

NTTD4401F

FETKY™ Power MOSFET and Schottky Diode

-20 V, -3.3 A P-Channel with 20 V, 1.0 A Schottky Diode, Micro8™ Package

The FETKY product family incorporates low $R_{DS(on)}$, true logic level MOSFETs packaged with industry leading, low forward drop, low leakage Schottky Barrier Diodes to offer high efficiency components in a space saving configuration. Independent pinouts for TMOS and Schottky die allow the flexibility to use a single component for switching and rectification functions in a wide variety of applications.

Features

- Low V_F and Low Leakage Schottky Diode
- Lower Component Placement and Inventory Costs along with Board Space Savings
- Logic Level Gate Drive – Can be Driven by Logic ICs
- Pb-Free Package is Available

Applications

- Buck Converter
- Synchronous Rectification
- Low Voltage Motor Control
- Load Management in Battery Packs, Chargers, Cell Phones, and other Portable Products

MOSFET MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Rating		Symbol	Value	Unit
Drain-to-Source Voltage		V_{DSS}	-20	V
Gate-to-Source Voltage		V_{GS}	± 10	V
Continuous Drain Current (Note 1)	$T_A = 25^\circ\text{C}$	I_D	-3.3	A
	$T_A = 100^\circ\text{C}$		-2.1	
Power Dissipation (Note 1)	Steady State	$T_A = 25^\circ\text{C}$	P_D	1.42
		$T_A = 100^\circ\text{C}$		
Continuous Drain Current (Note 2)	$T_A = 25^\circ\text{C}$	I_D	-2.4	A
	$T_A = 100^\circ\text{C}$		-1.5	
Power Dissipation (Note 2)	Steady State	$T_A = 25^\circ\text{C}$	P_D	0.78
Pulsed Drain Current	$t = 10 \mu\text{s}$	I_{DM}	-10	A
Operating Junction and Storage Temperature		T_J, T_{STG}	-55 to 150	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy Starting $T_A = 25^\circ\text{C}$ ($t \leq 10 \text{ s}$)		EAS	150	mJ
Lead Temperature for Soldering Purposes (1/8" from case for 10 s)		T_L	260	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Surface-mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
2. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = 0.172 in sq).



ON Semiconductor®

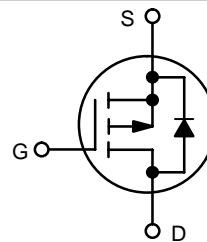
<http://onsemi.com>

MOSFET PRODUCT SUMMARY

$V_{(BR)DSS}$	$R_{DS(on)}$ TYP	I_D Max
-20 V	70 m Ω @ -4.5 V	-3.3 A
	100 m Ω @ -2.7 V	-2.7 A

SCHOTTKY DIODE SUMMARY

V_R Max	I_F Max	V_F Max
20 V	2.0 A	600 mV @ $I_F = 2.0 \text{ A}$

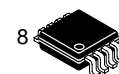


P-Channel MOSFET

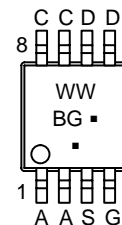


Schottky Diode

MARKING DIAGRAM & PIN ASSIGNMENT



Micro8 CASE 846A



BG = Specific Device Code
 WW = Work Week
 ■ = Pb-Free Package
 (Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
NTTD4401FR2	Micro8	4000/Tape & Reel
NTTD4401FR2G	Micro8 (Pb-Free)	4000/Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

NTTD4401F

SCHOTTKY DIODE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage	V	20	V
Average Forward Current (Rated V_R , $T_A = 100^\circ\text{C}$)	I_O	1.0	A
Peak Repetitive Forward Current (Note 3)	I_{FRM}	2.0	A
Non-Repetitive Peak Surge Current (Note 4)	I_{FSM}	20	A

THERMAL RESISTANCE RATINGS

Rating	Symbol	FET	Schottky	Unit
		Max		
Junction-to-Ambient – Steady State (Note 5)	$R_{\theta JA}$	88	135	$^\circ\text{C/W}$
Junction-to-Ambient – Steady State (Note 6)	$R_{\theta JA}$	160	250	$^\circ\text{C/W}$

MOSFET ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit
----------------	--------	----------------	-----	-----	-----	------

OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage	$V_{(BR)DSS}$	$V_{GS} = 0\text{ V}$	-20	-	-	V
Zero Gate Voltage Drain Current (Note 7)	I_{DSS}	$V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}$	-	-	-1.0	μA
		$V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}, V_{DS} = -16\text{ V}$	-	-	-25	
Gate-to-Source Leakage Current	I_{GSS}	$V_{DS} = 0\text{ V}, V_{GS} = \pm 10\text{ V}$	-	-	± 100	nA

ON CHARACTERISTICS

Gate Threshold Voltage	$V_{GS(TH)}$	$V_{GS} = V_{DS}, I_D = -250\ \mu\text{A}$	-0.5	-	-1.5	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	-	-	2.5	-	$\text{mV}/^\circ\text{C}$
Drain-to-Source On Resistance	$R_{DS(on)}$	$V_{GS} = -4.5\text{ V}, I_D = -3.3\text{ A}$	-	70	90	$\text{m}\Omega$
		$V_{GS} = -2.5\text{ V}, I_D = -1.2\text{ A}$	-	100	150	
Forward Transconductance	g_{FS}	$V_{DS} = -10\text{ V}, I_D = -2.7\text{ A}$	-	4.2	-	S

CHARGES, CAPACITANCES AND GATE RESISTANCE

Input Capacitance	C_{ISS}	$V_{GS} = 0\text{ V}, f = 1.0\text{ MHz}, V_{DS} = -16\text{ V}$	-	550	750	pF
Output Capacitance	C_{OSS}		-	200	300	
Reverse Transfer Capacitance	C_{RSS}		-	50	175	
Total Gate Charge	$Q_{G(TOT)}$	$V_{GS} = -4.5\text{ V}, V_{DS} = -16\text{ V}, I_D = -3.3\text{ A}$	-	10	18	nC
Gate-to-Source Gate Charge	Q_{GS}		-	1.5	3.0	
Gate-to-Drain "Miller" Charge	Q_{GD}		-	5.0	10	

SWITCHING CHARACTERISTICS

Turn-On Delay Time	$t_{d(ON)}$	$V_{GS} = -4.5\text{ V}, V_{DD} = -10\text{ V}, I_D = -3.3\text{ A}, R_G = 6.0\ \Omega$	-	11	20	ns
Rise Time	t_r		-	35	65	
Turn-Off Delay Time	$t_{d(OFF)}$		-	33	60	
Fall Time	t_f		-	29	55	

DRAIN-SOURCE DIODE CHARACTERISTICS

Forward Diode Voltage	V_{SD}	$V_{GS} = 0\text{ V}, I_S = -2.0\text{ A}$	-	-0.88	-1.0	V
Reverse Recovery Time	t_{RR}	$V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}, I_S = -3.3\text{ A}$	-	37	50	ns
Charge Time	t_a		-	16	-	
Discharge Time	t_b		-	21	-	
Reverse Recovery Charge	Q_{RR}	-	-	0.025	0.05	nC

3. Rated V_R , square wave, 20 kHz, $T_A = 105^\circ\text{C}$.
4. Surge applied at rated load conditions, half-wave, single phase, 60 Hz.
5. Surface-mounted on FR4 board using 1 inch sq pad size (Cu area = 1.127 in sq [1 oz] including traces).
6. Surface-mounted on FR4 board using the minimum recommended pad size (Cu area = 0.172 in sq).
7. Body diode leakage current.

NTTD4401F

SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS ($T_J = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Test Condition	Min	Typ	Max	Unit	
Reverse Breakdown Voltage	B_V	$I_R = 1.0 \text{ mA}$	20	-	-	V	
Reverse Leakage Current	I_R	$V_R = 20 \text{ V}$	$T_A = 25^\circ\text{C}$	-	-	0.05	mA
			$T_A = 125^\circ\text{C}$	-	-	10	
Forward Voltage	V_F	$I_F = 1.0 \text{ A}$	$T_A = 25^\circ\text{C}$	-	-	0.5	V
			$T_A = 125^\circ\text{C}$	-	-	0.39	
		$I_F = 2.0 \text{ A}$	$T_A = 25^\circ\text{C}$	-	-	0.6	
			$T_A = 125^\circ\text{C}$	-	-	0.53	
Voltage Rate of Change	dV/dt	$V_R = 20 \text{ V}$	-	10,000	-	V/ μs	

TYPICAL ELECTRICAL CHARACTERISTICS

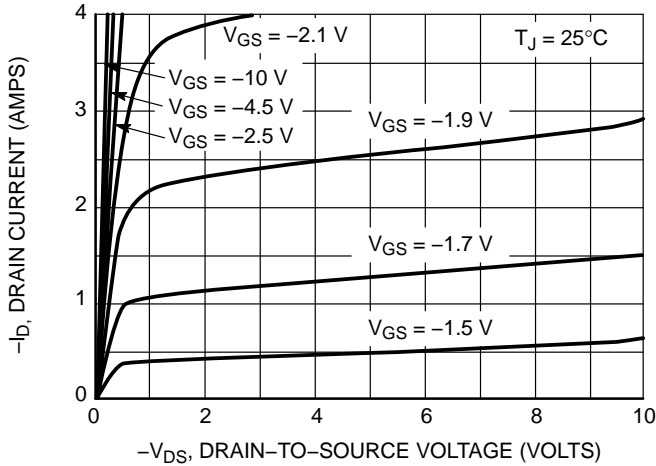


Figure 1. On-Region Characteristics

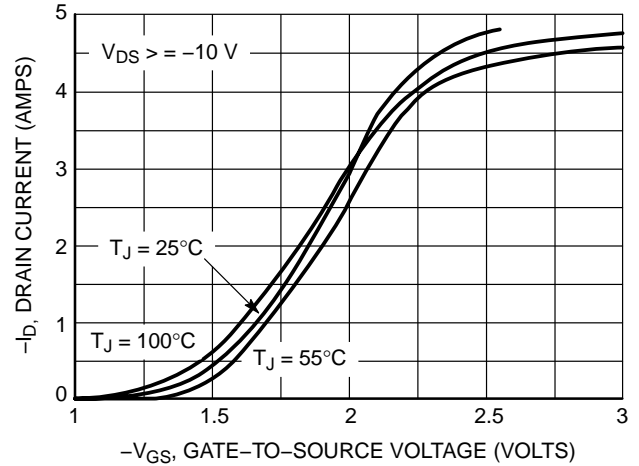


Figure 2. Transfer Characteristics

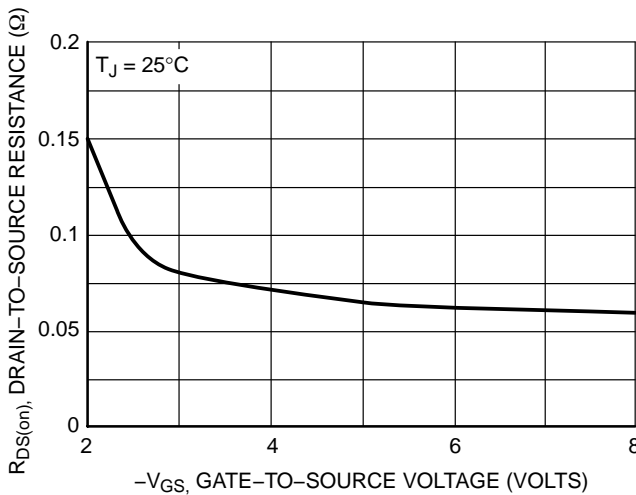


Figure 3. On-Resistance vs. Gate-to-Source Voltage

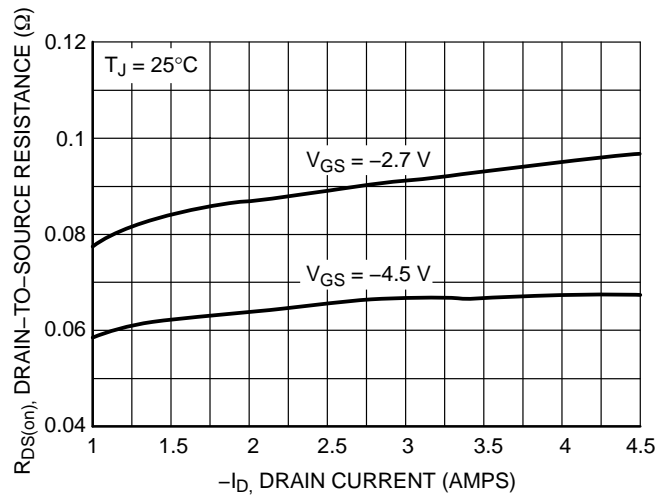


Figure 4. On-Resistance vs. Drain Current and Gate Voltage

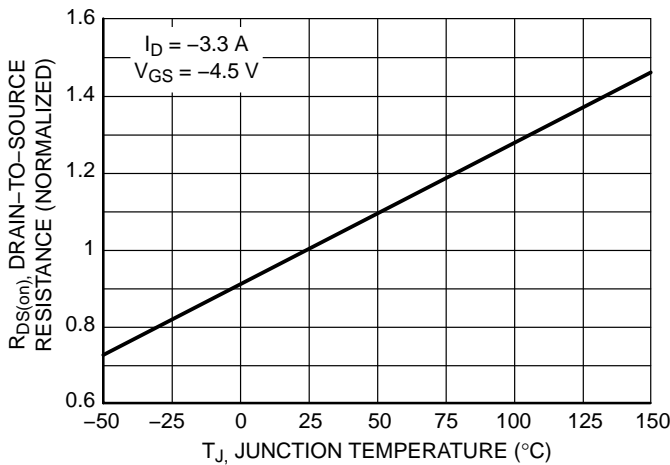


Figure 5. On-Resistance Variation with Temperature

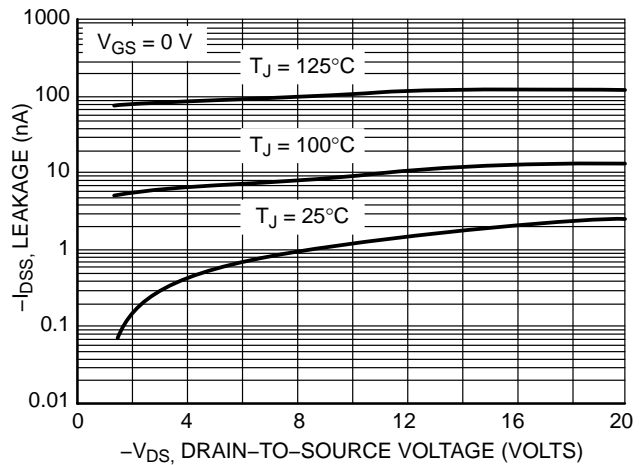


Figure 6. Drain-to-Source Leakage Current vs. Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

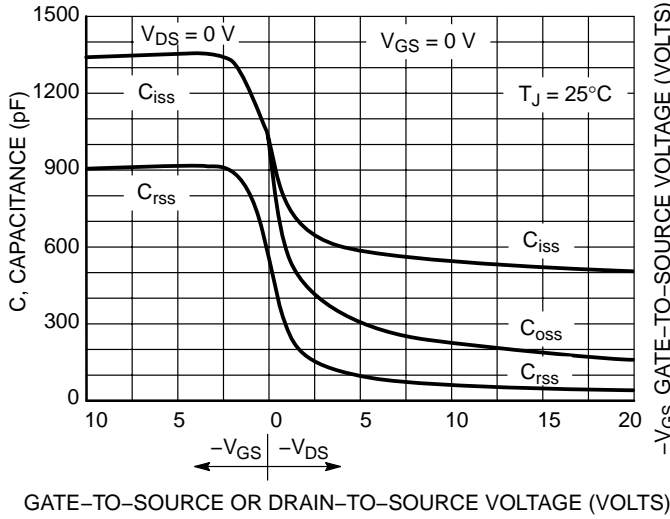


Figure 7. Capacitance Variation

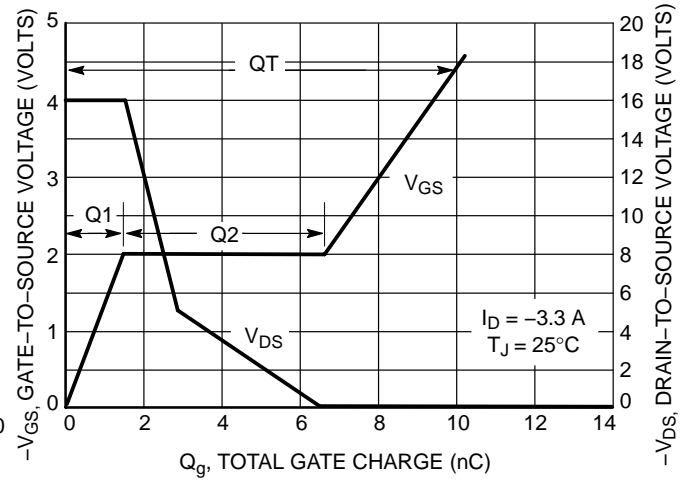


Figure 8. Gate-to-Source and Drain-to-Source Voltage vs. Total Charge

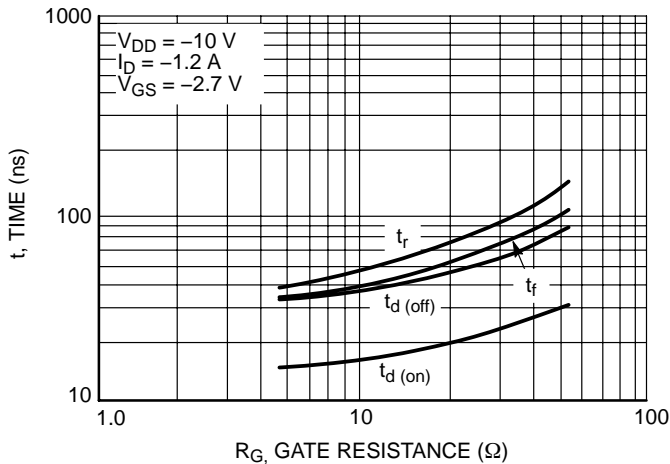


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

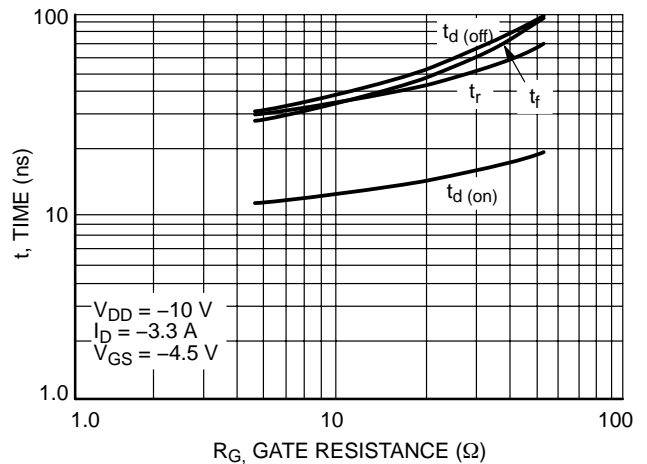


Figure 10. Resistive Switching Time Variation vs. Gate Resistance

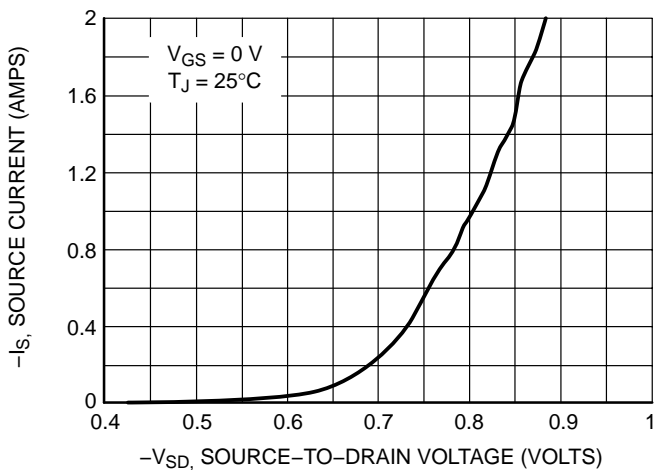


Figure 11. Diode Forward Voltage vs. Current

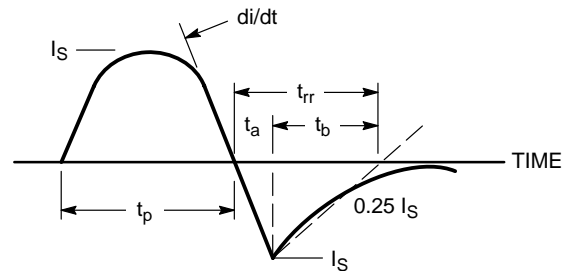


Figure 12. Diode Reverse Recovery Waveform

NTTD4401F

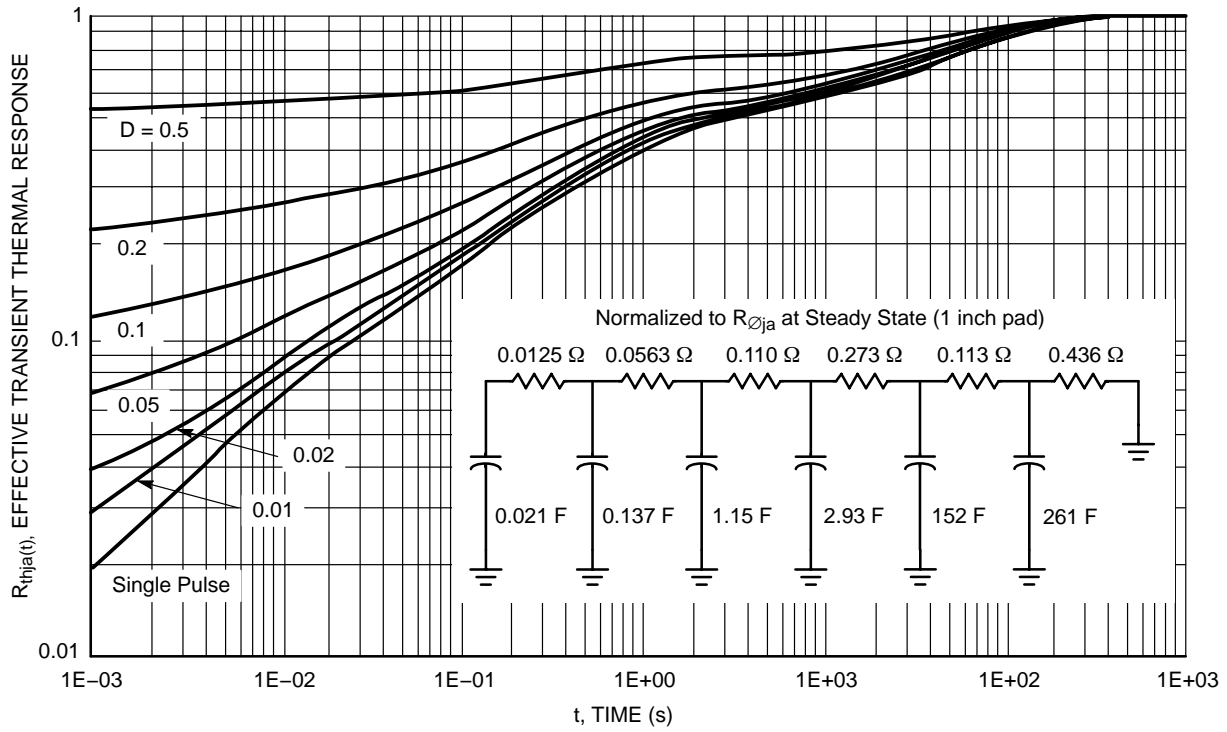


Figure 13. FET Thermal Response

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

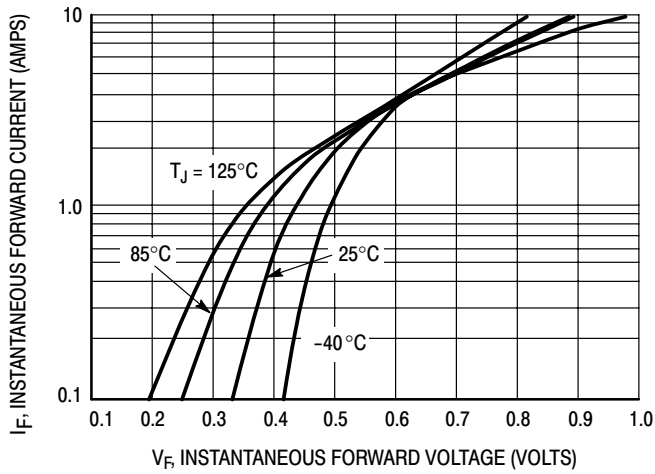


Figure 14. Typical Forward Voltage

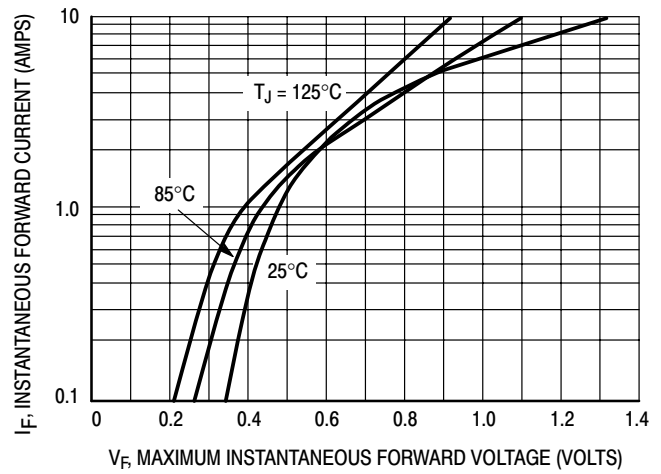


Figure 15. Maximum Forward Voltage

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

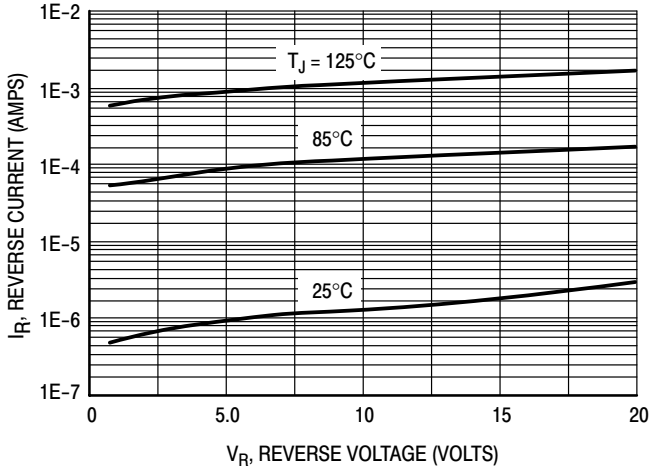


Figure 16. Typical Reverse Current

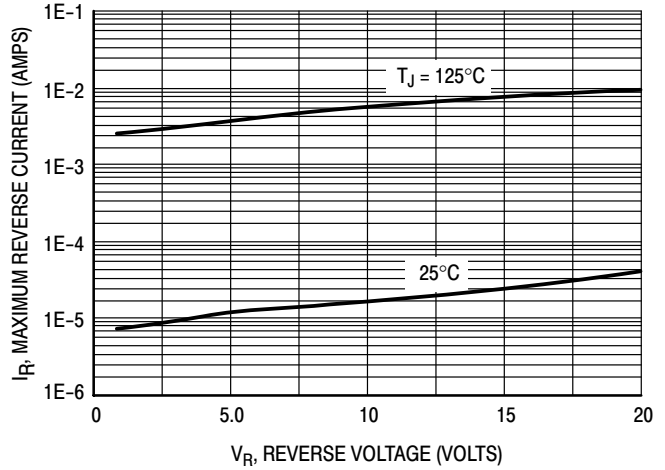


Figure 17. Maximum Reverse Current

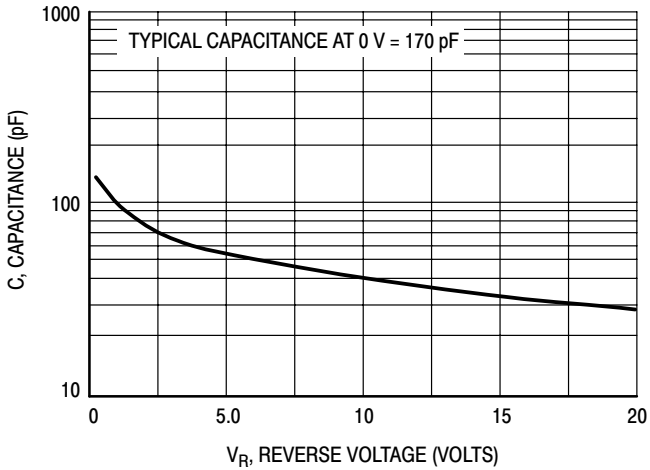


Figure 18. Typical Capacitance

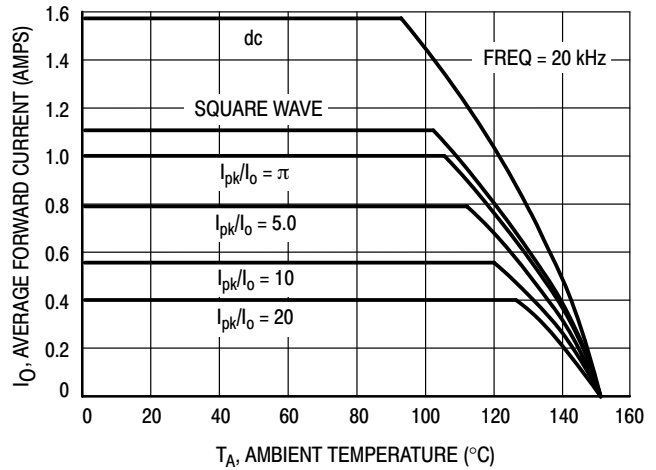


Figure 19. Current Derating

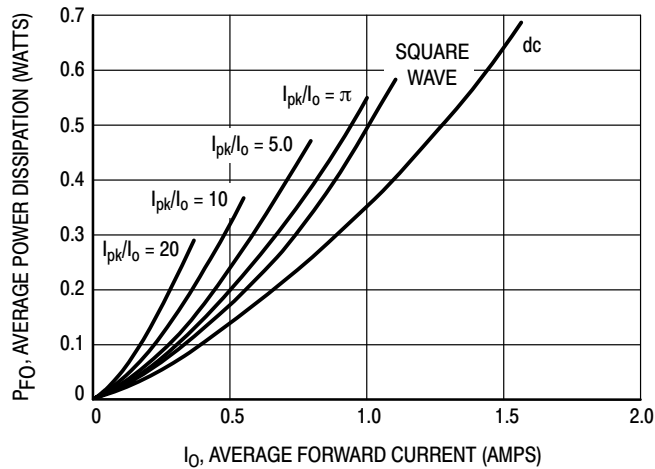


Figure 20. Forward Power Dissipation

MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



SCALE 2:1

Micro8 CASE 846A-02 ISSUE K

DATE 16 JUL 2020

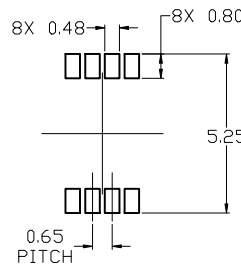
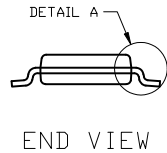
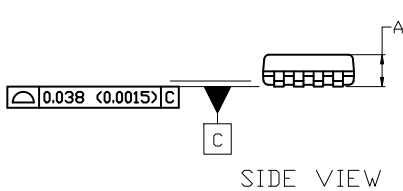


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2009.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION *b* DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10 mm IN EXCESS OF MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER SIDE. DIMENSION E DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 mm PER SIDE. DIMENSIONS D AND E ARE DETERMINED AT DATUM F.
5. DATUMS A AND B ARE TO BE DETERMINED AT DATUM F.
6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

⌀0.08 (0.003) M C B S A S

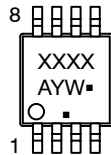
NOTE 3



DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	---	---	1.10
A1	0.05	0.08	0.15
<i>b</i>	0.25	0.33	0.40
<i>c</i>	0.13	0.18	0.23
D	2.90	3.00	3.10
E	2.90	3.00	3.10
<i>e</i>	0.65 BSC		
H _E	4.75	4.90	5.05
L	0.40	0.55	0.70

■ For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

GENERIC MARKING DIAGRAM*



- XXXX = Specific Device Code
- A = Assembly Location
- Y = Year
- W = Work Week
- = Pb-Free Package

(Note: Microdot may be in either location)

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLE 1:

1. SOURCE
2. SOURCE
3. SOURCE
4. GATE
5. DRAIN
6. DRAIN
7. DRAIN
8. DRAIN

STYLE 2:

1. SOURCE 1
2. GATE 1
3. SOURCE 2
4. GATE 2
5. DRAIN 2
6. DRAIN 2
7. DRAIN 1
8. DRAIN 1

STYLE 3:

1. N-SOURCE
2. N-GATE
3. P-SOURCE
4. P-GATE
5. P-DRAIN
6. P-DRAIN
7. N-DRAIN
8. N-DRAIN

DOCUMENT NUMBER:	98ASB14087C	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	MICRO8	PAGE 1 OF 1

ON Semiconductor and ON are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales