

# MMDFS6N303

## Product Preview

# Power MOSFET 6 Amps, 30 Volts

## N-Channel SO-8, FETKY™

The FETKY product family incorporates low  $R_{DS(on)}$ , true logic level MOSFETs packaged with industry leading, low forward drop, low leakage Schottky Barrier rectifiers to offer high efficiency components in a space saving configuration. Independent pinouts for MOSFET and Schottky die allow the flexibility to use a single component for switching and rectification functions in a wide variety of applications such as Buck Converter, Buck-Boost, Synchronous Rectification, Low Voltage Motor Control, and Load Management in Battery Packs, Chargers, Cell Phones and other Portable Products.

- Power MOSFET with Low  $V_F$
- Lower Component Placement and Inventory Costs along with Board Space Savings
- Logic Level Gate Drive — Can be Driven by Logic ICs
- Mounting Information for SO-8 Package Provided
- Applications Information Provided
- R2 Suffix for Tape and Reel (2500 units/13" reel)
- Marking: 6N303

### MOSFET MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise noted) (Note 1.)

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	$V_{DSS}$	30	Vdc
Drain-to-Gate Voltage ( $R_{GS} = 1.0\text{ M}\Omega$ )	$V_{DGR}$	30	Vdc
Gate-to-Source Voltage — Continuous	$V_{GS}$	$\pm 20$	Vdc
Drain Current (Note 2.)			
— Continuous @ $T_A = 25^\circ\text{C}$	$I_D$	6.0	Adc
— Single Pulse ( $t_p \leq 10\ \mu\text{s}$ )	$I_{DM}$	30	Apk
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ (Note 2.)	$P_D$	2.0	Watts
Single Pulse Drain-to-Source Avalanche Energy — STARTING $T_J = 25^\circ\text{C}$ $V_{DD} = 30\text{ Vdc}$ , $V_{GS} = 5.0\text{ Vdc}$ , $V_{DS} = 20\text{ Vdc}$ , $I_L = 9.0\text{ Apk}$ , $L = 10\text{ mH}$ , $R_G = 25\ \Omega$	$E_{AS}$	325	mJ

1. Pulse Test: Pulse Width  $\leq 250\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .
2. Mounted on 2" square FR4 board (1" sq. 2 oz. Cu 0.06" thick single sided), 10 sec. max.

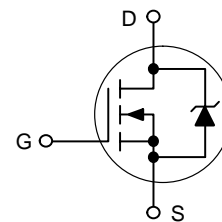


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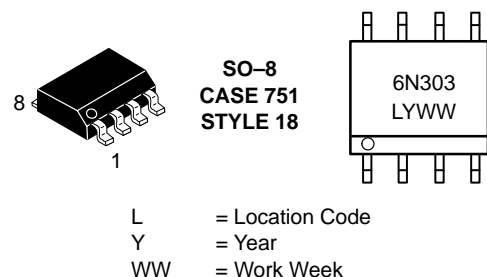
<http://onsemi.com>

**6 AMPERES**  
**30 VOLTS**  
 **$R_{DS(on)} = 35\text{ m}\Omega$**   
 **$V_F = 0.42\text{ Volts}$**

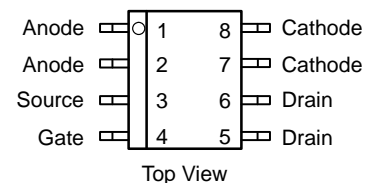
### N-Channel



### MARKING DIAGRAM



### PIN ASSIGNMENT



### ORDERING INFORMATION

Device	Package	Shipping
MMDFS6N303R2	SO-8	2500 Tape & Reel

This document contains information on a product under development. ON Semiconductor reserves the right to change or discontinue this product without notice.

# MMDFS6N303

## SCHOTTKY RECTIFIER MAXIMUM RATINGS (T<sub>J</sub> = 25°C unless otherwise noted)

Peak Repetitive Reverse Voltage DC Blocking Voltage	V <sub>RRM</sub> V <sub>R</sub>	30	Volts
Average Forward Current (Note 2.) (Rated V <sub>R</sub> ) T <sub>A</sub> = 104°C	I <sub>O</sub>	2.0	Amps
Peak Repetitive Forward Current (Note 2.) (Rated V <sub>R</sub> , Square Wave, 20 kHz) T <sub>A</sub> = 108°C	I <sub>frm</sub>	4.0	Amps
Non-Repetitive Peak Surge Current (Surge applied at rated load conditions, halfwave, single phase, 60 Hz)	I <sub>fsm</sub>	30	Amps

## THERMAL CHARACTERISTICS — SCHOTTKY AND MOSFET

Thermal Resistance — Junction-to-Ambient (Note 3.) — MOSFET	R <sub>θJA</sub>	167	°C/W
Thermal Resistance — Junction-to-Ambient (Note 4.) — MOSFET	R <sub>θJA</sub>	97	
Thermal Resistance — Junction-to-Ambient (Note 2.) — MOSFET	R <sub>θJA</sub>	62.5	
Thermal Resistance — Junction-to-Ambient (Note 3.) — Schottky	R <sub>θJA</sub>	197	
Thermal Resistance — Junction-to-Ambient (Note 4.) — Schottky	R <sub>θJA</sub>	97	
Thermal Resistance — Junction-to-Ambient (Note 2.) — Schottky	R <sub>θJA</sub>	62.5	
Operating and Storage Temperature Range	T <sub>j</sub> , T <sub>stg</sub>	-55 to 150	

- Mounted on 2" square FR4 board (1" sq. 2 oz. Cu 0.06" thick single sided), 10 sec. max.
- Mounted with minimum recommended pad size, PC Board FR4.
- Mounted on 2" square FR4 board (1" sq. 2 oz. Cu 0.06" thick single sided), Steady State.

## MOSFET ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted) (Note 5.)

Characteristic	Symbol	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Drain-Source Voltage (V <sub>GS</sub> = 0 Vdc, I <sub>D</sub> = 0.25 mA) Temperature Coefficient (Positive)	V <sub>(BR)DSS</sub>	30	—	—	Vdc mV/°C
Zero Gate Drain Current (V <sub>DS</sub> = 24 Vdc, V <sub>GS</sub> = 0 Vdc) (V <sub>DS</sub> = 24 Vdc, V <sub>GS</sub> = 0 Vdc, T <sub>J</sub> = 125°C)	I <sub>DSS</sub>	—	—	1.0 20	μAdc
Gate Body Leakage Current (V <sub>GS</sub> = ± 20 Vdc, V <sub>DS</sub> = 0)	I <sub>GSS</sub>	—	—	100	nAdc

### ON CHARACTERISTICS (Note 5.)

Gate Threshold Voltage (V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 0.25 mA) Temperature Coefficient (Negative)	V <sub>GS(th)</sub>	1.0	—	—	Vdc
Static Drain-Source Resistance (V <sub>GS</sub> = 10 Vdc, I <sub>D</sub> = 5.0 Adc) (V <sub>GS</sub> = 4.5 Vdc, I <sub>D</sub> = 3.9 Adc)	R <sub>DSON</sub>	—	28 42	35 50	mΩ
Forward Transconductance (V <sub>DS</sub> = 15 Vdc, I <sub>D</sub> = 5.0 Adc)	g <sub>FS</sub>	—	9.0	—	mos

### DYNAMIC CHARACTERISTICS

Input Capacitance	(V <sub>DS</sub> = 24 Vdc, V <sub>GS</sub> = 0 Vdc, f = 1.0 MHz)	C <sub>iss</sub>	—	430	600	pF
Output Capacitance		C <sub>oss</sub>	—	217	300	
Reverse Transfer Capacitance		C <sub>rss</sub>	—	67.5	135	

- Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

# MMDFS6N303

## MOSFET ELECTRICAL CHARACTERISTICS – continued ( $T_C = 25^\circ\text{C}$ unless otherwise noted) (Note 5.)

Characteristic	Symbol	Min	Typ	Max	Unit	
<b>SWITCHING CHARACTERISTICS</b> (Note 6.)						
Turn-On Delay Time	$(V_{DD} = 15\text{ Vdc}, I_D = 1.0\text{ Adc}, V_{GS} = 10\text{ Vdc}, R_G = 6.0\ \Omega)$	$t_{d(on)}$	—	8.2	16.5	ns
Rise Time		$t_r$	—	8.5	17	
Turn-Off Delay Time		$t_{d(off)}$	—	89.6	179	
Fall Time		$t_f$	—	61.1	122	
Gate Charge	$(V_{DS} = 15\text{ Vdc}, I_D = 5.0\text{ Adc}, V_{GS} = 10\text{ Vdc})$	$Q_T$	—	15.7	31.4	nC
		$Q_1$	—	2.0	—	
		$Q_2$	—	4.6	—	
		$Q_3$	—	3.9	—	

## DRAIN SOURCE DIODE CHARACTERISTICS

Forward On-Voltage (Note 5.)	$(I_S = 1.7\text{ Adc}, V_{GS} = 0\text{ Vdc})$	$V_{SD}$	—	0.77	1.2	Vdc
Reverse Recovery Time	$(V_{GS} = 0\text{ V}, I_S = 5.0\text{ A}, dI_S/dt = 100\text{ A}/\mu\text{s})$	$t_{rr}$	—	54.5	—	ns
		$t_a$	—	14.8	—	
		$t_b$	—	39.7	—	
Reverse Recovery Stored Charge		$Q_{RR}$	—	0.048	—	$\mu\text{C}$

## SCHOTTKY RECTIFIER ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

Maximum Instantaneous Forward Voltage (Note 5.) $I_F = 100\text{ mAdc}$ $I_F = 3.0\text{ Adc}$ $I_F = 6.0\text{ Adc}$	$V_F$	<b><math>T_J = 25^\circ\text{C}</math></b>	<b><math>T_J = 125^\circ\text{C}</math></b>	Volts
		0.28	0.13	
		0.42	0.33	
		0.50	0.45	
Maximum Instantaneous Reverse Current (Note 5.) $V_R = 30\text{ V}$	$I_R$	<b><math>T_J = 25^\circ\text{C}</math></b>	<b><math>T_J = 125^\circ\text{C}</math></b>	$\mu\text{A}$
		250	—	
		—	25	mA
Maximum Voltage Rate of Change $V_R = 30\text{ V}$	$dV/dt$	10,000		$\text{V}/\mu\text{s}$

5. Pulse Test: Pulse Width  $\leq 300\ \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

6. Switching characteristics are independent of operating junction temperature.

TYPICAL FET ELECTRICAL CHARACTERISTICS

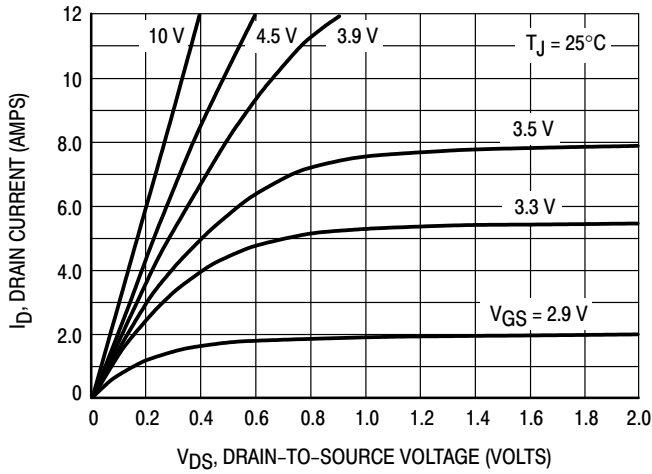


Figure 1. On-Region Characteristics

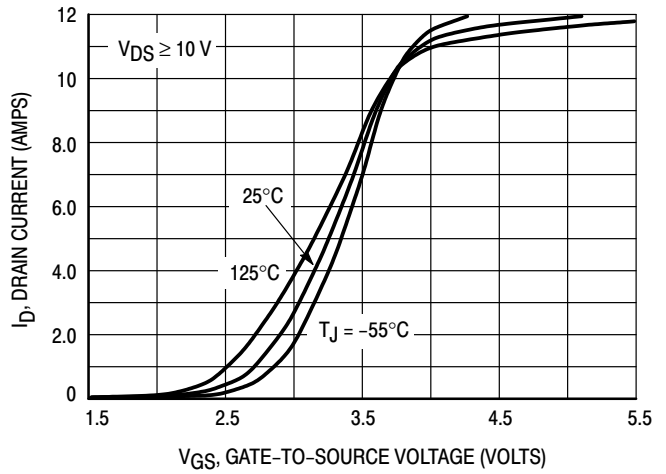


Figure 2. Transfer Characteristics

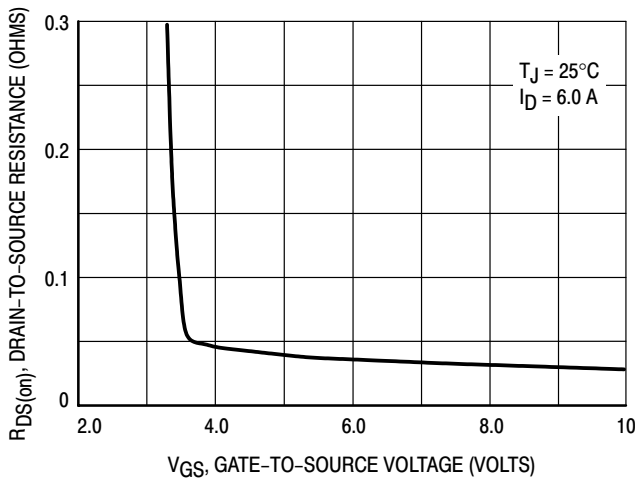


Figure 3. On-Resistance versus Gate-to-Source Voltage

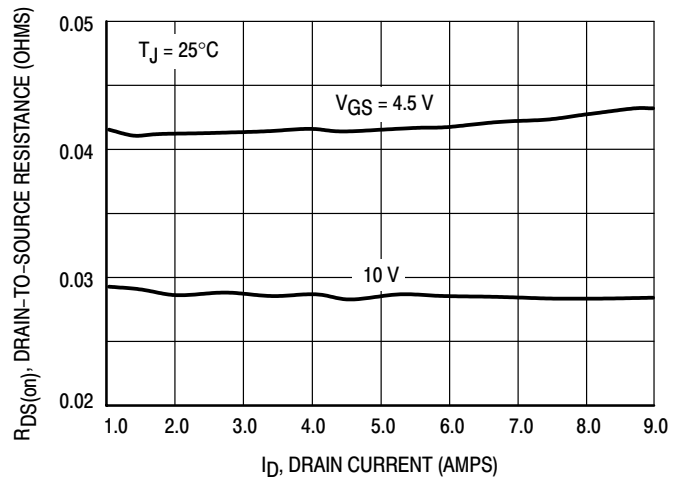


Figure 4. On-Resistance versus Drain Current and Gate Voltage

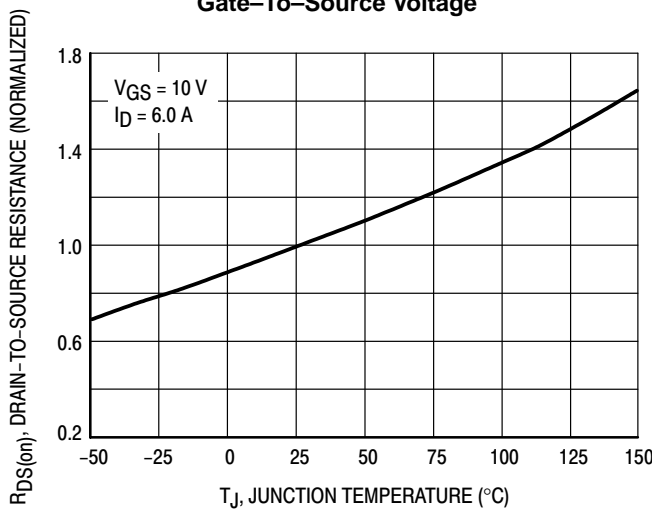


Figure 5. On-Resistance Variation with Temperature

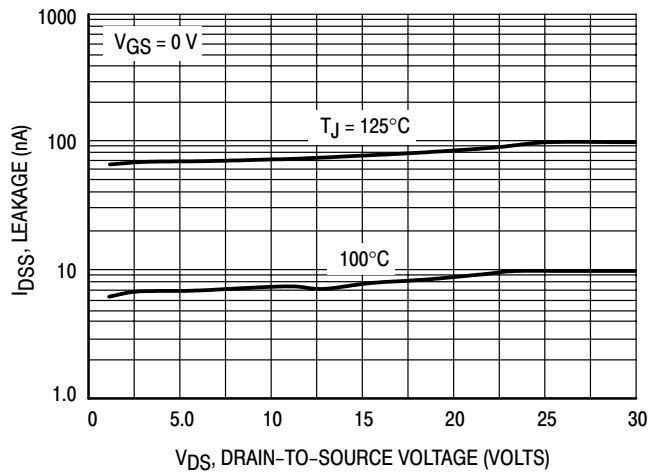


Figure 6. Drain-to-Source Leakage Current versus Voltage

TYPICAL FET ELECTRICAL CHARACTERISTICS

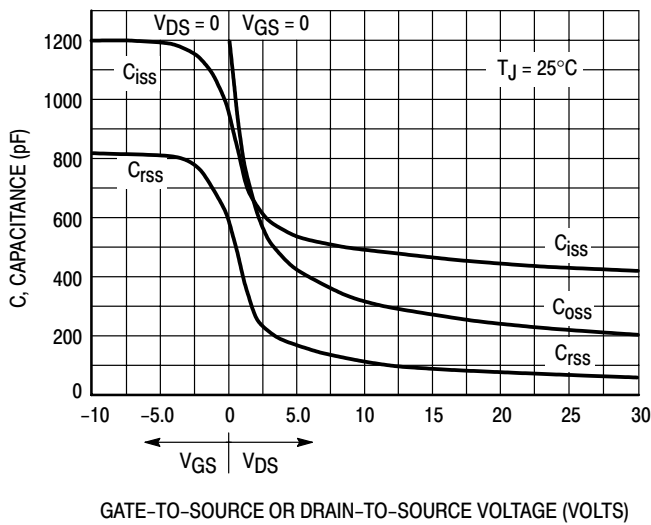


Figure 7. Capacitance Variation

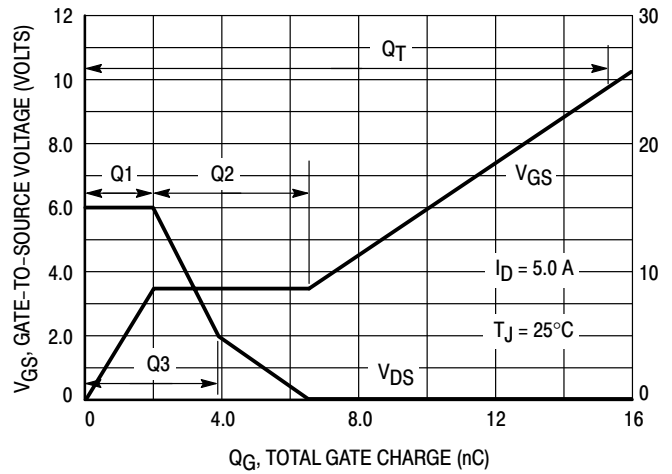


Figure 8. Gate-To-Source and Drain-To-Source Voltage versus Total Charge

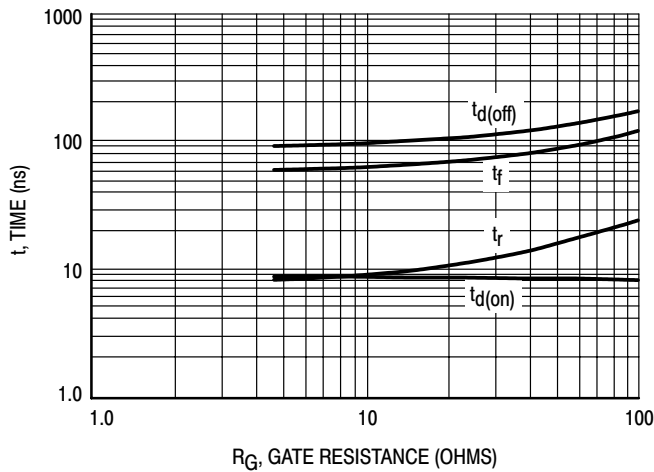


Figure 9. Resistive Switching Time Variation versus Gate Resistance

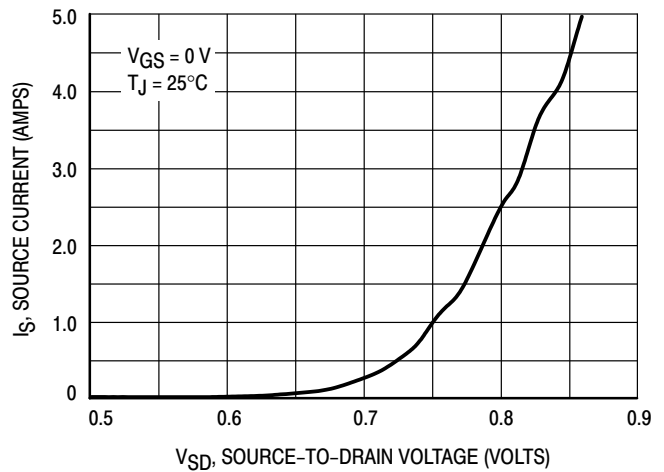


Figure 10. Diode Forward Voltage versus Current

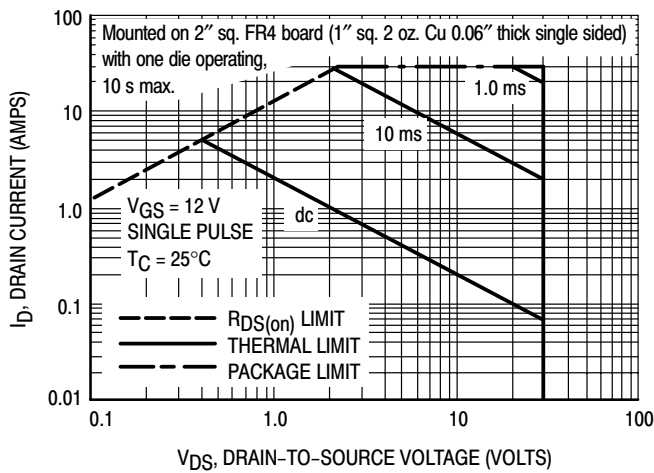


Figure 11. Maximum Rated Forward Biased Safe Operating Area

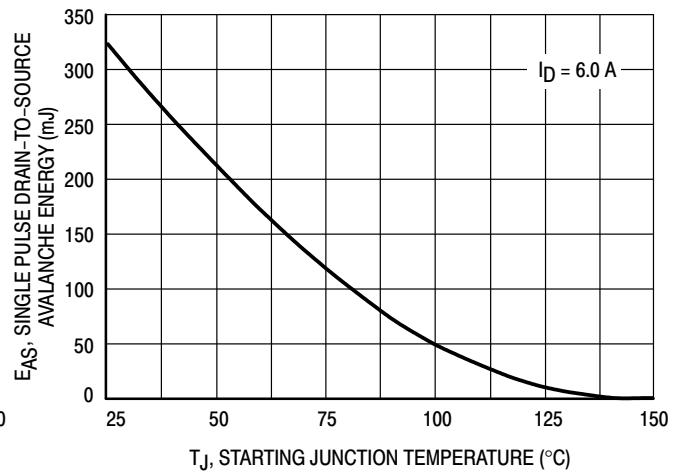


Figure 12. Maximum Avalanche Energy versus Starting Junction Temperature

TYPICAL FET ELECTRICAL CHARACTERISTICS

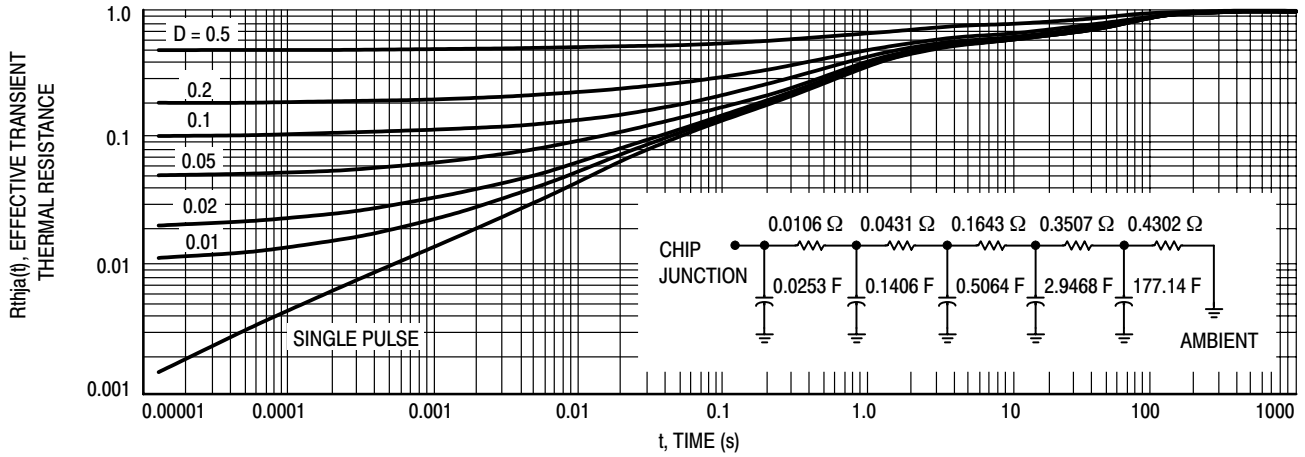


Figure 13. FET Thermal Response

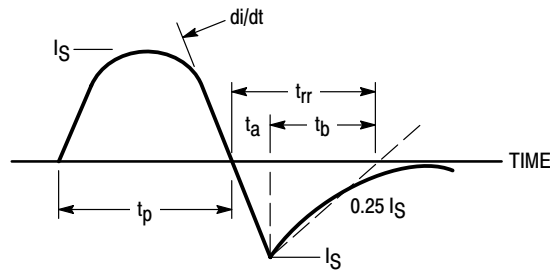


Figure 14. Diode Reverse Recovery Waveform

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

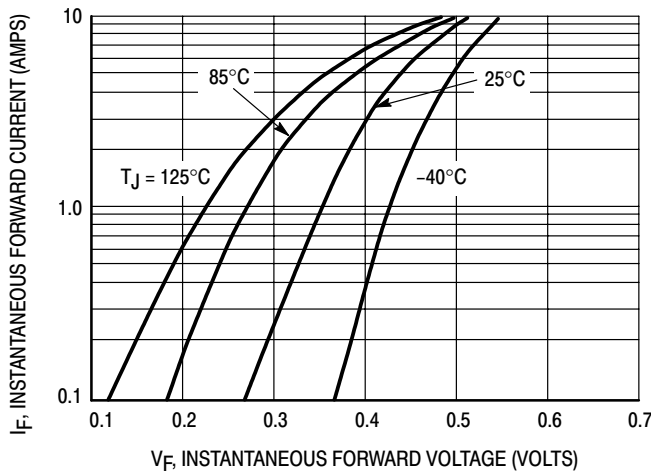


Figure 15. Typical Forward Voltage

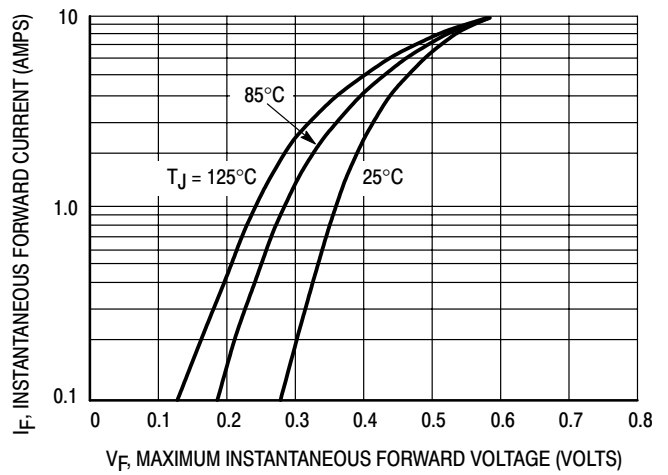


Figure 16. Maximum Forward Voltage

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## TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

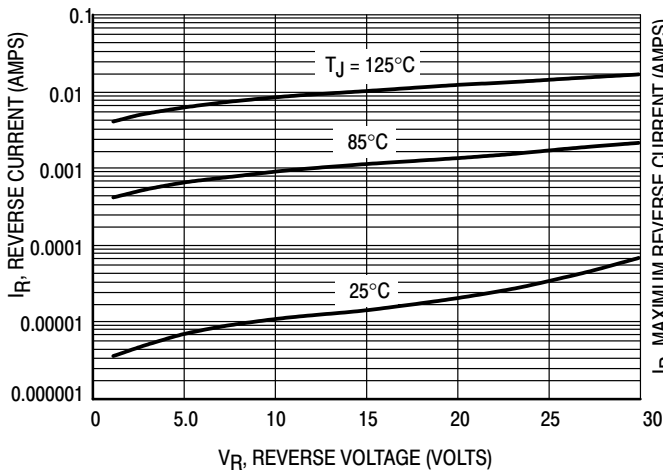


Figure 17. Typical Reverse Current

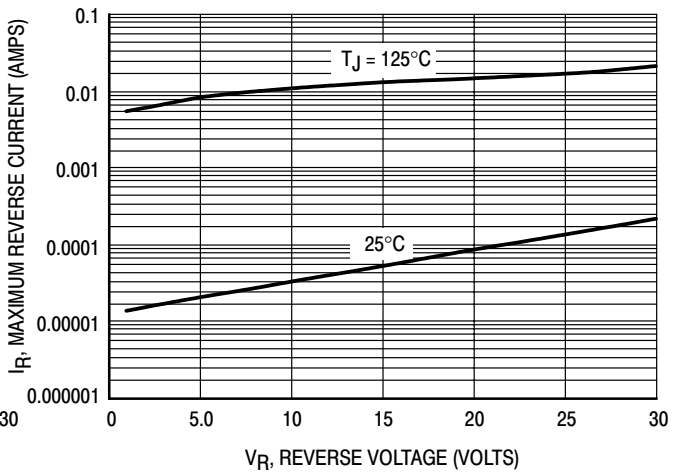


Figure 18. Maximum Reverse Current

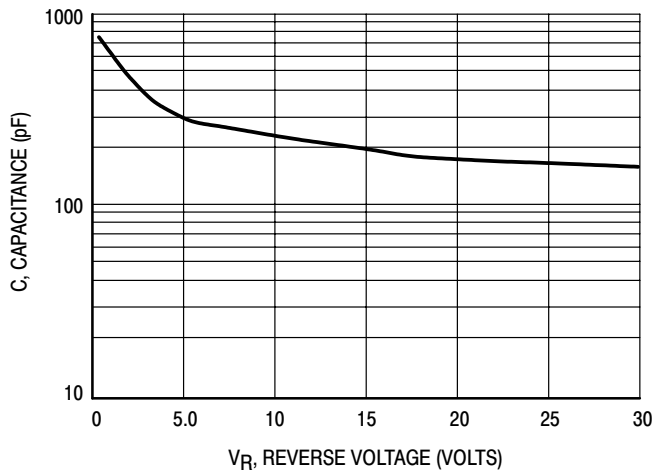


Figure 19. Typical Capacitance

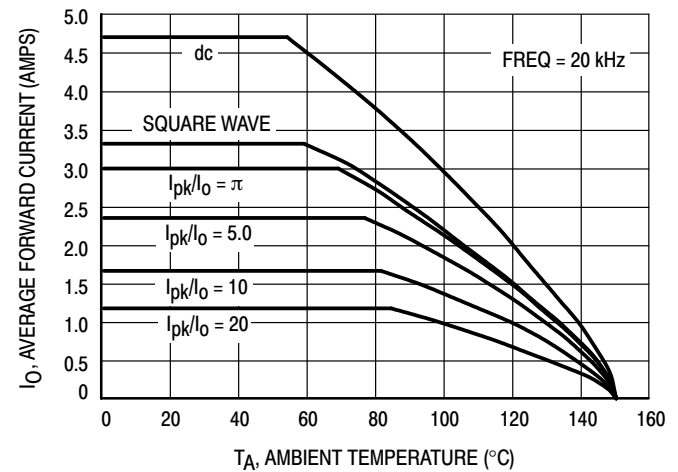


Figure 20. Current Derating

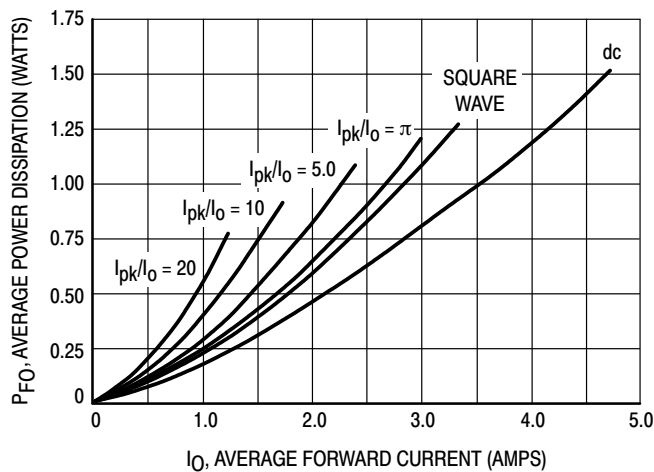


Figure 21. Forward Power Dissipation

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

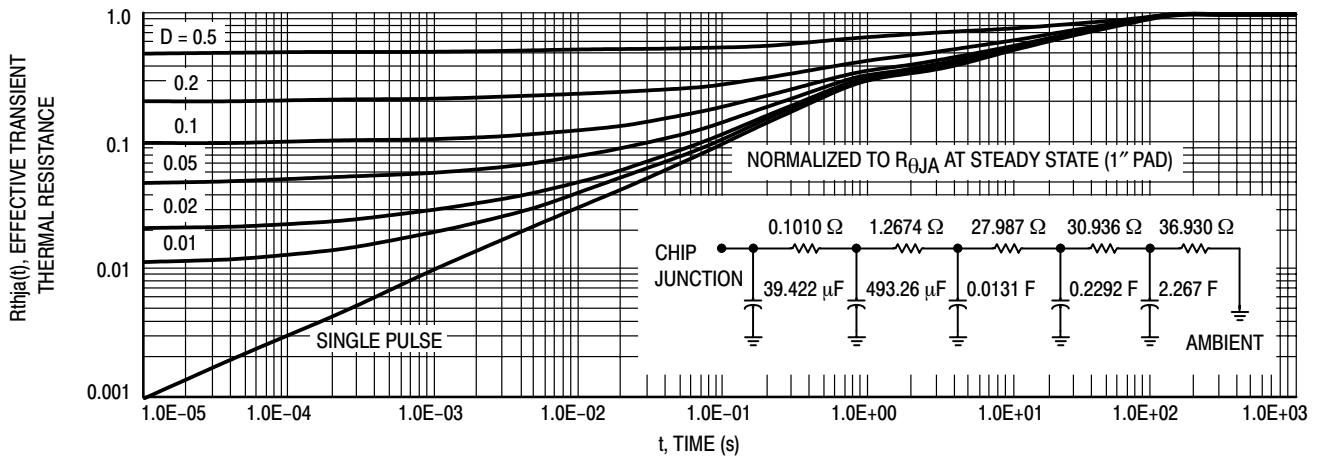
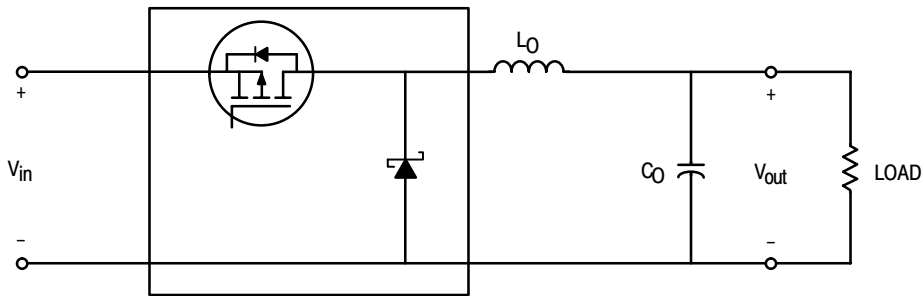


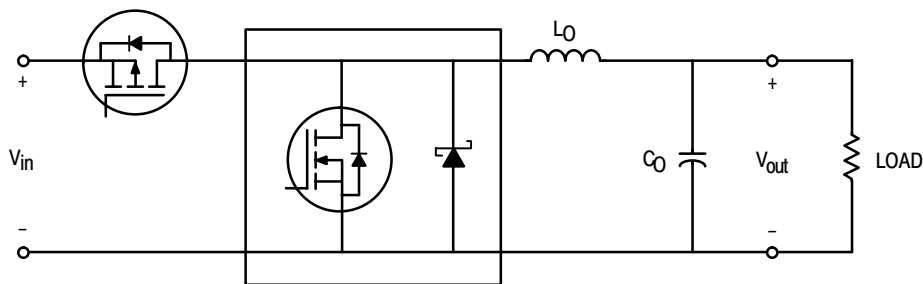
Figure 22. Schottky Thermal Response

TYPICAL APPLICATIONS

STEP DOWN SWITCHING REGULATORS



Buck Regulator



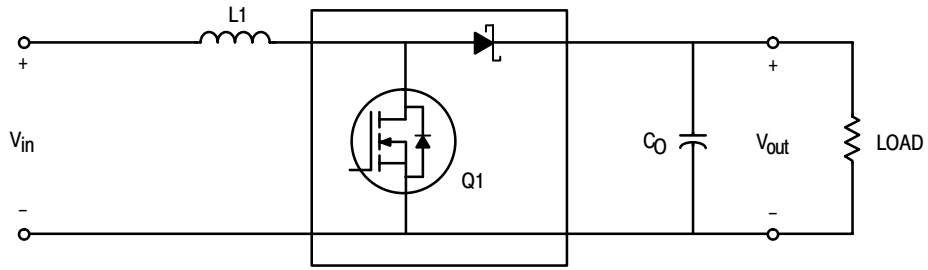
Synchronous Buck Regulator



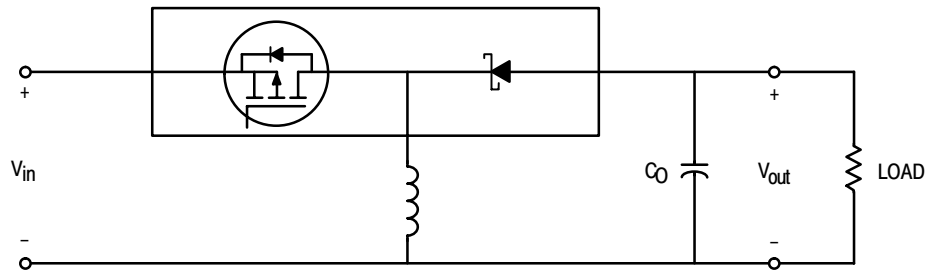
# MMDFS6N303

## TYPICAL APPLICATIONS

### STEP UP SWITCHING REGULATORS

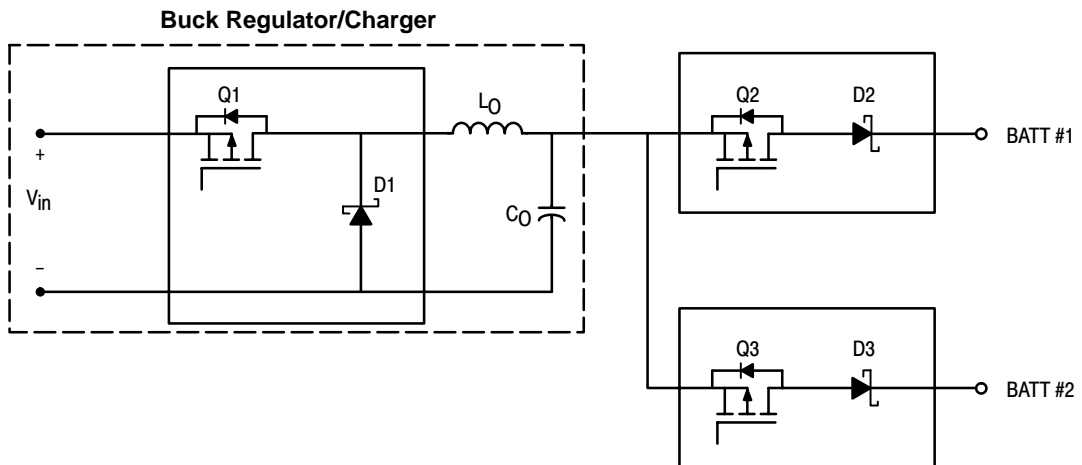


**Boost Regulator**



**Buck-Boost Regulator**

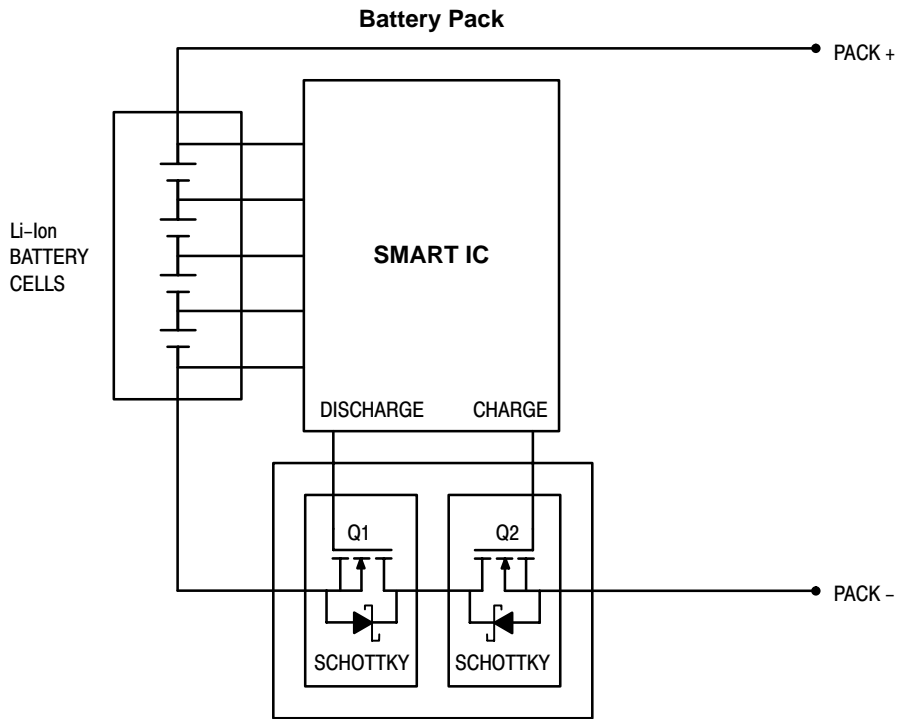
### MULTIPLE BATTERY CHARGERS



# MMDFS6N303

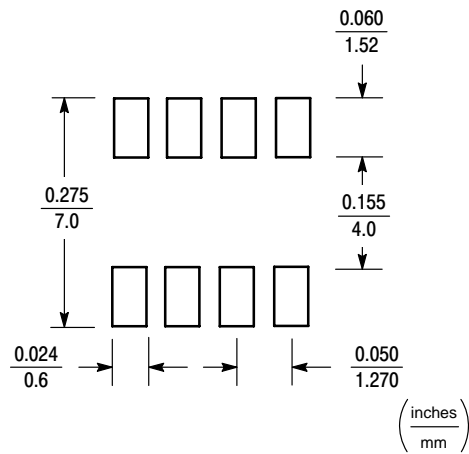
## TYPICAL APPLICATIONS

### Li-Ion BATTERY PACK APPLICATIONS



- Applicable in battery packs which require a high current level.
- During charge cycle Q2 is on and Q1 is off. Schottky can reduce power loss during fast charge.
- During discharge Q1 is on and Q2 is off. Again, Schottky can reduce power dissipation.
- Under normal operation, both transistors are on.

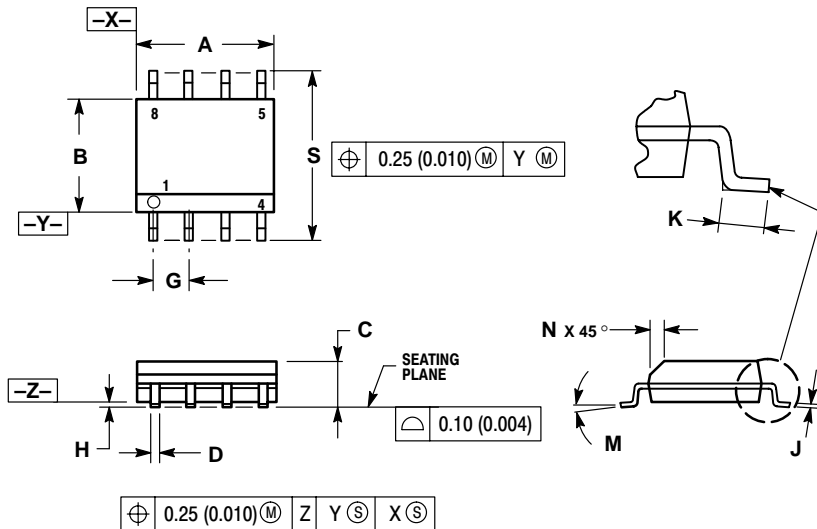
### SO-8 FOOTPRINT



# MMDFS6N303

## PACKAGE DIMENSIONS

SO-8  
CASE 751-07  
ISSUE V



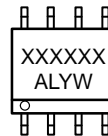
**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.197
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.020
G	1.27 BSC		0.050 BSC	
H	0.10	0.25	0.004	0.010
J	0.19	0.25	0.007	0.010
K	0.40	1.27	0.016	0.050
M	0°	8°	0°	8°
N	0.25	0.50	0.010	0.020
S	5.80	6.20	0.228	0.244

**STYLE 18:**

- PIN 1. ANODE  
 2. ANODE  
 3. SOURCE  
 4. GATE  
 5. DRAIN  
 6. DRAIN  
 7. CATHODE  
 8. CATHODE



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