

NB4L858M

2.5V/3.3V, 3 GHz Dual Differential Clock/Data 2x2 Crosspoint Switch with CML Output and Internal Termination

Description

The NB4L858M is a high-bandwidth low voltage fully differential dual 2 x 2 crosspoint switch with CML outputs that is suitable for applications such as SDH/SONET DWDM and high speed switching applications. Design technique minimizes jitter accumulation, crosstalk, and signal skew which make this device ideal for loop-through and protection channel switching application. Each 2 x 2 crosspoint switch can fan out and/or multiplex up to 3 Gb/s data and 3 GHz clock signals.

Differential inputs incorporate a pair of internal 50 Ω termination resistors in a center-tapped configuration (V_{TDx} Pins) and can accept LVPECL (Positive ECL) or CML input signal without any external component. This feature provides transmission line termination on-chip, at the receiver end, eliminating external components. Differential 16 mA CML output provides matching internal 50 Ω terminations, and 400 mV output swings when externally terminated, 50 Ω to V_{CC} .

The SELECT inputs are single-ended and can be driven with either LVCMOS or LVTTTL input levels. The device is housed in a low profile 7 x 7 mm 32-pin LQFP package.

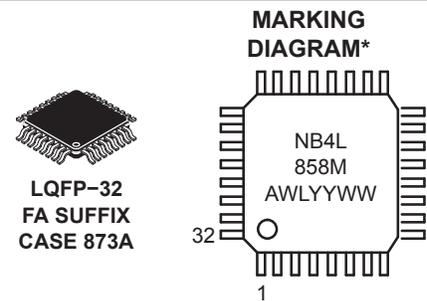
Features

- Maximum Input Clock Frequency 3 GHz
- Maximum Input Data Frequency 3 Gb/s
- 350 ps Typical Propagation Delay
- 80 ps Typical Rise and Fall Times
- 12 ps Channel to Channel Skew
- 0.5 ps RMS Jitter
- 5 ps Deterministic Jitter @ 2.5 Gb/s
- Operating Range: $V_{CC} = 2.3V$ to 3.6 V with $GND = 0 V$
- CML Output Level (400 mV Peak-to-Peak Output), Differential Output
- These are Pb-Free Devices



ON Semiconductor®

<http://onsemi.com>



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G = Pb-Free Package

*For additional marking information, refer to Application Note AND8002/D.

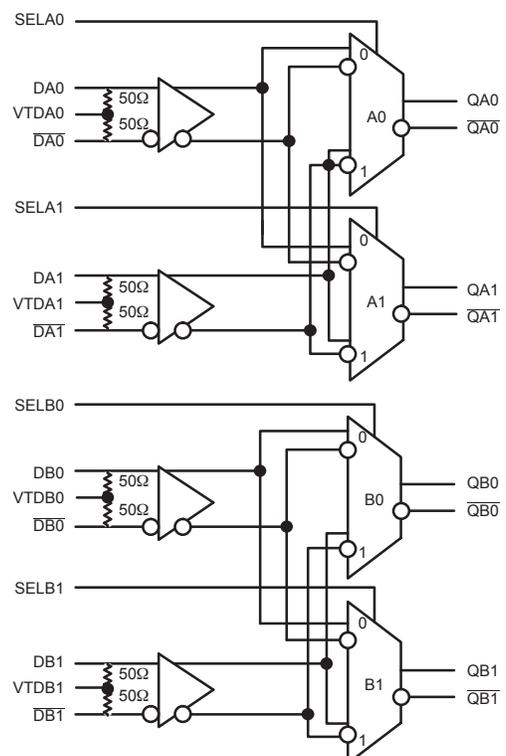


Figure 1. Functional Block Diagram

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

NB4L858M

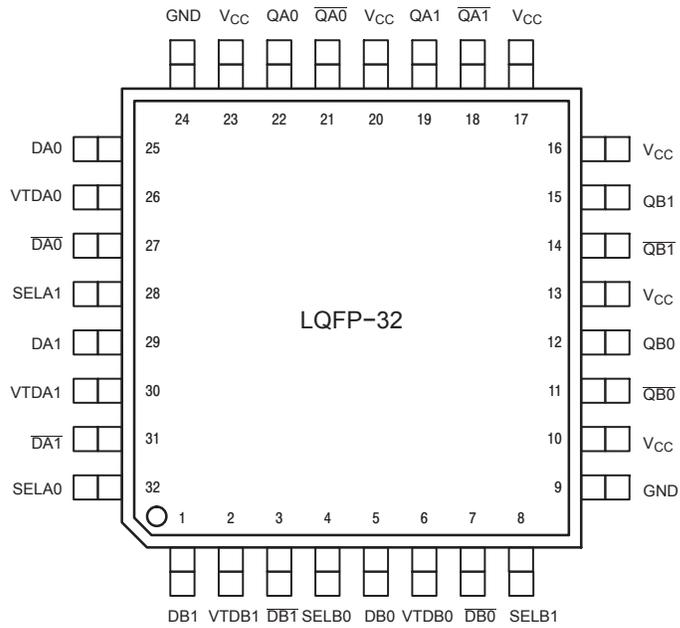


Figure 1. Pin Configuration (Top View)

Table 1. TRUTH TABLE

SELA0/SELB0	SELA1/SELB1	QA0/QB0	QA1/QB1	Function
L	L	DA0/DB0	DA0/DB0	1:2 Fanout or Redundant Distribution
L	H	DA0/DB0	DA1/DB1	Quad Repeater or Crosspoint Switch
H	L	DA1/DB1	DA0/DB0	Quad Repeater or Crosspoint Switch
H	H	DA1/DB1	DA1/DB1	1:2 Fanout or Redundant Distribution

NB4L858M

Table 2. PIN DESCRIPTION

Pin	Name	I/O	Description
1	DB1	LVPECL, CML Input	Channel B1 positive signal input.
2	VTDB1	-	Internal 100 Ω center-tapped termination pin for channel B1.
3	$\overline{DB1}$	LVPECL, CML Input	Channel B1 negative signal input.
4	SELB0	LVTTTL / LVCMOS	Channel B0 Output Select. See Table 1.
5	DB0	LVPECL, CML Input	Channel B0 positive signal input.
6	VTDB0	-	Internal 100 Ω center-tapped termination pin for channel B0.
7	$\overline{DB0}$	LVPECL, CML Input	Channel B0 negative signal input.
8	SELB1	LVTTTL / LVCMOS	Channel B1 output select. See Table 1.
9,24	GND	-	Supply ground. All GND pins must be externally connected to power supply to guarantee proper operation.
10, 13, 16, 17, 20, 23	V _{CC}	-	Positive Supply. All V _{CC} pins must be externally connected to power supply to guarantee proper operation.
11	$\overline{QB0}$	CML Output	Channel B0 negative signal output. Typically terminated with 50 Ω resistor to V _{CC} .
12	QB0	CML Output	Channel B0 positive signal output. Typically terminated with 50 Ω resistor to V _{CC} .
14	$\overline{QB1}$	CML Output	Channel B1 negative signal output. Typically terminated with 50 Ω resistor to V _{CC} .
15	QB1	CML Output	Channel B1 positive signal output. Typically terminated with 50 Ω resistor to V _{CC} .
18	$\overline{QA1}$	CML Output	Channel A1 negative signal output. Typically terminated with 50 Ω resistor to V _{CC} .
19	QA1	CML Output	Channel A1 positive signal output. Typically terminated with 50 Ω resistor to V _{CC} .
21	$\overline{QA0}$	CML Output	Channel A0 negative signal output. Typically terminated with 50 Ω resistor to V _{CC} .
22	QA0	CML Output	Channel A0 positive signal output. Typically terminated with 50 Ω resistor to V _{CC} .
25	DA0	LVPECL, CML Input	Channel A0 positive signal input.
26	VTDA0	-	Internal 100 Ω center-tapped termination pin for channel A0.
27	$\overline{DA0}$	LVPECL, CML Input	Channel A0 negative signal input.
28	SELA1	LVTTTL	Channel A1 output select. See Table 1.
29	DA1	LVPECL, CML Input	Channel A1 positive signal input.
30	VTDA1	-	Internal 100 Ω center-tapped termination pin for channel A1.
31	$\overline{DA1}$	LVPECL, CML Input	Channel A1 negative signal input.
32	SELA0	LVTTTL	Channel A0 output select. See Table 1.

NB4L858M

Table 3. Table 3. ATTRIBUTES

Characteristics		Value
ESD Protection	Human Body Model Machine Model	> 2000 V >110 V
Moisture Sensitivity (Note 1)	32-LQFP	Level 2
Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in
Transistor Count		380
Meets or exceeds JEDEC Spec EIA/JESD78 IC Latchup Test		

1. For additional information, see Application Note AND8003/D.

Table 4. MAXIMUM RATINGS

Symbol	Parameter	Condition 1	Condition 2	Rating	Unit
V _{CC}	Positive Power Supply	GND = 0 V		3.8	V
V _I	Positive Input	GND = 0 V	GND ≤ V _I ≤ V _{CC}	3.8	V
V _{INPP}	Differential Input Voltage	D - \bar{D}		3.8	V
I _{IN}	Input Current Through Internal R _T (50 Ω Resistor)	Static Surge		45 80	mA mA
I _{OUT}	Output Current	Continuous Surge		25 80	mA mA
T _A	Operating Temperature Range	LQFP-32		-40 to +85	°C
T _{stg}	Storage Temperature Range			-65 to +150	°C
θ _{JA}	Thermal Resistance (Junction-to-Ambient)	0 LFPM 500 LFPM	32 LQFP 32 LQFP	80 55	°C/W °C/W
θ _{JC}	Thermal Resistance (Junction-to-Case)	2S2P (Note 2)	32 LQFP	12 to 17	°C/W
T _{sol}	Wave Solder	Pb-Free	<3 sec @ 260°C	265	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

2. JEDEC standard 51-6, multilayer board – 2S2P (2 signal, 2 power).

NB4L858M

Table 5. DC CHARACTERISTICS, CLOCK INPUTS, CML OUTPUTS $V_{CC} = 2.3 \text{ V to } 3.6 \text{ V}$, $GND = 0 \text{ V}$ $T_A = -40^\circ\text{C to } +85^\circ\text{C}$

Symbol	Characteristic	Min	Typ	Max	Unit
I_{CC}	Power Supply Current		130	190	mA
V_{outdiff}	CML Differential Output Swing (Note 3) No Load Loaded 50Ω to V_{CC}	640	800 400	1000	mV
V_{OH}	Output HIGH Voltage (No Load)	$V_{CC}-40$	$V_{CC}-10$	V_{CC}	mV
V_{OL}	Output LOW Voltage (No Load)	$V_{CC}-1000$	$V_{CC}-800$	$V_{CC}-650$	mV
R_{TOUT}	Output Source Resistance Q_x or $\overline{Q_x}$	40	50	60	Ω
V_{IH}	Input HIGH Voltage	1600		V_{CC}	mV
V_{IL}	Input LOW Voltage	1500		$V_{CC}-100$	mV
V_{ID}	Differential Input Voltage ($V_{IHD} - V_{ILD}$)	100		1600	mV
R_{TIN}	Input Termination Resistance D_x or $\overline{D_x}$ to V_{TDx}	40	50	60	Ω

LVTTL CONTROL INPUT PINS

V_{IH}	Input HIGH Voltage (LVTTL Inputs)	2000			mV
V_{IL}	Input LOW Voltage (LVTTL Inputs)			800	mV
I_{IH}	Input HIGH Current (LVTTL inputs)	-10		10	μA
I_{IL}	Input LOW Current (LVTTL Inputs)	-10		10	μA

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lpm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

3. CML outputs require 50Ω receiver termination resistors to V_{CC} for proper operation.

NB4L858M

Table 6. AC CHARACTERISTICS $V_{CC} = 2.3\text{ V to }3.6\text{ V}$, $GND = 0\text{ V}$; (Note 4)

Symbol	Characteristic	-40°C			25°C			85°C			Unit
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
V_{OUTPP}	Output Voltage Amplitude (@ $V_{INPPmin}$) (See Figure 2) $f_{in} \leq 2\text{ GHz}$ $f_{in} \leq 3\text{ GHz}$ $f_{in} \leq 3.5\text{GHz}$	280	365		280	365		280	365		mV
f_{DATA}	Maximum Operating Data Rate	3			3			3			Gb/s
t_{PLH} , t_{PHL}	Propagation Delay to Output Differential D/D to Q/Q	220	350	450	220	350	450	220	350	450	ps
t_{SWITCH}	SELYx to Valid Qyx Output (Note 9)		0.5	1.0		0.5	1.0		0.5	1.0	ns
t_{SKEW}	Within -Device Skew (Note 5) Within -Device Skew (Note 6) Device to Device Skew (Note 9)		12 25 100			12 25 100			12 25 100		ps
t_{JITTER}	RMS Random Clock Jitter (Note 8) $f_{in} = 2\text{ GHz}$ $f_{in} = 3\text{ GHz}$ Peak-to-Peak Data Dependent Jitter $f_{in} = 2.5\text{Gb/s}$ (Note 9) $f_{in} = 3.2\text{Gb/s}$ Crosstalk Induced RMS Jitter (Note 11)		0.5 1.0 2.0 10 0.5			0.5 1.0 5.0 10 0.5			0.5 1.0 2.0 10 0.5		ps
V_{INPP}	Input Voltage Swing/Sensitivity (Differential Configuration)	100		800	100		800	100		800	mV
t_r , t_f	Output Rise/Fall Times @ 0.5 GHz (20% - 80%) Q_x, \overline{Q}_x		80	120		80	120		80	120	ps

NOTE: Device will meet the specifications after thermal equilibrium has been established when mounted in a test socket or printed circuit board with maintained transverse airflow greater than 500 lfm. Electrical parameters are guaranteed only over the declared operating temperature range. Functional operation of the device exceeding these conditions is not implied. Device specification limit values are applied individually under normal operating conditions and not valid simultaneously.

4. Measured by forcing V_{INPP} (MIN) from a 50% duty cycle clock source. All loading with an external $R_L = 50\ \Omega$ to V_{CC} . Input edge rates 40 ps (20% - 80%).
5. Worst-case difference between QA0 and QA1 from either DA0 or DA1 (or between QB0 and QB1 from either DB0 or DB1 respectively), when both outputs come from the same input.
6. Worst-case difference between QA and QB outputs, when DA or DB inputs are shorted.
7. Additive RMS jitter with 50% duty cycle input clock signal.
8. Additive peak-to-peak data dependent jitter with input NRZ data signal.
9. Device to device skew is measured between outputs under identical transition @ 0.5 GHz.
10. LVTTTL/LVCMOS input edge rate less than 1.5 ns
11. Data taken on the same device under identical condition.

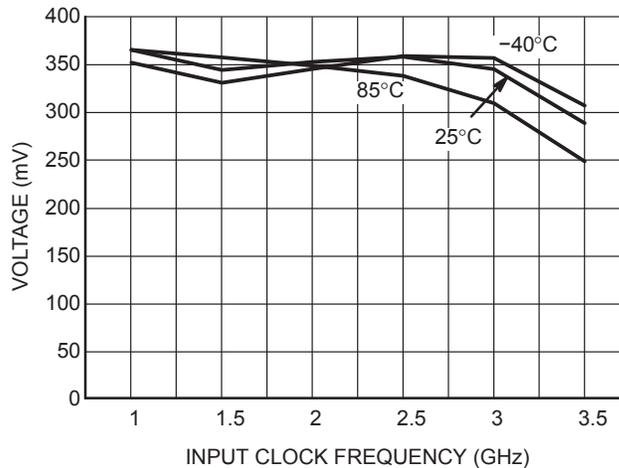


Figure 2. Output Voltage Amplitude (V_{OUTPP}) versus Input Clock Frequency (f_{in}) and Temperature

NB4L858M

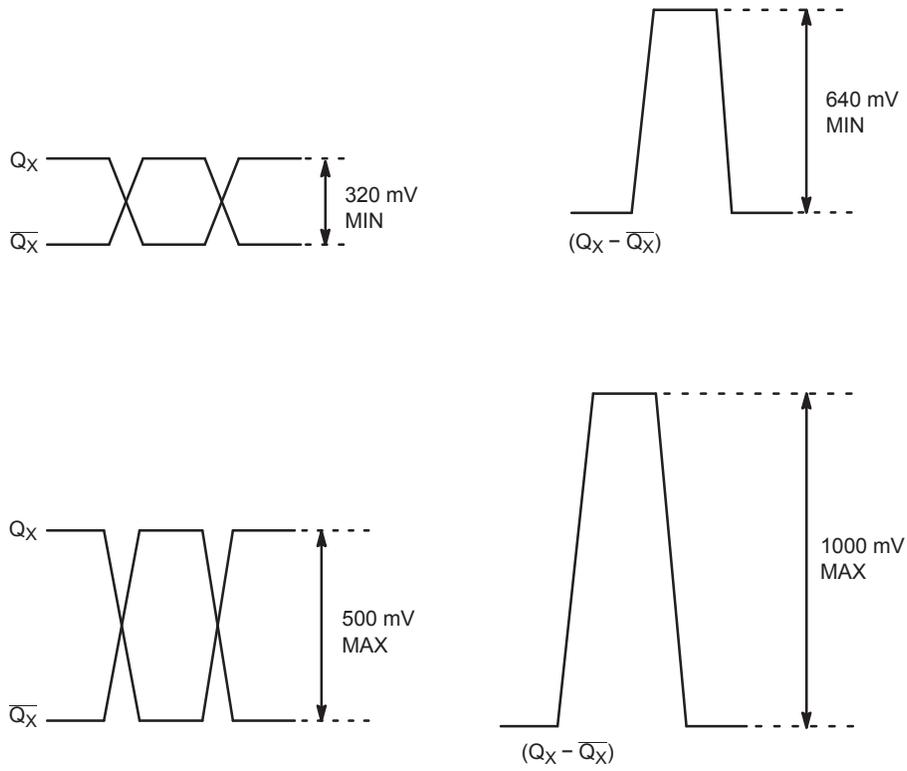


Figure 6. CML Output Levels

ORDERING INFORMATION

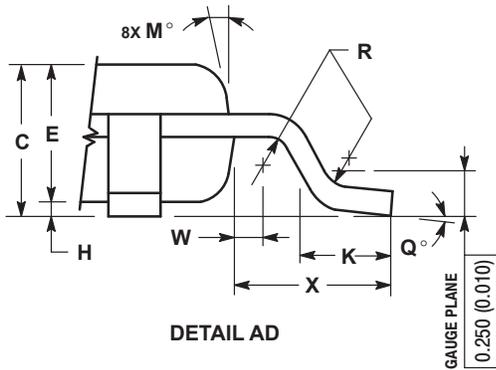
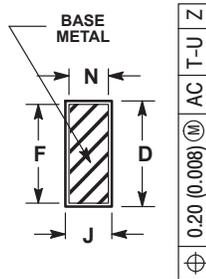
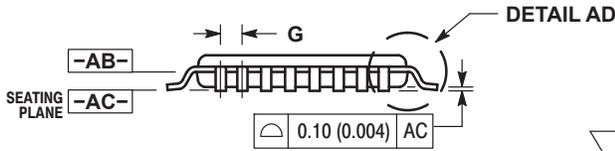
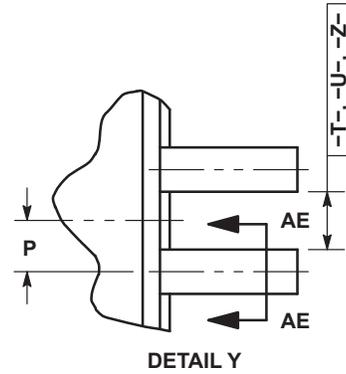
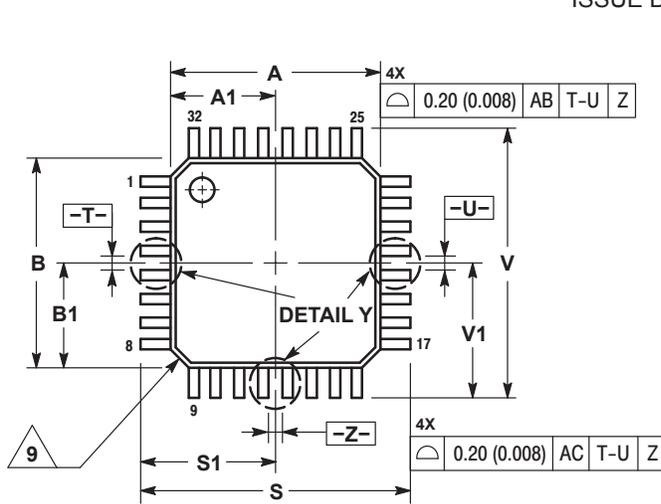
Device	Package	Shipping [†]
NB4L858MFAG	LQFP-32 (Pb-Free)	250 Units / Tray
NB4L858MFAR2G	LQFP-32 (Pb-Free)	2000 / Tape & Reel

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

NB4L858M

PACKAGE DIMENSIONS

LQFP
FA SUFFIX
32-LEAD PLASTIC PACKAGE
CASE 873A-02
ISSUE B



- NOTES:
- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 - CONTROLLING DIMENSION: MILLIMETER.
 - DATUM PLANE -AB- IS LOCATED AT BOTTOM OF LEAD AND IS COINCIDENT WITH THE LEAD WHERE THE LEAD EXITS THE PLASTIC BODY AT THE BOTTOM OF THE PARTING LINE.
 - DATUMS -T-, -U-, AND -Z- TO BE DETERMINED AT DATUM PLANE -AB-.
 - DIMENSIONS S AND V TO BE DETERMINED AT SEATING PLANE -AC-.
 - DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION. ALLOWABLE PROTRUSION IS 0.250 (0.010) PER SIDE. DIMENSIONS A AND B DO INCLUDE MOLD MISMATCH AND ARE DETERMINED AT DATUM PLANE -AB-.
 - DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. DAMBAR PROTRUSION SHALL NOT CAUSE THE D DIMENSION TO EXCEED 0.520 (0.020).
 - MINIMUM SOLDER PLATE THICKNESS SHALL BE 0.0076 (0.0003).
 - EXACT SHAPE OF EACH CORNER MAY VARY FROM DEPICTION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	7.000 BSC		0.276 BSC	
A1	3.500 BSC		0.138 BSC	
B	7.000 BSC		0.276 BSC	
B1	3.500 BSC		0.138 BSC	
C	1.400	1.600	0.055	0.063
D	0.300	0.450	0.012	0.018
E	1.350	1.450	0.053	0.057
F	0.300	0.400	0.012	0.016
G	0.800 BSC		0.031 BSC	
H	0.050	0.150	0.002	0.006
J	0.090	0.200	0.004	0.008
K	0.500	0.700	0.020	0.028
M	12° REF		12° REF	
N	0.090	0.160	0.004	0.006
P	0.400 BSC		0.016 BSC	
Q	1°	5°	1°	5°
R	0.150	0.250	0.006	0.010
S	9.000 BSC		0.354 BSC	
S1	4.500 BSC		0.177 BSC	
V	9.000 BSC		0.354 BSC	
V1	4.500 BSC		0.177 BSC	
W	0.200 REF		0.008 REF	
X	1.000 REF		0.039 REF	

NB4L858M

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

ON Semiconductor and  are registered 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. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

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: orderlit@onsemi.com

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

Japan: ON Semiconductor, Japan Customer Focus Center
2-9-1 Kamimeguro, Meguro-ku, Tokyo, Japan 153-0051
Phone: 81-3-5773-3850

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

Order Literature: <http://www.onsemi.com/litorder>

For additional information, please contact your
local Sales Representative.

NB4L858M/D