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°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°C	I_D	−3.3	A
		T_A = 100°C		−2.1	
Power Dissipation (Note 1)	Steady State	T_A = 25°C	P_D	1.42	W
Continuous Drain Current (Note 2)		T_A = 25°C	I_D	−2.4	A
		T_A = 100°C		−1.5	
Power Dissipation (Note 2)	Steady State	T_A = 25°C	P_D	0.78	W
Pulsed Drain Current	t = 10 μs		I_{DM}	−10	A
Operating Junction and Storage Temperature			T_J, T_{STG}	−55 to 150	°C
Single Pulse Drain−to−Source Avalanche Energy Starting T_A = 25°C (t ≤ 10 s)			EAS	150	mJ
Lead Temperature for Soldering Purposes (1/8″ from case for 10 s)			T_L	260	°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®

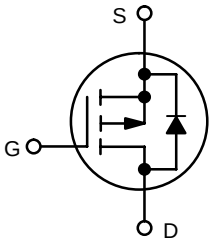
http://onsemi.com

MOSFET PRODUCT SUMMARY

$V_{(BR)DSS}$	$R_{DS(on)}$ Typ	I_D Max
−20 V	70 mΩ @ −4.5 V	−3.3 A
	100 mΩ @ −2.7 V	−2.7 A

SCHOTTKY DIODE SUMMARY

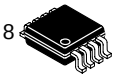
V_R Max	I_F Max	V_F Max
20 V	2.0 A	600 mV @ I_F = 2.0 A



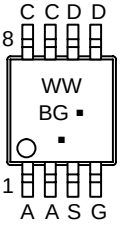
P−Channel MOSFET

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.

SCHOTTKY DIODE MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Peak Repetitive Reverse Voltage	V	20	V
Average Forward Current (Rated V_R, T_A = 100°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	°C/W
Junction−to−Ambient – Steady State (Note 6)	$R_{\theta JA}$	160	250	°C/W

MOSFET ELECTRICAL CHARACTERISTICS (T_A = 25°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 V	−20	−	−	V
Zero Gate Voltage Drain Current (Note 7)	I_{DSS}	V_{GS} = 0 V, V_{DS} = −16 V	−	−	−1.0	μA
		V_{GS} = 0 V, T_J = 125°C, V_{DS} = −16 V	−	−	−25	
Gate−to−Source Leakage Current	I_{GSS}	V_{DS} = 0 V, V_{GS} = ±10 V	−	−	±100	nA
ON CHARACTERISTICS						
Gate Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = −250 μA	−0.5	−	−1.5	V
Negative Threshold Temperature Coefficient	$V_{GS(TH)}/T_J$	−	−	2.5	−	mV/°C
Drain−to−Source On Resistance	$R_{DS(on)}$	V_{GS} = −4.5 V, I_D = −3.3 A	−	70	90	mΩ
		V_{GS} = −2.5 V, I_D = −1.2 A	−	100	150	
Forward Transconductance	g_{FS}	V_{DS} = −10 V, I_D = −2.7 A	−	4.2	−	S
CHARGES, CAPACITANCES AND GATE RESISTANCE						
Input Capacitance	C_{ISS}	V_{GS} = 0 V, f = 1.0 MHz, V_{DS} = −16 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 V, V_{DS} = −16 V, I_D = −3.3 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 V, V_{DD} = −10 V, I_D = −3.3 A, R_G = 6.0 Ω	−	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 V, I_S = −2.0 A	−	−0.88	−1.0	V
Reverse Recovery Time	t_{RR}	V_{GS} = 0 V, d_{IS}/dt = 100 A/μs, I_S = −3.3 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°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.

SCHOTTKY DIODE ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

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

TYPICAL ELECTRICAL CHARACTERISTICS

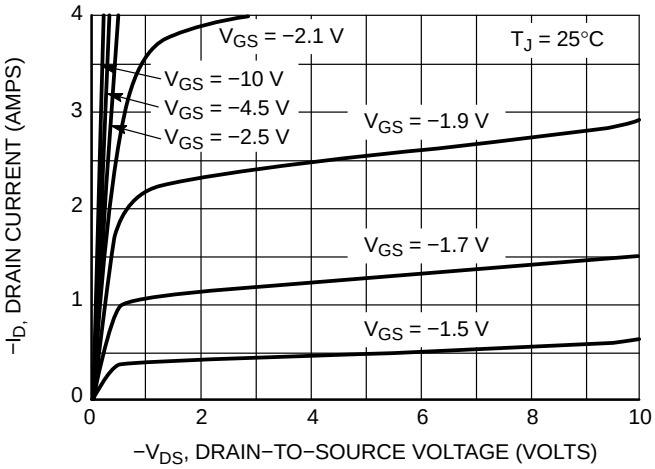


Figure 1. On−Region Characteristics

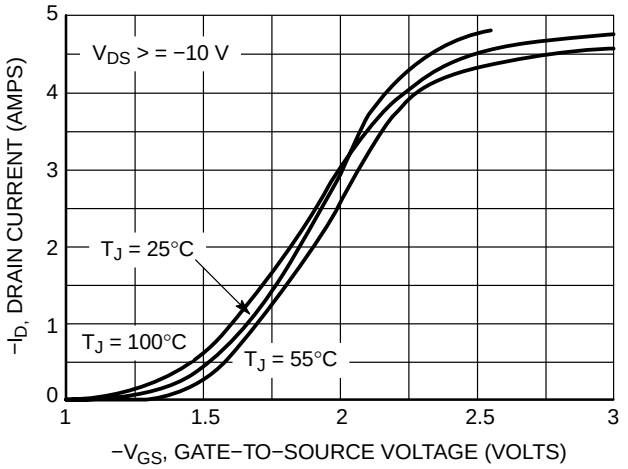


Figure 2. Transfer Characteristics

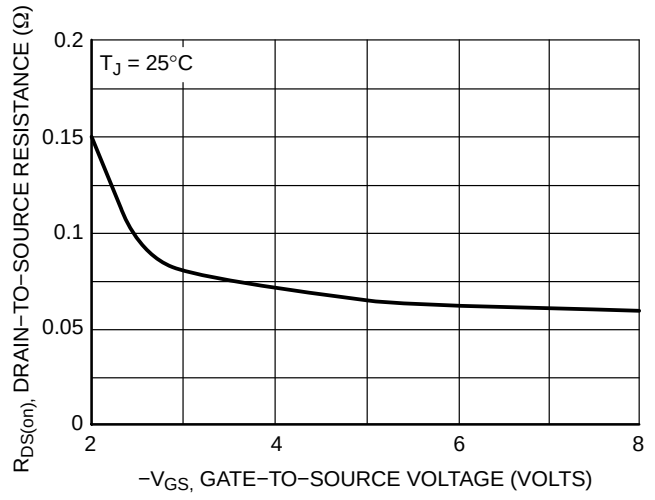


Figure 3. On−Resistance vs. Gate−to−Source Voltage

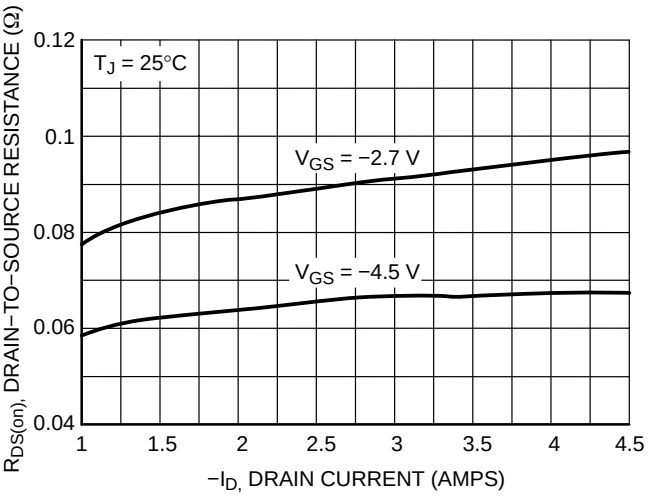


Figure 4. On−Resistance vs. Drain Current and Gate Voltage

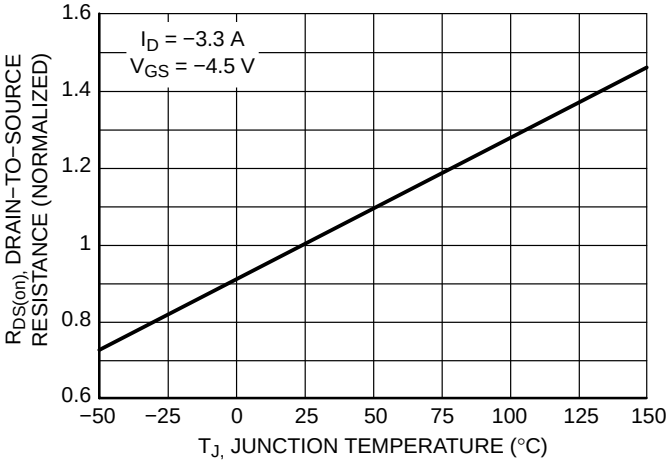


Figure 5. On−Resistance Variation with Temperature

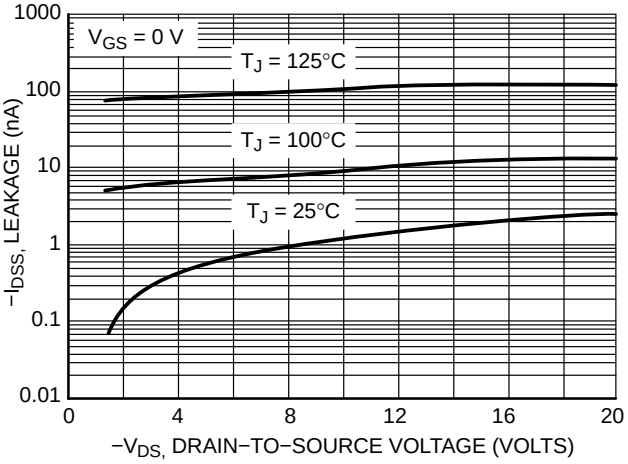


Figure 6. Drain−to−Source Leakage Current vs. Voltage

TYPICAL ELECTRICAL CHARACTERISTICS

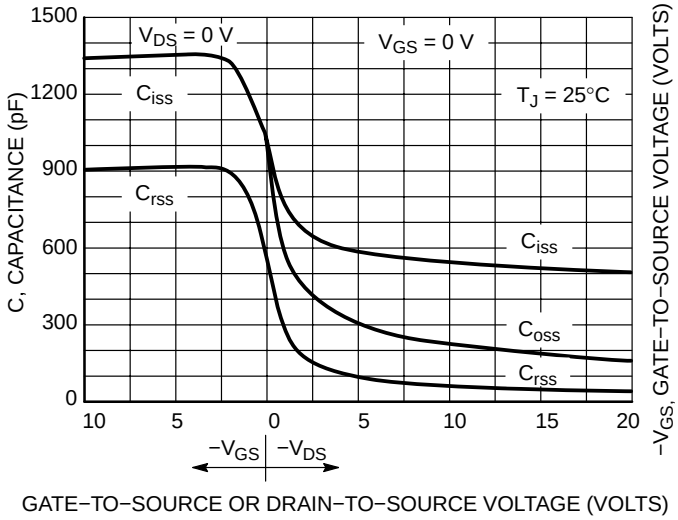


Figure 7. Capacitance Variation

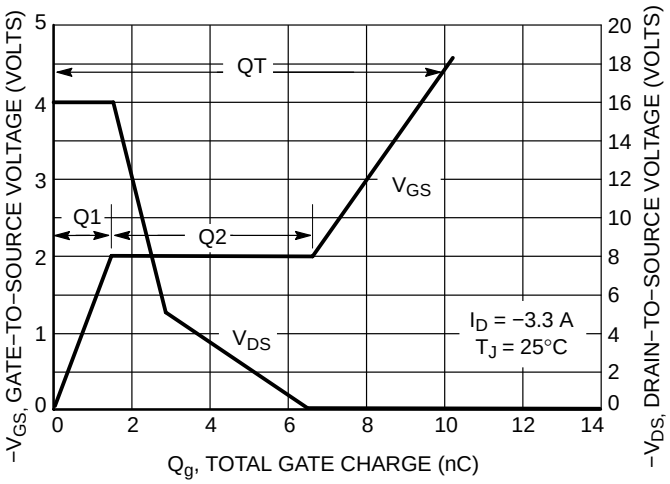


Figure 8. Gate−to−Source and Drain−to−Source Voltage vs. Total Charge

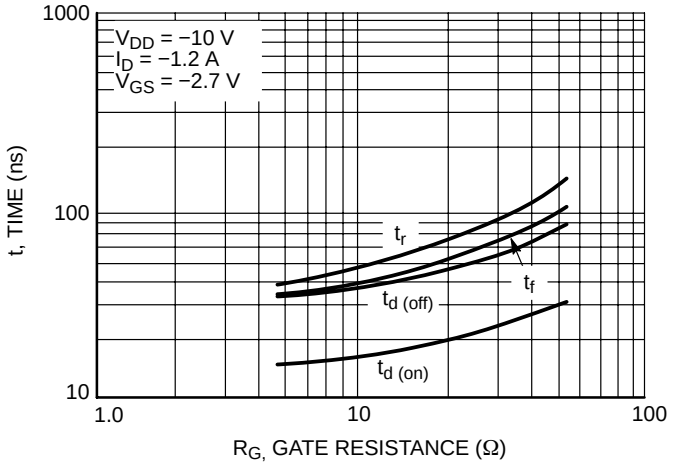


Figure 9. Resistive Switching Time Variation vs. Gate Resistance

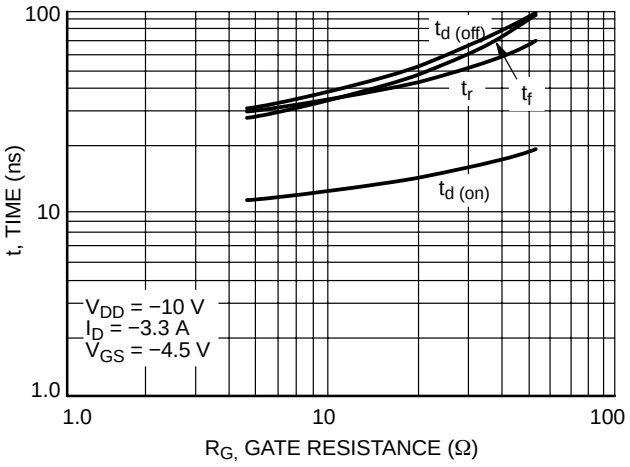


Figure 10. Resistive Switching Time Variation vs. Gate Resistance

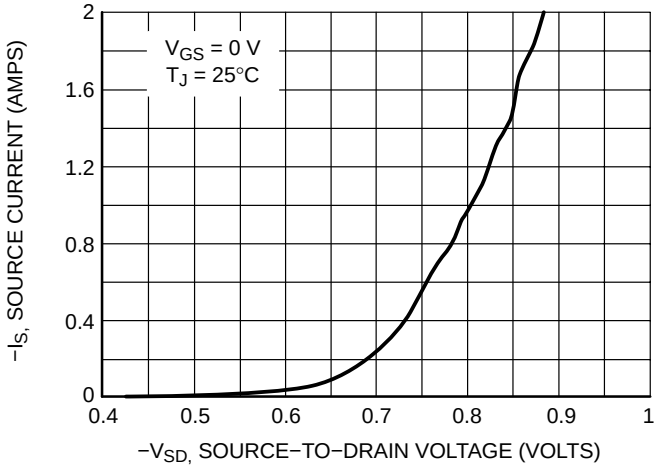


Figure 11. Diode Forward Voltage vs. Current

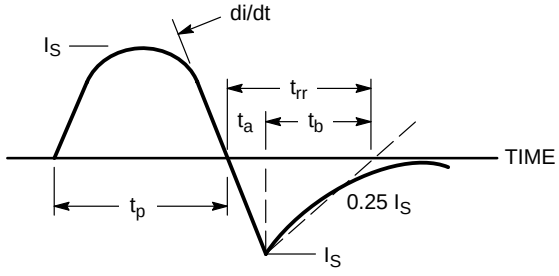


Figure 12. Diode Reverse Recovery Waveform

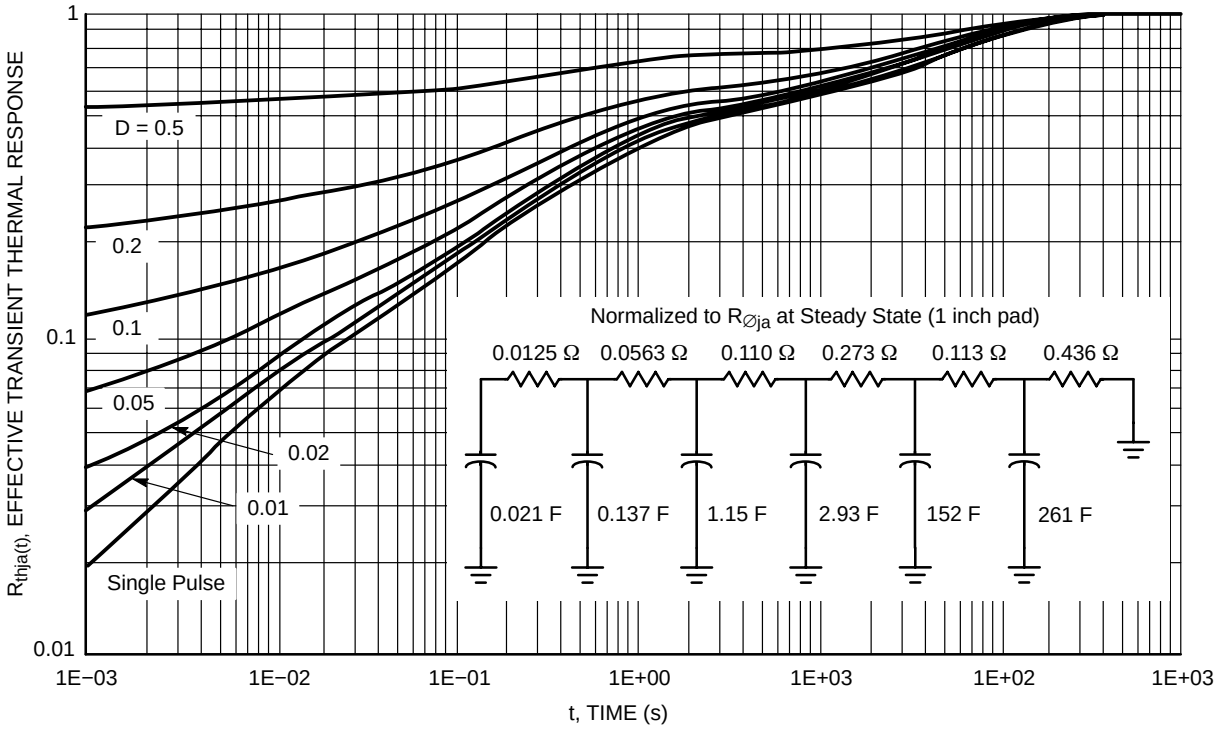


Figure 13. FET Thermal Response

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

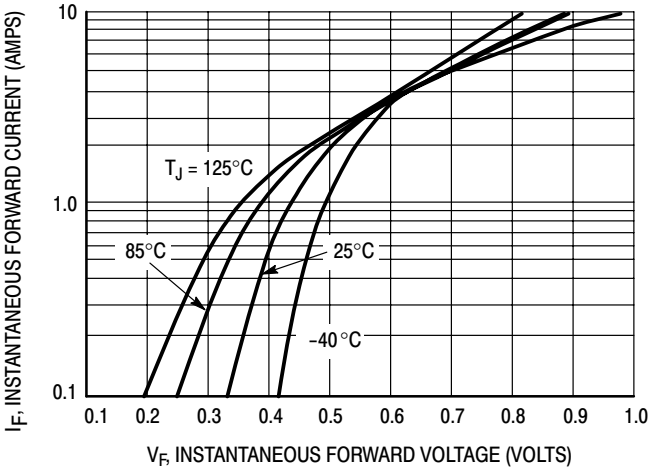


Figure 14. Typical Forward Voltage

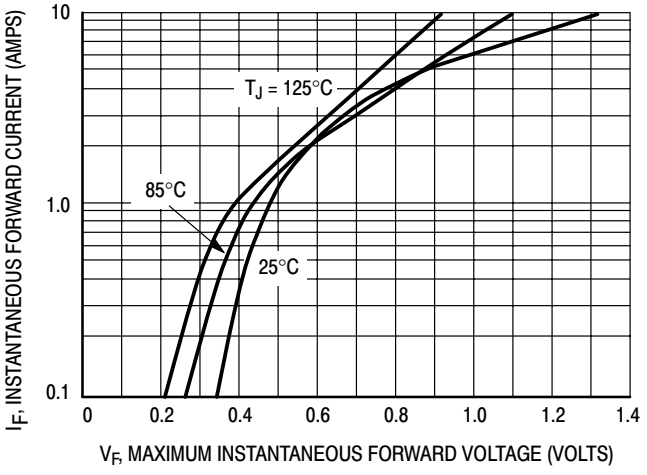


Figure 15. Maximum Forward Voltage

TYPICAL SCHOTTKY ELECTRICAL CHARACTERISTICS

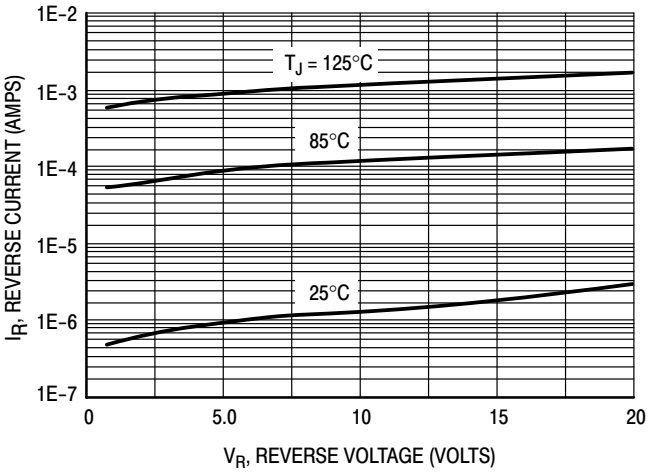


Figure 16. Typical Reverse Current

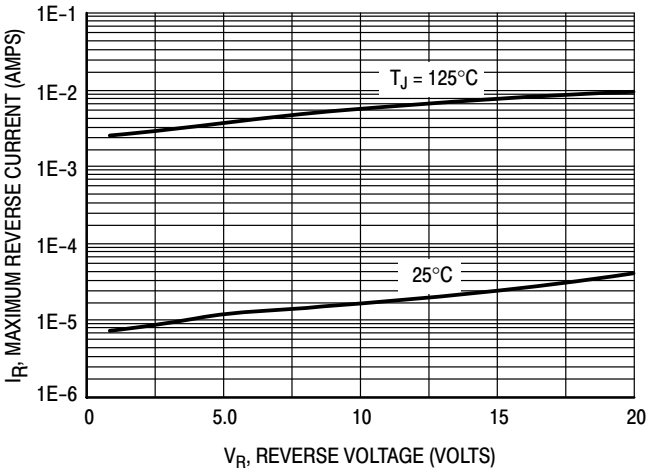


Figure 17. Maximum Reverse Current

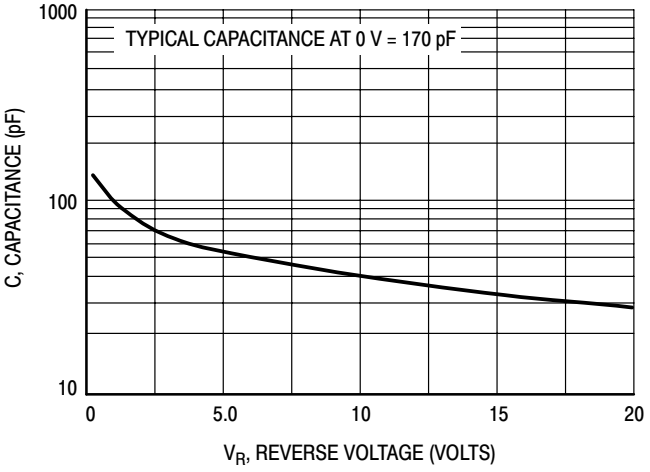


Figure 18. Typical Capacitance

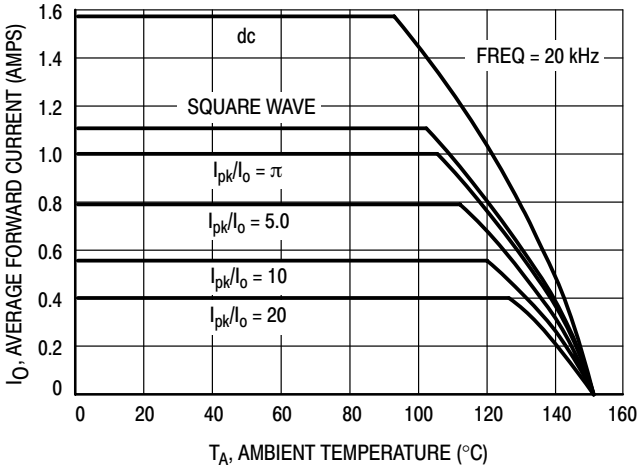


Figure 19. Current Derating

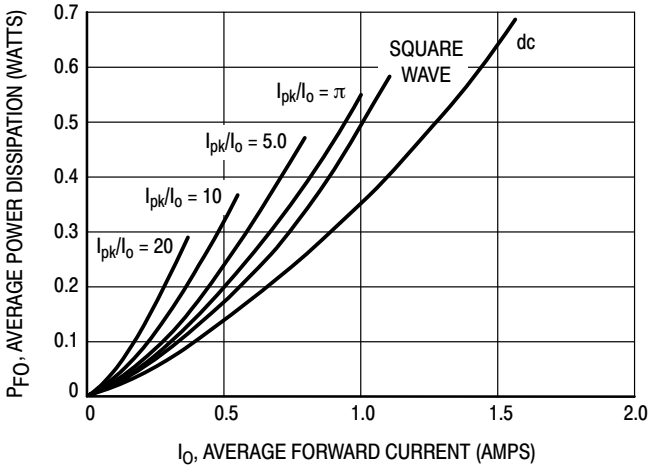


Figure 20. Forward Power Dissipation

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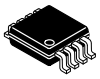
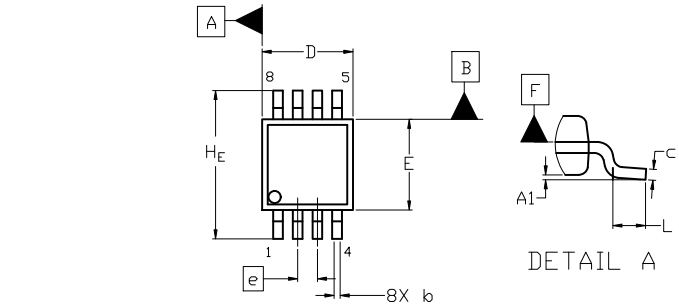
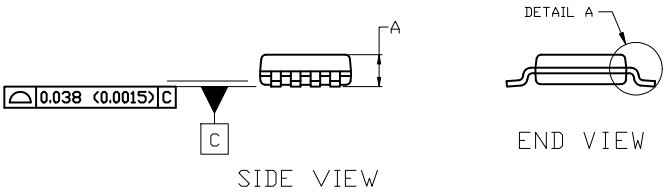


SCALE 2:1

Micro8
CASE 846A–02
ISSUE K

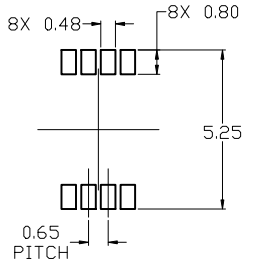
DATE 16 JUL 2020





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.

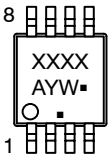


RECOMMENDED
MOUNTING FOOTPRINT

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

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

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

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

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DESCRIPTION:	**MICRO8**	**PAGE 1 OF 1**

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

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