# MMFTP336

P-Channel Enhancement Mode MOSFET

Features

• Surface-mounted package

Applications

• Portable appliances
• Battery management
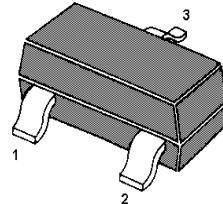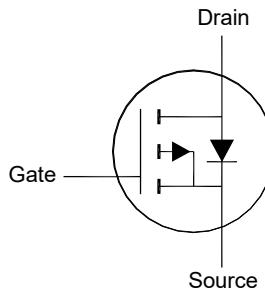
1. Gate 2. Source 3. Drain
SOT-23 Plastic Package

Absolute Maximum Ratings (T$_a$ = 25℃)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	-V$_{DS}$	20	V
Gate-Source Voltage	V$_{GS}$	± 10	V
Continuous Drain Current	-I$_D$	2.5	A
Peak Drain Current, Pulsed [1]	-I$_{DM}$	20	A
Power Dissipation [2]	P$_D$	0.5	W
Operating Junction Temperature Range	T$_j$	- 55 to + 150	℃
Storage Temperature Range	T$_{stg}$	- 55 to + 150	℃

Thermal Characteristics

Parameter	Symbol	Max.	Unit
Thermal Resistance from Junction to Ambient	R$_{θJA}$	250 [2] 100 [3]	℃/W

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

[2] Device mounted on FR-4 substrate PC board, with minimum recommended pad layout.

[3] Device mounted on FR-4 substrate PC board, 2oz copper, with 1-inch square copper plate in still air.
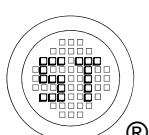
Characteristics at T$_a$= 25℃ unless otherwise specified

Parameter	Symbol	Min.	Typ.	Max.	Unit
STATIC PARAMETERS					
Drain-Source Breakdown Voltage at -I$_D$ = 250 µA	-V$_{(BR)DSS}$	20	-	-	V
Zero Gate Voltage Drain Current at -V$_{DS}$ = 16 V	-I$_{DSS}$	-	-	1	µA
Gate-Source Leakage at V$_{GS}$ = ± 8 V	I$_{GSS}$	-	-	± 100	nA
On state drain current at -V$_{DS}$ = 5 V, -V$_{GS}$ = 4.5 V	-I$_{D(ON)}$	5	-	-	A
Gate-Source Threshold Voltage at V$_{DS}$ = V$_{GS}$, -I$_D$ = 250 µA	-V$_{GS(th)}$	0.4	-	1.5	V
Drain-Source On-State Resistance at -V$_{GS}$ = 4.5 V, -I$_D$ = 1.3 A at -V$_{GS}$ = 2.5 V, -I$_D$ = 1.1 A	R$_{DS(on)}$	- -	100 -	200 270	mΩ
DYNAMIC PARAMETERS					
Forward Transconductance at -V$_{DS}$ = 5 V, -I$_D$ = 2.5 A	g$_{fs}$	-	6.9	-	S
Gate resistance at V$_{DS}$ = 0 V, V$_{GS}$ = 0 V, f = 1 MHz	R$_g$	-	18.4	-	Ω
Input Capacitance at -V$_{DS}$ = 10 V, V$_{GS}$ = 0 V, f = 1 MHz	C$_{iss}$	-	337	-	pF
Output Capacitance at -V$_{DS}$ = 10 V, V$_{GS}$ = 0 V, f = 1 MHz	C$_{oss}$	-	71	-	pF
Reverse Transfer Capacitance at -V$_{DS}$ = 10 V, V$_{GS}$ = 0 V, f = 1 MHz	C$_{rss}$	-	50	-	pF
Total Gate Charge at -V$_{GS}$ = 4.5 V, -V$_{DS}$ = 10 V, -I$_D$ = 2.5 A at -V$_{GS}$ = 2.5 V, -V$_{DS}$ = 10 V, -I$_D$ = 2.5 A	Q$_g$	- -	4.7 2.8	- -	nC
Gate-Source Charge at -V$_{GS}$ = 4.5 V, -V$_{DS}$ = 10 V, -I$_D$ = 2.5 A	Q$_{gs}$	-	0.8	-	nC
Gate-Drain Charge at -V$_{GS}$ = 4.5 V, -V$_{DS}$ = 10 V, -I$_D$ = 2.5 A	Q$_{gd}$	-	1.5	-	nC
Turn-On Delay Time at -V$_{DD}$ = 10 V, -I$_D$ = 2.5 A, -V$_{GS}$ = 4.5 V, R$_G$ = 4.7 Ω	t$_{d(on)}$	-	10.7	-	nS
Turn-On Rise Time at -V$_{DD}$ = 10 V, -I$_D$ = 2.5 A, -V$_{GS}$ = 4.5 V, R$_G$ = 4.7 Ω	t$_r$	-	40	-	nS
Turn-Off Delay Time at -V$_{DD}$ = 10 V, -I$_D$ = 2.5 A, -V$_{GS}$ = 4.5 V, R$_G$ = 4.7 Ω	t$_{d(off)}$	-	19	-	nS
Turn-Off Fall Time at -V$_{DD}$ = 10 V, -I$_D$ = 2.5 A, -V$_{GS}$ = 4.5 V, R$_G$ = 4.7 Ω	t$_f$	-	10	-	nS
Body-Diode PARAMETERS					
Drain-Source Diode Forward Voltage at -I$_S$ = 0.42 A	-V$_{SD}$	-	-	1.2	V
Body-Diode Continuous Current	-I$_S$	-	-	2.5	A
Body Diode Reverse Recovery Time at -I$_S$ = 2.5 A, di/dt = 50 A / µs	t$_{rr}$	-	7.4	-	nS
Body Diode Reverse Recovery Charge at -I$_S$ = 2.5 A, di/dt = 50 A / µs	Q$_{rr}$	-	1.2	-	nC
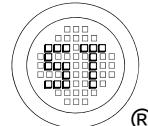
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Electrical Characteristics Curves

Fig. 1 Typical Output Characteristics

Fig. 2 Typical Transfer Characteristics


Fig. 3 on-Resistance vs. Drain Current
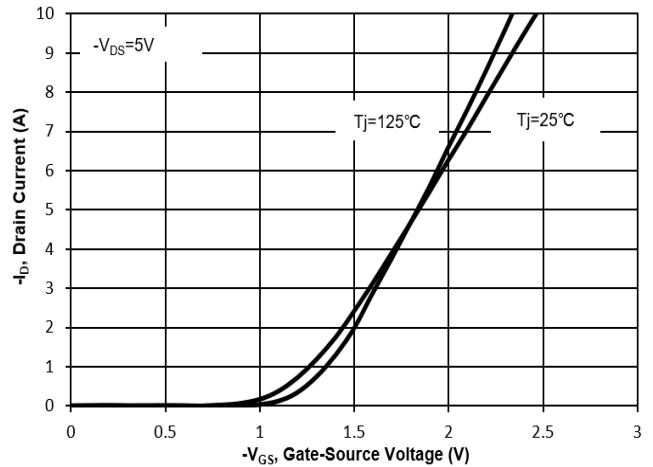
Fig. 4 on-Resistance vs. Gate Voltage


Fig. 5 on-Resistance vs.T_j
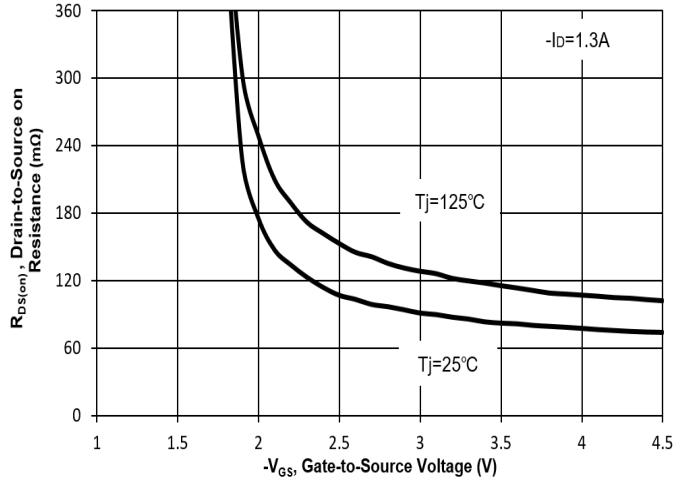
Fig. 6 Typical Forward Characteristics
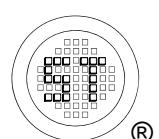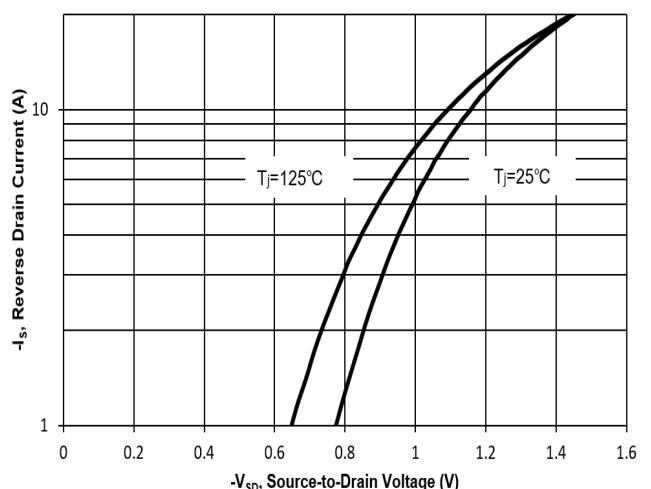
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Electrical Characteristics Curves

Fig. 7 Typical Junction Capacitance

C_j, Junction Capacitance (pF) vs. $-V_{DS}$, Drain-Source Voltage (V)

f=1MHz

Ciss
Coss
Crss
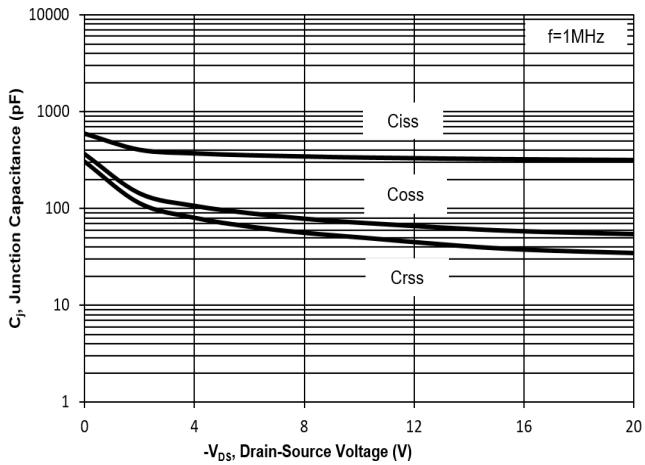
Fig. 8 Drain-Source Leakage Current vs. T_j

$-I_{DSS}$, Drain-Source Leakage Current (μA) vs. T_J, Junction Temperature (℃)

$-V_{DS}$=20V
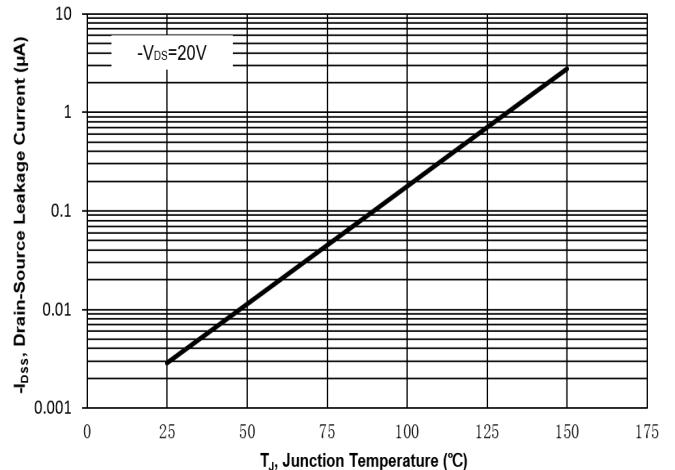
Fig. 9 $V_{(BR)DSS}$ vs. Junction Temperature

$-V_{DSS}$, Normalized Drain-Source Breakdown Voltage vs. T_J, Junction Temperature (℃)

$-I_D$=250μA
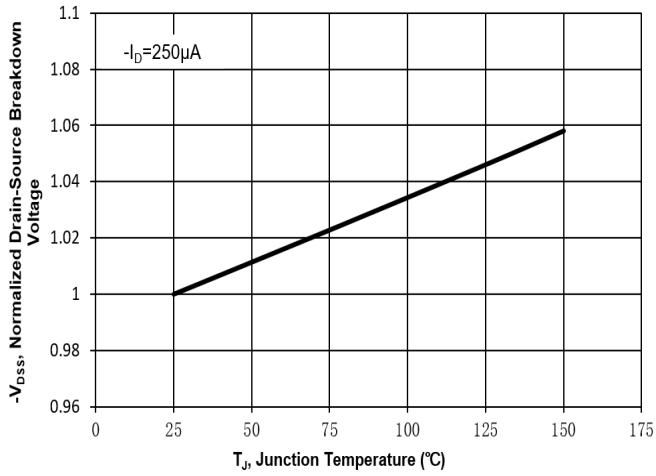
Fig. 10 Gate Threshold Variation vs. T_j

$-V_{GS(th)}$, Gate-Source Threshold Voltage (V) vs. T_j, Junction Temperature (℃)

$-I_D$=2.5mA

$-I_D$=250μA

Fig. 11 Gate Charge

$-V_{GS}$, Gate-to-Source Voltage(V) vs. Q_g, Total Gate Charge(nC)

$-V_{DS}$=10V
$-I_D$=2.5A
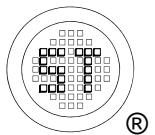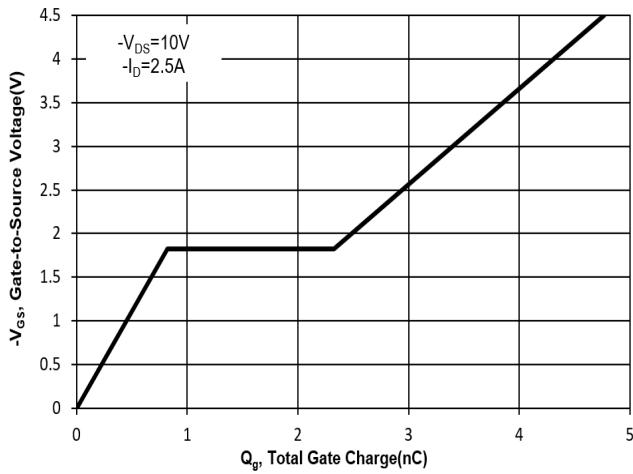
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## Test Circuits

Fig.1-1 Switching times test circuit
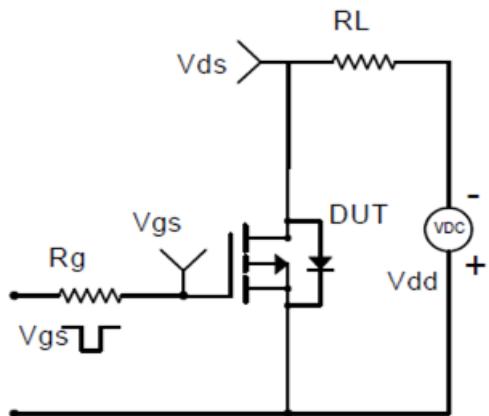

### Fig.1-2 Switching Waveform
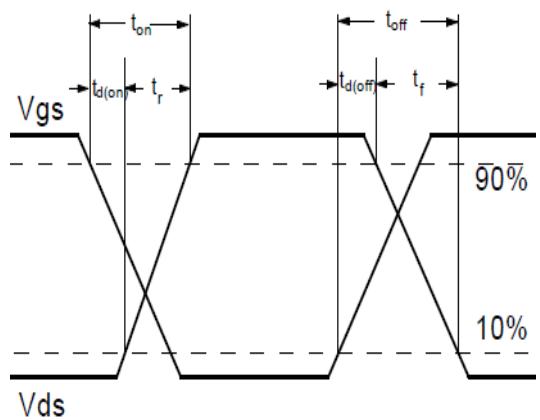
Fig.2-1 Gate charge test circuit
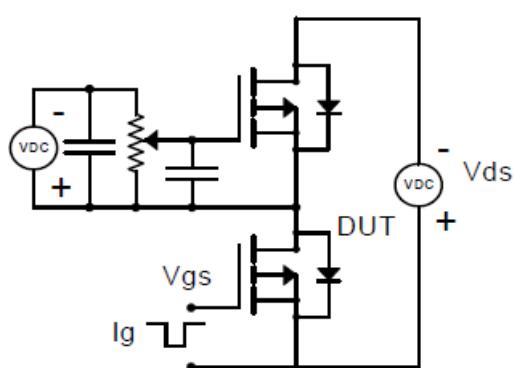
Fig.2-2 Gate charge waveform
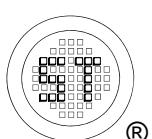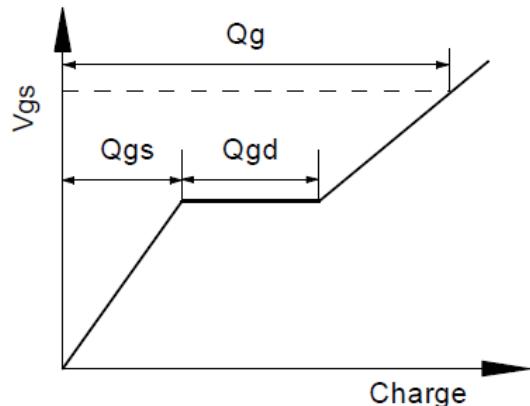
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Package Outline (Dimensions in mm)

SOT-23
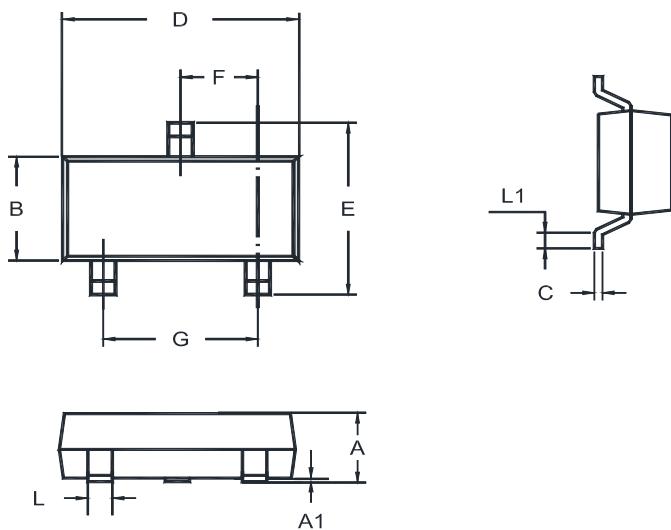
Unit	A	A1	B	C	D	E	F	G	L	L1
mm	1.20	0.100	1.40	0.19	3.04	2.6	1.02	2.04	0.51	0.2
	0.89	0.013	1.20	0.08	2.80	2.2	0.89	1.78	0.37	MIN

Recommended Soldering Footprint
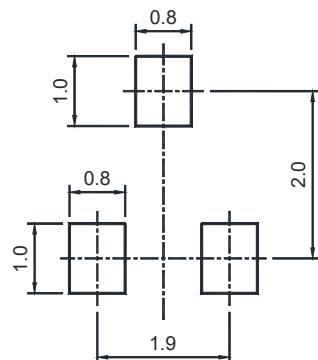
Packing information

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

" MQ " = Part No.

" YM " = Date Code Marking

" Y " = Year

" M " = Month

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