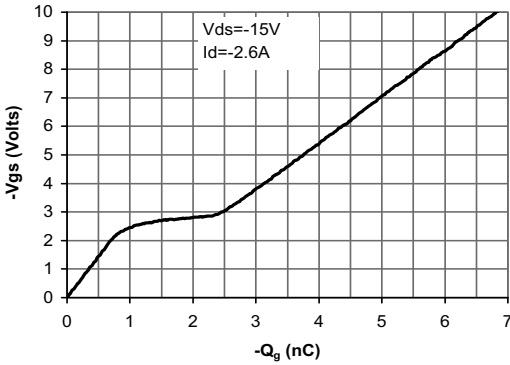


Figure 7: Gate-Charge Characteristics

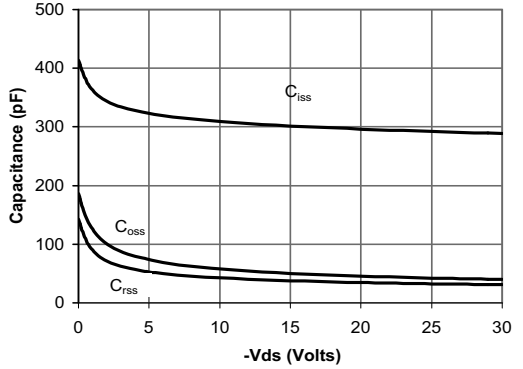


Figure 8: Capacitance Characteristics

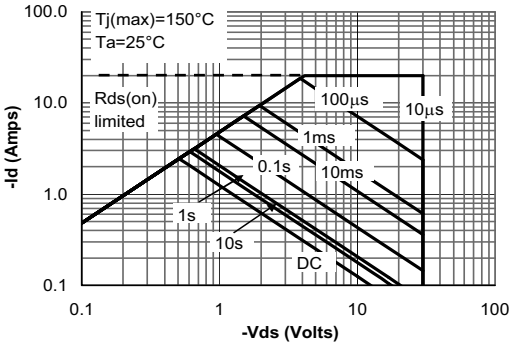


Figure 9: Maximum Forward Biased Safe Operating Area (Note E)

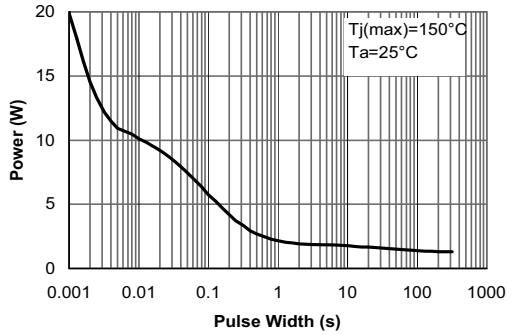


Figure 10: Single Pulse Power Rating Junction-to-Ambient (Note E)

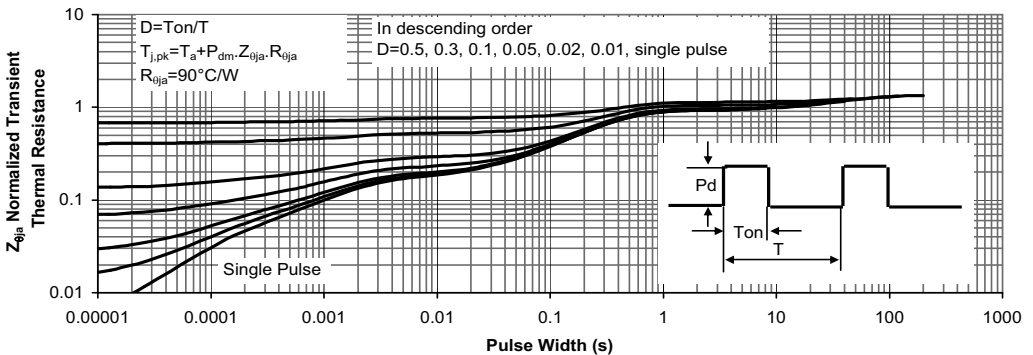


Figure 11: Normalized Maximum Transient Thermal Impedance