

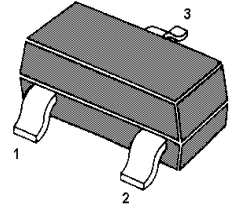
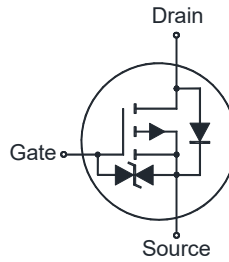
MMFTP3409K-HAF

P-Channel Enhancement Mode Power MOSFET

Features

- Halogen and Antimony Free(HAF),
RoHS compliant
- Typical ESD Protection HBM Class 2

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
TO-236 Plastic Package

Application

- Portable appliances
- Battery management

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

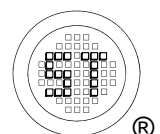
Parameter	Symbol	Value	Unit
Drain-Source Voltage	$-V_{DS}$	30	V
Gate-Source Voltage	V_{GS}	± 20	V
Continuous Drain Current	$-I_D$	2.6	A
Pulsed Drain Current ¹⁾	$-I_{DM}$	20	A
Power Dissipation ²⁾	P_D	1.4	W
Operating Junction Temperature Range	T_j	- 55 to + 150	$^\circ\text{C}$
Storage Temperature Range	T_{stg}	- 55 to + 150	$^\circ\text{C}$

Thermal Resistance Ratings

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Ambient Steady State	$R_{\theta JA}$	90 ²⁾ 125	$^\circ\text{C/W}$

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

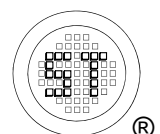
²⁾ Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air, $t \leq 10 \text{ S}$.



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

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at $-I_D = 250\ \mu\text{A}$	$-V_{(BR)DSS}$	30	-	-	V
Drain-Source Leakage Current at $-V_{DS} = 24\ \text{V}$	$-I_{DSS}$	-	-	1	μA
Gate-Source Leakage at $V_{GS} = \pm 20\ \text{V}$	I_{GSS}	-	-	± 10	μA
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$, $-I_D = 250\ \mu\text{A}$	$-V_{GS(th)}$	1	-	3	V
Drain-Source On-State Resistance at $-V_{GS} = 10\ \text{V}$, $-I_D = 2.6\ \text{A}$ at $-V_{GS} = 4.5\ \text{V}$, $-I_D = 2\ \text{A}$	$R_{DS(on)}$	- -	- -	130 200	m Ω
DYNAMIC PARAMETERS					
Gate Resistance at $-V_{DS} = 0$, $V_{GS} = 0$, $f = 1\ \text{MHz}$	R_g	-	21	-	Ω
Forward Transconductance at $-V_{DS} = 5\ \text{V}$, $-I_D = 2.5\ \text{A}$	g_{fs}	-	4.6	-	S
Input Capacitance at $-V_{DS} = 30\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{iss}	-	441	-	pF
Output Capacitance at $-V_{DS} = 30\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{oss}	-	41	-	pF
Reverse Transfer Capacitance at $-V_{DS} = 30\ \text{V}$, $V_{GS} = 0\ \text{V}$, $f = 1\ \text{MHz}$	C_{rss}	-	35	-	pF
Total Gate Charge at $-V_{DS} = 15\ \text{V}$, $-V_{GS} = 10\ \text{V}$, $-I_D = 2.6\ \text{A}$ at $-V_{DS} = 15\ \text{V}$, $-V_{GS} = 4.5\ \text{V}$, $-I_D = 2.6\ \text{A}$	Q_g	- -	9 4.5	- -	nC
Gate-Source Charge at $-V_{DS} = 15\ \text{V}$, $-V_{GS} = 10\ \text{V}$, $-I_D = 2.6\ \text{A}$	Q_{gs}	-	3	-	nC
Gate-Drain Charge at $-V_{DS} = 15\ \text{V}$, $-V_{GS} = 10\ \text{V}$, $-I_D = 2.6\ \text{A}$	Q_{gd}	-	1.2	-	nC
Turn-On Delay Time at $-V_{DD} = 15\ \text{V}$, $-V_{GS} = 10\ \text{V}$, $R_L = 5.8\ \Omega$, $R_G = 3\ \Omega$	$t_{d(on)}$	-	7.5	-	ns
Turn-On Rise Time at $-V_{DD} = 15\ \text{V}$, $-V_{GS} = 10\ \text{V}$, $R_L = 5.8\ \Omega$, $R_G = 3\ \Omega$	t_r	-	3.2	-	ns
Turn-Off Delay Time at $-V_{DD} = 15\ \text{V}$, $-V_{GS} = 10\ \text{V}$, $R_L = 5.8\ \Omega$, $R_G = 3\ \Omega$	$t_{d(off)}$	-	17	-	ns
Turn-Off Fall Time at $-V_{DD} = 15\ \text{V}$, $-V_{GS} = 10\ \text{V}$, $R_L = 5.8\ \Omega$, $R_G = 3\ \Omega$	t_f	-	6.8	-	ns
Body-Diode PARAMETERS					
Body Diode Voltage at $-I_S = 1\ \text{A}$	$-V_{SD}$	-	-	1	V
Body-Diode Continuous Current	$-I_S$	-	-	2.6	A
Body Diode Reverse Recovery Time at $-I_S = 2.6\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	t_{rr}	-	17	-	nS
Body Diode Reverse Recovery Charge at $-I_S = 2.6\ \text{A}$, $di/dt = 100\ \text{A} / \mu\text{s}$	Q_{rr}	-	10	-	nC



Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

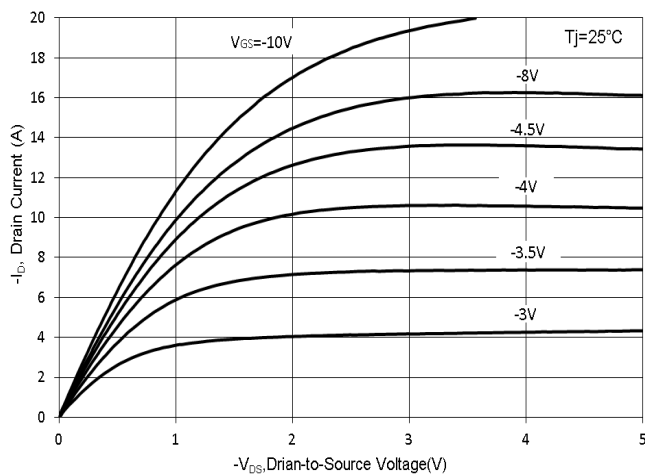


Fig. 2 Typical Transfer Characteristics

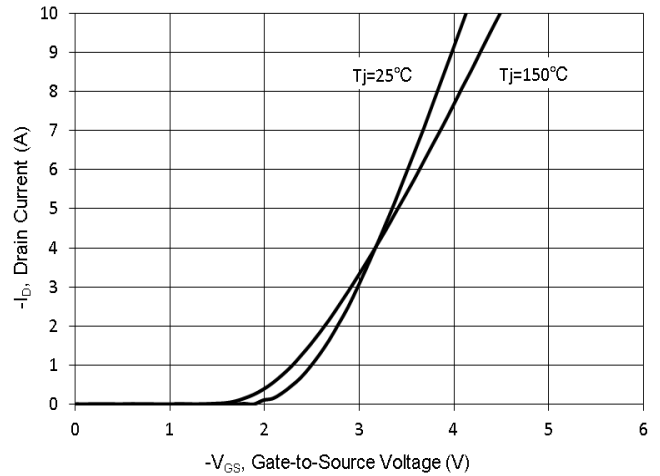


Fig. 3 on-Resistance vs. Gate Voltage

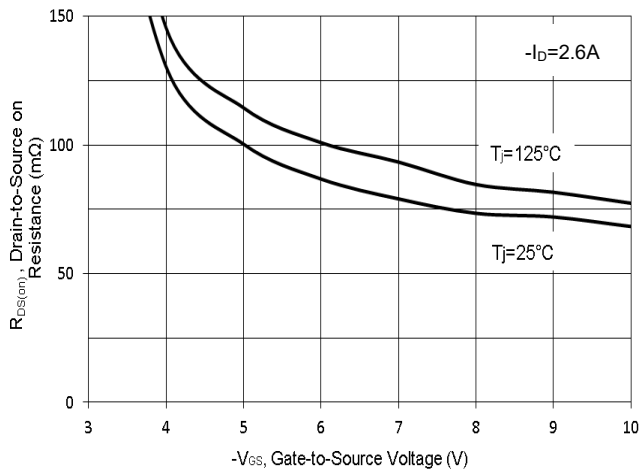


Fig. 4 on-Resistance vs. T_J

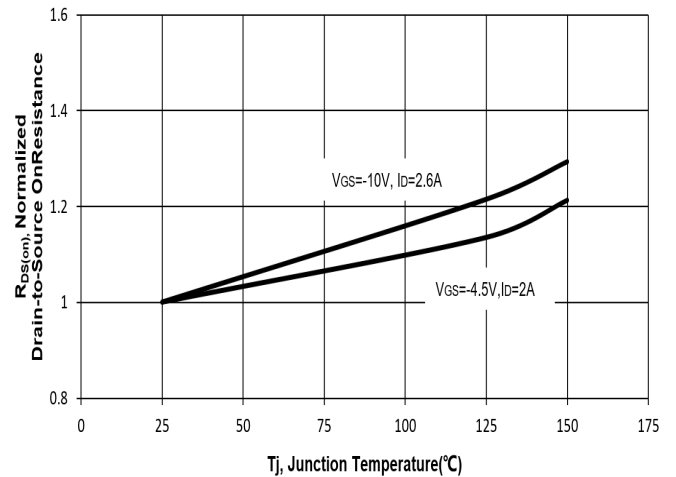


Fig. 5 on-Resistance vs. Drain Current

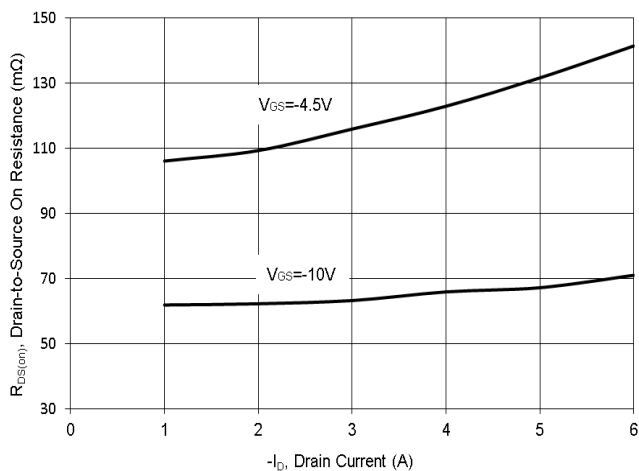
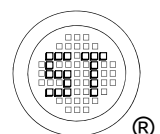
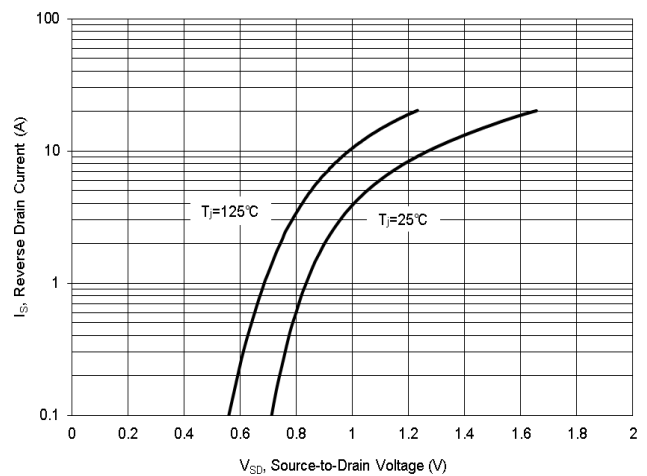


Fig. 6 Typical Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Drain-Source Leakage Current vs. T_j

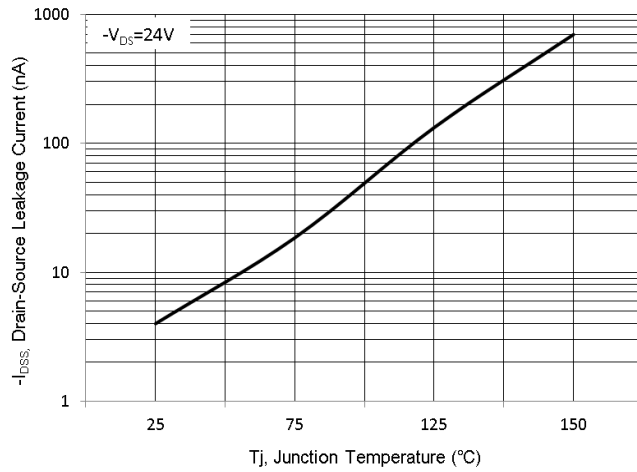


Fig. 8 Gate Charge

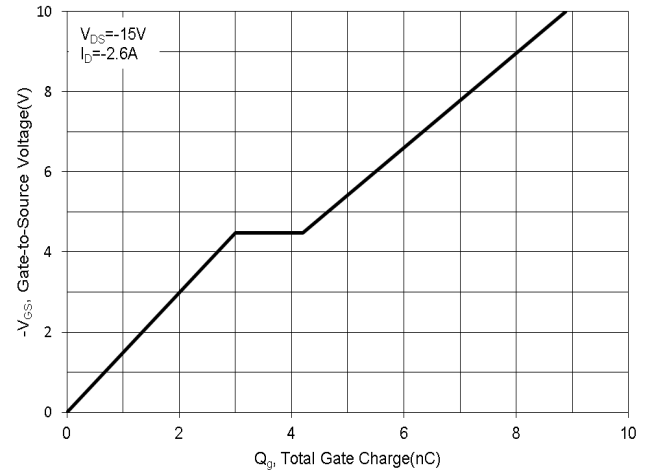


Fig. 9 Gate Threshold Variation vs. T_j

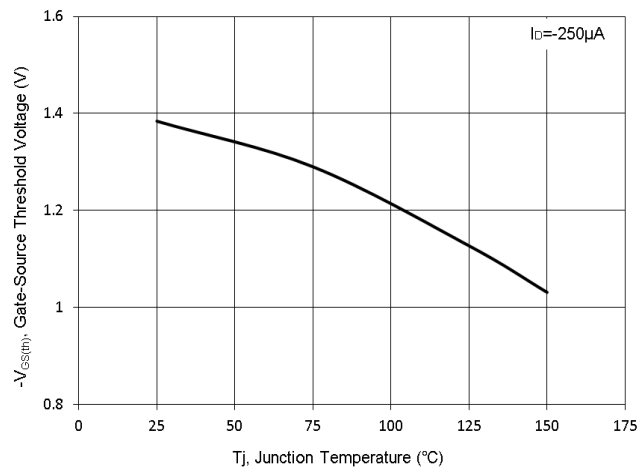


Fig. 10 $V_{(BR)DSS}$ vs. Junction Temperature

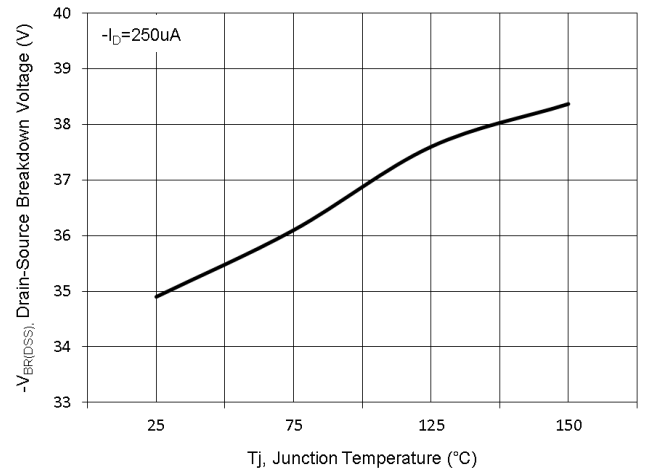
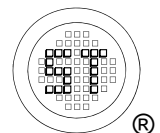
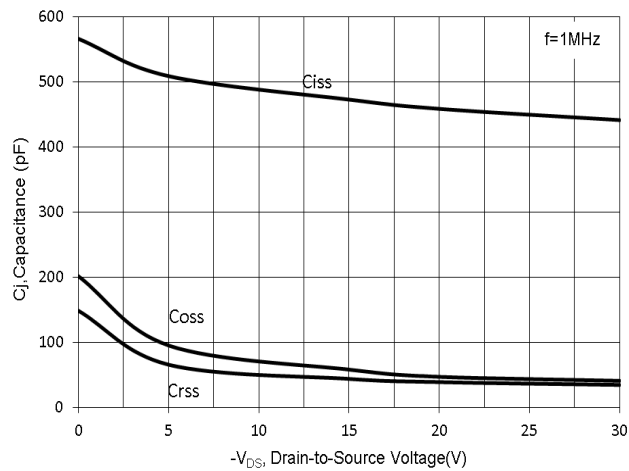


Fig. 11 Typical Junction Capacitance



Test Circuits

Fig.1-1 Switching times test circuit

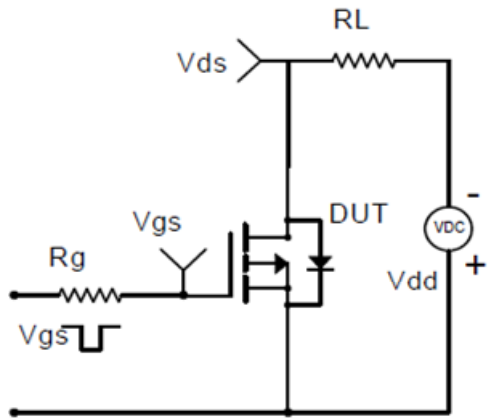


Fig.1-2 Switching Waveform

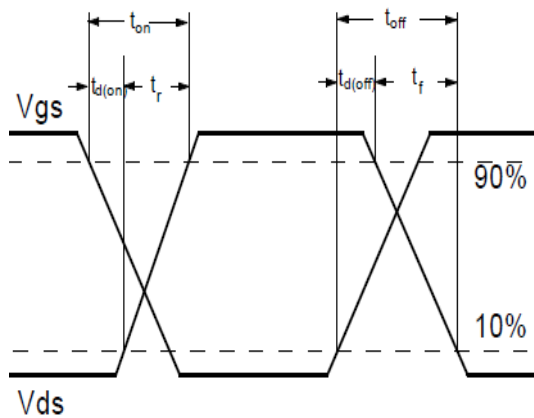


Fig.2-1 Gate charge test circuit

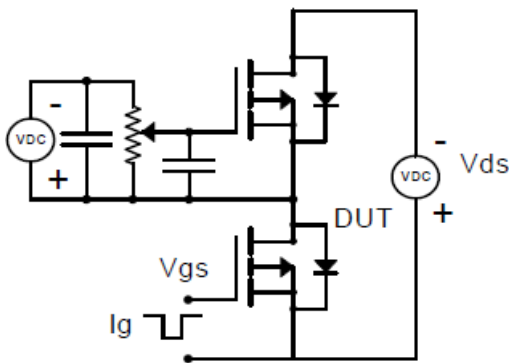
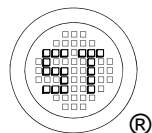
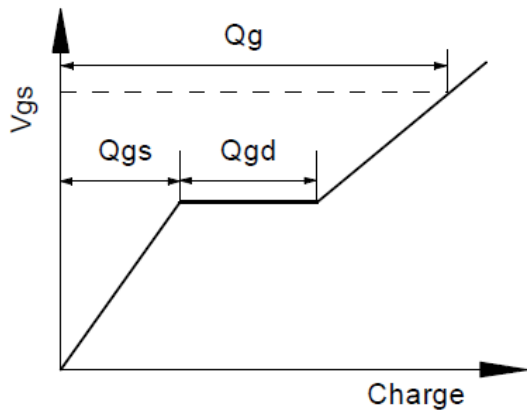


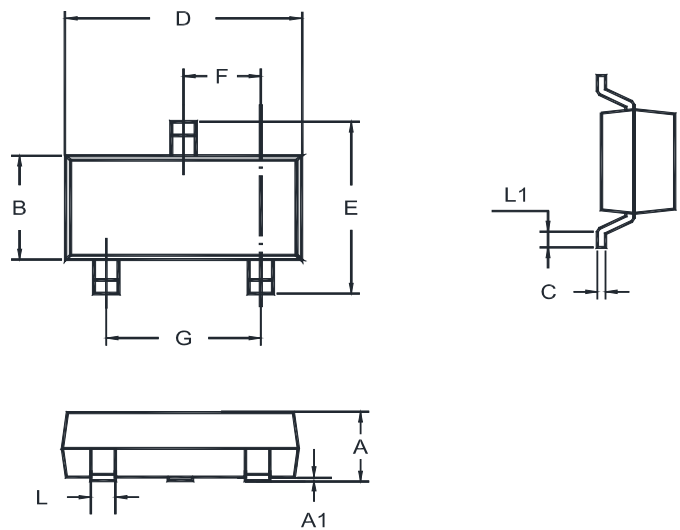
Fig.2-2 Gate charge waveform



MMFTP3409K-HAF

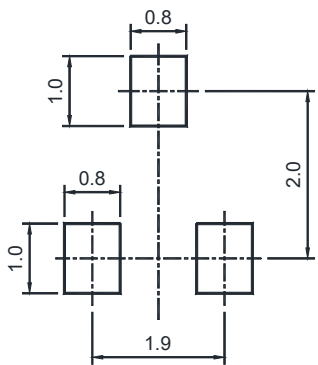
Package Outline (Dimensions in mm)

TO-236



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	
TO-236	8	4 ± 0.1	0.157 ± 0.004	178	7	3,000

Marking information

- " TR " = Part No.
 - " • " = HAF (Halogen and Antimony Free)
 - " YM " = Date Code Marking
 - " Y " = Year
 - " M " = Month
- Font type: Arial

