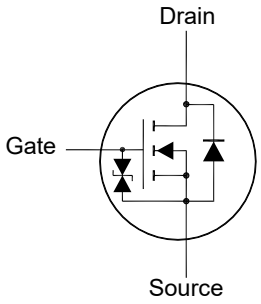
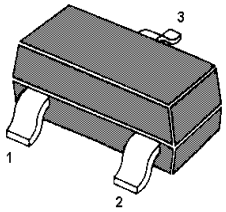
MMFTN3416K-HAF

N-Channel Enhancement Mode MOSFET





1. Gate 2. Source 3. Drain
TO-236 Plastic Package

Features

- Halogen and Antimony Free(HAF), RoHS compliant
- 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

Applications

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

Absolute Maximum Ratings(T_a = 25℃)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	20	V
Gate-Source Voltage	V_{GS}	± 8	V
Continuous Drain Current	I_D	6.5	A
Peak Drain Current, Pulesd [1)]	I_{DM}	30	A
Power Dissipation	P_D	1.4	W
Operating Junction Temperature Range	T_j	- 55 to + 150	℃
Storage Temperature Range	T_{stg}	- 55 to + 150	℃

Thermal Resistance Ratings

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Ambient [2)]	$R_{\theta JA}$	89	℃/W

[1)] Pulse Test: Pulse Width ≤ 100 μs, Duty Cycle ≤ 2%,Repetitive rating, pulse width limited by junction temperature $T_{J(MAX)}$=150°C.

[3)] Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate, t ≤ 10 s.

Dated: 11/11/2020 CL Rev: 02

Characteristics at T_a= 25℃ unless otherwise specified

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at I_D = 250 µA	$V_{(BR)DSS}$	20	-	-	V
Gate Voltage Drain Current at V_{DS} = 16 V	I_{DSS}	-	-	1	µA
Gate-Source Leakage at V_{GS} = ± 4.5 V at V_{GS} = ± 8 V	I_{GSS}	- -	- -	± 1 ± 10	µA
Gate-Source Threshold Voltage at V_{DS} = V_{GS}, I_D = 250 µA	$V_{GS(th)}$	0.4	-	1	V
Drain-Source On-State Resistance at V_{GS} = 4.5 V, I_D = 6.5 A at V_{GS} = 2.5 V, I_D = 5.5 A at V_{GS} = 1.8 V, I_D = 5 A	$R_{DS(on)}$	- - -	- - -	22 26 34	mΩ
DYNAMIC PARAMETERS					
Gate Resistance at V_{GS} = 0 V, V_{DS} = 0 V, f = 1 MHz	R_g	-	1.5	-	KΩ
Forward Transconductance at V_{DS} = 5 V, I_D = 6.5 A	g_{fs}	-	13	-	S
Input Capacitance at V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MH_Z	C_{iss}	-	564	-	pF
Output Capacitance at V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MH_Z	C_{oss}	-	120	-	pF
Reverse Transfer Capacitance at V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MH_Z	C_{rss}	-	25	-	pF
Total Gate Charge at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 4.5 V at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 2.5 V	Q_g	- -	16 10	- -	nC
Gate Source Charge at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 4.5 V	Q_{gs}	-	1	-	nC
Gate Drain Charge at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 4.5 V	Q_{gd}	-	4	-	nC
Turn-On Delay Time at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 5 V, R_{GEN} = 3 Ω	$t_{d(on)}$	-	3.8	-	µs
Turn-On Rise Time at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 5 V, R_{GEN} = 3 Ω	t_r	-	1.9	-	µs
Turn-Off Delay Time at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 5 V, R_{GEN} = 3 Ω	$t_{d(off)}$	-	2.5	-	µs
Turn-Off Fall Time at V_{DS} = 10 V, I_D = 6.5 A, V_{GS} = 5 V, R_{GEN} = 3 Ω	t_f	-	1	-	µs
Body-Diode PARAMETERS					
Body Diode Voltage at I_S = 1 A	V_{SD}	-	-	1	V
Body Diode Reverse Recovery Time at I_S = 5 A, di/dt = 50 A / µs	t_{rr}	-	1.5	-	µS
Body Diode Reverse Recovery Charge at I_S = 5 A, di/dt = 50 A / µs	Q_{rr}	-	10	-	µC

Electrical Characteristics Curves

Fig. 1 Input Characteristic

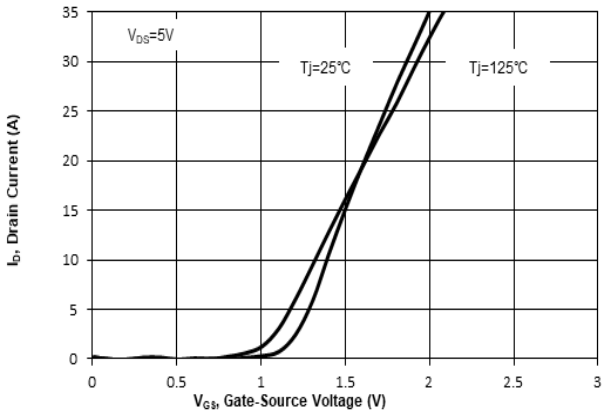


Fig. 2 Output Characteristics

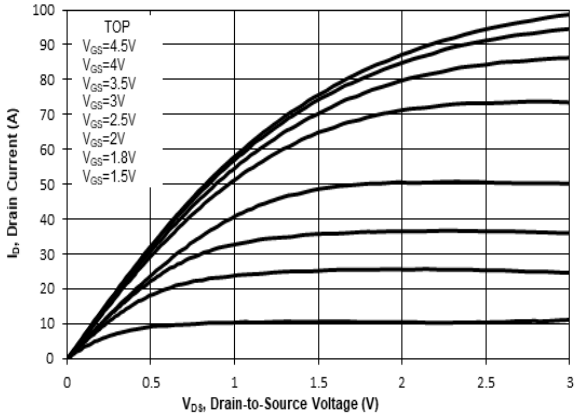


Fig. 3 On-Resistance vs. Drain Current

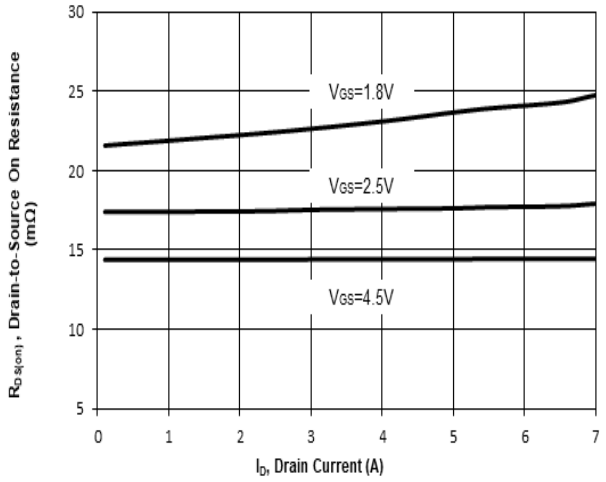


Fig. 4 On-Resistance vs. Gate-Source Voltage

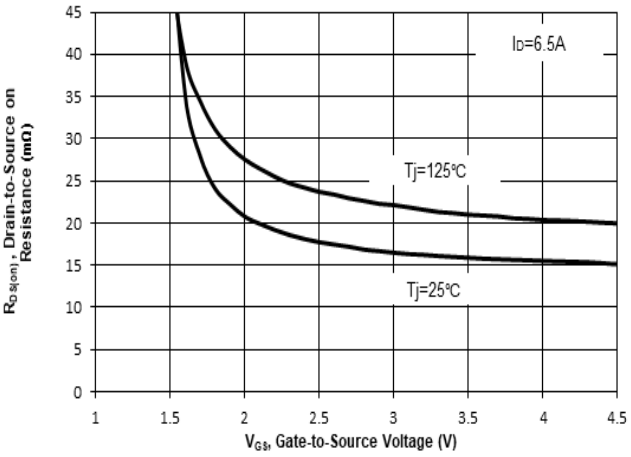


Fig. 5 On-Resistance vs. Junction Temperature

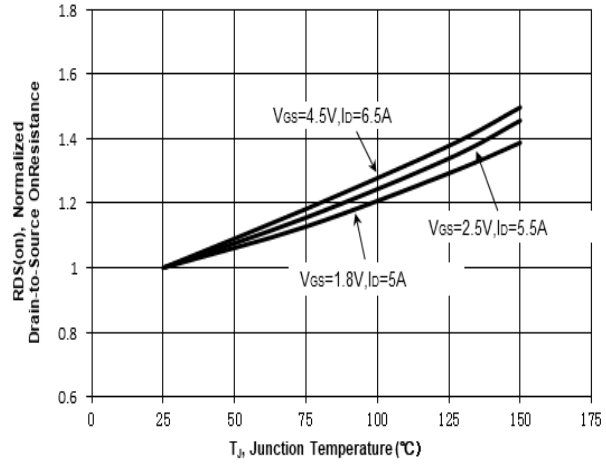
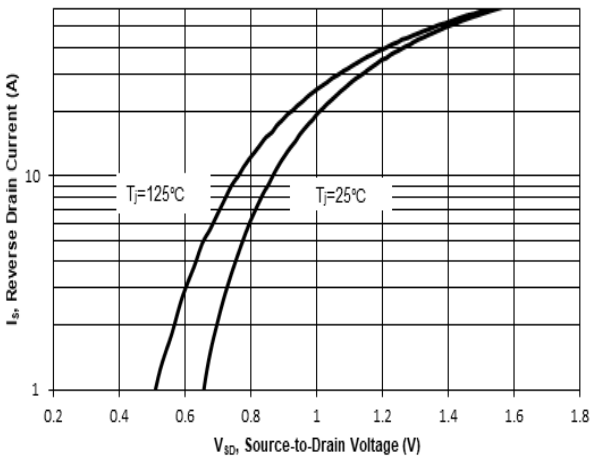


Fig. 6 Typical Forward Characteristics



Electrical Characteristics Curves

Fig. 7 Capacitance Characteristic

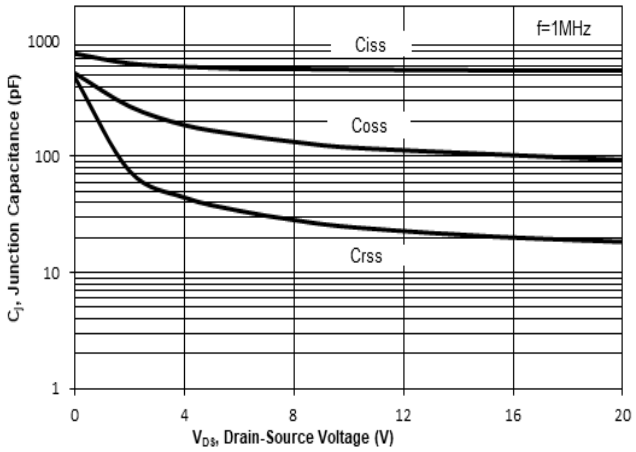


Fig. 8 IDSS vs. Junction Temperature

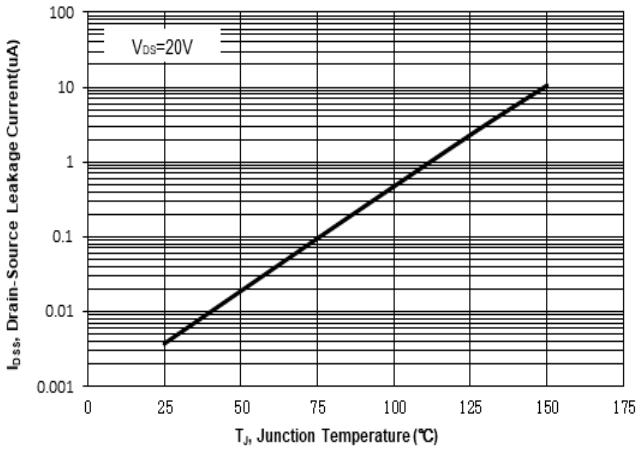


Fig. 9 B_{VDSS} Voltage vs. T_j

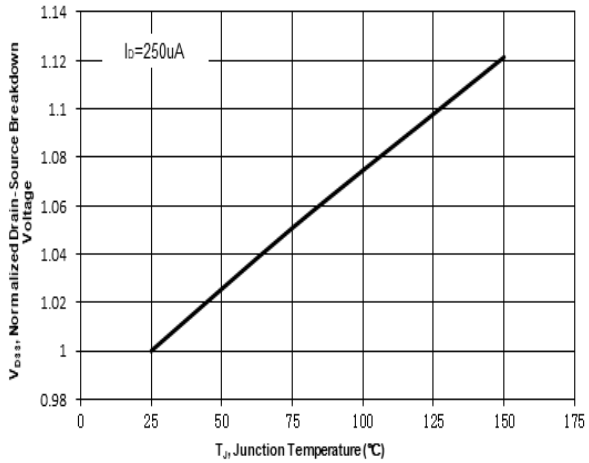


Fig. 10 Gate-Source Threshold Voltage vs. T_j

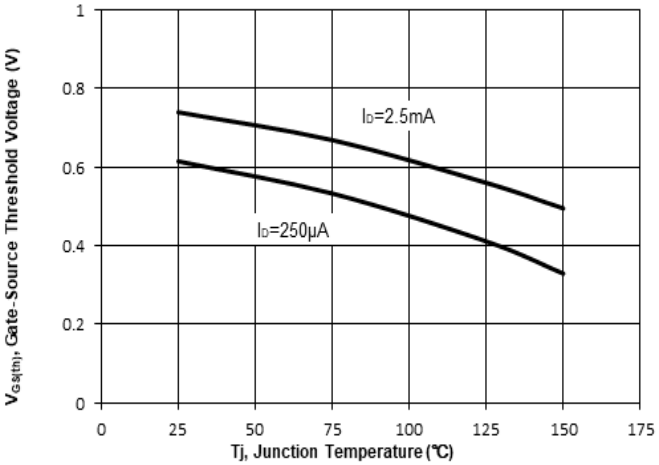
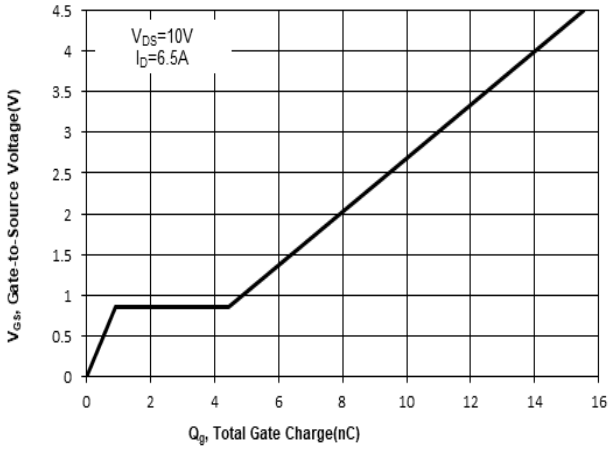


Fig. 11 Gate Charge



Test Circuits

Fig.1-1 Switching times test circuit

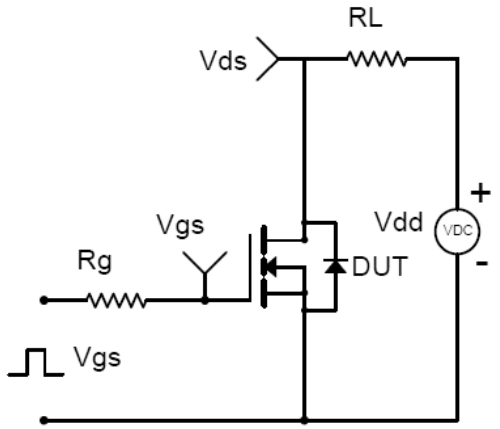


Fig.1-2 Switching Waveform

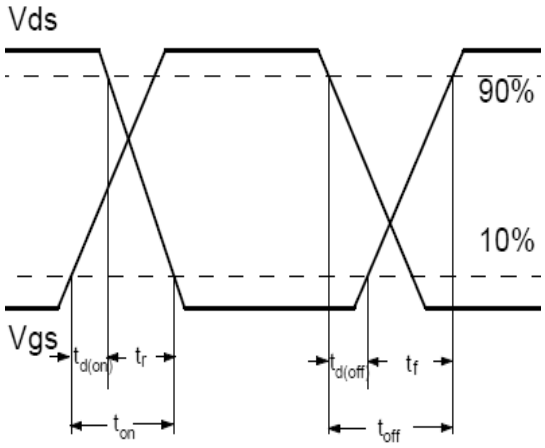


Fig.2-1 Gate charge test circuit

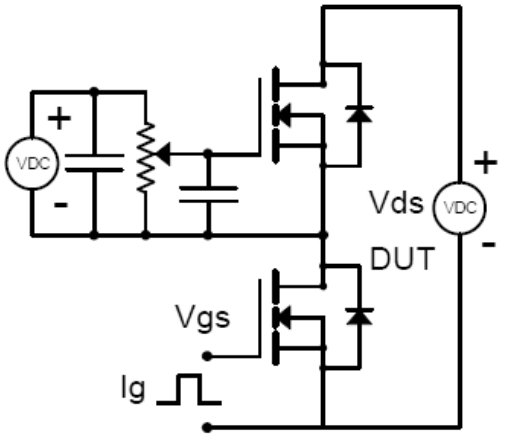
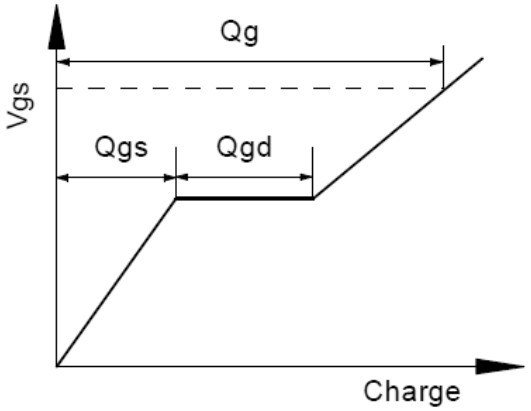
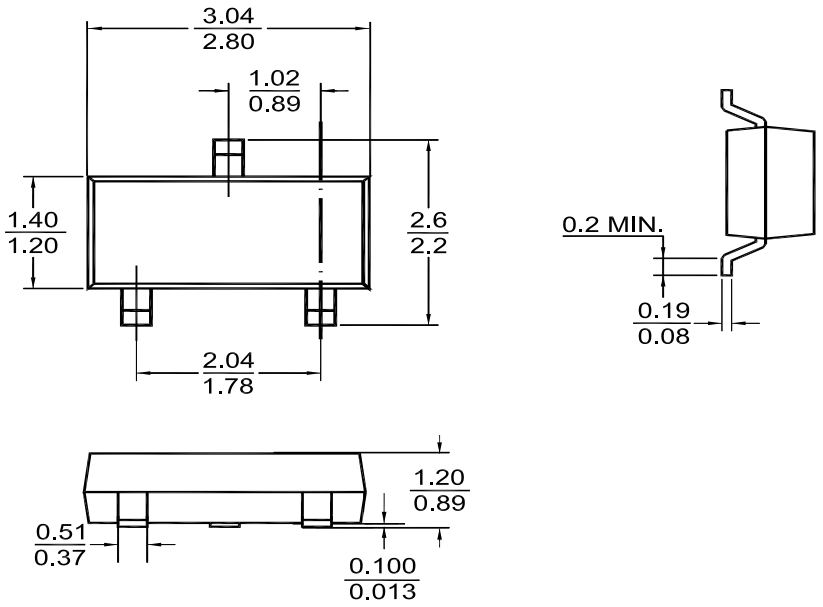


Fig.2-2 Gate charge waveform

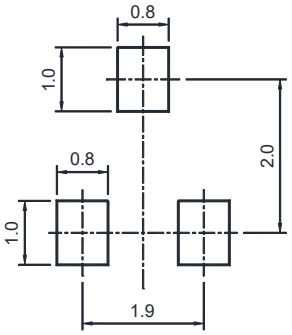


PACKAGE OUTLINE

Plastic surface mounted package (Dimensions in mm) TO-236



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

" VR " = Part No.

" • " = HAF (Halogen and Antimony Free)

"YM" = Date Code Marking

"Y" = Year

"M" = Month

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