

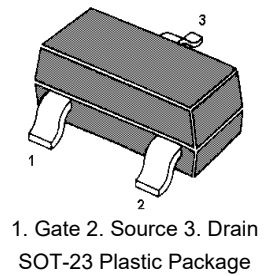
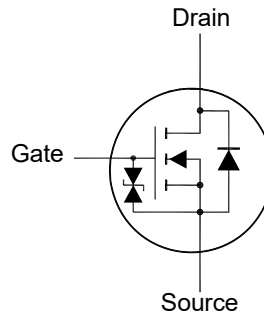
MKA02N013UK

N-Channel Enhancement Mode MOSFET

Features

- Surface-mounted package
- Built-in G-S Protection Diode
- Typical ESD Protection HBM Class 1B

Classification	Voltage Range(V)
0A	< 125
0B	125 to < 250
1A	250 to < 500
1B	500 to < 1000
1C	1000 to < 2000
2	2000 to < 4000
3A	4000 to < 8000
3B	≥ 8000



1. Gate 2. Source 3. Drain
SOT-23 Plastic Package

Applications

- Portable appliances
- Battery management
- High speed switch
- Low power DC to DC

Absolute Maximum Ratings(at $T_a = 25^\circ\text{C}$ unless otherwise specified)

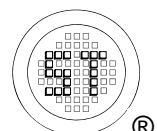
Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	20	V
Gate-Source Voltage	V_{GS}	± 12	V
Continuous Drain Current	I_D	7	A
Peak Drain Current, Pulsed ¹⁾	I_{DM}	40	A
Total Power Dissipation ²⁾	P_{tot}	1.25	W
Operating Junction and Storage Temperature Range	T_j, T_{stg}	- 55 to + 150	$^\circ\text{C}$

Thermal Resistance Ratings

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Ambient ²⁾	$R_{\theta JA}$	100	$^\circ\text{C/W}$

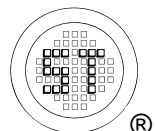
¹⁾ Pulse Test: Pulse Width $\leq 100 \mu\text{s}$, Duty Cycle $\leq 2\%$, Repetitive rating, pulse width limited by junction temperature $T_{j(\text{MAX})}=150^\circ\text{C}$.

²⁾ Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate.



Characteristics at $T_a = 25^\circ\text{C}$ unless otherwise specified

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at $I_D = 250\ \mu\text{A}$	$V_{(BR)DSS}$	20	-	-	V
Gate Voltage Drain Current at $V_{DS} = 16\ \text{V}$	I_{DSS}	-	-	1	μA
Gate-Source Leakage at $V_{GS} = \pm 10\ \text{V}$	I_{GSS}	-	-	± 10	μA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$	$V_{GS(th)}$	0.5	-	1	V
Drain-Source On-State Resistance at $V_{GS} = 4.5\ \text{V}$, $I_D = 6.5\ \text{A}$ at $V_{GS} = 2.5\ \text{V}$, $I_D = 5.5\ \text{A}$ at $V_{GS} = 1.8\ \text{V}$, $I_D = 5\ \text{A}$	$R_{DS(on)}$	- - -	13 - -	18 21 28	m Ω
DYNAMIC PARAMETERS					
Gate Resistance at $V_{GS} = 0\ \text{V}$, $V_{DS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	R_g	-	1.5	-	K Ω
Forward Transconductance at $V_{DS} = 5\ \text{V}$, $I_D = 6.5\ \text{A}$	g_{fs}	-	13	-	S
Input Capacitance at $V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{iss}	-	564	-	pF
Output Capacitance at $V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{oss}	-	120	-	pF
Reverse Transfer Capacitance at $V_{DS} = 10\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{rss}	-	25	-	pF
Total Gate Charge at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 4.5\ \text{V}$ at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 2.5\ \text{V}$	Q_g	- -	16 10	- -	nC
Gate to Source Charge at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 4.5\ \text{V}$	Q_{gs}	-	1	-	nC
Gate to Drain Charge at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 4.5\ \text{V}$	Q_{gd}	-	4	-	nC
Turn-On Delay Time at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 5\ \text{V}$, $R_{GEN} = 3\ \Omega$	$t_{d(on)}$	-	3.8	-	μs
Turn-On Rise Time at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 5\ \text{V}$, $R_{GEN} = 3\ \Omega$	t_r	-	1.9	-	μs
Turn-Off Delay Time at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 5\ \text{V}$, $R_{GEN} = 3\ \Omega$	$t_{d(off)}$	-	2.5	-	μs
Turn-Off Fall Time at $V_{DS} = 10\ \text{V}$, $I_D = 6.5\ \text{A}$, $V_{GS} = 5\ \text{V}$, $R_{GEN} = 3\ \Omega$	t_f	-	1	-	μs
Body-Diode PARAMETERS					
Body Diode Voltage at $I_S = 1\ \text{A}$	V_{SD}	-	-	1	V
Body-Diode Continuous Current	I_S	-	-	7	A
Body Diode Reverse Recovery Time at $I_S = 5\ \text{A}$, $di/dt = 50\ \text{A} / \mu\text{s}$	t_{rr}	-	1.5	-	μs
Body Diode Reverse Recovery Charge at $I_S = 5\ \text{A}$, $di/dt = 50\ \text{A} / \mu\text{s}$	Q_{rr}	-	10	-	μC



Electrical Characteristics Curves

Fig. 1 Input Characteristics

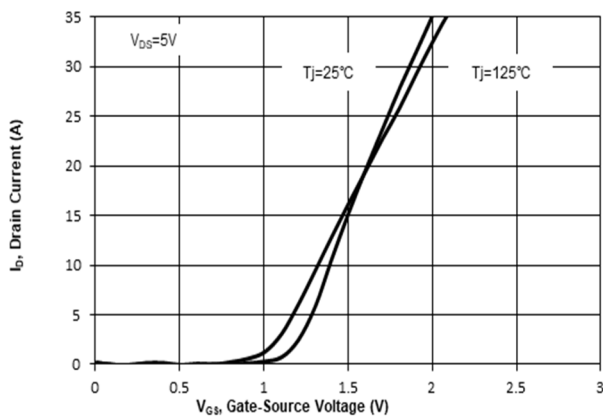


Fig. 2 Output Characteristics

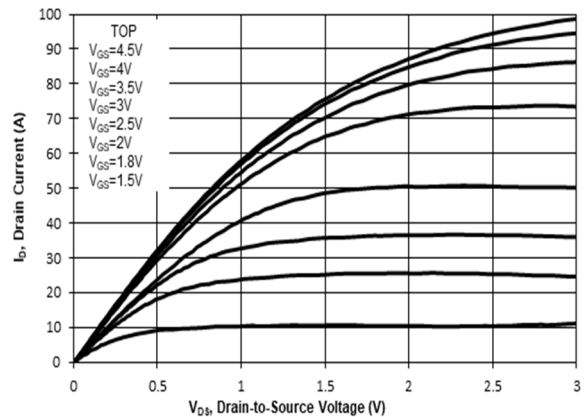


Fig. 3 On-Resistance vs. Drain Current

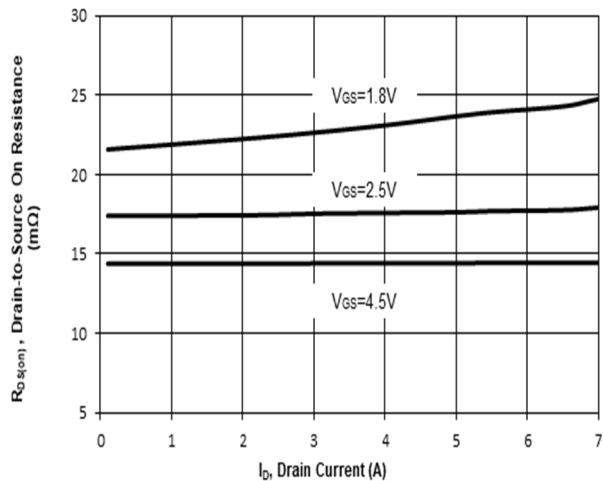


Fig. 4 On-Resistance vs. Gate-Source Voltage

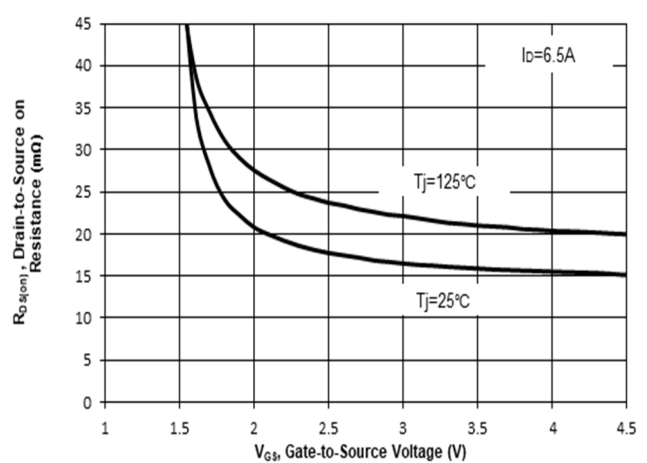


Fig. 5 On-Resistance vs. Junction Temperature

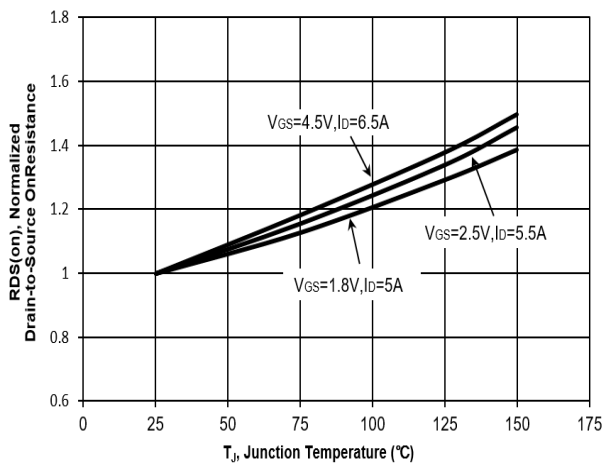
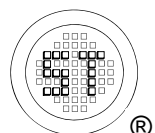
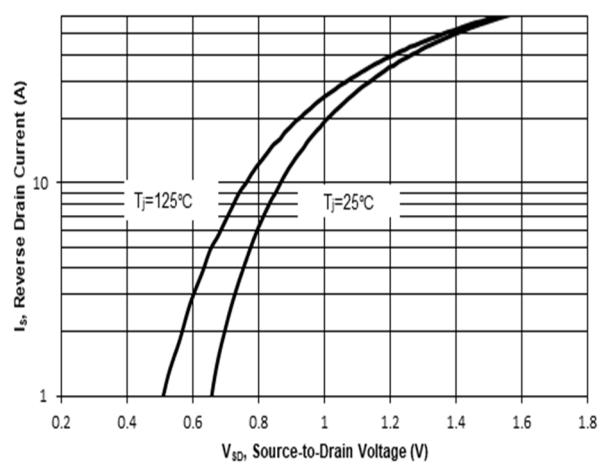


Fig. 6 Typical Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Capacitance Characteristics

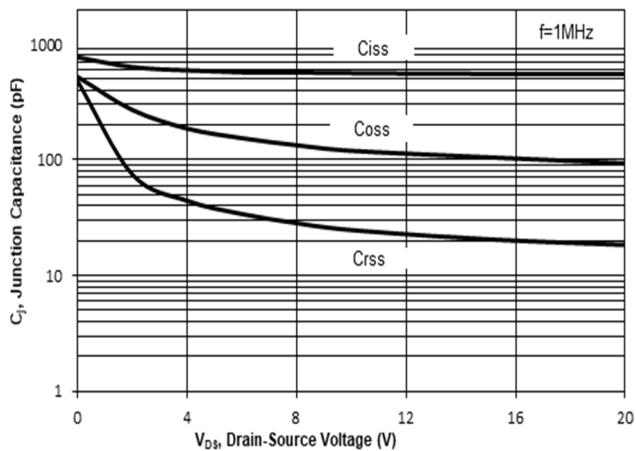


Fig. 8 I_{DSS} vs. Junction Temperature

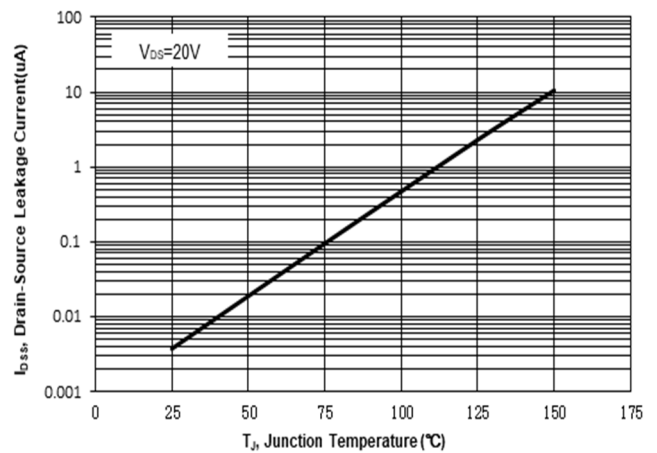


Fig. 9 $B_{V_{DSS}}$ Voltage vs. T_J

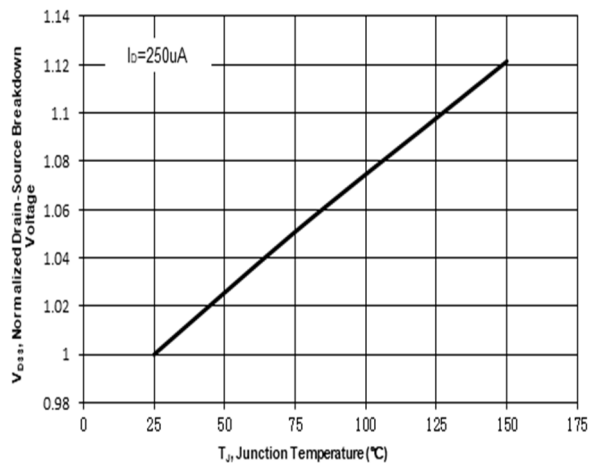


Fig. 10 Gate-Source Threshold Voltage vs. T_J

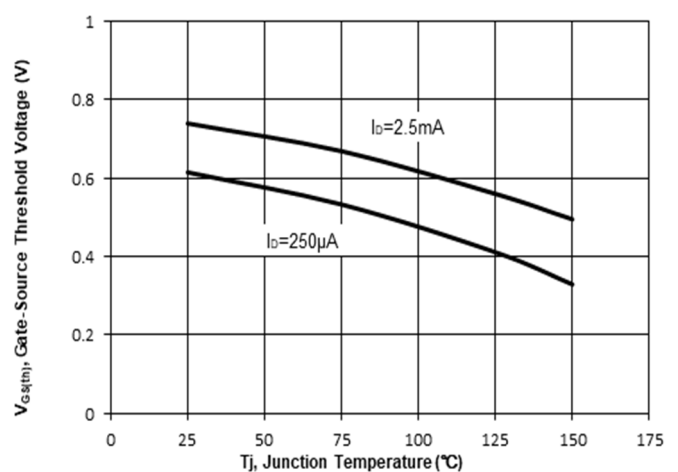
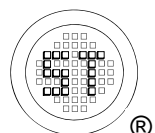
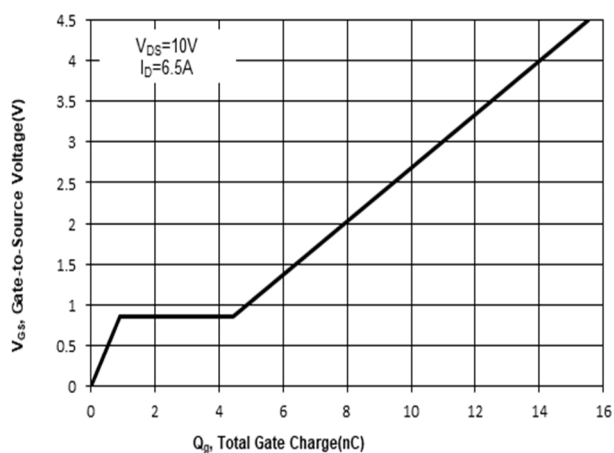


Fig. 11 Gate Charge



Test Circuits

Fig.1-1 Switching times test circuit

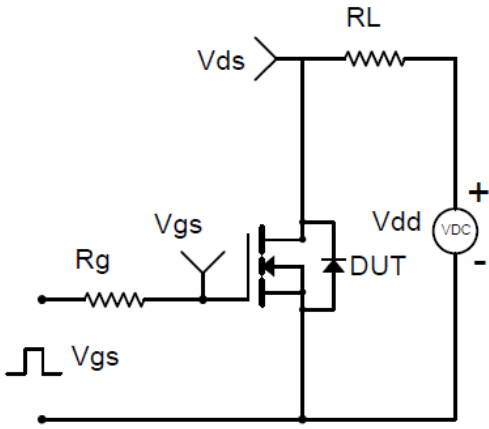


Fig.1-2 Switching Waveform

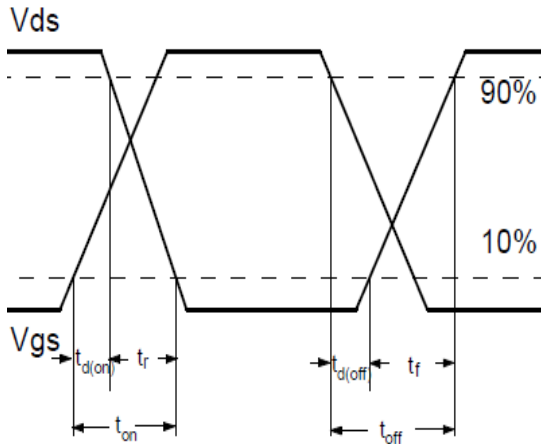


Fig.2-1 Gate charge test circuit

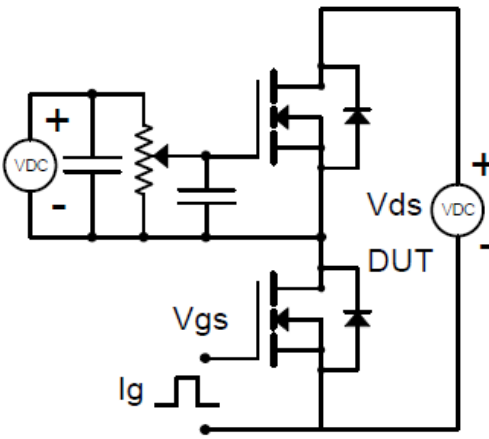
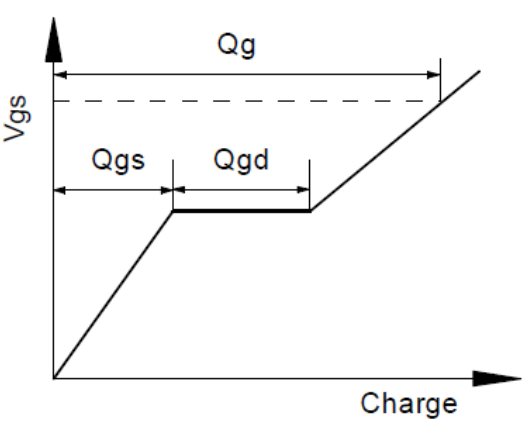


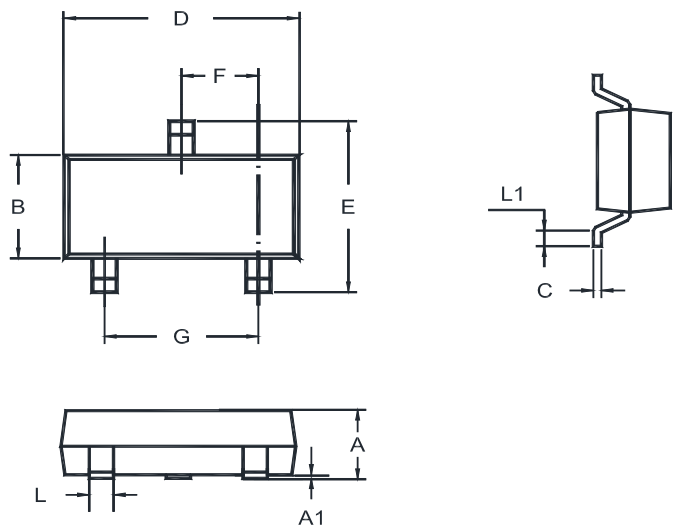
Fig.2-2 Gate charge waveform



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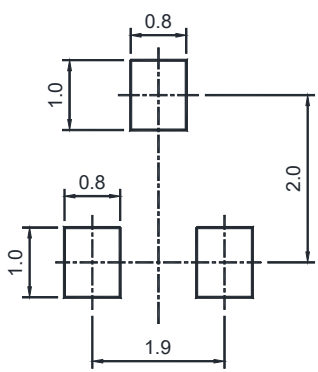
Package Outline (Dimensions in mm)

SOT-23



Unit	A	A1	B	C	D	E	F	G	L	L1
mm	1.20 0.89	0.100 0.013	1.40 1.20	0.19 0.08	3.04 2.80	2.6 2.2	1.02 0.89	2.04 1.78	0.51 0.37	0.2 MIN

Recommended Soldering Footprint



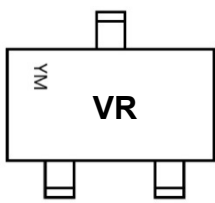
Packing information

Package	Tape Width (mm)	Pitch		Reel Size		Per Reel Packing Quantity
		mm	inch	mm	inch	
SOT-23	8	4 ± 0.1	0.157 ± 0.004	178	7	3,000

Marking information

- " VR " = Part No.
- " YM " = Date Code Marking
- " Y " = Year
- " M " = Month

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