

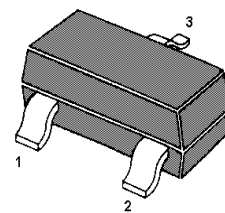
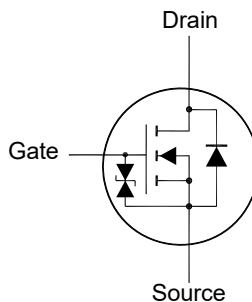
# MMFTN3416K

## N-Channel Enhancement Mode MOSFET

### Features

- 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)

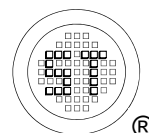
Parameter	Symbol	Value	Unit
Drain-Source Voltage	$V_{DS}$	20	V
Gate-Source Voltage	$V_{GS}$	$\pm 8$	V
Continuous Drain Current	$I_D$	6.5	A
Peak Drain Current, Pulesd <sup>1)</sup>	$I_{DM}$	30	A
Total Power Dissipation <sup>2)</sup> $t \leq 10$ s Steady State	$P_{tot}$	1.4 1	W
Operating Junction and Storage 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 <sup>2)</sup> $t \leq 10$ s Steady State	$R_{\theta JA}$	89 125	$^\circ\text{C/W}$

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

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



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

Parameter	Symbol	Min.	Typ.	Max.	Unit
<b>STATIC PARAMETERS</b>					
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	$\mu\text{A}$
Gate-Source Leakage at $V_{GS} = \pm 4.5\ \text{V}$ at $V_{GS} = \pm 8\ \text{V}$	$I_{GSS}$	- -	- -	$\pm 1$ $\pm 10$	$\mu\text{A}$
Gate-Source Threshold Voltage at $V_{DS} = V_{GS}$ , $I_D = 250\ \mu\text{A}$	$V_{GS(th)}$	0.4	-	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 $V_{GS} = 1.8\ \text{V}$ , $I_D = 5\ \text{A}$	$R_{DS(on)}$	- - -	- - -	22 26 34	m $\Omega$
<b>DYNAMIC PARAMETERS</b>					
Gate Resistance at $V_{GS} = 0\ \text{V}$ , $V_{DS} = 0\ \text{V}$ , $f = 1\ \text{MHz}$	$R_g$	-	1.5	-	K $\Omega$
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 $V_{DS} = 10\ \text{V}$ , $I_D = 6.5\ \text{A}$ , $V_{GS} = 5\ \text{V}$ , $R_{GEN} = 3.3\ \Omega$	$t_{d(on)}$	-	3.8	-	$\mu\text{s}$
Turn-On Rise Time at $V_{DS} = 10\ \text{V}$ , $I_D = 6.5\ \text{A}$ , $V_{GS} = 5\ \text{V}$ , $R_{GEN} = 3.3\ \Omega$	$t_r$	-	1.9	-	$\mu\text{s}$
Turn-Off Delay Time at $V_{DS} = 10\ \text{V}$ , $I_D = 6.5\ \text{A}$ , $V_{GS} = 5\ \text{V}$ , $R_{GEN} = 3.3\ \Omega$	$t_{d(off)}$	-	2.5	-	$\mu\text{s}$
Turn-Off Fall Time at $V_{DS} = 10\ \text{V}$ , $I_D = 6.5\ \text{A}$ , $V_{GS} = 5\ \text{V}$ , $R_{GEN} = 3.3\ \Omega$	$t_f$	-	1	-	$\mu\text{s}$
<b>Body-Diode PARAMETERS</b>					
Body Diode Voltage at $I_S = 1\ \text{A}$	$V_{SD}$	-	-	1	V
Body-Diode Continuous Current	$I_S$	-	-	6.5	A
Body Diode Reverse Recovery Time at $I_S = 5\ \text{A}$ , $di/dt = 50\ \text{A} / \mu\text{s}$	$t_{rr}$	-	1.5	-	$\mu\text{s}$
Body Diode Reverse Recovery Charge at $I_S = 5\ \text{A}$ , $di/dt = 50\ \text{A} / \mu\text{s}$	$Q_{rr}$	-	10	-	$\mu\text{C}$

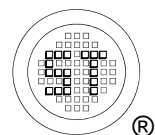


Fig. 1 Input Characteristics

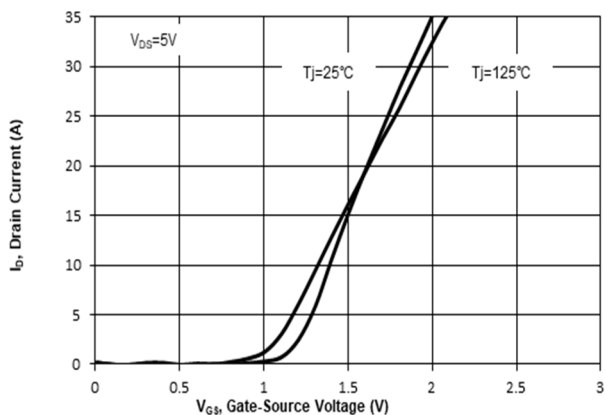


Fig. 2 Output Characteristics

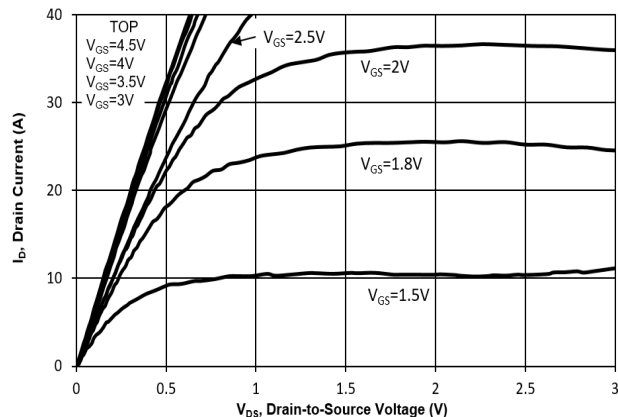


Fig. 3 On-Resistance vs. Drain Current

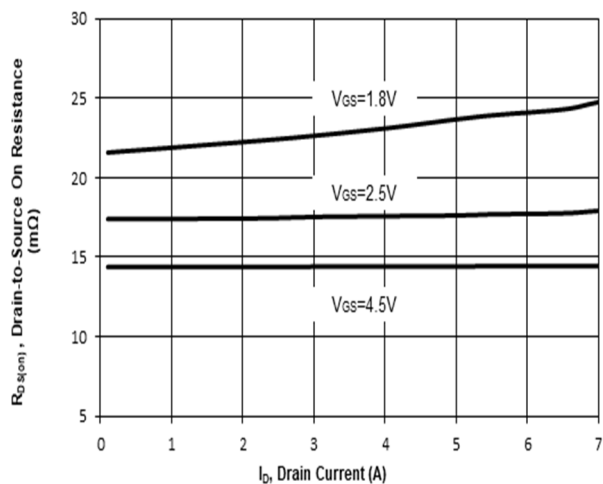


Fig. 4 On-Resistance vs. Gate-Source Voltage

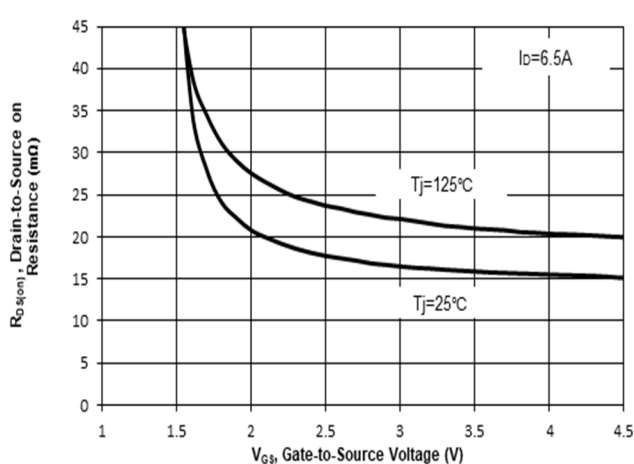


Fig. 5 On-Resistance vs. Junction Temperature

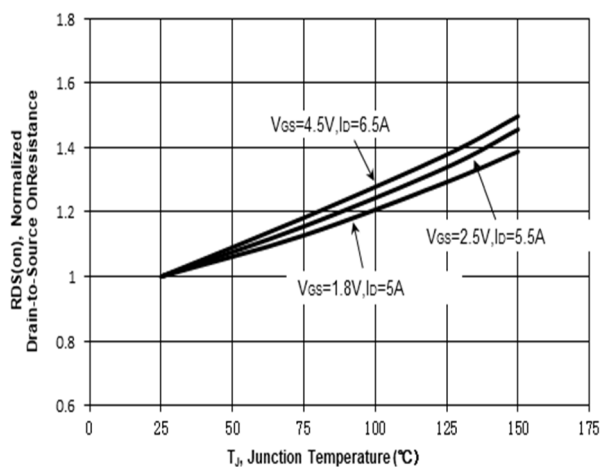
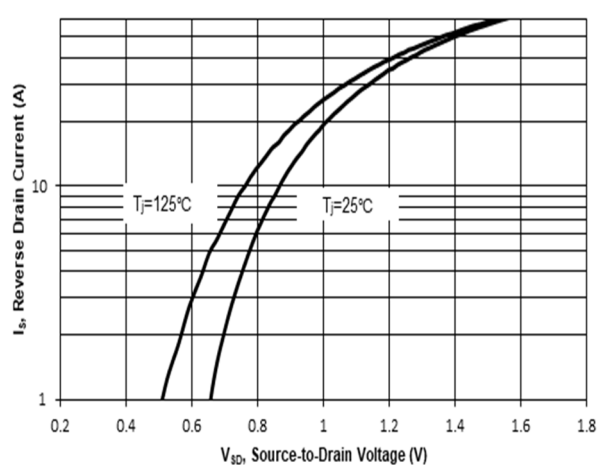


Fig. 6 Typical Forward Characteristics



# MMFTN3416K

## Electrical Characteristics Curves

Fig. 7 Capacitance Characteristics

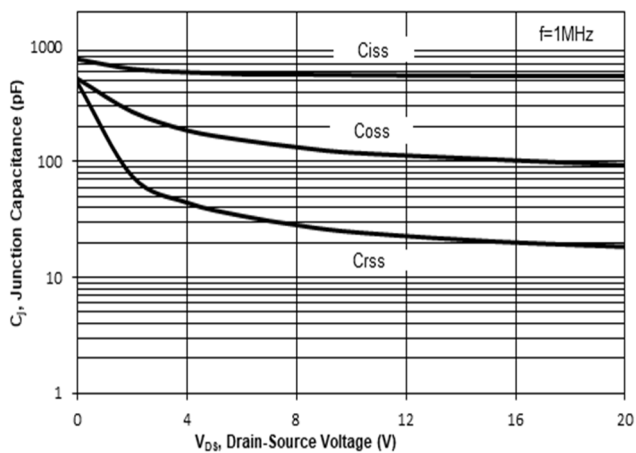


Fig. 8  $I_{DSS}$  vs. Junction Temperature

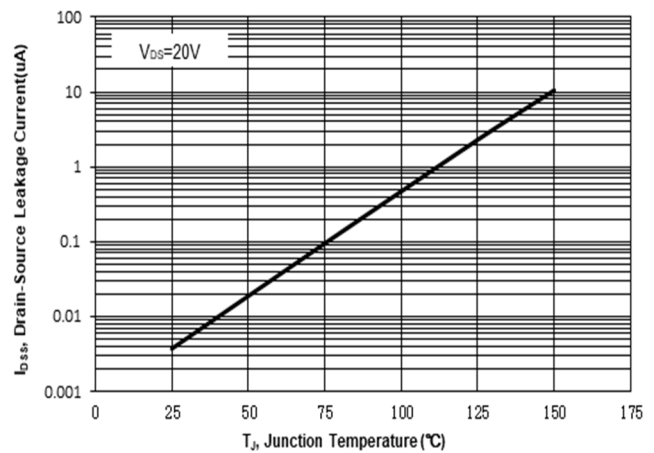


Fig. 9  $V_{(BR)DSS}$  vs. Junction Temperature

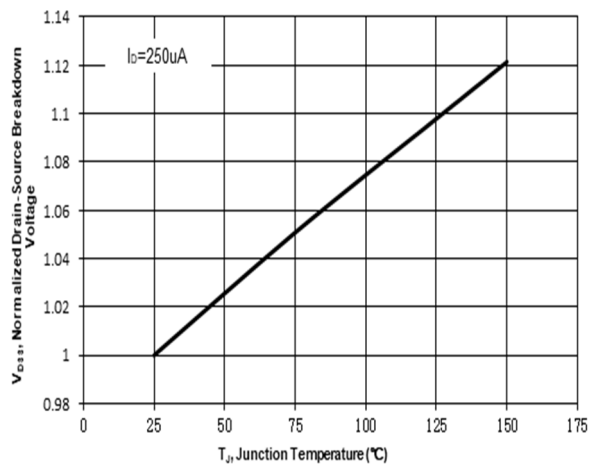


Fig. 10 Gate-Source Threshold Voltage vs.  $T_J$

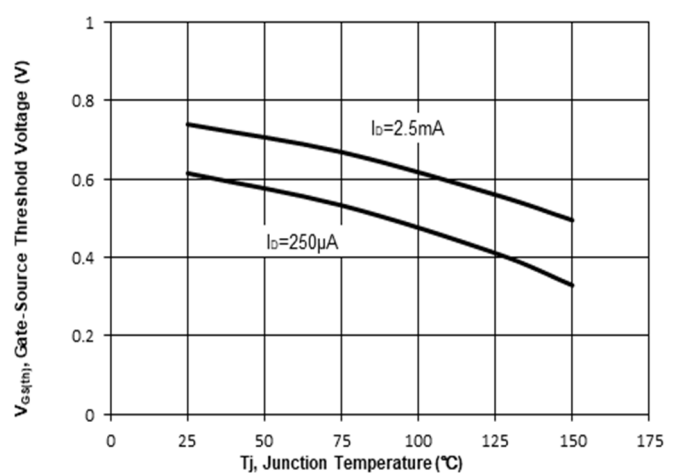
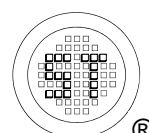
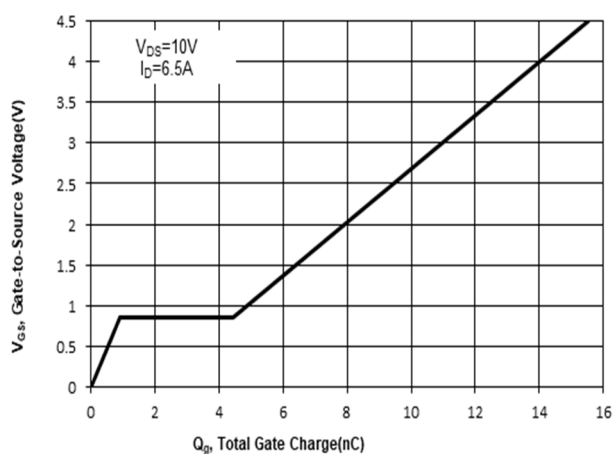


Fig. 11 Gate Charge



Test Circuits

Fig.1-1 Switching times test circuit

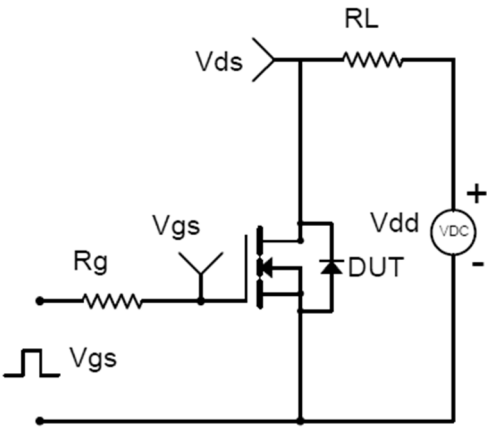


Fig.1-2 Switching Waveform

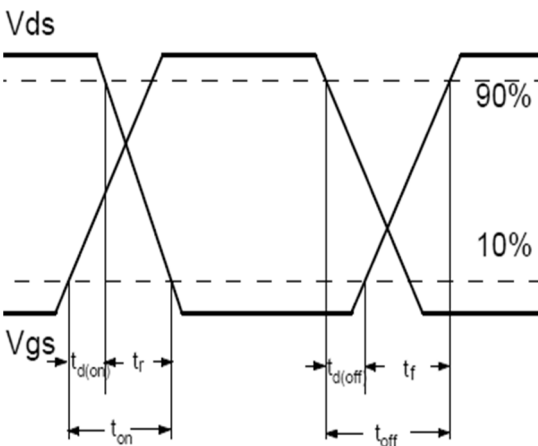


Fig.2-1 Gate charge test circuit

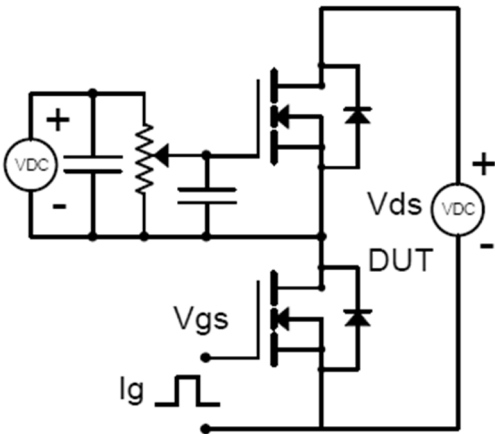
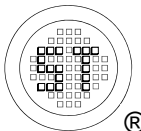
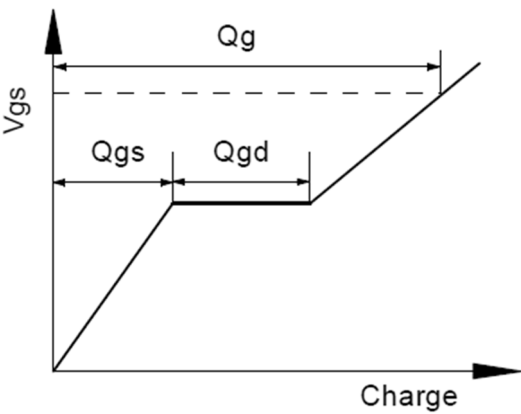


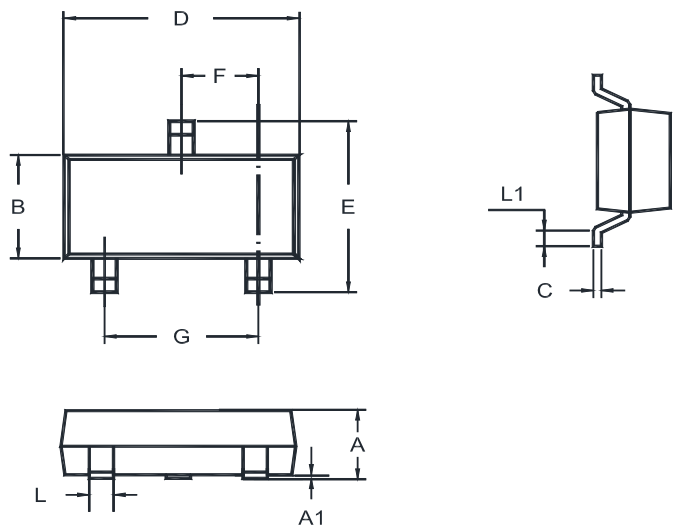
Fig.2-2 Gate charge waveform



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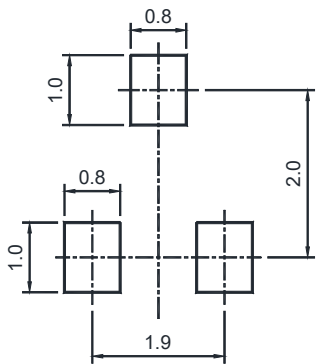
## Package Outline (Dimensions in mm)

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



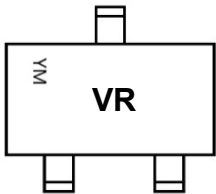
## Packing information

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

Font type: Arial



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