

NIB6404-5L

Preferred Device

Product Preview

SMARTDISCRETES™

52 Amps, 40 Volts

Self Protected with Temperature Sense

N-Channel D2PAK

SMARTDISCRETES devices are an advanced series of Power MOSFETs which utilize ON Semiconductor's latest MOSFET technology process to achieve the lowest possible on-resistance per silicon area while incorporating additional features such as clamp diodes. They are capable of withstanding high energy in the avalanche and commutation modes. The avalanche energy is specified to eliminate guesswork in designs where inductive loads are switched and offer additional safety margin against unexpected voltage transients.

This new SMARTDISCRETES device features integrated Gate-to-Source diodes for ESD protection, and Gate-to-Drain clamp for overvoltage protection. Also, this device integrates a sense diode for temperature monitoring.

- Ultra Low $R_{DS(on)}$ Provides Higher Efficiency
- I_{DSS} Specified at Elevated Temperature
- Avalanche Energy Specified
- Overvoltage Protection
- Temperature Sense Diode
- ESD Human Body Model Discharge Sensitivity Class 3

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

Rating	Symbol	Value	Unit
Drain-to-Source Voltage	V_{DSS}	40	Vdc
Drain-to-Gate Voltage	V_{DGR}	40	Vdc
Gate-to-Source Voltage	V_{GS}	± 10	Vdc
Operating and Storage Temperature Range	T_J, T_{stg}	-55 to +175	$^\circ\text{C}$
Single Pulse Drain-to-Source Avalanche Energy – Starting $T_J = 25^\circ\text{C}$ (Note 1.) ($V_{DD} = 25\text{ Vdc}$, $V_{GS} = 5.0\text{ Vdc}$, $I_{L(pk)} = 25\text{ A}$, $L = 1.4\text{ mH}$, $R_G = 10\text{ k}\Omega$)	E_{AS}	450	mJ
Drain Current <ul style="list-style-type: none">– Continuous @ $T_A = 25^\circ\text{C}$– Continuous @ $T_A = 140^\circ\text{C}$– Single Pulse ($t_p \leq 10\text{ }\mu\text{s}$)	I_D I_D I_{DM}	52 25 200	Adc
Total Power Dissipation ($t \leq 10\text{ seconds}$) Linear Derating Factor	$P_D @ T_A = 25^\circ\text{C}$	115 0.76	W W/ $^\circ\text{C}$
Thermal Resistance <ul style="list-style-type: none">– Junction-to-Case– Junction-to-Ambient (Note 1.)	$R_{\theta JC}$ $R_{\theta JA}$	1.3 80	$^\circ\text{C/W}$

1. Measured while surface mounted to an FR4 board using the minimum recommended pad size. Typical value is 64°C/W .

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



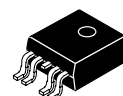
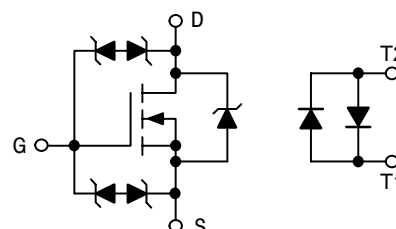
ON Semiconductor

<http://onsemi.com>

52 AMPERES

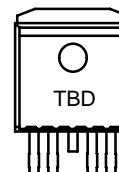
40 VOLTS

$R_{DS(on)} = 20\text{ m}\Omega$



D2PAK
CASE 936D
PLASTIC

MARKING DIAGRAM



TBD = Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
NIB6404-5L	D2PAK	TBD

Preferred devices are recommended choices for future use and best overall value.

NIB6404–5L

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

Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

OFF CHARACTERISTICS

Drain-to-Source Breakdown Voltage (Note 2.) (V _{GS} = 0 Vdc, I _D = 250 μAdc, –55°C < T _J < 175°C) Temperature Coefficient (Negative)	V _{(BR)DSS}	40 –	51 7.0	55 –	Vdc mV/°C
Gate-to-Source Clamp Voltage (Note 2.) (V _{GS} = 0 Vdc, I _G = 20 μAdc)	V _{(BR)GSS}	10	13	20	Vdc
Zero Gate Voltage Drain Current (V _{DS} = 35 Vdc, V _{GS} = 0 Vdc) (V _{DS} = 15 Vdc, V _{GS} = 0 Vdc) (V _{DS} = 35 Vdc, V _{GS} = 0 Vdc, T _J = 125°C)	I _{DSS}	– – –	1.1 0.2 4.0	100 2.0 20	μAdc
Gate-Body Leakage Current (V _{GS} = 5.0 Vdc, V _{DS} = 0 Vdc)	I _{GSS}	–	0.02	1.0	μAdc

ON CHARACTERISTICS (Note 2.)

Gate Threshold Voltage (Note 2.) (V _{DS} = V _{GS} , I _D = 1.0 mAdc) Threshold Temperature Coefficient (Negative)	V _{GS(th)}	1.0 –	1.7 4.5	2.0 –	Vdc mV/°C
Static Drain-to-Source On-Resistance (Note 2.) (V _{GS} = 5.0 Vdc, I _D = 20 Adc)	R _{DS(on)}	–	18	20	mΩ
Forward Transconductance (V _{DS} = 15 Vdc, I _D = 10 Adc) (Note 2.)	g _{FS}	TBD	34	–	mhos

DYNAMIC CHARACTERISTICS

Input Capacitance	(V _{DS} = 25 Vdc, V _{GS} = 0 Vdc, f = 1.0 MHz)	C _{iss}	–	1720	–	pF
Output Capacitance		C _{oss}	–	525	–	
Transfer Capacitance		C _{rss}	–	120	–	

SWITCHING CHARACTERISTICS (Note 3.)

Turn-On Delay Time	(V _{DD} = 32 Vdc, I _D = 25 Adc, V _{GS} = 5.0 Vdc, R _G = 10 Ω) (Note 2.)	t _{d(on)}	–	16	–	ns
Rise Time		t _r	–	263	–	
Turn-Off Delay Time		t _{d(off)}	–	149	–	
Fall Time		t _f	–	345	–	
Gate Charge	(V _{DS} = 32 Vdc, I _D = 25 Adc, V _{GS} = 5.0 Vdc) (Note 2.)	Q _T	–	29	–	nC
		Q ₁	–	6.0	–	
		Q ₂	–	16	–	
		Q ₃	–	2.0	–	

SOURCE–DRAIN DIODE CHARACTERISTICS

Forward On-Voltage	(I _S = 20 Adc, V _{GS} = 0 Vdc) (Note 2.) (I _S = 20 Adc, V _{GS} = 0 Vdc, T _J = 125°C)	V _{SD}	– –	0.876 0.746	1.2 –	Vdc
Reverse Recovery Time	(I _S = 25 Adc, V _{GS} = 0 Vdc, dI _S /dt = 100 A/μs) (Note 2.)	t _{rr}	–	60	–	ns
		t _a	–	29	–	
		t _b	–	32	–	
Reverse Recovery Stored Charge		Q _{RR}	–	80	–	pC

TEMPERATURE SENSE DIODE CHARACTERISTICS

Forward (Reverse) On-Voltage	(I _{F(R)} = 250 μAdc) (Note 2.) (I _{F(R)} = 250 μAdc, T _J = 125°C)	V _{AC(ACR)}	715 –	743 570	775 –	mVdc
Temperature Coefficient (Negative)	I _{F(R)} = 250 μAdc, T _J = 160°C	V _{FTC}	1.57	1.71	1.85	mV/°C
Forward Voltage Hysteresis	I _{F(R)} = 125 μAdc to 250 μAdc	V _{hys}	25	37	50	mVdc

- Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2%.
- Switching characteristics are independent of operating junction temperatures.

TYPICAL ELECTRICAL CHARACTERISTICS

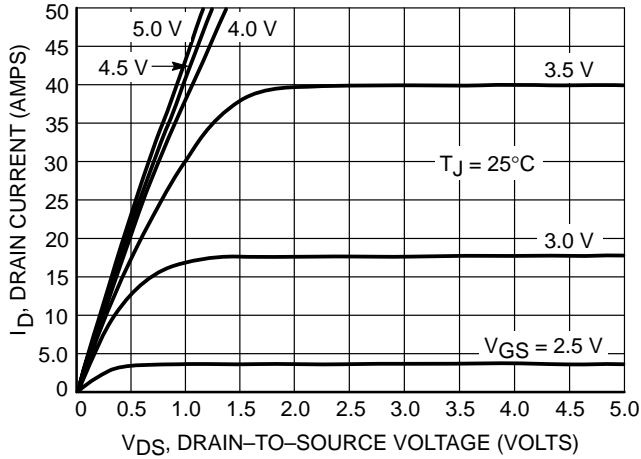


Figure 1. On-Region Characteristics

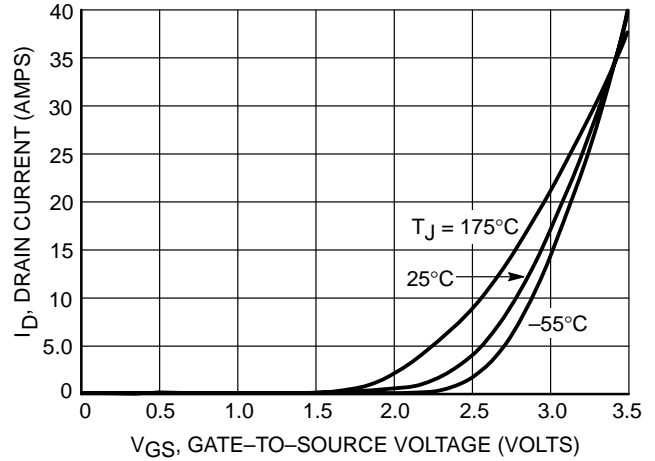


Figure 2. Transfer Characteristics

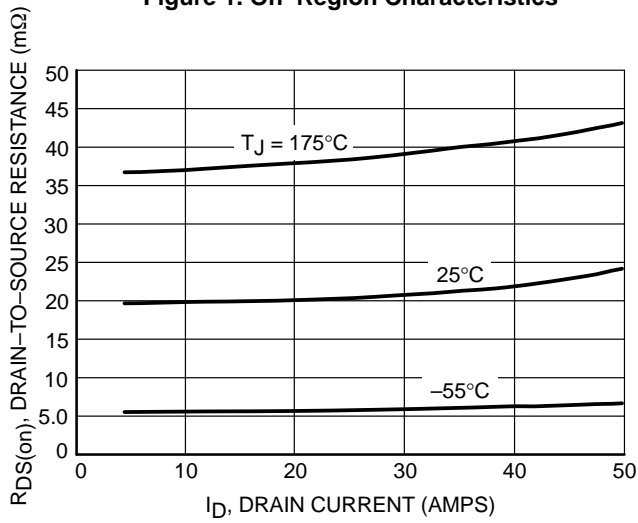


Figure 3. On-Resistance versus Drain Current and Temperature

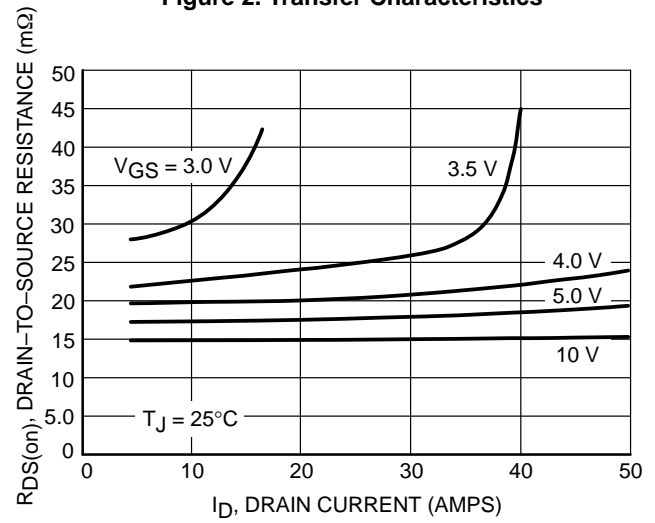


Figure 4. On-Resistance versus Drain Current and Gate Voltage

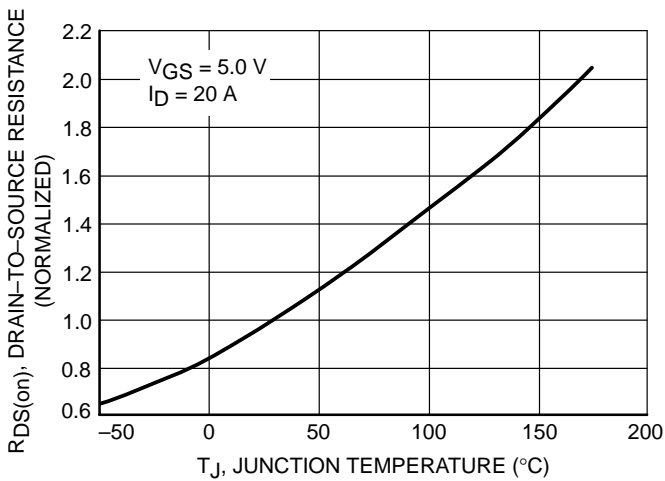


Figure 5. On-Resistance Variation with Temperature

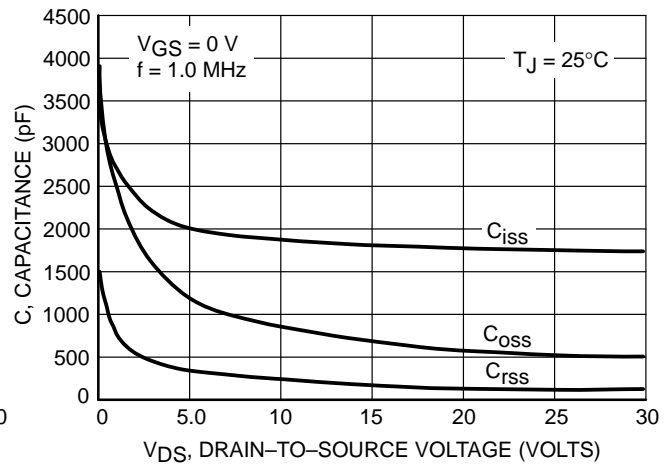


Figure 6. Capacitance Variation

TYPICAL ELECTRICAL CHARACTERISTICS

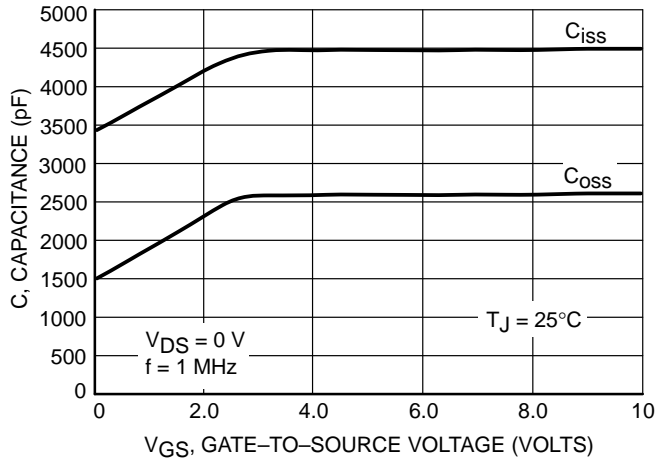


Figure 7. Capacitance Variation

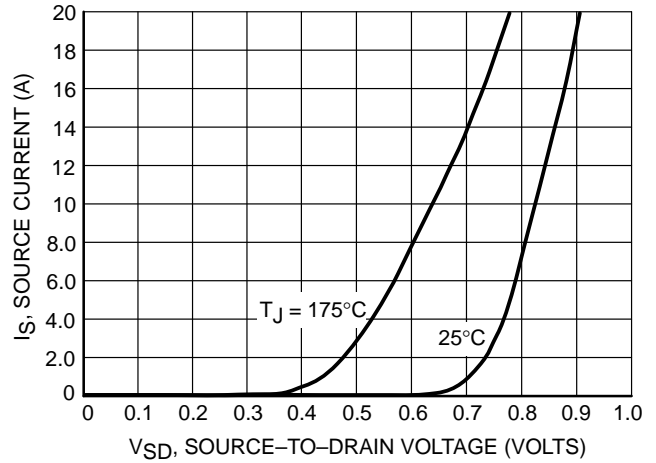


Figure 8. Diode Forward Voltage versus Current

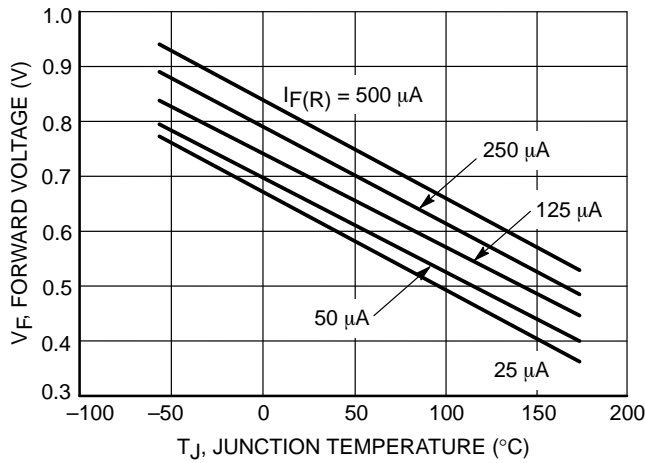


Figure 9. Sense Diode Forward Voltage Variation with Temperature

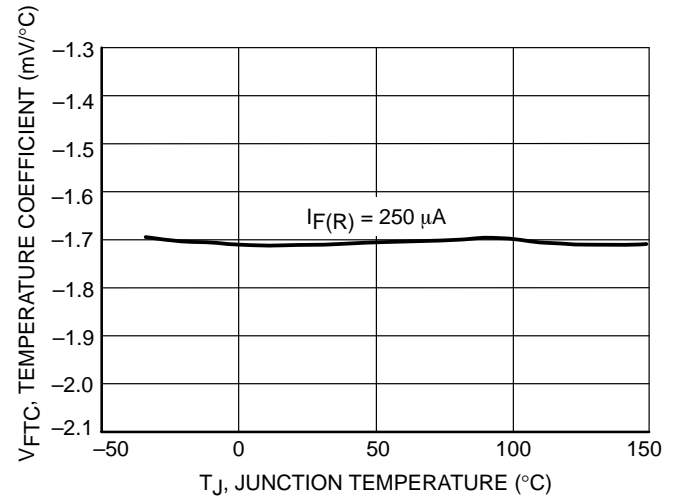
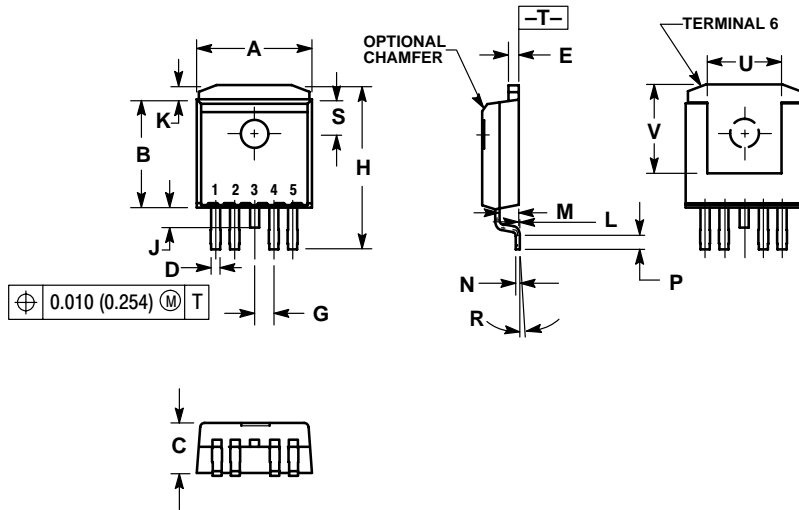


Figure 10. Sense Diode Temperature Coefficient Variation with Temperature

NIB6404-5L

PACKAGE DIMENSIONS

DPAK CASE 936D-03 ISSUE B



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. TAB CONTOUR OPTIONAL WITHIN DIMENSIONS A AND K.
4. DIMENSIONS U AND V ESTABLISH A MINIMUM MOUNTING SURFACE FOR TERMINAL 6.
5. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.025 (0.635) MAXIMUM.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.386	0.403	9.804	10.236
B	0.356	0.368	9.042	9.347
C	0.170	0.180	4.318	4.572
D	0.026	0.036	0.660	0.914
E	0.045	0.055	1.143	1.397
G	0.067 BSC		1.702 BSC	
H	0.539	0.579	13.691	14.707
J	0.125 MAX		3.175 MAX	
K	0.050 REF		1.270 REF	
L	0.000	0.010	0.000	0.254
M	0.088	0.102	2.235	2.591
N	0.018	0.026	0.457	0.660
P	0.058	0.078	1.473	1.981
R	5° REF		5° REF	
S	0.116 REF		2.946 REF	
U	0.200 MIN		5.080 MIN	
V	0.250 MIN		6.350 MIN	

Notes

Notes

SMARTDISCRETES is a trademark of Semiconductor Components Industries, LLC (SCILLC).

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC 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. "Typical" parameters which may be provided in SCILLC 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. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC 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 SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer.

PUBLICATION ORDERING INFORMATION

NORTH AMERICA Literature Fulfillment:

Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: ONlit@hibbertco.com
Fax Response Line: 303-675-2167 or 800-344-3810 Toll Free USA/Canada

N. American Technical Support: 800-282-9855 Toll Free USA/Canada

EUROPE: LDC for ON Semiconductor – European Support

German Phone: (+1) 303-308-7140 (Mon-Fri 2:30pm to 7:00pm CET)
Email: ONlit-german@hibbertco.com
French Phone: (+1) 303-308-7141 (Mon-Fri 2:00pm to 7:00pm CET)
Email: ONlit-french@hibbertco.com
English Phone: (+1) 303-308-7142 (Mon-Fri 12:00pm to 5:00pm GMT)
Email: ONlit@hibbertco.com

EUROPEAN TOLL-FREE ACCESS*: 00-800-4422-3781

*Available from Germany, France, Italy, UK, Ireland

CENTRAL/SOUTH AMERICA:

Spanish Phone: 303-308-7143 (Mon-Fri 8:00am to 5:00pm MST)
Email: ONlit-spanish@hibbertco.com
Toll-Free from Mexico: Dial 01-800-288-2872 for Access –
then Dial 866-297-9322

ASIA/PACIFIC: LDC for ON Semiconductor – Asia Support

Phone: 303-675-2121 (Tue-Fri 9:00am to 1:00pm, Hong Kong Time)
Toll Free from Hong Kong & Singapore:
001-800-4422-3781
Email: ONlit-asia@hibbertco.com

JAPAN: ON Semiconductor, Japan Customer Focus Center
4-32-1 Nishi-Gotanda, Shinagawa-ku, Tokyo, Japan 141-0031
Phone: 81-3-5740-2700
Email: r14525@onsemi.com

ON Semiconductor Website: <http://onsemi.com>

For additional information, please contact your local Sales Representative.